WORKSHOP MANUAL

ENERGY 60/80 SERIES

Edition ▸ *july 2017*

P/N ▸ *06381264*

From serial number ► *From* 0000579942

MADE in ITALY

GOLDONI

Tractors for **Life**

INDEX

Chapter N°	Description
1	INTRODUCTION
2	ENGINE
3	CLUTCH HOUSING
4	GEARBOX
5	REAR DIFFERENTIAL
6	REAR FINAL DRIVES
7	FRONT AXLE
8	DRIVE TRANSMISSION
9	DRIVE TRANSFER UNIT, MECHANICAL VERSION
10	REAR POWER TAKE-OFF
11	BRAKES
12	FRONT POWER TAKE-OFF
13	HYDRAULIC SYSTEM
14	PLATFORM
15	CAB
16	FRONT HITCH
17	ELECTRICAL SYSTEM
18	TROUBLESHOOTING
19	SPECIAL TOOLS

Chapter 1 : Introduction

Index

Section 1 : Reading this manual 1-3
1.1 Introduction 1-4
1.2 Structure of this manual 1-4
1.3 Identifying the tractor 1-5

Section 2 : Safety rules 1-7
2.1 Essential preventive guidelines 1-8
2.2 Using the tractor safely 1-14

Section 3 : General 1-19
3.1 Spare parts 1-20
3.2 Specific tools 1-20
3.3 Oil seals for rotating shafts 1-21
3.4 Adjuster shims 1-21
3.5 O-ring seals 1-22
3.6 Sealants used 1-22
3.7 Spring pins 1-22

Section 4 : Technical characteristics 1-23
4.1 Engine 1-24
4.2 Transmission 1-24
4.3 Brakes and steering 1-25
4.4 Rear Power Take Off 1-25
4.5 Front Power Take Off 1-25
4.6 Rear lift 1-25
4.7 Front lift 1-26
4.8 Hydraulic circuit 1-26
4.9 Driver zone 1-26
4.10 Weights and dimensions 1-27
4.11 Lubricants 1-29
4.12 Speed 1-31
4.13 Conversion tables 1-33

Section 5 : Tightening torques and sealants 1-35
5.1 Tightening torques for nuts 1-36
5.2 Tightening torques for ring nuts 1-36
5.3 Tightening torques for hex head screws 1-37
5.4 Tightening torques for stud bolts 1-37
5.5 Tightening torques for tapered plugs 1-37
5.6 Loctite sealant types 1-38

Section 6 : General assembly instructions 1-39
6.1 Oil seals 1-40
6.2 O-Rings 1-41
6.3 Bearings 1-42

Section 1 : Reading this manual

Index

1.1 Introduction 1-4

1.2 Structure of this manual 1-4

1.3 Identifying the tractor 1-5

1.1 Introduction

The purpose of this workshop manual is to provide all the essential information necessary, explain operating principles and describe the settings which must be made to the different parts and assemblies of our tractors.

The information and disassembly sequences given in this manual are not exhaustive as the manual itself is intended for use by technical service personnel who have attended training courses on the product. As a result, the theoretical knowledge and practical experience acquired during the training course are required in order to follow the instructions given in this manual.

To prevent the risk of operator error or distraction which could put the technical personnel working in the service centre at risk, the section "2-Safety rules" must be read before reading any other part of this manual.

The information contained in this manual is up to date at the time of publication. Goldoni S.p.A. reserves the right to modify its products without notification. If any discrepancies are noted or for any other queries, contact your area dealer or importer.

1.2 Structure of this manual

This manual is subdivided into chapters, which are subdivided in turn into sections.

Pages are numbered from 1 at the start of each chapter, with the page number indicated after the chapter number.

Example: For example, 3-9 indicates page 9 of chapter 3.

Figures are numbered from 1 at the start of each chapter, with the figure number indicated after the chapter number.

Example: For example, 8.16 indicates figure 16 of chapter 8.

The special tools deemed necessary to disassemble, reassemble and adjust the respective parts and assemblies are indicated at the end of each chapter.

The main tightening torques for assembling the parts of the tractor correctly are indicated at the end of each chapter. For all unspecified tightening torque values, refer to the section "Tightening Torques" in chapter "1-Introduction"

1.3 Identifying the tractor

Always cite the identification details of the machine when contacting the Technical Support Service or ordering a part from the Spare Parts Warehouse. Specifically, the following information is needed:

- Commercial name;
- Production series;
- Machine type;
- Variant/Version;
- Identification number (serial number).

All the aforementioned details are stamped on a metal plate fixed to the machine in an easily accessible place for reference whenever needed.

1 - Commercial name
2 - Production series
3 - Machine type
4 - Variant/Version
5 - Identification number (serial number)

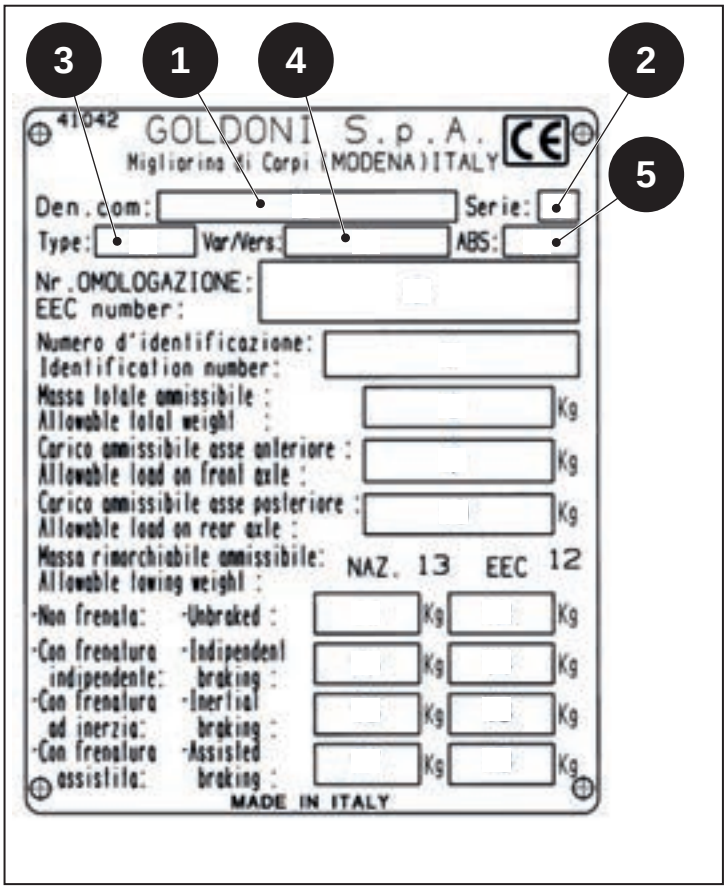


Fig. 1.1

Fig. 1.2

The chassis number is also stamped on the chassis itself.

1 - Code and brand of the manufacturer
2 - Production series
3 - Machine type
4 - Chassis number (serial number)

Note

See the workshop manual provided by the respective manufacturer for instructions on identifying the engine installed in the tractor.

Fig. 1.3

Section 2 : Safety rules

Index

2.1 Essential preventive guidelines 1-8
2.1.1 General rules 1-9
2.1.1.1 Preliminary guidelines 1-9
2.1.1.2 Work Garments 1-9
2.1.1.3 Machines and Installations 1-10
2.1.1.4 Lifting and transporting 1-10
2.1.1.5 Driving in indoor spaces 1-10
2.1.1.6 Electrics 1-10
2.1.1.7 Fire 1-10
2.1.1.8 Dangerous substances and products 1-11
2.1.1.9 Protection against exposure to harmful gas, fumes and dust:1-11
2.1.1.10 Biological agents 1-11
2.1.1.11 Guidelines for choosing the correct fire extinguishing measures 1-11
2.1.2 Implements 1-12
2.1.3 First Aid 1-12
2.1.4 Safety rules regarding the tractor 1-13
2.1.4.1 Start 1-13
2.1.4.2 Engine 1-13
2.1.4.3 Electrical system 1-13
2.1.4.4 Hydraulic system 1-13
2.1.4.5 Disassembly and reassembly 1-13

2.2 Using the tractor safely 1-14
2.2.1 ROPS 1-15
2.2.2 Cab safety 1-17

2.1 Essential preventive guidelines

The premises, installations and equipment of the repair workshop must all be compliant with applicable work safety legislation to ensure the health and safety of all persons working in the workshop.

While clearly not exhaustive, the safety rules given in this section provide important information for workers on the hazards they may encounter while carrying out their jobs.

Your own safety and the safety of others must always be the first priority when working on any machine of any type.

To work in complete safety, it is essential that personnel understand the nature of the work to be done, use the right tools and materials for the job correctly, and act with good common sense. Read all the safety messages in this introduction of this manual and take note of all "**Caution**", "**Warning**" and "**Danger**" notices in this document.

	This symbol means: **NOTE!** This symbol is used to draw attention to specific methods or procedures which must be applied in order to perform maintenance on the tractor correctly.
	This symbol means: **WARNING** This symbol is used to draw attention to operations which must be performed with particular caution as they may put the structure of the tractor or its components at risk.
	This symbol means: **CAUTION!** This symbol is used to draw attention to safety related information. Read these messages with particular care. Make sure that you have fully understood what may cause potentially dangerous or fatal accidents.
	This symbol means: **DANGER!** This symbol is used to identify a situation of danger for yourself and for others. Read these messages with particular care. Make sure that you have fully understood what may cause potentially dangerous or fatal accidents.

2.1.1 General rules

2.1.1.1 Preliminary guidelines

- always follow the directions given by your superiors;
- always comply with safety signs;
- do not use machines or installations without the proper authorisation and do not attempt to perform any operation that you are not authorised or qualified to do;
- use all safety and protection devices and measures properly;
- notify your superiors of any defective or missing safety and protection devices, and of any hazardous situations that come to your attention;
- do not remove or modify any safety or protection devices unless specifically authorised to do so;
- notify your superiors immediately of any injury sustained by yourself or others, describing the situation as clearly and completely as possible;
- keep your work space clean and tidy, keep the floor clear of any materials or objects not directly required for your job and avoid spilling greasy or oily products (clean any spillage immediately with appropriate absorbent cleaning products).

Fig. 1.4

2.1.1.2 Work Garments

- Do not wear loose-fitting garments or garments with loose or hanging elements which may become tangled in moving parts. Only wear garments with tight-fitting cuffs;
- do not wear necklaces, rings, bracelets or other jewellery;
- do not clean garments with flammable or harmful substances or with compressed air;
- do not wear sandals, flip-flops, clogs or high-heeled footwear;
- use the required personal protective devices at all times (eyewear - face shield - gloves - shoes etc.).

2.1.1.3 Machines and Installations

- Before starting work, check that the protective devices and guards are fitted correctly in place and in proper working order, and that all safety devices are working correctly;
- check that any fume extraction and/or ventilation systems in place are working correctly;
- the protective guards and safety devices of machines and installations must never be removed except when strictly necessary for a specific task and only with prior authorisation from your superiors, who will inform you of the substitute safety measures to adopt;
- protective guards and safety devices must be refitted correctly and reactivated as soon as the reason for their temporary removal no longer exists;
- never clean, oil or grease the moving parts of machines and installations by hand;
- never work on or adjust moving parts.

2.1.1.4 Lifting and transporting

By hand

- keep your back straight when lifting loads;
- hold the load as safely as possible using the most accessible and comfortable grip points;
- do not carry loads with oil or grease on your hands;
- hand trolleys with no tow bar must always be pushed and not pulled;
- do not place loads near staircases, firefighting installations, first aid stations and transit areas.

When working with motorised machinery,

- comply with load limits and drive at an appropriately safe speed in relation to the route taken and the load carried and to be sure that the machine can be stopped safely;
- ensure that loads are fastened safely with straps and securely attached;
- do not drive with a suspended load in places where a falling load may constitute a hazard - if this is unavoidable, ensure that all persons in the area are adequately warned of your manoeuvres or keep persons out of the area;

2.1.1.5 Driving in indoor spaces

Persons

- use permitted and designated walkways (pedestrian crossings, walkways etc.);
- do not run;
- do not walk or stand under suspended loads and keep out of areas which may be subject to the risk of falling loads;
- do not ride on transport or lifting machinery intended for handling materials only.

Vehicles

drive at moderate speed and take all precautions necessary for the route taken - observe all company regulations and signage.

2.1.1.6 Electrics

- Do not make makeshift connections. In particular, never make a connection by inserting the bare ends of wires into socket holes;
- always disconnect a plug from the socket by gripping the outer casing of the plug itself, never pull the cord;
- avoid twisted wires;
- take care not to damage the insulating sheath of wires and the insulated housings of electrical equipment, and check frequently that they are undamaged;
- report any damage to electrical devices and, in particular, to earth conductors;
- never open electrical cabinets or the casings of electrical equipment and do not attempt to perform maintenance on electrical cabinets and electrical equipment unless trained and authorised to do so;
- take all precautions to avoid contact with overhead power lines when manoeuvring or working in the vicinity.

2.1.1.7 Fire

In areas and in operations subject to the risk of fire due to the use of flammable substances:

- do not smoke;
- do not use equipment involving naked flames and do not handle incandescent materials;
- keep flammable materials away from sources of heat;
- do not place materials in front of extinguishers and fire hydrants.

2.1.1.8 Dangerous substances and products

When using dangerous chemical products (fire hazard, explosion hazard, irritant, caustic burn hazard, burn hazard or poisoning hazard), always observe the following precautions:

- keep recipients containing dangerous products open only for the time strictly necessary to use them;
- do not use or transfer dangerous products into containers not intended for use with them or without the necessary labelling indicating the contents and safety markings;
- when using chemical products, follow the instructions given on the respective label.

2.1.1.9 Protection against exposure to harmful gas, fumes and dust:

- check that any fume extraction systems in place are working correctly;
- use personal protective devices;
- place mobile extractor ducts as close as possible to the source of emissions;
- avoid closing using doors which will obstruct the air flow carrying emissions generated by the extractor system.

2.1.1.10 Biological agents

- in case of fermentation (due to proliferation of algae), avoid direct contact and use appropriate protective measures to eliminate the problem;
- only enter areas subject to anaerobic fermentation producing harmful gases (e.g. ammonia) with appropriate protective breathing equipment.

2.1.1.11 Guidelines for choosing the correct fire extinguishing measures

Agente estinguente					
Classe di fuoco	Acqua	Polvere	CO^2	Schiuma	Polveri speciali
combustibili solidi ordinari	✓	✓	✓ Solo per incendi di piccole dimensioni	✓	✗
liquidi infiammabili	✗ Tranne che utilizzando attrezzature adatte	✓	✓	✓	✗
gas infiammabili	✗	✓	✓	✗	✗
metalli combustibili	✗ Possono reagire con l'acqua	✗	✗	✗	✓
Apparecchiature elettriche	✗	✓	✓	✗	✗

Fig. 1.5

2.1.2 Implements

Makeshift, unsuitable and faulty tools can cause problems and accidents. Never use the wrong tools, as these may put you at risk and compromise the work done.

Only use the special tools recommended by the manufacturer to disassemble, service and refit the components of the tractor.

Using the correct specific tools will make work less tiring and quicker, letting you save costs while being sure that the job has been done correctly.

Never use:

- a hammer with a loose head or a damaged handle;
- pliers or pieces of metal instead of a hammer;
- drill bits or screws instead of pin punches;
- worn or welded wrenches;
- a steel hammer to tap bearings or heat-treated components (use a bronze or brass hammer).

Certain procedures on components of the tractor require the engine to be separated from the gearbox and the separation of the front and rear transmission casings. These operations are facilitated and made safer by using the specific separator trolley kit.

When lifting heavy parts, make sure that all chains, brackets, hooks, cables and ropes used for lifting are compliant with EC standards. Unless specified otherwise, an adjustable hoisting bracket must be used when lifting all heavy parts.

All chains and cables used must be parallel to each other and maintained as close as possible to vertical with respect to the object lifted.

2.1.3 First Aid

Mechanics are exposed to a number of risks in the workplace.

Treat injuries with disinfectant products and sterile materials, which must be kept in a specific first aid box equipped in accordance with applicable legislation.

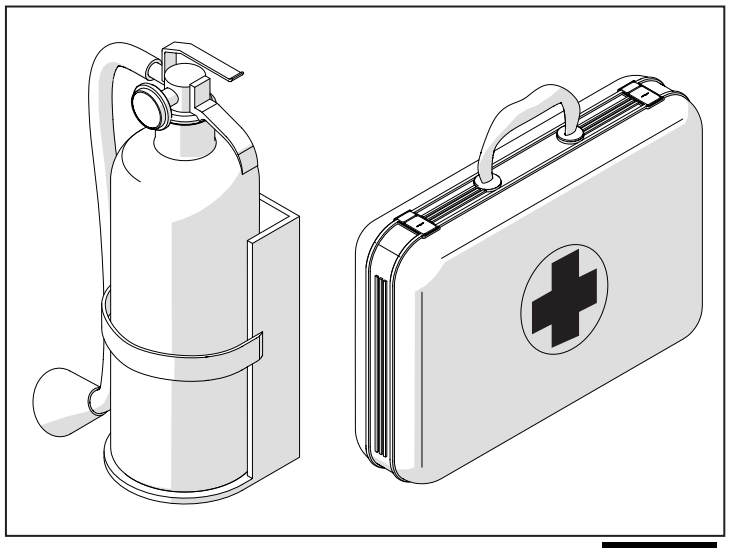


Fig. 1.6

2.1.4 Safety rules regarding the tractor

Attention

Read the use and maintenance manually thoroughly before boarding the tractor, and follow the instructions given precisely.

2.1.4.1 Start

- Never run the engine in an enclosed space without adequate ventilation or extraction systems for evacuating the exhaust gas.
- Keep your head, body, limbs, feet, hands and fingers away from rotating fans and belts at all times.

2.1.4.2 Engine

- Unscrew the radiator cap very slowly before removing to release pressure from the system.

  Only top up with coolant with the engine off or, if still hot, idling.
- To prevent the risk of fire caused by spilt fuel, never refuel the machine while the engine is running, especially if the engine is hot.
- Never attempt to check or adjust the tension of fan belts while the engine is running. Do not adjust the fuel injection pump settings while the engine is running.
- Do not lubricate the machine while the engine is running.

2.1.4.3 Electrical system

- If it is necessary to use an auxiliary battery, connect the cable terminals correctly: connect (+) to (+) and connect (-) to (-). Never short-circuit the terminals.

Danger

The gas released by batteries is highly flammable.

When charging a battery, leave the battery compartment uncovered to ensure more effective ventilation. Never check battery charge by jumpering the terminals with a metal object. Avoid sparks and flame in the vicinity of batteries. Do not smoke - explosion hazard!

- Check for fuel leaks before starting any work, and rectify any leaks found before continuing.
- Never charge batteries in an enclosed space: ensure that the area is adequately ventilated to prevent the risk of explosion caused by the build-up of gas released by the batteries during charging.
- Always disconnect the battery before staring any work on the electrical system.
- If the electrolyte in the battery freezes, the battery may explode if you attempt to charge the battery or push-start the vehicle. Keep the battery fully charged at all times to prevent the electrolyte from freezing.
- Batteries release corrosive fumes and flammable gases. Sparks, naked flame and incorrectly connected cables may cause explosions.

2.1.4.4 Hydraulic system

- pressurised hydraulic fluid escaping from a very small hole may be practically invisible and yet be projected with sufficient force to penetrate the skin. Use a piece of cardboard or wood to search for leaks. **Never search for leaks with your hands**. In the event of skin contact with the fluid, seek immediate medical assistance. Failure to treat a fluid injection injury immediately may lead to severe infection or skin disease.
- Use specific instruments to check the pressure of the system.

2.1.4.5 Disassembly and reassembly

- Lift and handle all heavy parts with lifting equipment of sufficient capacity. Use appropriate straps and hooks to secure parts when lifting. Use the specific hoisting eye-bolts. Be aware of any persons in the vicinity of the load being lifted.
- Handle all parts with extreme caution. Never place your hands or fingers between two parts. Wear approved accident prevention garments and equipment such as safety eyewear, gloves and shoes.
- Do not allow chains or metal cables to twist. Always wear safety gloves when handling cables or chains.

2.2 Using the tractor safely

You need to be suitably qualified and authorised to operate an agricultural tractor safely. To be qualified to use this tractor, you must also have read and understood the complete contents of the use and maintenance manual and observe the instructions given precisely.

You must be aware of and understand all applicable work safety regulations. Note that in certain countries, persons under the age of 18 years are not permitted to operate a tractor.

It is your responsibility to learn these regulations and apply them in the workplace. These regulations include the following instructions for using the tractor safely.

CAUTION
The operator must not consume alcohol or take drugs which could impair concentration and/or coordination.

Observe the following precautions

- Never let minors or unqualified persons drive the tractor.
- Fasten the seat belt if the tractor is equipped with an ROPS safety roll bar.
- If possible, avoid using the tractor near excavation sites or large ditches.
- Reduce speed when steering and when driving across hilly, uneven, slippery or muddy terrain.
- Keep away from steep slopes as they are dangerous.
- Always watch where you are going, especially during headland turns and around trees.
- Never allow anyone to climb onto the tractor or implement.
- Use the tractor calmly, avoiding rushed or sudden manoeuvres. Do not steer, start or stop suddenly.
- Only use the drawbar or other specific hitching points to tow. Never attach a towed load above the centreline of the rear axle.
- Engage the parking brake when the tractor is parked.
- Do not modify or remove any part of component of the original equipment of the tractor.
- Keep others out of your work area.
- Do not use hitching or towing devices that are not intended for your tractor.

2.2.1 ROPS

The tractor may be equipped with an ROPS safety roll bar and a seat belt. If the ROPS structure has been removed, the tractor must be equipped with a new ROPS and seat belt. The ROPS reduces the risk of injury in the event of a roll-over. A roll-over without the ROPS roll bar may cause serious damage and injury.

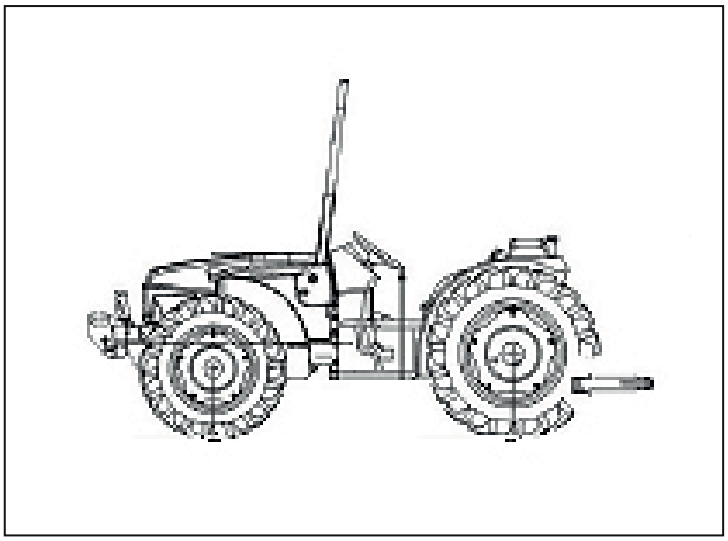


Fig. 1.7

Usage

- Before using the tractor, make sure that the ROPS is not damaged and is fastened correctly to the tractor.

- Never attach chains, cables etc. to the ROPS or cab to tow a load, as this may cause the tractor to overturn: always use the drawbar to tow.

- Always fasten your seat belt. Do not use the seat belt if the tractor is not equipped with an ROPS safety roll bar.

- Check the seat belt for damage. Replace the seat belt if damaged.

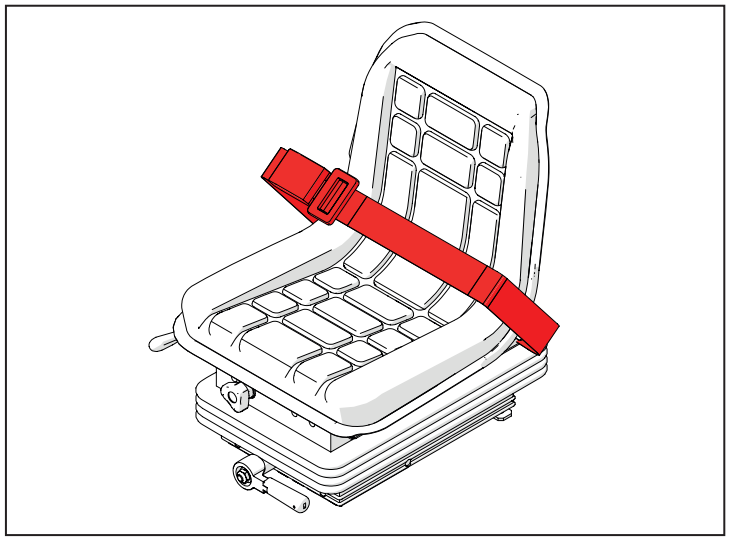


Fig. 1.8

Damage to ROPS safety roll bar

If the tractor has rolled over or if the ROPS safety roll bar has been damaged (e.g. due to collision with a bridge), it must be replaced to ensure the same degree of safety originally offered by the tractor.

After an accident, check that the ROPS safety roll bar, the driver seat, the seat belt and the seat belt anchor points. Replace all damaged parts before using the tractor again.

Do not weld, drill, bend or straighten the ROPS safety roll bar or parts of the cab: these actions will compromise the original safety of the tractor.

Precautions for working safely

- Protect yourself against injury

- Wear appropriate protective garments and use the personal protective devices required for the task.

- Do not take risks.

Use the following personal protective equipment and garments (Fig. 1.9):

- A safety helmet;

- Safety glasses or a protective face mask;

- Hearing defenders;

- A protective breathing mask or filter;

- Appropriate garments to protect against bad weather;

- Reflective garments;

- Heavy work gloves (in neoprene for handling chemical products, in leather for heavy duty work).

- Safety footwear.

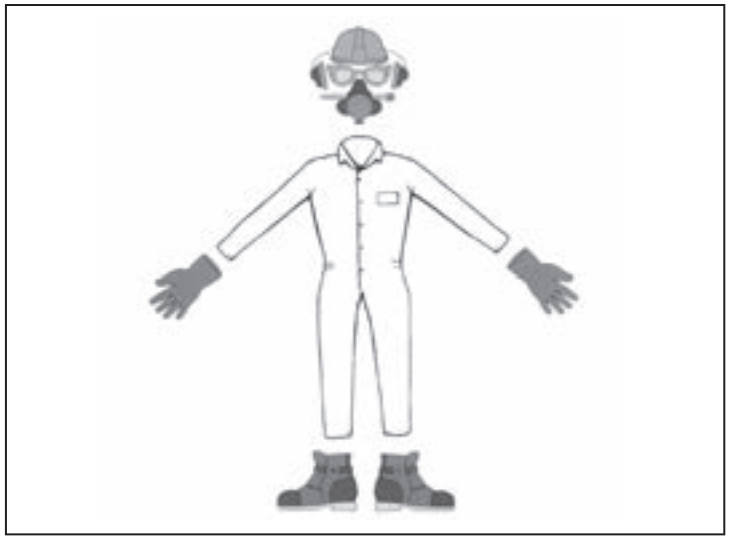


Fig. 1.9

2.2.2 Cab safety

- The safety cab is specifically designed to be installed on this series of tractors and is compliant with all safety and noise requisites of applicable legislation.
- The safety cab is conformant with international safety standards. Never drill or modify the cab to install accessories or implements.
- Do not attempt to repair damaged parts of the cab by welding.
- Never attach chains or cables to the main chassis of the cab for towing loads.

Section 3 : General

Index

3.1 Spare parts 1-20

3.2 Specific tools 1-20

3.3 Oil seals for rotating shafts 1-21

3.4 Adjuster shims 1-21

3.5 O-ring seals 1-22

3.6 Sealants used 1-22

3.7 Spring pins 1-22

3.1 Spare parts

If it is necessary to replace a part, ask for and make sure that you use original spare parts only

Using non-original spare parts will void the warranty.

Always provide the following information when ordering spare parts:

- Tractor model and commercial name;

- Chassis number;

- Order code of required part (this can be found in the Spare Parts Catalogue).

3.2 Specific tools

The tools and equipment specified and illustrated in this manual have been developed specifically by the manufacturer to make working on the tractor quicker, simpler and more effective.

These tools and equipment will ensure the best results possible with minimum operator strain, and let you avoid any operations which could compromise the successful outcome of the job.

Note
The wear limits indicated are recommended only and not mandatory. The indications “front”, “rear”, “right” and “left” are with respect to the operator facing towards the front of the vehicle and seated in the drive seat.

3.3 Oil seals for rotating shafts

Observe the following precautions and instructions to ensure that oil seals are installed correctly:

- Clean the shaft thoroughly and check that the contact surfaces of the shaft itself are undamaged.
- Fit with the seal lip facing towards the fluid; when fitting hydrodynamic lip seals, the grooves must be oriented correctly in relation to the direction of rotation of the shaft so that they will carry fluid towards the interior of the seal.
- Spread a film of lubricant (preferably use oil and not grease) on the seal lip and, with double lip seals, fill the gap between the oil seal lip and the dust seal lip with grease;
- Install the oil seal in its seat with a flat tipped punch; never hit the seal directly with a hammer.
- While installing the seal, make sure that the oil seal remains perpendicular relative to its seat. Once the seal is installed, where applicable, check that it fits completely against the relative shoulder.
- To prevent the shaft from damaging the seal lip, place suitable protection between the two parts during assembly.

3.4 Adjuster shims

Each time an adjustment with shims is necessary, measure each adjuster shim with a micrometer and assemble a pack of the required thickness on the basis of the values measured.

Note

Do not rely on the measurement of the assembled pack and do not base your calculations on the measurements indicated on each shim, as they may be incorrect.

3.5 O-ring seals

Lubricate O-rings before fitting in their respective seals to prevent them from twisting and seating incorrectly, compromising the integrity of the seal itself.

3.6 Sealants used

A number of different sealants must be used during assembly, with specific characteristics to suit different applications.

Sealants

LOCTITE 518 mastic sealant must be used where a hermetic seal is required between two or more components.

Usage:

- Remove any encrusted residue from both mating surfaces with a wire brush.
- Degrease the surfaces thoroughly with one of the following cleaners: trichloroethylene, petroleum spirit, acetone or a solution of hot water and caustic soda.
- Spread the product evenly onto just one of the contact surfaces and assemble.

Thread lock compound

LOCTITE 243 and LOCTITE 270 thread lock compounds are used when it is necessary to impede a screw or nut from loosening.

Usage:

- Clean as described previously.
- Spread one or two drops of the product onto the thread of the screw or in the threaded hole.
- Fit the screw or nut and tighten.

3.7 Spring pins

When fitting split spring pins, ensure that the split in the pin itself is facing in the same direction as the force exerted on the pin.

Coiled spring pins can be fitted in any orientation.

Section 4 : Technical characteristics

Index

4.1 Engine 1-24

4.2 Transmission 1-24

4.3 Brakes and steering 1-25

4.4 Rear Power Take Off 1-25

4.5 Front Power Take Off 1-25

4.6 Rear lift 1-25

4.7 Front lift 1-26

4.8 Hydraulic circuit 1-26

4.9 Driver zone 1-26

4.10 Weights and dimensions 1-27

4.10.1 Maximum axle loads 1-28

4.11 Lubricants 1-29

4.12 Speed 1-31

4.13 Conversion tables 1-33

4.1 Engine

	Energy 60	Energy 80
Brand	VM	VM
Model	D754 TE3	D754 TE3
Power	Direct diesel injection	Direct diesel injection
Rated power (ECE R120)	41.2 kW / 56 HP	55.2 kW / 75 HP
Emissions compliance	STEP 3A	STEP 3A
Number of cylinders	3	4
Intake	Turbocharged	Turbocharged
Rated speed	2600 rpm	2600 rpm
Cooling	Liquid	Liquid
Displacement	2082 cm3	2970 cm3
Specific fuel consumption (at max. torque engine speed)	235 g/KWh	238 g/kWh
Maximum torque	195Nm @ 1400 rpm	250Nm @ 1600 rpm
Torque rise	22,4%	18,9%
Tank capacity	50 litres	50 litres
Engine hood	Pressed steel	Pressed steel

4.2 Transmission

	Energy 60	Energy 80
Transmission type	Mechanical transmission, four wheel drive	Mechanical transmission, four wheel drive
Gearbox type	DUAL POWER 16+8/8+8 synchronised	DUAL POWER 16+8/8+8 synchronised
Shift control system	Mechanical with lateral levers	Mechanical with lateral levers
Clutch	Single plate dry clutch, 9" diameter	Single plate dry clutch, 10" diameter
Clutch control	Mechanical with pedal	Mechanical with pedal
Safety	PUSH & START device on clutch pedal	PUSH & START device on clutch pedal
Reverse shuttle type	Mechanical, synchronised	Mechanical, synchronised
Reverse shuttle control	Lever	Lever
Rear differential lock	Mechanical	Mechanical
Front axle	Four-wheel drive	4WD, selectable without disengaging drive
Front wheel drive clutch	-	Multiplate wet clutch
4WD engagement control	Mechanical	Electrohydraulic
Front differential lock	NO-SPIN (Automatic)	NO-SPIN (Automatic)
Front axle swing angle	11°	11°
Minimum speed	0,9 Km/h	1,0 Km/h
Maximum speed (homologated)	30 Km/h	40 Km/h

4.3 Brakes and steering

	Energy 60	Energy 80
Rear brake type	Mechanically controlled multi-disc wet brakes	Mechanically controlled multi-disc wet brakes
Front brake type	-	IST (simultaneous 4WD engagement under braking)
Lever operated emergency and parking brake	Independently and mechanically controlled. Braking action on rear wheels.	Independently and mechanically controlled. Braking action on rear wheels.
Steering type	Hydrostatic with load sensing valve	Hydrostatic with load sensing valve
Steering angle	55°	55°

4.4 Rear Power Take Off

Type	Single shaft, independent and synchronised
PTO speed independent of ground speed	540/750 rpm 540/1000 rpm
Groundspeed synchronised	Yes
Direction of rotation (looking at PTO)	Clockwise
Profile	1-3/8" with 6 splines
Clutch	Independent, mechanical dry clutch
Clutch control	Mechanical
Safety	PUSH & START device on clutch pedal and on PTO

4.5 Front Power Take Off

Direction of rotation	Anticlockwise
Profile	1-3/8" with 6 splines
Speed	1000 rpm
Type	Single shaft, independent
Clutch	Electromagnetic
Operation	Electric

4.6 Rear lift

Type	Hydraulic with position and draft control
Lift capacity at lower link ends	2,300 kg
3-point linkage category	Category 1 and 2
Mechanical top link arm	Category 1 and 2
Lower link arm type	Fixed
Right hand tie-rod type	Mechanical

4.7 Front lift

Type	Up-Down Float mode
Lift capacity at lower link ends	1,000 kg
3-point linkage	Cat. 1 and 1N

4.8 Hydraulic circuit

	Energy 60	Energy 80
Type	Open centre	Open centre
Pump delivery	38 litres / minute	38 litres / minute
First rear hydraulic distributor	Transformable, with single or double acting operation	Transformable, with single or double acting operation
Second rear hydraulic distributor	Double action	Double acting
Third rear hydraulic distributor	Single action with float mode detent; or double action with lever detent; or double action with lever return spring; or double action with fourth float mode position	Single action with float mode detent; or double action with lever detent; or double action with lever return spring; or double action with fourth float mode position
Front hydraulic distributors		Up to 3, single/double action
Free oil return coupling	1/2 NPTF quick coupler	1/2 NPTF quick coupler

4.9 Driver zone

Platform	Full size, suspended
Platform carrier	Silent-block
Front mudguards	Independent steering mudguards in rubber
Rear mudguard protection	Rubber profile
ROPS	Central, fully foldable
Standard cab	Goldoni Overview GL9
LH rear-view mirror	Adjustable
Seat	With elastic suspension and seat belt
Seat adjustment	Fore/aft, up/down and driver weight
Toolbox	Yes
Use and maintenance manual	Yes

4.10 Weights and dimensions

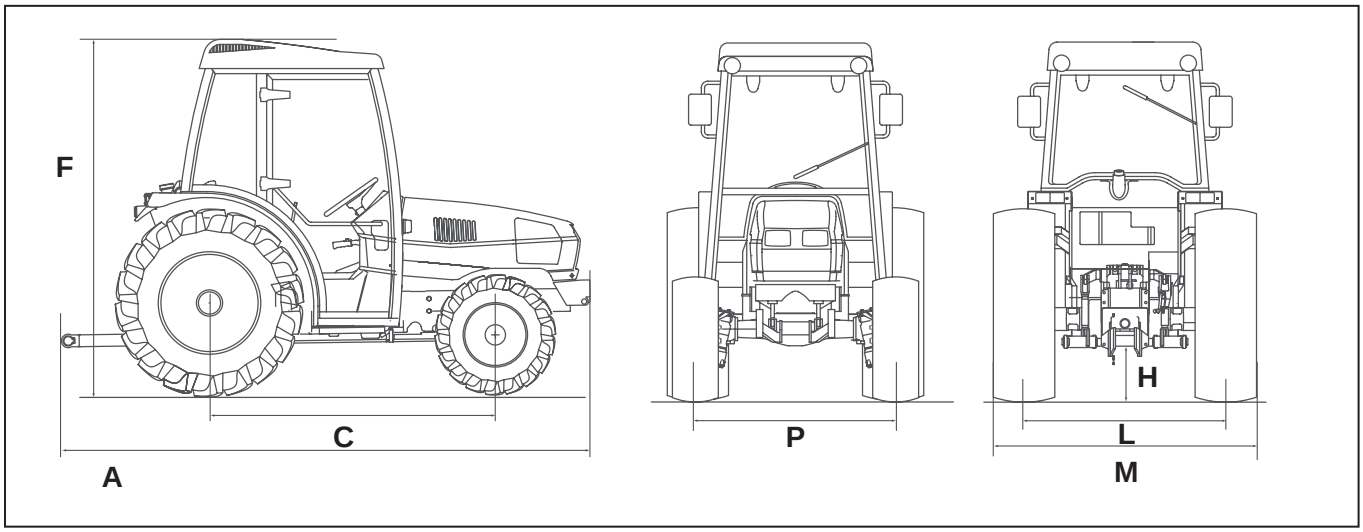


Fig. 1.10

Values given are for tractor with 320/70-R24" rear tyres and 240/70-R16" front tyres

Reference	Description	Energy 60	Energy 80
		Low version (high version)	
A	Maximum length	3090-3455 mm	3231-3596 mm
M	Minimum width	1290 mm (1293 mm)	1290 mm (1293 mm)
	Maximum width	1766 mm	1770 mm
F	Frame height	2000-2071 mm (2150 mm)	2081-2145 mm (2196-2214 mm)
F	Cab version	2050-2130 mm (2218 mm)	2054-2159 mm (2184-2209 mm)
H	Ground clearance	167-243 mm (331 mm)	170-269 mm (306-329 mm)
C	Wheelbase	1690 mm (1706 mm)	1831 mm (1854 mm)
P	Minimum front track	1038 mm (1123 mm)	1038 mm (1123 mm)
	Maximum front track	1414 mm (1447 mm)	1414 mm (1447 mm)
L	Minimum rear track	998 mm	998 mm
	Maximum rear track	1474 mm	1474 mm
	Minimum turning radius with brakes	3 m	3 m
	Weight with ROPS	1850-1920 kg	1930-2075 kg
	Weight with cab	2030-2100 kg	2070-2240 kg

4.10.1 Maximum axle loads

Energy 60 - Low version

	Tyres	Load capacity	Maximum front axle load	Total mass
Rear	41/14.00-20"	1397 kg	1950 kg	3050 kg
Front	27/8.50-15"	660 kg	1100 kg	
Rear	360/70-R20"	1400 kg	1950 kg	3050 kg
Front	11.0/65-R12"	1170 kg	1100 kg	
Rear	320/70-R24"	1340 kg	1950 kg	3050 kg
Front	240/70-R16”	900 kg	1100 kg	

Energy 80 - Low version

	Tyres	Load capacity	Maximum front axle load	Total mass
Rear	41/14.00-20"	1397 kg	1950 kg	3050 kg
Front	27/8.50-15"	660 kg	1100 kg	
Rear	360/70-R20"	1400 kg	1950 kg	3050 kg
Front	11.0/65-R12"	772 kg	1100 kg	
Rear	320/70-R24"	1340 kg	1950 kg	3050 kg
Front	240/70-R16”	900 kg	1100 kg	
Rear	360/70-R24"	1500 kg	1950 kg	3050 kg
Front	260/70-R16”	1030 kg	1100 kg	

Energy 60 - High version

	Tyres	Load capacity	Maximum front axle load	Total mass
Rear	320/70-R24"	1340 kg	1950 kg	3050 kg
Front	240/70-R16”	900 kg	1100 kg	

Energy 80 - High version

	Tyres	Load capacity	Maximum front axle load	Total mass
Rear	320/70-R24"	1340 kg	1950 kg	3050 kg
Front	240/70-R16”	900 kg	1100 kg	
Rear	360/70-R24"	1500 kg	1950 kg	3050 kg
Front	260/70-R16”	1030 kg	1100 kg	

4.11 Lubricants

Original lubricants

Arbor Alfatech Synt 10W-40 oil	
Viscosity at 100°C	14 mm2/s
Viscosity grade	158
Flash point V.A.	200°C
Pour point	-33°C
Volumetric Mass at 15° C	0.875 kg/l

Arbor Universal 15W-40 oil	
Viscosity at 40°C	110 mm2/s
Viscosity at 100°C	14 mm2/s
Viscosity at -15°C	3450 mPa.s
Viscosity grade	135
Flash point V.A.	220°C
Pour point	-36°C
Volumetric Mass at 15° C	0.886 kg/l

Arbor TRW 90 oil	
Viscosity at 40°C	135 mm2/s
Viscosity at 100°C	14.3 mm2/s
Viscosity at -26°C	108000 mPa.s
Viscosity grade	104
Flash point V.A.	220°C
Pour point	-27°C
Volumetric Mass at 15° C	0.895 kg/l

Arbor MTA oil	
Viscosity at -40°C	28000 mPa.s
Viscosity at 40°C	35.5 mm2/s
Viscosity at 100°C	7.5 mm2/s
Viscosity grade	160
Flash point V.A.	200°C
Pour point	-40°C
Volumetric Mass at 15° C	0.870 kg/l
Colour	Red

Arbor MP Extra grease	
NLGI consistency number	2
Worked penetration (60)	285 dmm
Dropping point	190°C
4-ball weld load	300 kg
Viscosity of oil at 40° C	200 mm2/s

Original protective fluids

PARAFLU 11 antifreeze fluid	
Density at 15° C	1,135 g /cm3
pH	7.7, diluted to 50%
Reserve alkalinity	16 ml HCl 0.1 N
Boiling point	-38° C diluted to 50%
Foam at 88°C	50 cc

4.12 Speed

Speed values are for an engine speed of 2600 rpm and with tractor fitted with 320/70-R24" tyres (values are indicative only).

Energy 60 Forward-Slow

Gear	Dual Power mode (16+8 speeds)		Reverse shuttle mode (8+8 speeds)
	Normal gears	20% Dual Power drive ratio reduction	
1st	1,34 Km/h	1,00 Km/h	1,34 Km/h
2nd	2,21 Km/h	1,65 Km/h	2,21 Km/h
3rd	3,80 Km/h	2,84 Km/h	3,80 Km/h
4th	5,50 Km/h	4,14 Km/h	5,50 Km/h

Energy 60 Forward-Fast

Gear	Dual Power mode (16+8 speeds)		Reverse shuttle mode (8+8 speeds)
	Normal gears	20% Dual Power drive ratio reduction	
1st	7,63 Km/h	5,72 Km/h	7,63 Km/h
2nd	12,56 Km/h	9,42 Km/h	12,56 Km/h
3rd	21,68 Km/h	16,26 Km/h	21,68 Km/h
4th	31,36 Km/h	23,52 Km/h	31,36 Km/h

Energy 60 Reverse-Slow

Gear	Dual Power mode (16+8 speeds)		Reverse shuttle mode (8+8 speeds)
	Normal gears	20% Dual Power drive ratio reduction	
1st	3,19 Km/h	2,40 Km/h	1,14 Km/h
2nd	5,26 Km/h	3,94 Km/h	1,87 Km/h
3rd	9,07 Km/h	6,81 Km/h	3,23 Km/h
4th	13,13 Km/h	9,85 Km/h	4,67 Km/h

Energy 60 Reverse-Fast

Gear	Dual Power mode (16+8 speeds)		Reverse shuttle mode (8+8 speeds)
	Normal gears	20% Dual Power drive ratio reduction	
1st	-	-	6,48 Km/h
2nd	-	-	10,67 Km/h
3rd	-	-	18,42 Km/h
4th	-	-	26,66 Km/h

Energy 80 Forward-Slow

Gear	Dual Power mode (16+8 speeds)		Reverse shuttle mode (8+8 speeds)
	Normal gears	20% Dual Power drive ratio reduction	
1st	1,61 Km/h	1,21 Km/h	1,61 Km/h
2nd	2,65 Km/h	1,99 Km/h	2,65 Km/h
3rd	4,58 Km/h	3,44 Km/h	4,58 Km/h
4th	6,63 Km/h	4,97 Km/h	6,63 Km/h

Energy 80 Forward-Fast

Gear	Dual Power mode (16+8 speeds)		Reverse shuttle mode (8+8 speeds)
	Normal gears	20% Dual Power drive ratio reduction	
1st	9,20 Km/h	6,90 Km/h	9,20 Km/h
2nd	15,14 Km/h	11,36 Km/h	15,14 Km/h
3rd	26,14 Km/h	19,60 Km/h	26,14 Km/h
4th	37,82 Km/h	28,36 Km/h	37,82 Km/h

Energy 80 Reverse-Slow

Gear	Dual Power mode (16+8 speeds)		Reverse shuttle mode (8+8 speeds)
	Normal gears	20% Dual Power drive ratio reduction	
1st	3,85 Km/h	2,89 Km/h	1,37 Km/h
2nd	6,34 Km/h	4,75 Km/h	2,26 Km/h
3rd	10,94 Km/h	8,21 Km/h	3,89 Km/h
4th	15,83 Km/h	11,87 Km/h	5,63 Km/h

Energy 80 Reverse-Fast

Gear	Dual Power mode (16+8 speeds)		Reverse shuttle mode (8+8 speeds)
	Normal gears	20% Dual Power drive ratio reduction	
1st	-	-	7,82 Km/h
2nd	-	-	12,87 Km/h
3rd	-	-	22,22 Km/h
4th	-	-	32,14 Km/h

4.13 Conversion tables

1 mm	= 3.28 ft
1 cm	= 0.39 in
1 mm	= 0.039 in
1 km	= 0.62 ml
1 Km/h	= 0.62 mph
1 l	= 0.21 UK gal
1 l	= 0.26 US gal lqd
1 kg	= 2.20 lb
1 hp	= 735.49 W
1 hp	= 0.98 hp
1 kW	= 1.35 hp
1 bar	= 14.50 psi
1 bar	= 100 kPa
1 psi	= 6.89 kPa

Section 5 : Tightening torques and sealants

Index

5.1 Tightening torques for nuts 1-36

5.2 Tightening torques for ring nuts 1-36

5.3 Tightening torques for hex head screws 1-37

5.4 Tightening torques for stud bolts 1-37

5.5 Tightening torques for tapered plugs 1-37

5.6 Loctite sealant types 1-38

5.1 Tightening torques for nuts

Type	Nm	kgm
M 8x8	30	3
M 10x10	50	5
M 10x10 self-locking	50	5
M 12x1.25x12 (fastening gearbox selector forks)	80	8
M 12x1.5x8	80	8
M 12x10	90	9
M 12x12	90	9
M 12x12 self-locking	80	8
M 12x14	90	9
M 12x18	90	9
M 12x14.6	90	9
M 12x1.25x8 (fastening hydraulic pump gear)	50	5
M 12x1.25x8	90	9
M 14x14	120	12
M 16x1.5x8 (fastening gearbox selector forks)	80	8
M 16x1.5x14	140	14
M 16x16	120	12
M 16x16	100	10
M 18x15	180	18
M 20x1.5x9	65	6.5
M 30x1.25x10	250	25

5.2 Tightening torques for ring nuts

Type	Nm	kgm
M 20x1.5	35	3.5
M 20x1x9	80	8
M 25x1.5 (PTO)	35	3.5
M 25x1.5 (steering cylinder)	130	13
M 30x1.5x10	240-250	24-25
M 30x1.5x10	160	16
M 30x1.5	150	15
M 35x1.5x10	200	20
M 40x1.5	150	15
M 50x1.5	250	25

5.3 Tightening torques for hex head screws

Type	Nm	kgm
M 6	13	1.3
M 8	30	3
M 10	60	6
M 10 x 1.25	70	7
M 12	90	9
M 14	120	12
M 14 (front track chain leaf spring carrier)	180	18
M 18 x 1.5	250	25
M 16	130	13
M 16 x 1.5	130	13

5.4 Tightening torques for stud bolts

Type	Nm	kgm
M 10	30	3
M 12	40	4
M 14	50	5
M 16	60	6
M 18	70	7
M 20	80	8

5.5 Tightening torques for tapered plugs

Type	Nm	kgm
1/2"	30	3

5.6 Loctite sealant types

	Description	Type	Usage
Thread lock	Weak thread lock	Loctite 222	Weak thread lock and sealing action for screws and adjuster screws
	Medium strength thread lock	Loctite 243 (replaces 242)	Medium strength thread lock and sealing action for threaded parts in general.
	High strength thread lock	Loctite 271 (replaces 270)	High strength thread lock and sealing action for stud bolts, nuts and screws.
	Penetrating thread lock adhesive	Loctite 290	Thread locking and sealant action achieved by wicking between previously assembled parts. Micro-porosity sealant.
Assembling parts	Locking adhesive	Loctite 603 (replaces 601)	High bonding strength retaining compound.
	Retaining compound	Loctite 641	Medium strength retaining compound for bushes, bearings etc. . Permits disassembly with normal tools.
	High strength retaining compound	Loctite 638	Rapid, heat resistant, high strength retaining compound for cylindrical parts. For dynamic applications.
	High temperature retaining compound	Loctite 648	Rapid, heat resistant, high strength retaining compound for cylindrical parts.
Sealant for	hydraulic and pneumatic couplings	Loctite 542	For sealing threaded connections of hydraulic or pneumatic lines up to 3/4" in diameter.
	Slow curing	Loctite 572	For sealing threaded connectors in general.
Liquid gaskets	Dense gasketing compound for surfaces	Loctite 510	Sealing surfaces. Applied manually.
	Gasketing compound for surfaces	Loctite 573	Sealing precise surfaces. Applied manually or with screen printing system.
Clean	Cleaner/degreaser	Loctite 7063	Prepares components for application of an adhesive sealant.
	Gasket remover	Loctite 7200	Removes all residue of sealants and gaskets.

Section 6 : General assembly instructions

Index

6.1 Oil seals 1-40
6.1.1 General instructions and guidelines 1-40
6.1.2 Assembly 1-40
6.1.3 Replacement 1-41

6.2 O-Rings 1-41
6.2.1 Assembly 1-41

6.3 Bearings 1-42
6.3.1 Introduction 1-42
6.3.2 Preparing for assembly 1-42
6.3.3 Assembly 1-43
6.3.4 Disassembly 1-44

6.1 Oil seals

6.1.1 General instructions and guidelines

Normally, one gasket is sufficient to ensure seal tightness. The seal lip must face towards the fluid retained or the pressurised side.

Do not allow mechanical parts to come into contact with the seal lip as this would compromise seal tightness and significantly reduce the lifespan of the gasket.

Lubricate the seal ring thoroughly before installing to prevent the seal from operating dry during the first revolutions of the shaft.

Grooved seal rings must be lubricated with oil and not grease, as grease would fill the grooves and render them ineffective.

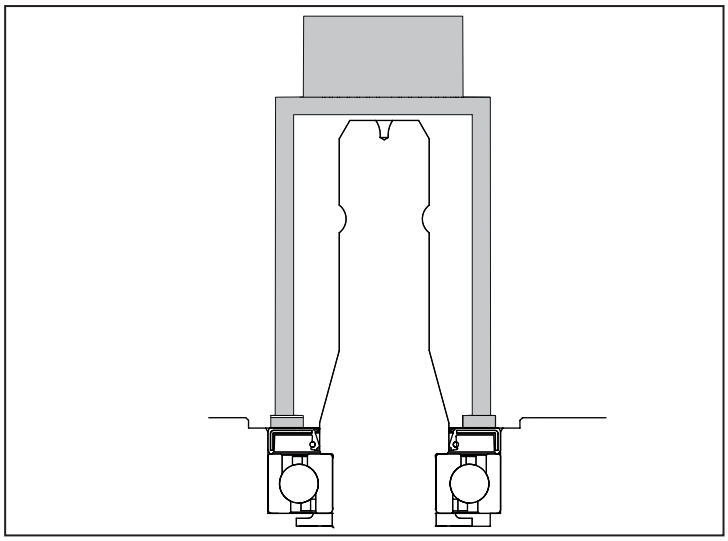


Fig. 1.11

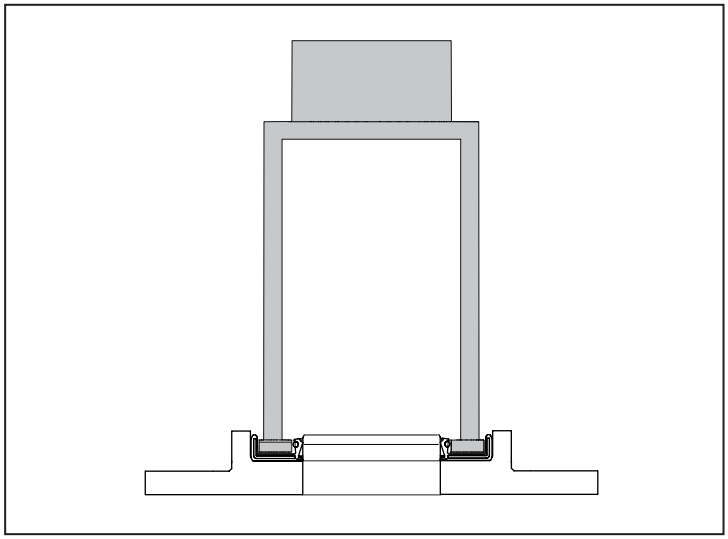


Fig. 1.12

6.1.2 Assembly

1 - When fitting gaskets on the shaft, check that there is a bevelled guide edge on the shaft.

2 - Protect the seal lip against damage caused by threads, recesses, sharp edges, keying slots etc; cover these parts of the shaft appropriately when fitting the gasket.

3 - Preferably use a hydraulic or mechanical press to install the gasket in its seat.

4 - The installing force must be applied as closely as possible to the outer diameter of the gasket, ensuring that the gasket itself remains perfectly perpendicular to the hole during installation.

5 - Do not use adhesive to fix the gasket in its seat. Even if all possible precautions are taken, there is a risk of adhesive fouling the seal lip, causing damage to the gasket and fluid leakage even from the first revolutions of the shaft.

6.1.3 Replacement

When servicing an assembly, replace all seal rings on rotating shafts and all gaskets in general.

Make sure that the seal lip of the new ring does not run against the same surface on the shaft as the previous ring.

6.2 O-Rings

6.2.1 Assembly

1 - Do not force O-rings over sharp edges, threads or splines. In cases where, due to construction constraints, this cannot be avoided, use a conical installation bush or an equivalent solution.

2 - Before fitting an O-ring, check that it is the correct type specified for the application. Clean the seat of the O-ring very carefully. Any remaining contaminants could damage both the O-ring and the sliding surfaces.

3 - To facilitate installation and ensure effective lubrication immediately after fitting, immerse the O-ring in the same type of oil with which it will be in contact, or apply a light film of grease compatible with the material from which the O-ring itself is made.

4 - Take care not to twist the O-ring when installing in its seat.

5 - Take care not to damage the O-ring when assembling components.

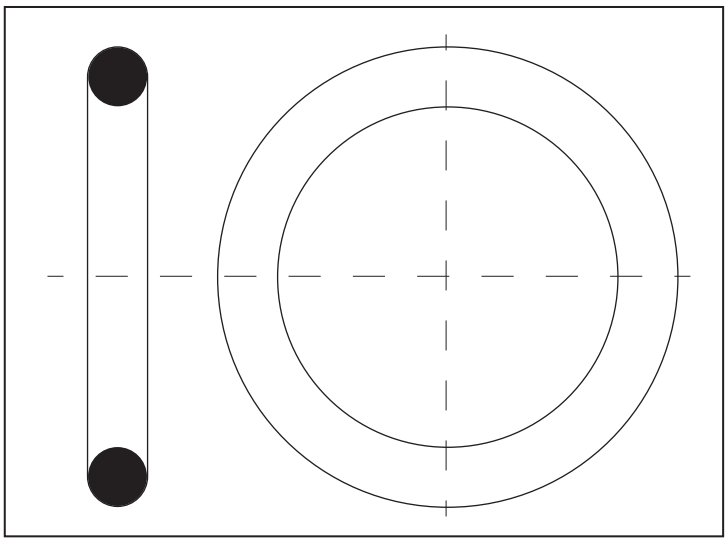


Fig. 1.13

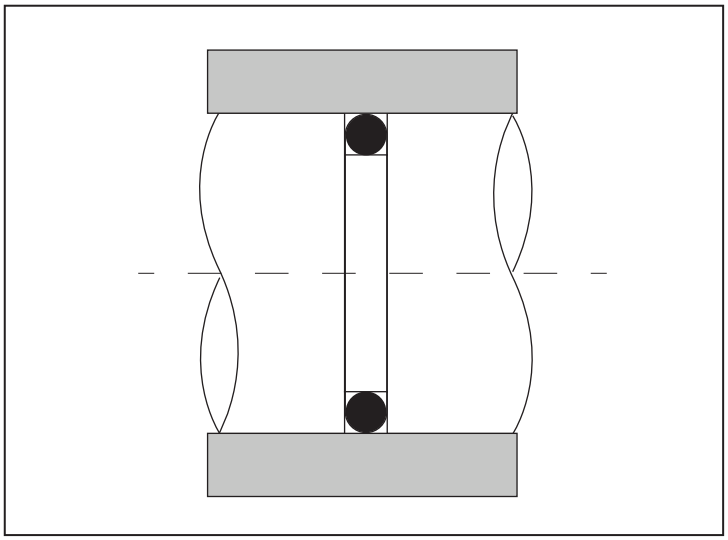


Fig. 1.14

6.3 Bearings

6.3.1 Introduction

Expertise and maintaining cleanliness are the two most important factors when installing bearings to ensure that the bearings function correctly and to prevent premature bearing failure. Bearings should be installed in a dust-free, dry place away from machining tools or machines which produce dust.

6.3.2 Preparing for assembly

1 - Before installing a bearing, ensure that all the parts, tools and equipment needed are at hand, and that all parts are arranged in the same order in which they will be installed, as indicated in the instructions or drawings.

2 - All parts involved in the installation of a bearing (seats, shafts etc.) must be thoroughly cleaned to remove all machining residue. The unfinished inner surfaces of cast iron housings must be free of any casting sand residue. Before installation, check the dimensions and forms of all bearing-related components. Bearings will only work correctly if the specified tolerances are observed.

3 - To prevent contamination with foreign objects, only remove bearings from the original packaging immediately before fitting.

4 - Usually, the anti-corrosion coating applied to the cylindrical outer surface and the inner hole of new bearings before they leave the factory must be removed before installing

If it is necessary to lubricate a bearing with a special grease for very high or very low temperatures, wash and dry the bearing before application to prevent any loss in the temperature resistant properties of the grease used.

5 - Any bearings contaminated by improper handling (damaged packaging etc.) must also be washed and dried before installing. Bearings which are coated in a thick and greasy layer of corrosion inhibitor product when removed from their original packaging must be washed and dried before installation, as this coating has been applied with a hot-dip bath (a method still used for large bearings in particular).

Bearings shipped ready-lubricated and with sealed or protective shielding on both sides must NOT be washed before installation.

6.3.3 Assembly

1 - Never hit the shell, race or rotating elements of a bearing directly during installation, as this will damage the bearing itself. Never apply pressure to one bearing shell to facilitate installation of another bearing shell. Lubricate the surfaces of the bearing seats lightly with oil before installing bearings.

Never hit the shell, race or rotating elements of a bearing directly during installation, as this will damage the bearing itself. Never apply pressure to one bearing shell to facilitate installation of another bearing shell. Lubricate the surfaces of the bearing seats lightly with oil before installing bearings.

2 - As a guideline, install the bearing shell with the greatest interference first. Smaller bearings with only a small degree of assembly interference may be seated by tapping gently into place using a mallet and a soft punch or, preferably, a piece of pipe placed with its end against the circumference of the bearing shell. Tap uniformly around the entire circumference of the bearing shell to ensure that it remains perfectly perpendicular relative to its seat. The cup tool illustrated in Fig. 1.15 ensures that force is applied perfectly perpendicularly and distributed evenly around the entire circumference of the bearing shell. Mechanical or hydraulic presses are generally used to install bearings on the production line.

3 - When installing a non-disassemblable bearing on the shaft and in its respective seat simultaneously, place a disc (Fig.) between the bearing and the tubular tool to distribute the installation force even more evenly over the circumferences of the two bearing shells. This method is recommended in particular for swivelling bearings to prevent misalignment of the outer shell relative to the seat. As an alternative, a cup tool with two contact surfaces (one for the inner shell and one for the outer shell) may be used (Fig.). These two surfaces must be coplanar.

4 - The inner and outer shells of disassemblable bearings may be installed separately. This significantly facilitates assembly, especially in cases where both shells must be forced into their seats. When mating two parts of a bearing that have already been installed in their seats, ensure that the two rings of rotating bearing elements remain perpendicularly aligned, as the bearing races may be damaged if they are misaligned.

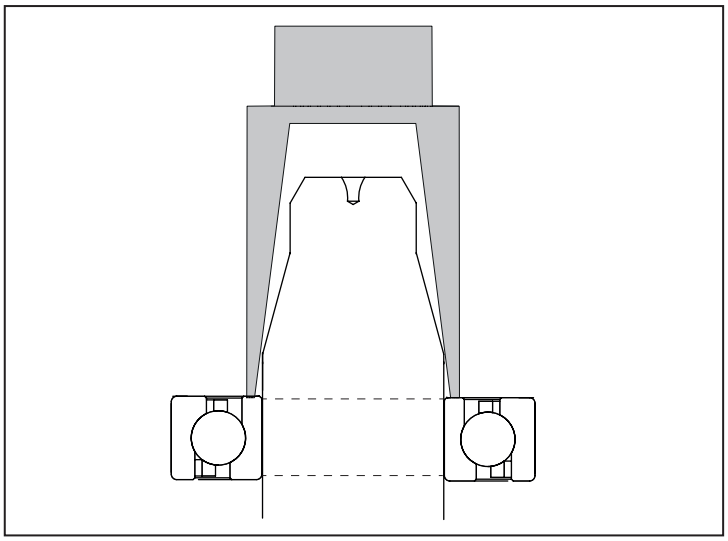


Fig. 1.15

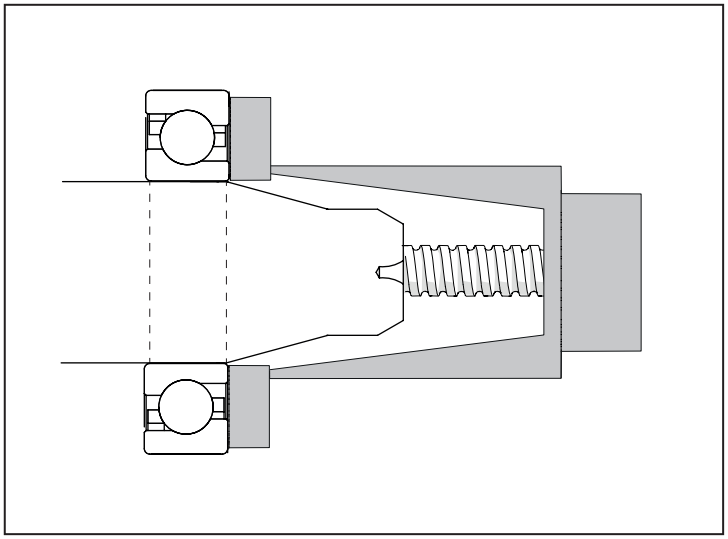


Fig. 1.16

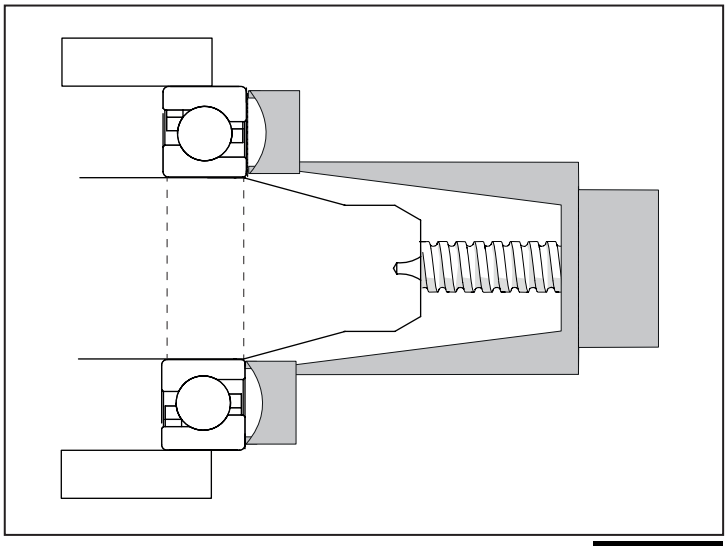


Fig. 1.17

- It may not be possible to install larger bearings onto the shaft or in their seats without heating, as the force necessary to install a bearing increases with its size. In this case, bearings, bearing shells and bearing mounts (hubs etc.) must be heated before installing.
- The temperature difference necessary between the bearing shell and the receiving component depends on the degree of interference required and the diameter of the bearing seat.
- Heat bearings in an oil bath or muffle furnace. If using electrical heating plates, turn the bearings over several times to ensure that they are heated uniformly.

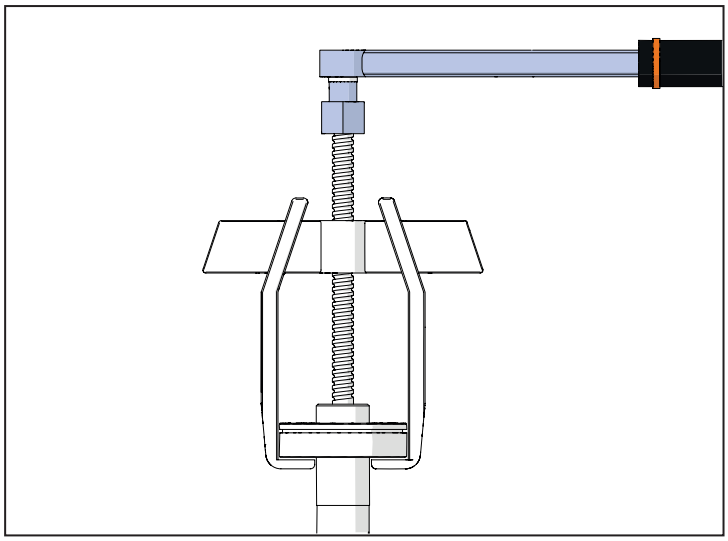


Fig. 1.18

Warning

Do not heat bearings to above 125°C, as this may alter the structure of the material, causing variations in dimension and a loss of hardness.

Avoid localised heating of a bearing.

Warning

Bearings with protective shielding and sealed bearings must not be heated before installation as this may compromise the properties of the lubricant.

6.3.4 Disassembly

- If a bearing is to be used, do not apply force via the revolving bearing elements to remove. In the case of non-disassemblable bearings, detach the bearing shell with the least assembly interference first. Depending on the type and size of the bearing itself, the tools and equipment described as follows must be used to extract bearing shells with a high degree of assembly interference.
- Smaller bearings may be removed from their seats with:
  - a mallet and a punch in soft metal tap gently around the entire circumference of the bearing shell.
  - a mechanical puller tool; apply the puller tool directly onto the bearing shell to be removed, or to an adjacent component.

  Removal will be significantly facilitated if the shoulders of the shaft and bearing seat include notches for the grippers of a puller tool or threaded holes for extractor screws.
- To remove the inner shells of cylindrical roller bearings with no lip or with only one small lip, special tools have been developed which heat the bearing shells rapidly before the shaft has sufficient time to heat significantly and expand.

Chapter 2 : Engine

Index

Section 1 : Safety rules 2-2

Section 2 : Technical characteristics 2-5

2.1 Technical characteristics 2-6

Section 3 : Removing and refitting the engine 2-7

3.1 Energy 60 2-8

3.2 Energy 80 2-21

Section 1 : Safety rules

A number of safety precautions and warnings are indicated in this paragraph; these must be observed to prevent the risk of operator injury. However, the safety measures indicated in the use and maintenance manual and in chapter 1 of this manual must be applied at all times.

Attention
Never fill the engine with lubricant oil beyond the marking on the dipstick as this may damage the engine.
To prevent damage to the engine, if the lubrication system has been drained, lubricate the rocker shaft and the camshaft before starting the engine.
Only use these engines for their specifically intended applications. Do not modify the technical characteristics of the engine.
Clean any spilt fuel. Materials contaminated with fuel must be moved away to a safe place.
Unless absolutely necessary, do not pour fuel into the tank while the engine is running.
Do not clean, add oil to or adjust the engine while it is running unless you are specifically trained to do so. Even if you are specifically trained, use the utmost caution to prevent accidents.
Do not attempt to make adjustments that you do not understand.
Do not run the engine in a place in which harmful emissions may accumulate.
Keep all persons not involved in the task at a safe distance while the engine or any ancillary equipment are running.
Do not run the engine with any of the protective guards removed.
Disconnect the battery terminals before performing any repair work on the electrical system.
The engine must only be operated from the control panel or driver area.
Check that the gear lever is in neutral before starting the engine.
Dispose of used oil correctly to prevent the risk of contaminating the environment.
Work with the utmost caution when performing emergency repairs in difficult conditions.
Never clean the engine while it is running. Using cold cleaning products on a hot engine may damage a number of components.
Use only original spare parts.

Danger
Do not smoke when refuelling.
The combustible materials used for certain components of the engine (such as seals, for example) may produce extremely dangerous substances when burnt. Avoid all contact between burnt materials and the skin or eyer.
Never remove the coolant system filler cap while the engine is hot and the coolant is under pressure, as this may cause boiling liquid to escape violently from the filler.
Seek immediate medical assistance in the event of skin contact with pressurised fuel. Diesel and lubricant oil (especially if used) may be harmful to the skin. Protect the hands with gloves or with specific protective cream. Do not wear garments contaminated with lubricant oil. Do not put materials contaminated with lubricant oil in your pockets.
Avoid contact between compressed air and the skin. Seek immediate medical assistance in the event of compressed air breaking or penetrating the skin.
Keep away from moving parts while the engine is running. Danger! Some moving parts are not clearly visible when the engine is running.
Keep loose clothing and long hair well away from moving parts.
Turbochargers operate at high speed and high temperature. Keep fingers, tools and other objects away from the inlet and outlet ports of the turbocharger and avoid contact with hot surfaces.
Avoid sparks and naked flame in the vicinity of batteries (especially when charging), as the gas released by electrolyte is extremely flammable. Battery fluid is dangerous for the skin and extremely dangerous for the eyes.
The gas contained in the air conditioning system is harmful to the health. Open the doors and ventilate the area adequately once the procedure is complete.

Lifting the engine safely

Danger
Ensure that there are no persons in the vicinity of the load being handled.

Danger
The engine is very heavy. Work with due caution and observe all safety rules.

Attention
Always use an approved engine hoist of adequate load capacity to lift the engine.
Preferably use the hoisting equipment recommended by the manufacturer.
Preferably use the hoisting equipment recommended by the manufacturer.
Check that the hoisting brackets used are undamaged and are securely fastened before lifting the engine.
Check that there is sufficient clear space between the lift hooks and the rocker cover to prevent damage to the rocker cover.
Use appropriate lifting equipment or work with the assistance of another mechanic to lift heavy engine components such as the cylinder block, cylinder head, flywheel housing, crankshaft and flywheel.

Section 2 : Technical characteristics

Index

2.1 Technical characteristics 2-6

2.1 Technical characteristics

	ENERGY 60	ENERGY 80
Brand	VM	VM
Model	D703 TE3	D754 TE3
Power	Direct diesel injection	Direct diesel injection
Rated Power	41.2 KW	55.2 kW
Emissions compliance	STEP 3A	STEP 3A
Number of cylinders	3	4
Intake	Turbocharged	Turbocharged
Rated speed	2600 rpm	2600 rpm
Cooling	Liquid	Liquid
Displacement	2082 cm3	2970 cm3
Specific fuel consumption (at max. torque engine speed)	235 g/KWh	238 g/kWh
Maximum torque	195Nm @ 1400 rpm	250Nm @ 1600 rpm
Torque rise	22.4 %	18.9 %
Tank capacity	50 litres	50 litres
Engine hood	Pressed steel	Pressed steel

Section 3 : Removing and refitting the engine

Index

3.1 Energy 60 2-8
3.1.1 Removal 2-8
3.1.2 Refitting 2-16

3.2 Energy 80 2-21
3.2.1 Removal 2-21
3.2.2 Refitting 2-29

3.1 Energy 60

3.1.1 Removal

Disconnect the connectors (1).

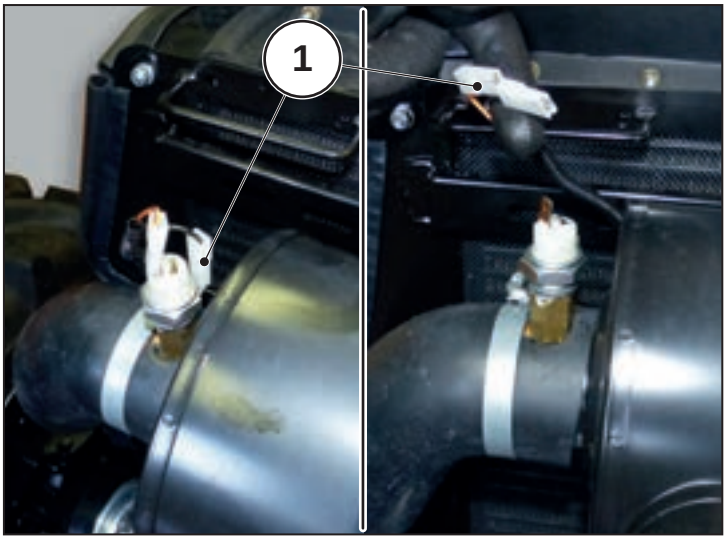


Fig. 2.1

Loosen the clamp (2) of the hose (3), then remove the hose.

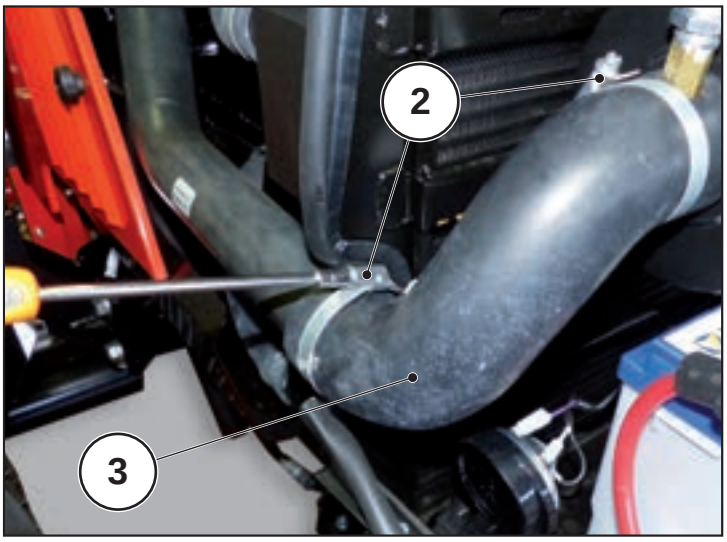


Fig. 2.2

Undo the bolts (4) of the clamps (5) fastening the air filter (6), then remove the filter.

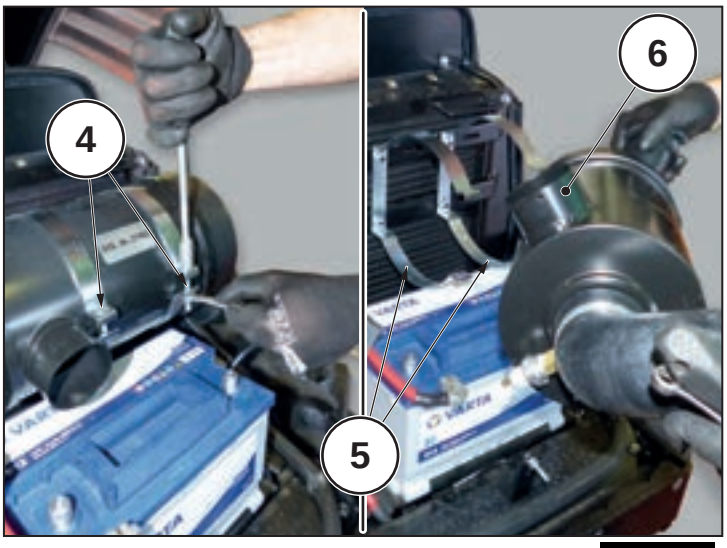


Fig. 2.3

Disconnect the battery, disconnecting the negative terminal first (7).

Undo the rear bracket and one of the two lateral brackets fastening the battery, and then remove the battery.

> **Warning**
>
> It is not necessary to remove the remaining lateral battery fastener bracket. Lift the battery out with due caution.

Fig. 2.4

Disconnect the connectors (8).

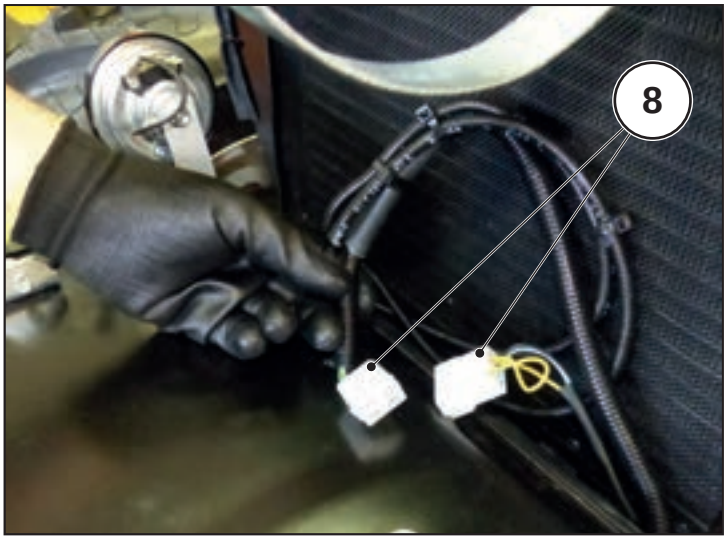


Fig. 2.5

Undo the screws (6) and remove the right hand lateral guard (5).

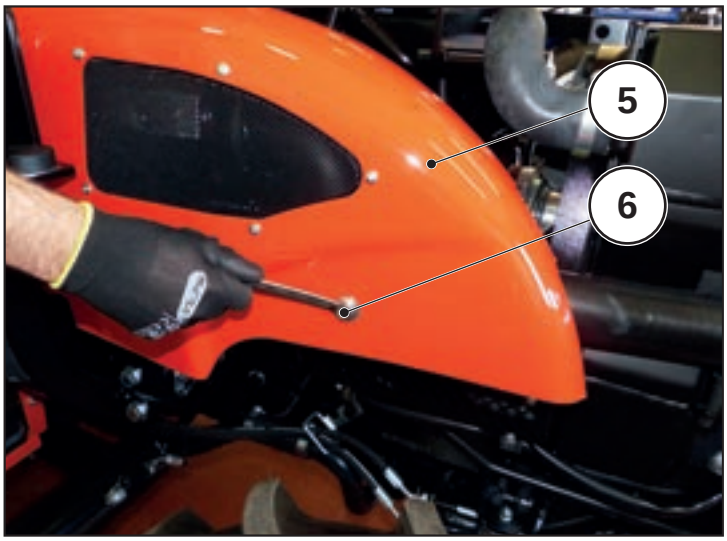


Fig. 2.6

Undo the screws (11) of the plate, then remove the entire battery mount (12).

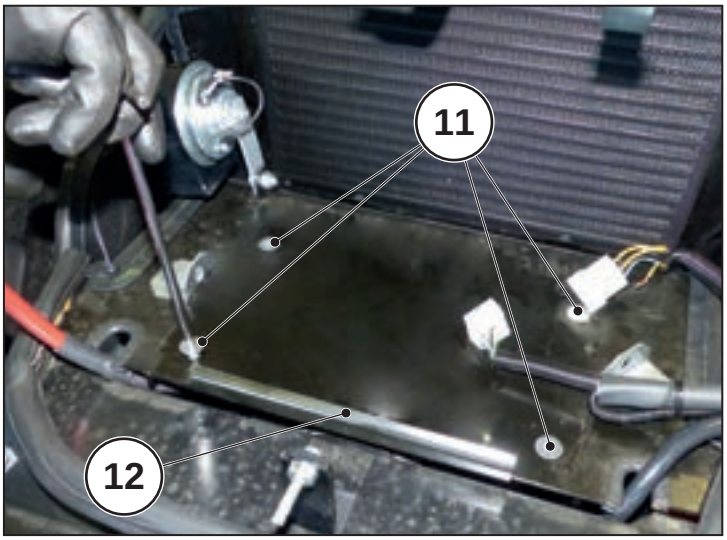


Fig. 2.7

Loosen the clamps (13) and then remove the turbocharger hose.

Note
Close the turbocharger port (14) provisionally with a cap (15).

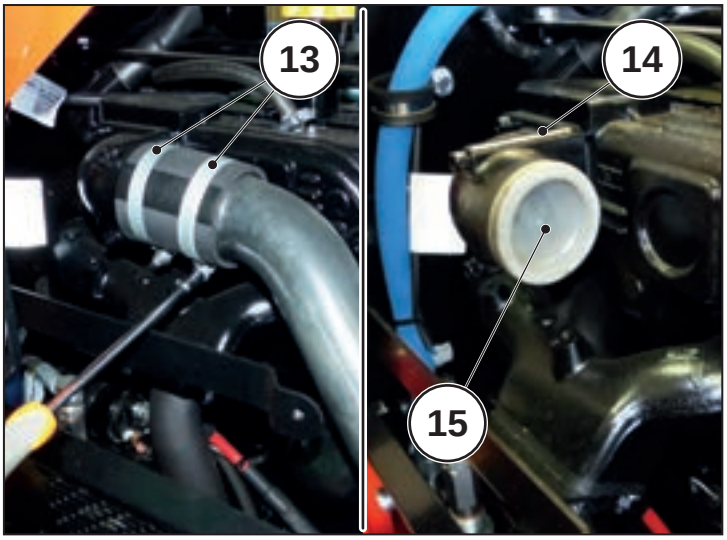


Fig. 2.8

Disconnect wiring connector (18).

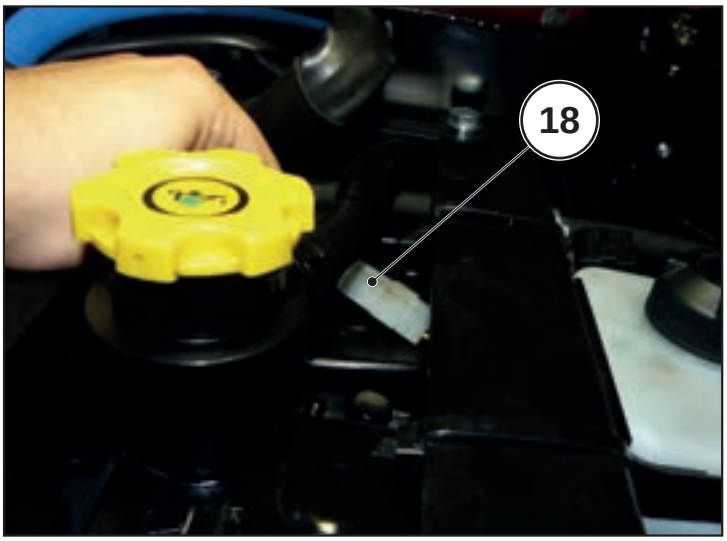


Fig. 2.9

Undo the radiator cap (19).

Drain the coolant contained in the radiator.

Refit and tighten the cap (19) after draining.

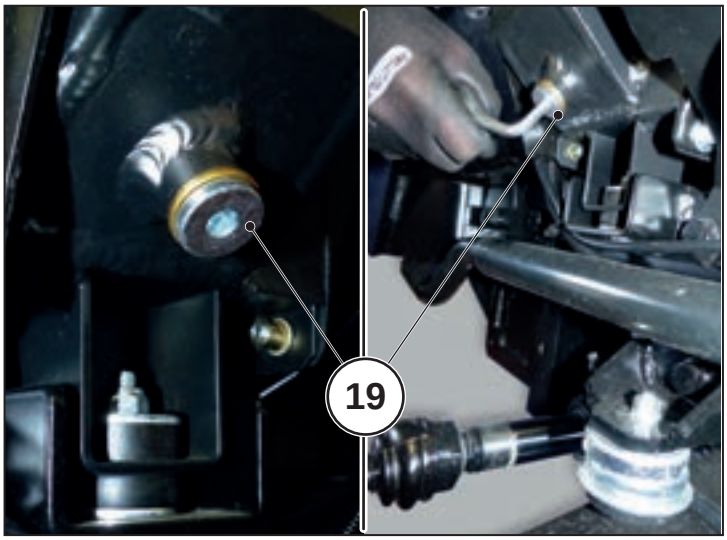


Fig. 2.10

Undo the screws (20) of the right hand guard bracket (21), and then remove the bracket.

Repeat for the left hand guard.

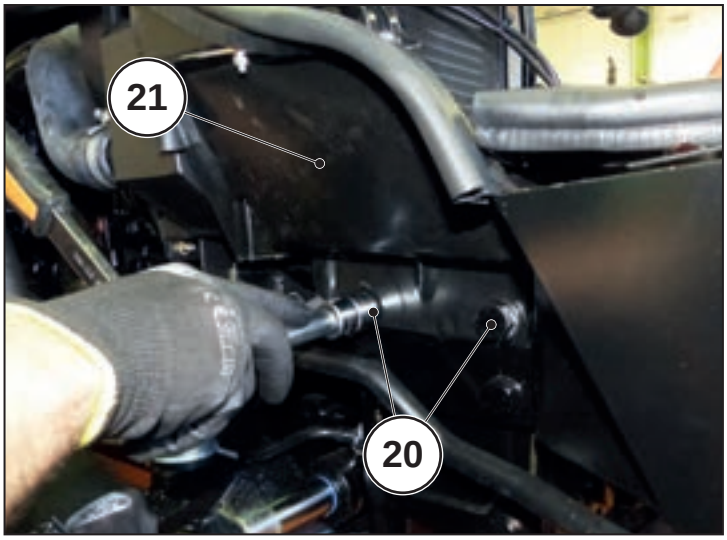


Fig. 2.11

Loosen the clamps (23) and remove the sleeve (24).

Loosen the clamps (25) and remove the sleeve (26).

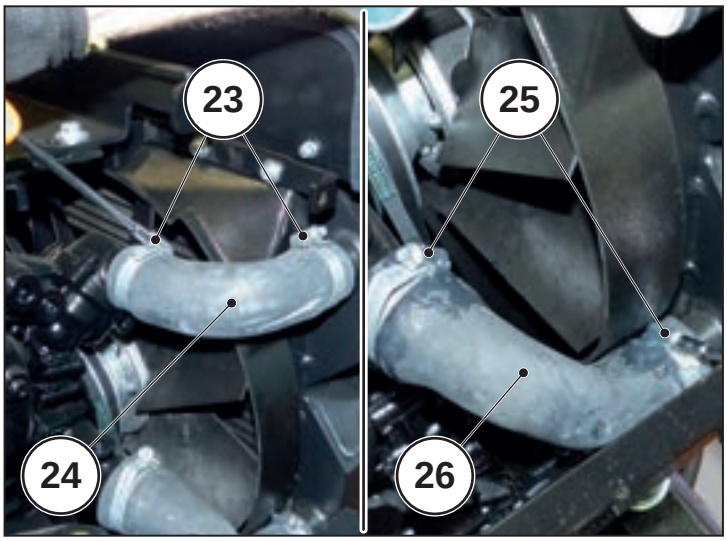


Fig. 2.12

Loosen the clamp (27) and remove the pipe (28).

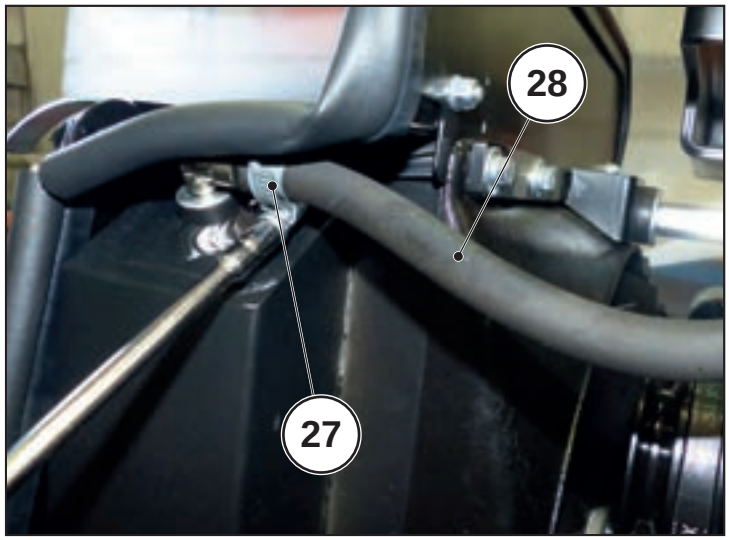


Fig. 2.13

Undo the screws (29) of the left hand guard (30), and then remove the guard.

Repeat for the right hand guard.

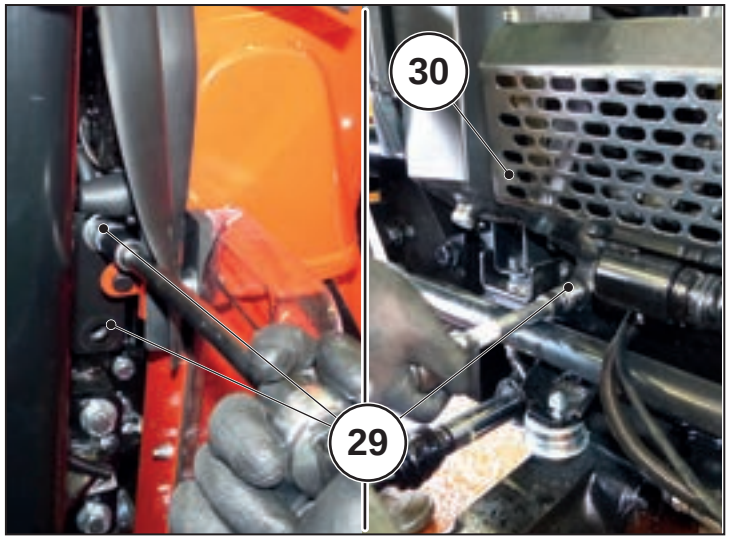


Fig. 2.14

Undo the screws (32) fastening the conveyor (33).

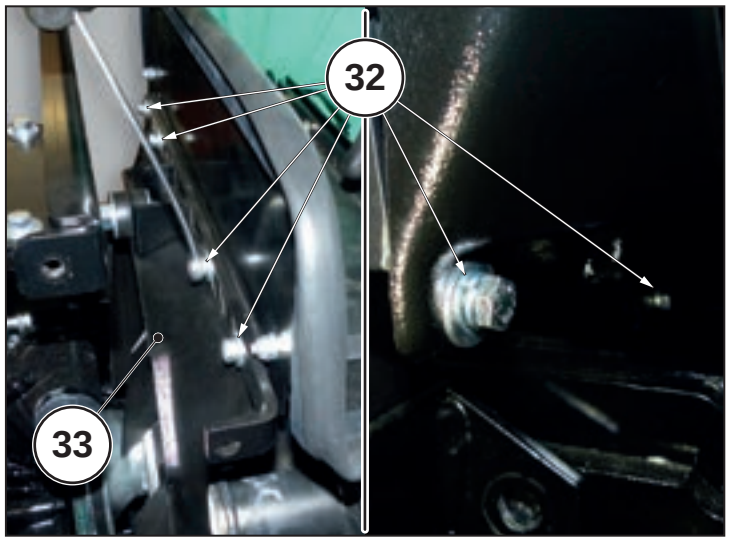


Fig. 2.15

Undo the radiator fastener bolts (31) on both sides.

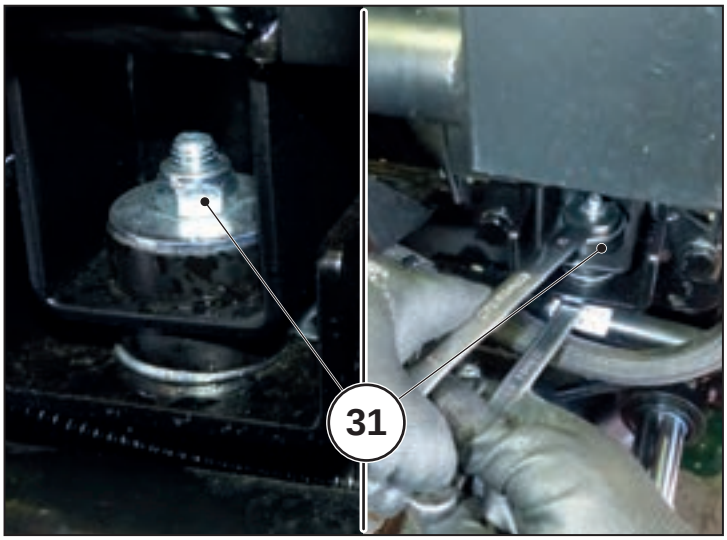


Fig. 2.16

Warning

Ensure that all the fastener screws (32) have been removed.

Remove the conveyor (33) and the radiator (34).

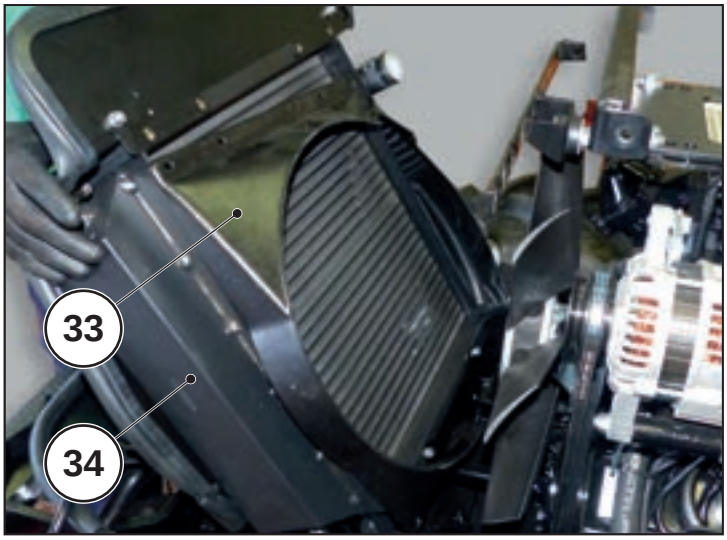


Fig. 2.17

Loosen the belt tensioner pulley (35).

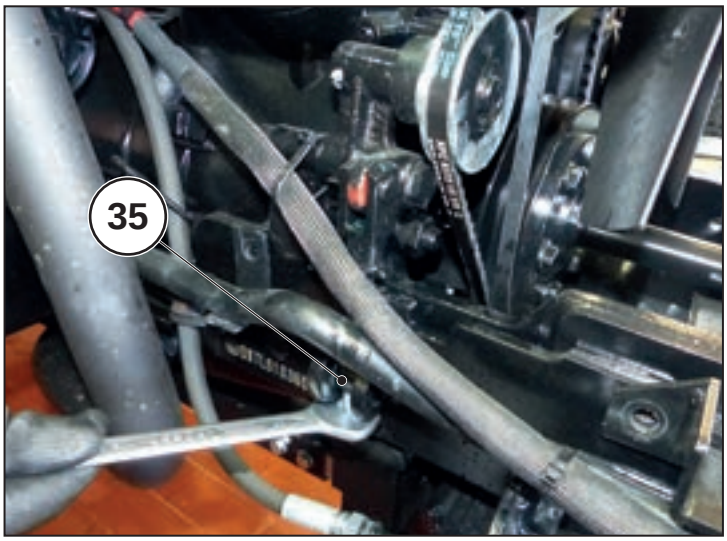


Fig. 2.18

Loosen the screw (36) of the alternator pulley bracket.

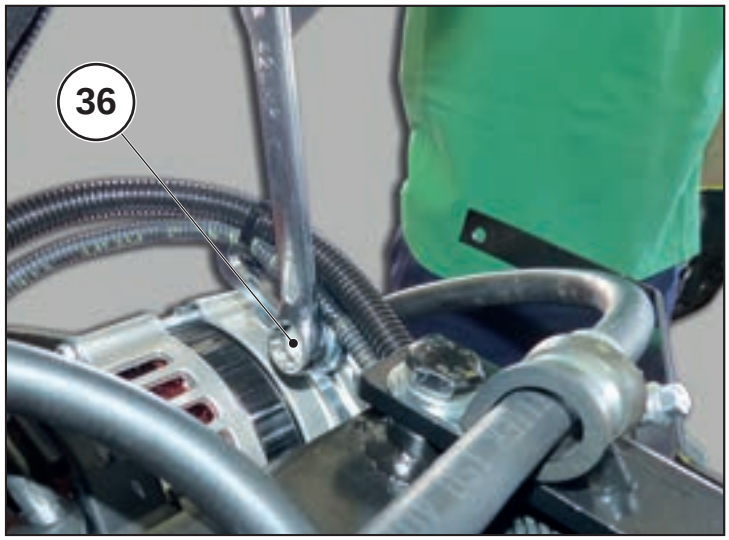


Fig. 2.19

Undo the hex socket screw (37) and remove the fan (38).

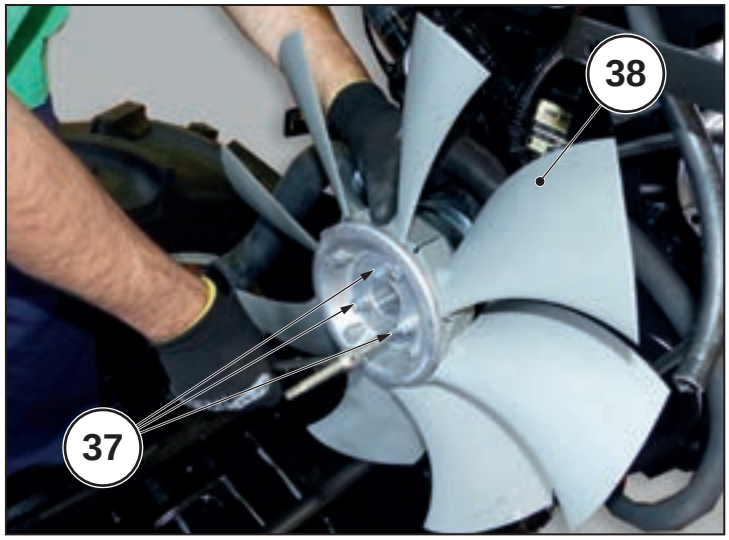


Fig. 2.20

Remove the pulley (39) situated behind the fan.

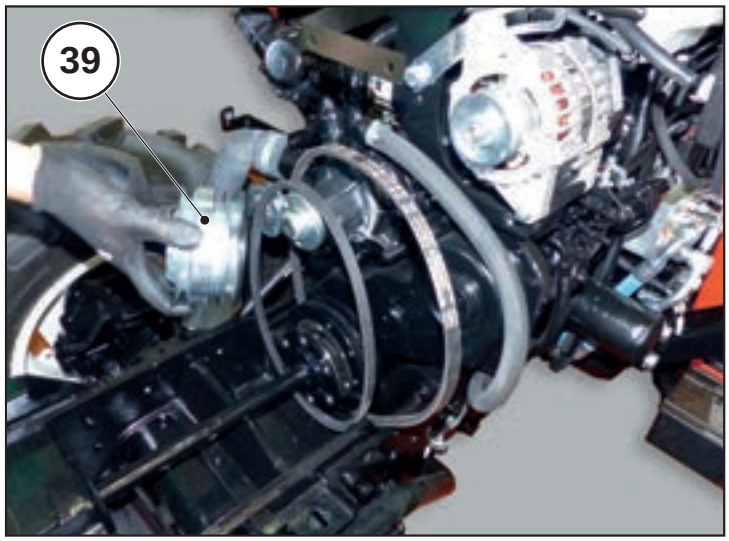


Fig. 2.21

Undo the screws (40) of the shaft pulley and then remove the belts (41).

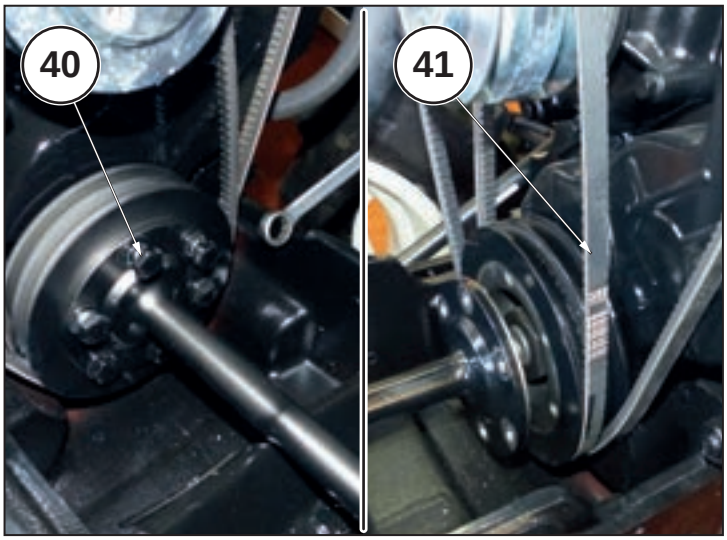


Fig. 2.22

3.1.2 Refitting

Danger

All other persons must stay at a safe distance from the danger area. Avoid vibration when loosening screws.

Warning

Read the instructions in chapter "1-Introduction" and, in particular, the sections concerning the installation of O-rings, oil seals and bearings, with particular care before reassembling, and follow these instructions precisely when working.

Apply the correct tightening torques when tighten the fasteners of components. Where tightening torques are not specified, refer to the table in chapter "1-Introduction".

Use the specified sealant products during reassembly. Where the sealant required is not specified, refer to the table in chapter "1-Introduction".

Reassemble by following the procedure for removal in reverse order, noting the following additional instructions:

Fit the belts (41) into the grooves on the respective pulleys, ensuring that they are aligned correctly.

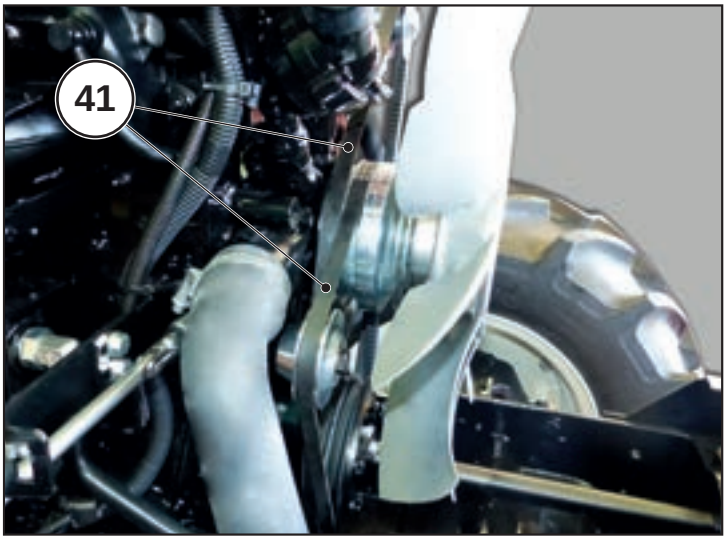


Fig. 2.23

Fit the fan (38) with the anchor screws (42) facing forwards with respect to the engine.

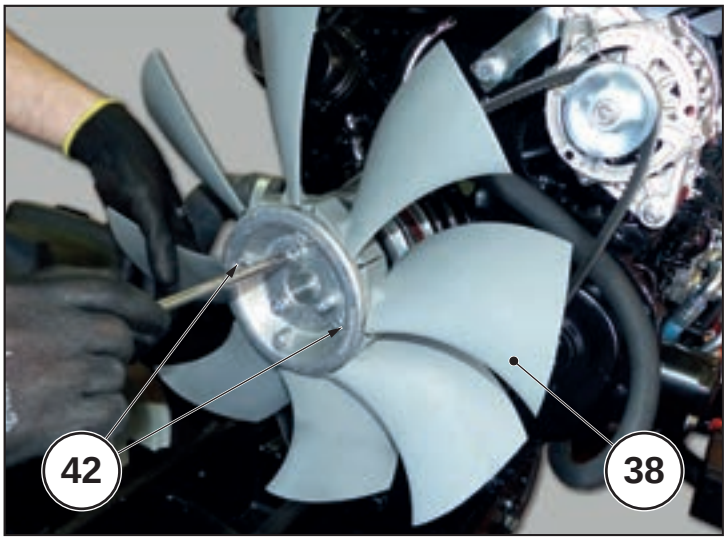


Fig. 2.24

To tension the belt, fit a hoist (43) and tighten the screw (36) of the alternator pulley bracket.

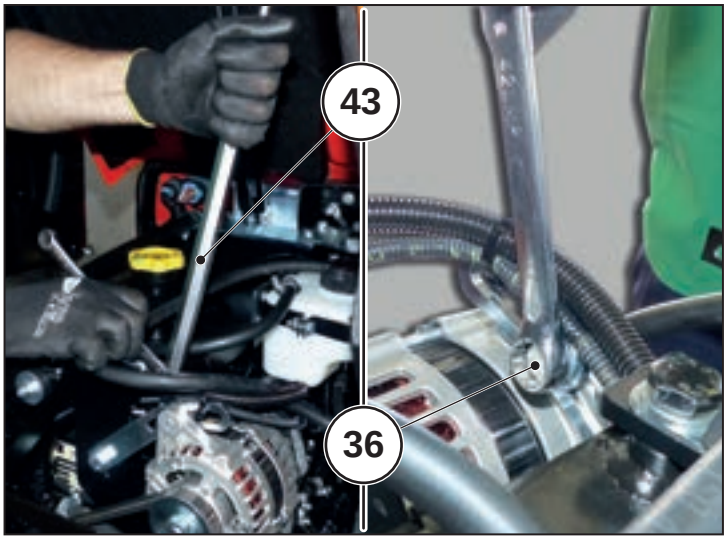


Fig. 2.25

Fit the conveyor (33).

> **Warning**
>
> The conveyor must not be fitted later as this may damage the fan.

Fit the radiator and tighten the fastener bolts (31) partially to allow the conveyor (33) to settle into the correctly aligned position.

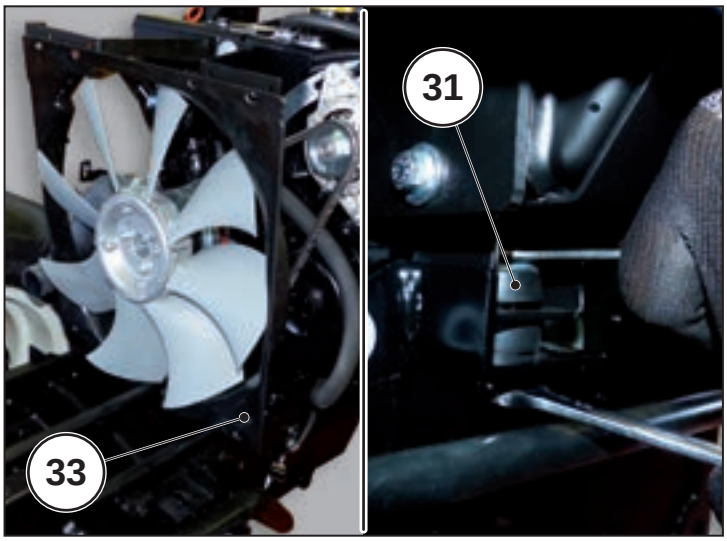


Fig. 2.26

Fit all the screws fastening the conveyor (32).

Warning
Do not tighten the screws.

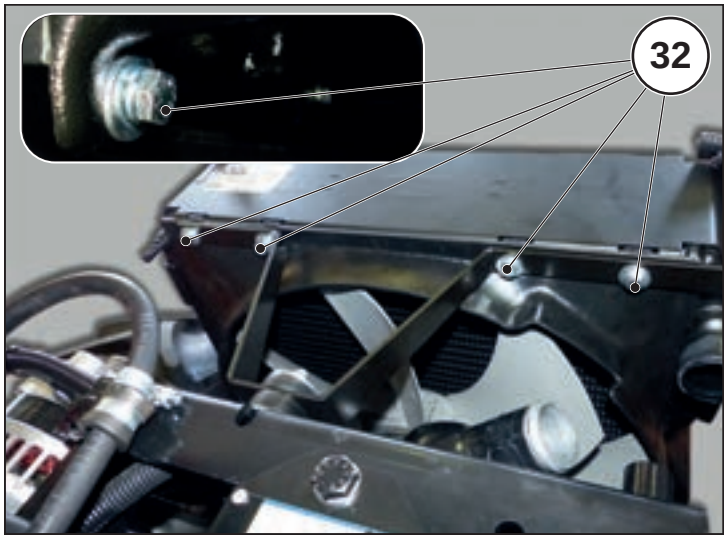


Fig. 2.27

Tighten the lower screws (32) first and then tighten the upper screws.

Warning
Do not tighten the upper screws before the lower screws.

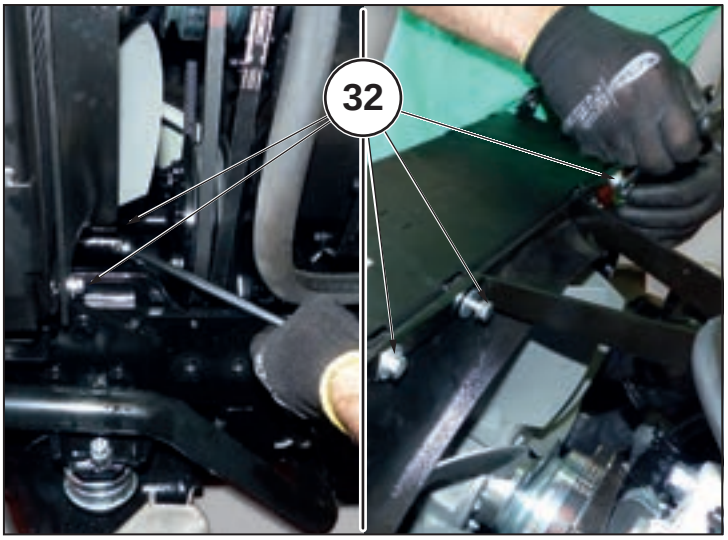


Fig. 2.28

Tighten the fastener bolts (31) of the radiator completely.

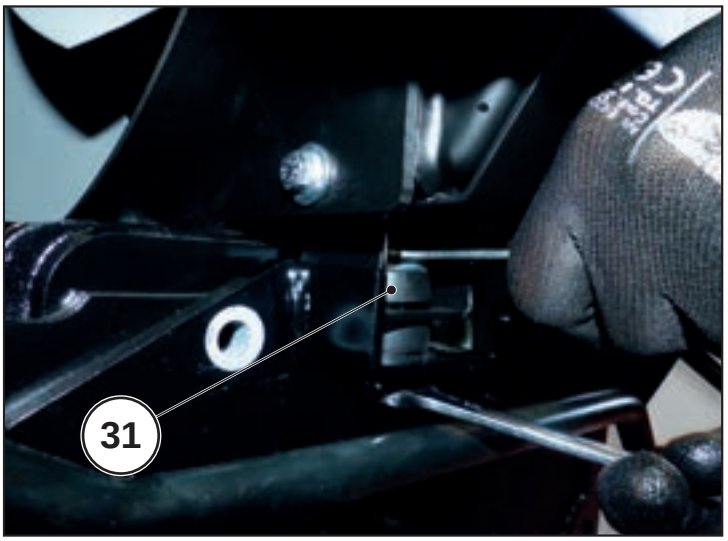


Fig. 2.29

Warning

Check that the fan rotates freely without impediment. If not, both the fan and the conveyor may be damaged.

Fig. 2.30

Warning

Remove the cap applied to the turbocharger during removal.

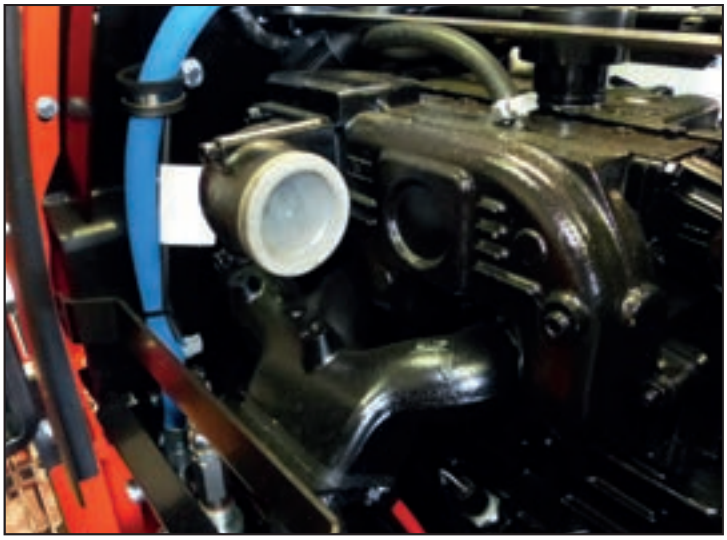


Fig. 2.31

Warning

Connect the battery, connecting the positive terminal (44) first.

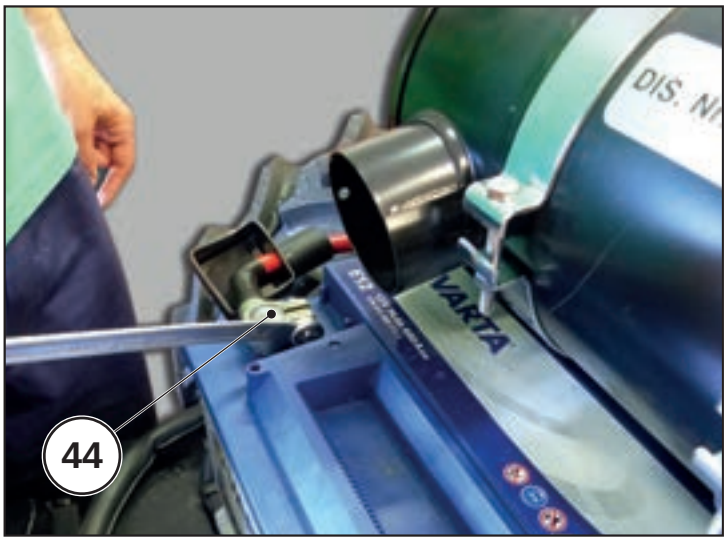


Fig. 2.32

Fit the guard (5), tightening the screws (6).

Close the cowl and check that it sits flush with the cowl seal (45)

Note

If the guard does close against the cowl seal (45), push it upwards and tighten the screws completely.

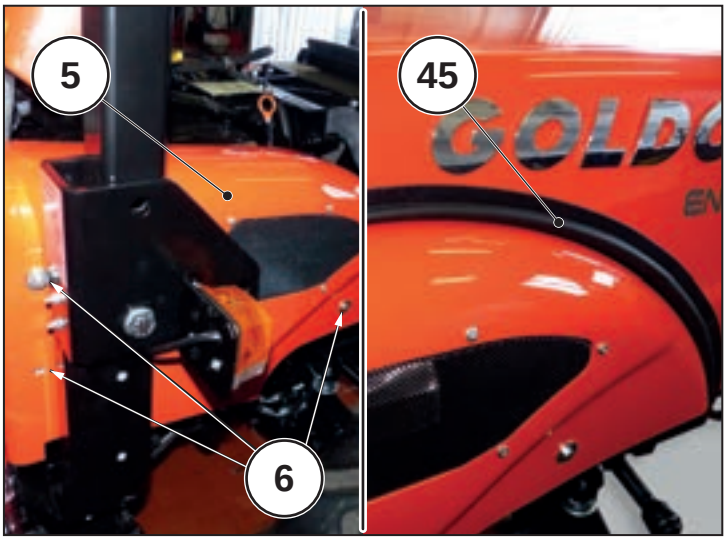


Fig. 2.33

Top up with coolant to the correct level.

Start the engine and wait until the water temperature reaches 60°C. Check the coolant level in the tank and top up if necessary.

Warning

Check that there are no leaks from the hoses.

3.2 Energy 80

3.2.1 Removal

Disconnect the battery (1), disconnecting the negative terminal (2) first, and then remove the battery.

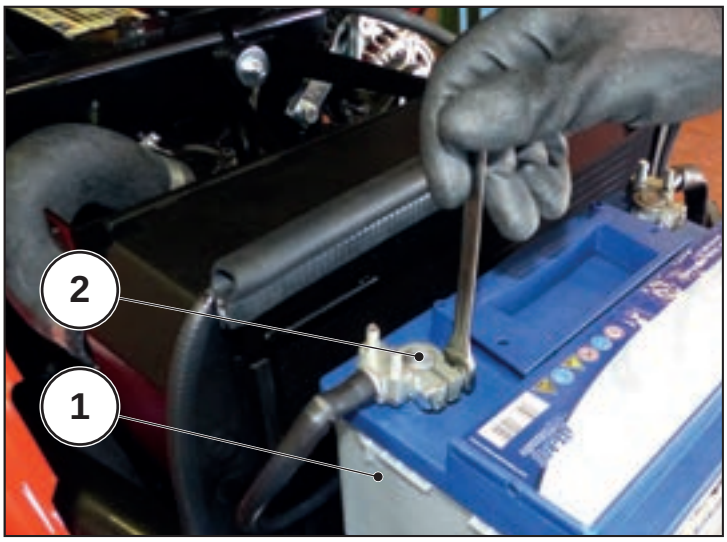


Fig. 2.34

Disconnect the horn connectors (3).

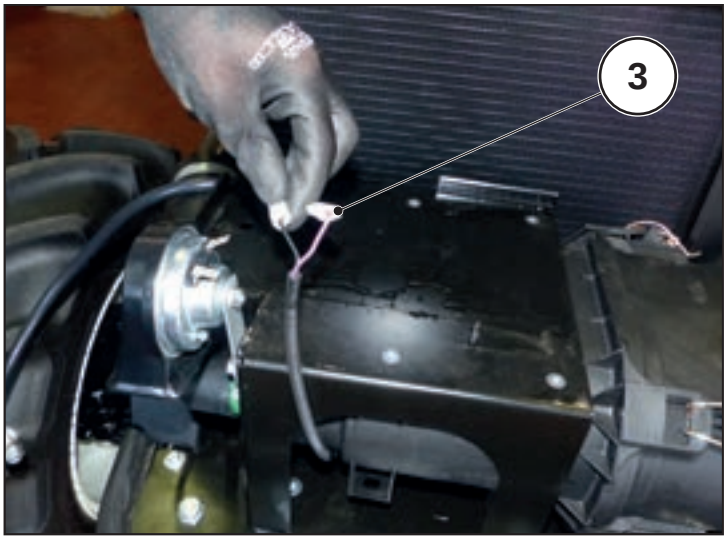


Fig. 2.35

Disconnect the air filter connector (4) and then unscrew and remove the filter.

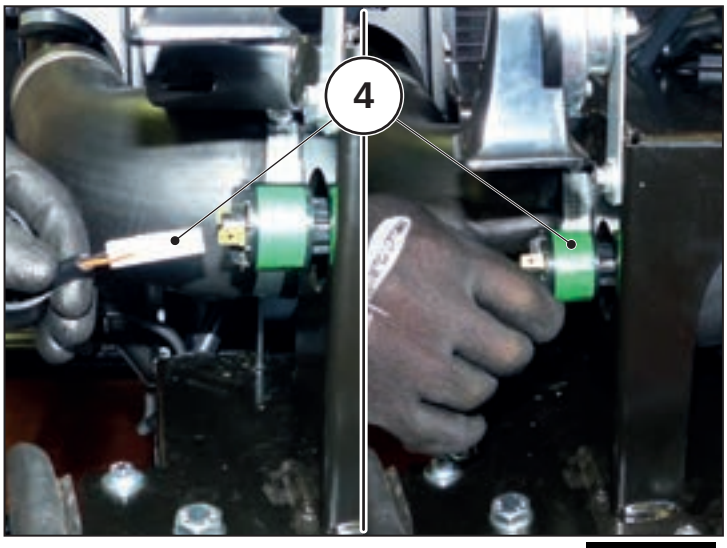


Fig. 2.36

Undo the screws (6) and remove the right hand lateral guard (5).

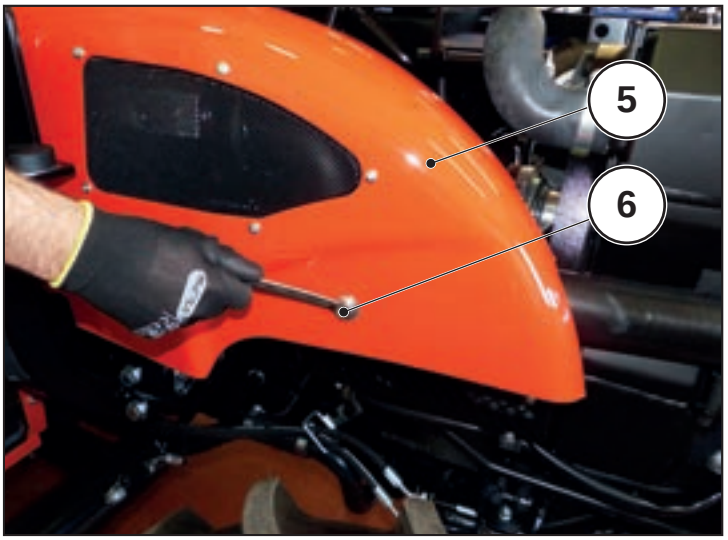


Fig. 2.37

On both sides, undo the screws (8) and remove the bracket (7).

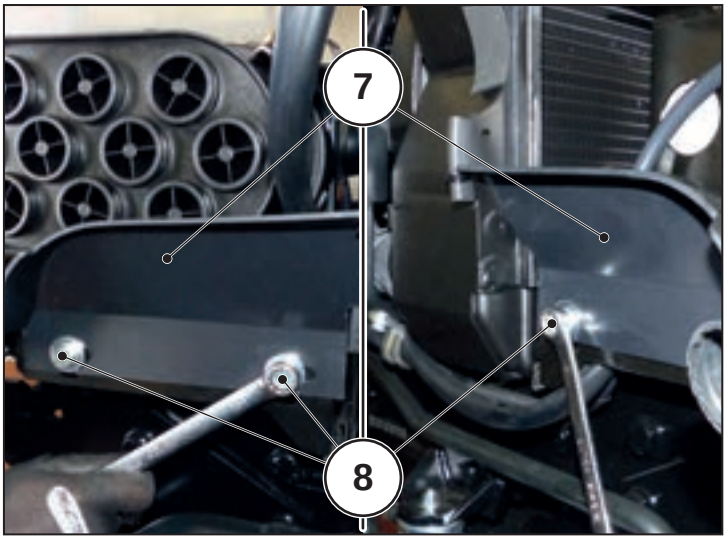


Fig. 2.38

Loosen the clamps (9) of the air filter hose.

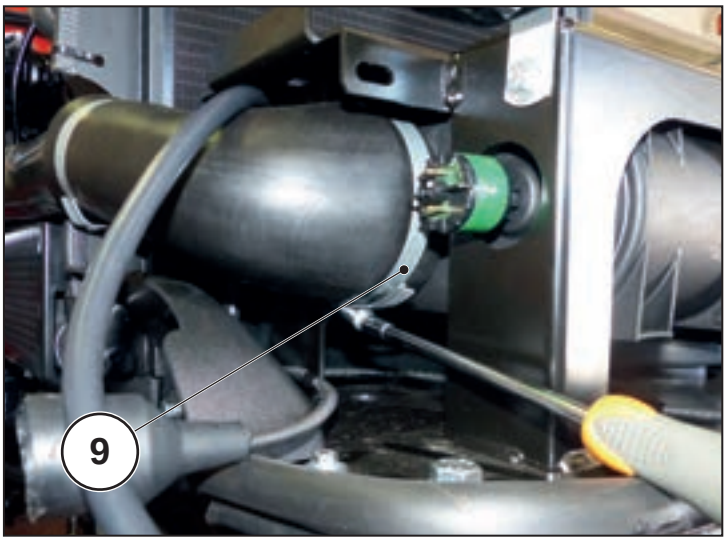


Fig. 2.39

Undo the screws (10), detach the hose (11) completely and then remove the air filter (12).

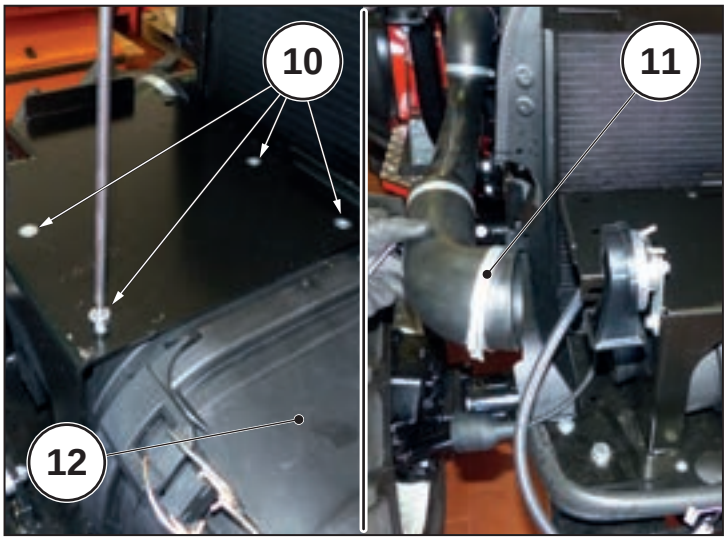


Fig. 2.40

Remove the radiator guard mesh (13).

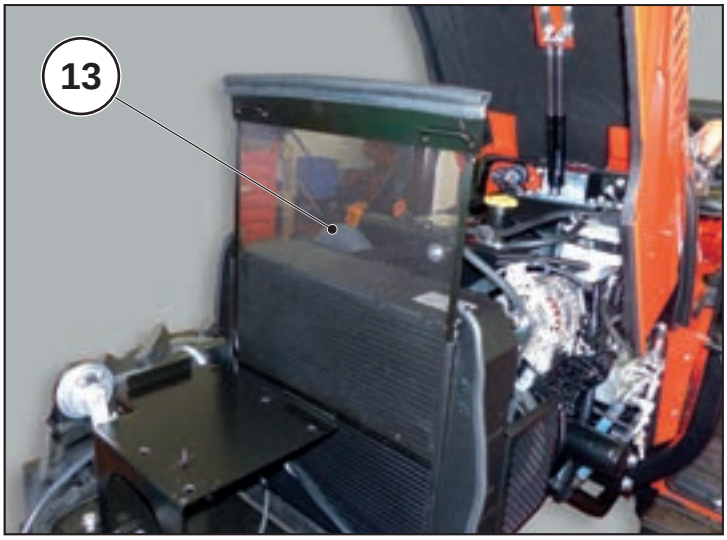


Fig. 2.41

Loosen the clamp (14) and then remove the turbocharger hose.

Note

Close the turbocharger port (15) provisionally with a cap (16).

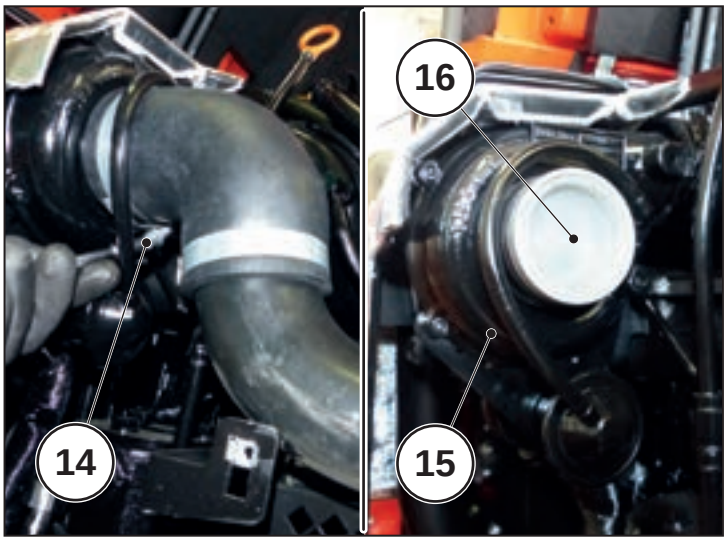


Fig. 2.42

Undo the screws (17) of the battery mounting plate (18) and then remove the plate.

Note

It is not necessary to disconnect the electrical system cables to remove the battery mount.

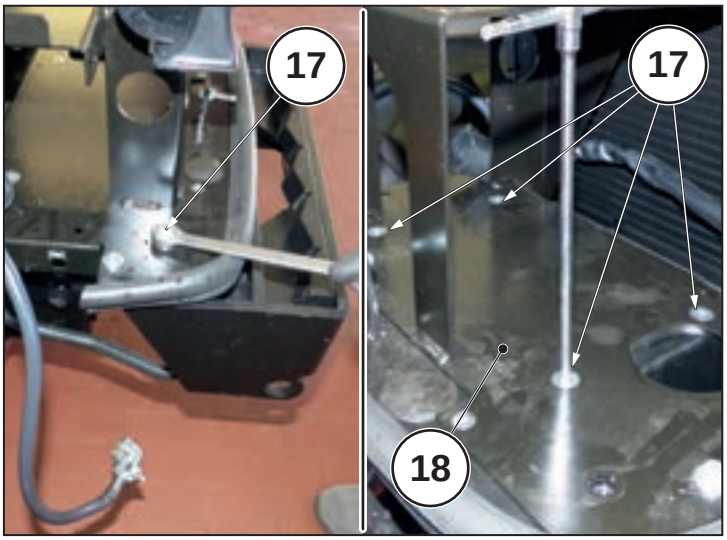


Fig. 2.43

Undo the radiator cap (19).

Drain the coolant contained in the radiator.

Refit and tighten the cap (19) after draining.

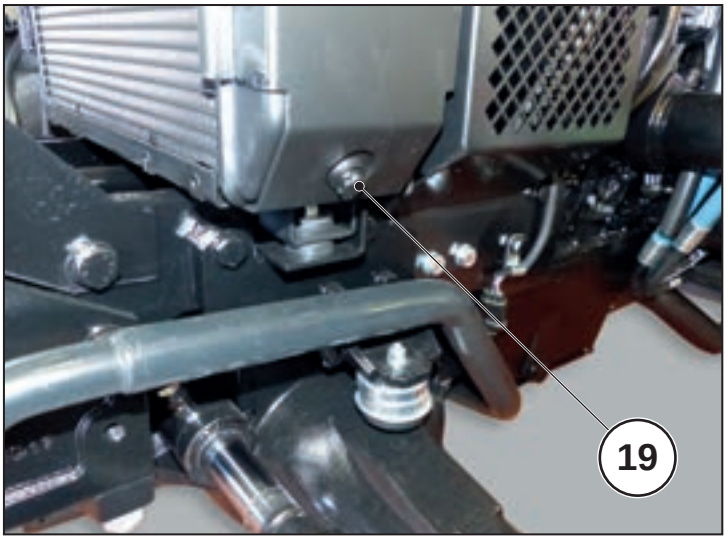


Fig. 2.44

Loosen the clamps (20) and remove the sleeve (21).

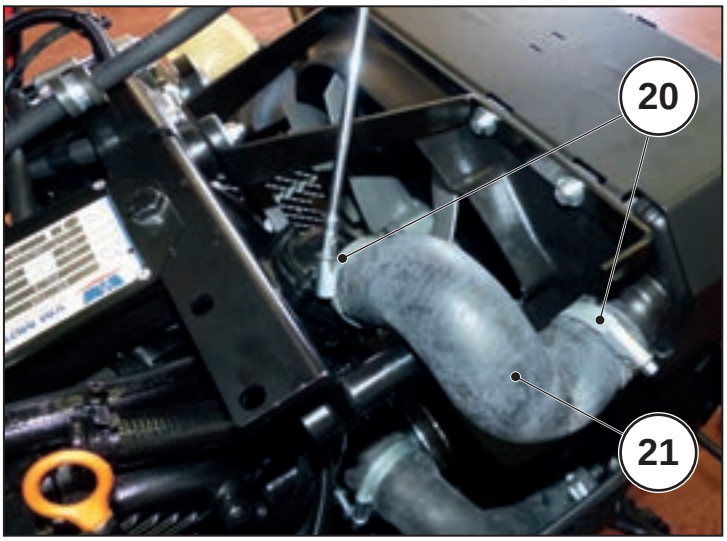


Fig. 2.45

Loosen the clamp (22) and remove the pipe (23).

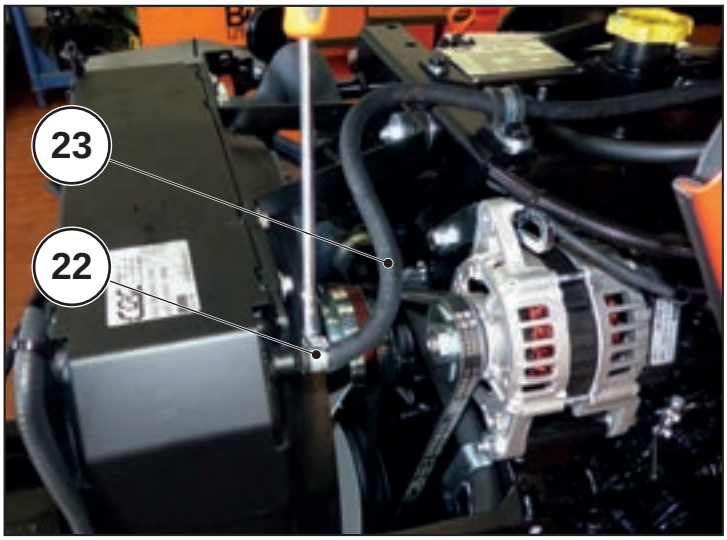


Fig. 2.46

Undo the screws (24) and remove the right hand guard (25).

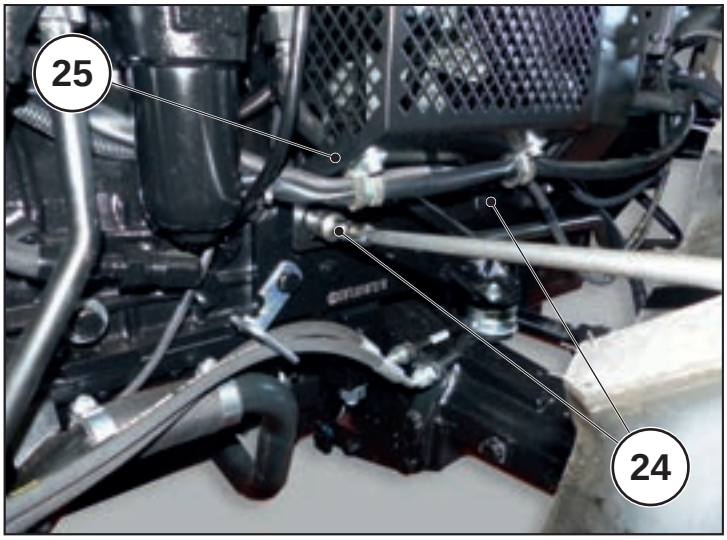


Fig. 2.47

Loosen the clamp (26) and pull out the hose (27) without detaching it completely.

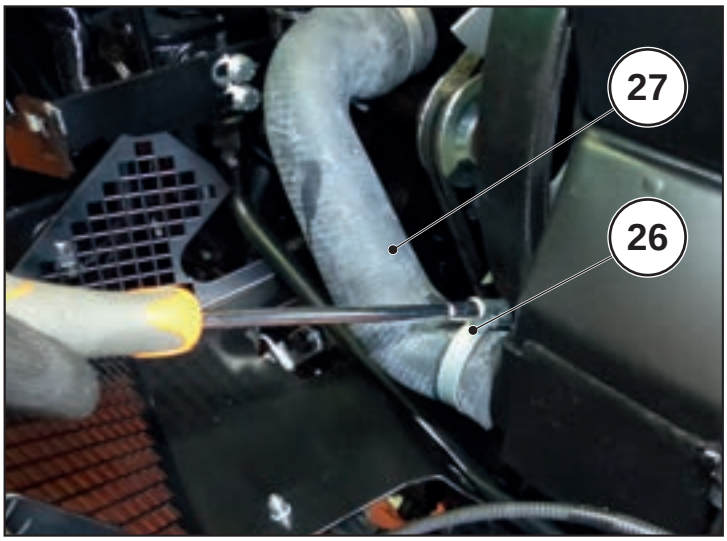


Fig. 2.48

Undo the screws (28) of the left hand guard (29), and then remove the guard.

Warning
Remove the radiator pipe retainer bracket (30).

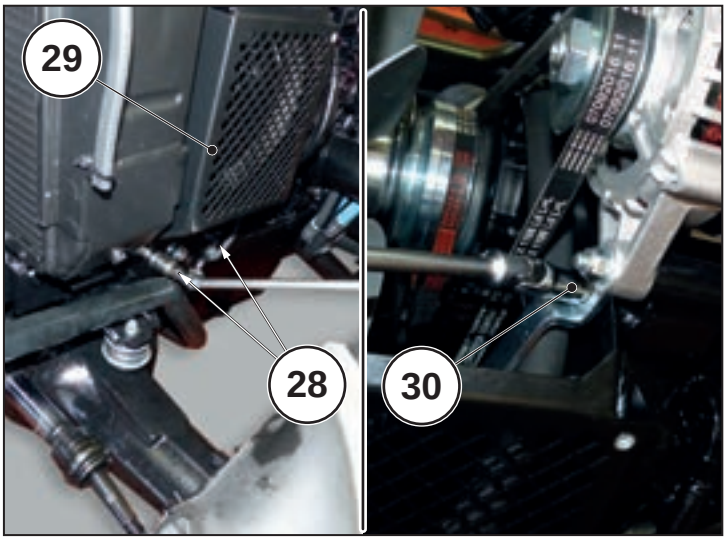


Fig. 2.49

Undo the screws (31) fastening the conveyor (32).

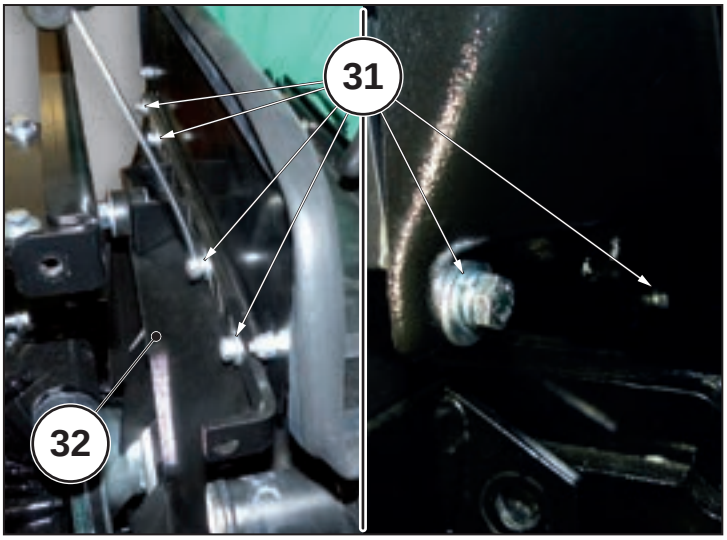


Fig. 2.50

Undo the radiator fastener bolts (33) on both sides.

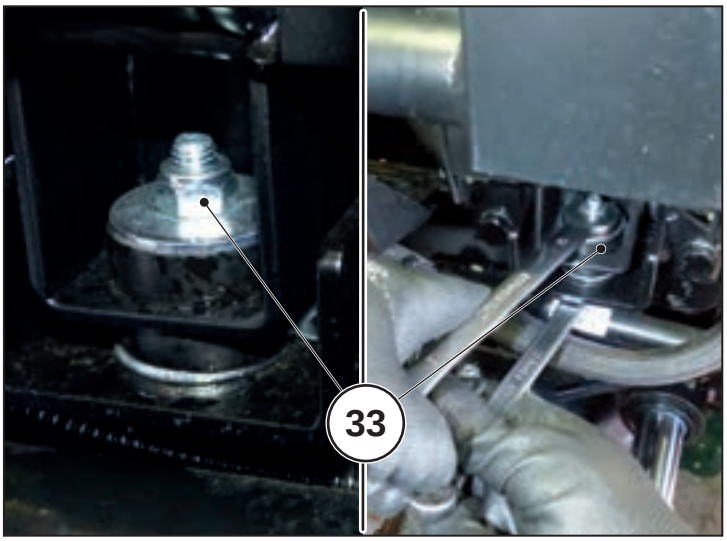


Fig. 2.51

Warning

Ensure that all the fastener screws (31) have been removed.

Remove the conveyor (32) and the radiator (34).

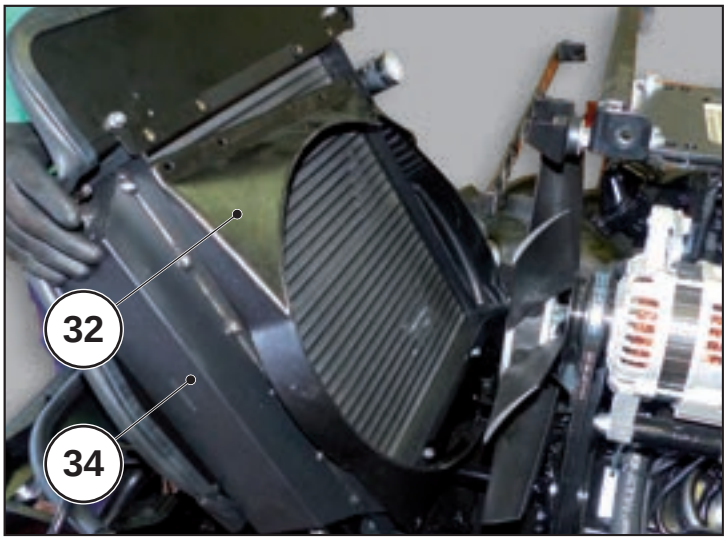


Fig. 2.52

Loosen the belt tensioner pulley (35).

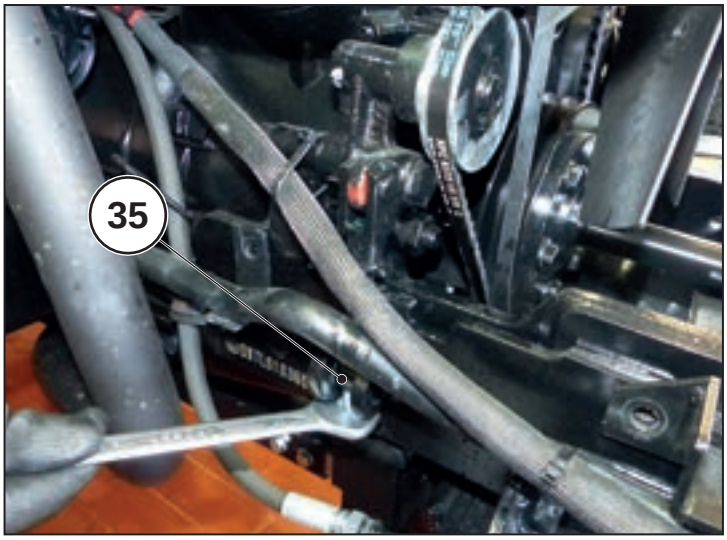


Fig. 2.53

Loosen the screw (36) of the alternator pulley bracket.

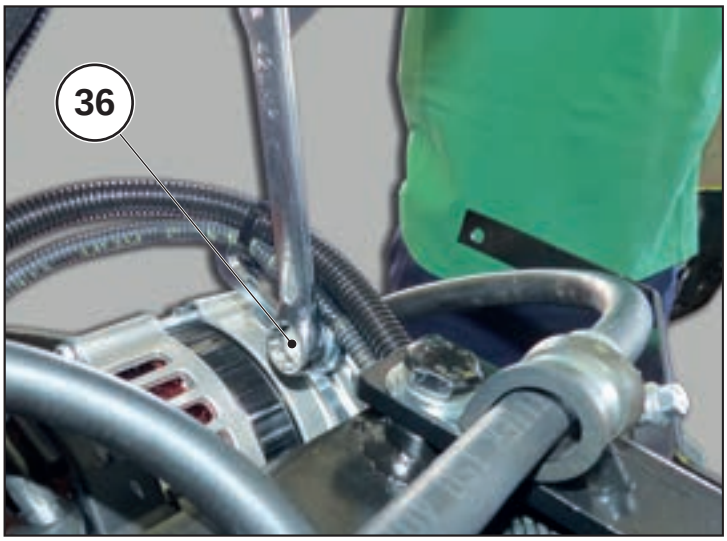


Fig. 2.54

Undo the hex socket screw (37) and remove the fan (38).

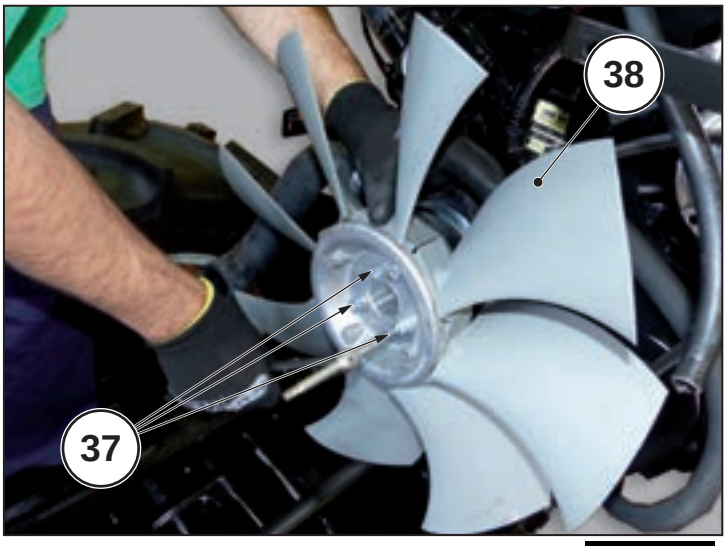


Fig. 2.55

Remove the pulley (39) situated behind the fan.

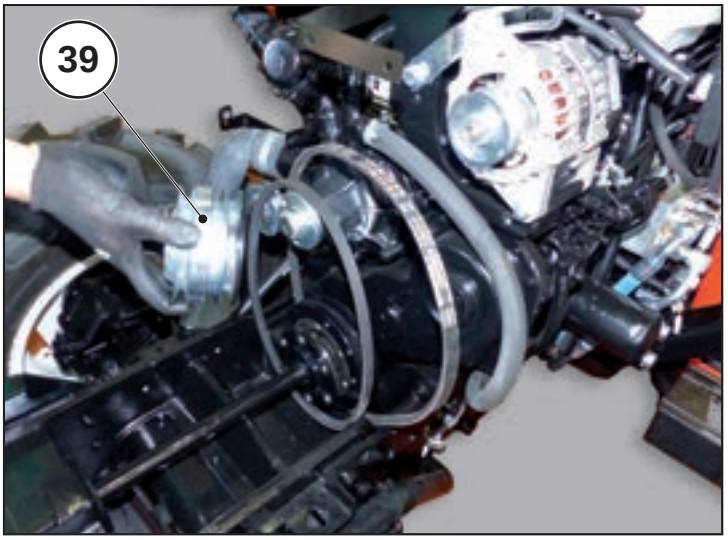


Fig. 2.56

Undo the screws (40) of the shaft pulley and then remove the belts (41).

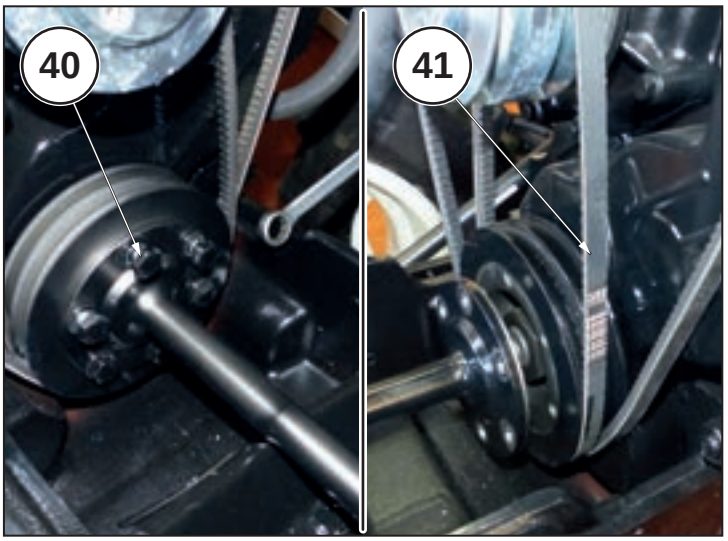


Fig. 2.57

3.2.2 Refitting

Danger

All other persons must stay at a safe distance from the danger area. Avoid vibration when loosening screws.

Warning

Read the instructions in chapter "1-Introduction" and, in particular, the sections concerning the installation of O-rings, oil seals and bearings, with particular care before reassembling, and follow these instructions precisely when working.

Apply the correct tightening torques when tighten the fasteners of components. Where tightening torques are not specified, refer to the table in chapter "1-Introduction".

Use the specified sealant products during reassembly. Where the sealant required is not specified, refer to the table in chapter "1-Introduction".

Reassemble by following the procedure for removal in reverse order, noting the following additional instructions:

Fit the belts (41) into the grooves on the respective pulleys, ensuring that they are aligned correctly.

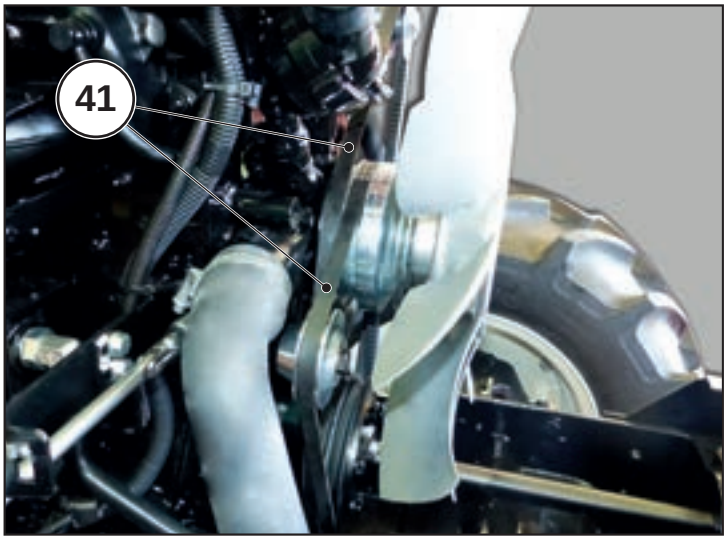


Fig. 2.58

Fit the fan (38) with the anchor screws (42) facing forwards with respect to the engine.

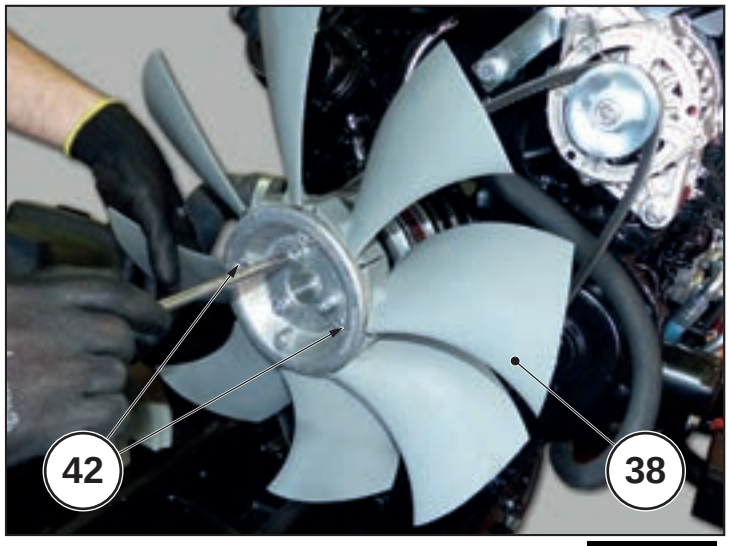


Fig. 2.59

To tension the belt, fit a hoist (43) and tighten the screws (36) of the alternator bracket.

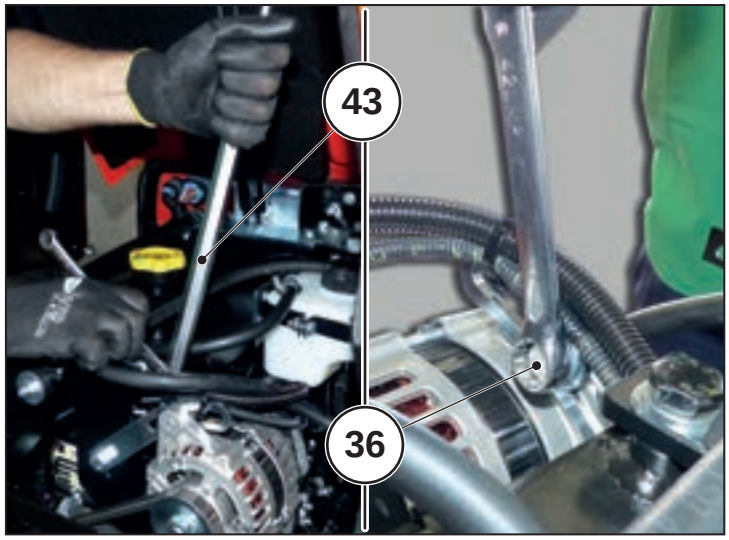


Fig. 2.60

Fit the conveyor.

Warning
The conveyor must not be fitted later as this may damage the fan.

Fit the radiator and tighten the fastener bolts (33) partially to allow the conveyor (32) to settle into the correctly aligned position.

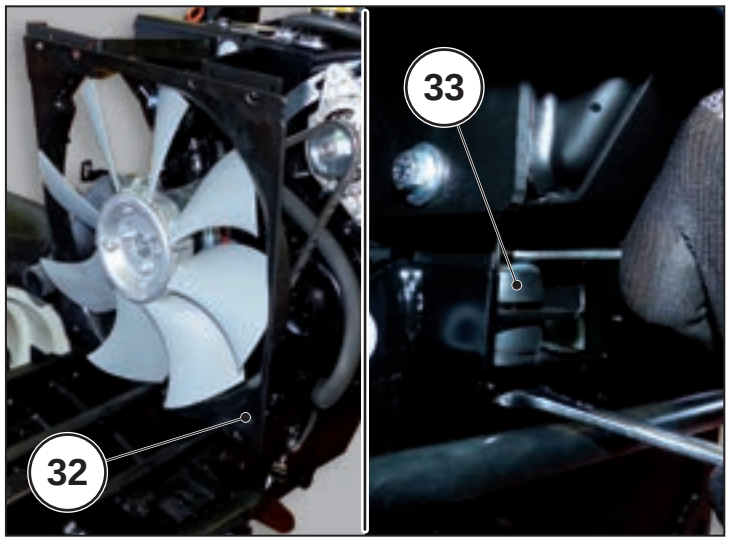


Fig. 2.61

Fit all the screws fastening the conveyor (31).

Warning
Do not tighten the screws.

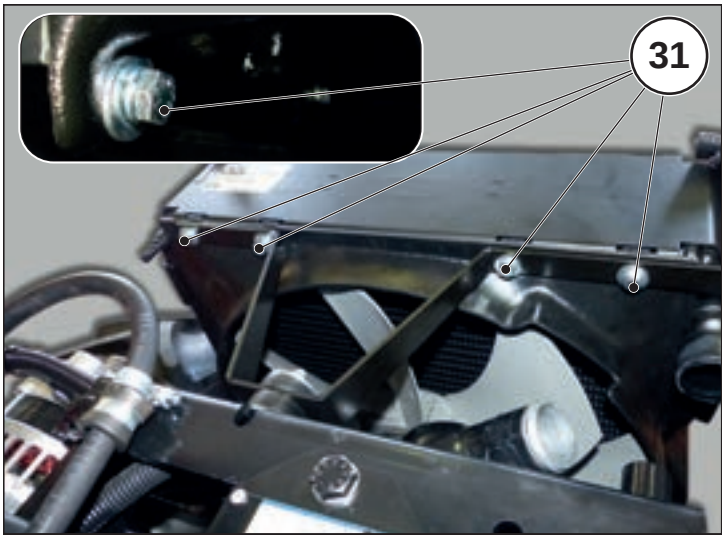


Fig. 2.62

Tighten the lower screws first and then tighten the upper screws (31) completely.

Warning
Tighten the lower screws before the upper screws.

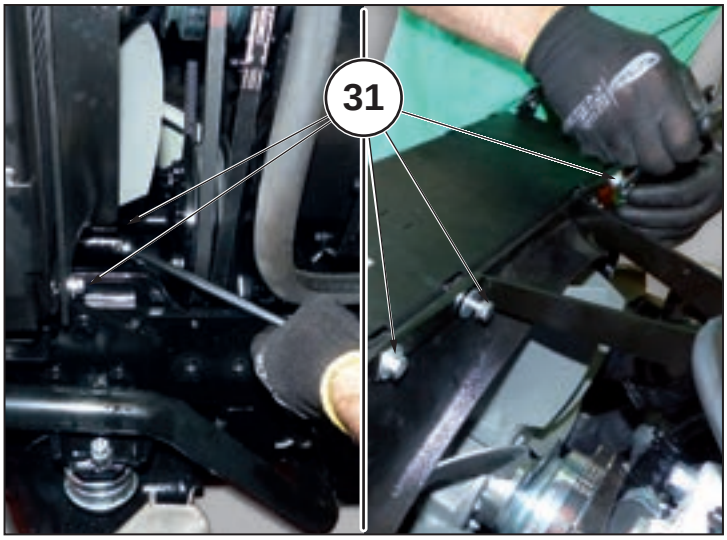


Fig. 2.63

Tighten the fastener bolts (33) of the radiator completely.

Fig. 2.64

Warning

Check that the fan rotates freely without impediment. If not, both the fan and the conveyor may be damaged.

Fig. 2.65

Warning

Remove the cap applied to the turbocharger during removal.

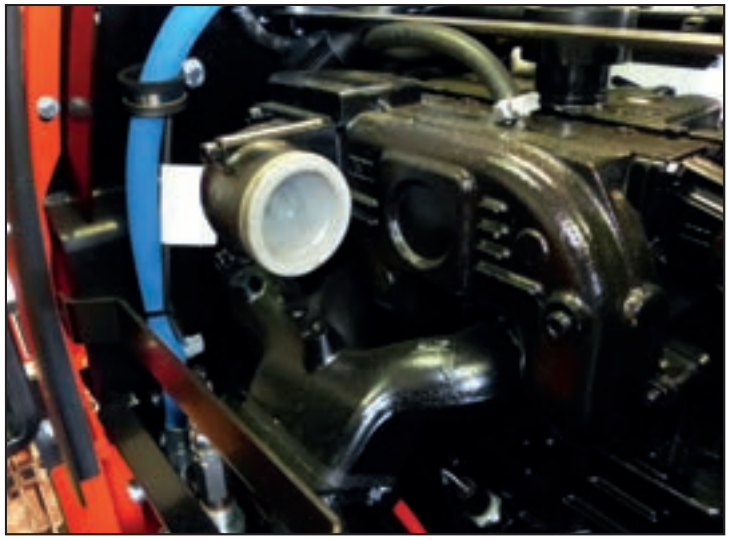


Fig. 2.66

Warning

Connect the battery, connecting the positive terminal (44) first.

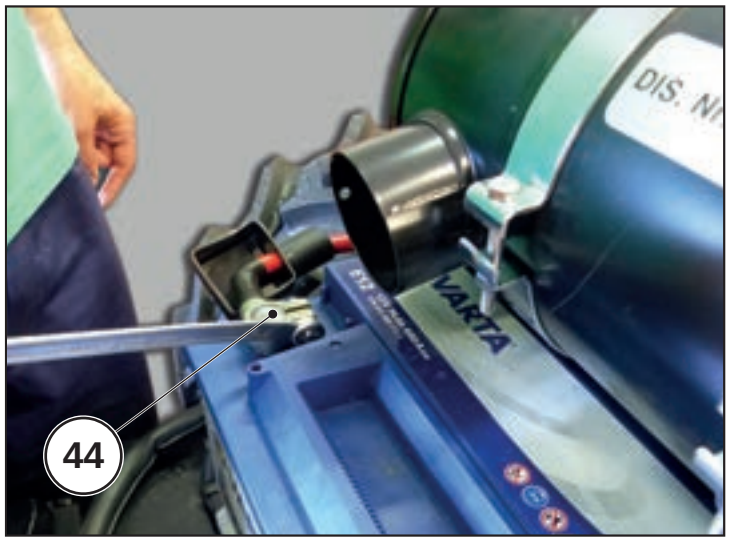


Fig. 2.67

Fit the guard (5), tightening the screws (6).

Close the cowl and check that it sits flush with the cowl seal (45)

Note

If the guard does close against the cowl seal (45), push it upwards and tighten the screws completely.

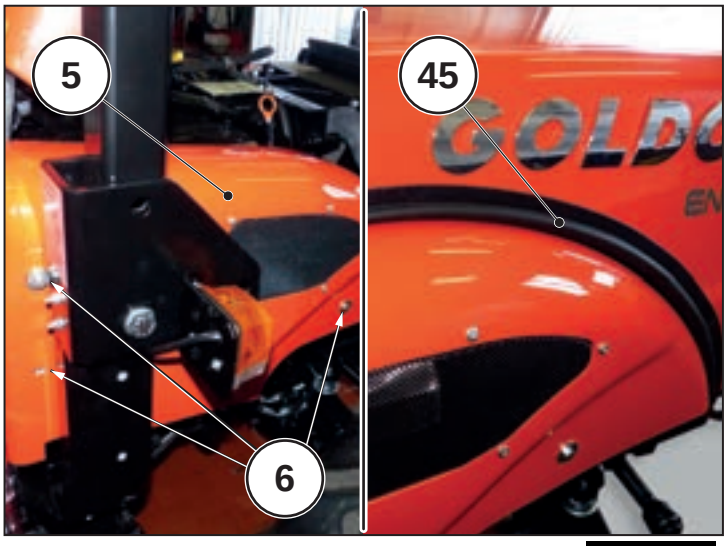


Fig. 2.68

With the cowl closed, fit the bracket (7), tightening the screws (8) on both sides.

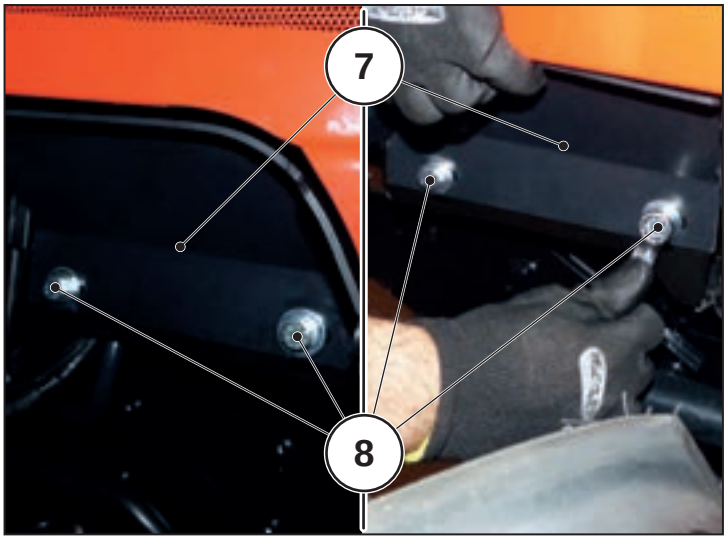


Fig. 2.69

Top up with coolant to the correct level.

Start the engine and wait until the water temperature reaches 60°C. Check the coolant level in the tank and top up if necessary.

Warning

Check that there are no leaks from the hoses.

Chapter 3 : Clutch housing

Index

Section 1 : Safety rules 3-2

Section 2 : General introduction 3-3

2.1 Assembly drawing 3-4

Section 3 : Technical characteristics 3-5

3.1 Technical characteristics 3-6

Section 4 : Disassembly 3-7

4.1 Preliminary operations 3-8

4.2 Removing the Clutch 3-27

Section 5 : Main inspection, reassembly and adjustment procedures 3-29

5.1 Inspection 3-30

5.2 Reassembly and adjustment 3-32

Section 6 : Tightening torques 3-39

6.1 Tightening specifications 3-40

Section 7 : Tools necessary 3-41

7.1 Tools necessary 3-42

Section 1 : Safety rules

These safety precautions and warnings given in this paragraph must be observed at all times to prevent the risk of operator injury. However, the safety measures indicated in the use and maintenance manual and in chapter 1 of this manual must also be applied at all times.

Danger

All other persons must keep at a safe distance from the danger area.

Danger

Lift and handle all heavy parts with lifting equipment of adequate load capacity. Hoisting straps and hooks must be positioned safely on the load. When lifting loads, all personnel must keep at a safe distance from the load itself and remain within safe areas.

Danger

Do not allow the chains or metal cables used for hoisting to twist. Always wear safety gloves when handling cables or chains.

Danger

Use appropriate tools to align the holes correctly. NEVER USE YOUR HANDS OR FINGERS.

Danger

Handle all parts with extreme caution. Never place your hands or fingers between two parts.

Danger

When removing assemblies which could fall, always leave two screws in opposite positions in place for safety until the assembly is secured. Only remove these screws after securing the assembly to a hoist or after fitting support blocks in place.

Danger

If any of the screws fastening the frame or cab are loosened, or if the frame or cab is removed, ensure that all parts are refitted correctly at the end of the procedure to ensure that the driver is protected.

Attention

Beware of sharp edges and corners at the top of the gearbox housing.

Attention

Used oils must be collected and disposed of in compliance with applicable legislation.

Section 2 : General introduction

Index

2.1 Assembly drawing.....3-4

2.1 Assembly drawing

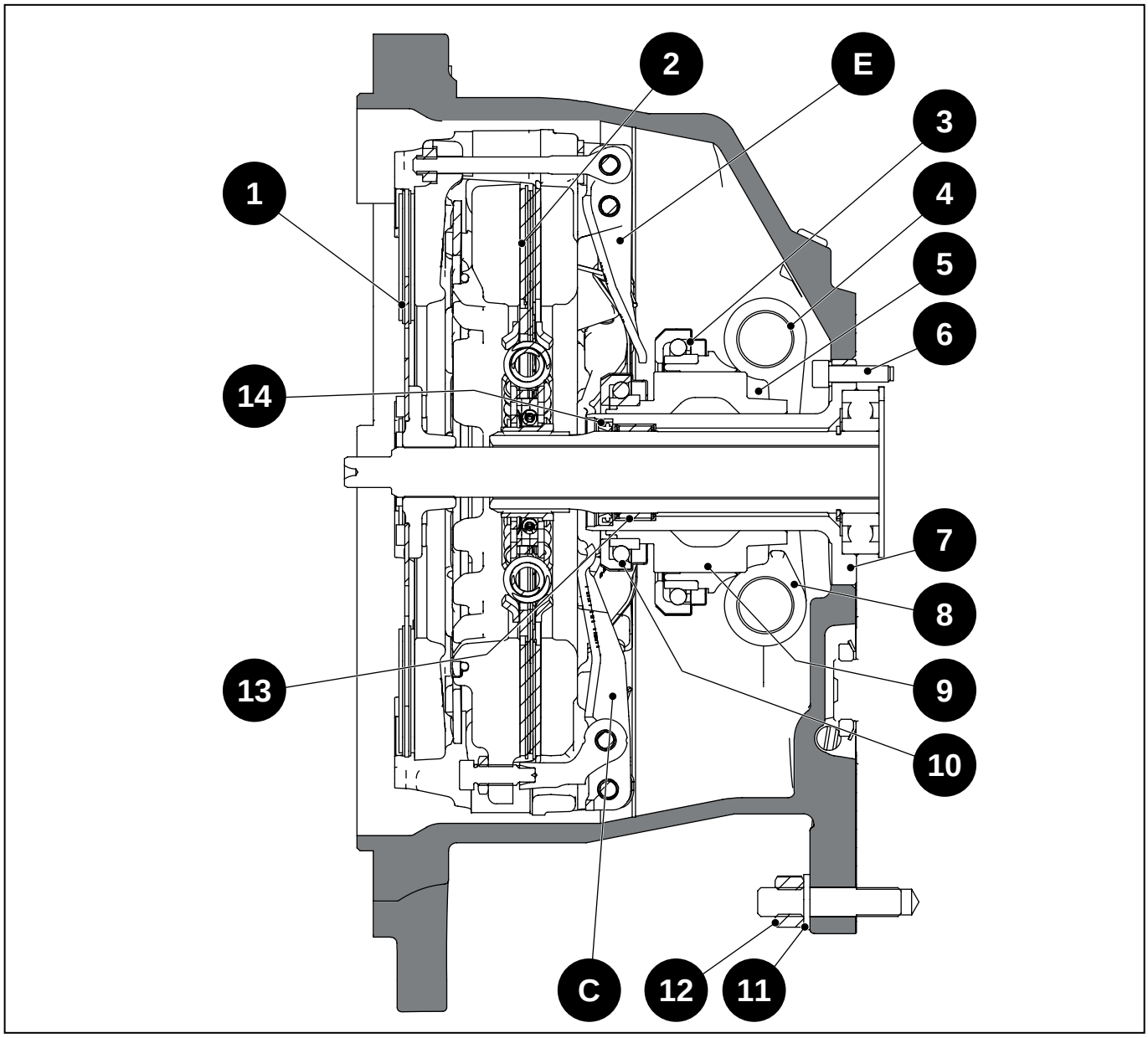


Fig. 3.1

1 - PTO clutch plate
2 - Gearbox clutch plate
3 - Bearing
4 - Transmission clutch lever
5 - Sleeve
6 - Screw
7 - Sleeve guide cover
8 - PTO clutch lever
9 - Sleeve
10 - Bearing
11 - Washer
12 - Nut
13 - Roller bearing
14 - Oil seal
C - Gearbox clutch lever
E - PTO clutch lever

Section 3 : Technical characteristics

Index

3.1 Technical characteristics 3-6

3.1 Technical characteristics

Clutch Type

Description	ENERGY 60	ENERGY 80
Transmission	Single plate dry clutch, 9" diameter	Single plate dry clutch, 10" diameter
Power Take Off	Independent, mechanical dry clutch	Independent, mechanical dry clutch

Clutch Control

Description	ENERGY 60	ENERGY 80
Transmission	Mechanical with pedal	Mechanical with pedal
Power Take Off	Mechanical with lever	Mechanical with lever

Section 4 : Disassembly

Index

4.1 Preliminary operations 3-8

4.2 Removing the Clutch 3-27

4.1 Preliminary operations

The main operations necessary to access the assembly are indicated as follows.

Danger

Secure the assemblies to lifting equipment of adequate load capacity before disassembly.

If suitable lifting equipment is not available, assemblies may be secured with a support stand.

Attention

Always make sure that the assemblies are completely disconnected before separation to prevent damage to components.

Note

See the relative chapters for specific disassembly and reassembly procedures.

ENERGY 80:

Remove the engine cowl, disconnecting the wiring loom.

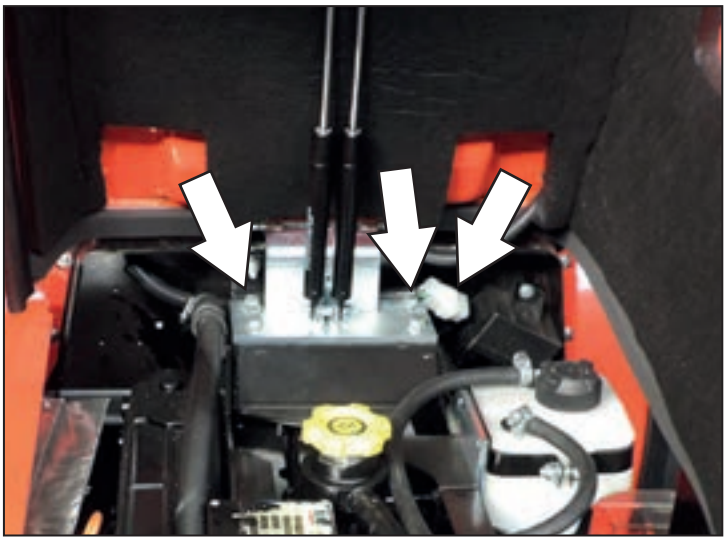


Fig. 3.2

ENERGY 60:

Remove the engine cowl, undoing the screws under the bumper.

Fig. 3.3

Remove the right hand protective cover.

Fig. 3.4

Remove the drive transfer shaft guards.

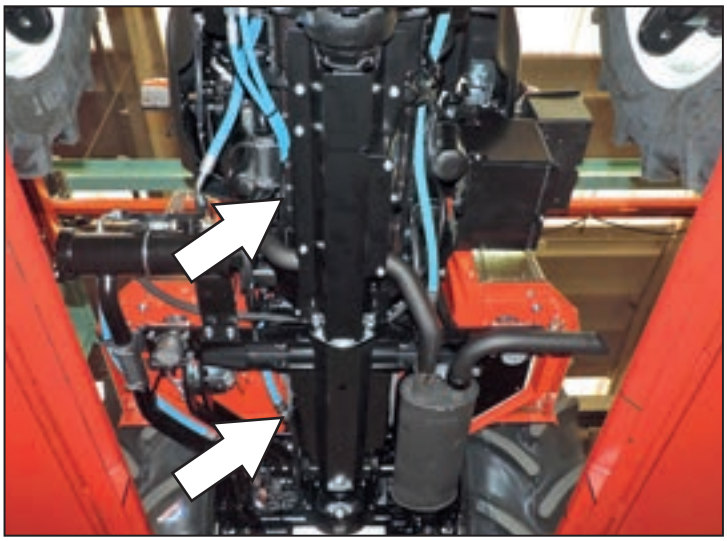


Fig. 3.5

Remove the transfer bearing and its mount.

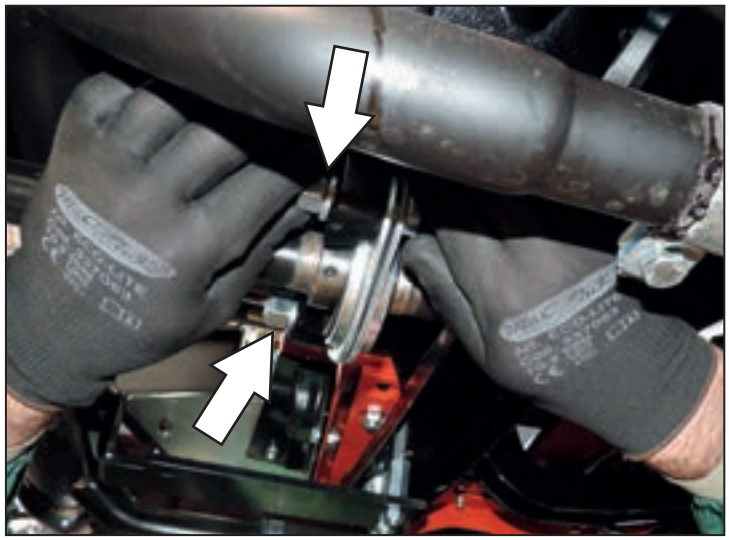


Fig. 3.6

Detach the circlips to free the sleeves fastening the 4WD shaft to the splined shafts at the front and rear.

Fig. 3.7

Pull the sleeves back to free the 4WD drive shaft, and remove the shaft.

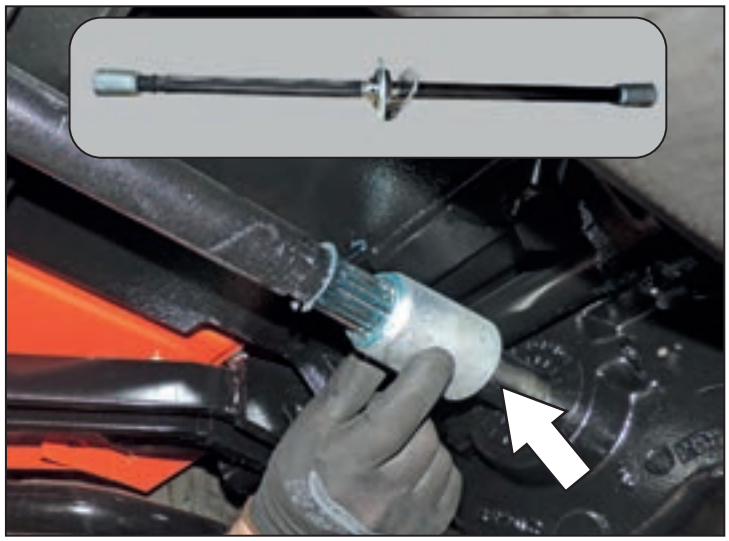


Fig. 3.8

Remove the roll bar hoop. Disconnect the wiring looms for the front turn indicators and the roll bar sensor.

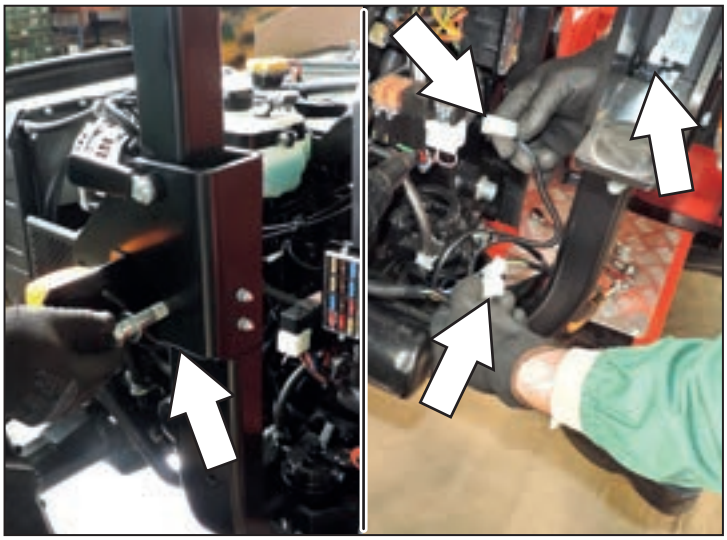


Fig. 3.9

Remove the roll bar hoop mounts.

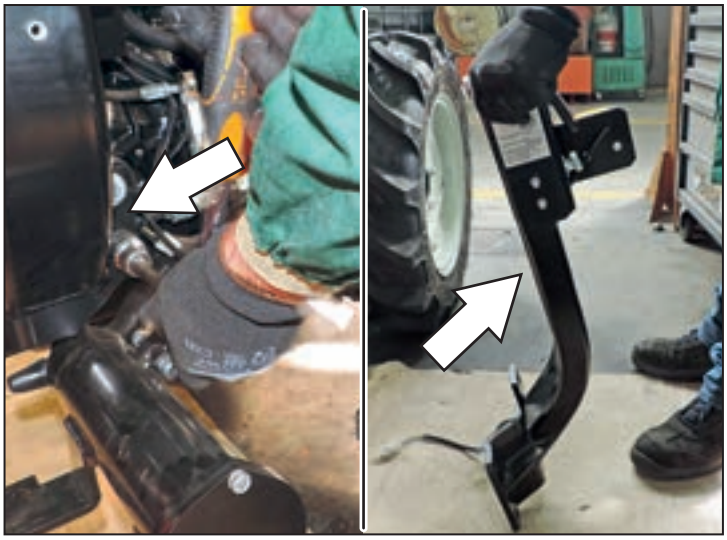


Fig. 3.10

Remove the silencer connector.

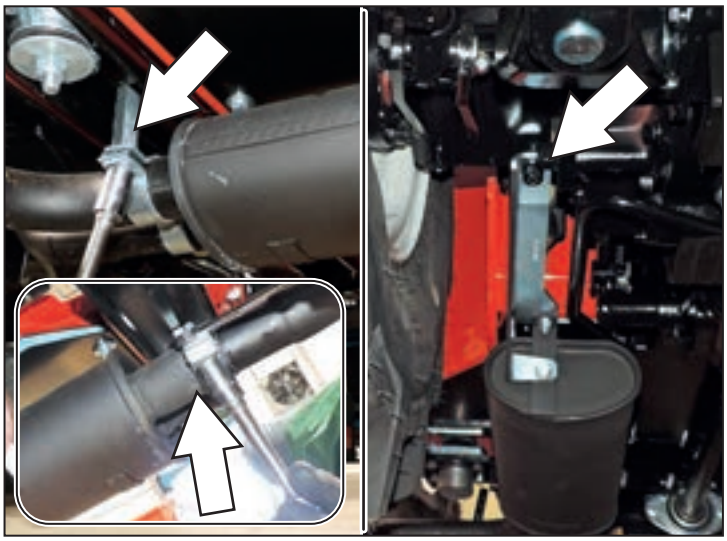


Fig. 3.11

Remove the steering wheel cover and remove the fastener nut and the washer.

Loosen the steering wheel position adjustment lever and raise and extend the steering column completely.

Use the puller tool (A-07006212) and a hammer to detach the steering wheel so that it can be removed.

Warning
Tap gently.

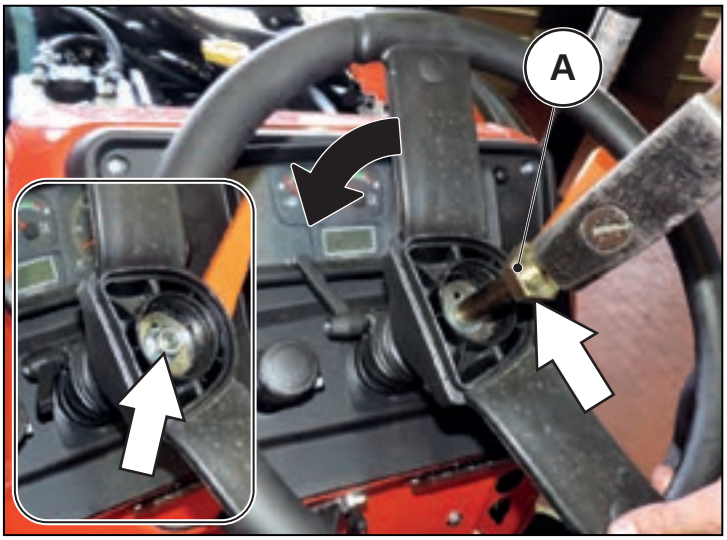


Fig. 3.12

Remove the reverse shuttle lever and the hand throttle lever.

Fig. 3.13

Remove the steering wheel position adjustment lever.

Warning
Pull the lever first and then loosen the retainer screw.

Fig. 3.14

Undo the fastener screws and remove the dashboard.

Fig. 3.15

Disconnect the connectors.

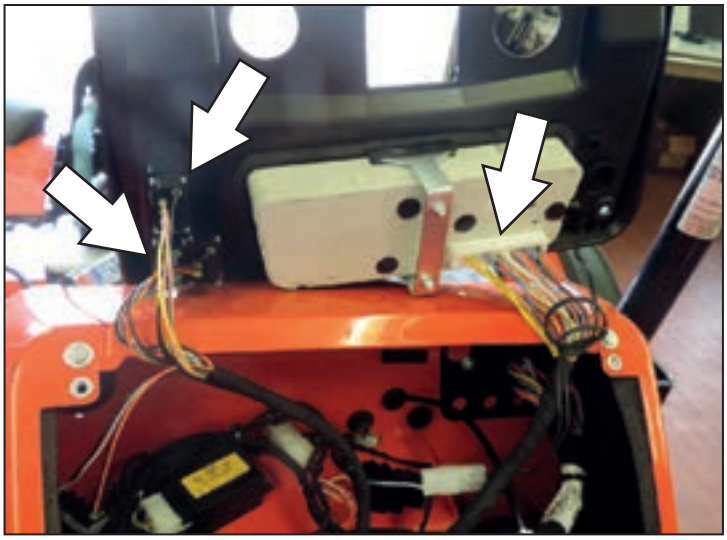


Fig. 3.16

Undo the fastener of the PTO selector and remove the lever.

Fig. 3.17

Undo the screws fastening the front lateral panels.

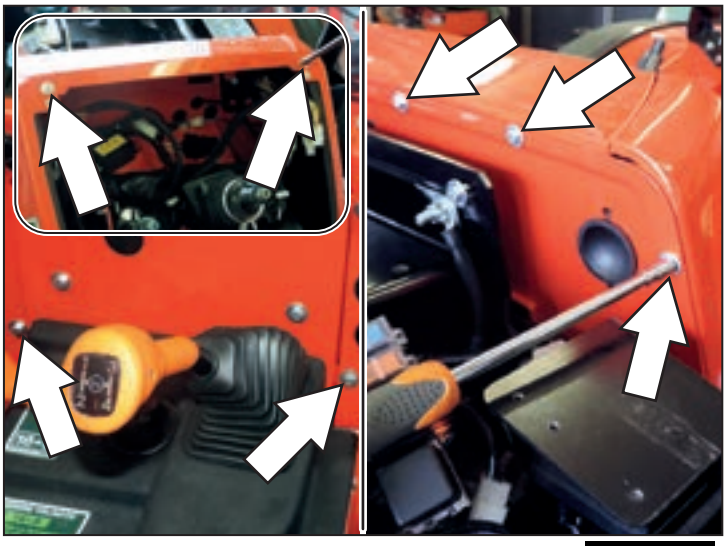


Fig. 3.18

Disconnect the cables and then remove the lateral panels.

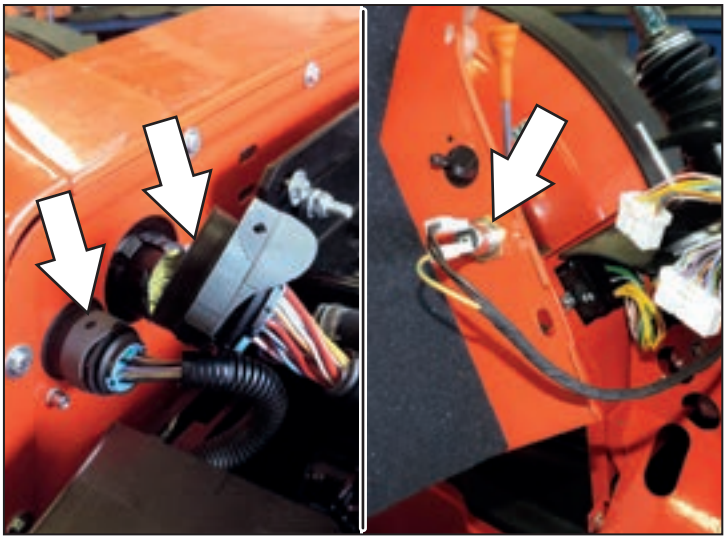


Fig. 3.19

Remove the grip.

Fig. 3.20

Undo the fastener screw and remove the gear selector lever.

Fig. 3.21

Remove the fastener pin and then remove the parking brake lever and the spacer.

Fig. 3.22

Undo the fastener screws and remove the washers of the casing cover.

Remove the casing cover.

> **Warning**
>
> To facilitate removal of the centre cover, set the PTO selector lever to "Groundspeed".

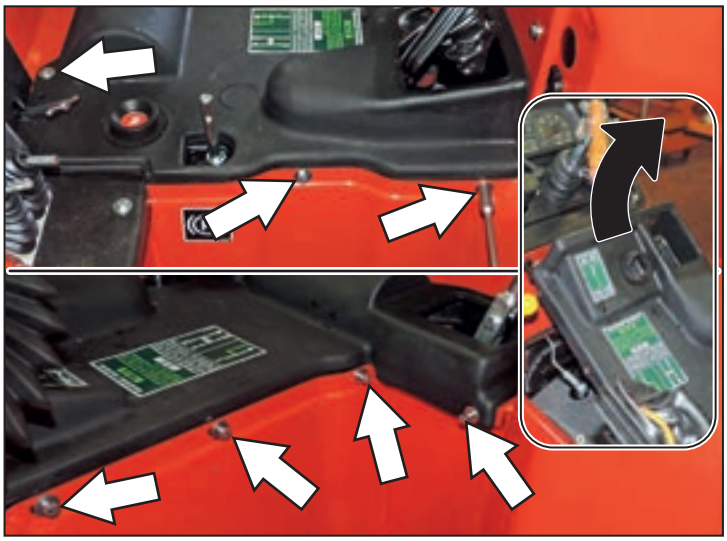


Fig. 3.23

Undo the fastener screws and remove the washers of the upper mudguard guard.

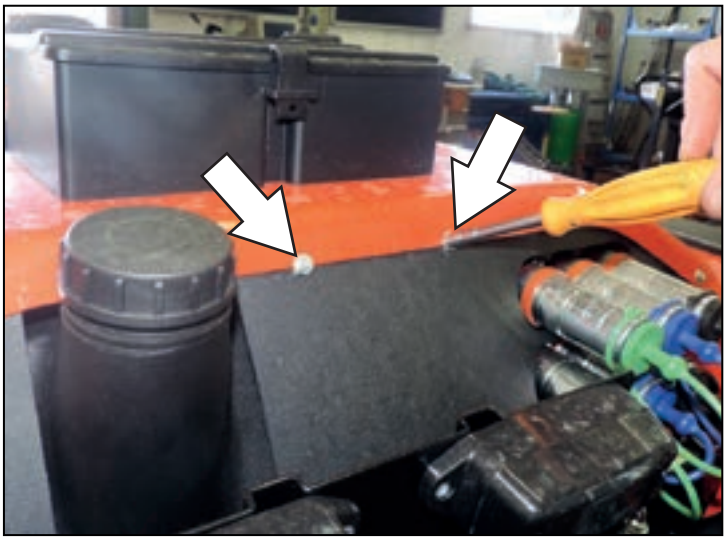


Fig. 3.24

Undo the fastener screws and remove the lateral washers under the mudguards.

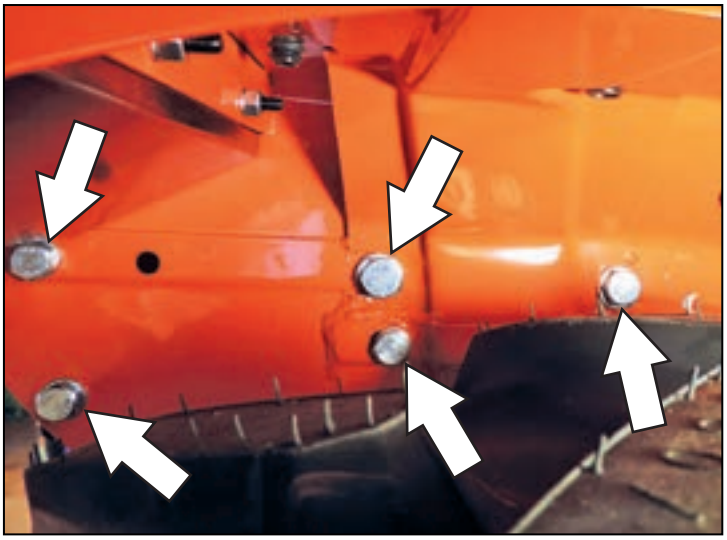


Fig. 3.25

Remove the rear cross member.

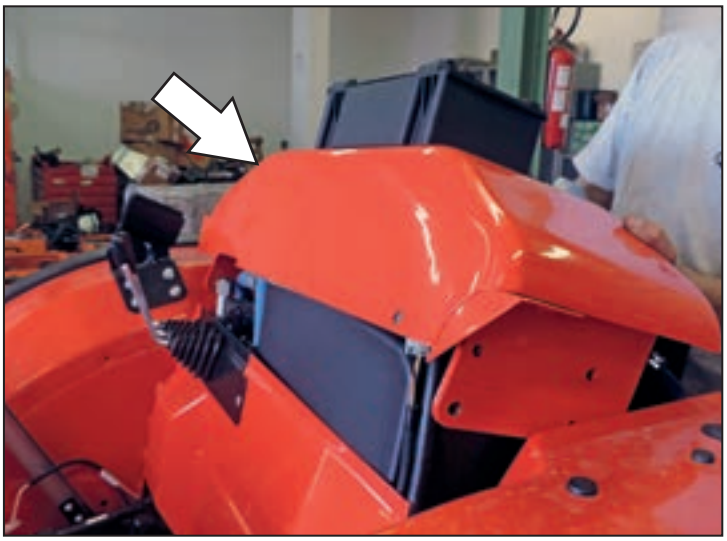


Fig. 3.26

Unscrew and remove the throttle pedal.

Fig. 3.27

Undo the fastener screws of the brake pedals and remove the pedals.

Fig. 3.28

Undo the clamp and the fastener screws of the rollover protection frame and remove the frame.

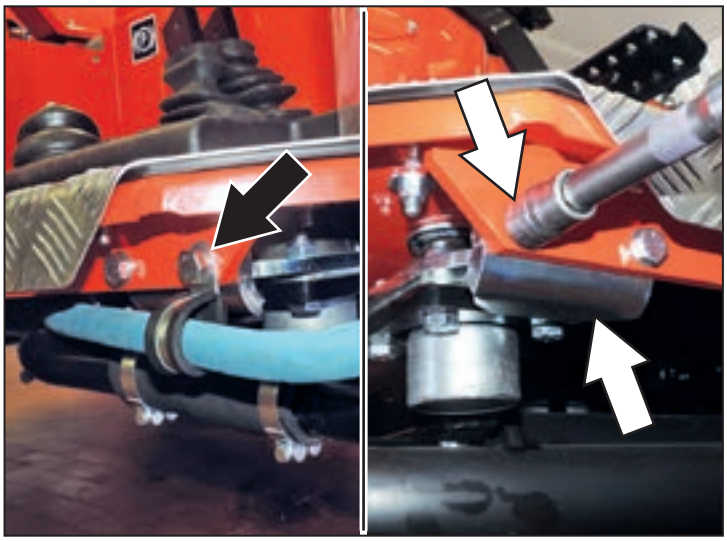


Fig. 3.29

Undo the screw and remove the clutch pedal spacers.

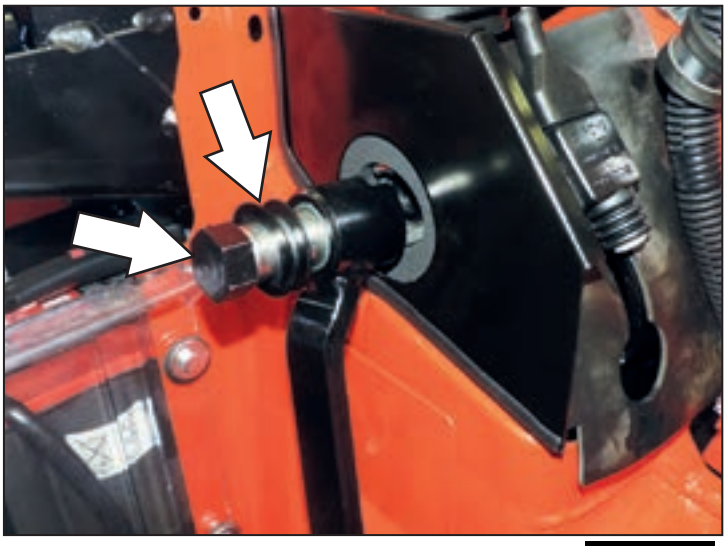


Fig. 3.30

Disconnect the connectors of the start enable switch and of the PTO switch.

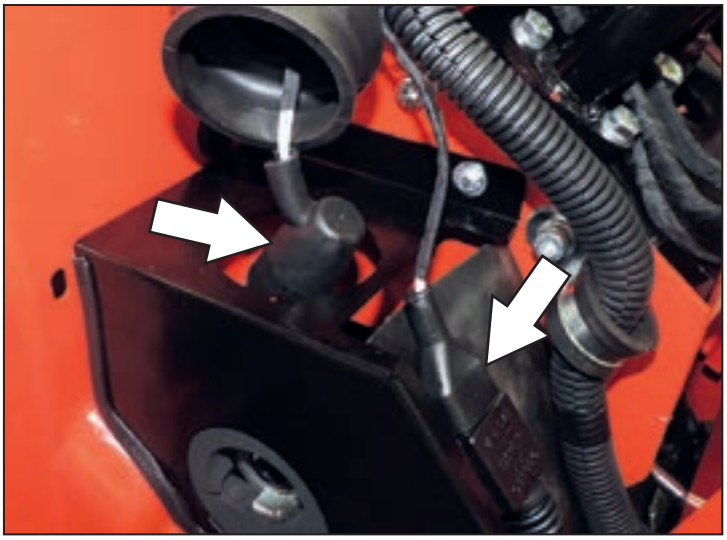


Fig. 3.31

Undo the screws and washers fastening the clutch pedal protective guard and then remove the guard.

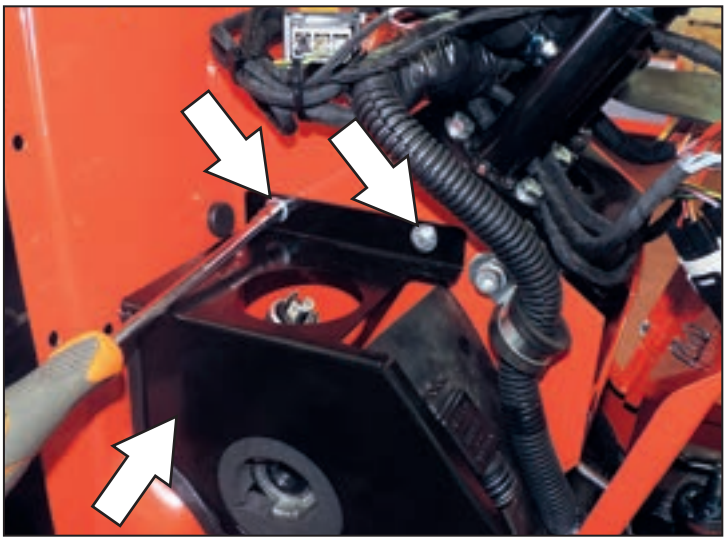


Fig. 3.32

Loosen the end stop screws of the clutch pedal.

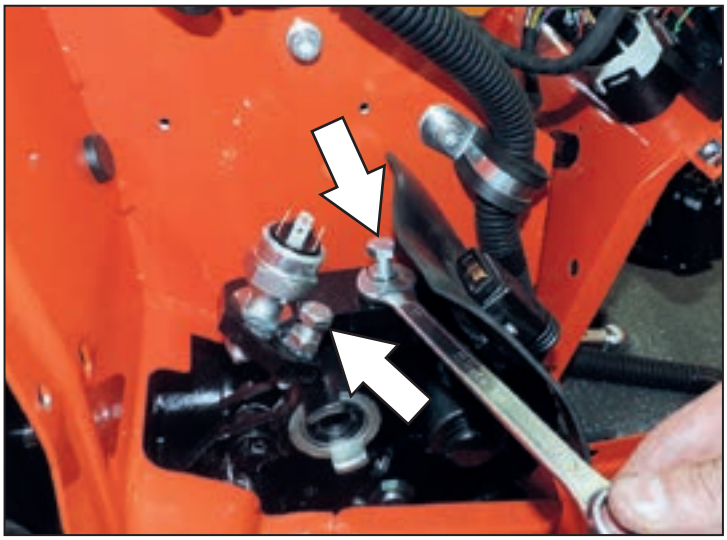


Fig. 3.33

Undo the screw with washer via the clutch pedal access aperture and then remove the pedal.

Undo the nut to slacken the clutch return spring.

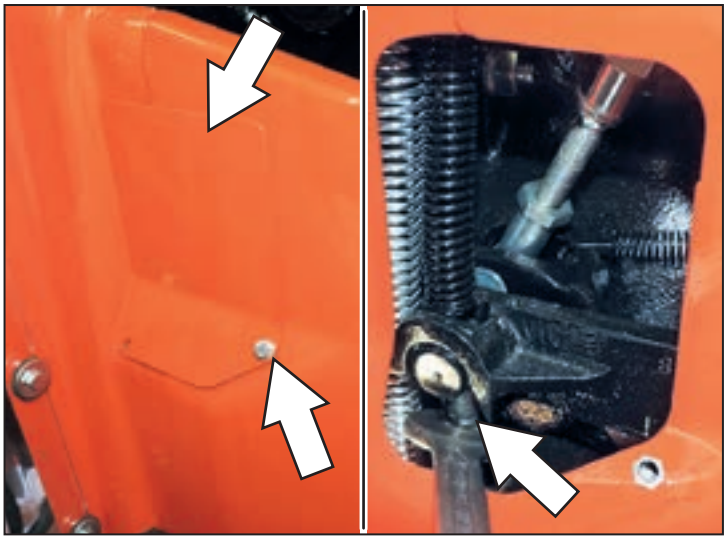


Fig. 3.34

Restrain the throttle cables with pipe wrench pliers and undo the plates.

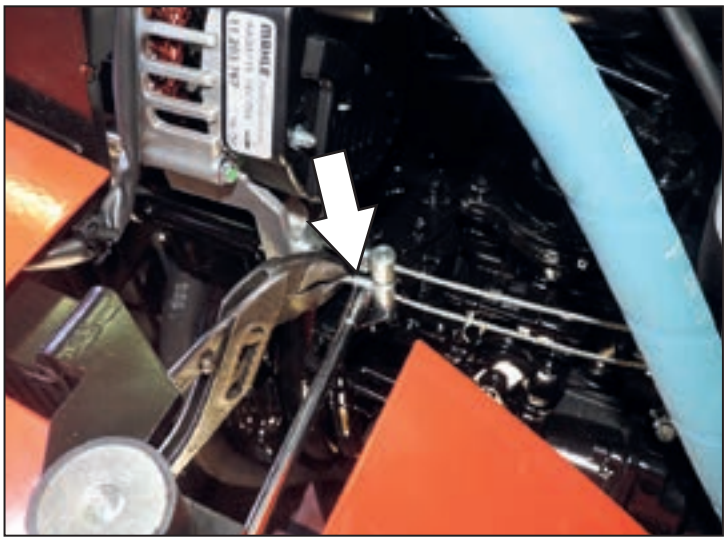


Fig. 3.35

Pull out the cable complete with sheath from the driver area.

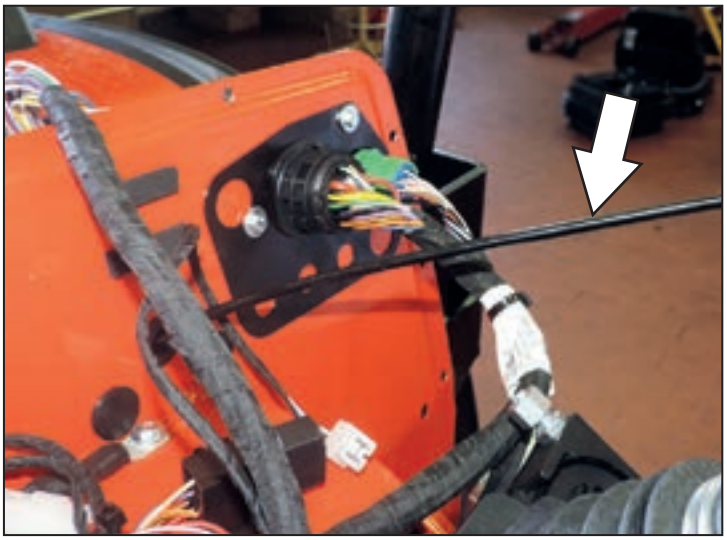


Fig. 3.36

Undo the fastener screws and remove the hand throttle mounting plate.

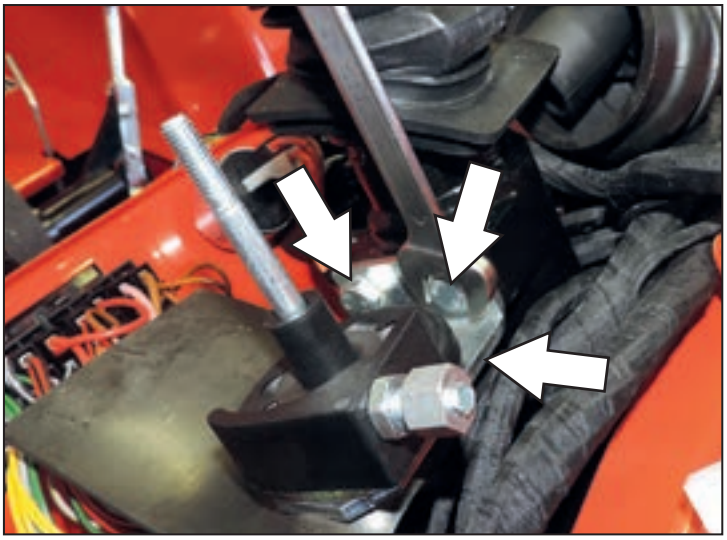


Fig. 3.37

Undo the fastener screws and remove the wiring loom fastener plate to allow access to the lift point of the platform.

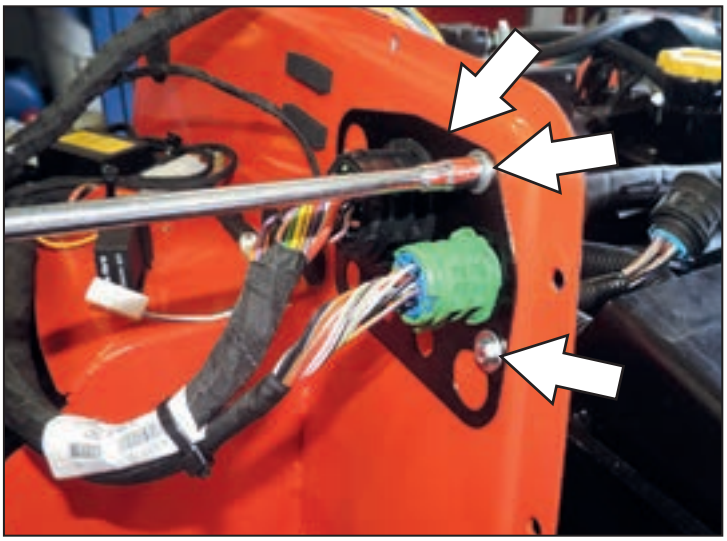


Fig. 3.38

Undo the nut and screw fastening the lever and then remove the lever.

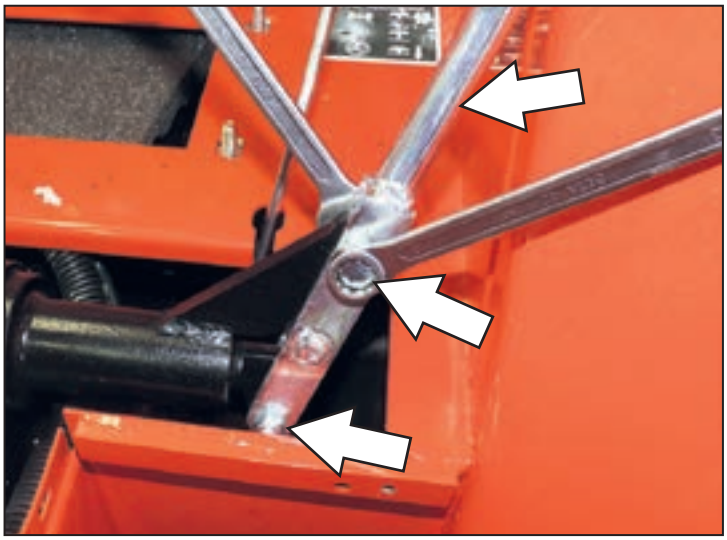


Fig. 3.39

Undo the hex socket screws fastening the hydraulic steering unit.

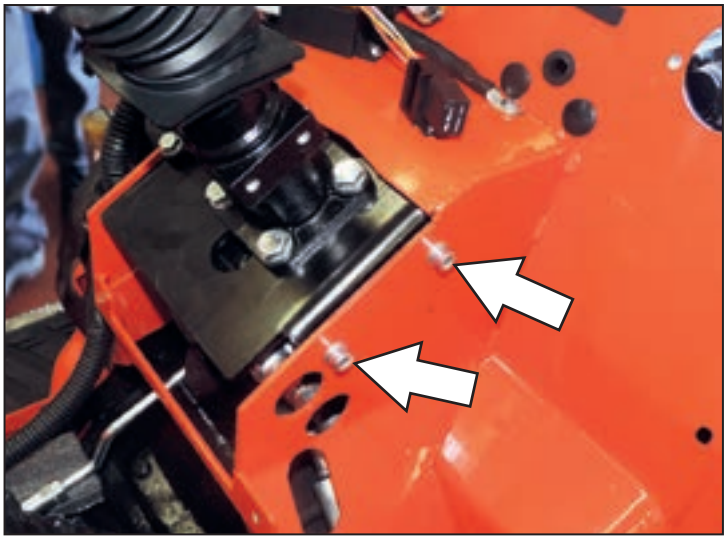


Fig. 3.40

Undo the clamp and remove the fuel return pipe.

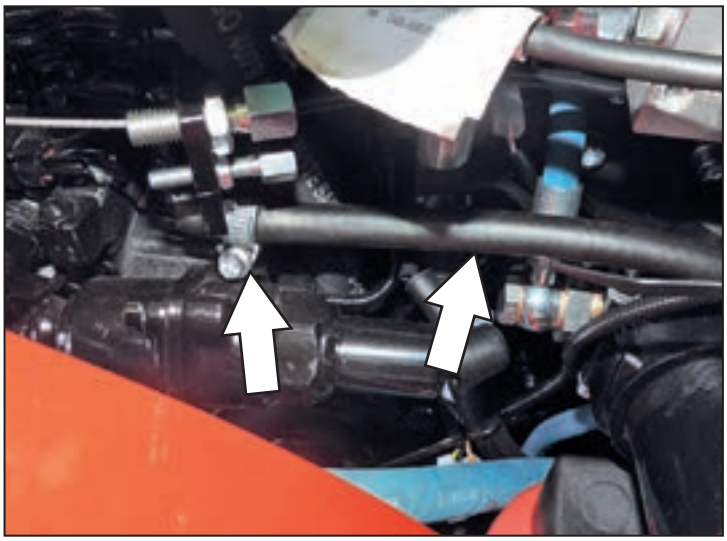


Fig. 3.41

Remove the caps on the footboards and undo the front and rear fastener screws.

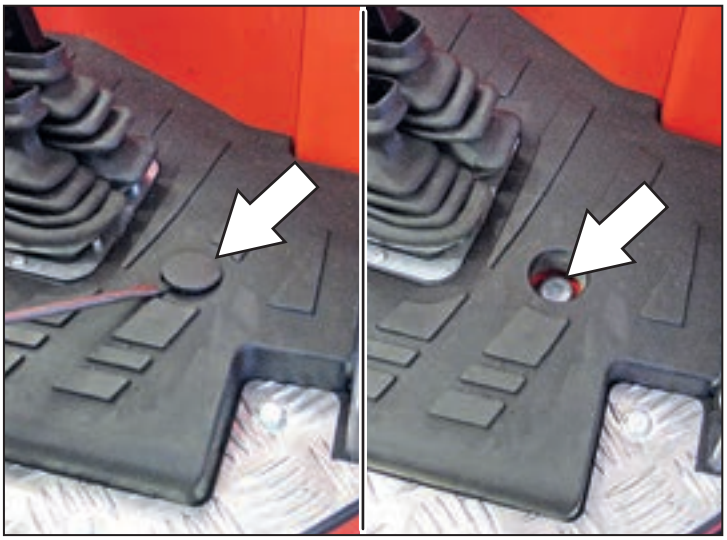


Fig. 3.42

Remove the nut fastening the ground point and remove the lug terminal.

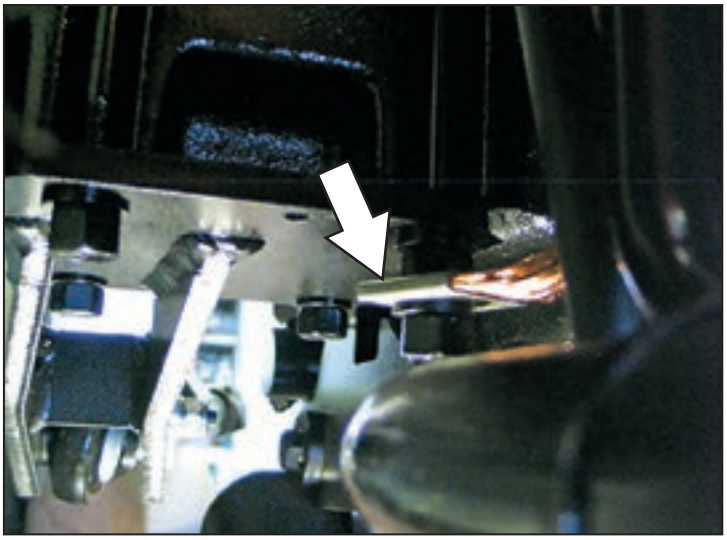


Fig. 3.43

Use tool (B-07007181) connected to a hoist to secure the platform safely.

Danger
Ensure that the hoist is of adequate capacity for the load lifted.

Lift and remove the platform.

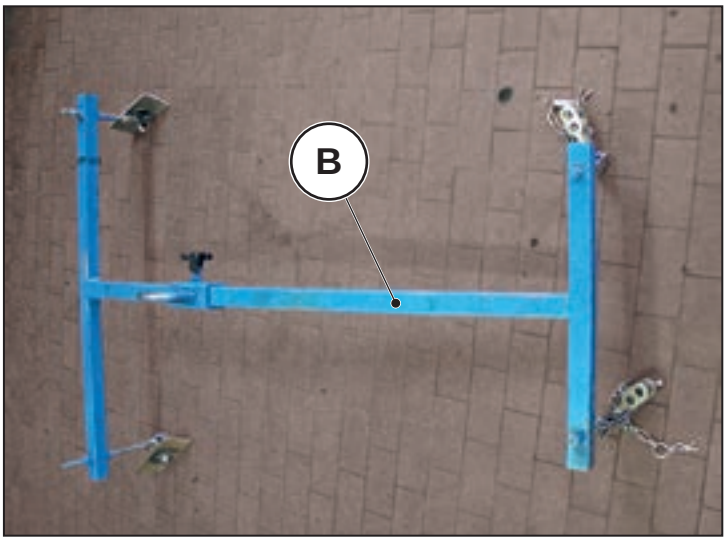


Fig. 3.44

Undo the connectors and remove the hydraulic pipes of the hydraulic steering unit.

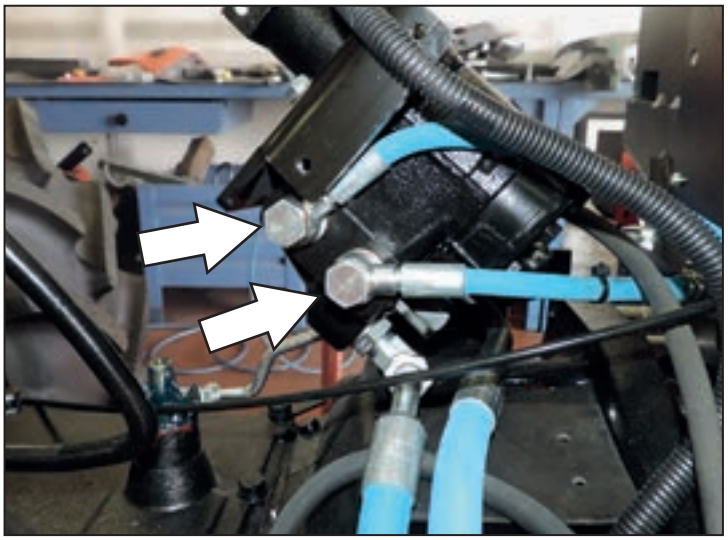


Fig. 3.45

Disconnect the pipe.

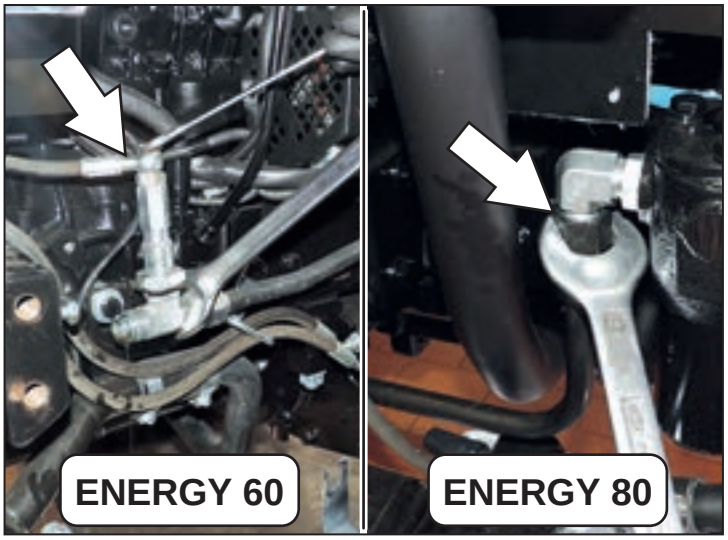


Fig. 3.46

ENERGY 80:

Disconnect the hydraulic unit delivery pipe, the return pipe and the 4WD unit delivery pipe.

Warning

Mark the components before removing to make sure that they are reassembled in their original positions.

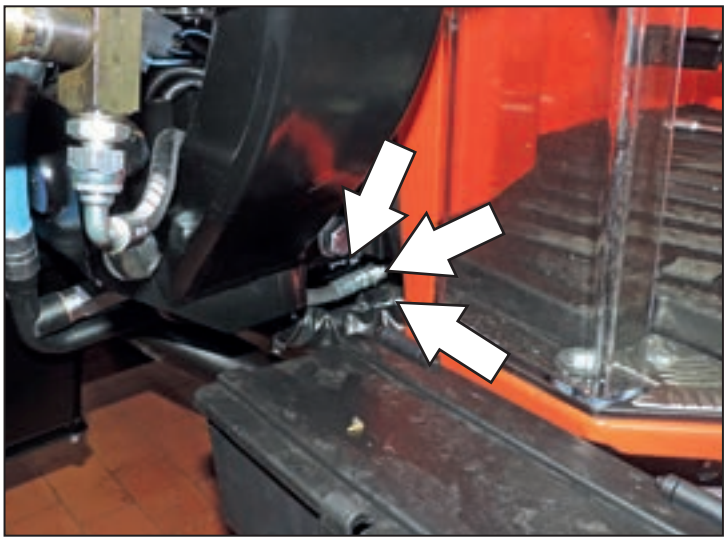


Fig. 3.47

Undo the filter mounting screws.

Warning
Drain the oil from the gearbox.

Undo the clamps and remove the hose connector.

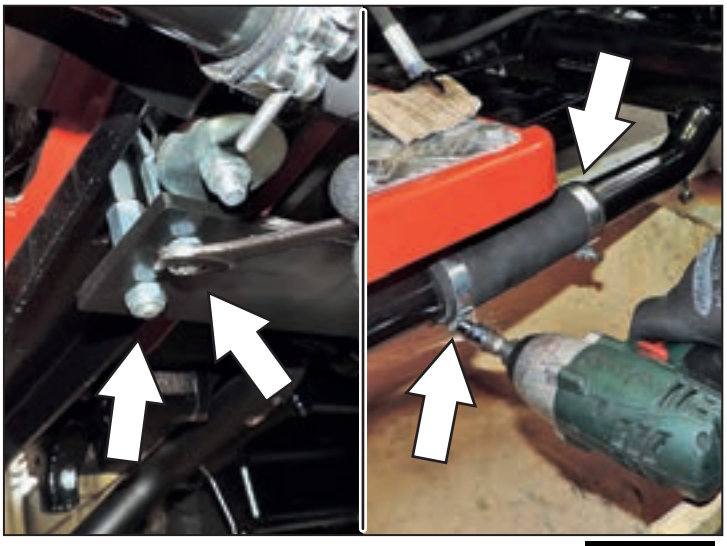


Fig. 3.48

Undo the filter mounting screw.

Loosen the clamp and remove the oil filter.

Disconnect the filter cable.

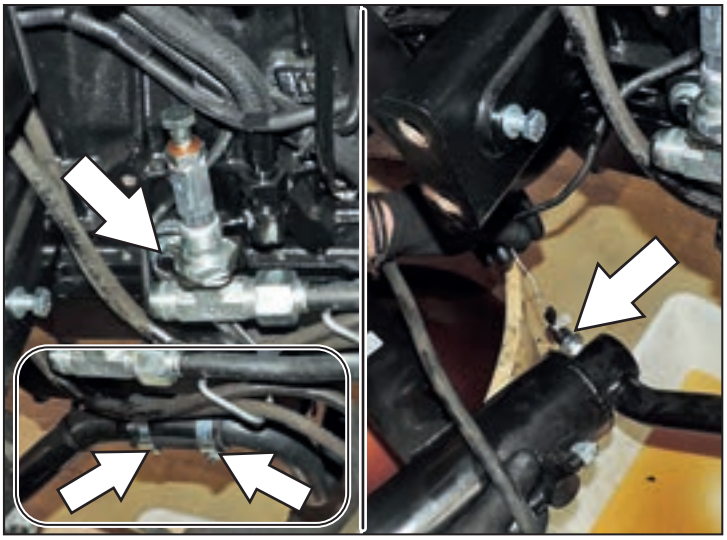


Fig. 3.49

Check that the screws of the footboard mount are tightened on both sides of the tractor.

Place a stand under the footboard mount to secure the tractor safely.

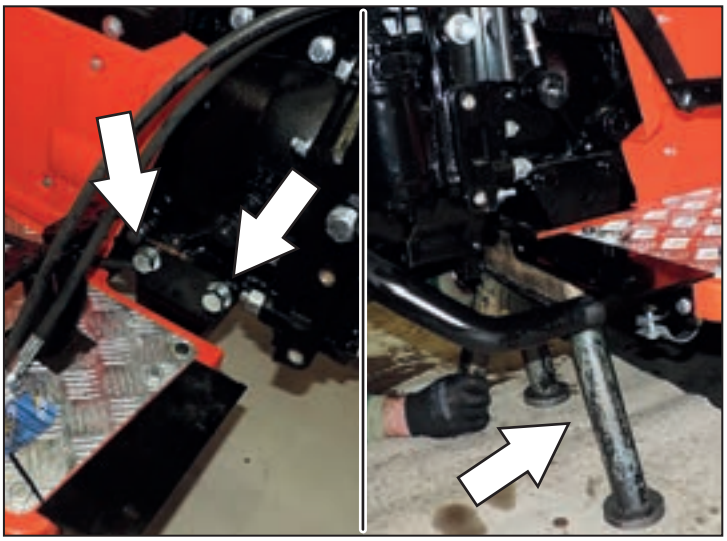


Fig. 3.50

Use the tool (C-p/n_____) to support the weight of the engine assembly.

Warning

Fit pins under the front axle shock absorbers to immobilise the engine.

Danger

Pull the parking brake lever and select a gear as an additional safety measure.

Fig. 3.51

Undo all the screws and nuts of the clutch housing.

Warning

There is not enough space to remove the screw and the bolt highlighted in the figures. These can only be loosened and removed during separation.

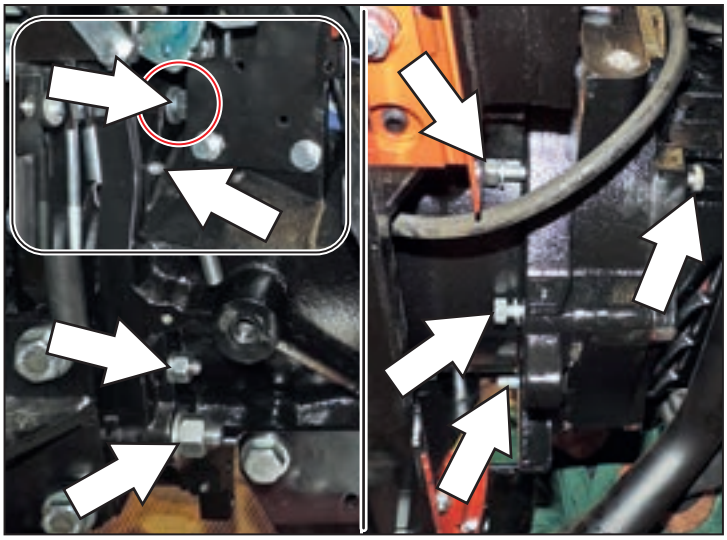


Fig. 3.52

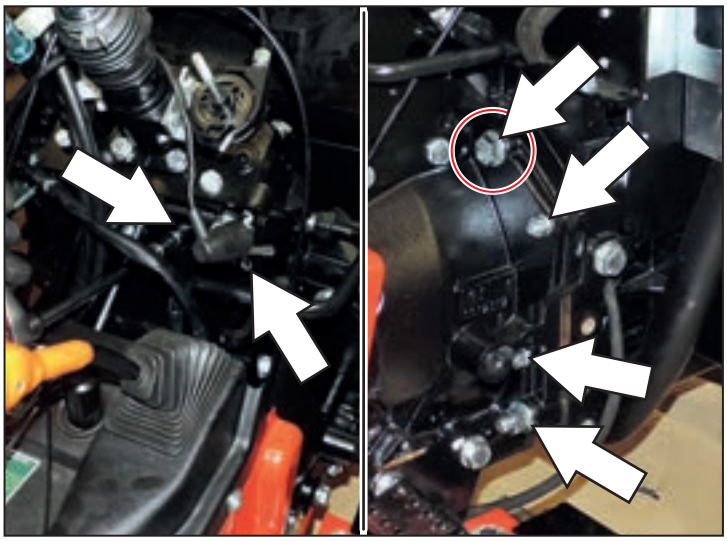


Fig. 3.53

Separate the assemblies with the utmost caution.

Danger

Lift and handle all heavy parts with a hoist of adequate load capacity.

Ensure that the lift straps and hooks are applied and positioned safely.

When lifting loads, all personnel must keep at a safe distance from the load itself and remain within safe areas.

Secure the assemblies to lifting equipment of adequate load capacity before disassembly.

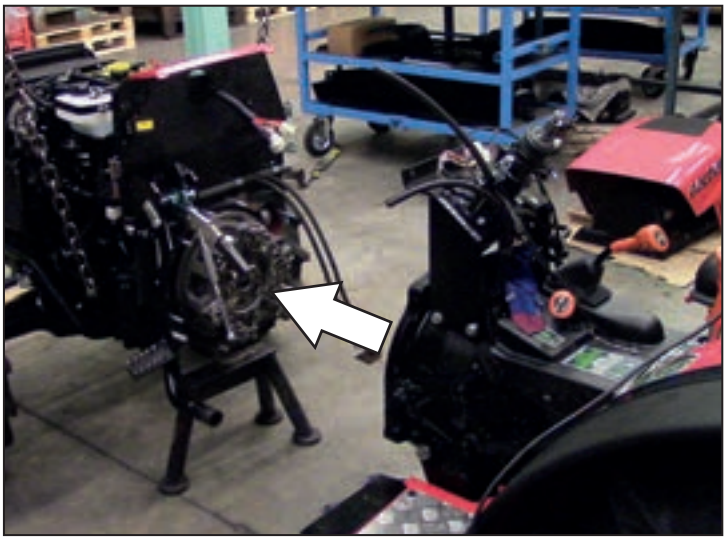


Fig. 3.54

4.2 Removing the Clutch

Fit the tool (D-07007171) and secure the clutch assembly safely with a hoist of suitable load capacity.

Undo the screws fastening the clutch.

Remove the complete clutch assembly.

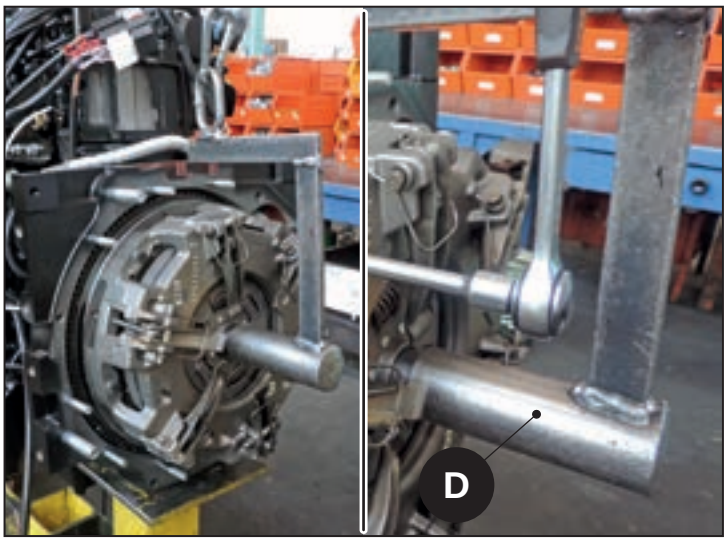


Fig. 3.55

Remove the levers of the transmission clutch (4) and the PTO clutch (8) from the housing, complete with rods, levers and springs.

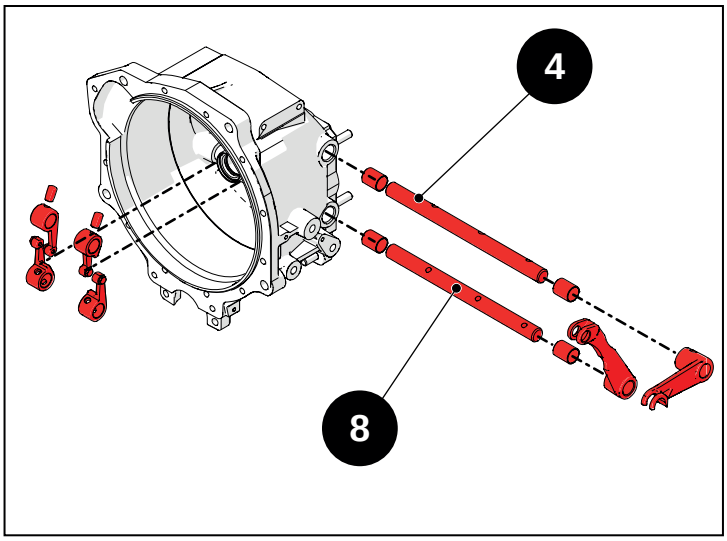


Fig. 3.56

Remove the transmission clutch control sleeve (9) and bearing (10).

Remove the PTO clutch control sleeve (5) and bearing (3).

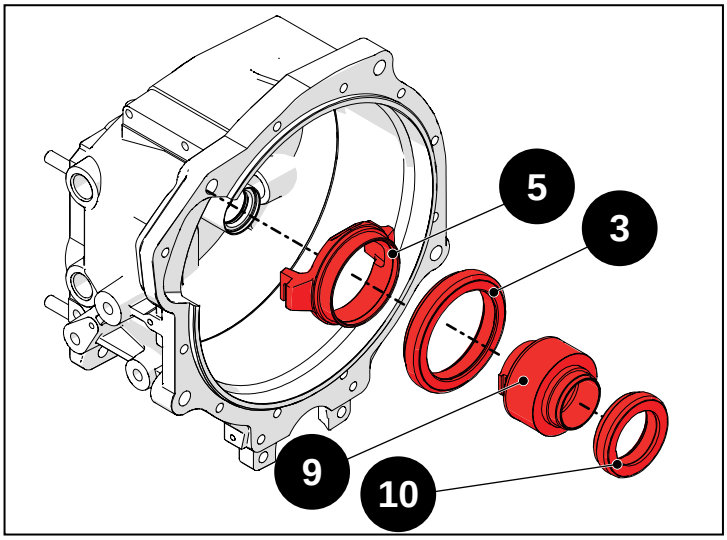


Fig. 3.57

Undo the screws (6) and the sleeve guide cover (7).

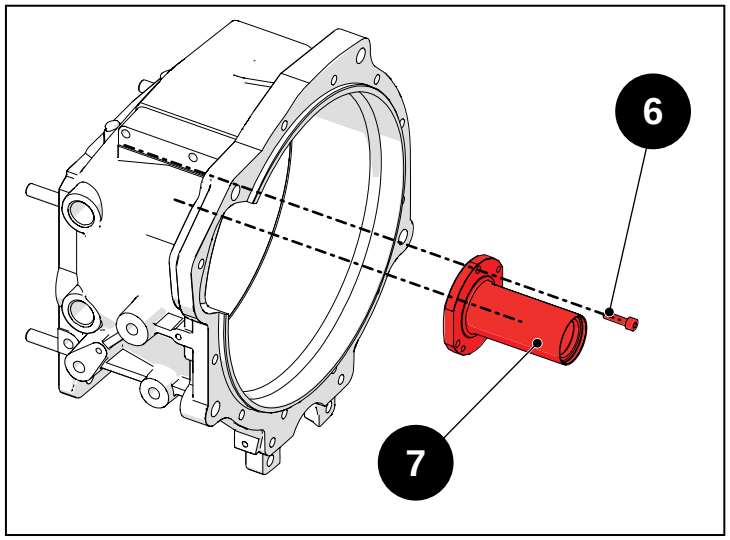


Fig. 3.58

Remove the roller bearing cage (13) and the oil seal (14) from the sleeve guide cover.

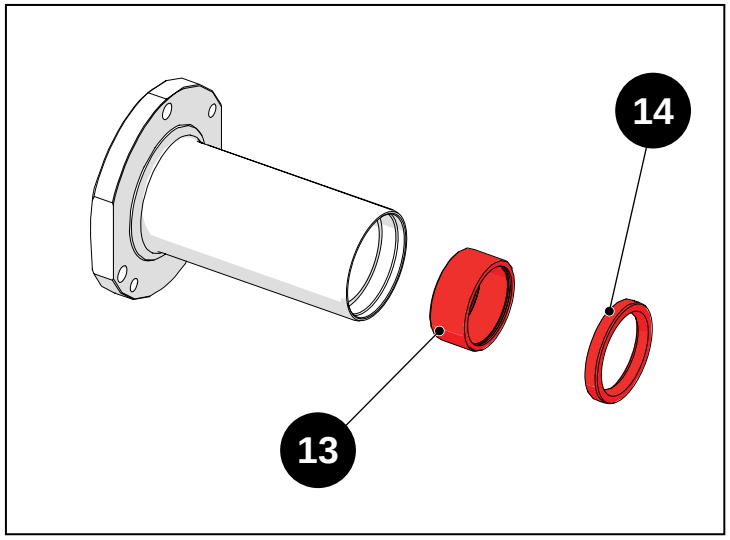


Fig. 3.59

Section 5 : Main inspection, reassembly and adjustment procedures

Index

5.1 Inspection 3-30
5.1.1 Inspecting and checking clutch components 3-30
5.1.2 Adjusting the clutch levers 3-31

5.2 Reassembly and adjustment 3-32
5.2.1 Refitting the clutch 3-32
5.2.2 Adjusting the PTO clutch lever 3-37
5.2.3 Clutch pedal adjustment 3-38

5.1 Inspection

5.1.1 Inspecting and checking clutch components

The thrust plate rings must be in good condition for the clutches to work correctly. Check that the rings show no signs of scoring or overheating. If any scoring or signs of overheating are found, the thrust surfaces of the rings must be reground.

Grind 0.5 mm of material from the thrust surfaces of the rings.

If it is necessary to grind more material, remove the same amount from the clutch mating surface on the flywheel.

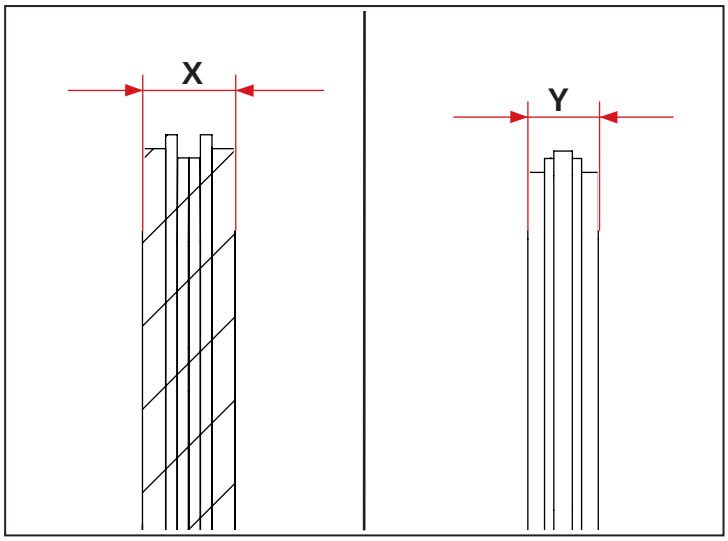


Fig. 3.60

Warning

Do not remove more than 1 mm in total. If more material must be removed to rectify wear, replace the assembly.

Warning

Mark the components before removing to make sure that they are reassembled in their original positions.

The wear thickness limits of the discs are listed as follows:

Transmission: X = 10.3 to 6.3 mm

Power Take Off: Y = 8.7 to 5.7 mm

Check that the length of the spring in relaxed state is 11.7 ± 0.1 mm:

If not, the spring must be replaced as it will not exert the correct thrust against the clutch plate.

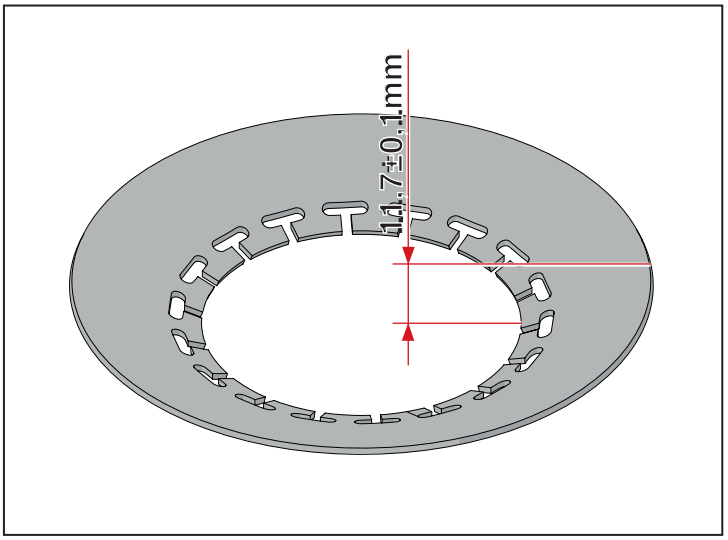


Fig. 3.61

5.1.2 Adjusting the clutch levers

For the clutches to engage correctly and controllably, the levers of the transmission clutch (C) and the PTO clutch (E) must be adjusted correctly.

To adjust the transmission clutch correctly, adjust the levers (C) to obtain the measurement X indicated in the table.

Loosen the check nuts and tighten or loosen the nuts (D) as necessary to obtain the measurement X indicated in the table.

clutch Ø	9"	10"
X	35 mm (LUK) 27 mm (GOLDONI)	32 mm

Tighten the check nuts after adjusting.

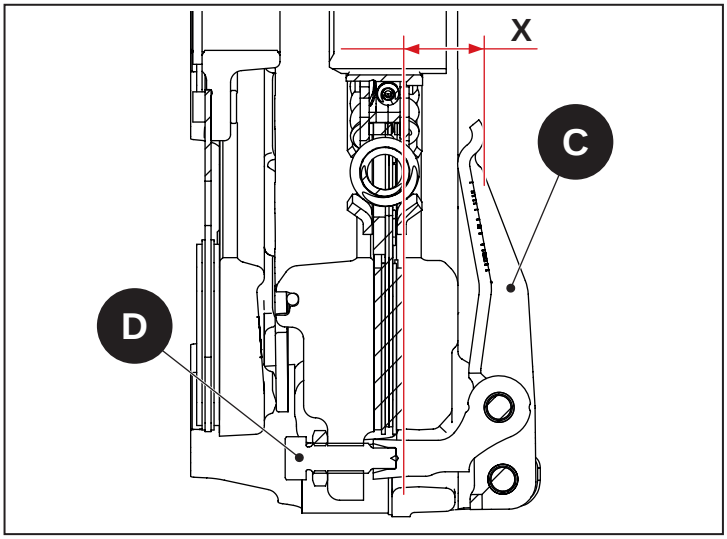


Fig. 3.62

To adjust the PTO clutch correctly, adjust the levers (E) to obtain the measurement Y indicated in the table.

Tighten or loosen the nuts (F) as necessary to obtain the measurement Y indicated in the table.

clutch Ø	9"	10"
Y	59 mm (LUK) 51 mm (GOLDONI)	56 mm

After adjusting, press the edge of the nut with a clinching wrench and apply a dot of colour to mark the nut.

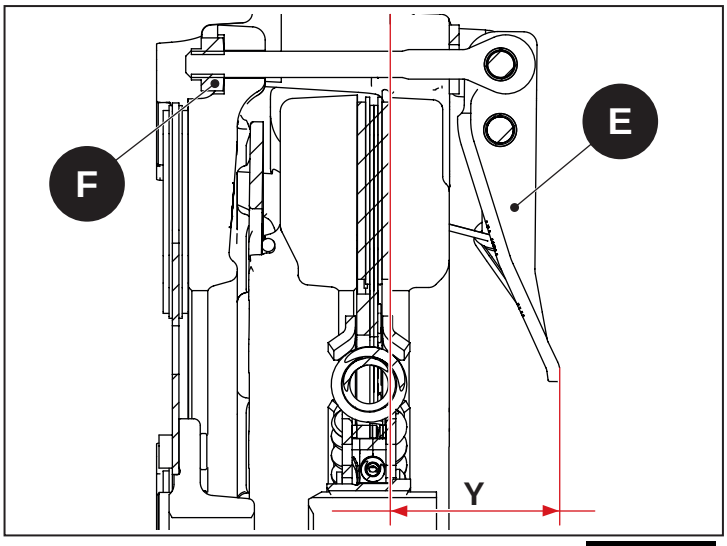


Fig. 3.63

Check that the maximum clearance between the clutch thrust plates and the clutch housing is within the correct operating range.

Measure the values A and B.

Calculate the clearance X with the formula: X = A - B.

X must be between 0.3 mm and 0.8 mm

Measure and calculate the values for both clutches.

Warning

Replace the clutch assembly if X is not within the specified range.

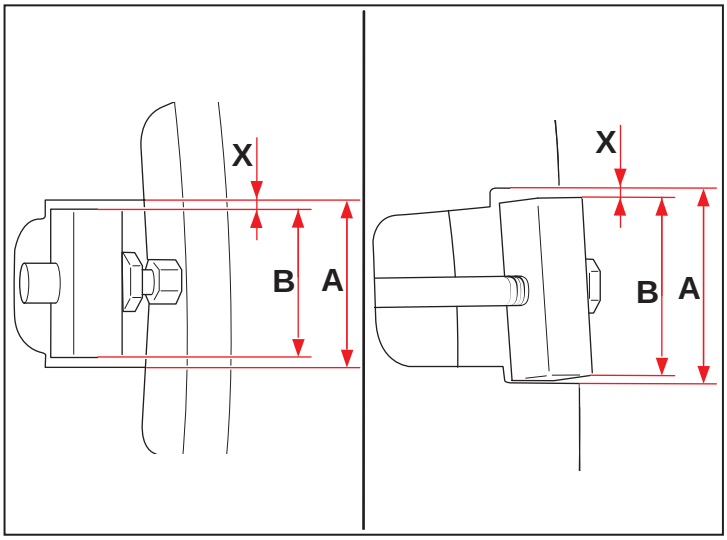


Fig. 3.64

5.2 Reassembly and adjustment

Warning

Read the instructions in chapter "1-Introduction" and, in particular, the sections concerning the installation of O-rings, oil seals and bearings, with particular care before reassembling, and follow these instructions precisely when working.

Apply the correct tightening torques when tighten the fasteners of components. Where tightening torques are not specified, refer to the table in chapter "1-Introduction".

Use the specified sealant products during reassembly. Where the sealant required is not specified, refer to the table in chapter "1-Introduction".

5.2.1 Refitting the clutch

Using a bearing race punch tool of suitable diameter, install the roller bearing cage (13) in the sleeve guide cover.

Apply a layer of mastic sealant on the outer perimeter of the oil seal (14), and use a punch tool of suitable diameter to install it in the sleeve guide cover.

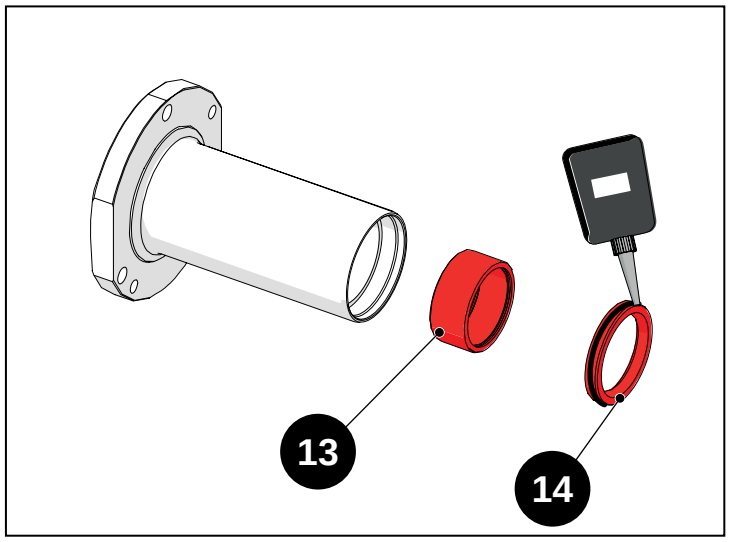


Fig. 3.65

Fasten the sleeve guide cover (7) to the housing, fitting and tightening the screws (6).

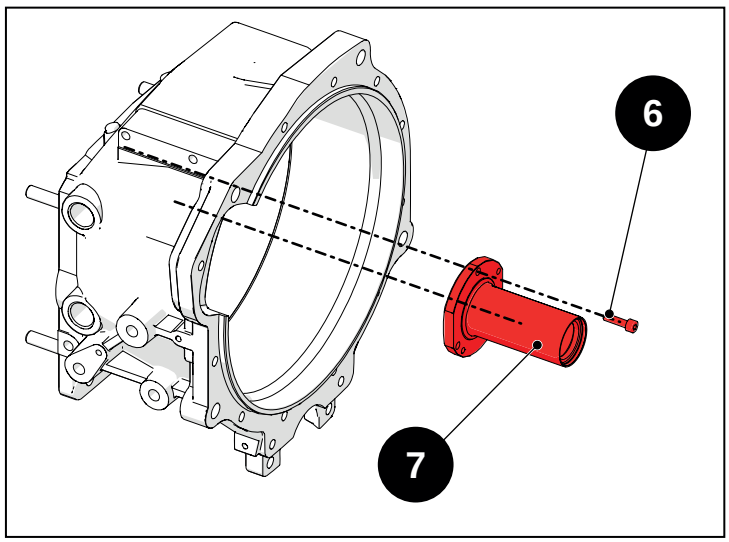


Fig. 3.66

Using a bearing race punch tool of suitable diameter, install the bearing (3) on the sleeve (5).

Using a bearing race punch tool of suitable diameter, install the bearing (10) on the sleeve (9).

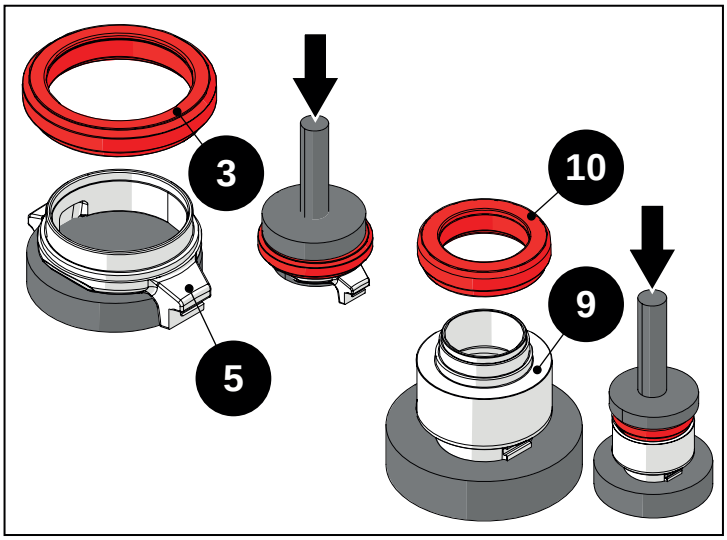


Fig. 3.67

Fit the complete transmission clutch control sleeve (9) and PTO clutch control sleeve (5) on the sleeve guide cover (7).

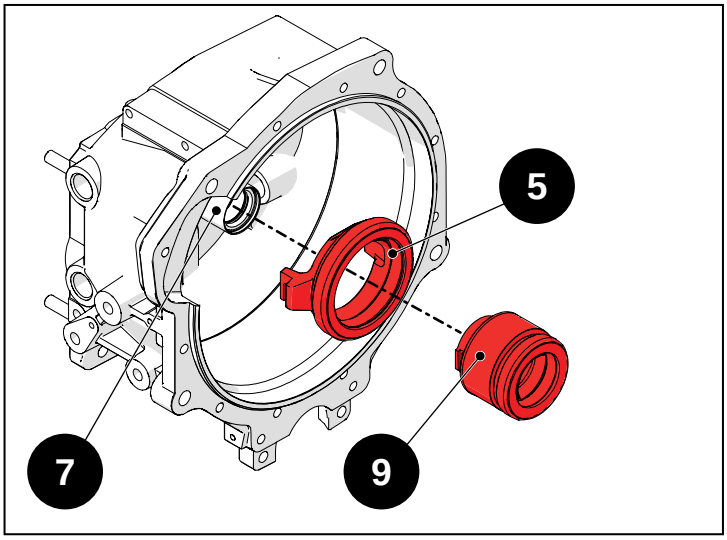


Fig. 3.68

Install the transmission clutch lever (4) and the PTO clutch lever (8), complete with rods, levers and springs.

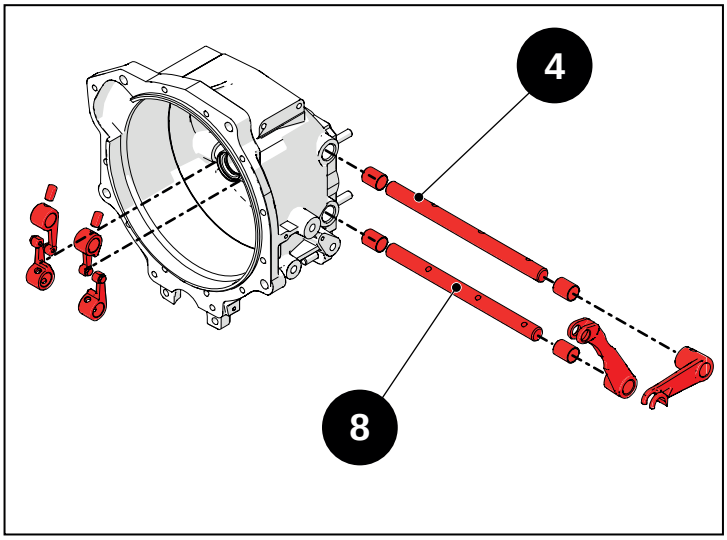


Fig. 3.69

Fit the tool (D-07007171) and lift the clutch assembly with a hoist of suitable load capacity.

Fasten the clutch assembly to the engine, tightening the screws to a torque of 30 Nm (3 kgm).

Warning
Use new M8 screws at each reassembly

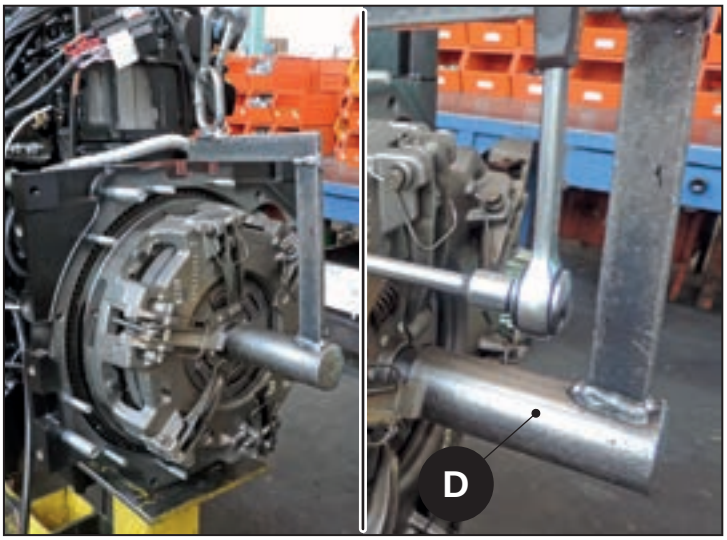


Fig. 3.70

Mate the two assemblies

Note
When installing the engine into the gearbox clutch housing, select a gear and set the PTO lever to "Independent" to facilitate engagement of the clutch and the PTO disc onto the splined shafts.

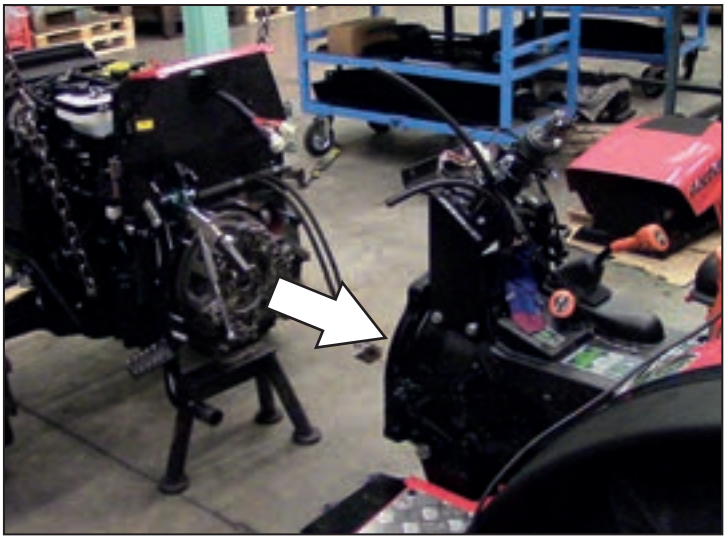


Fig. 3.71

Tighten the screws and nuts fastening the housing to the engine to the following tightening torques:

Nuts = 60 Nm (6 kgm)

Screws = 100 Nm (10 kgm)

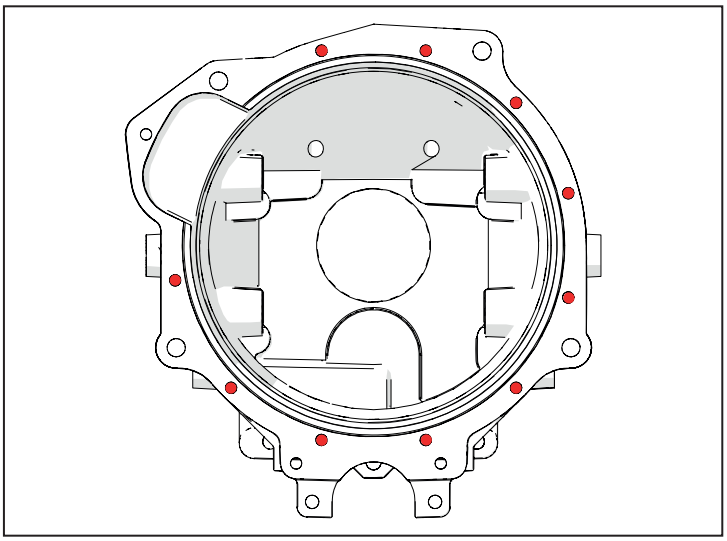


Fig. 3.72

When the assemblies are joined, there will not be enough space to fit the nut and the screw indicated. These must be fitted before joining the assemblies completely and tightened while the assemblies are being brought together.

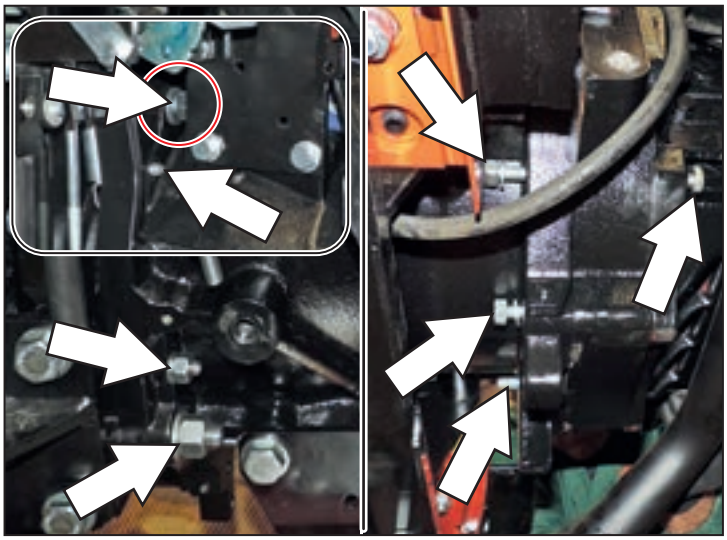


Fig. 3.73

Reassemble by following the procedure for disassembly in reverse order, noting the following additional instructions:

Adjust the throttle cables after connecting them. Use the adjuster nuts to set the correct tension.

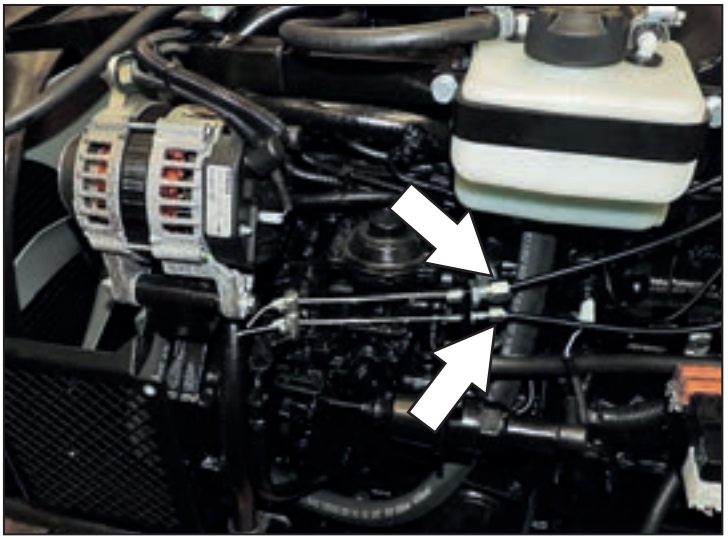


Fig. 3.74

Warning

Ensure that the lift valve has not been left under the casing cover before fastening the cover.

Fig. 3.75

The fastener screw of the casing cover situated under the underdrive gear selector lever is longer than the others.

Warning

Tighten this screw carefully by hand, as it may break otherwise.

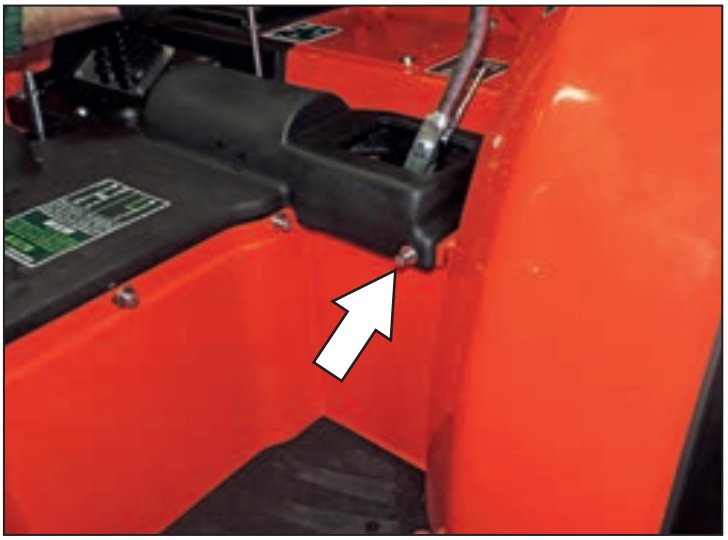


Fig. 3.76

5.2.2 Adjusting the PTO clutch lever

Adjust the nut so that the lever has a dead zone of 20 mm.

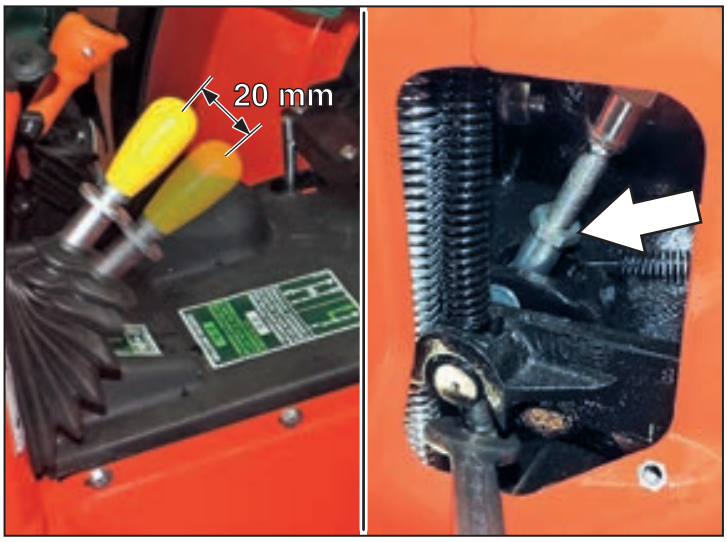


Fig. 3.77

5.2.3 Clutch pedal adjustment

The clutch pedal travel must be set correctly for the transmission clutch to engage and disengage correctly.

> **Warning**
>
> The clutch assembly must be reassembled completely onto the gearbox and engine before adjusting the clutch pedal.

To set the pedal travel, adjust the engage point (SA), release point (SC) and dead zone (SB) screws to obtain the correct values.

> **Note**
>
> The left hand front lateral panel must be removed to allow access to the clutch pedal end stop screws (see chapter "Platform").

> **Attention**
>
> After fastening the base assembly and before refitting the platform, check that the clutch works correctly by pressing the clutch with four gear selected and checking that the tractor moves when pushed. Also check that the PTO clutch works correctly, by engaging the PTO and turning the rear shaft by hand.

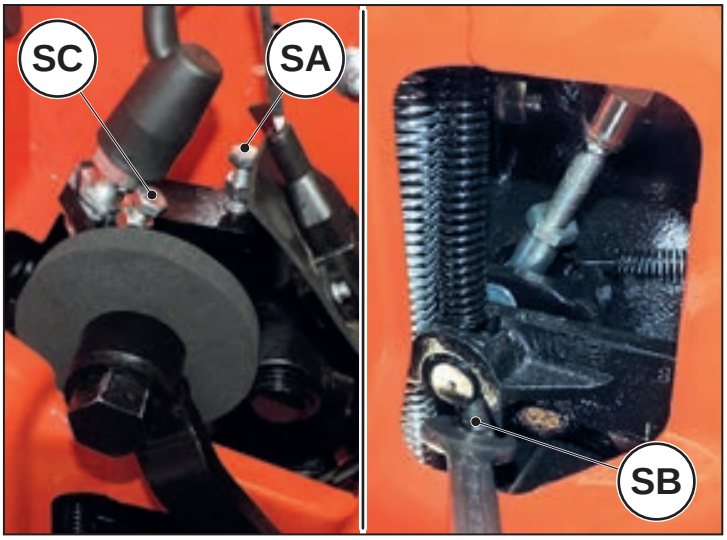


Fig. 3.78

ENERGY 60:

Pedal rest position (A)	210 mm
Pedal engage point (B)	245 mm
Pedal release point (C)	390 mm

ENERGY 80:

Pedal rest position (A)	195 mm
Pedal engage point (B)	220 mm
Pedal release point (C)	390 mm

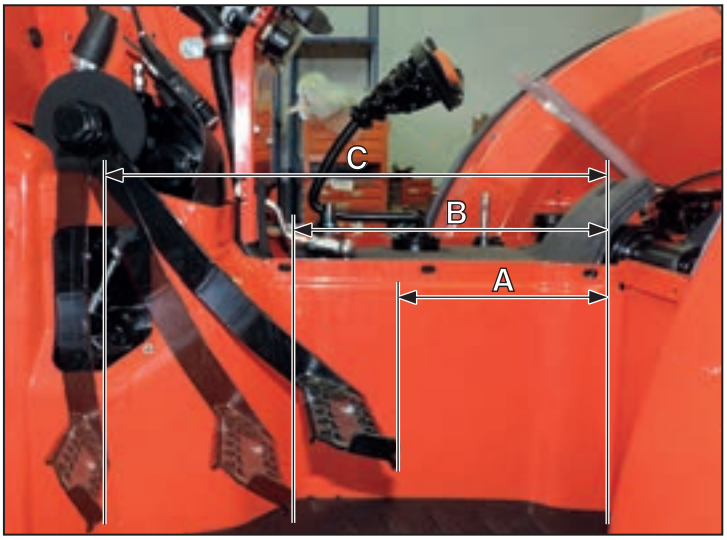


Fig. 3.79

Section 6 : Tightening torques

Index

6.1 Tightening specifications 3-40

6.1 Tightening specifications

The main tightening torques are listed as follows. For all other tightening torques, see chapter "1-Introduction".

Tightening torque	Nm	Kgm
Screw fastening clutch to engine flywheel	30	3
Nut fastening engine flange - clutch housing	60	6
Primary shaft sleeve fastener screw	33	3.3
Dashboard mount fastener screw	80	8
Screw fastening engine flange - clutch housing	100	10

Section 7 : Tools necessary

Index

7.1 Tools necessary 3-42

7.1 Tools necessary

p/n	Description	Quantity
A-07006212	Flywheel puller tool	1
B-07007181	Platform lifting tool	1
C-p/n_____	Front tractor assembly lifting tool	1
D-07007171	Support for lifting clutch	1

Chapter 4 : Gearbox

Index

Section 1 : Safety notes 4-2

Section 2 : General introduction 4-3

2.1 Drawing of the assembly 4-4

Section 3 : Technical specifications 4-7

3.1 Technical specifications 4-8

Section 4 : Disassembly 4-9

4.1 Preliminary operations 4-10

4.2 Gearbox disassembly 4-11

Section 5 : Main inspection, re-assembly and adjustment operations 4-25

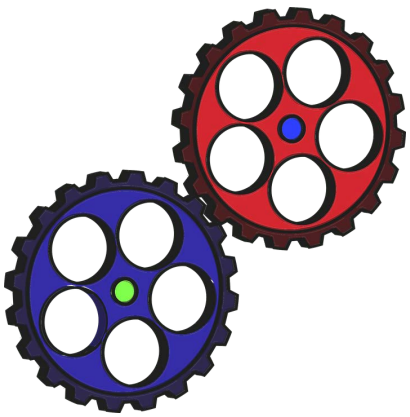
5.1 Main inspection, re-assembly and adjustment operations 4-26

Section 6 : Tightening torques 4-45

6.1 Tightening torques 4-46

Section 7 : Tools required 4-47

7.1 Tools required 4-48



Section 1 : Safety notes

To prevent accidents and injuries, always comply with the precautions and safety recommendations described in this section. In addition, operators must always comply with the safety instructions given in the operation and maintenance manual and in chapter 1 of this manual.

Danger

Make sure that all persons keep well away from the danger zone. Avoid vibrations when the bolts are loosened.

Danger

Lift and handle all heavy parts with lifting equipment of an adequate capacity. Arrange all harness and hooks in safe positions. Operators must remain at a distance and in a safe position, well away from the lifted load.

Danger

Do not twist the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Danger

Use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.

Danger

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

Danger

For safety reasons, always leave two screws on opposite sides when removing components that could fall. Only remove these screws after having secured the component to lifting equipment or placed bearing blocks underneath.

Danger

If the bolts that fix the safety frame or cab have loosened or if the safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

Caution

Keep clear of the sharp edges around the top of the transmission housing.

Caution

Used oil must be collected and disposed of in compliance with the anti-pollution laws in force.

Section 2 : General introduction

Index

2.1 Drawing of the assembly 4-4

2.1 Drawing of the assembly

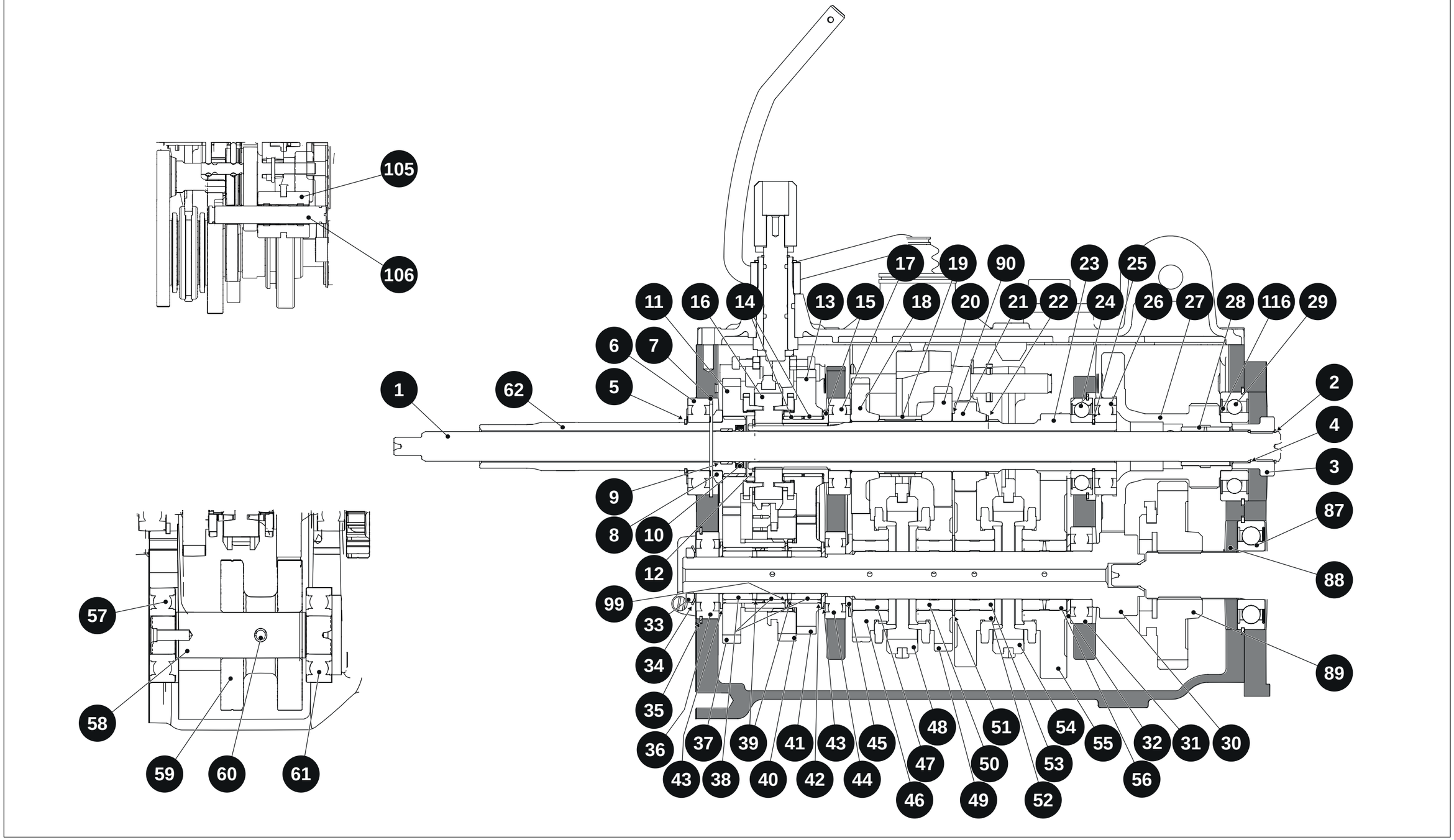


Fig. 4.1

1 - P.T.O. drive shaft
2 - Circlip
3 - P.T.O gear
4 - Spring ring
5 - Circlip
6 - Bearing
7 - Circlip
8 - Drive shaft spacer
9 - Rod guiding ring
10 - Oil retainer
11 - 8+8 gear
12 - Circlip
13 - 16+8 gear
14 - Roller cage
15 - Keyed bushing
16 - Synchromesh
17 - Bearing
18 - 4th speed gear
19 - Spacer
20 - 3rd speed gear
21 - 2nd speed gear
22 - Circlip
23 - Shaft
24 - Bearing
25 - Circlip
26 - Bearing
27 - Gear
28 - Bushing
29 - Bearing
30 - Layshaft
31 - Bearing
32 - Spacer
33 - Ring nut
34 - Safety washer
35 - Circlip
36 - Bearing
37 - Driven gear
38 - Roller cage
39 - Spacer
40 - Reverse shuttle gear
41 - Driving gear
42 - Bush
43 - Spacer
44 - Bearing
45 - Spacer
46 - 4-8 gear
47 - Bush
48 - Synchromesh
49 - 3-7 gear
50 - Bush
51 - Spacer
52 - 2-6 gear
53 - Bush
54 - Synchromesh
55 - 1-5 driven gear
56 - Bush
57 - Bearing
58 - Reverse shuttle shaft
59 - Reverse shuttle double gear
60 - Spring pin
61 - Bearing
62 - Gearbox front drive shaft
87 - Bearing
88 - Spacer
89 - Driving gear
90 - Spacer
99 - Spacer
105 - Reverse gear
106 - Reverse shaft
116 - Spacer

Section 3 : Technical specifications

Index

3.1 Technical specifications 4-8

3.1 Technical specifications

Type	Dual Power 16+8/8+8 synchronized
Operating mechanism	Mechanical with side levers

Section 4 : Disassembly

Index

4.1 Preliminary operations 4-10

4.2 Gearbox disassembly 4-11

4.1 Preliminary operations

Comply with the following instructions to access the gearbox unit:

1 - Remove the platform (see chapter "13- Platform")

Remove the cab (see chapter "14- Cab")

2 - Split the Clutch/Gearbox (see chapter "3- Clutch bowl")

3 - Split the Rear differential/Gearbox (see chapter "4- Gearbox")

Fasten the clutch bowl to lifting equipment.

Unscrew the nuts (117) and remove the washers (118) that fasten the bowl to the gearbox.

Tools
07000245: Tractor splitting support.
07000215: Gearbox - base unit support.

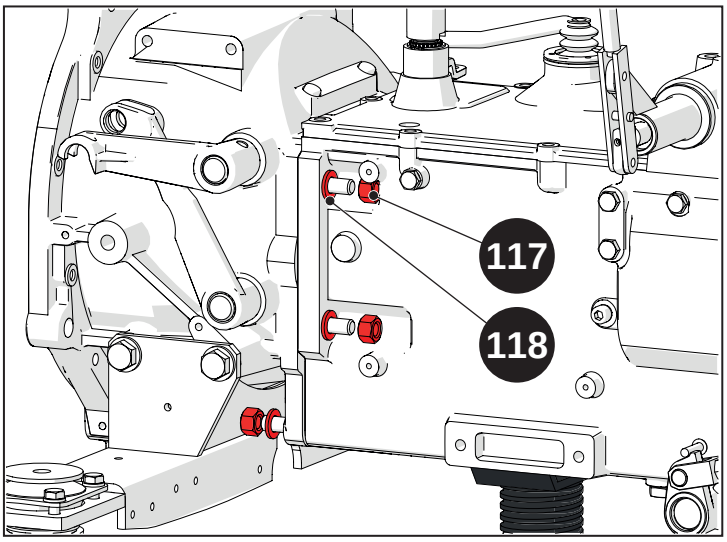


Fig. 4.2

Remove the clutch bowl assembly and recover the paper gasket (119).

Note
The paper gasket (119) keeps the heat produced by the clutch away from the gearbox assembly.

Tools
07000246: Gearbox housing support.
07000215: Gearbox - base unit support.

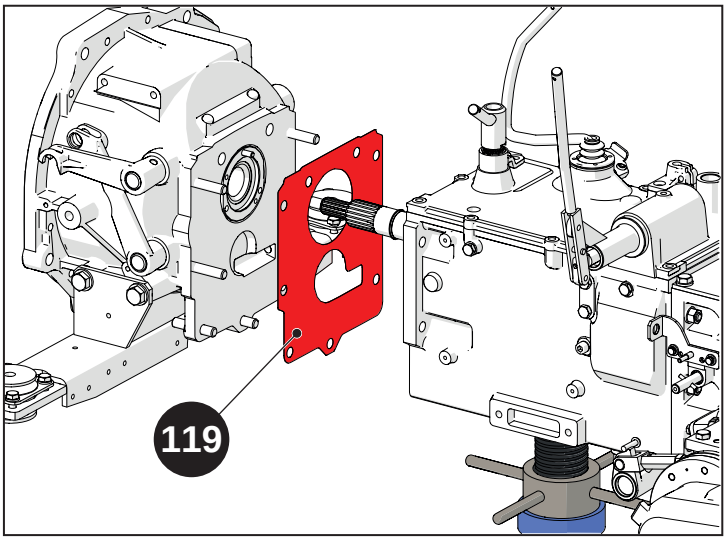


Fig. 4.3

4.2 Gearbox disassembly

Unscrew the screws (107) and washers (108) that fasten the cover.

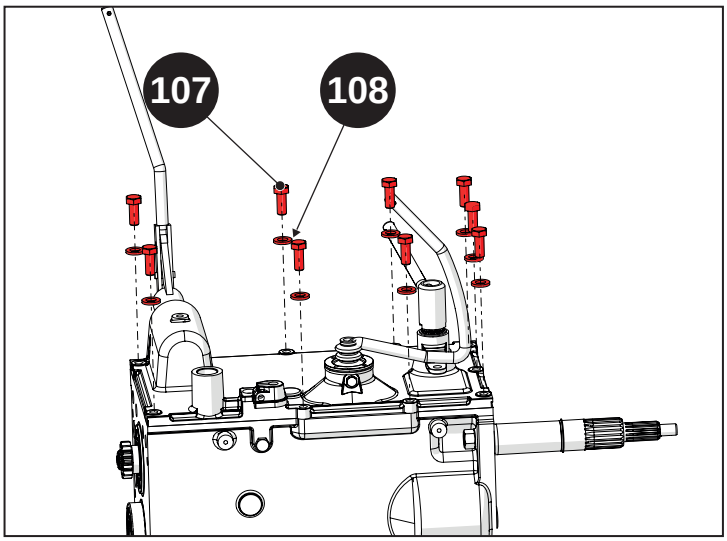


Fig. 4.4

Remove the complete cover (109).

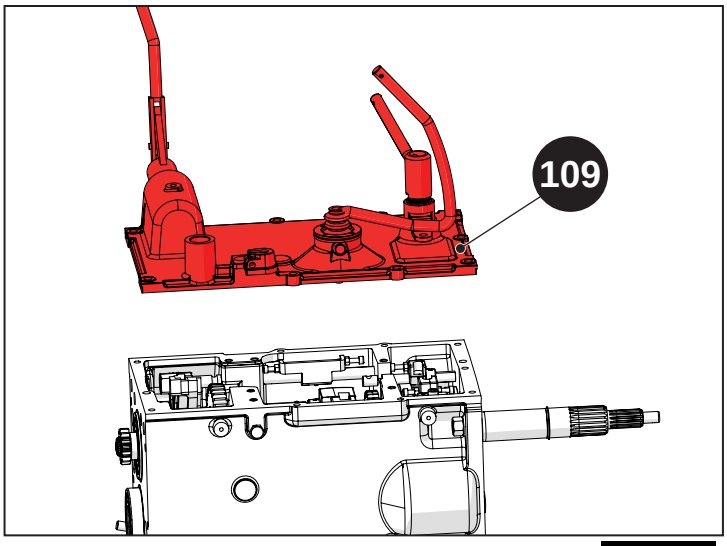


Fig. 4.5

Remove the springs (110) and balls (111).

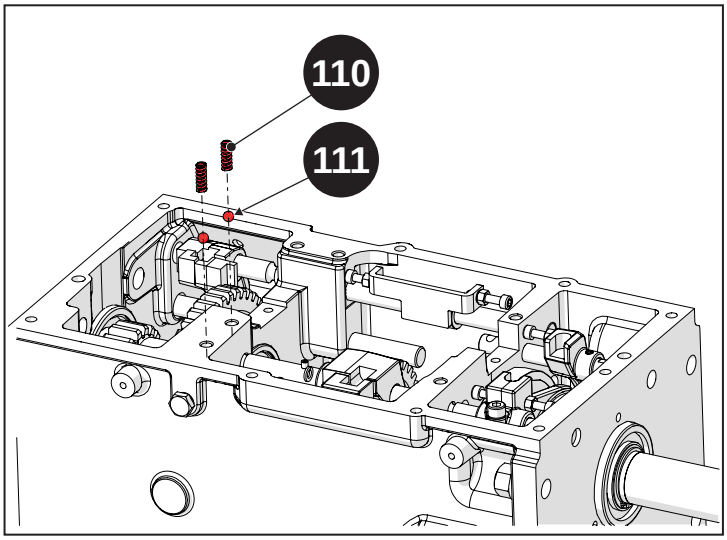


Fig. 4.6

Unscrew the screws (114) and remove washers (115) and sleeve (113).

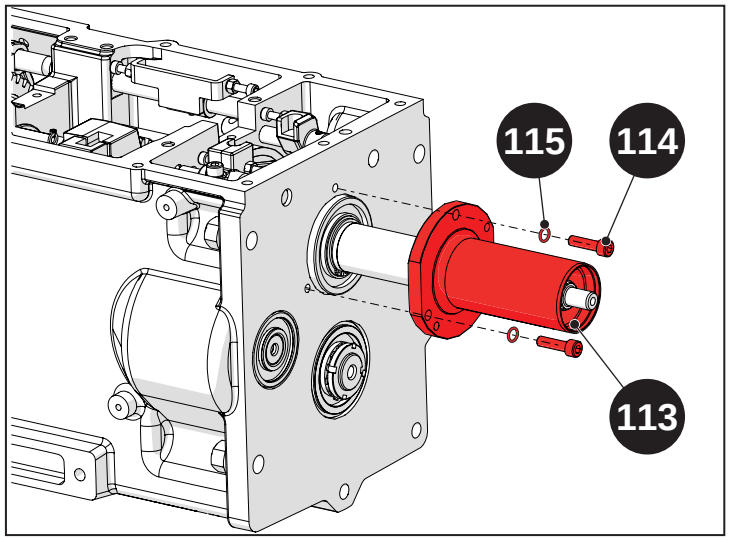


Fig. 4.7

Remove the front drive shaft (62) complete with bearing (6), circlip (5) and spacer (8).

Remove the circlip (7).

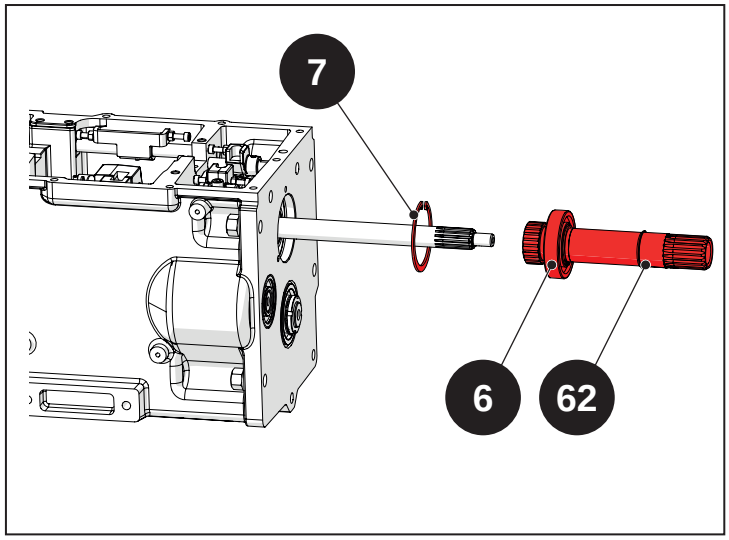


Fig. 4.8

Remove the P.T.O. drive shaft (1) along with the gear (3), spring ring (4) and circlip (2).

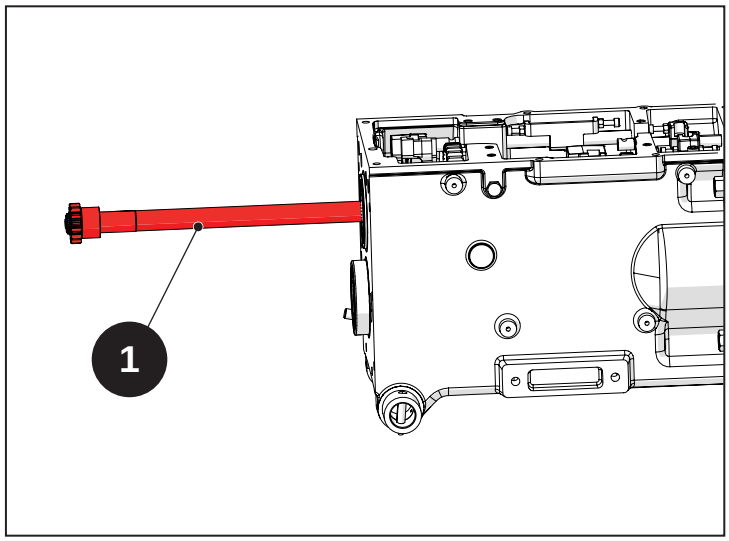


Fig. 4.9

Remove the centring pin (63) and rod (64).

Danger

When removing the rod (64), plug the hole where the spring and selection ball are positioned since they could suddenly spring out in a dangerous way.

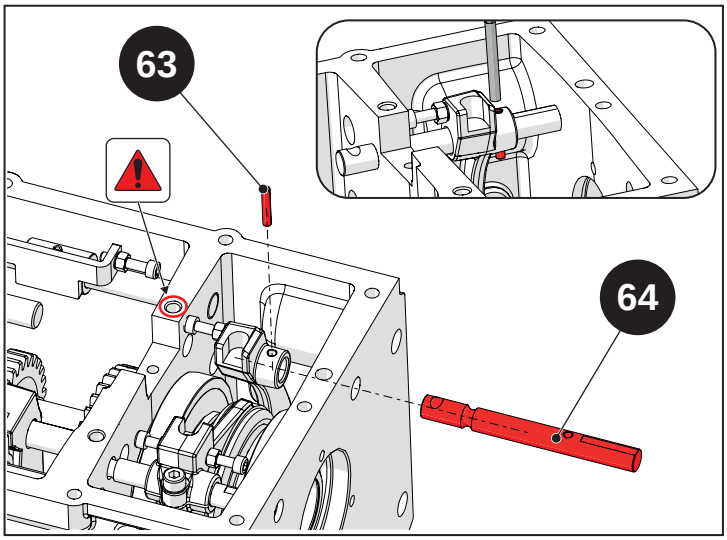


Fig. 4.10

Remove the spring (65) and ball (66).

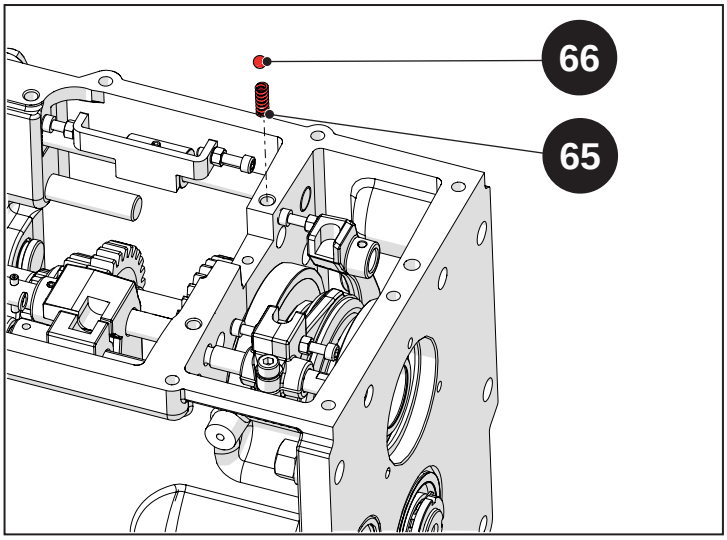


Fig. 4.11

Unscrew the plug (67), washer (68) and then the retainer (69).

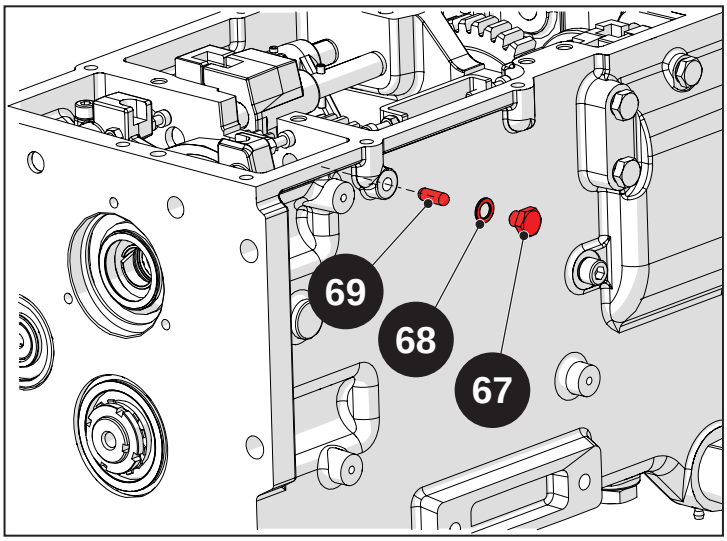


Fig. 4.12

Remove the fork (70).

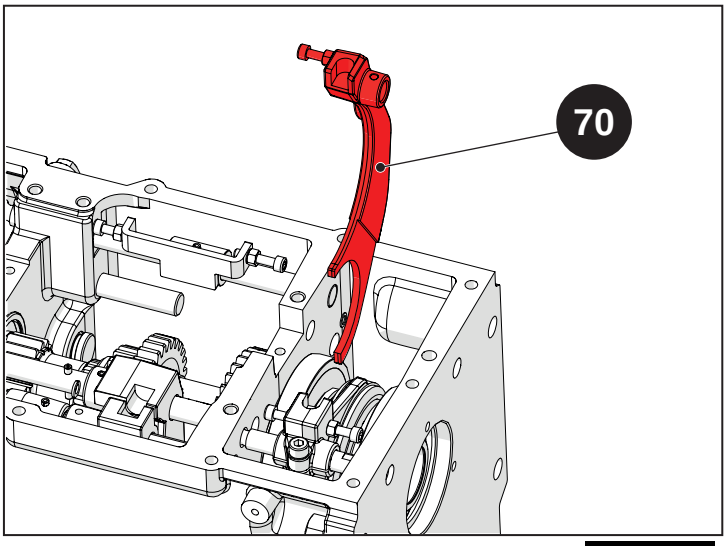


Fig. 4.13

Remove the rod (71).

Danger

When removing the rod (71), plug the hole where the spring and selection ball are positioned since they could suddenly spring out in a dangerous way.

Remove the spring (100) and ball (101).

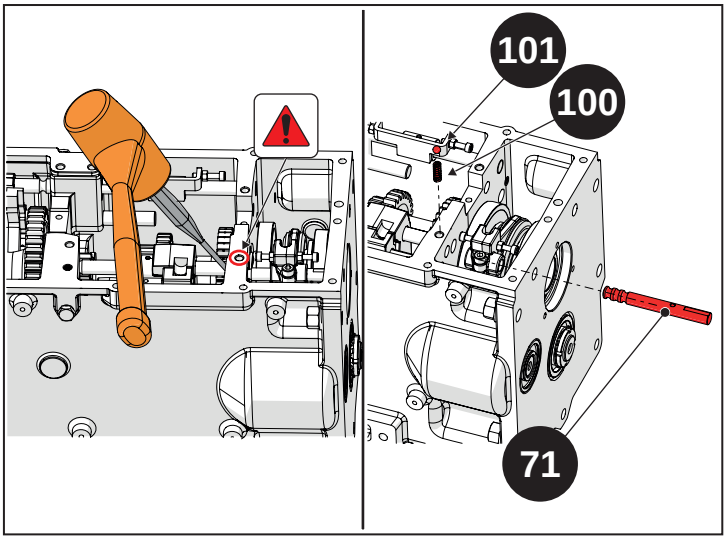


Fig. 4.14

Remove the fork (72).

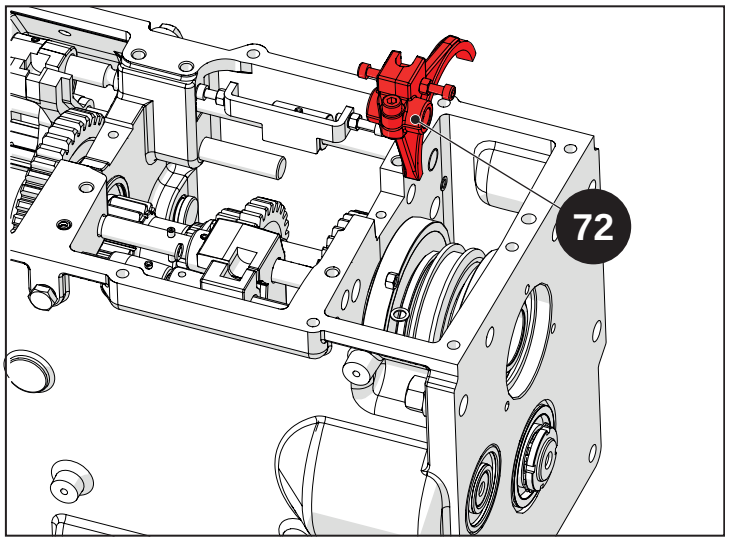


Fig. 4.15

Remove the 2 fixing pins (73) and (74).

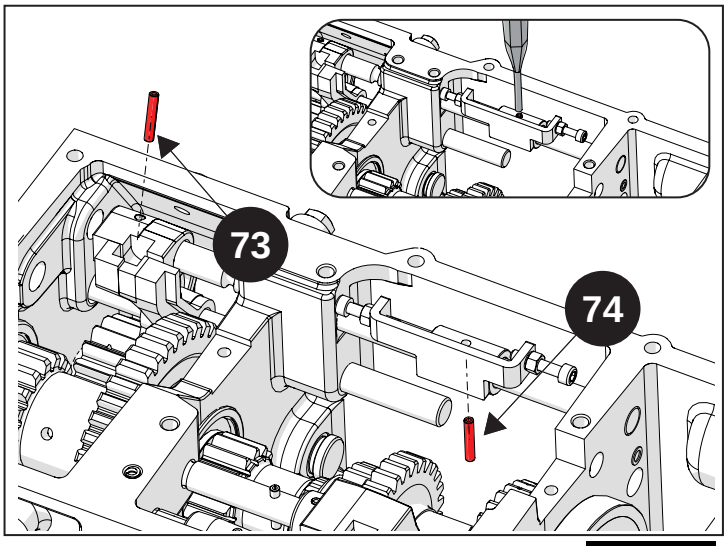


Fig. 4.16

Lock the selection rod (75) in place then move it towards the front so as to release and remove it.

Warning

Make sure that the gear (89) is in neutral.

Danger

When removing the rod (64), plug the hole where the spring and selection ball are positioned since they could suddenly spring out in a dangerous way.

Remove the selection rod (75) and the adjuster block (76).

Remove the ball (77), spring (78) and the second ball (79).

Remove the retainer (80).

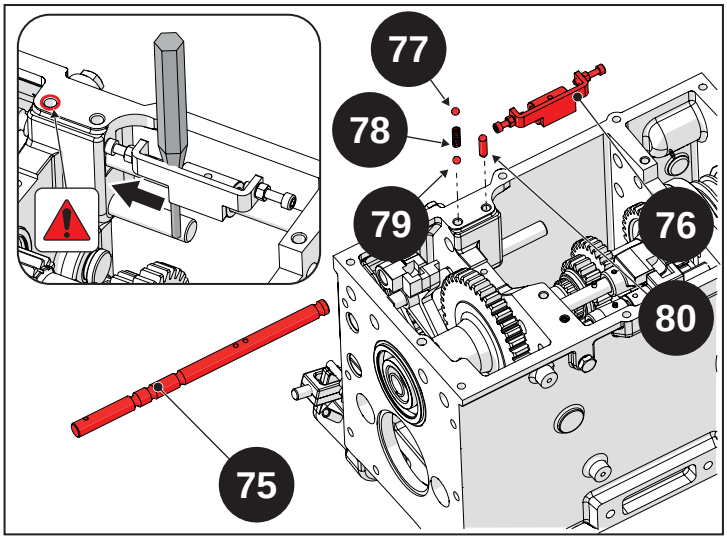


Fig. 4.17

Remove the locking pin (81).

Tap the rod (82) to release it from the pin (81).

Note

The pin (81) will remain inside the gearbox. Remember to recover it.

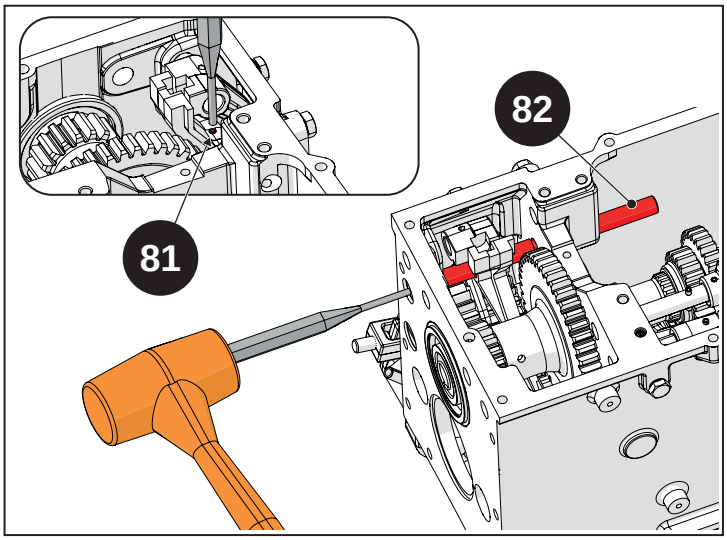


Fig. 4.18

Take out the rod (82) and the reversing fork (83).

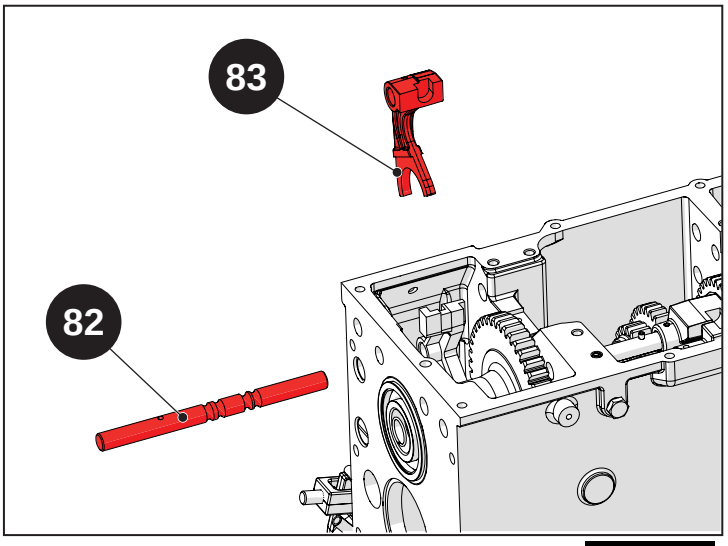


Fig. 4.19

Using a soft mallet, release the gear (27) from its housing and, using a puller, remove the bearing (29) and fork (84).

> **Note**
>
> The gear (27) will remain inside the gearbox during this phase.

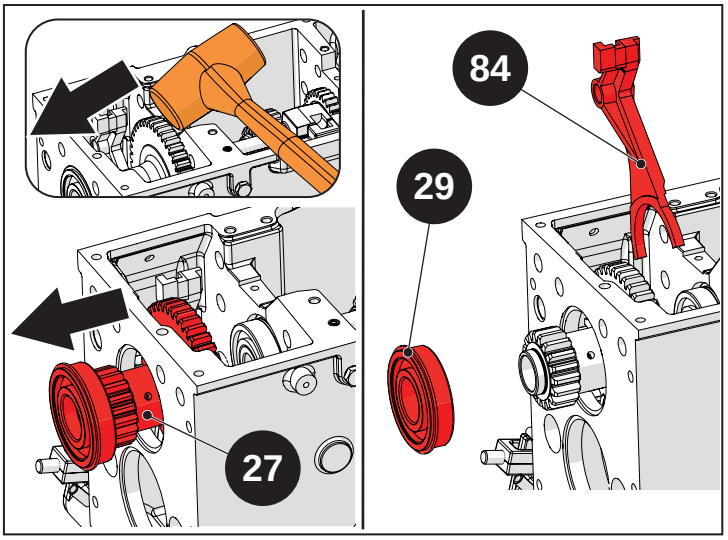


Fig. 4.20

Unscrew the screw (85) and remove washer (86), then take out the reverse shaft (106).

Remove the gear (105) at the same time.

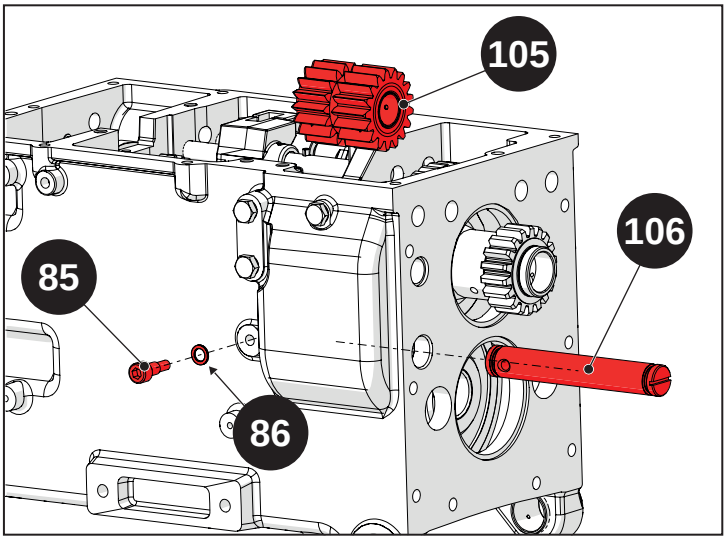


Fig. 4.21

Release and remove the bearing (26).

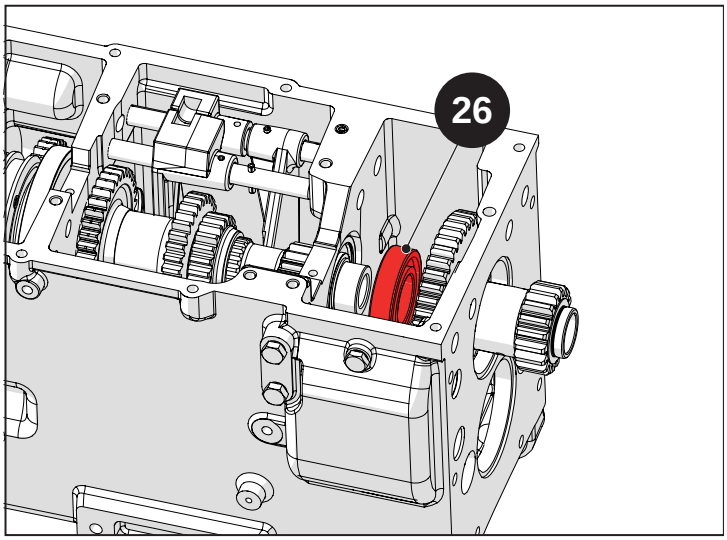


Fig. 4.22

Remove the circlip (25) and then remove the bearing (24).

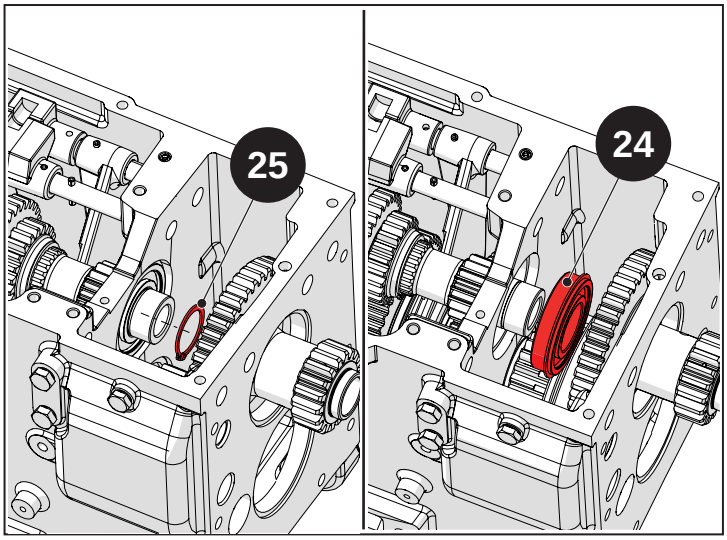


Fig. 4.23

Remove the circlip (12).

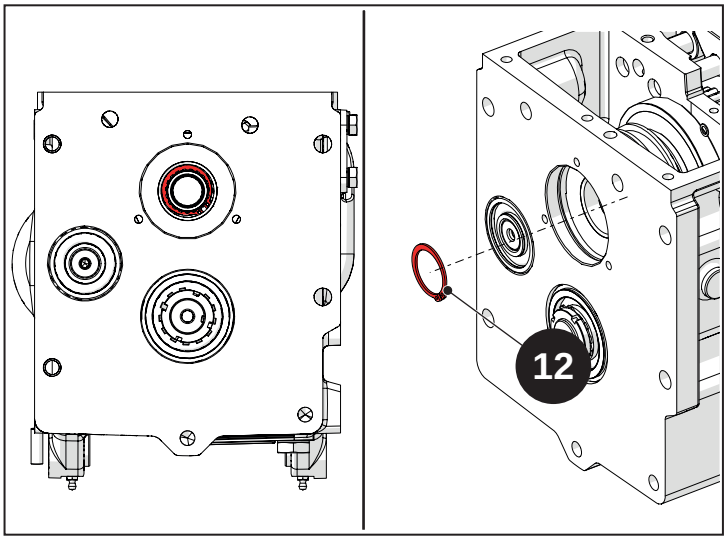


Fig. 4.24

Move the shaft so as to release and turn it.

Turn the shaft so as to remove the circlip (22) from its housing.

Note
It will not be possible to remove the circlip (22) from the shaft during this phase.

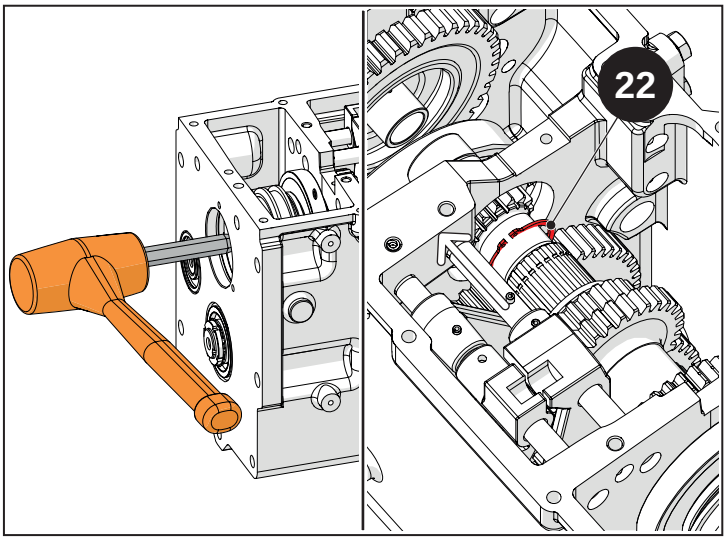


Fig. 4.25

Having done this, it will now be possible to remove the assembly from the gearbox complete with

- 8+8 gear (11);
- Synchromesh (16);
- 16+8 gear (13);
- Keyed bushing (15);
- Roller cage (14);

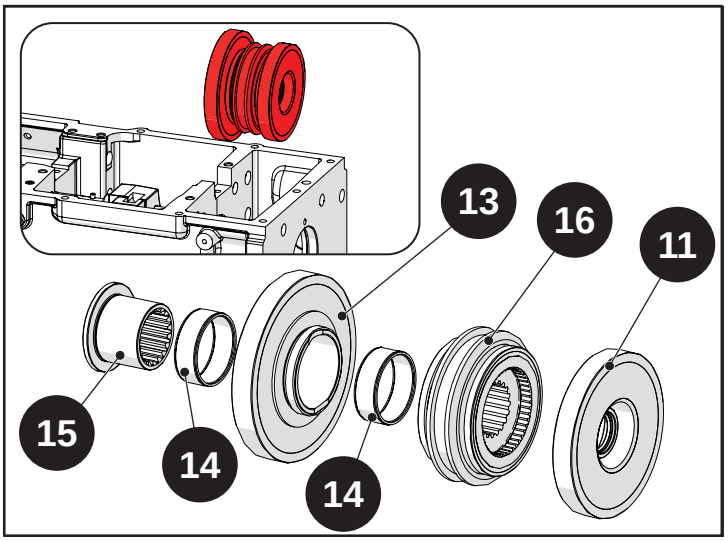


Fig. 4.26

Move the shaft so as to remove the gear (27) complete with bushing (28).

Remove the gear (89).

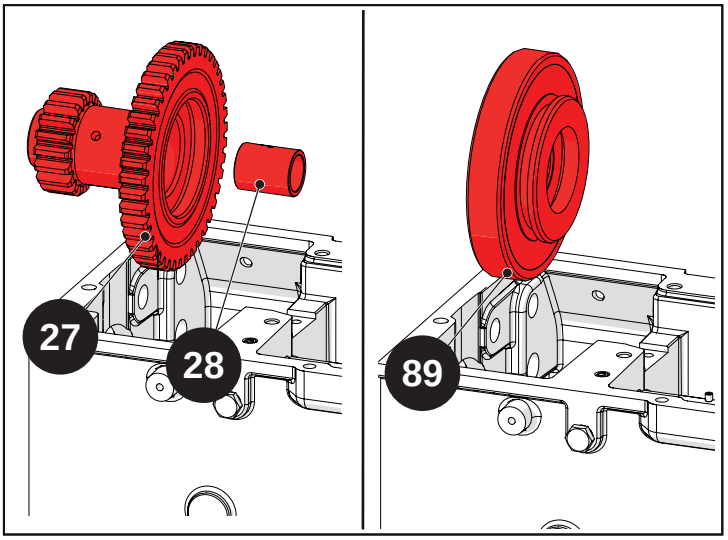


Fig. 4.27

Remove the bearing (17).

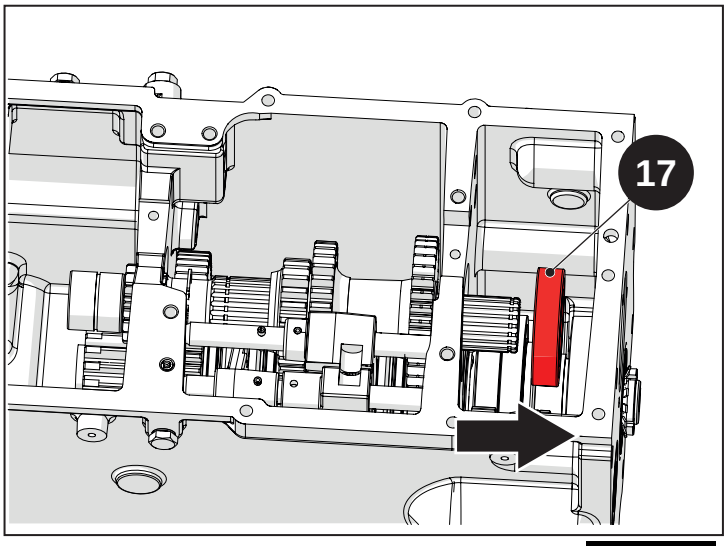


Fig. 4.28

By removing the shaft (23) it will also be possible to move:

- the 4th speed gear (18);
- the spacer (19);
- the 3rd speed gear (20);
- the spacers (90);
- the 2nd speed gear (21);

Note

The circlip (22) can now be removed from the shaft.

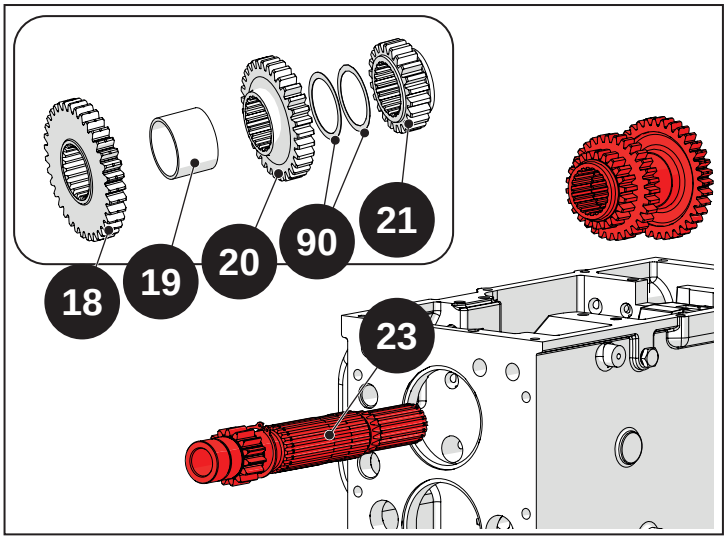


Fig. 4.29

Remove the plug (91), then remove the rod (92) and fork (93).

Unscrew the screw (102), then remove the washer (103) and retainer (104).

Note

The retainer (104) differs from the others since it has a groove at the end.

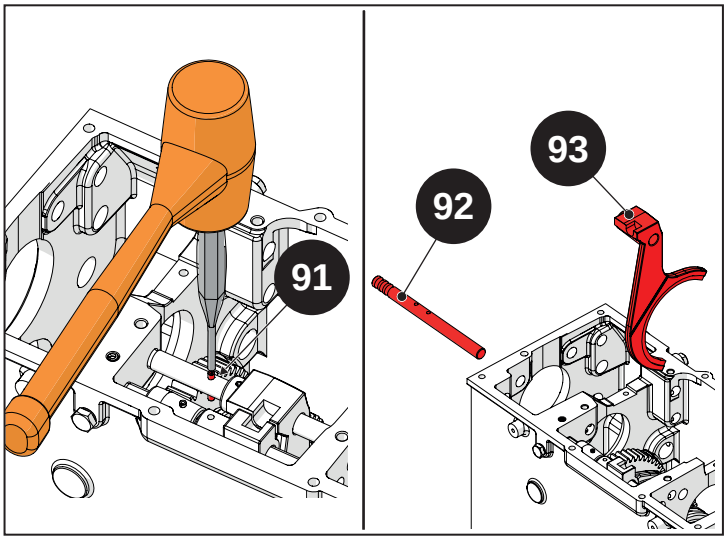


Fig. 4.30

Remove the pins (94) and (95, then remove the rod (96) and sleeve.

Take out the rod (96), sleeve (97) and fork (98).

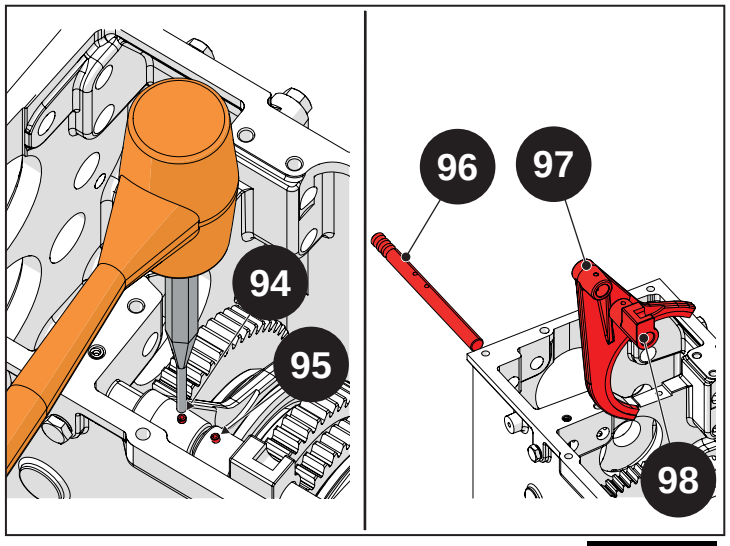


Fig. 4.31

Use tool (A-07007955) to lock the layshaft (30).

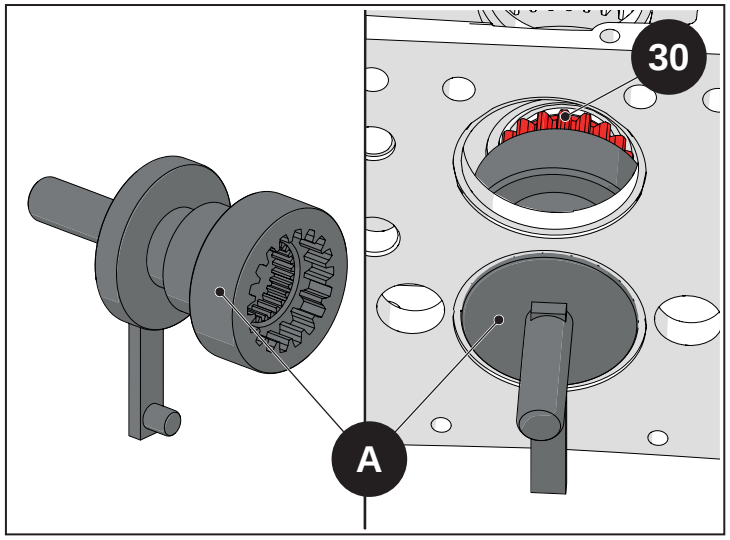


Fig. 4.32

Use tool (B-07000240) to unscrew and remove the ring nut (33).

Remove the safety washer (34).

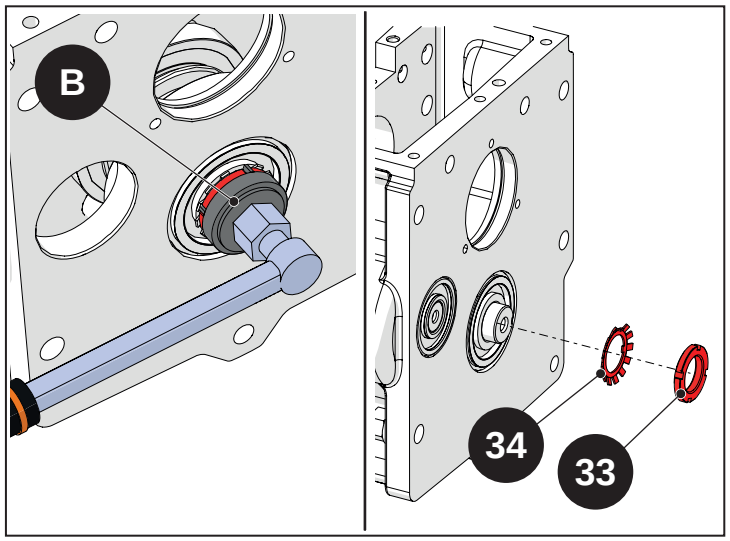


Fig. 4.33

Tap the layshaft (30) so as to remove it from the opposite side along with the bearing (31).

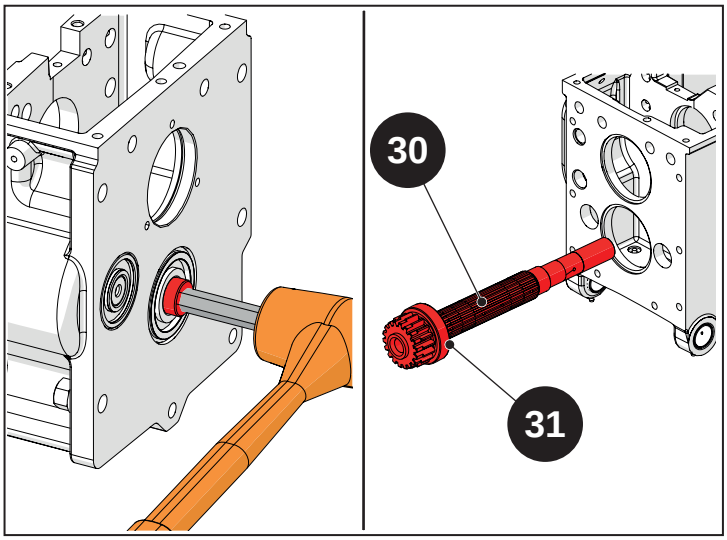


Fig. 4.34

The gear pack can now be removed from the gearbox together with:

- driven gear (37);
- roller cage (38);
- spacers (39);
- reverse shuttle gear (40);
- driving gear (41);
- bush (42);
- spacer (43);
- spacer (99);

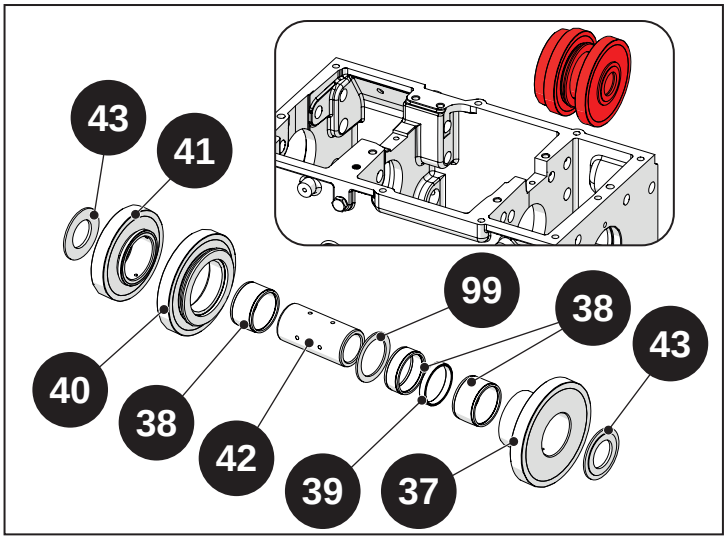


Fig. 4.35

Remove the gear pack from the gearbox together. The pack consists of:

- spacer (45);
- 4-8 gear (46);
- bush (47);
- synchromesh (48);
- 3-7 gear (49);
- bush (50);
- spacer (51);
- 2-6 gear (52);
- bush (53);
- synchromesh (54);
- 1-5 driven gear (55);
- bush (56);
- spacer (32);

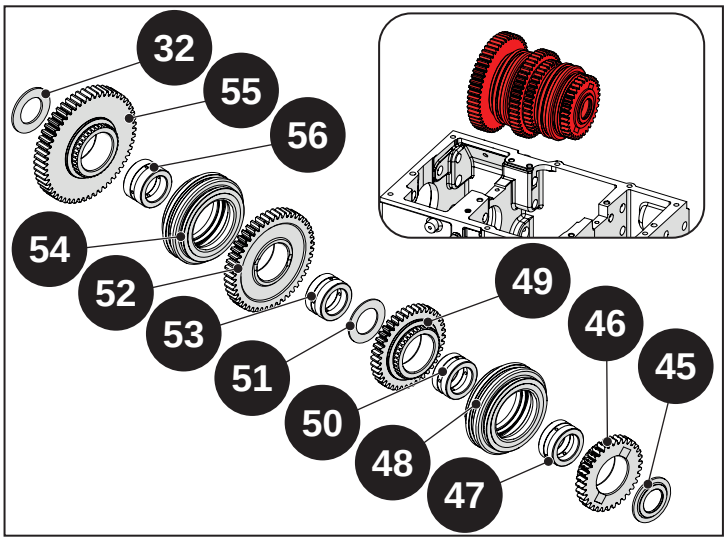


Fig. 4.36

Remove the bearings (36) and (44).

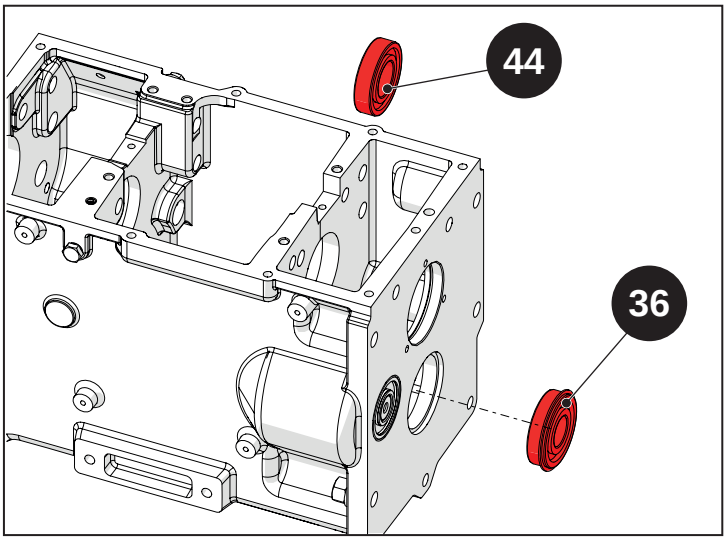


Fig. 4.37

Remove the pin (60).

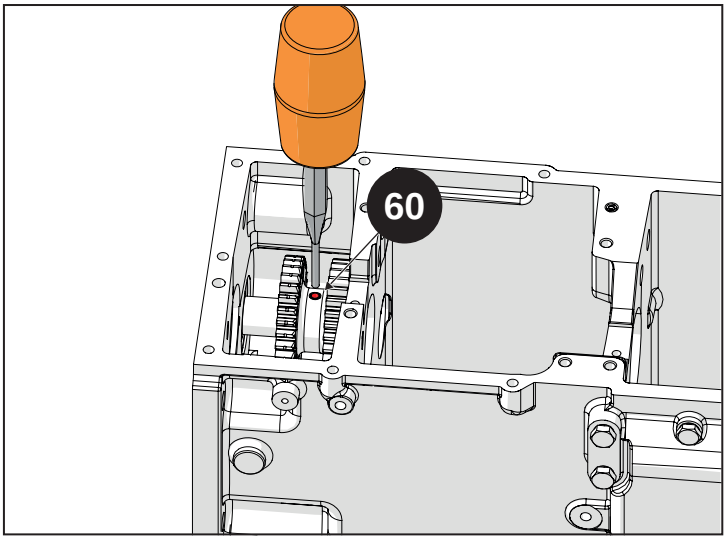


Fig. 4.38

Screw the tool (C-07000306) into the threaded hole of the reverse shuttle shaft (58).

Continue to screw in the tool (B) until the reverse shuttle shaft (58) can be removed along with the bearing (58).

Remove the double gear (59) of the reverse shuttle.

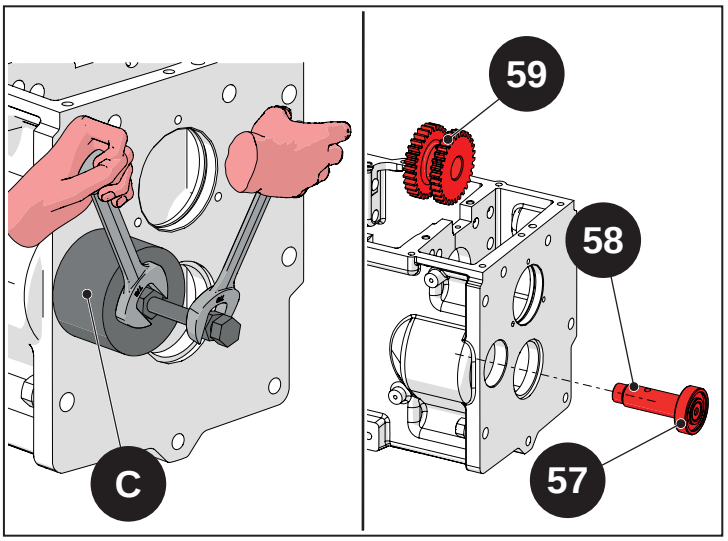


Fig. 4.39

Remove the bearing (61).

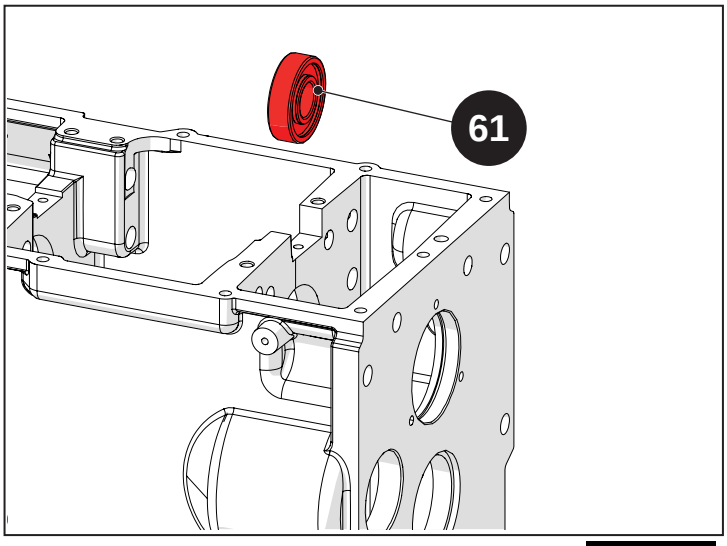


Fig. 4.40

Section 5 : Main inspection, re-assembly and adjustment operations

Index

5.1 Main inspection, re-assembly and adjustment operations.....4-26

5.1 Main inspection, re-assembly and adjustment operations

Warning

Before proceeding with the re-assembly operations, carefully read and comply with the instructions given in chapter "1-Introduction", especially those describing how to assemble O-Rings, oil retainers and bearings.

Use the correct tightening torques when screwing in the components. Consult the table in chapter "1-Introduction" if the tightening torque value is not given.

Use the indicated sealants when re-assembling the parts. Consult the table in chapter "1-Introduction" if the sealant is not indicated.

Use tool (D-07007954) to lock the synchromeshes and to insert the 2 complete gear packs. make sure that you do not disassemble them unintentionally.

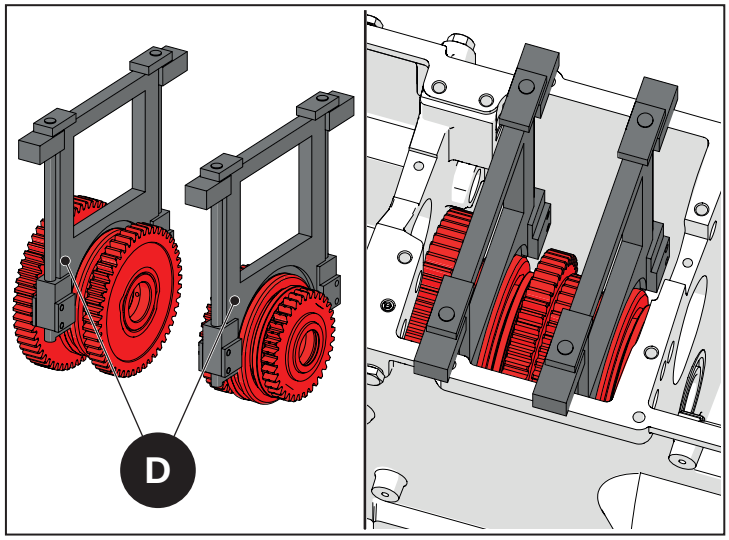


Fig. 4.41

Use tool (E-07007957) to insert the spacer (51) between the two gear packs and make sure that you do not drop it.

Warning

Make sure that the spacer is installed in the right direction (51).

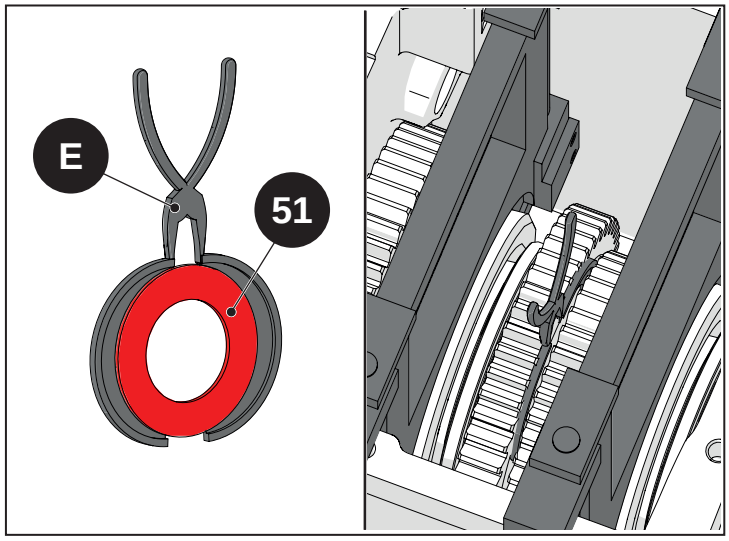


Fig. 4.42

Insert the shaft (30) complete with bearing (31) and spacer (32).

Use tool (F-07007956) to make it easier to insert the shaft (30) into the gearbox.

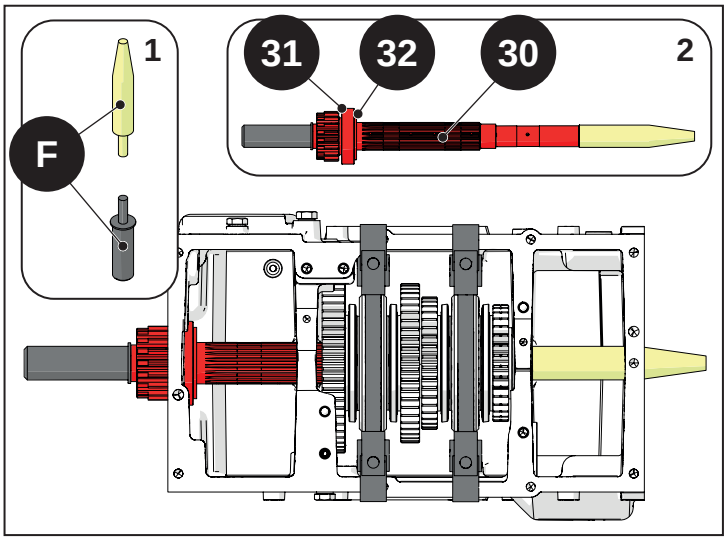


Fig. 4.43

Insert the spacer (45) and bearing (44).

Warning

Make sure that the spacer is installed in the right direction (45).

The relieved part must point towards the bearing to facilitate lubrication.

Use a plug of an adequate diameter to completely seat the bearing (44).

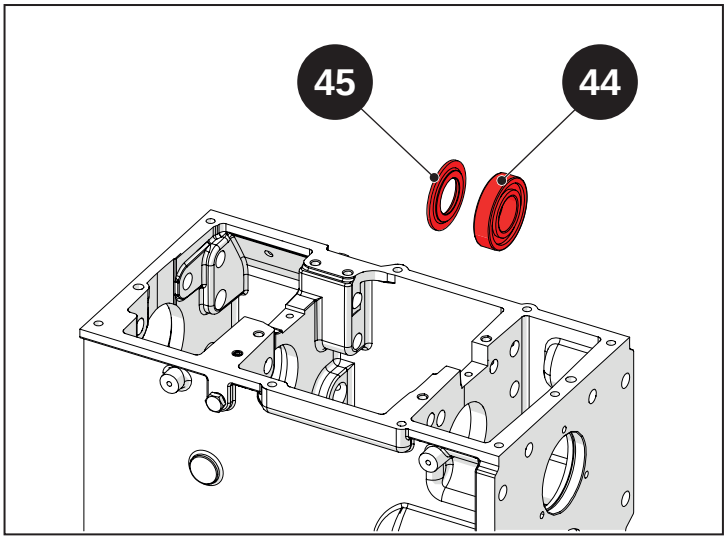


Fig. 4.44

Tools (D) and (E) can be removed after the gears have been mounted on the shaft (30).

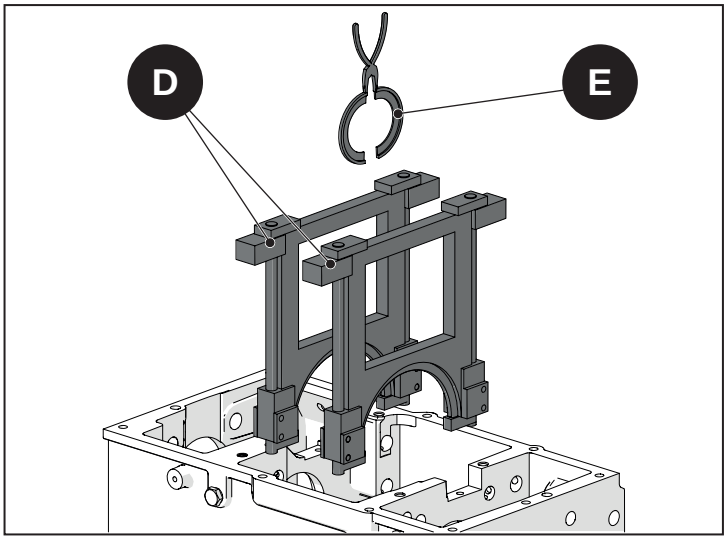


Fig. 4.45

Insert the complete gear pack into the gearbox and align the joint with the shaft (30).

The gear pack includes:

- driven gear (37);
- roller cage (38);
- spacers (39);
- reverse shuttle gear (40);
- driving gear (41);
- bush (42);
- spacer (43);
- spacer (99);

Warning

Make sure that the spacers are installed in the right direction (43).

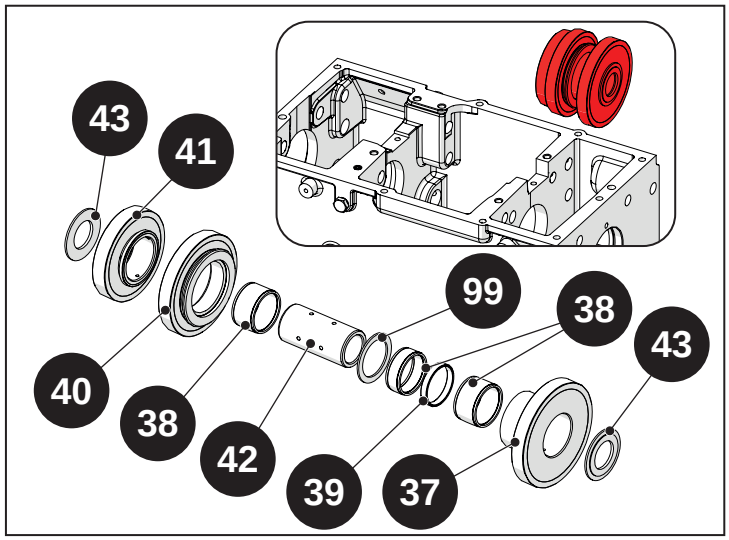


Fig. 4.46

Use a mallet and a plug of a suitable diameter to tap the shaft (30) and fully seat it together with the bearing (31).

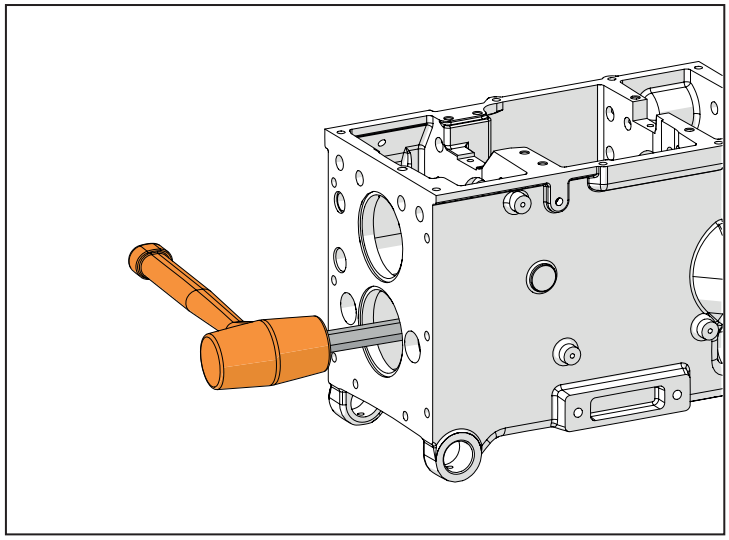


Fig. 4.47

Screw tool (G-07007953) onto the shaft (30) so as to hold it in place and prevent it from slipping out of its seat when the bearing (36) is reassembled.

Use a plug of a suitable diameter to fully insert the bearing (36).

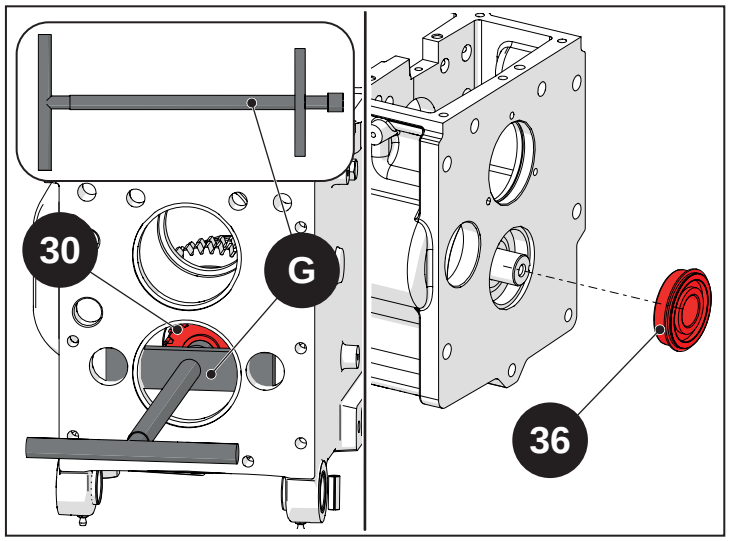


Fig. 4.48

Remove the tool (G).

Use tool (A-07007955) to lock the layshaft (30).

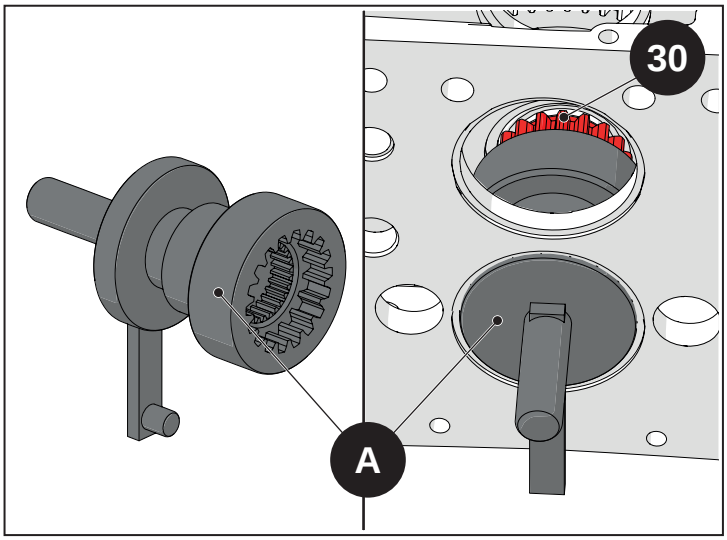


Fig. 4.49

Insert the safety washer (34) and ring nut (33).

Use tool (B-07000240) to tighten the ring nut (33). Apply 100 Nm tightening torque

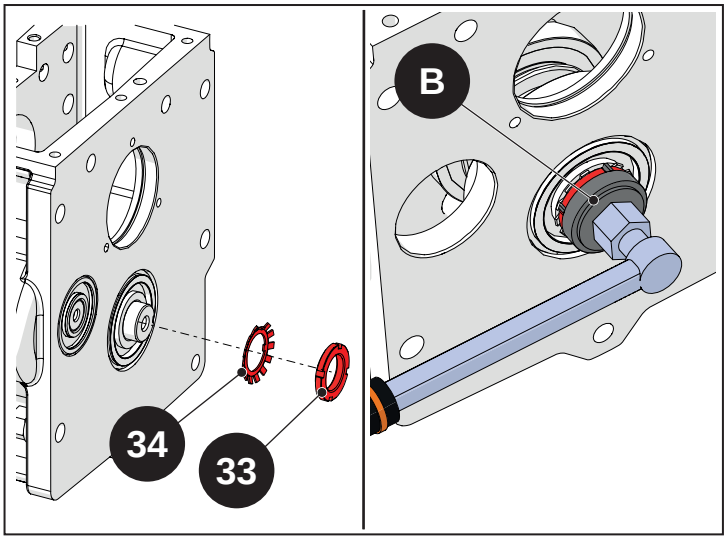


Fig. 4.50

Clinch the tooth of the safety washer (34) into the groove of the ring nut (33) as a further safety measure.

Punch the ring nut on a level with the groove in the layshaft (30).

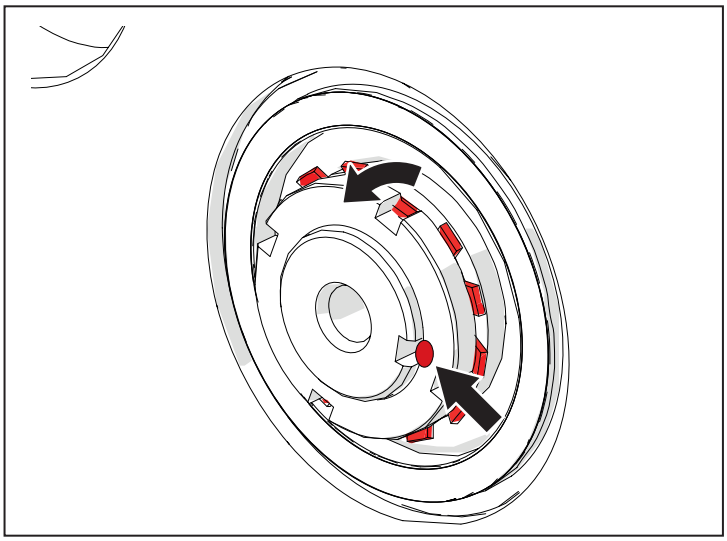


Fig. 4.51

Use a plug of an adequate diameter to seat the bearing (61).

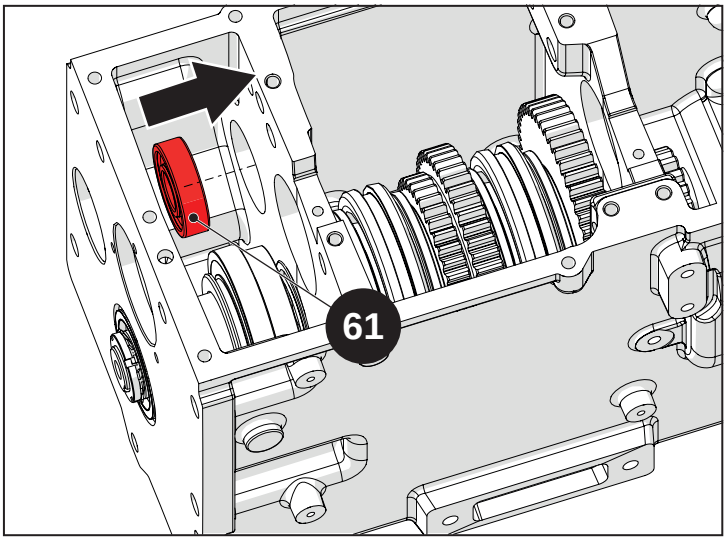


Fig. 4.52

Insert the double gear of the reverse shuttle (59), then the transmission shaft (58) complete with bearing (57).

Insert the locking pin (60) of the reverse shuttle shaft.

Caution

Fit the gear (59) into the gearbox with the starting edge of the teeth pointing towards the rear part.

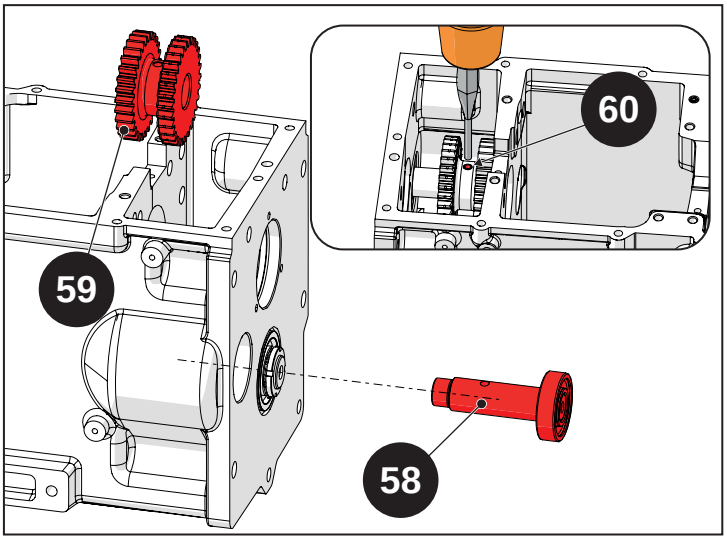


Fig. 4.53

Insert the gear (105) and reverse shaft (106).

Warning

Ensure that the notch at the end of the reverse shaft (106) is vertical so as to make the setscrew easier to insert (85).

Insert the washer (86) then tighten the setscrew (85).

Caution

Fit the gear (105) into the gearbox with the starting edge of the teeth pointing towards the rear part.

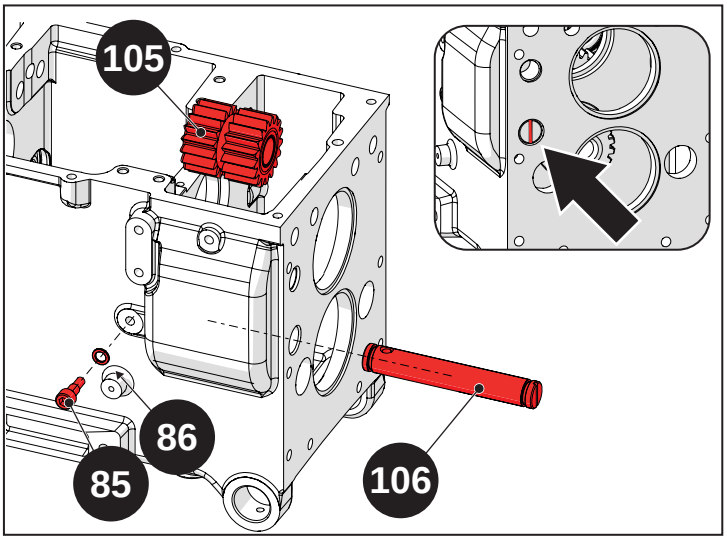


Fig. 4.54

Assemble the forks (93) and (98).

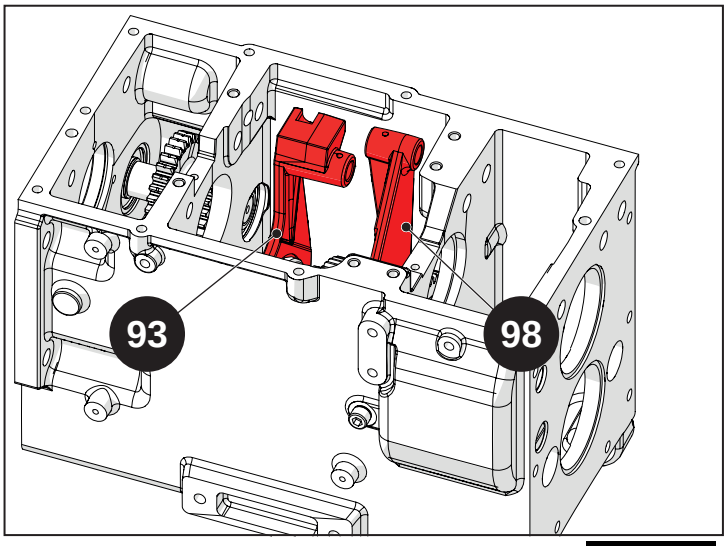


Fig. 4.55

insert the rod (92) and lock in place with the fastening pin (91).

Insert the retainer (104).

> **Warning**
>
> The retainer (104) differs from the others since it has a groove at the end.

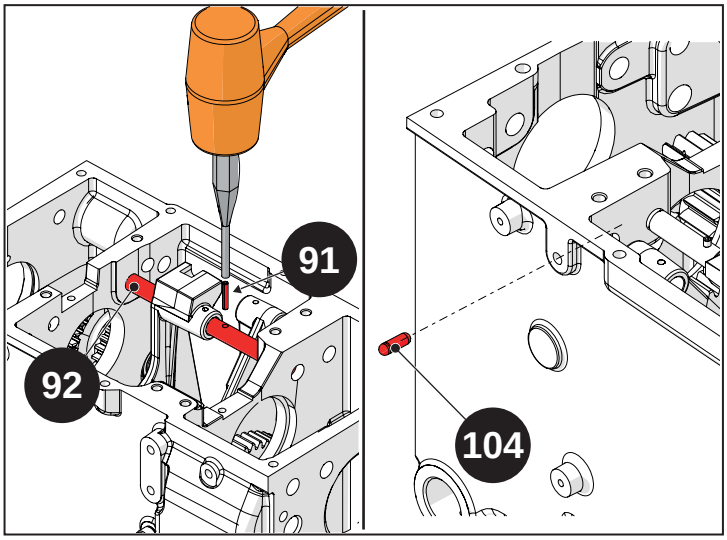


Fig. 4.56

insert the rod (96), the sleeve (98) and lock them in place with the fastening pins (94) and (95).

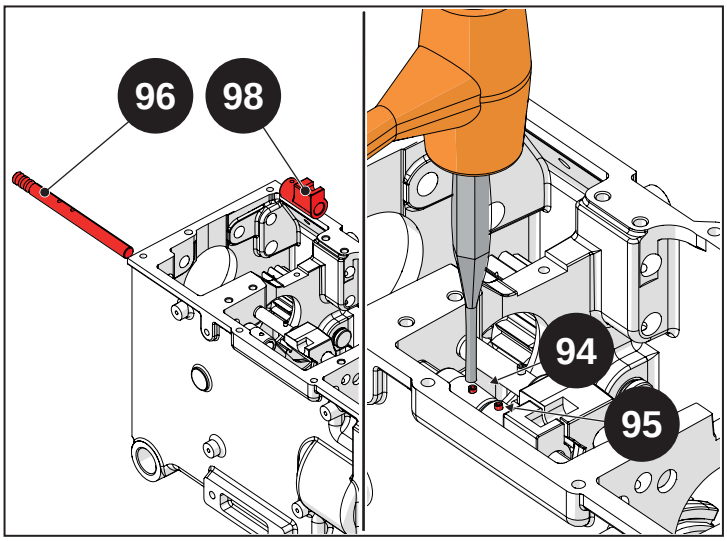


Fig. 4.57

Fit the circlip (22) into the drive shaft (23).

Warning

The circlip (22) must be inserted with the smaller diameter holes pointing towards the rear part of the tractor.

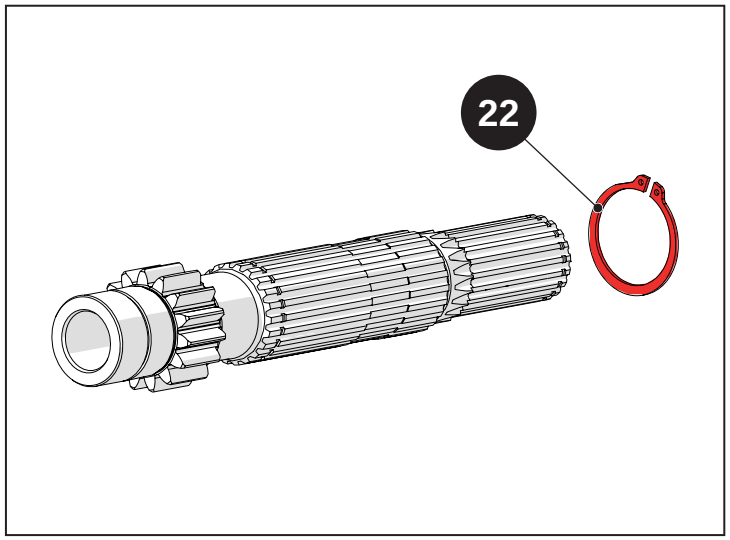


Fig. 4.58

Fit the drive shaft (23) into the gearbox, then align the following components in the given order:

- 2nd speed gear (21);
- spacers (90);
- 3rd speed gear (20);
- spacer (19);
- 4th speed gear (18);

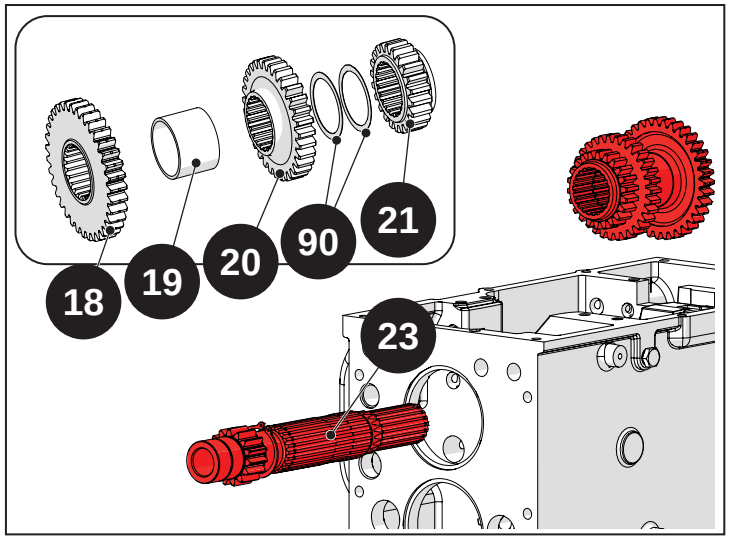


Fig. 4.59

Fit gear (89) and gear (27) into the gearbox complete with the bush (28) and bearing (26).

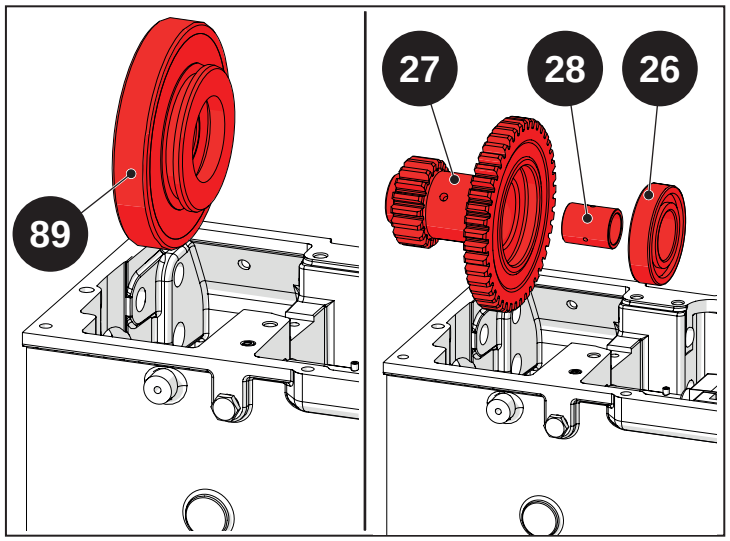


Fig. 4.60

Seat the bearings (17) and (24), then use a plug of a suitable diameter to fully insert them.

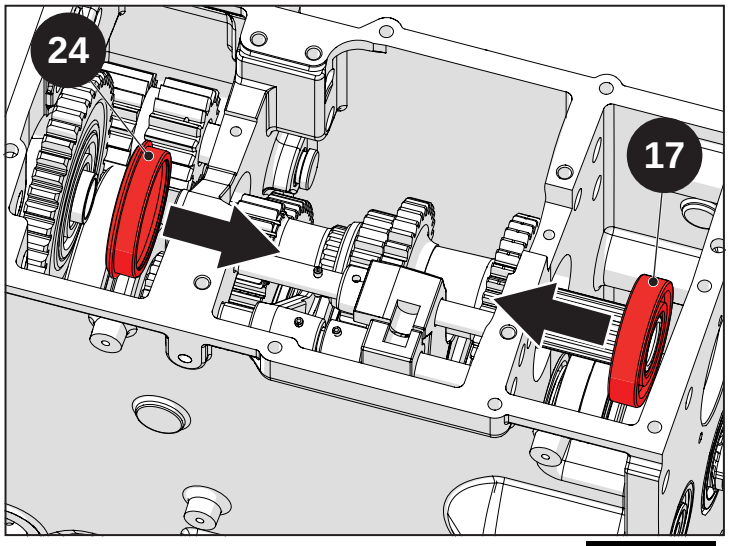


Fig. 4.61

Fit the complete gear pack into the gearbox. The pack consists of:

- 8+8 gear (11);
- Synchromesh (16);
- 16+8 gear (13);
- Keyed bushing (15);
- Roller cage (14);

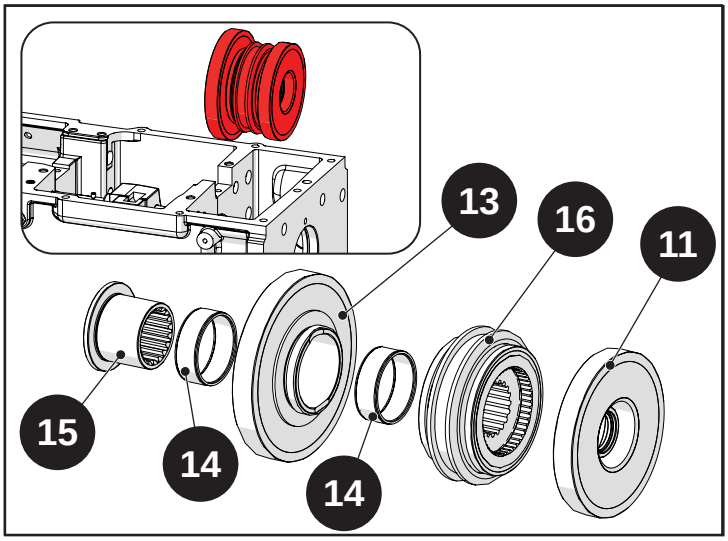


Fig. 4.62

Fit the circlip (22) into its housing.

Insert a shim between the 8+8 gear and the end of the box to prevent it from moving when the drive shaft (23) is installed.

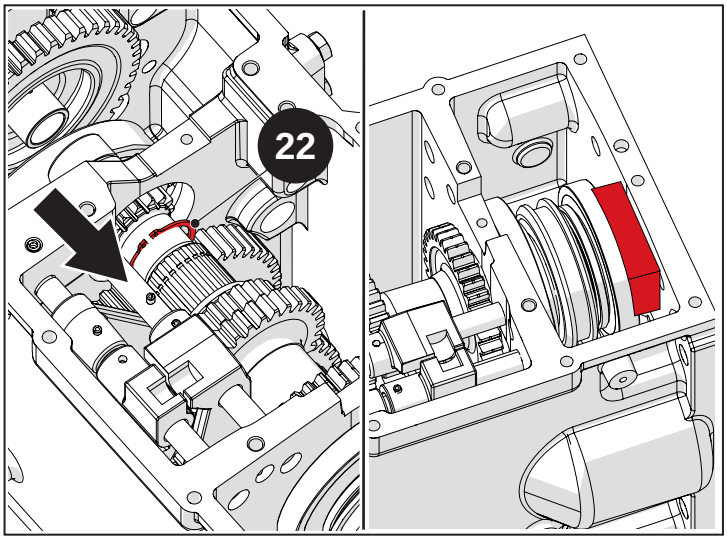


Fig. 4.63

Tap the shaft (23) with a mallet made of soft material so as to fully seat it.

Lock the shaft in place with the circlips (12) and (25).

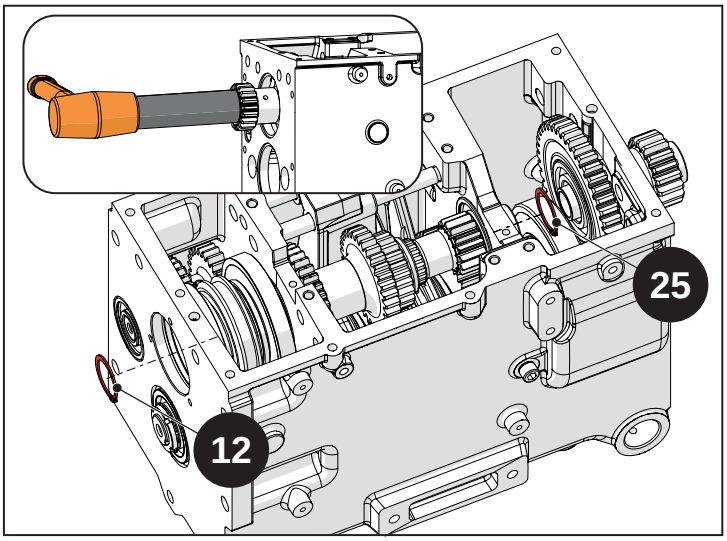


Fig. 4.64

Insert the forks (83) and (84).

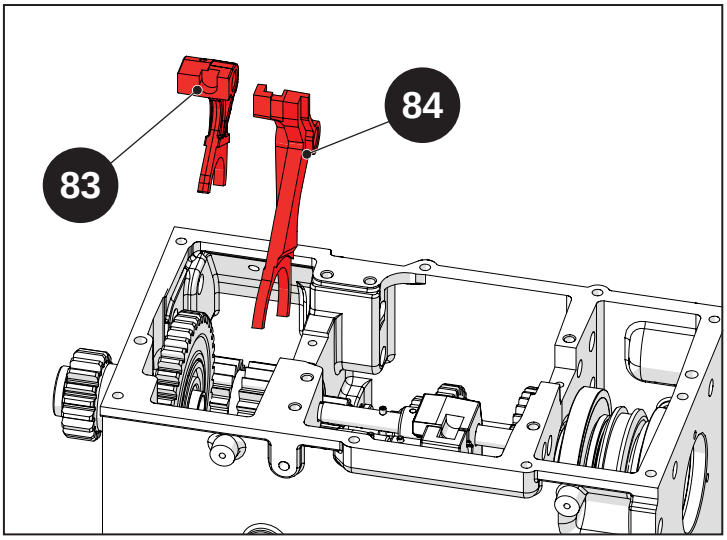


Fig. 4.65

Insert the spacer (116) and bearing (29).

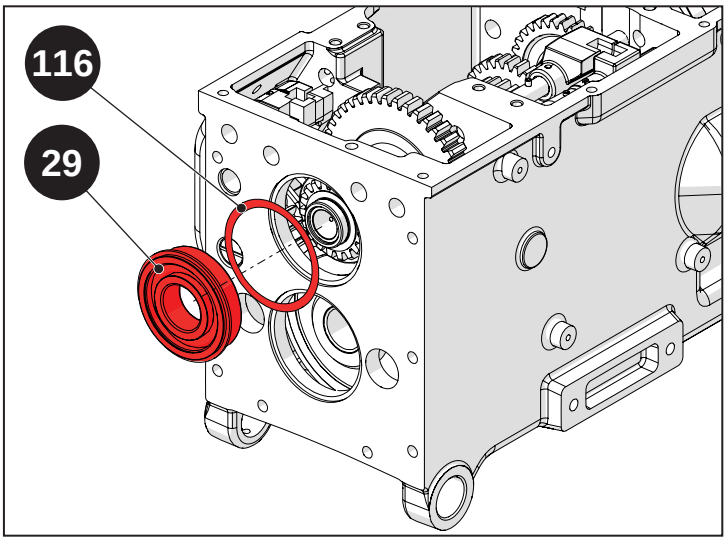


Fig. 4.66

Insert the forks (70) and (72).

Insert the rods (64) and (71).

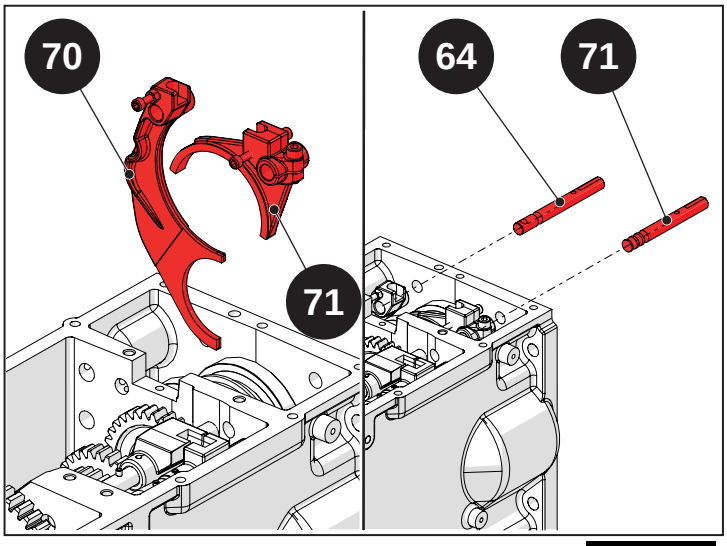


Fig. 4.67

Fit the spring (100) and ball (101) into the hole.

Fit the spring (65) and ball (66) into the hole.

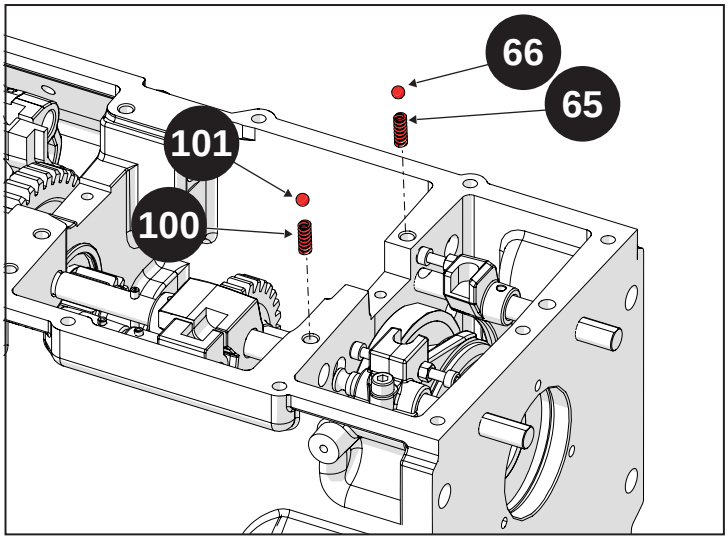


Fig. 4.68

Using a pin driver or punch, push the springs (100) and (65) downwards while pushing the rods (64) and (71), so as to fit the balls (101) and (66) into their seats.

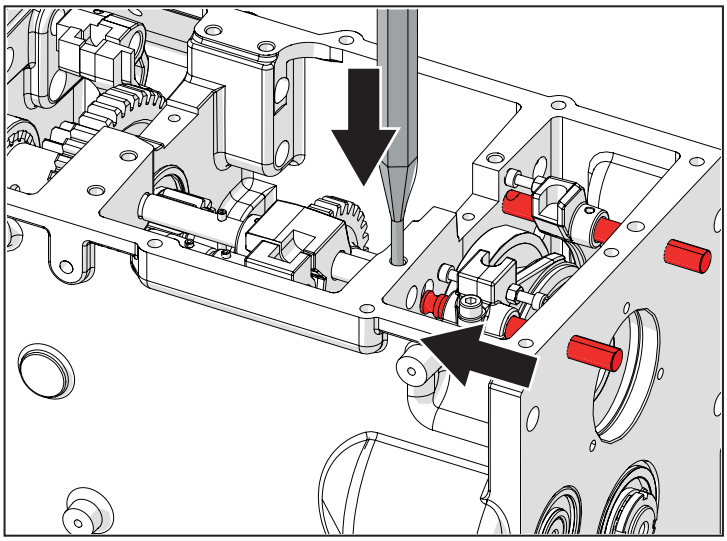


Fig. 4.69

Insert the retainer (69) and washer (68), then tighten the plug (67).

Warning
Apply a layer of SILICONE to the seating perimeter of the plug (67).

Fix the rod (64) in place with the plug (63).

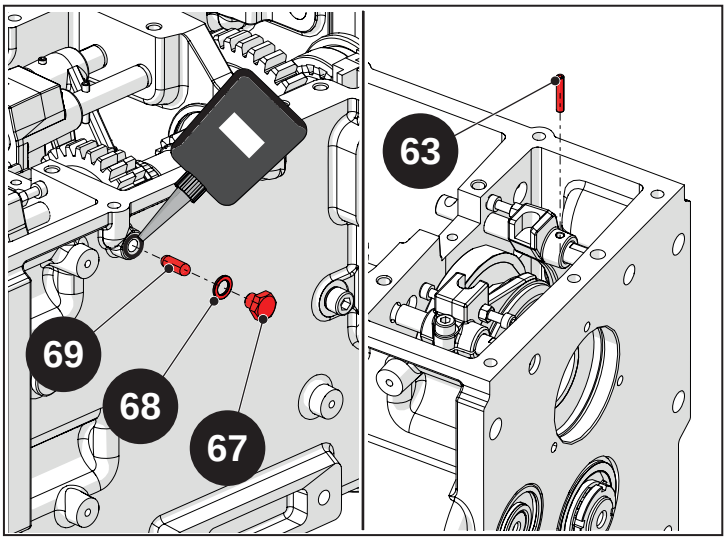


Fig. 4.70

Insert the rod (82) and lock in place with the centring pin (81).

Insert the retainer (80).

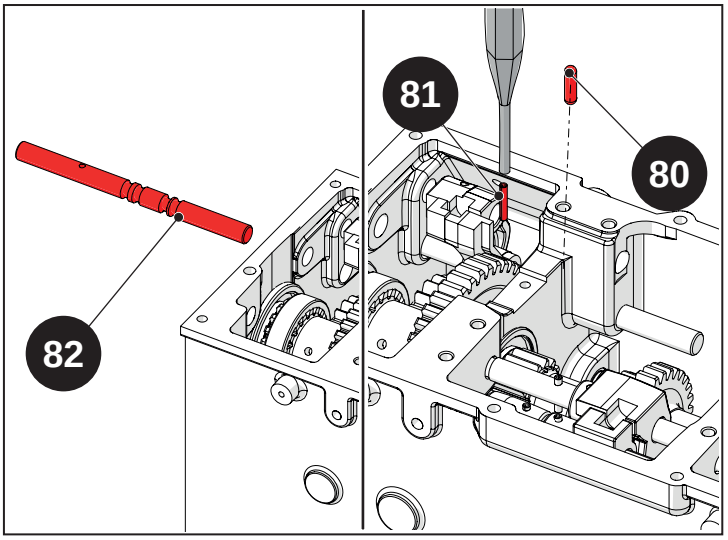


Fig. 4.71

Insert the ball (79), spring (78) and ball hole (77).

Insert the rod (75).

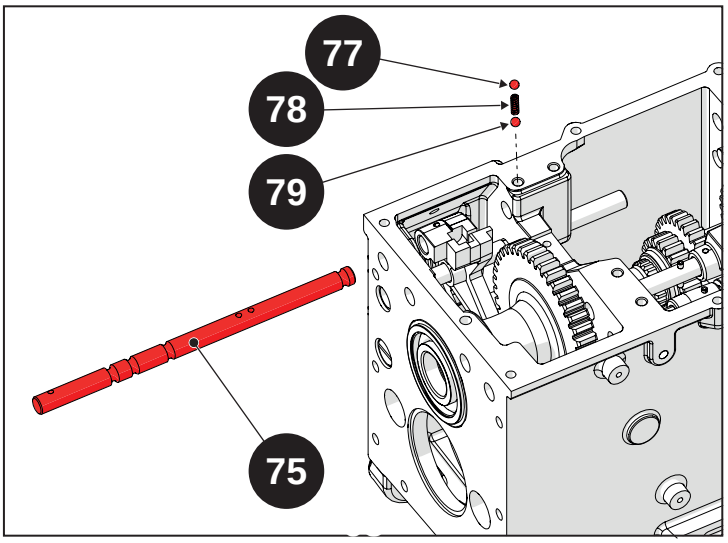


Fig. 4.72

Using a pin driver or punch, push the spring (78) downwards while pushing the rod (75), so as to fit the ball (79) into its seat.

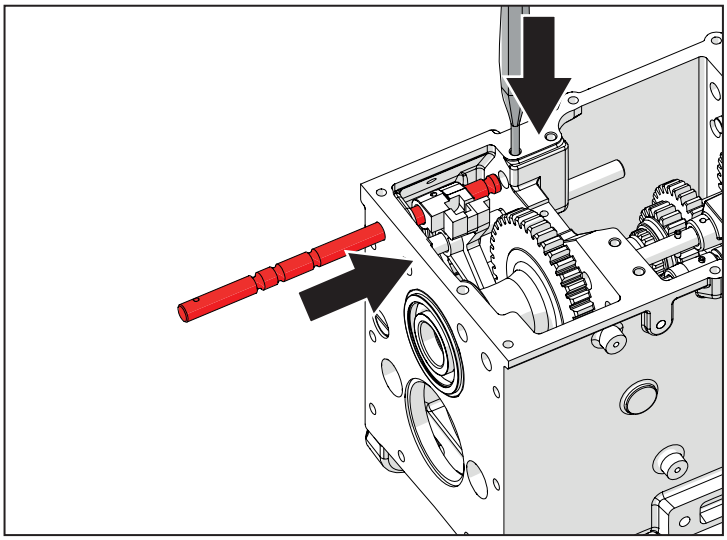


Fig. 4.73

Insert the adjuster block (76).

Lock the rod (75) and block (76) in place with the fastening pins (73) and (74).

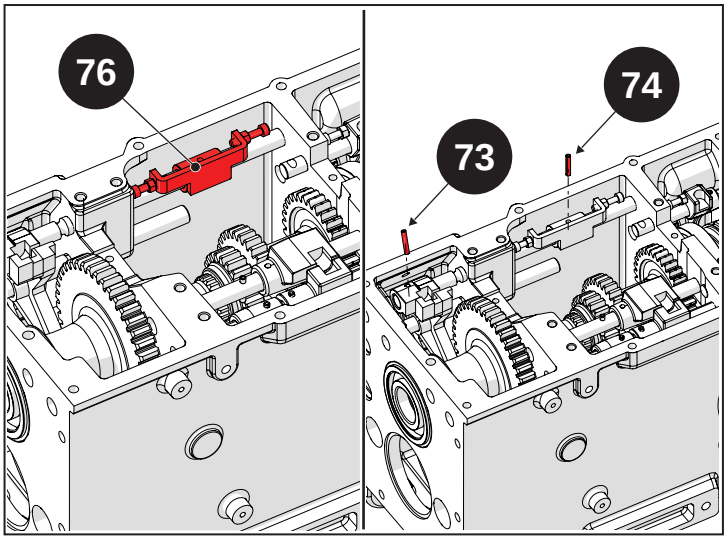


Fig. 4.74

Insert the P.T.O. drive shaft (1) along with the gear (3), spring ring (4) and circlip (2).

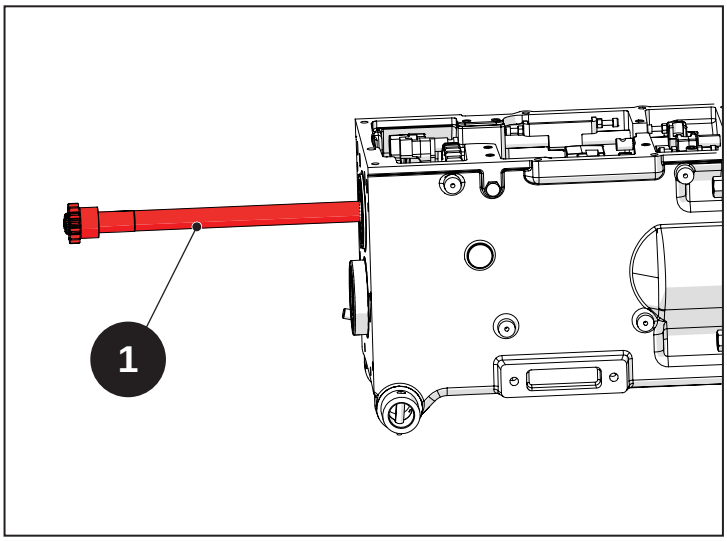


Fig. 4.75

How to shim the upper drive shaft

To ensure the synchromesh (16) has the right amount of play, the distance (X) between the spacer (8) and 8+8 gear (11) must be 0.6 mm.

Spacers (112), the sum of which must always be 1.8 mm, must be inserted in order to obtain the correct distance. The position of the shims will change the distance (value X).

Depending on the positioning required, insert shims (112) between the bearing (6) and circlip (5)(furthest away) or between the bearing (6) and spacer (8) (nearest). Make sure that the sum of these shims is always 1.8 mm.

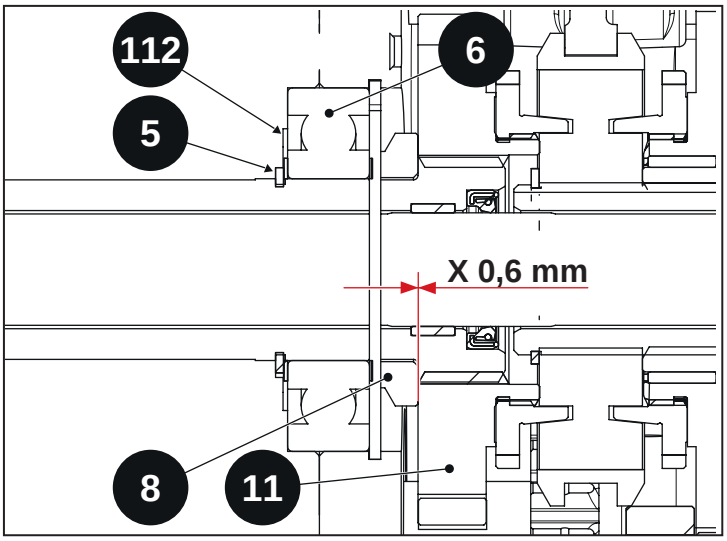


Fig. 4.76

Install the circlip (7) and insert the shaft (62), complete with:

- spacer (8);
- rod guiding ring (9);
- oil retainer (10);
- bearing 6
- pack of shims (112);
- circlip (5);

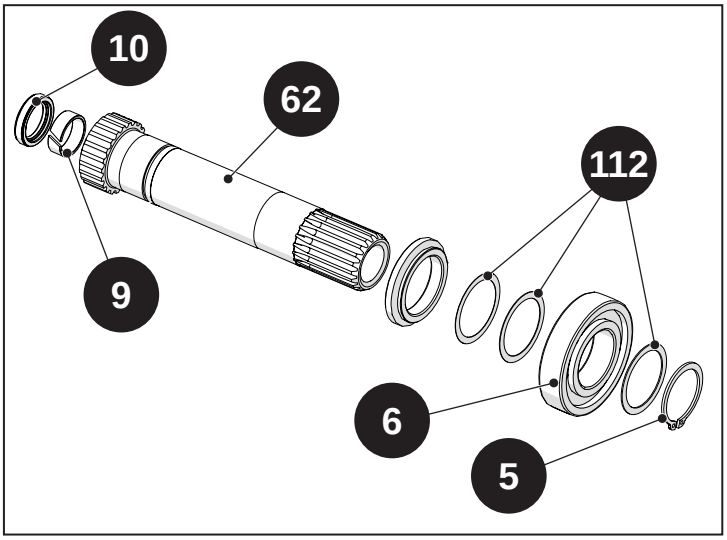


Fig. 4.77

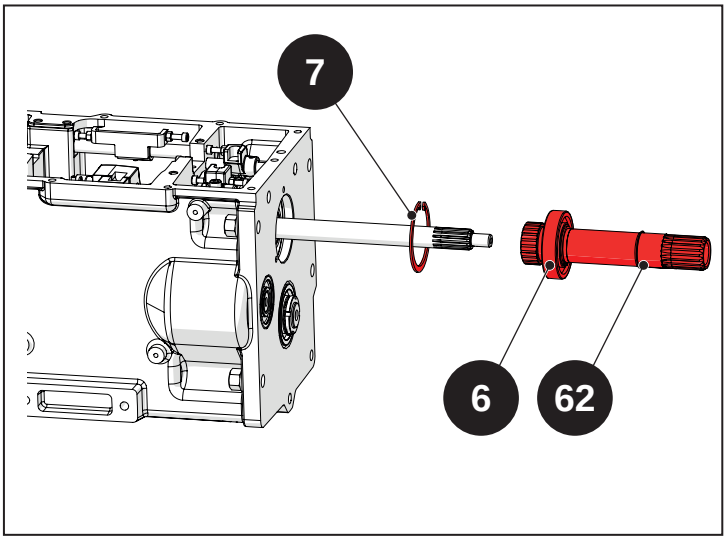


Fig. 4.78

Check that the distance (X) between the spacer (8) and the 8+8 gear (11) is 0.6 mm.

If this is not the case, move the shims to obtain the correct value.

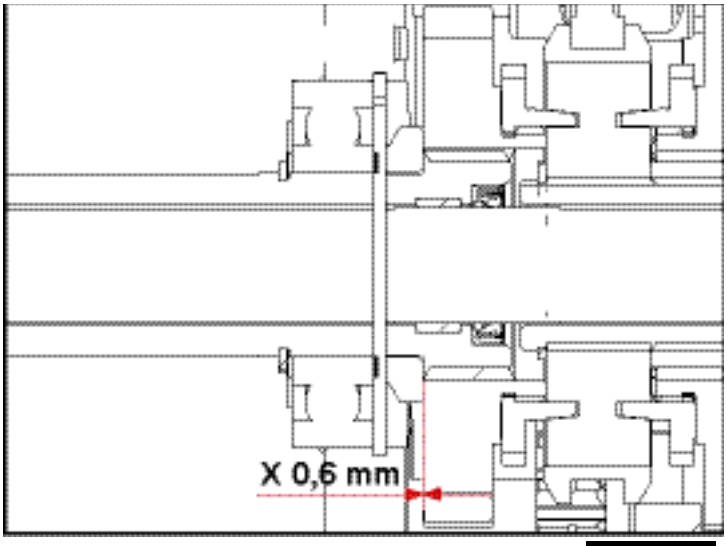


Fig. 4.79

Apply a layer of SILICONE to the coupling surface of the sleeve (113).

Insert the sleeve (113), washers (115) and tighten the screws by applying 30 Nm (3 kgm) tightening torque.

Apply a layer of TEFLON or SILICONE to the screw threads (114).

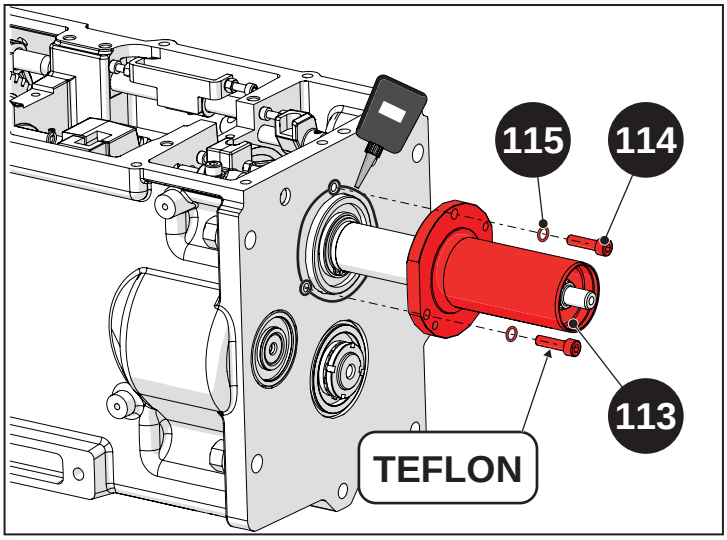


Fig. 4.80

Gearshift lever end of travel adjustment

To engaged the speed gears correctly, the gearshift levers must be adjusted so that the fork is exactly in the centre, between two gears.

When a speed gear is engaged, a space between 0.5 and 1 mm must be left between the adjuster screws and gearbox casing to ensure the rod engages on the ball.

Set the fork in the idle position and check that it is in the centre of the gap between the two gears.

Tighten the screw to lock the position of the fork.

> **Warning**
>
> Engage the speed gear and, using a small screwdriver, check that the ring of the synchromesh under the fork moves slightly. If the ring is blocked, it means that the fork has been fixed too near the speed gear that has just been engaged.
>
> Check synchromesh engagement in both positions.

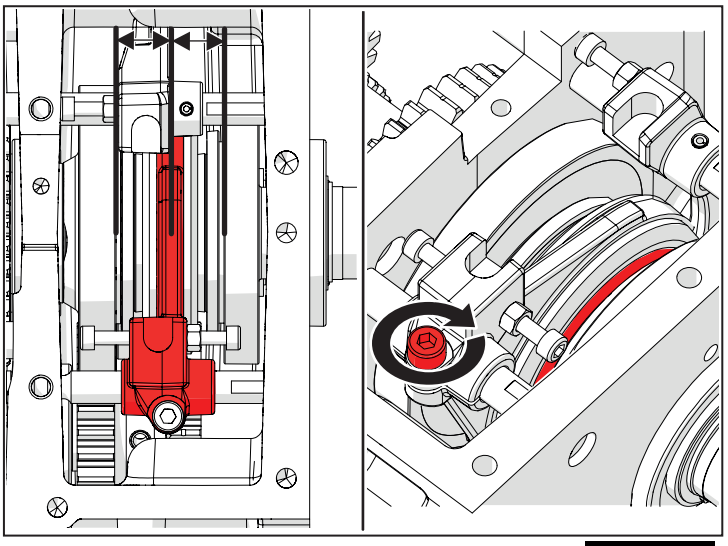


Fig. 4.81

Engage a speed gear.

Position the adjuster screw between 0.5 and 1 mm away from the casing.

Lock the screw in position with a nut.

Adjust the second speed gear in the same way.

> **Warning**
>
> All the levers on the gearshift must be adjusted.

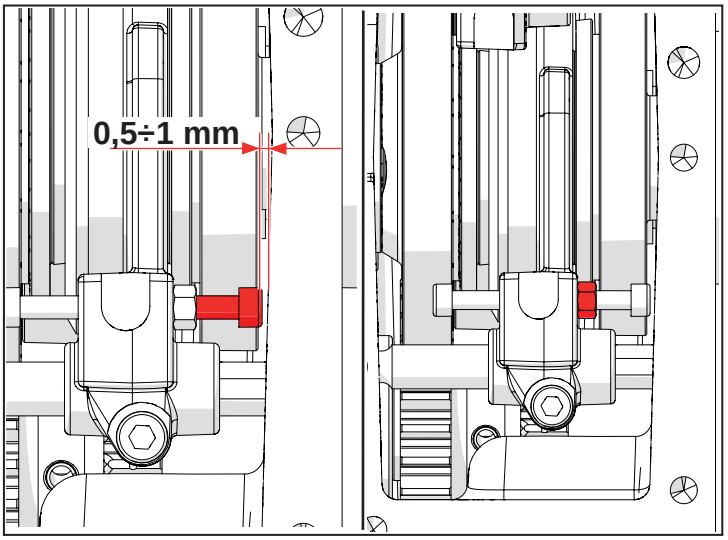


Fig. 4.82

Insert the balls (111) and springs (110).

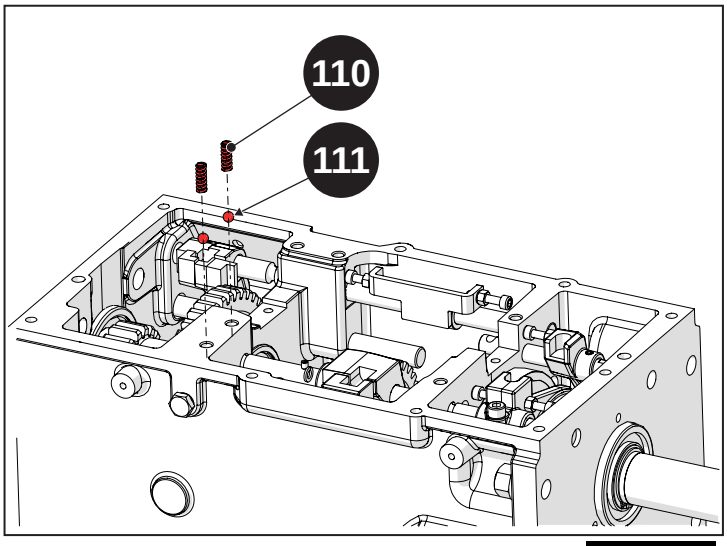


Fig. 4.83

Fit on the complete cover (109) and match the forks with the levers.

> **Warning**
>
> Apply a layer of SILICONE along the entire bearing perimeter of the cover.

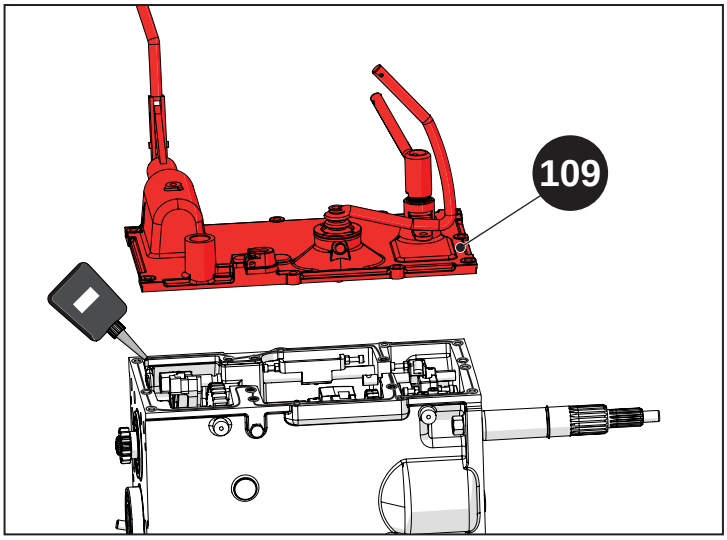


Fig. 4.84

Insert the washers (108) and tighten the screws (107) by applying 54 Nm (5.4 kgm) tightening torque.

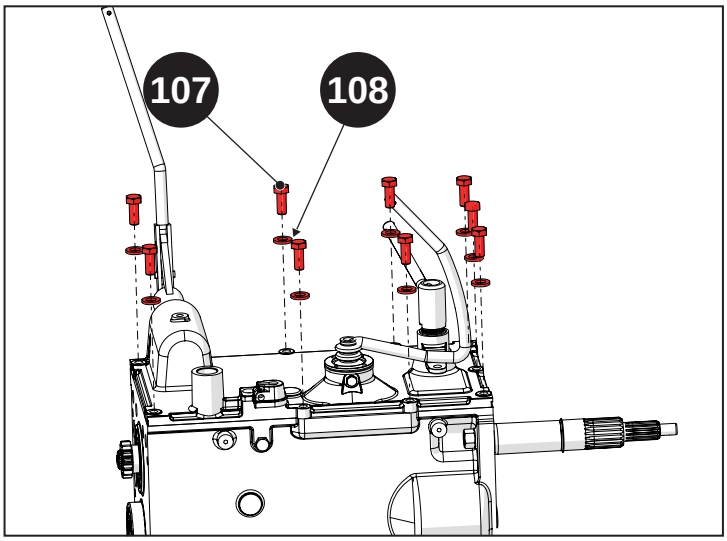


Fig. 4.85

Fit the stud bolts into the gearbox and tighten them through to the end of their threads.

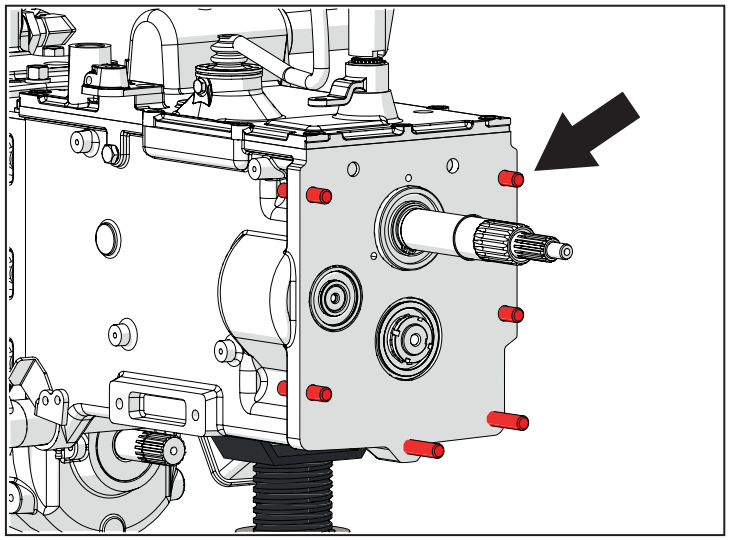


Fig. 4.86

Apply a layer of SILICONE to the surface on which the gearbox couples with the clutch bowl.

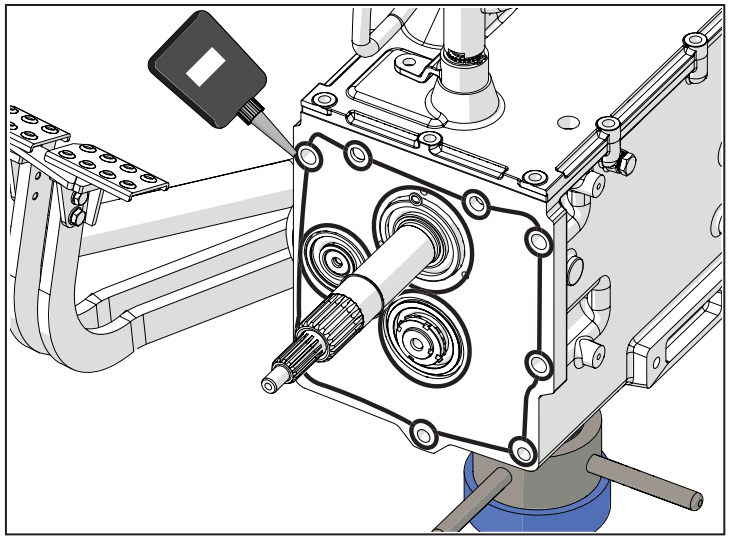


Fig. 4.87

Insert the paper gasket (119), then apply a further layer of SILICONE to the gasket.

⚠ Warning
Replace the paper gasket (119) whenever the components are reassembled.

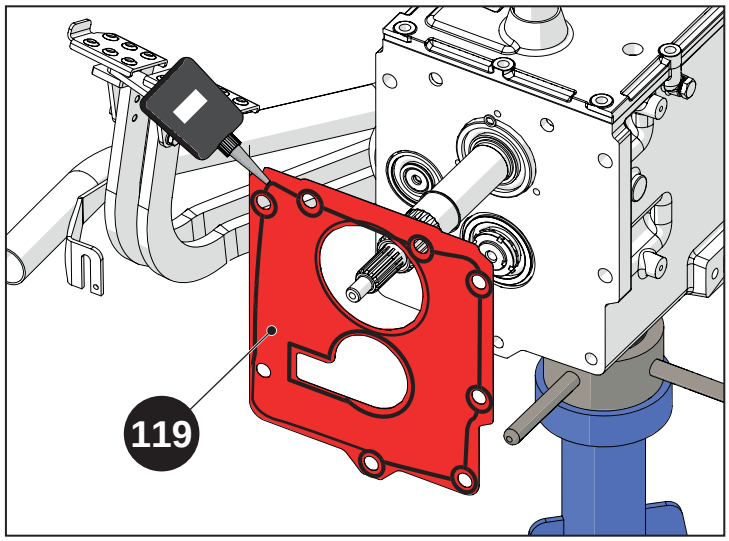


Fig. 4.88

Insert the spacer.

Caution
Use silicone to keep the spacer in the centre.

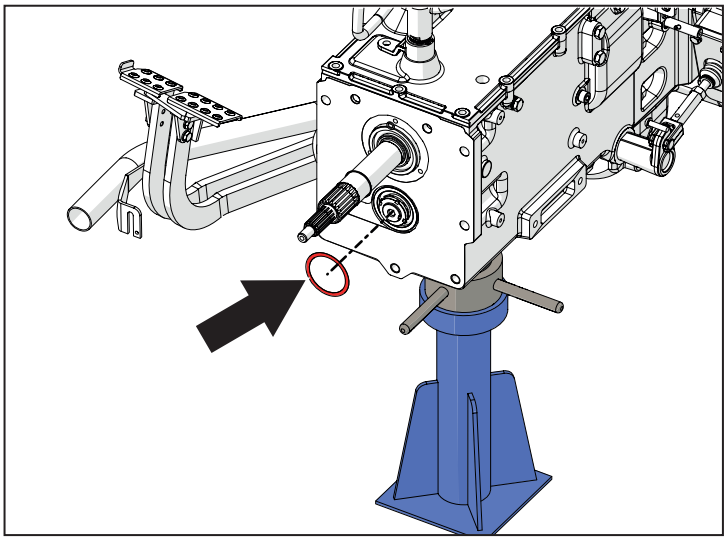


Fig. 4.89

Align the clutch bowl with the gearbox.

Insert the washers (118) and nuts (117), then tighten them by applying 80 Nm (8 kgm) tightening torque.

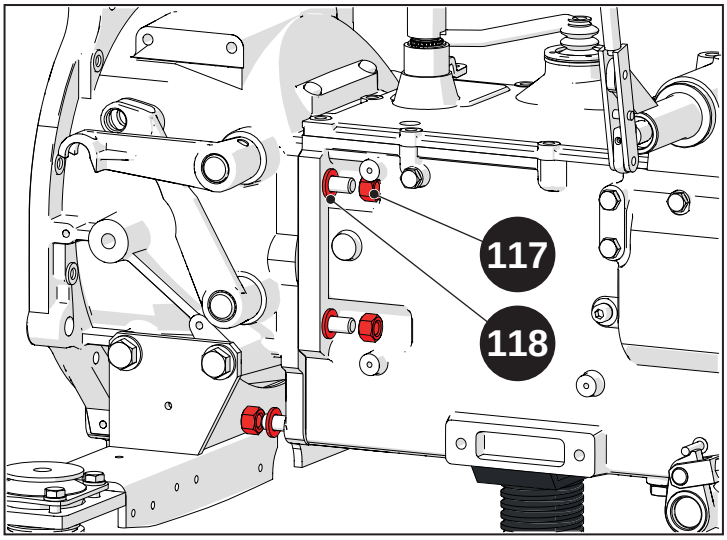


Fig. 4.90

Section 6 : Tightening torques

Index

6.1 Tightening torques.....4-46

6.1 Tightening torques

The main tightening torque values are listed below. Consult chapter "1- Introduction" for the remaining tightening torques.

Screws and nuts to be tightened	Nm	kgm
M10x30 gearbox cover screw	54	5.4
M30x1.5 transmission shaft ring nut	100	10
M35x1.5 transmission shaft ring nut	100	10
M8x30 drive shaft cover screw	24	2.4
M8x16 retainer plate fastening screw	24	2.4
M10x140 screw that fastens engine flange - clutch bowl	100	10
Screw that locks fork on rod	35	3.5

Section 7 : Tools required

Index

7.1 Tools required 4-48

7.1 Tools required

Code	Description	Quantity
07007955	Layshaft locking tool	1
07000240	Tool for removing/inserting ring nuts	1
07000306	Tool for removing reverse shuttle shaft	1
07007954	Synchromesh locking tool	1
07007957	Spacer inserting tool	1
07007956	Tool for fitting shaft into gearbox	1
07007953	Layshaft spacer tool	1
07000215	Gearbox - base unit support	1
07000245	Tractor splitting support	1
07000246	Gearbox housing support	1

Chapter 5 : Rear differential

Index

Section 1 : Safety notes 5-2

Section 2 : General introduction 5-3

2.1 Drawing of the assembly 5-4

Section 3 : Technical specifications 5-7

3.1 Technical specifications 5-8

Section 4 : Disassembly 5-9

4.1 Preliminary operations 5-10

4.2 Disassembly 5-14

Section 5 : Main inspection, re-assembly and adjustment operations 5-25

5.1 Main inspection, re-assembly and adjustment operations 5-26

Section 6 : Tightening torques 5-43

6.1 Tightening torques 5-44

Section 7 : Tools required 5-45

7.1 Tools required 5-46

Section 1 : Safety notes

To prevent accidents and injuries, always comply with the precautions and safety recommendations described in this section. In addition, operators must always comply with the safety instructions given in the operation and maintenance manual and in chapter 1 of this manual.

Danger

Make sure that all persons keep well away from the danger zone. Avoid vibrations when the bolts are loosened.

Danger

Lift and handle all heavy parts with lifting equipment of an adequate capacity. Arrange all harness and hooks in safe positions. Operators must remain at a distance and in a safe position, well away from the lifted load.

Danger

Do not twist the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Danger

Use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.

Danger

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

Danger

For safety reasons, always leave two screws on opposite sides when removing components that could fall. Only remove these screws after having secured the component to lifting equipment or placed bearing blocks underneath.

Danger

If the bolts that fix the safety frame or cab have loosened or if the safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

Caution

Keep clear of the sharp edges around the top of the transmission housing.

Caution

Used oil must be collected and disposed of in compliance with the anti-pollution laws in force.

Section 2 : General introduction

Index

2.1 Drawing of the assembly 5-4

2.1 Drawing of the assembly

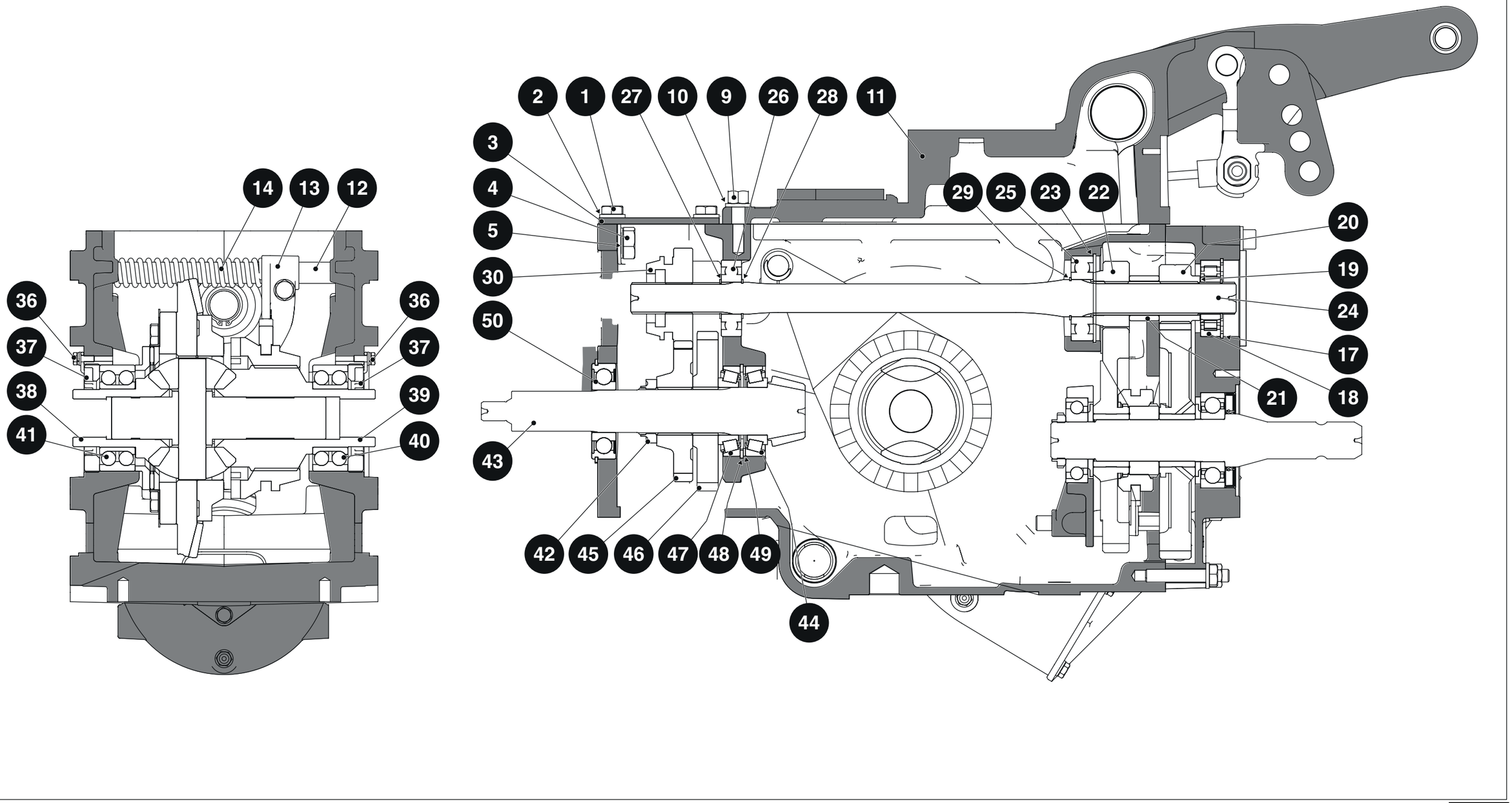


Fig. 5.1

1 - Screw
2 - Washer
3 - Housing cover
4 - Screw
5 - Washer
9 - Nut
10 - Washer
11 - Hitch unit
12 - Rod
13 - Spring
14 - Fork
17 - Circlip
18 - Bearing
19 - Spacer
20 - Gear
21 - Spacer
22 - Gear
23 - Circlip
24 - P.T.O. internal shaft
25 - Bearing
26 - Bearing
27 - Circlip
28 - Circlip
29 - Circlip
30 - P.T.O engaging gear
36 - Ring nut retainer
37 - Ring nut
38 - Crown wheel
39 - Crown wheel
40 - Bearing
41 - Bearing
42 - Nut
43 - Pinion
44 - Bearing
45 - P.T.O gear
46 - Driving gear
47 - Bearing
48 - Circlip
49 - Spacer
50 - Bearing

Section 3 : Technical specifications

Index

3.1 Technical specifications 5-8

3.1 Technical specifications

Operating mechanism	Electrohydraulic
Pinion / ring gear play	0.07 to 0.15 mm

Section 4 : Disassembly

Index

4.1 Preliminary operations 5-10

4.2 Disassembly 5-14

4.2.1 Disassembly/Assembly of the differential ring gear 5-20

4.1 Preliminary operations

The main operations required to access the rear differential assembly are described below:

Caution

Always make sure that the assemblies have been completely freed before splitting them, otherwise their components could be damaged.

- Remove the platform (see chapter "13- Platform")

  Remove the cab (see chapter "14- Cab")

Danger

Before proceeding with the disassembly operations, make sure that the rear differential and gearbox have been secured to lifting equipment of an adequate capacity.

If lifting equipment is not available, place the units on a stand.

Tools

07000245: Tractor splitting support.

07000215: Gearbox - base unit support.

07000247: Differential support.

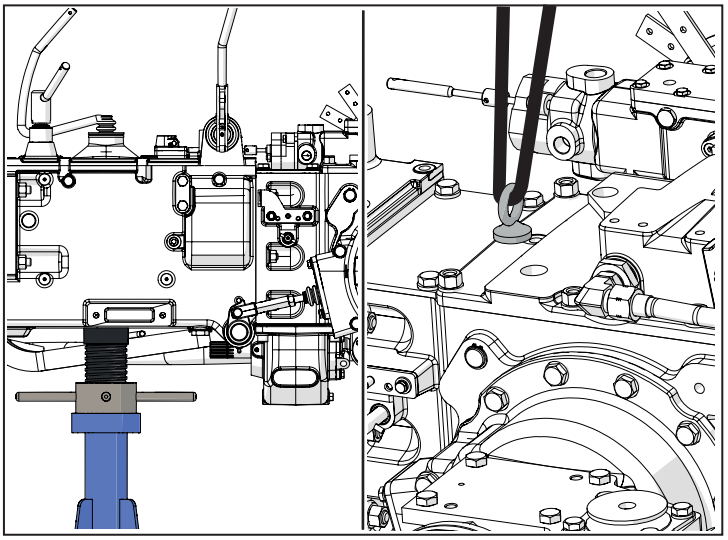


Fig. 5.2

Unscrew the screws (1) and remove the washers (2).

Remove the cover (3).

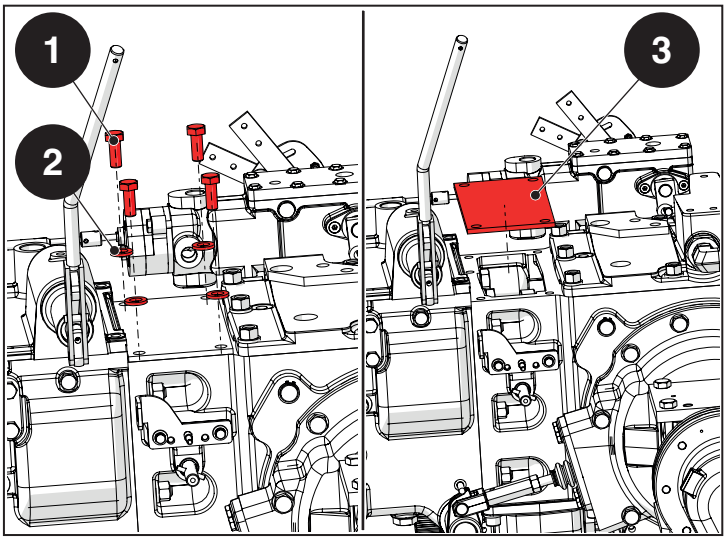


Fig. 5.3

Unscrew and remove the screws and washers.

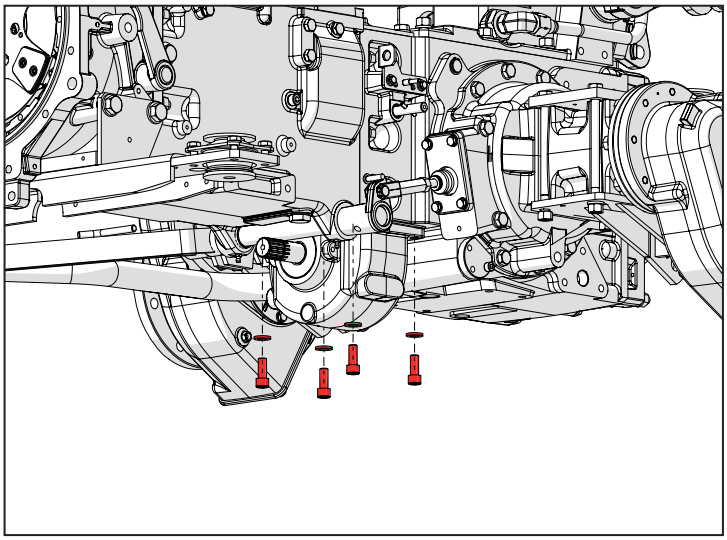


Fig. 5.4

Remove the complete drive transmission unit.

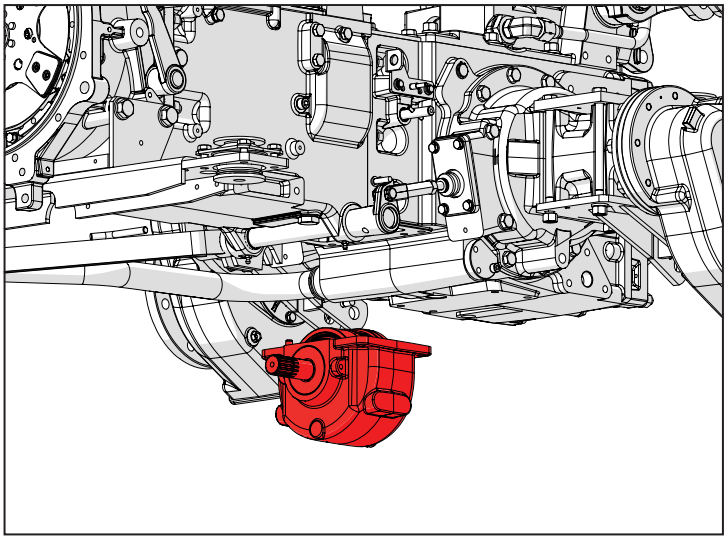


Fig. 5.5

Unscrew the self-locking nuts.

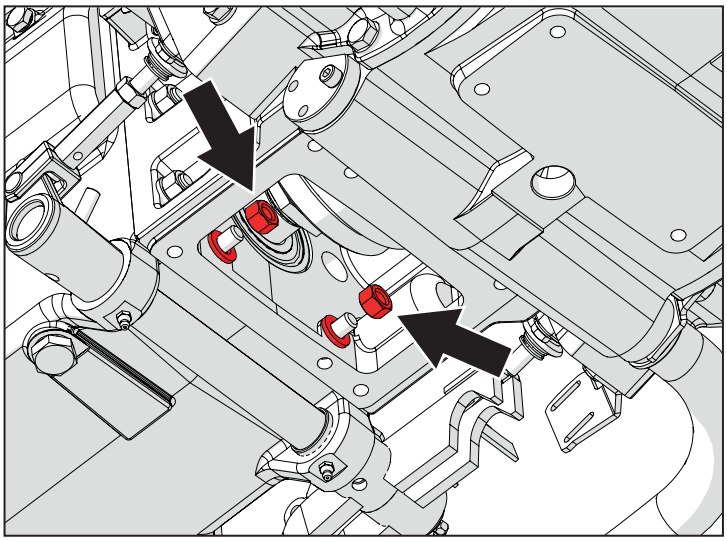


Fig. 5.6

Unscrew the screws (4) and remove the washers (5) that fasten the gearbox to the rear differential assembly.

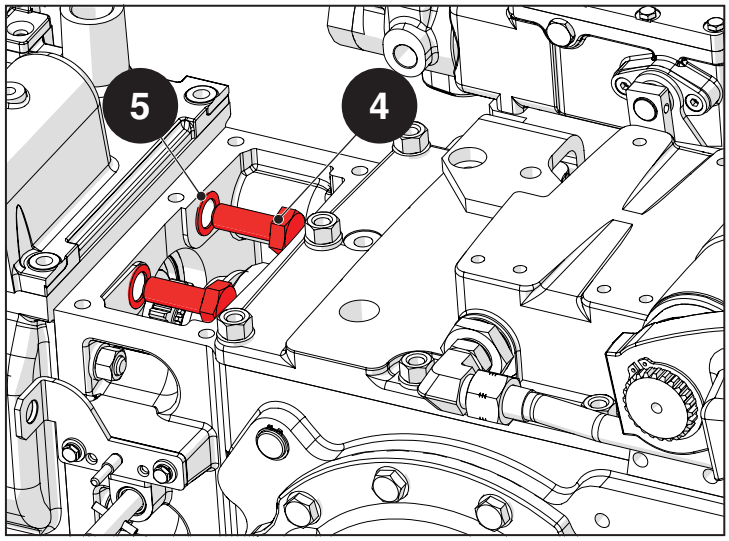


Fig. 5.7

Unscrew the nuts (6) and remove the washers (7) that fasten the gearbox to the rear differential assembly.

Remove the pins (8) from the brake rods.

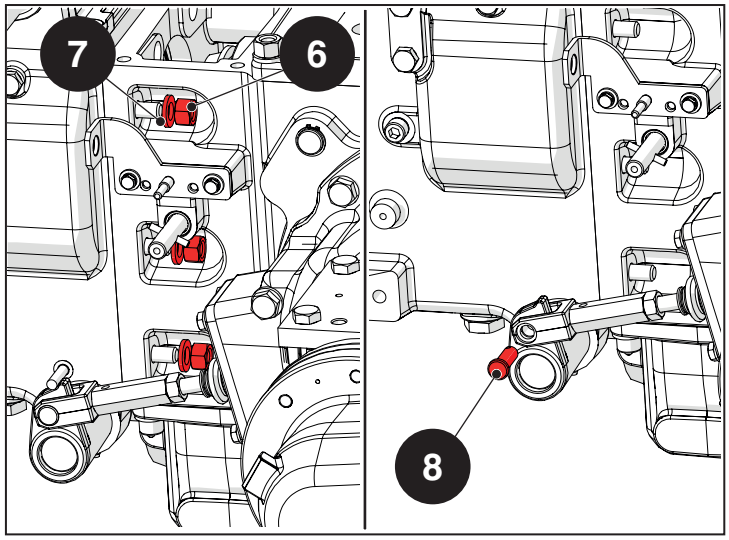


Fig. 5.8

Split the units.

Danger

Lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the hooks and harness are fixed in safe positions. Operators must remain at a distance and in a safe position, well away from the lifted load. Before proceeding with the disassembly operations, make sure that the rear differential and gearbox have been secured to lifting equipment of an adequate capacity.

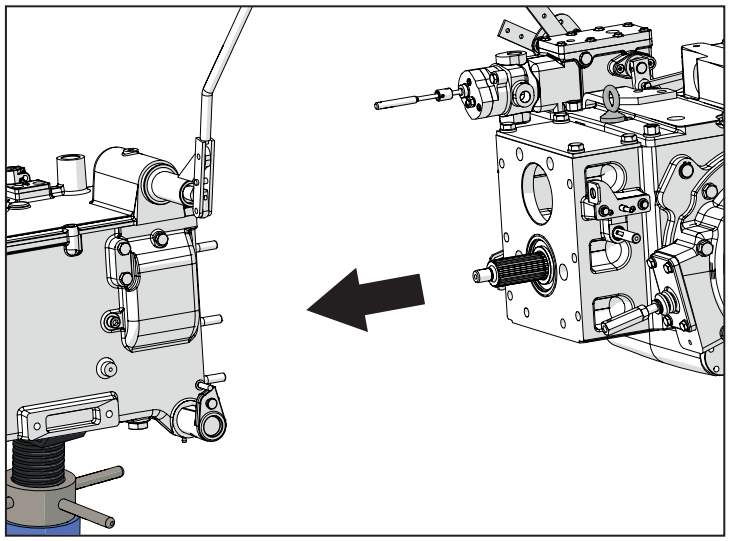


Fig. 5.9

Danger

Secure the hitch unit to lifting equipment of adequate capacity.

Unscrew the nuts (9) and remove the washers (10) that fasten the hitch to the rear differential assembly.

Lift and remove the rear hitch assembly (11).

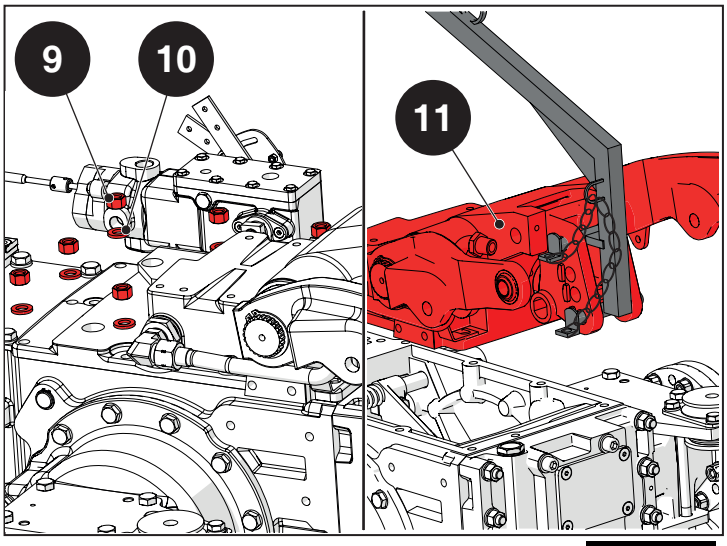


Fig. 5.10

Continue disassembling the components from the rear differential as described below:

1 - Remove the final drives (see chapter "6- Rear final drives")

2 - Remove the rear P.T.O. (see chapter "9- Rear P.T.O.")

4.2 Disassembly

Remove the rod (12), spring (13) and fork (14) of the differential lock unit.

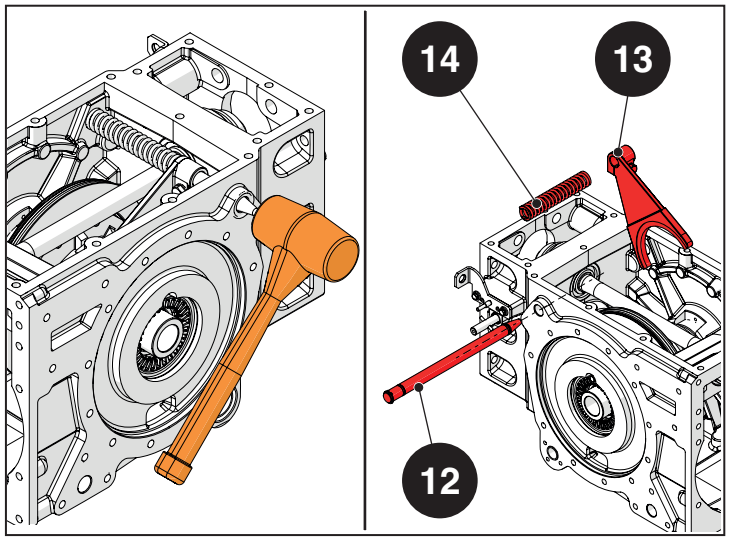


Fig. 5.11

Remove the circlip (15) and the O-Rings (16) from the rod (12) of the differential lock.

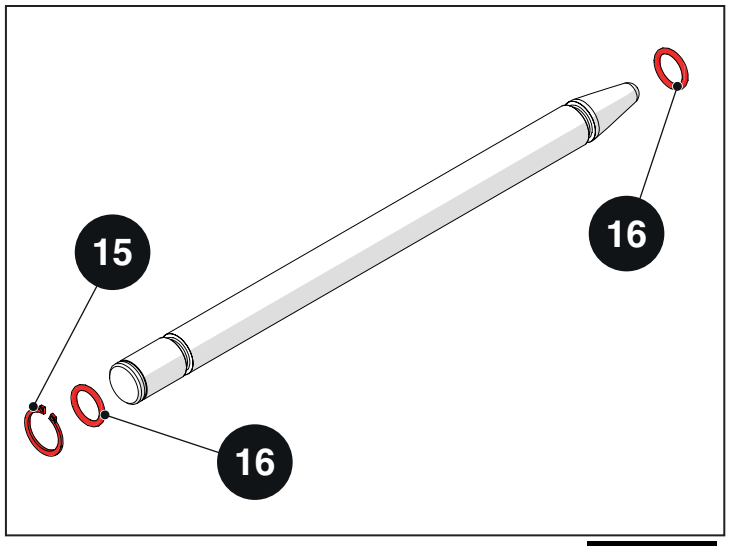


Fig. 5.12

Remove the circlip (17).

Using a puller, now remove the bearing (18), spacers (19) and gear (20) from the shaft.

Remove the spacer (21) and gear (22).

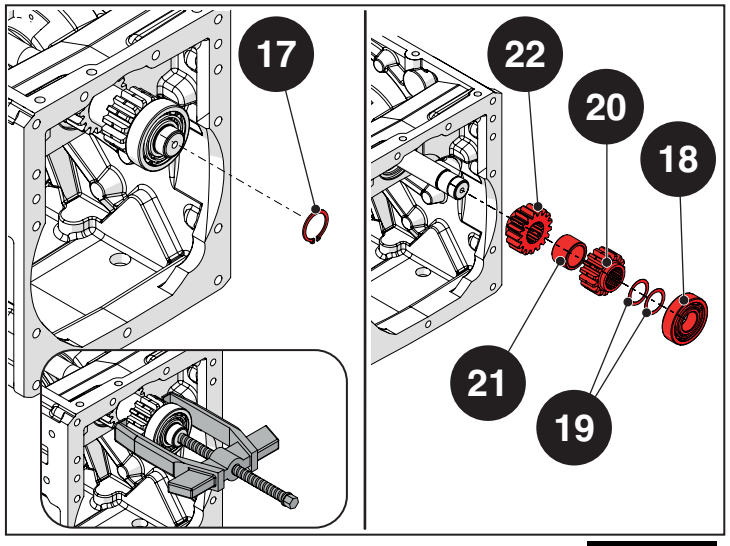


Fig. 5.13

Remove the circlip (23).

Tap the shaft (24) from the opposite side to release it together with the bearings.

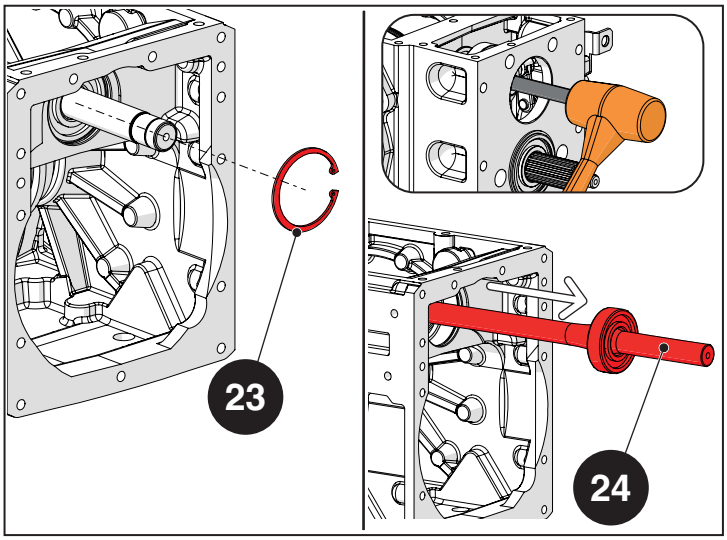


Fig. 5.14

Use a puller to remove the bearing (25).

You will now be able to remove the shaft (24) complete with bearing (26) and circlips (27), (28) and (29) from the differential housing.

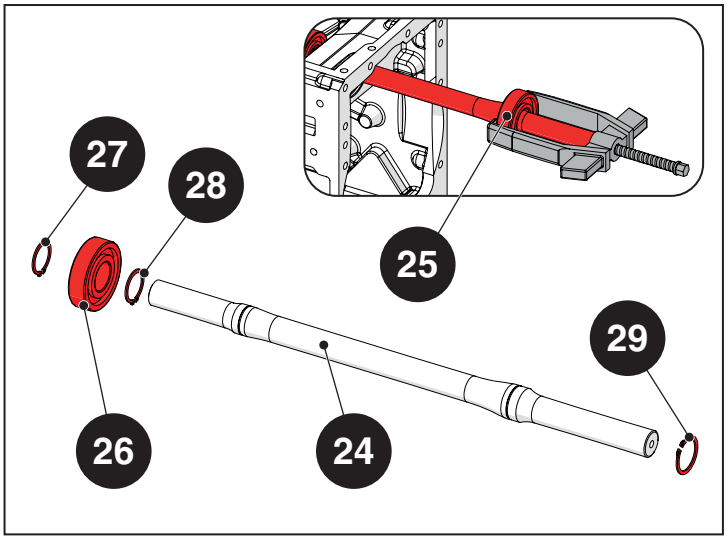


Fig. 5.15

Remove the gear (30).

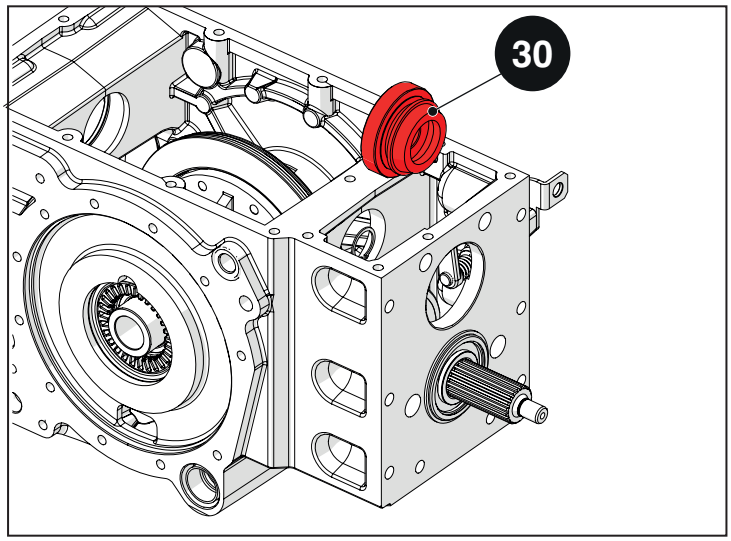


Fig. 5.16

Remove the selector pin (31).

Remove the pin then remove the selection lever (32) complete with spring (33) and spacer (34).

Remove the oil retainer (35).

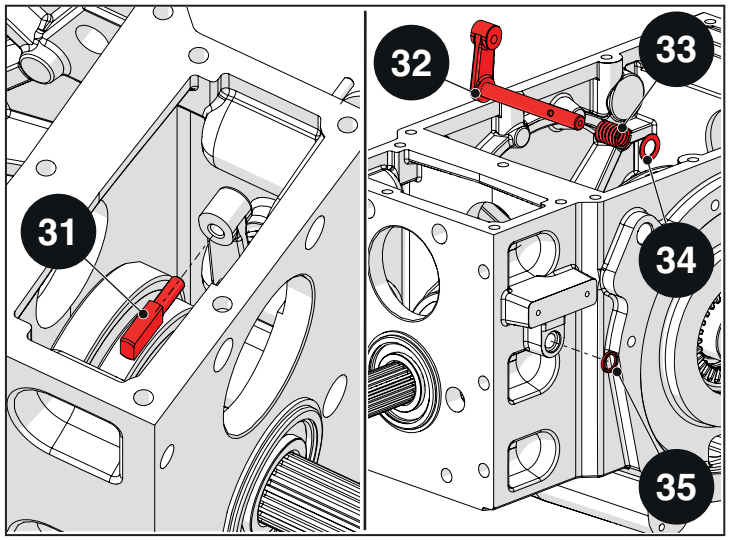


Fig. 5.17

Remove the ring nut retainer (36) from both sides.

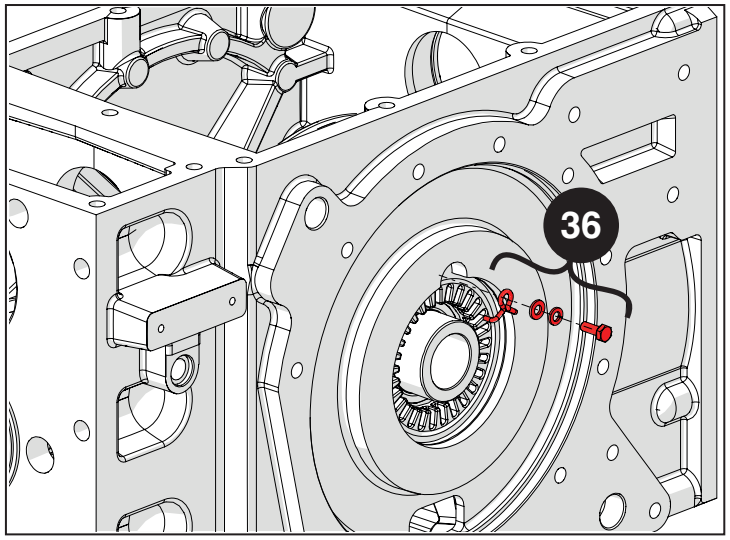


Fig. 5.18

Unscrew and remove the ring nut (37) from both sides.

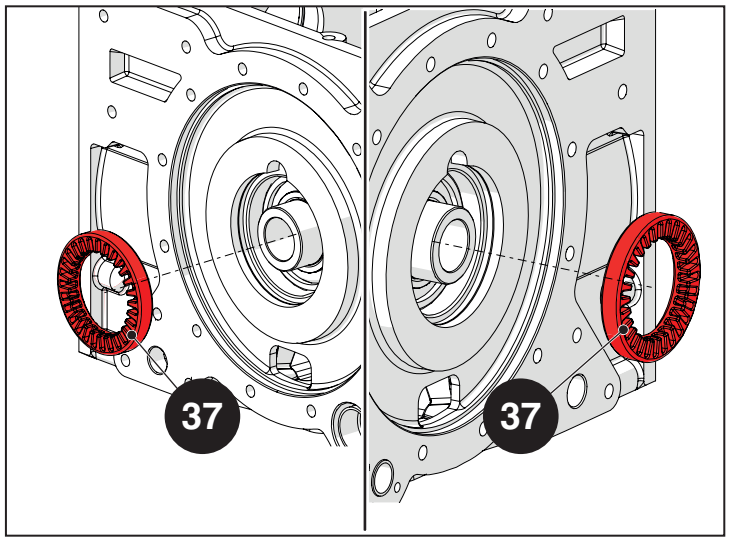


Fig. 5.19

Remove both crown wheels (38) and (39) with the bearings (40) and (41).

Use a puller to remove the bearings from the crown wheels.

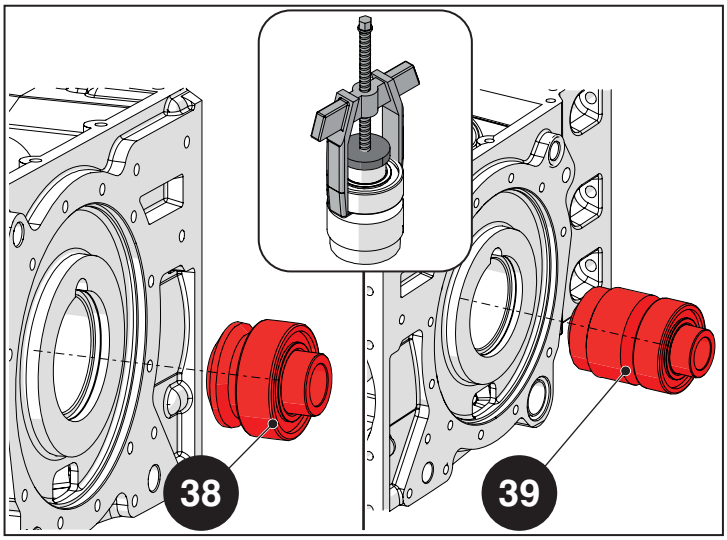


Fig. 5.20

Working from above, remove the complete ring gear from the rear differential housing.

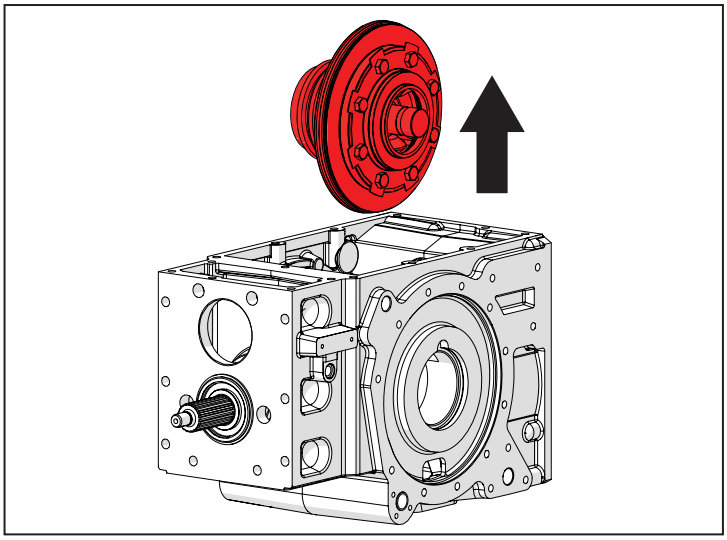


Fig. 5.21

Lock the nut (42), using tool (A- Code 07000239).

Use tool (A) to tighten the pinion (43) and consequently unscrew the nut (42).

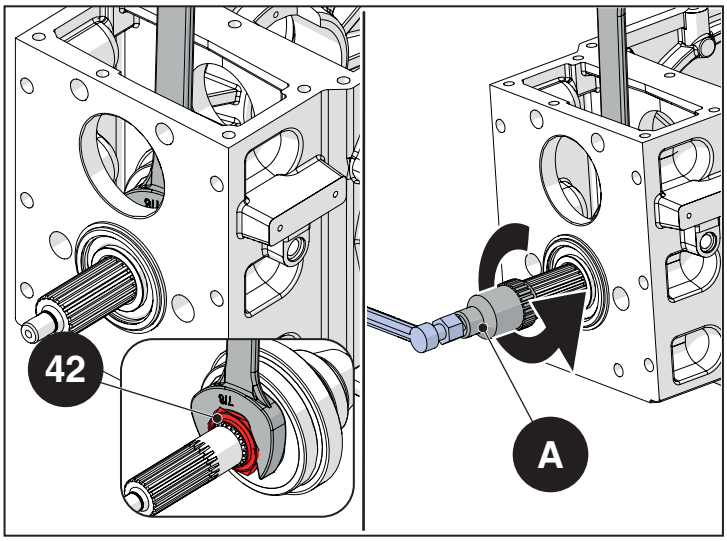


Fig. 5.22

After having unscrewed the nut (42), tap on the pinion (43) so as to remove it from the opposite side along with the external ring of the bearing (44).

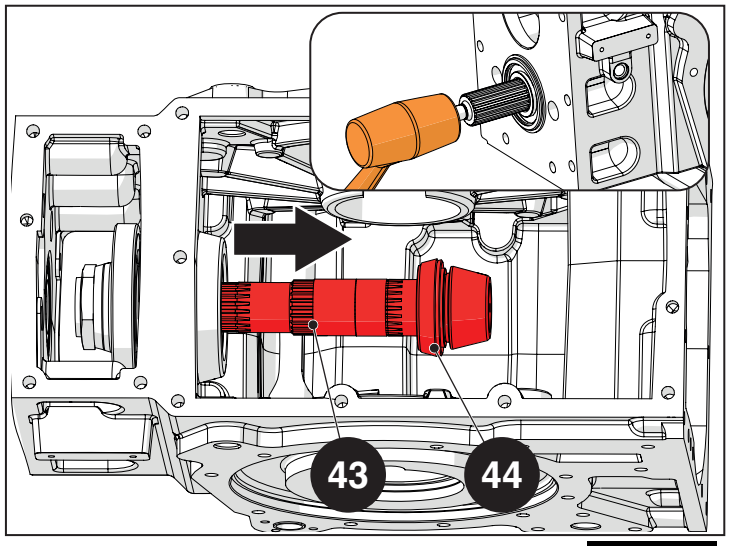


Fig. 5.23

Remove the following components from the differential housing:

- Nut (42);
- P.T.O. gear (45);
- Driving gear (46);
- Inner bearing ring (44);

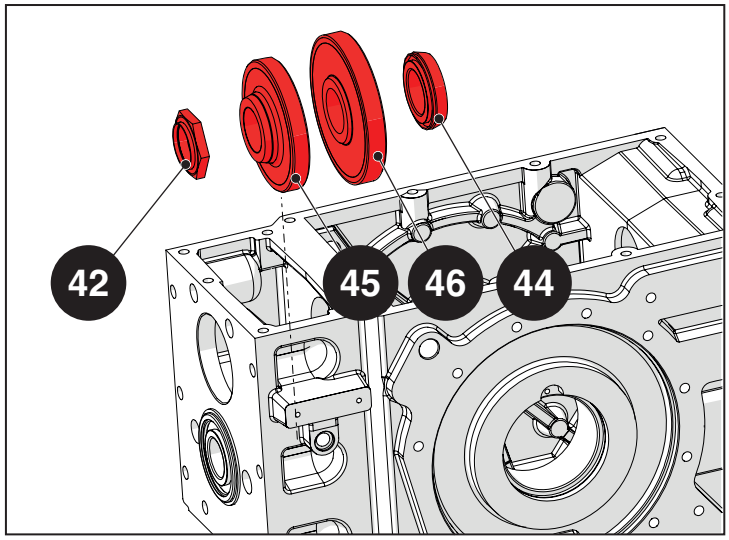


Fig. 5.24

Remove the bearing (47), external bearing ring (44), the circlip (48) and the spacer (49).

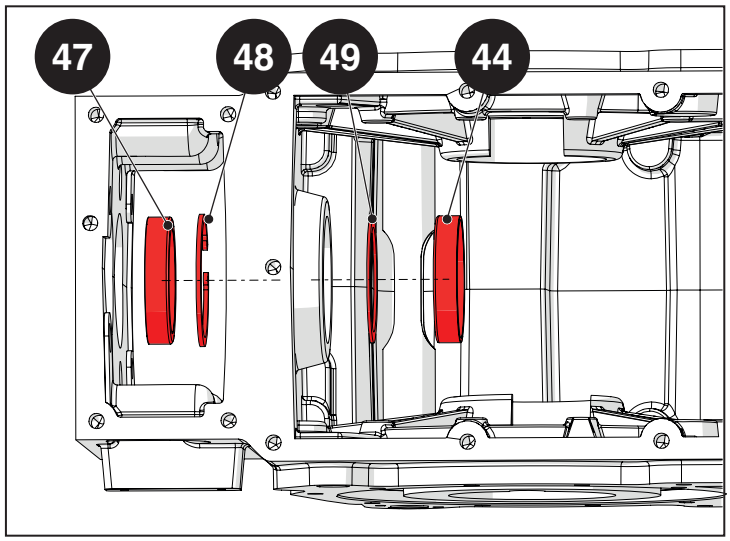


Fig. 5.25

Remove the bearing (50).

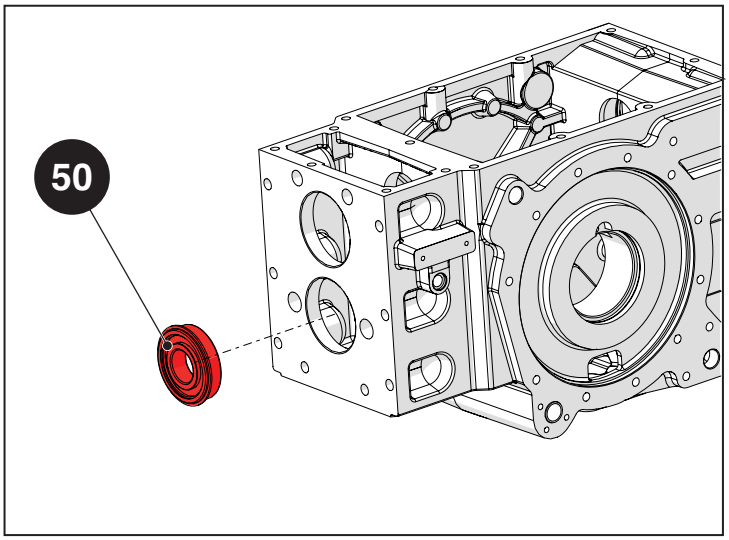


Fig. 5.26

4.2.1 Disassembly/Assembly of the differential ring gear

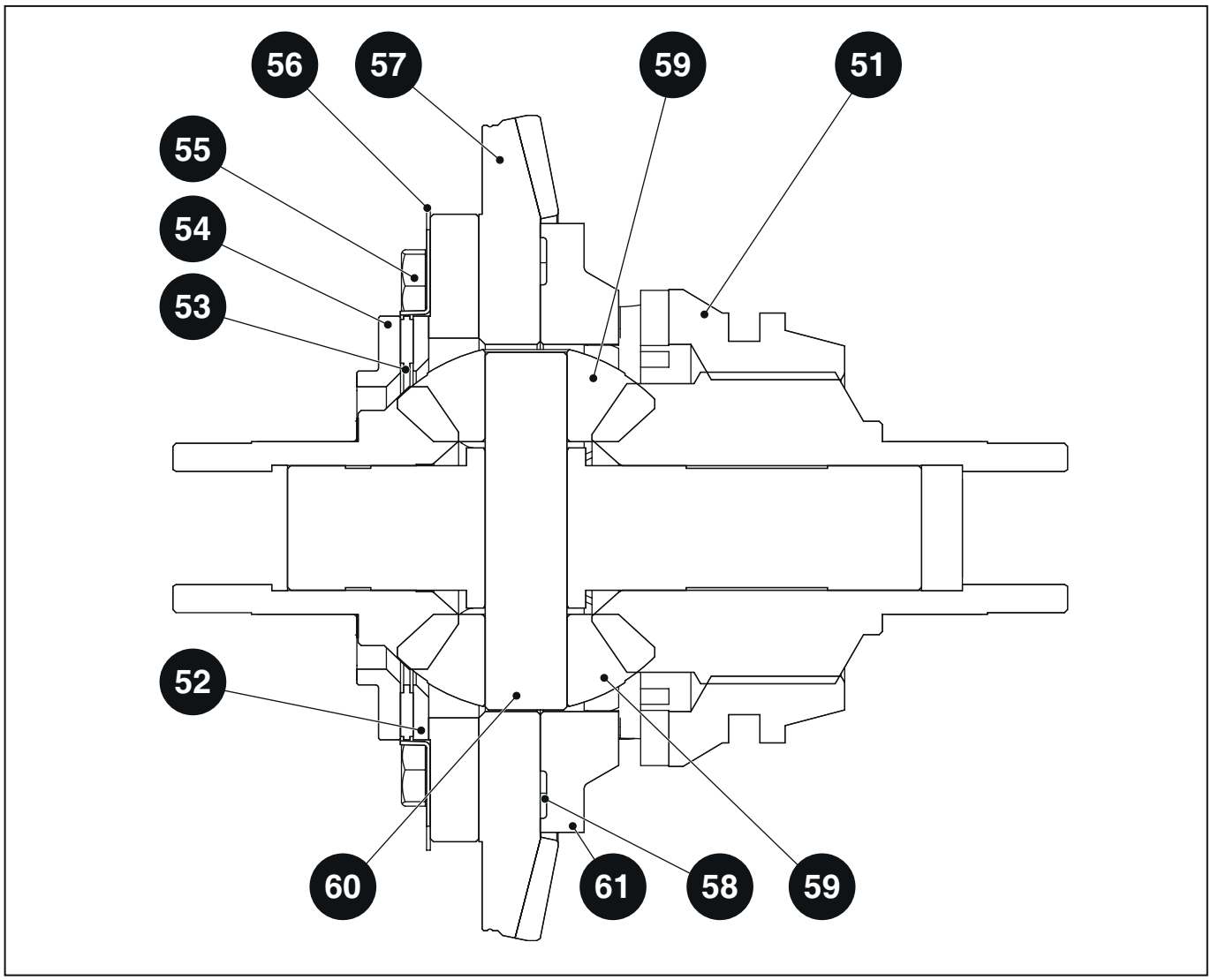


Fig. 5.27

51 - Differential lock pinion
52 - Spacer
53 - Roller cage
54 - Spacer
55 - Screw
56 - Plate
57 - Ring gear
58 - Pin
59 - Planetary gear
60 - Central differential shaft
61 - Diff lock fixed ring

Disassembly

Remove the pinion (51) and fixed ring (61) of the differential lock.

Remove the spacer (52), roller cage (53) and the spacer (54).

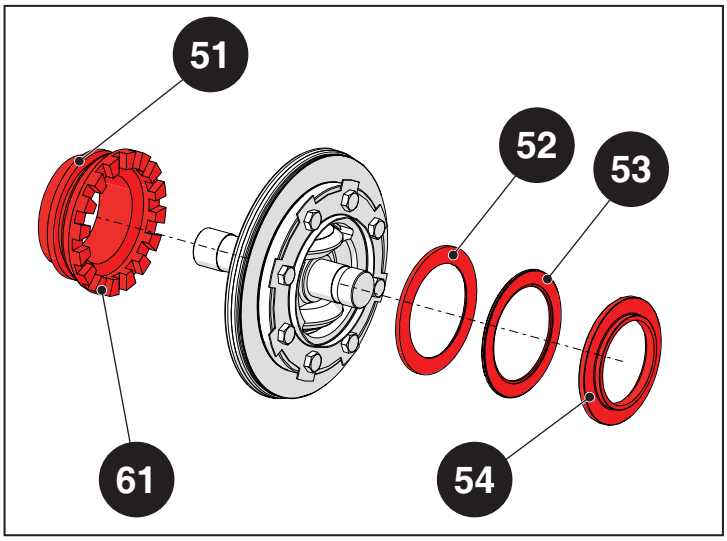


Fig. 5.28

Free the screws (55) from the folds in the plate (56) using a chisel (56).

Unscrew the screws (55) and remove the plate (56).

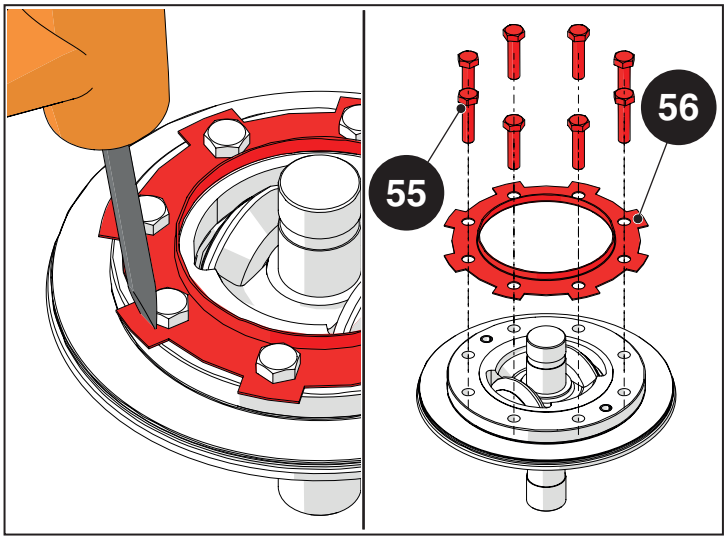


Fig. 5.29

Remove the ring gear (57).

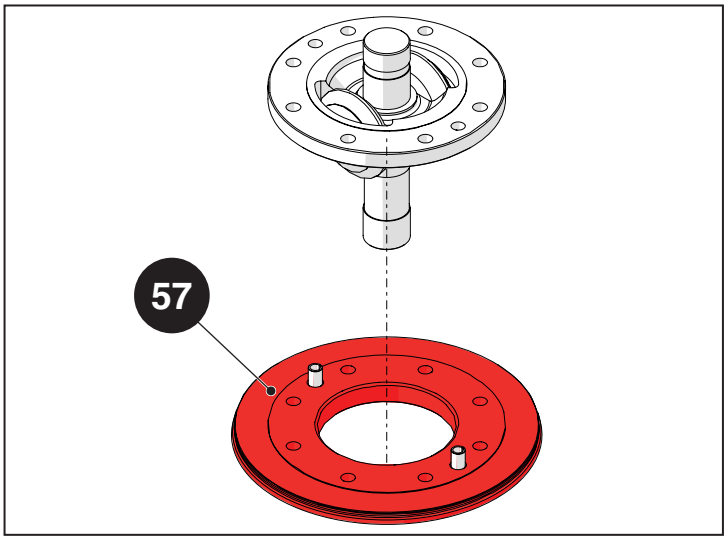


Fig. 5.30

Remove the pins (58) from the ring gear (57).

Remove the planetary gears (59) and central shaft (60) of the differential.

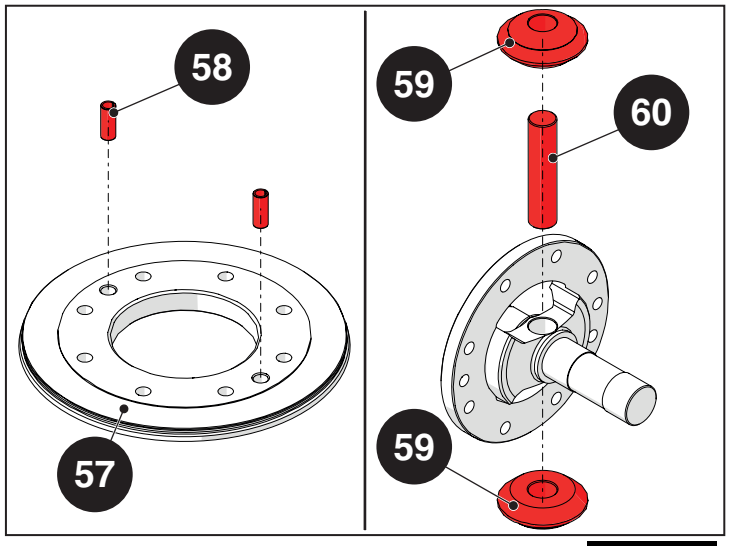


Fig. 5.31

Assembly

Insert the planetary gears (59) and central shaft (60) of the differential.

Insert the pins (58) into the ring gear (57).

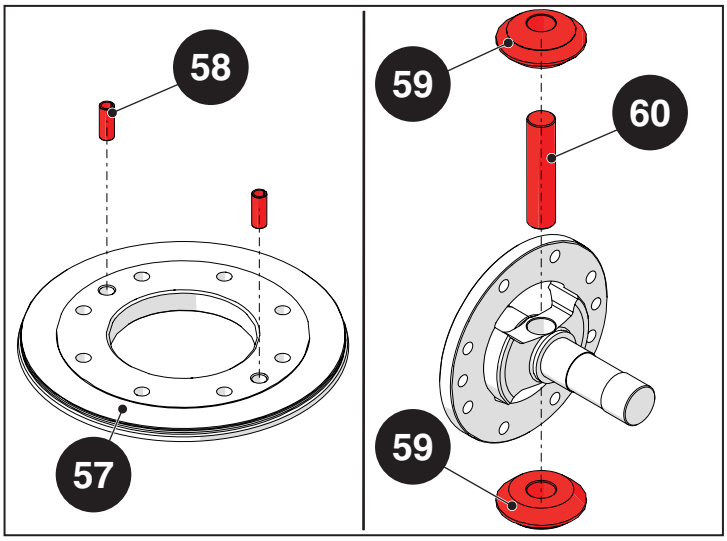


Fig. 5.32

Install the two assembled units. Make sure that the pins (59) match.

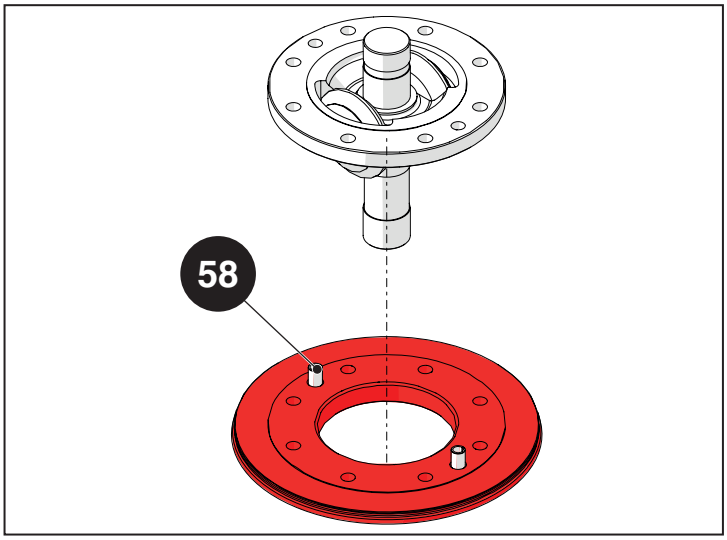


Fig. 5.33

Insert the plate (56).

Tighten the screws (55) by applying a 90 Nm (9 kgm) tightening torque.

Clinch the plate over the screw heads (55) with a hammer and chisel.

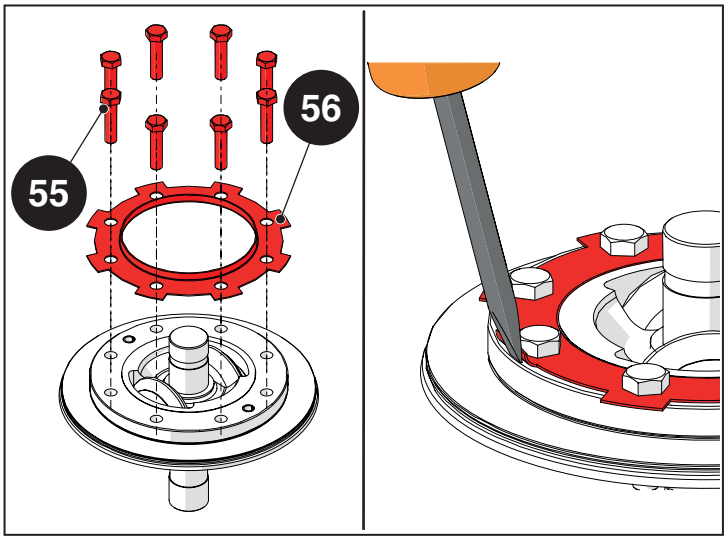


Fig. 5.34

Section 5 : Main inspection, re-assembly and adjustment operations

Index

5.1 Main inspection, re-assembly and adjustment operations.....5-26

5.1 Main inspection, re-assembly and adjustment operations

Warning

Before proceeding with the re-assembly operations, carefully read and comply with the instructions given in chapter "1-Introduction", especially those describing how to assemble O-Rings, oil retainers and bearings.

Use the correct tightening torques when screwing in the components. Consult the table in chapter "1-Introduction" if the tightening torque value is not given.

Use the indicated sealants when re-assembling the parts. Consult the table in chapter "1-Introduction" if the sealant is not indicated.

Pinion shimming

Caution

The bearings behind the pinion must be shimmed whenever the rear taper bearing, the bevel gear pair or gearbox are replaced.

The thickness of the spacer (49) between the bearing (44) and circlip (48) must be calculated in order to adjust the position of the pinion (43) in relation to the ring gear.

Total dimension Y of the bearing (44), circlip (48) and the spacer (49) to be inserted must be **27.75 mm**.

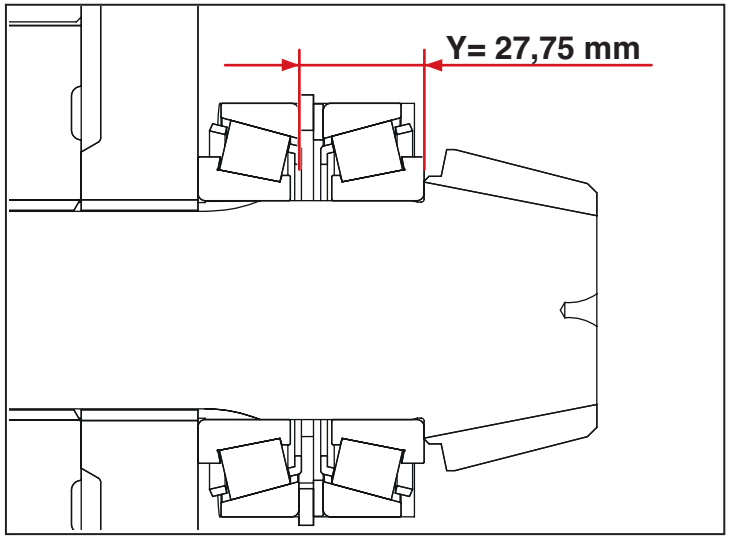


Fig. 5.35

Measure the thickness X of the taper bearing (44) along with the circlip (48).

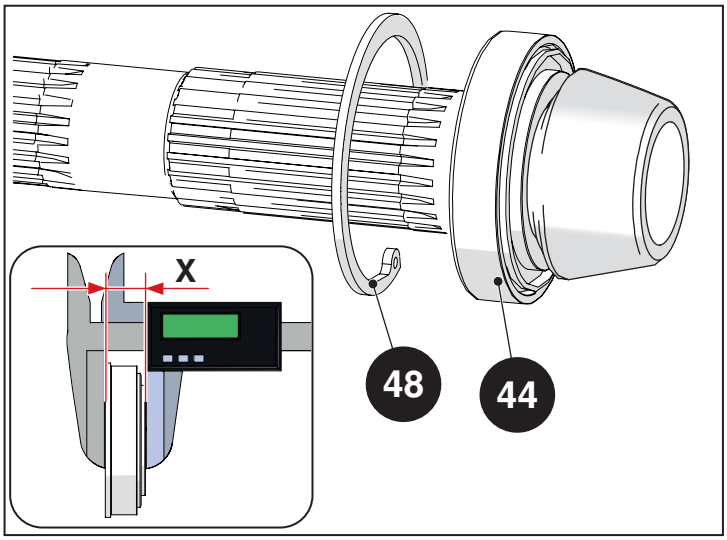


Fig. 5.36

The thickness (Z) of the spacer (49) to be inserted is obtained by means of the following formula:

Y (dimension required 27.75) **- X** (thickness of bearing+circlip) **= Z** (spacer thickness)

Caution
Choose the shim nearest to the calculated value from among those available.

Fit the calculated spacer (49) into the differential housing followed by the circlip (48).

Use the plug (B-code 07006223) to seat the external bearing rings (44) and (47)

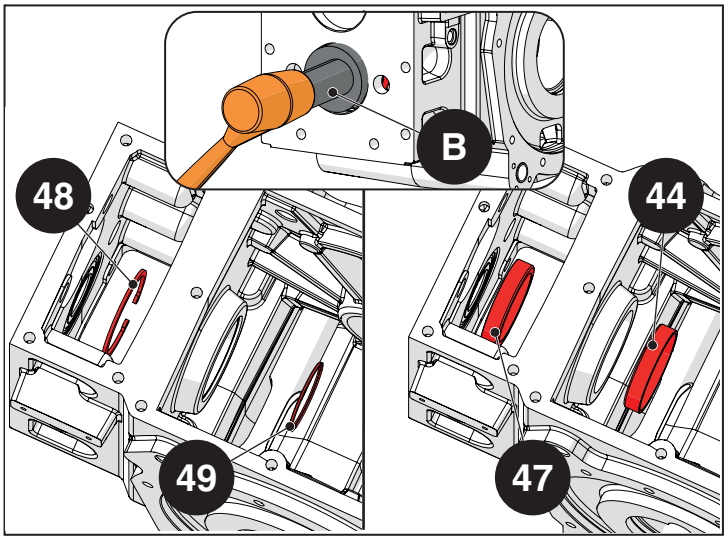


Fig. 5.37

Insert the inner bearing ring (47) into the differential housing.

Use the plug (C-code 07006224) to insert the inner bearing ring (44) into the pinion (43).

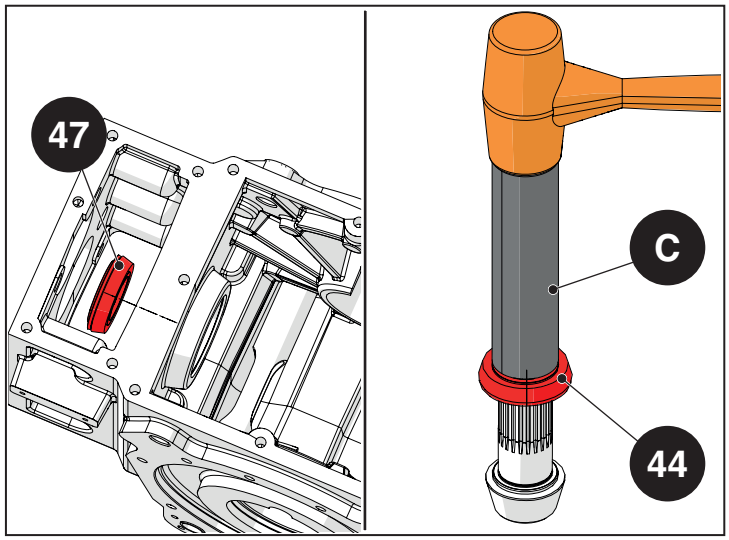


Fig. 5.38

Fit the pinion into the differential housing and mesh it with the driving gear (46), P.T.O. gear (45) and nut (42).

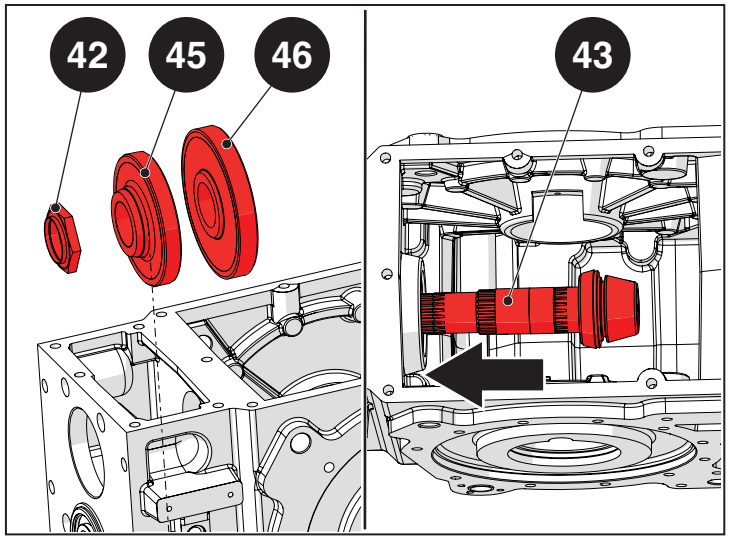


Fig. 5.39

Use the plug (C-code 07006224) to fully seat the bearings.

Use the tool (I-code 07006225) to restrain the pinion.

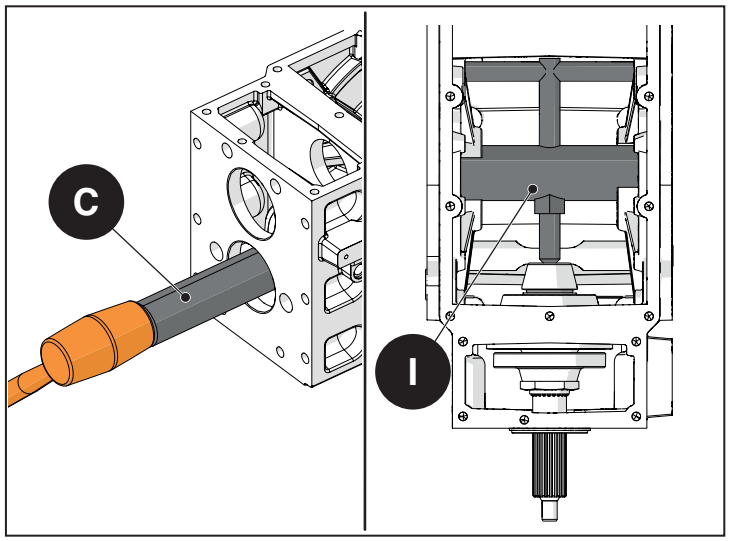


Fig. 5.40

Lock the nut (42), using tool (A- Code 07000239).

Use tool (A) to unscrew the pinion (43) and consequently tighten the nut (42), applying a 60 Nm (6 kgm) tightening torque.

Fully tighten the nut (42), then loosen it about 1/4 of a turn and tighten it again by applying a 40 Nm (4 kgm) tightening torque.

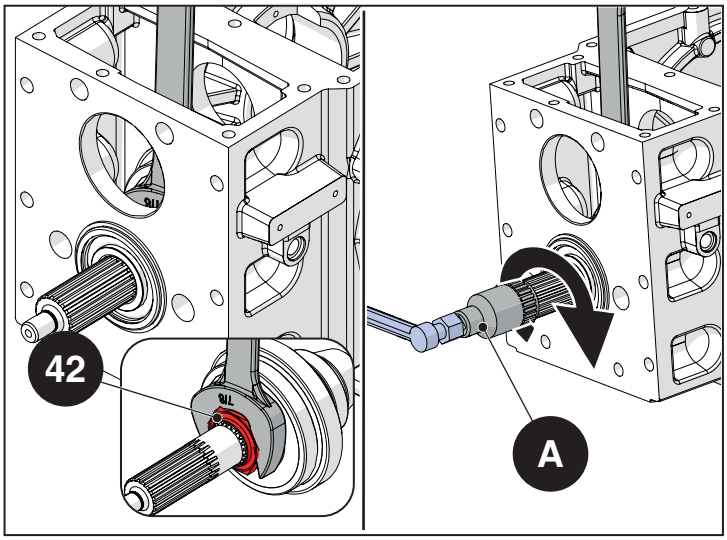


Fig. 5.41

Caution

Tap the pinion with a mallet made of soft material.

Tighten the nut again to the indicated tightening torque so as to ensure that all play has been eliminated.

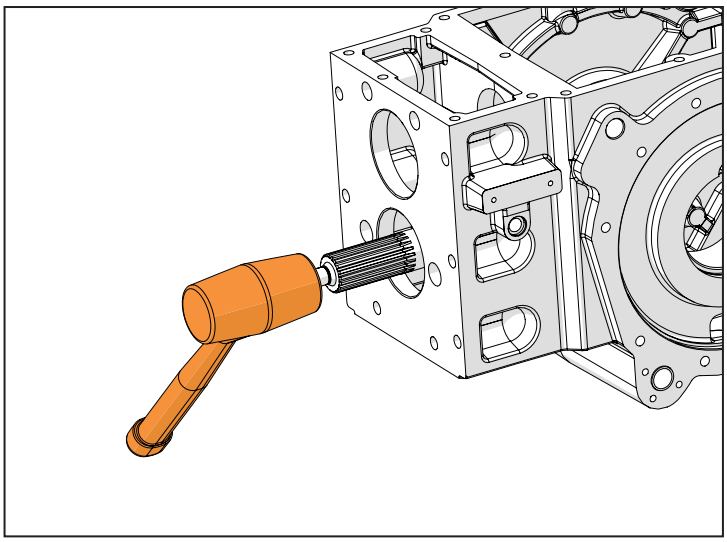


Fig. 5.42

Use tool (D-code 07006221) to chamfer the nut (42).

Position it on the nut (42), then tap it with a mallet to create the chamfers.

Caution

Make sure that the pinion is able to turn smoothly, which must occur by applying a minimum force.

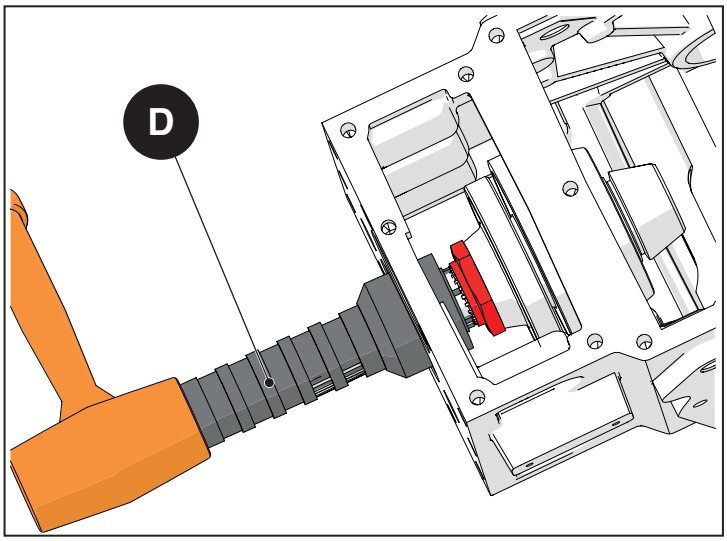


Fig. 5.43

Insert and fully seat the bearing (50).

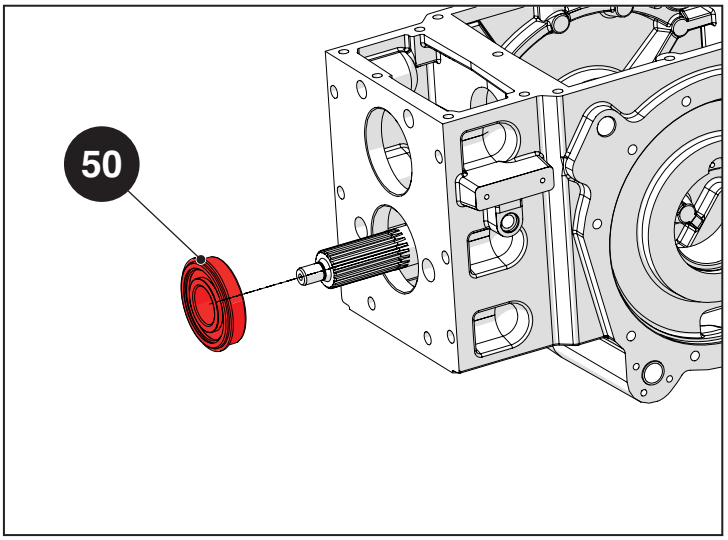


Fig. 5.44

Pinion / ring gear play adjustment

Position the complete ring gear of the differential in the differential housing.

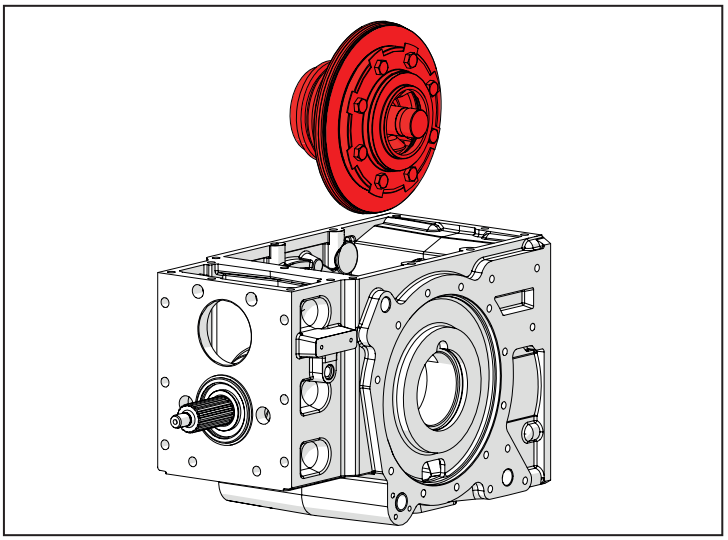


Fig. 5.45

Remove the crown wheels (38) and (39).

Insert the bearings (40) and (41), then seat them by using the plug (E-cod.07006226).

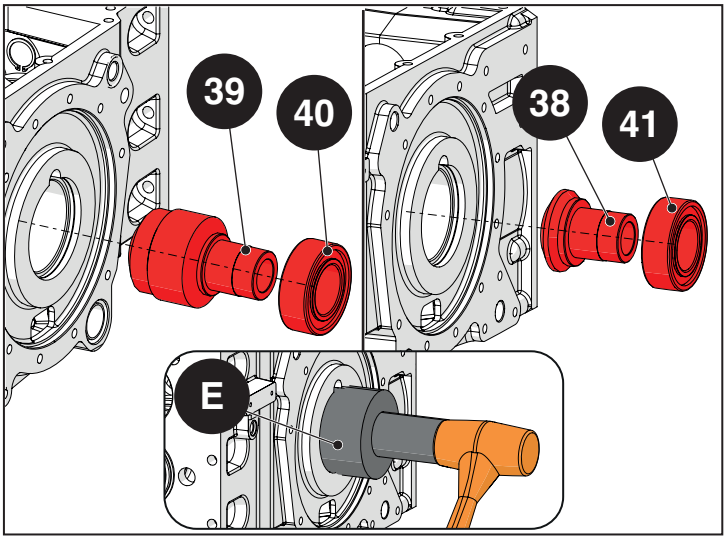


Fig. 5.46

Use tool (F-code 07000237) and fully tighten the left-hand ring nut (37) so as to eliminate the play between the pinion and ring gear.

> **Caution**
>
> Match any slits in the ring nut with the hole where the ring nut retainer is inserted.

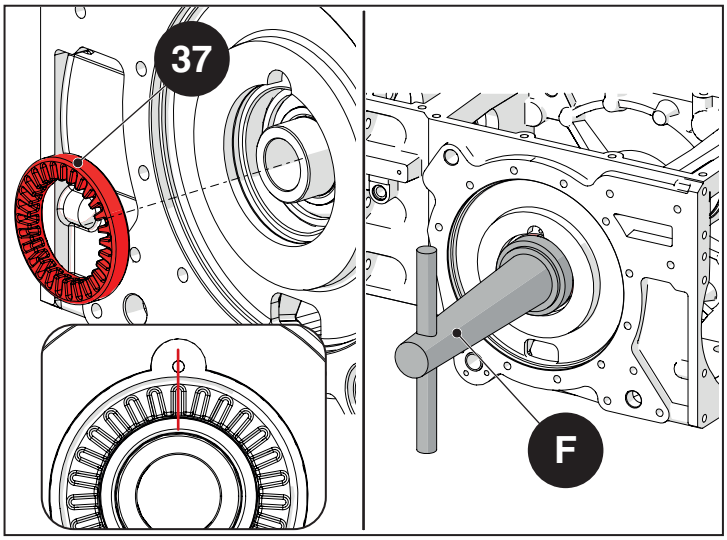


Fig. 5.47

Unscrew the ring nut by 3 grooves, using the ring nut retainer hole as a reference.

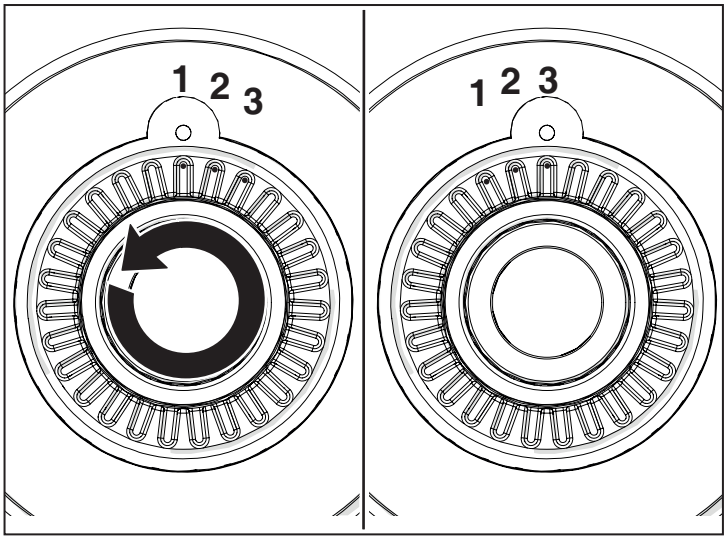


Fig. 5.48

Use tool (F-code 07000237) and fully tighten the right-hand ring nut (37) by applying a 20 Nm (2 kgm) tightening torque.

> **Caution**
>
> Match any slits in the ring nut with the hole where the ring nut retainer is inserted.

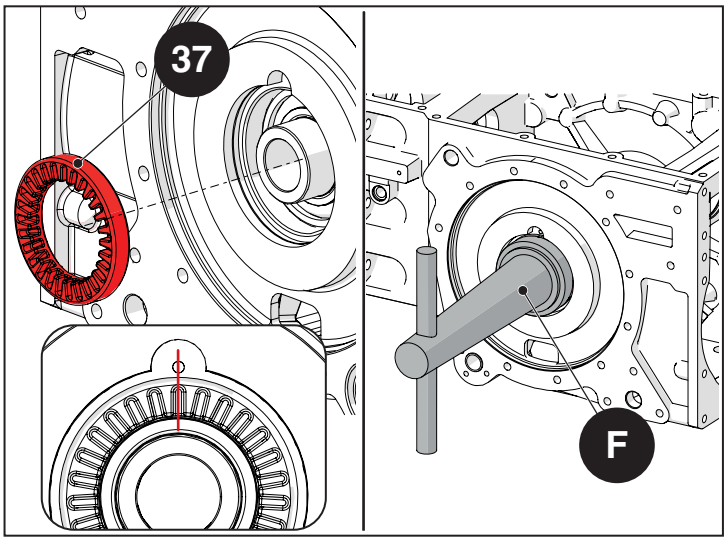


Fig. 5.49

Now measure the play that formed when the left-hand ring nut was unscrewed.

Position a comparator with magnetic base (G) on one of the ring gear teeth and reset it to zero.

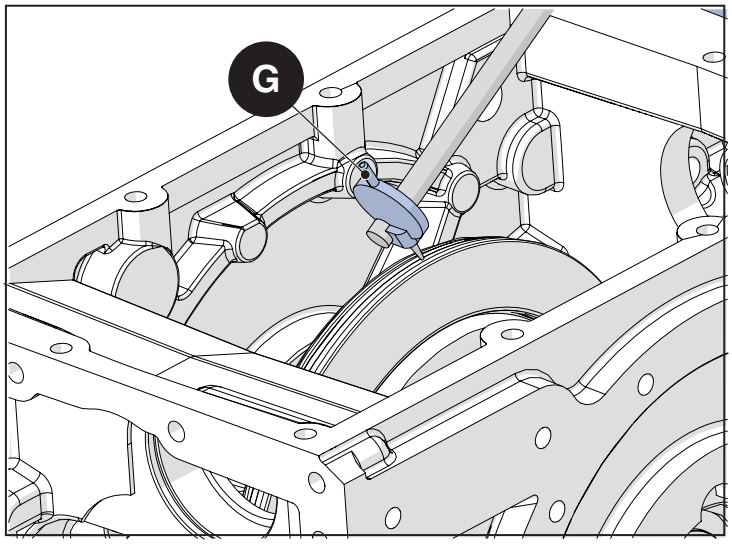


Fig. 5.50

Slightly move the ring nut so as to measure the play on the pinion teeth.

The play between the pinion and ring gear teeth must be 0.07 to 0.15 mm.

Caution

Take the measurements in at least 4 different points of the ring gear.

Note

If the play does not fall within the given values, tighten or loosen the ring nut (37) on the ring gear side.

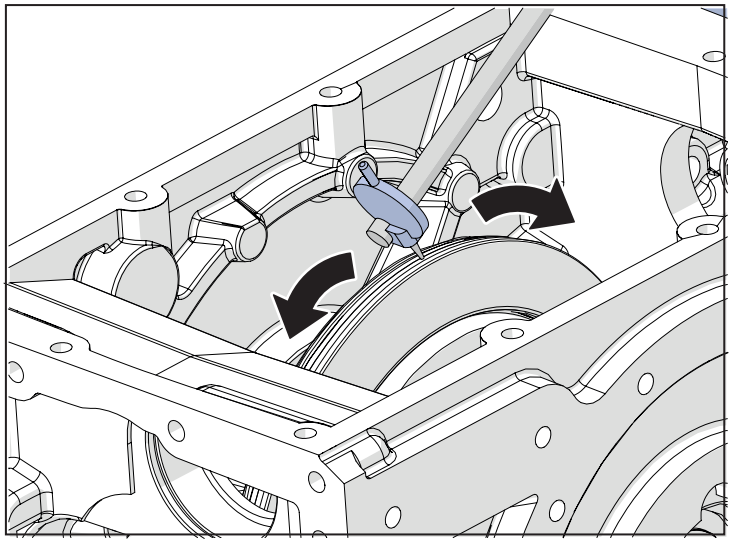


Fig. 5.51

Use tool (F-code 07000237) and fully tighten the right-hand ring nut (37).

Now unscrew it in the anti-clockwise direction by 5 grooves, using the ring nut retainer hole as a reference.

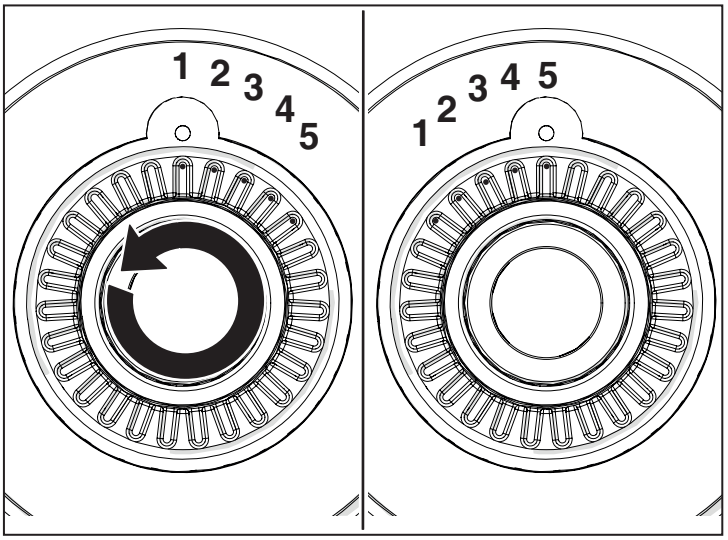


Fig. 5.52

To make sure that the preload is correct on both sides, tap with a mallet on the planetary gear (59) on the ring gear.

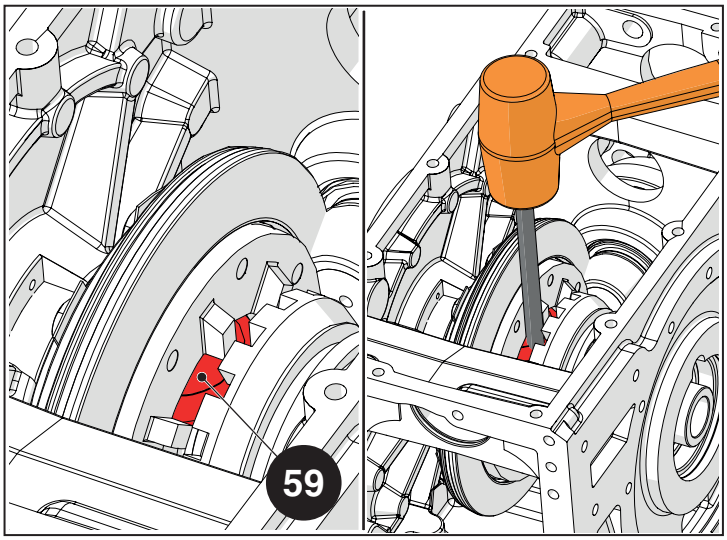


Fig. 5.53

Continue to press down on the planetary gear (59), then attempt to turn one of the crown wheels (38) or (39) and check that, in this phase, the play between the teeth of the pinion and ring gear has been completely eliminated.

Adjust the right-hand ring nut if there is a still play between the teeth.

Caution
Check both the crown wheels.

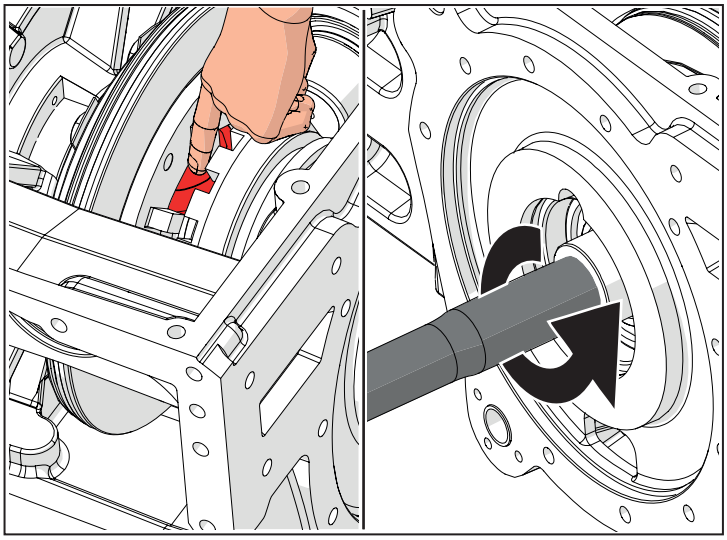


Fig. 5.54

Tighten the ring nut retainer (36).

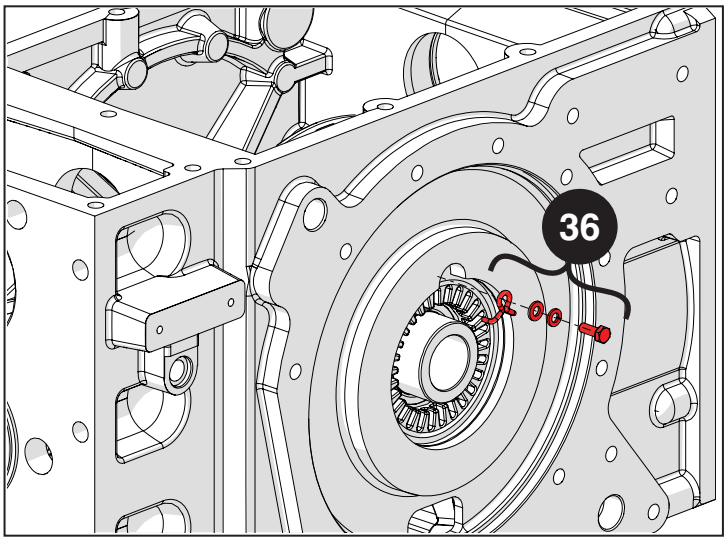


Fig. 5.55

Assemble the oil retainer (35).

Insert the selection lever (32) complete with spring (33) and spacer (34), then lock the lever with the centring pin.

Insert the selector pin (31).

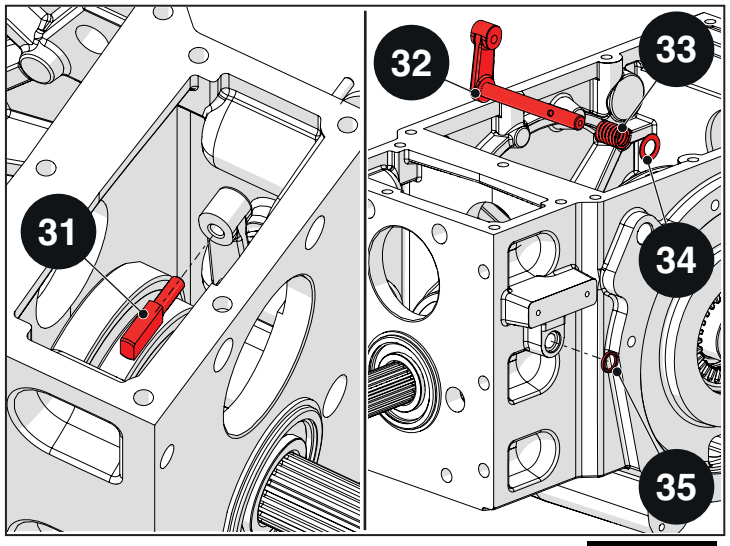


Fig. 5.56

Assemble the circlip (28) on the P.T.O. shaft (24), then use a plug of a suitable diameter to fully seat the bearing (26).

Caution

Insert the circlip (28) upside down so as to facilitate the disassembly operations.

Take care not to bend the circlip when the bearing is installed.

Insert the circlips (27) and (29).

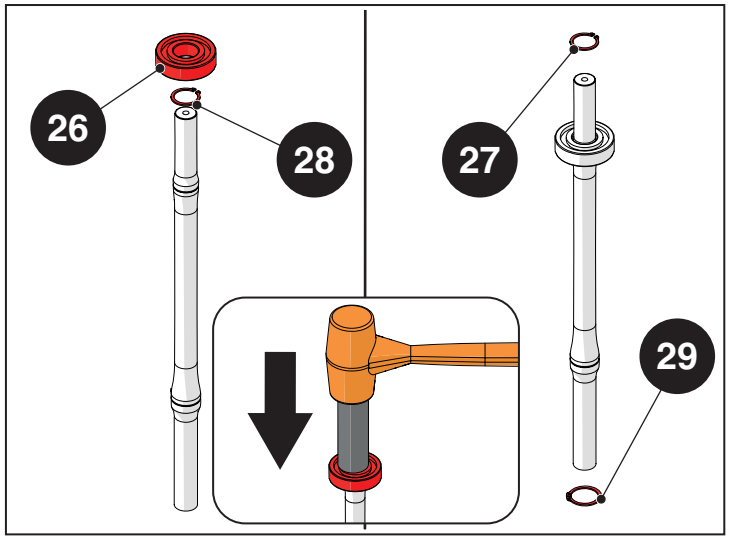


Fig. 5.57

Fit the complete shaft (24) into the differential housing. Make sure that it aligns with the gear (30).

Align the gear (30) with the selector pin (31) at the same time.

Caution

Tap the shaft (24) with a mallet made of soft material so as to fully seat the bearing (26).

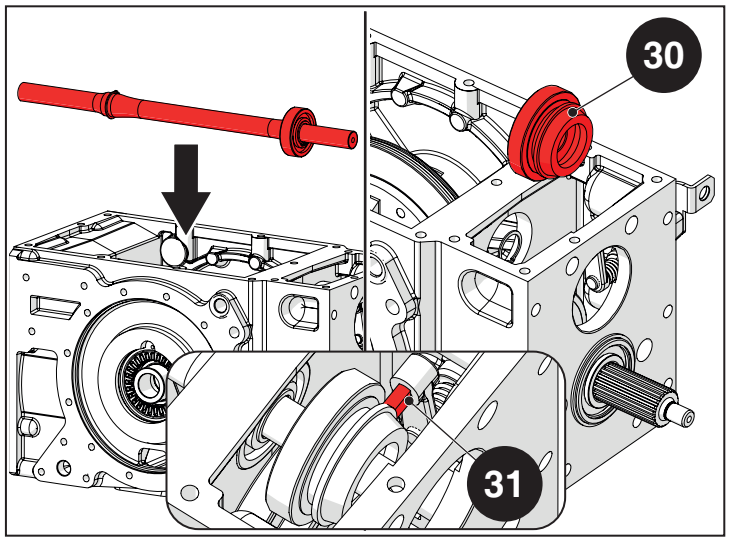


Fig. 5.58

Use a plug of a suitable diameter to insert the bearing (25) and seat it onto the circlip (29).

Caution

Take care not to bend the circlip when the bearing is installed.

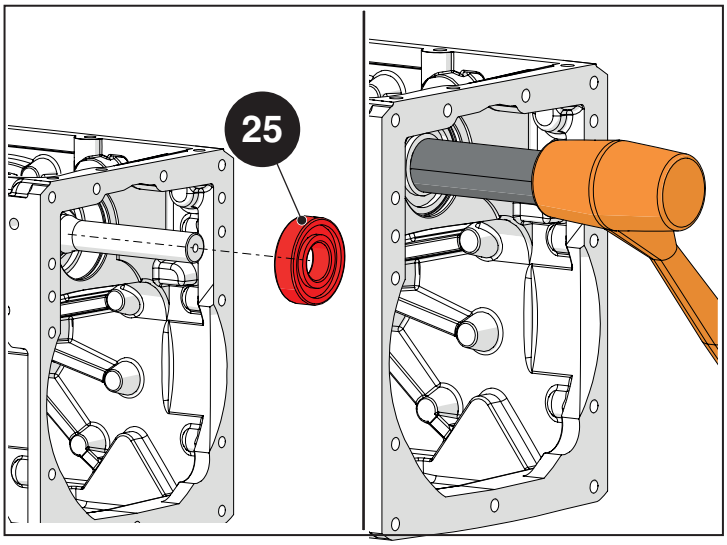


Fig. 5.59

Insert the circlip (23);

Insert the following components in the given order:

- gear (22);
- spacer (21);
- gear (20);
- spacers (19) - one size 0.2 mm and the other 0.4 mm;

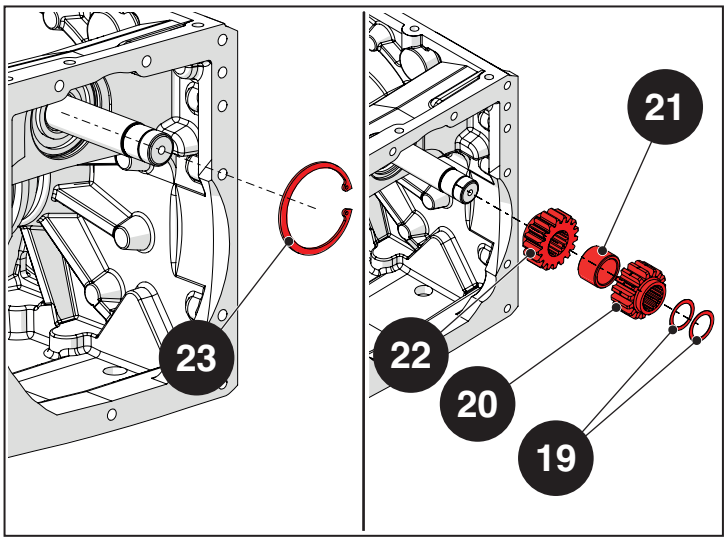


Fig. 5.60

Caution

Fit a spacer between the casing of the housing and the shaft to prevent it from moving and damaging the circlips.

Use a plug of an adequate diameter to completely seat the inner race of the bearing (18).

Assemble the outer race of the bearing (18) and the circlip (17).

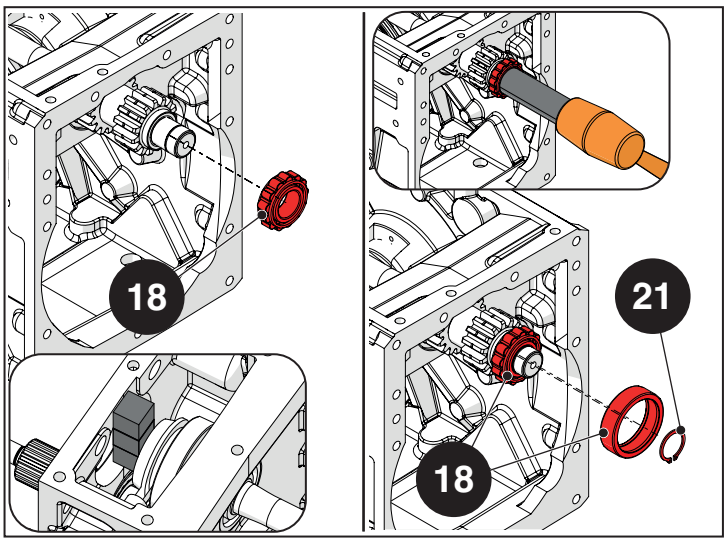


Fig. 5.61

Pre-assemble the rod (12) with the O-Rings (16) and circlip (15).

Fit the the rod (12), spring (14) and fork (13) into the differential housing.

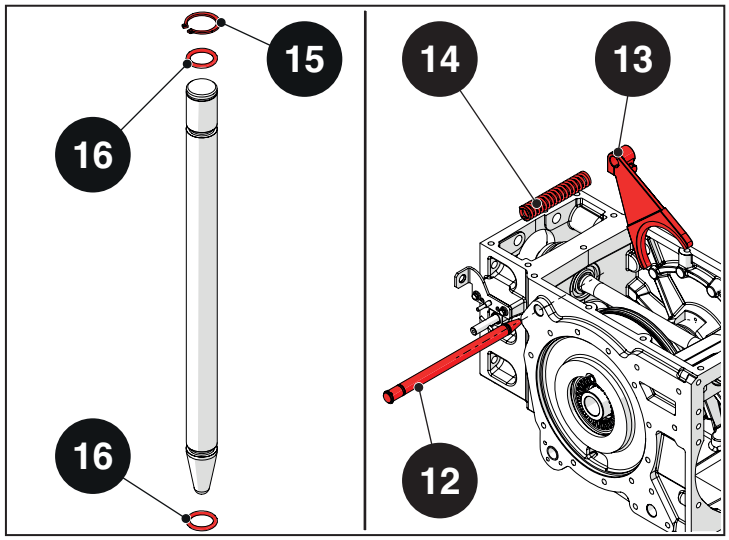


Fig. 5.62

Insert the spring rings (62) into the piston (63).

Apply a layer of grease to the cylinder of the lever (64), then insert the piston.

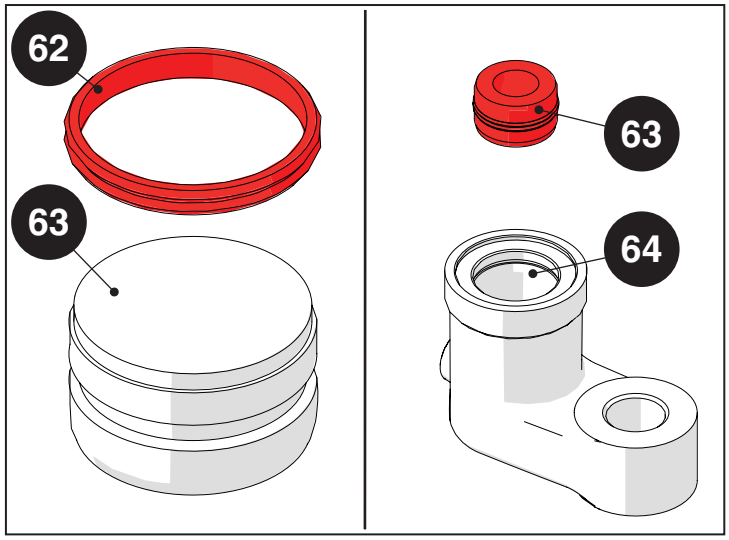


Fig. 5.63

Push the piston fully into the cylinder and then fit the circlip (65) into its housing.

Make sure that the piston slides smoothly by blowing compressed air into the hole until it reaches the circlip (65).

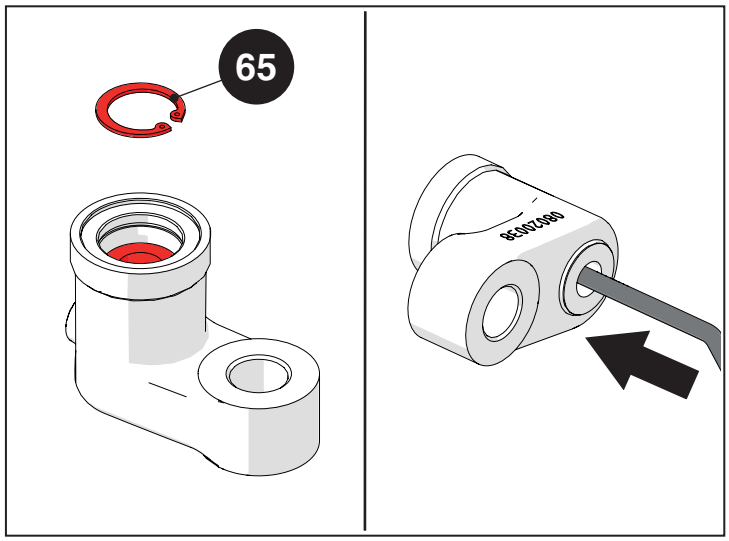


Fig. 5.64

Screw tool (H-07007183) onto the cylinder to keep it against the circlip (65).

Assemble the stud bolt (66), lever (67), cylinder (64) and washers (68) on the differential unit.

Tighten the nut (69).

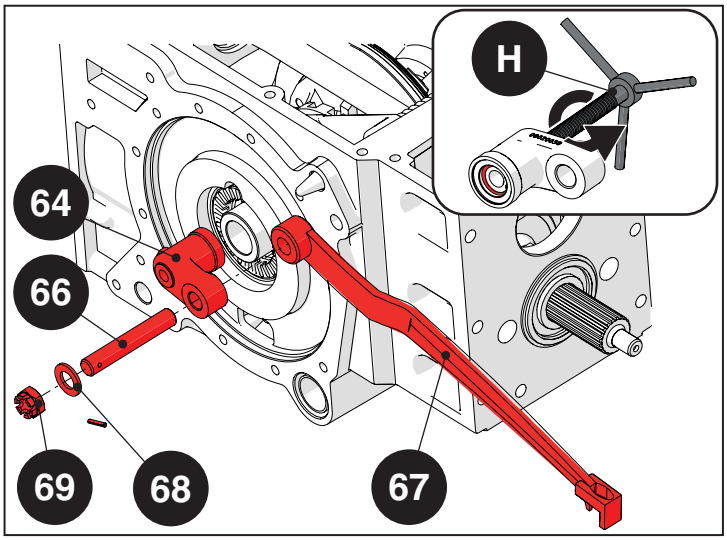


Fig. 5.65

After having assembled the lever of the differential lock, adjust the travel of the fork by checking that a 1.5 to 2 mm gap remains between the differential lock ring and ring gear teeth.

Screw tool (H-07007183) into the hole again so as to push the piston (63) and, consequently, the rod (12).

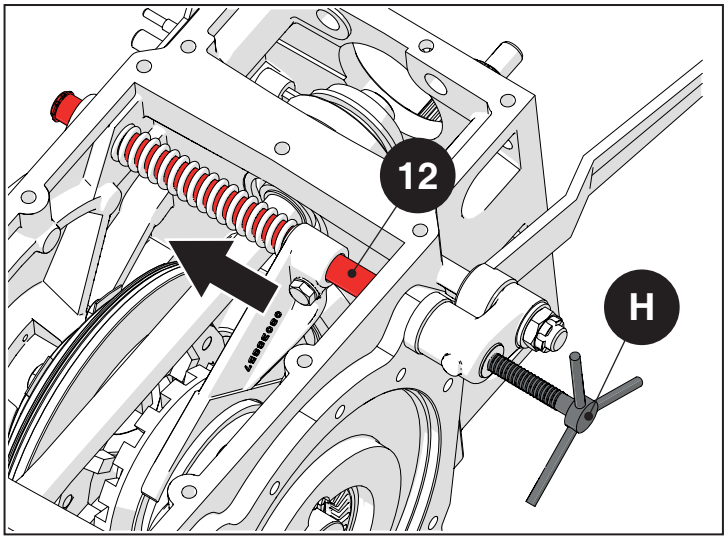


Fig. 5.66

Move the fork (13) with a lever so as to load the spring (14).

Push the rod (12) fully against the piston (63).

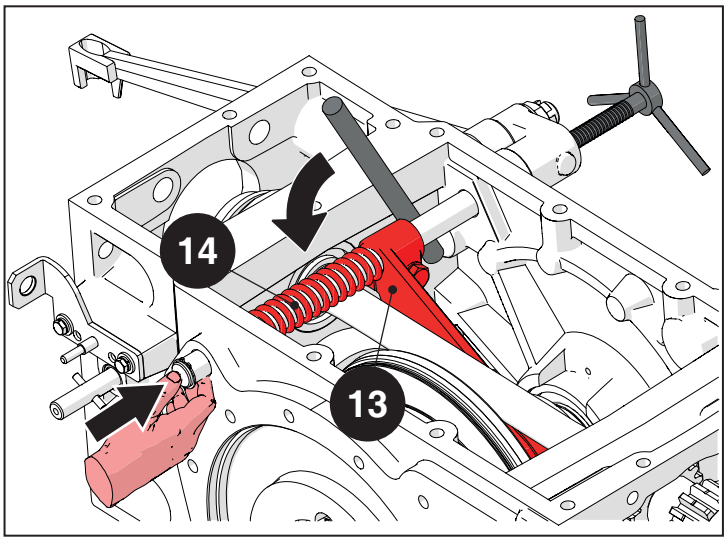


Fig. 5.67

Relieve the spring (14) by making the fork (13) travel 1.5-2 mm.

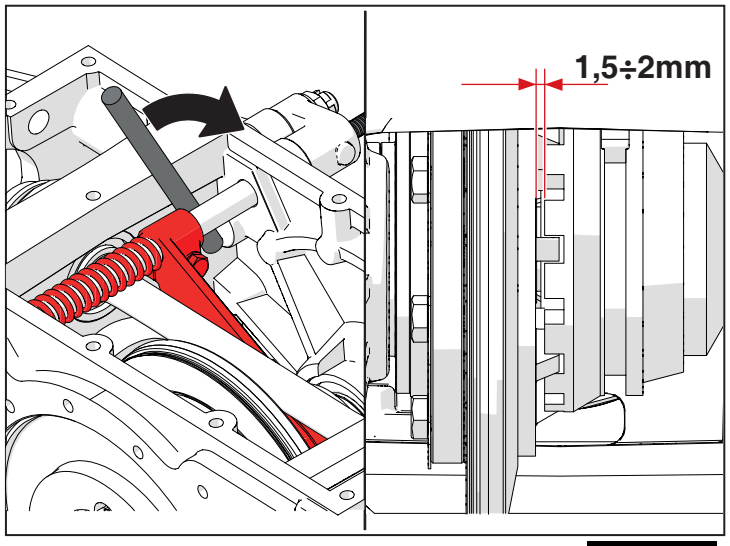


Fig. 5.68

Tighten the fixing screw of the fork (13) onto the rod (12).

Unscrew tool (H) and fully relieve the spring (14).

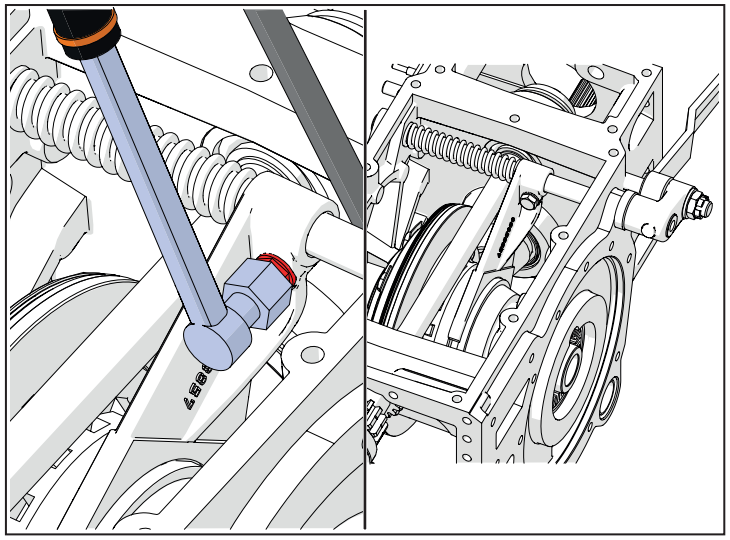


Fig. 5.69

P.T.O. selection lever adjustment

Put the selection lever in neutral.

Assemble tool (G-code 07001643) on the differential housing, aligning the plug of the tool with the gear race (30).

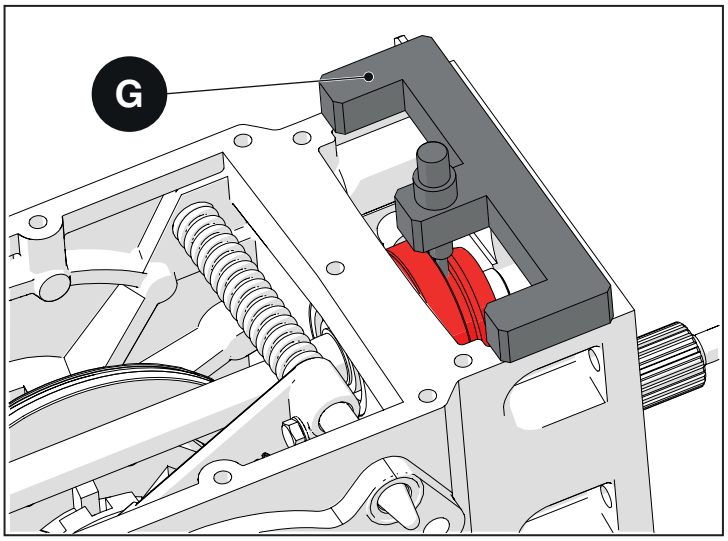


Fig. 5.70

Tighten the screws and washers to fix the selector plate in position.

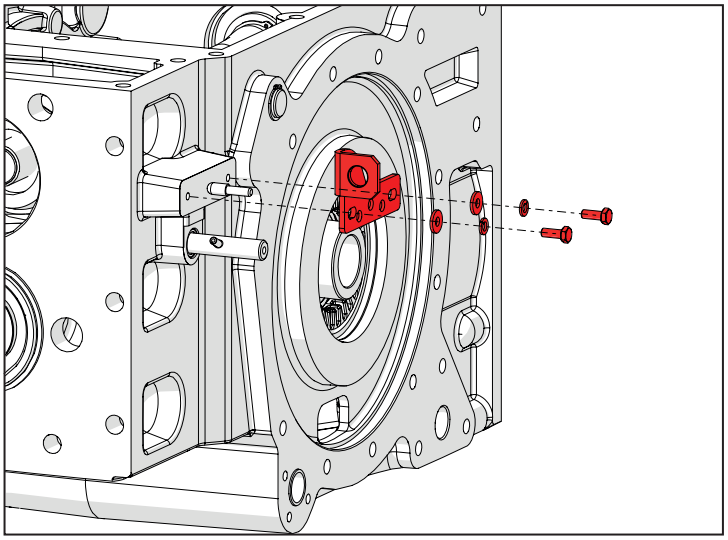


Fig. 5.71

Apply TEFLON to the stud bolt on a level with the through hole so as to prevent leaks.

Apply a layer of SILICONE to the surface on which the gearbox couples with the differential.

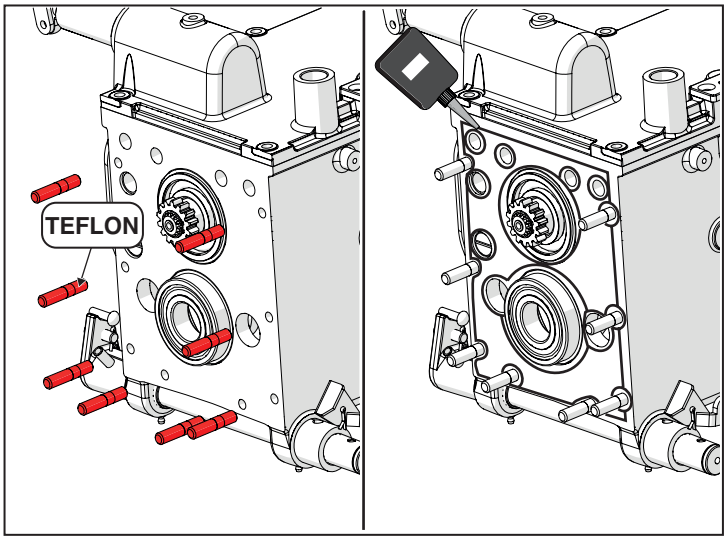


Fig. 5.72

Align the gearbox with the differential.

> **Caution**
>
> Engage the speed gears to make it easier to couple the units.

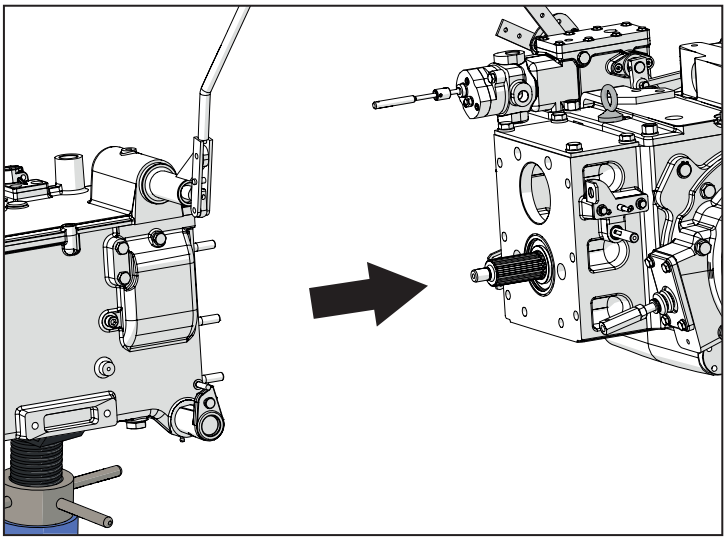


Fig. 5.73

Insert the washers (5) and tighten the screws (4) by applying 160 Nm (16 kgm) tightening torque.

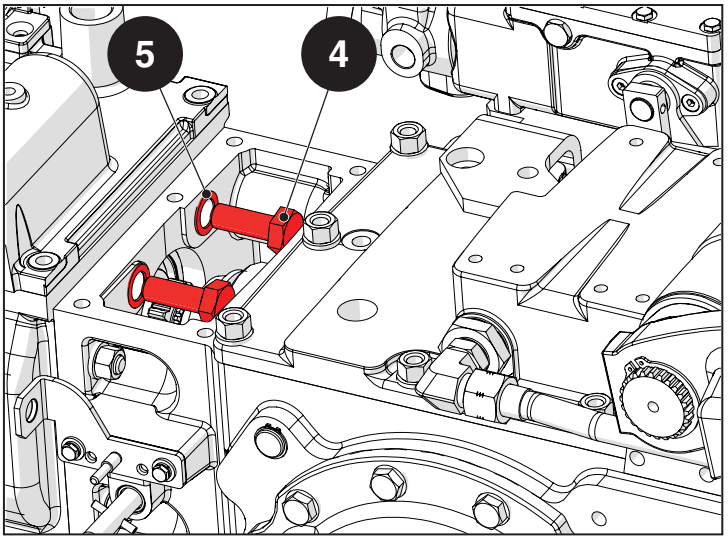


Fig. 5.74

Tighten the two self-locking nuts.

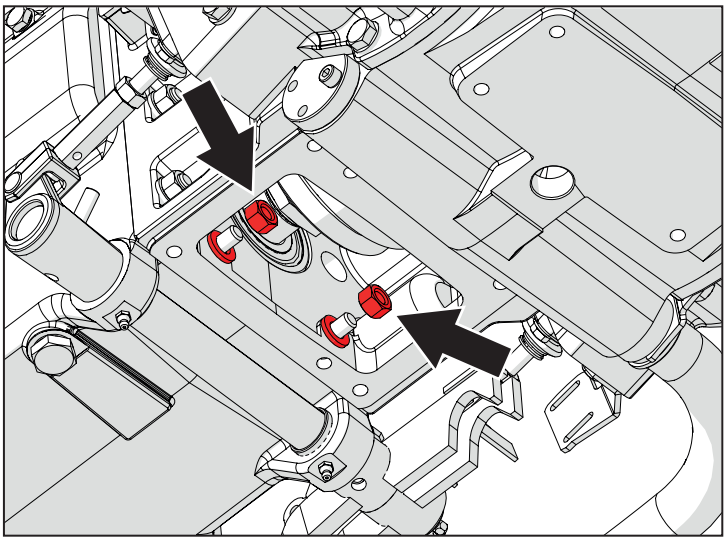


Fig. 5.75

Insert the washers (7) and tighten the nuts (6) by applying 85 Nm (8.5 kgm) tightening torque.

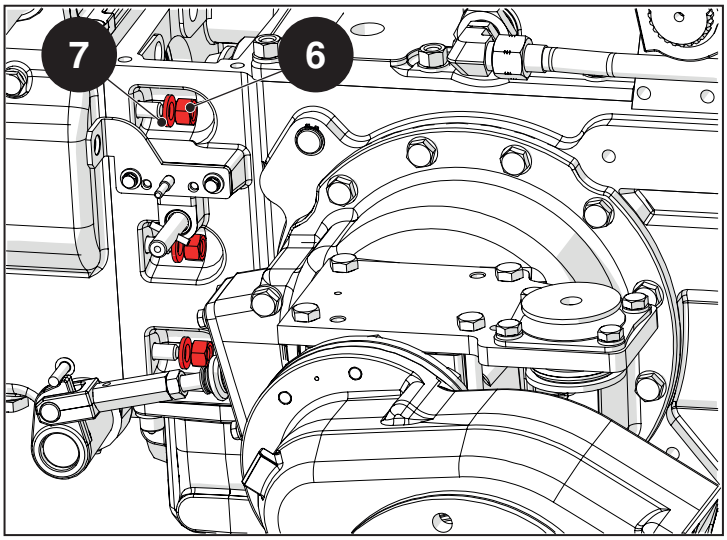


Fig. 5.76

Apply a layer of SILICONE to the coupling surface.

Insert the complete drive transmission unit.

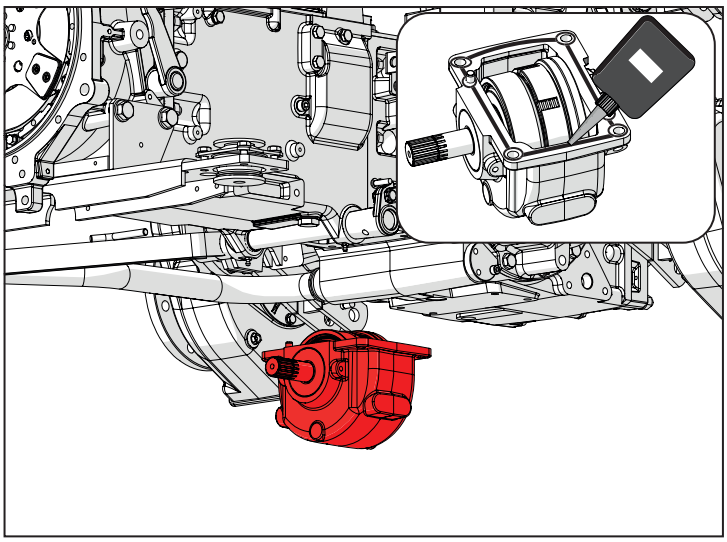


Fig. 5.77

Insert the washers and tighten the screws by applying 85 Nm (8.5 kgm) tightening torque.

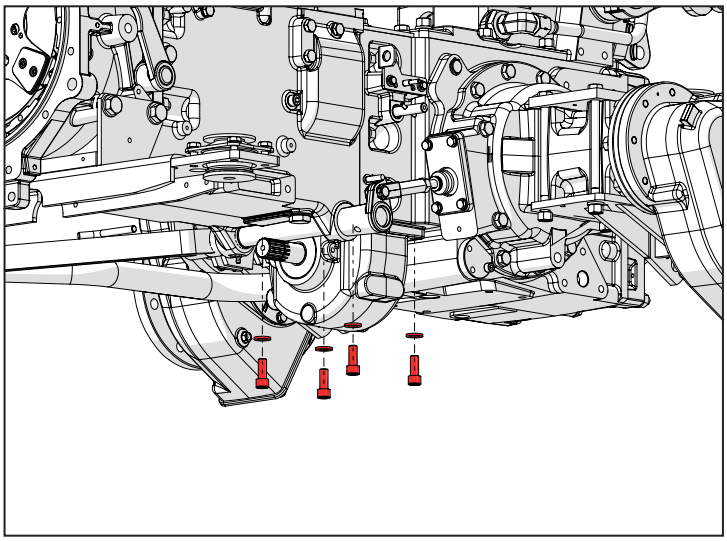


Fig. 5.78

Section 6 : Tightening torques

Index

6.1 Tightening torques.....5-44

6.1 Tightening torques

The main tightening torque values are listed below. Consult chapter "1- Introduction" for the remaining tightening torques.

Screws and nuts to be tightened	Nm	kgm
M12x12 nut for fastening differential housing-gearbox	85	8.5
M18x1.5 screw for fastening differential housing-gearbox	160	16
M12x12 nut for fastening differential housing-hitch	85	8.5
M12x30 screw for fixing rear hitch cover	85	8.5
M12x12 nut for fastening differential housing-rear P.T.O. cover	85	8.5
M12x40 screw for fastening differential housing-hubs	85	8.5
M12x35 screw for fastening differential housing-drive transmission support	85	8.5
M10x50 screw for fastening bevel gear pair	90	9
M10x35 screw for fastening diff lock control fork	55	5.5
Ring nut for fastening bevel pinion	40	4
Ring nut for fastening differential	20	2
Ring nut for fastening P.T.O. shaft	25	2.5

Section 7 : Tools required

Index

7.1 Tools required 5-46

7.1 Tools required

Code	Description	Quantity
07000237	Ring nut wrench - 1363	1
07000239	Tool 1363/20 - 1363	1
07000247	Differential support	1
07006221	Plug for multiple chiseling of pinion ring nut	1
07006223	Plug for assembling differential taper bearings	1
07006224	Plug for assembling bevel pinion taper bearings	1
07006225	Bevel pinion retainer tool	1
07006226	Plug for assembling differential crown wheel bearing	1
07001643	P.T.O. selection lever adjuster tool	1
07007183	Tool for assembling rear diff lock locking cylinder	1
07000215	Gearbox - base unit support	1
07000245	Tractor splitting support	1

Chapter 6 : Rear final drives

Index

Section 1 : Safety notes 6-2

Section 2 : General introduction 6-3

2.1 Drawing of the assembly 6-4

Section 3 : Disassembly 6-5

3.1 Disassembly 6-6

Section 4 : Main inspection, re-assembly and adjustment operations 6-11

4.1 Main inspection, re-assembly and adjustment operations 6-12

Section 5 : Tightening torques 6-19

5.1 Tightening torques 6-20

Section 6 : Tools required 6-21

6.1 Tools required 6-22

Section 1 : Safety notes

To prevent accidents and injuries, always comply with the precautions and safety recommendations described in this section. In addition, operators must always comply with the safety instructions given in the operation and maintenance manual and in chapter 1 of this manual.

Danger

Make sure that all persons keep well away from the danger zone.

Danger

Lift and handle all heavy parts with lifting equipment of an adequate capacity. Arrange all harness and hooks in safe positions. Operators must remain at a distance and in a safe position, well away from the lifted load.

Danger

Do not twist the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Danger

Use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.

Danger

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

Danger

For safety reasons, always leave two screws on opposite sides when removing components that could fall. Only remove these screws after having secured the component to lifting equipment or placed bearing blocks underneath.

Danger

If the bolts that fix the safety frame or cab have loosened or if the safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

Caution

Keep clear of the sharp edges around the top of the transmission housing.

Caution

Used oil must be collected and disposed of in compliance with the anti-pollution laws in force.

Section 2 : General introduction

Index

2.1 Drawing of the assembly 6-4

2.1 Drawing of the assembly

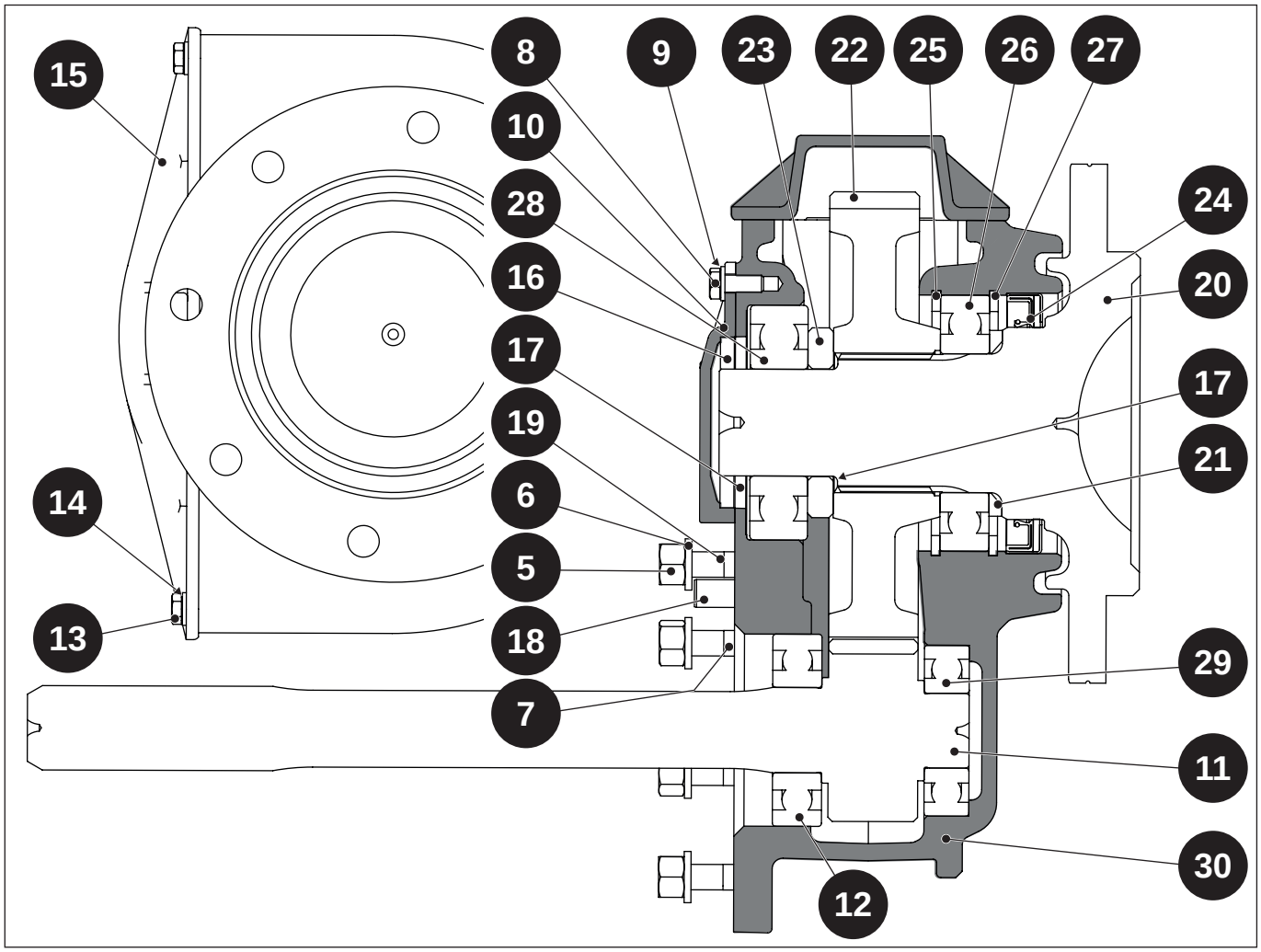


Fig. 6.1

5 - Nut
6 - Washer
7 - Plate
8 - Screw
9 - Washer
10 - Cover
11 - Pinion
12 - Bearing
13 - Screw
14 - Washer
15 - Cover
16 - Ring nut
17 - Retainer washer
18 - Centring pin
19 - Stud bolt
20 - Axle shaft
21 - Spacer
22 - Final drive gear
23 - Spacer
24 - Oil retainer
25 - Circlip
26 - Bearing
27 - Circlip
28 - Bearing
29 - Bearing
30 - Rear final drive casing

Section 3 : Disassembly

Index

3.1 Disassembly 6-6

3.1 Disassembly

Caution

The following instructions apply to both final drives. Bear in mind that the ring nut (16) on the left final drive has a left-hand thread, while the ring nut on the right final drive has a right-hand thread. Moreover, the left axle shaft (20) is shorter than the one on the right.

Use a hammer and chisel to release the nuts.

Unscrew the nuts (5) and remove the washers (6).

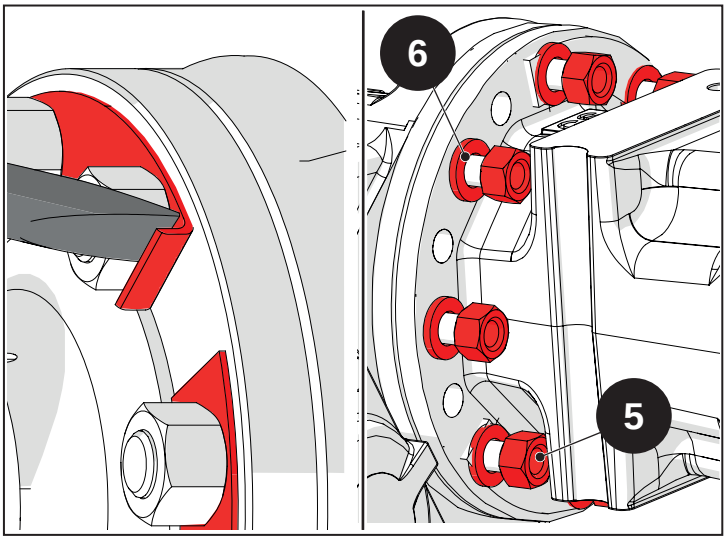


Fig. 6.2

Remove the plates (7).

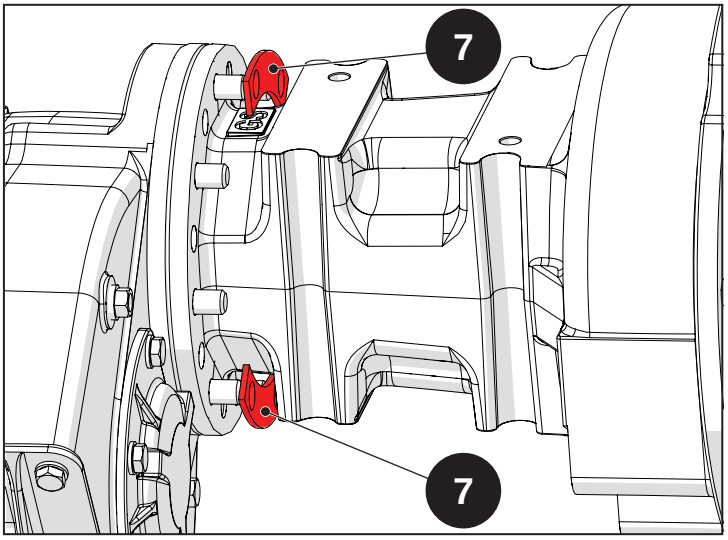


Fig. 6.3

Remove the complete final drive from the rear axle shaft, along with the O-Ring.

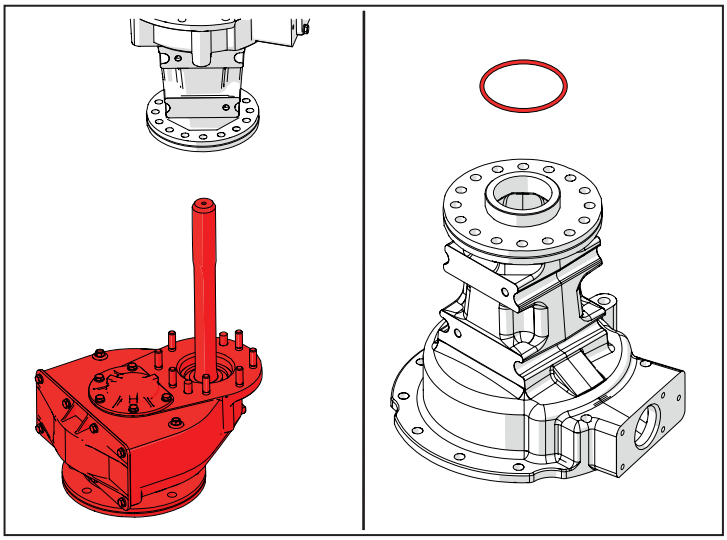


Fig. 6.4

Unscrew the screws (8) and remove washers (9) and cover (10).

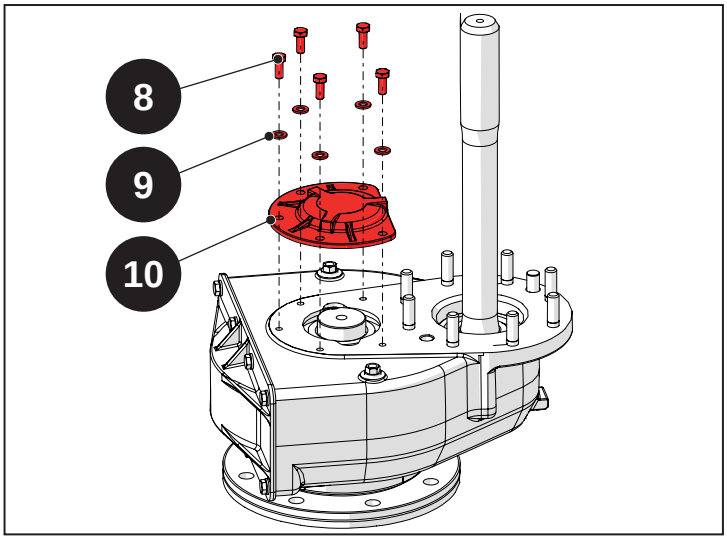


Fig. 6.5

Remove the pinion (11) from the final drive.

Remove the bearing (12) from the pinion (11).

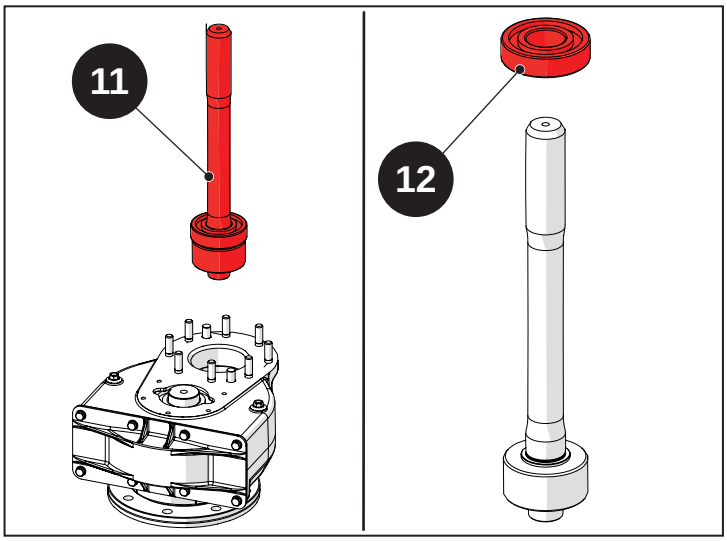


Fig. 6.6

Unscrew the screws (13) and remove washers (14) and cover (15).

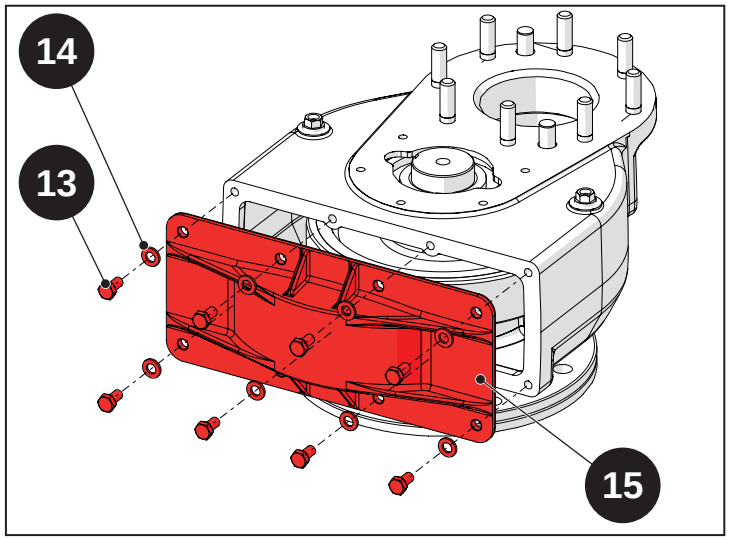


Fig. 6.7

Use tool (A-code 07000227) to remove the ring nut (16).

Remove the safety washer (17).

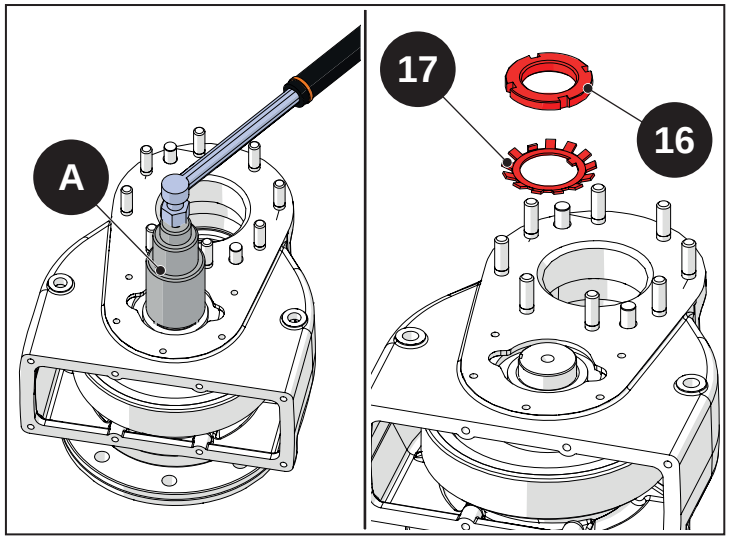


Fig. 6.8

Remove the rear axle shaft (20) from the casing, then remove the spacer (21).

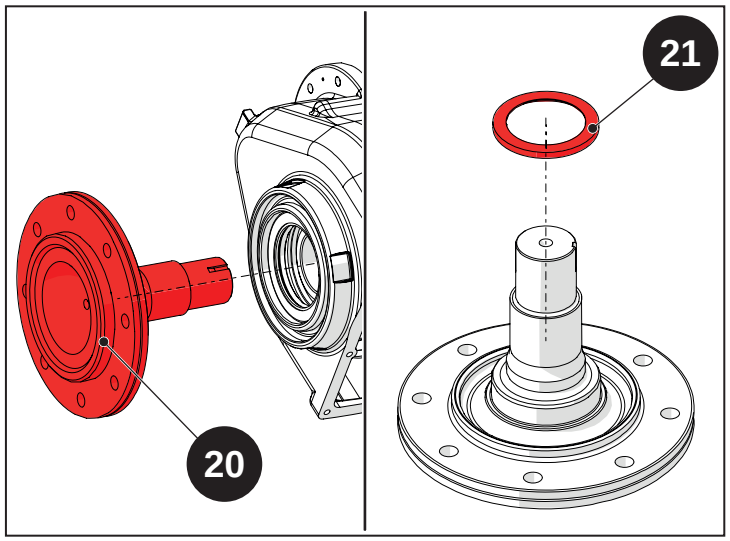


Fig. 6.9

Remove the reduction gear (22) and spacer (23) from the rear final drive housing.

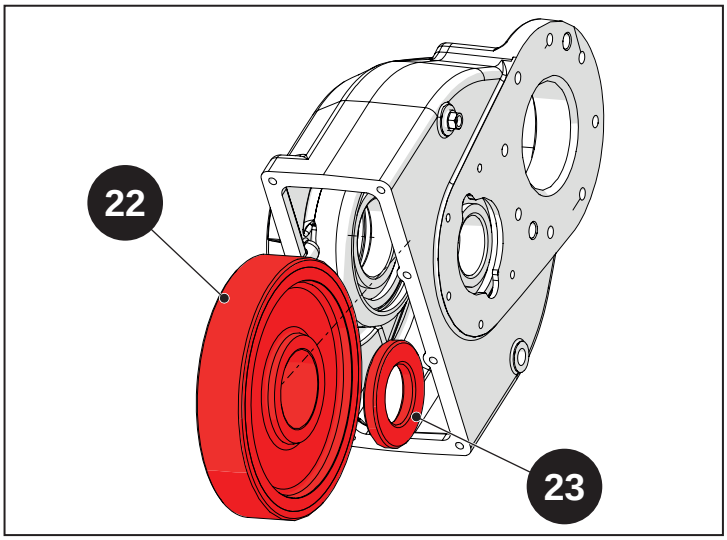


Fig. 6.10

Remove the oil retainer (24).

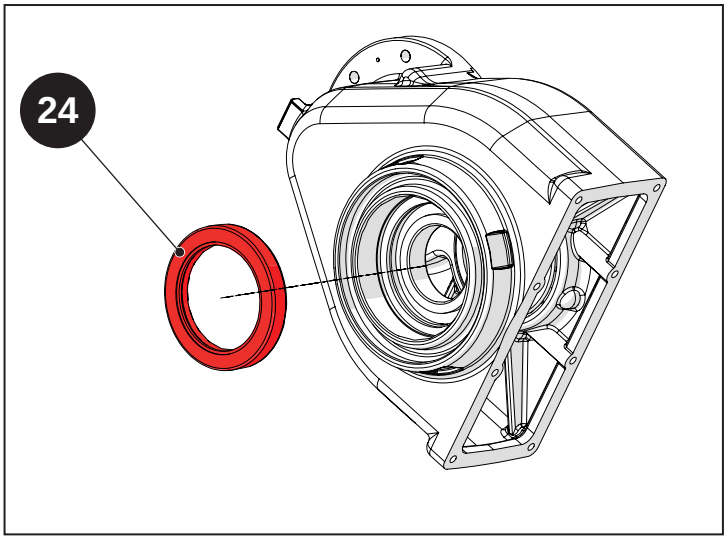


Fig. 6.11

Remove the circlip (25) and bearing (26).

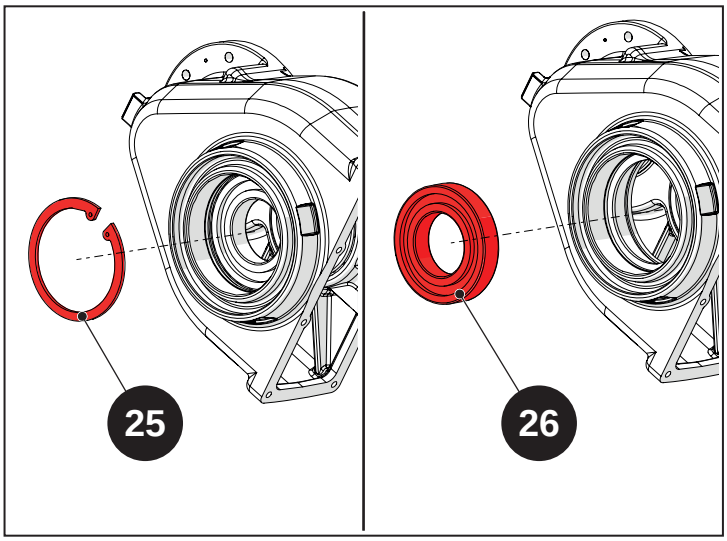


Fig. 6.12

Remove the circlip (27).

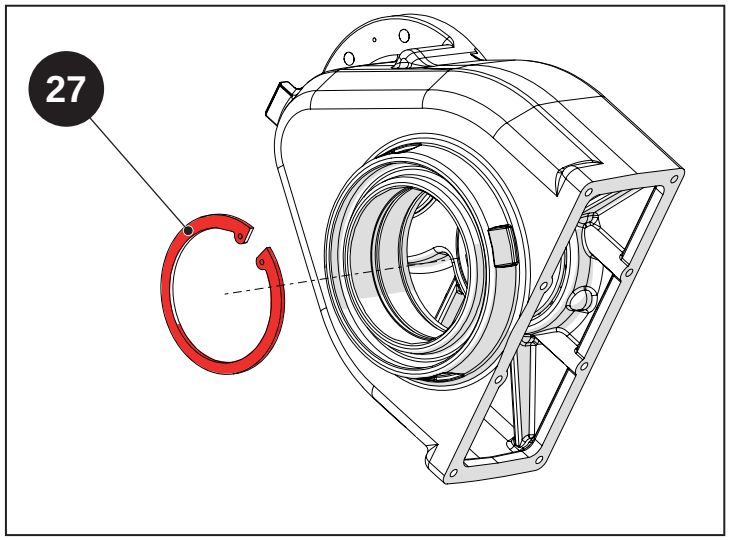


Fig. 6.13

Remove the bearing (28).

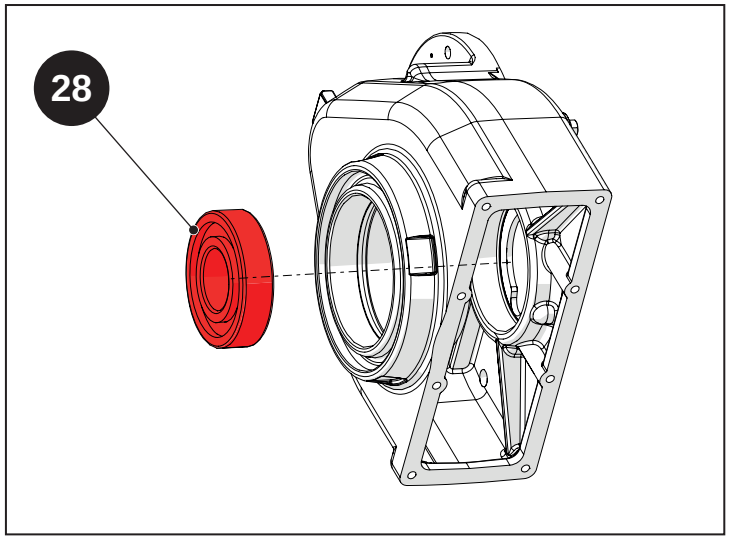


Fig. 6.14

Remove the bearing (29)

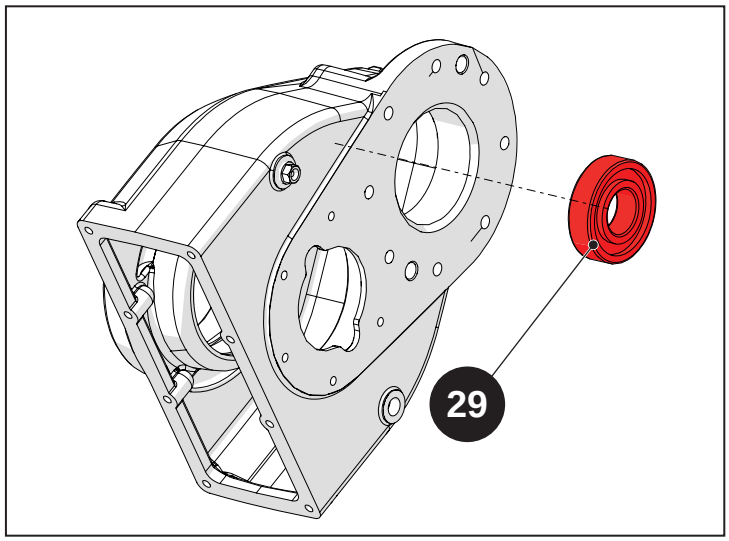


Fig. 6.15

Section 4 : Main inspection, re-assembly and adjustment operations

Index

4.1 Main inspection, re-assembly and adjustment operations.....6-12

4.1 Main inspection, re-assembly and adjustment operations

Warning

Before proceeding with the re-assembly operations, carefully read and comply with the instructions given in chapter "1-Introduction", especially those describing how to assemble O-Rings, oil retainers and bearings.

Use the correct tightening torques when screwing in the components. Consult the table in chapter "1-Introduction" if the tightening torque value is not given.

Use the indicated sealants when re-assembling the parts. Consult the table in chapter "1-Introduction" if the sealant is not indicated.

Apply a layer of SILICONE to the threads, then tighten the plugs (31).

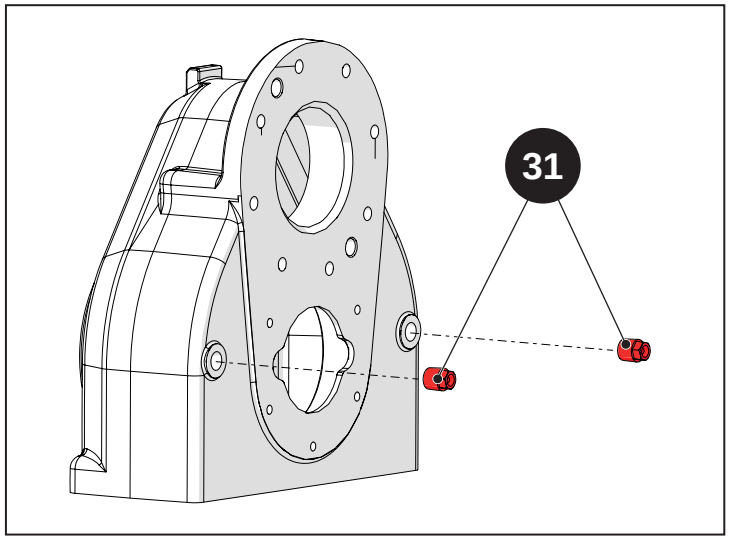


Fig. 6.16

Use a plug of a suitable diameter to insert the bearing (29) onto the rear final drive casing.

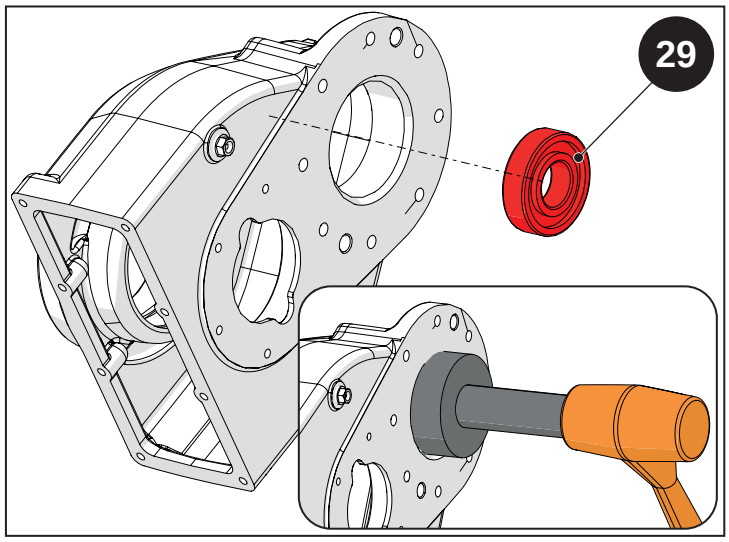


Fig. 6.17

Use a plug of a suitable diameter to insert the bearing (28) onto the rear final drive casing.

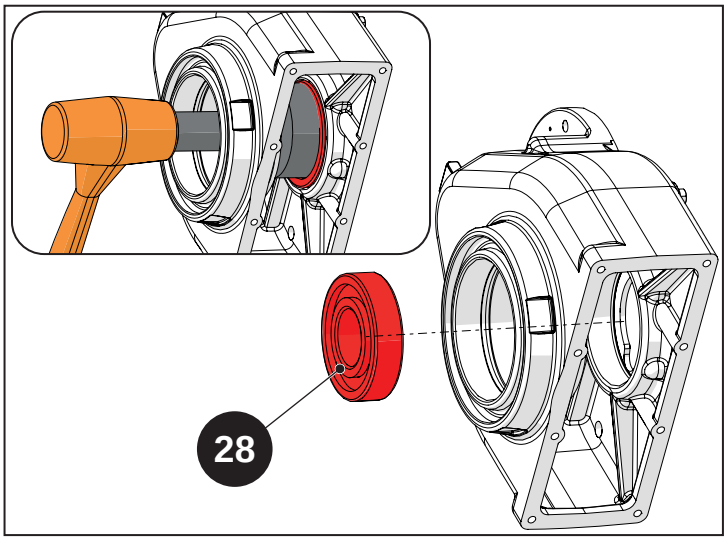


Fig. 6.18

Insert the circlip (27);

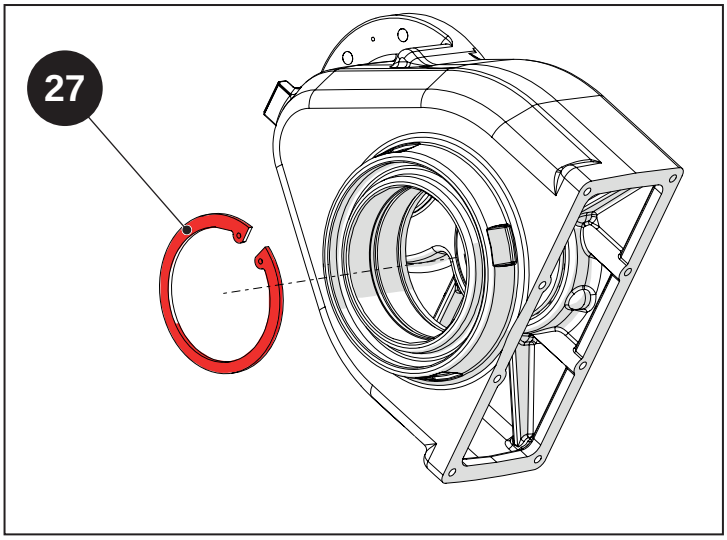


Fig. 6.19

Insert the bearing (26) and then the circlip (25).

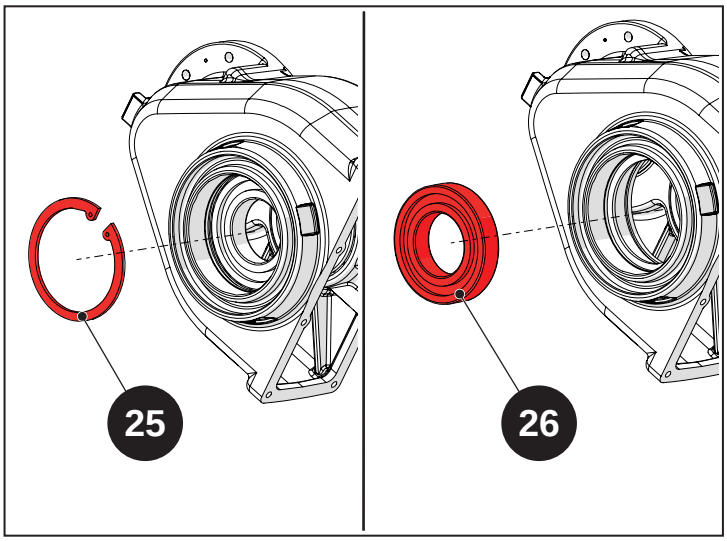


Fig. 6.20

Fit the oil retainer (24) into its housing using a plug of adequate diameter.

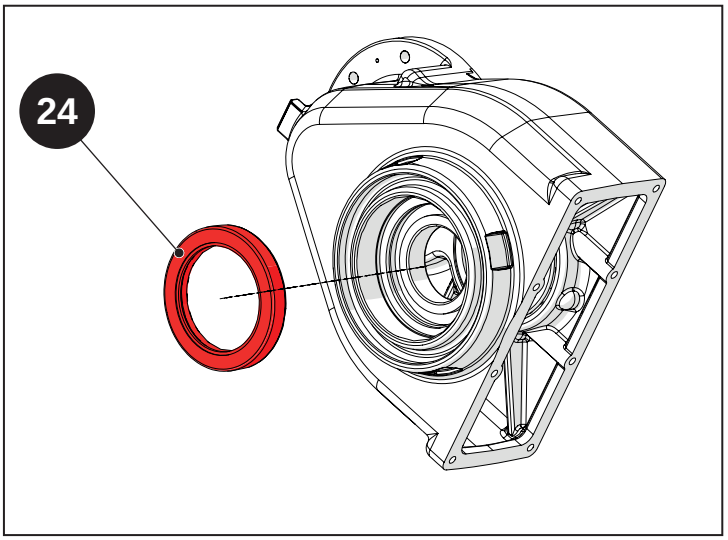


Fig. 6.21

Fit the reduction gear (22) and spacer (23) into the rear final drive housing.

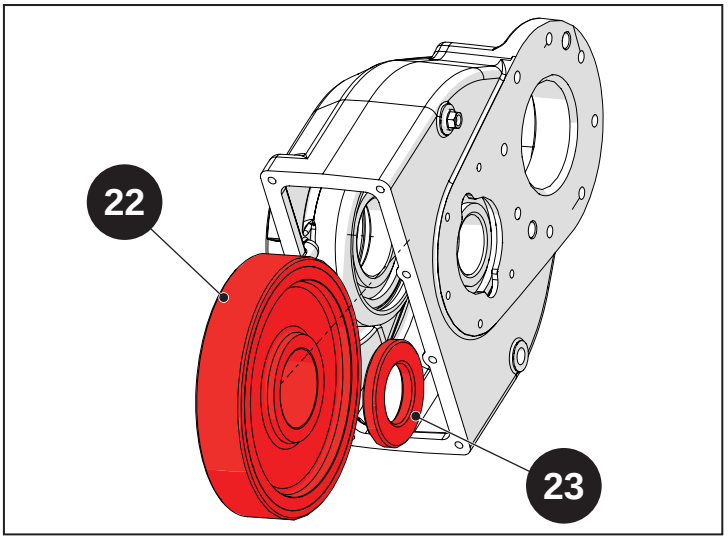


Fig. 6.22

Assemble the spacer (21) on the rear half axle (20), then fit the entire unit into the casing.

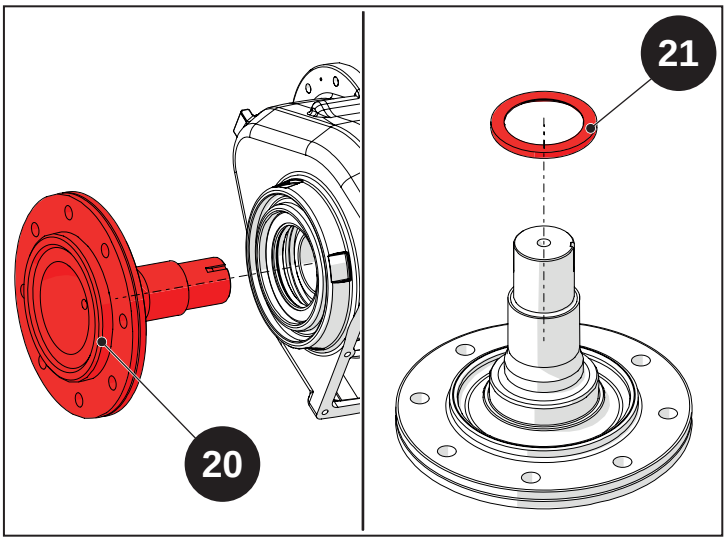


Fig. 6.23

Use a plug of an adequate diameter to completely seat the bearing (28).

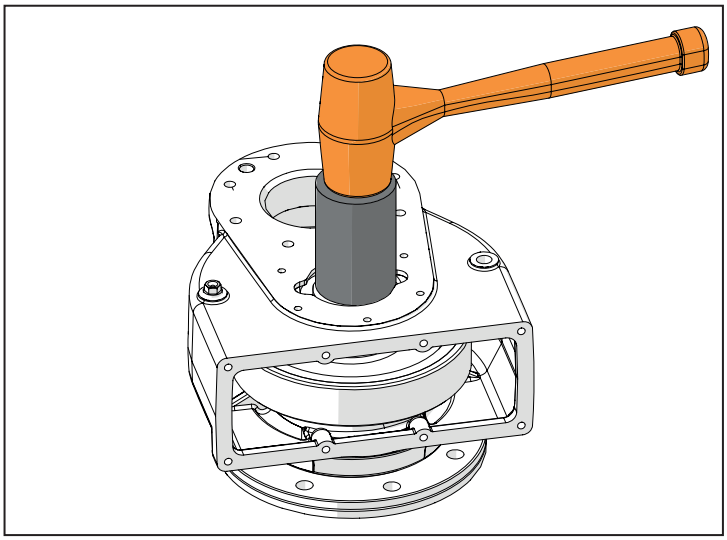


Fig. 6.24

Insert the pins (18) and tighten the stud bolts (19).

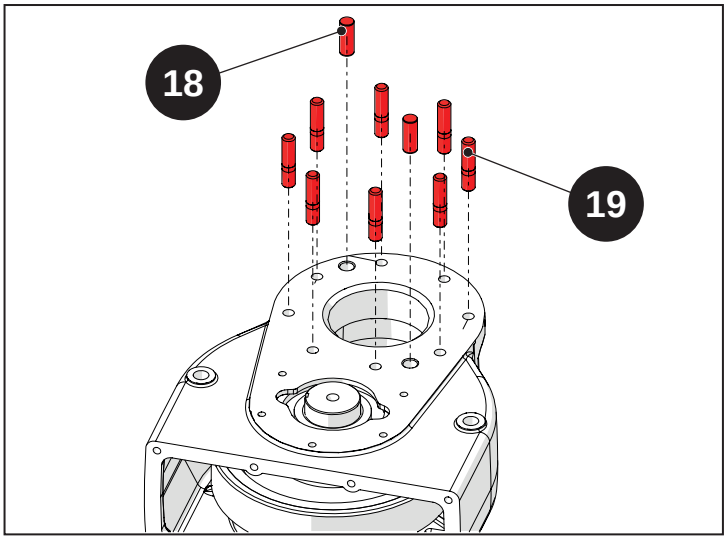


Fig. 6.25

Insert the safety washer (17) and ring nut (16).

Use tool (A-code 07000227) and tighten the ring nut (16) by applying a 250 Nm (25 kgm) tightening torque.

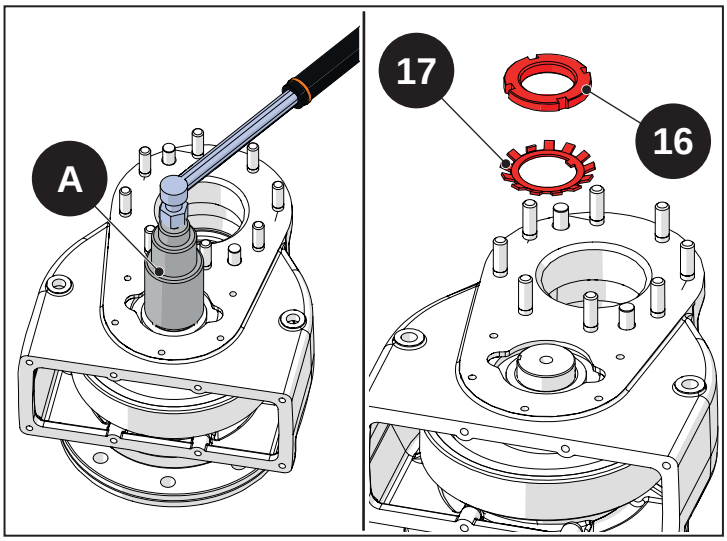


Fig. 6.26

Lock the ring nut (16) by raising the safety washer (17).

Chisel the ring nut (16).

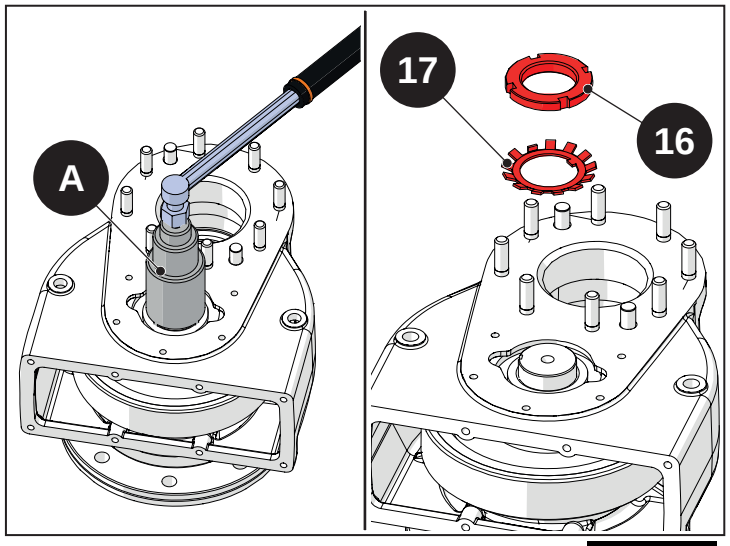


Fig. 6.27

Apply a layer of SILICONE to the coupling surface of the cover (15).

Assemble the cover (15) then fix it in place by inserting the washers (14) and tightening the screws (13) by applying 24 Nm (2.4 kgm) tightening torque.

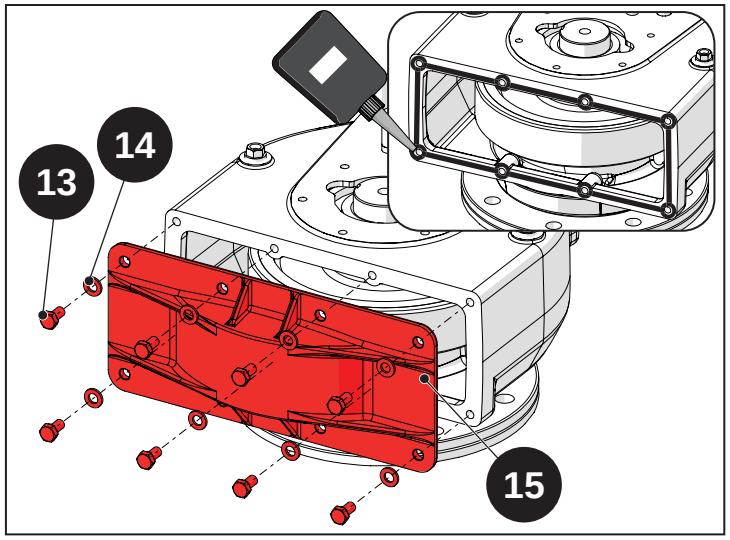


Fig. 6.28

Insert the bearing (12) onto the pinion (1).

Fit the pinion (11) into the final drive (43).

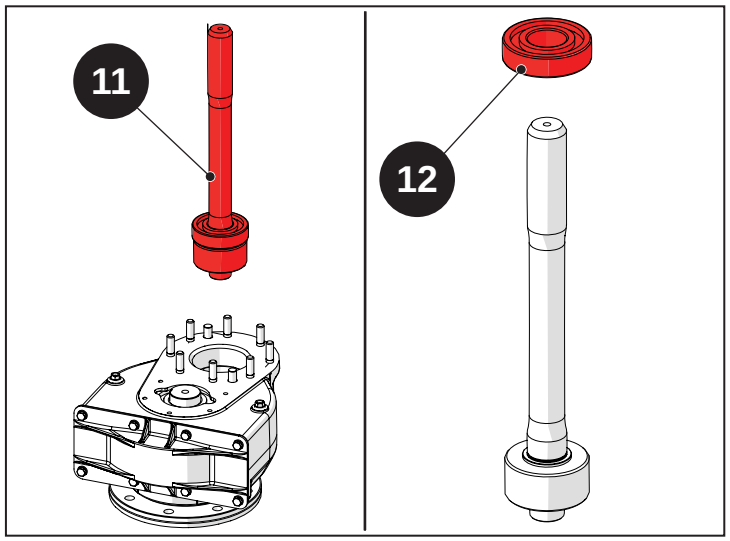


Fig. 6.29

Apply a layer of SILICONE to the coupling surface of the cover.

Fasten the cover (10) to the final drive with the washers (9) and screws (8) by applying 24 Nm (2.4 kgm) tightening torque.

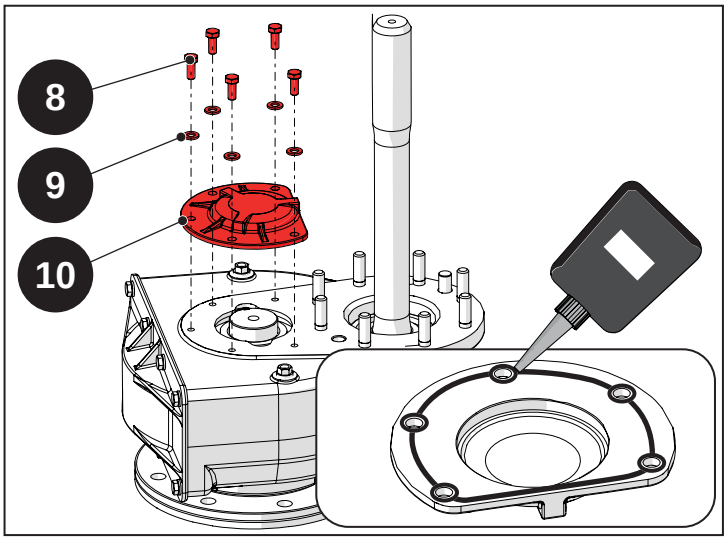


Fig. 6.30

Assemble the O-ring.

Apply a layer of SILICONE to the O-Ring.

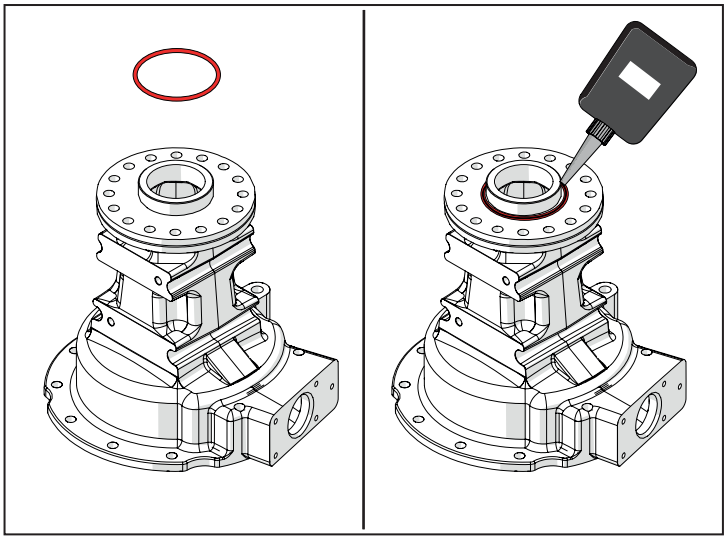


Fig. 6.31

Insert the plates (7).

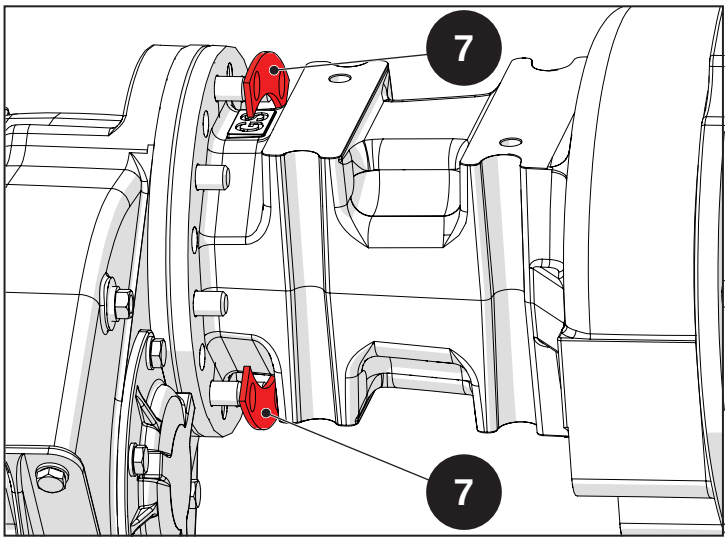


Fig. 6.32

Insert the washers (6) and tighten the nuts (5) by applying 80 Nm (8 kgm) tightening torque.

Use a hammer and chisel to clinch the plates (7) over the nuts (5).

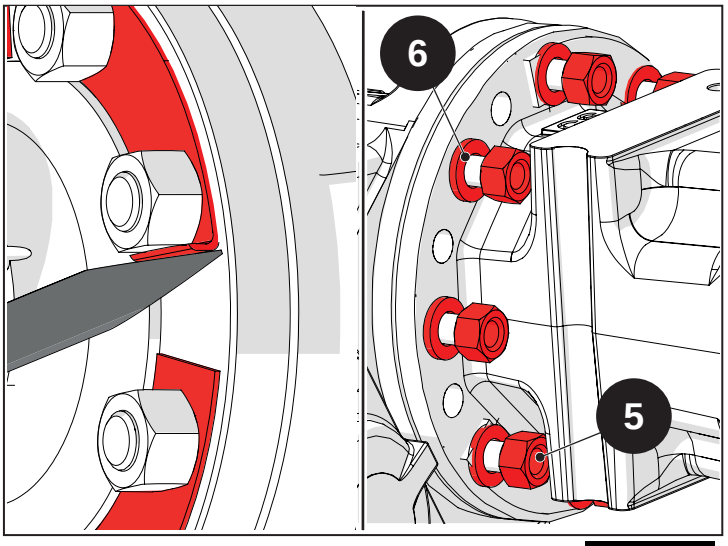


Fig. 6.33

Section 5 : Tightening torques

Index

5.1 Tightening torques.....6-20

5.1 Tightening torques

The main tightening torque values are listed below. Consult chapter "1- Introduction" for the remaining tightening torques.

Screws and nuts to be tightened	Nm	kgm
M50x1.5 axle shaft fastening nut	250	25
M18x1.5 screw for fastening wheel to axle shaft	310	31
M12 nut for fastening final drive to axle shaft support	80	8
M8x20 screw for fastening axle shaft ring nut cover	24	2.4
M8x20 screw for fastening final drive gear cover	24	2.4

Section 6 : Tools required

Index

6.1 Tools required 6-22

6.1 Tools required

Code	Description	Quantity
07000227	Ring nut wrench	1

Chapter 7 : Front axle

Index

Section 1 : Safety rules 7-2

Section 2 : General introduction 7-3

2.1 Assembly drawing 7-4

Section 3 : Technical characteristics 7-7

3.1 Technical characteristics 7-8

Section 4 : Removal 7-9

4.1 Removal 7-10

Section 5 : Main components 7-17

5.1 NoSpin front differential 7-18

5.2 Final drive unit 7-36

Section 6 : Refitting 7-53

6.1 Refitting 7-54

Section 7 : Tightening specifications 7-63

7.1 Tightening specifications 7-64

Section 8 : Tools necessary 7-65

8.1 Tools necessary 7-66

Section 1 : Safety rules

These safety precautions and warnings given in this paragraph must be observed at all times to prevent the risk of operator injury. However, the safety measures indicated in the use and maintenance manual and in chapter 1 of this manual must also be applied at all times.

Danger

All other persons must keep at a safe distance from the danger area. Avoid vibration when loosening screws.

Danger

Lift and handle all heavy parts with lifting equipment of adequate load capacity. Hoisting straps and hooks must be positioned safely on the load. When lifting loads, all personnel must keep at a safe distance from the load itself and remain within safe areas.

Danger

Do not allow the chains or metal cables used for hoisting to twist. Always wear safety gloves when handling cables or chains.

Danger

Use appropriate tools to align the holes correctly. NEVER USE YOUR HANDS OR FINGERS.

Danger

Handle all parts with extreme caution. Never place your hands or fingers between two parts.

Danger

When removing assemblies which could fall, always leave two screws in opposite positions in place for safety until the assembly is secured. Only remove these screws after securing the assembly to a hoist or after fitting support blocks in place.

Danger

If any of the screws fastening the frame or cab are loosened, or if the frame or cab is removed, ensure that all parts are refitted correctly at the end of the procedure to ensure that the driver is protected.

Section 2 : General introduction

Index

2.1 Assembly drawing.....7-4

2.1 Assembly drawing

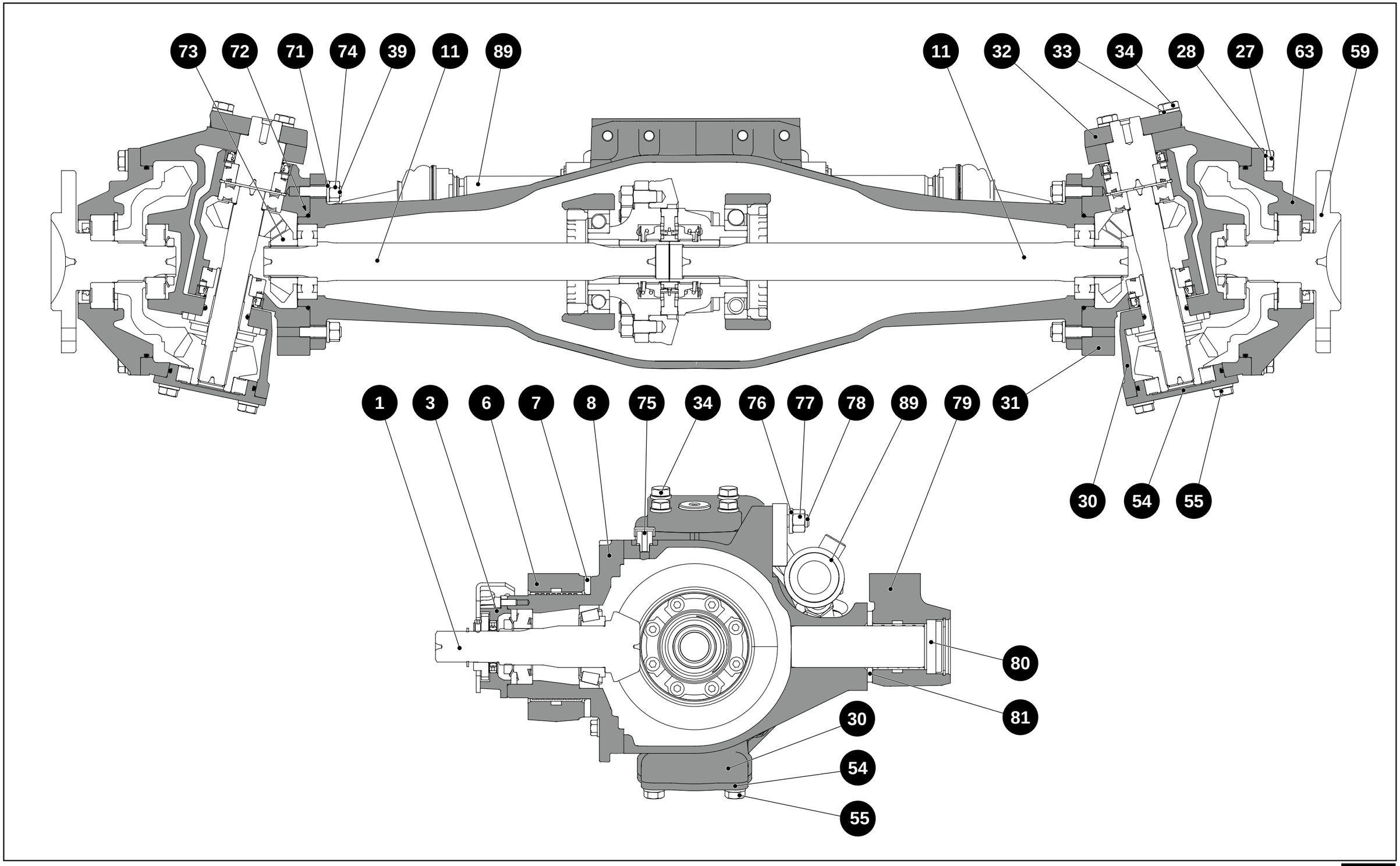


Fig. 7.1

1 - Bevel pinion
3 - Cover
6 - Rear casing mount
7 - Spacer
8 - Differential case
11 - Half shaft
27 - Screw
28 - Conical washer
30 - Reduction gearbox
31 - Knuckle flange
32 - Flange
33 - Washer
34 - Screw
39 - Stud bolt
54 - Reduction gear cover
55 - Screw
59 - Half shaft
63 - Cover
71 - Conical washer
72 - O-ring
73 - Gear
74 - Nut
75 - Vent plug and valve
76 - Conical washer
77 - Nut
78 - Stud bolt
79 - Front casing mount
80 - Dust cover
81 - Spacer
89 - Steering cylinders

Section 3 : Technical characteristics

Index

3.1 Technical characteristics 7-8

3.1 Technical characteristics

Energy 60

Description	High Model	Low Model
Steering angle	55°	55°
Front axle swing angle	11°	11°
Traction	Dual	Dual
Differential lock	NO-SPIN (Automatic)	NO-SPIN (Automatic)
Front brake type	-	-

Energy 80

Description	High Model	Low Model
Steering angle	55°	55°
Front axle swing angle	11°	11°
Traction	Four wheel drive, selectable without disengaging drive	Four wheel drive, selectable without disengaging drive
Differential lock	NO-SPIN (Automatic)	NO-SPIN (Automatic)
Front brake type	IST*	IST*

* Simultaneous 4WD engagement under braking

Section 4 : Removal

Index

4.1 Removal 7-10

4.1 Removal

Undo the hex socket screws and remove the front shaft guard casing.

Fig. 7.2

Undo the fastener screws and remove the rear shaft guard casing.

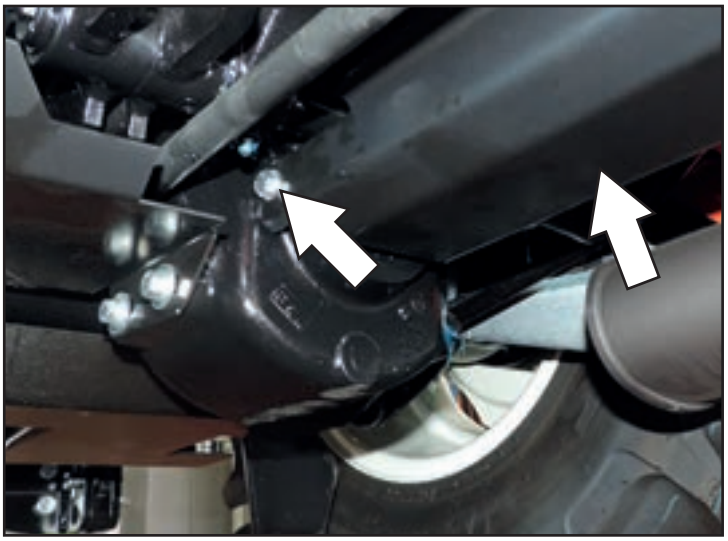


Fig. 7.3

Undo the nuts and screws fastening the intermediate bearing onto the shaft.

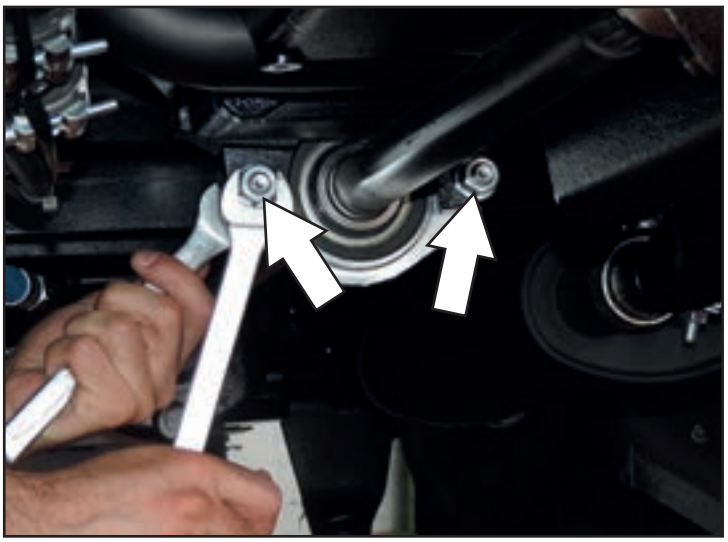


Fig. 7.4

Remove the shaft retainer circlips from their seats.

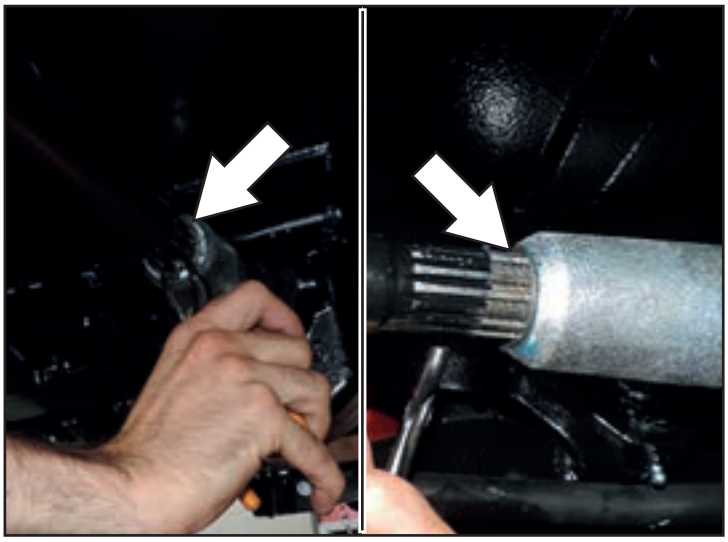


Fig. 7.5

Move the sleeves and remove the shaft.

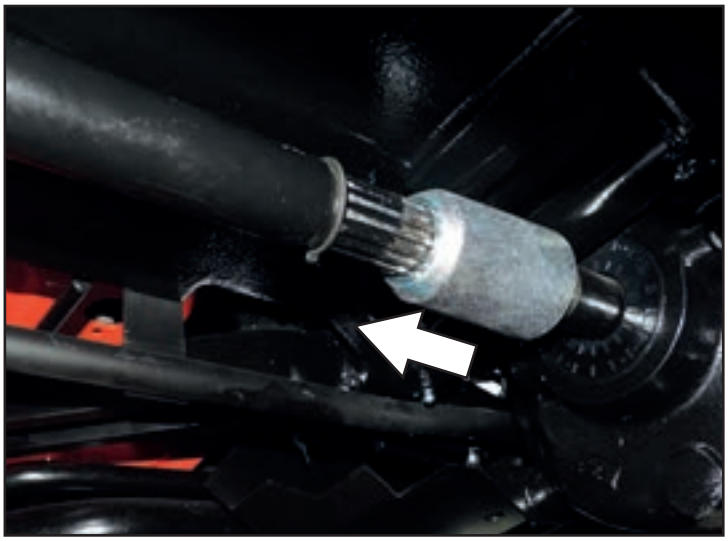


Fig. 7.6

Secure the tractor to a hoist.

Note

Ensure that the maximum lift capacity of the hoist used is adequate for the load.

Fig. 7.7

Secure the axle with stands.

Fig. 7.8

Undo the indicated connectors and disconnect the hydraulic steering pipes.

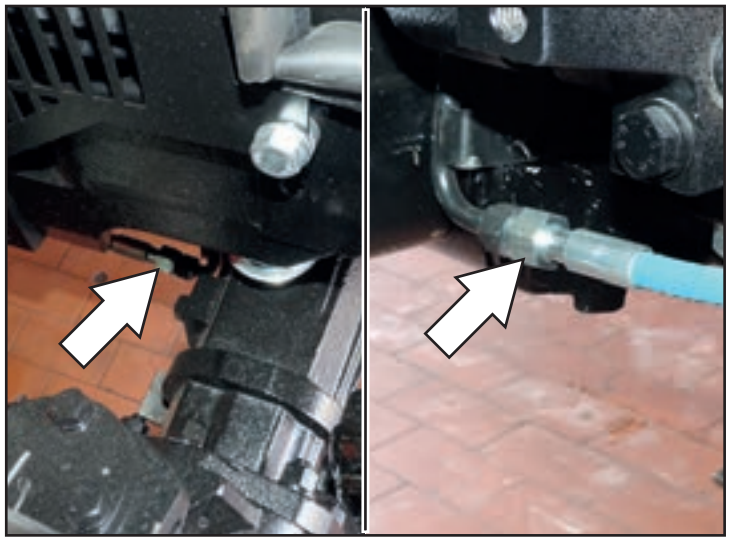


Fig. 7.9

Undo the front nuts fastening the axle.

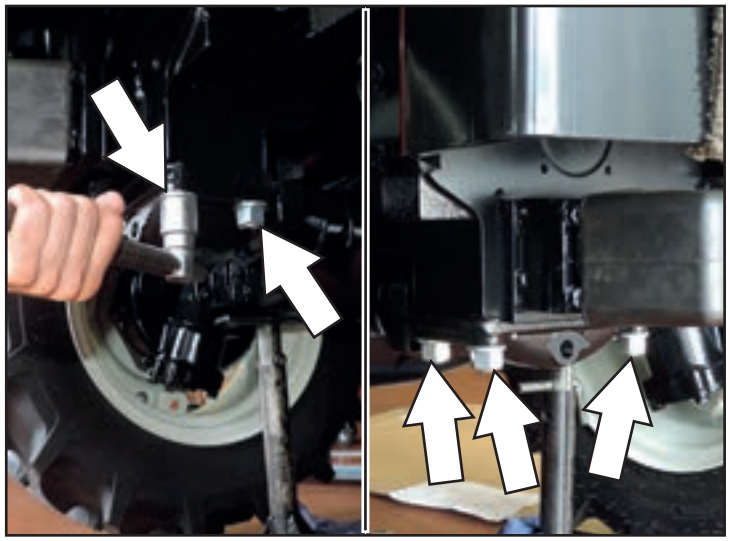


Fig. 7.10

Undo the rear nuts fastening the axle.

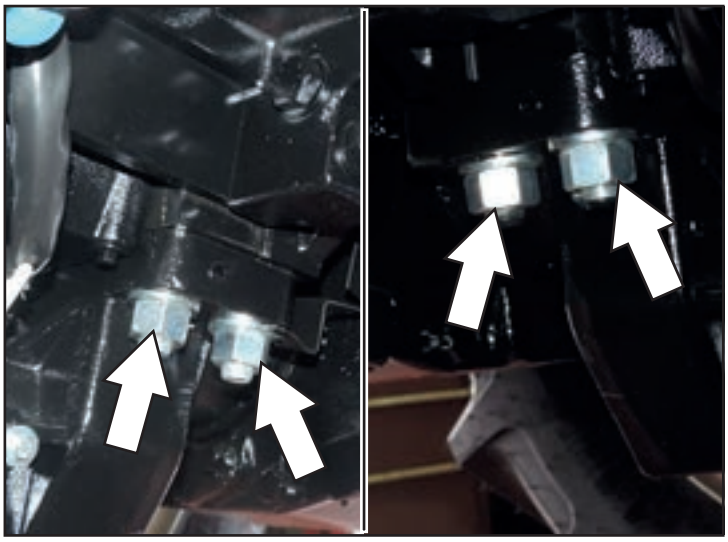


Fig. 7.11

Lift the tractor and remove the complete front axle.

Fig. 7.12

Remove the front (79) and rear (6) casing mounts together with the spacers (81) and (7).

Remove the circlip (102) and the oil seal (80) from the front casing.

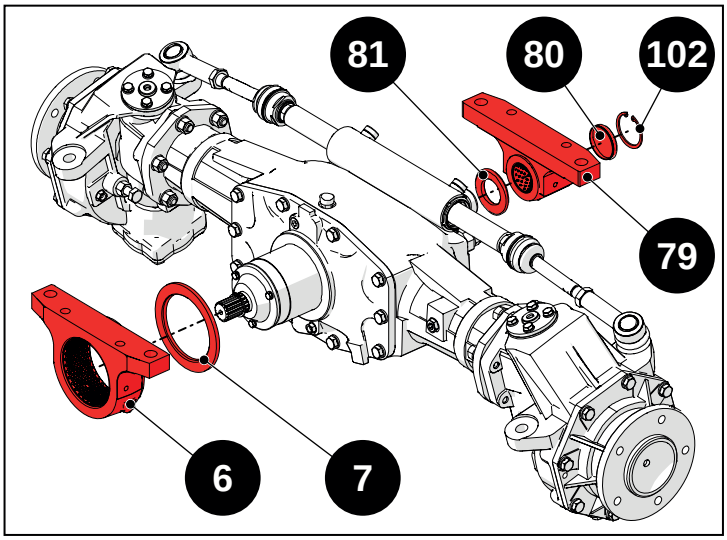


Fig. 7.13

Remove: the plug (95), the plug (96), the plug (97) and the plug (75), complete with washers, to drain the oil from the axle.

Note
Place empty drums under the plugs to collect oil.

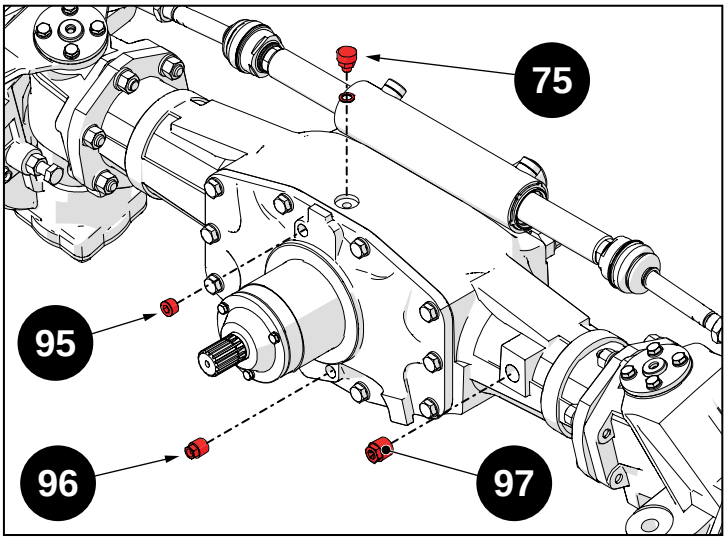


Fig. 7.14

Remove the split pin (105) and undo the retainer nut (104).

Remove the steering cylinder pins (103) from their seats on both sides.

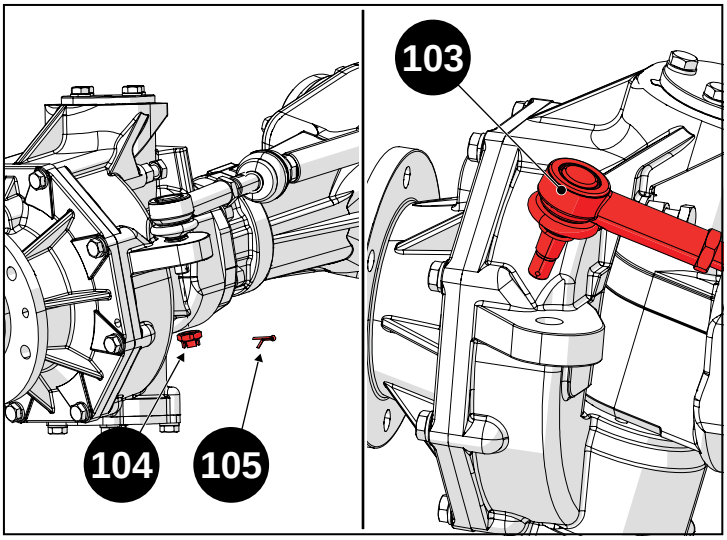


Fig. 7.15

Undo the nuts (77) fastening the steering cylinder to the front axle and remove them together with the washers (76).

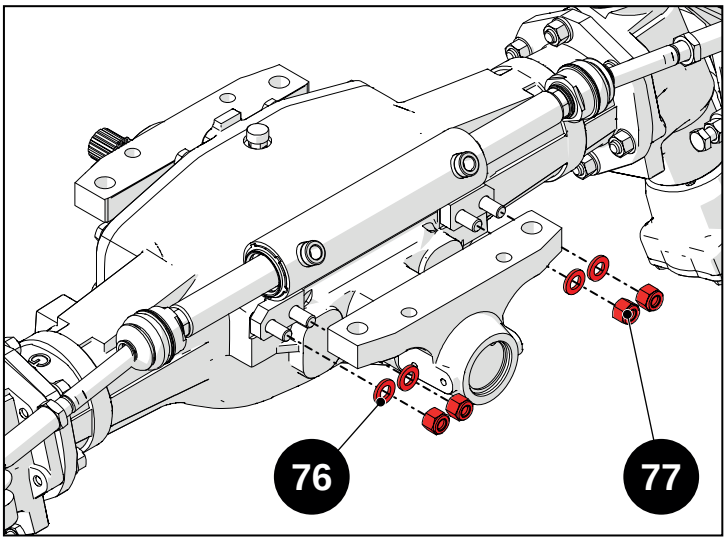


Fig. 7.16

Remove the complete steering cylinder (89).

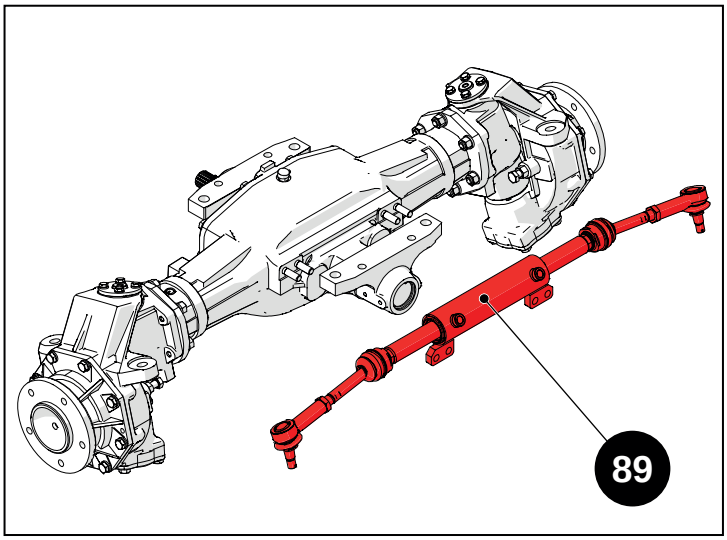


Fig. 7.17

Undo one of the fastener screws (34) of the upper final drive unit cover, complete with washer, and fit and tighten a hoisting eye-bolt (L) in its place.

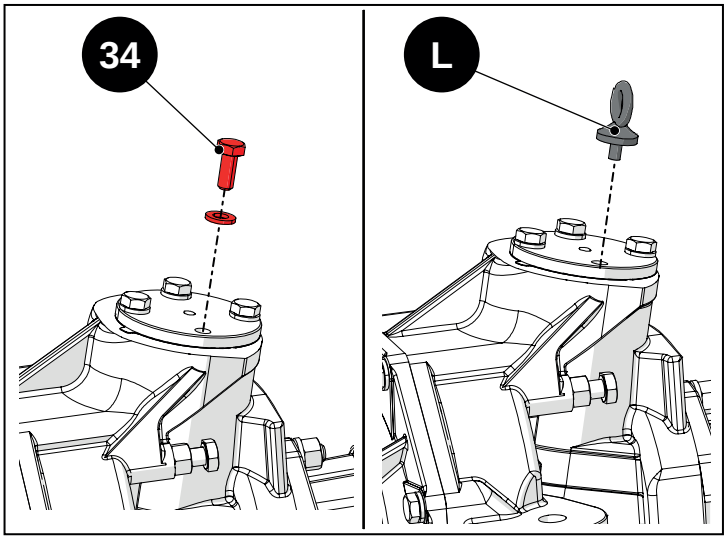


Fig. 7.18

Secure the lateral reduction gear unit to a suitable hoist using the eye-bolt.

Remove the fastener nuts (74) and washers (71), and then remove the final drive unit from the axle.

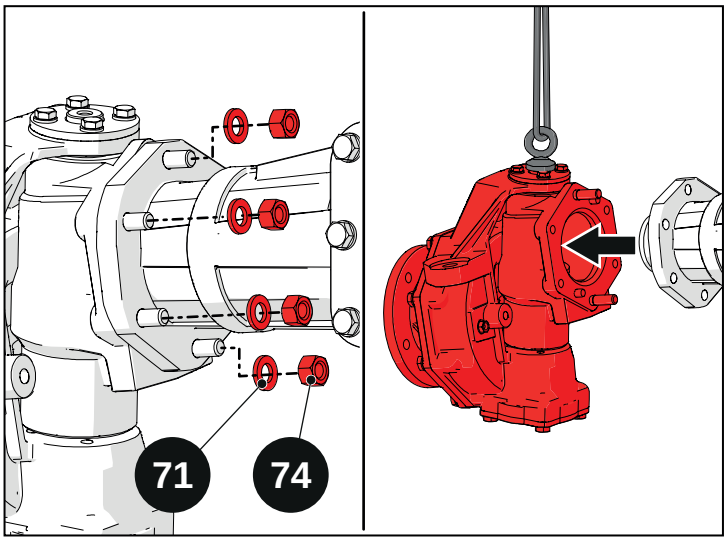


Fig. 7.19

Remove the complete half-axle (11) and remove the O-ring (72).

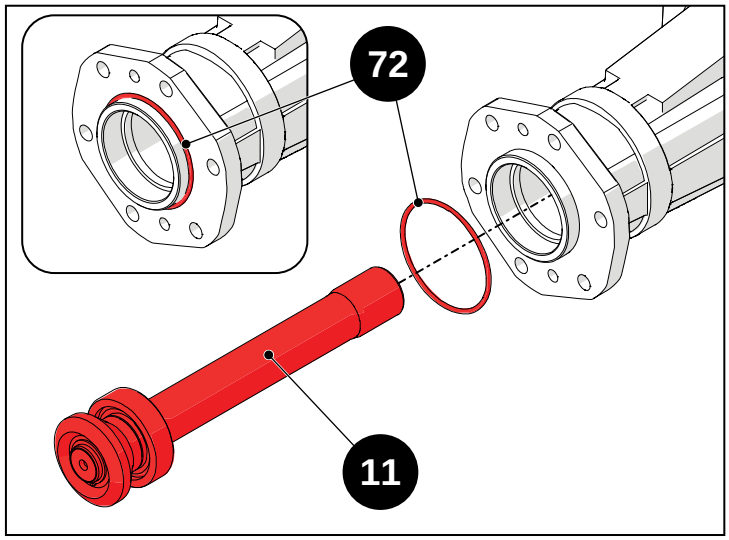


Fig. 7.20

Repeat the same procedure to remove the other final drive unit.

Fit the 2 hoisting eye-bolts (L) into the holes for the plugs on the front differential and secure them to a hoist.

Unscrew and remove the screws (9) and the washers (10).

Warning

The direction in which the front differential is installed is different on the High and Low versions.

Mark the differential before removal to ensure that it is refitted the right way around.

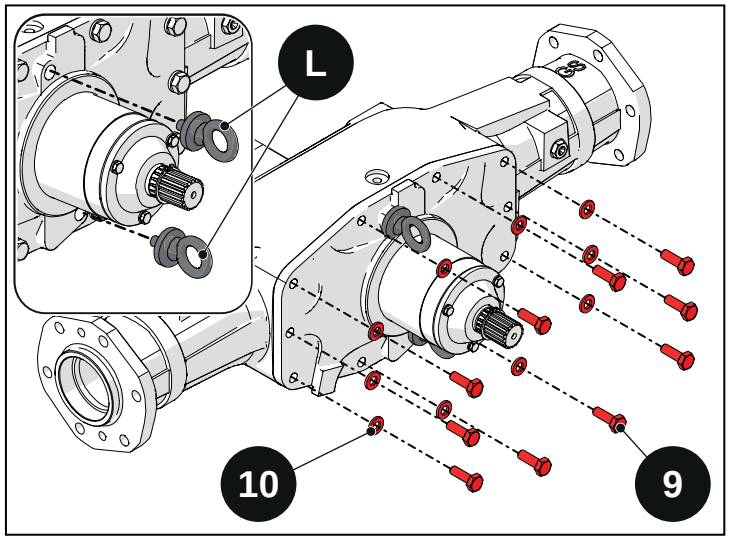


Fig. 7.21

Remove the complete front differential assembly (8).

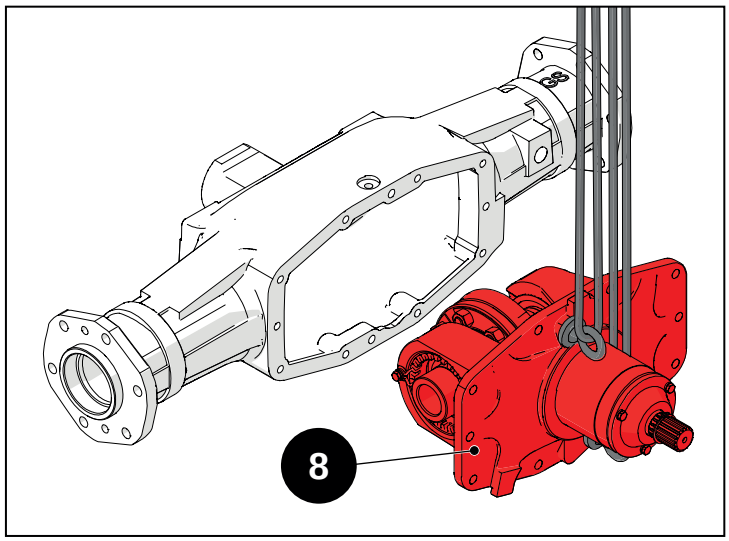


Fig. 7.22

Section 5 : Main components

Index

5.1 NoSpin front differential 7-18
5.1.1 Assembly drawing and main components 7-18
5.1.2 Disassembly 7-20
5.1.3 Main inspection, reassembly and adjustment procedures 7-26
5.1.3.1 Checking that the NoSPIN device functions correctly 7-35

5.2 Final drive unit 7-36
5.2.1 Assembly drawing and main components, HIGH version 7-36
5.2.2 Assembly drawing and main components, LOW version 7-38
5.2.3 Disassembly 7-40
5.2.4 Main inspection, reassembly and adjustment procedures 7-46

5.1 NoSpin front differential

5.1.1 Assembly drawing and main components

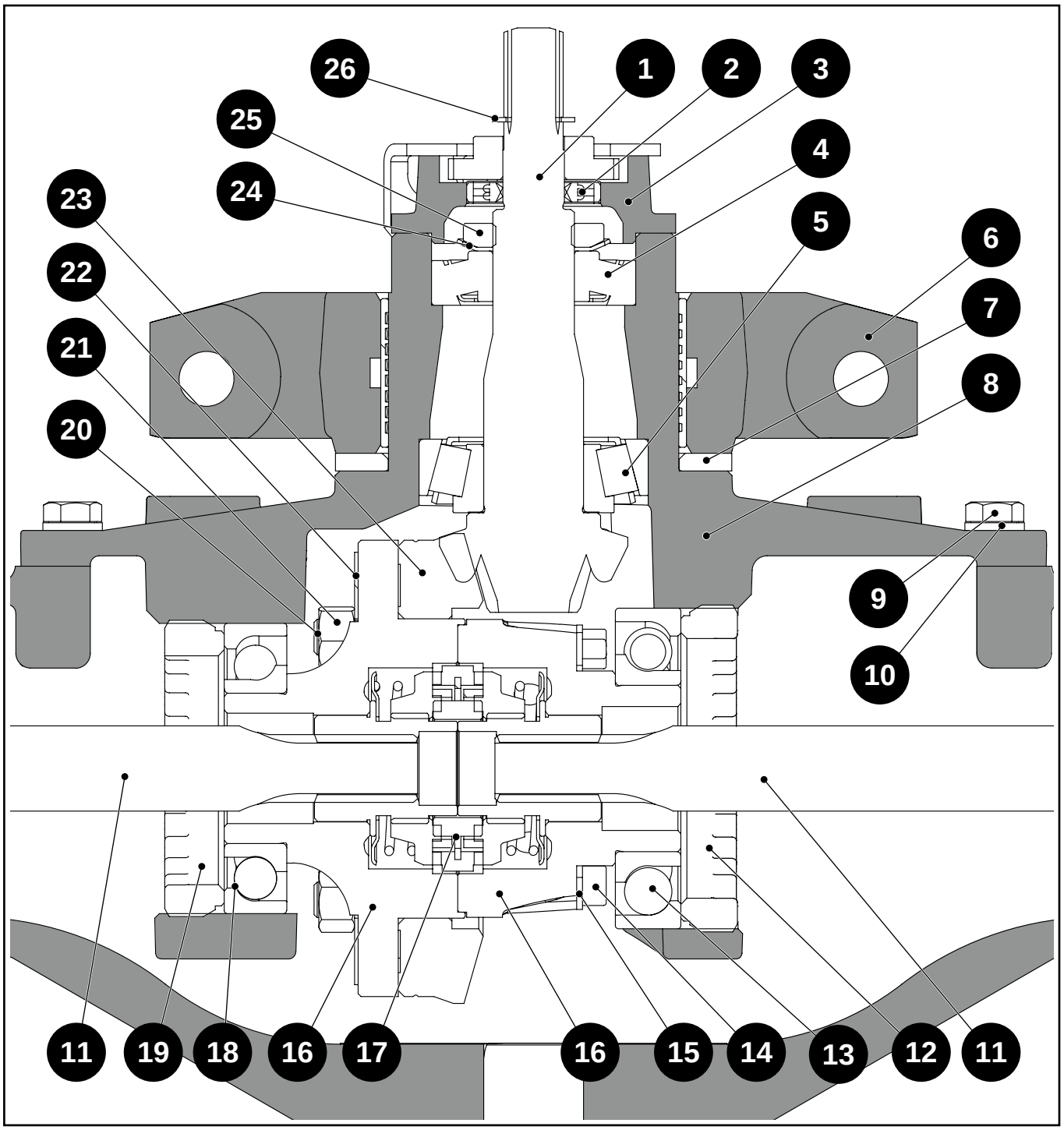


Fig. 7.23

1 - Bevel pinion
2 - Oil seal
3 - Cover
4 - Bearing
5 - Bearing
6 - Rear casing mount
7 - Spacer
8 - Differential case
9 - Screw
10 - Conical washer
11 - Half shaft
12 - Ring nut on side opposite crown wheel
13 - Bearing
14 - Hex socket head cap screw
15 - Conical washer
16 - NoSpin case
17 - NoSpin
18 - Bearing
19 - Ring nut on crown wheel side
20 - Stud bolt
21 - Nut
22 - Plate
23 - Conical crown wheel
24 - Ring nut retainer washer
25 - Ring nut
26 - Circlip

5.1.2 Disassembly

Remove the ring nut retainer screws (68) complete with washers (69), washers (70) and ring nut retainer hooks (67).

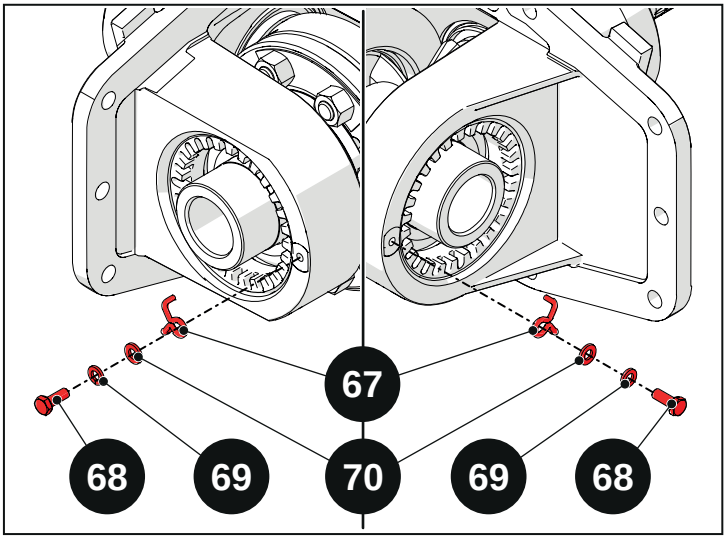


Fig. 7.24

Use the tool (C-p/n_____) to undo the ring nut (12) on the side opposite the crown wheel.

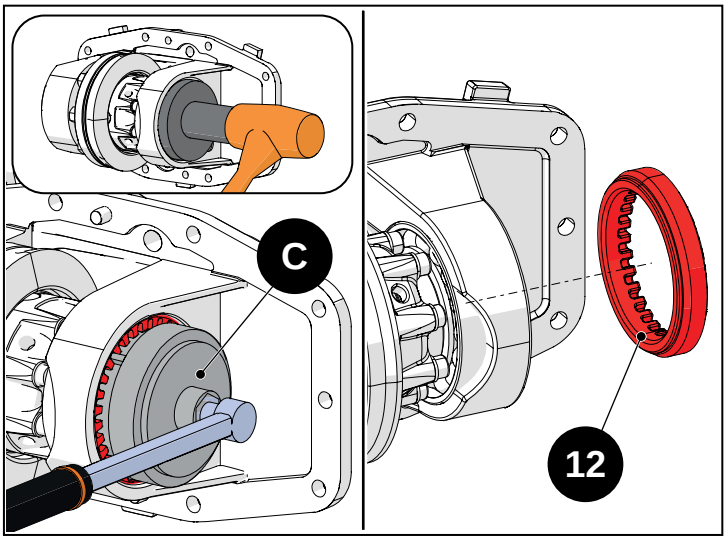


Fig. 7.25

Tighten a screw (F), complete with 2 flat washers (F1), and a wing nut (F2), to secure the springs of the NoSPIN device.

Danger

Check that the screw and the wing nut have been tightened correctly, to prevent the springs from detaching while removing the NoSPIN device.

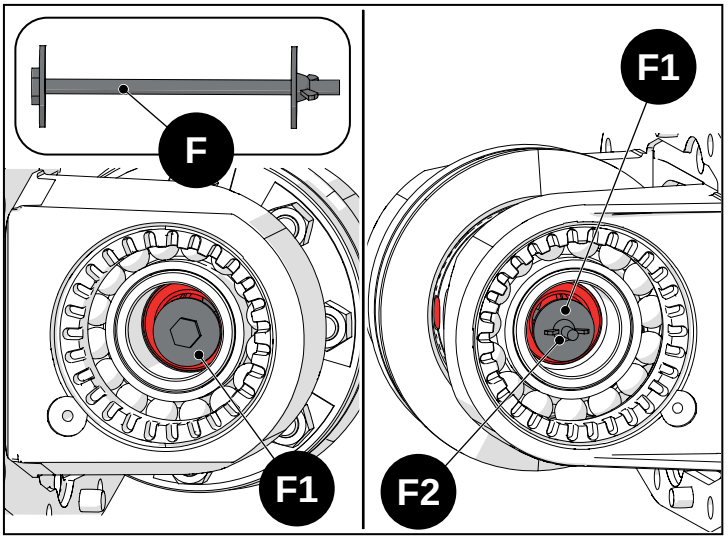


Fig. 7.26

Remove the bearing (13) on the side opposite the crown wheel, tapping on the inner race.

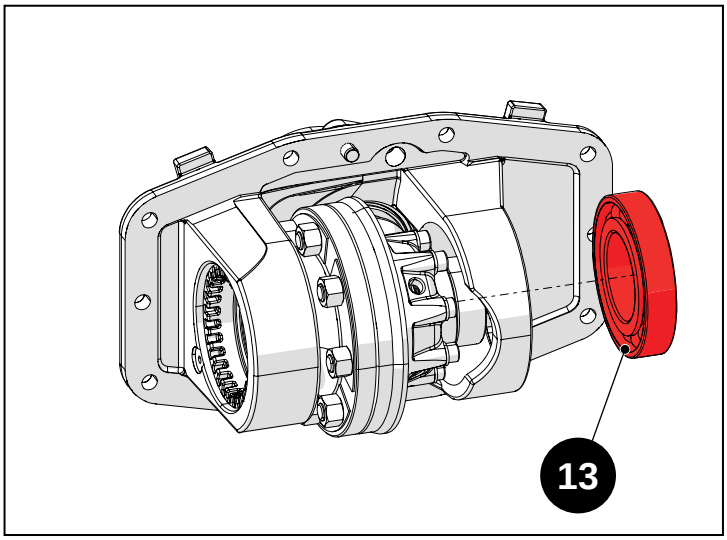


Fig. 7.27

Note

Mark the 2 parts of the NoSPIN case with a marker pen to facilitate reassembly.

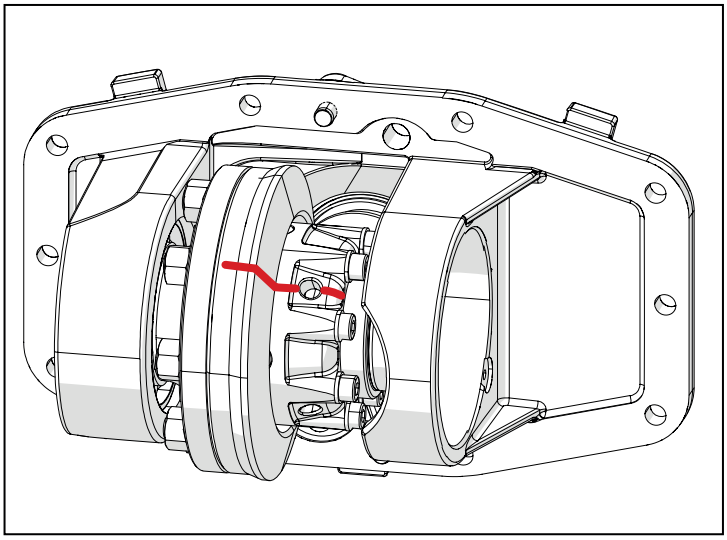


Fig. 7.28

Undo and remove the screws (14) and the conical washers (15) securing the NoSpin case.

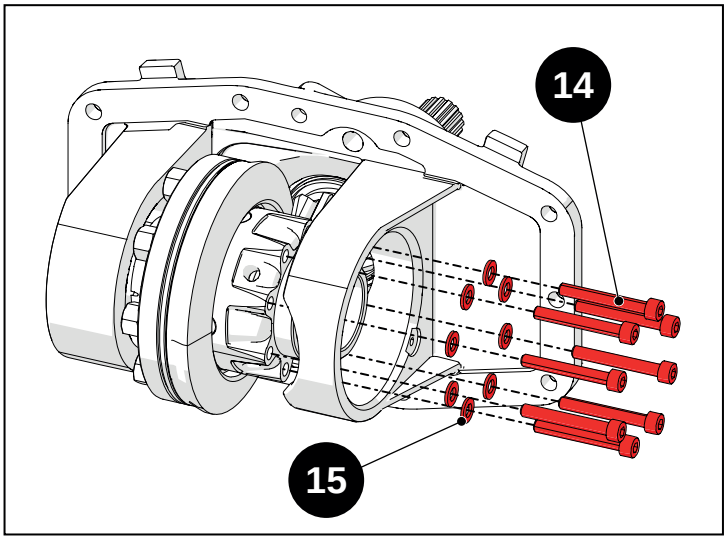


Fig. 7.29

Remove the loosened NoSpin case (16).

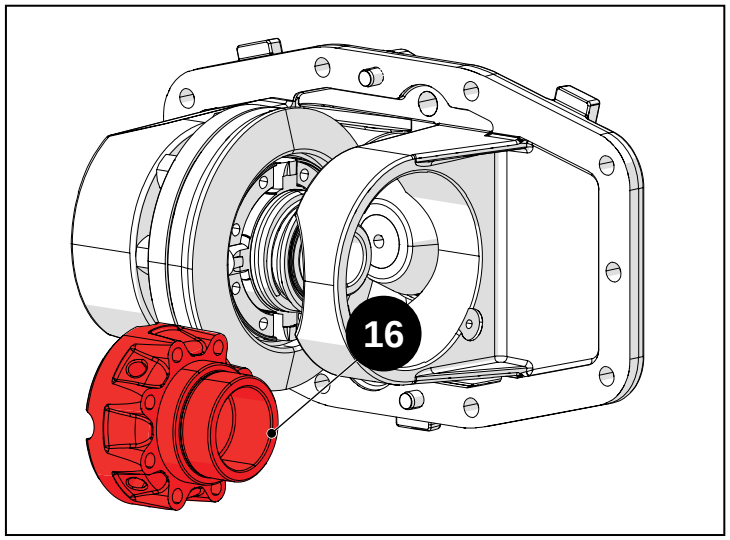


Fig. 7.30

Remove the complete NoSpin device (17).

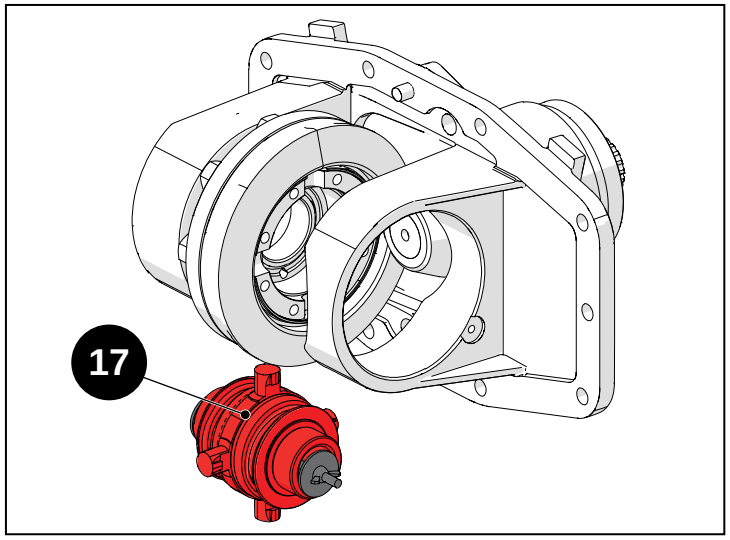


Fig. 7.31

Use the tool (A-p/n_____) to undo and remove the crown wheel side ring nut (19).

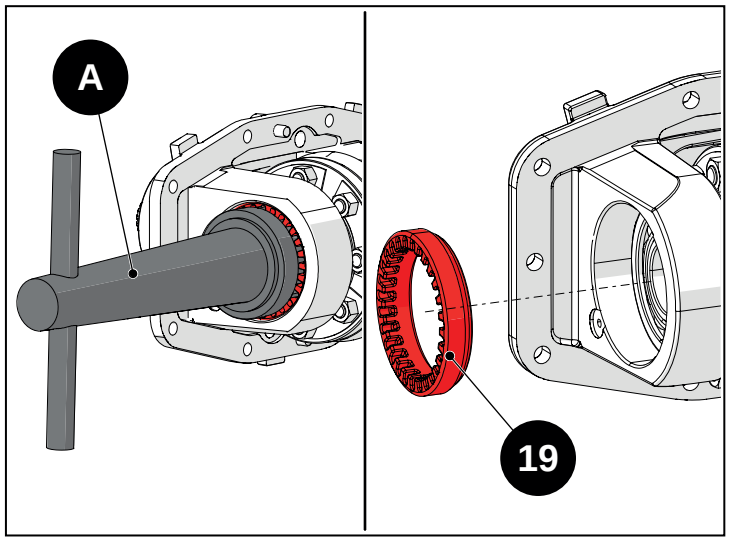


Fig. 7.32

Working via the extraction holes, tap the race of the bearing (18) with a pin punch to free the crown wheel (23).

Remove the bearing (18).

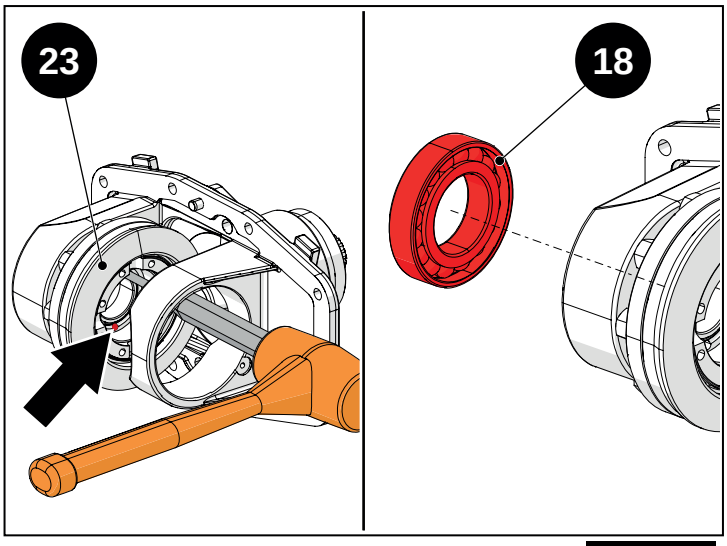


Fig. 7.33

Remove the complete crown wheel (23).

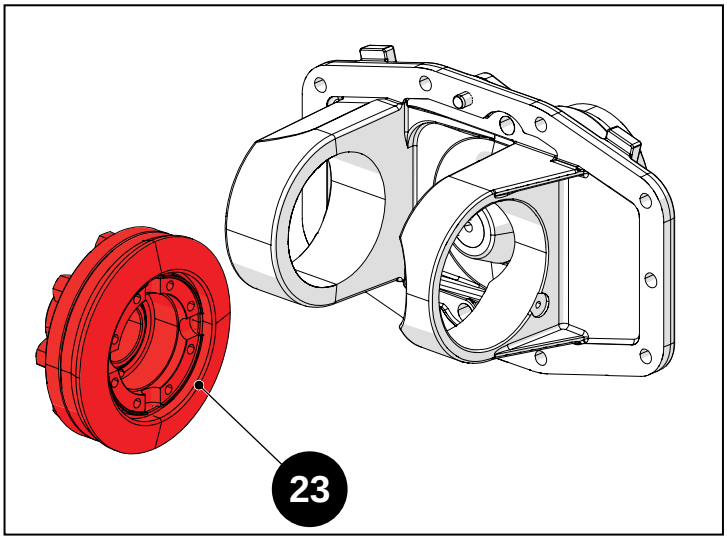


Fig. 7.34

Use a scalpel to bend back the tooth on the ring nut retainer washer (24).

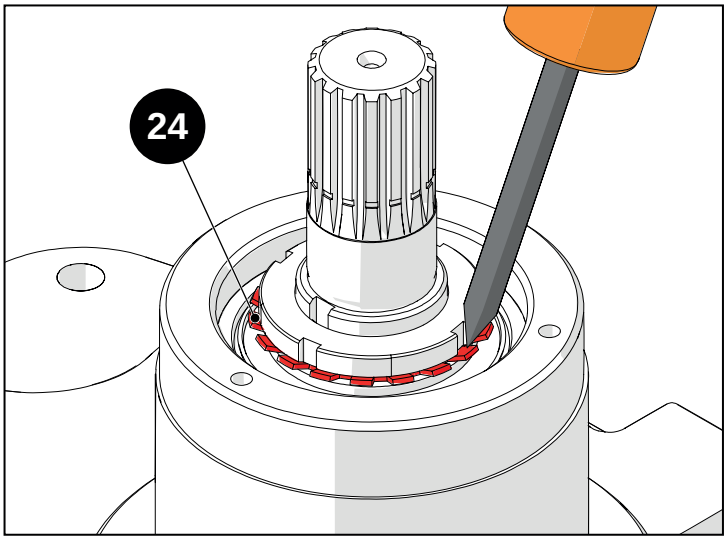


Fig. 7.35

Use the tool (B-p/n_____) together with a torque wrench to undo the fastener ring nut (25) of the bevel gear.

Remove the ring nut (25) and the ring nut retainer washer (24).

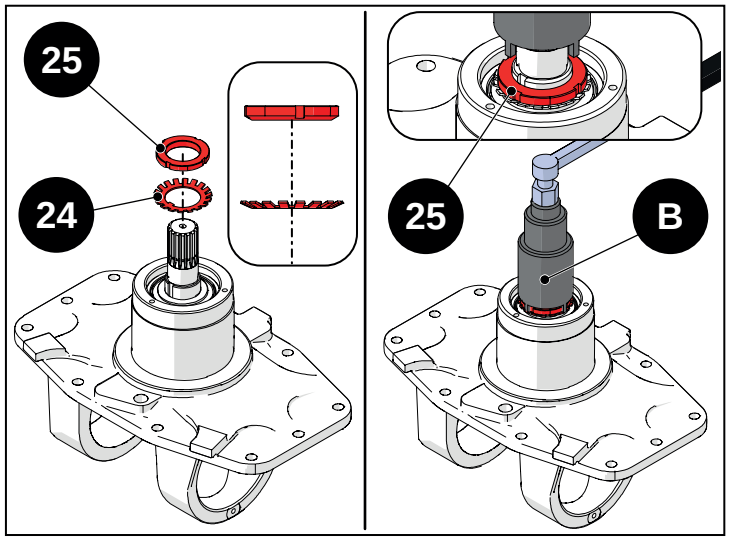


Fig. 7.36

Tap the bevel pinion (1) with a soft mallet to detach it from its seat together with the bearing (5).

Separate the bearing (5) from the pinion.

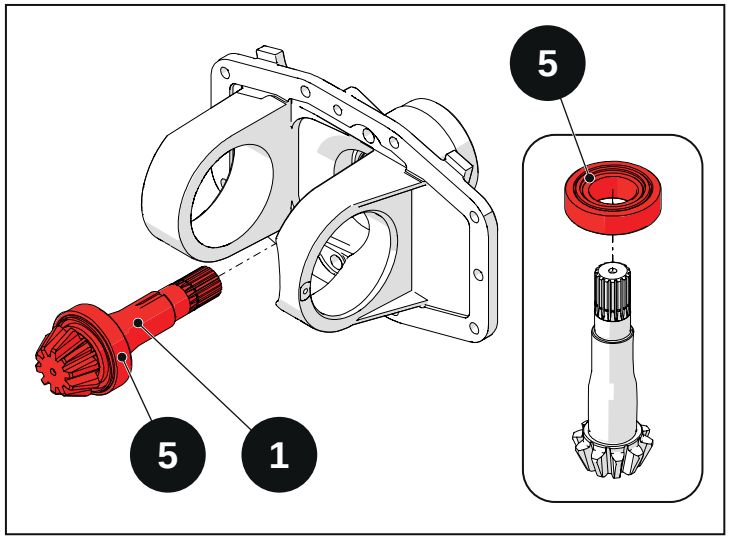


Fig. 7.37

Using a bearing race punch tool of suitable diameter, remove the bearing (4) from the differential case.

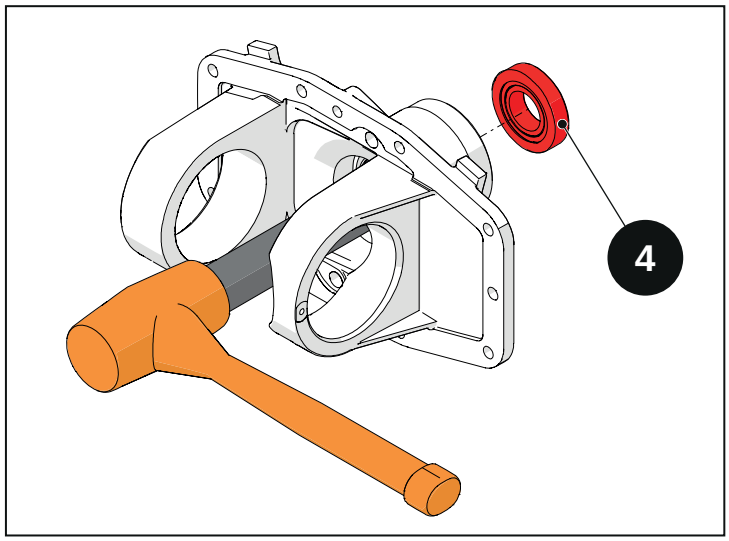


Fig. 7.38

Remove the centring pins (83) from the differential case.

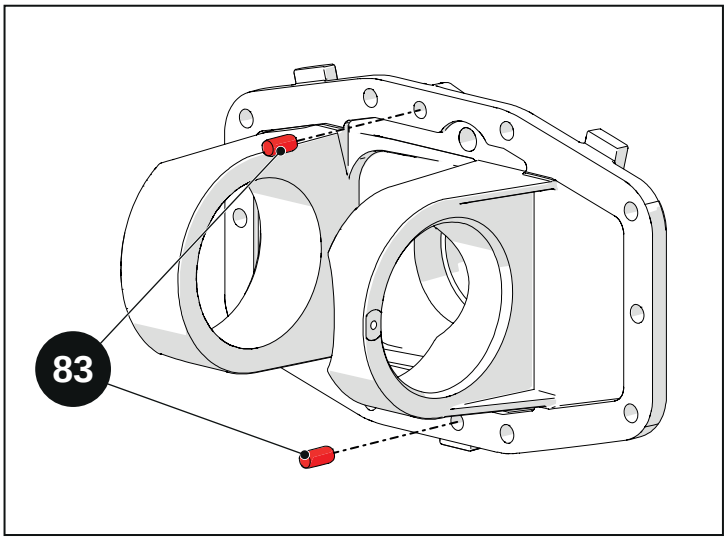


Fig. 7.39

5.1.3 Main inspection, reassembly and adjustment procedures

Warning

Read the instructions in chapter "1-Introduction" and, in particular, the sections concerning the installation of O-rings, oil seals and bearings, with particular care before reassembling, and follow these instructions precisely when working.

Apply the correct tightening torques when tighten the fasteners of components. Where tightening torques are not specified, refer to the table in chapter "1-Introduction".

Use the specified sealant products during reassembly. Where the sealant required is not specified, refer to the table in chapter "1-Introduction".

Fit the centring pins (83).

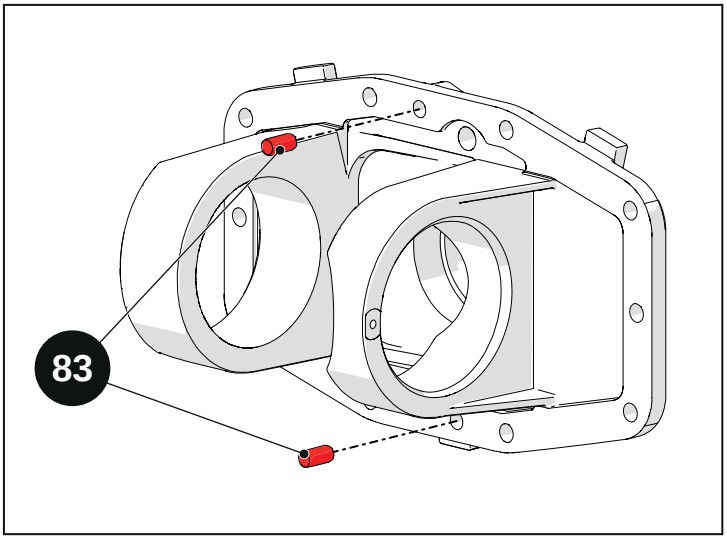


Fig. 7.40

Fit the stud bolts (20) and align the crown wheel (23) with the crown wheel mount (16).

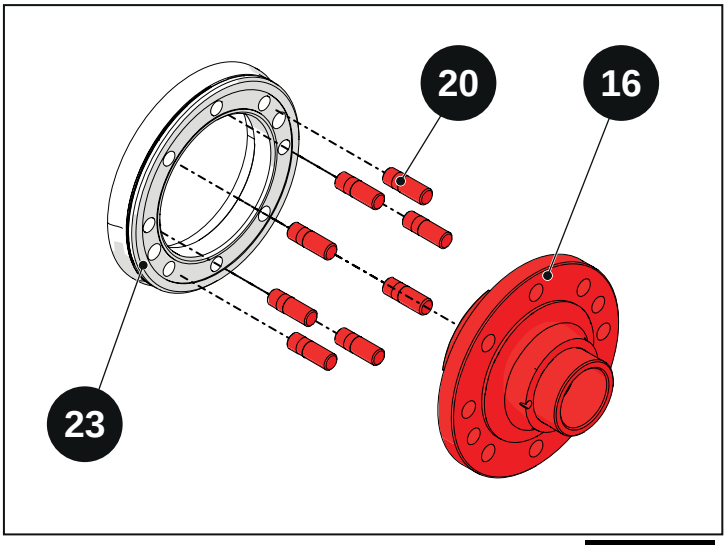


Fig. 7.41

Fit the pins (84) on the crown wheel mount (16).

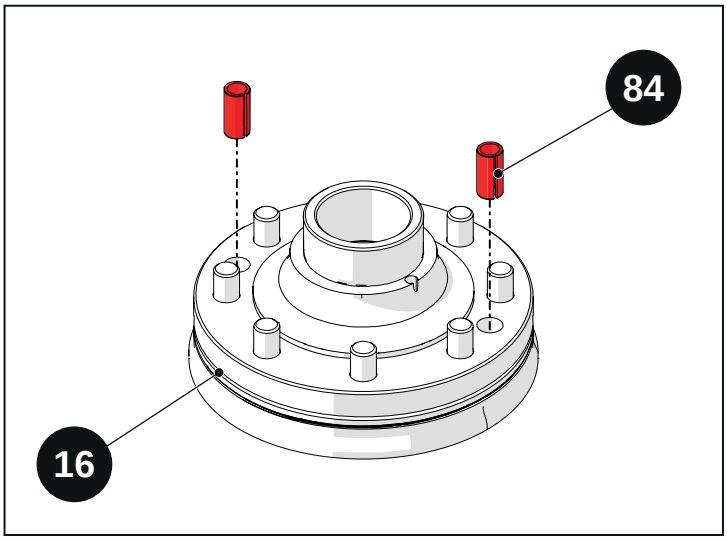


Fig. 7.42

Fit the plates (22), with the flat sides facing upwards.

Warning
Fit the plates (22) over the pins (84).

Tighten the nuts (21) to a torque of 80 Nm (8 kgm).

Use a scalpel to bed the edges of the plates (22) to secure the nuts (21) and prevent them from loosening.

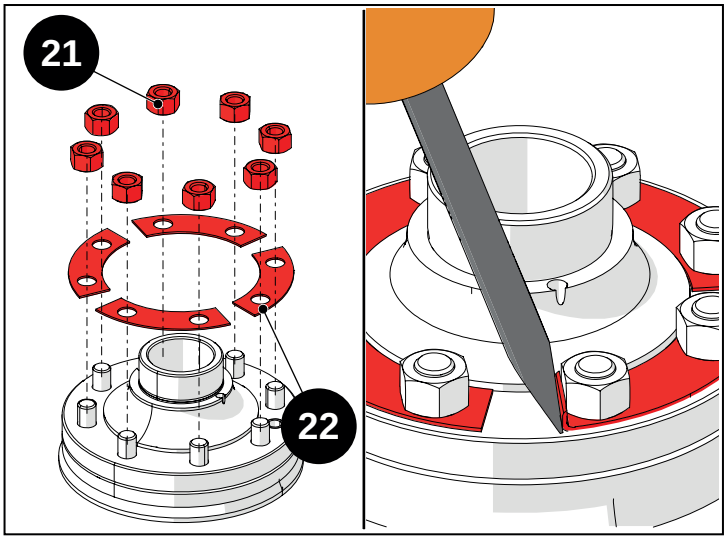


Fig. 7.43

Use a press to install the bearing (5) on the bevel pinion (1), with the protruding side of the bearing turned towards the toothed end of the bevel pinion.

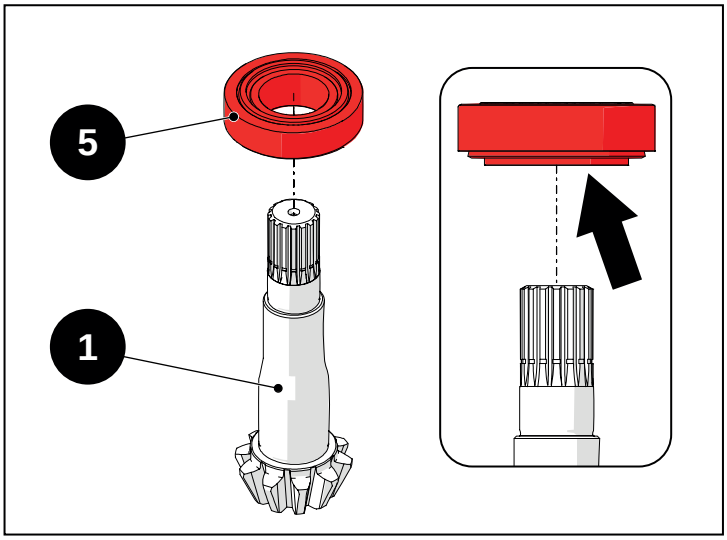


Fig. 7.44

Using a suitable bearing race punch tool, install the outer race of the newly fitted bearing (5) onto the differential case (8).

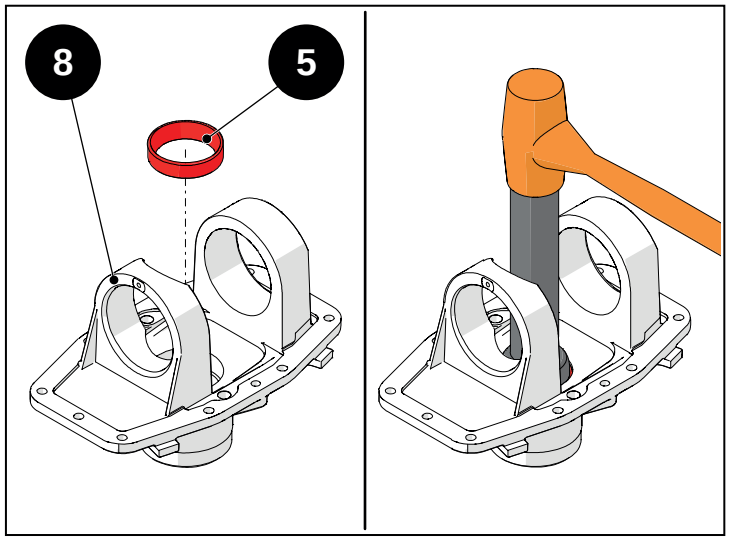


Fig. 7.45

Fit the bevel pinion (1), complete with bearing (5), in the differential case (8).

Using a suitable bearing punch tool, install the upper bearing (4) on the bevel pinion, with the protruding side of the bearing facing towards the end opposite the bearing fitted previously (5).

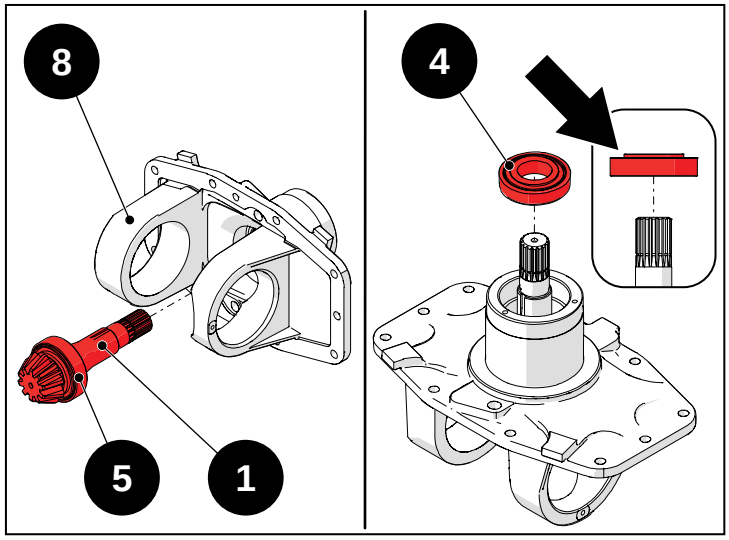


Fig. 7.46

Fit the ring nut retainer washer (24) and the ring nut (25), with the bevelled side facing towards the bevel pinion.

Tighten the ring nut (25) using the special tool (B-p/n_____) and a torque wench, to a torque of 40 Nm (4 Kgm). Tighten until the ring nut clicks.

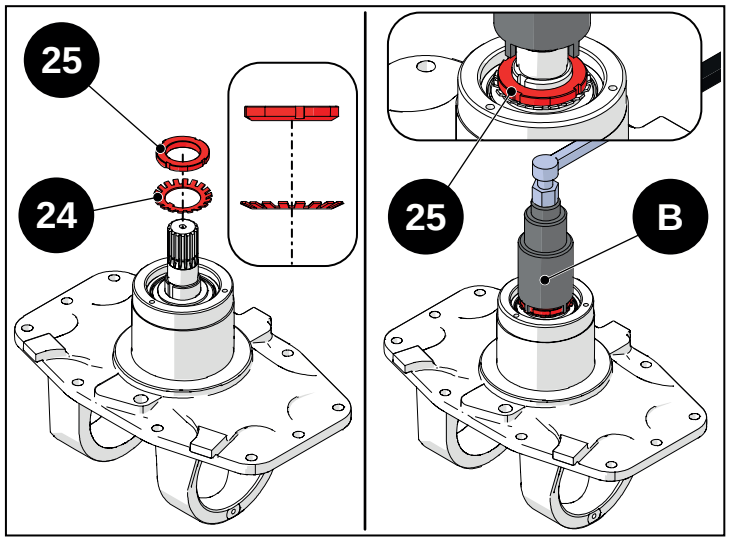


Fig. 7.47

Tap the bevel pinion (1) to seat it completely, and check that it rotates correctly.

Tighten the ring nut (25) if the pinion turns too freely, loosen the ring nut it the pinion does not turn freely enough.

Note

Ensure that one of the teeth of the ring nut retainer washer (24) is aligned with one of the notches of the ring nut (25). One tooth is enough to secure the ring nut.

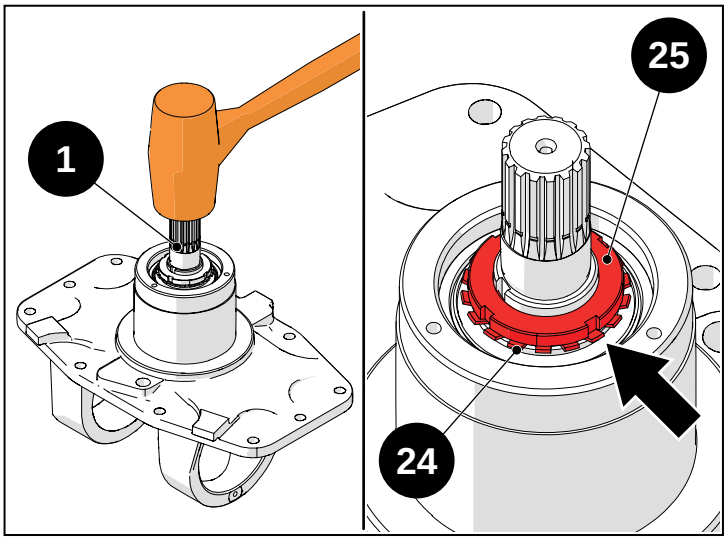


Fig. 7.48

Bend the tooth of the ring nut retainer washer (24) into the notch on the ring nut (25).

Punch the ring nut next to the notch in the bevel pinion (1), taking care not to damage the ring nut itself.

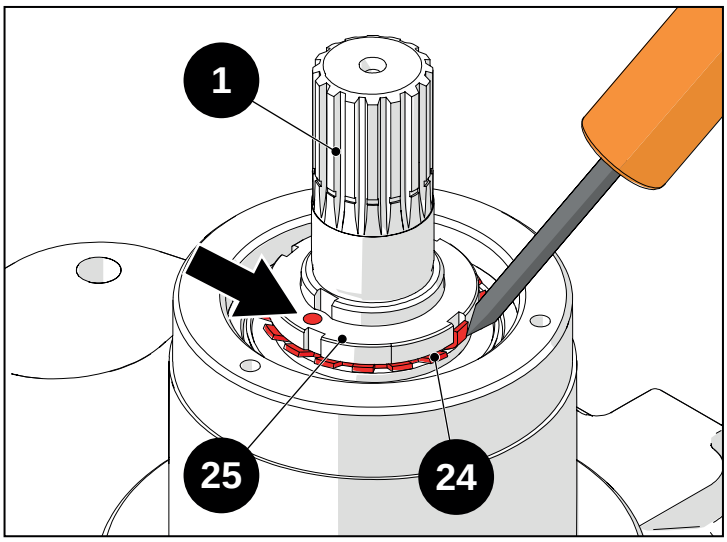


Fig. 7.49

Fit the crown wheel assembly (23).

Fit the NoSpin device (17).

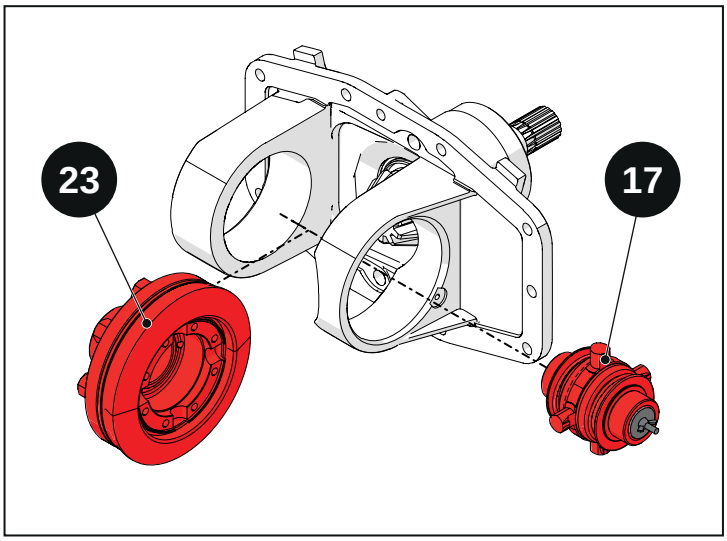


Fig. 7.50

Pre-assemble the NoSpin case (16), fitting the conical washers (15) and the hex socket screws (14).

Apply a layer of LOCTITE 243 to the tip of the thread of the screws.

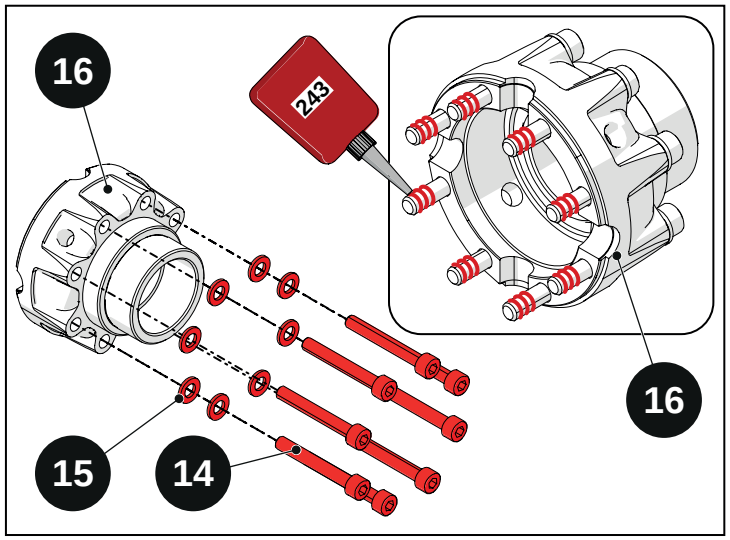


Fig. 7.51

Fit the NoSpin case (16), aligning the markings made during disassembly.

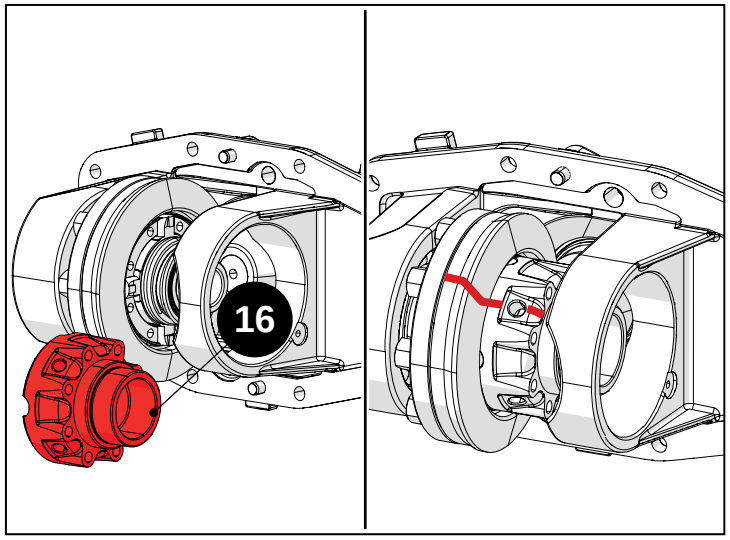


Fig. 7.52

Tighten the screws (14) to a torque of 50 Nm (5 Kgm).

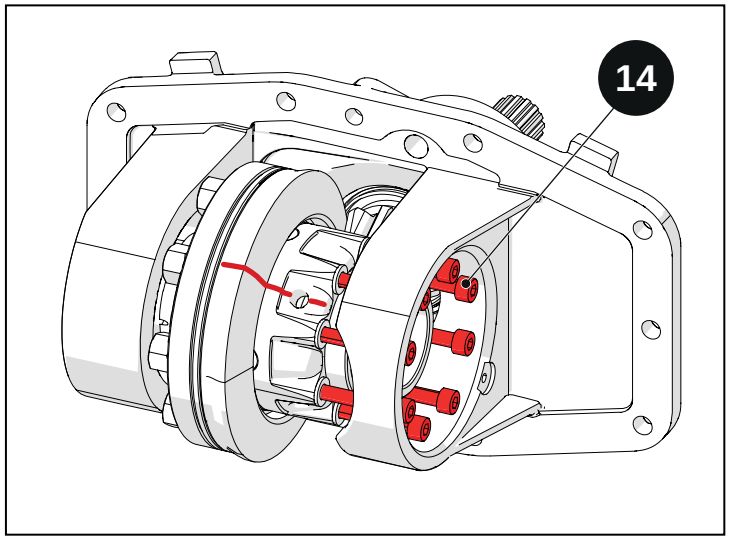


Fig. 7.53

Use a suitably sized bearing punch tool to drive the bearings (13) and (18) into their seats.

Note

Lubricate the bearing seats before installing the bearings.

Make sure that the bearings are installed on the right sides and the right way around: fit bearing (18) on the crown wheel side, and fit bearing (13) on the side opposite the crown wheel.

The bearings have a wider gap on one side. This side must face inwards.

Do NOT drive the bearings fully into their seats.

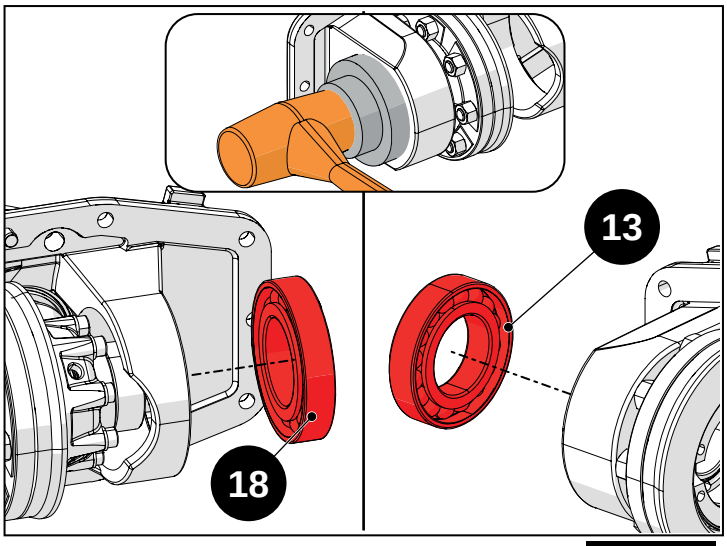


Fig. 7.54

Check that the crown wheel (23) is perpendicular to the differential case, and then drive the crown wheel side bearing fully into its seat.

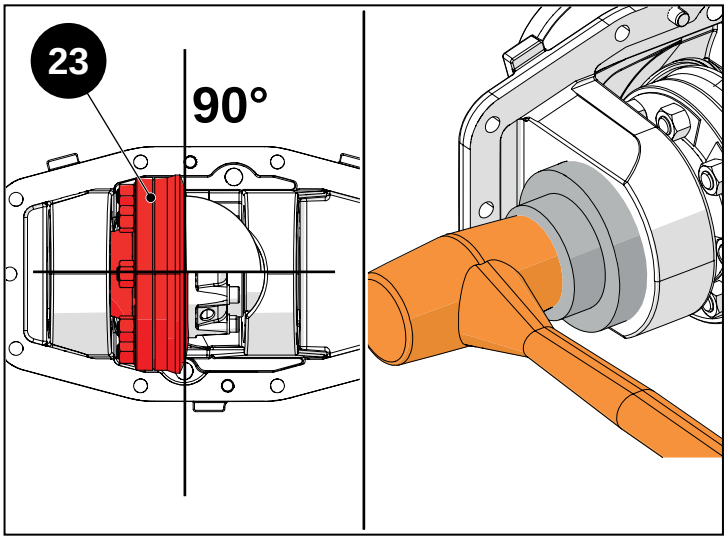


Fig. 7.55

Tighten the ring nut (19) completely using the special tool (A-p/n_____).

Tighten the screws to a torque of 15 Nm (1.5 kgm).

Note

Align the hole on the ring nut retainer with one of the holes on the ring nut (19).

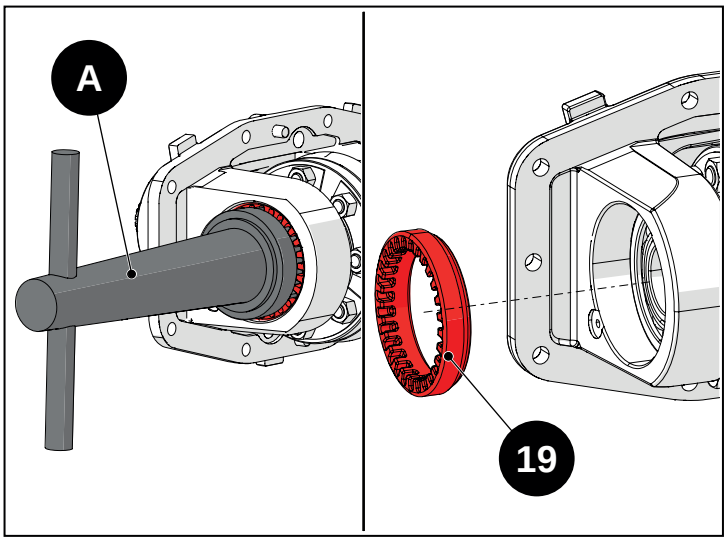


Fig. 7.56

Turning anticlockwise, loosen the crown wheel side ring nut (19) by 6 slots, using the hole in the ring nut retainer as reference.

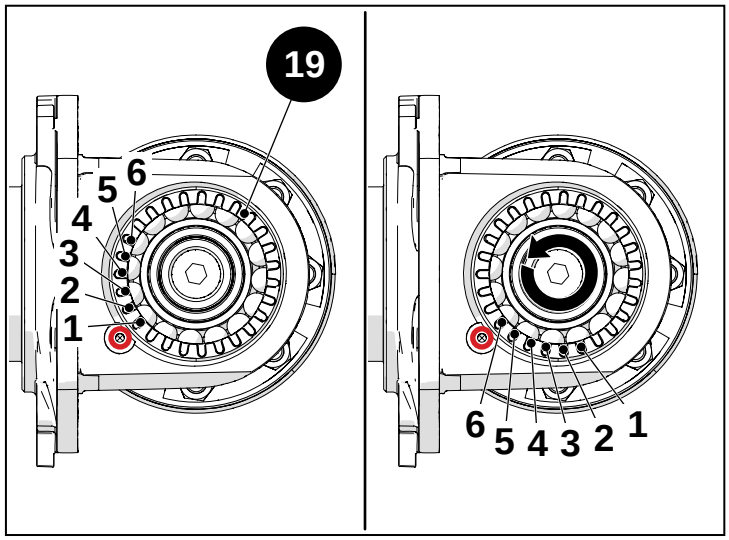


Fig. 7.57

Use a bearing punch tool to drive the bearing (13) on the side opposite the crown wheel fully into its seat.

Tighten the ring nut (12) using the special tool (B-p/n_____) and a torque wench, to a torque of 40 Nm (4 kgm).

Note
Align the hole on the ring nut retainer with one of the holes on the ring nut (12).

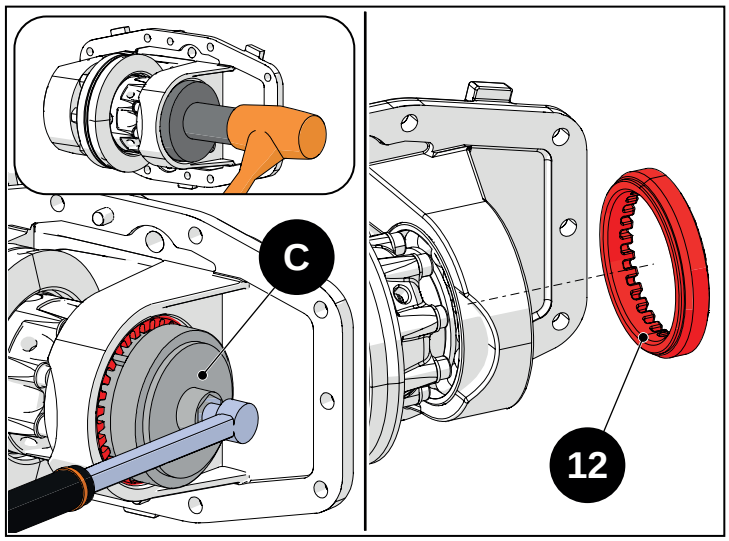


Fig. 7.58

Tap the crown wheel with a soft mallet to drive it fully against the bearing (18).

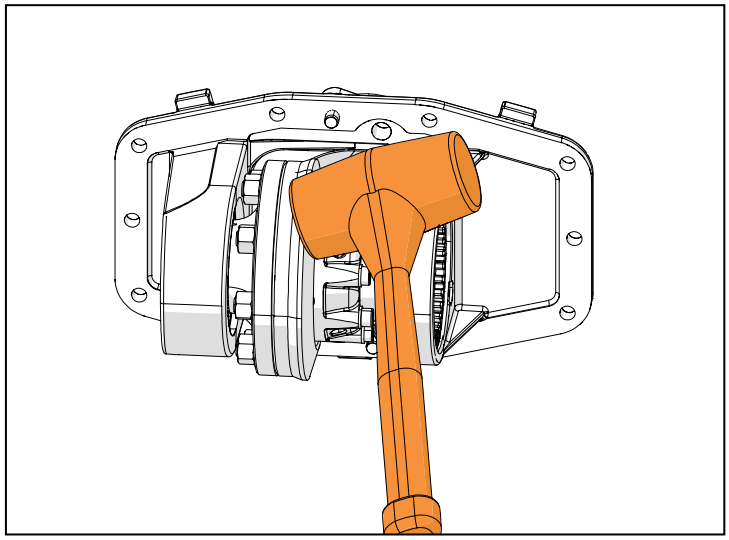


Fig. 7.59

Check that the crown wheel rotates correctly.

Restrain the pinion and turn the crown wheel to check that the backlash between the teeth of the crown wheel and the teeth of the pinion is between 0.10 and 0.18 mm.

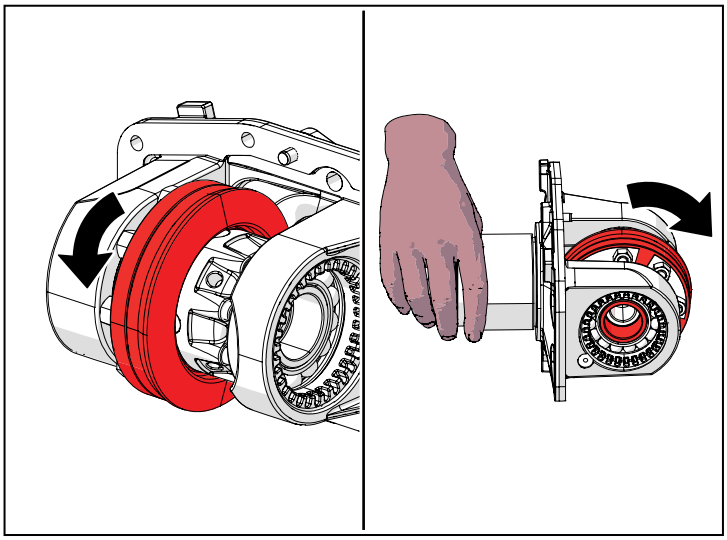


Fig. 7.60

Tighten the ring nut retainer screws (68) complete with washers (69), washers (70) and ring nut retainer hook (67).

Insert the ring nut retainer hook in the hole on the ring nut.

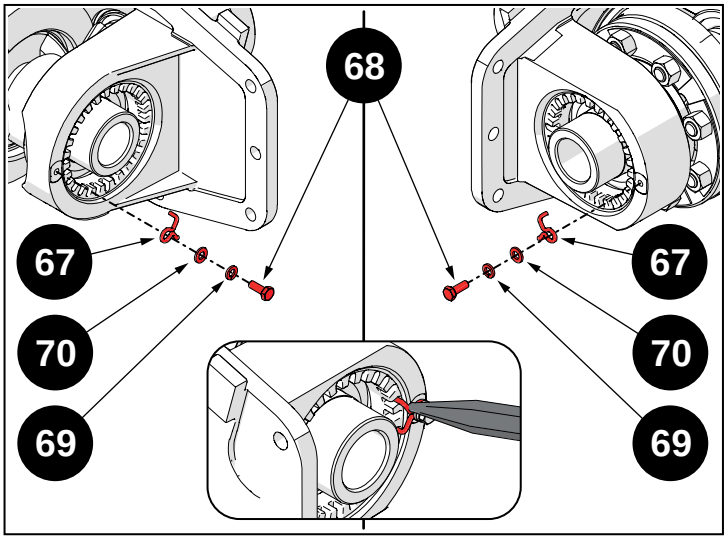


Fig. 7.61

Remove the screw and the wing nut (F) locking the NoSPIN mechanism.

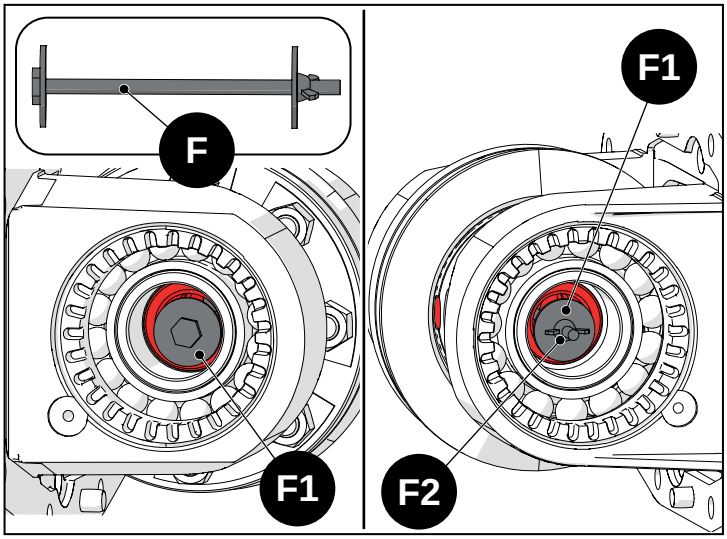


Fig. 7.62

Lubricate the oil seal seat on the cover (3).

Use a press and a suitable punch tool to install the oil seal (2) in the cover.

Apply a layer of silicone sealant on the mating surface of the cover.

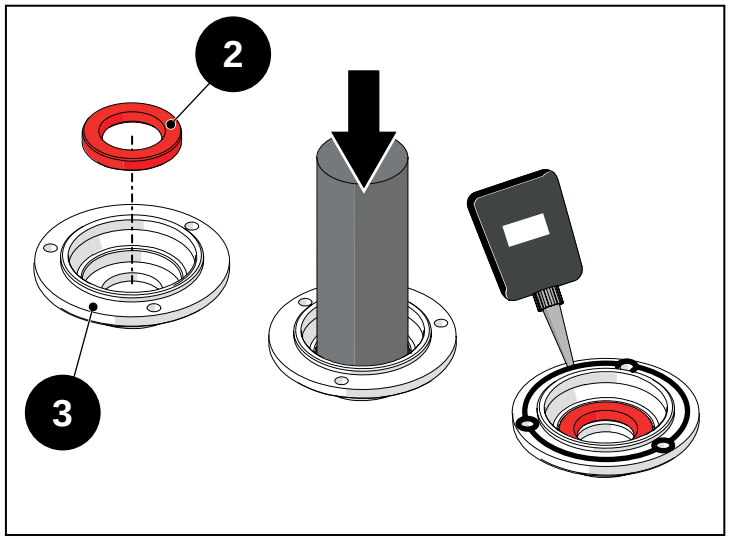


Fig. 7.63

Fit the cover (3) on the differential case (8). Tighten the screws (66) with the washers (82) to a torque of 15 Nm (1.5 Kgm).

Fit the circlip (26) on the bevel pinion (1).

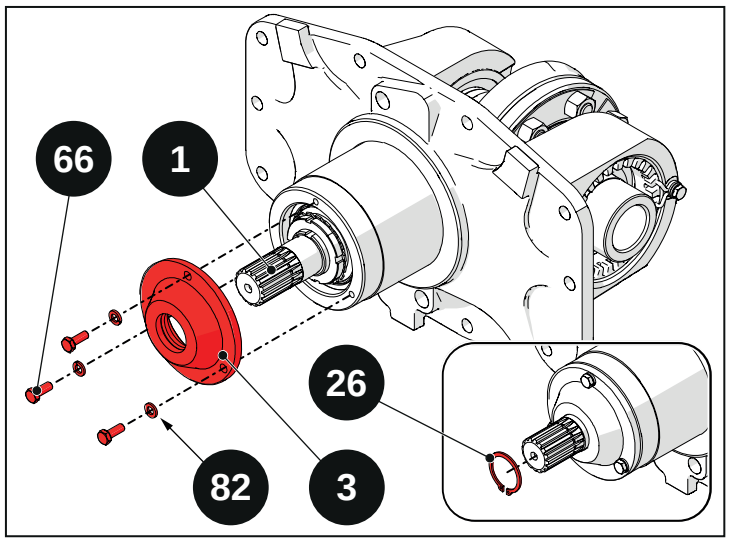


Fig. 7.64

5.1.3.1 Checking that the NoSPIN device functions correctly

Lock the pinion with the tool (E-p/n_____).

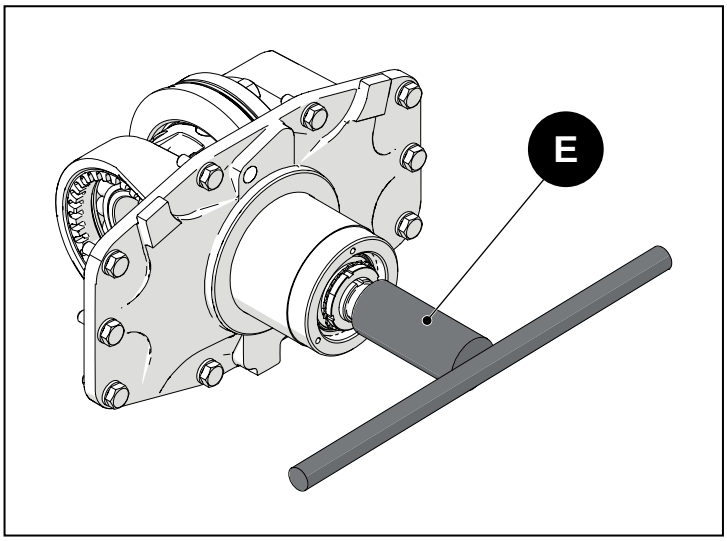


Fig. 7.65

Use the levers (D-07007179) to simulate engagement and disengagement of the differential lock. While holding one lever still, check that the other lever can be turned freely. Test in both directions of rotation on both sides.

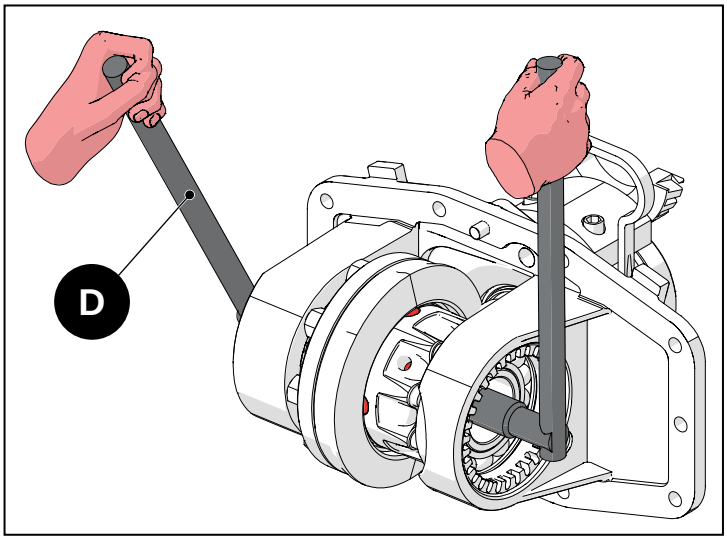


Fig. 7.66

5.2 Final drive unit

5.2.1 Assembly drawing and main components, HIGH version

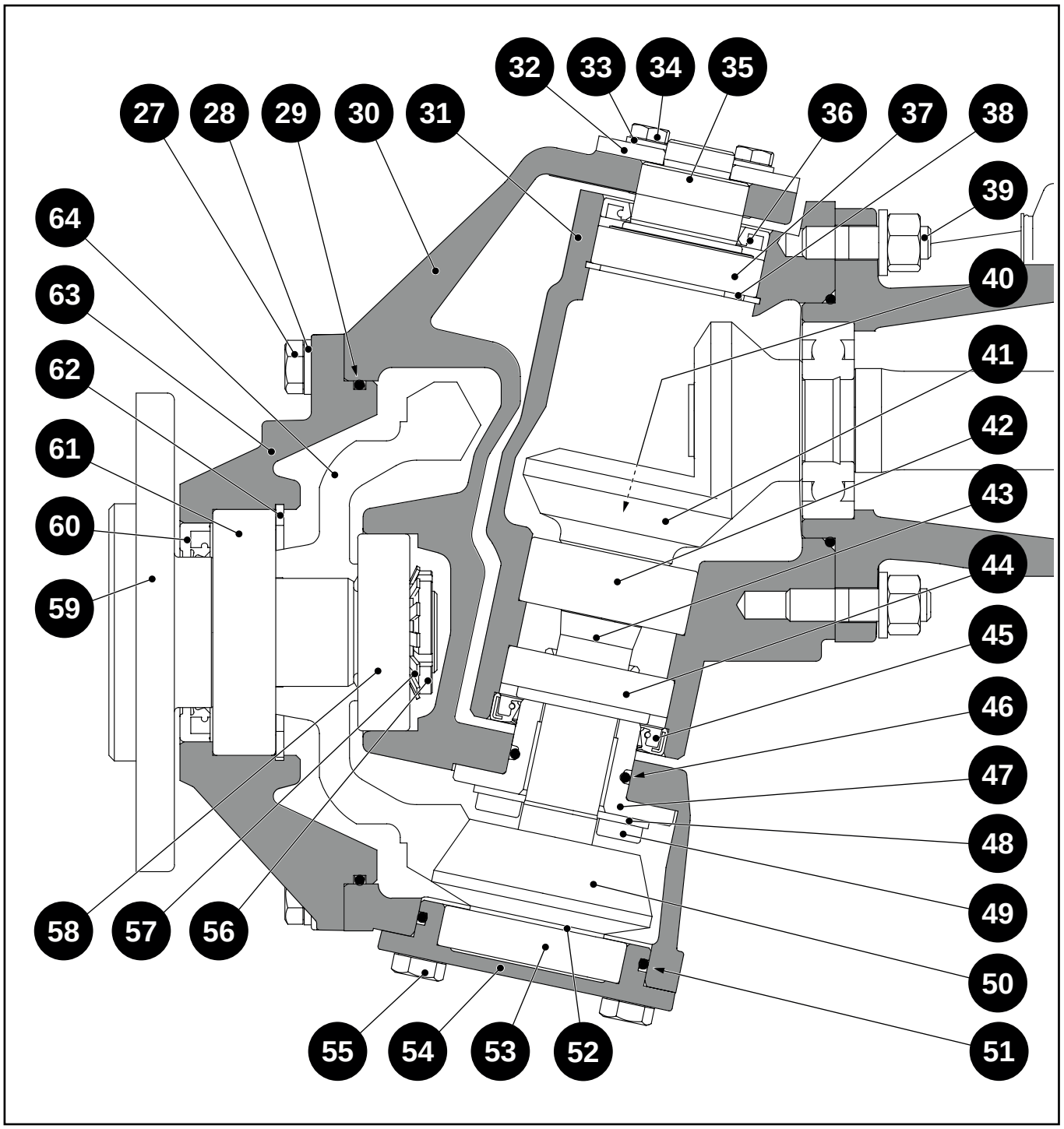


Fig. 7.67

27 - Screw
28 - Conical washer
29 - O-ring
30 - Reduction gearbox
31 - Knuckle flange
32 - Flange
33 - Conical washer
34 - Screw
35 - Reduction gear knuckle pin
36 - Oil seal
37 - Bearing
38 - Circlip
40 - Circlip
41 - Gear
42 - Bearing
43 - Reduction gear shaft
44 - Bearing
45 - Oil seal
46 - O-ring
47 - Internal knuckle flange
48 - Washer
49 - Screw
50 - Gear
51 - O-ring
52 - Circlip
53 - Bearing
54 - Reduction gear cover
55 - Screw
56 - Ring nut
57 - Ring nut retainer washer
58 - Bearing
59 - Front half-axle
60 - Combi ring
61 - Bearing
62 - Circlip
63 - Cover
64 - Front crown wheel

5.2.2 Assembly drawing and main components, LOW version

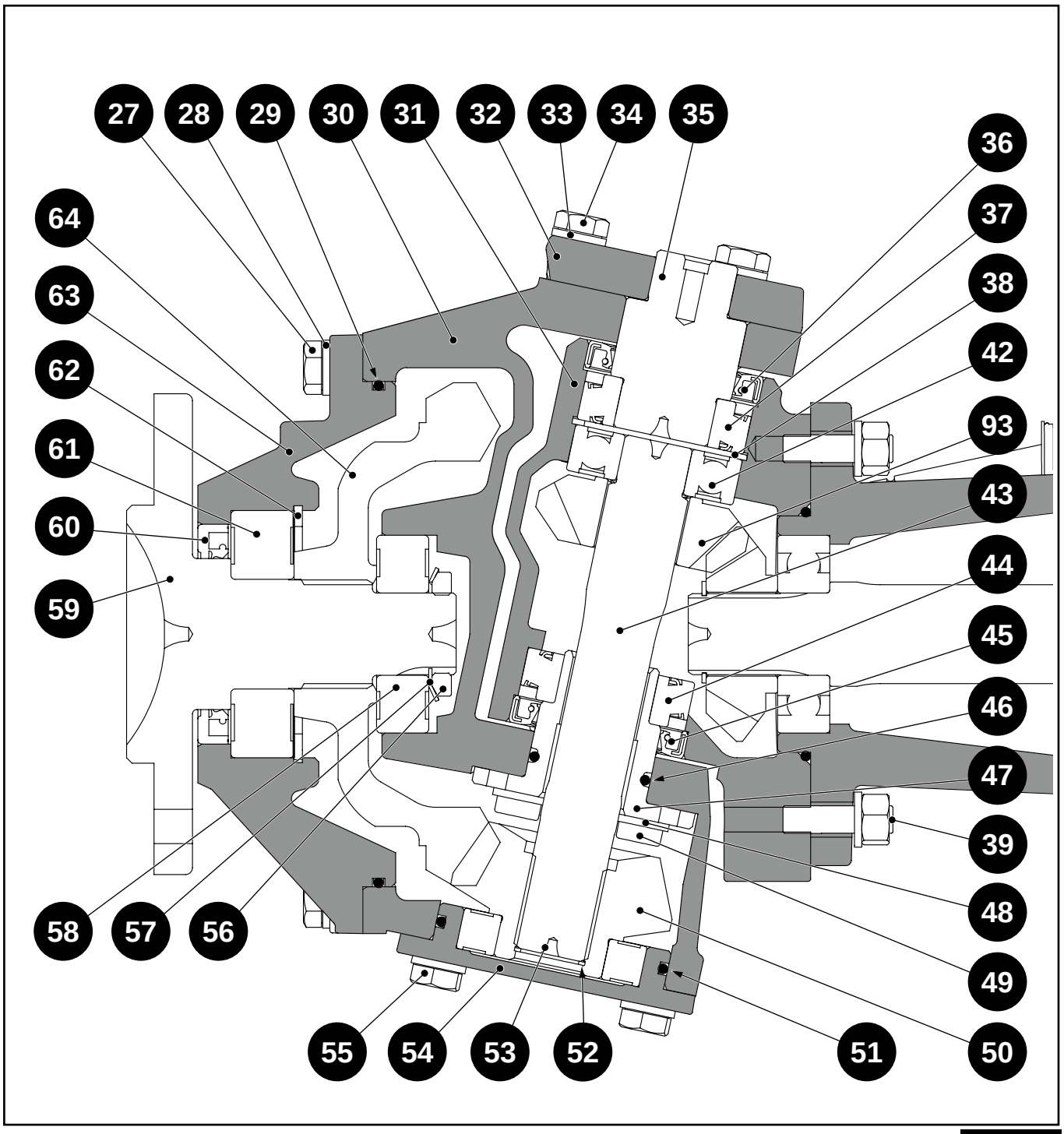


Fig. 7.68

27 - Screw
28 - Conical washer
29 - O-ring
30 - Reduction gearbox
31 - Knuckle flange
32 - Flange
33 - Conical washer
34 - Screw
35 - Reduction gear knuckle pin
36 - Oil seal
37 - Bearing
38 - Circlip
40 - Circlip
42 - Bearing
43 - Reduction gear shaft
44 - Bearing
45 - Oil seal
46 - O-ring
47 - Internal knuckle flange
48 - Washer
49 - Screw
50 - Gear
51 - O-ring
52 - Circlip
53 - Bearing
54 - Reduction gear cover
55 - Screw
56 - Ring nut
57 - Ring nut retainer washer
58 - Bearing
59 - Front half-axle
60 - Combi ring
61 - Bearing
62 - Circlip
63 - Cover
64 - Front crown wheel
93 - Gear

5.2.3 Disassembly

Note

Place empty drums under the plugs to collect oil.

Undo the screws (55), complete with conical washers, and then remove the complete lower cover (54).

Detach the gear (50), the bearing (53) and the O-ring (51) from the cover (54).

Remove the circlip (52) from the gear (50).

Warning

Replace the O-ring (51) with a new component when reassembling.

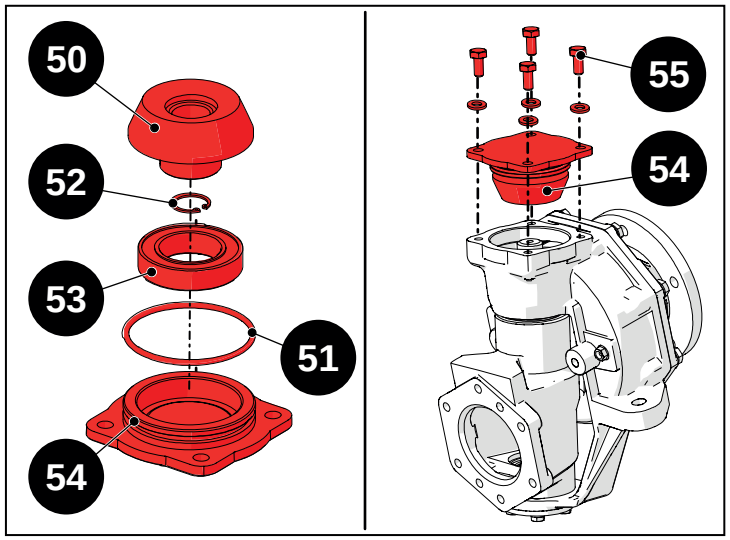


Fig. 7.69

Undo the screws (27) and remove the conical washers (28).

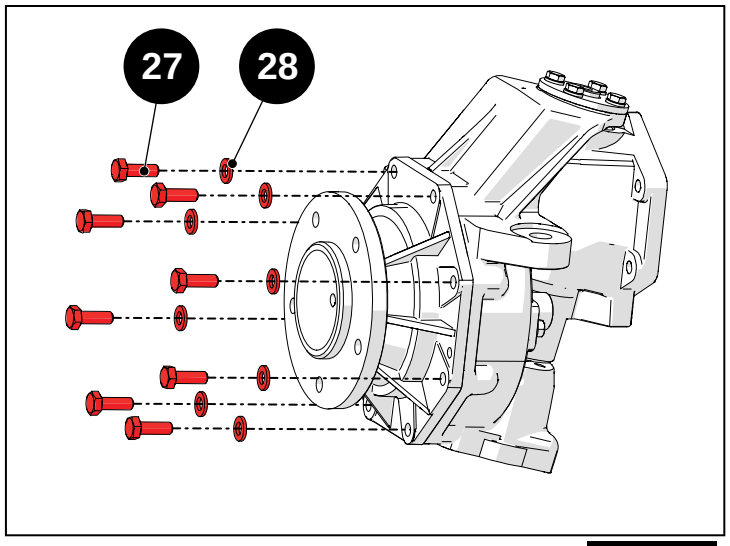


Fig. 7.70

Fit 2 screws into the extraction holes, and then tighten them to remove the final drive gear cover (63).

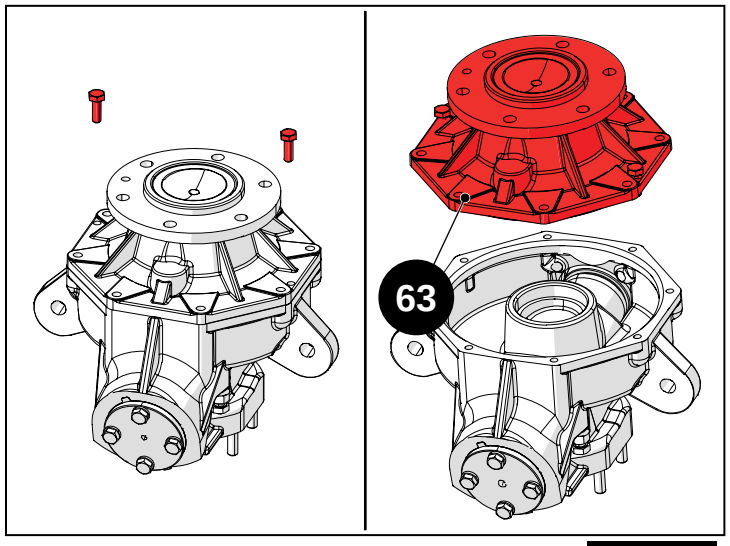


Fig. 7.71

Remove O-ring (29).

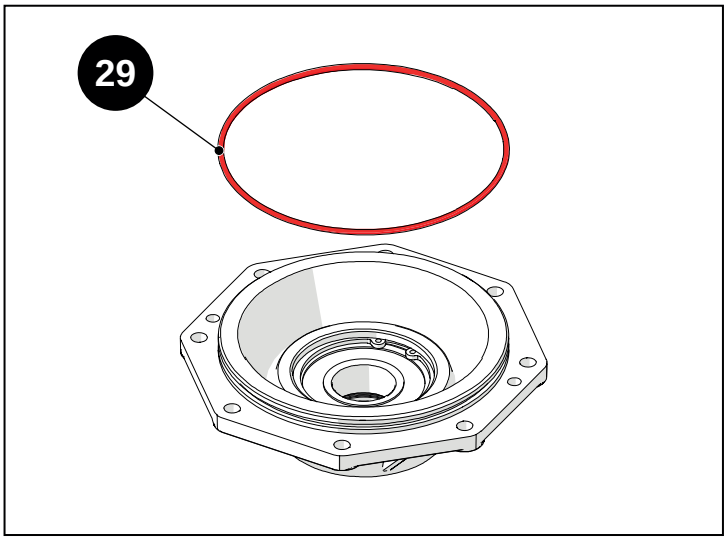


Fig. 7.72

Undo the hex socket screws (49) complete with conical washers (48), and then remove the flange (47) complete with O-ring (46).

Remove the O-ring (46) from the inner flange (47).

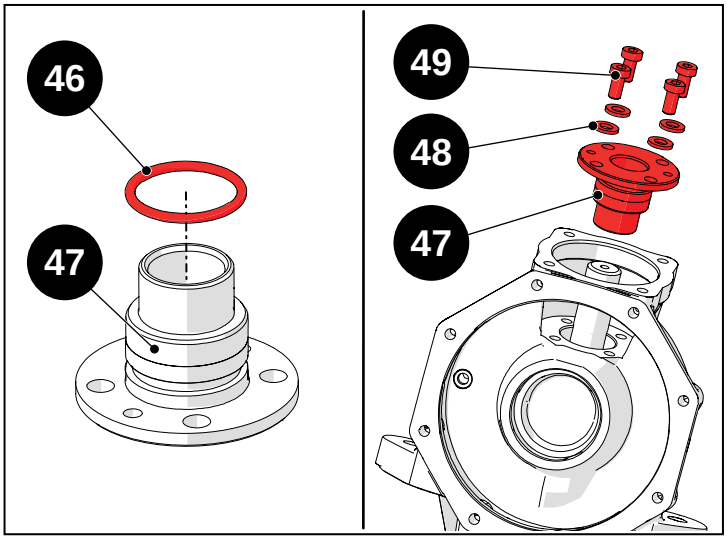


Fig. 7.73

Undo the screws (34), complete with washers (33), and remove the flange (32).

Unscrew the plug (85).

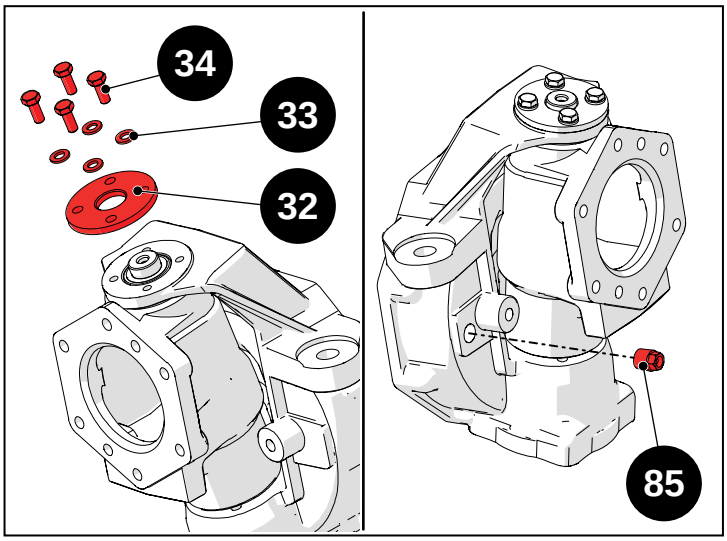


Fig. 7.74

Remove the spacer (88) and the pivot pin (35).

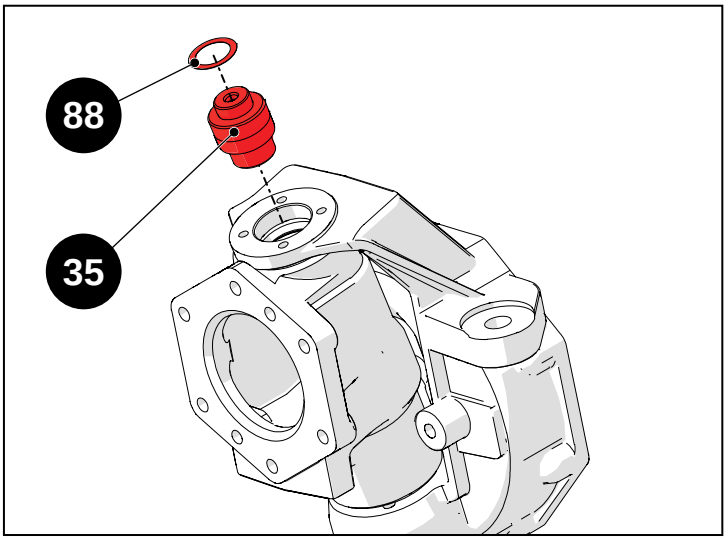


Fig. 7.75

HIGH model:

Remove the circlip (40), freeing the gear (41) and the shaft (43).

Tap the shaft (43) with a pin punch to drive out and remove the shaft.

Remove the gear (41).

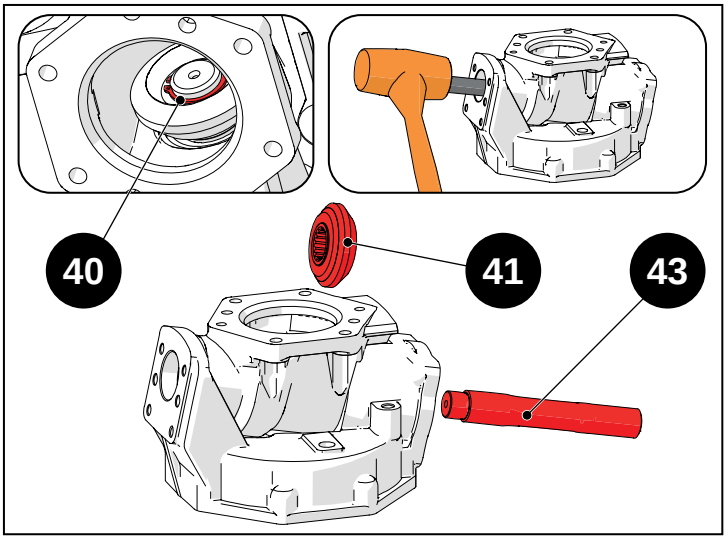


Fig. 7.76

LOW model:

Tap the shaft (43) with a pin punch to drive out and remove the shaft.

Remove the gear (93).

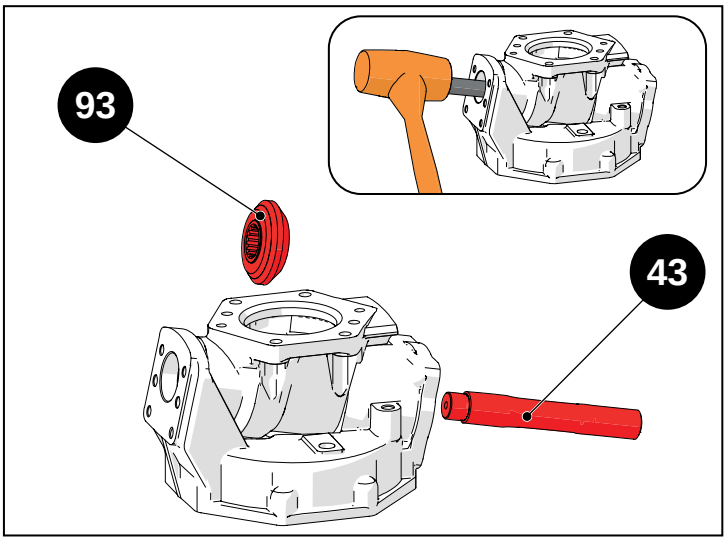


Fig. 7.77

Remove the flange (31) from the complete final drive unit.

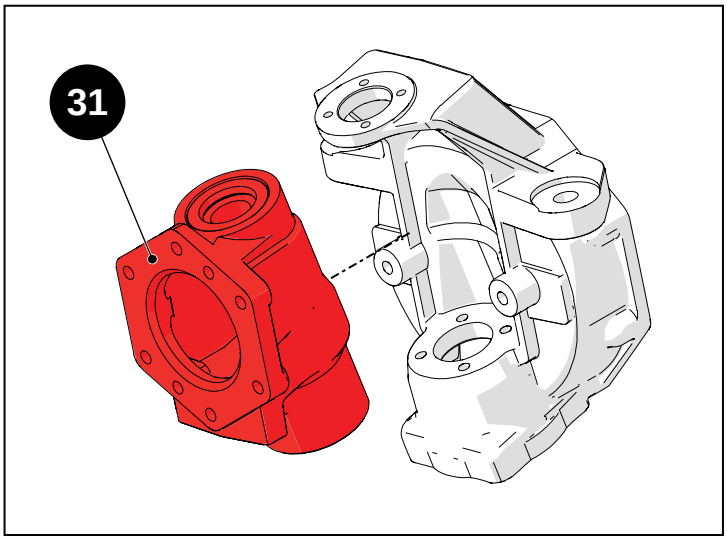


Fig. 7.78

Remove the oil seal (36) and the bearing (37).

Remove the oil seal (45) and the bearing (44).

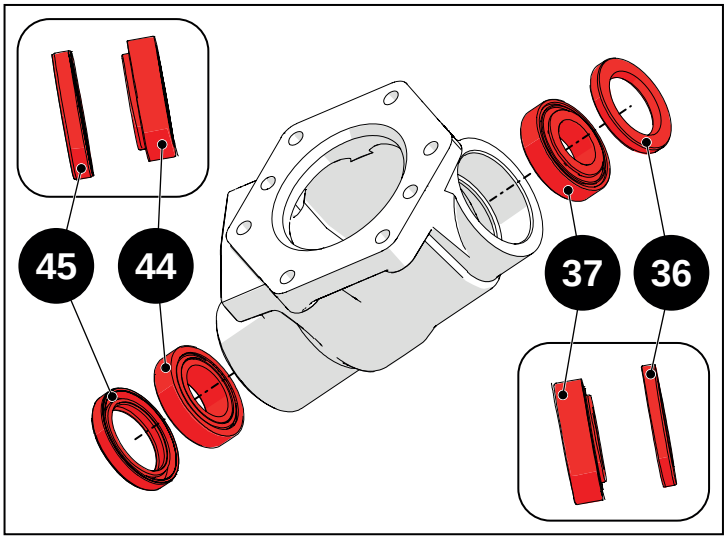


Fig. 7.79

Remove the circlip (38) from the knuckle flange (31).

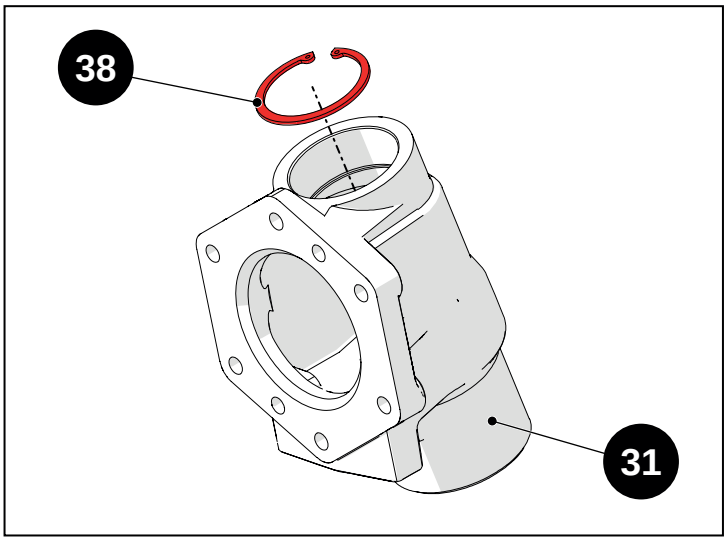


Fig. 7.80

Remove the bearing (42) from the knuckle flange.

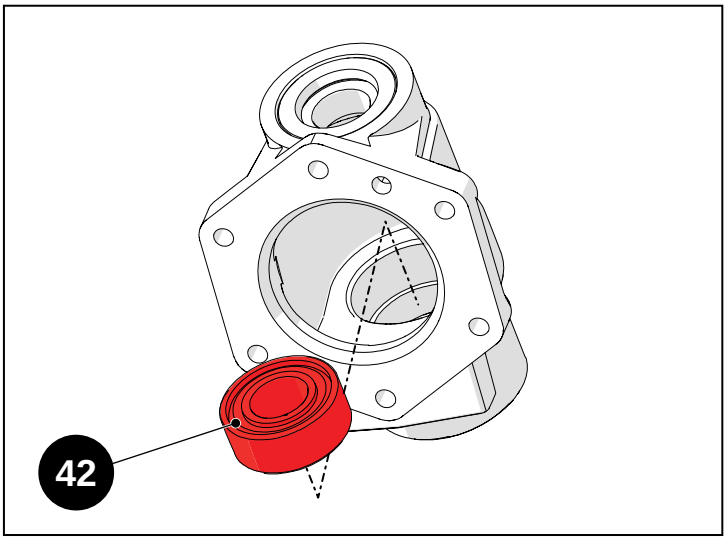


Fig. 7.81

Bend back the tooth of the ring nut retainer (57).

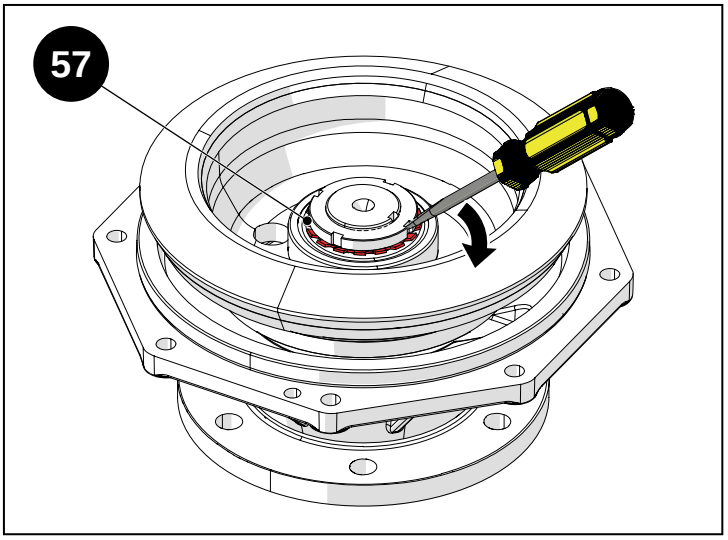


Fig. 7.82

Use the special tool (G-07000234) to undo and remove the ring nut (56).

Remove the ring nut retainer (57).

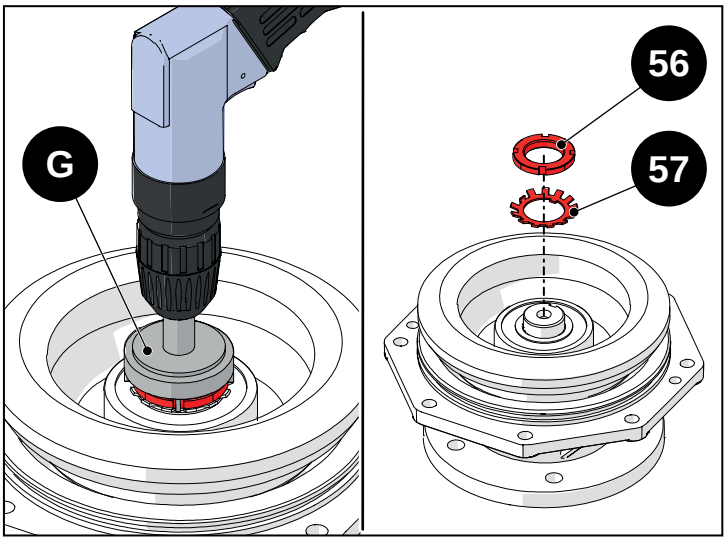


Fig. 7.83

Tap the half axle with a soft mallet to detach the bearing (58) and the crown wheel (64).

Remove the half axle (59) from the cover (63).

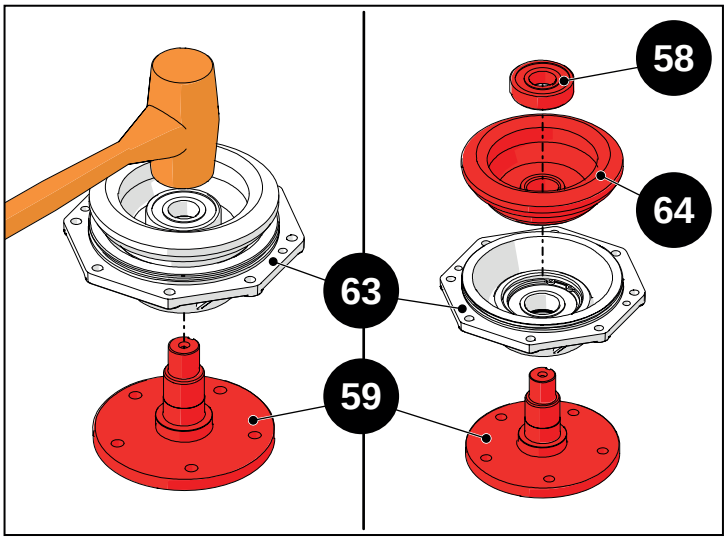


Fig. 7.84

Remove the circlip (62).

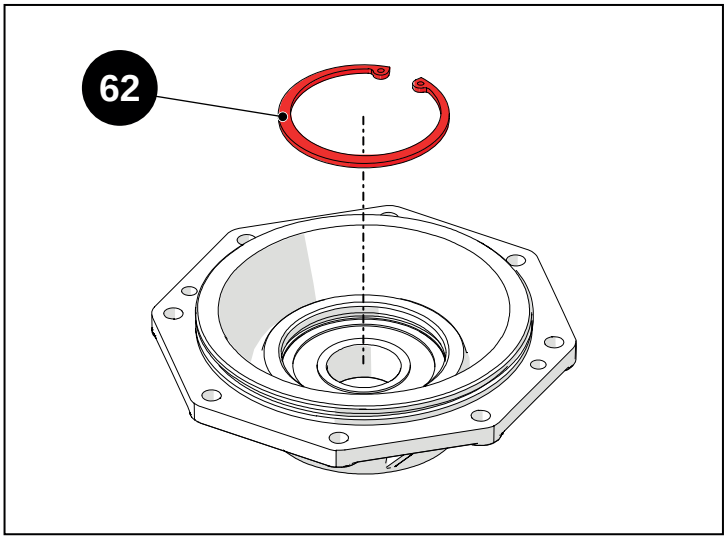


Fig. 7.85

Remove the oil seal (60).

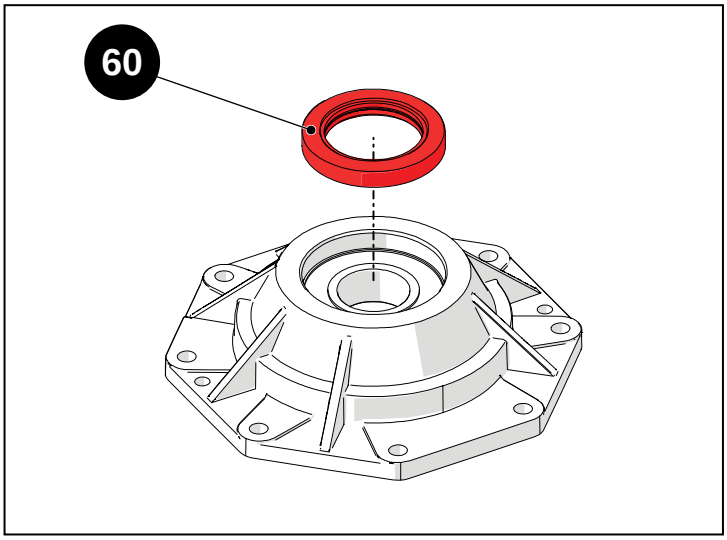


Fig. 7.86

Use a bearing punch tool to remove the bearing (61).

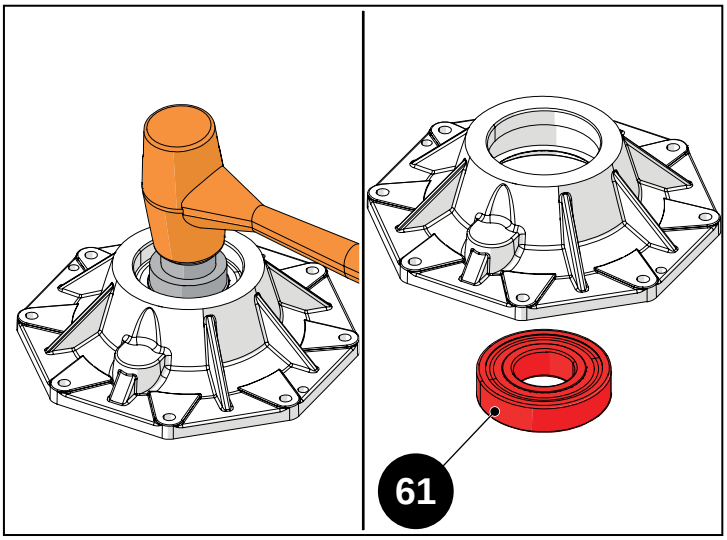


Fig. 7.87

5.2.4 Main inspection, reassembly and adjustment procedures

Warning

Read the instructions in chapter "1-Introduction" and, in particular, the sections concerning the installation of O-rings, oil seals and bearings, with particular care before reassembling, and follow these instructions precisely when working.

Apply the correct tightening torques when tighten the fasteners of components. Where tightening torques are not specified, refer to the table in chapter "1-Introduction".

Use the specified sealant products during reassembly. Where the sealant required is not specified, refer to the table in chapter "1-Introduction".

Use a bearing punch tool to install the bearing (61) in the cover (63).

Fasten the bearing by fitting the circlip (62) in its seat.

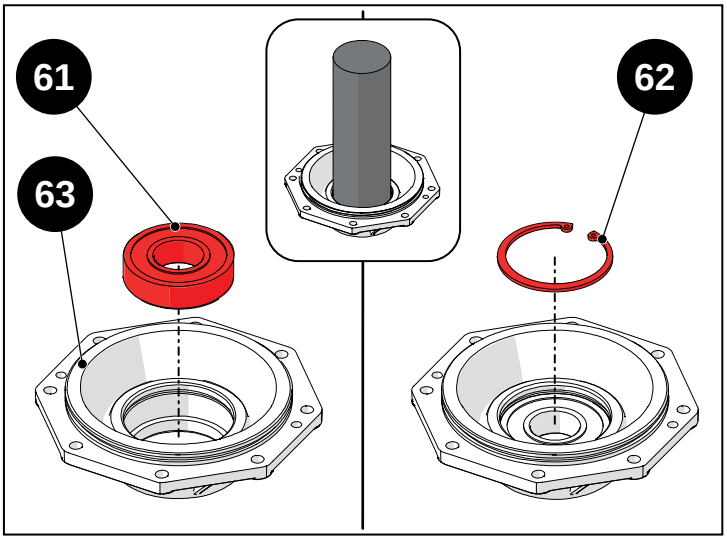


Fig. 7.88

Fit the oil seal (60), applying a layer of mastic sealant around its perimeter.

Note

Replace the oil seal with a new component. Do not reuse the old oil seal after removal.

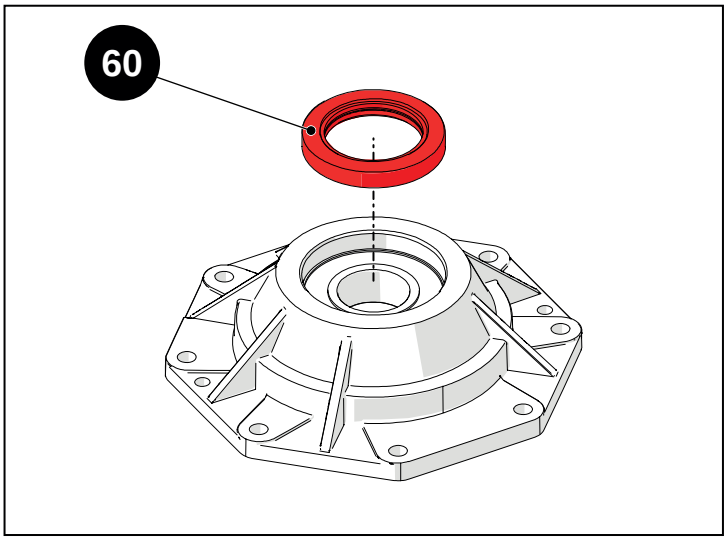


Fig. 7.89

Apply a layer of grease and then fit the O-ring (29) in its seat.

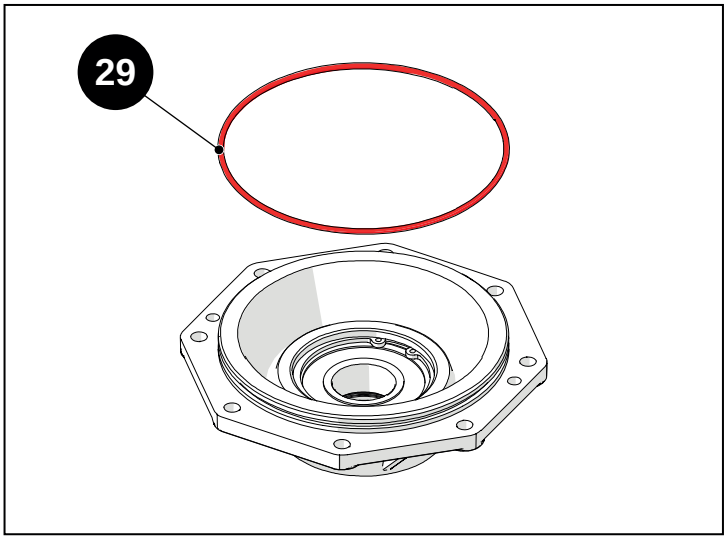


Fig. 7.90

Fit the half axle (59) in the cover (63).

Fit the crown wheel (64) onto the half axle and install the bearing (58), driving it fully into its seat with a suitable bearing punch tool.

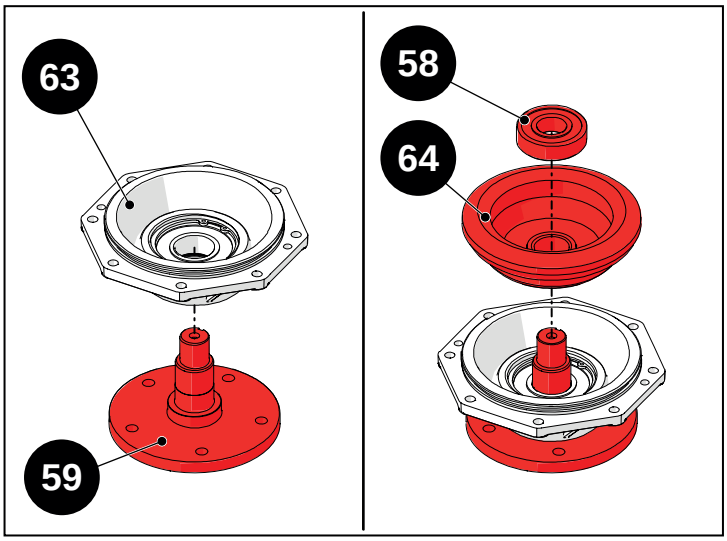


Fig. 7.91

Fit the ring nut retainer washer (57) and the ring nut (56). Use the special tool (G-07000234) to tighten the ring nut (56) to a torque of 150 Nm (15 kgm).

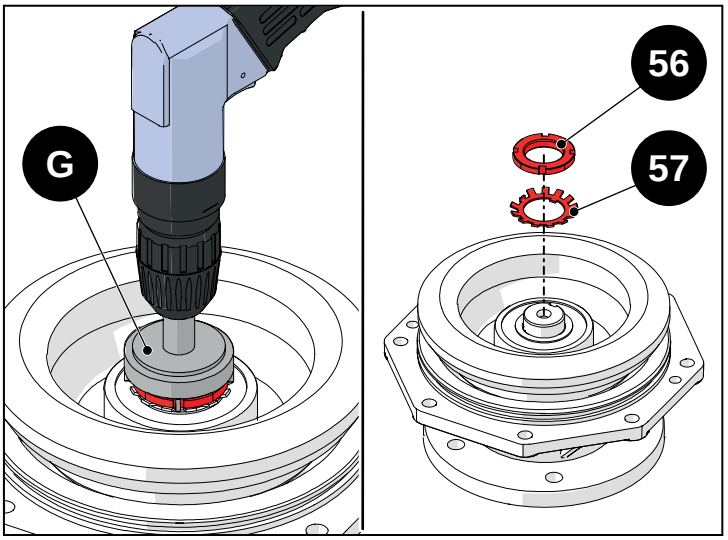


Fig. 7.92

Bend up the tooth of the ring nut retainer washer (57) to lock the ring nut (56).

> **Warning**
>
> Initially lift the tooth with pliers to prevent damage to the shielding of the bearing underneath.

Punch a dot on the ring nut (56) next to the groove on half axle as an additional safety measure.

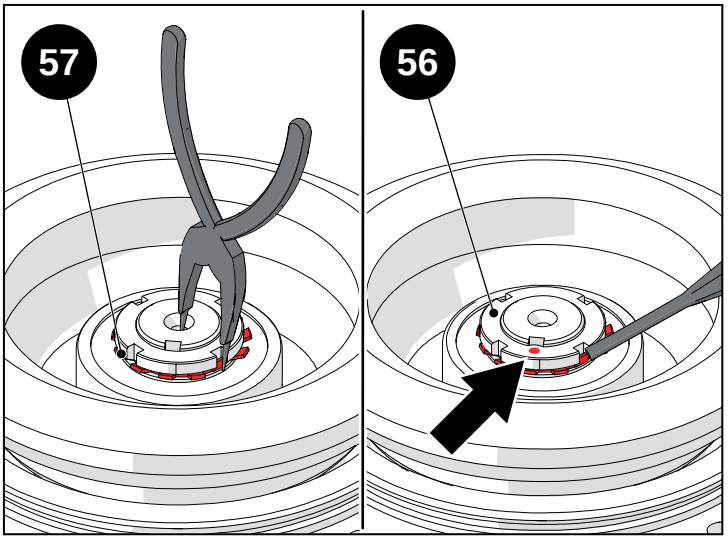


Fig. 7.93

Fit the circlip (38) on the knuckle flange (31).

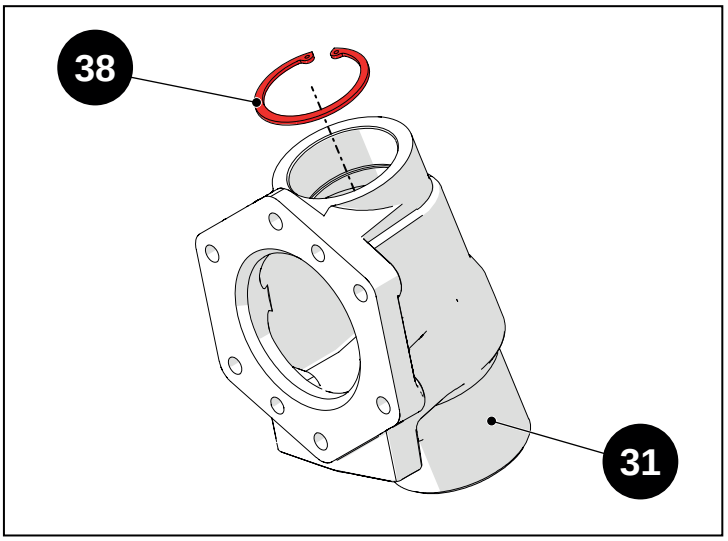


Fig. 7.94

Lubricate the seats, and then fit the bearings (37) and (44) together with the oil seals (36) and (45).

Warning

The protruding side of each bearing must face towards the respective oil seal.

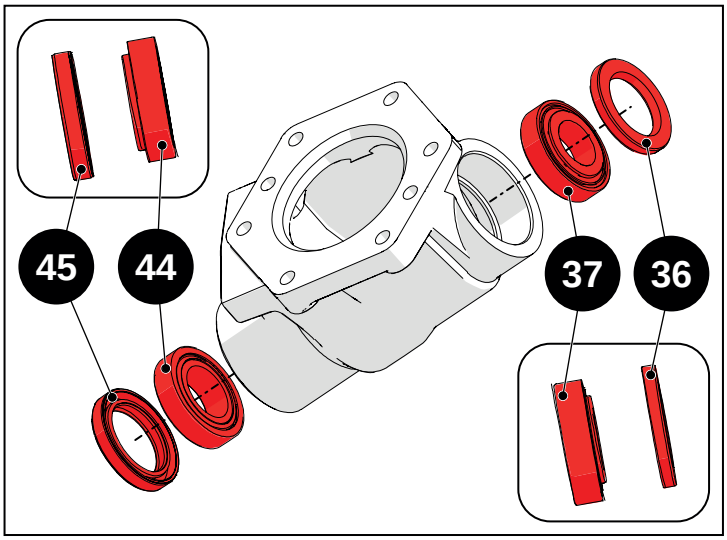


Fig. 7.95

Fit the bearing (42) on the knuckle flange and drive it fully into its seat with a bearing punch tool of suitable diameter.

Warning

The seat used to install the bearing (42) depends on the tractor model.

HIGH model: install in the lower seat of the flange (as shown in the figure).

LOW model: install in the upper seat of the flange.

Punch a dot on the flange near the bearing (42) to secure the bearing in its seat.

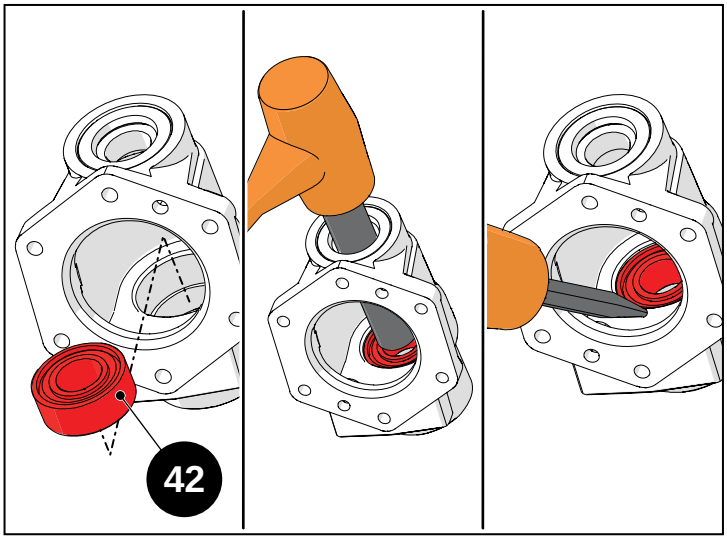


Fig. 7.96

Fit the knuckle flange (31) in the final drive unit case (30).

Fit the pin (35) and the spacer (88).

Note

The rigidity of the knuckle depends on the thickness of the spacer (88).

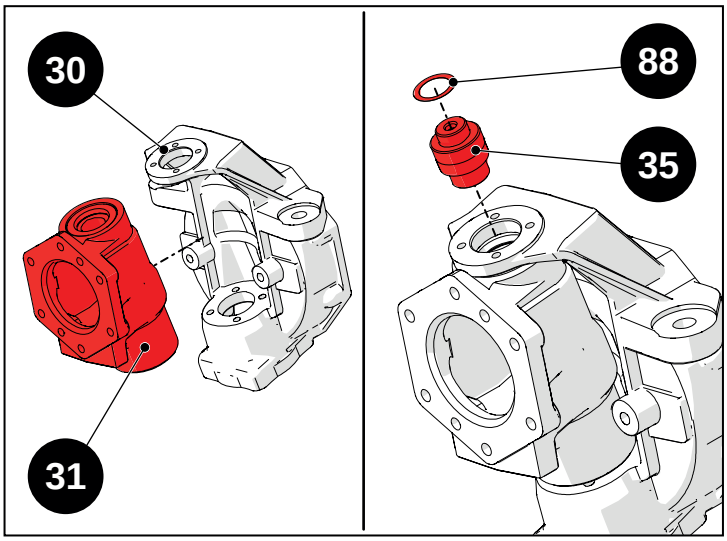


Fig. 7.97

Fasten the flange (32) with the screws (34) and the washers (33).

Tighten the plug (85), applying a coating of Teflon to the thread.

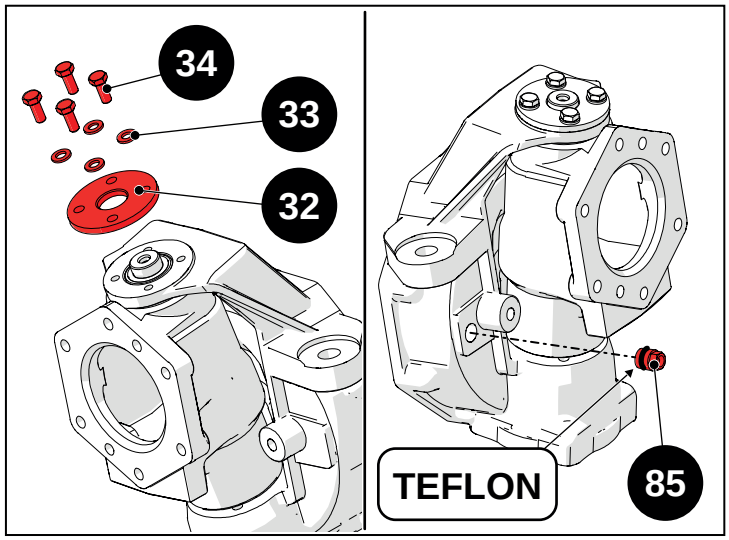


Fig. 7.98

HIGH model:

Fit the final drive unit shaft (43), engaging it with the gear (41).

Secure the gear (41) on the shaft by fitting the circlip (40).

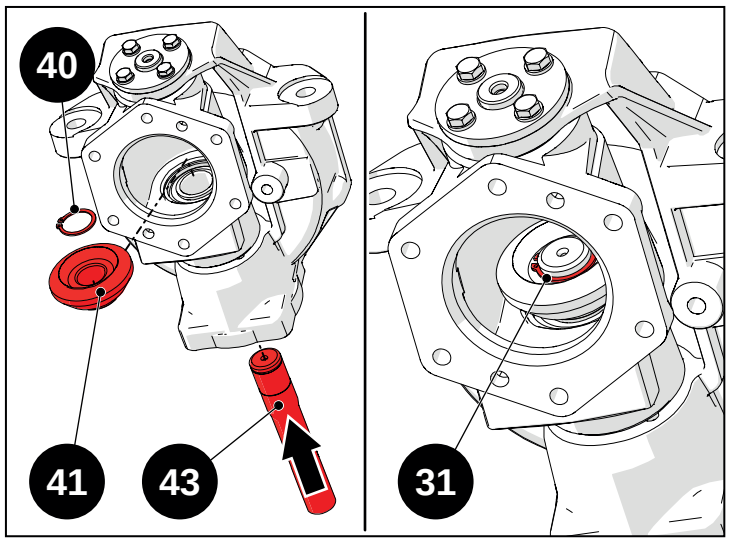


Fig. 7.99

LOW model:

Turn the final drive unit upside down and fit the gear (93), with the toothed side facing upwards.

Fit the shaft (43) fully into the gear (93).

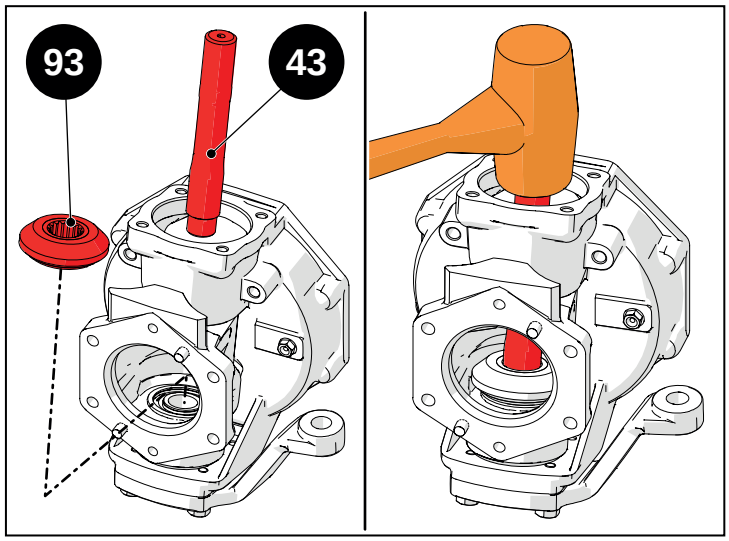


Fig. 7.100

Fit the O-ring (46) on the inner flange (47). Lubricate the O-ring.

Fit the inner flange (47) in the final drive unit, with the conical washers (48) and the hex socket screws (49).

Apply a coating of Loctite 577 to the thread of the hex socket screws (49), and then fit and tighten the screws to a torque of 50 Nm (5 kgm).

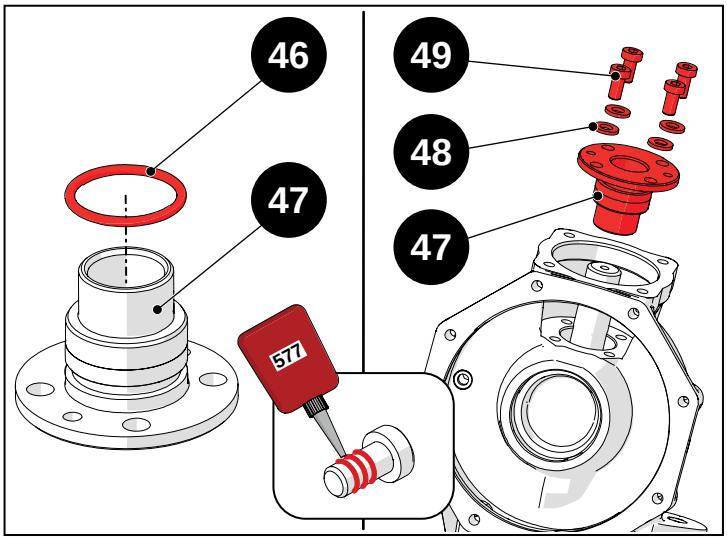


Fig. 7.101

Fit the complete cover (63) on the final drive unit case (30).

Fit the conical washers (28) and tighten the screws (27) to a torque of 60 Nm (6 kgm).

Warning

The two lower screws (27) indicated in the figure are shorter than the others.

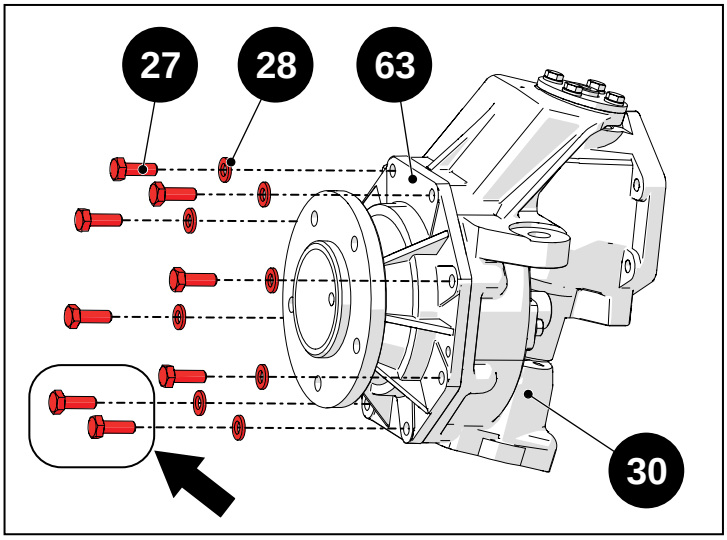


Fig. 7.102

Fit the O-ring (51) on the lower cover (54).

Pre-assemble the gear (50), fitting the circlip (52) in its seat.

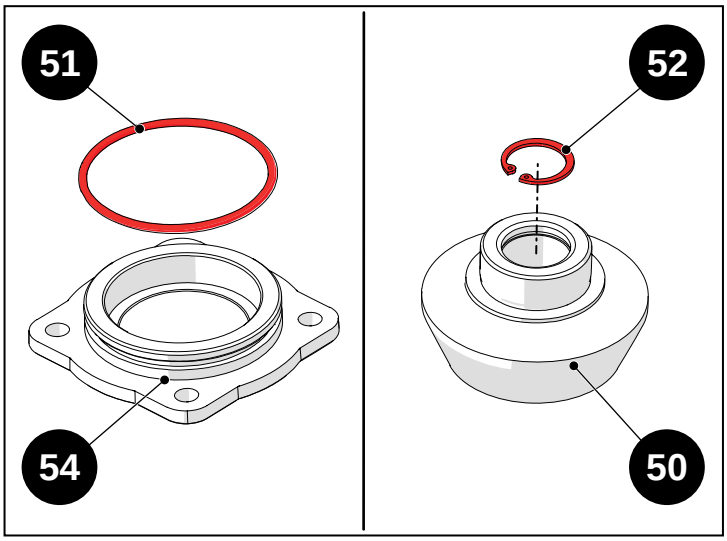


Fig. 7.103

Using a punch tool or a press, install the following components in the order indicated: the bearing (53) and the gear (50), in the lower cover.

Fit complete lower cover (54) on the final drive unit case.

Fit the conical washers and tighten the screws (55) to a torque of 50 Nm (5 kgm).

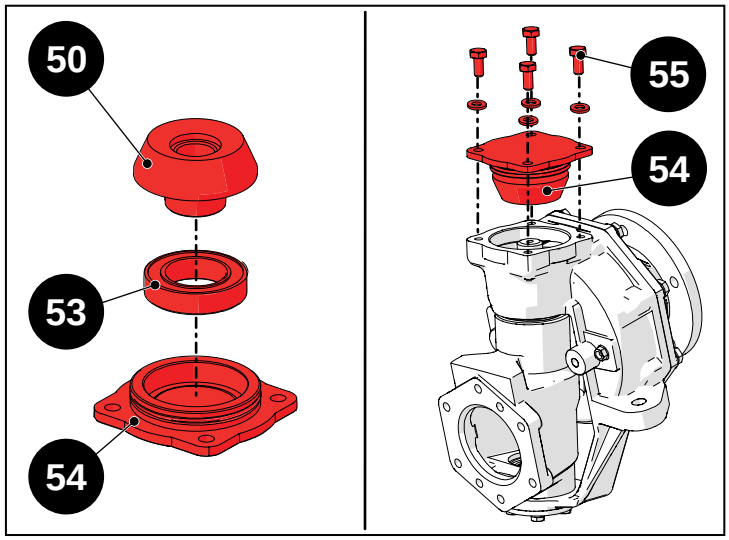


Fig. 7.104

Fit the centring pins (94).

Apply a coating of Loctite 270 to thread of the stud bolts (39), and then tighten the stud bolts onto the flange.

> **Warning**
>
> On the HIGH version, the stud bolt tightened into the top hole of the flange has a shorter threaded shank.

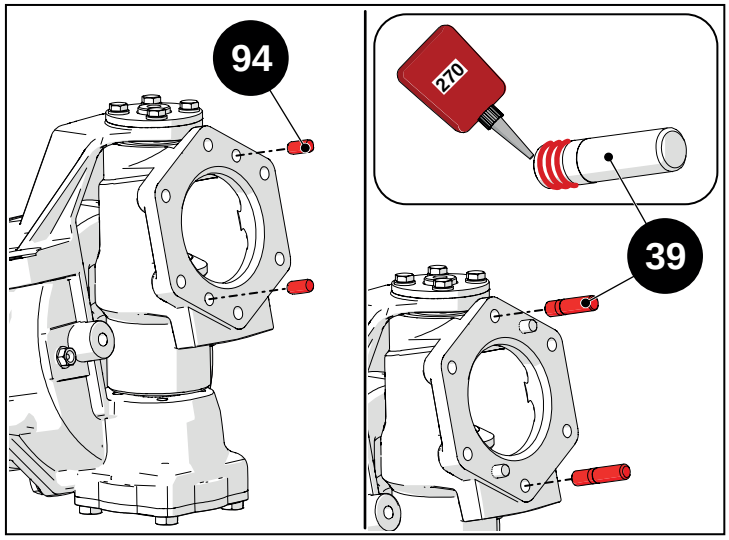


Fig. 7.105

Section 6 : Refitting

Index

6.1 Refitting 7-54
6.1.1 Adjusting the steering cylinder 7-60

6.1 Refitting

Warning

Read the instructions in chapter "1-Introduction" and, in particular, the sections concerning the installation of O-rings, oil seals and bearings, with particular care before reassembling, and follow these instructions precisely when working.

Apply the correct tightening torques when tighten the fasteners of components. Where tightening torques are not specified, refer to the table in chapter "1-Introduction".

Use the specified sealant products during reassembly. Where the sealant required is not specified, refer to the table in chapter "1-Introduction".

Apply a layer of silicone sealant on the mating surface of the half axle carrier case.

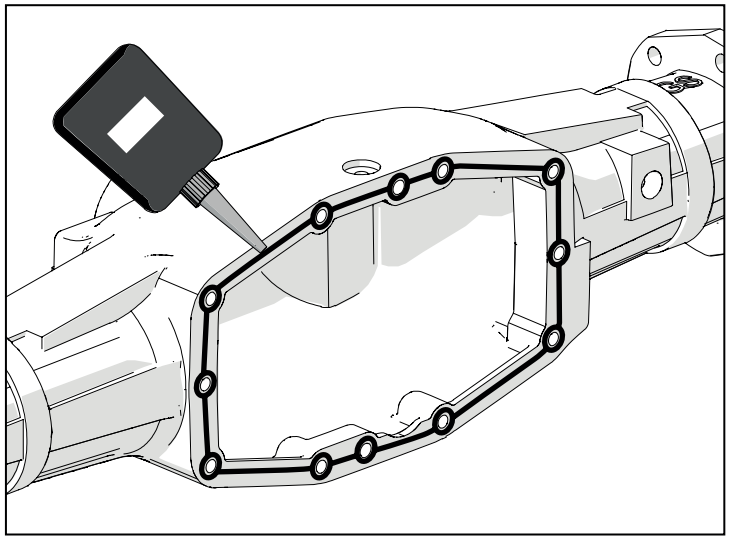


Fig. 7.106

Fit the complete front differential assembly (8).

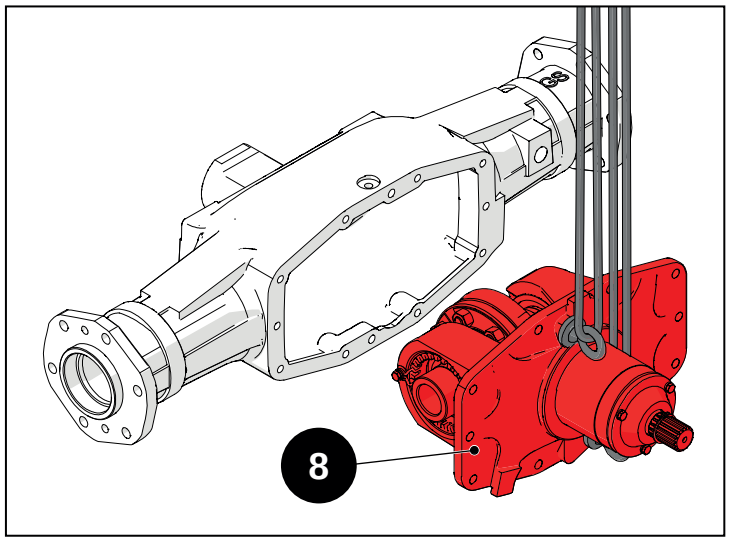


Fig. 7.107

Fit the conical washers (10) and tighten the screws (9) to a torque of 60 Nm (6 kgm).

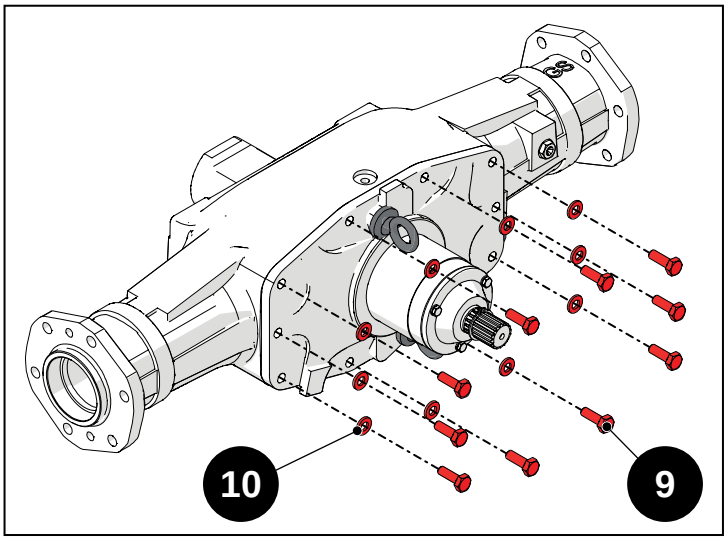


Fig. 7.108

Tighten the plugs (95) and (96) onto the differential case.

Refit plug (97) by screwing it back into place.

Note
Apply a coating of Teflon to the threads of the plugs.

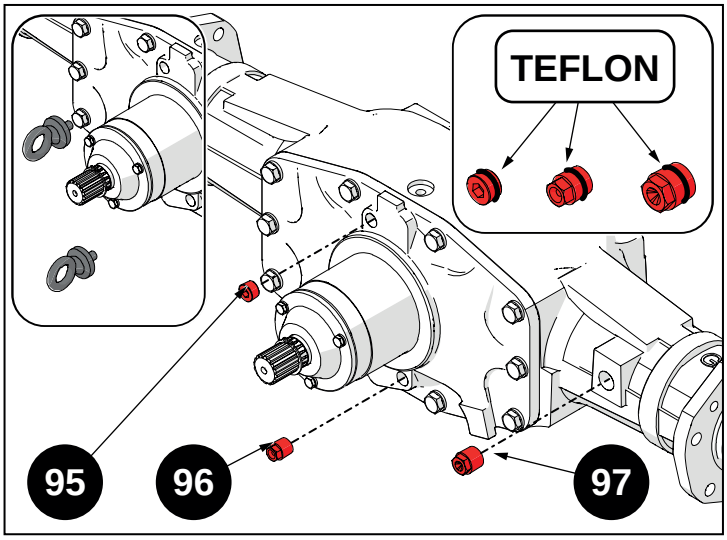


Fig. 7.109

Perform the procedure described as follows on both half axles (11):

1 - use a bearing punch tool of suitable diameter or a press to install the bearing (98) fully into its seat on the half axle;

2 - fit the gear (73) and secure with the circlip (99).

Note
The toothed side of the gear (73) must face outwards

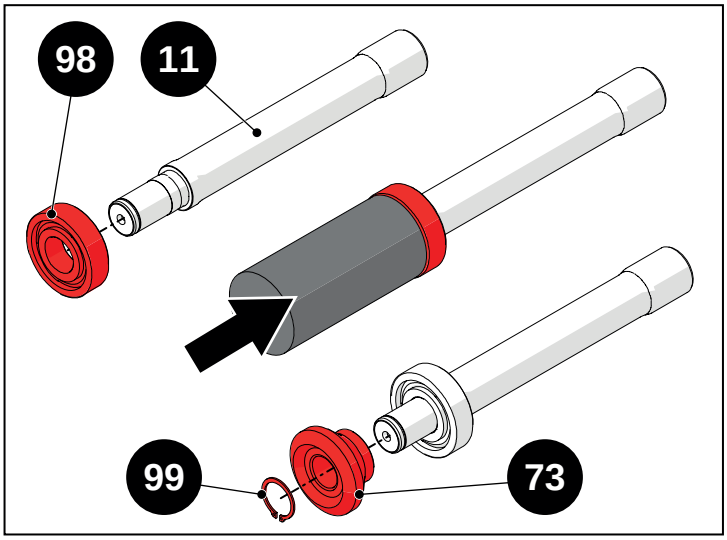


Fig. 7.110

Install the half axles:

1 - fit the O-ring (72) on the half axle carrier case;

2 - fit the complete half axle (11) on the axle, engaging correctly with the planetary gear. Ensure that the half axle is seated completely.

Note

Replace the O-ring (72) removed during disassembly with a new component. Do not reuse the old O-ring after removal.

Warning

Make sure that the half axles are installed on the correct sides: install the shorter half axle on the left hand side (crown wheel side) of the half axle case, and install the longer half axle on the right hand side.

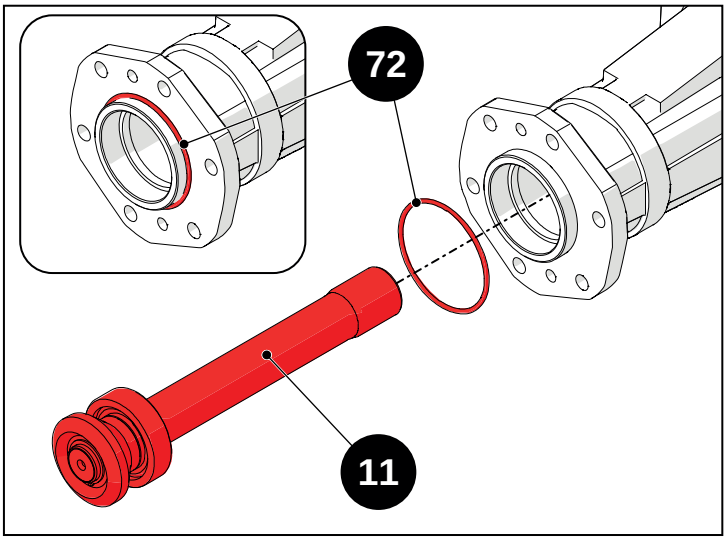


Fig. 7.111

Fit the complete final drive unit on the axle.

Tighten the stud bolts (39), fit the washers (71) and tighten the nuts (74) to a torque of 55 Nm (5.5 kgm).

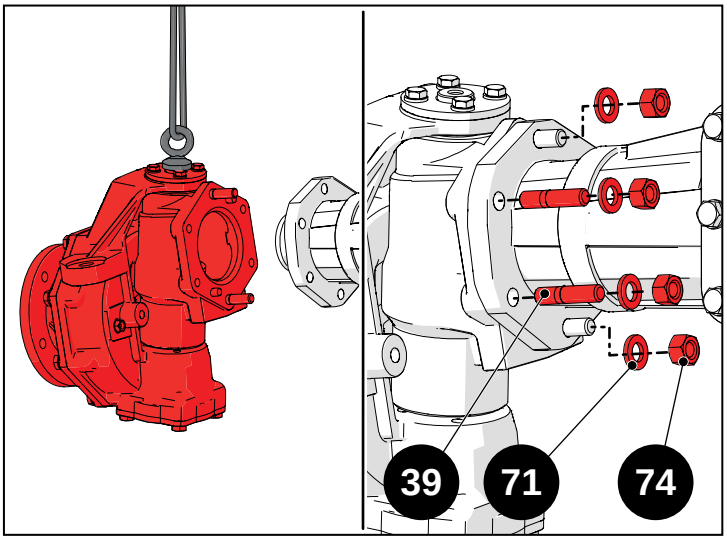


Fig. 7.112

Remove the hoisting eye bolt and tighten a fastener screw (34) complete with washer (33) in its place.

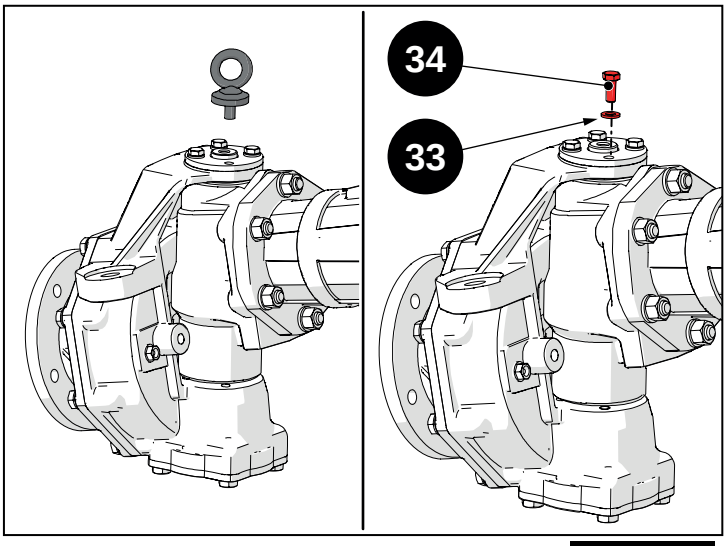


Fig. 7.113

Tighten the adjuster screws (87) with the nuts (86).

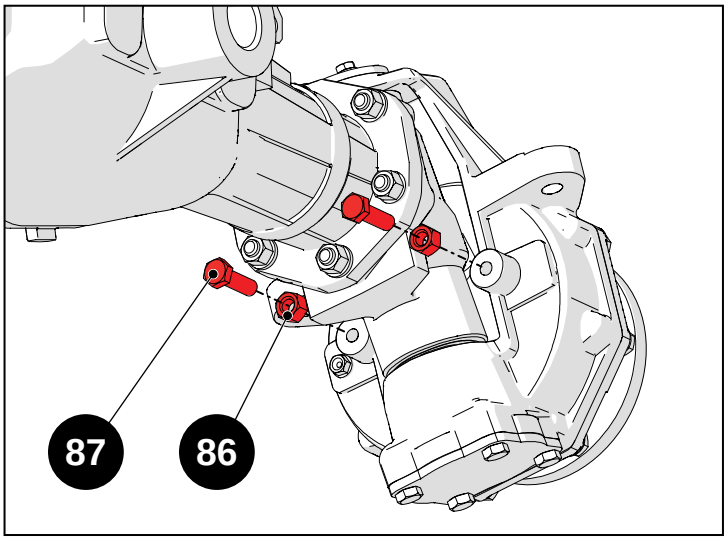


Fig. 7.114

Note

Repeat the same procedure for the other final drive unit.

Fit and tighten the vent plug (75) complete with washer (100).

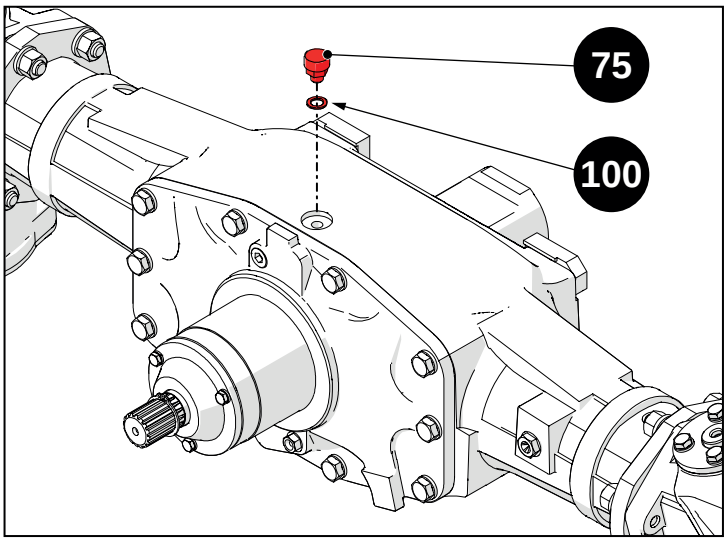


Fig. 7.115

Fit and tighten the grease nipples (101) on the case mounts.

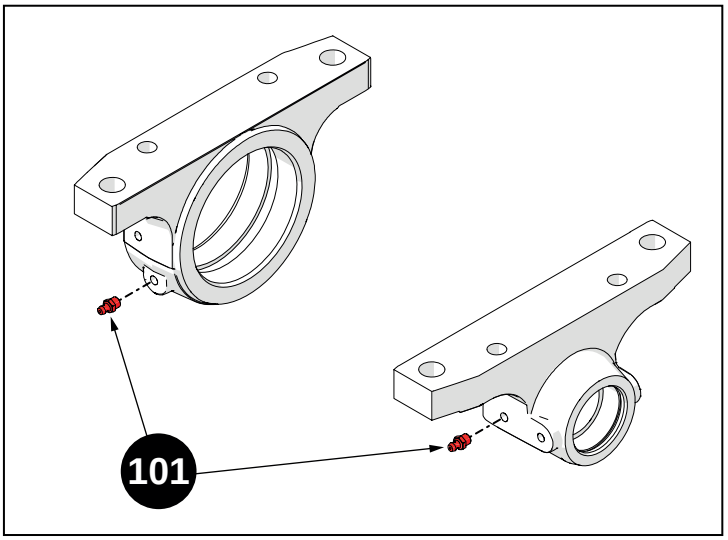


Fig. 7.116

Fit the rear case mount (6) with the spacer (7).

Warning

The bevelled part of the case mount (6) must face towards the spacer (7).

Note

Apply a layer of grease to the seat of the case mount to facilitate installation of the mount itself.

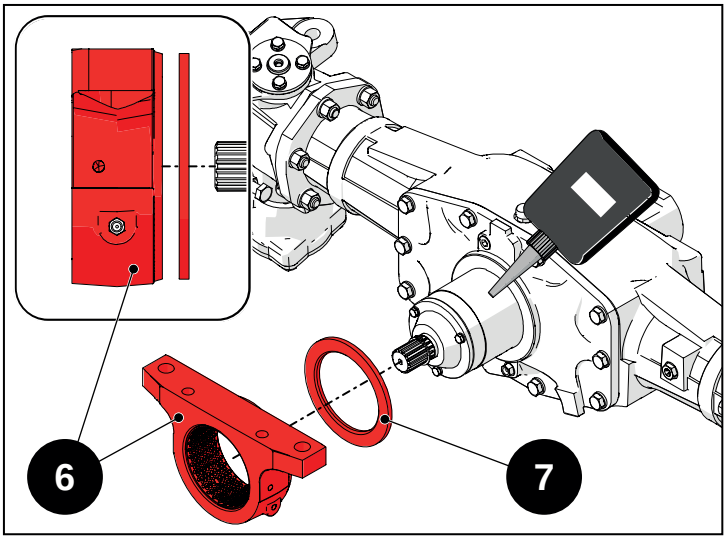


Fig. 7.117

Fit the front case mount (79) with the spacer (81).

Fit the dust cover (80) and fasten with the circlip (102).

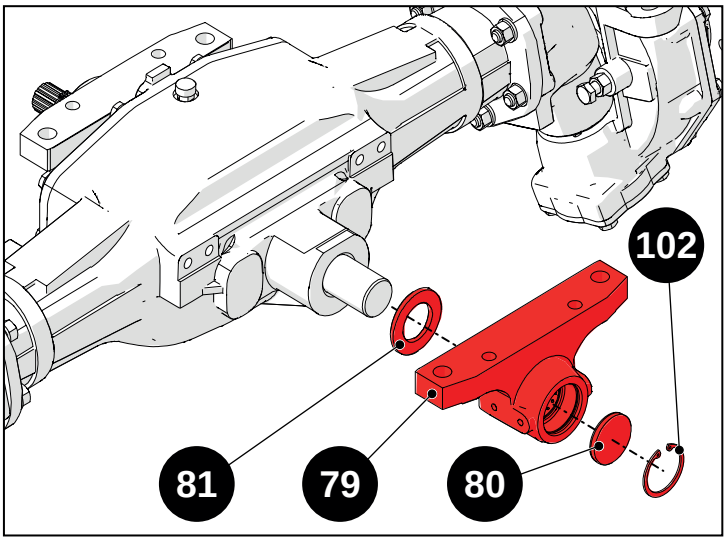


Fig. 7.118

Fill the axle with oil via the indicated hole.

Fill the final drive units with oil via the indicated hole.

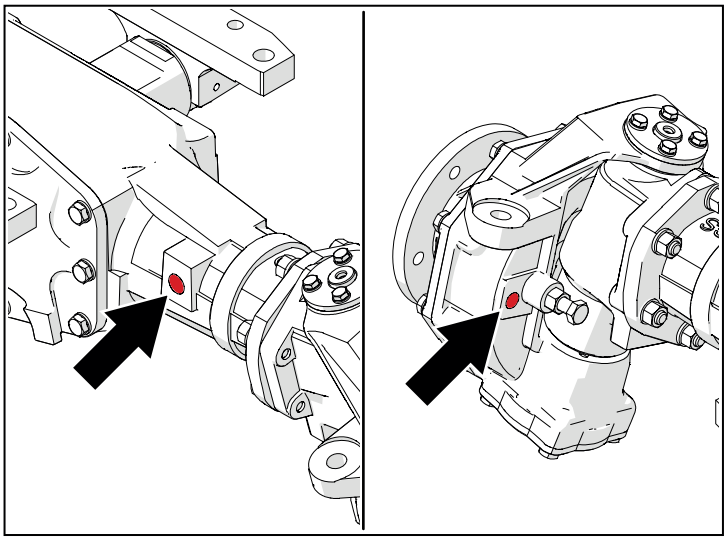


Fig. 7.119

Tighten the stud bolts (78) onto the half axle carrier case.

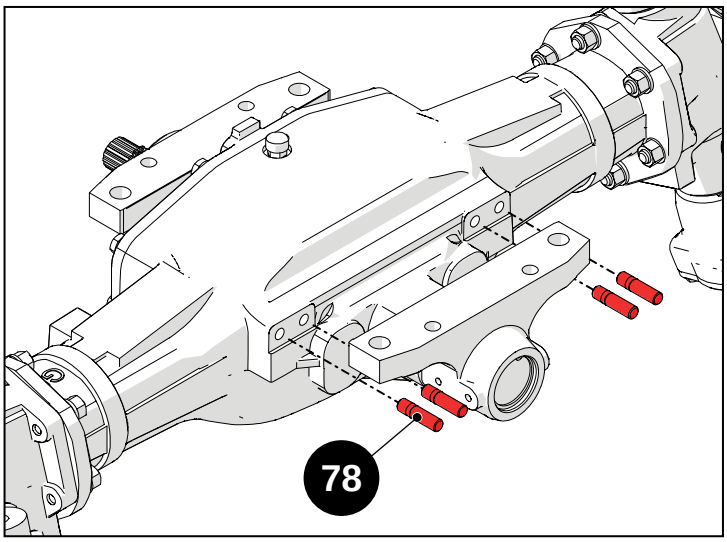


Fig. 7.120

Fit the complete steering cylinder (89).

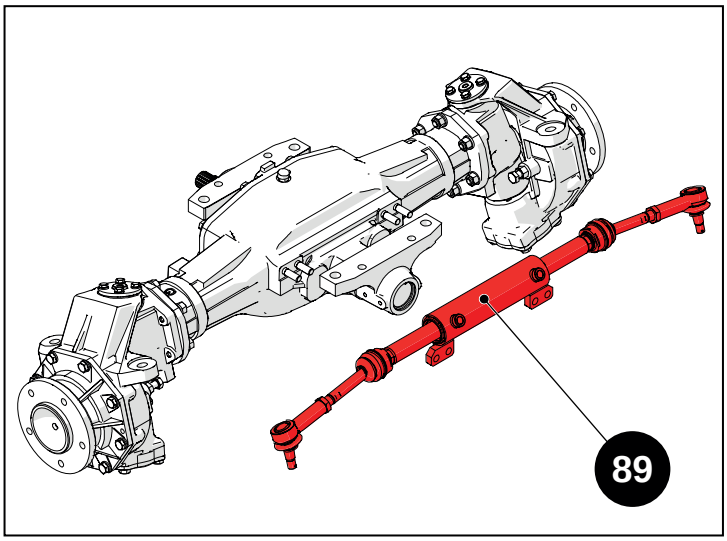


Fig. 7.121

Fit the flat washers (76) and fit and tighten the self-locking nuts (77) fastening the steering cylinder to the front axle.

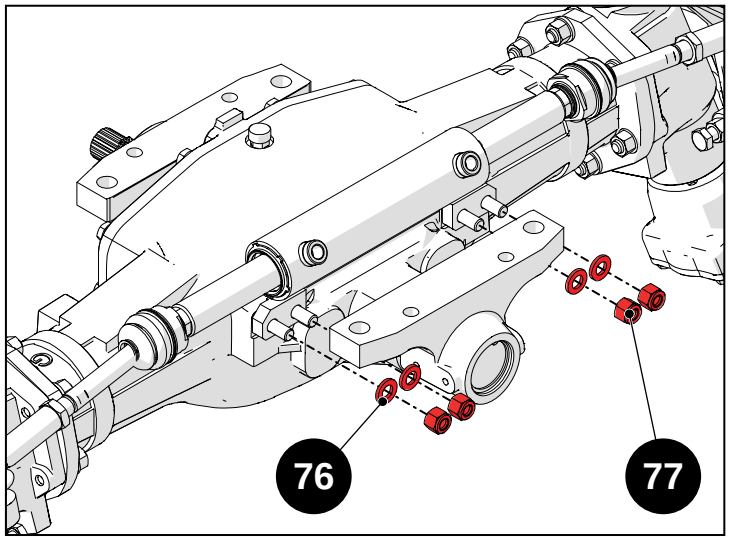


Fig. 7.122

6.1.1 Adjusting the steering cylinder

Adjust the toe angle to ensure even tyre wear and correct steering geometry.

For both final drive units:

1 - fit the steering cylinder pin (103) in its seat;

2 - fit and tighten the retainer nut (104) and secure with the split pin (105).

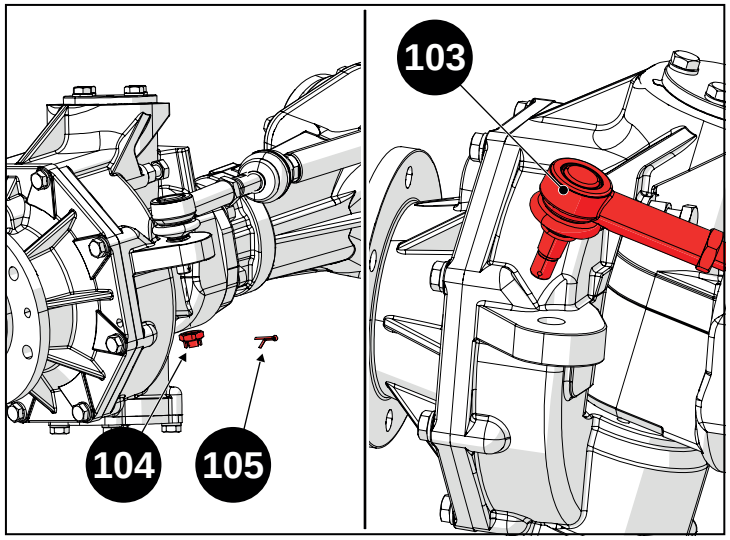


Fig. 7.123

Tighten the fastener nuts of the steering pins.

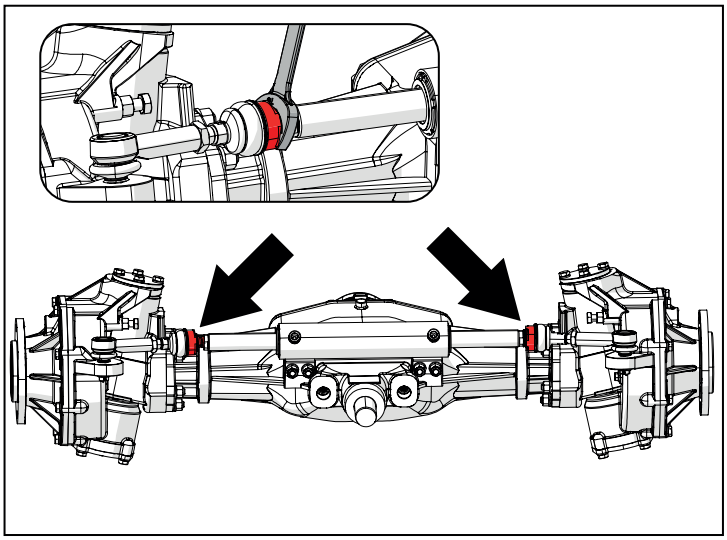


Fig. 7.124

Fit and tighten the special tools (H-07007180) for adjusting the cylinder on the final drive unit half axles.

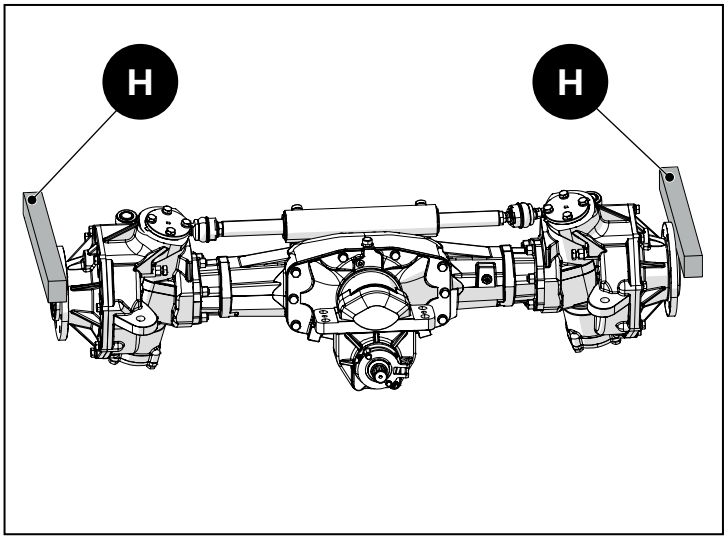


Fig. 7.125

Fit the special tools (H-07007180) at right angles relative to the half axles.

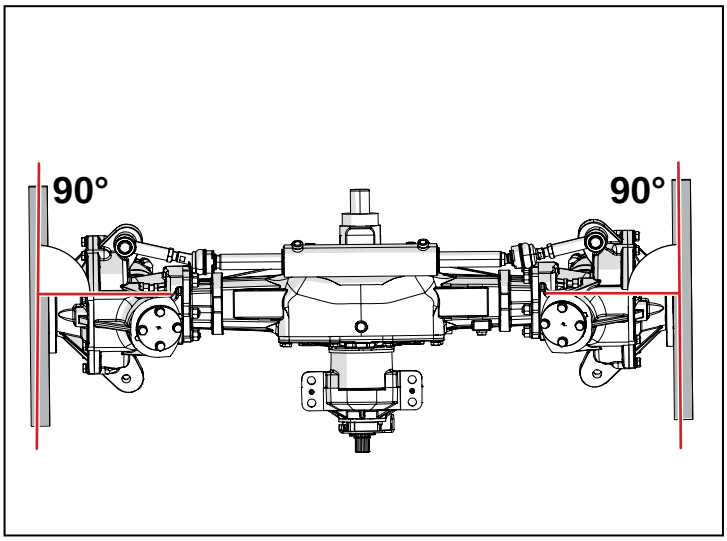


Fig. 7.126

Measure the distance between the ends of the tools (G) at the front (X) and rear (Y).

The values measured must satisfy the following formula:

Y = X - 2 to 5 mm

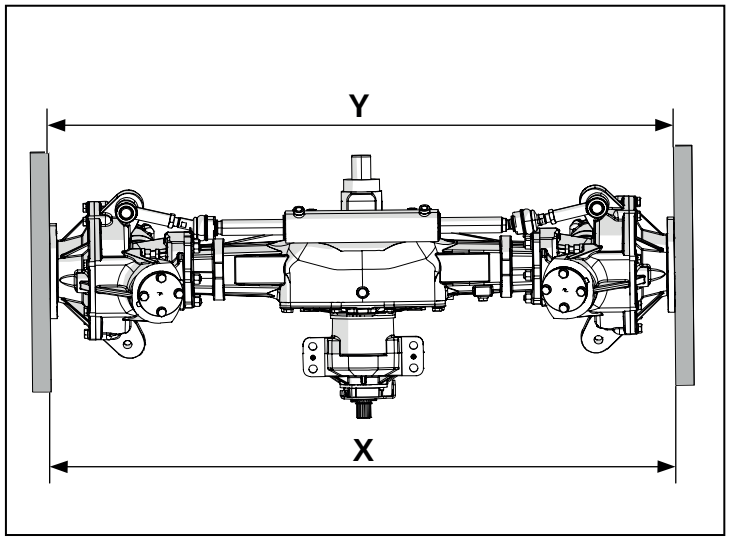


Fig. 7.127

Tighten or loosen the nuts of the steering cylinder pins to increase or decrease the distance between the half axles.

The default base measurement for Energy-Star tractors is 6 thread turns on one side and 7 thread turns on the other.

Warning

When increasing or decreasing the distance, the lengths of the cylinder rods must be the same on both sides.

If one bar is longer than the other, the turning circle will be shorter on that side.

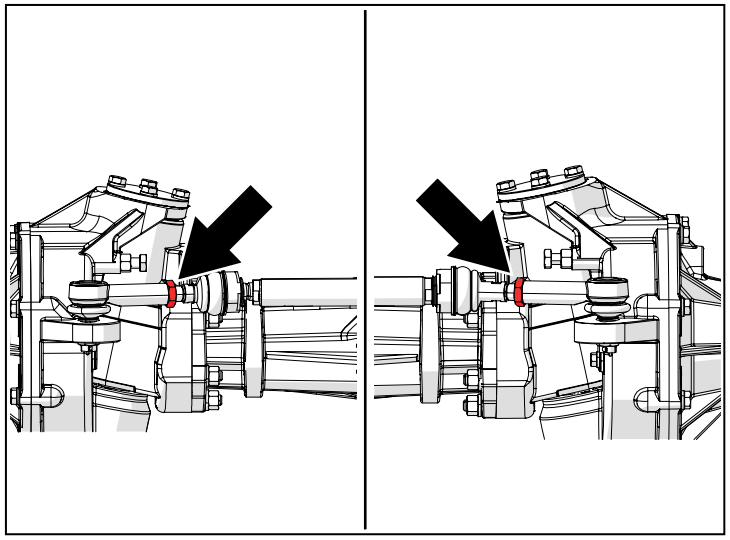


Fig. 7.128

Reassemble by following the procedure for disassembly in reverse order.

Section 7 : Tightening specifications

Index

7.1 Tightening specifications 7-64

7.1 Tightening specifications

The main tightening torques are listed as follows. For all other tightening torques, see chapter "1-Introduction".

Tightening torque	Nm	Kgm
Nut and stud bolt fastening final drive unit to axle	55	5.5
Ring nut fastening final drive unit crown wheel	150	15
Ring nut fastening bevel pinion	40	4
Ring nut on NoSpin crown wheel side	15	1.5
Ring nut on side opposite NoSpin crown wheel	40	4
Stud bolt and nut fastening conical crown wheel	80	8
Screw fastening bevel pinion cover	15	1.5
Screw fastening final drive unit cover	50	5
Screw fastening final drive unit internal flange	50	5
Screw fastening differential carrier to axle	60	6
Screw fastening wheel to half axle	220	22
NoSpin case screw	50	5

Section 8 : Tools necessary

Index

8.1 Tools necessary 7-66

8.1 Tools necessary

p/n	Description	Quantity
A-p/n_____	Wrench for differential ring nut	-
B-p/n_____	Wrench for bevel pinion ring nut	-
C-p/n_____	Bush for NoSpin differential ring nut	-
D-07007179	NoSpin test lever	-
E-p/n_____	Lock tool for front bevel pinion	-
G-07000234	Bush for final drive unit half axle ring nut	-
H-07007180	Toe angle measurement bar	-

Chapter 8 : Drive transmission

Index

Section 1 : Safety notes 8-2

Section 2 : General introduction 8-3

2.1 Drawing of the assembly 8-4

Section 3 : Technical specifications 8-7

3.1 Technical specifications 8-8

Section 4 : Disassembly 8-9

4.1 Disassembly 8-10

Section 5 : Main inspection, re-assembly and adjustment operations 8-17

5.1 Main inspection, re-assembly and adjustment operations 8-18

Section 6 : Tightening torques 8-31

6.1 Tightening torques 8-32

Section 7 : Tools required 8-33

7.1 Tools required 8-34

Section 1 : Safety notes

To prevent accidents and injuries, always comply with the precautions and safety recommendations described in this section. In addition, operators must always comply with the safety instructions given in the operation and maintenance manual and in chapter 1 of this manual.

Danger

Make sure that all persons keep well away from the danger zone.

Danger

Lift and handle all heavy parts with lifting equipment of an adequate capacity. Arrange all harness and hooks in safe positions. Operators must remain at a distance and in a safe position, well away from the lifted load.

Danger

Do not twist the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Danger

Use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.

Danger

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

Danger

For safety reasons, always leave two screws on opposite sides when removing components that could fall. Only remove these screws after having secured the component to lifting equipment or placed bearing blocks underneath.

Danger

If the bolts that fix the safety frame or cab have loosened or if the safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

Caution

Keep clear of the sharp edges around the top of the transmission housing.

Caution

Used oil must be collected and disposed of in compliance with the anti-pollution laws in force.

Section 2 : General introduction

Index

2.1 Drawing of the assembly 8-4

2.1 Drawing of the assembly

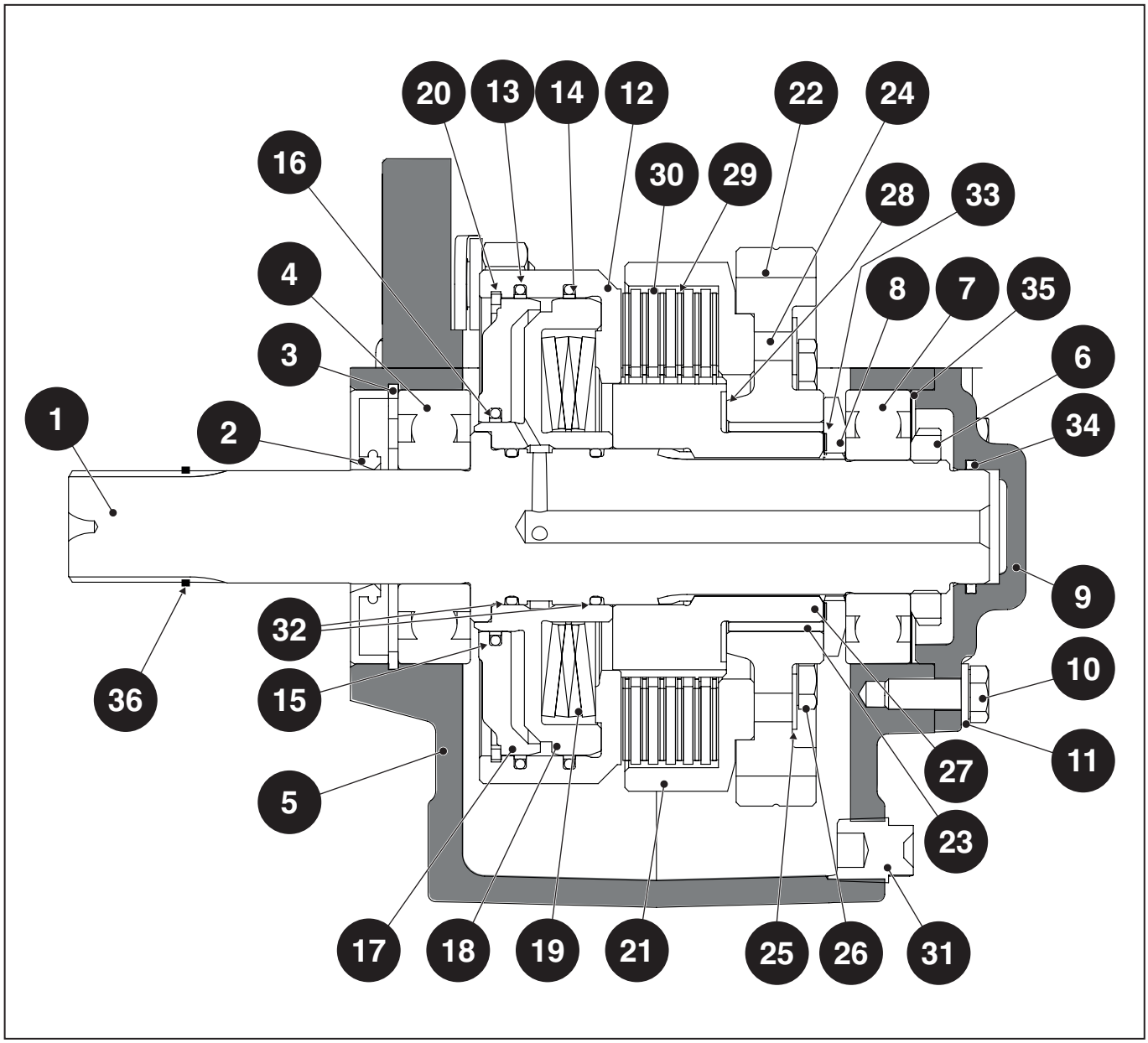


Fig. 8.1

1 - Front drive shaft
2 - Oil retainer
3 - Circlip
4 - Bearing
5 - Gearbox
6 - Ring nut
7 - Bearing
8 - Spacer
9 - Cover
10 - Screw
11 - Washer
12 - Front drive drum
13 - O-ring
14 - Seal ring
15 - O-ring
16 - Seal ring
17 - Front drive disengagement flange
18 - Fixed disengagement flange
19 - Belleville washer
20 - Spring ring
21 - Clutch bowl
22 - Front drive gear
23 - Bush
24 - Centring pins
25 - Screw retainer plate
26 - Screw
27 - Bush
28 - Spacer
29 - Clutch plate
30 - Steel plate
31 - Plug
32 - O-ring
33 - Spacer
34 - Quad-ring
35 - Spacer
36 - Circlip

Section 3 : Technical specifications

Index

3.1 Technical specifications 8-8

3.1 Technical specifications

Operating mechanism	Electrohydraulic
Clutch	Oil-cooled multiple-plate

Section 4 : Disassembly

Index

4.1 Disassembly 8-10

4.1 Disassembly

Unscrew and remove the screws (35) and washers (36).

> **Caution**
>
> Make sure the unit is supported during the operations.

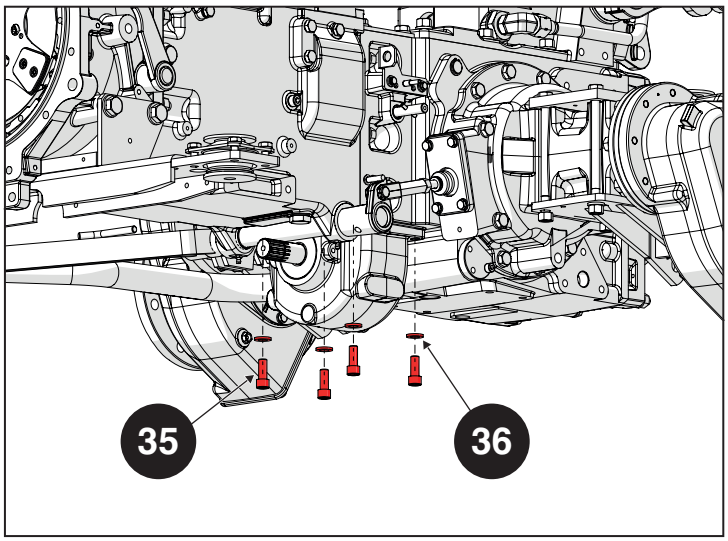


Fig. 8.2

Remove the complete unit.

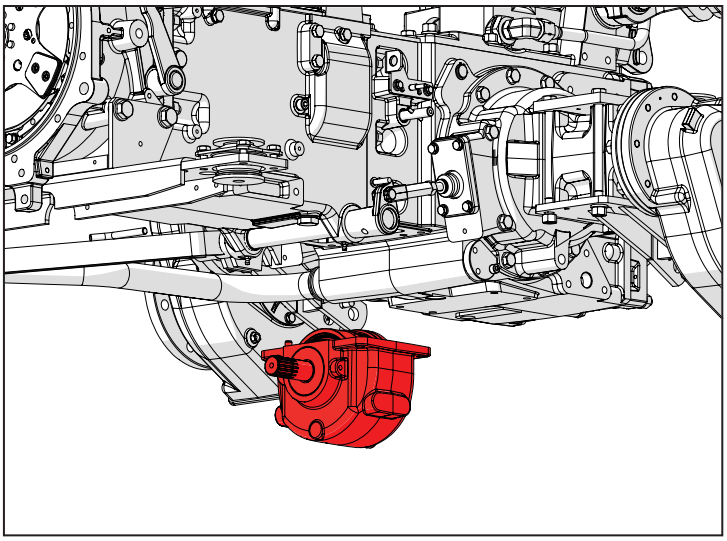


Fig. 8.3

Remove the oil retainer (2).

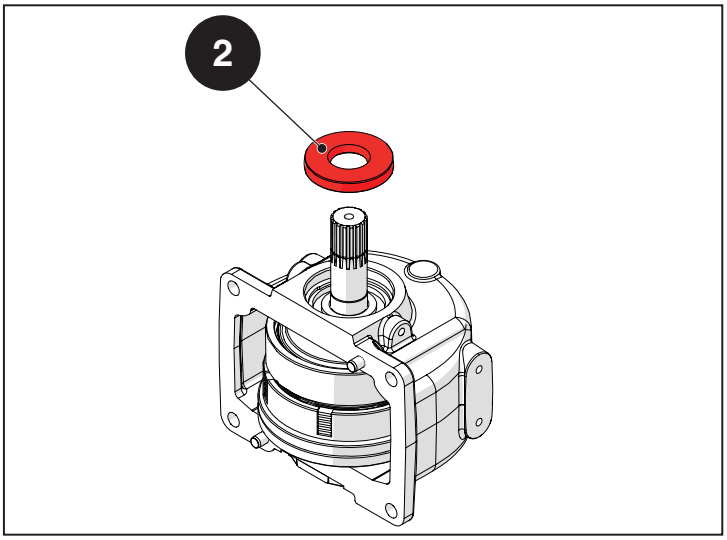


Fig. 8.4

Remove the screws (10), washers (11), screws (10) and cover (9).

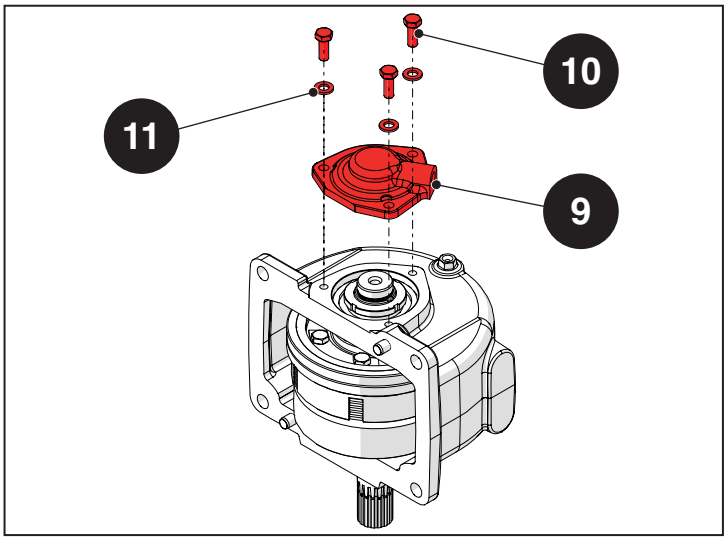


Fig. 8.5

Remove the Quad ring (34) from the cover.

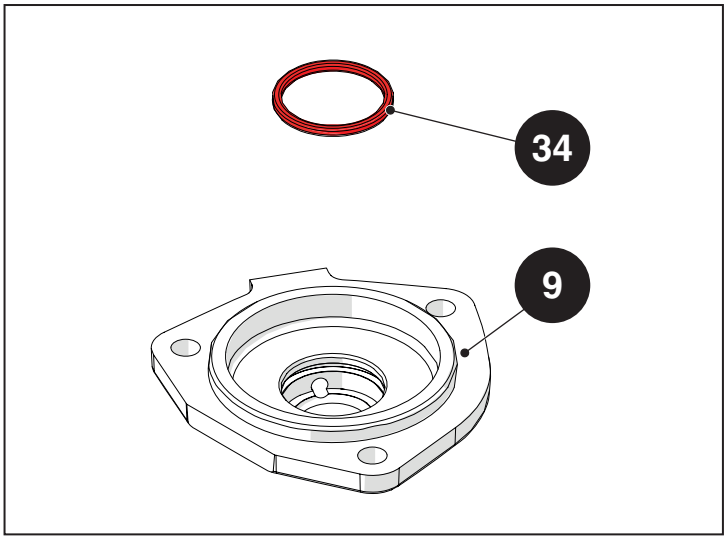


Fig. 8.6

Remove the shim (35).

Remove the ring nut (6).

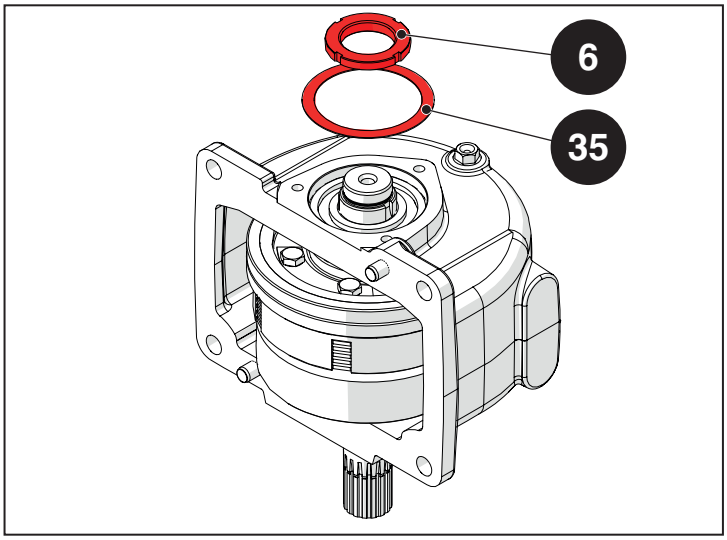


Fig. 8.7

Remove the circlip (3), then remove the shaft (1) complete with bearing (32).

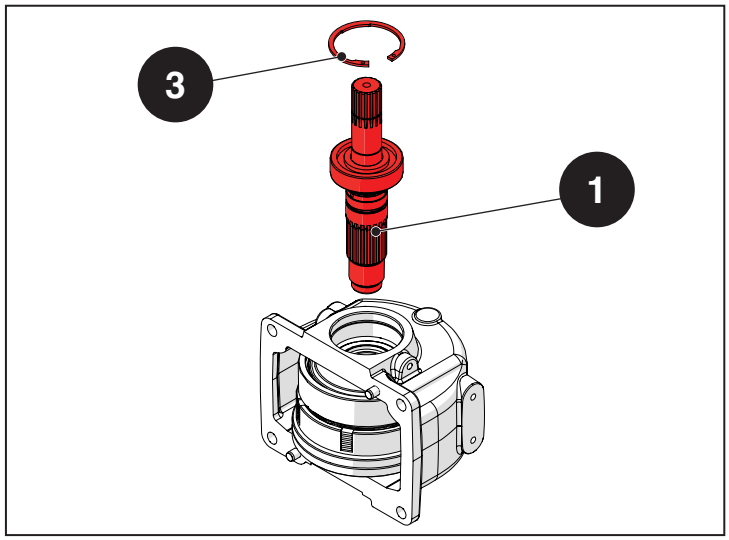


Fig. 8.8

Remove the bearing (7), spacers (33) and spacer (8).

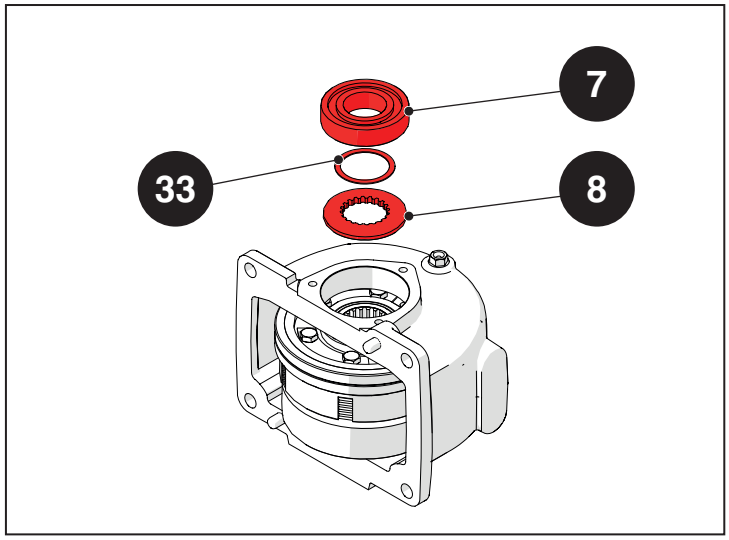


Fig. 8.9

Remove the O-rings (32) from the shaft.

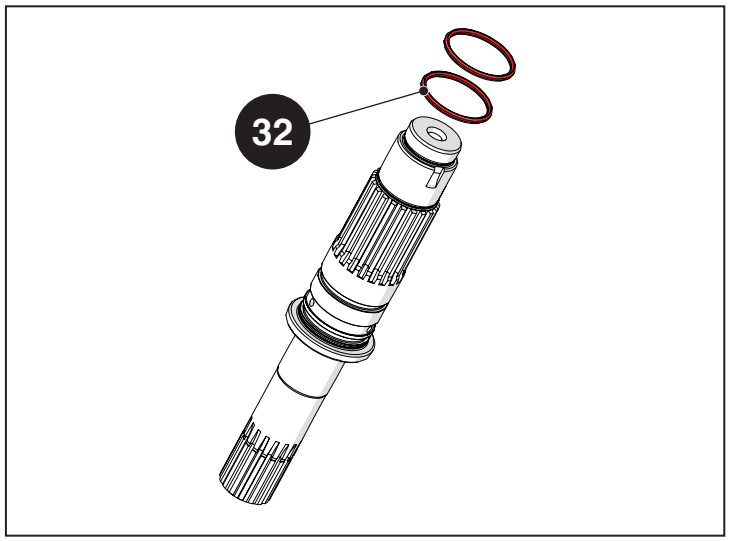


Fig. 8.10

Remove the clutch pack from the housing (5).

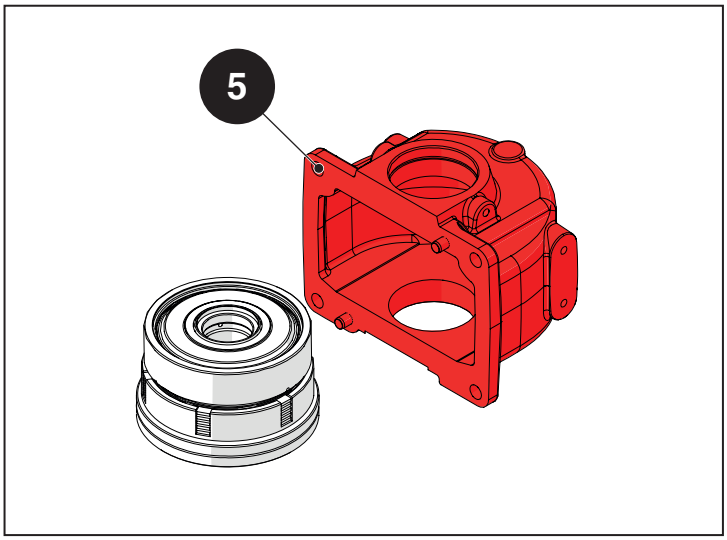


Fig. 8.11

Split the two units then remove the clutch plates (29) and steel plates (30) from the bowl (21).

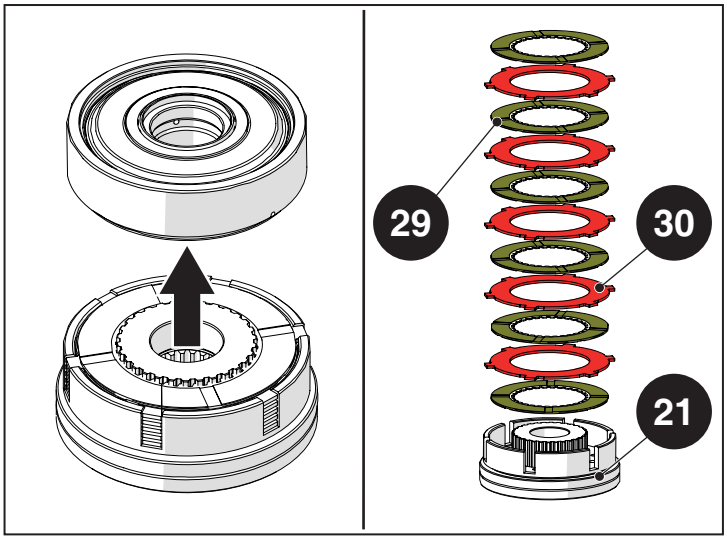


Fig. 8.12

Remove the spacers (28) and bush (27).

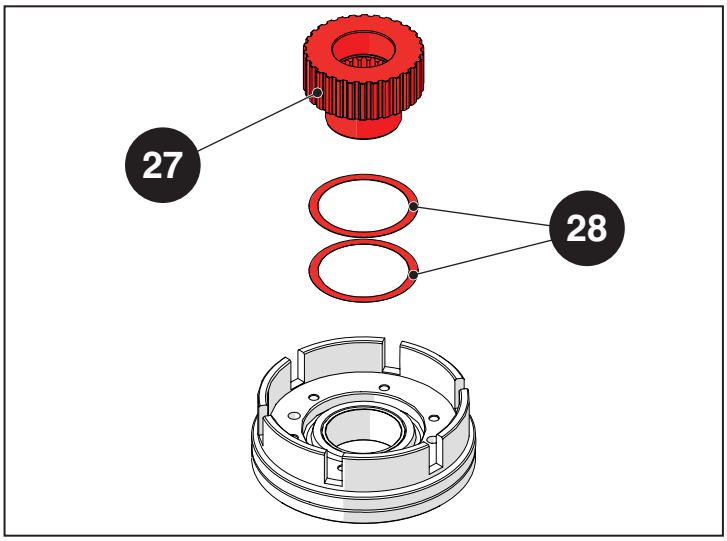


Fig. 8.13

Lower the sides of the plates (25) so as to remove the screws (26).

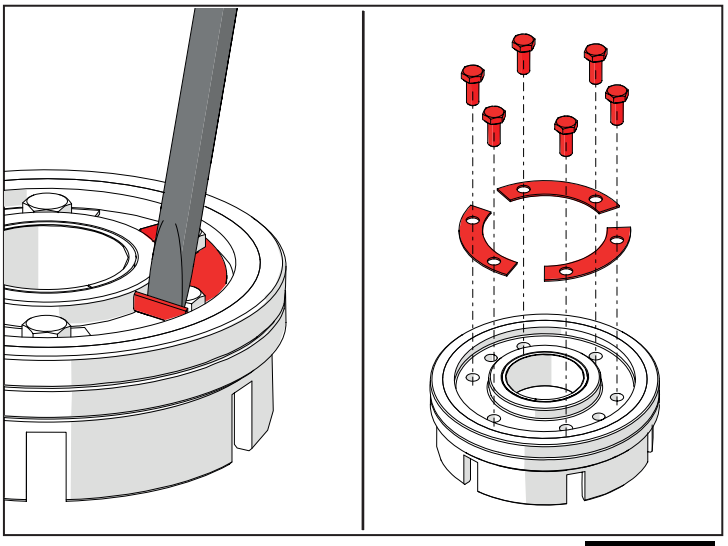


Fig. 8.14

Remove the centring pins (24), then remove the front drive gear (22) complete with bush (23) from the clutch bowl (21).

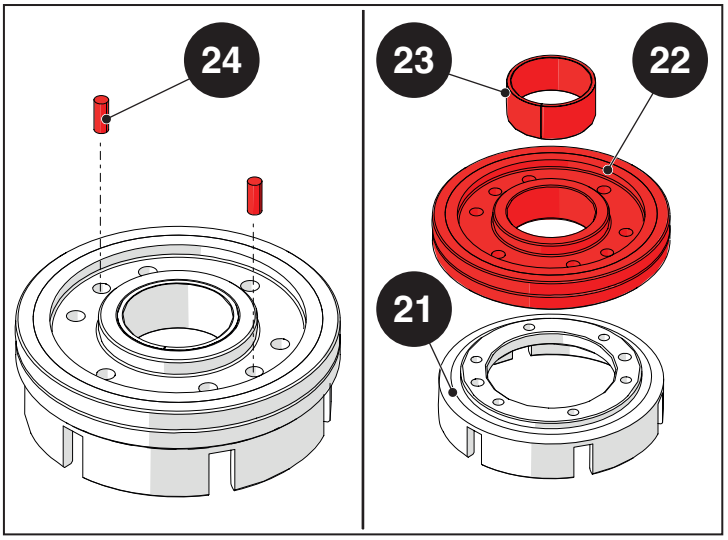


Fig. 8.15

Use a press and the driver tool (G- p/n 07006210) to press the flange (17) and compress the Belleville washers (19) and clear the seat of the circlip (20).

Caution
Use a press with a loading capacity of at least 500 kg.

Remove the spring ring (20).

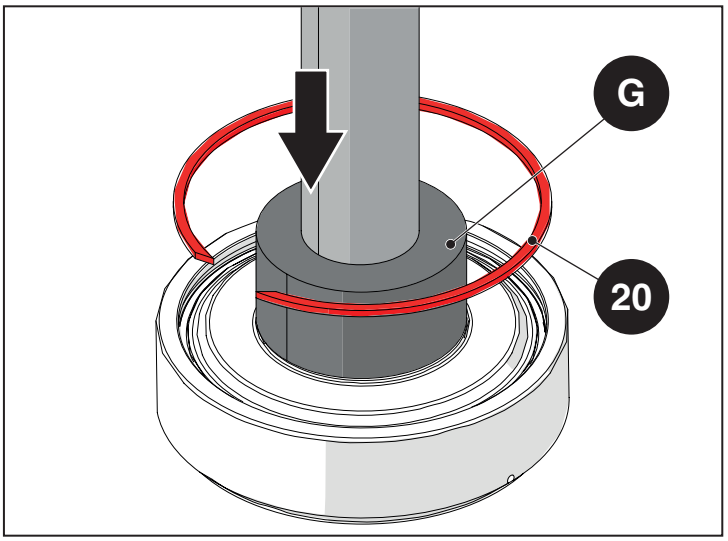


Fig. 8.16

Remove the complete unit from the front drive drum (12).

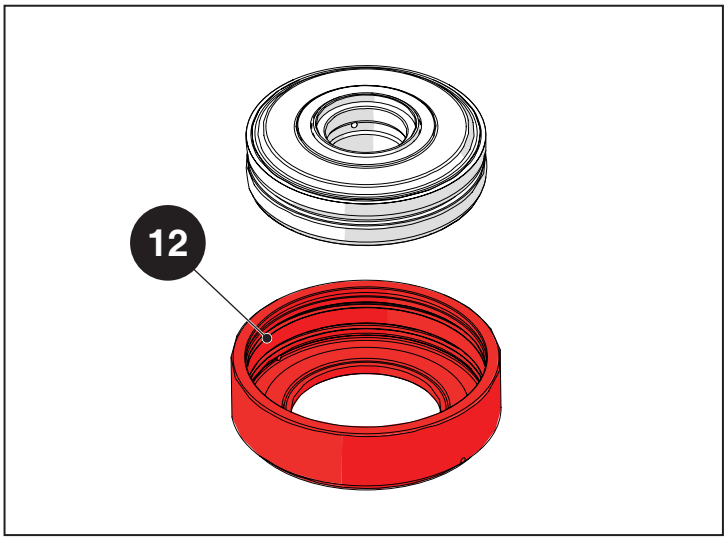


Fig. 8.17

Remove the flange (17) from the fixed disengagement flange (18).

Now remove the belleville washers (19).

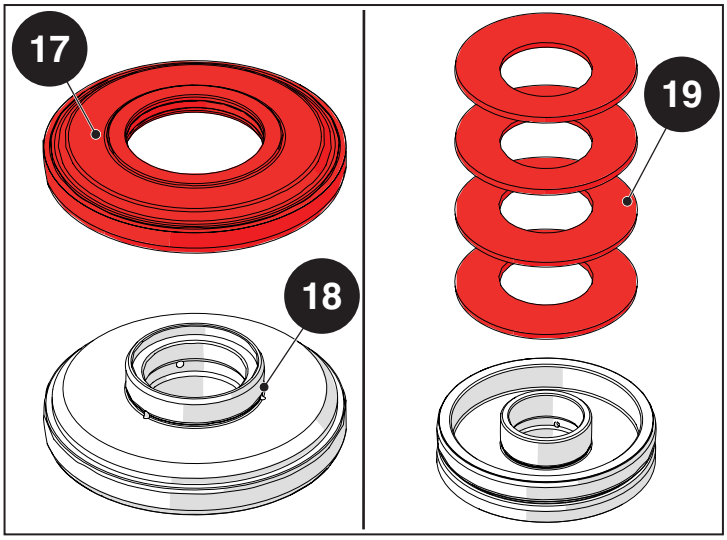


Fig. 8.18

Remove the O-rings (13) and flat seal rings (14) from the drive drum (12).

Remove the O-ring (15) and flat seal ring (16) from the front drive disengaging flange (17).

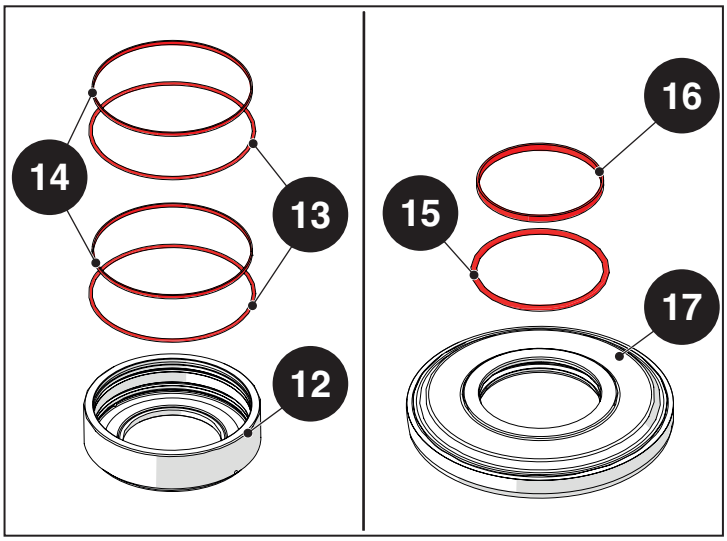


Fig. 8.19

Section 5 : Main inspection, re-assembly and adjustment operations

Index

5.1 Main inspection, re-assembly and adjustment operations.....8-18

5.1 Main inspection, re-assembly and adjustment operations

Danger

Make sure that all persons keep well away from the danger zone.

Warning

Before proceeding with the re-assembly operations, carefully read and comply with the instructions given in chapter "1-Introduction", especially those describing how to assemble O-Rings, oil retainers and bearings.

Use the correct tightening torques when screwing in the components. Consult the table in chapter "1-Introduction" if the tightening torque value is not given.

Use the indicated sealants when re-assembling the parts. Consult the table in chapter "1-Introduction" if the sealant is not indicated.

Prepare the drive drum (12) by fitting the O-rings (13) and flat seal rings (14) into their seats.

Prepare the front drive disengaging flange (17) by fitting the O-ring (15) and flat seal ring (16) into their seats.

Caution

Make sure that the flat seal rings are not bent after having been fitted into their housings, this to prevent them from being damaged when the components are reassembled.

After the seal rings have been fitted, lubricate them with OIL to facilitate their engagement with the other components.

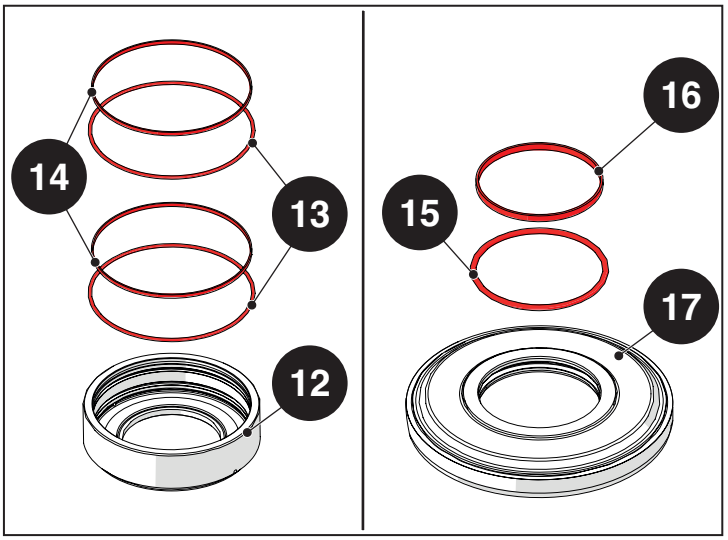


Fig. 8.20

Caution

Make sure that the flat seal rings (14) and (16) are installed in the right direction.

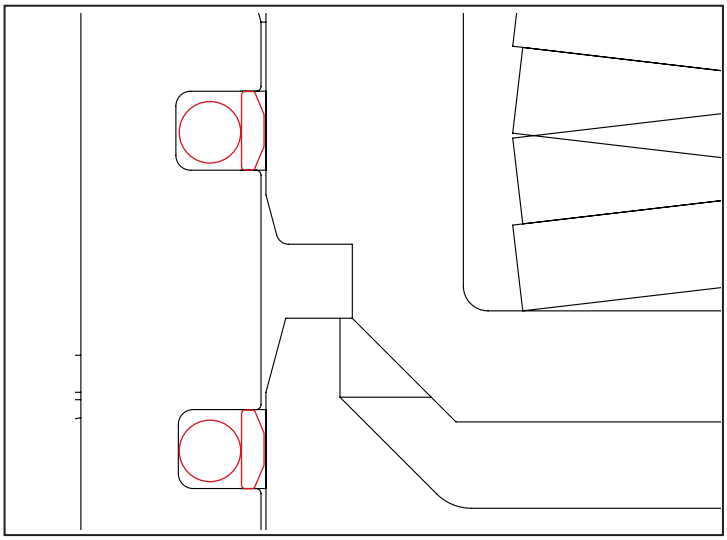


Fig. 8.21

Insert the flange (17) into the fixed disengagement flange (18).

Now insert the belleville washers (19).

Caution

Make sure that the belleville washers are installed in the right direction.

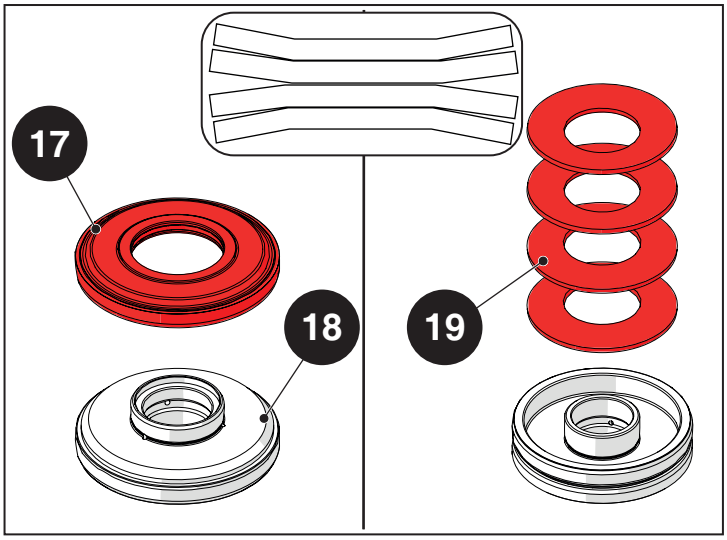


Fig. 8.22

Insert the drum (12) onto the complete unit.

Caution

Lubricate the seal rings.

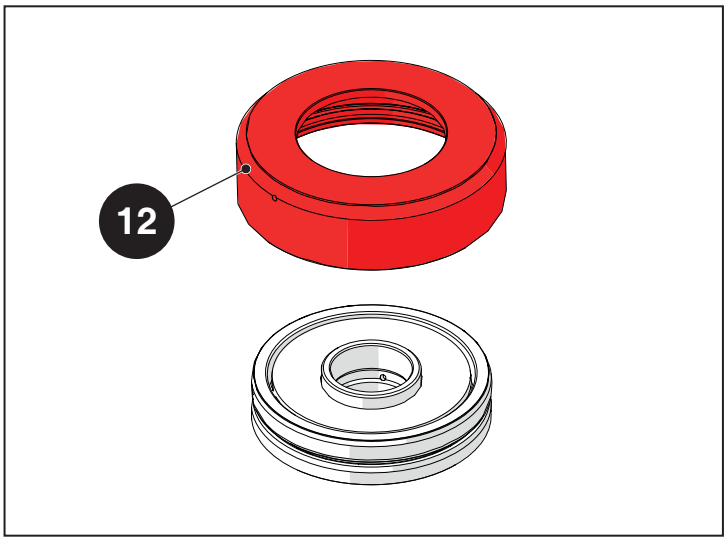


Fig. 8.23

Use a press and the driver tool (G- p/n 07006210) to press the flange (17) and compress the Belleville washers (19) and clear the seat of the circlip (20).

Caution
Use a press with a loading capacity of at least 500 kg.

Insert the spring ring (20) and turn it in its housing.

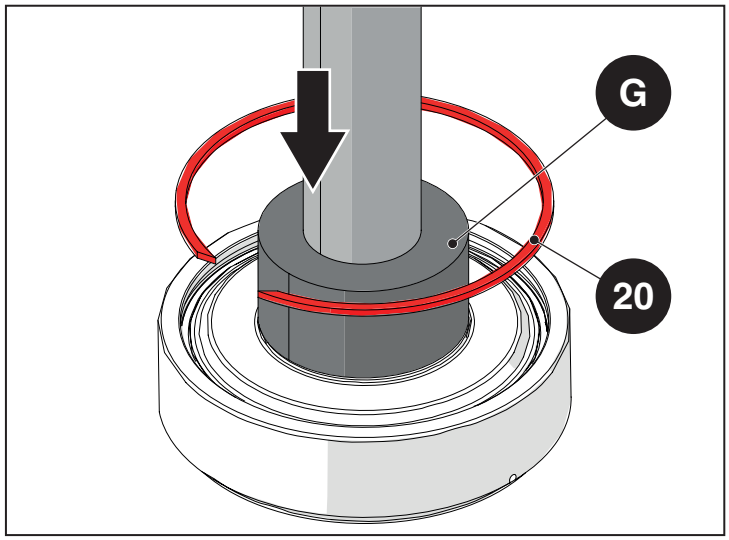


Fig. 8.24

Insert the front drive gear (22) complete with bush (23) onto the clutch bowl (21).

Caution
Align the holes.

Insert the centring springs (24).

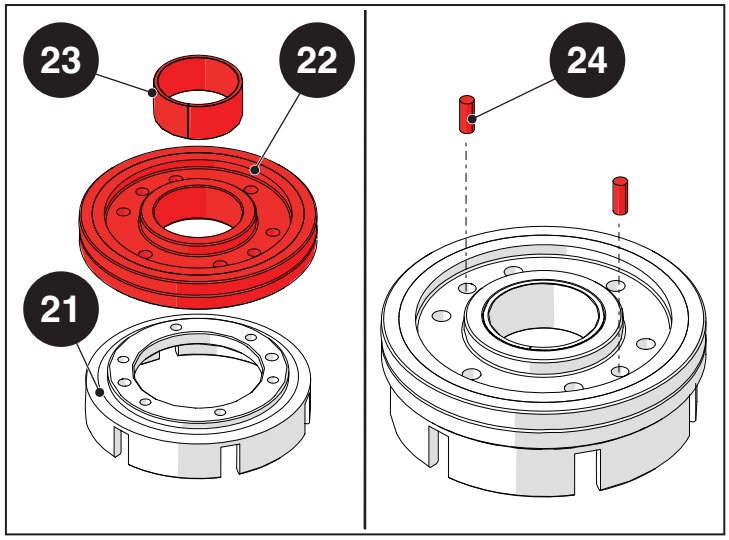


Fig. 8.25

Position the screw retainer plates (25), then tighten the screws (26) by applying 30 Nm (3 kgm) tightening torque.

Clinch the corners of the plates (25) with a chisel so as to lock the screws 826).

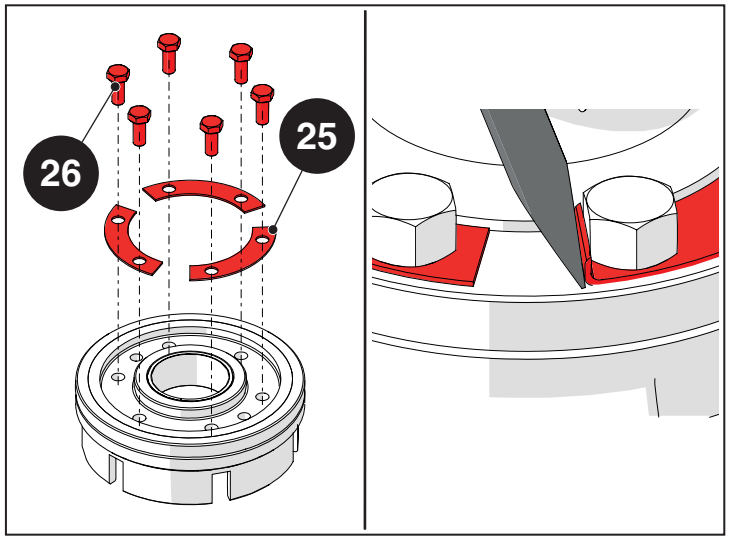


Fig. 8.26

Insert the bush (27) and the 1 mm and 1.2 mm thick spacers 828)..

> **Caution**
>
> Make sure that the bush turns (27).

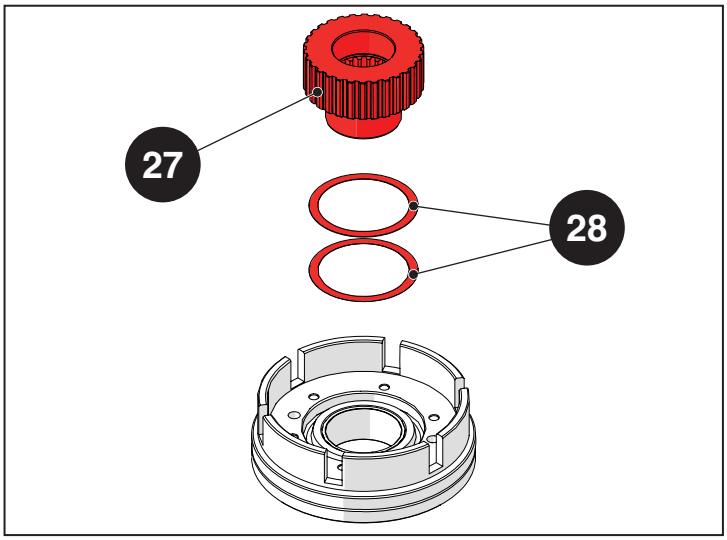


Fig. 8.27

Insert the clutch plates (29) and steel plates (30) alternately. Always begin with a clutch plate.

A total 6 clutch plates (29) and 5 steel plates (30) must be installed.

Couple the two newly assembled units.

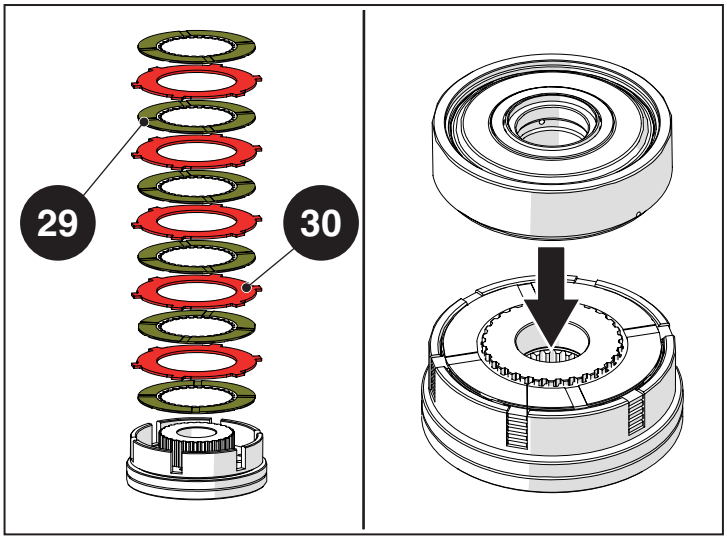


Fig. 8.28

Fit the two O-rings (32) on the shaft (1).

> **Caution**
>
> Use a guide (A-07003831) to prevent the O-rings from being damaged by contact with the shaft teeth.
>
> After having installed the O-rings, lubricate them with OIL.

Install the circlip (36).

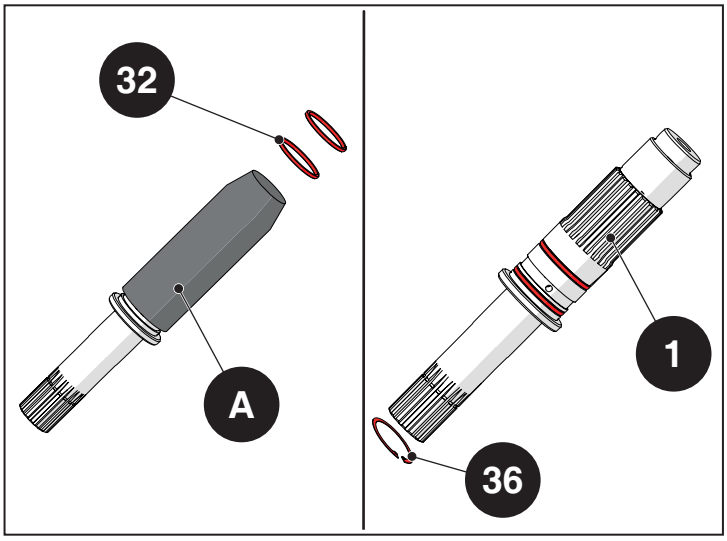


Fig. 8.29

Shimming

To ensure that the transmission clutch engages properly, make sure that the engaging pressure is optimal and that the clutch plates are positioned at the correct distance in the unit.

Place the assembly on a support (F- code 07006211).

Using an external hydraulic pump, apply a pressure of 60 bar so as to compress the belleville washers and free the plates.

Caution
Make sure that there are no oil leaks.

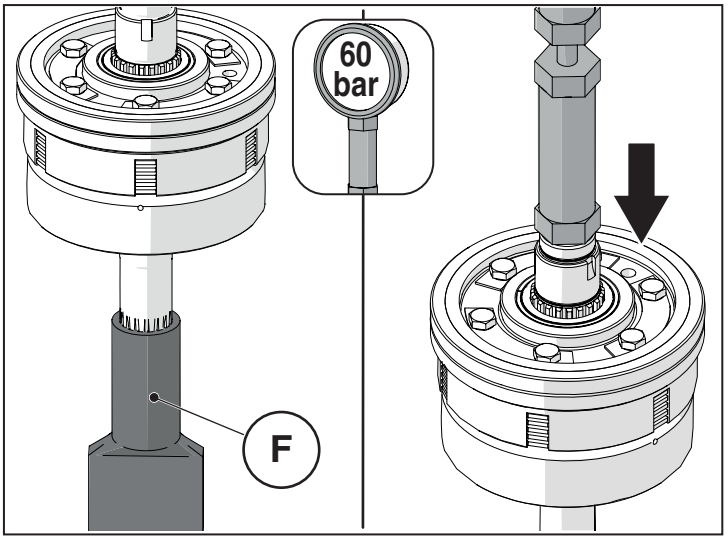


Fig. 8.30

Insert the spacers (33) and spacer (8).

Insert a dummy bearing (C-code 07002766).

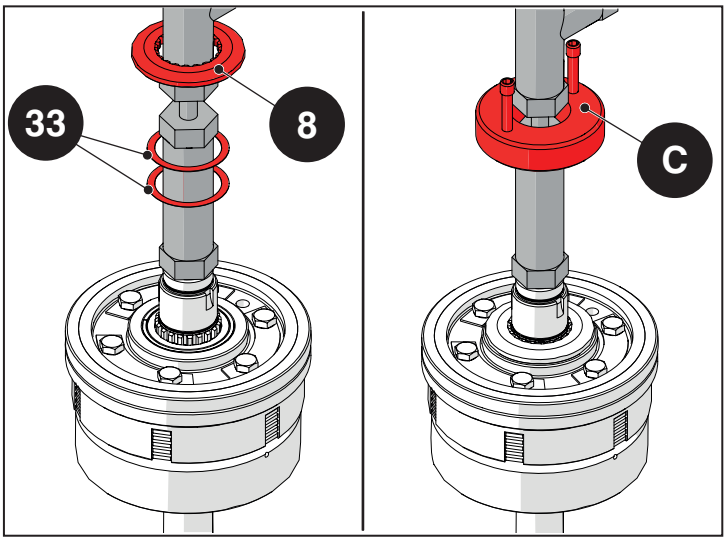


Fig. 8.31

Insert the ring nut (6) and use tool (D-code 07006128) to tighten it by applying 220 Nm (22 kgm) tightening torque.

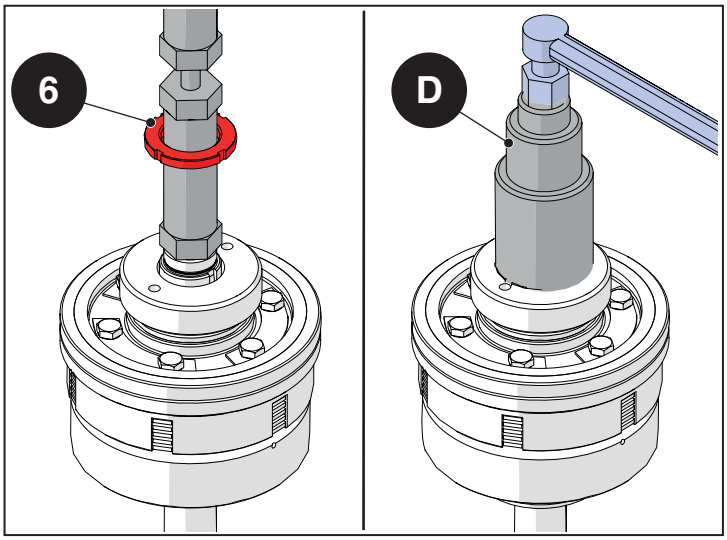


Fig. 8.32

Pressure 42 bar pressure.

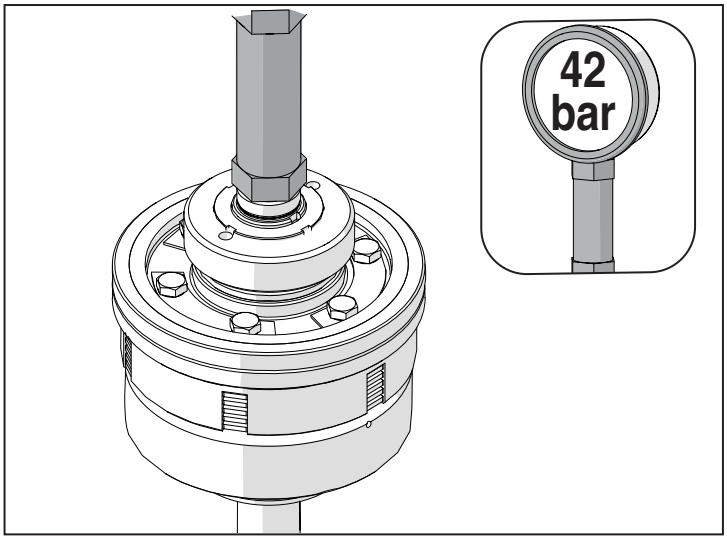


Fig. 8.33

Exercise pressure on the clutch bowl and check with a thickness gauge that the distance netween the clutch plates and pack of belleville washers is 0.8-1.2 mm.

The previously assembled spacers (28) must be changed if the play is not within this measurement.

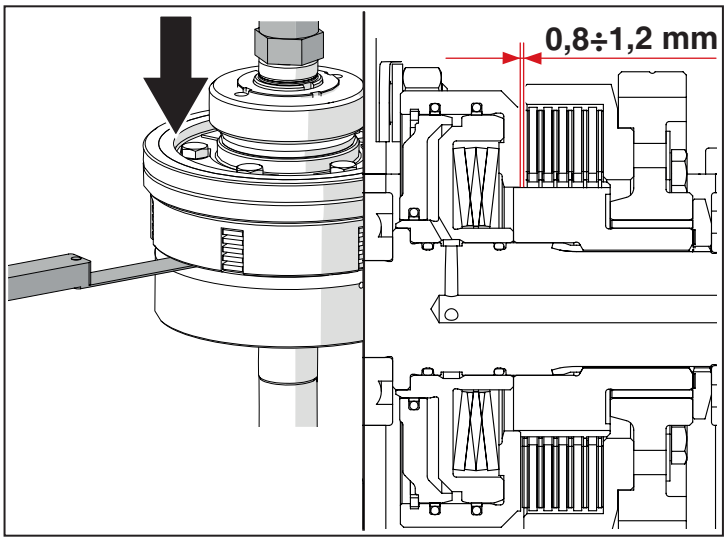


Fig. 8.34

Now check that the clutch disengages when the right pressure is applied.

Slowly apply pressure to the unit while moving the gear.

Check that the gear releases at a pressure of 30-32 bar.

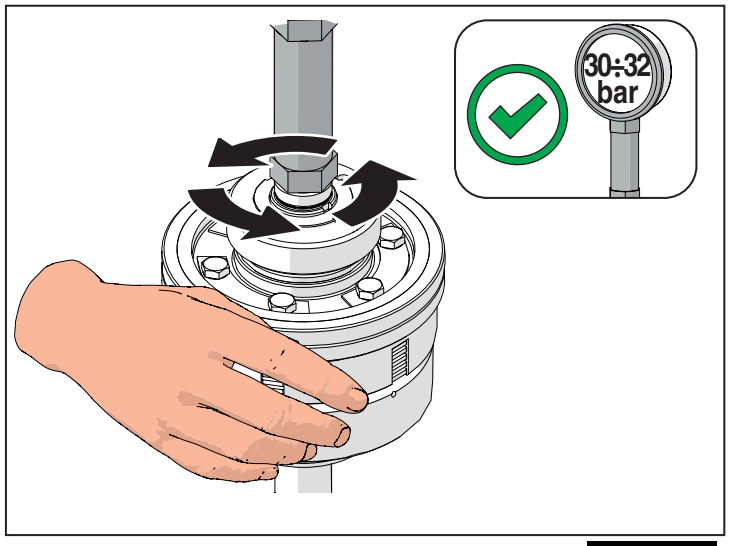


Fig. 8.35

The group of spacers (33) must be replaced if the gear fails to release at the established pressure. Bear in mind that:

- By increasing the total thickness, the gear will lock at a lower pressure than the value required previously.
- By decreasing the total thickness, the gear will lock at a higher pressure than the value required previously.

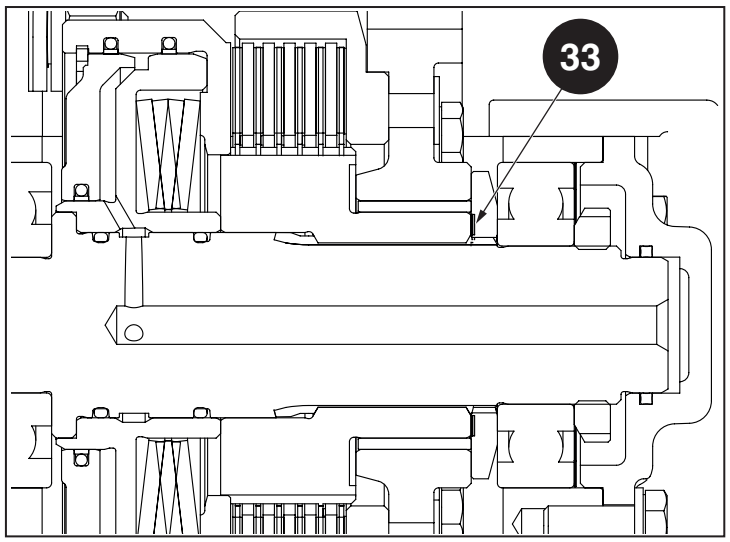


Fig. 8.36

Maintain a pressure of 42 bar and check that the play between the gear (22) and spacer (8) is 0.3-0.5 mm.

Check to make sure that the previous adjustments have been made correctly if the play is not within the given values.

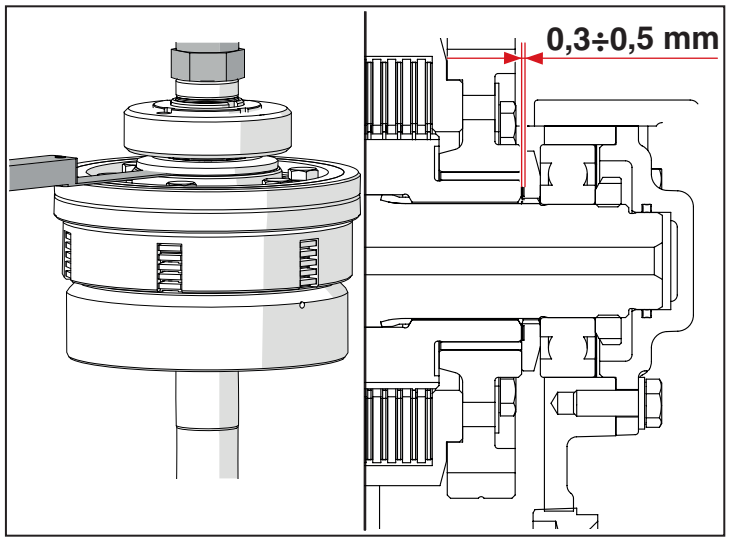


Fig. 8.37

If all the values are correct, the components can be reassembled.

Apply 60 bar pressure, then remove the ring nut (6) and dummy bearing (C- code 07002766)

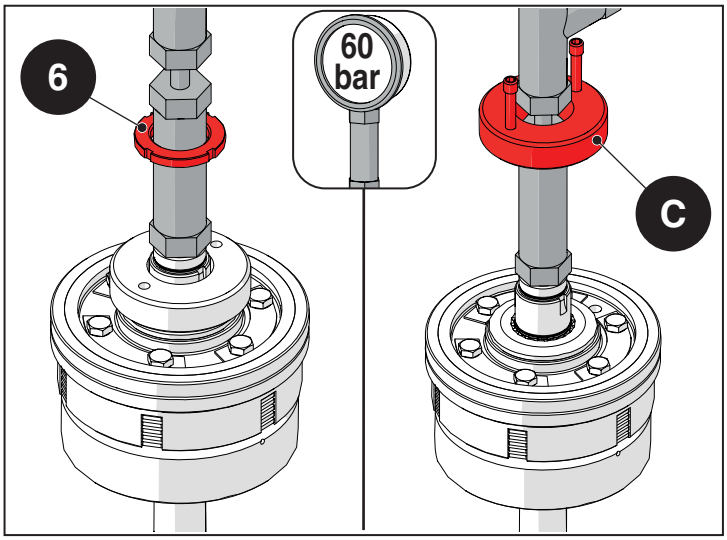


Fig. 8.38

Relieve the pressure, then remove the sleeve of the hydraulic pump.

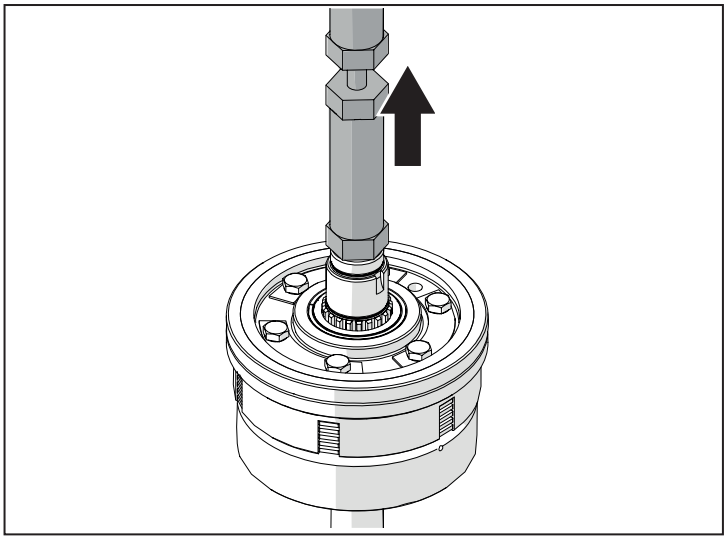


Fig. 8.39

Apply TEFLON to the thread of the plug (31) and screw it into the transmission housing (5).

Fit the complete clutch pack into the housing (5).

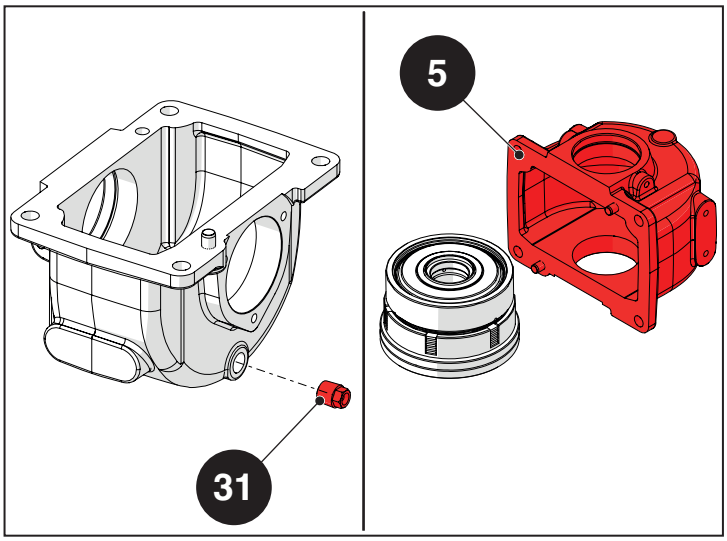


Fig. 8.40

Insert the bearing (4), then seat it by using the plug (B-code 07006208).

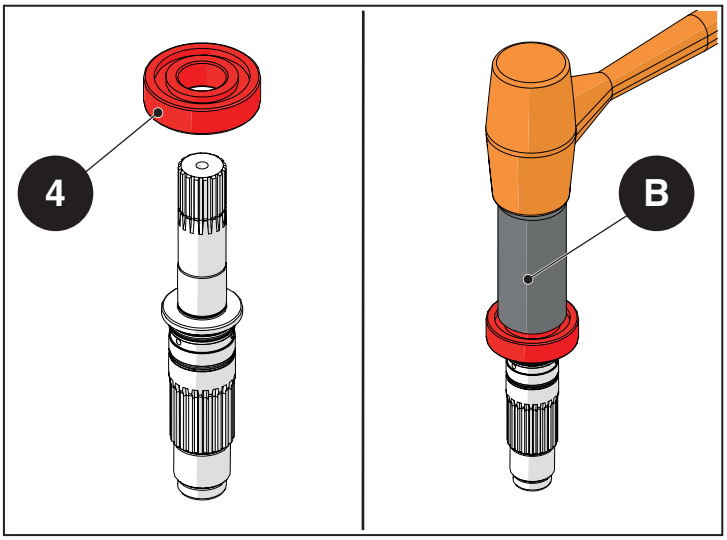


Fig. 8.41

Insert the complete shaft (1), then seat it by using the plug (B-code 07006208).

Lock with the circlip (3).

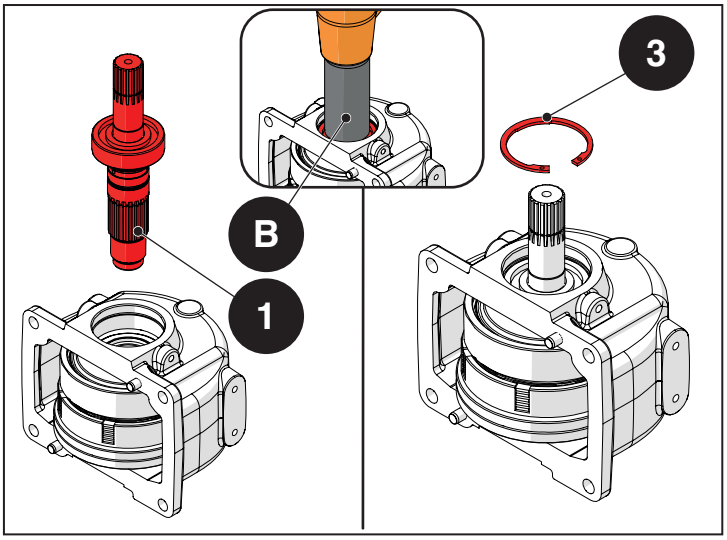


Fig. 8.42

Insert the spacers (33) and spacer (8).

Insert the bearing (7) and seat it by using plug (E-code 07006209).

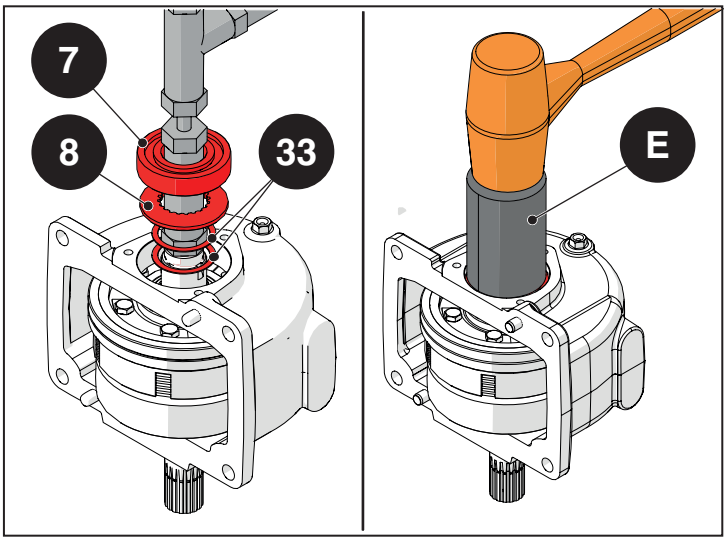


Fig. 8.43

Insert the ring nut (6) and tighten it by applying 220 Nm (22 kgm) tightening torque.

Chisel the ring nut (6).

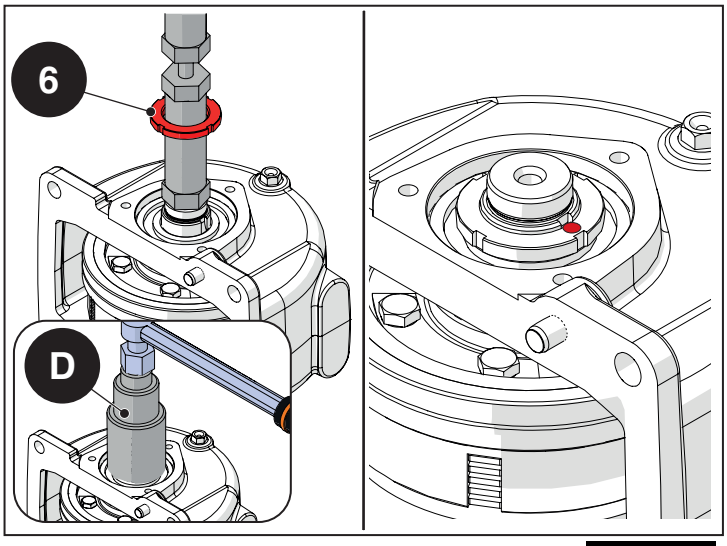


Fig. 8.44

Caution

Repeat the previously described tests for the sake of safety since the dummy bearing (A) has been replaced with the real bearing (7).

Before the cover is reassembled, establish the shims required by the bearing (7) so as to eliminate any play inside the unit.

Measure cover edge distance (X).

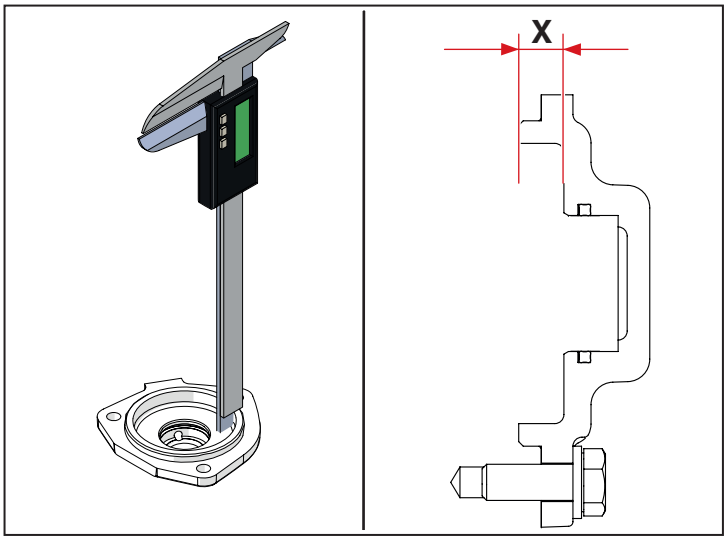


Fig. 8.45

Measure the distance (Y) between the operating surface of the transmission housing and the bearing.

The result of the X-Y formula will be the value of the shim to insert between the bearing (7) and cover (9).

E.g.:

X= 5.20 mm

Y= 5.00 mm

X-Y= 0.20 mm

In this case, the shim must be 0.2 mm thick.

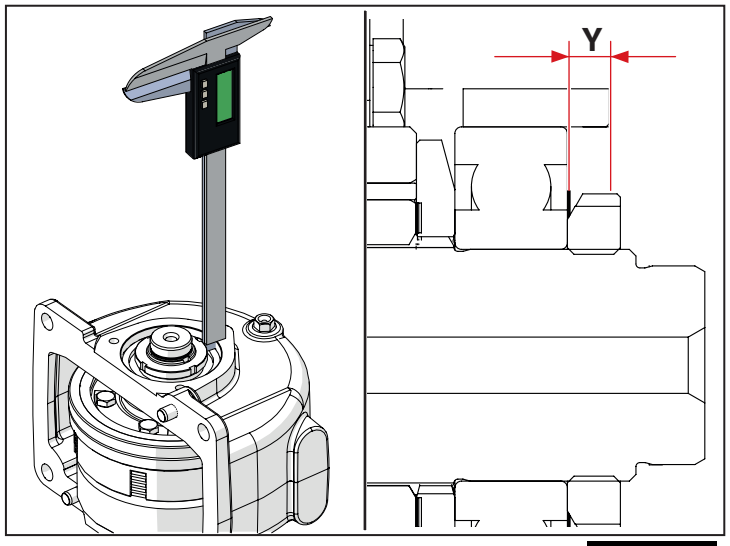


Fig. 8.46

Insert the newly calculated shim (35).

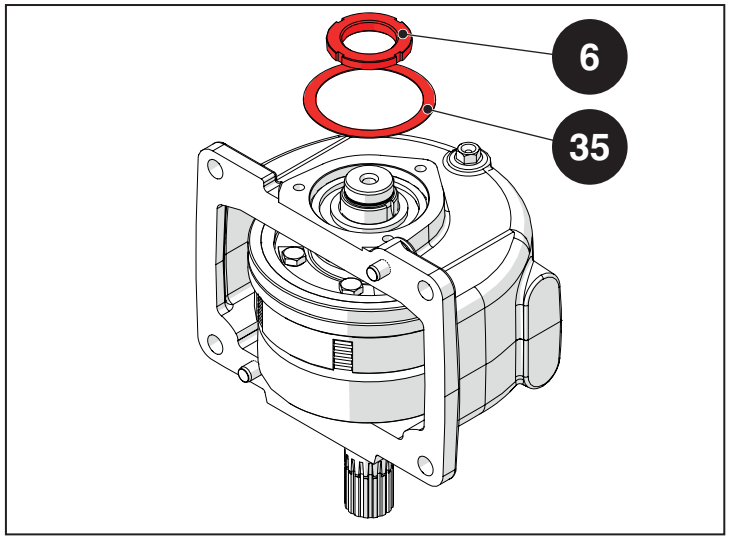


Fig. 8.47

Fit the Quad ring (34) inside the cover.

Caution

Make sure that the Quad Ring is not bent after having been fitted into its housing, this to prevent it from being damaged when the components are reassembled.

After the Quad Ring has been fitted, lubricate it with OIL to facilitate its engagement with the other components.

Apply a layer of SILICONE to the cover (9).

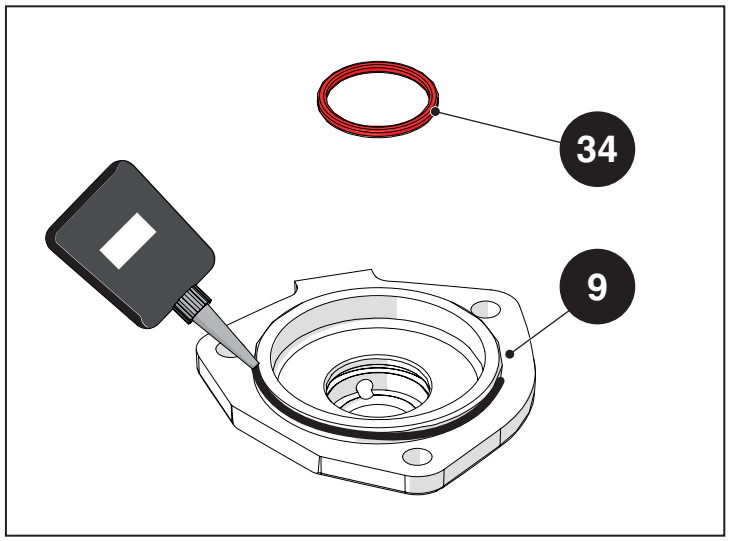


Fig. 8.48

Insert the cover (9).

Insert the washers (11) and screws (10), then tighten them by applying 35 Nm (3.5 kgm) tightening torque.

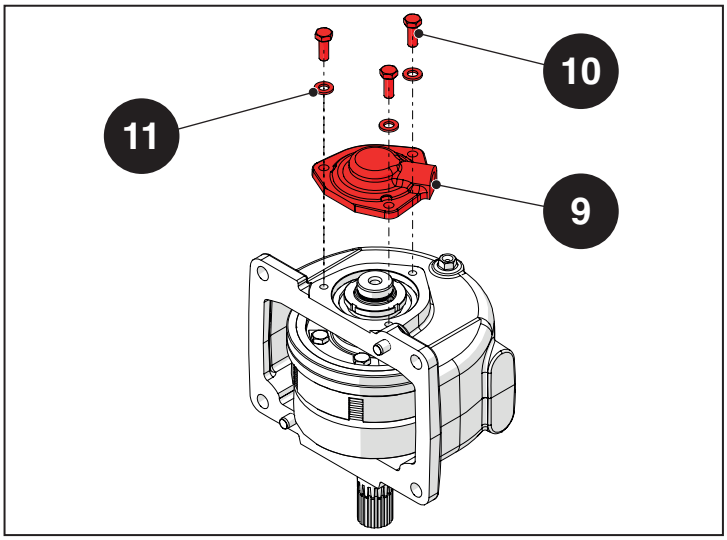


Fig. 8.49

Make sure that there are no leaks from the cover by using a hydraulic pump and applying 60 bar pressure on the indicated hole.

Caution
Replace the Quad ring (34) is leaks are discovered.

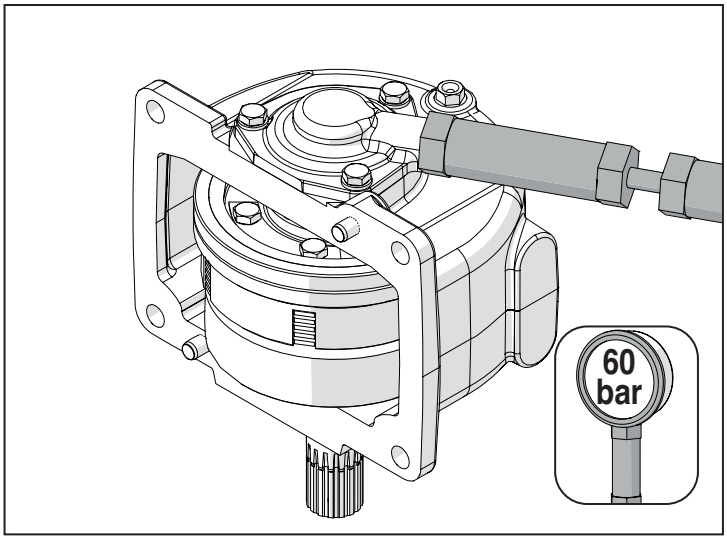


Fig. 8.50

Apply a layer of SEALANT to the outer edge of the oil retaioner (2), then fit it into its housing using a plug of an adequate diameter.

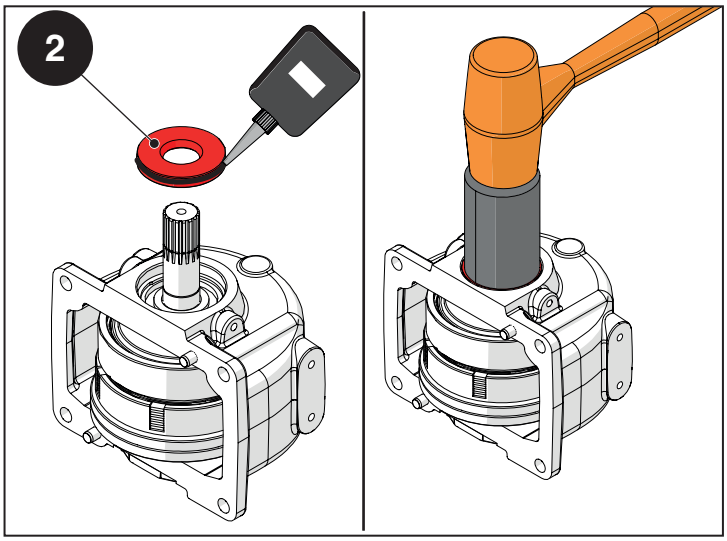


Fig. 8.51

Apply a layer of SILICONE to the coupling surface.

Fit the complete unit into the gearbox.

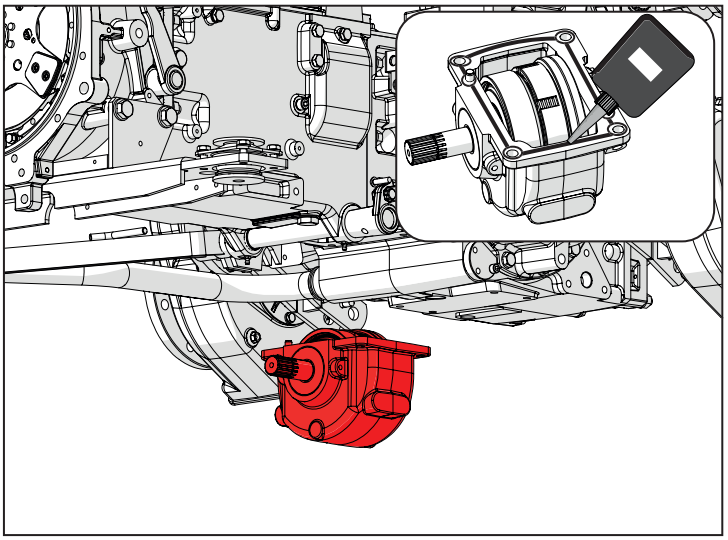


Fig. 8.52

Insert the washers (36) and tighten the screws (35) by applying 85 Nm (8.5 kgm) tightening torque.

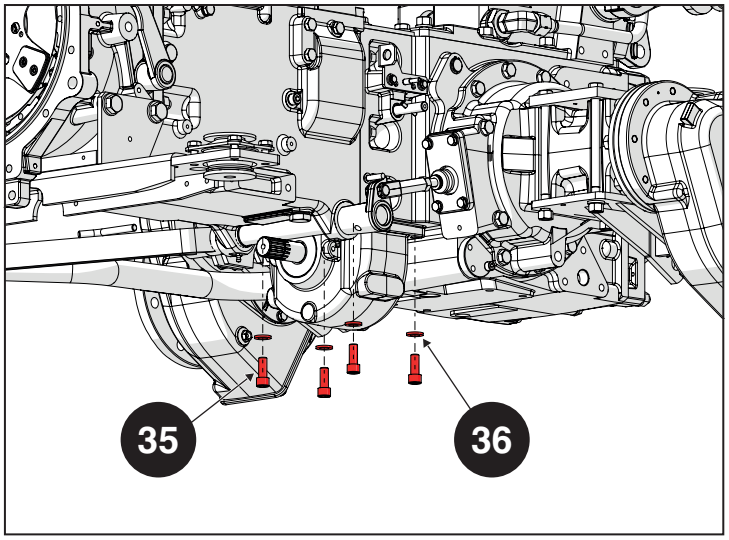


Fig. 8.53

Section 6 : Tightening torques

Index

6.1 Tightening torques.....8-32

6.1 Tightening torques

The main tightening torque values are listed below. Consult chapter "1- Introduction" for the remaining tightening torques.

Screws and nuts to be tightened	Nm	kgm
M8 screw that fastens the transmission housing cover	35	3.5
M12 screw that fastens the transmission housing	8	8
Ring nut for fastening the 4WD clutch pack	220	22
1/4” nipple for clutch pack supply	30	3
Screw for fixing the transmission unit	85	8.5

Section 7 : Tools required

Index

7.1 Tools required 8-34

7.1 Tools required

Code	Description	Quantity
07002766	Spacer for bearing assembly	1
07006128	Ring nut wrench	1
07006208	Plug for assembling bearing	1
07006209	Plug for assembling bearing	1
07006210	Driver tool for installing flange in spring pack	1
07006211	4WD housing support	1
07003831	4WD shaft guard	1

Chapter 9 : Drive transfer unit, mechanical version

Index

Section 1 : Safety rules 9-2

Section 2 : General introduction 9-3

2.1 Assembly drawing 9-4

Section 3 : Technical characteristics 9-5

3.1 Technical characteristics 9-6

Section 4 : Disassembly 9-7

4.1 Preliminary operations 9-8

4.2 Disassembly 9-10

Section 5 : Main inspection, reassembly and adjustment procedures 9-15

5.1 Main inspection, reassembly and adjustment procedures 9-16

Section 6 : Tightening specifications 9-23

6.1 Tightening specifications 9-24

Section 7 : Tools necessary 9-25

7.1 Tools necessary 9-26

Section 1 : Safety rules

These safety precautions and warnings given in this paragraph must be observed at all times to prevent the risk of operator injury. However, the safety measures indicated in the use and maintenance manual and in chapter 1 of this manual must also be applied at all times.

Danger

All other persons must keep at a safe distance from the danger area.

Danger

Lift and handle all heavy parts with lifting equipment of adequate load capacity. Hoisting straps and hooks must be positioned safely on the load. When lifting loads, all personnel must keep at a safe distance from the load itself and remain within safe areas.

Danger

Do not allow the chains or metal cables used for hoisting to twist. Always wear safety gloves when handling cables or chains.

Danger

Use appropriate tools to align the holes correctly. NEVER USE YOUR HANDS OR FINGERS.

Danger

Handle all parts with extreme caution. Never place your hands or fingers between two parts.

Danger

When removing assemblies which could fall, always leave two screws in opposite positions in place for safety until the assembly is secured. Only remove these screws after securing the assembly to a hoist or after fitting support blocks in place.

Danger

If any of the screws fastening the frame or cab are loosened, or if the frame or cab is removed, ensure that all parts are refitted correctly at the end of the procedure to ensure that the driver is protected.

Attention

Beware of sharp edges and corners at the top of the gearbox housing.

Attention

Used oils must be collected and disposed of in compliance with applicable legislation.

Section 2 : General introduction

Index

2.1 Assembly drawing.....9-4

2.1 Assembly drawing

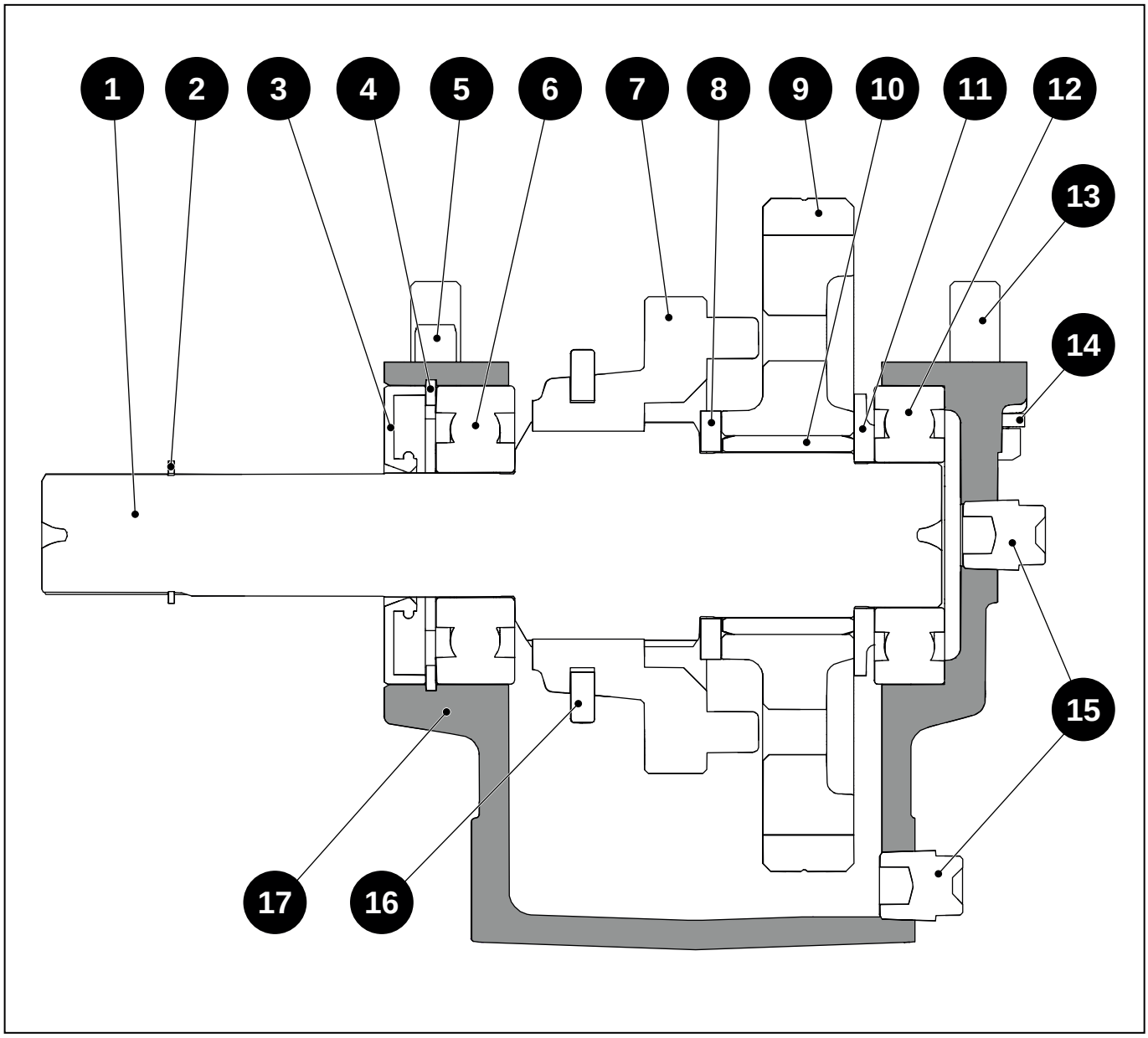


Fig. 9.1

1 - Shaft
2 - Circlip
3 - Oil seal
4 - Circlip
5 - Alignment stud
6 - Bearing
7 - Sleeve
8 - Spacer
9 - Gear
10 - Bush
11 - Spacer
12 - Bearing
13 - Screw
14 - Conical washer
15 - Plug
16 - Drive selector fork
17 - Casing

Section 3 : Technical characteristics

Index

3.1 Technical characteristics 9-6

3.1 Technical characteristics

Operation	Mechanical
Clutch	-

Section 4 : Disassembly

Index

4.1 Preliminary operations 9-8

4.2 Disassembly 9-10

4.1 Preliminary operations

The main operations necessary to access the assembly are indicated as follows.

Note
See the relative chapters for specific disassembly and reassembly procedures.

Remove the drive transfer shaft guards.

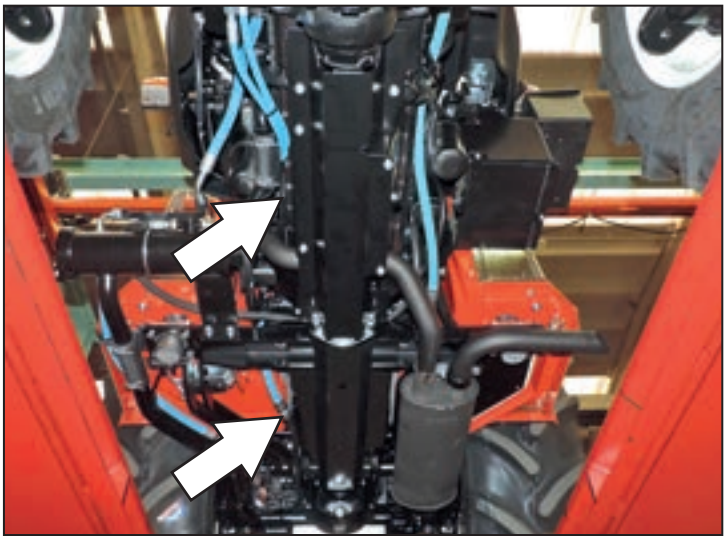


Fig. 9.2

Remove the transfer bearing and its mount.

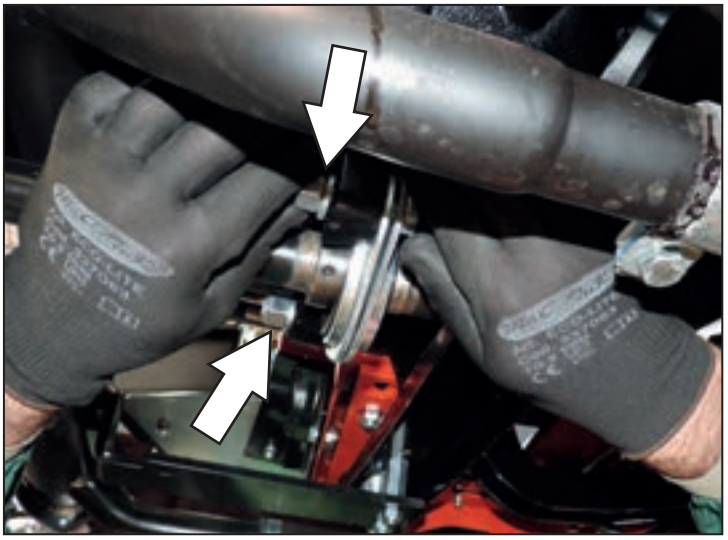


Fig. 9.3

Detach the circlips to free the sleeves fastening the 4WD shaft to the splined shafts at the front and rear.

Fig. 9.4

Pull the sleeves back to free the 4WD drive shaft, and remove the shaft.

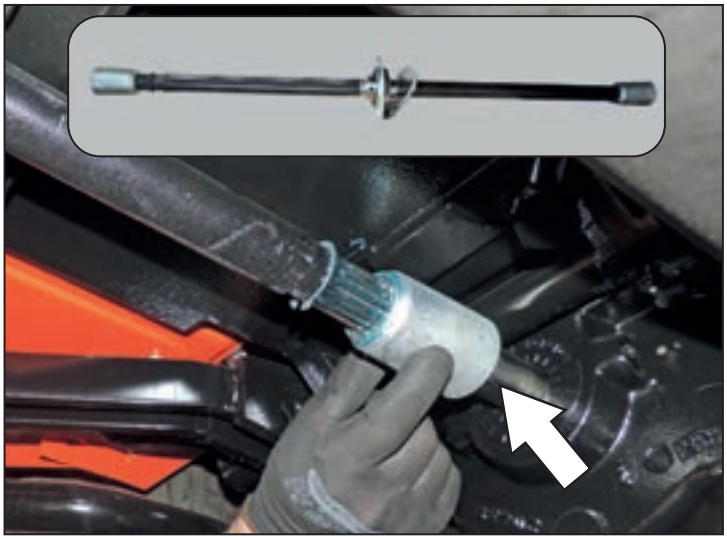


Fig. 9.5

4.2 Disassembly

Lift the cap (15) and wait for the oil to drain.

> **Note**
>
> Place a container of suitable capacity under the assembly to collect draining oil.

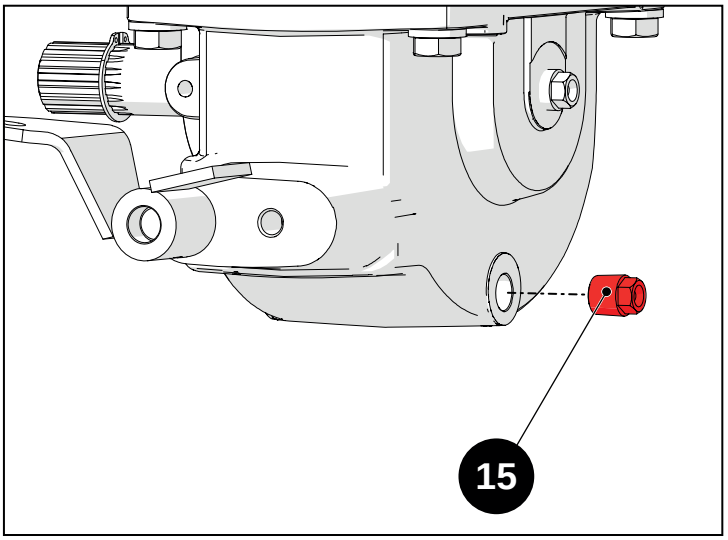


Fig. 9.6

Unscrew and remove the screws (13) and the washers (14).

> **Attention**
>
> Support the weight of the assembly during the procedure.

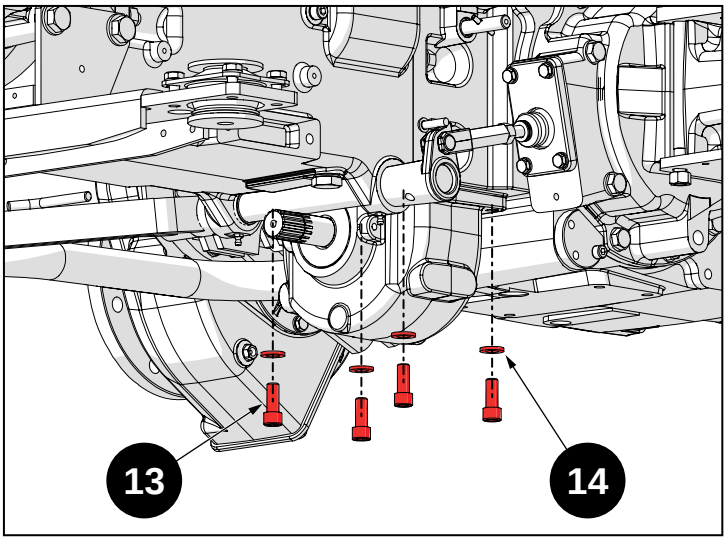


Fig. 9.7

Remove the complete assembly.

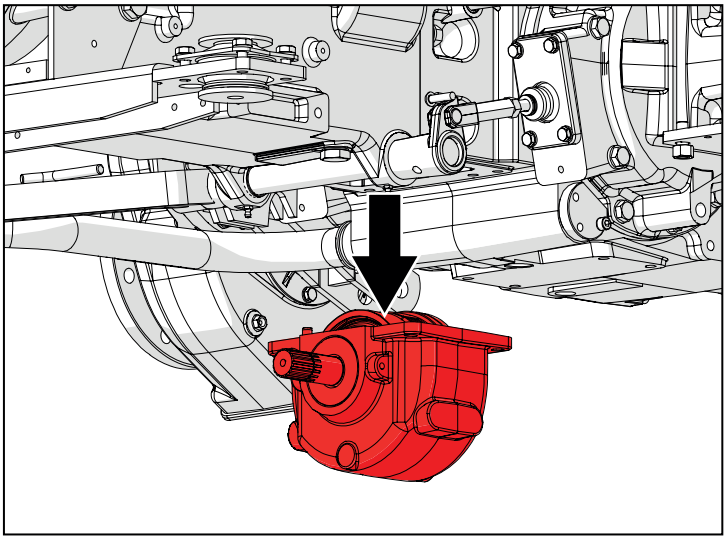


Fig. 9.8

Remove the centring pins (5).

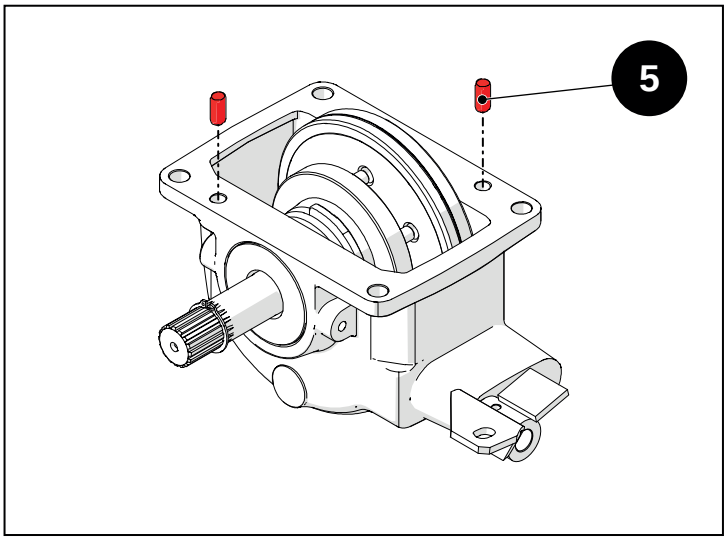


Fig. 9.9

Remove the circlip (2).

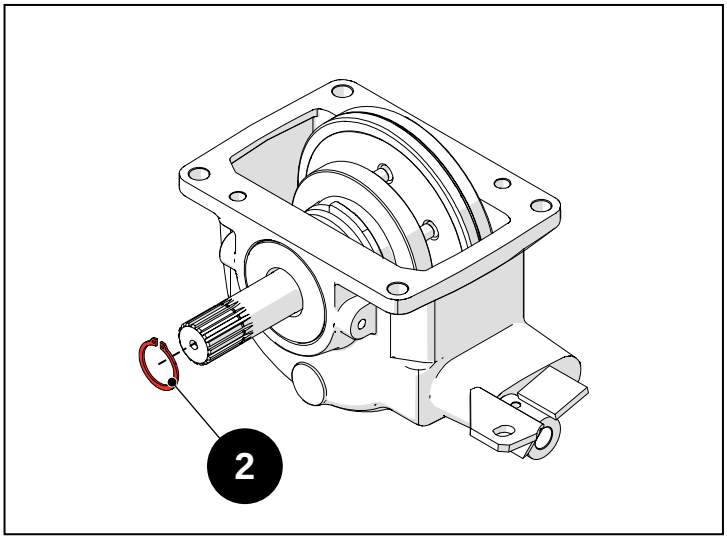


Fig. 9.10

Remove oil seal (3).

Remove the circlip (4).

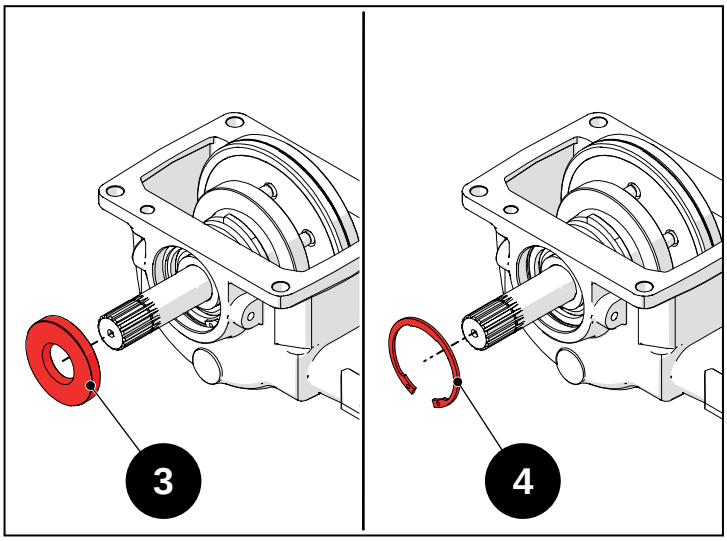


Fig. 9.11

Drive out the pin (18) with a pin punch.

Remove the 4WD selector lever (19).

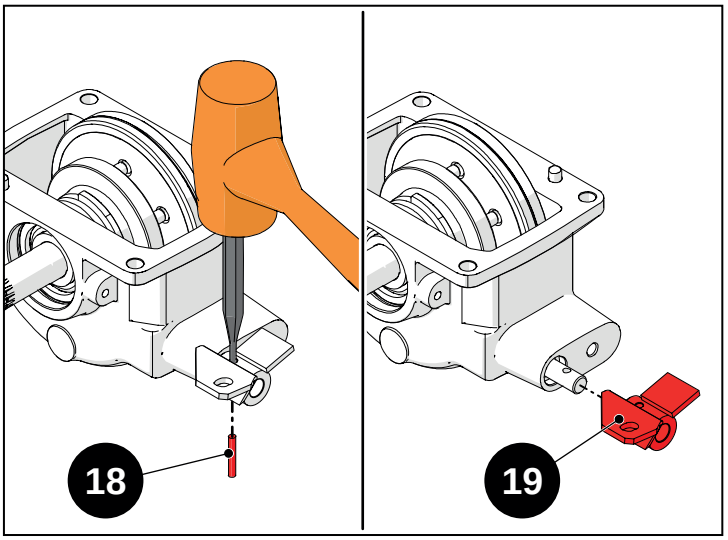


Fig. 9.12

Unscrew the plug (15).

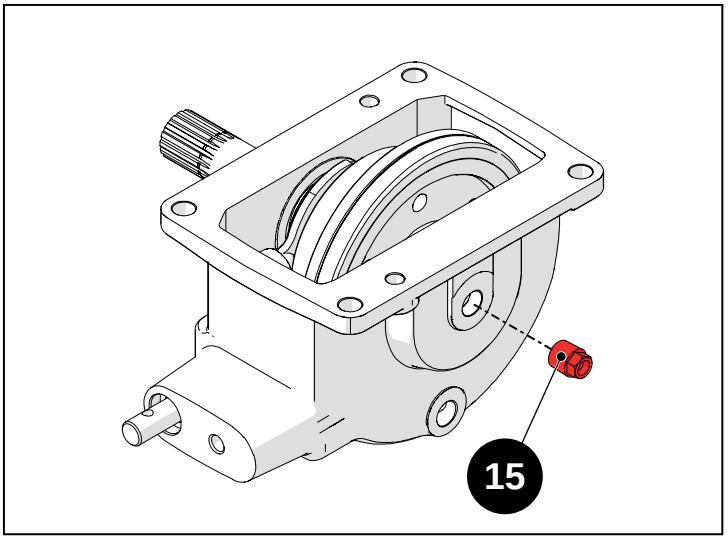


Fig. 9.13

Tap the shaft (1) with a scalpel via the plug hole, and then pull out the shaft together with the bearing (6).

Separate the bearing from the shaft.

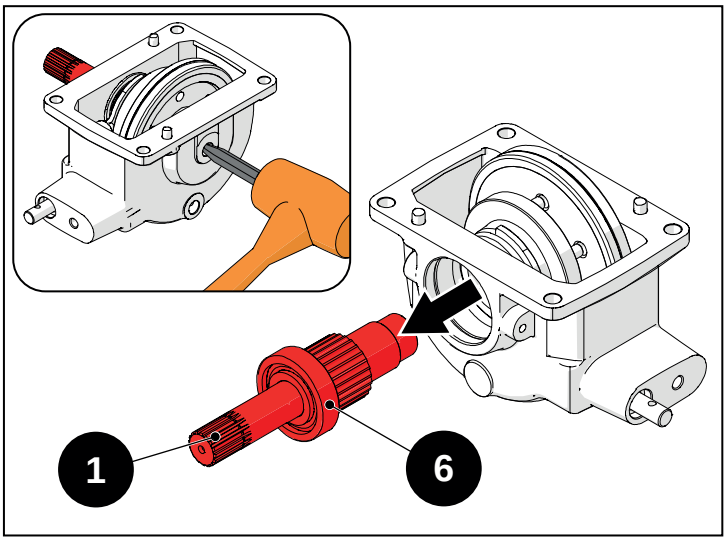


Fig. 9.14

Remove the following components from the case:

- the spacer (11);
- the gear (9) complete with bush (10);
- the spacer (8).

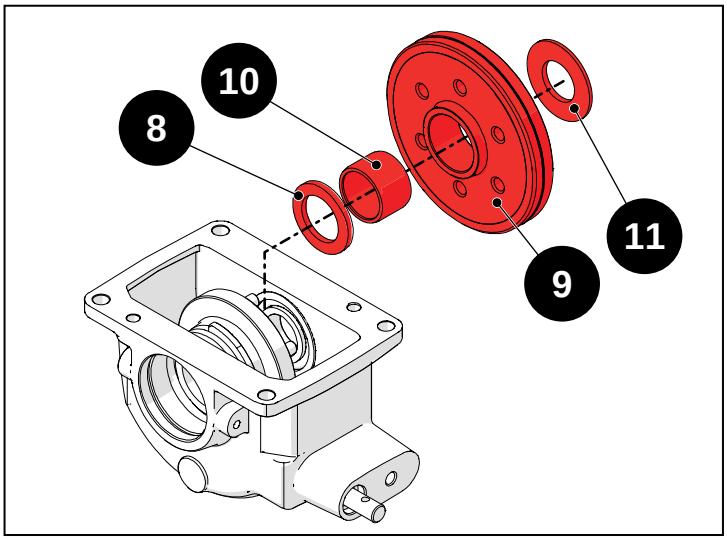


Fig. 9.15

Remove the sleeve (7).

Remove the complete lever (20).

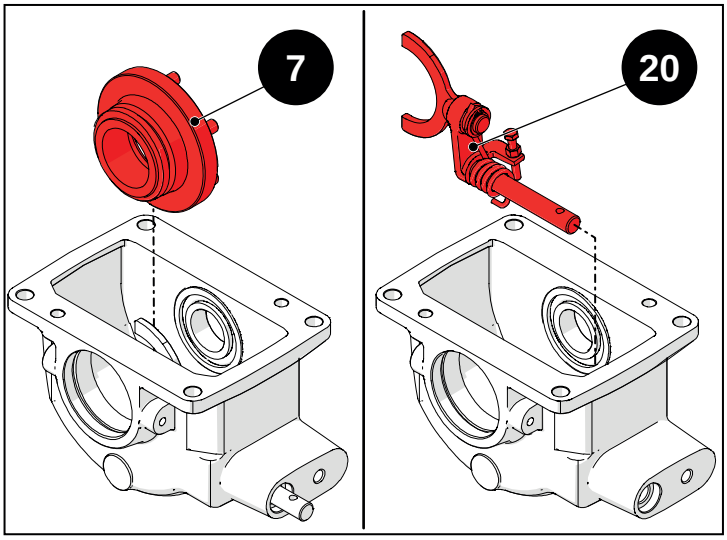


Fig. 9.16

Remove the spring (21).

Remove the circlip (22) and remove the fork (16) from the 4WD selector lever (20).

Undo the adjuster screw (23), complete with the nut (24) and the washer (25).

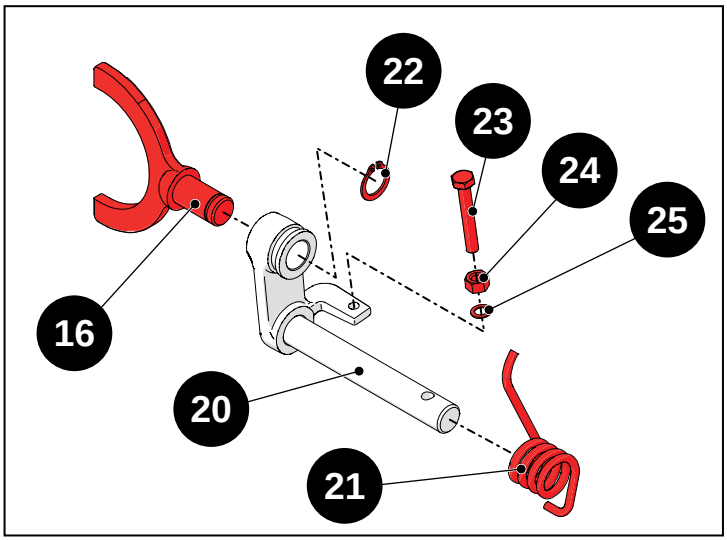


Fig. 9.17

Use a bearing puller tool to remove the bearing (12).

Remove oil seal (26).

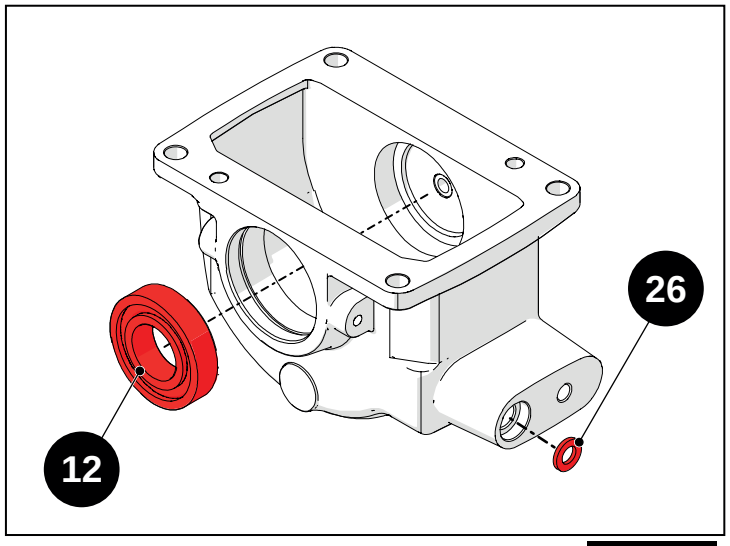


Fig. 9.18

Section 5 : Main inspection, reassembly and adjustment procedures

Index

5.1 Main inspection, reassembly and adjustment procedures 9-16

5.1 Main inspection, reassembly and adjustment procedures

Danger

All other persons must keep at a safe distance from the danger area.

Warning

Read the instructions in chapter "1-Introduction" and, in particular, the sections concerning the installation of O-rings, oil seals and bearings, with particular care before reassembling, and follow these instructions precisely when working.

Apply the correct tightening torques when tighten the fasteners of components. Where tightening torques are not specified, refer to the table in chapter "1-Introduction".

Use the specified sealant products during reassembly. Where the sealant required is not specified, refer to the table in chapter "1-Introduction".

Apply a layer of silicone to the threads of the plugs (15), and fit and tighten the plugs onto the case (17) to a torque of _____ Nm (_____ Kgm).

Warning

The plugs must not protrude into the interior of the case.

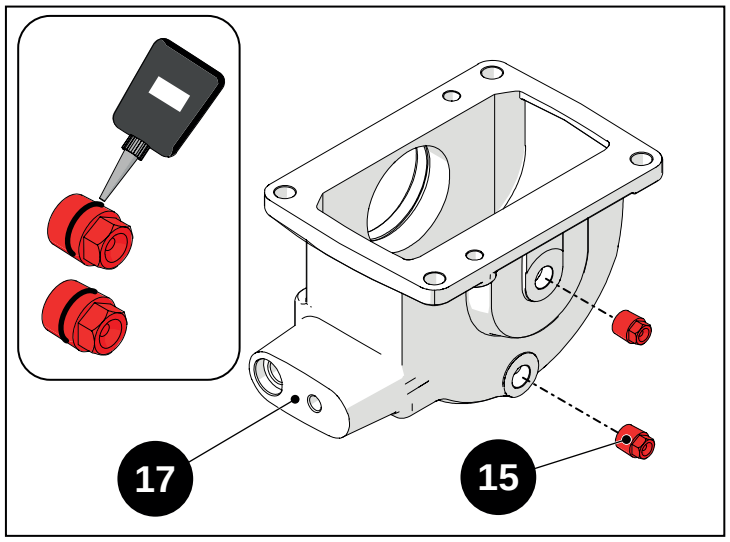


Fig. 9.19

Fit the bearing (12) and drive it into its seat with a bearing punch tool of suitable diameter.

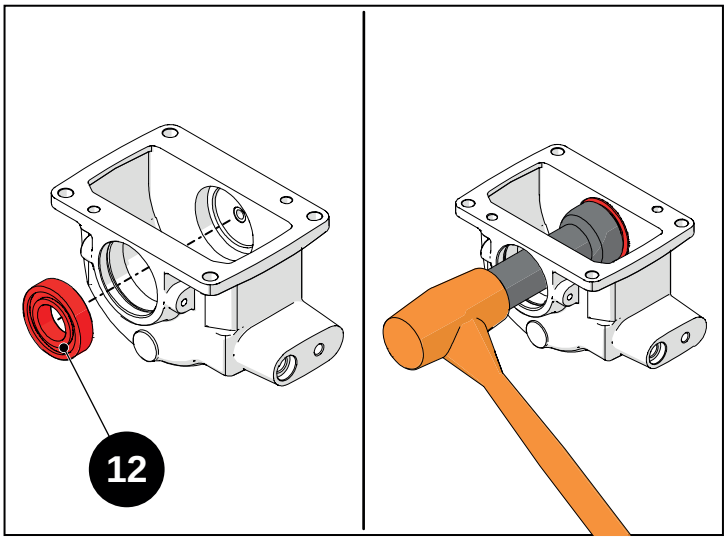


Fig. 9.20

Pre-assemble the 4WD selector lever (20), fitting the fork (16) and securing the fork with the circlip (22).

Tighten the adjuster screw (23), with the nut (24) and the washer (25).

Fit the spring (21).

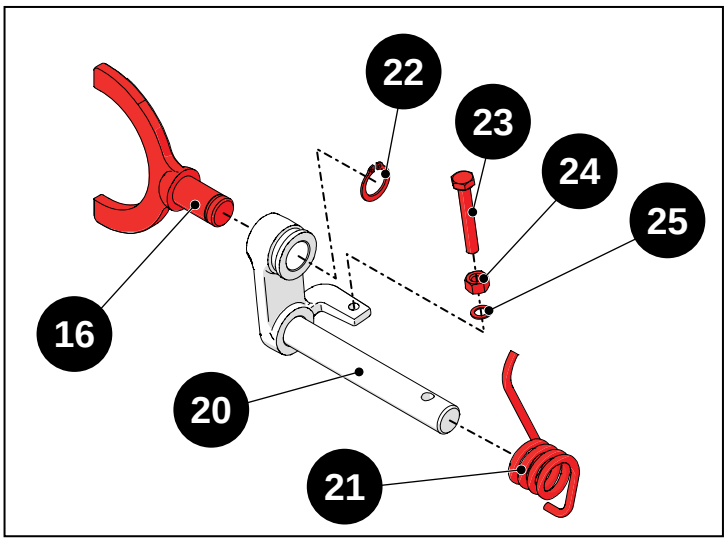


Fig. 9.21

Grease the hole and fit the complete 4WD selector lever (20) on the case.

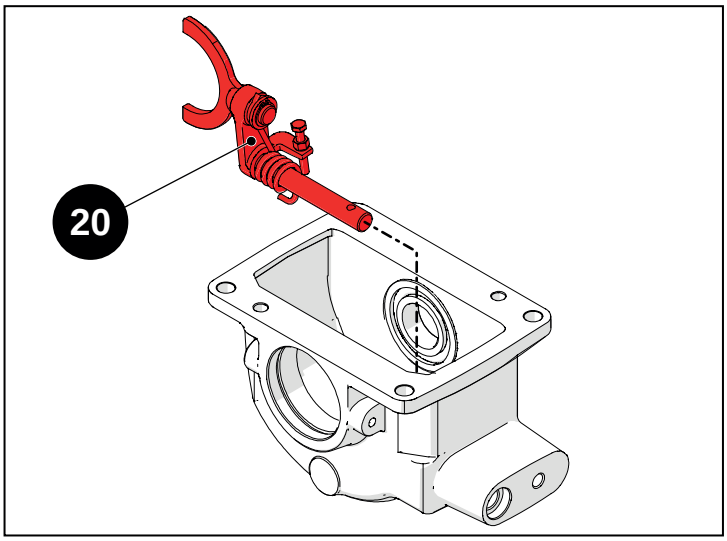


Fig. 9.22

Fit the oil seal (26) on the 4WD selector lever, using a guide tool to facilitate installation and driving it completely into its seat on the case.

Fit the lever of the tie-rod (19). Secure to the rod with the pin (18).

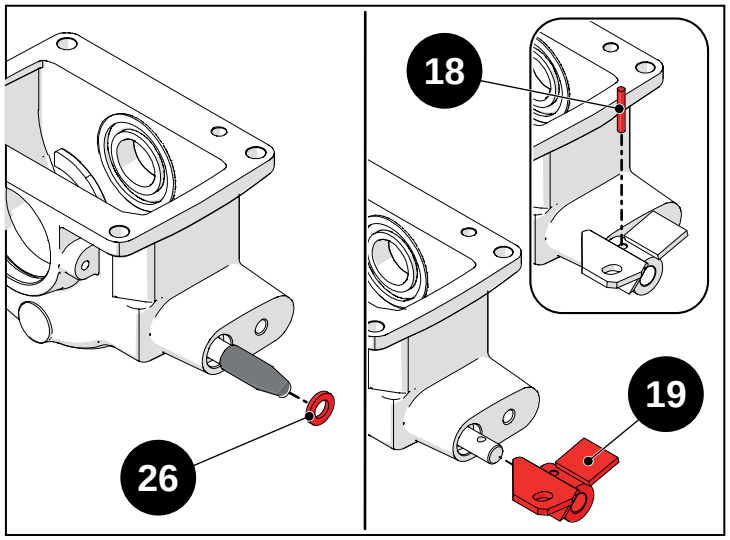


Fig. 9.23

Fasten the spring (21) to the 4WD selector lever (20).

Fit the tool (A-p/n_____) to immobilise the tie-rod lever (19).

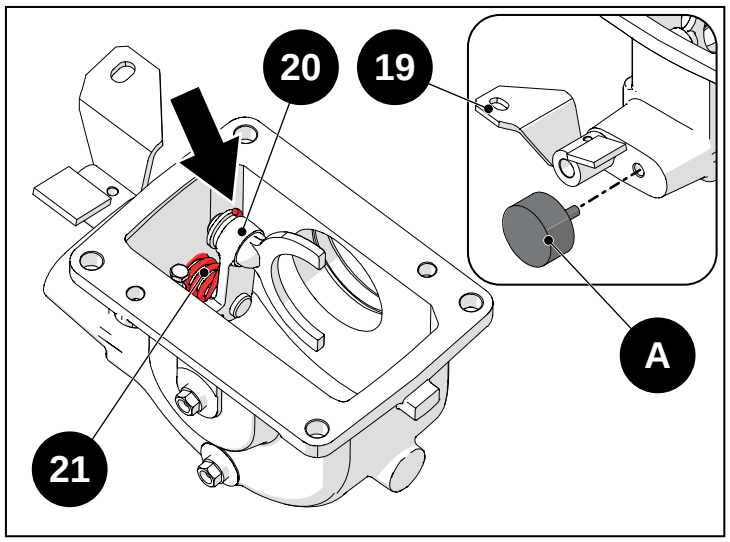


Fig. 9.24

Apply grease to the spacer mounting seat on the sleeve (7).

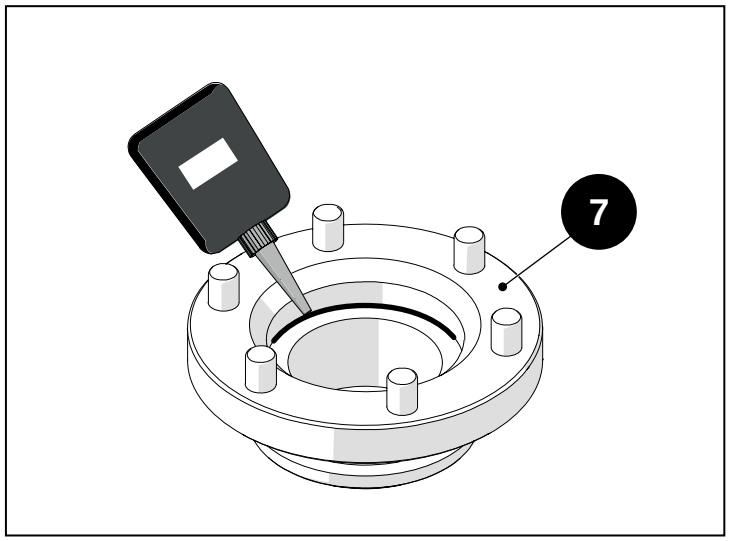


Fig. 9.25

Fit the sleeve (7) in the case, matching up with the fork (16).

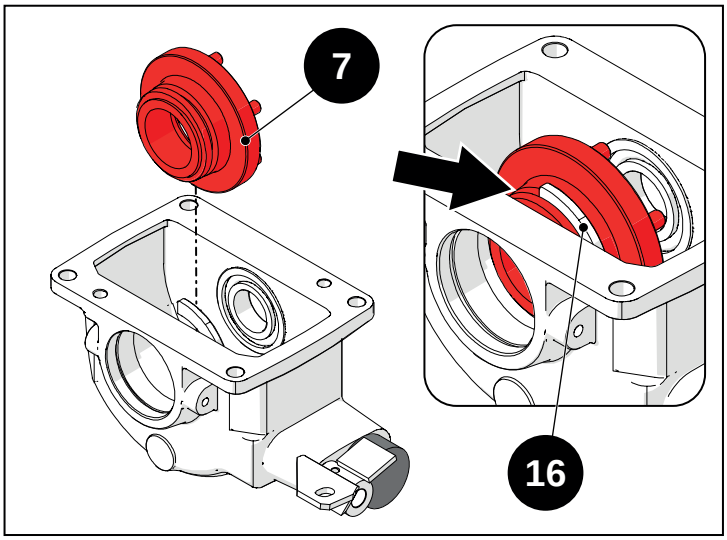


Fig. 9.26

Partially insert the shaft (1) into the case and into the sleeve (7).

Fit the following components onto the shaft in the order given:

- the spacer (8);
- the gear (9), complete with bush (10), fitting it onto the pegs of the sleeve (7);
- the spacer (11).

Warning

Take care not to drop the spacer (8) during this procedure.

Push the shaft (1) completely into the case.

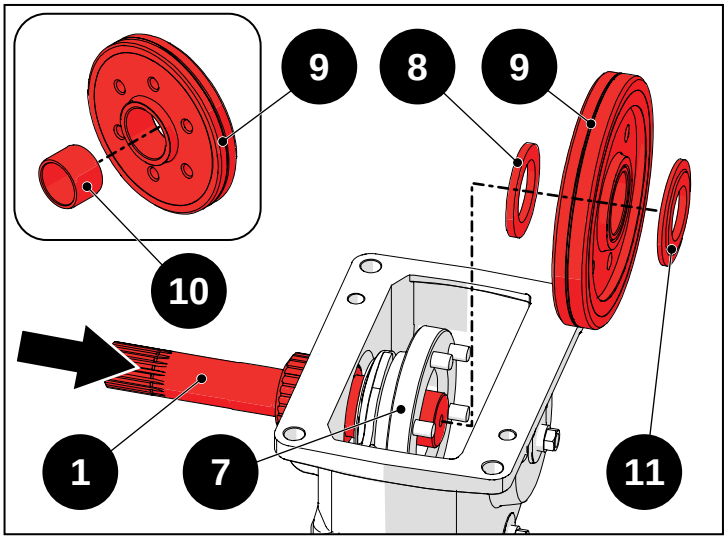


Fig. 9.27

Tap the shaft (1) with a mallet to drive fully into place.

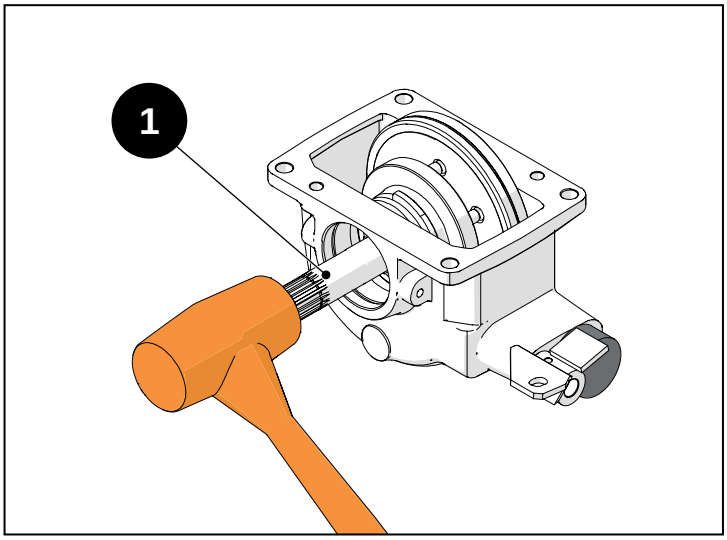


Fig. 9.28

Fit the bearing (6) and drive it fully into its seat with a bearing punch tool of suitable diameter.

Fit the circlip (4) tor retain the bearing in its seat.

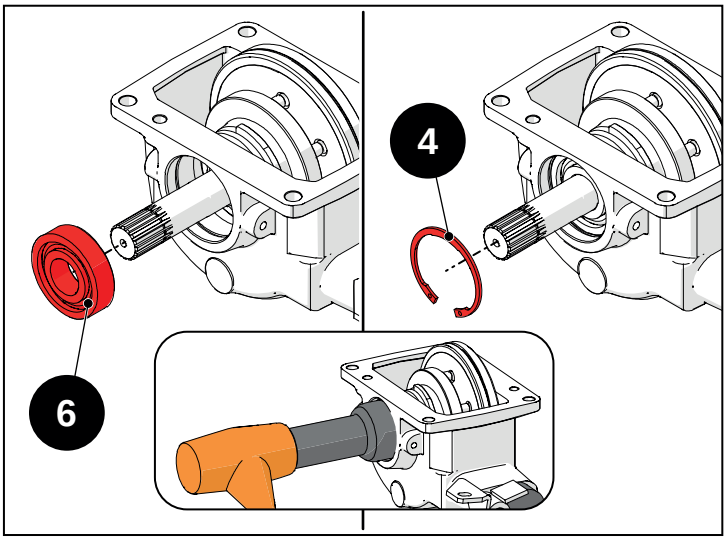


Fig. 9.29

Remove the special tool (A-p/n_____).

Engage 4WD by pushing the sleeve (7) against the gear (9).

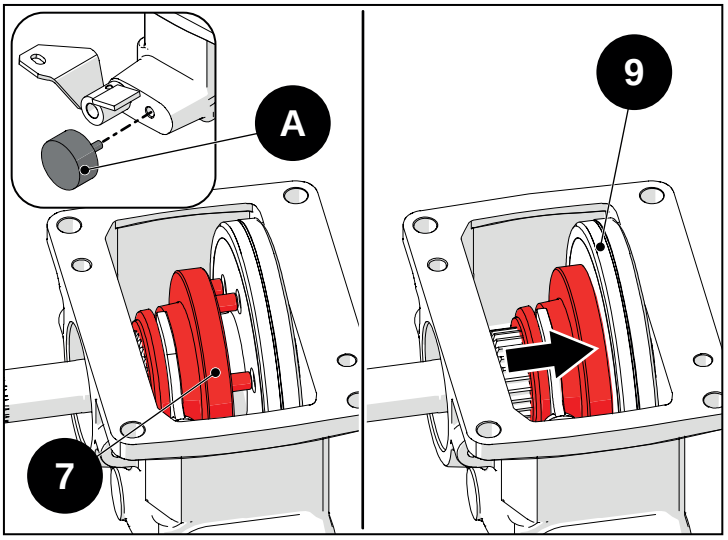


Fig. 9.30

Adjust the screw (23) to obtain a clearance of _____ to_____ mm between the fork (16) and the sleeve (7) on both the right and left hand sides. This clearance is necessary to prevent excessive friction between the two components when 4WD is engaged.

After setting the correct clearance, secure the screw (23) in place by tightening the check nut (24).

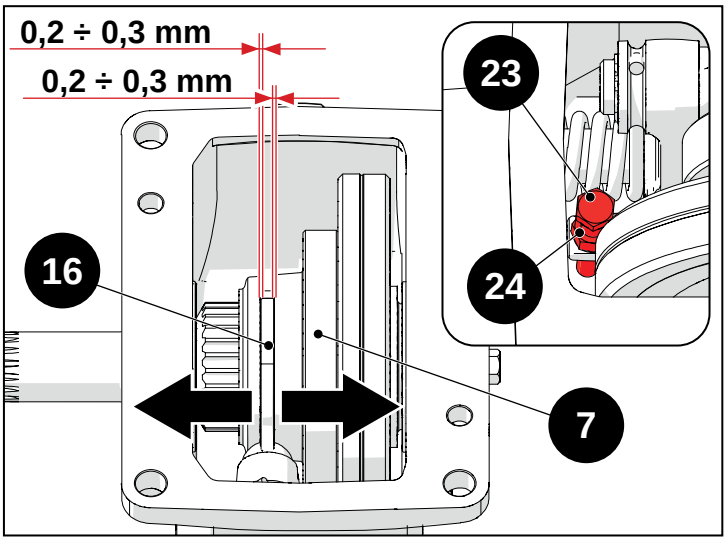


Fig. 9.31

Apply a layer of mastic sealant to the outer surface of the oil seal (3), then install the seal in its seat with a punch tool of suitable diameter.

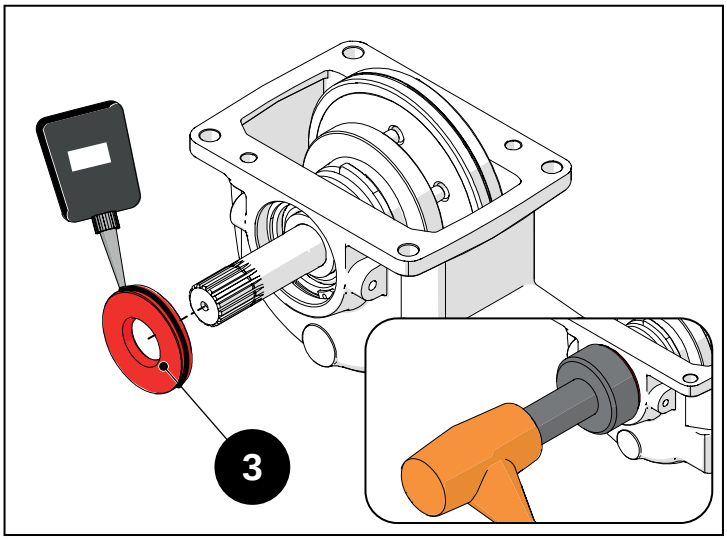


Fig. 9.32

Fit the circlip (2) on the shaft.

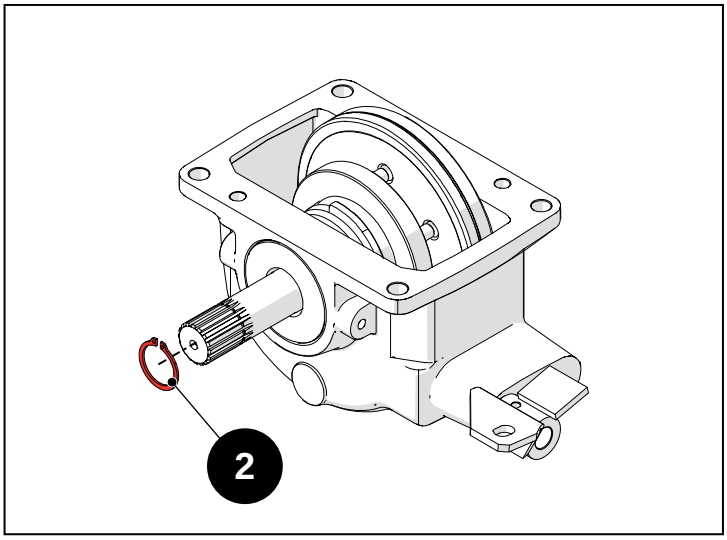


Fig. 9.33

Insert the centring pins (5).

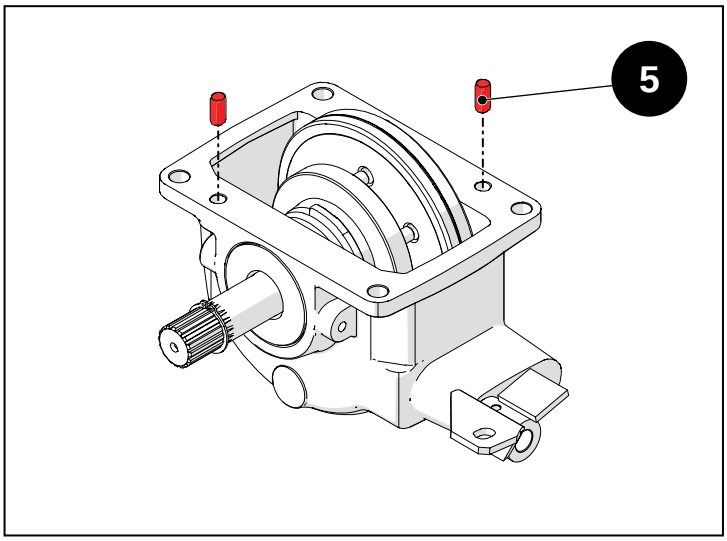


Fig. 9.34

Apply a layer of silicone sealant on the mating surface of the case.

Install the complete assembly underneath the gearbox housing.

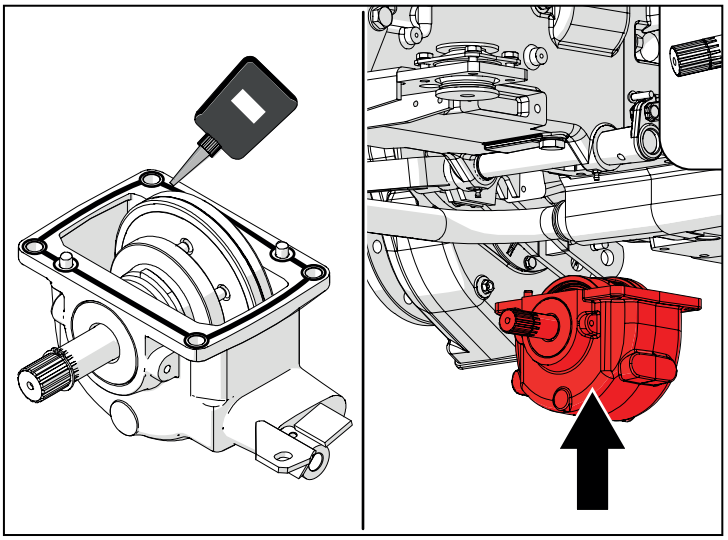


Fig. 9.35

Fit the washers (14) and tighten the screws (13) to a torque of 85 Nm (8.5 kgm).

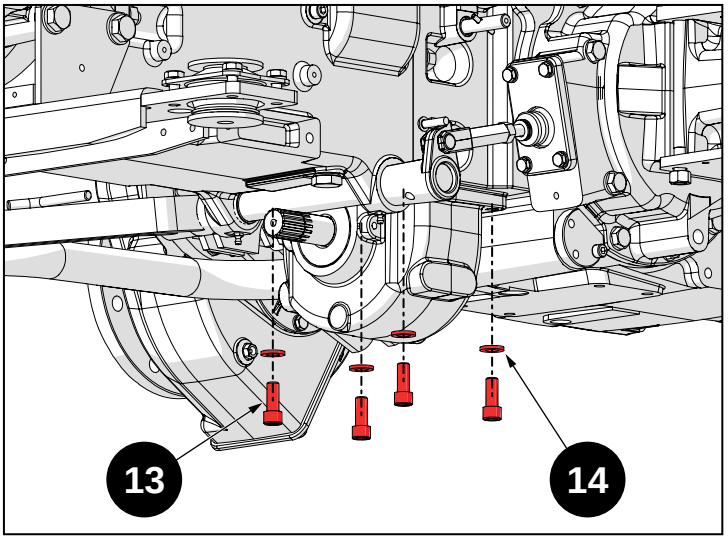


Fig. 9.36

Section 6 : Tightening specifications

Index

6.1 Tightening specifications 9-24

6.1 Tightening specifications

The main tightening torques are listed as follows. For all other tightening torques, see chapter "1-Introduction".

Tightening torque	Nm	Kgm
4WD case screw	85	8.5

Section 7 : Tools necessary

Index

7.1 Tools necessary 9-26

7.1 Tools necessary

p/n	Description	Quantity
A-p/n_____	4WD selector lever retainer pin	1

Chapter 10 : Rear Power Take-Off

Index

Section 1 : Safety notes 10-2

Section 2 : General introduction 10-3

2.1 Drawing of the assembly 10-4

Section 3 : Technical specifications 10-5

3.1 Technical specifications 10-6

Section 4 : Disassembly 10-7

4.1 Disassembly 10-8

Section 5 : Main inspection, re-assembly and adjustment operations 10-13

5.1 Main inspection, re-assembly and adjustment operations 10-14

Section 6 : Tightening torques 10-21

6.1 Tightening torques 10-22

Section 7 : Tools required 10-23

7.1 Tools required 10-24

Section 1 : Safety notes

To prevent accidents and injuries, always comply with the precautions and safety recommendations described in this section. In addition, operators must always comply with the safety instructions given in the operation and maintenance manual and in chapter 1 of this manual.

Danger

Make sure that all persons keep well away from the danger zone.

Danger

Lift and handle all heavy parts with lifting equipment of an adequate capacity. Arrange all harness and hooks in safe positions. Operators must remain at a distance and in a safe position, well away from the lifted load.

Danger

Do not twist the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Danger

Use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.

Danger

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

Danger

For safety reasons, always leave two screws on opposite sides when removing components that could fall. Only remove these screws after having secured the component to lifting equipment or placed bearing blocks underneath.

Danger

If the bolts that fix the safety frame or cab have loosened or if the safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

Caution

Keep clear of the sharp edges around the top of the transmission housing.

Caution

Used oil must be collected and disposed of in compliance with the anti-pollution laws in force.

Section 2 : General introduction

Index

2.1 Drawing of the assembly 10-4

2.1 Drawing of the assembly

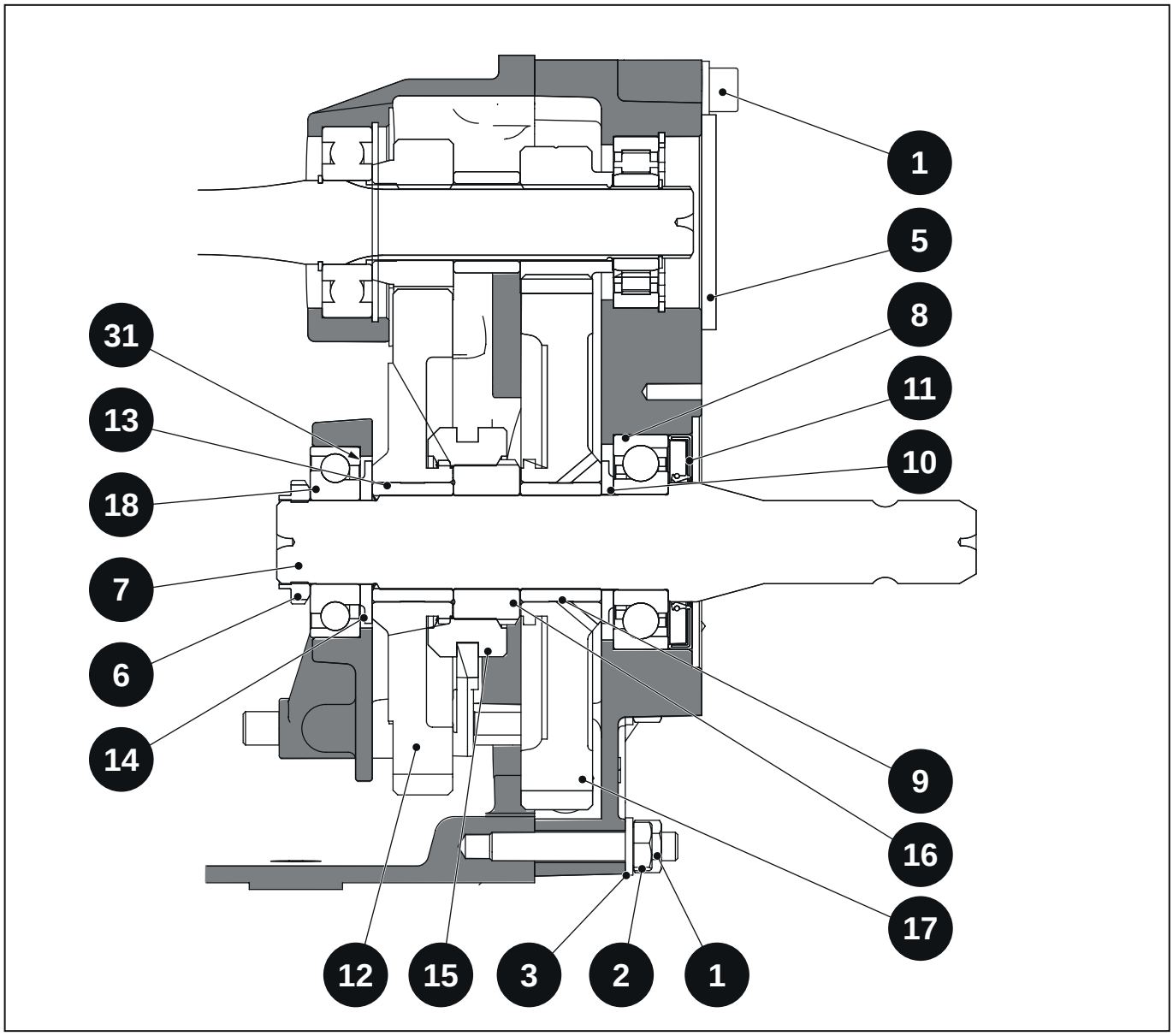


Fig. 10.1

1 - Screw
2 - Nut
3 - Washer
5 - Cover
6 - Ring nut
7 - Shaft
8 - Bearing
9 - Bush
10 - Spacer
11 - Oil retainer
12 - Gear
13 - Bush
14 - Spacer
15 - Sleeve
16 - Grooved bushing
17 - Gear
18 - Bearing
31 - Spacers
32 - 750/1000 gear
33 - 540 gear

Section 3 : Technical specifications

Index

3.1 Technical specifications 10-6

3.1 Technical specifications

Type	Single-shaft, independent and synchronized
Speeds independent from ground speed	540/750 rpm
Other speeds independent from ground speed	540/1000 rpm
Speed synchronized with ground speed	Yes
Direction of rotation (viewing the PTO)	Clockwise
Profile	1-3/8" with 6 splines
Clutch	Independent, mechanical with dry disc
Clutch control	Mechanical, lever operated
Safety	PUSH & START device on clutch pedal and on PTO

PTO speed table

PTO speed selector lever	Direction of rotation	Ratio	PTO rpm rate	Engine rpm rate
540	Clockwise rotation	4.500	540	2430
540E	1"-3/8 profile with 6 splines	3.471	750	2603
	540	1874	1000	
2.214	1000	2214		

Synchronized PTO speed table

Low version

540	540E	1000
4.684	6.074	9.520

High version

540	540E	1000
4.258	5.522	8.654

Section 4 : Disassembly

Index

4.1 Disassembly 10-8

4.1 Disassembly

Unscrew the screws (1) and nuts (2), and remove the washers (3).

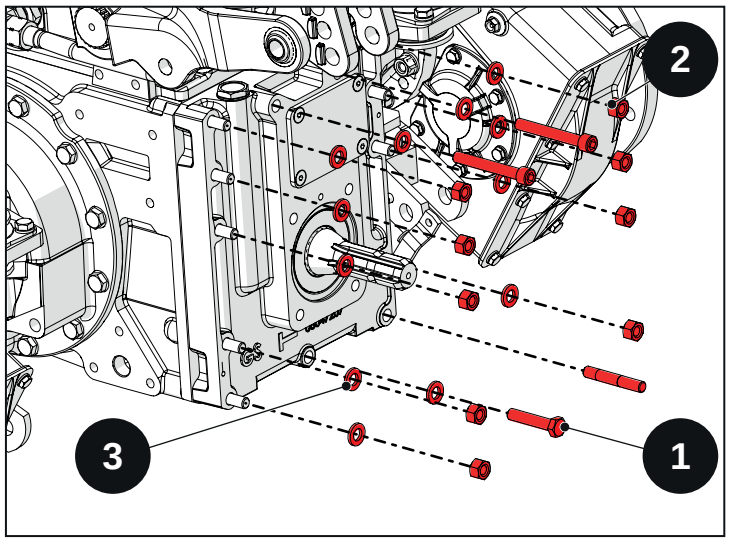


Fig. 10.2

Connect lifting equipment to the PTO unit, then remove it from the differential assembly.

Warning
Screw two threaded screws into the extraction holes to facilitate the operation.

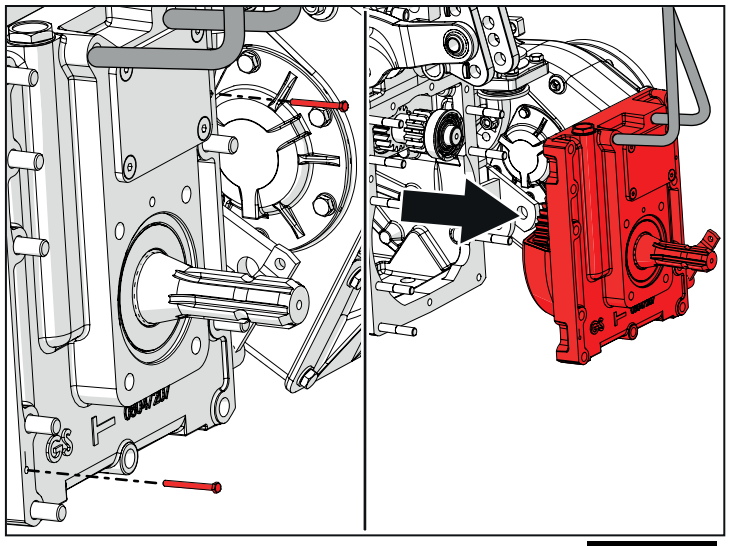


Fig. 10.3

Remove the fixing screws from the cover (4) and remove the cover (5).

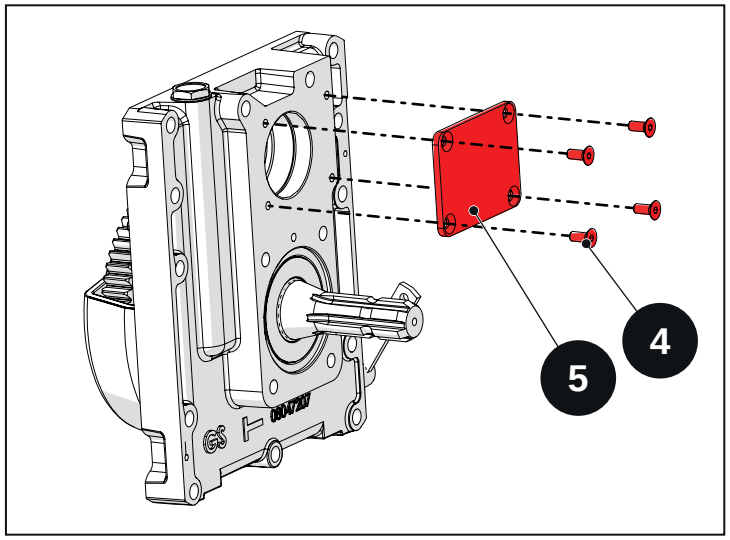


Fig. 10.4

Use tool (A-code 07006128) to remove the ring nut (6).

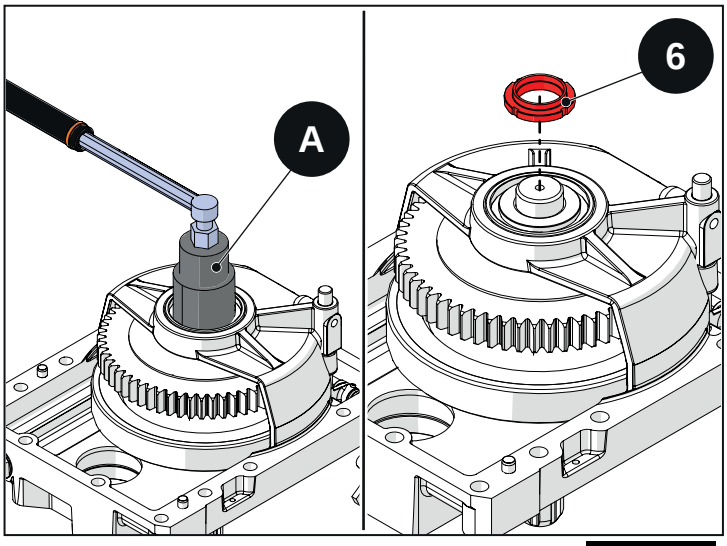


Fig. 10.5

Remove the shaft (7) complete with bearing (8), bush (9), spacer (10) and oil retainer (11).

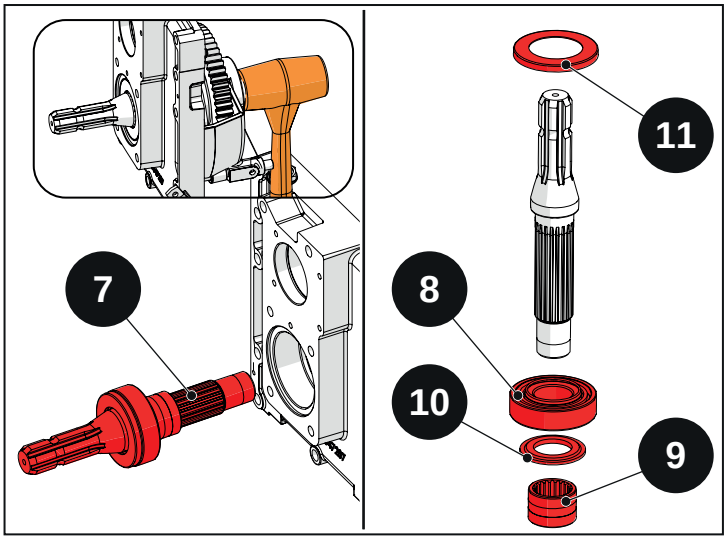


Fig. 10.6

Remove the gear (12).

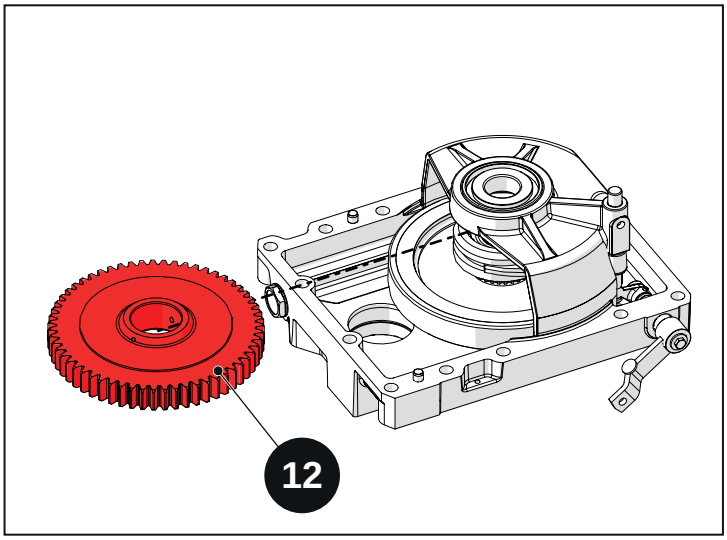


Fig. 10.7

Remove the sleeve (15) and grooved bush (16).

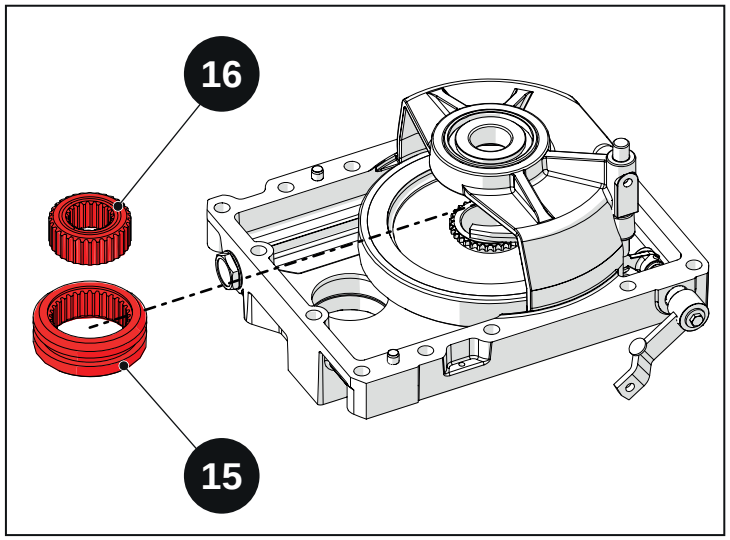


Fig. 10.8

Remove the gear (17).

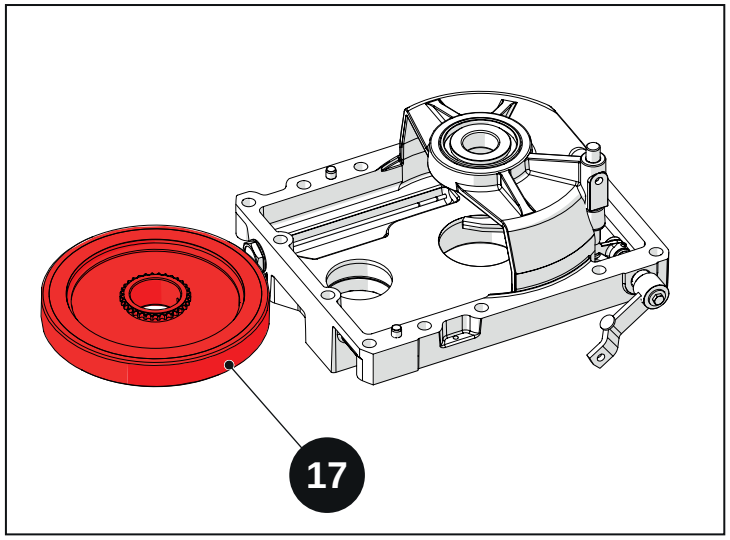


Fig. 10.9

Remove the bearing (18) with the aid of a hammer.

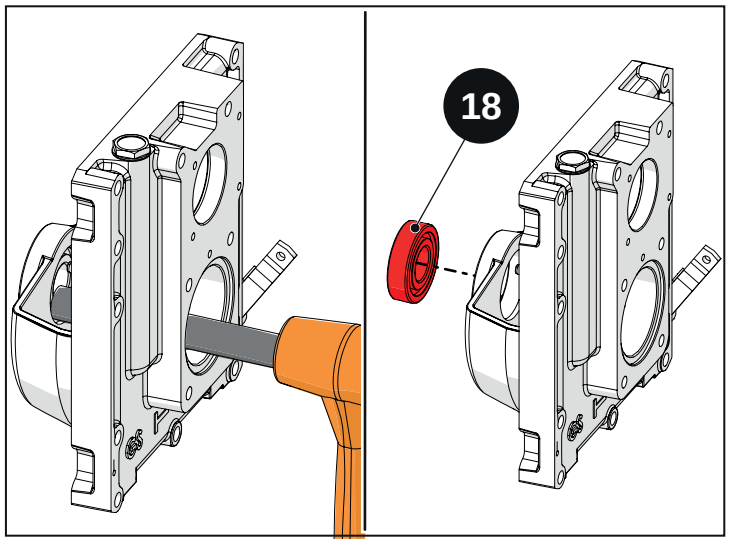


Fig. 10.10

Remove the pin (19).

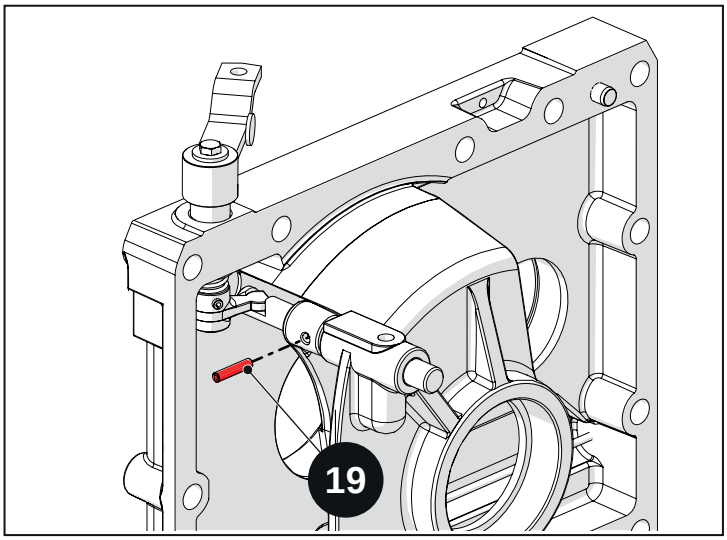


Fig. 10.11

Turn the lever to release the rod.

Unscrew the screw (20), then remove the washer (21) and lever (22).

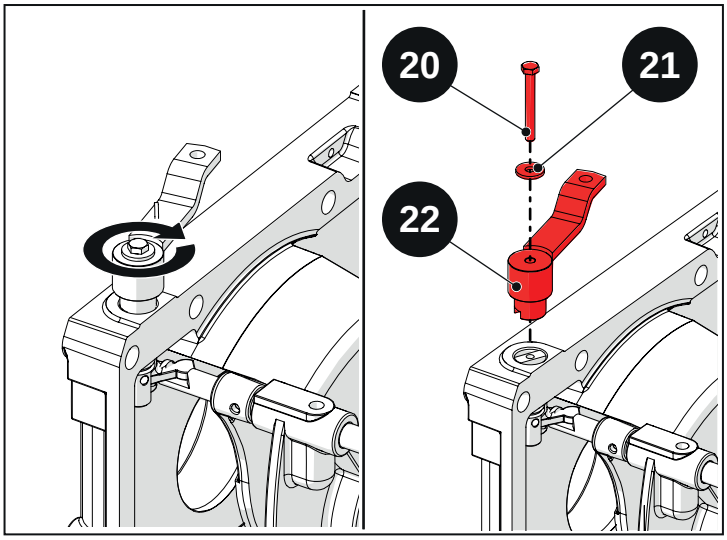


Fig. 10.12

Take out the rod (23) and fork (24).

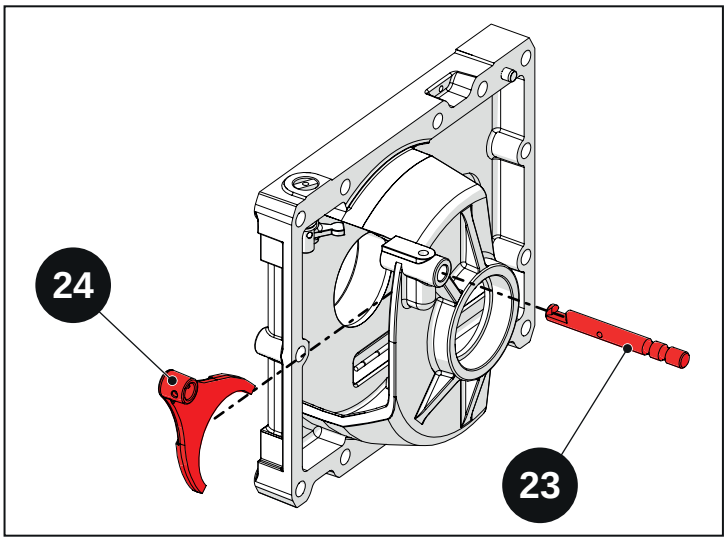


Fig. 10.13

Remove the pin (25) then remove the lever (26), the spring (27) and spacer (28).

Danger
The spring is loaded. Take care and protect yourself when the pin is removed.

Remove the plug (29) and O-ring (30).

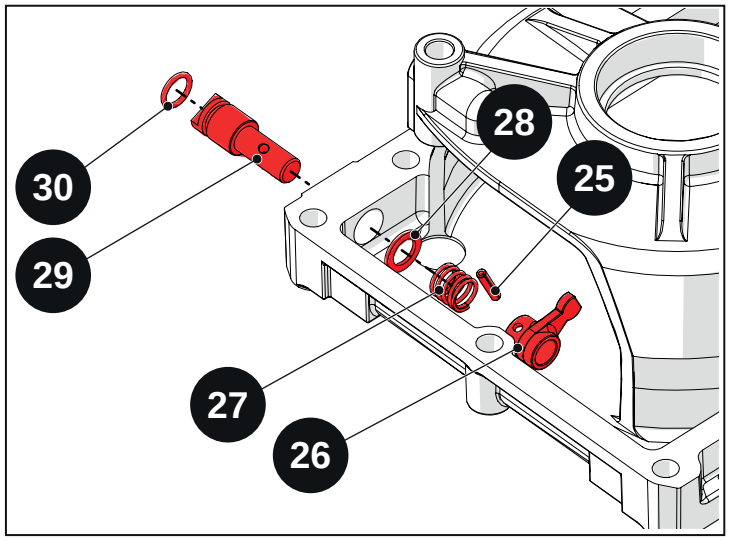


Fig. 10.14

Section 5 : Main inspection, re-assembly and adjustment operations

Index

5.1 Main inspection, re-assembly and adjustment operations.....10-14

5.1 Main inspection, re-assembly and adjustment operations

Warning

Before proceeding with the re-assembly operations, carefully read and comply with the instructions given in chapter "1-Introduction", especially those describing how to assemble O-Rings, oil retainers and bearings.

Use the correct tightening torques when screwing in the components. Consult the table in chapter "1-Introduction" if the tightening torque value is not given.

Use the indicated sealants when re-assembling the parts. Consult the table in chapter "1-Introduction" if the sealant is not indicated.

Fit the O-ring (30) onto the pin (29).

Warning

Apply a layer of grease to the O-Ring (10) before fitting it into its housing.

Insert the spacer (28), spring (27) and lever (26).

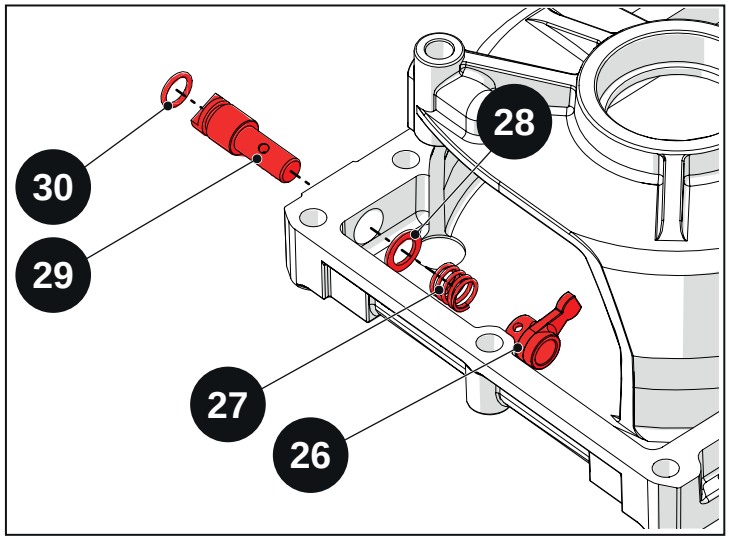


Fig. 10.15

Use tool (B-07007182) to load the spring, then insert the pin (29).

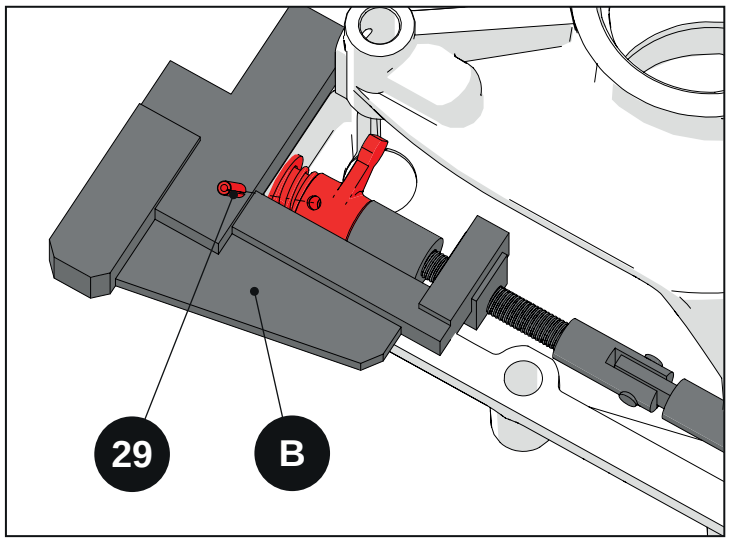


Fig. 10.16

Insert the rod (23) and fork (24).

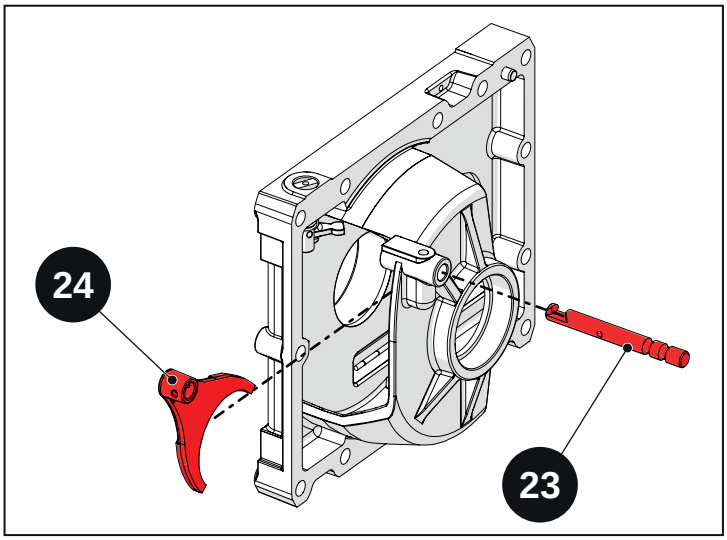


Fig. 10.17

Insert the lever (22), the washer (21), and tighten the screw (20).

Insert the pin (19).

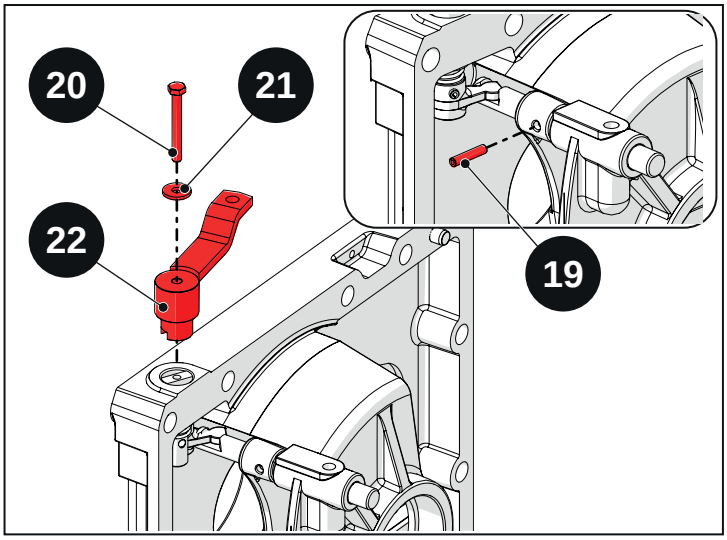


Fig. 10.18

Insert the gear (17).

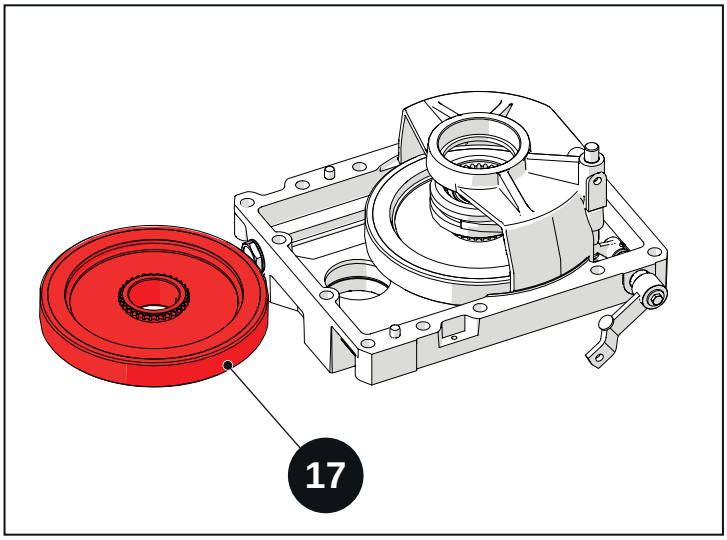


Fig. 10.19

Insert the sleeve (15) and grooved bush (16).

Warning
Align the fork with the sleeve.

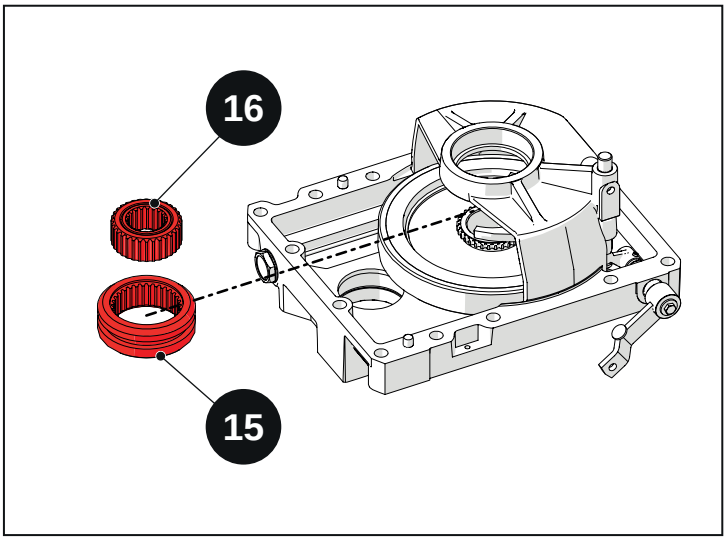


Fig. 10.20

Insert the gear (12).

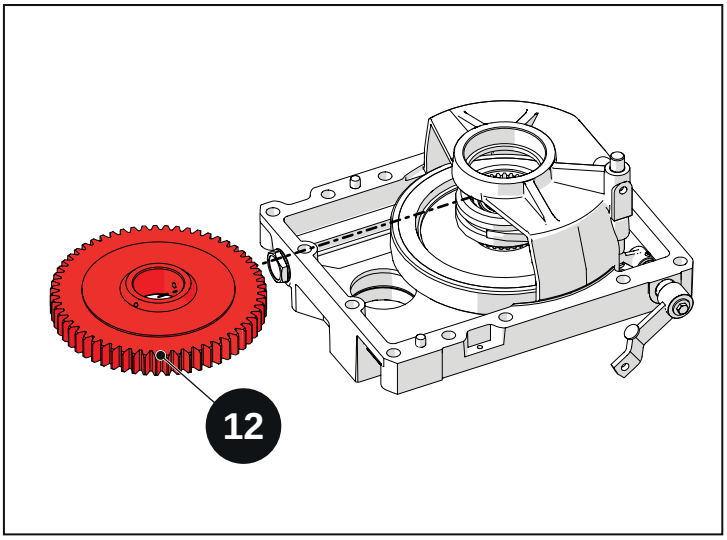


Fig. 10.21

Assemble the bearing (8) on the shaft (7) and fully seat it using a plug of a suitable diameter.

Fit the bush (9) and spacer (10) onto the shaft.

Warning
Make sure that the spacer is installed correctly. The chamfered part must point towards the bearing.

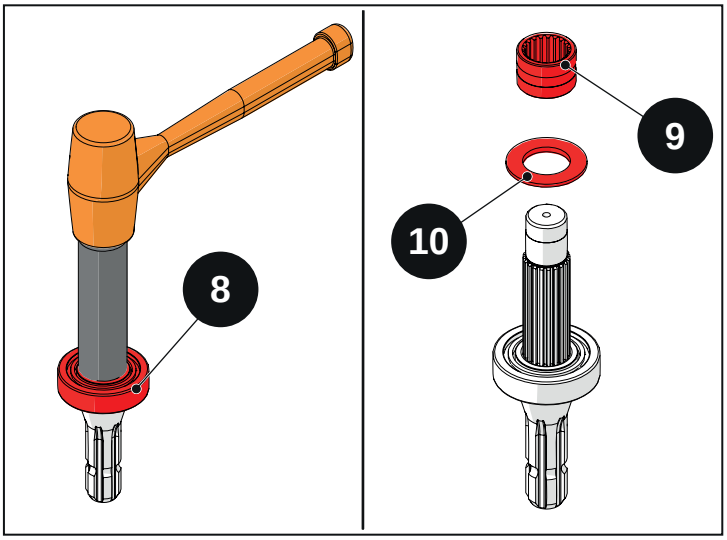


Fig. 10.22

Fit the newly assembled shaft into the unit, then insert the spacers (10).

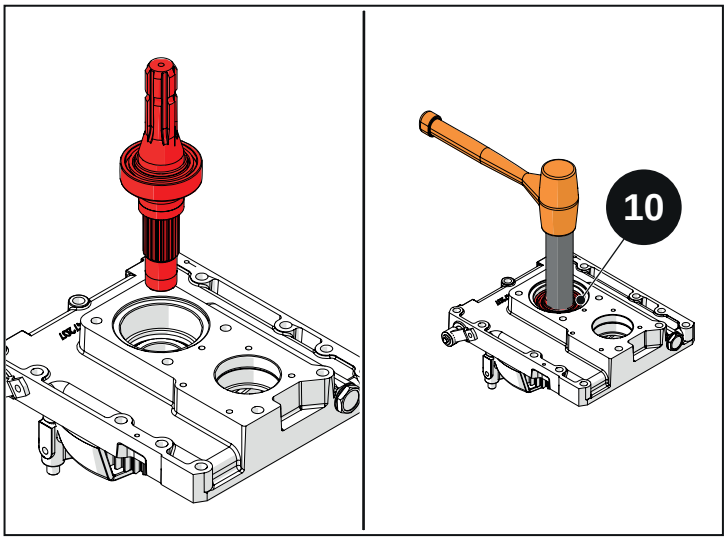


Fig. 10.23

Insert the bush (13), spacer (14) and 0.2 mm spacer (31).

Assemble the bearing (18) and fully seat it using a plug of a suitable diameter.

Warning

Make sure that the spacer is installed correctly.

The chamfered part must point towards the bearing.

Warning

Make sure that the taper bearings (8) and (18) are installed in the right direction.

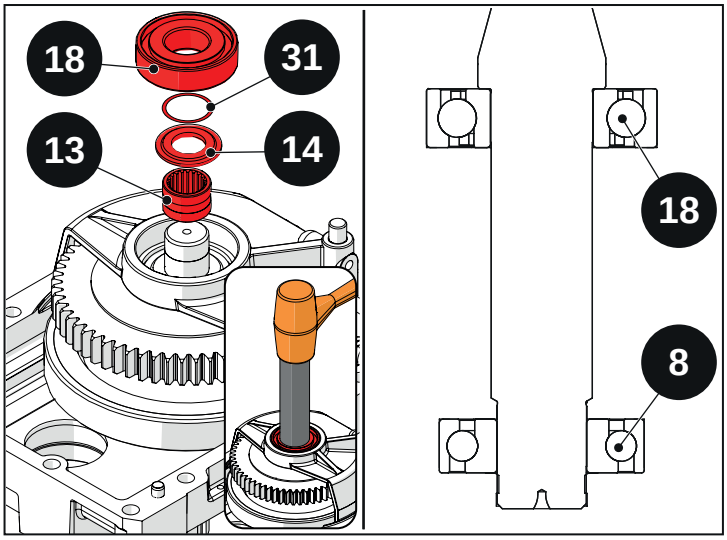


Fig. 10.24

Apply a layer of LOCTITE 270 to the ring nut thread (6), then tighten it using tool (A- code. 07006128). Apply 25 Nm (2.5 kgm) tightening torque.

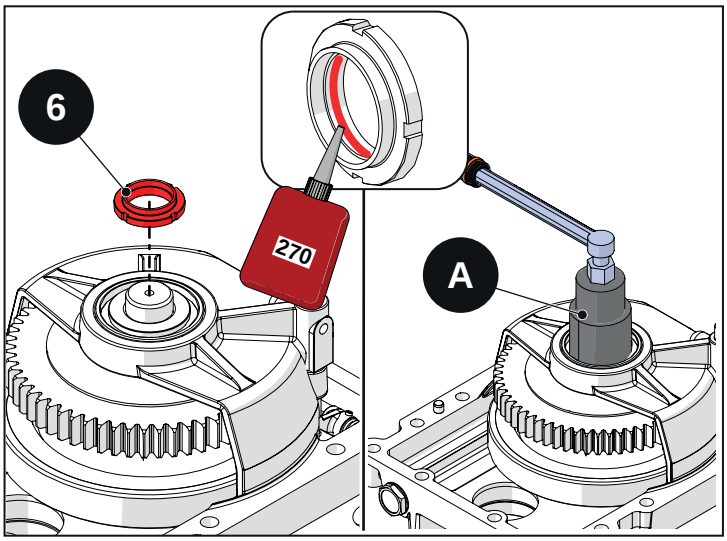


Fig. 10.25

Loosen the ring nut and tighten it again by applying 25 Nm (2.5 kgm) tightening torque.

Make a mark on the ring nut and on the shaft. Make another mark on the shaft turned 45° in the clockwise direction.

Loosen the ring nut and tighten it again to 200 Nm (20 kgm).

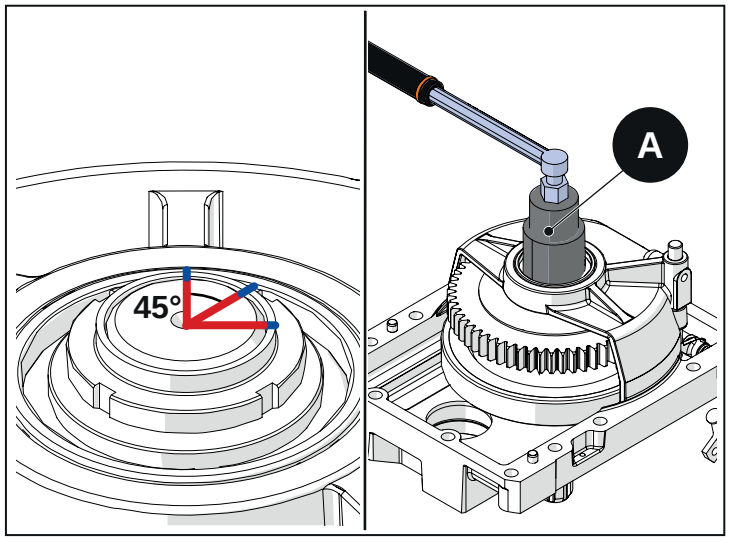


Fig. 10.26

Make sure that the ring nut has moved no more than 45° by checking the previously made marks.

Warning

If it has moved more than 45°, increase the thickness of the previously installed spacer (31).

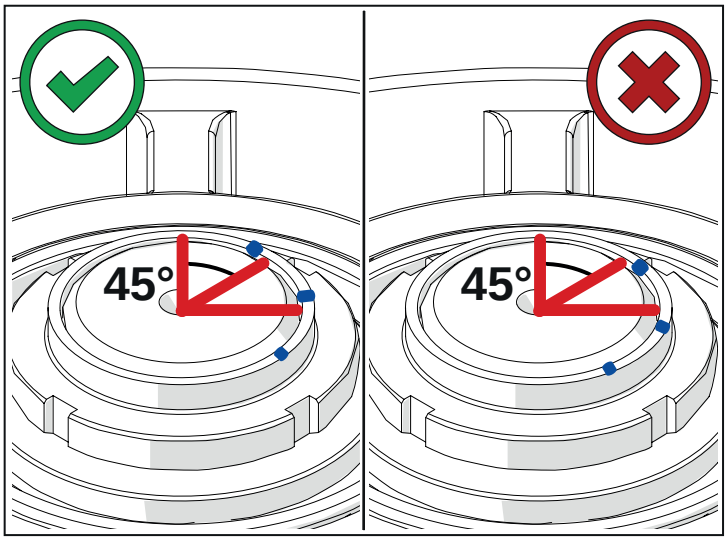


Fig. 10.27

Punch the ring nut (6) to lock it definitively in place.

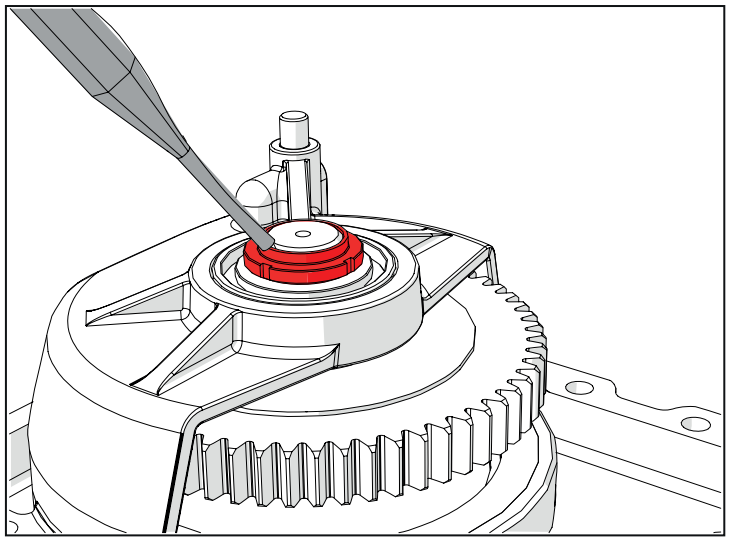


Fig. 10.28

Insert the oil retainer (11) and fully seat it by using a plug of a suitable diameter.

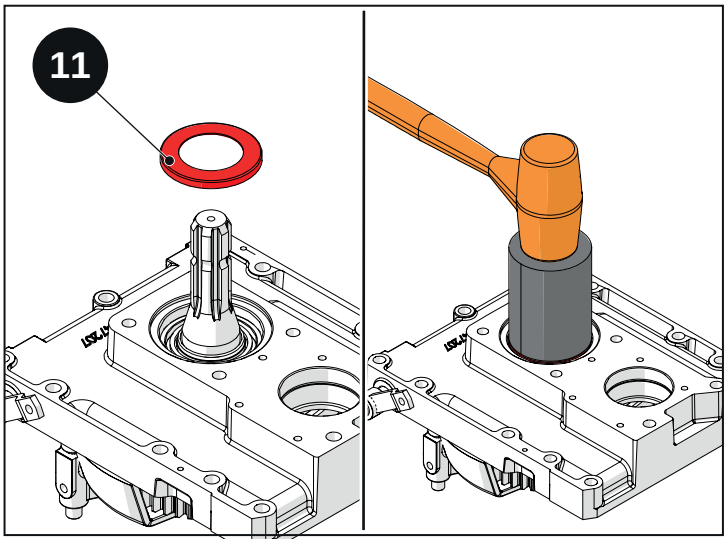


Fig. 10.29

Apply a layer of SILICONE to the coupling surface of the PTO.

Use lifting equipment to slign the PTO unit with the rear differential.

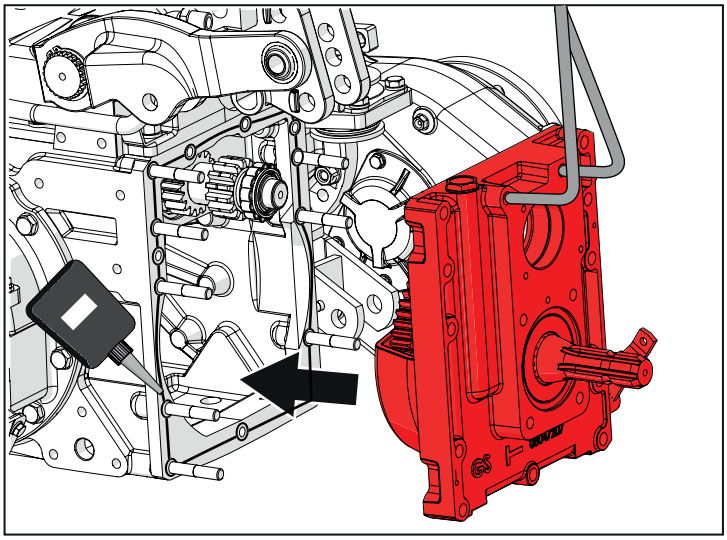


Fig. 10.30

Insert the outer race of the bearing using a plug of an adequate diameter, then lock it with the circlip.

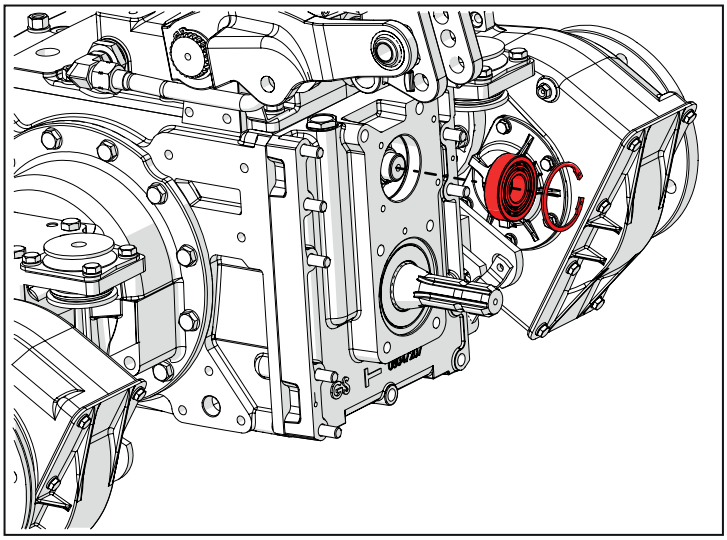


Fig. 10.31

Apply a layer of SILICONE and fit on the cover (5).

Fasten the cover with the screws (6).

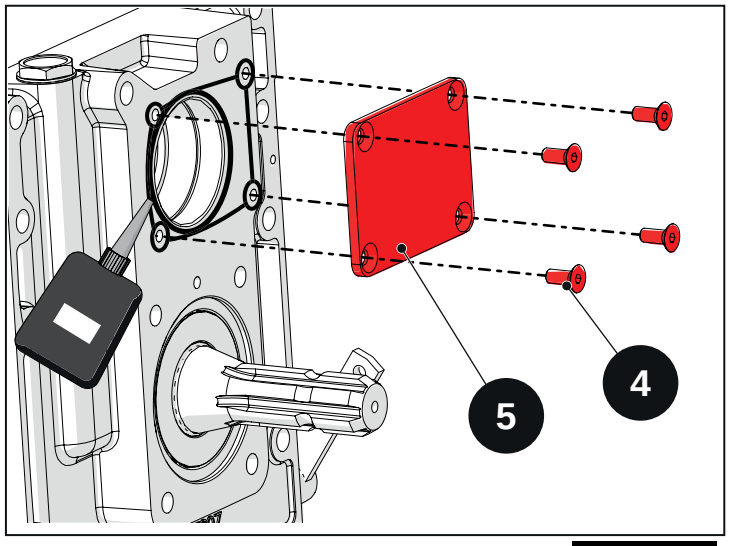


Fig. 10.32

Insert the washers (3) and tighten the screws (1) and nuts (2) by applying 90 Nm (9 kgm) tightening torque.

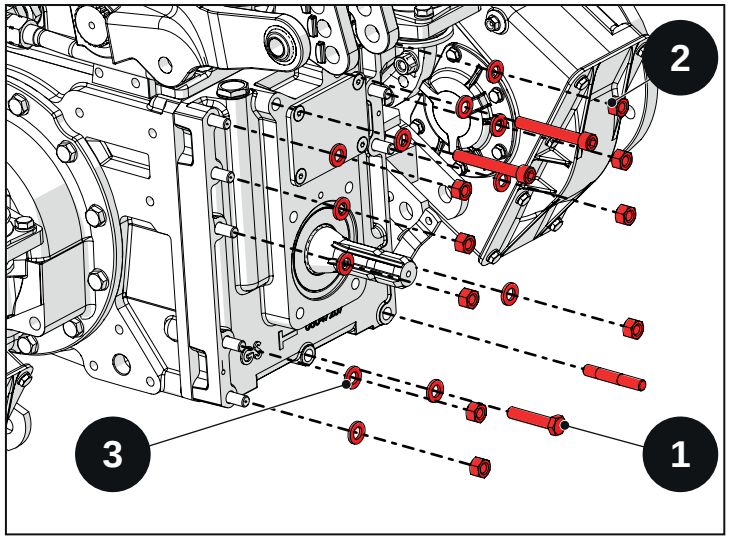


Fig. 10.33

Section 6 : Tightening torques

Index

6.1 Tightening torques.....10-22

6.1 Tightening torques

The main tightening torque values are listed below. Consult chapter "1- Introduction" for the remaining tightening torques.

Screws and nuts to be tightened	Nm	kgm
M35x1.5 ring nut for fastening rear P.T.O. shaft	200	20
M12 nut for fastening rear P.T.O. assembly	80	8
M12x30 screw for fastening upper P.T.O. compartment cover	49	4.9
M12x35 screw for fastening transmission unit	49	4.9
M8x20 screw for fastening rear P.T.O. cover	24	2.4
Screw for fastening P.T.O. unit to differential	90	9

Section 7 : Tools required

Index

7.1 Tools required 10-24

7.1 Tools required

Code	Description	Quantity
07006128	Ring nut wrench	1
07007182	Spring pre-loading tool	1

Chapter 11 : Brakes

Index

Section 1 : Safety notes 11-2

Section 2 : General introduction 11-3

2.1 Drawing of the assembly 11-4

Section 3 : Technical specifications 11-5

3.1 Technical specifications 11-6

Section 4 : Disassembly 11-7

4.1 Preliminary operations 11-8

4.2 Disassembly 11-10

Section 5 : Main inspection, re-assembly and adjustment operations 11-13

5.1 Main inspection, re-assembly and adjustment operations 11-14

5.2 Adjustment of the main brakes 11-16

5.3 Adjustment of the parking and emergency brake 11-18

Section 6 : Tightening torques 11-19

6.1 Tightening torques 11-20

Section 7 : Tools required 11-21

7.1 Tools required 11-22

Section 1 : Safety notes

To prevent accidents and injuries, always comply with the precautions and safety recommendations described in this section. In addition, operators must always comply with the safety instructions given in the operation and maintenance manual and in chapter 1 of this manual.

Danger

Make sure that all persons keep well away from the danger zone.

Danger

Lift and handle all heavy parts with lifting equipment of an adequate capacity. Arrange all harness and hooks in safe positions. Operators must remain at a distance and in a safe position, well away from the lifted load.

Danger

Do not twist the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Danger

Use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.

Danger

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

Danger

For safety reasons, always leave two screws on opposite sides when removing components that could fall. Only remove these screws after having secured the component to lifting equipment or placed bearing blocks underneath.

Danger

If the bolts that fix the safety frame or cab have loosened or if the safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

Caution

Keep clear of the sharp edges around the top of the transmission housing.

Caution

Used oil must be collected and disposed of in compliance with the anti-pollution laws in force.

Section 2 : General introduction

Index

2.1 Drawing of the assembly 11-4

2.1 Drawing of the assembly

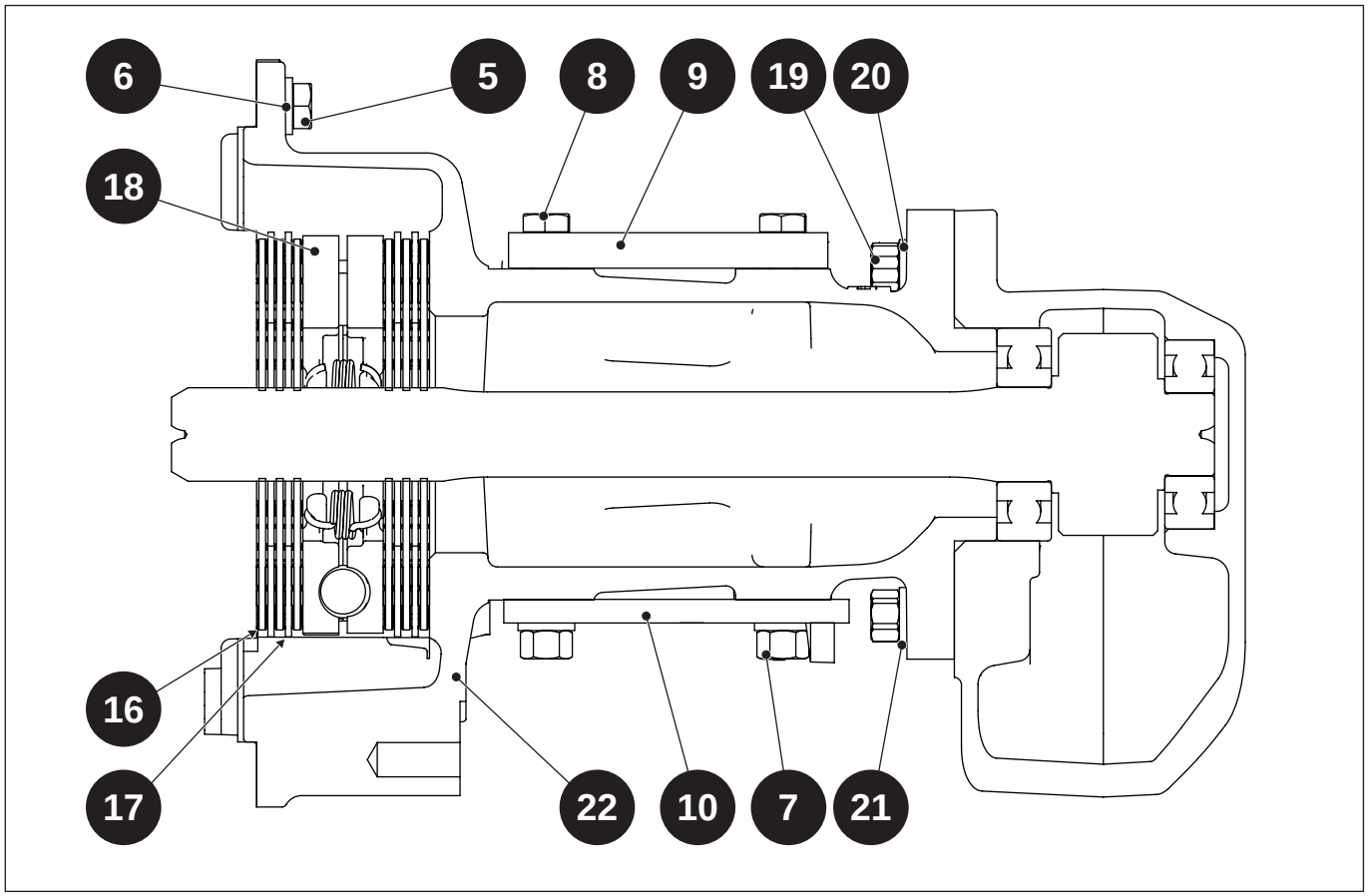


Fig. 11.1

5 - Screw
6 - Washer
7 - Nut
8 - Screw
9 - Upper flange for supporting platform
10 - Lower flange for supporting platform
16 - Friction plate
17 - Steel plate
18 - Braking mass
19 - Nut
20 - Washer
21 - Plate
22 - Hub

Section 3 : Technical specifications

Index

3.1 Technical specifications 11-6

3.1 Technical specifications

Type of braking	with oil-cooled multiple-plates
Operating mechanism	mechanical
Safety and parking brake	independent with mechanical control

Section 4 : Disassembly

Index

4.1 Preliminary operations 11-8

4.2 Disassembly 11-10

4.1 Preliminary operations

The main operations required to access the side final drives are described below:

Remove the front screws (1) that fix the platform.

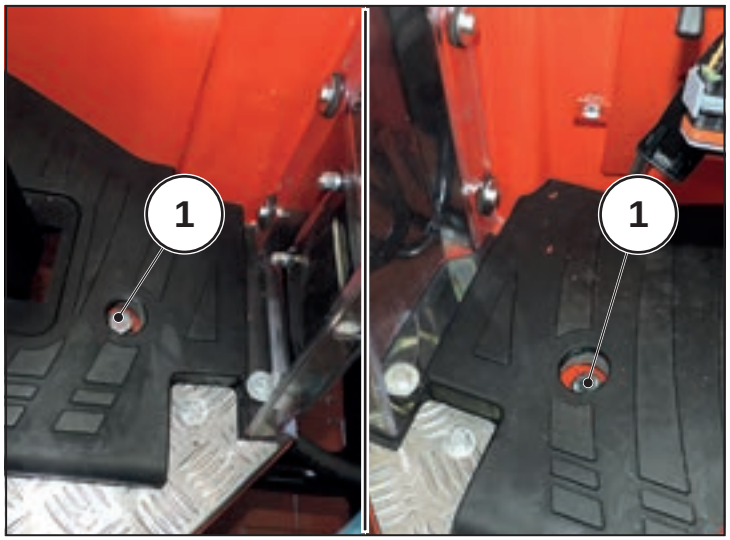


Fig. 11.2

Remove the roll-over protection devices (2) from the rear hubs.

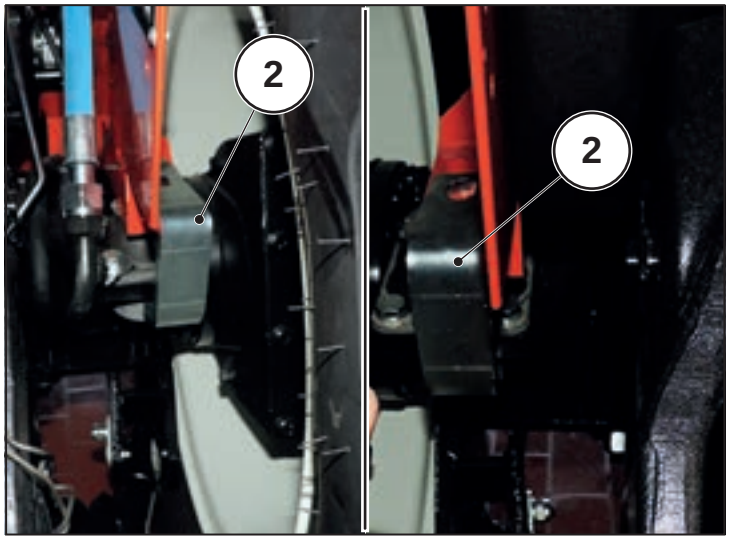


Fig. 11.3

Unscrew and disconnect the discharge pipe of the rear control valves (3).

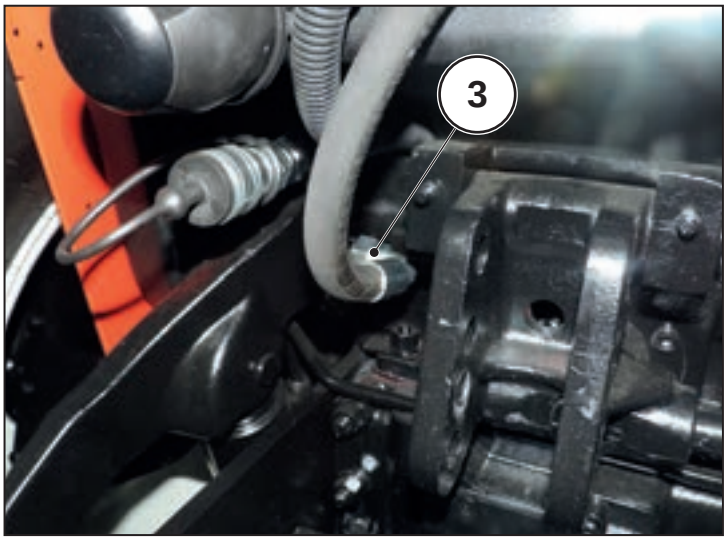


Fig. 11.4

Connect a lifting device to the rear cross-member of the mudguards so as to lift the machine.

Warning
Use lifting equipment with an adequate capacity.

Fig. 11.5

Raise the platform about 20 cm and fit two safety spacers (4) between the platform and tank.

Caution
Take care not to damage any of the pipes or components when the platform is lifted.

Danger
Make sure that the safety spacers remain firmly in position. Make sure that the lifting equipment is secure and that it functions correctly.

Fig. 11.6

4.2 Disassembly

Harness the unit to suitable lifting equipment.

Warning
Use lifting equipment with an adequate capacity.

Unscrew the screws (5) and remove the washers (6).

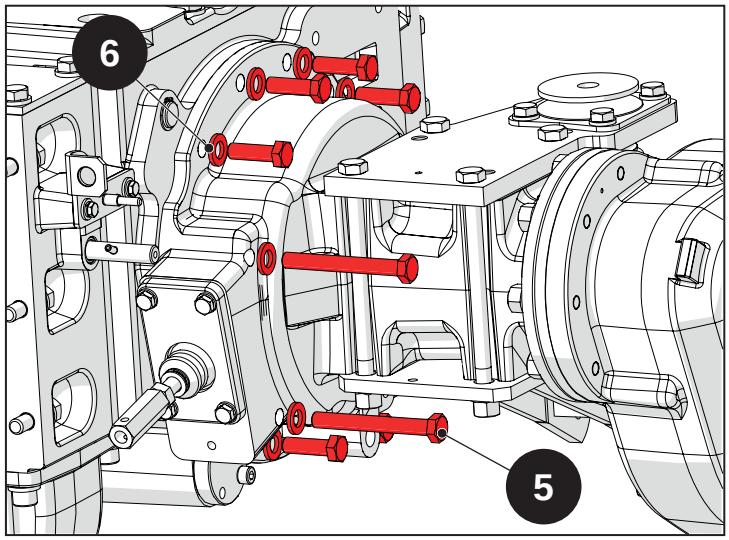


Fig. 11.7

Using lifting equipment, remove the unit from the rear differential.

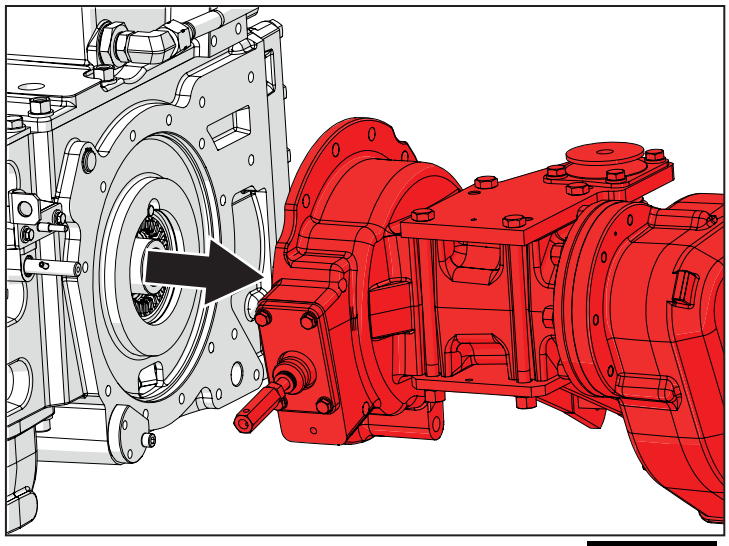


Fig. 11.8

Unscrew the screws (11) and remove washers (12) and flange (14).

Remove the link (19) and nut (20), then remove the retention spring (21), the bellow (13), cover (15) and O-ring (22).

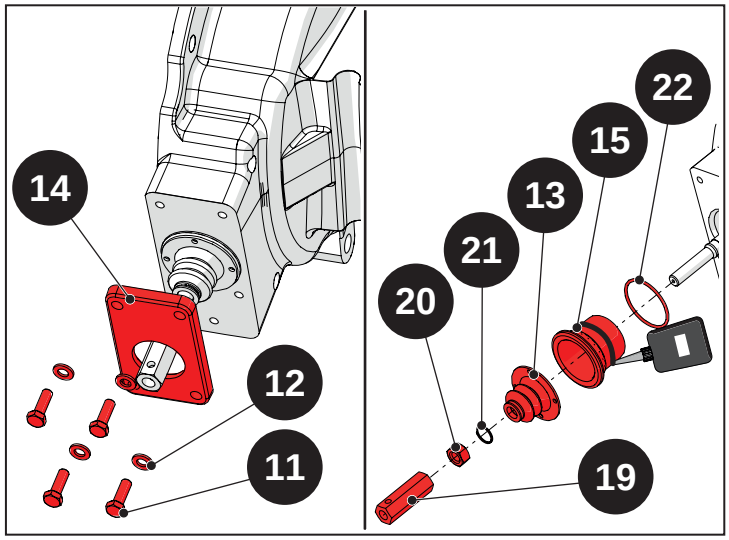


Fig. 11.9

Remove the six friction plates (16), the four steel plates (17) and the brake assembly (18) from the hub.

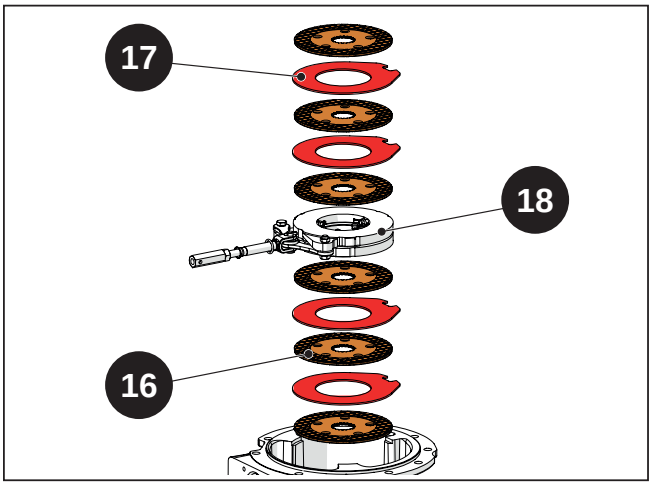


Fig. 11.10

Section 5 : Main inspection, re-assembly and adjustment operations

Index

5.1 Main inspection, re-assembly and adjustment operations 11-14

5.2 Adjustment of the main brakes 11-16

5.3 Adjustment of the parking and emergency brake 11-18

5.1 Main inspection, re-assembly and adjustment operations

Warning

Before proceeding with the re-assembly operations, carefully read and comply with the instructions given in chapter "1-Introduction", especially those describing how to assemble O-Rings, oil retainers and bearings.

Use the correct tightening torques when screwing in the components. Consult the table in chapter "1-Introduction" if the tightening torque value is not given.

Use the indicated sealants when re-assembling the parts. Consult the table in chapter "1-Introduction" if the sealant is not indicated.

Insert thefriction plates (16), the steel plates (17) and the brake assembly (18) into the hub.

Note

A total of three friction plates and two steel plates must be installed on each side of the braking mass.

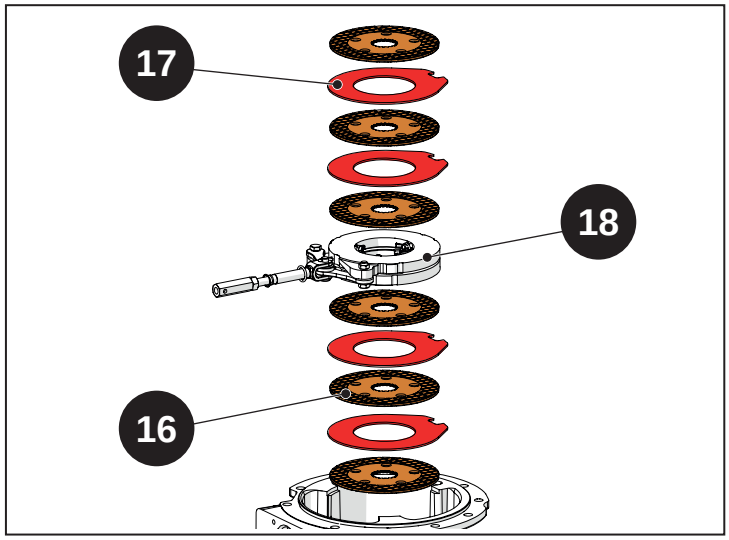


Fig. 11.11

Insert the O-ring (22), then apply a layer of SILICONE to the perimeter of the cover (15), then fit it into its housing.

Insert the bellow (13) and lock it with the retaining spring (21).

Tighten the nut (20) and link (19).

Warning

Make sure that the brake link is positioned in the centre of the hole.

Insert the flange (14), the washers (12) and tighten the screws (11).

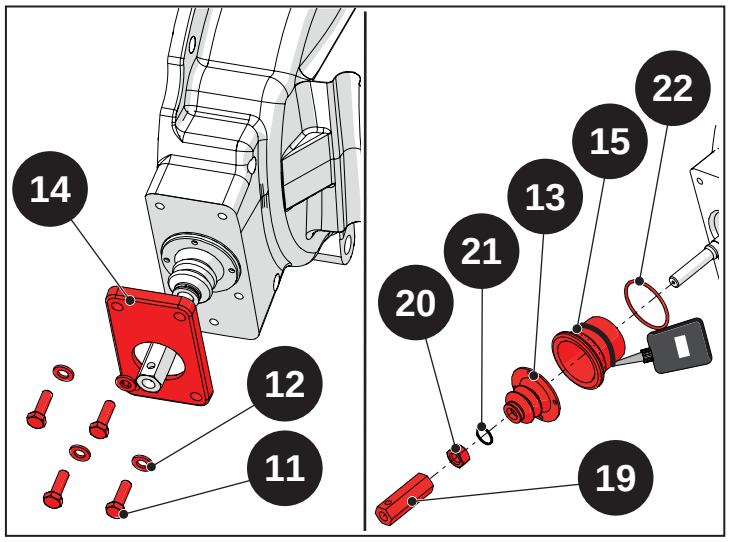


Fig. 11.12

Apply a layer of SILICONE to the surface on which the hub couples with the rear differential.

Harness the unit to lifting equipment and align the hub with the rear differential unit.

Warning
Use lifting equipment with an adequate capacity.

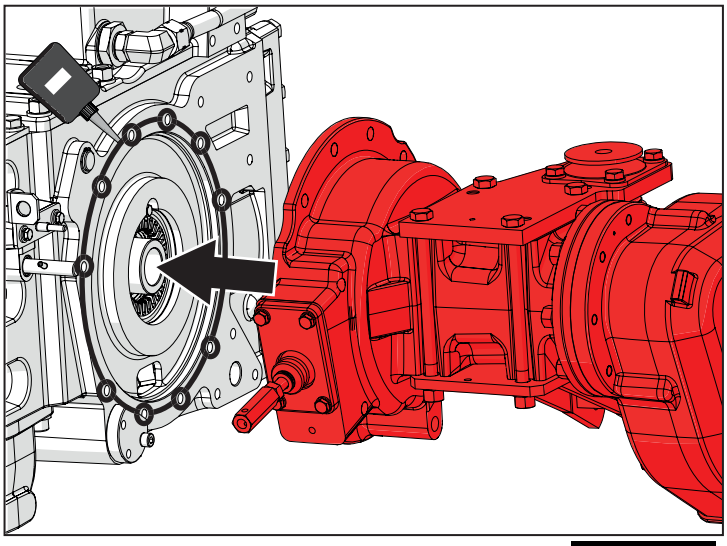


Fig. 11.13

Insert the washers (6) and tighten the screws (5) by applying 85 Nm (8.5 kgm) tightening torque.

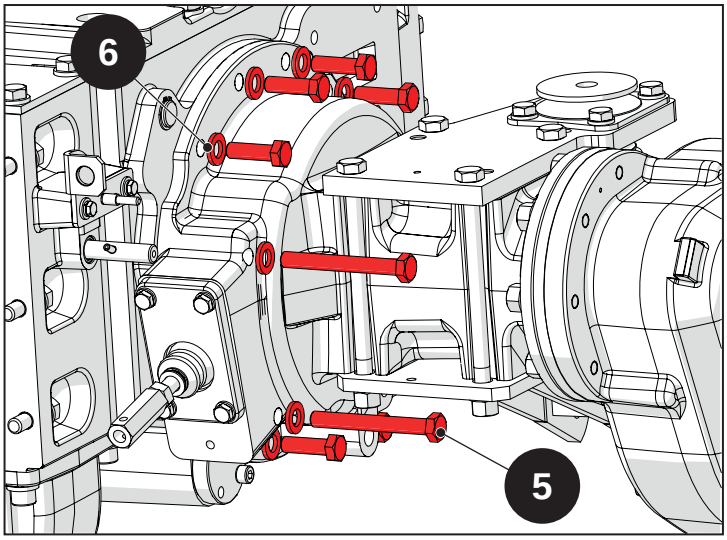


Fig. 11.14

5.2 Adjustment of the main brakes

To ensure that the main brakes function correctly, the braking action must occur after 35-40 mm free pedal travel.

Loosen the nut (D) and adjust the link (E) until the distance indicated above has been reached.

Tighten the nut (D).

> **Warning**
>
> Make sure that the braking action occurs simultaneously on both wheels. If this fails to occur, loosen the link of the wheel that brakes in advance.

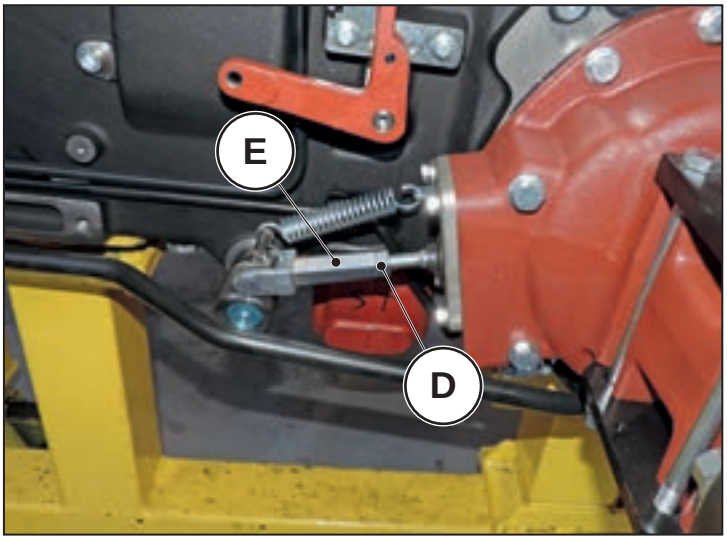


Fig. 11.15

Once the adjustments have been made, grease the internal bushes by means of the grease nipples (F).

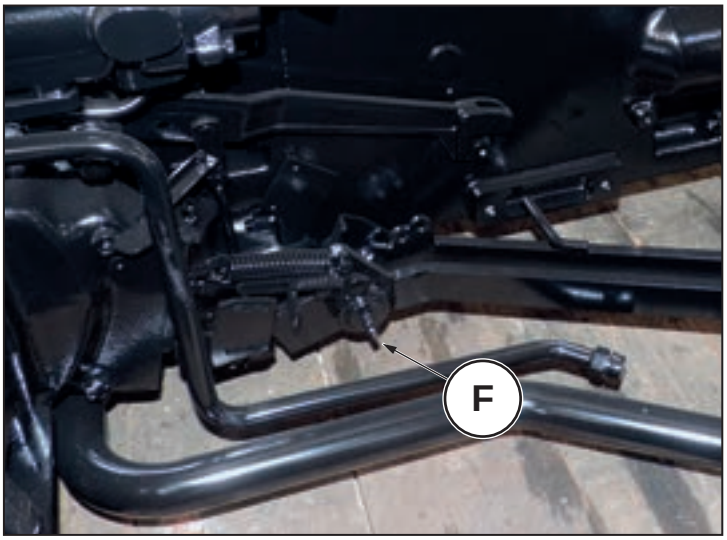


Fig. 11.16

The brake pedals must be about 15 cm away from the footboard.

Once the adjustments have been made, check that the idle travel of the pedals prior to the braking action is 30-35 mm.

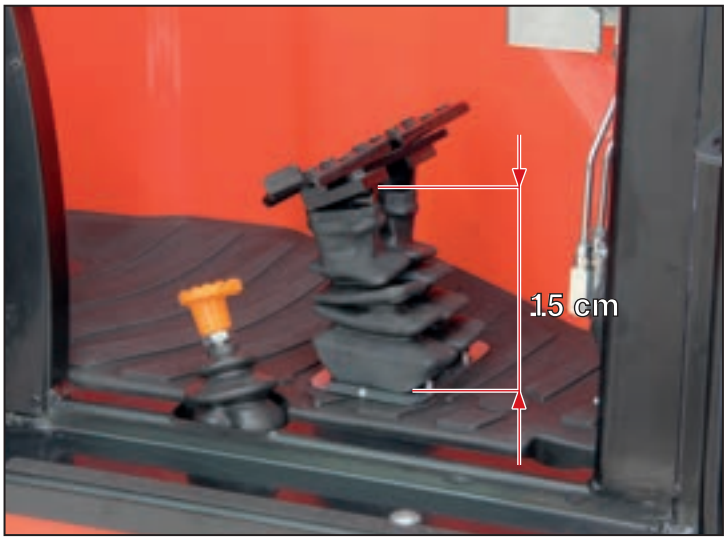


Fig. 11.17

5.3 Adjustment of the parking and emergency brake

Check the relative control lever must be adjusted so as to ensure that the parking brake functions correctly.

Adjust the control lever (A) by calculating a maximum travel of 6-7 positions (clicks).

Tighten the nut (B) that fixes the block.

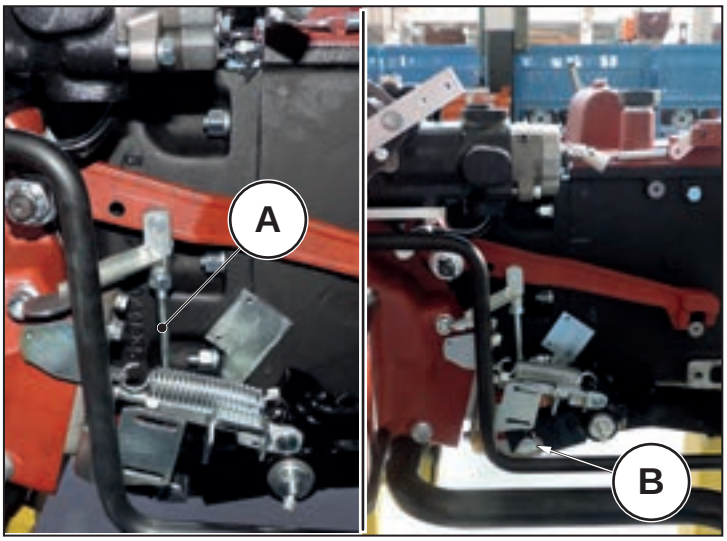


Fig. 11.18

Section 6 : Tightening torques

Index

6.1 Tightening torques.....11-20

6.1 Tightening torques

The main tightening torque values are listed below. Consult chapter "1- Introduction" for the remaining tightening torques.

Screws and nuts to be tightened	Nm	kgm

Section 7 : Tools required

Index

7.1 Tools required 11-22

7.1 Tools required

Code	Description	Quantity

Chapter 12 : Front power take-off

Index

Section 1 : Safety notes 12-2

Section 2 : General introduction 12-3

2.1 Drawing of the assembly 12-4

Section 3 : Technical specifications 12-7

3.1 Technical specifications 12-8

Section 4 : Disassembly 12-9

4.1 Preliminary operations 12-10

Section 5 : Work on the assembly 12-11

5.1 Clutch adjustment 12-12

5.2 Clutch plate shimming 12-15

Section 6 : Tightening torques 12-19

6.1 Tightening torques 12-20

Section 1 : Safety notes

To prevent accidents and injuries, always comply with the precautions and safety recommendations described in this section. In addition, operators must always comply with the safety instructions given in the operation and maintenance manual and in chapter 1 of this manual.

Danger

Make sure that all persons keep well away from the danger zone.

Danger

Lift and handle all heavy parts with lifting equipment of an adequate capacity. Arrange all harness and hooks in safe positions. Operators must remain at a distance and in a safe position, well away from the lifted load.

Danger

Do not twist the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Danger

Use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.

Danger

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

Danger

For safety reasons, always leave two screws on opposite sides when removing components that could fall. Only remove these screws after having secured the component to lifting equipment or placed bearing blocks underneath.

Danger

If the bolts that fix the safety frame or cab have loosened or if the safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

Section 2 : General introduction

Index

2.1 Drawing of the assembly 12-4

2.1 Drawing of the assembly

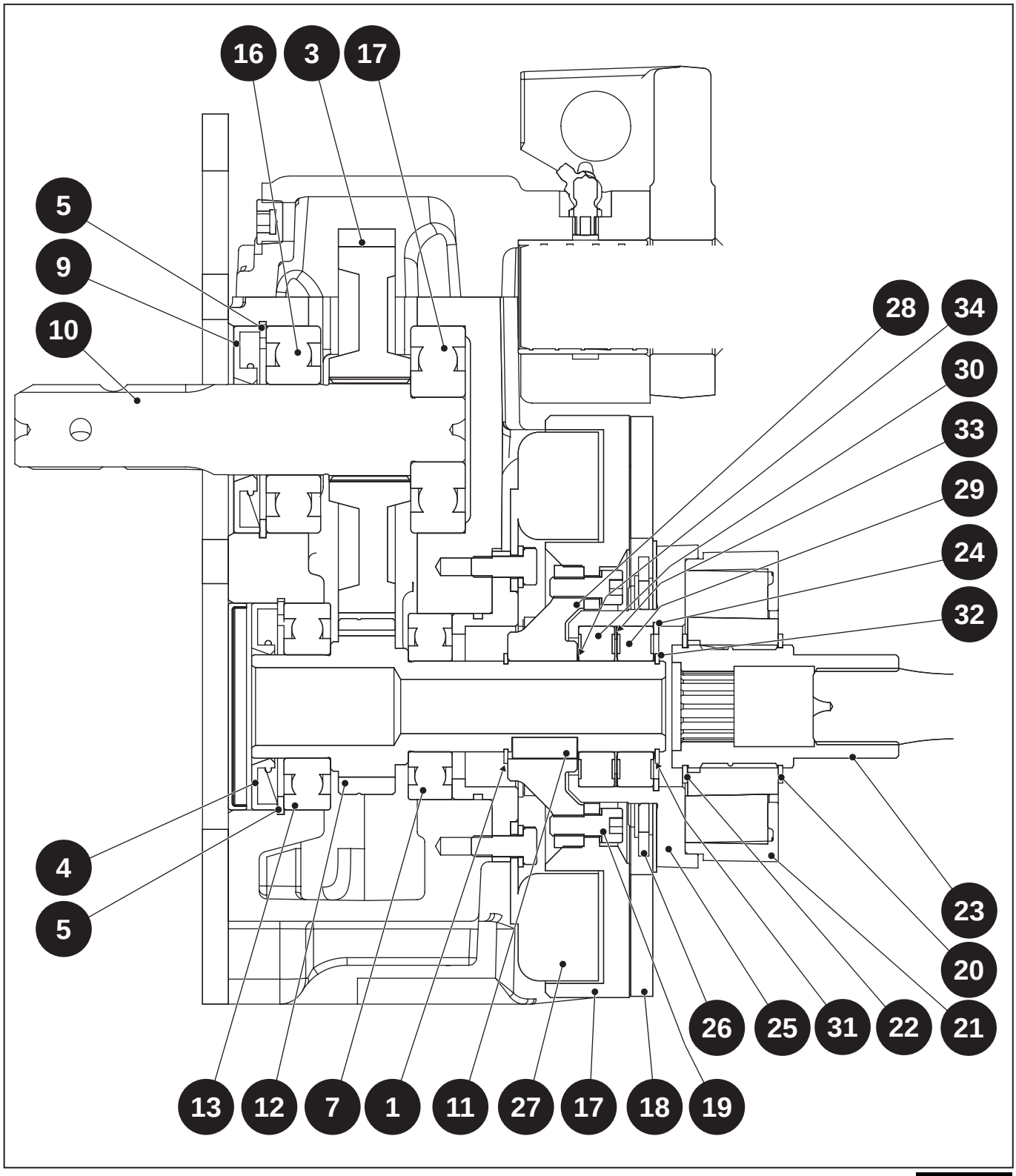


Fig. 12.1

1 - Circlip
2 - Bearing
3 - P.T.O gear
4 - Oil retainer
5 - Circlip
6 - Spacer
7 - Bearing
8 - Spacer
9 - Oil retainer
10 - Front P.T.O. shaft
11 - Feather key
12 - Shaft
13 - Bearing
14 - Spacer
15 - Spacer
16 - Bearing
17 - Front P.T.O. disc
18 - Disc
19 - Screw
20 - Circlip
21 - Flexible coupling
22 - Circlip
23 - Sleeve
24 - Circlip
25 - Bearing hub
26 - Threaded spacer
27 - Clutch magnet
28 - Flange
29 - Screened bearing
30 - Screened bearing
31 - Shims
32 - Circlip
33 - Shim
34 - Shim

Section 3 : Technical specifications

Index

3.1 Technical specifications 12-8

3.1 Technical specifications

Type	Independent single-shaft
Speeds independent from ground speed	1000 rpm
Direction of rotation (viewing the PTO)	Anticlockwise
Profile	1-3/8" with 6 splines
Clutch	Electromagnetic
Clutch control	Electrical

Section 4 : Disassembly

Index

4.1 Preliminary operations 12-10

4.1 Preliminary operations

The air filter and support must be removed in order to access the P.T.O. unit.

See chapter "2- Engine".

Remove the plates.

Warning
If the plates are difficult to remove, the operation can be facilitated by raising the machine with the front axle slanting. The swinging movement will allow the components to be accessed.

Section 5 : Work on the assembly

Index

5.1 Clutch adjustment 12-12

5.2 Clutch plate shimming 12-15

5.1 Clutch adjustment

Adjustments must be made to ensure that the front P.T.O. functions correctly.

Use a thickness gauge to measure the distance between the discs (17) and (18), which must be between 0.6 and 1.2 mm.

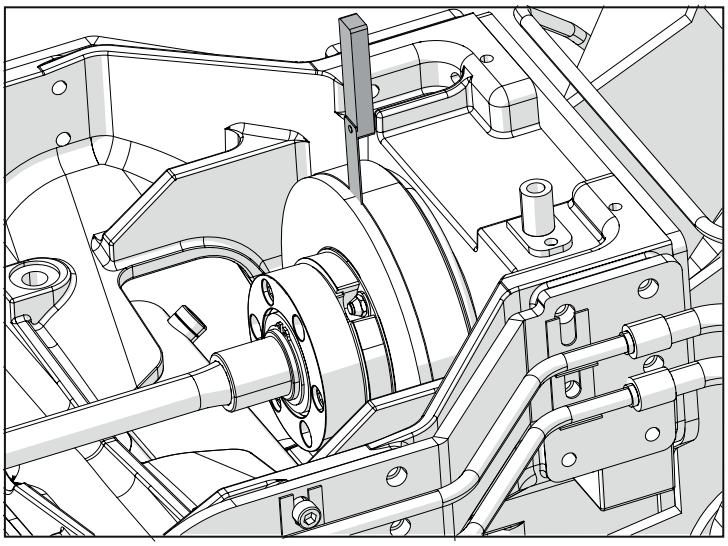


Fig. 12.2

Unscrew the screws (19) and remove the circlip (20).

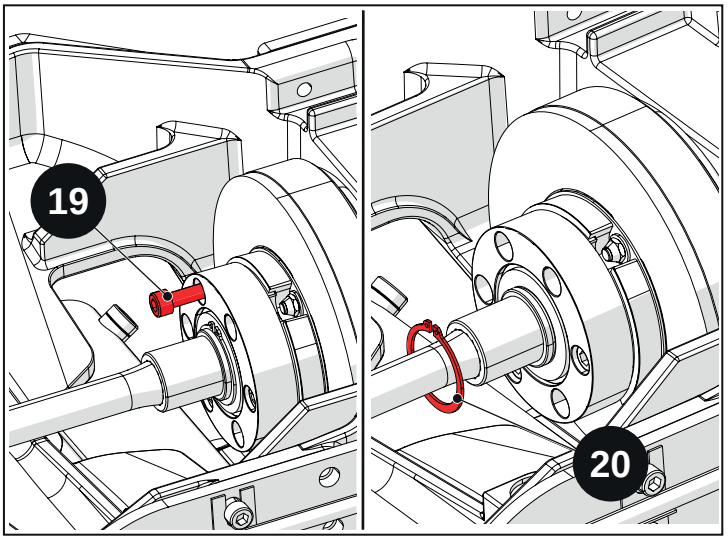


Fig. 12.3

Slide the flexible coupling (21) towards the engine and remove the circlip (22) from its housing.

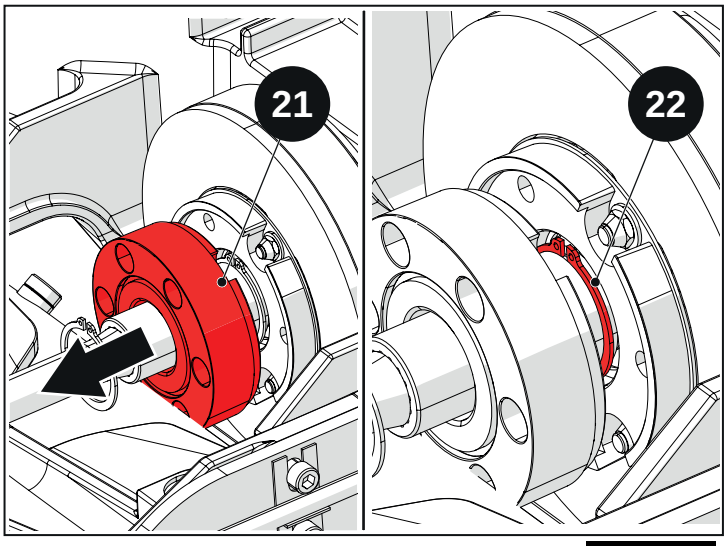


Fig. 12.4

Slide the keyed sleeve (23) towards the engine while holding back the coupling (21).

Remove the coupling (21).

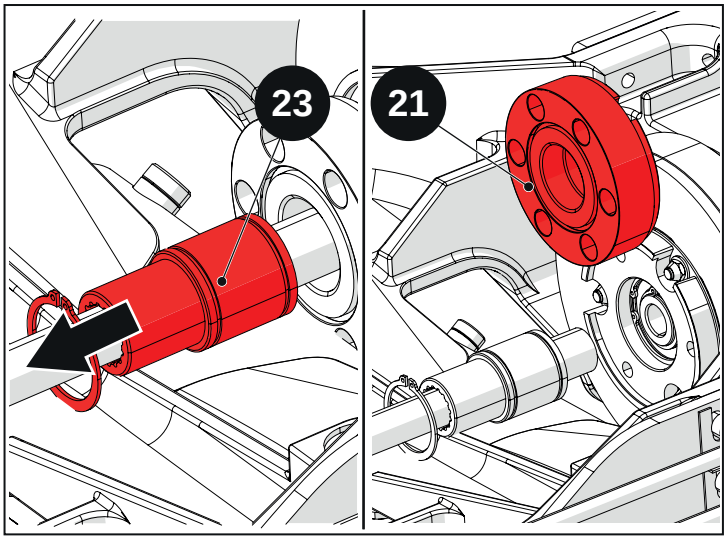


Fig. 12.5

Remove the circlip (32) and spacers (31). Remove the bearing hub (25) complete with threaded spacer (26) and disc (18).

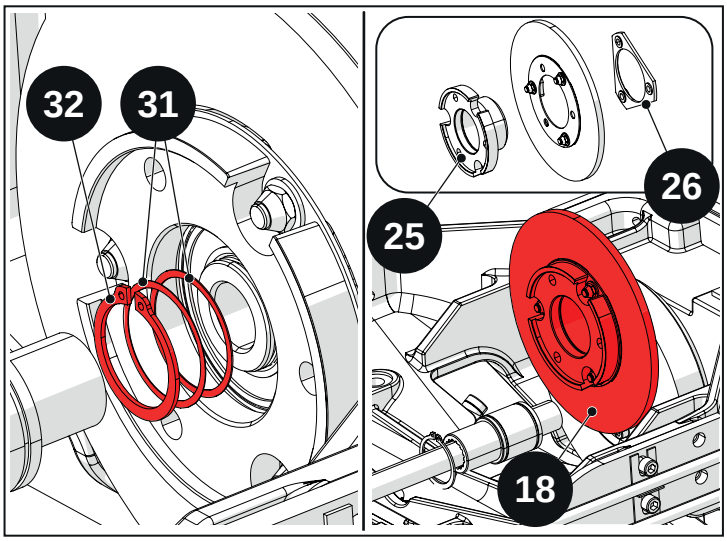


Fig. 12.6

Remove the circlip (24), bearing (29) and the spacers (33) of bearing (30) from the hub.

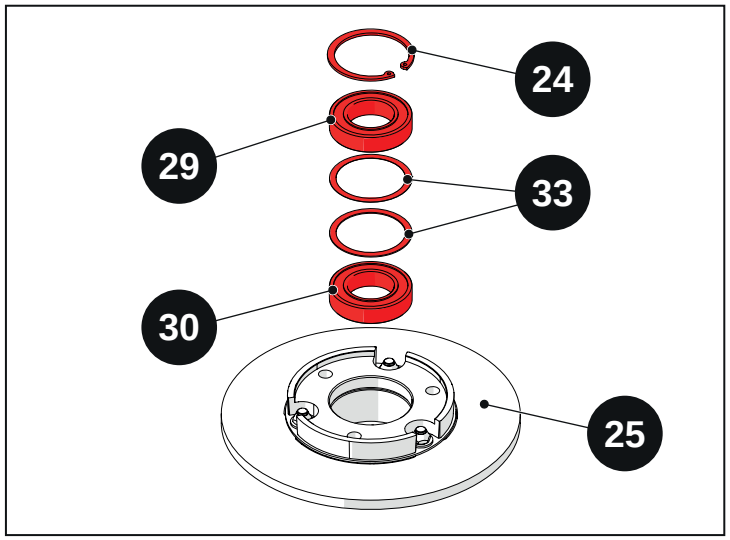


Fig. 12.7

Remove the spacers (34)

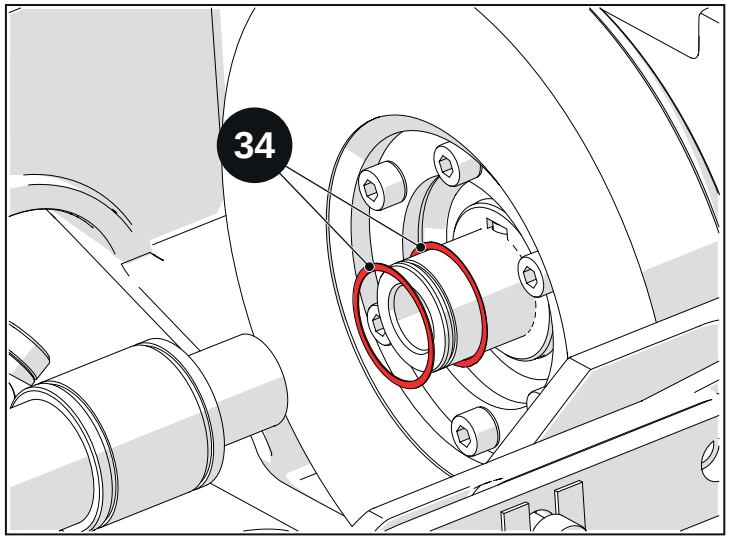


Fig. 12.8

Measure and make a note of the thickness of the disc (18).

Warning

Replace the clutch if the thickness of the disc (18) is less than 6.4 mm.

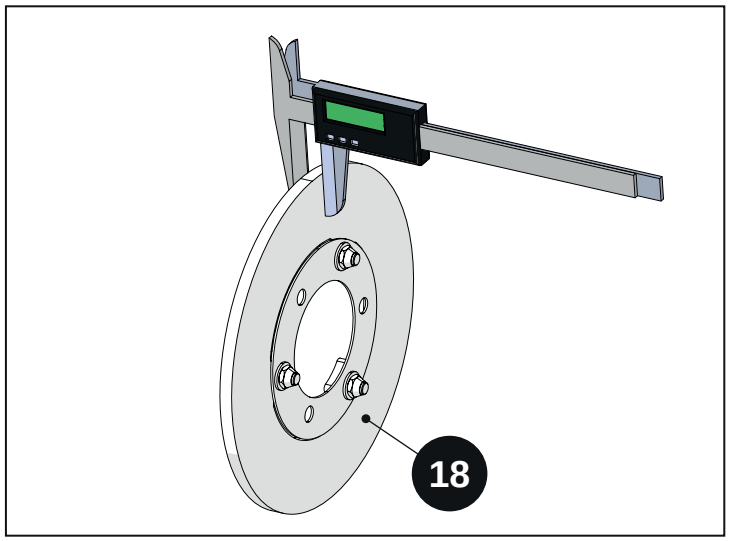


Fig. 12.9

5.2 Clutch plate shimming

Warning

It may be necessary to replace the discs (18) and (17) or flange (28) if the feather key has broken (11) or for other reasons.

Shimming must be performed whenever the discs (17), (18) and flange (28) are replaced.

Assemble the bearing hub (25) with the disc (28) and threaded spacer (26).

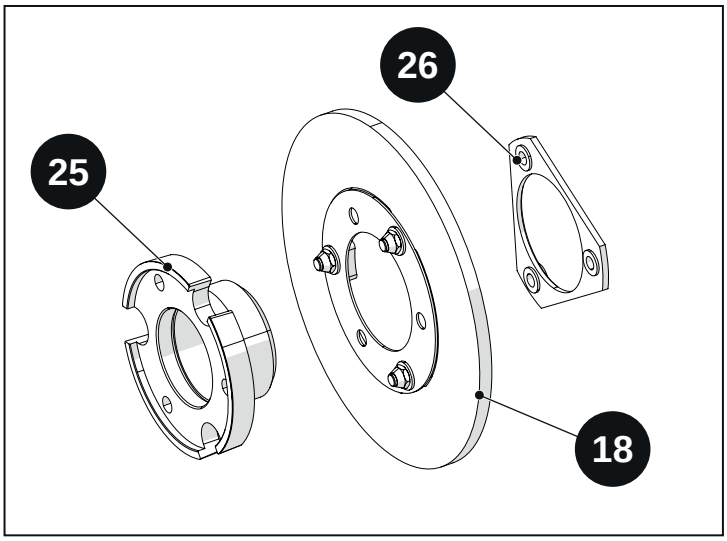


Fig. 12.10

Insert the screened bearings (29) and (30) onto the hub together with the shims (31).

Warning

The number of shims inserted must completely eliminate the play of bearings (29) and (30).

Lock the bearings with the circlip (24).

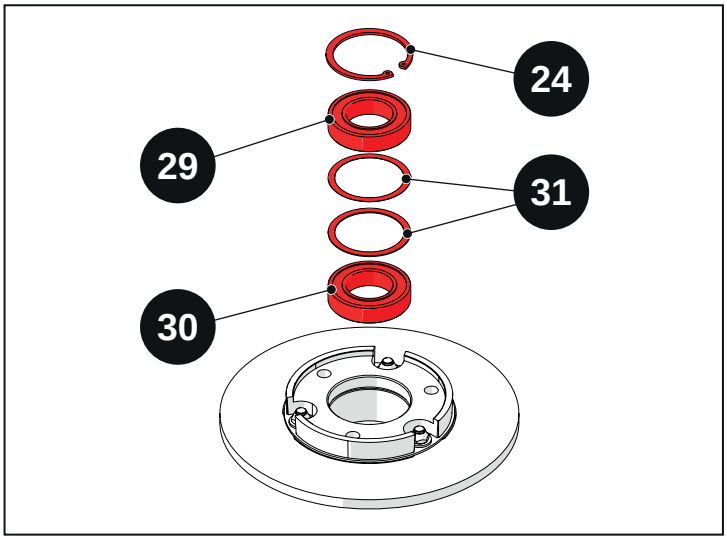


Fig. 12.11

Using a tube of a width suited to the bearings, assemble the complete hub (28), the clutch magnet (27), disc (17), and insert the previously removed spacers (34).

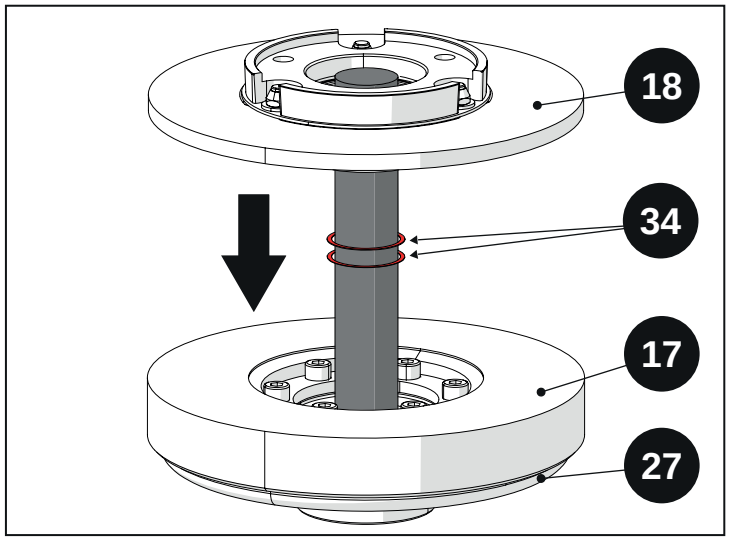


Fig. 12.12

Use a thickness gauge to measure distance Y between the discs (17) and (18), which must be between 0.6 and 0.8 mm.

Warning

Increase or reduce the thickness of the spacers (34) if the value of distance Y fails to comply with the parameters.

Warning

After having assembled the moving part, check again to make sure that the value of Y is within the parameters.

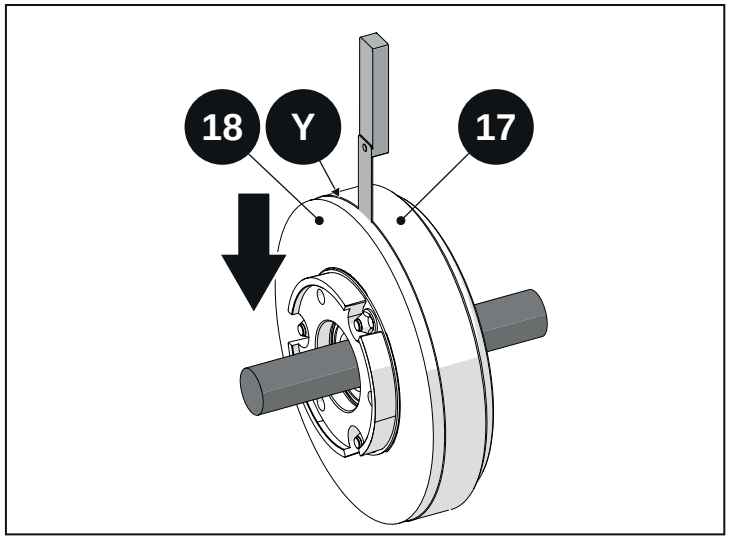


Fig. 12.13

Proceed with the reassembly operations by inserting the discs (17) and (18), the spacers (31) and circlip (32).

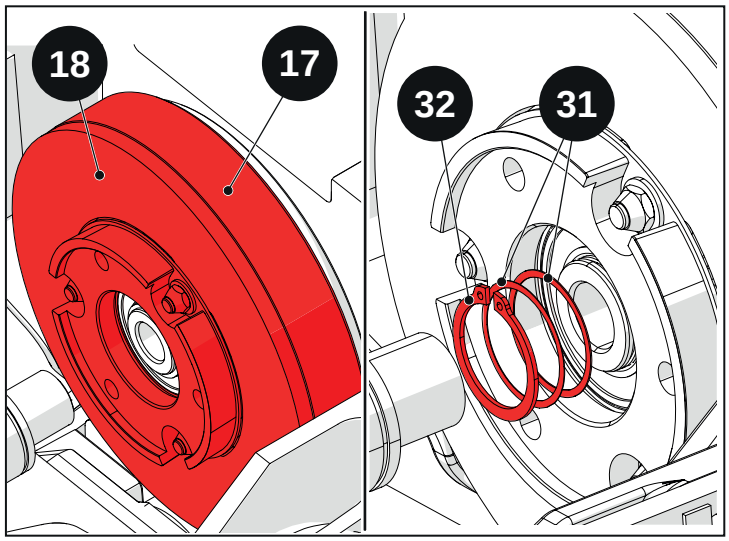


Fig. 12.14

Assemble the flexible coupling (21) with the sleeve (23) and lock it in place with circlips (20) and (22).

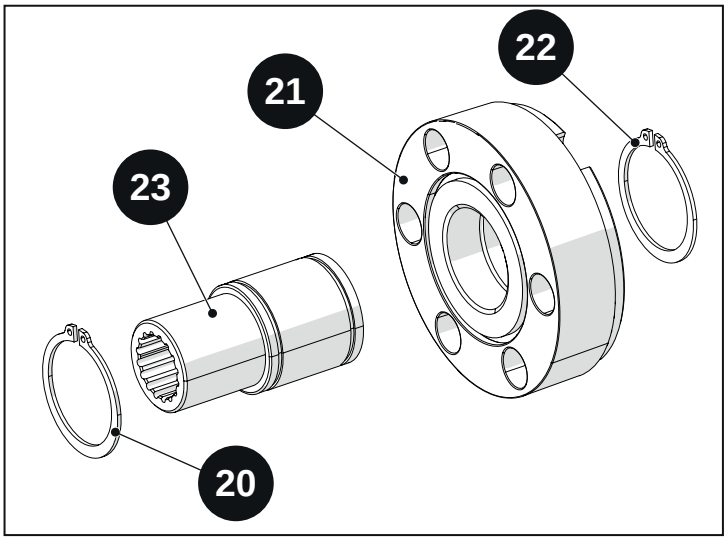


Fig. 12.15

Apply a layer of LOCTITE 5922 inside the sleeve (23) to eliminate the play between the teeth and prevent vibrations.

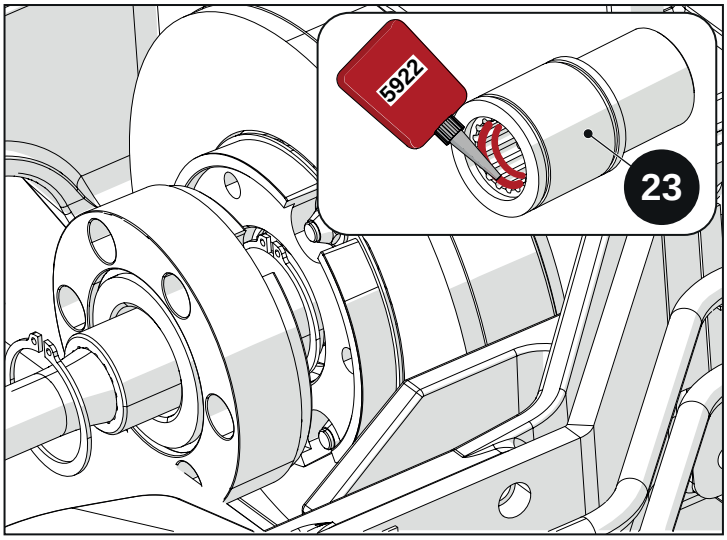


Fig. 12.16

Apply a layer of LOCTITE threadlocker to the screws (19) then tighten them by applying 30 Nm (3 kgm) tightening torque.

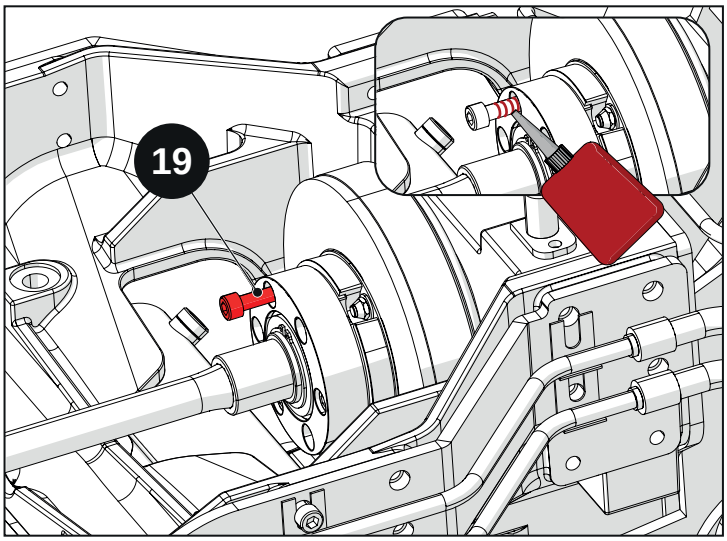


Fig. 12.17

After having reassembled the unit, check again to make sure that the distance between discs (17) and (18) is between 0.6 and 1.2 mm.

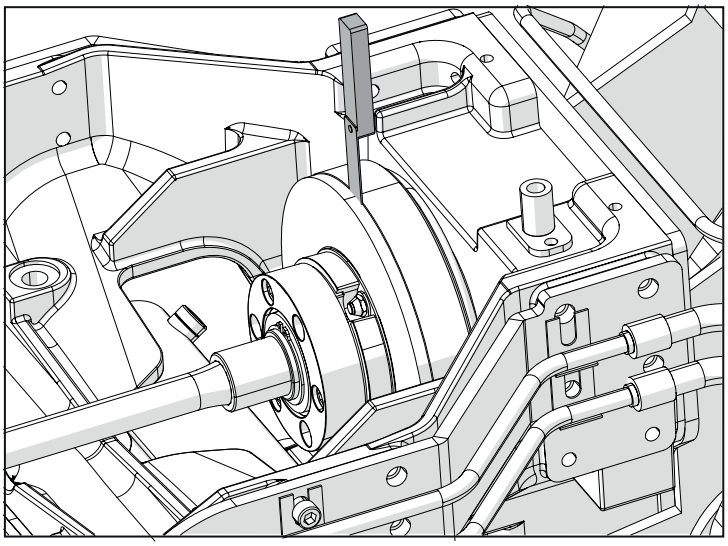


Fig. 12.18

Section 6 : Tightening torques

Index

6.1 Tightening torques.....12-20

6.1 Tightening torques

The main tightening torque values are listed below. Consult chapter "1- Introduction" for the remaining tightening torques.

Screws and nuts to be tightened	Nm	kgm
Electromagnetic flange screw	25	2.5
Damper fixing screw	30	3
Coil fastening screw	20	2
Clutch fixing screw	40	4

Chapter 13 : Hydraulic System

Index

Section 1 : Safety rules 13-2

Section 2 : Main hydraulic circuit 13-3
- 2.1 Hydraulic circuit, Energy 60 13-4
- 2.2 Hydraulic circuit, Energy 80 13-6
- 2.3 Technical characteristics 13-8

Section 3 : Lift hydraulic system 13-9
- 3.1 Hydraulic circuit diagram 13-10
- 3.2 Using the control levers 13-11
- 3.3 Functions of control distributor 13-14

Section 4 : Lift with position and draft control 13-21
- 4.1 General introduction 13-22
- 4.2 Technical characteristics 13-27
- 4.3 Main settings 13-28
- 4.4 Checking the cylinder seals 13-30
- 4.5 Disassembling front side of distributor 13-32
- 4.6 Disassembling rear side of distributor 13-33
- 4.7 Installing rear lift internal linkages 13-36

Section 5 : Main components 13-45
- 5.1 Hydraulic pump 13-46
- 5.2 Hydraulic steering valve 13-47
- 5.3 Rear hydraulic distributors 13-48
- 5.4 Hydraulic unit 13-49
- 5.5 Front hydraulic distributors 13-50
- 5.6 Trailer brake valve, ITALY 13-51

Section 6 : Checking operating pressure values 13-53
- 6.1 Introduction 13-54
- 6.2 Checking the hydraulic steering unit pressure relief valve calibration pressure 13-55
- 6.3 Checking the pressure of the 4WD circuit 13-57
- 6.4 Checking the pressure of the auxiliary distributors 13-57
- 6.5 Checking the pressure of the rear lift distributor 13-58

Section 7 : Tools necessary 13-59
- 7.1 Tools necessary 13-60

Section 1 : Safety rules

These safety precautions and warnings given in this paragraph must be observed at all times to prevent the risk of operator injury. However, the safety measures indicated in the use and maintenance manual and in chapter 1 of this manual must also be applied at all times.

Danger

Do not start work until the pressure in the hydraulic system has dropped to zero.

Danger

Jets of escaping pressurised fluid may penetrate the skin and cause severe injury. In the event of an accident involving pressurised fluid, seek immediate medical attention to avoid the risk of severe infection.

Danger

When using adhesives or detergents, follow the safety and usage instructions provided by the manufacturer.

Danger

Take all precautions necessary to avoid burns when working with hot oil Never heat oil to above 190°C, as the oil vapour may suddenly and spontaneously ignite.

Attention

Used oils must be collected and disposed of in compliance with applicable legislation.

Section 2 : Main hydraulic circuit

Index

2.1 Hydraulic circuit, Energy 60 13-4
2.1.1 General description 13-5
2.2 Hydraulic circuit, Energy 80 13-6
2.2.1 General description 13-7
2.3 Technical characteristics 13-8

2.1 Hydraulic circuit, Energy 60

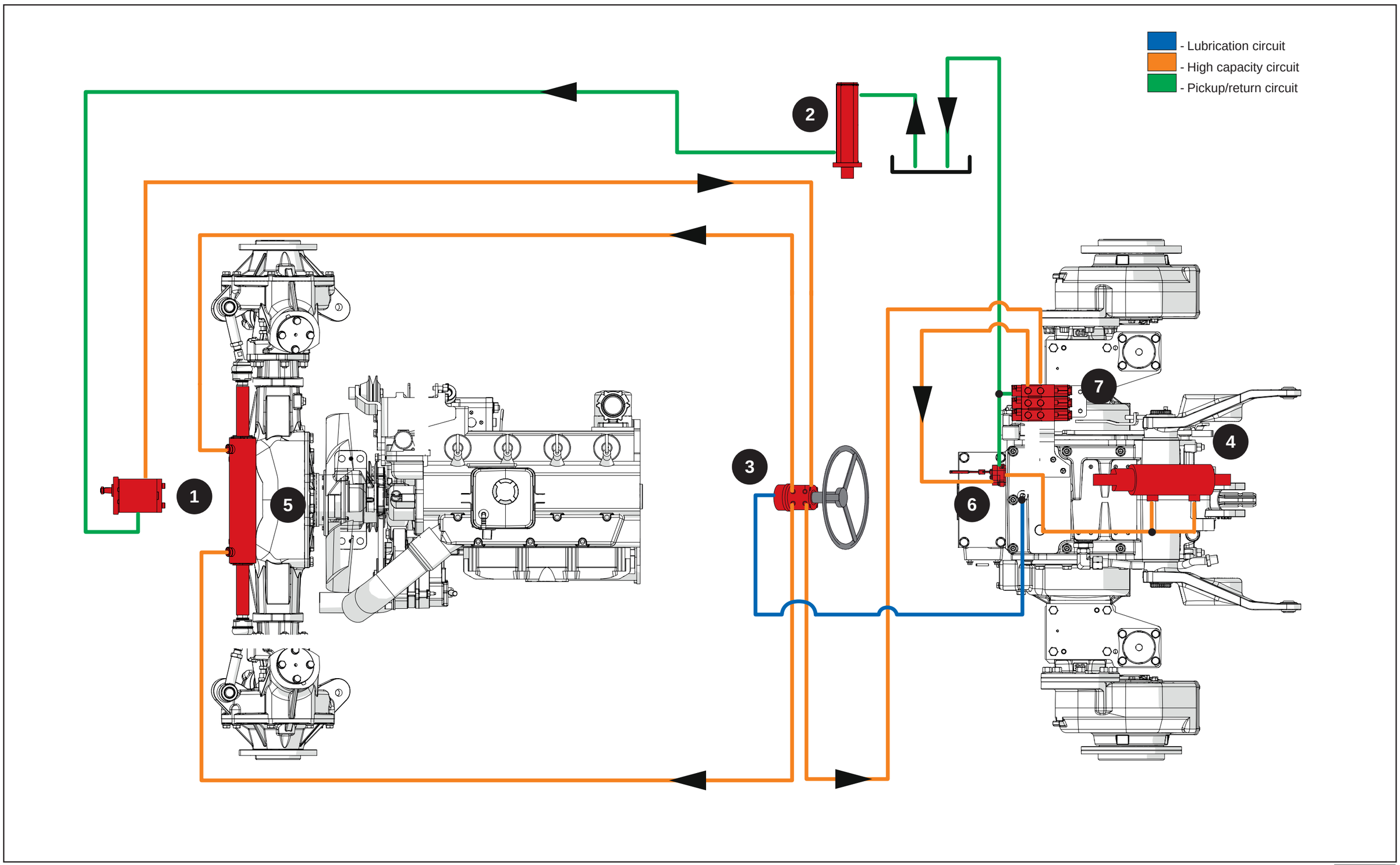


Fig. 13.1

1 - Hydraulic pump
2 - Suction line filter
3 - Hydraulic steering valve
4 - Rear lift cylinder
5 - Steering cylinders
6 - Rear lift distributor
7 - Rear auxiliary distributors

2.1.1 General description

The hydraulic system consists of a single circuit fed by a pump driven directly by the crankshaft. A pickup line filter cleans the oil aspirated by the pump.

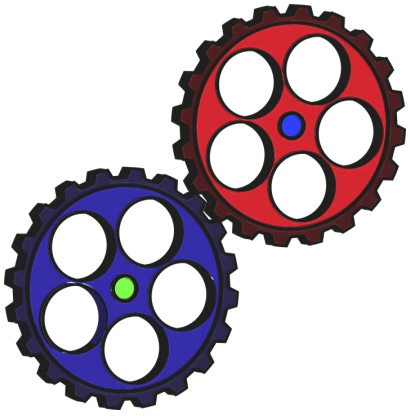
A priority valve mounted directly on the hydraulic steering unit receives oil from the main pump and delivers an outgoing flow with priority for the steering system.

Oil is then delivered to the auxiliary distributor block and the rear lift. The pressure relief valve within the distributor block input flange is calibrated to 180 bar

Oil which is not used by the lift and the auxiliary distributors is returned to the gearbox.

Oil for the gearbox forced lubrication system is sourced from after the hydraulic pump.

The trailer braking valve, if installed, receives oil immediately after the hydraulic steering unit.



2.2 Hydraulic circuit, Energy 80

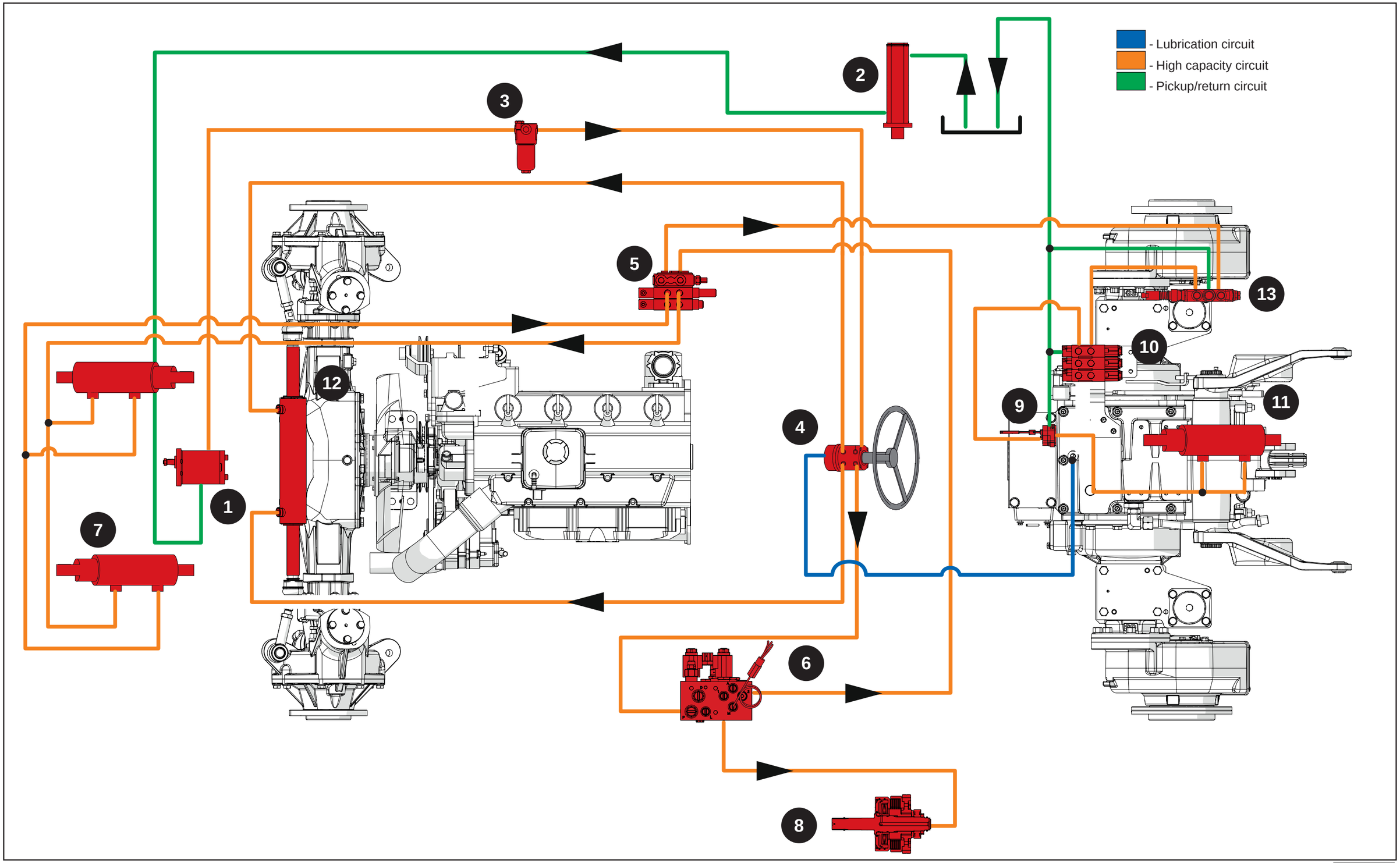


Fig. 13.2

1 - Hydraulic pump
2 - Suction line filter
3 - High flow rate circuit delivery line filter
4 - Hydraulic steering valve
5 - Front auxiliary distributors
6 - Hydraulic unit
7 - Front lift cylinders
8 - Four-wheel drive
9 - Rear lift distributor
10 - Rear auxiliary distributors
11 - Rear lift cylinder
12 - Steering cylinders
13 - Trailer brake valve

2.2.1 General description

The hydraulic system consists of a single circuit fed by a pump driven directly by the crankshaft. A pickup line filter cleans the oil aspirated by the pump.

A priority valve mounted directly on the hydraulic steering unit receives oil from the main pump and delivers an outgoing flow with priority for the steering system.

After the hydraulic steering unit, oil is delivered to the hydraulic unit, which uses solenoid valves and a pressure switch to engage and disengage 4WD. The 4WD engagement solenoid valve is energised when the tractor is switched on. A pressure switch situated on the hydraulic unit detects the drop in pressure in the 4WD circuit and energises a second solenoid valve to request additional oil flow from the main circuit to compensate for the deficiency in pressure.

Oil is then delivered to the auxiliary distributor block and the rear lift. The pressure relief valve within the distributor block input flange is calibrated to 180 bar

Oil for lubricating the gearbox is sourced from after the hydraulic pump.

In the full house configuration, the front auxiliary distributors are fed immediately after the hydraulic steering unit, together with the low regulator valve and the trailer brake valve. The front distributor pressure relief valve is calibrated to 180 bar.

2.3 Technical characteristics

Pump, Energy 80

Direction of rotation (looking at drive shaft)	Left
Displacement	14.53 cm3/rev
Pump delivery pressure range	0.7 - 3 bar abs.
Maximum continuous pressure	250 bar
Maximum intermittent pressure	280 bar
Maximum peak pressure	300 bar
Max. speed	3000 rpm
Minimum speed	500 rpm
Minimum operating temperature	-25 °C

Pump, Energy 60

Manufacturer	Hidroirma	Bosch
Direction of rotation (looking at drive shaft)	Left	Left
Displacement	11 cm3/rev	11 cm3/rev
Maximum pressure	210 bar	280 bar
Max. speed	3000 rpm	3500 rpm

Hydraulic steering valve

Displacement, Energy 80	80 cc
Displacement, Energy 60	50 cc
Pressure relief valve pressure	115 bar
Antishock valve pressure	220 Bar
Priority valve pressure	4 bar

Intake filter

Filtration rating	90 microns

Distributors

Coupler type	Front and rear quick couplings
Calibration valve	180 bar

Section 3 : Lift hydraulic system

Índice

3.1 Hydraulic circuit diagram.....13-10

3.2 Using the control levers.....13-11

3.3 Functions of control distributor 13-14

3.1 Hydraulic circuit diagram

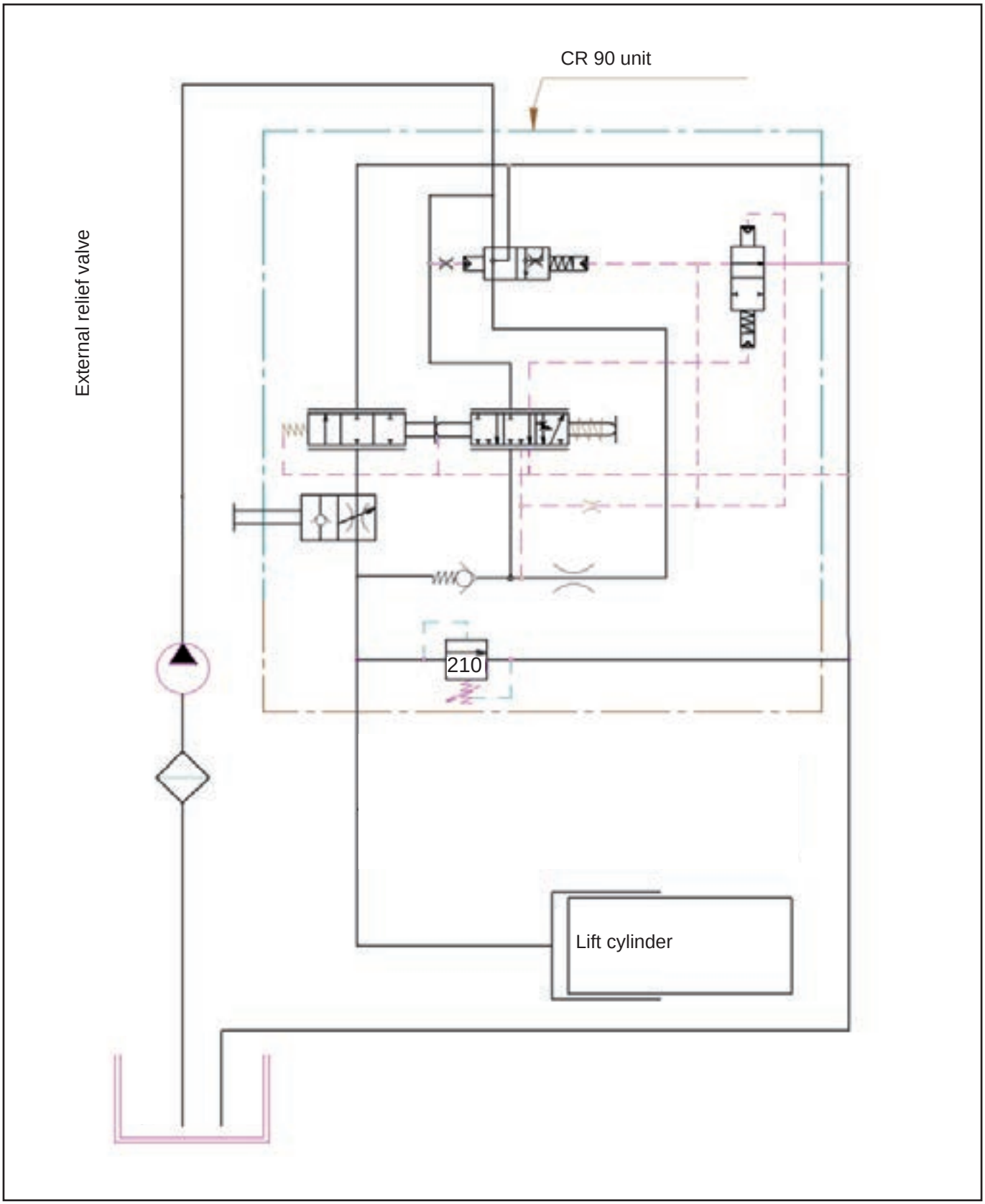


Fig. 13.3

3.2 Using the control levers

The two control levers may be used to obtain the following operating modes.

- position control;
- draft control;
- mixed position/draft control.

The mode used must be selected in accordance with the task, the type of implement and the hardness of the surface of the soil.

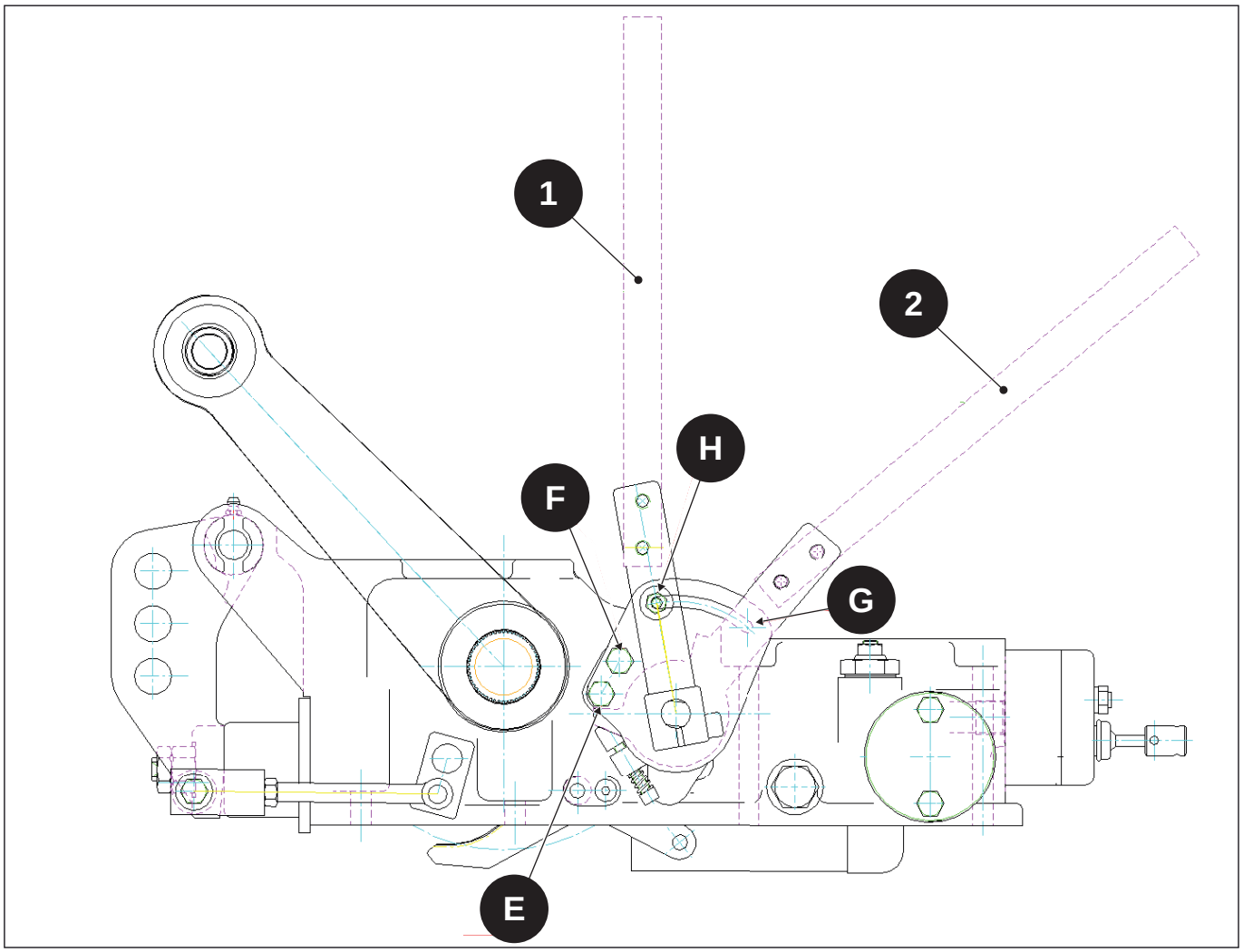


Fig. 13.4

A - Position control (lever 1)

In POSITION CONTROL mode, the position of the lift arms reflects the position of control lever 1.

To use this mode, move lever 2 (draft control) downwards against the stop E. To set the implement position (engaged or disengaged with soil), move lever 1 up towards the stop H to raise the implement, or down towards the stop G to lower the implement.

B - Draft control (lever 2)

DRAFT CONTROL mode adjusts the working depth of the implement in relation to the draft force requested from the tractor, maintaining a constant working depth even when working on uneven terrain.

To use this mode, move control lever 1 (position control) against the stop G, and then engage the implement to the required working depth by gradually moving lever 2 downwards towards the stop E. In this mode, each position of lever 2 corresponds to a specific draft or compression force exerted on the top link.

The working depth attained by the implement is proportional to the draft force and dependent on the consistency of the soil. In this mode, the draft force requested by the lift from the tractor remains constant.

Once the required working depth has been set, let go of lever 2 (draft control) and use lever 1 only to raise the implement at the end of each pass.

Differences in soil hardness will cause variations in working depth. If this occurs, adjust the draft control lever 2 to restore the correct working depth.

During the final portion of travel of lever 2, as it approaches position E, the lift arms function in float mode (lift cylinder connected to drain line) and the lift no longer functions in draft control mode.

C - Mixed position/draft control

MIXED POSITION/DRAFT CONTROL mode is particularly useful when working in uneven terrain conditions. In this mode, the lift functions as if it were in draft control mode but also prevents the implement from engaging excessively when softer soil is encountered, ensuring more uniform results.

Engage the implement in the soil and set the required working depth as described for draft control mode. Once at the required depth, raise lever 1 gradually towards the stop H until the lift arms lift slightly.

Use the lever 1 (position control) only to lift and engage the implement at the end and start of each pass.

In all three of the modes described above, in some cases it may also be necessary to adjust the drop rate of the implement to the required value using the adjuster screw (RD) on the distributor box.

When the adjuster screw (RD) is tightened completely, the lift arms remain locked even if the control levers 1 and 2 are lowered.

Locking the lift arms is recommended when driving on the road and when parking the tractor with the implement raised.

3.3 Functions of control distributor

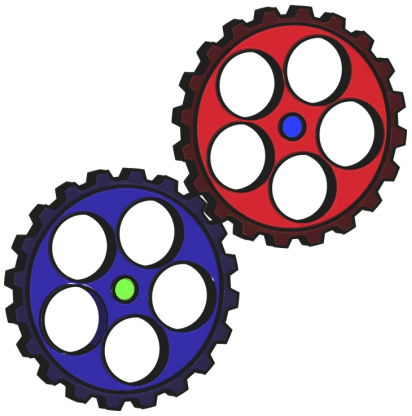
The control distributor has three operating states:

- A) NEUTRAL
- B) DELIVERY
- C) RETURN

A) NEUTRAL

In this state, the control distributor keeps the oil in the cylinder under pressure, supporting the load, while oil from the pump drains freely to the tank.

In this state, the control spool (1) connects the chamber (26) of the pilot valve (27) directly with the drain line via the port (16). The pilot valve (27) opens port (28), which connects the chamber (15) of the regulator piston (2) to the drain line via the channel (29). In this condition, oil from the pump is delivered to the chamber (22), allowing the regulator piston (2) to open the ports (17), through which the oil drains to the tank.



The oil in the cylinder chamber (23) remains under pressure and sustains the load applied to the lift arms. The oil is retained by check valve (3), the drain valve (4) and the safety relief valve (5), which are all connected to the cylinder by the annular channel (18).

The safety relief valve (5) protects the cylinder against overpressure produced by the load oscillating while driving on the road.

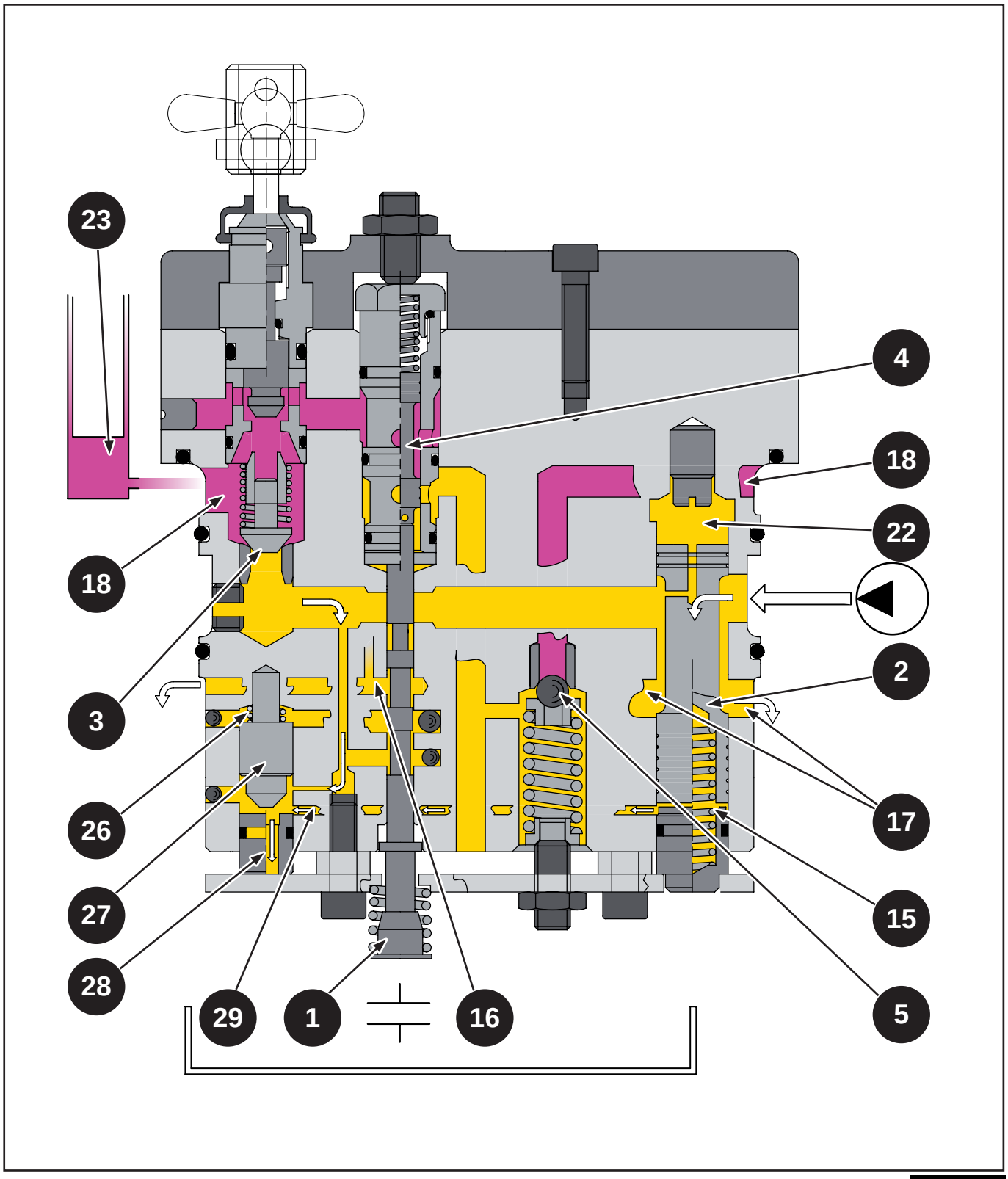


Fig. 13.5

B) DELIVERY

In delivery state, the control distributor sends pressurised oil to the cylinder chamber (23), causing the arms to lift.

The position occupied by the control spool (1) in this state allows oil to reach the chamber (26) via the annular channel (19) and ports (21), (20) and (30), and close the pilot valve (27).

Oil from the pump is now delivered at the same pressure to chamber (22) and chamber (15) (via channel the 29) of the regulator piston (2), which closes the drain holes (17) due to the action of the return spring.

Pressurised oil reaches the cylinder via the annular channel (19), enters the port (20) via the fixed throttle (6) and the variable throttle passage created by the control spool (1) and port (21), opens the check valve (3), enters the annular channel (18) and feeds chamber (23) of the cylinder.

To regulate the flow of oil delivered to the cylinder, the regulator piston (2) uses the difference in pressure exerted on chambers (15) and (22) generated by the flow of oil through the variable throttle passage (31), which is opened or closed by the control spool (1) as it is moved by the internal linkages of the lift.

Oil flow in excess of the pressure required to lift the arms is exhausted via the ports (17), limiting the maximum lift rate and ensuring a damped action when the arms start and stop.

The maximum operating pressure is controlled by a safety relief valve in the hydraulic circuit outside the CR90 unit (this valve may be installed on the auxiliary distributor block, for example).

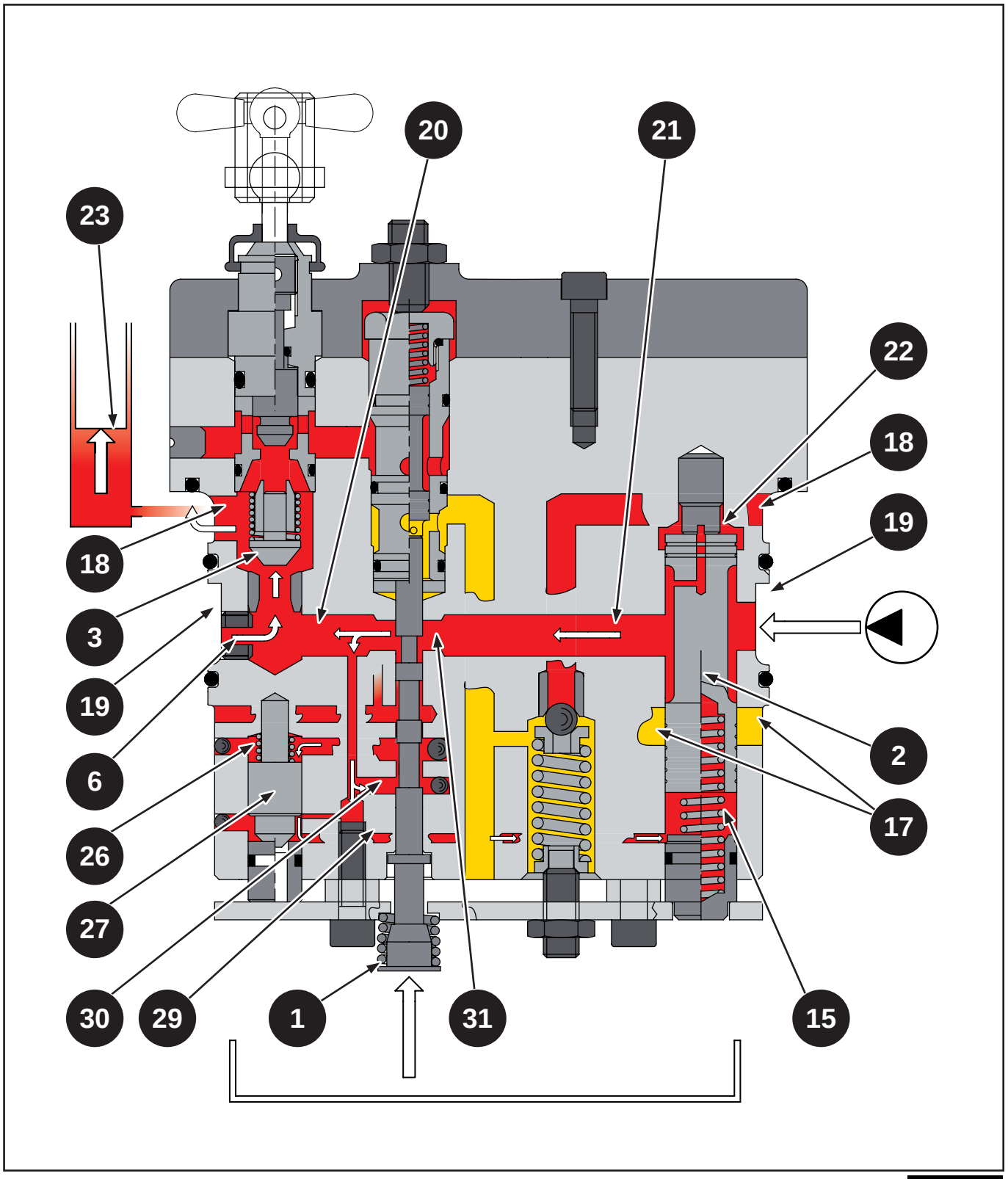


Fig. 13.6

C) RETURN

In return state, the control distributor directs oil flow received from the pump and from the cylinder chamber (23) to the drain line, causing the lift arms to lower.

The position occupied by the control spool (1) in this state connects chamber (26) of the pilot valve (27) directly to the drain line via port (16). This causes the pilot valve to open port (28), connecting chamber (15) of the regulator piston (2) to the drain line via channel (29).

As in the neutral state, the oil pressure from the pump now pushes the regulator piston towards chamber (15), causing the piston to open the drain ports (17) and drain the oil back to the tank.

Simultaneously, pressurised oil from the cylinder (chamber (23) enters the annular channel (18), flows out from the ports (32) of the drop rate regulator (8) and from port (24), and enters the drain valve (4), from which it drains to the tank via port (25), causing the arms to drop.

In return state, the drop rate of the arms may be adjusted with the manual lever (RD: tighten to reduce drop rate).

As a safety measure to prevent the lift control levers from being operated unintentionally when driving on the road, tighten the lever (RD) completely; this brings the valve (8) against its seat, sealing off the passage between the chamber (23) of the cylinder and the drain valve (4).

When the safety lock is in use, the cylinder is still protected against accidental overpressure by the safety relief valve (5).

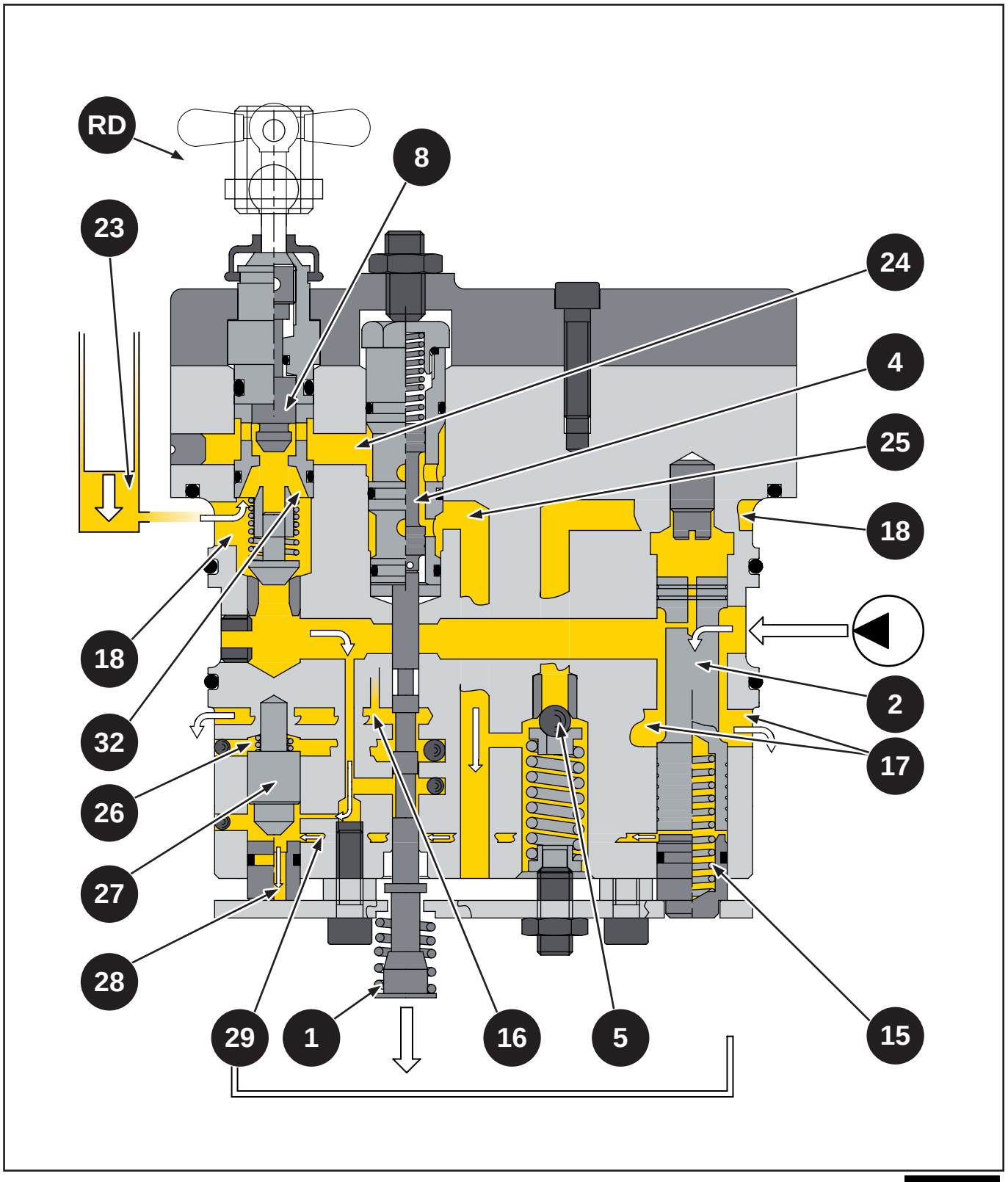


Fig. 13.7

Section 4 : Lift with position and draft control

Índice

4.1 General introduction 13-22
4.1.1 General system diagram 13-22
4.1.2 Control levers 13-23
4.1.3 Operating mode 13-24

4.2 Technical characteristics 13-27

4.3 Main settings 13-28
4.3.1 Adjusting the position and draft control tie-rods 13-28

4.4 Checking the cylinder seals 13-30

4.5 Disassembling front side of distributor 13-32

4.6 Disassembling rear side of distributor 13-33

4.7 Installing rear lift internal linkages 13-36

4.1 General introduction

4.1.1 General system diagram

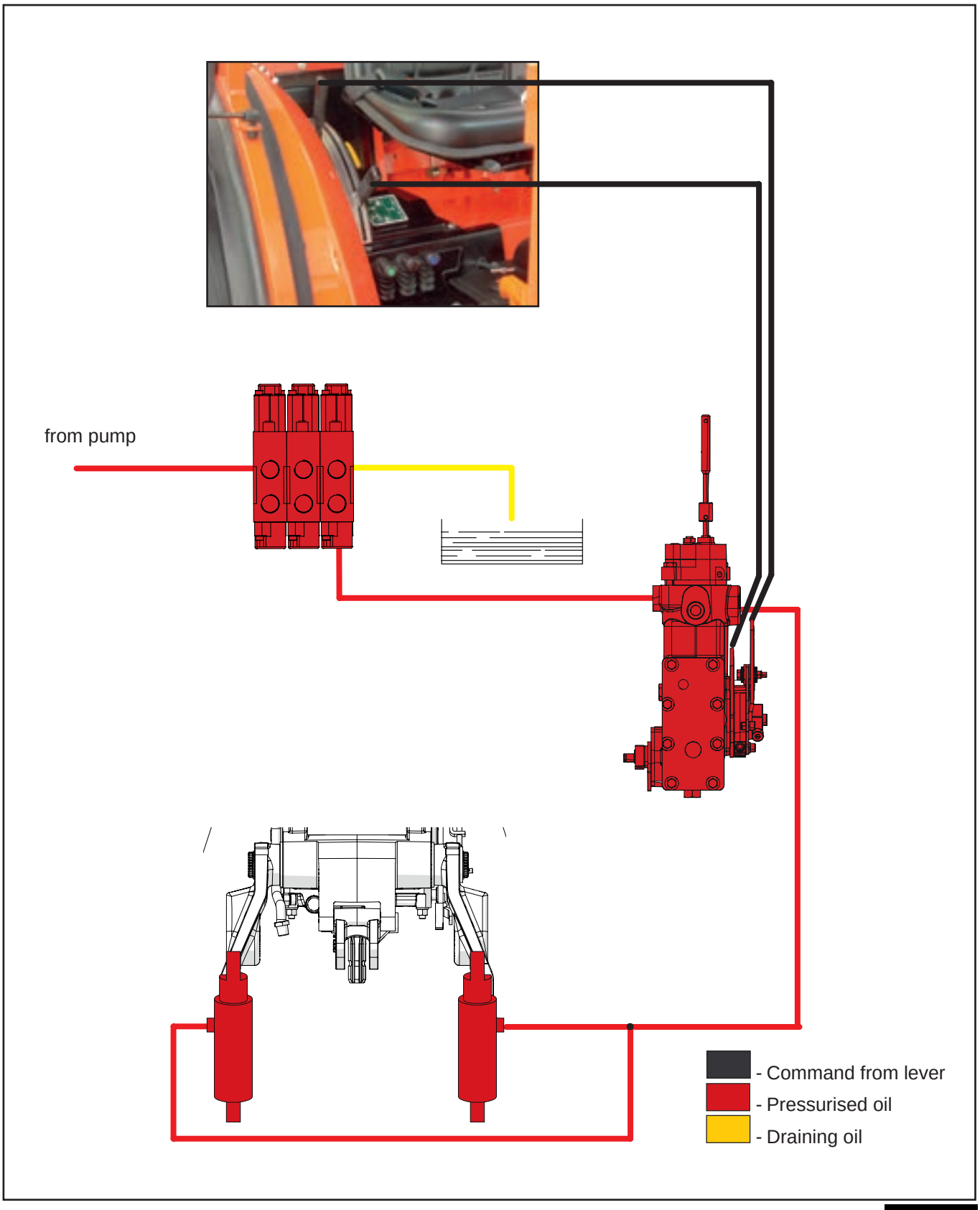


Fig. 13.8

4.1.2 Control levers

The lift with draft and position control may be used in the following modes:

- position control;
- draft control;
- mixed position/draft control.
- float mode.

The required mode is set by using the position control lever (1) and the draft control lever (2) in combination.

The control levers for the position and draft control lift are situated to the right of the driver, next to the seat

(1) - Position control lever.
(2) - Draft control lever.
(3) - Lift arm drop rate setting lever.
Turn clockwise to reduce drop rate; turn anticlockwise to increase drop rate.

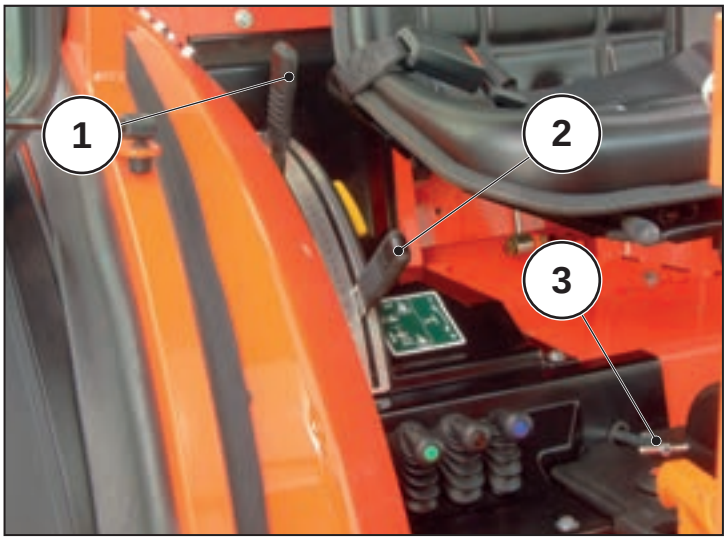


Fig. 13.9

4.1.3 Operating mode

POSITION CONTROL

Position control mode may be used to set and maintain the implement in any position between fully raised and fully lowered, either engaged in the soil or above the ground, by moving the control lever (1) into the required position.

Proceed as follows:

- The lever (1) controls the position of the arms; each position of the lever corresponds to a position of the lift arms from fully raised (lever pulled back fully) to fully lowered (lever pushed fully forwards).
- Push the draft control lever (2) fully forwards.
- Move the position control lever (1) forwards to lower the arms or back to raise the arms.

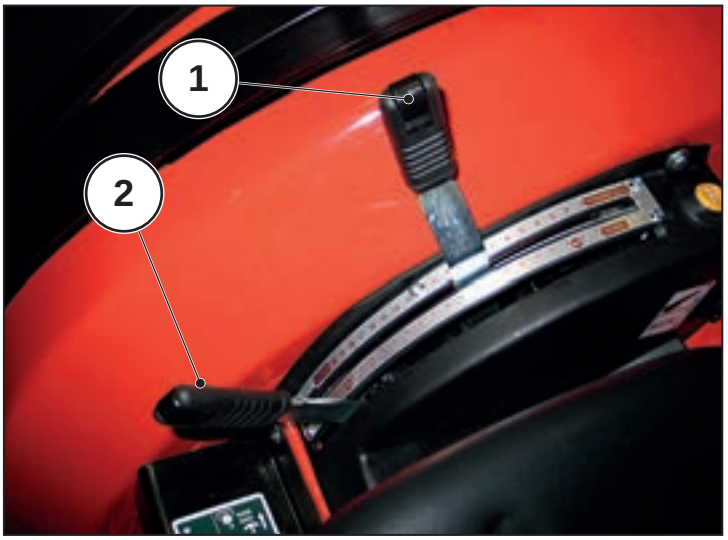


Fig. 13.10

The implement remains at the same working depth even if the consistency of the terrain changes (e.g.: zone c = clay soil; zone d = sandy soil; zone e = compacted soil)

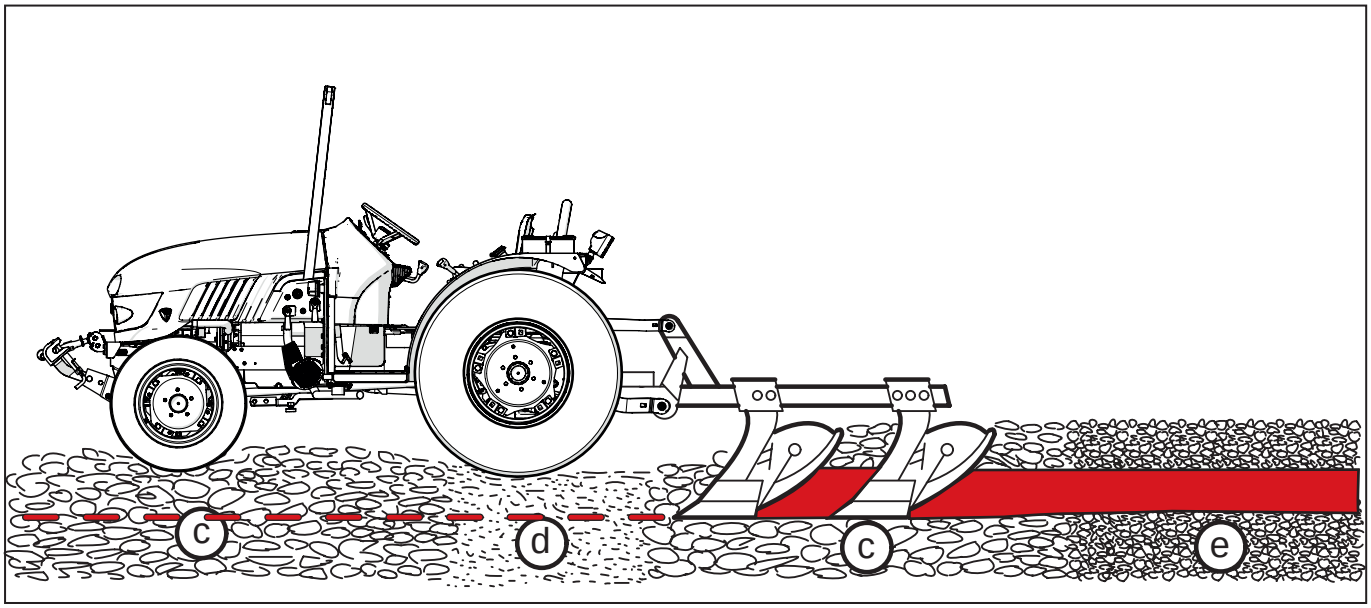


Fig. 13.11

DRAFT CONTROL

The draft control function is particularly useful for tasks with high draft demands performed with mounted implements, as the weight of the implement shifts much of the draft force to the rear wheels and increases the traction of the tractor relative to the terrain.

With this mode, the working depth of the implement may vary significantly when the implement itself encounters differences in terrain consistency (e.g.: zone c = clay soil; zone d = sandy soil; zone e = compacted soil), whether flat or with dips and humps.

Proceed as follows:

- Move the position control lever (1) fully forwards.
- Move the draft control lever (2) forwards gradually to engage the implement at the required soil depth. The working depth attained by the implement is proportional to the draft force and dependent on the consistency of the soil. In this mode, the draft force requested by the lift from the tractor remains constant.
- At the end of each pass, use the position control lever (1) to raise the implement.

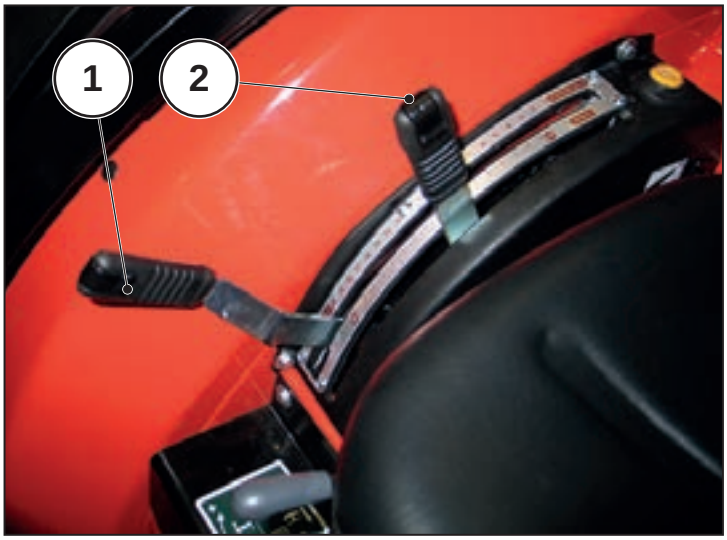


Fig. 13.12

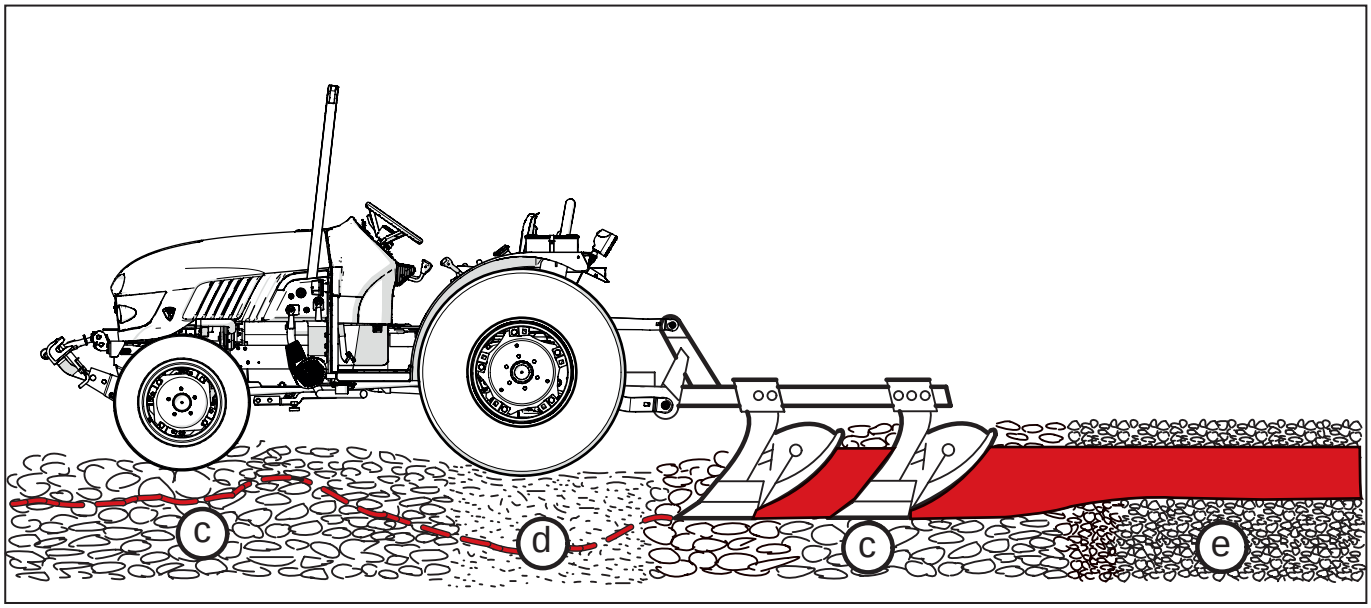


Fig. 13.13

MIXED POSITION/DRAFT CONTROL

Using the draft control function may produce excessive variations in working depth for certain crop applications

In these cases, mixed position/draft control mode may be used instead. Engage the implement in the soil and set the required working depth as described for draft control mode.

- Engage the implement in the soil and set the required working depth as described for draft control mode.
- Once the implement has stabilised at the required working depth, pull the position control lever (1) back until the lift arms tend to lift.
- With these settings, the lift controls draft but prevents the implement from engaging too deeply if it encounters softer terrain.
- Use the position control lever (1) to lower and raise the implement at the start and end of each pass.

Adjust the lever while working to determine the ideal position which offers the best compromise between variations in draft and variations in depth.

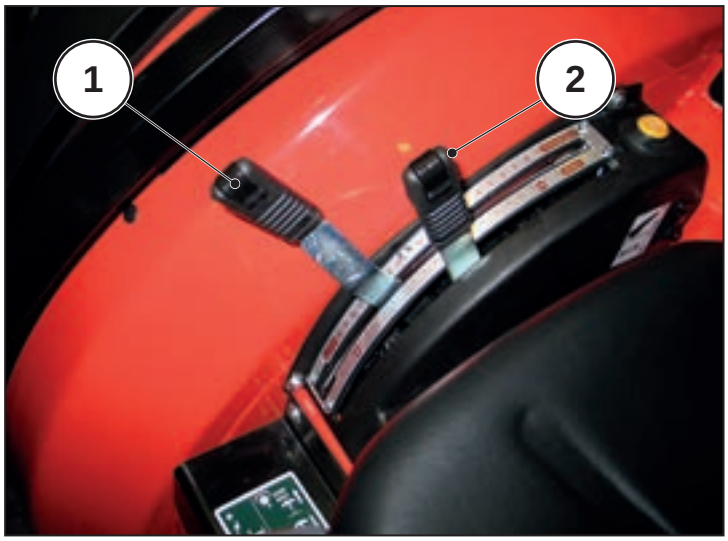


Fig. 13.14

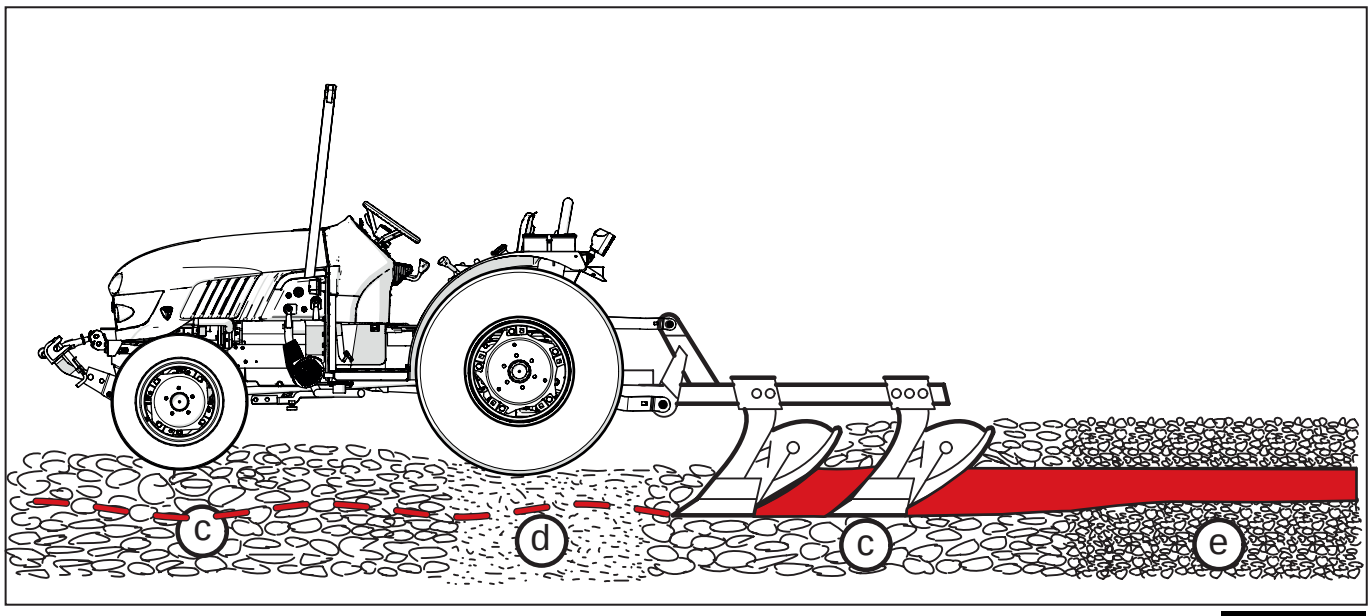


Fig. 13.15

FLOAT MODE

- Push the position control lever (1) and the draft control lever (2) fully forwards.
- Use the position control lever (1) to lower and raise the implement at the start and end of each pass.

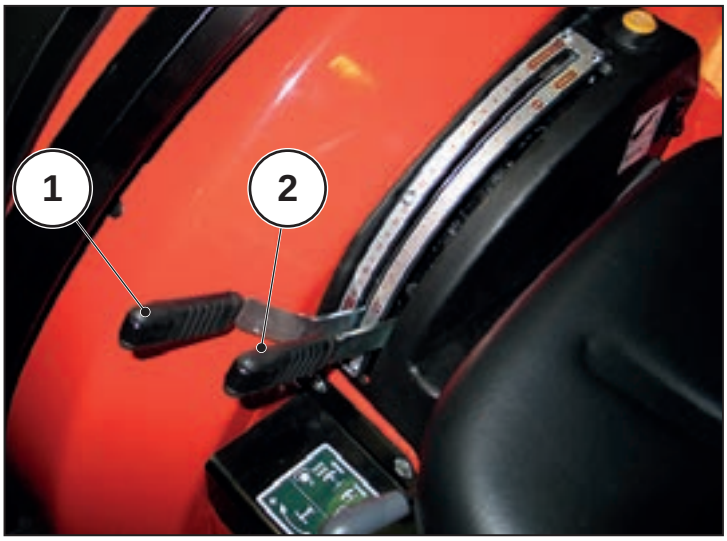


Fig. 13.16

4.2 Technical characteristics

Rear lift	Hydraulic with position and draft control
Lift capacity at lower link ends	2,300 kg
3-point linkage category	Category 1 and 2
Mechanical top link arm	Category 1 and 2
Lower link arm type	Fixed
Right hand tie-rod type	Mechanical

4.3 Main settings

4.3.1 Adjusting the position and draft control tie-rods

> **Warning**
>
> The adjustments described below must be made with no implements hitched to the tractor.

Adjusting the position lever tie-rod

The maximum lift height of the lift is adjustable with the cam lever. Move the position lever (1) all the way up and the draft lever (2) all the way down.

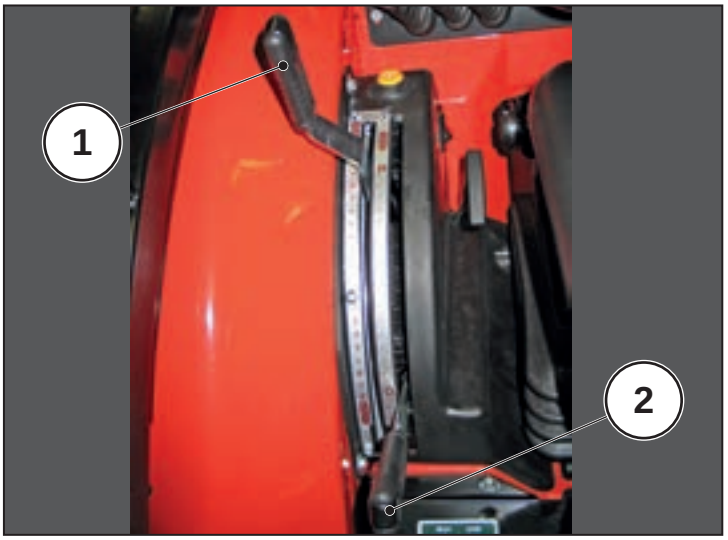


Fig. 13.17

Adjust the tie-rod with the nut until the pump is under no load.

> **Warning**
>
> The lift arms must have a dead zone of 3 cm in the maximum lift height position to prevent the pump from remaining under pressure.

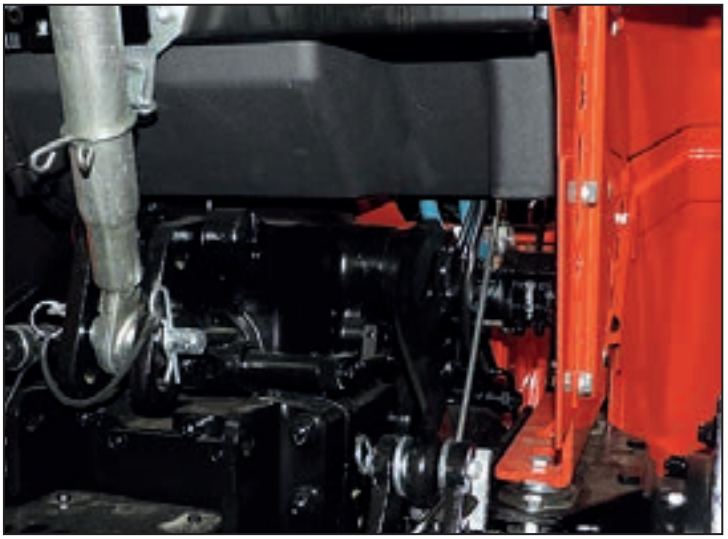


Fig. 13.18

Adjusting the draft lever tie-rod

Fit tool (F-p/n 07000249) to pull the top link mount back.

Warning
The top link must have no free play.

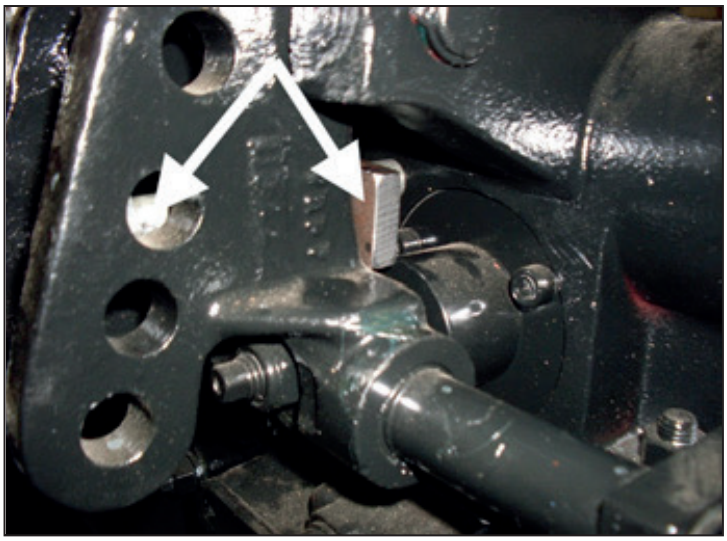


Fig. 13.19

Move the position lever (1) all the way down and the draft lever (2) all the way up. The lift rises.

Move the lever down by 5-6 notches.

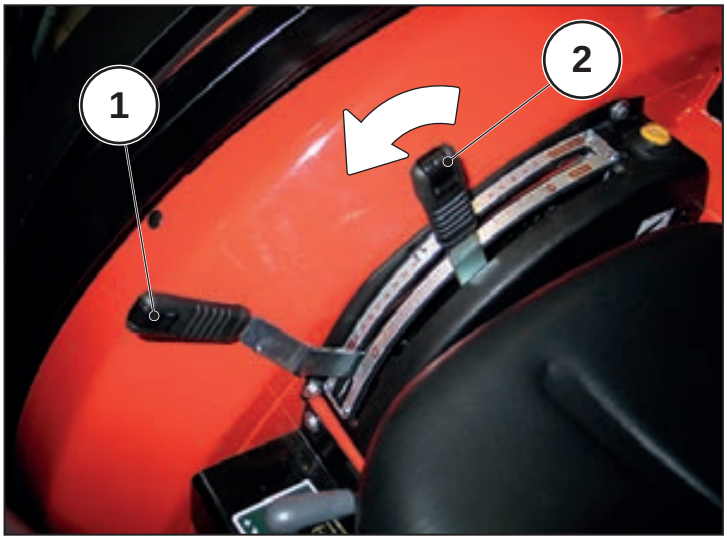


Fig. 13.20

Adjust the tie-rod on the top link mount until the lift just starts to lower, and then tighten the check nut.

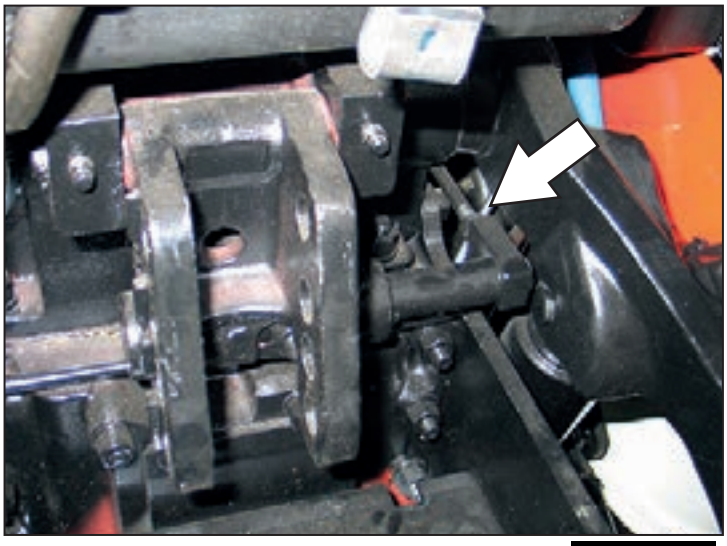


Fig. 13.21

4.4 Checking the cylinder seals

Check the seals of the lift cylinder as illustrated and replace if necessary.

> **Warning**
>
> Lubricate the seals before refitting to prevent damage to the seals themselves.

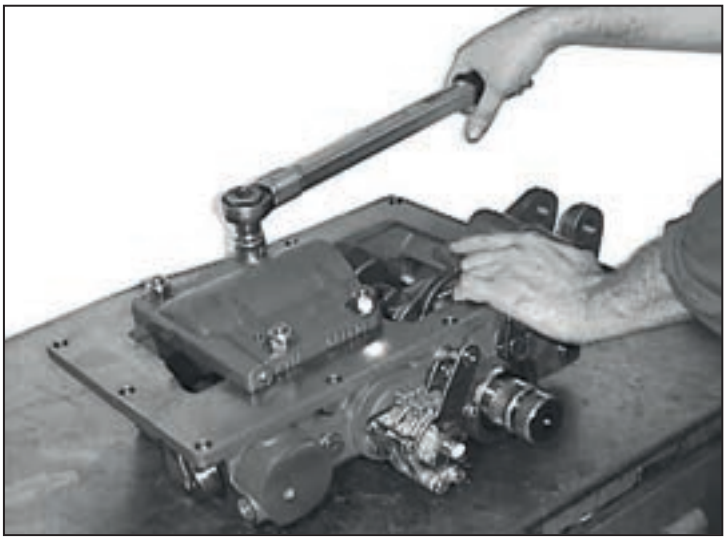


Fig. 13.22

During reassembly, apply a coating of LOCTITE thread lock and tighten the screws of the cylinder to a torque of 90 Nm (9 kgm) .

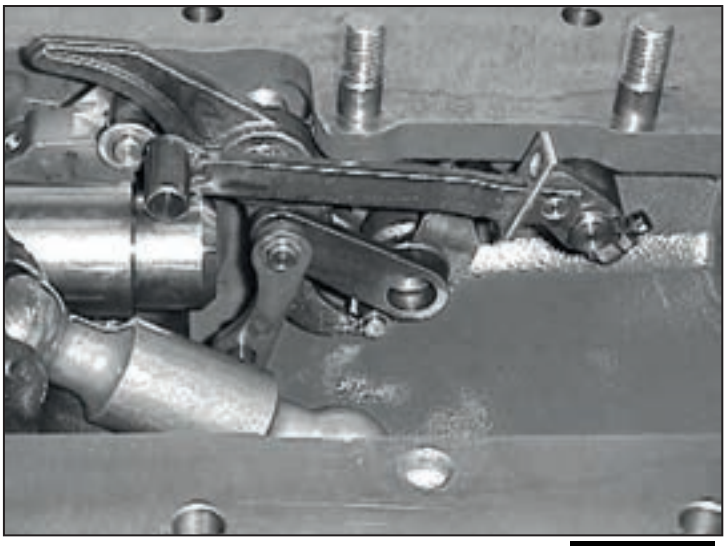


Fig. 13.23

Grease the cylinder seals before reassembly

Fig. 13.24

To facilitate removal of the piston from the cylinder, connect a compressed air line to the piston delivery pipe and blow compressed air into the cylinder.

Fig. 13.25

When fitting the lift distributor, check that the measurement indicated is correct. If the measurement is not correct, adjust the screw B and the check nut A as necessary. This value must be measured with both lift levers lowered completely and with the lift arms at the bottom end of travel.

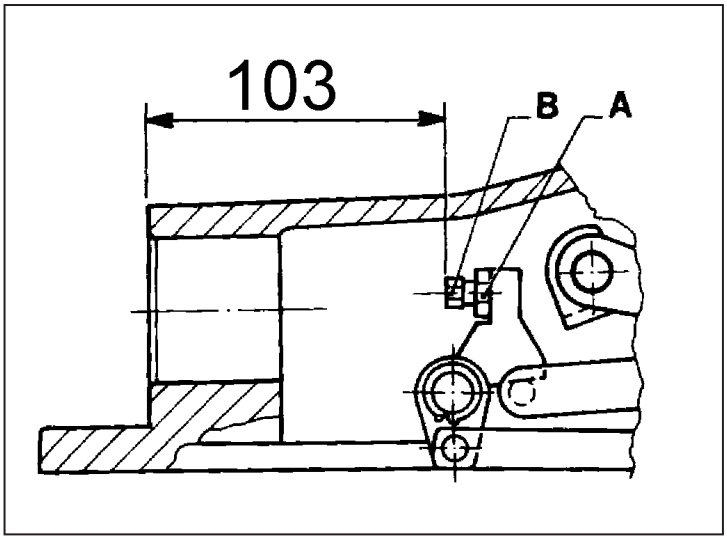


Fig. 13.26

4.5 Disassembling front side of distributor

Undo the 3 fastener screws of the cover and remove the cover. The internal components of the two valves may now be removed.

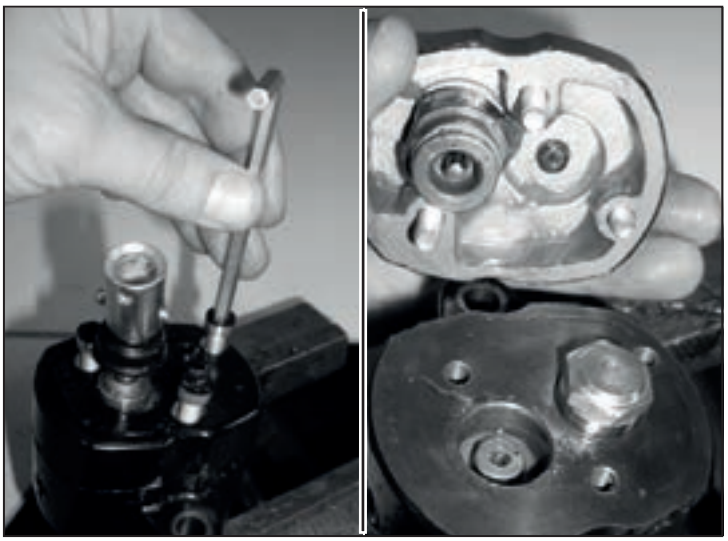


Fig. 13.27

The internal components of the distributor, grouped by utility channel, are shown in the figure.

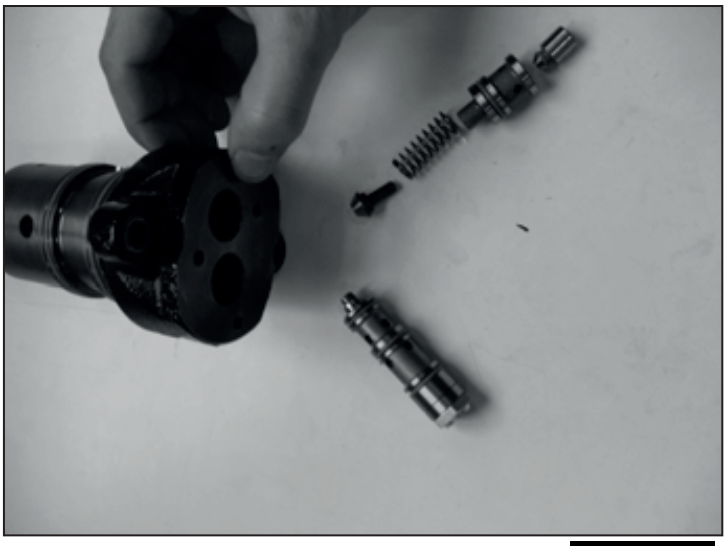


Fig. 13.28

4.6 Disassembling rear side of distributor

Undo the 3 screws and remove the spool retainer plate.

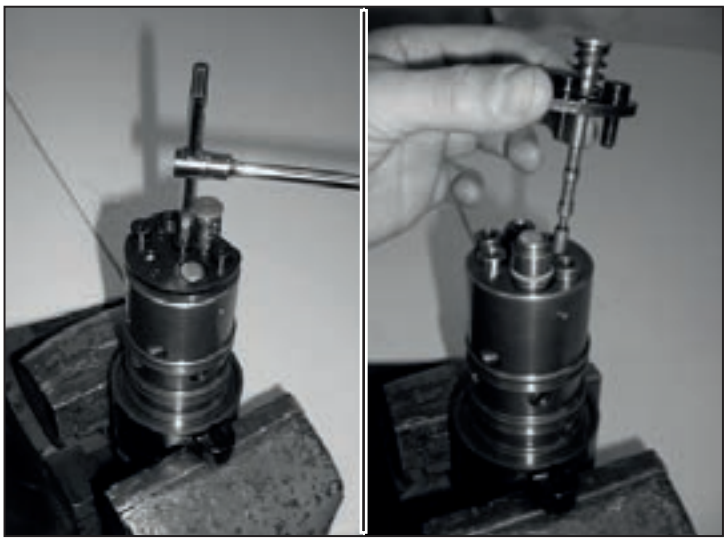


Fig. 13.29

Remove the spring, the ball and the two spacers.

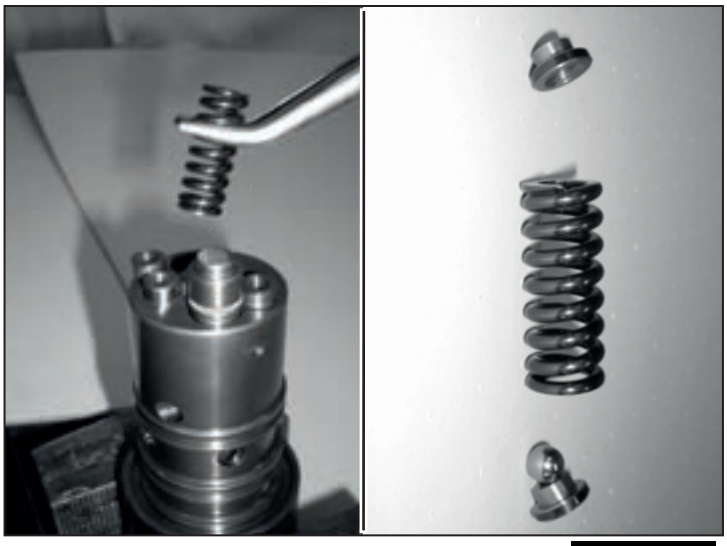


Fig. 13.30

Remove the valve seat, the valve and the relative spring.

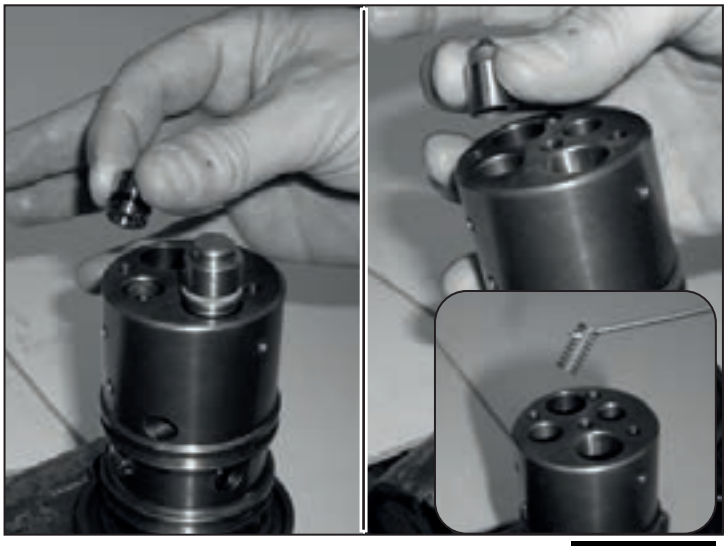


Fig. 13.31

Remove the spring holder cap and the valve seat.

Fig. 13.32

The internal components of the distributor, grouped by utility channel, are shown in the figure.

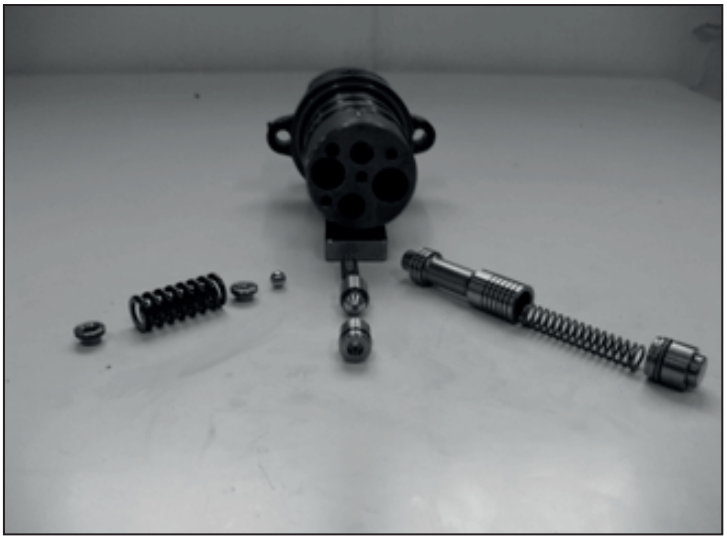


Fig. 13.33

The retainer plate, the three fastener screws with the relative spacers and the internal spool with the relative spring are shown in the figure.

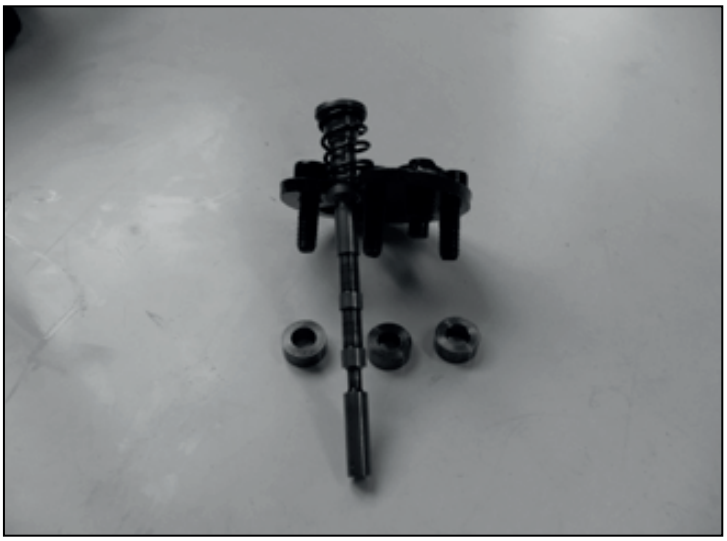


Fig. 13.34

When reassembling the distributor, check that the O-rings are in good condition and are not pinched.

Lubricate the O-rings with grease to prevent malfunctions requiring the unit to be disassembled and serviced again.

Fig. 13.35

If the lift bounces when weight is applied, adjust the sensitivity with the screw B.

Move the lift arms to approximately the mid travel point. In this position, the control distributor is in the neutral state. Loosen the check nut and undo the grub screw until the lift stops bouncing. Undo the grub screw by another half a turn and tighten the check nut.

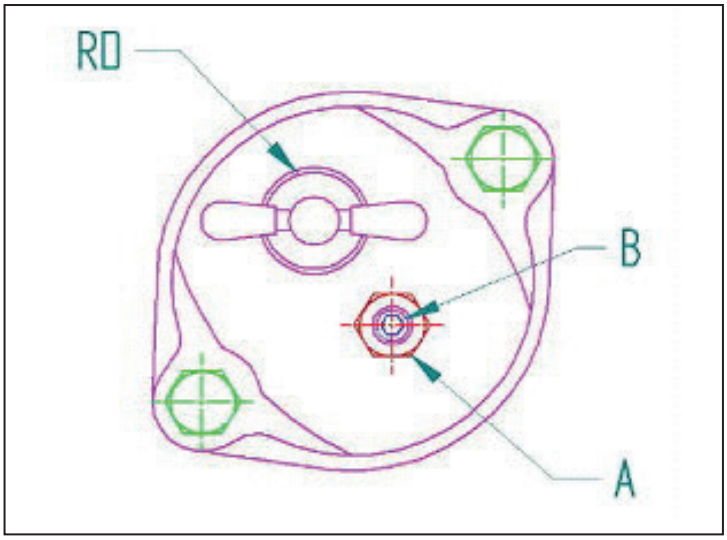


Fig. 13.36

4.7 Installing rear lift internal linkages

The correct sequence for installing the internal and external lift linkages is illustrated on the following pages. This procedure is illustrated for informative purposes only, to present the main linkage components of the rear lift.

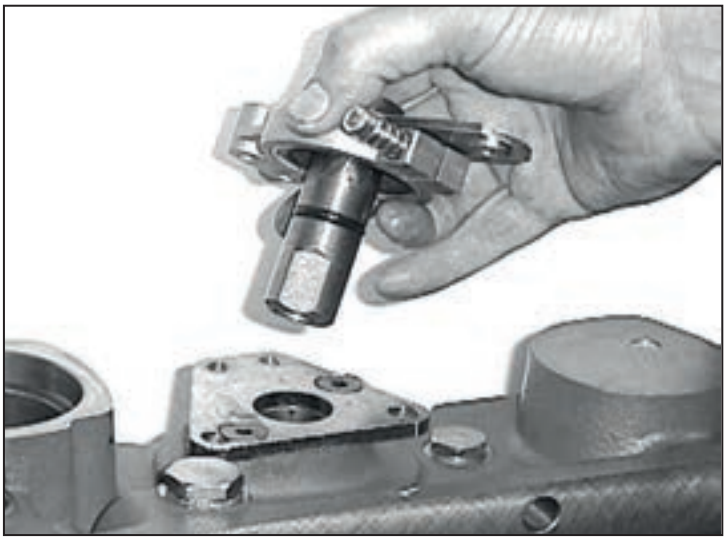


Fig. 13.37

All lift linkage components are available from our Spare Parts Service. Problems with these components are extremely unlikely, however, and the installation procedure is simple enough to comprehend from this sequence of photographs without an excessively detailed description.

Fig. 13.38

As mentioned again later in this section, a specific and highly detailed workshop manual regarding the linkages and the entire rear lift assembly is available if the information given here is not adequate.

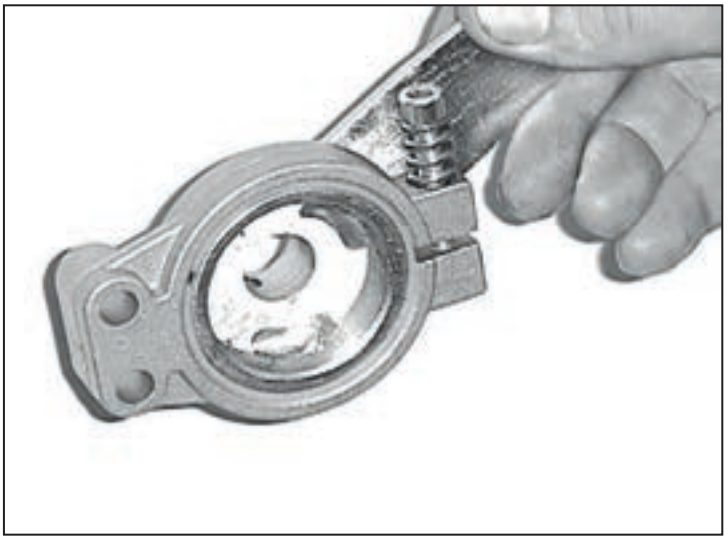


Fig. 13.39

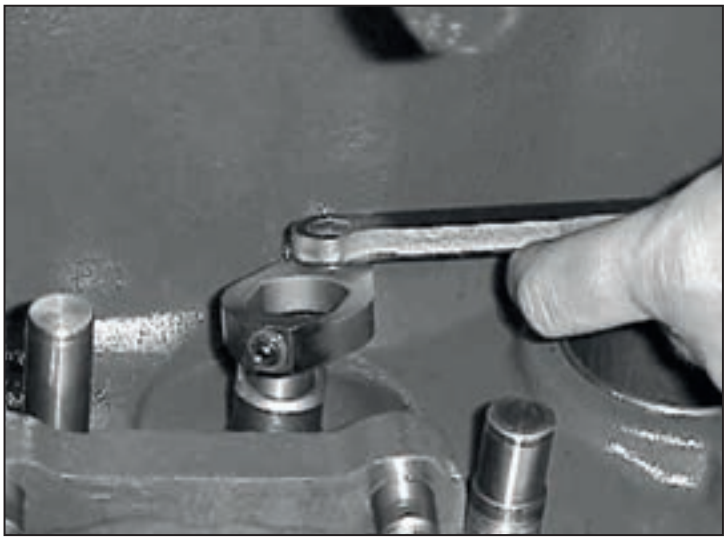


Fig. 13.40

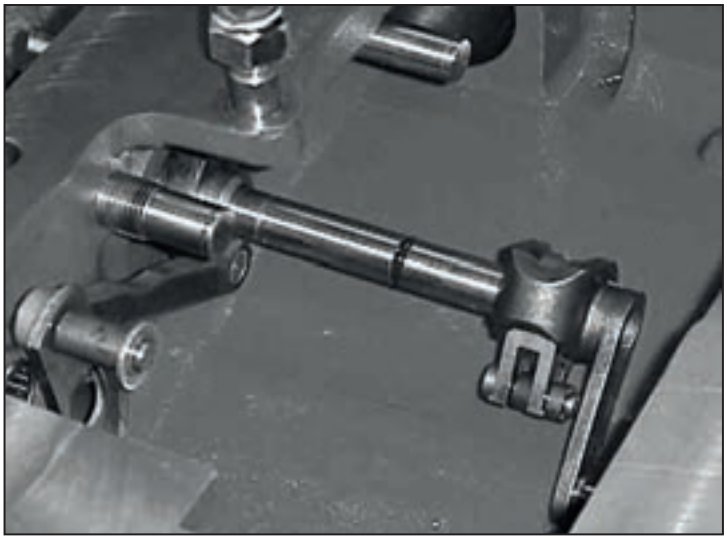


Fig. 13.41

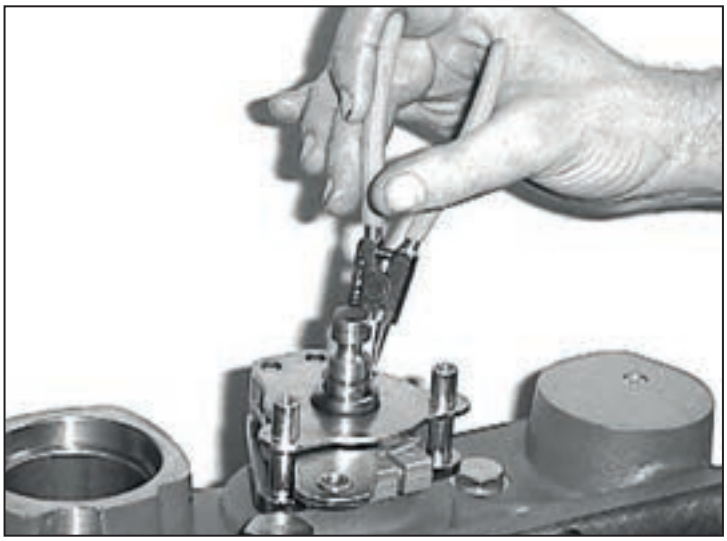


Fig. 13.42

Fig. 13.43

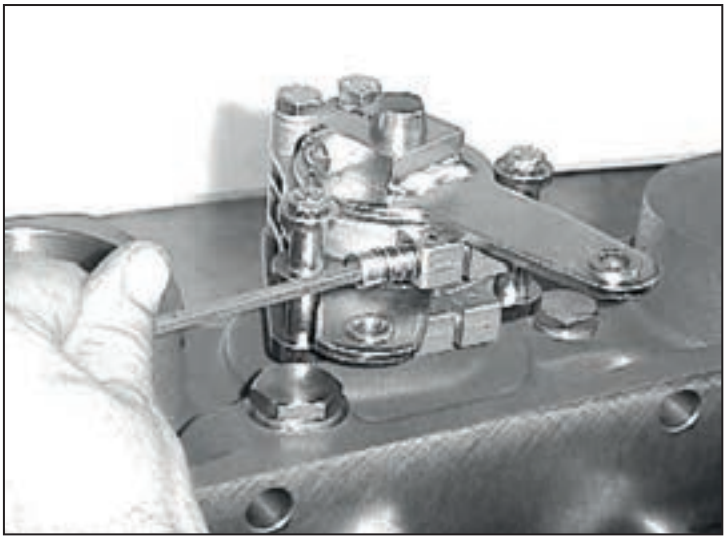


Fig. 13.44

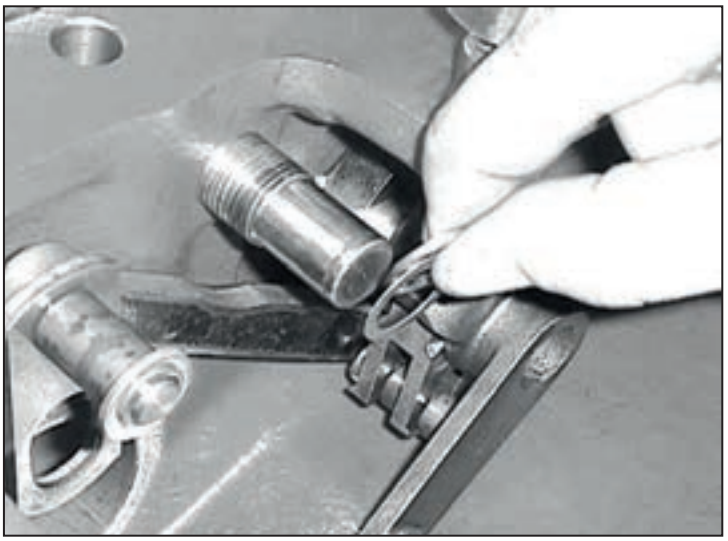


Fig. 13.45

Fig. 13.46

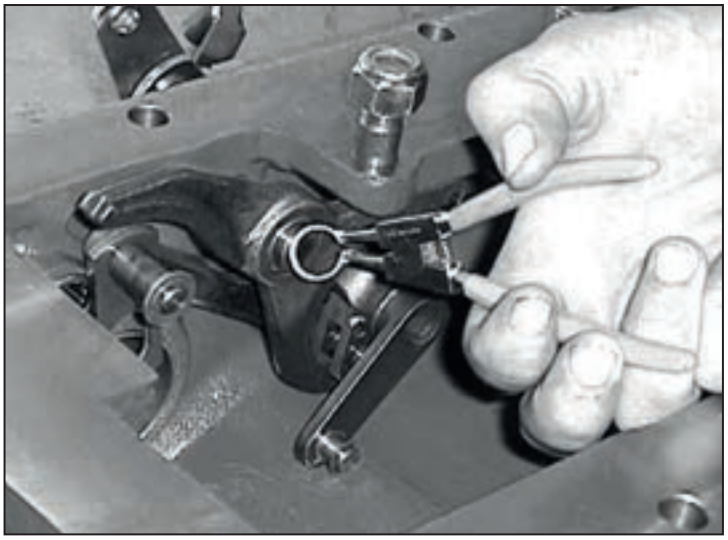


Fig. 13.47

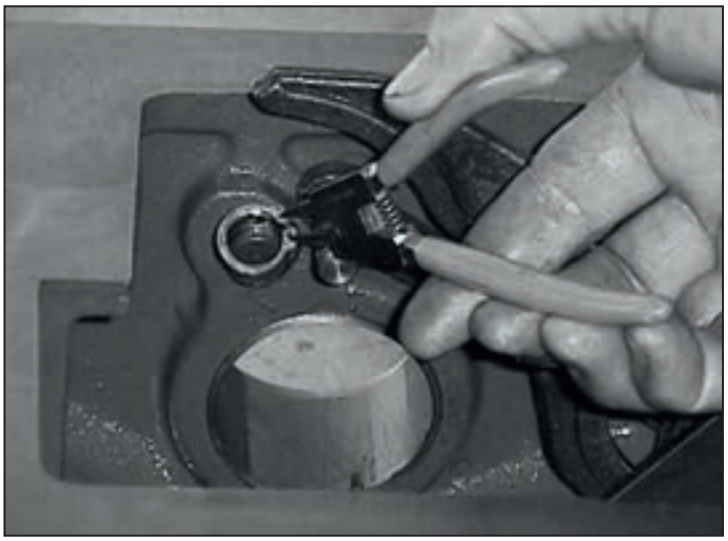


Fig. 13.48

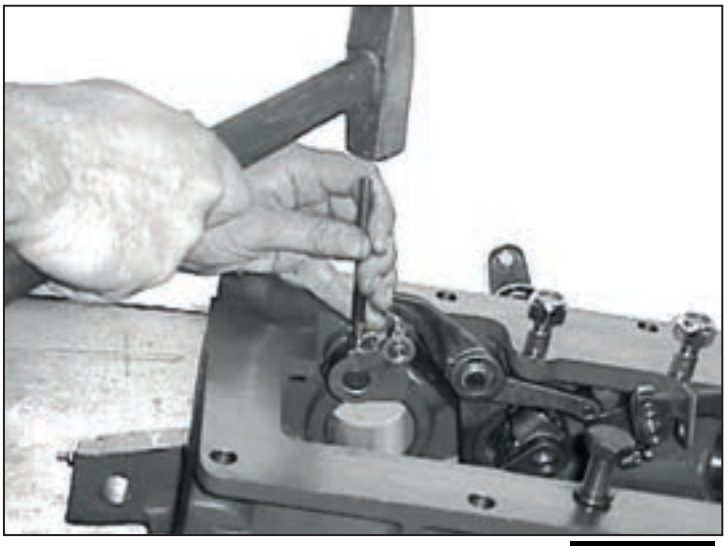


Fig. 13.49

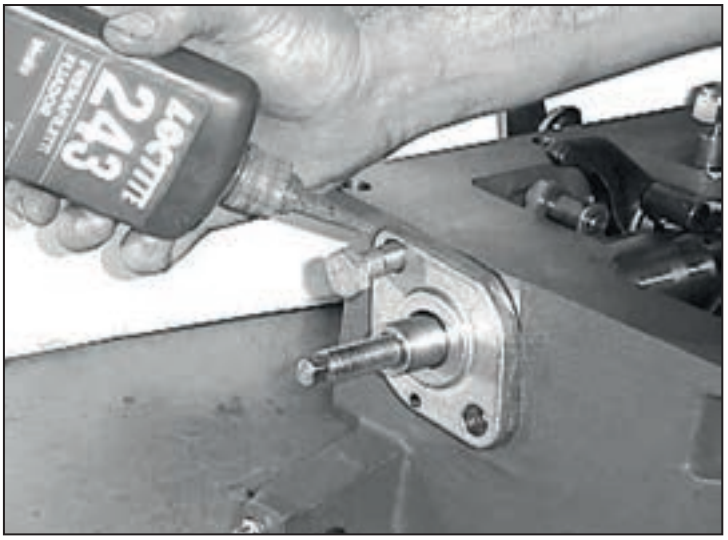


Fig. 13.50

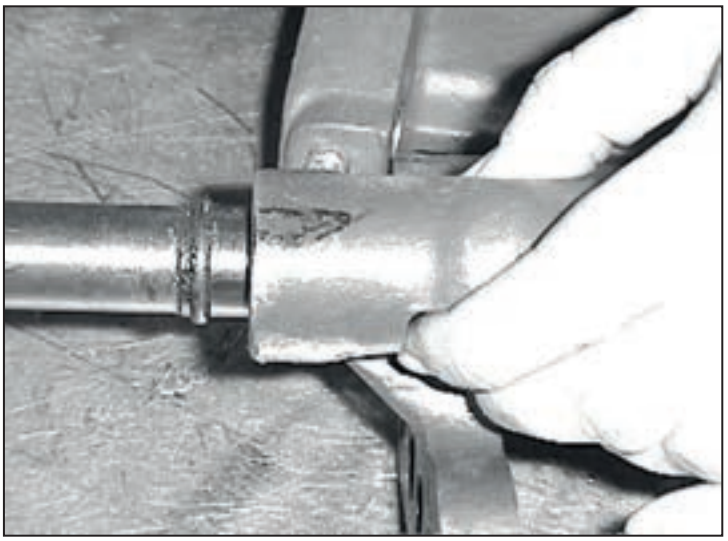


Fig. 13.51

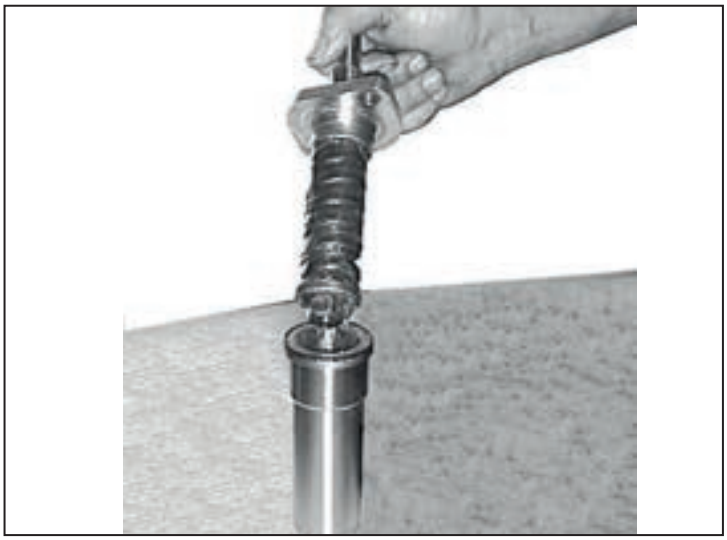


Fig. 13.52

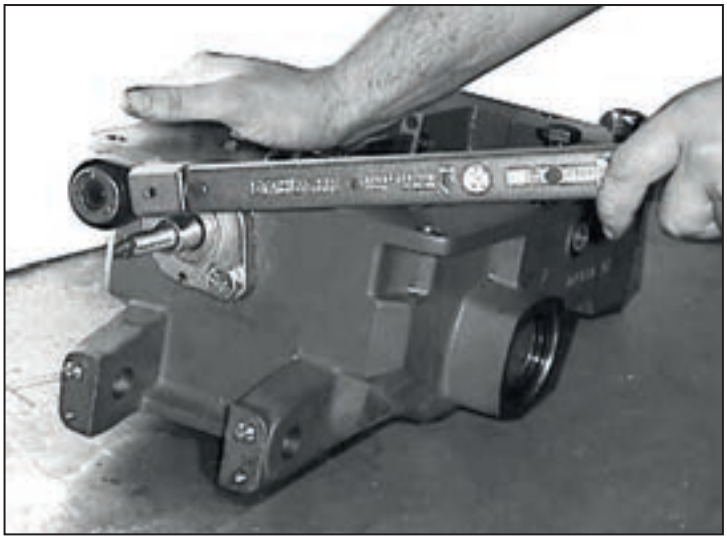


Fig. 13.53

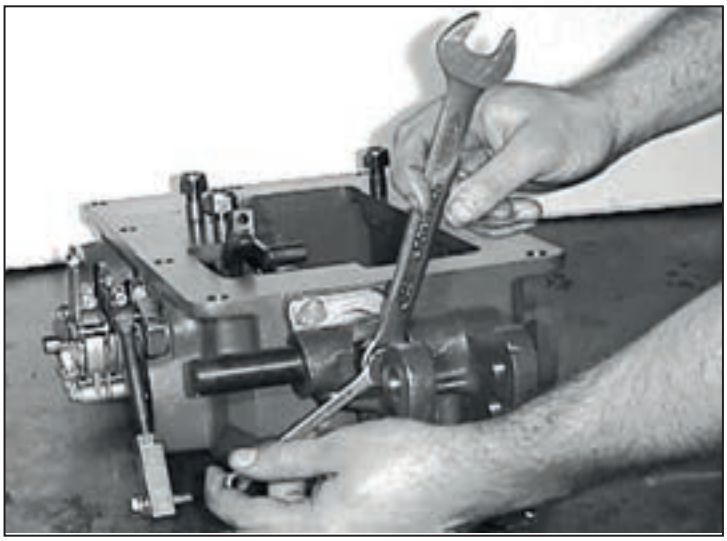


Fig. 13.54

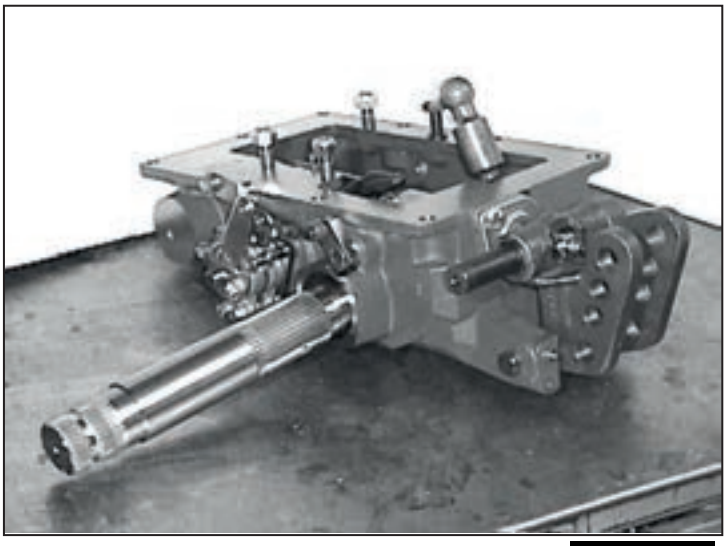


Fig. 13.55

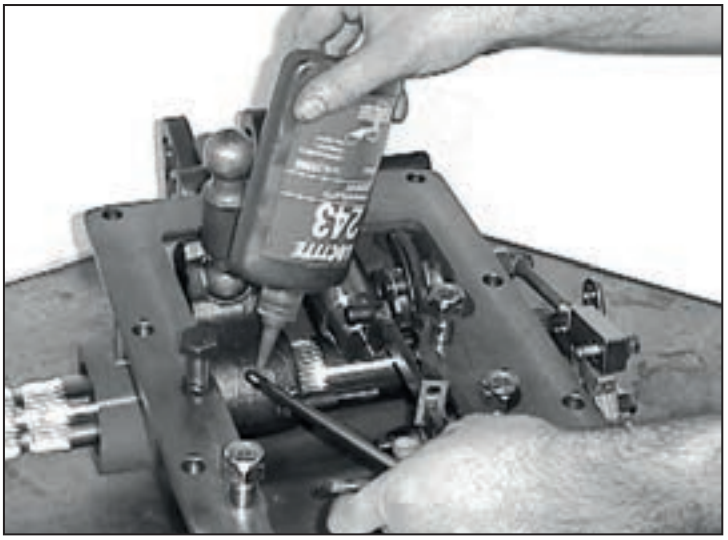


Fig. 13.56

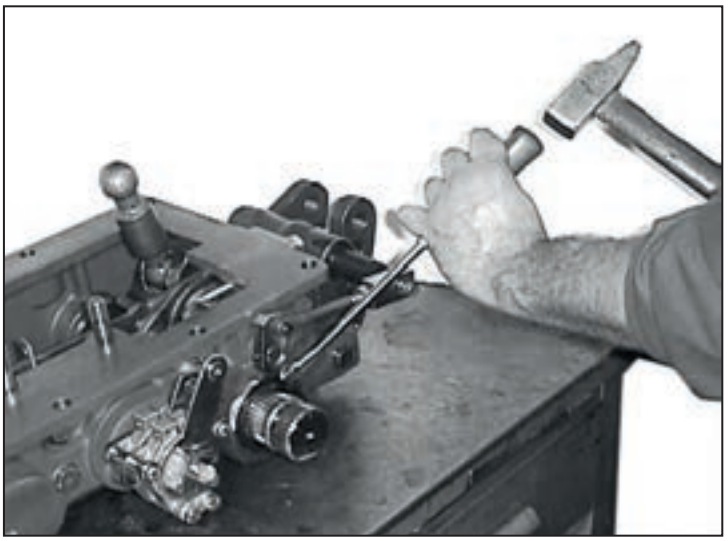


Fig. 13.57

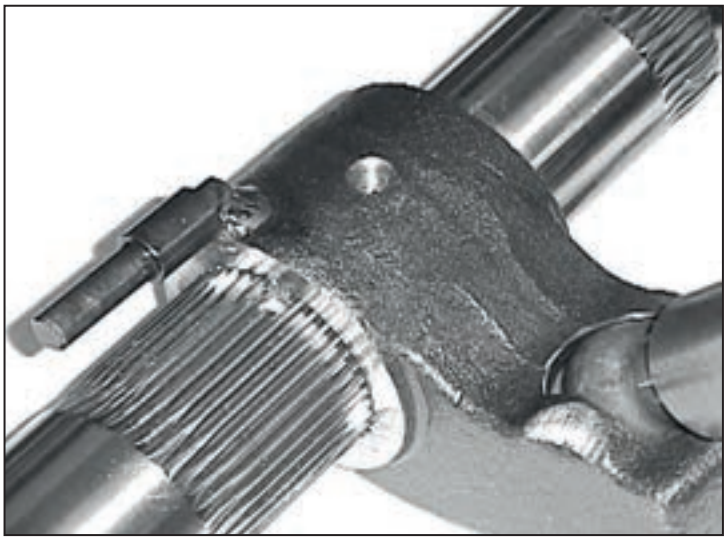


Fig. 13.58

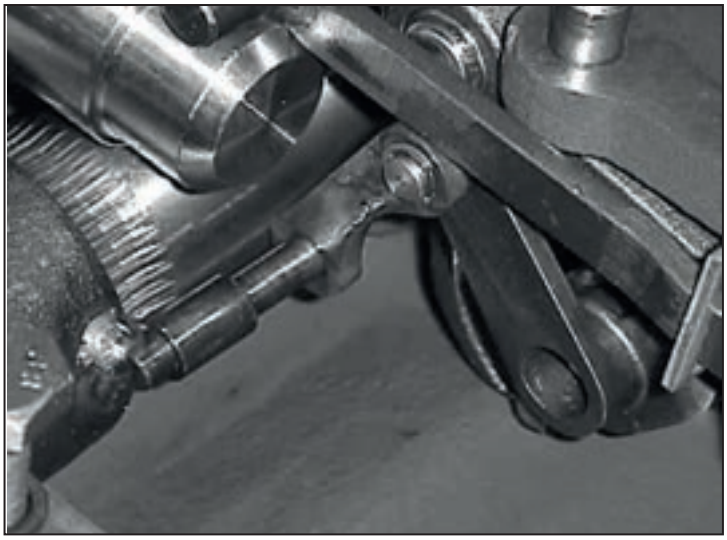


Fig. 13.59

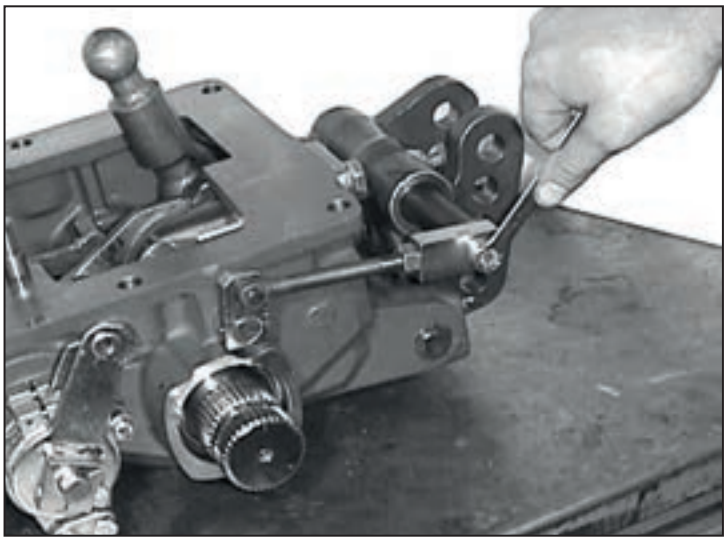


Fig. 13.60

Section 5 : Main components

Índice

5.1 Hydraulic pump.....13-46

5.2 Hydraulic steering valve 13-47

5.3 Rear hydraulic distributors 13-48

5.4 Hydraulic unit.....13-49

5.5 Front hydraulic distributors.....13-50

5.6 Trailer brake valve, ITALY 13-51

5.1 Hydraulic pump

The hydraulic pump is situated in front of the engine. The pump is driven directly by the crankshaft and feeds the hydraulic circuit of the tractor. Oil from the gearbox and filtered by the suction line filter flows into the suction pipe (P1). The pump delivers oil via (P2) to the high flow rate hydraulic steering circuit, to the auxiliary distributors and to the rear lift. The oil is then sent to the gearbox lubrication circuit.

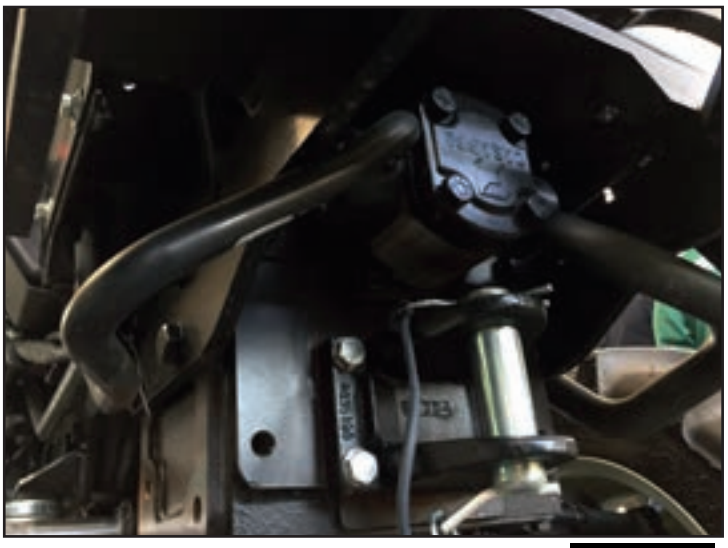


Fig. 13.61

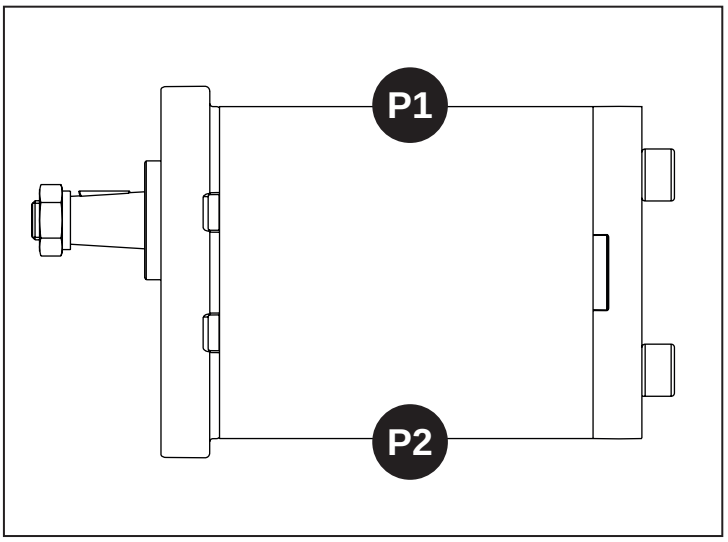


Fig. 13.62

5.2 Hydraulic steering valve

The hydraulic steering circuit consists of a priority valve which, whenever the steering wheel is turned, draws the necessary quantity of oil from the oil circuit, with priority over other functions, to move the double acting cylinder in response to the steering input of the driver. The circuit also includes a pressure relief valve calibrated to 115 bar and two overpressure safety valves protecting the cylinder and the hydraulic steering valve against accidental damage.

Fig. 13.63

5.3 Rear hydraulic distributors

The tractor is equipped with auxiliary hydraulic distributors situated on the rear right hand side of the tractor for operating external hydraulic cylinders. The distributors are fed from the high flow rate circuit with oil received from the hydraulic steering valve.

A number of different configurations with the following types of distributor are available:

- Single action;
- Double action;
- Double action with drain detent;
- Double action distributor with float mode.

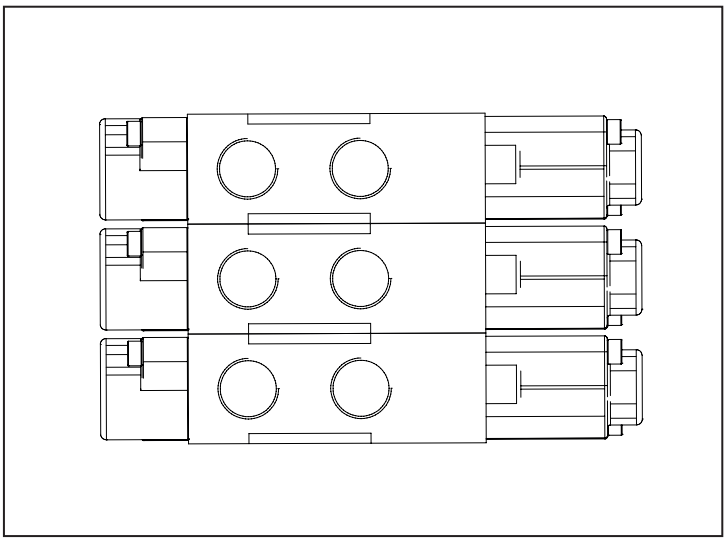


Fig. 13.64

Oil received from the hydraulic steering valve flows into the inlet head (R1), which is equipped with a pressure relief valve calibrated to 180 bar. In response to movements of the distributor levers, oil is sent to the delivery (R2) or return (R3) hydraulic couplers, and then drained directly back to the gearbox housing. If no oil flow is requested from the distributors, the oil is sent to the rear lift distributor.

Note

While the distributors are fed simultaneously, operating one disables oil feed to the other distributors in the system and the lift, impeding simultaneous usage.

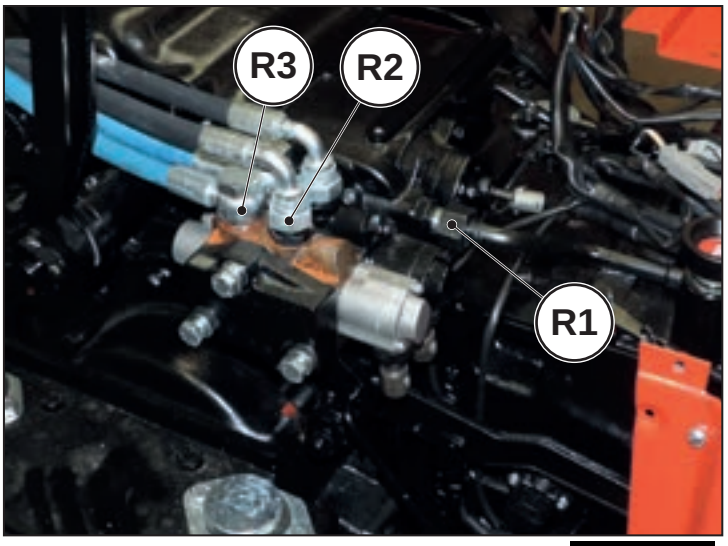


Fig. 13.65

5.4 Hydraulic unit

The hydraulic unit is situated on the left hand side under the cowl. The unit receives filtered oil from the pump (C1) and engages/disengages 4WD. The unit is equipped with a relief valve (C2) calibrated to 45 bar.

4WD is engaged by default and is actively disengaged. Each time the tractor is switched on, the 4WD engagement solenoid valve (C3) is energised and delivers oil (C4) at a pressure of 42 bar to disengage the hydraulic clutch. When the driver presses the 4WD selector button, the solenoid valve is de-energised, compressing the clutch pack and transmitting drive to the front wheels.

The pressure switch (C5) monitors for pressure drops in the 4WD circuit. If a pressure drop is detected, the switch energises the solenoid valve (C6), which requests oil from the main circuit to re-establish the correct pressure.

A nitrogen accumulator (C7) situated on top of the hydraulic unit acts as an oil reservoir to ensure that 4WD is disengaged immediately.

After the 4WD unit, oil is delivered to the subsequent utilities in the system via (C8).

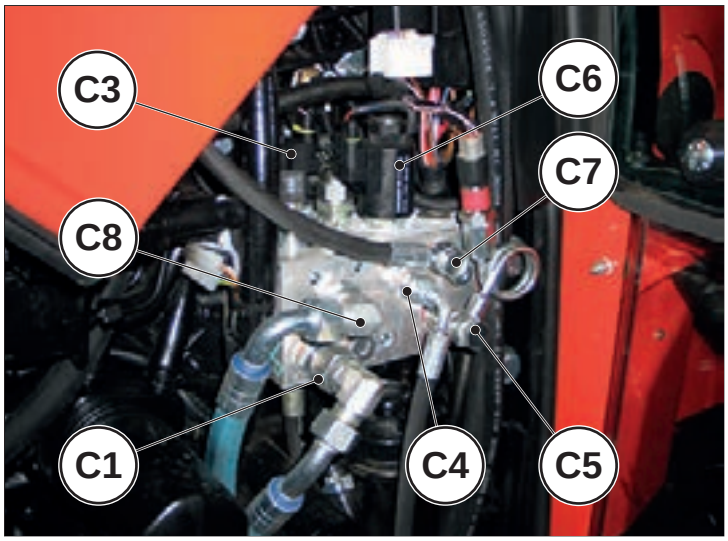


Fig. 13.66

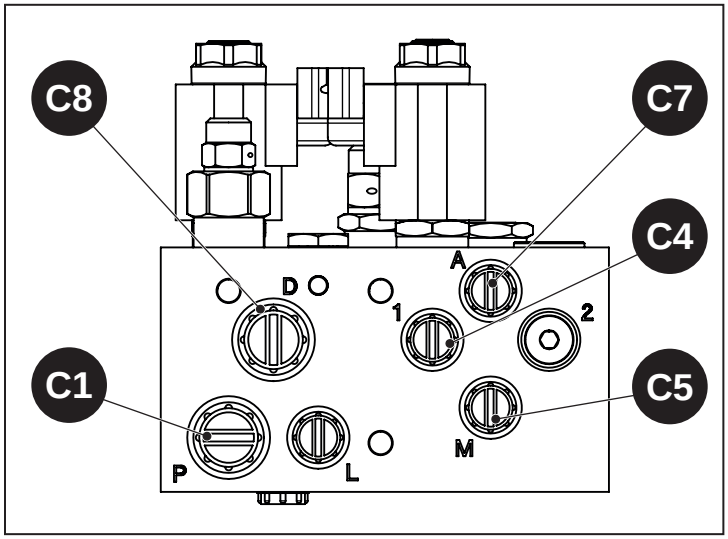


Fig. 13.67

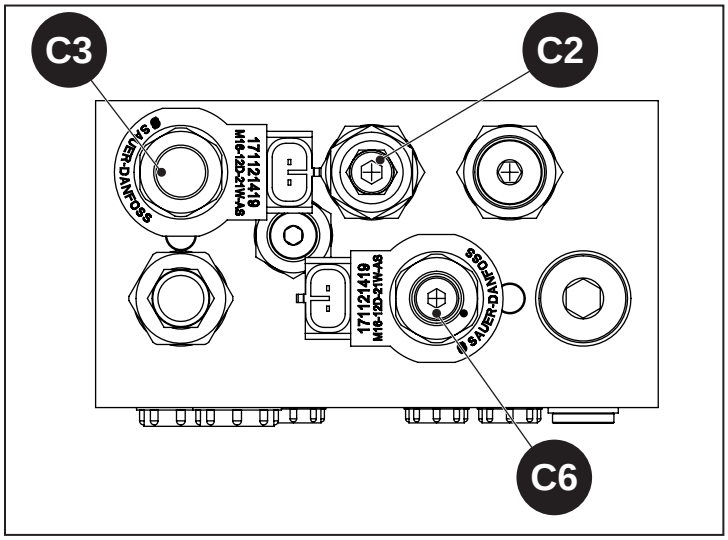


Fig. 13.68

5.5 Front hydraulic distributors

Depending on configuration, the tractor may be equipped with supplementary distributors situated at the front right of the machine. On tractors with front distributors, these distributors are fed with oil from the hydraulic steering unit via the high flow rate circuit. The oil flow is controlled by a flow regulator situated after the distributors.

A number of different configurations with the following types of distributor are available:

- Single action with float mode detent;
- Double action;
- Double action with lever detent;
- Double action with fourth float mode position and lever detent.

The number of front distributors installable depends on the configuration of the tractor

Configuration	No. of distributors
Roll bar without front lift	3
GL cab without front lift	3
Roll bar with front lift	2
GL cab with front lift	2

Oil from the hydraulic steering unit is sent to the flow regulator (F1). The flow rate delivered to the front distributors may be increased or decreased by adjusting the cock of the regulator valve (F2). This may be useful when it necessary to maintain a higher oil flow for other utilities (rear lift and rear distributors) or to prevent accidental damage implements which do not require the full flow rate.

In response to movements of the distributor levers, oil is sent to the delivery (F3) or return (F4) hydraulic couplers, and then to the drain line (F5). If no oil flow is requested from the distributors, the oil is sent to the trailer brake valve.

Note

While the distributors are fed simultaneously, operating one disables oil feed to the other distributors in the system, impeding simultaneous usage.

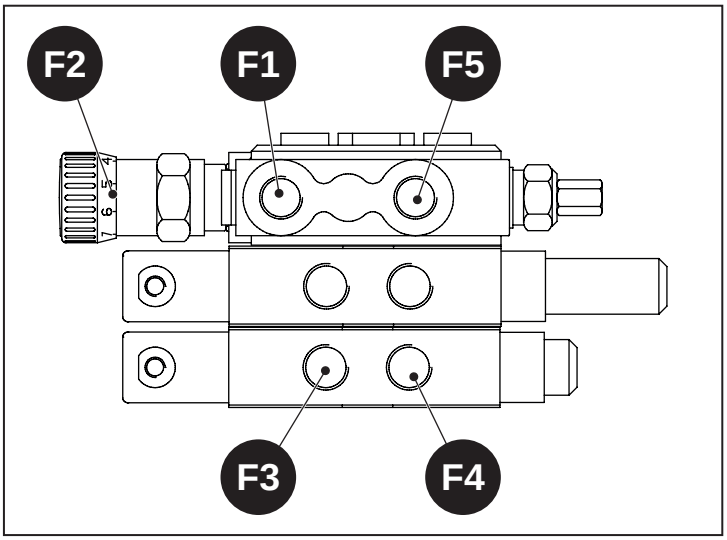


Fig. 13.69

5.6 Trailer brake valve, ITALY

Italian legislation requires trailers to brake automatically when they are unhitched from the tractor. This legislation also requires the trailer brake to be applied when the parking brake is applied. To comply with this legislation, when a trailer is hitched to the tractor, oil must be delivered to the trailer brake at a constant pressure of 12.5 bar even when the tractor brakes are not applied to keep the mechanical brake of the trailer released.

Oil from the pump is delivered to the trailer via (T1) and to the rear distributors via (T2). Oil is returned to the drain line via (T3).

Fig. 13.70

Flow rate	20-80 l/min
Maximum pressure	200 bar
Maximum pressure at quick coupler	120-140 bar
Constant pressure at quick coupler	10.5-14.5 bar

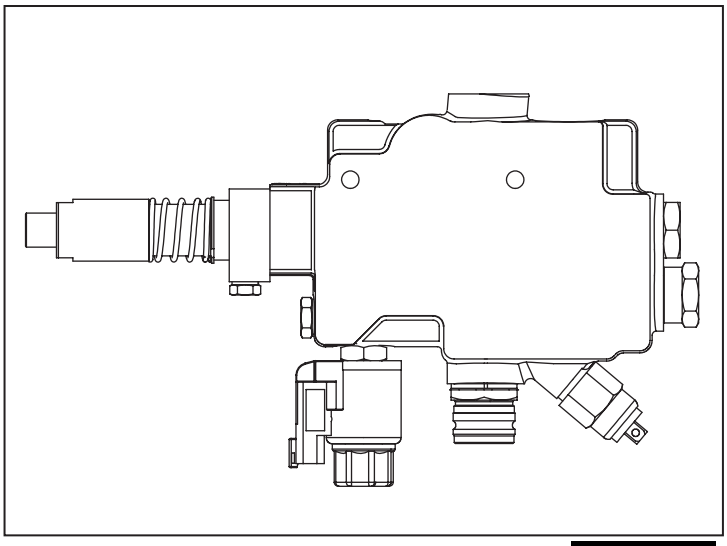


Fig. 13.71

Note

The trailer brake valve is disabled if no implement is hitched to the tractor, and will remain inoperative until the next time an implement is hitched.

Using the distributor pressurises the circuit, causing the mechanism inside the valve to move and disable the valve itself.

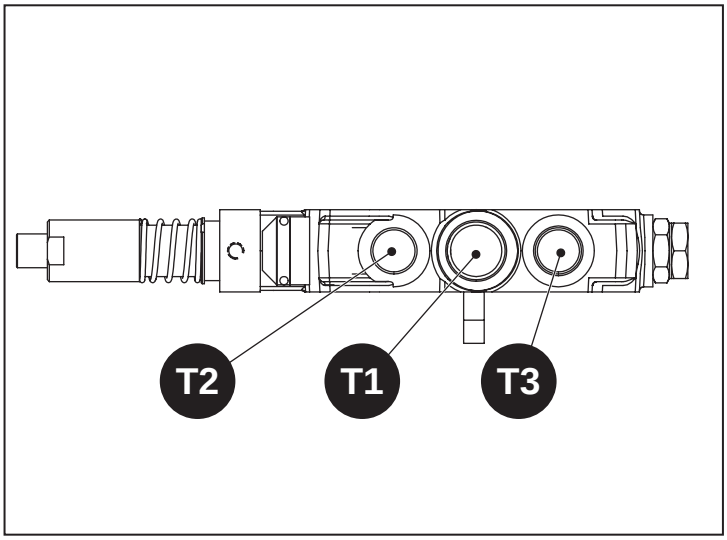


Fig. 13.72

Section 6 : Checking operating pressure values

Índice

6.1 Introduction 13-54

6.2 Checking the hydraulic steering unit pressure relief valve calibration pressure 13-55

6.3 Checking the pressure of the 4WD circuit 13-57

6.4 Checking the pressure of the auxiliary distributors 13-57

6.5 Checking the pressure of the rear lift distributor 13-58

6.1 Introduction

The operating pressure values must be checked if any problems are experienced with any utilities and during a general check of the tractor itself.

Excessively low calibration settings for the pressure relief valves in the circuit may cause the hydraulic clutches to slip and unsatisfactory performance of the steering system, auxiliary distributors and lift.

Excessively high calibration settings for the pressure relief valves will stress all the components in the system and may cause the seal rings to fail.

After checking the values, correct the calibration settings if necessary with the relative adjuster screws.

Danger

Jets of escaping pressurised fluid may penetrate the skin and cause severe injury. In the event of an accident involving pressurised fluid, seek immediate medical attention to avoid the risk of severe infection

Danger

Take all precautions necessary to avoid burns when working with hot oil Never heat oil to above 190°C, as the oil vapour may suddenly and spontaneously ignite.

Attention

Used oils must be collected and disposed of in compliance with applicable legislation.

Attention

Do not start work until the pressure in the hydraulic system has dropped to zero.

6.2 Checking the hydraulic steering unit pressure relief valve calibration pressure

The hydraulic steering unit pressure relief valve is calibrated to 115 bar. To check the calibration pressure of pressure relief valve, connect the pressure gauge (A-p/n 07000122) to the hydraulic steering valve/cylinder delivery pipe and move the steering cylinder to the end stops on the right and left hand sides.

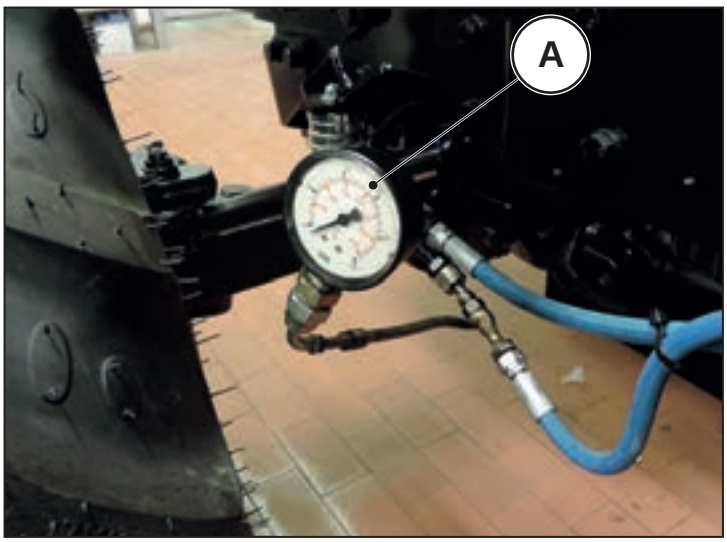


Fig. 13.73

Open the plug R to adjust the calibration pressure of the hydraulic steering unit pressure relief valve.

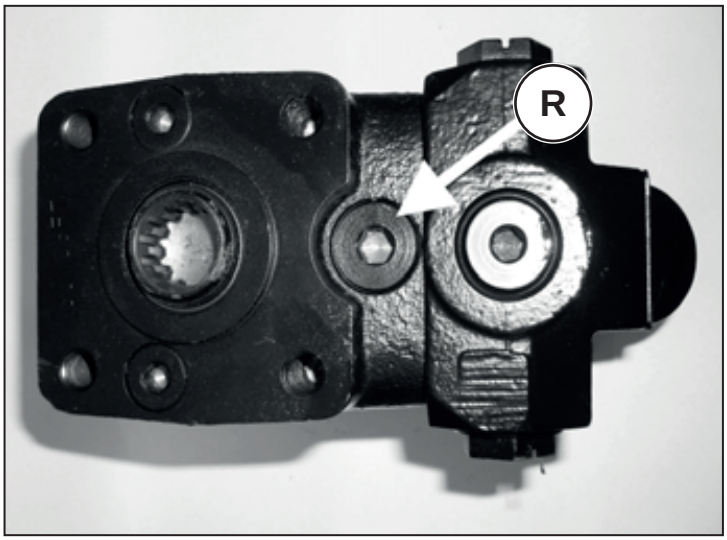


Fig. 13.74

Hydraulic steering malfunctions may be caused by debris clogging the port or the spool of the priority valve.

Fig. 13.75

Clean the interior of the priority valve.

Warning

Make sure that all the components are reassembled in the correct order.

Note

For more detailed instructions, see the use and maintenance manual provided by the manufacturer.

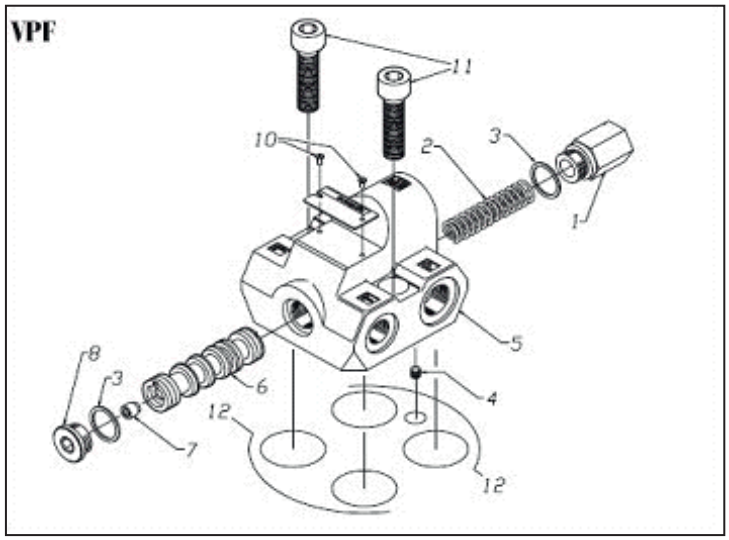


Fig. 13.76

6.3 Checking the pressure of the 4WD circuit

To check the pressure in the 4WD circuit, a pressure gauge with a cock may be fitted onto the 4WD unit delivery connector. Close the cock and check that the output pressure from the solenoid valve is between 42 and 45 bar.

If the pressure value is not within this range, check for oil leaks within the 4WD unit. Open the cock and check that the pressure does not drop.

Note

A loss of oil pressure in the 4WD circuit due to a leak is detected by the pressure switch, which energises the solenoid valve and opens the circuit. If this loss of pressure persists, the solenoid valve will be permanently energised, and as a result, the oil flow reaching the distributors and the lift will be inadequate, and the distributors and lift will not function correctly.

Fig. 13.77

6.4 Checking the pressure of the auxiliary distributors

Connect a pressure gauge to the outlet of the quick connector of one of the hydraulic couplers. With the engine running, use the relative control lever.

A value of 180 bar should be read on the pressure gauge.

If the values read are not as indicated, adjust the setting of the pressure relief valve on the rear distributor mounting plate.

Warning

The upper mudguard cross bar and the distributor lever guard plate must be removed to access the pressure relief valve.

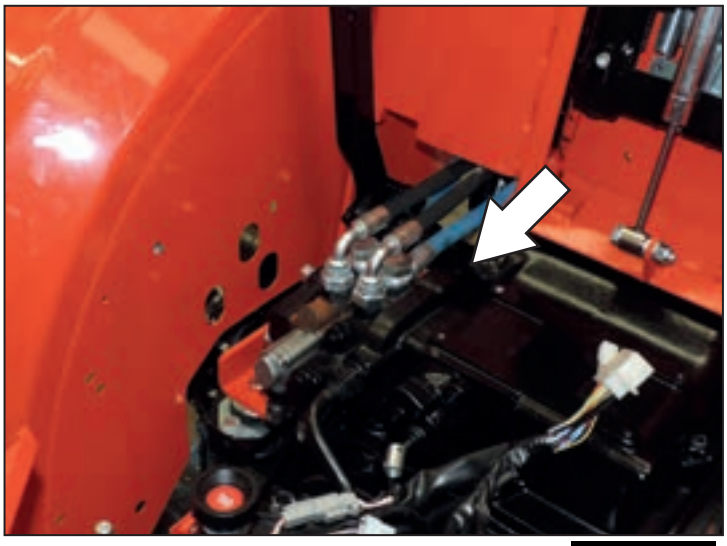


Fig. 13.78

6.5 Checking the pressure of the rear lift distributor

Fit a pressure gauge on the delivery connector to check the pressure of the lift distributor.

Lock the lift arms with the tool (B-p/n 07006220). This tool simulates lifting a load exceeding the maximum capacity of the lift.

Use the lift position lever and check that a pressure of 180 bar is indicated on the pressure gauge.

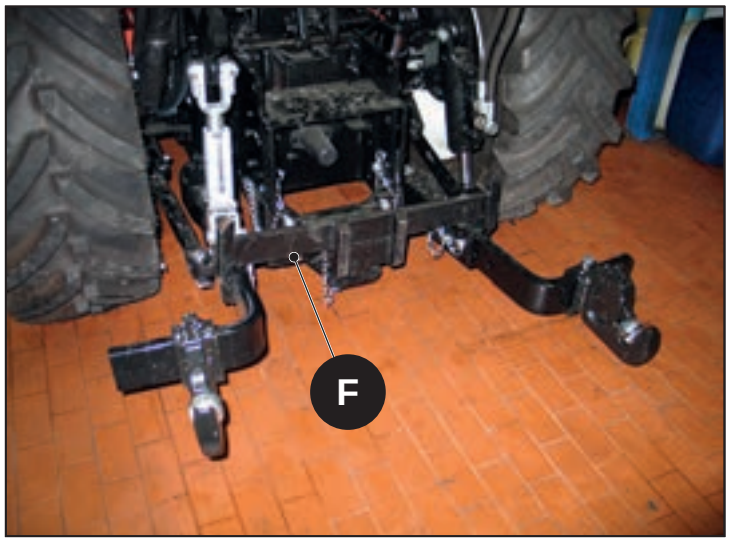


Fig. 13.79

The safety relief valve protects the cylinder against overpressure produced by the load oscillating while driving on the road.

To adjust the calibration of the lift distributor relief valve, turn the screw (C) and then tighten the check nut to secure it in position.

Use the tool (E-p/n 07000241) to check that the safety relief valve (C) is calibrated correctly to 200 bar, and correct the calibration if necessary with the adjuster screw.

To check the calibration, pressurise the distributor per pressing and holding the spool D pressed, wait for the inlet pressure to stabilise and then check that it matches the calibration value specified for the valve. Release the spool D to drain the distributor.

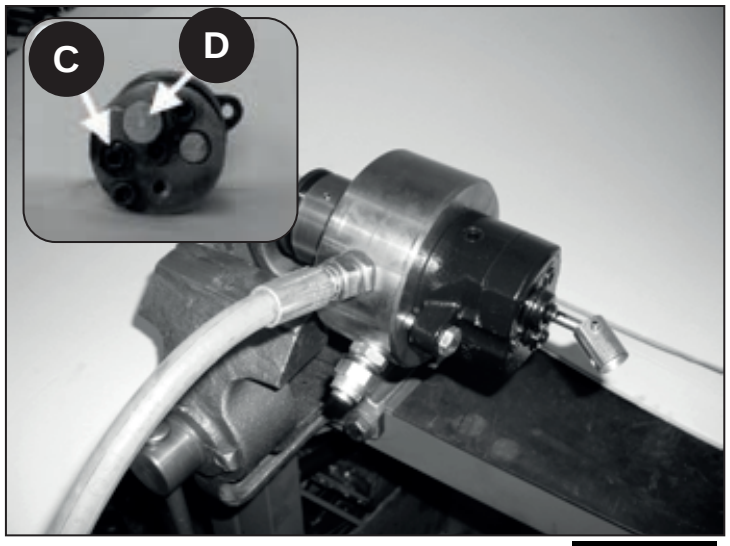


Fig. 13.80

Section 7 : Tools necessary

Índice

7.1 Tools necessary 13-60

7.1 Tools necessary

p/n	Description	Quantity
07000249	Lift draft adjustment tool	1
07000122	Pressure gauge	1
07006220	Arm locking tool	1
07000241	Distributor testing tool 1363	1

Chapter 14 : Platform

Index

Section 1 : Safety notes 14-2

Section 2 : Splitting and re-assembly of the platform 14-3

2.1 Preliminary operations 14-4
2.2 Splitting 14-4
2.3 Re-assembly 14-20

Section 3 : Tools required 14-21

3.1 Tools required 14-22

Section 1 : Safety notes

To prevent accidents and injuries, always comply with the precautions and safety recommendations described in this section. In addition, operators must always comply with the safety instructions given in the operation and maintenance manual and in chapter 1 of this manual.

Danger

Make sure that all persons keep well away from the danger zone.

Danger

Lift and handle all heavy parts with lifting equipment of an adequate capacity. Arrange all harness and hooks in safe positions. Operators must remain at a distance and in a safe position, well away from the lifted load.

Danger

Do not twist the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Danger

Use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.

Danger

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

Danger

For safety reasons, always leave two screws on opposite sides when removing components that could fall. Only remove these screws after having secured the component to lifting equipment or placed bearing blocks underneath.

Danger

If the bolts that fix the safety frame or cab have loosened or if the safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

Caution

Keep clear of sharp edges.

Caution

Used oil must be collected and disposed of in compliance with the anti-pollution laws in force.

Section 2 : Splitting and re-assembly of the platform

Index

2.1 Preliminary operations 14-4

2.2 Splitting 14-4

2.3 Re-assembly 14-20

2.1 Preliminary operations

The main operations required to disassemble the platform are described below:

- Removal of the front drive shaft (see chapter "7- Front axle")

2.2 Splitting

Unscrew the screws (1) and remove the right and left covers (2).

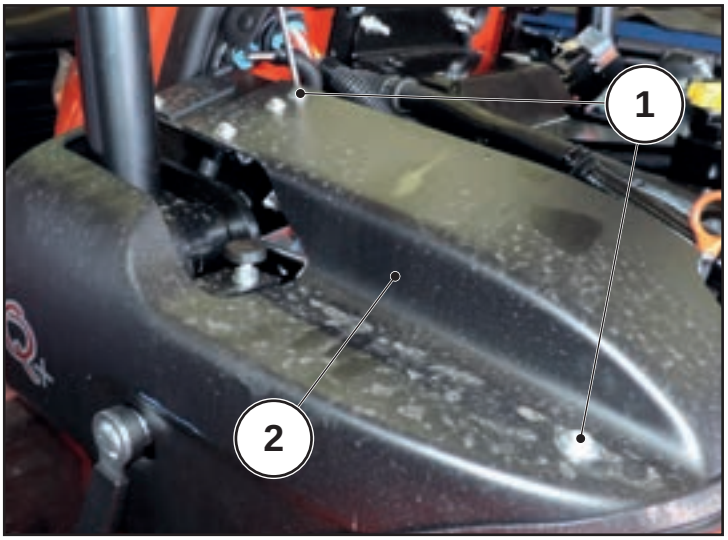


Fig. 14.1

Unscrew the screws (3) and remove the rubber seal (4) of the bonnet.

Warning
The screws can be loosened without removing them.

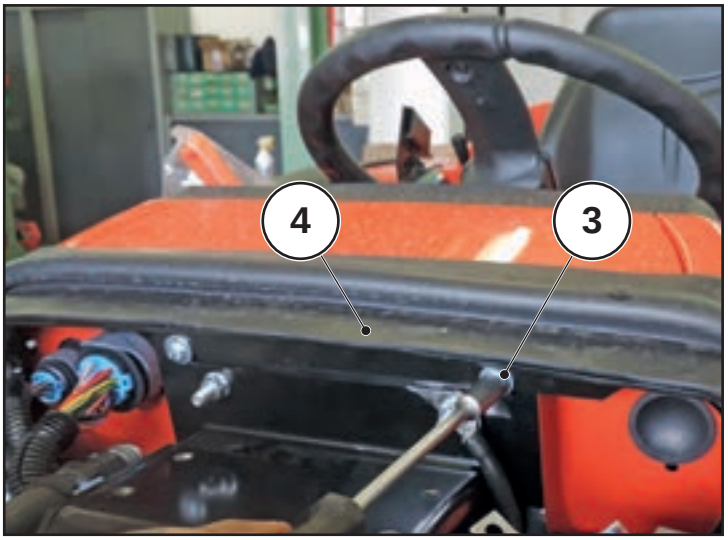


Fig. 14.2

Unscrew the allen screw (5), loosen the lever (6) and remove the seat.

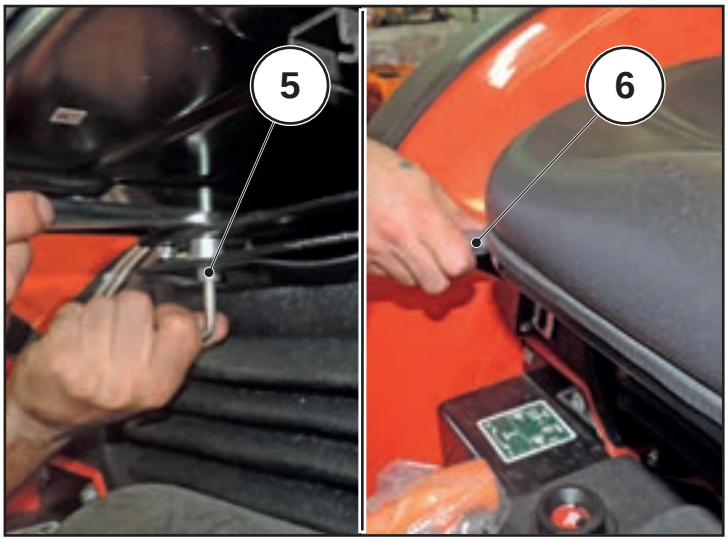


Fig. 14.3

Unscrew the 4 screws (7) that fasten the seat suspension.

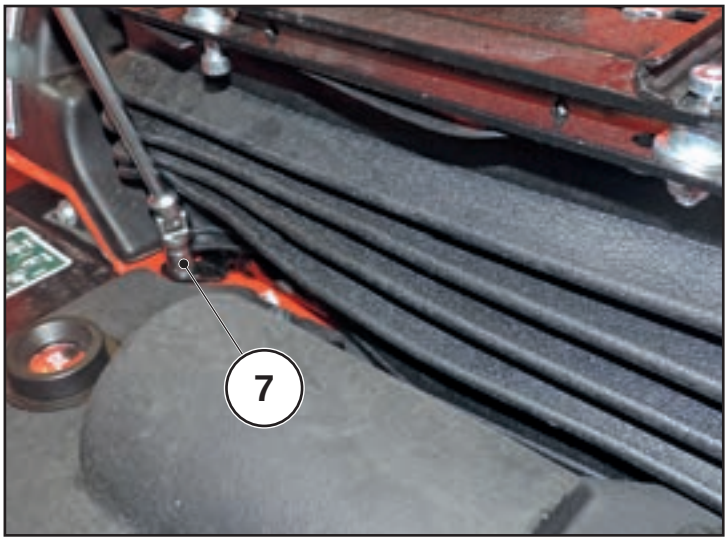


Fig. 14.4

Remove the knob of the rear P.T.O. lever (8) and the hitch lever knobs (9).

Unscrew the fixing screws (10).

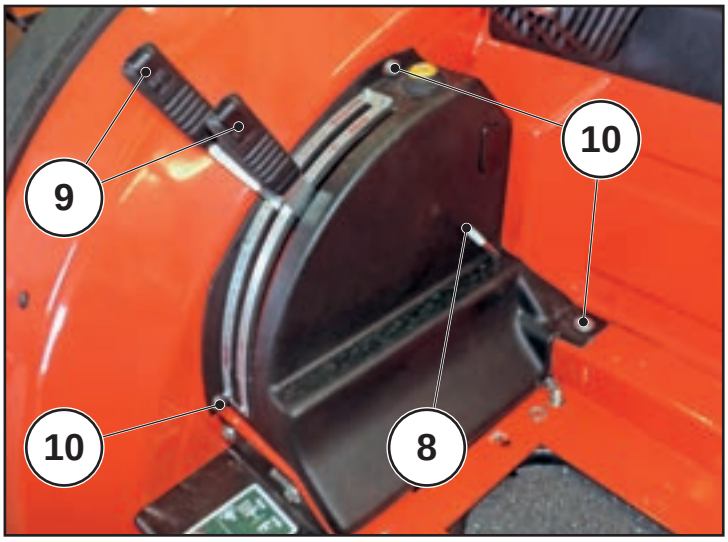


Fig. 14.5

Remove the wiring of the push-button that activates the diff lock (11) and the lever protection (12).

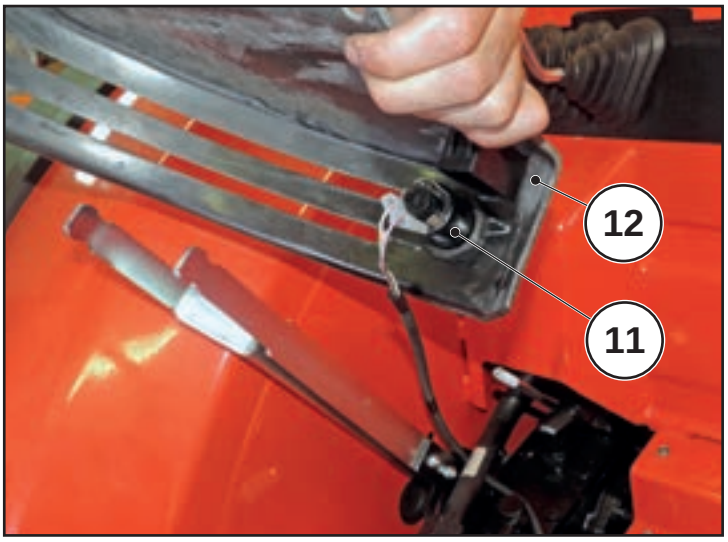


Fig. 14.6

Remove the cover and remove the nut (13) and washer.

Fig. 14.7

Loosen the lever that adjusts the position of the steering wheel and lift this latter so as to completely extent the column.

Use a puller (A- code 07006212) and hammer, move the steering wheel so that it can be removed.

⚠ Warning
Tap very delicately.

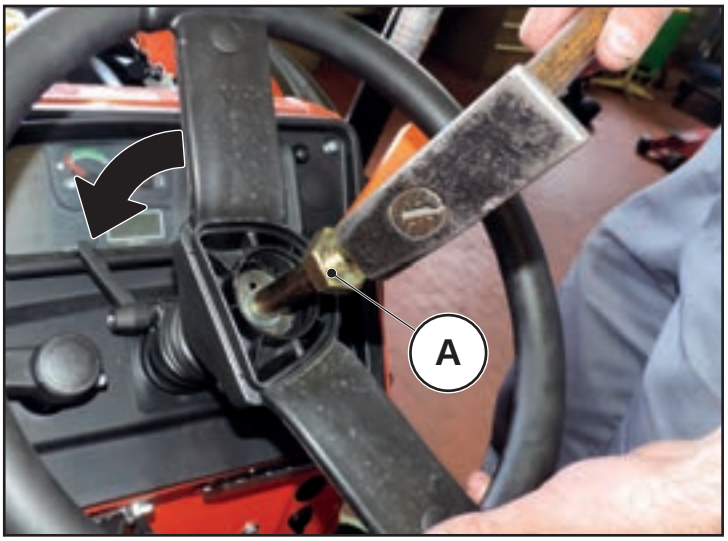


Fig. 14.8

Remove the reverse shuttle lever (14) and the hand throttle lever (15).

Fig. 14.9

Remove the lever that adjusts the position of the steering wheel (16).

Warning
Pull the lever, then unscrew the screw.

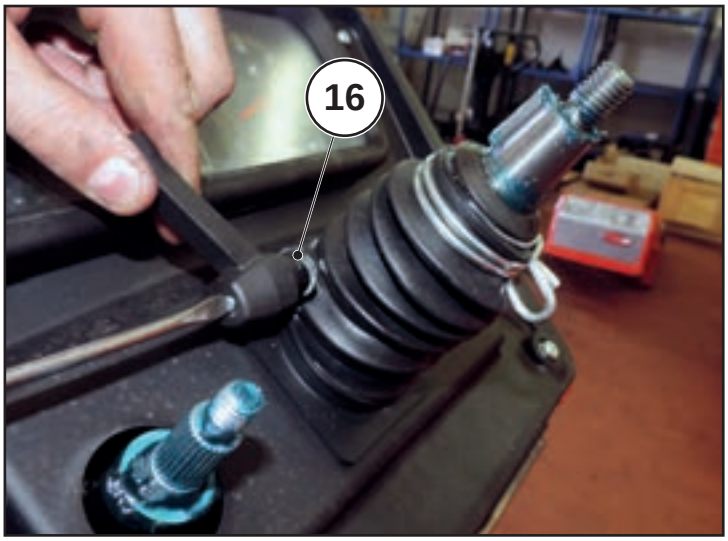


Fig. 14.10

Remove the dashboard by unscrewing the screws that fasten it (17).

Fig. 14.11

Disconnect the connectors.

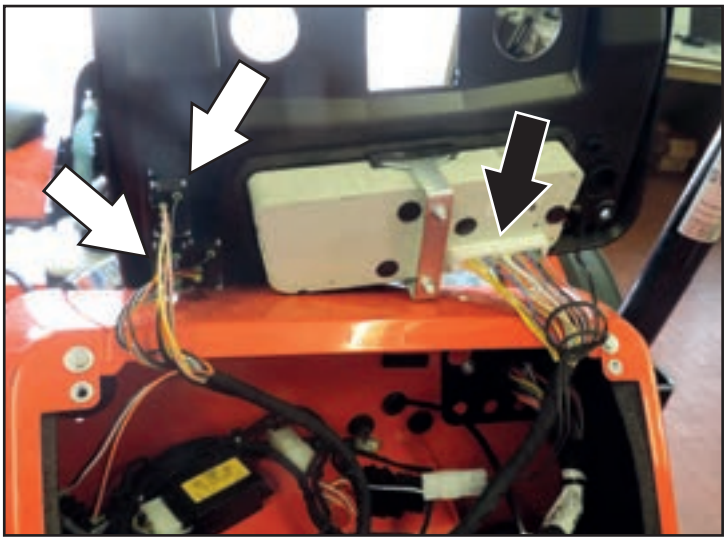


Fig. 14.12

Unscrew the lever that engages the P.T.O. (18) and remove it.

Fig. 14.13

Unscrew the screws that hold the front compartments in place.

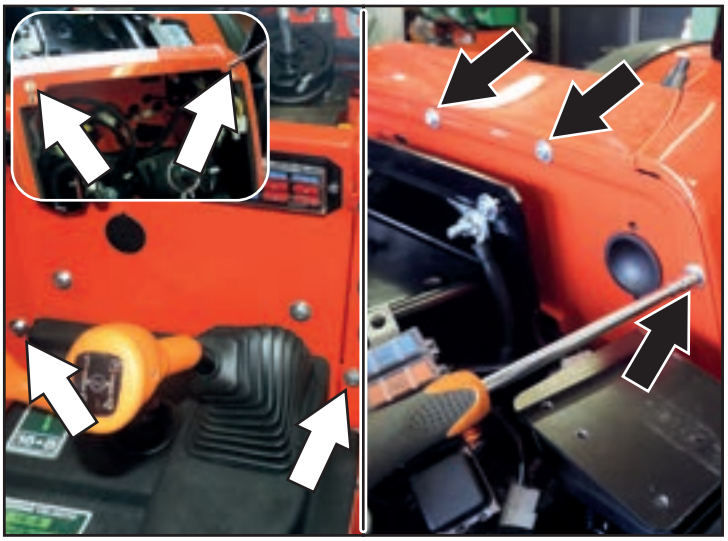


Fig. 14.14

Disconnect the wiring, then remove the compartments.

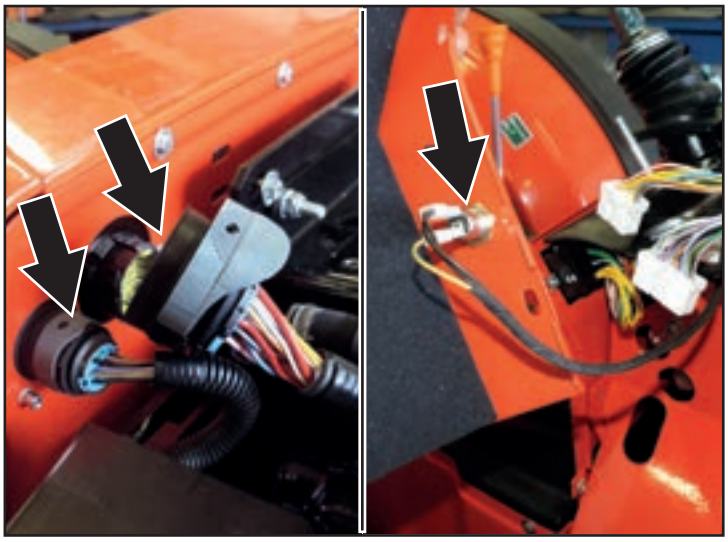


Fig. 14.15

Remove the handgrip (19).

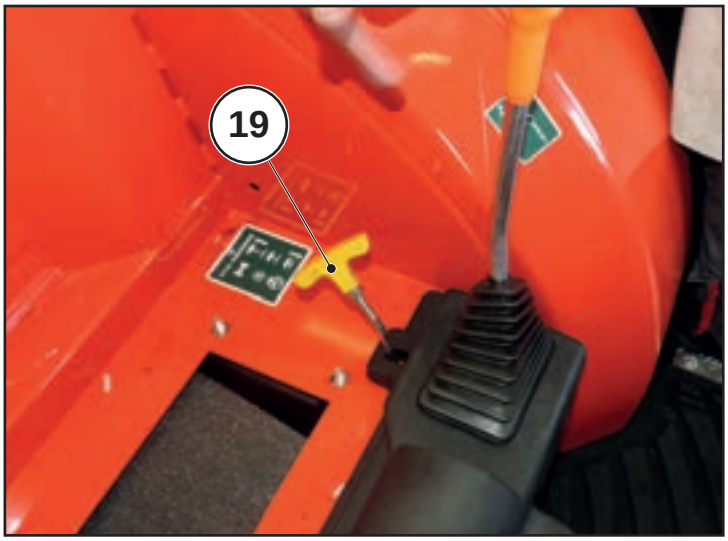


Fig. 14.16

Remove the gearshift lever (20) by unscrewing the screw.

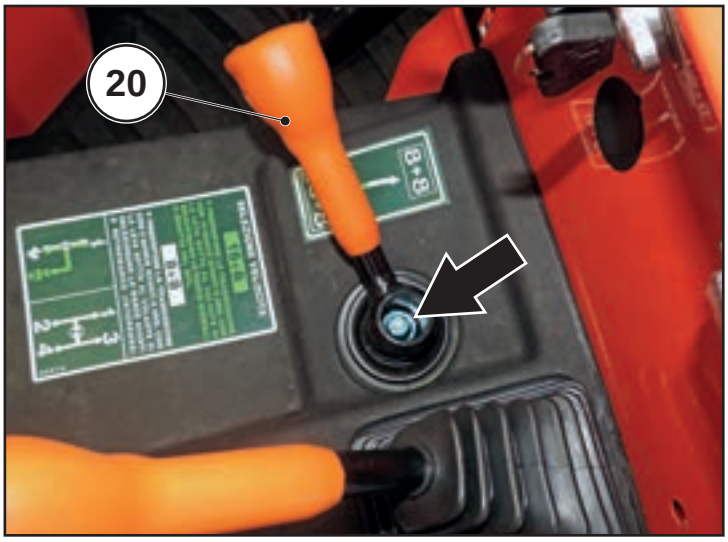


Fig. 14.17

Remove the pin (21) then remove the hand brake lever (22) and spacer (23).

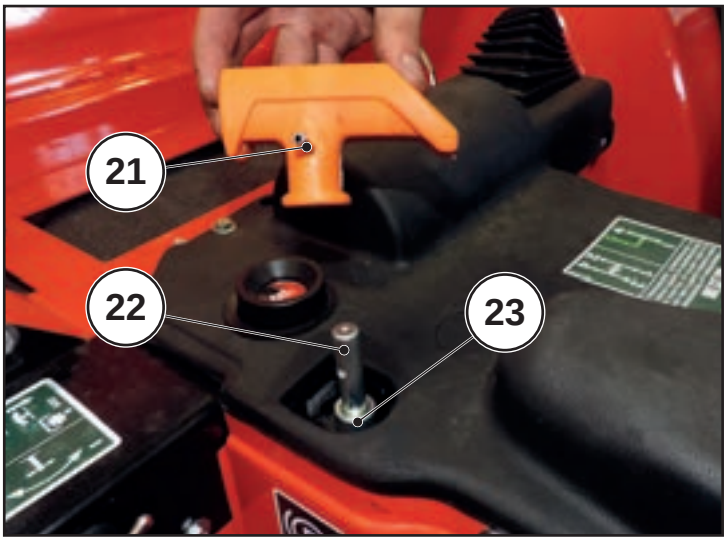


Fig. 14.18

Unscrew the fixing screws (24) and remove the washers (25) of the central covering.

Remove the central covering (26).

Warning

To remove the central covering more easily, the P.T.O. lever must be moved to the "Synchronized" position.

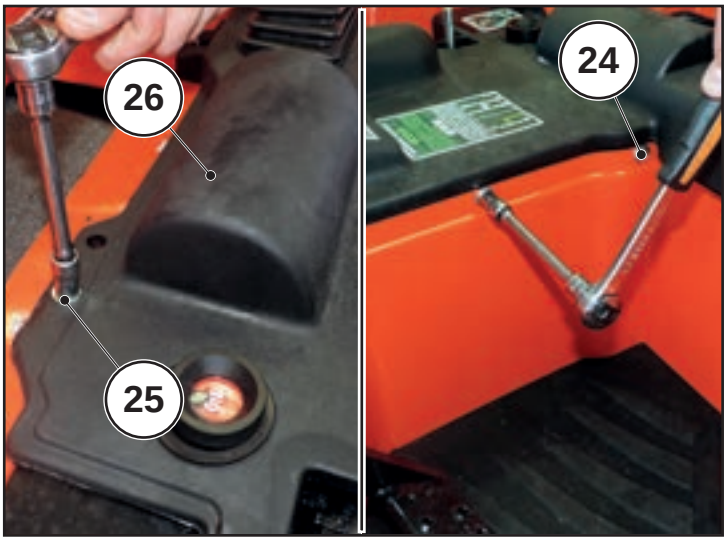


Fig. 14.19

Unscrew the fixing screws (27) and remove the washers (28) of the upper mudguard protection.

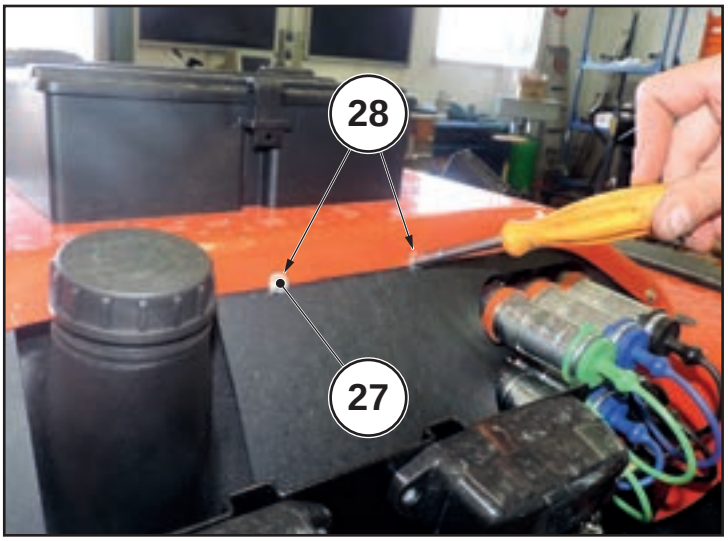


Fig. 14.20

Unscrew the fixing screws (29) and remove the side washers (25) from under the mudguards.

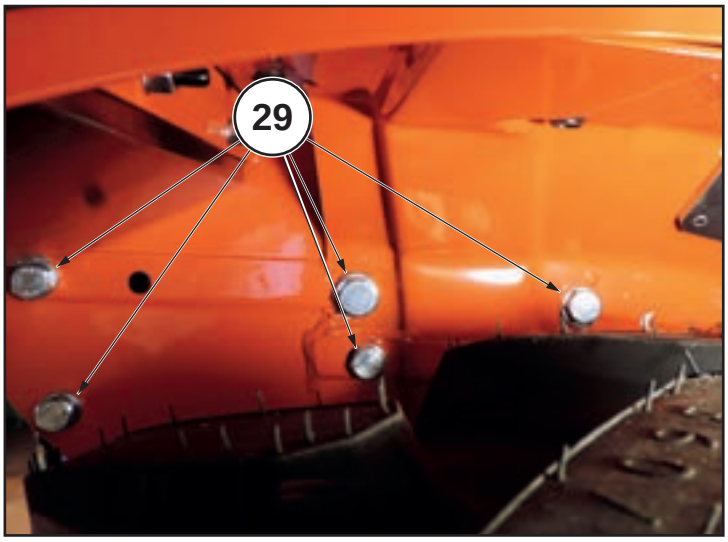


Fig. 14.21

Remove the rear protection.

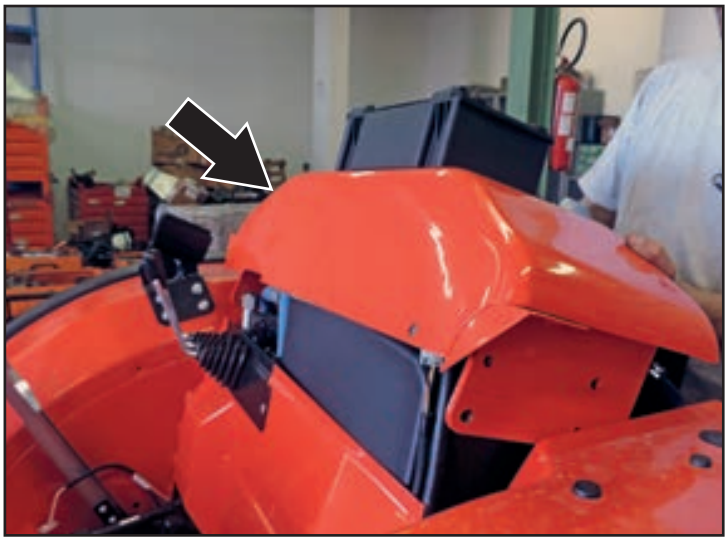


Fig. 14.22

Unscrew the fixing screws (30) and remove the washers (28) from the protective casing of the hitch cock.

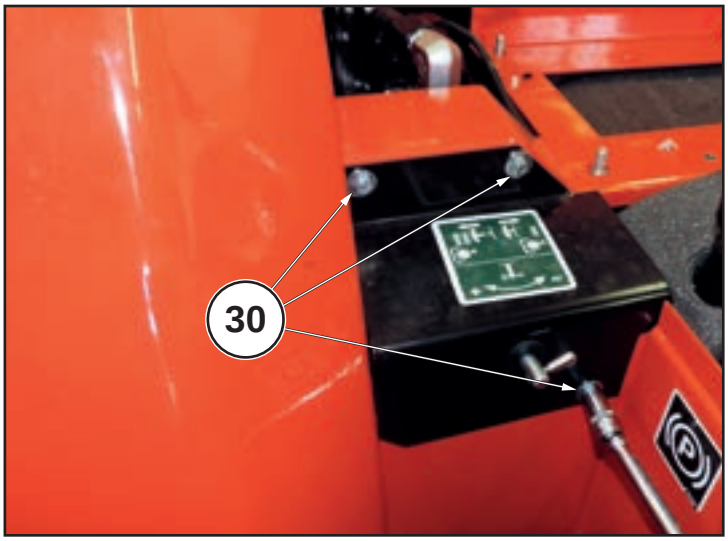


Fig. 14.23

Unscrew the nut (31) and screw (32) so as to remove the cock lever (33).

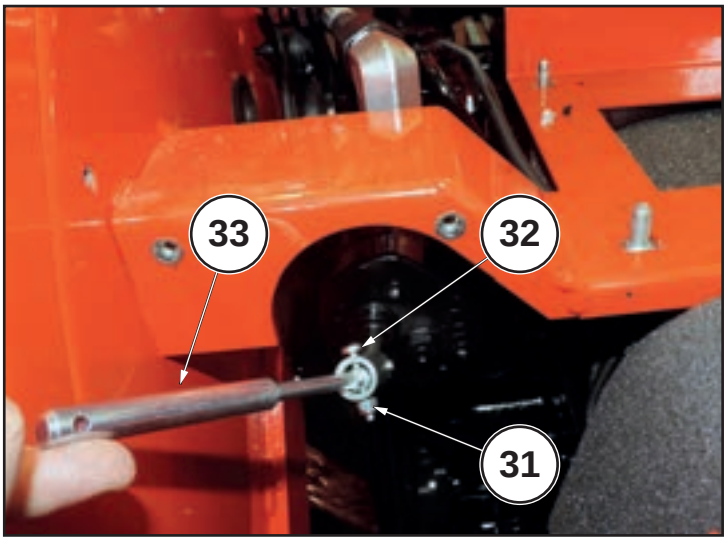


Fig. 14.24

Unscrew and remove the accelerator pedal (34).

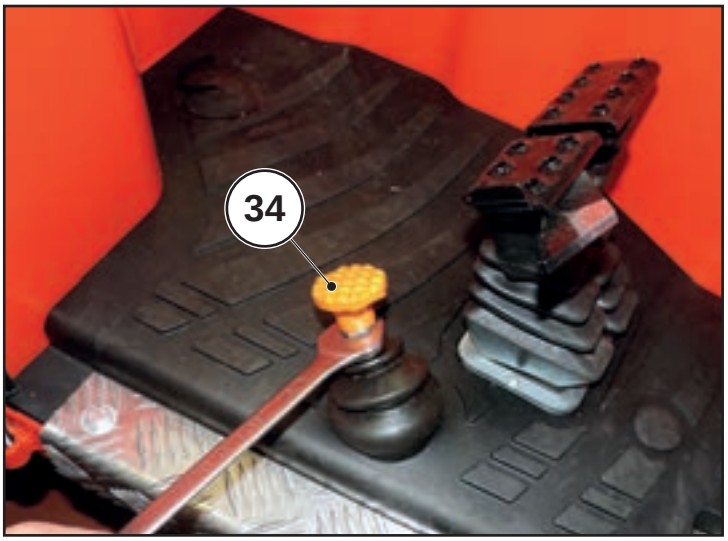


Fig. 14.25

Unscrew the screws (35) that fix the brake pedals and remove them.

Fig. 14.26

Remove the knobs of the rear control valve levers (36), unscrew the screws and remove the support.

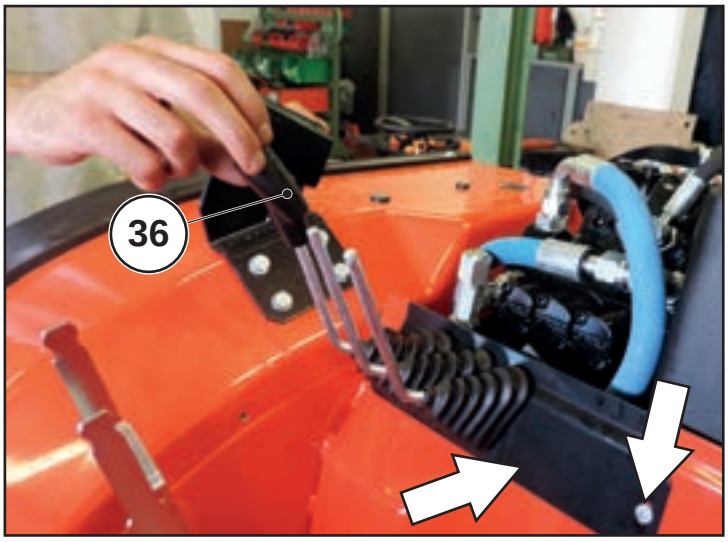


Fig. 14.27

Unscrew the clamp (37) and screws (38) of the protective structure (39), then remove it.

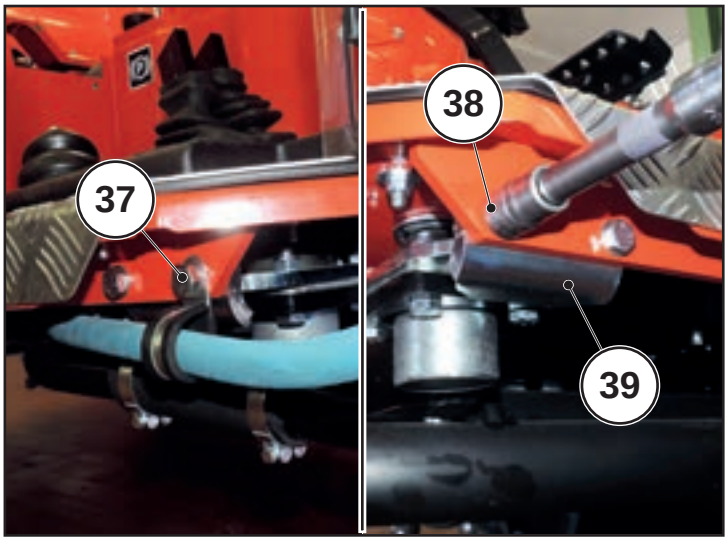


Fig. 14.28

Unscrew the screw and remove the spacers from the clutch pedal (40).

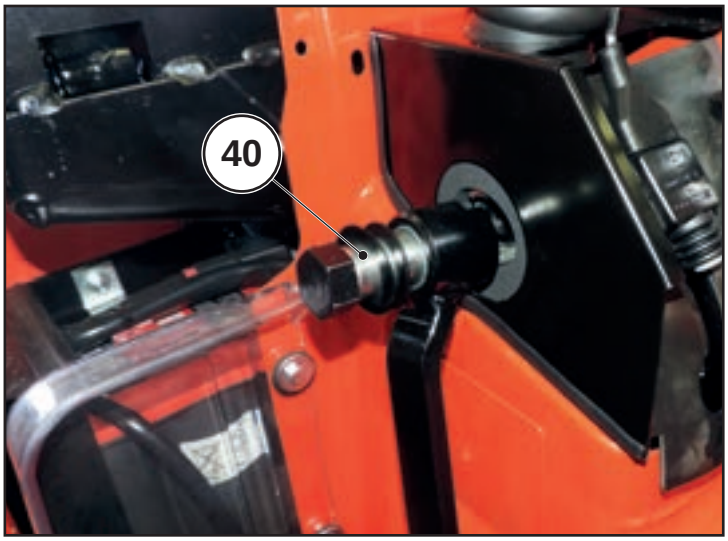


Fig. 14.29

Disconnect the ignition enabling (41) and P.T.O. switch (42) connectors.

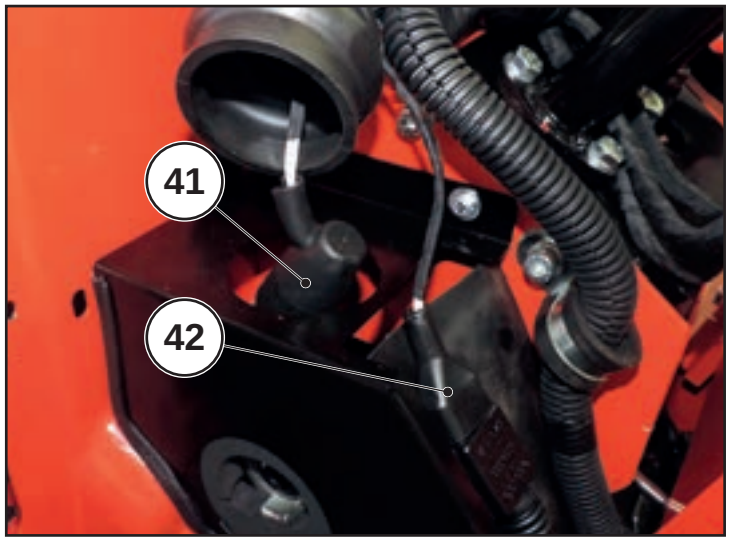


Fig. 14.30

Unscrew the screws and washers (43) from the protective casing of the clutch pedal, then remove it.

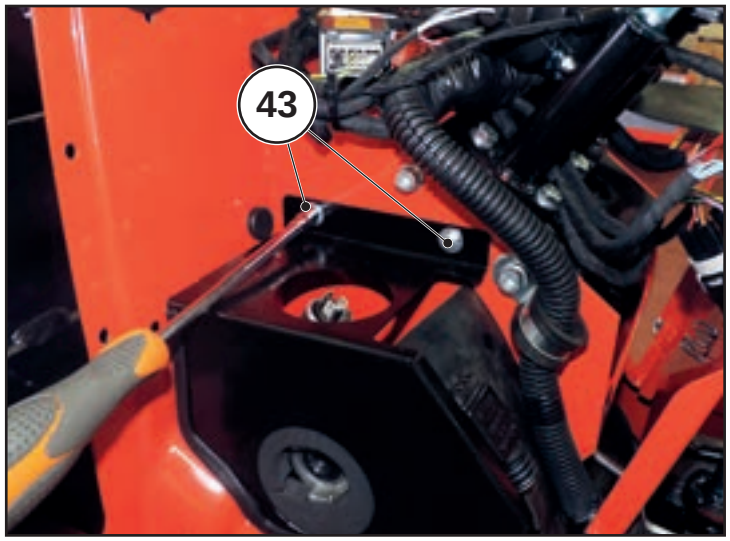


Fig. 14.31

Loosen the clutch pedal end of travel screws (44).

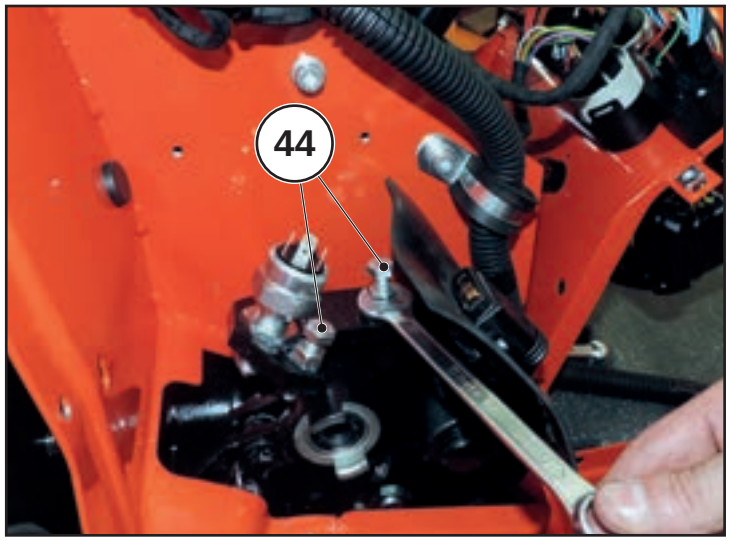


Fig. 14.32

Unscrew the screw (45) and washer from the door (46) that accesses the clutch pedal, then remove it.

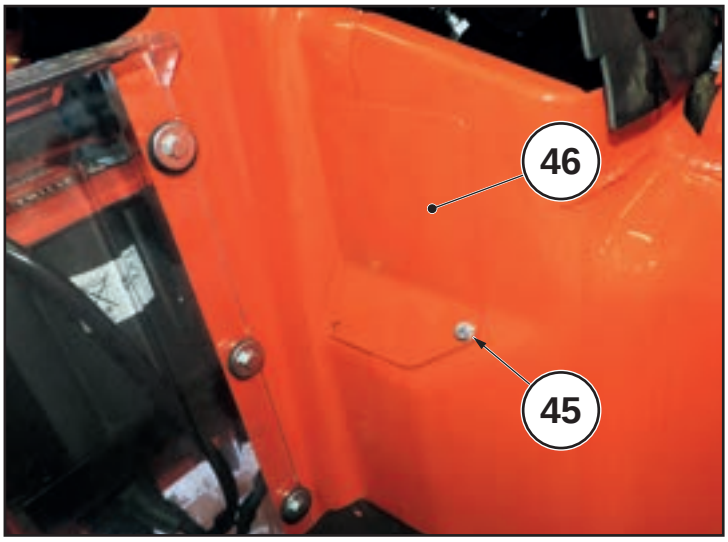


Fig. 14.33

Unscrew the nut (47) to release the clutch return spring.

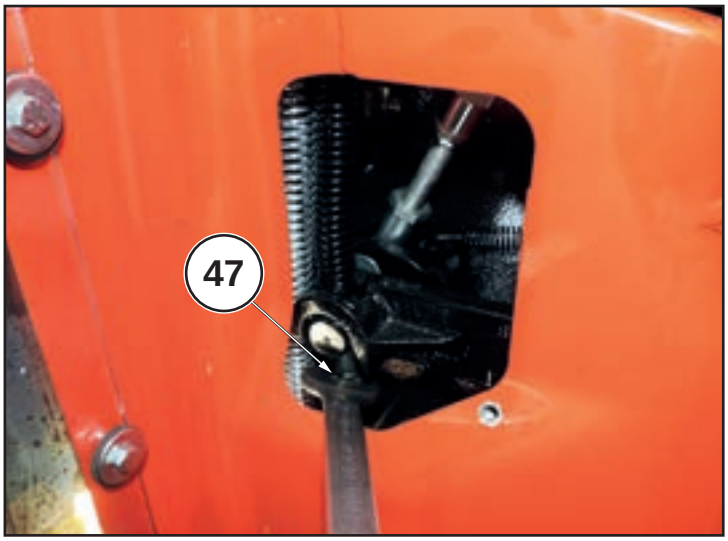


Fig. 14.34

Disconnect the discharge pipe of the control valves (48).

Disconnect the delivery pipe of the control valves (49).

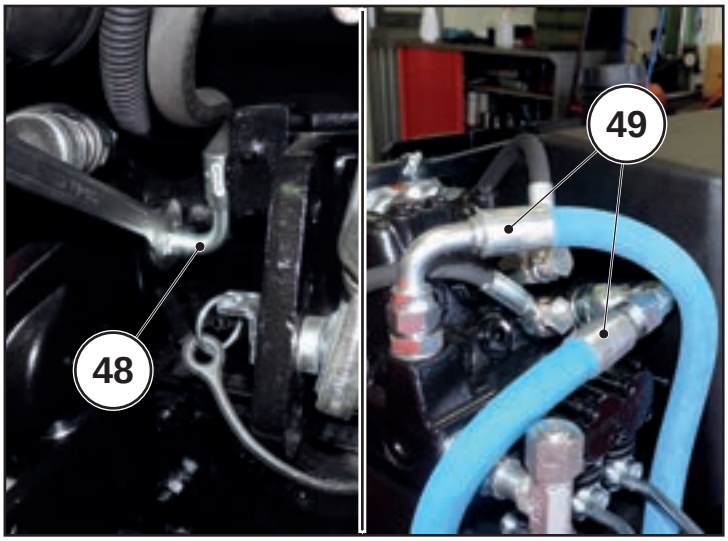


Fig. 14.35

Hold the cable in place with a pair of needle-nose pliers and unscrew the plate (50).

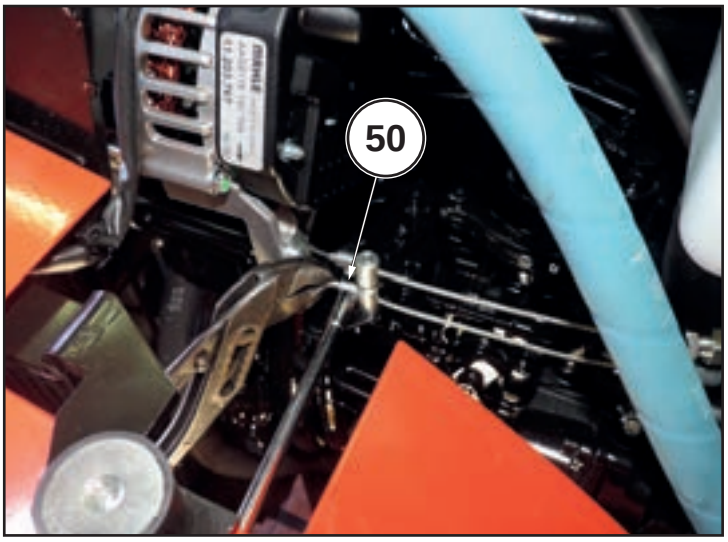


Fig. 14.36

Remove the cable (51) from the driver's position along with the sheath.

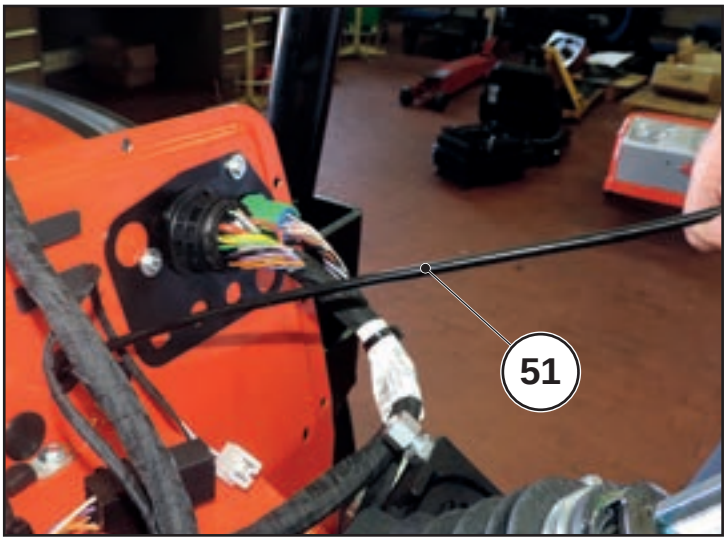


Fig. 14.37

Unscrew the fixing screw (52) and remove the throttle support plate (53).

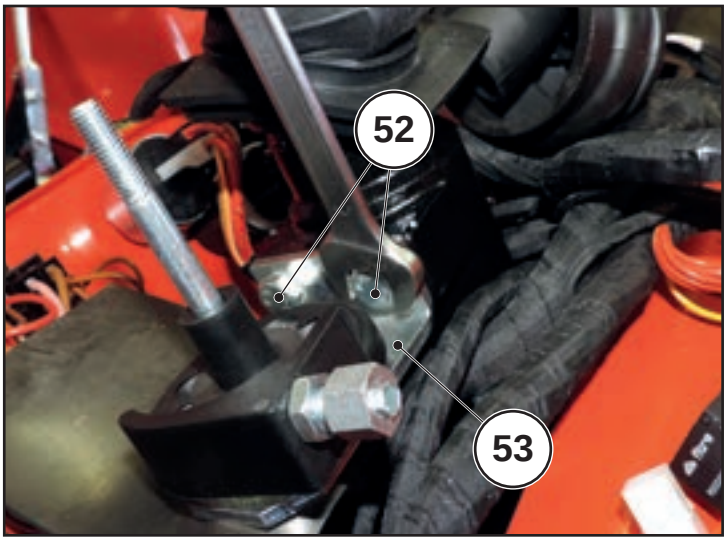


Fig. 14.38

Unscrew the fixing screws (54) and remove the wiring support plate (55) so as to free the point in which the platform is lifted.

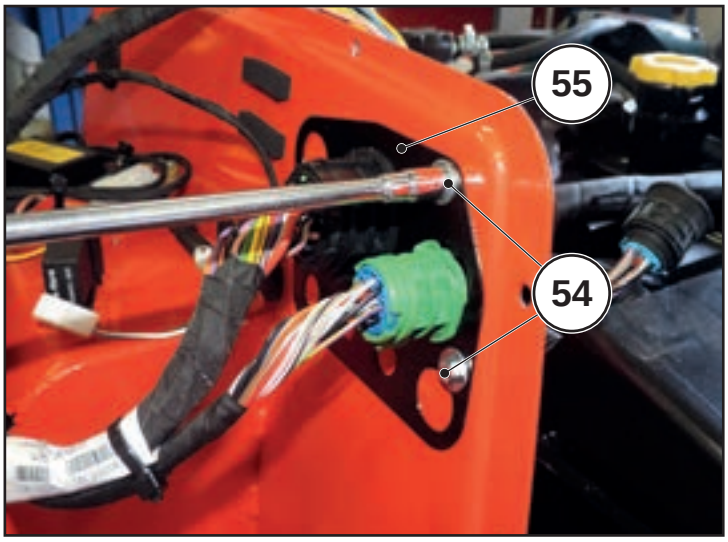


Fig. 14.39

Unscrew the nut and screw (56) that fix the lever (57), then remove it.

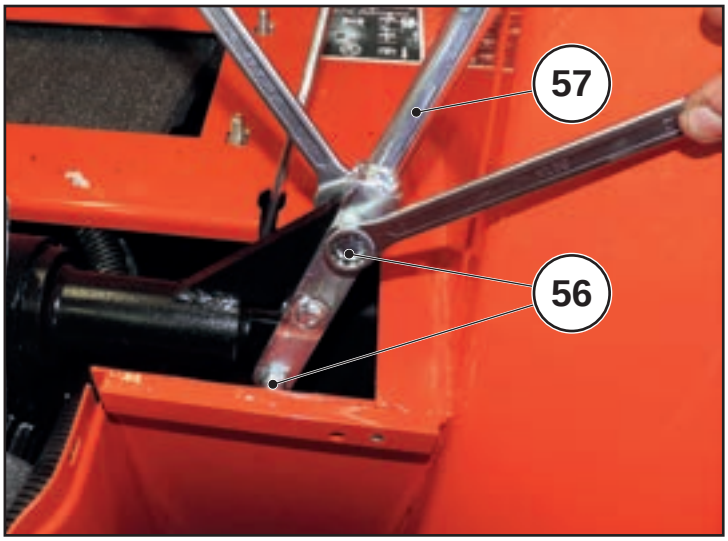


Fig. 14.40

Unscrew the allen screws (58) that fasten the power steering unit.

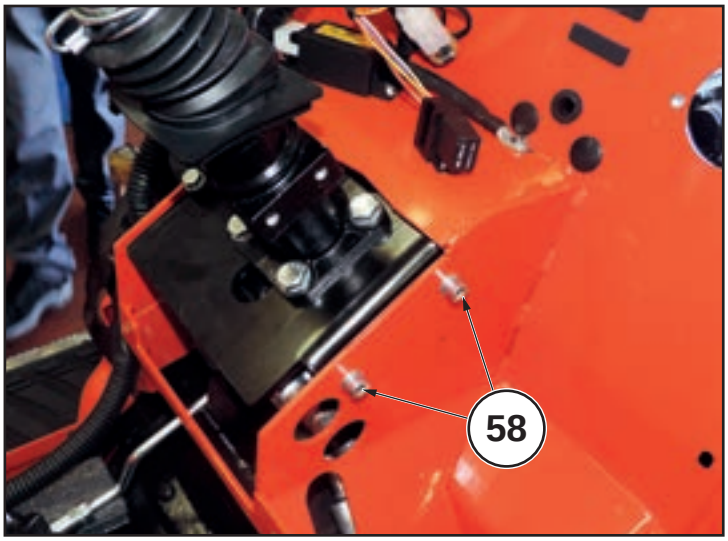


Fig. 14.41

Unscrew the clamp (59) and remove the fuel outlet pipe (60).

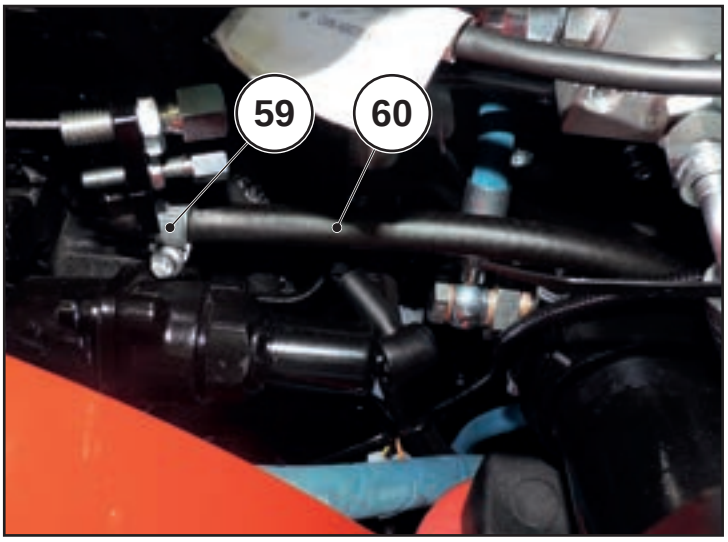


Fig. 14.42

Unscrew the screws and remove the washers (61) from the protective casing of the engine oil filter, then remove the casing (62).

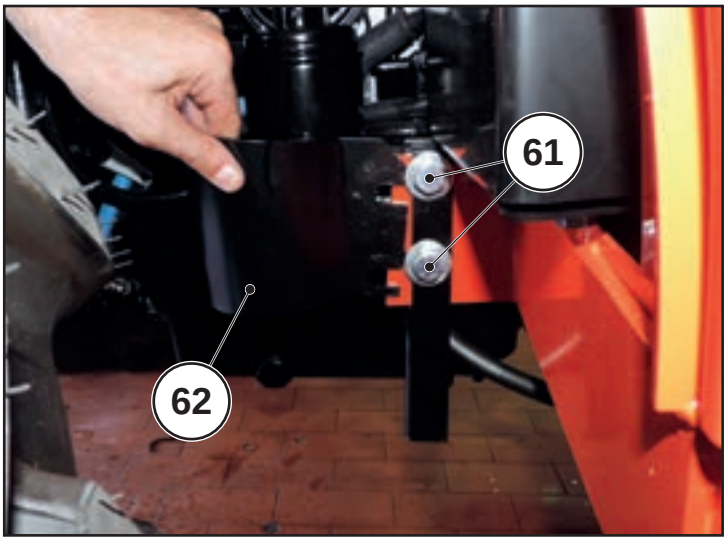


Fig. 14.43

Unscrew the clamp (63) and disconnect the delivery tube of the filter.

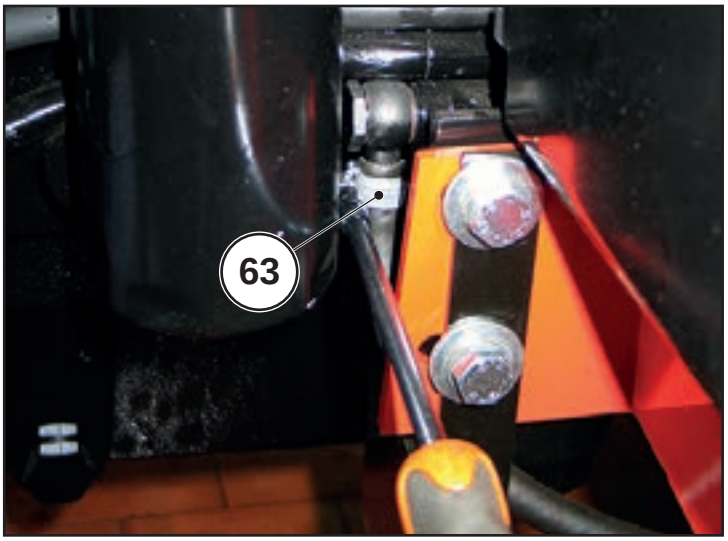


Fig. 14.44

Remove the Kalvas plate (64) of the accelerator pedal cable (65) and remove it from its housing.

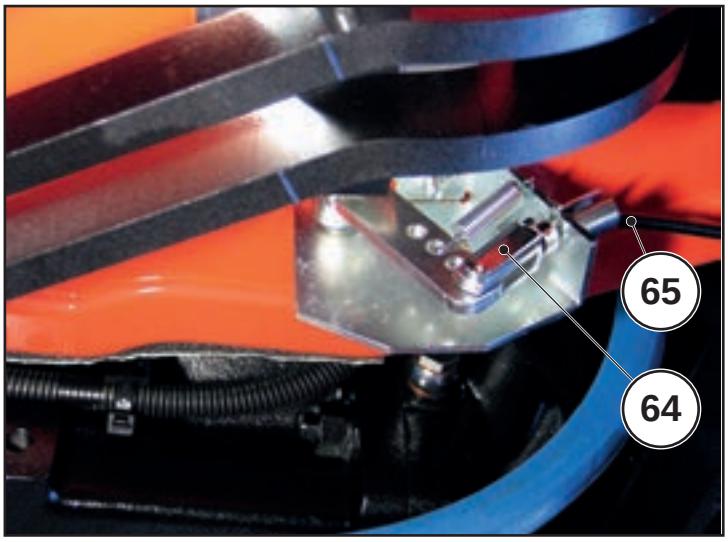


Fig. 14.45

Remove the plugs (66) from the footboards and unscrew the front and rear screws (67).

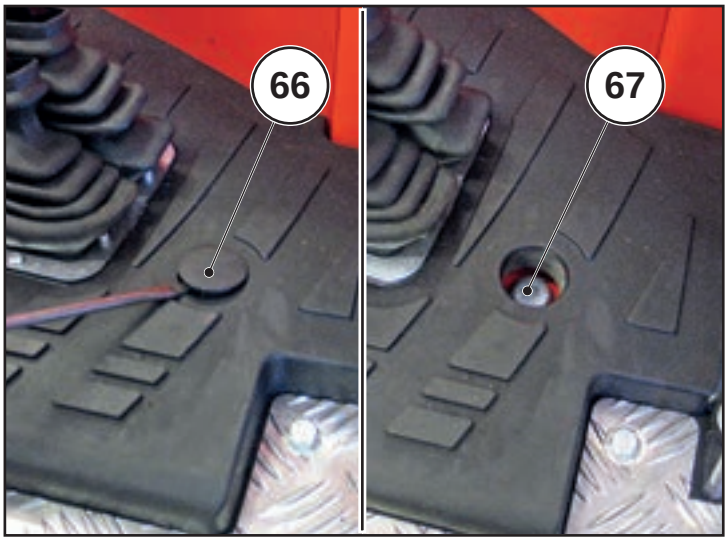


Fig. 14.46

Remove the ground point nut (68) and take out the eyelet.

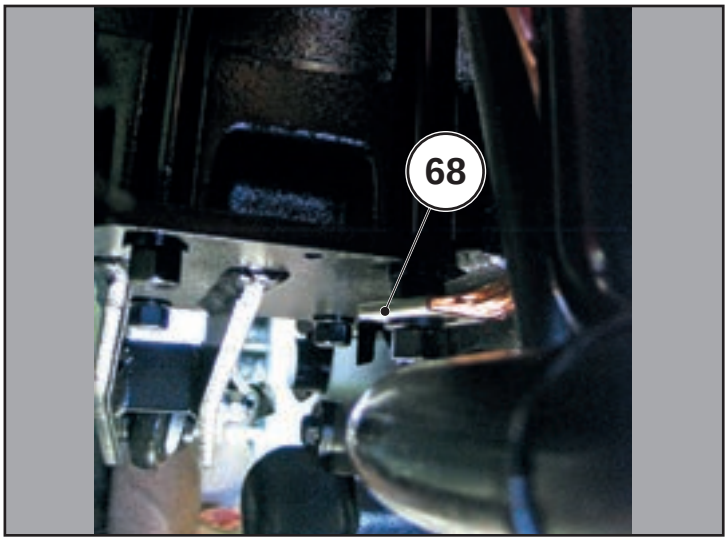


Fig. 14.47

Use tool (B-07007181) to lift the platform.

Warning
Use lifting equipment with an adequate capacity.

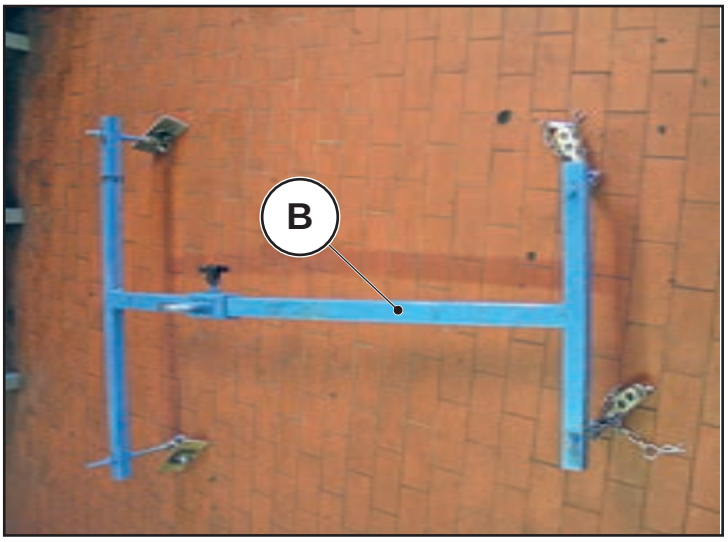


Fig. 14.48

2.3 Re-assembly

Danger
Make sure that all persons keep well away from the danger zone.

Warning
Before proceeding with the re-assembly operations, carefully read and comply with the instructions given in chapter "1-Introduction", especially those describing how to assemble O-Rings, oil retainers and bearings. Use the correct tightening torques when screwing in the components. Consult the table in chapter "1-Introduction" if the tightening torque value is not given. Use the indicated sealants when re-assembling the parts. Consult the table in chapter "1-Introduction" if the sealant is not indicated.

Comply with the disassembly instructions in reverse order when re-assembling the platform.

Section 3 : Tools required

Index

3.1 Tools required 14-22

3.1 Tools required

Code	Description	Quantity
07006212	Steering wheel puller	1
07007181	Platform/cab lifting tool	1

Chapter 15 : Cab

Index

Section 1 : Safety notes 15-2

Section 2 : Technical specifications 15-5

2.1 Technical specifications 15-6

Section 3 : Splitting and re-assembly 15-7

3.1 Preliminary operations 15-8
3.2 Removal of SG1 cab 15-8
3.3 Reassembly of SG1 cab 15-11
3.4 Removal of GL9 cab 15-12
3.5 Reassembly of GL9 cab 15-16

Section 4 : Air conditioning system 15-17

4.1 General description 15-18
4.2 How to empty and recharge the system 15-36
4.3 Functionality tests 15-40

Section 5 : Tools required 15-43

5.1 Tools required 15-44

Section 1 : Safety notes

To prevent accidents and injuries, always comply with the precautions and safety recommendations described in this section. In addition, operators must always comply with the safety instructions given in the operation and maintenance manual and in chapter 1 of this manual.

Danger

Make sure that all persons keep well away from the danger zone.

Danger

Always comply with the operating instructions supplied by the manufacturer when using adhesive materials or detergents.

Danger

Used oil must be collected and disposed of in compliance with the anti-pollution laws in force.

Danger

Take care to avoid burns when working with boiling oil. Never heat oil to temperatures exceeding 190°C as the oil or its vapours could suddenly catch fire.

Danger

Splashes of fluid under pressure can penetrate under the skin and cause serious injuries. If accidents occur, immediately seek medical help in order to avoid serious infections.

Danger

Lift and handle all heavy parts with lifting equipment of an adequate capacity. Arrange all harness and hooks in safe positions. Operators must remain at a distance and in a safe position, well away from the lifted load.

Danger

Do not twist the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Danger

Use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.

Danger

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

Danger

For safety reasons, always leave two screws on opposite sides when removing components that could fall. Only remove these screws after having secured the component to lifting equipment or placed bearing blocks underneath.

Danger

If the bolts that fix the safety frame or cab have loosened or if the safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

Danger

Always wear protective goggles and gloves when handling coolant.

Do not allow the coolant to splash on to the skin.

Danger

The equipment for treating the coolant must be used in adequately ventilated places, with at least four air changes per hour.

Danger

Do not use equipment for treating coolant near open containers holding inflammable substances or with leaks.

Danger

Do not tamper with or modify the settings of the breather and safety valves in the containers and equipment for treating coolant.

Danger

Do not fill any vessel (cylinder, A/C charging equipment) with coolant unless it has not been approved for the purpose and equipped with a relative safety valve.

Danger

Do not fill any storage vessel beyond 80% of its capacity.

Danger

Take the utmost care when the service pipes are disconnected since they may contain pressurized coolant.

Section 2 : Technical specifications

Index

2.1 Technical specifications 15-6

2.1 Technical specifications

Coolant fluid

Type	R134
Quantity	0.8 kg

Section 3 : Splitting and re-assembly

Index

3.1 Preliminary operations 15-8

3.2 Removal of SG1 cab 15-8

3.3 Reassembly of SG1 cab 15-11

3.4 Removal of GL9 cab 15-12

3.5 Reassembly of GL9 cab 15-16

3.1 Preliminary operations

Warning
Discharge all the gas from the air conditioning system before proceeding with the operations required to split the cab from the tractor.

3.2 Removal of SG1 cab

Unscrew the screws (1) and washers and remove the side covers (2).

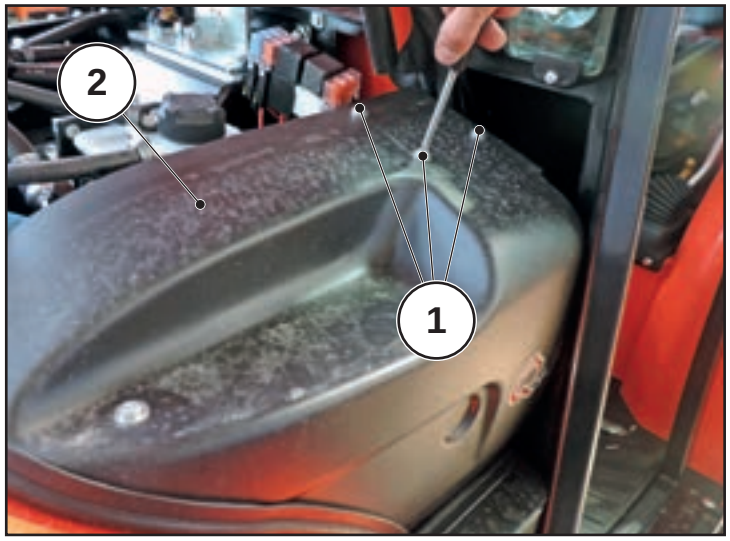


Fig. 15.1

Remove the clamps (3).

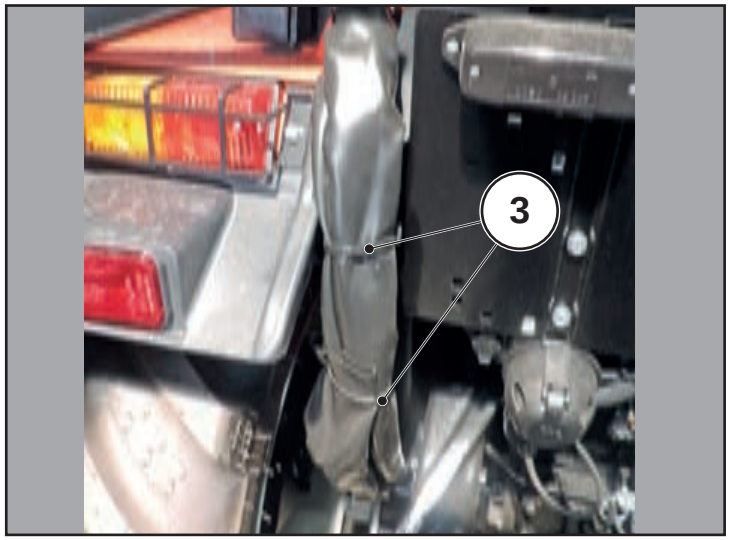


Fig. 15.2

Disconnect the wiring (4).

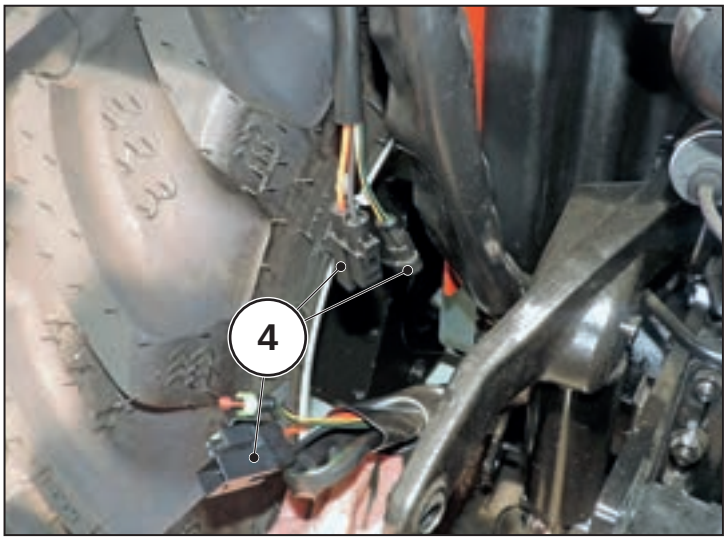


Fig. 15.3

Disconnect the water and air conditioning tubes (5) on the right and left sides.

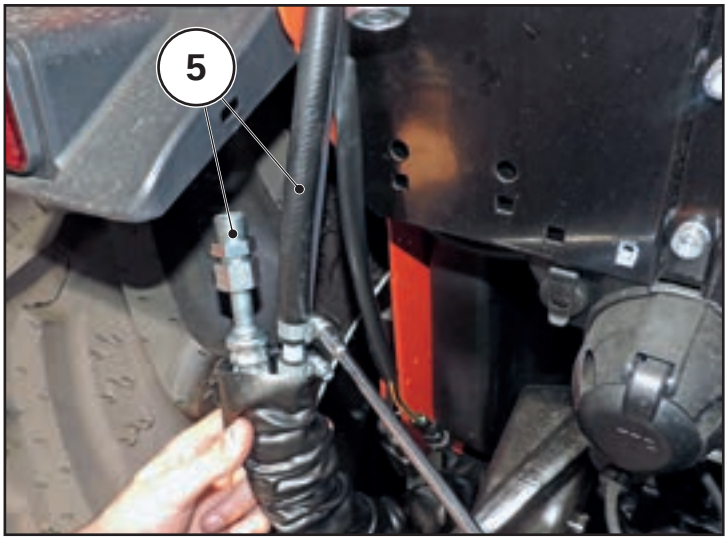


Fig. 15.4

Remove the screws that fasten the cab (6) along with their nuts and washers on the rear right and rear left sides.

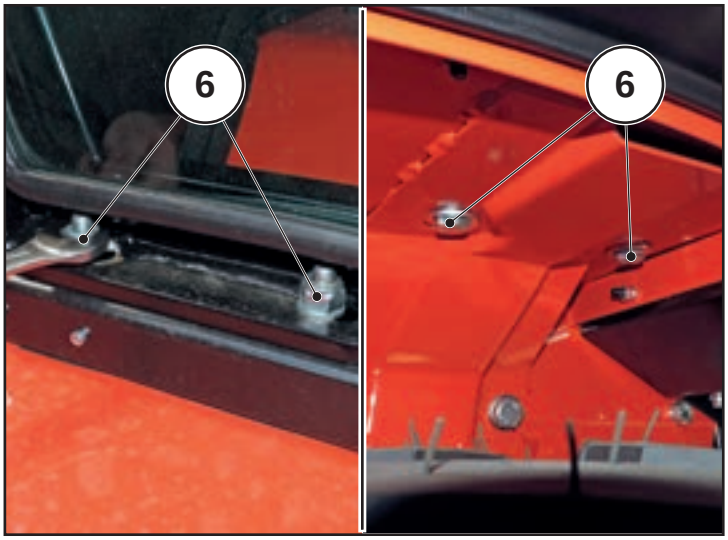


Fig. 15.5

Unscrew the nuts and remove the lower screws (7) from the front part of the footboards.

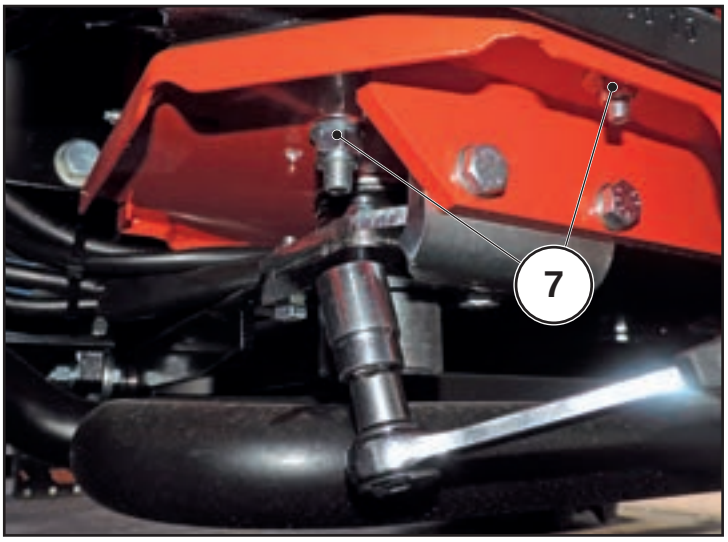


Fig. 15.6

Unscrew and remove the clamps (10) and disconnect the water pipes.

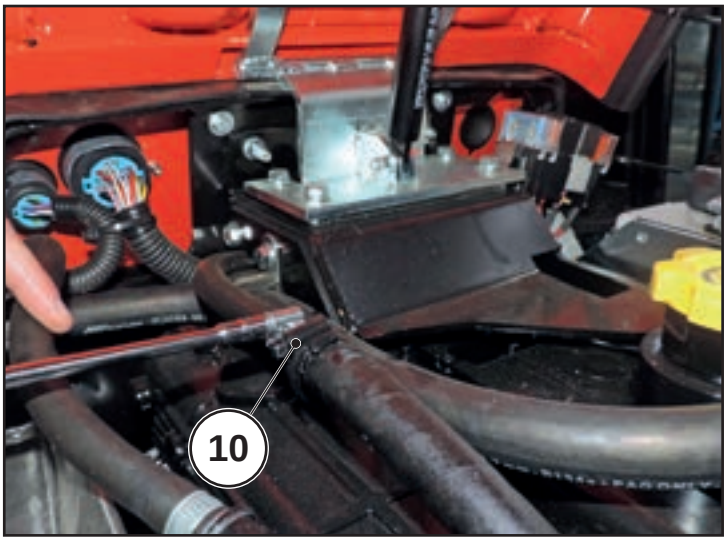


Fig. 15.7

Warning

If the cab is to be completely removed from the tractor, unscrew the pipe unions (8) from the compressor (9).

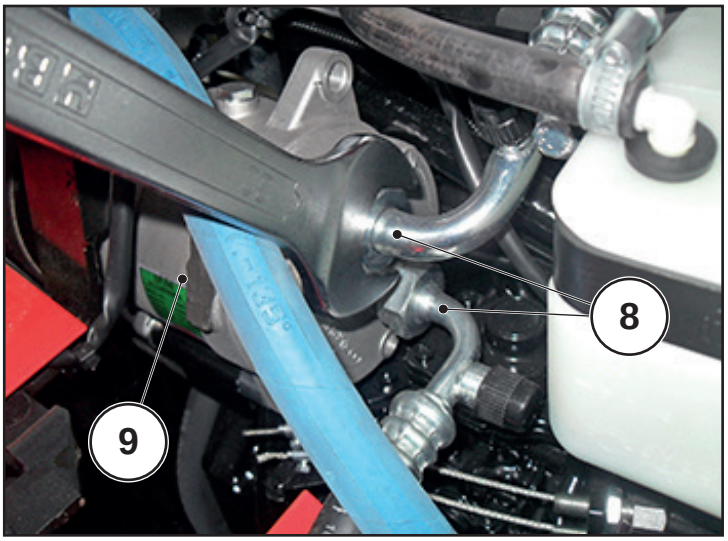


Fig. 15.8

Raise the cab (25) using suitable lifting equipment (24).

Caution

Make sure that the lifting harness is positioned as near as possible to the rear part of the cab so as to prevent this from becoming misshapen when the cab is lifted.

Fig. 15.9

3.3 Reassembly of SG1 cab

Danger

Make sure that all persons keep well away from the danger zone.

Warning

Before proceeding with the re-assembly operations, carefully read and comply with the instructions given in chapter "1-Introduction", especially those describing how to assemble O-Rings, oil retainers and bearings.

Use the correct tightening torques when screwing in the components. Consult the table in chapter "1-Introduction" if the tightening torque value is not given.

Use the indicated sealants when re-assembling the parts. Consult the table in chapter "1-Introduction" if the sealant is not indicated.

Comply with the splitting instructions in reverse order when reassembling the cab.

3.4 Removal of GL9 cab

Remove the side covers (11).

Fig. 15.10

Unscrew the four screws that fasten the cab (12), two in the front part and two in the rear part of the cab.

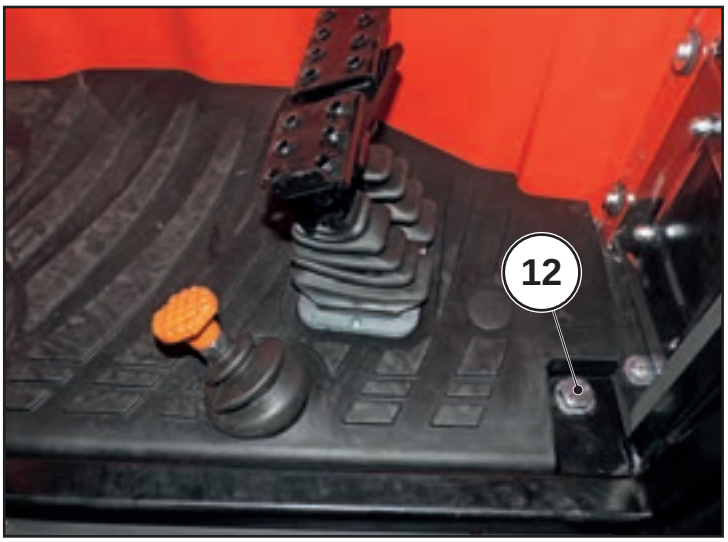


Fig. 15.11

Unscrew the tube unions (8) from the compressor (9).

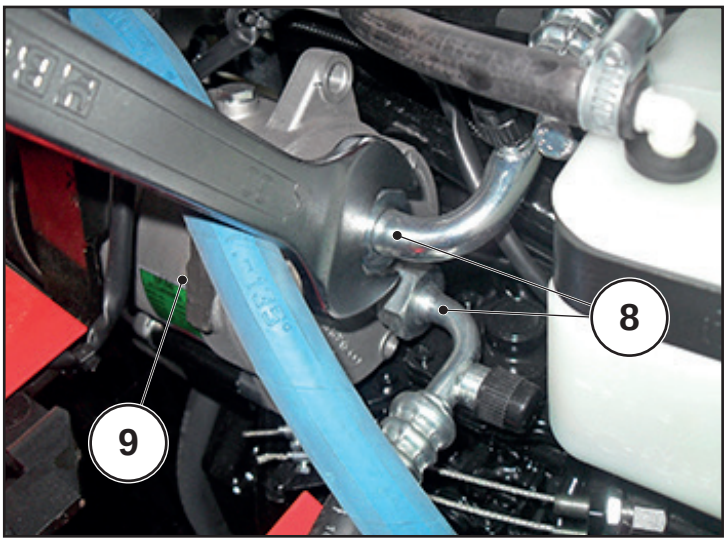


Fig. 15.12

Unscrew the clamp (13).

Disconnect the water pipes (14).

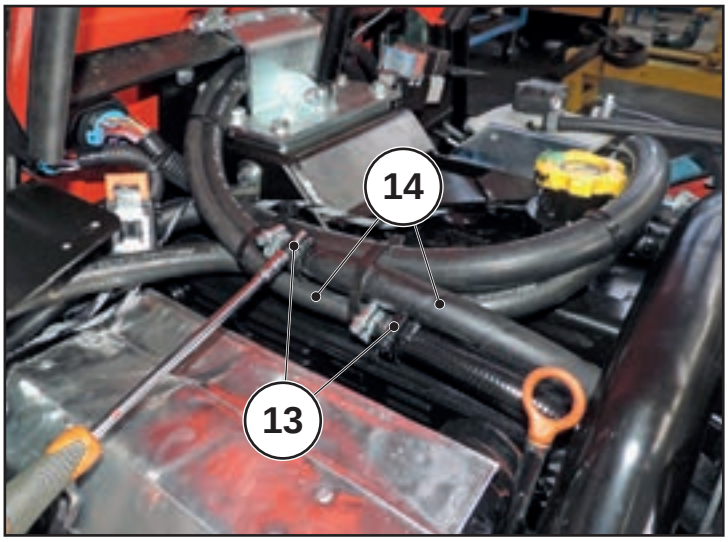


Fig. 15.13

Unscrew the nut (15) and remove the grounding eyelet (16).

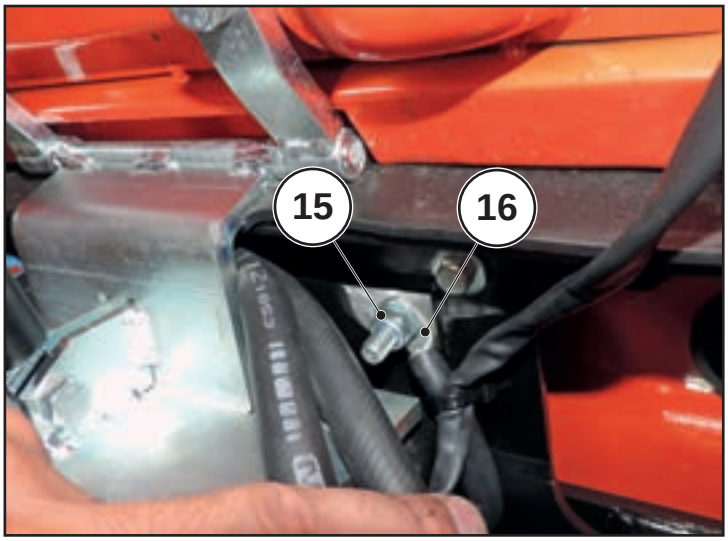


Fig. 15.14

Unscrew the screws (17) and remove the protection (18).

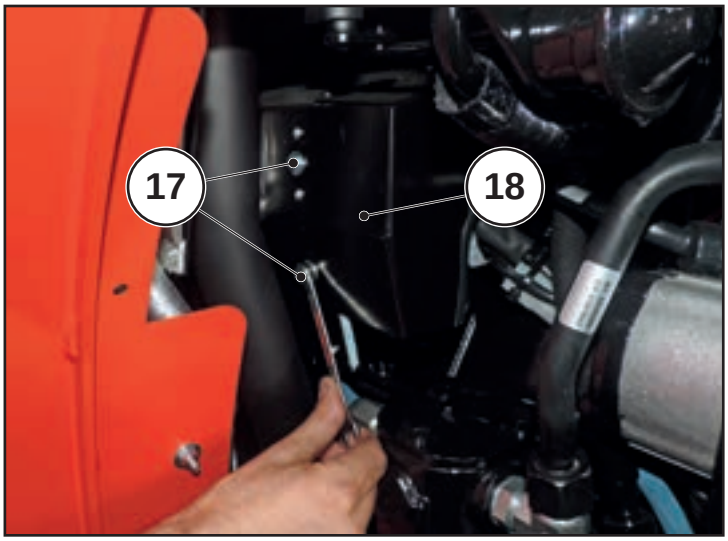


Fig. 15.15

Disconnect the connector (19).

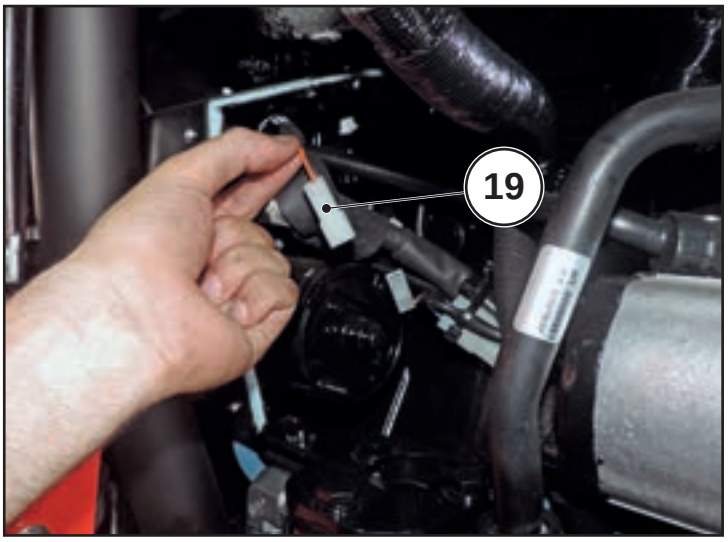


Fig. 15.16

Disconnect the positive cable (20).

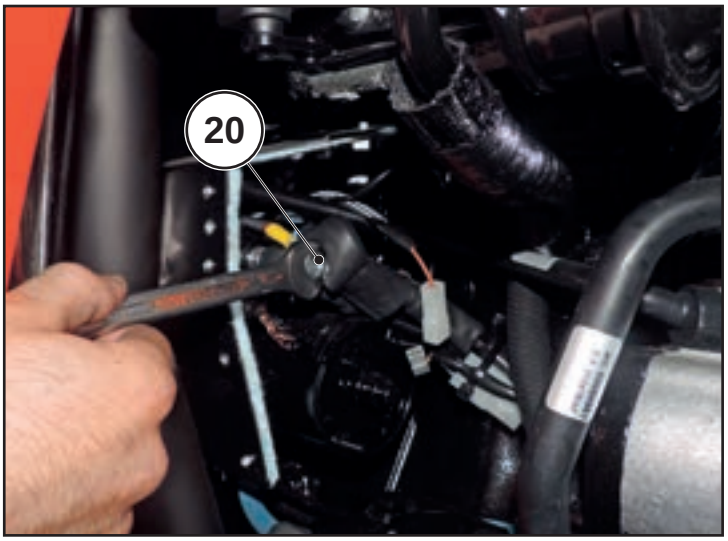


Fig. 15.17

Unscrew the four screws (21).

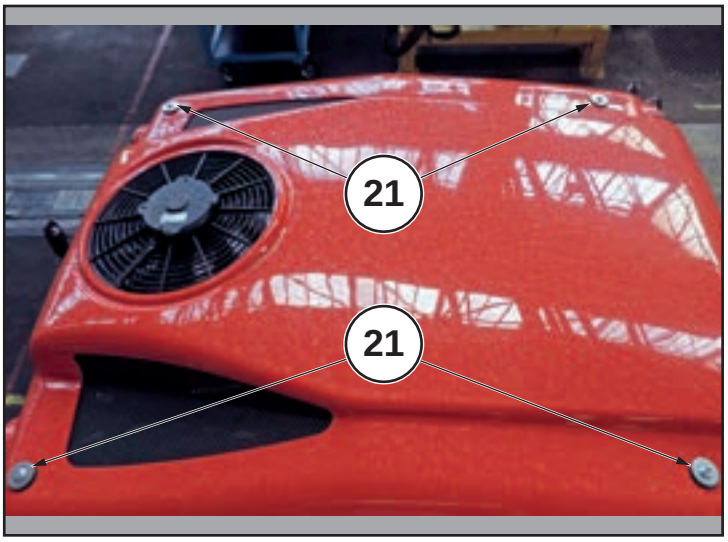


Fig. 15.18

Remove the cover (22).

Screw in the four eyebolts (23).

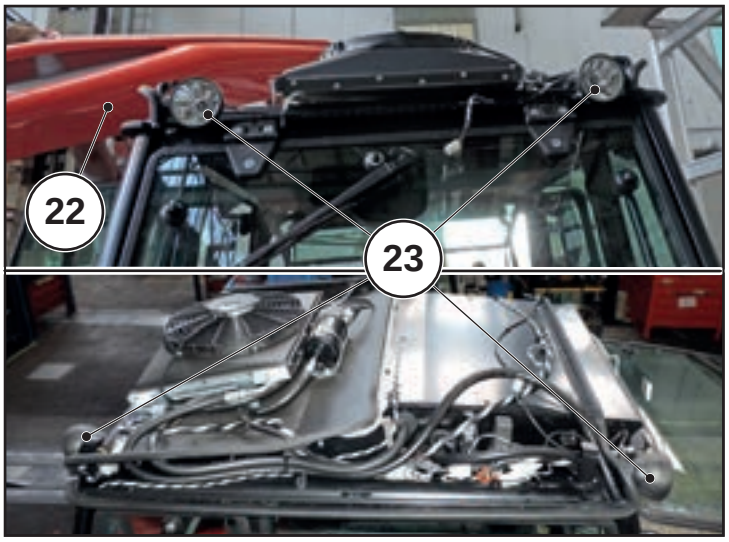


Fig. 15.19

Use tool (A-07007181) to lift the platform.

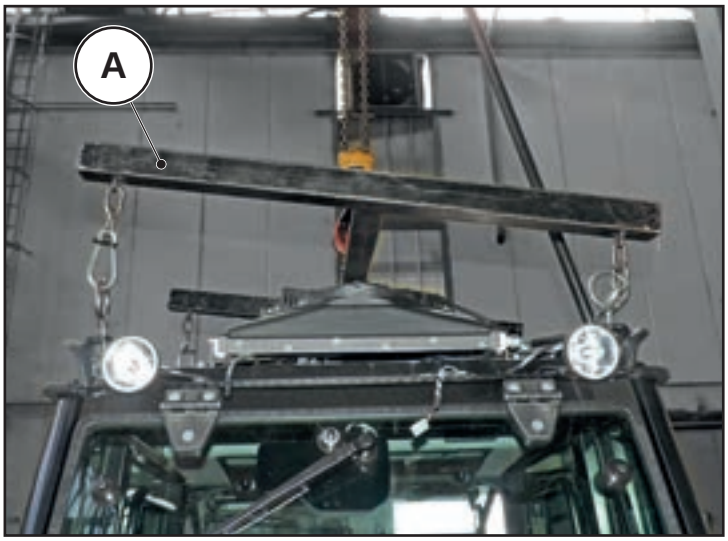


Fig. 15.20

3.5 Reassembly of GL9 cab

Danger

Make sure that all persons keep well away from the danger zone.

Warning

Before proceeding with the re-assembly operations, carefully read and comply with the instructions given in chapter "1-Introduction", especially those describing how to assemble O-Rings, oil retainers and bearings.

Use the correct tightening torques when screwing in the components. Consult the table in chapter "1-Introduction" if the tightening torque value is not given.

Use the indicated sealants when re-assembling the parts. Consult the table in chapter "1-Introduction" if the sealant is not indicated.

Comply with the splitting instructions in reverse order when reassembling the cab.

Section 4 : Air conditioning system

Index

4.1 General description 15-18
4.1.1 Basic concepts 15-18
4.1.1.1 Introduction 15-18
4.1.1.2 Pressure 15-18
4.1.1.3 Heat and temperature 15-20
4.1.1.4 Influence of heat on transformations of physical states in bodies (at constant pressure) 15-23
4.1.1.5 Influence of pressure on transformations of physical state in bodies 15-26
4.1.1.6 Relations between temperature, pressure and volume in aeriform substances 15-28
4.1.1.7 Humidity 15-28
4.1.2 Operating principle of a cooling cycle 15-29
4.1.2.1 Description of a cooling cycle and air treatment 15-29
4.1.2.2 Notes and considerations 15-32
4.1.3 Main components of an air conditioning system 15-33
4.1.3.1 Coolant or cooling fluid 15-33
4.1.3.2 Evaporator 15-34
4.1.3.3 Compressor (F) 15-34
4.1.3.4 Condenser (G) 15-35
4.1.3.5 Filter or dehydrator (H) 15-35
4.1.3.6 Expansion or governor valve 15-35

4.2 How to empty and recharge the system 15-36
4.2.1 Safety notes 15-36
4.2.2 Recharging procedure 15-36
4.2.2.1 Introduction 15-36
4.2.2.2 Basic equipment 15-36
4.2.2.3 Procedure 15-37

4.3 Functionality tests 15-40
4.3.1 Specific equipment 15-40
4.3.2 Temperature check 15-41

4.1 General description

4.1.1 Basic concepts

4.1.1.1 Introduction

We considered it advisable to give a brief explanation of the more important basic principles dictated by elementary notions of physics before proceeding with the theoretical-practical analysis of the air conditioning system.

Nowadays, an increasingly higher number of tractors is being equipped with an air conditioning system. It is therefore essential for repair engineers to acquire a theoretic knowledge of those fundamental principles on which a cooling system is based in order to be able to work with adequate competence when servicing and repairing such systems.

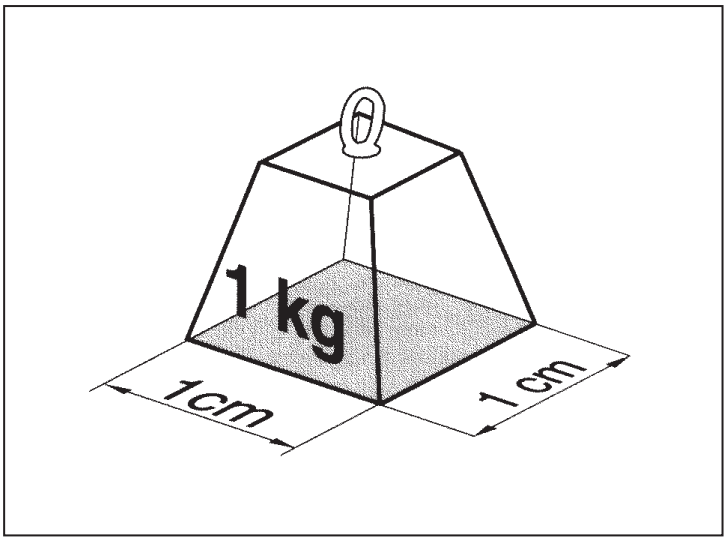


Fig. 15.21

4.1.1.2 Pressure

The **pressure** is a physical entity defined by the ratio between a certain force, perpendicular to a surface, and the area of the surface itself (e.g.: 1 kg on 1 cm2 of a horizontal surface).

The **atmospheric pressure**in a determined point of the atmosphere, is the weight of the air column of unitary section (e.g.: 1 cm2), that goes from the above mentioned point to the upper limit of the atmosphere itself. The higher the point in which atmospheric pressure is measured, the less it will therefore be (e.g.: atmospheric pressure in mountain districts is less than at sea level).

The unit of measurement most commonly used in the past was the**Atmosphere**, since it corresponded to the atmospheric pressure at sea level in determined conditions - Normal Atmospheric Pressure - and equivalent to the pressure exercised by a mercury column (Hg) of unitary section, 760 mm high at 0°C, at sea level and at a latitude of 45°. This unit of measurement is the**physical atmosphere** and its symbol is the **atm**.

The instrument used to measure the pressure of fluids is the pressure gauge (Fig.15.22).

The pressure gauges normally used in practice are the differential type since they indicate the difference between the pressure of the environment in question and the atmospheric pressure.

The dials of differential pressure gauges have scales (in the required units of measurement) where zero“0” corresponds to the atmospheric pressure and where the indicated pressure or manometric pressure is called relative pressure.

On the other hand, absolute pressure is the pressure measured on a scale where zero “0” is the absolute vacuum and “1” corresponds to the normal atmospheric pressure.

The absolute pressure is therefore given by the sum of the manometric (or relative) pressure and the normal pressure (_1 by definition).

A relative pressure that is lower than the normal pressure is indicated as negative pressure or vacuum, or degree of vacuum. The instrument used to measure the negative pressure is the vacuometer (Fig.15.23).

Main conversions between the more common units of measurement for pressure:

- 1 N/m2 = 1 Pa
- 1 N/cm2 = 104 Pa
- 1 bar = 105 Pa = 105 N/m2 = 10 N/cm2
- 1 atm= 101325 Pa= 1.01325 x 105 Pa
- 1 at = 98066.5 Pa = 0.980665 x 105 Pa
- 1 atm = 1.01325 bat = 10.1325 N/cm2
- 1 at = 0.980665 bar = N/cm2
- 1 bar = 0.98692 atm = 1.01972 at
- 1 psi = 0.068 atm = 0.069 bar = 6894.6 Pa
- 1 atm = 14.697 psi
- 1 bar =14.505 psi

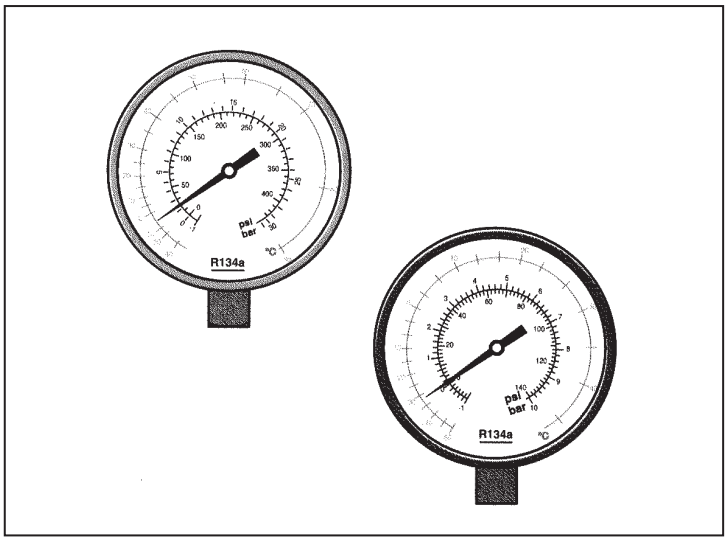


Fig. 15.22

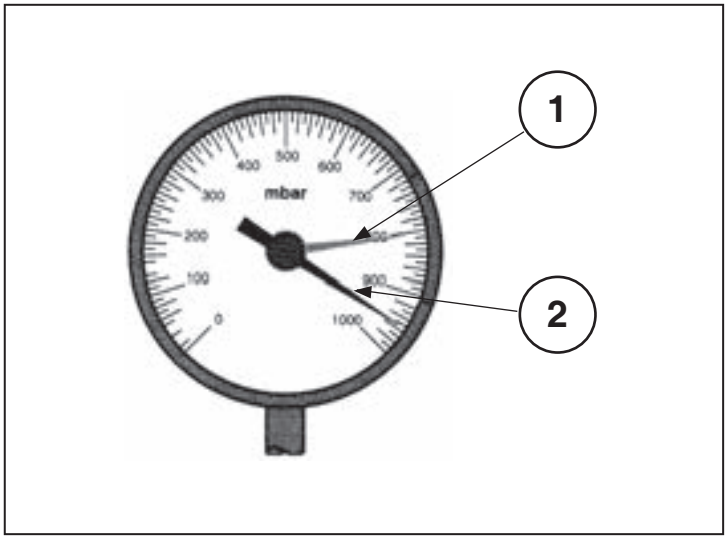


Fig. 15.23

1 - reference pointer
2 - measuring pointer

4.1.1.3 Heat and temperature

The terms heat and temperature are often used in daily practice.

For example, heat is received from a flame or from the Sum. For this reason, they are called heat sources.

An object which, when touched, gives us the sensation of being hotter than another, is said to have a higher temperature.

To explain the meanings of the terms heat and temperature and to allow them to be correctly used, we will now give stricter definitions indicating the main properties and the relative units of measurement (which are widely interdependent).

Heat

Heat is a form of energy (thermal energy) generally present in nature since it is contained in all bodies, although in different concentrations.

The quantity of heat exchanged between bodies cannot be measured directly but only according to the effects produced (temperature variation, modification of the physical status, chemical reactions, production of mechanical work, etc.).

The conventional unit of measurement for the quantity of heat is the calorie (cal) or small calorie, defined in the following way: the quantity of heat required to increase the temperature of the mass of 1 gram of distilled water at the normal atmospheric pressure at sea level by 1°C - from 14.5 to 15.5°C.

In practice, the large calorie (Cal) or kilocalorie (kcal) = 1000 cal is used and is defined as: quantity of heat required to increase the temperature of the mass of one kg of distilled water at the normal atmospheric pressure at sea level by 1 degree - from 14.5 to 15.5°C.

In English speaking countries, the unit of measurement for heat in use is the British Thermal Unit (BTU):

1 BTU = 0.252 kcal

Both the calorie and the BTU are units of measurement that are not permitted by the International System (SI), according to which the unit of measurement for the heat quantity is the Joule (J):

1 J = 0.000239 kcal = 0.000948 BTU

Other conversion formulas amongst the above mentioned units of measurement are:

- 1 cal = 4.186 J
- 1 kcal = 4186 J = 4.186 kJ
- 1 kcal = 3.968 BTU
- 1 BTU = 1054.87 J

In refrigerating, air conditioning systems and in the cold industry in general, the commonly used unit of measurement is the refrigeration unit, defined as the quantity of heat removed equivalent to 1 kcal.

In English speaking countries, the unit of measurement for cooling is the ton of refrigeration (meaning the extraction of 288000 BTU/day). Hence the following equivalences:

1 ton = 12000 BTU/h = 3027 kcal/h = 12672 kj/h = 3.52 kw.

Temperature

The temperature of a body indicates the level of heat

concentration it contains, given the weight (qualtity of matter) and the volume of the body itself.

The unit of measurement of temperature is the degree.

Since the temperature can be measured with reference to the different scales in use, the temperature interval corresponding to 1 degree differs in the various scales themselves.

The most commonly used scales are Celsius and Kelvin.

The Celsius scale is obtained by dividing the interval between the temperature of melting ice (considered = 0) and that of boiling water (considered = 100) into one hundred equal parts (distilled water, atmospheric pressure at sea level). Thus defined, the symbol of the Celsius degree is °C. By convention, the absolute absence of heat is -273.16°C on the Celsius scale.

The Kelvin scale considers the same reference points (melting ice and boiling water) and the same division (into 100 equal parts) of the relative temperature interval, but the zero mark corresponds to absolute zero (absence of heat): this is why the Kelvin scale is also called absolute scale of temperature. This scale includes the temperature of ice.

Freezing point of water at 273.16 and the temperature of boiling water at 373.16. Symbol K represents the degree in the Kelvin scale.

The Fahrenheit scale is used in English speaking countries, where the temperature of ice is 32 and that of boiling water 212 and the absolute absence of heat is -459.67. Symbol °F represents the Fahrenheit temperature degree.

Fig.15.24 compares the different temperature scales: Fahrenheit (°F), Celsius (°C), Réaumur (°r), Kelvin (K) and Rankine (°R).

The table on the right gives the conversion formulas allowing users to switch from one unit of measurement to the other.

scale	conversion tables
°F > °C	°C = (°F-32):1.8
°F > °C	°F = (°Cx1.8):32
°F > K	K = (°F+459.67):1.8
°C > K	K = °C+273.16
°r > K	K = (°r+1.25)+273.16
°R > K	K = °R:1.8
K > °F	°F = (Kx1.8)-459.67
K > °C	°C = K-273.16

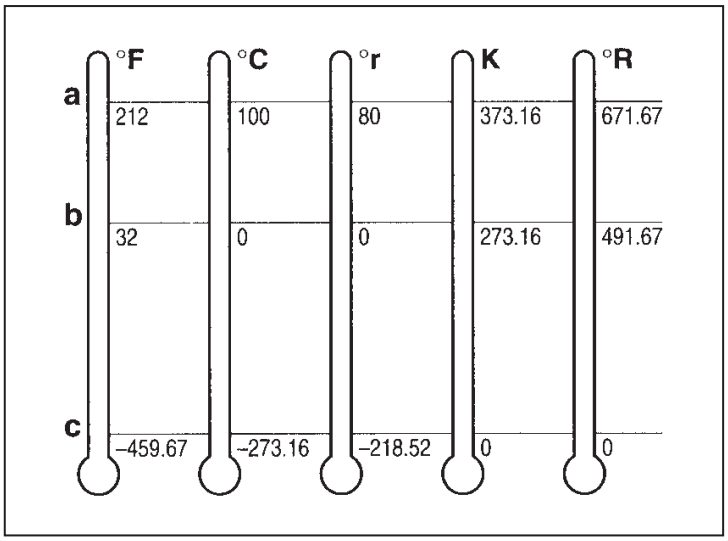


Fig. 15.24

a - boiling point of water
b - freezing point of water
c - absolute zero

Heat transmission properties and modes

The basic property is that, according to which, when there are two bodies at different temperatures, heat moves spontaneously from the higher temperature body (the warmer one) to that with a lower temperature (the cooler one); or, within a single body where the temperature is not uniform, heat moves spontaneously from the higher temperature parts to those at a lower temperature.

Heat transfer from a cooler body to a warmer one can only be carried out in a forced way, thus with a use of energy.

The quantity of heat that can be transmitted within a given time unit from a body at a higher temperature to one at a lower temperature is directly proportional to the temperature difference.

There are three basic methods according to which heat can be transmitted from one body to another of a different temperature:

- Transmission by conduction

  This occurs by contact between the two bodies without movement of matter (characteristic between solid bodies).
- Transmission by convection

  Occurs by movement of matter (typical in fluids).
- Transmission by radiation

  Occurs between different bodies, not in contact, by means of electromagnetic waves (particularly infrared rays) even if the space between the bodies themselves is completely empty (without matter).

  Typical and most important example in nature is the Earth, heated by the sun's rays.

4.1.1.4 Influence of heat on transformations of physical states in bodies (at constant pressure)

To make the general considerations given on this subject easier to understand and to justify their use in an air conditioning system, we are proposing a simple experiment for purely indicative purposes, which will allow certain physical phenomena to take place in a determined substance (e.g.: water) depending on the heat administered.

The experiment must be carried out at sea level and at normal atmospheric pressure (760 mmHg = 1 absolute Atm) using a vessel, a heat source (e.g.: a flame), a thermometer and 1 kg of distilled water.

Experiment

The experiment begins by placing water in a freezer to form ice, i.e. so that it solidifies. Now transfer the block of ice to the vessel, place the thermometer bulb in contact with the ice and place everything over the flame (Fig.15.26 a-b).

At the beginning of the experiment, the thermometer will indicate the temperature of ice as taken from the freezer, e.g.: – 10°C.

As time goes by, you will note that the heat will cause the temperature of the ice to progressively rise to -9°C, -8°C, etc., until it reaches 0°C.

Drops of liquid will now begin to form on the surface of the ice (Fig.15.26 c): the ice has begun to melt and this process will continue (Fig.15.26 d) until the solid phase disappears and the water is all in the liquid state (Fig.15.26 e).

If you watch the thermometer, you will note that the temperature indicated will remain at 0°C all through the ice melting phase.

If you continue to administer heat, maintaining the thermometer bulb immersed in the water, you will note that the temperature progressively increases (Fig.15.26 f) until the following phenomena occur at the same time (Fig.15.26 g):

- the thermometer indicates 100°C
- turbulent movement occurs in the water, with separation of a great quantity of steam.

Boiling or water evaporation has begun. This phenomenon will continue for as long as a trace of water remains.

During this period of time (from the beginning of evaporation to the end) and if the thermometer bulb is kept in continuous contact with the boiling liquid, the temperature indicated will have remained at 100°C.

If the steam that has developed is collected in a suitable vessel (Fig.15.26 h) and heat continues to be administered, the liquid will completely disappear (Fig.15.26 i), after which the temperature of the steam will progressively increase above 100°C (Fig.15.26 l).

Graph Fig.15.25 represents the successive phases of the experiment.

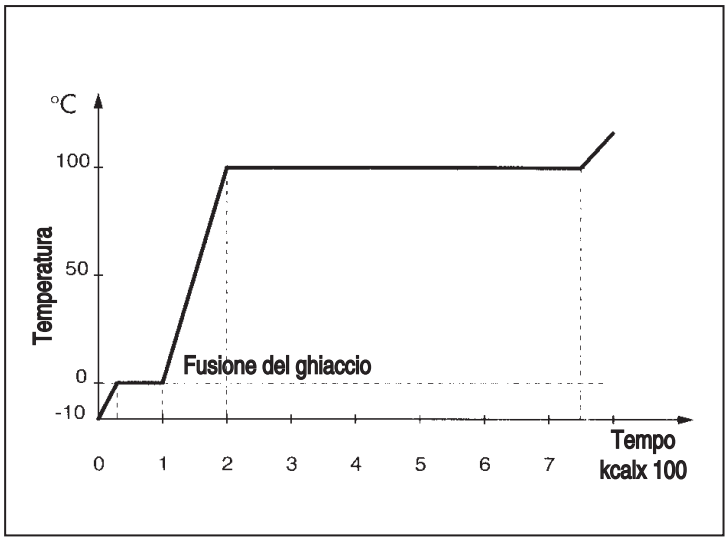


Fig. 15.25

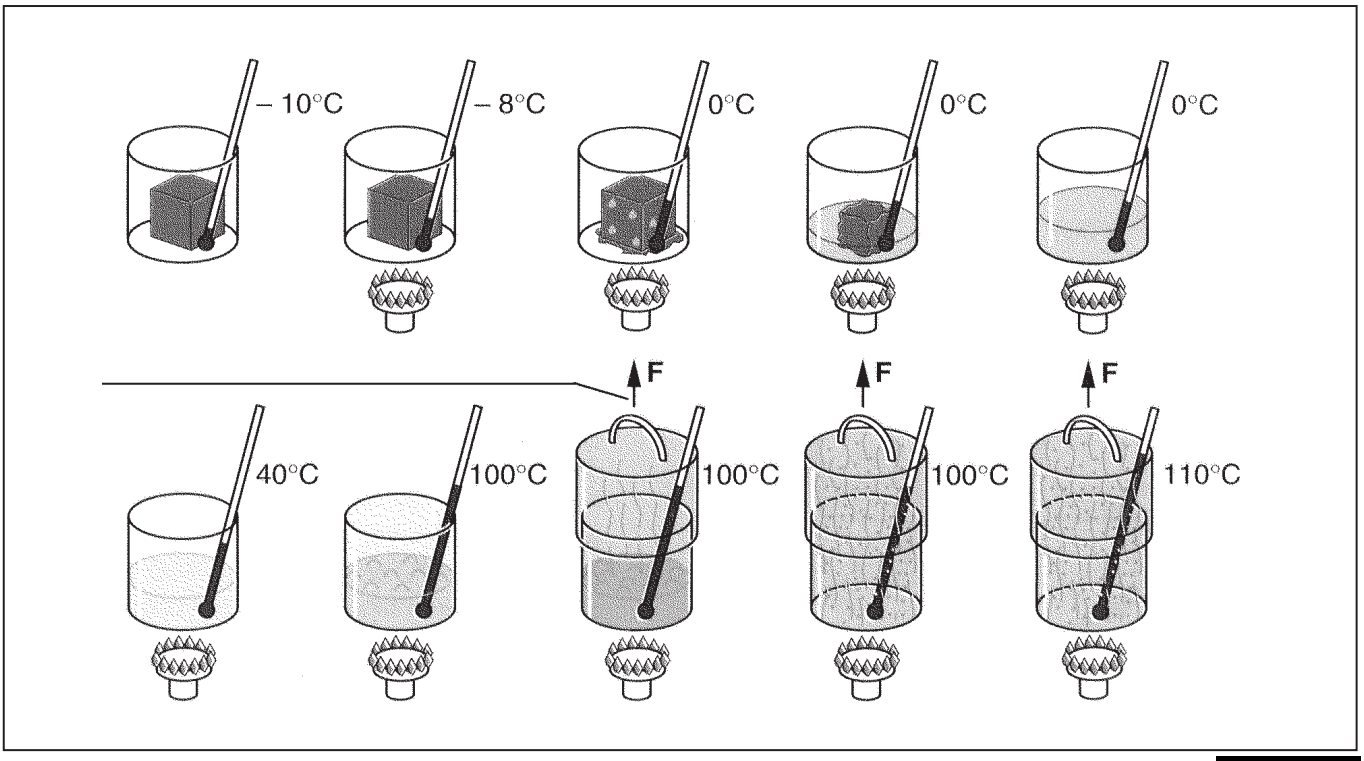


Fig. 15.26

During the experiment, two changes in the physical state will have been observed, by solely administering heat and keeping the pressure at a constant value:

- from solid (iced) to liquid melting
- from liquid to steam evaporation

You will have also noted that heat applied when there is one single phase (solid, liquid, steam) is shown by a temperature increase in the examined substance (water):

- from - 10°C to 0°C, for the solid state (ice)
- from 0°C to 100°C, for the liquid state
- over 100°C for steam (water in a gaseous state).

The heat applied within these intervals and that determines the temperature variation, is called sensitive heat.

On the other hand, you will have noted that during changes in the physical state - melting and evaporation - the heat applied caused no variations to the temperature, which remained the same:

- at 0°C during the melting phase
- at 100°C during the evaporation phase.

The heat exchanged during these intervals is known as latent heat – of melting and evaporation –, i.e. hidden, since there is no temperature variation.

Steam in the presence of liquid and at evaporation temperature is called saturated steam.

Steam that is no longer in the presence of liquid and with a higher temperature than that of evaporation is called overheated steam.

If the above described experiment is repeated beginning with overheated steam and subtracting heat, one obtains in succession: saturated steam at 100°C, liquid at 100°C, liquid at 0°C, solid (ice) at 0°C, solid at a temperature of less than 0°C (e.g.: –10°C).

The transformation of saturated steam into liquid water is called condensation and the quantity of heat subtracted is called latent heat of condensation.

The changes in the physical state are schematized and summarized in Fig.15.27 while a diagram of the relative quantities of exchanged heat is given in Fig.15.28.

If the described experiment is conducted using a constant source of heat and all the heat issued by this source is transferred to the substance in question, the quantity of heat exchanged will be proportional to the time elapsed. You will also note (Fig.15.26) that the quantity of heat absorbed by the substance itself as the physical state changes from liquid to saturated steam (latent heat) is much more than that absorbed during the heating phase from 0°C to 100°C (sensitive heat).

In this particular case, 1 kg of water: approx. 100 kcal (418.6 kj) are required to heat it from 0°C to 100°C while 540 kcal (2260 kl) are required to evaporate it.

Similar considerations can be made proceeding in reverse, i.e. when heat is subtracted.

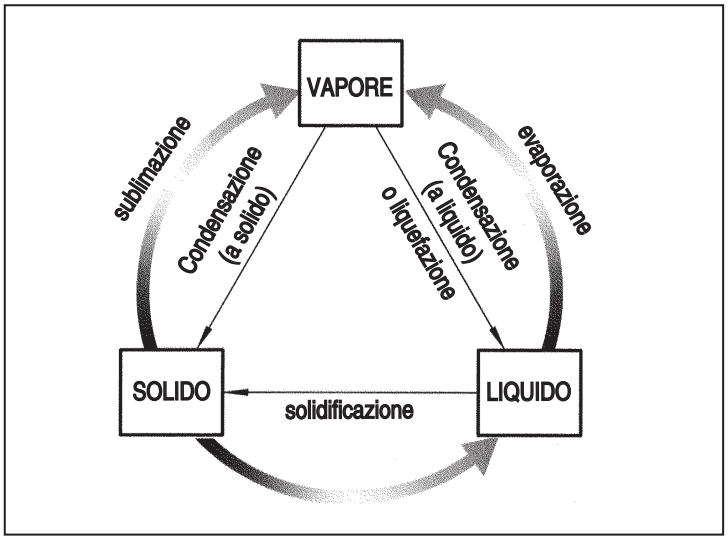


Fig. 15.27

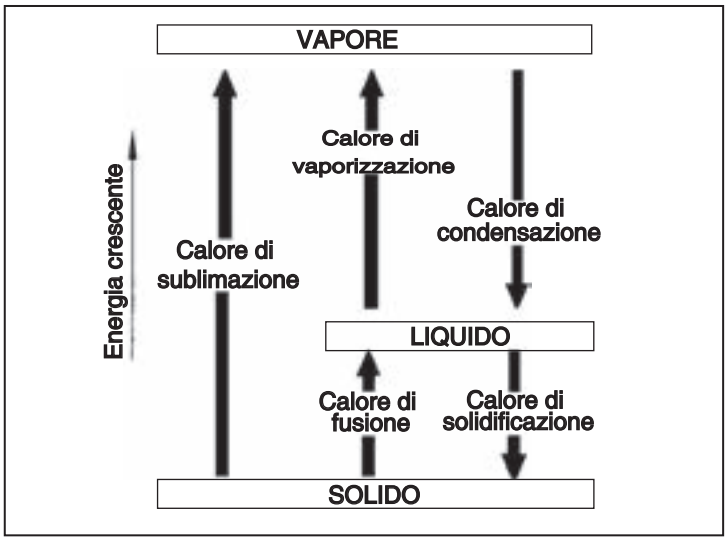


Fig. 15.28

Observations

In view of the above, one can affirm that for a certain mass of substance, the quantity of heat required to change its physical state at a constant pressure is much more than that required to change the temperature from the end of one state to the beginning of the next (e.g.: from the end of melting to the beginning of evaporation or vice versa).

This important property of bodies is used to form the operating cycle of an air conditioner (cooling cycle).

Note: Solid substances that melt at a given temperature, called melting point, are those with a crystalline structure.
There are solid substances, i.e. with an amorphous structure (e.g.: glass, plastic) which, when heated, do not melt immediately but which are subjected to a gradual softening process and that become fluid within a more or less extensive temperature range.

4.1.1.5 Influence of pressure on transformations of physical state in bodies

The previous section described how, if a certain quantity of water is maintained at the (constant) pressure (p) of 1 absolute bar, boiling will occur when the temperature (t) of the actual water reaches 100°C (Fig.15.29 a).

If a pressure is created in the vessel above the liquid, e.g. with a piston tight against the walls of the vessel, pushed with a force F (Fig.15.29 b) - at a pressure of more than 1 absolute atm, the water will boil at a temperature of more than 100°C.

Vice versa, if a pressure of less than 1 absolute atm (vacuum) is created in the vessel, e.g. by removing the piston (Fig.15.29 c) - the water will boil at a temperature of less than 100°C.

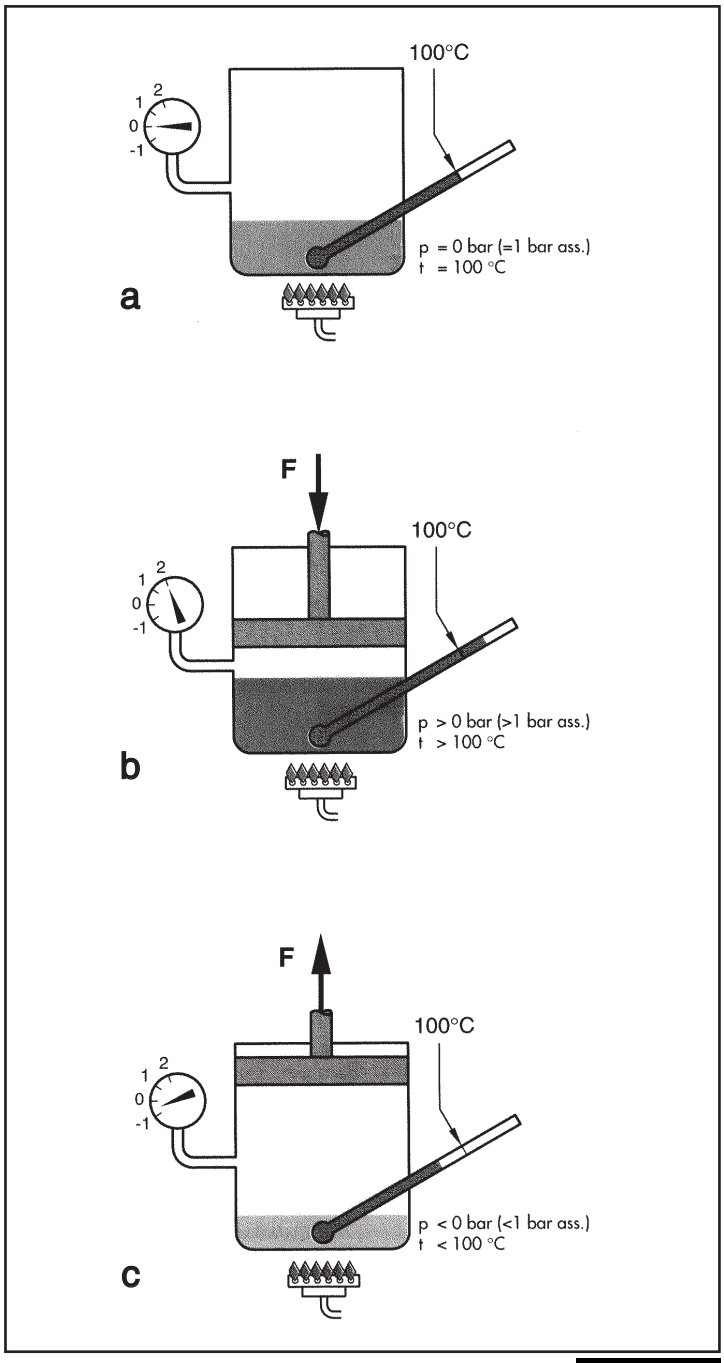


Fig. 15.29

By conducting a significant number of tests in various conditions, one can plot a graph (Fig.15.30) in which the curve (Z) is formed by all the pressure/ temperature conditions in correspondence to which the liquid state and the saturated steam state of water are balanced. Liquid changes into steam when heat is applied in correspondence to these combinations, while steam changes into liquid when heat is subtracted.

p - absolute pressure (in bar)
t - temperature (in °C)

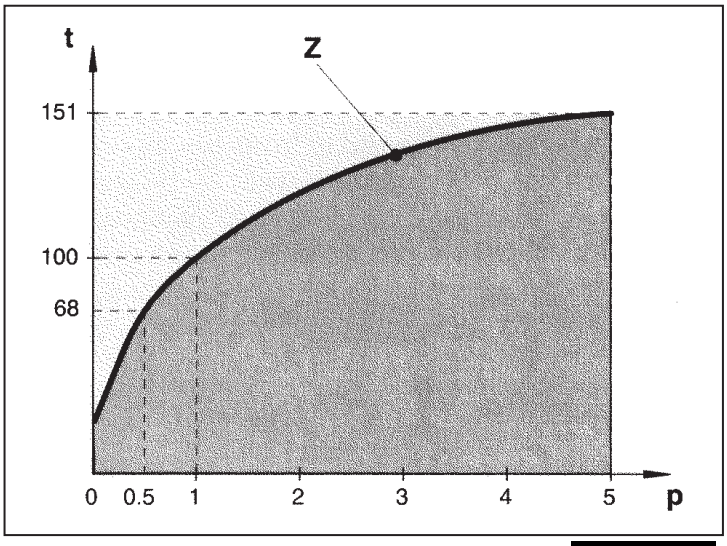


Fig. 15.30

4.1.1.6 Relations between temperature, pressure and volume in aeriform substances

Certain laws established by Physics for ideal gases can be considered valid for aeriform fluids (gases and vapours) used in technics, although with the appropriate approximations.

These laws are outlined in the Ideal gas equation of state:

PV = RT

Where P = pressure, T = absolute temperature, V = volume, R = universal constant.

This means that in practice, if one of the entities is varied at least one of the other two also varies.

The following relations should be considered when use is made in a cooling cycle:

- a reduction in volume (compression) determines an increase in pressure and temperature;
- an increase in volume (expansion) determines a reduction in pressure and temperature.

In particular, for a given mass of substance one has:

- with constant temperature
  - an increase in volume involves a decrease in pressure;
  - a decrease in volume involves an increase in pressure;
- with constant pressure
  - an increase in temperature involves an increase in volume;
  - a decrease in temperature involves a decrease in volume.
- with constant volume
  - an increase in temperature involves an increase in pressure;
  - a decrease in temperature involves a decrease in pressure.

4.1.1.7 Humidity

Humidity is generally the percentage ratio between the weight (or the volume) of the water in a body and the weight (or the volume) of the body itself.

In relation to atmospheric air, it is a mixture of dry air and water vapour, the rate of which is atmospheric humidity.

Two temperature values are used to define the atmospheric humidity rate:

- dry bulb temperature (in °C) measured with a common thermometer
- wet bulb temperature (in °C) measured with a thermometer whose bulb is covered with a gauze soaked in water and ventilated.

The wet bulb temperature is always lower than that of the dry bulb since the water used to soak the gauze tends to evaporate, cooling the bulb itself still further.

The following values can be determined using the two values indicated above:

- the absolute humidity, defined as the mass of the water vapour contained in the unit of volume of air: it is expressed in grams of vapour per cubic meter of air;
- the relative humidity, defined as the percentage relation between the mass of water vapour effectively present in a certain volume of air and the amount that could be there in saturation conditions, with the same temperature and pressure.

100% relative humidity indicates saturation point.

When saturated air is cooled, the water vapour condenses and produces fog, rain and snow.

4.1.2 Operating principle of a cooling cycle

4.1.2.1 Description of a cooling cycle and air treatment

Let us now examine the basic layout and operating principle of the air conditioning system.

In the highly simplified layout shown in Fig.15.31, the system appears to consist of a closed circuit formed by the chain of four components: evaporator (1), compressor (2), condenser (3) and expansion valve (4) (all essential in a cooling cycle and arranged in their functional sequence), plus pipes (5) which connect the components together.

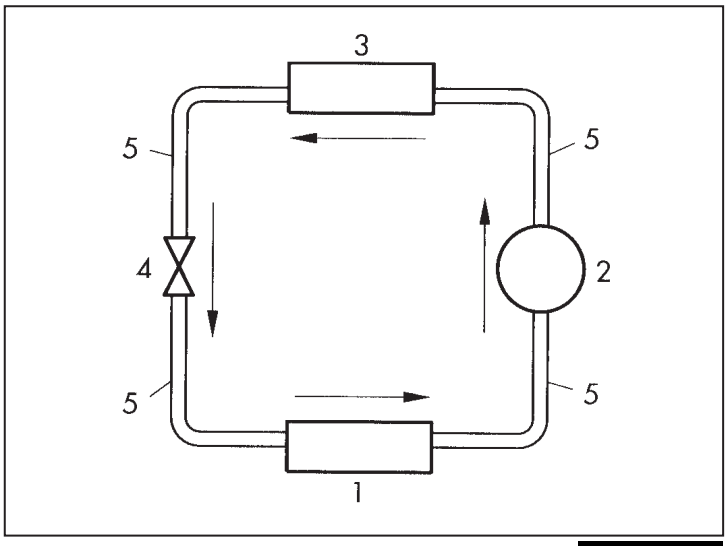


Fig. 15.31

The essential function of the system, i.e. that of transferring heat from one place (passenger compartment) to another (the environment surrounding the vehicle) is achieved by subjecting a cooling fluid with which the system itself must be filled, to a thermodynamic cycle that includes pressure variations (by means of the compressor and expansion valve) and changes in physical state (by means of two heat exchangers: the evaporator and the condenser).

The notions of Physics mentioned in the previous chapter allow each phase in the cycle to be explained and justified. For the sake of convenience, we will also refer to another simplified layout of the circuit (Fig.15.33), similar to the one in Fig.15.31. Before proceeding, and to allow readers to understand the mentioned pressure and temperature values in a better way (although solely by way of example and highly approximate), we also include the pressure/ temperature diagram of the R134a coolant currently used in air conditioning systems for vehicles and farming tractors (see Fig.15.32).

p - absolute pressure (in bar)
t - temperature (in °C)

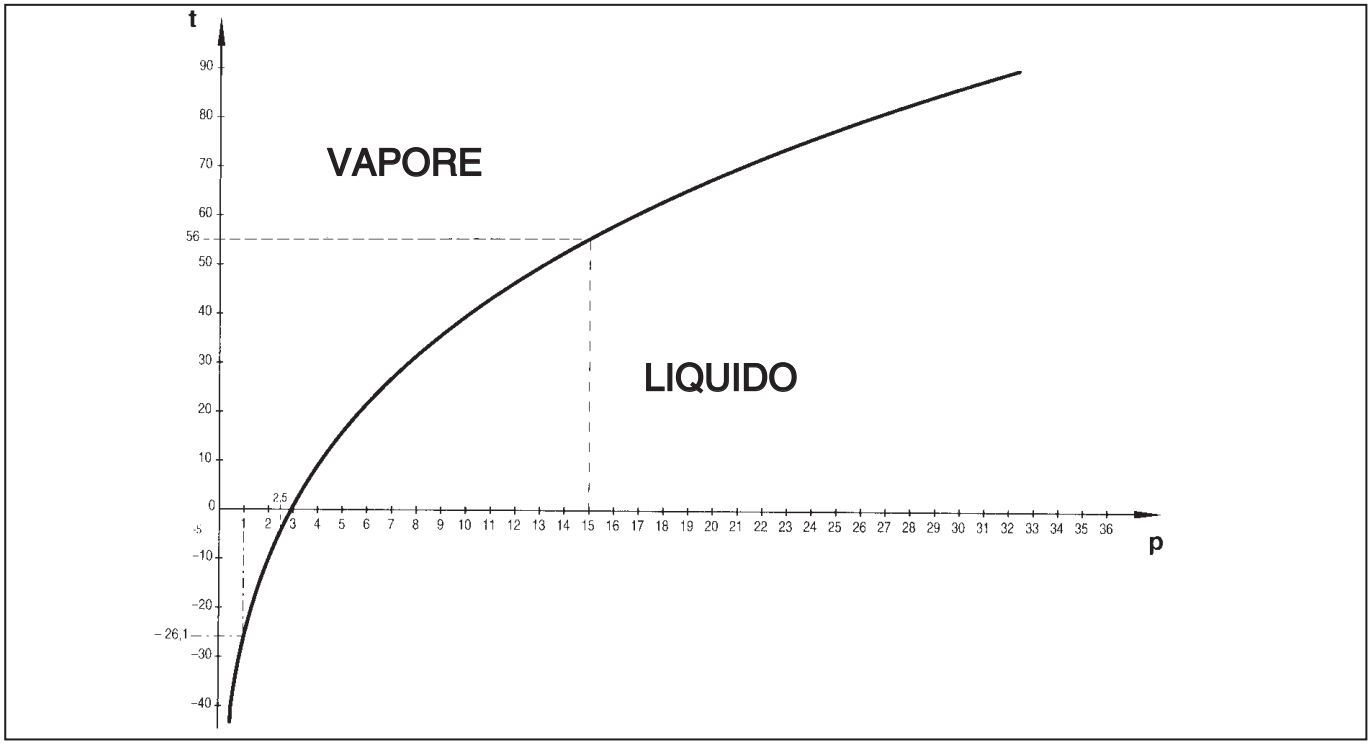


Fig. 15.32

By examining the previously mentioned diagram and while waiting to go more deeply into the subject in the next chapter, note that the boiling point of R134a is -26.1°C at a pressure of 1 abs.bar (atmospheric pressure at sea level) and that very low temperatures can be obtained by expanding it at low pressure. Vice versa, when compressed at relatively modest pressures, vapour can remain as such at fairly high temperatures (e.g.: p = 15 bar and t = 56 °C).

Another important characteristic for the particular use in question, is the high latent heat value of evaporation and condensation (e.g.: 51 kcal/kg at 1 abs.bar).

In short, this substance possesses characteristics that make it suitable for cooling circuits since both very low temperatures and relatively high temperatures can be obtained while working with modest pressure values that therefore allow fairly lightweight and not very bulky components to be used in the system.

To get back to the phases in the cycle, we will consider Sect. A (Fig.15.33) at the entrance to the evaporator as starting point. The evaporator is the component that removes heat from the cab. It is therefore positioned either in the actual cab itself or in close communication with it. To allow it to carry out its function, its temperature must be lower than that of the environment to cool so that heat can spontaneously flow from this (higher temperature) towards the evaporator itself. Let us suppose that the coolant in A is liquid at a pressure of 2.5 bar, thus at a temperature of about -5°C (Fig.15.32).

To cool the cab, it is necessary to:

- either “flush” it with cold air
- or remove the air it contains, cool it and then let it in again.

In the former case, air from the outside environment is allowed to flow towards the evaporator and is then forced into the cab, thus expelling the hotter air inside this.

In the latter case, the air in the cab must be made to recirculate through the evaporator.

Supposing that the air in the environment surrounding the vehicle or the air in the cab is at a temperature of 25°C.

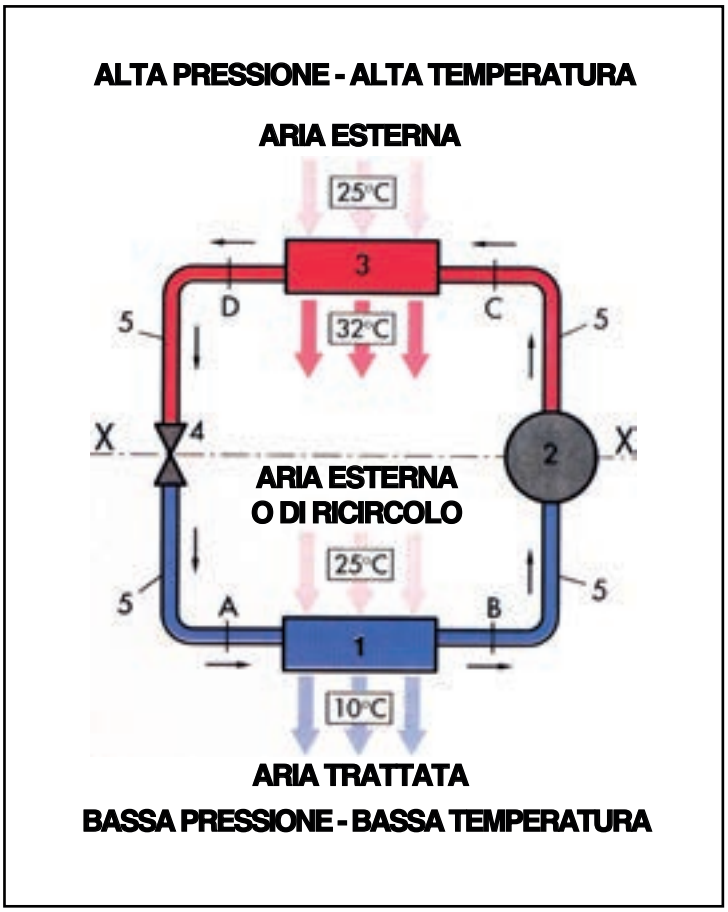


Fig. 15.33

Sect.A - p=2.5 bar t=-5°C
Sect.B - p=2.5 bar t=-5°C
Sect.C - p=15 bar t=56°C
Sect.D - p=15 bar t=56°C

This air passes through the evaporator, the external walls of which are at a temperature of 1 to 3°C for example. By virtue of its higher temperature of 22 to 24°C, the air transfers part of the heat to the evaporator, thus lowering its temperature from the initial 25°C to 10°C, for example.

Thus treated, the air enters the cab and, mixing with the already existing air initially at 25°C, progressively lowers the temperature there.

Meanwhile, the coolant that had p = 2.5 bar and t = -5 °C at the evaporator inlet, passes through this, absorbs the heat removed from the air and, at the same pressure, converts it from a liquid state to vapour, also maintaining the same temperature (latent heat).

The coolant will therefore have p = 2.5 bar and t = -5 °C at the evaporator outlet (Sect.B), but will be vapour and charged with the quantity of heat yielded by the air.

If the cycle is to have continuity and since the circuit is sealed, the coolant, which is now in B, will flow through the remaining part of the circuit and returns to A in the initial conditions (p = 2.5 bar, t = -5 °C).

To achieve this, the coolant itself must first be freed from the heat it absorbed as it passed through the evaporator and must then be brought to a low pressure and a low temperature.

The only way to dispose of the heat is to expel it into the surrounding environment where, however, the temperature is higher (25°C). The temperature of the coolant must therefore be raised from -5°C to a value higher than 25°C so that the heat can be spontaneaously transferred from the coolant itself to the outside environment. This is carried out by the compressor.

The compressor possesses these functions: it intakes vapour at a low pressure and low temperature from the evaporator, compresses it and discharges it (Sect.C) at a high pressure and high temperature (e.g.: 15 bar –56 °C).

Coolant, in the form of vapour, at a high pressure and a high temperature (approximately the same values as Sect.C), enters into the 2nd heat exchanger, the condenser, which transfers the heat the coolant had accumulated in the evaporator, into the outside environment.

To achieve this as efficiently as possible, its pressure and, thus, its temperature are kept at constant levels, but the vapour is transformed into liquid, thus the transferred heat will be latent condensation heat.

Note

By removing heat, the outside air that passes through the condenser is subjected to a temperature increase (e.g.: from 25 to 32°C), but then spreads around the surrounding environment without changing its conditions in an appreciable way.

On leaving the condenser, in Sect.D, the coolant will be in a liquid state and without the previously collected heat. However, compared to the initial condition (Sect.A), it is still at a high pressure and temperature. The expansion valve is used to lower the pressure and temperature of the coolant.

The main purpose of this component is to throttle the circuit, upstream of which the pressure and temperature are high. Downstream, since there is a space where it can expand, the coolant is subjected to a drastic pressure reduction (e.g.: from 15 to 2.5 bar) and, consequently, a temperature reduction (from 56°C to -5°C), remaining in the liquid state (even though atomized).

This forms the initial conditions again. The cycle can then be repeated in a continuous way for as long as the compressor operates.

Note

All this shows that when operating, the system is partly hot and partly cold.

The ideal separating line between the two parts is represented, in the diagram in Fig.15.33 , by straight line X-X, which cuts through the compressor and expansion valve.

Note that this is one of the basic elements to consider when evaluating whether the circuit is operating correctly or when identifying faults.

4.1.2.2 Notes and considerations

The described process has been extremely simplified. We have therefore added a certain number of notes that allow readers to understand how the notions of physics in the previous chapter have been used and have added considerations, at least in principle, about the differences between the described scheme and what actually happens in practice.

Heat exchanges

Heat exchanges amongst the various elements in question (air, components of the A/C and ECC system) and within the elements themselves, occur in the following way:

- from the air to the external walls of the evaporator (by convection)
- from the external walls to the internal walls of the evaporator and from these to the coolant (by conduction)
- from inside the coolant and when this is transferred from the evaporator to the condenser
- through the compressor (by convection)
- from the coolant to the internal walls of the condenser (by conduction)
- from internal walls to the external walls of the condenser (by conduction)
- from the external walls of the condenser to the air that passes through it and to the outside environment (by convection and by radiation).

Note: Heat exchanges between the internal parts of the system and the outside environment also occur through the walls of tubes and the filter, and this negatively influences the efficiency of the system although to a modest extent.

Practical notes

The pairs of temperature and pressure values chosen as examples for the sake of convenience, have been considered constants in each of the two parts (cold and hot) of the system and have been given with reference to the conditions of the coolant.

In practice, the following points must be taken into account:

a - there is a certain temperature difference between the internal and external surfaces of heat exchangers (e.g.: in the evaporator, internal temperature -5°C and external temperature +2°C; in the condenser, internal temperatrure +56°C and external temperature +50°C).

b - there is a difference in temperature between the coolant on the inlet and that leaving the exchangers established by the size of the system and how it is regulated in order to ensure that:
- the coolant that leaves the evaporator is completely in the state of vapour and that it reaches the compressor as such (the compressor is a pump that is only suitable for gaseous substances and not liquids).
  To ensure this, the vapour must be slightly overheated, i.e. its temperature must be higher than that of saturated vapour (e.g.: – 2°C instead of –5°C);
- when leaving the condenser, the coolant is completely in a liquid state to optimize its efficiency. Thus its temperature, at the considered pressure, must be lower than that of condensation (e.g.: 52°C instead of 56°C, liquid being cooled);

c - further differences (a few degrees more for the cold part or a few degrees less for the hot part) should then be considered owing to the effect of the heat exchanges along the route leading from one exchanger to the next (see previous note);

d - the pressure of the coolant is lowered along its route due to friction, turbulence, etc. (load loss); further variations to a greater or lesser extent than those determined by the expansion valve and compressor, are due to the previously mentioned heat exchanges along the circuit beyond the exchangers;

e - the energy used to operate the compressor (normally drawn from the vehicle's engine), is converted into heat and is then yielded to the coolant from which it must be extracted along with that collected by the evaporator.

Given that the sequence of components in the system along the circuit remains unchanged, in practice, their positions in the vehicle will be influenced by the availability of space and by all the measures taken to optimize both functionality and safety.

One essential constant to prevent the efficiency from being impaired is that the expansion valve must be positioned extremely near to the evaporator (it must practically form a single unit).

In the simplified diagram in Fig. 15-12, the four essential main components (evaporator, compressor, condenser, expansion valve) are represented together with the coolant they contain, by way of principle, in order to form the thermodynamic cycle (cooling cycle).

In actual fact, another component, the dehydrator filter, is installed in series in the circuit (between the condenser and the expansion valve) and has important functions, but does not contribute towards the operation of the thermodynamic

cycle itself.

4.1.3 Main components of an air conditioning system

4.1.3.1 Coolant or cooling fluid

This is the fluid used to fill the A/C and ECC system. It acts as a carrier of heat, transferring this from the point in which it is removed from the cab (or rather, from the air let into or re-circulated around the compartment) by means of the evaporator, to the point in which it is disposed of in the outside environment by means of the condenser.

Until a few years ago, a product bearing the code name R12 was generally used in the A/C systems of vehicles (and is still used when available, to service old systems). The chemical formula of this coolant is CCI2+F2 (Dichlorodifluoromethane) and it is marketed by various producers under different trademarks / denominations.

Since this product contains Chlorine (CI) in its molecule, it is part of the group of CFC substances most greatly responsible for the destruction of the Ozone layer (O3) in the stratosphere and the consequent ecological damage, all of which is causing global concern. Right from the "Vienna Convention" of 1985 and the successive "Protocol of Montreal" in 1987, the objective has been to prohibit the above mentioned substances by gradually reducing their use until their production completely ceases while establishing regulations to govern the permitted uses.

Production has already stopped throughout Europe (in Italy, with law N° 549 of 28/12/93) and in the majority of the other countries, while use of the product, governed by the above mentioned regulations, is now limited to the very small amounts of the substance available on the market.

In view of the above, three alternative substances have been identified with suitable technical characteristics which do not, however, contain Chlorine and which therefore do not damage the Ozone in the stratosphere.

In particular, a substance known as R134a (HFC – 134a), with the chemical formula CH2+FCF3+ (1, 1,2 – Tetrafluoroethane) is used as a replacement for R12 (CFC-12).

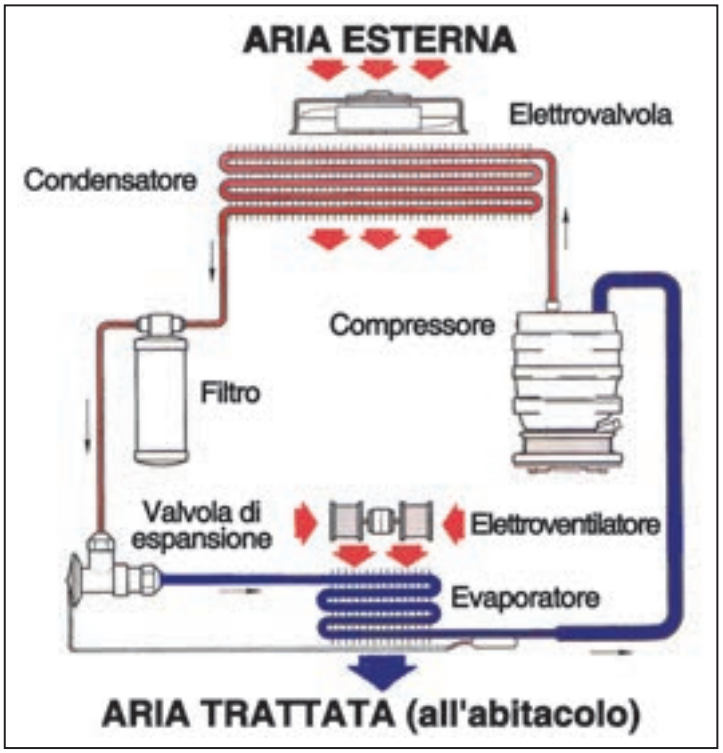


Fig. 15.34

- High pressure liquid
- High pressure vapour
- Low pressure liquid
- Low pressure vapour

The basic properties of these products that make them particularly suitable for use as coolants are:

- low boiling temperature, at atmospheric pressure at sea level (-29.8°C for R12 and –26.1°C for R134a).

  This means that it is easy to make a cold body (evaporator) able to collect the heat from the hot air that hits it.
- high vaporizing heat (latent) and condensation values in the various temperature and pressure conditions.

4.1.3.2 Evaporator

As was said in the previous chapter, the evaporator is that part of the A/C system that removes heat from the air let into the cab (the way the heat is exchanged has already been described).

Another very important function carried out by the evaporator and that has not been mentioned previously is that of dehumidifying the treated air.

This is done in the following way:

- in normal conditions, the air contains a certain quantity of watery vapour;
- the vapour condenses as it comes into contact with the cold surfaces of the evaporator;
- water in the liquid state (condensation) is collected in a receptacle and is disposed of through the relative channels;
- the condensing heat of the humidity is yielded to the coolant through the walls of the evaporator as occurs for the heat removed from the air in order to lower the temperature.

In view of the above, the treated air leaving the evaporator and let into the cab contains a lower quantity of moisture besides being cooler.

4.1.3.3 Compressor (F)

The compressor is the propelling part for the coolant in A/C systems.

Its functions are:

- to circulate the coolant around the circuit
- to raise the pressure and, thus, the temperature of the gaseous coolant from the evaporator at low pressure and low temperature.

Basically, to carry out these functions, they consist of:

- a container body (or casing) formed by a more or less large number of components and equipped with hangers to fix it to the vehicle.
- an internal mechanism to produce the pumping effect;
- a valve system to regulate coolant intake and delivery;
- fittings to connect the pipes;
- a pulley / clutch assembly (electro-clutch).
- a load of oil.

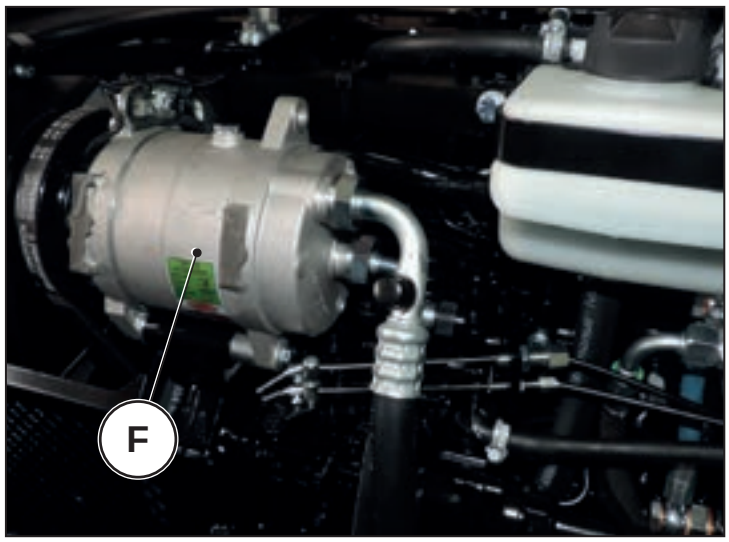


Fig. 15.35

4.1.3.4 Condenser (G)

The condenser is the exchanger that removes the heat absorbed by the evaporator and that created by converting the energy used to operate the compressor from the coolant that circulates around the A/C system.

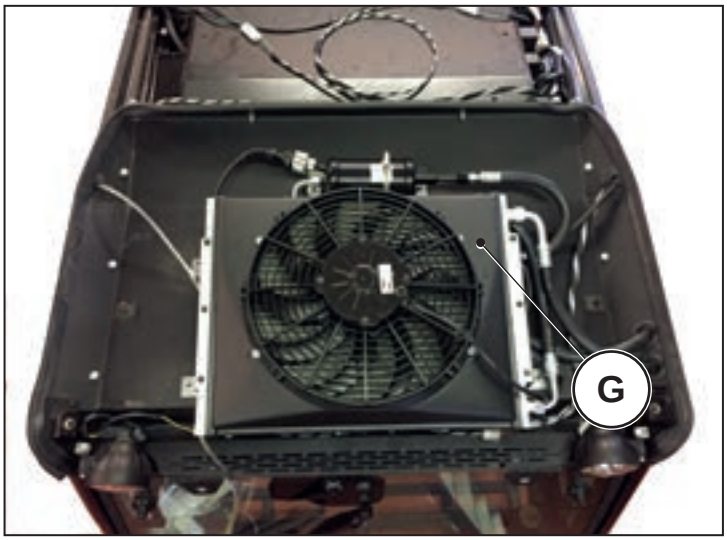


Fig. 15.36

4.1.3.5 Filter or dehydrator (H)

The filter is a component which, although being installed in series in the coolant flow within the A/C system, does not cause any type of thermodynamic effect and therefore does not influence the changes of state to which the coolant is subjected or the heat exchanges.

However, its functions are equally many and of considerable importance, as explained further on.

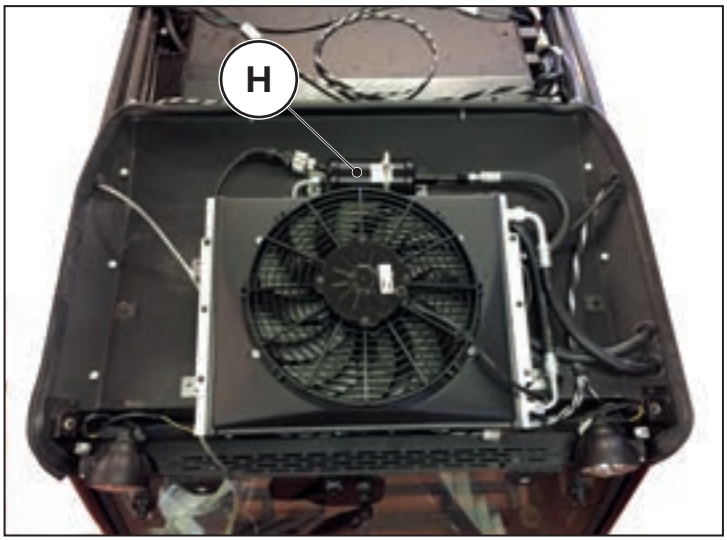


Fig. 15.37

4.1.3.6 Expansion or governor valve

The expansion valve in A/C systems carries out the following essential functions:

1 - it drastically reduces the pressure (and, thus, the temperature of the coolant fluid arriving from the condenser through the filter);

2 - it continuously regulates the coolant that flows to the evaporator so that it can completely evaporate and it passes through the evaporator in the various thermal load conditions. As it passes through the system, it also reaches a minimum degree of overheating that is sufficient to ensure it arrives in the compressor as vapour.

4.2 How to empty and recharge the system

4.2.1 Safety notes

When coolants are handled, it is always necessary to comply with the following safety rules to safeguard the health.

a - Always wear protective goggles and gloves when handling coolant.

If coolant splashes into the eyes it can damage the sight and cause blindness.

b - Do not allow the coolant to splash on to the skin.

Coolant has a very low boiling temperature which can lead to freezing (approx. -26 °C for R134a and approx. -30 °C for R12, at atmospheric pressure at sea level).

c - The equipment for treating the coolant must be used in adequately ventilated places, with at least four air changes per hour. Do not inhale coolant vapours for lengthy periods of time. It can be dangerous and even lethal.

d - Do not use equipment for treating coolant near open containers holding inflammable substances or with leaks.

e - Do not tamper with or modify the settings of the breather and safety valves in the containers and equipment for treating coolant.

f - Do not fill any vessel (cylinder, A/C charging equipment) with coolant unless it has not been approved for the purpose and equipped with a relative safety valve.

g - Do not fill any storage vessel beyond 80% of its capacity.

h - Take the utmost care when the service pipes are connected since they may contain pressurized coolant.

4.2.2 Recharging procedure

4.2.2.1 Introduction

An A/C or ECC system can be installed in a vehicle at its origin, when it is being assembled during the production phase, or it can be installed at a later date in a finished vehicle ready for delivery to the Purchaser or even in a tractor that has already been operating for some time.

In any case, once it has been completely and correctly installed, an A/C or ECC system must be adequately filled with coolant fluid. The following paragraphs therefore describe:

- the essential equipment used for charging purposes (filling with coolant);
- the relative procedures;
- the operating tests to verify the performances of the installed system.

4.2.2.2 Basic equipment

The basic equipment required to charge an A/C or ECC system consists of:

- a pump to produce vacuum;
- a metering cylinder or a scale to measure the quantity (in weight) of the required coolant;
- a pair of pressure gauges;
- a vacuometer;
- a set of taps to handle the connections of the various components listed above to the A/C system and to the coolant reserve tank (bottle);
- service pipes with relative fittings, to connect to the service valves of the system and to the bottle.

The above listed parts are normally assembled in relative casings to form a single component, allowing all the charging procedures to be carried out.

Remember that, according to the current laws in force in Italy, in Europe and in the majority of other countries, coolant can no longer be disposed of in the environment and that it is therefore obligatory to collect all the coolant emptied from a system in a suitable vessel.

It is consequently essential to be in possession of the adequate equipment when these operations are carried out.

Besides the specialistic components used for the charging operations, the Dvx coolant recovery, preparation and recharging station for R 12, R 134a and "refmaticplus" (Fig.26-12), also has:

- a hermetic compressor, which intakes the coolant when the A/C or ECC system is emptied and allows it to re-circulate through a special internal mechanism in order to prepare it, lastly depositing it in the reservoir for future use;
- a filter to retain the solid particles, the humidity and polluting acids in the recovered coolant;
- a distiller to separate the oil;
- a condensing apparatus to separate the incondensable gases, with relative automatic or manual expelling device;

- an electronic scale to weigh the coolant;
- a microprocessor, plus keypad and display, to automatically handle the various functions.

4.2.2.3 Procedure

This procedure includes the following phases:

- emptying the air from the system;
- dehydration;
- vacuum tightness test;
- filling with coolant;
- activation of the system and performance tests.

Emptying the air from the system

The air must be eliminated from the system:

- to leave all the space inside for the coolant;
- to prevent the air and the moisture it contains (even in tiny quantities) from polluting the coolant and altering its thermodynamic characteristics.

The coolant is emptied out by means of the vacuum pump which is connected, by the service pipes of the charging plant, to the HP and LP service valves of the A/C or ECC system, with the vehicle engine off.

This operation takes a very short time and during it, the pointers of the HP and LP pressure gauges move from 0 to positions near to -1.

Fig. 15.38

1 - Recovery pressure gauge
2 - Charging pressure gauge
3 - Info Display
4 - Start recovery
5 - Start vacuum
6 - Start charging
7 - Start/Stop
8 - Alarm indicator
9 - Report
10 - +/- menu

Dehydration

This follows the previous operation. The vacuum pump continues to operate and the pressure, indicated by the pressure gauges, remains near to -1.

The recommended length of this operation is 40 to 45 minutes and more, if the system is very large. In this way, humidity that is not discharged with the air but which has remained, in the liquid state, in the system (in the pores and recesses of the internal walls, especially in flexible hoses, dissolved in the compressor oil, absorbed by the filter, etc.) can be released as vapour and, as such, removed by means of the vacuum pump.

Note: Remember that the boiling point of water depends on the pressure.

Since the temperatures in a system when the charge is being prepared are practically the same as those of the environment (workshop) in which the work is carried out, they can also be very low (e.g.: 10 to 15°C) particularly in winter. The only way to evaporate the internal humidity is to lower the pressure. This is done by working with the vacuum pump.

The considerable length of this operation is also required to allow the vapour, escaping from the most distant parts of the system, to reach the service valves and to then be extracted.

Humidity must be eliminated from the system to prevent:

- the formation of corrosive acids caused by a chemical reaction with the coolant fluid and oil, which would consequently damage the components;
- the formation of ice around the expansion valve, which would clog the calibrated hole and block the system.

Vacuum tightness test

Before beginning to charge with coolant, make sure that the system is perfectly tight. To do this, at the end of the dehydration phase, shut off the tap that sets the A/C or ECC system in communication with the vacuum pump, stop this latter and open the connection between the system and the vacuometer.

The pointer of the vacuometer will set near to the -1 position. Note down this position (vacuometers often have a movable pointer. If the pointer itself has not appreciably moved after 10 minutes, the system can be considered perfectly tight). Now shut the vacuometer tap and proceed with the charging operation.

Vice versa, if the pointer of the vacuometer moves towards 0 during the above mentioned period of time, it means that the system is not tight and that, if it were to be charged in those conditions, it would very quickly lose its charge and, thus, its efficiency. In this case, identify the leak point or points, repair and repeat the procedure from the start.

Filling with coolant

The quantity (in weight) of coolant required to operate the A/C or ECC system in an optimum way is determined by the Manufacturer and indicated in the relative operation and maintenance manual.

If this value is not available for some reason, it can be determined in an empiric way by gradually charging with coolant until optimum pressure values are obtained.

Given, therefore, that the weight required for charging is known, this quantity must be measured exactly.

This can be done in two ways, depending on the available apparatus:

- by the difference between the two weight values of the coolant holder at the beginning and at the end of the charge, if a high precision scale (electronic) is available, as in Dvx "refmatic" stations for example.
- In an indirect way, depending on its pressure (temperature) and volume, using the conventional dosing cylinder (as in the Dvx "fill station"), again by the difference in the initial and final weight.

The coolant can be added:

In the liquid phase

When the pressure in the container or dosing cylinder is sufficiently high (8 to 10 bar), to allow the required quantity of coolant to be completely transferred with the sole aid of the difference in pressure between the container and the A/C or ECC system.

As the pressure inside a container of coolant (not in the presence or in contact with heat sources) is that corresponding to the temperature of the ambient in which it is to be found (e.g.: 5.7 bar at 20°C), the same pressure is also created in the A/C or ECC system by simply connecting one to the other.

Consequently, charging the liquid phase would not be completed owing to pressure balancing

To sufficiently raise the pressure in the container, the coolant is heated before it is transferred to the A/C or ECC system:

- with the resistance applied to the dosing cylinder (e.g.: in the “fill station”);
- with the compressor in the plant (e.g.: in “refmatic”).

Note

Recharging in the liquid phase can only be done by adding the coolant in the plant section after the compressor, through the high pressure valve.

If coolant were to be added prior to the compressor, it would damage this when the plant was activated.

In the vapour phase

If the container is connected to the low pressure service valve, the engine can be started and coolant drawn by the compressor in the pure vapour state. This is obtained by means of adequate throttles created with the plant taps installed along the route the coolant takes from the container to the system.

In a mixed phase

By first transferring liquid until the pressures are balanced and then vapour, with the aid of suction from the compressor.

In this case, it will be necessary to work with the plant taps so that liquid is transferred after the compressor and vapour prior to it.

Activation of the system and performance tests

Having completed the charging procedure and keeping the plant connected, activate the system and check its performances in the following way:

- start the engine and regulate the charging rate (1500 to 1800 rpm);
- select the A/C or ECC plant controls to obtain maximum cooling, i.e. the thermostat (when accessible) must be set to max position and the fan to maximum speed;
- open the doors of the vehicle;
- allow the system to operate in these conditions for about 10 minutes;
- shut the doors and windows;
- check the pressure values indicated on the (HP - High Pressure) and (LP - Low Pressure) gauges;
- check the temperature of the place in which the work is being carried out with the thermometer.

Taking the ambient temperature as a reference, the pressure values that indicate correct plant operation are within the ranges given in Table 1.

R134a				
Ambient temperature (°C)	Pressure gauge (High Pressure)(kg/cm²)		Pressure gauge (Low Pressure)(kg/cm²)	
	min	max	min	max
15.5°	9.5	13	0.5	3
21.0°	12.5	17.5	0.5	3
26.5°	14	20.5	0.5	3
32.0°	16	24	0.5	3.5
38.5°	18.5	25.5	0.5	3.5
43.0°	22	28	0.5	3.5
Table 1				

To correctly interpret the values shown on the pressure gauges, also remember that the pressures themselves are influenced by the atmospheric pressure which, apart from the differences bound to the climatic conditions, gradually decreases as the altitude increases.

To take these pressure variations into account, subtract the correction data of Table 2 from the values read on the pressure gauges.

Pressure variations depending on altitude		
Altitude (m above sea level)	Absolute atmospheric pressure (kg/cm²)	Correction (kg/cm²)
0	1.029	0
300	0.994	-0.035
600	0.959	-0.070
900	0.924	-0.105
1200	0.889	-0.140
1500	0.854	-0.175
1800	0.815	-0.210
2100	0.791	-0.238
2400	0.763	-0.266
Table 2		

4.3 Functionality tests

4.3.1 Specific equipment

Use the following equipment to test plant operation and identify any faults:

- Plant to recover, prepare and charge coolant (Fig.15.39).
- Thermometer and hygrometer (Fig.15.40).
- Coolant leak detectors (Fig.15.41).
- Protective goggles and gloves (Fig.15.42).

Fig. 15.39

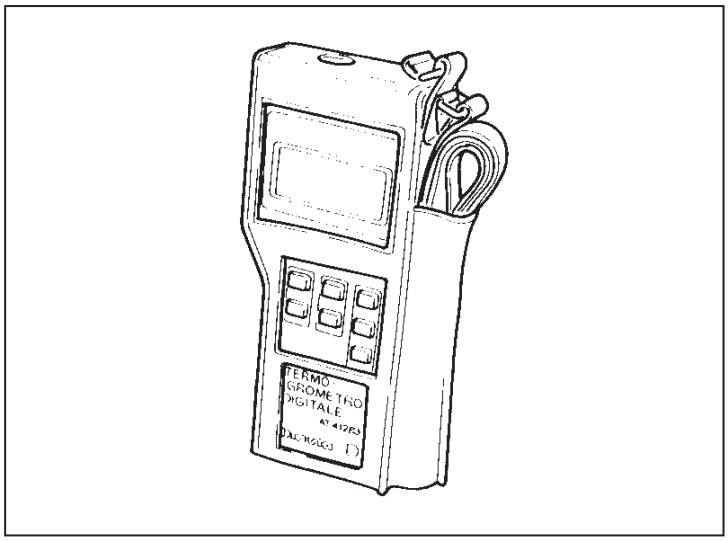


Fig. 15.40

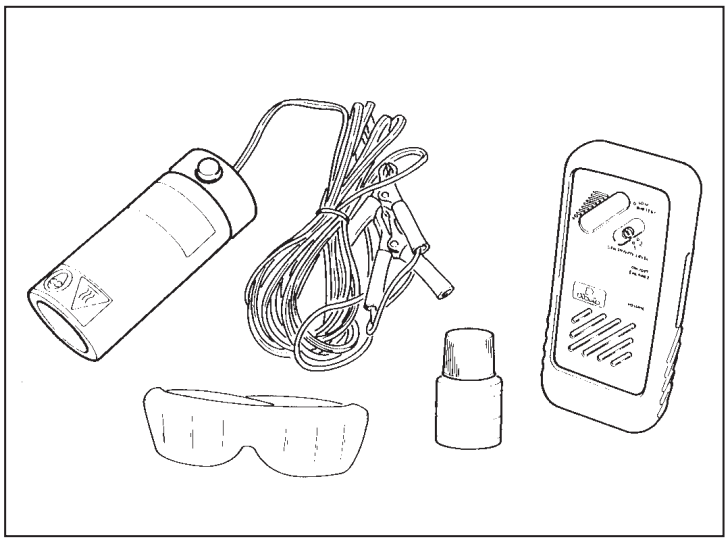


Fig. 15.41

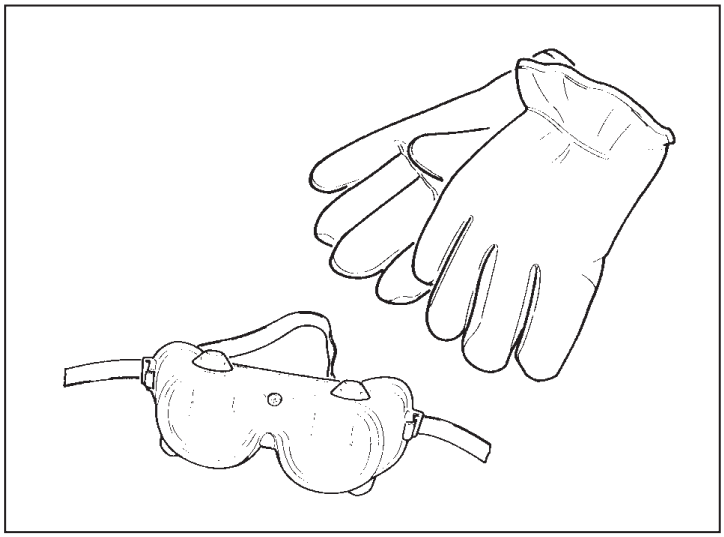


Fig. 15.42

4.3.2 Temperature check

Once you have ascertained that the pressure values are correct and that all the cab filters are clean, proceed with a functional test by measuring the temperature of the air delivered by the internal vents. Proceed as described below and refer to the following table.

Temperature table	
Temp. outside the vehicle (°C)	Temp. of air from central vents (°C) (average value)
20°	6°-8°
25°	8°-10°
30°	8°-12°
35°	9°-14°
Table 3	

1 - Select the minimum temperature available on the control panel and operate the fan at medium speed;

2 - Check that the thermostat setting (if installed) is correct (one quarter of a turn before the coldest position);

3 - Operate the system and bring the engine to a speed of 1500-1800 rpm;

4 - Measure the temperature by placing the thermometer near the vents, as shown in the table;

If the temperature inside the cab is higher than outdoors, open the doors and wait for the temperature to become stable by operating the system for 5-10 minutes. Then check the temperature again.

Consult a center specialized in Delphi A/C systems if there are further problems such as unpleasant odours, air not cool enough or abnormal noise from the system.

Section 5 : Tools required

Index

5.1 Tools required 15-44

5.1 Tools required

Code	Description	Quantity
07007181	Cab lifting tool	1

Chapter 16 : Front hitch

Index

Section 1 : Safety notes 16-2

Section 2 : Technical specifications 16-3

2.1 Technical specifications 16-4

Section 3 : Disassembly 16-5

3.1 Preliminary operations 16-6

3.2 Disassembly 16-7

Section 4 : Main inspection, re-assembly and adjustment operations 16-11

4.1 Re-assembly 16-12

Section 1 : Safety notes

To prevent accidents and injuries, always comply with the precautions and safety recommendations described in this section. In addition, operators must always comply with the safety instructions given in the operation and maintenance manual and in chapter 1 of this manual.

Danger

Make sure that all persons keep well away from the danger zone.

Danger

Lift and handle all heavy parts with lifting equipment of an adequate capacity. Arrange all harness and hooks in safe positions. Operators must remain at a distance and in a safe position, well away from the lifted load.

Danger

Do not twist the chains or metal ropes used for lifting purposes. Always wear safety gloves when handling cables or chains.

Danger

Use the right tools to align holes. NEVER USE YOUR FINGERS OR HANDS.

Danger

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next.

Danger

For safety reasons, always leave two screws on opposite sides when removing components that could fall. Only remove these screws after having secured the component to lifting equipment or placed bearing blocks underneath.

Danger

If the bolts that fix the safety frame or cab have loosened or if the safety frame or cab are removed, make sure that the parts are re-installed correctly so that adequate protection is provided for the operator.

Caution

Keep clear of the sharp edges around the top of the transmission housing.

Caution

Used oil must be collected and disposed of in compliance with the anti-pollution laws in force.

Section 2 : Technical specifications

Index

2.1 Technical specifications 16-4

2.1 Technical specifications

Type	Up and down
Lifting capacity at ball ends	1200 kg
Three-point linkage class	Class 1 and 1N

Section 3 : Disassembly

Index

3.1 Preliminary operations 16-6

3.2 Disassembly 16-7

3.1 Preliminary operations

The main operations required to access the unit are described below:

Remove one of the front wheels.

Danger

Place a stand under the front axle before removing the wheel.

Make sure that the stand is able to bear its weight.

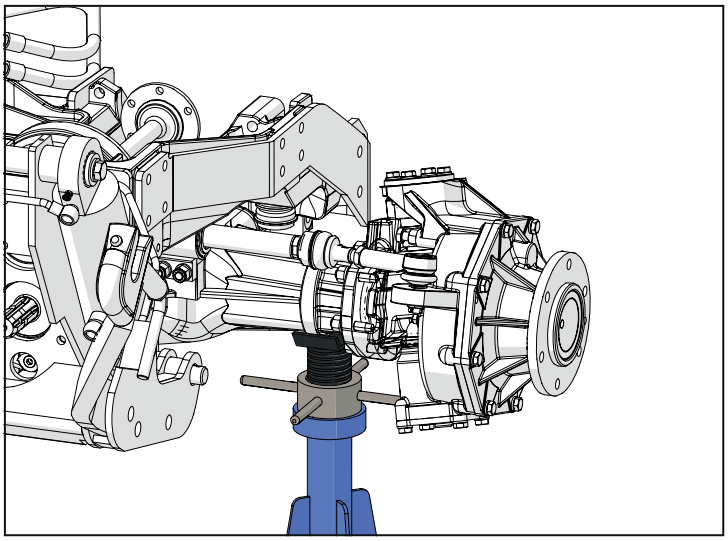


Fig. 16.1

3.2 Disassembly

Unscrew the two hydraulic pipes that come from the front control valve.

Unscrew the unions (1) and remove the washers (2) so as to free the hydraulic pipes.

> **Warning**
>
> Hydraulic pipe (3) cannot be removed at this stage. Leave it resting on the hydraulic cylinders. make sure that it is not damaged.

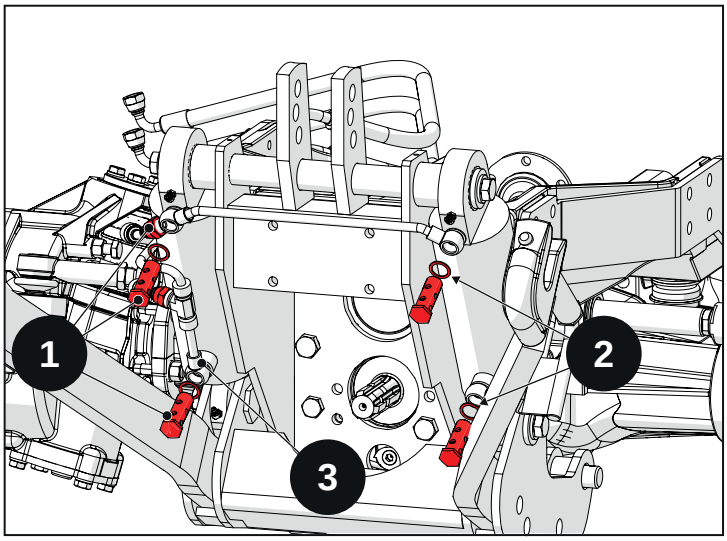


Fig. 16.2

Remove the split pins (4) and pins (5) from both sides, then remove the links (3).

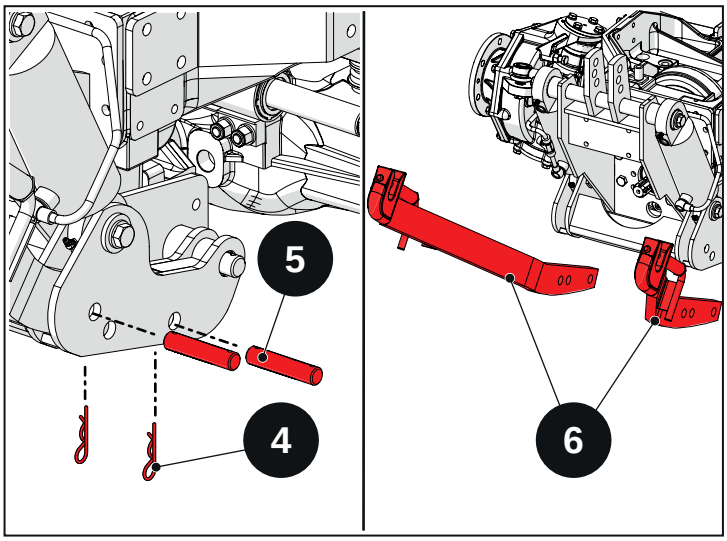


Fig. 16.3

Unscrew the screws (7) that fasten the rams (8), then remove the washers (9) and spacer (10) from both sides.

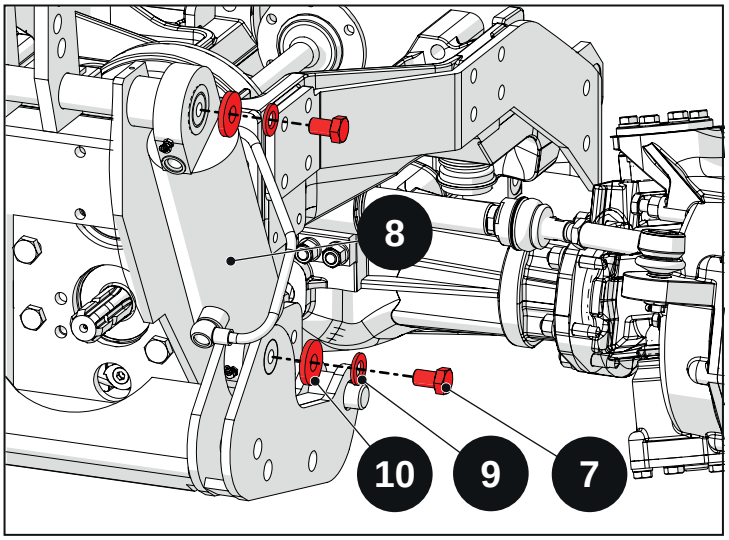


Fig. 16.4

Remove the pins (11) and take out the plug (12).

Danger

Once the plug has been removed, the link support will no longer be fastened to the machine.

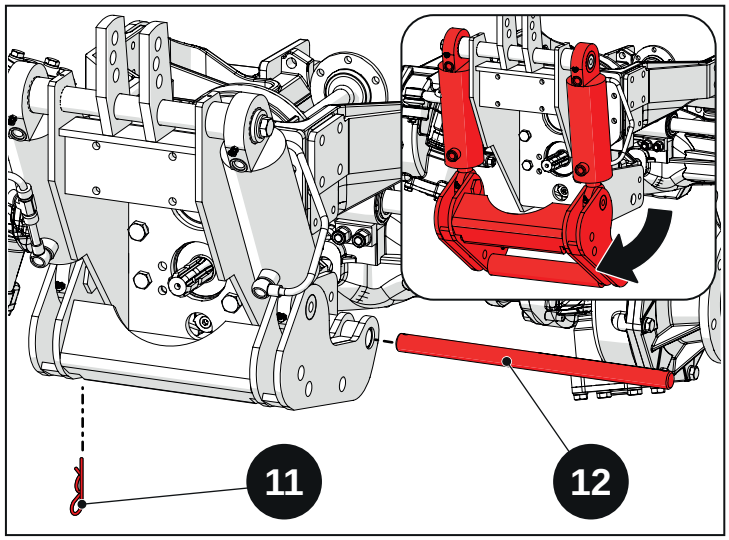


Fig. 16.5

Remove the plugs (13) and free the rams (8).

Remove the hitch link support (14).

Warning

Hydraulic pipe (3) can now be removed.

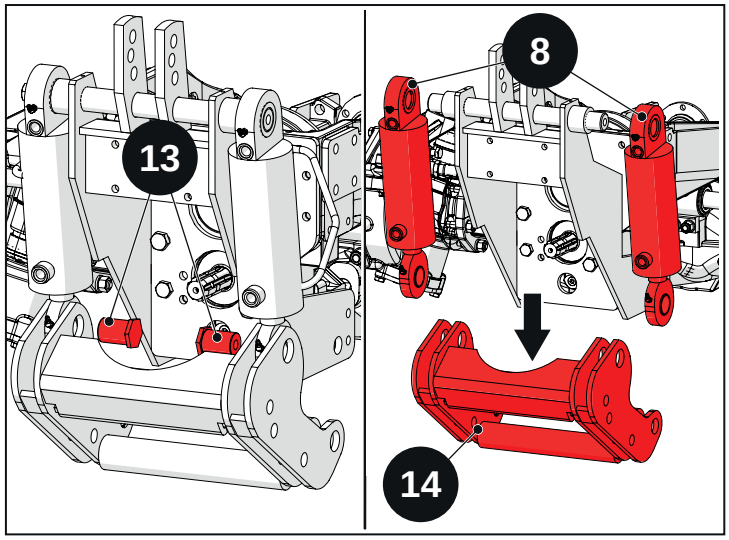


Fig. 16.6

Unscrew the screws (15) from both sides.

Unscrew the central screws (16).

Danger

Once the screws have been removed, the bearing frame of the hitch will no longer be fastened to the machine.

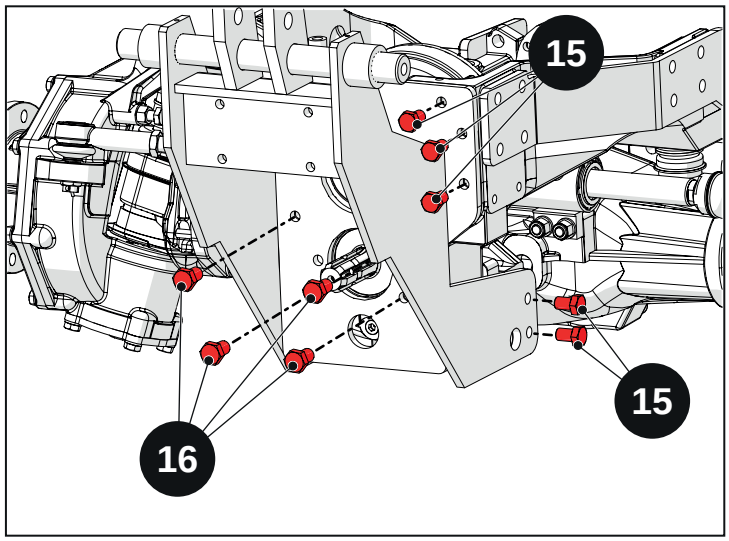


Fig. 16.7

Remove the bearing frame of the hitch (17).

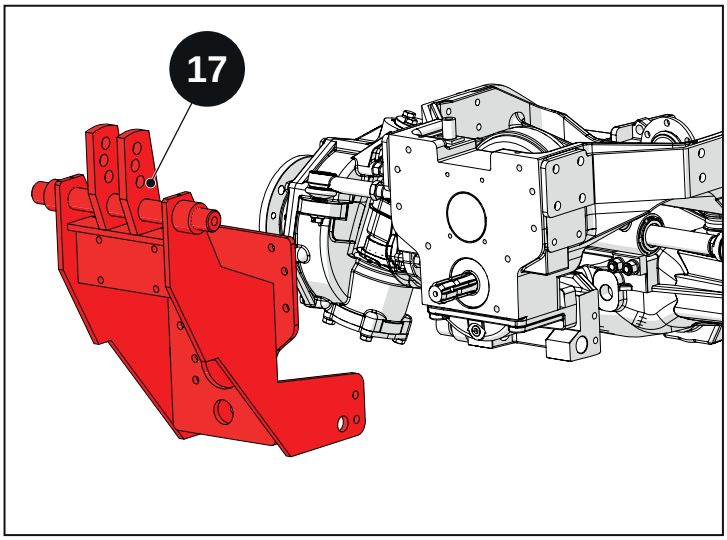


Fig. 16.8

Section 4 : Main inspection, re-assembly and adjustment operations

Index

4.1 Re-assembly.....16-12

4.1 Re-assembly

Warning	Before proceeding with the re-assembly operations, carefully read and comply with the instructions given in chapter "1-Introduction", especially those describing how to assemble O-Rings, oil retainers and bearings. Use the correct tightening torques when screwing in the components. Consult the table in chapter "1-Introduction" if the tightening torque value is not given. Use the indicated sealants when re-assembling the parts. Consult the table in chapter "1-Introduction" if the sealant is not indicated.

Comply with the disassembly instructions in reverse order when reassembling the hitch.

Chapter 17 : Electrical system

Index

Section 1 : Safety rules 17-2

Section 2 : Instrument panel 17-3

2.1 Analogue instrument panel 17-4
2.2 Digital instrument panel 17-6
2.3 Indicator lamps 17-9

Section 3 : Main components 17-11

3.1 Battery 17-12
3.2 Fuses 17-13
3.3 Sensors 17-17
3.4 Installing rotating beacon on roll bar 17-23

Section 4 : Main circuits 17-25

4.1 Start 17-26
4.2 Preheat glow plugs 17-27
4.3 Engage 4WD with brakes (Energy 80 only) 17-28
4.4 4WD circuit fill valve (Energy 80 only) 17-30
4.5 KSB - cold start (Energy 80 only) 17-31

Section 5 : Energy 60 wiring looms 17-33

5.1 02003123 - Engine 17-34
5.2 02003404 - Platform 17-36

Section 6 : Energy 80 wiring looms 17-41

6.1 02002737 - Front Power Take Off 17-42
6.2 02003403 - Engine (30 Km/h version) 17-44
6.3 02003404 - Platform 17-48
6.4 02003405 - Engine 17-52
6.5 02003406 17-56

Section 1 : Safety rules

A number of safety precautions and warnings are indicated in this paragraph; these must be observed to prevent the risk of operator injury. However, the safety measures indicated in the use and maintenance manual and in chapter 1 of this manual must be applied at all times.

Observe all safety rules with the following symbol with particular care:

Attention

Always read the instructions in the relative use and maintenance manual when working on the battery.

Attention

Take all the necessary precautions when installing batteries containing sulphuric acid. In the event of acid coming into contact with the skin or eyes, rinse the affected parts of the body immediately with clean water.

Attention

When mixing acid with water, POUR THE ACID SLOWLY INTO THE WATER. NEVER POUR WATER INTO ACID.

Attention

The battery releases explosive gas when charging. Ensure that the area is well ventilated and keep away from naked flame and sources of sparking.

Attention

Always switch the battery charger off before disconnecting the cables.

Attention

Keep the battery out of the reach of children.

Attention

Do not smoke when checking or handling batteries.

Attention

Disconnect the negative terminal first. When refitting the battery, connect the positive terminal first. Take particular care not to connect the terminals to the wrong battery poles.

Attention

Before working on the electrical system, always disconnect the ground cable (-) from the battery.

Section 2 : Instrument panel

Index

2.1 Analogue instrument panel 17-4
2.1.1 Functional diagram 17-5
2.2 Digital instrument panel 17-6
2.2.1 Functional diagram 17-7
2.2.2 Configuring the digital instrument panel 17-8
2.3 Indicator lamps 17-9

2.1 Analogue instrument panel

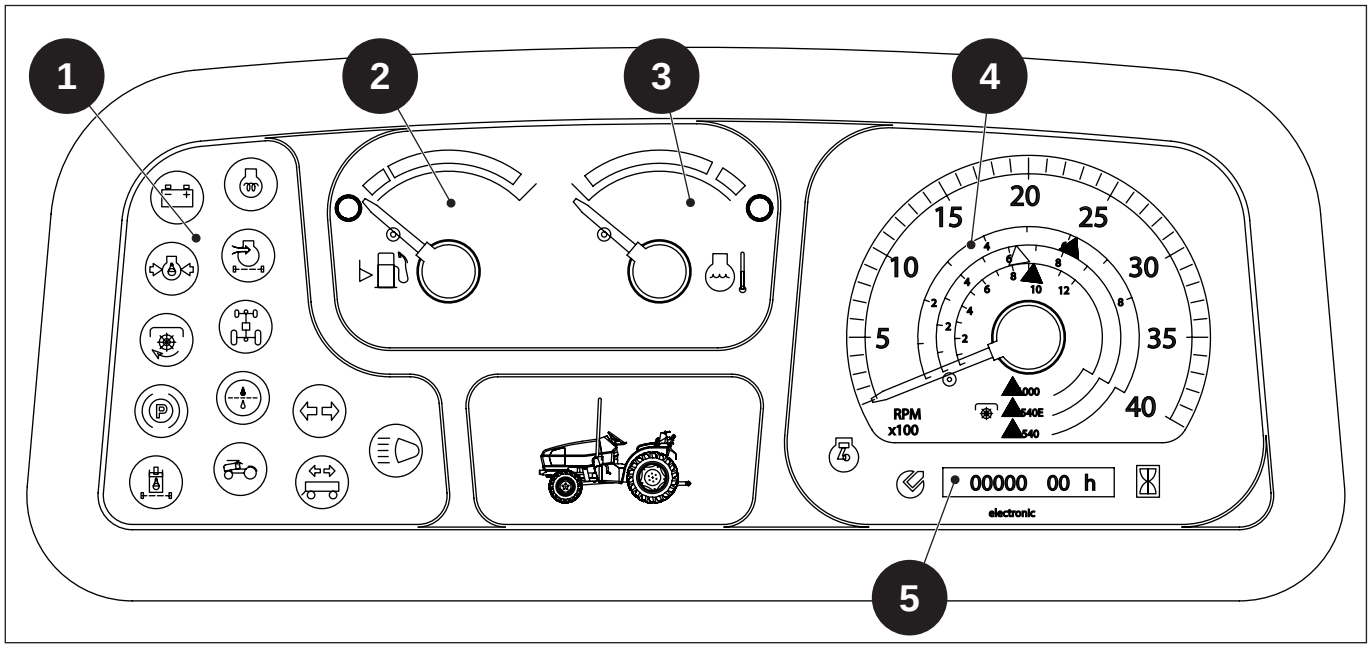


Fig. 17.1

1 - Indicator lamps
2 - Fuel gauge
3 - Water temperature indicator
4 - Tachometer
5 - Hour meter

2.1.1 Functional diagram

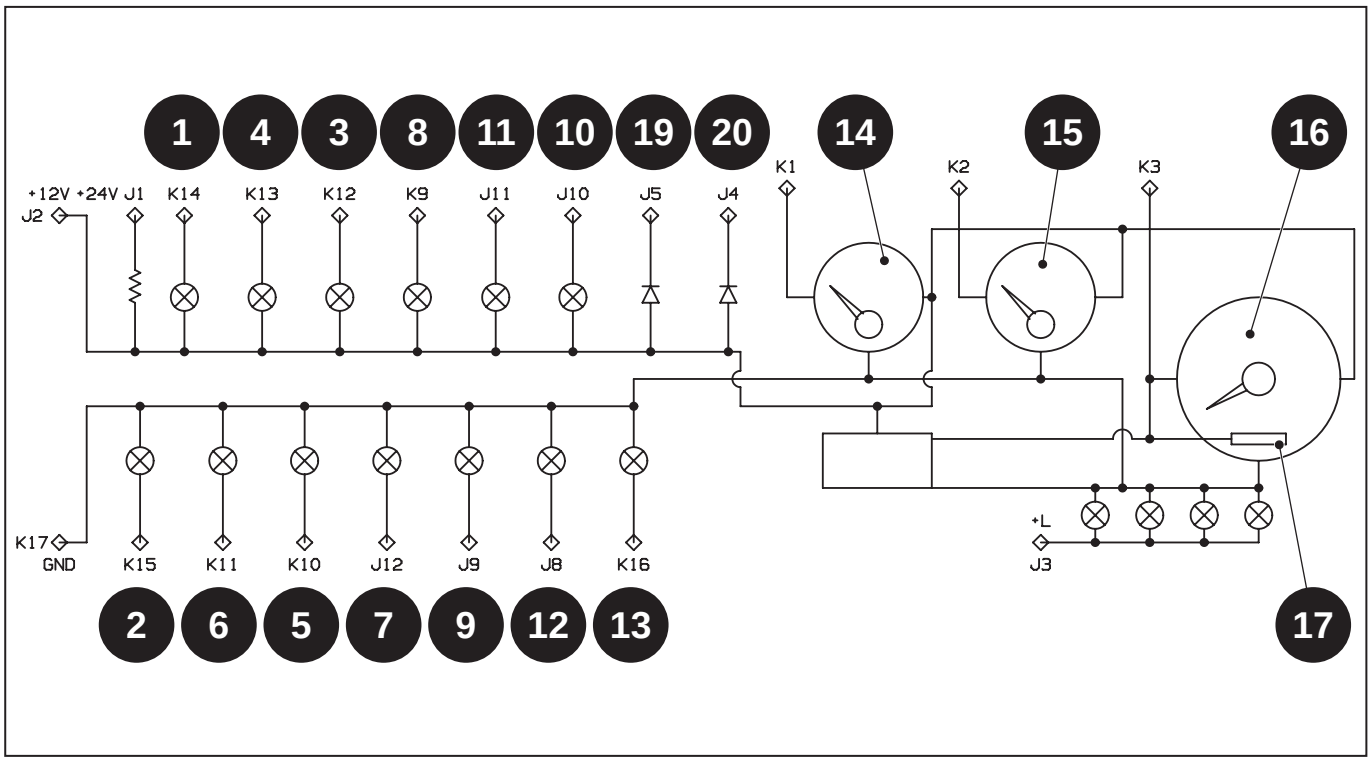


Fig. 17.2

1 - Low battery charge warning lamp, red
2 - Engine preheat indicator lamp, yellow
3 - Low engine oil pressure warning lamp, red
4 - Engine air filter clogged warning lamp, red
5 - PTO clutch disengaged indicator lamp, red
6 - Front wheel drive engaged indicator lamp, yellow
7 - Parking brake engaged warning lamp, red
8 - Oil filter clogged warning lamp, red
9 - Tractor turn signal indicator lamp, green
10 - Oil filter clogged warning lamp, red
11 - ROPS frame lowered warning lamp, red
12 - Trailer turn signal indicator lamp, green
13 - High beam headlights indicator lamp, blue
14 - Fuel level
15 - Water level
16 - Engine RPM
17 - Hour meter

2.2 Digital instrument panel

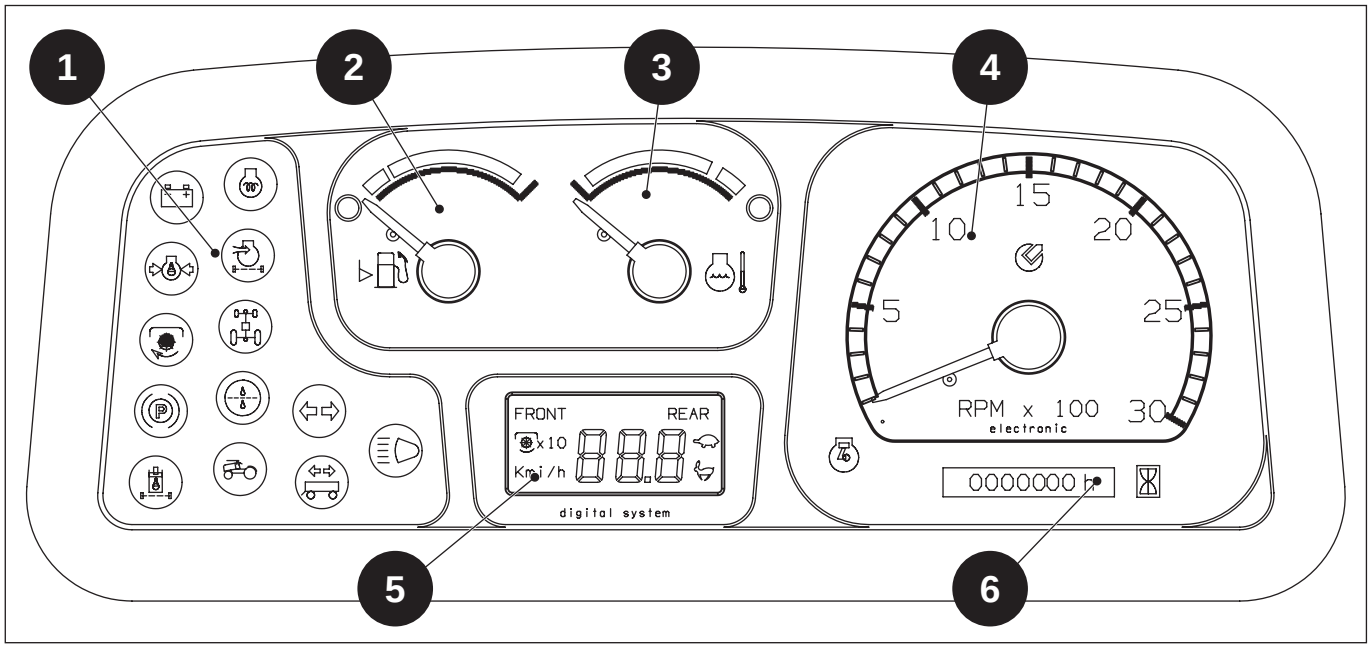


Fig. 17.3

1 - Indicator lamps
2 - Fuel gauge
3 - Water temperature indicator
4 - Tachometer
5 - Digital display
6 - Hour meter

2.2.1 Functional diagram

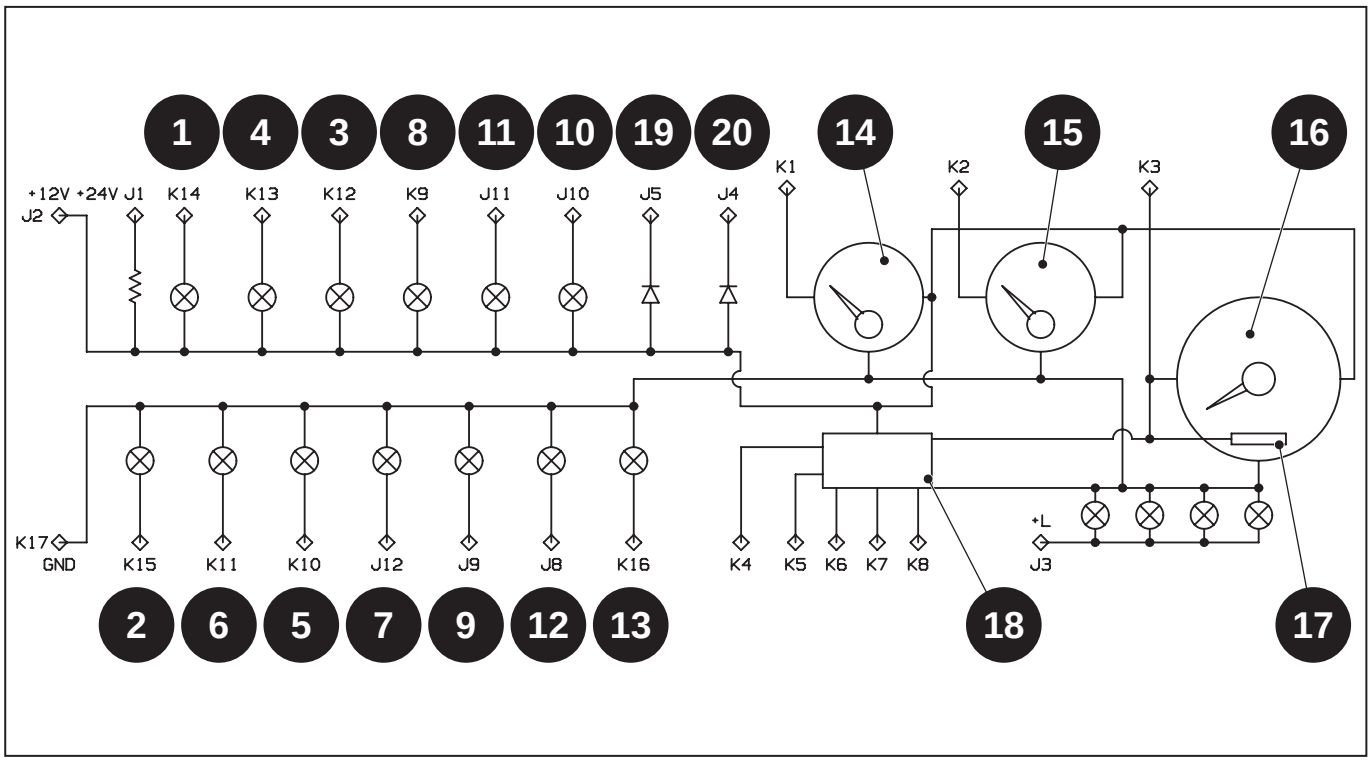


Fig. 17.4

1 - Low battery charge warning lamp, red
2 - Engine preheat indicator lamp, yellow
3 - Low engine oil pressure warning lamp, red
4 - Engine air filter clogged warning lamp, red
5 - PTO clutch disengaged indicator lamp, red
6 - Front wheel drive engaged indicator lamp, yellow
7 - Parking brake engaged warning lamp, red
8 - Oil filter clogged warning lamp, red
9 - Tractor turn signal indicator lamp, green
10 - Oil filter clogged warning lamp, red
11 - ROPS frame lowered warning lamp, red
12 - Trailer turn signal indicator lamp, green
13 - High beam headlights indicator lamp, blue
14 - Fuel level
15 - Water level
16 - Engine RPM
17 - Hour meter
18 - Digital display

2.2.2 Configuring the digital instrument panel

For the instrument panel to function correctly, it must be configured with a specific code for the tyres and type of PTO installed on the machine

Note

The configuration code is displayed on the screen for a few seconds each time the machine is started.

Warning

Disconnecting the battery terminals deletes the configuration code from the memory.

Tyres	540/540E
320/70-R24" 240/70-R16”	121
360/70-R20" 11.0/65-R12"	114
360/70-R24" 260/70-R16”	122
41/14.00-20" 27/8.50-15"	110

To configure the instrument panel:

1 - Turn the ignition switch while holding button (1) until the instrument panel switches on. Release button 4. The message SET is displayed on the screen.

2 - Press and hold button (1) again until the first of the three figures flashes.

3 - Press button (1) repeatedly to cycle through the values and set the required value.

4 - Press and hold button (1) to save the first value and move on to the second figure.

5 - Repeat the two steps described previously to set and store the second and third values.

6 - After storing all three values, press and hold button (1) until Km/h or mi/h is displayed.

7 - Release button (1) and then press and hold again until the message OFF is displayed. The configuration procedure is now complete

Fig. 17.5

2.3 Indicator lamps

1 - Low battery charge warning lamp, red
2 - Engine preheat indicator lamp, yellow
3 - Low engine oil pressure warning lamp, red
4 - Engine air filter clogged warning lamp, red
5 - PTO clutch disengaged indicator lamp, red
6 - Front wheel drive engaged indicator lamp, yellow
7 - Parking brake engaged warning lamp, red
8 - Oil filter clogged warning lamp, red
9 - Tractor turn signal indicator lamp, green
10 - Oil filter clogged warning lamp, red
11 - ROPS frame lowered warning lamp, red
12 - Trailer turn signal indicator lamp, green
13 - High beam headlights indicator lamp, blue

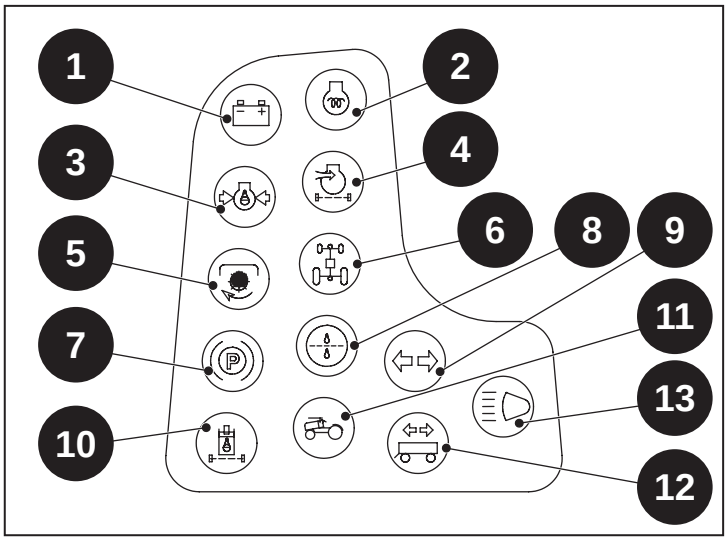


Fig. 17.6

Section 3 : Main components

Index

3.1 Battery 17-12

3.2 Fuses 17-13

3.3 Sensors 17-17

3.4 Installing rotating beacon on roll bar 17-23

3.1 Battery

Attention

Any work on the battery must be carried out with particular caution: electrolyte is corrosive and the gas released by the battery is highly flammable.

Check

Check that the battery is fastened correctly to the machine.

Clean

Keep the battery clean with a damp, antistatic cloth.

Keep the battery terminals and the cable terminal clamps clean.

Lubrication

When needed, lightly grease the terminals and terminal clamps.

Use a petroleum jelly based grease, not a standard grease.

Topping up

Check the electrolyte level and keep it topped up correctly so that the battery plates are completely covered. Top up with demineralised water, with the engine off and with no naked flame in the vicinity.

Periods with the machine not in use

In case of prolonged periods with the machine not in use:

- Charge the battery as indicated by the manufacturer.
- Disconnect both cables
- Keep the battery in a cool, dry and well ventilated place.

Replacement

If the battery has to be replaced, use a battery with the same technical specifications (see the values indicated on the battery itself).

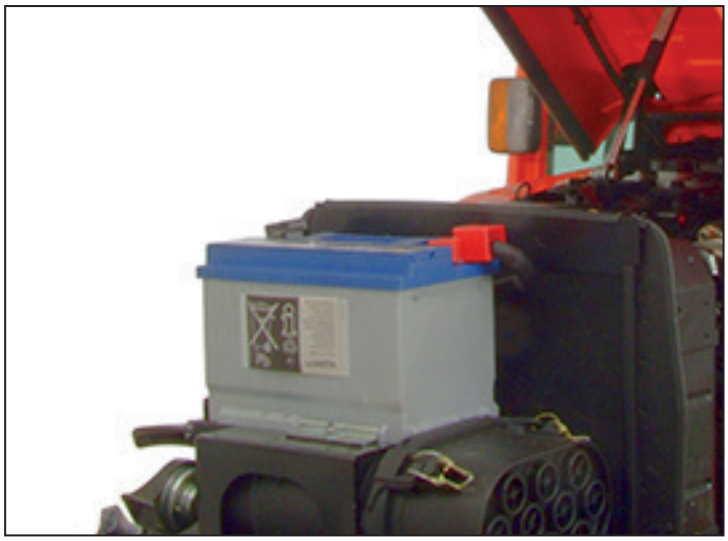


Fig. 17.7

3.2 Fuses

The electrical system is protected against short circuits or abnormal current absorption by fuses.

Identify and resolve the cause of the short circuit before replacing a fuse.

Replace failed fuses with new components with the same characteristics, as indicated on the fuse itself.

Contact a specialised technician in case of any doubt.

Functions of fuses, Energy 60:

A	Lights selector stalk power feed. Horn Seven pole socket.	10A
B	LH high beam headlight.	10A
C	Multifunction instrument. LH rear sidelight. LH number plate light Seven pole socket. LH high beam headlight. Cab power supply	10A
D	12V 1-pole socket	10A
E	Flash high beams. Hazard warning lights switch	15A
F	RH high beam headlight.	10A
G	12V 1-pole socket	20A
H	Hazard warning lights switch Parking brake	15A
I	Multifunction instrument. Headlights	20A
L	12V 1-pole socket	20A
M	4WD switch. Cab power supply	15A
N	LH rear sidelight. RH front sidelight. LH number plate light Seven pole socket. Cab power supply	15A

Fig. 17.8

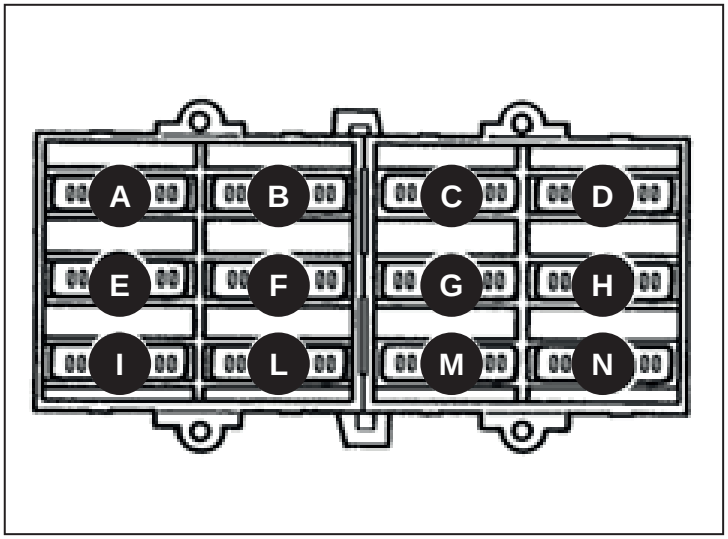


Fig. 17.9

Functions of fuses, Energy 80:

A	LH high beam headlight. RH high beam headlight.	15A
B	Flash high beams. Hazard warning lights switch Rotary beacon switch 1-pole socket power feed. Front	15A
C	Horn Seven pole socket.	15A
D	12V 1-pole socket Rear	20A
E	RH low beam headlight.	10A
F	LH low beam headlight.	10A
G	Cab power supply	10A
H	PTO switch Preheat ECU. Energise alternator. Engine stop solenoid power feed Engine speed sensor Variable advance unit Multifunction instrument.	10A
I	Multifunction instrument lighting LH number plate light Seven pole socket. LH front sidelight. RH rear sidelight.	10A
L	RH number plate light Seven pole socket. RH front sidelight. LH rear sidelight.	15A
M	Parking brake Brake lights. Differential lock	15A
N	Free	10A

Fig. 17.10

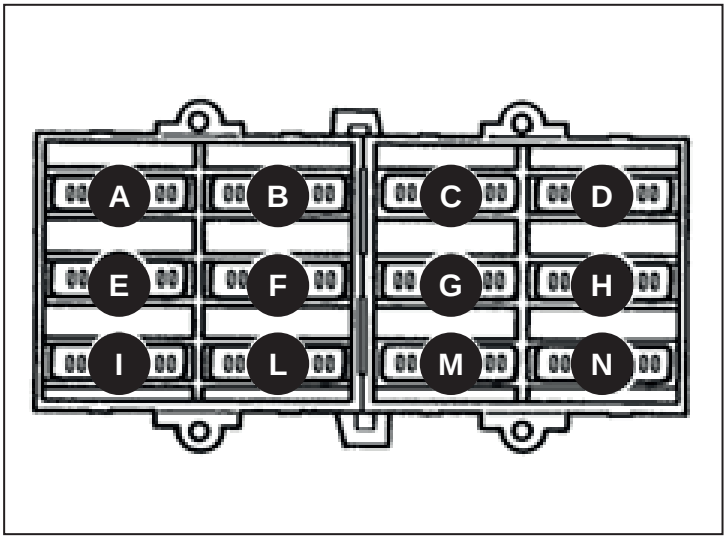


Fig. 17.11

Main fuses, Energy 60:

A	General electrical system protection.	70A
B	General cab electrical system protection (only for machines fitted with cab)	40A

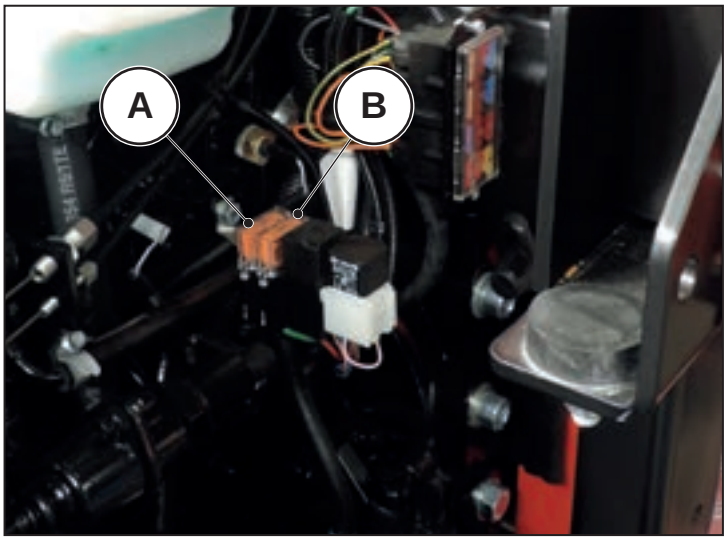


Fig. 17.12

Main fuses, Energy 80:

A	General electrical system protection.	40A
B	Engine preheat	40A
C	General cab electrical system protection (only for machines fitted with cab)	40A

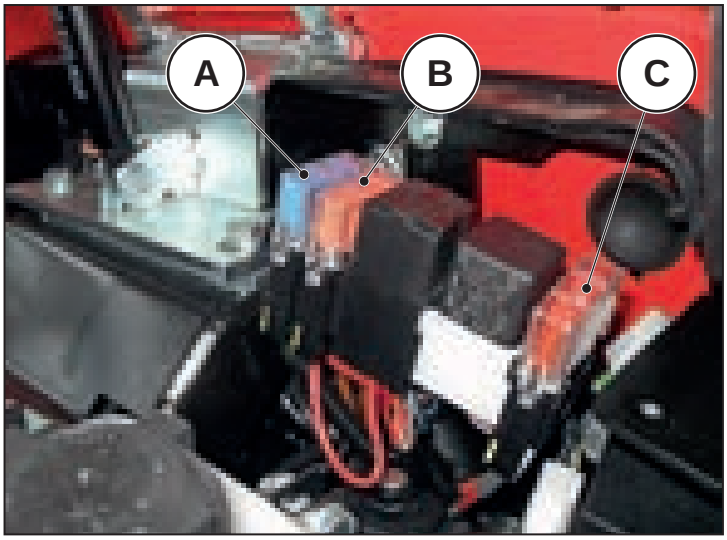


Fig. 17.13

Cab fuses:

A	Windscreen wiper/washer	7.5A
B	Ceiling unit fan switch	20A
C	Work light	15A
D	Fan housing/heat exchanger	25A
E	Rear lights	10A
F	Rotary beacon	20A

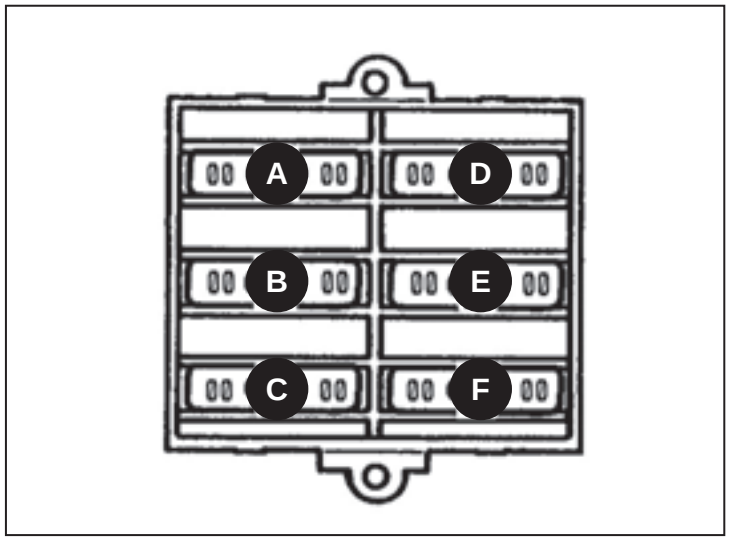


Fig. 17.14

Fig. 17.15

3.3 Sensors

Clutch engine start enable sensor

Detects if the clutch pedal is depressed or released.

> **Note**
>
> The tractor cannot be started when the pedal is released.

Fig. 17.16

Rear PTO engine start enable sensor

Detects if the rear PTO shaft is turning.

> **Note**
>
> The tractor cannot be started when the rear PTO shaft is turning.

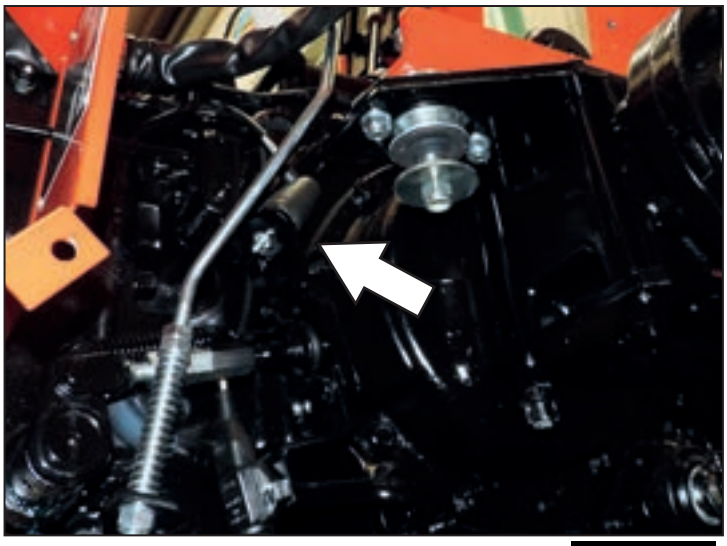


Fig. 17.17

KSB temperature sensor

Activates/deactivates KSB fuel injection pump advance function.

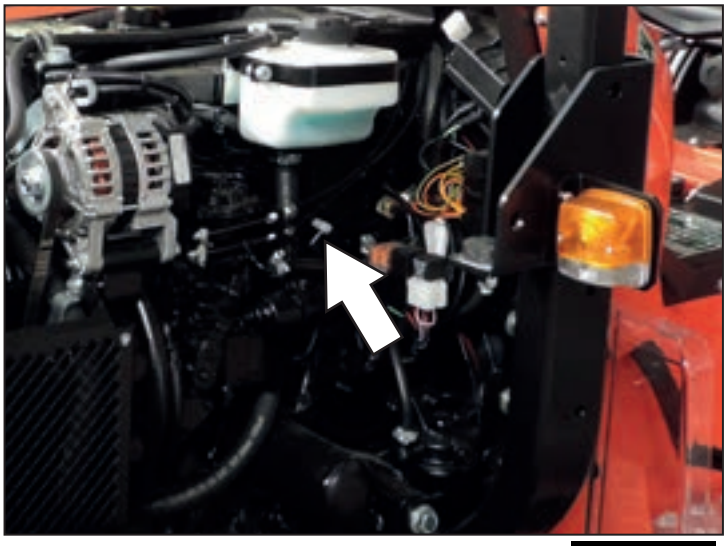


Fig. 17.18

Engine temperature sensor

Measures engine coolant temperature and sends relative signal to instrument panel.

Note
Use only original Goldoni bulbs.

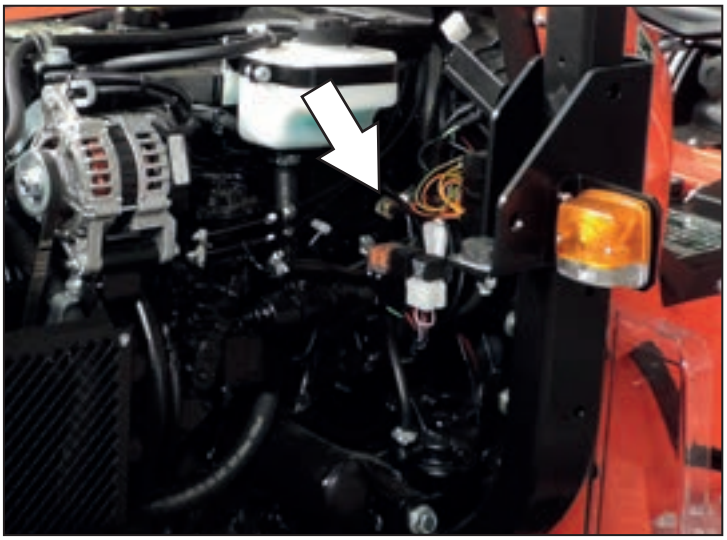


Fig. 17.19

Parking brake switch

Detects when parking brake is engaged and sends relative signal to instrument panel.

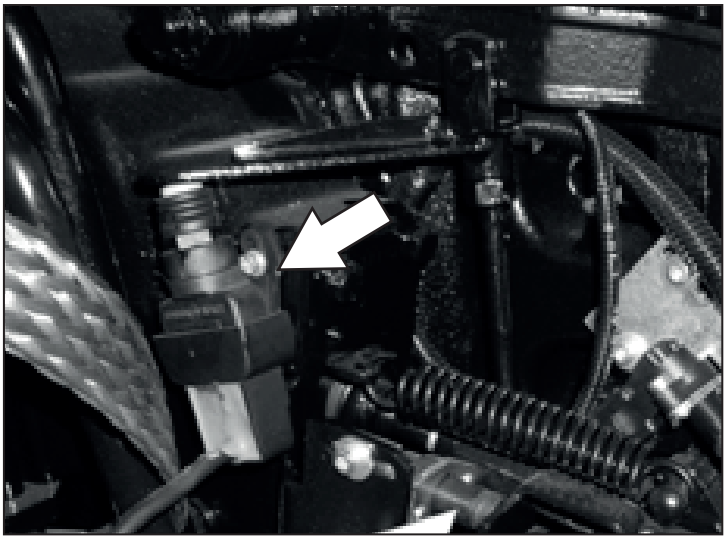


Fig. 17.20

Brake light switch

Activates the rear brake lights when the brake pedals are pressed.

Fig. 17.21

IST switch (Automatic 4WD Select) - Energy 80 only

Engages 4WD when the system detects that both brake pedals are pressed simultaneously or that the parking brake is applied.

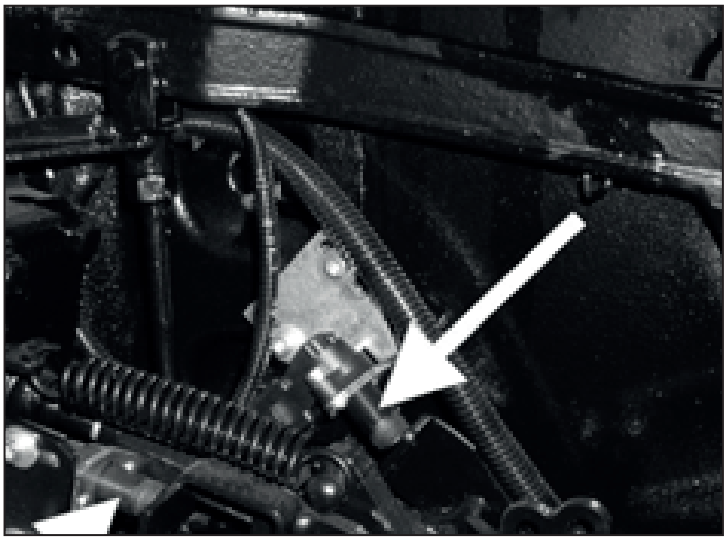


Fig. 17.22

Rear PTO engaged sensor

Detects when rear PTO clutch is engaged and sends relative signal to instrument panel.

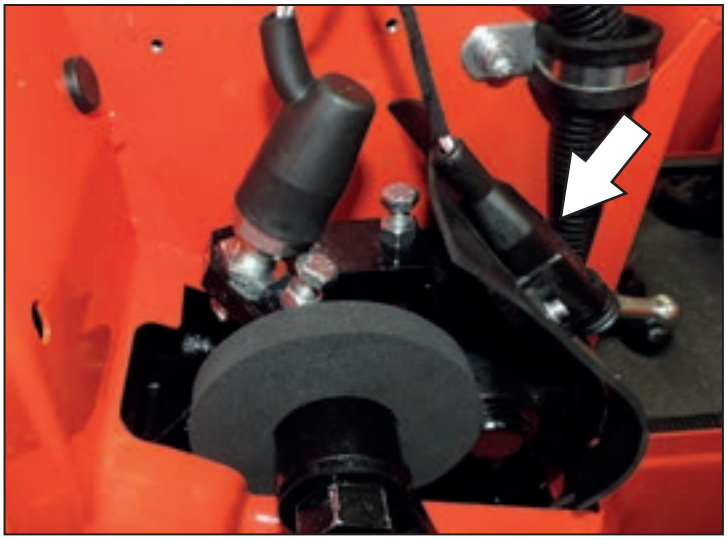


Fig. 17.23

Air filter sensor

Detects when air filter is clogged and sends relative signal to instrument panel.

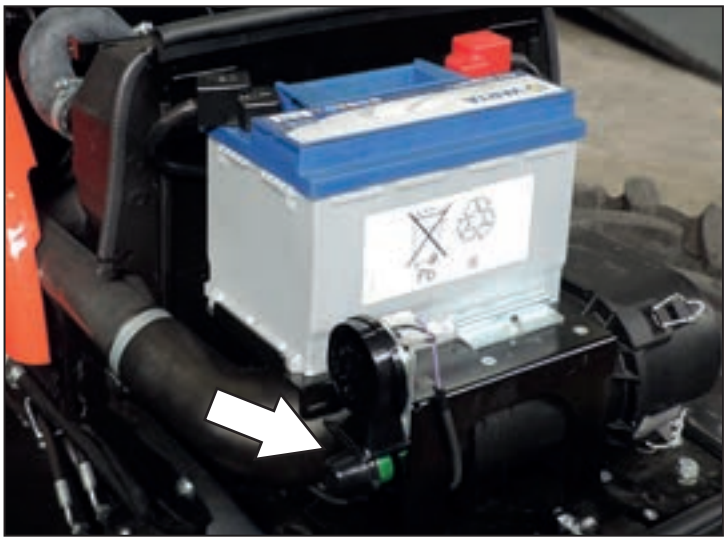


Fig. 17.24

4WD engage/disengage solenoid valve - Energy 80 only

Pressurises the 4WD circuit to disengage the relative clutch. The solenoid valve is energised when the tractor is switched on. When the driver presses both brake pedals simultaneously, presses the 4WD selector button or engages the parking brake, the solenoid valve is de-energised and releases the pressure in the circuit, which disengages the 4WD clutch.

Fig. 17.25

4WD circuit fill solenoid valve - Energy 80 only

This solenoid is energised/de-energised by the pressure switch installed on the hydraulic unit and requests oil from the main circuit when it detects a drop in pressure in the 4WD circuit.

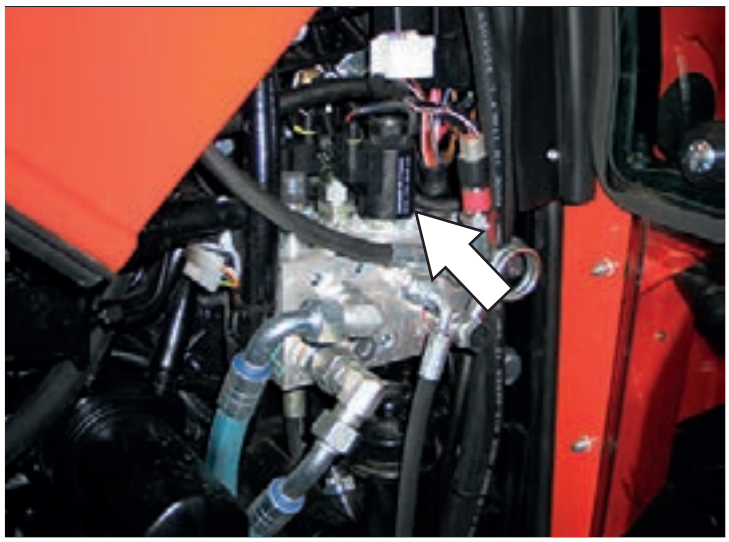


Fig. 17.26

Automatic 4WD engage relay - Energy 80 only

Engages/disengages 4WD. When the driver presses both brake pedals simultaneously, presses the 4WD selector button or engages the parking brake the relay contact opens and cuts power to the 4WD solenoid valve, which releases the pressure in the circuit.

Fig. 17.27

Engine oil pressure sensor

Sends a signal to the instrument panel when it detects an incorrect engine oil pressure value.

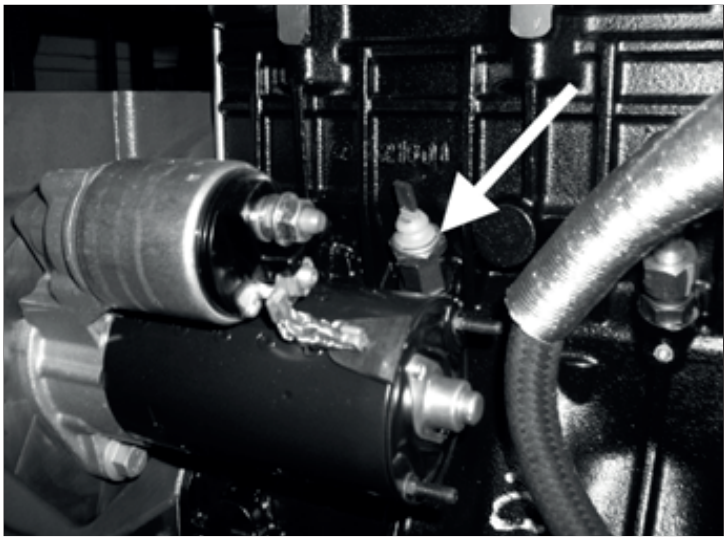


Fig. 17.28

Engine speed sensor

Reads engine speed from the tone wheel.

Note

The sensor must be set to a distance of 0.5 to 2 mm from the tone wheel.

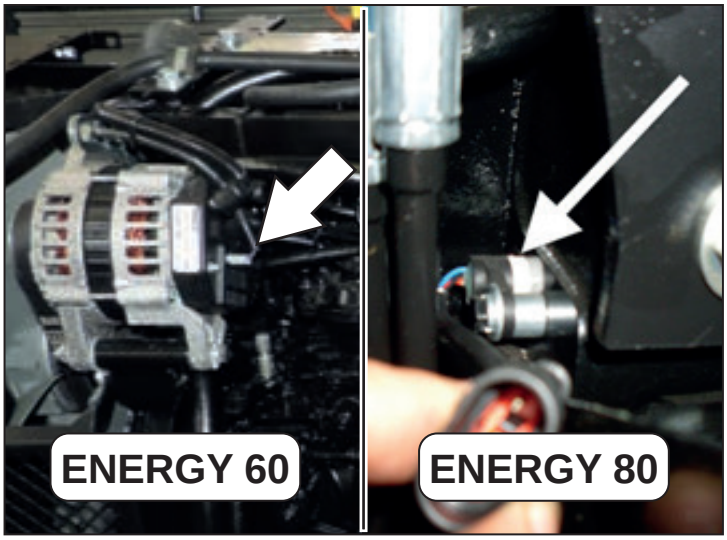


Fig. 17.29

Speed sensor - Energy 80 only

Reads the ground speed of the tractor from the 4WD shaft.

Note

The sensor must be set to a distance of 0.5 to 2 mm from the tone wheel.

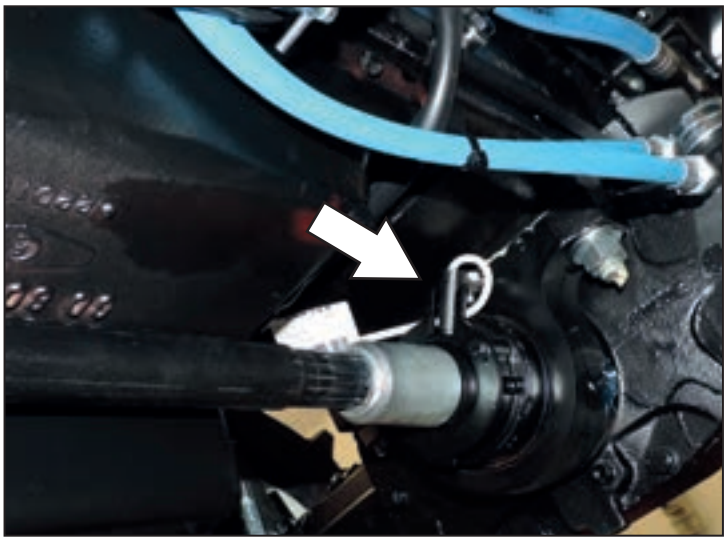


Fig. 17.30

Intake air filter clogged sensor

Detects when intake air filter is clogged and sends relative signal to instrument panel.

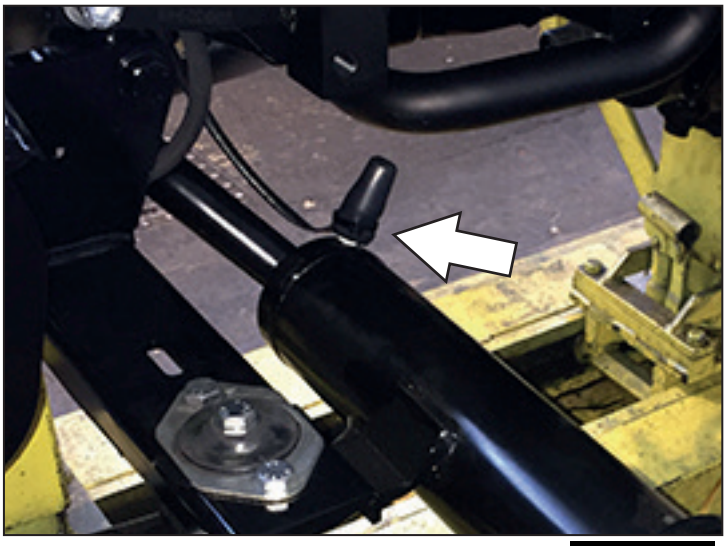


Fig. 17.31

Hazard warning lights relay

Activates the flashing hazard warning lights.

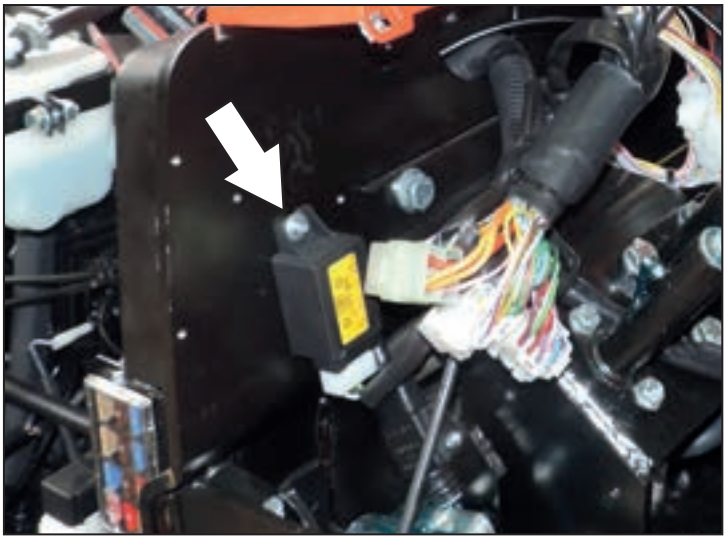


Fig. 17.32

3.4 Installing rotating beacon on roll bar

Feed the cable from the base of the right hand roll bar pillar (1) up to the hole at the top of the hoop (2).

Pass the cable through the rotating beacon mount (3), fasten the mount to the roll bar, fit the cylinder (4) into the mount, leaving the two ends of the cable protruding at the top of the cylinder, fit the two Faston connectors (5) onto the cables, with the respective connector covers, and then connect them to the plug (6).

Tighten the cylinder (4) onto the plug (6) and fasten to the rotating beacon carrier (3) with the grub screw (7).

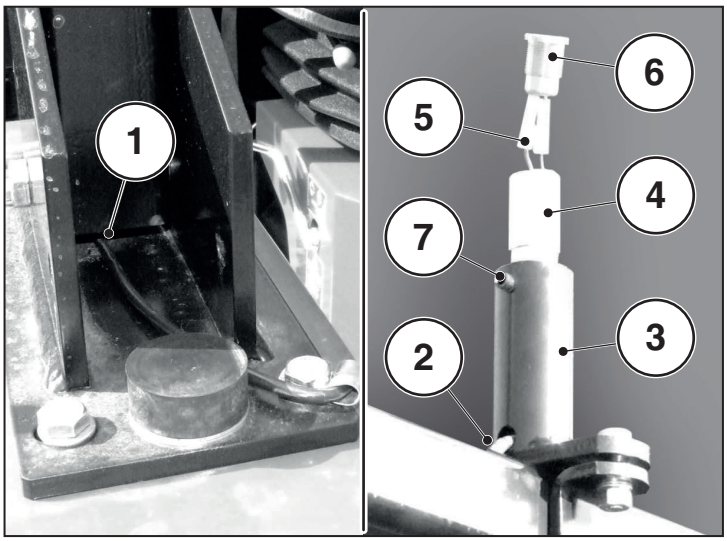


Fig. 17.33

Fasten the rotating beacon to the cylinder (4) and secure by tightening the screw (8).

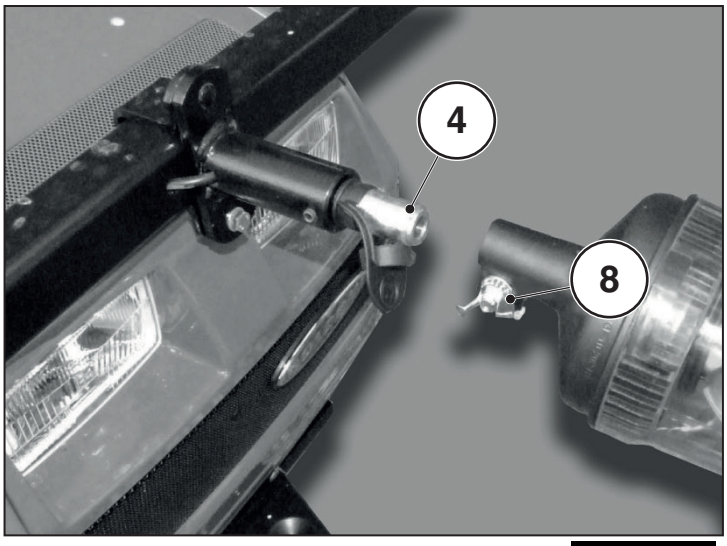


Fig. 17.34

Feed the cable through the cable guide and fasten the cable guide to one of the fastener bolts of the roll bar pillar.

Connect the cable terminal to the plug (10) of the rotating beacon switch (11), under the dashboard of the machine.

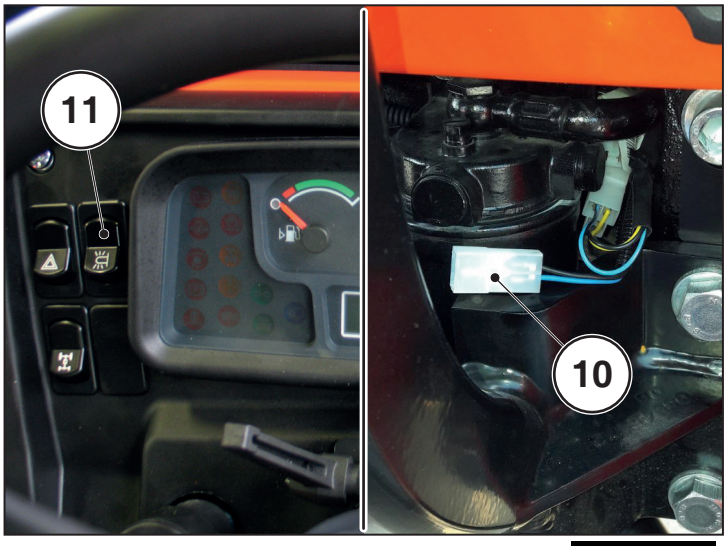


Fig. 17.35

Section 4 : Main circuits

Index

4.1 Start.....17-26

4.2 Preheat glow plugs.....17-27

4.3 Engage 4WD with brakes (Energy 80 only).....17-28

4.4 4WD circuit fill valve (Energy 80 only).....17-30

4.5 KSB - cold start (Energy 80 only).....17-31

4.1 Start

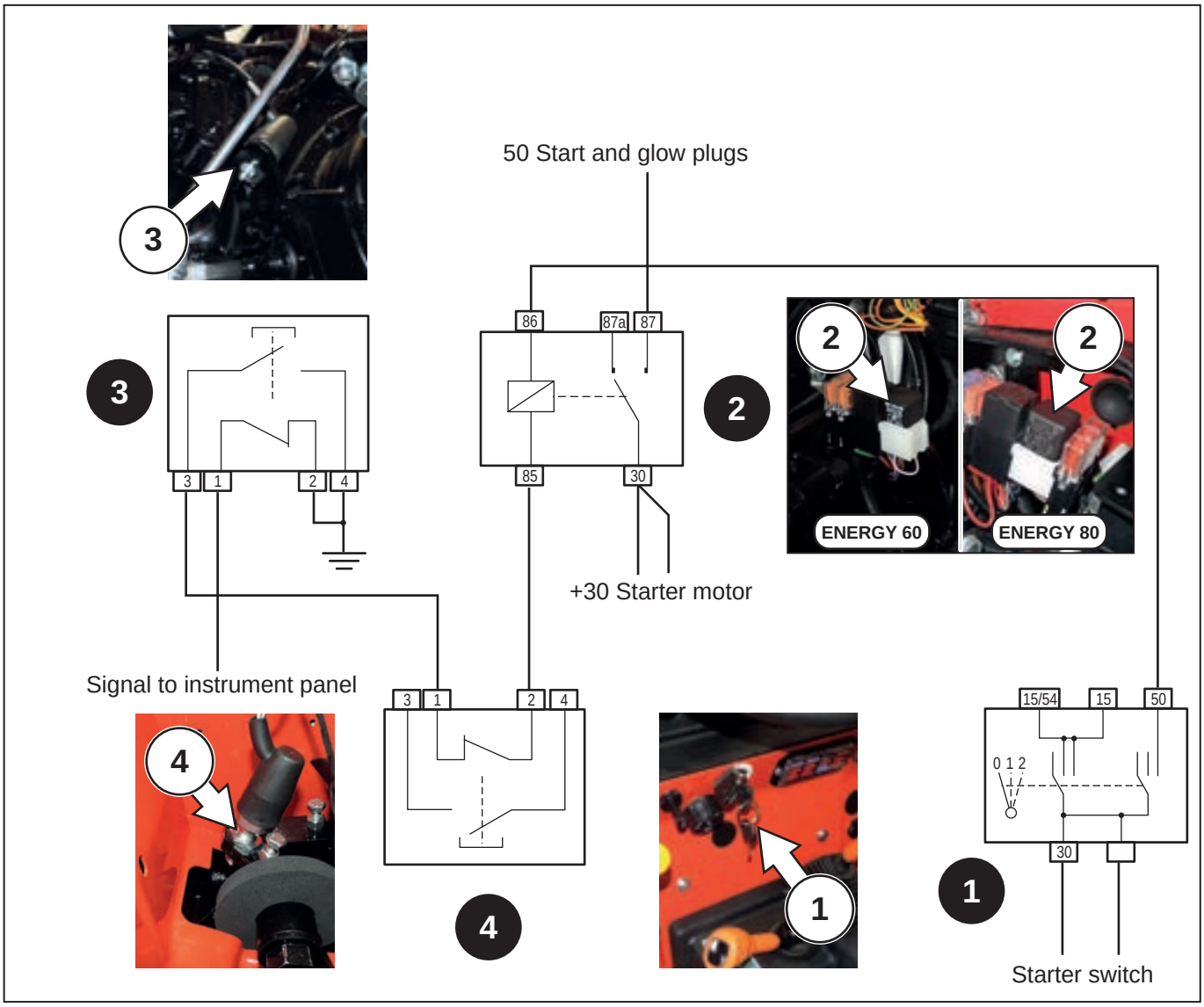


Fig. 17.36

The engine can only be started if the rear PTO start enable sensor (3) state is open (PTO disengaged) and the clutch pedal sensor (4) state is closed (pedal depressed). When these conditions are met, the ignition switch (1, from pin 50) powers the coil of the start relay (2, to pin 86). The energised coil closes the internal relay contact receiving voltage from the pin 30 of the starter motor and powers the glow plug preheat ECU via pin 87.

4.2 Preheat glow plugs

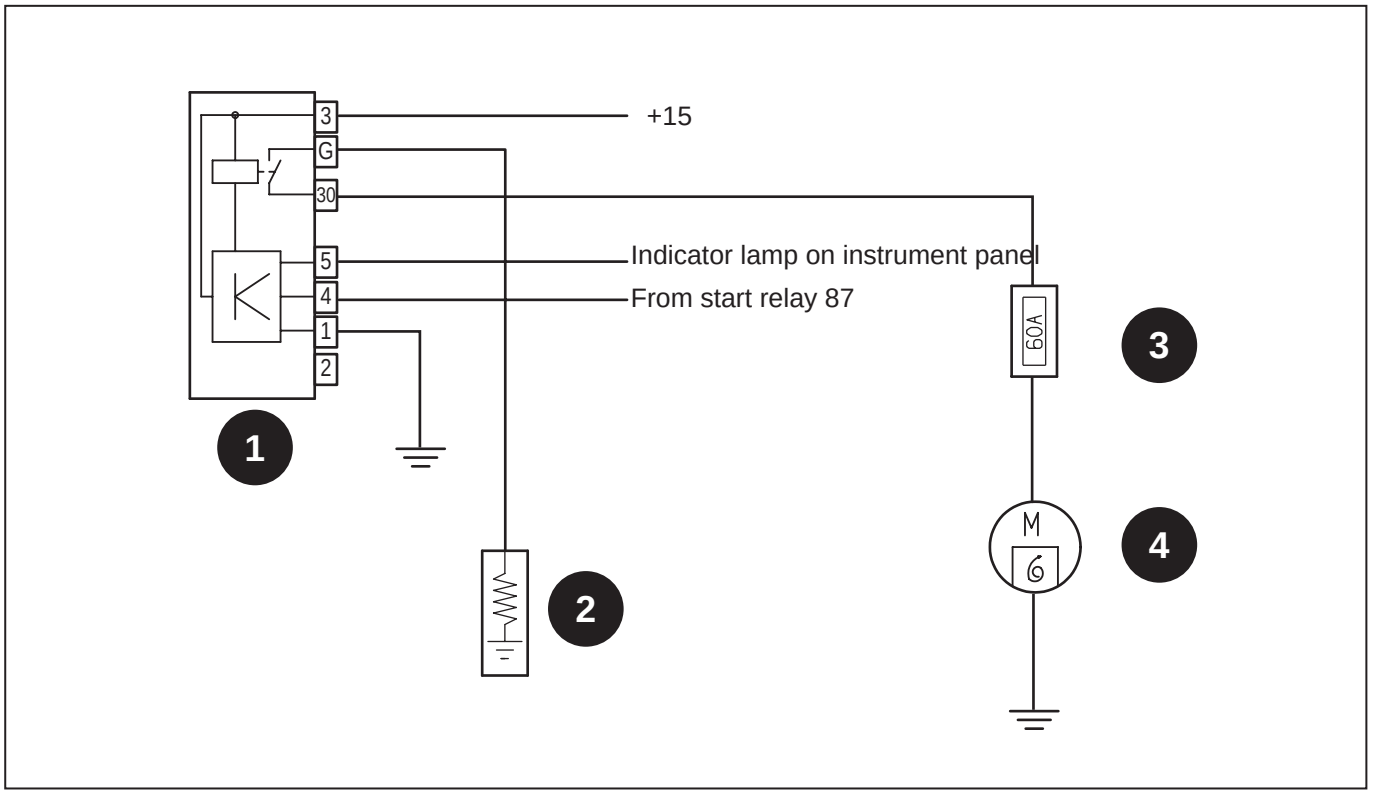


Fig. 17.37

The glow plug circuit is protected by a 60 A fuse (3). +15 ignition switched power is delivered to pin 3 of the preheat ECU (1) and energises the coil. This closes the contact heating the glow plugs (2), which receives power directly from the starter motor (4).

Via the connection to the start relay on pin 4, the ECU continues to deliver current and power the indicator lamp on pin 5.

4.3 Engage 4WD with brakes (Energy 80 only)

Note

4WD is DISENGAGED when the coil of the 4WD solenoid valve is energised.

4WD is ENGAGED when the coil of the 4WD solenoid valve is not energised.

The coil of the 4WD solenoid valve is always energised when the tractor is started.

4WD is automatically engaged when the driver presses the brake pedals or engages the parking brake.

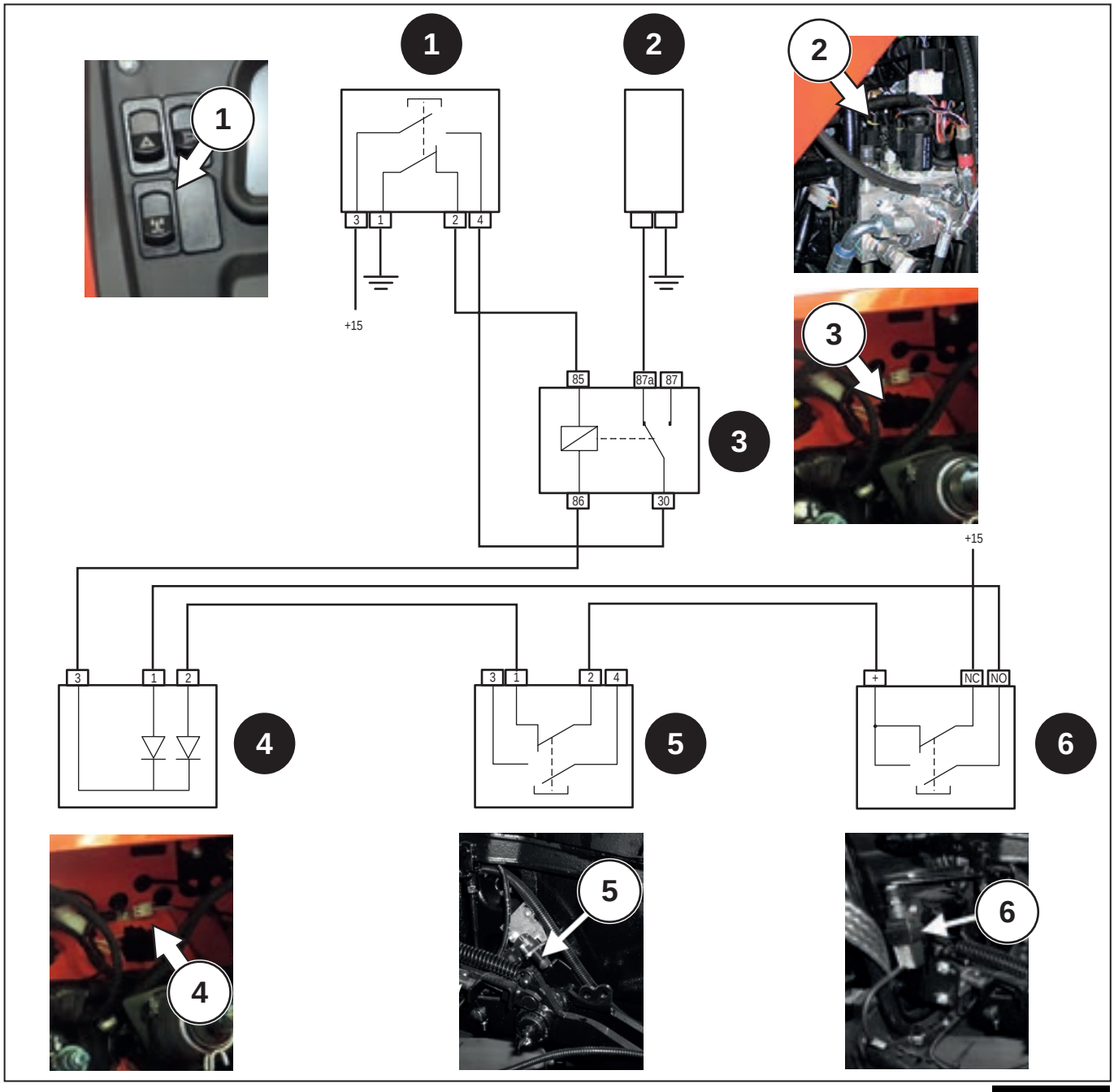


Fig. 17.38

The 4WD with brakes circuit is protected by a 15A fuse.

4WD button not pressed

When the 4WD select button (1) is not pressed, the circuit receives ignition switched power (+15) at the NC (normally closed) pin of the parking brake switch (6) and at pin 2 of the brake pedal switch (5).

In this state, the circuit is connected to ground at pin 1 of the 4WD switch (1) via the diode (4) and the 4WD engage relay (3).

The coil of the solenoid valve (2) is energised and the 4WD clutch is disengaged

4WD button pressed

The 4WD select button (1) receives +15 power on pin 3. When the driver presses the button, the normally open contact closes and the normally closed contact opens.

The contact of the 4WD engage relay (3) opens, cutting the power feed to the solenoid valve (2), and the 4WD clutch engages.

Each time the driver presses the brakes (5) or engages the parking brake (6), the circuit is opened, cutting the power feed. 4WD is automatically engaged.

4.4 4WD circuit fill valve (Energy 80 only)

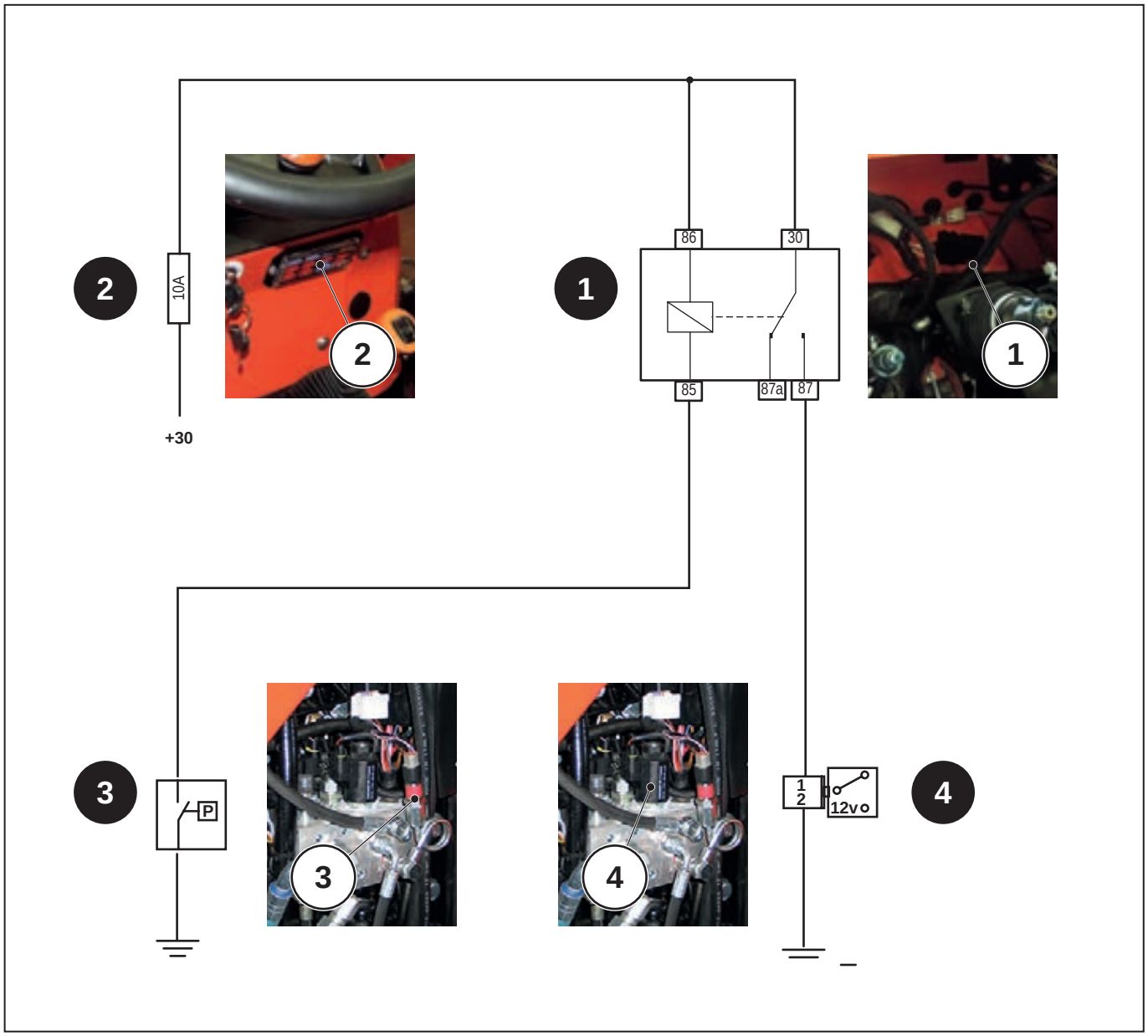


Fig. 17.39

The control relay of the circuit (1) receives ignition switched power (+30 from injection pump) at pins 30 and 86 via the red/blue wire, and is protected by a 10A fuse (2).

When the normally open contact pressure switch (3) detects a drop in pressure, the circuit is connected to ground, powering the relay coil. Pin 87 of the relay contact now changes state, closing the circuit and powering the coil of the fill solenoid valve (4), which requests oil from the main hydraulic circuit.

4.5 KSB - cold start (Energy 80 only)

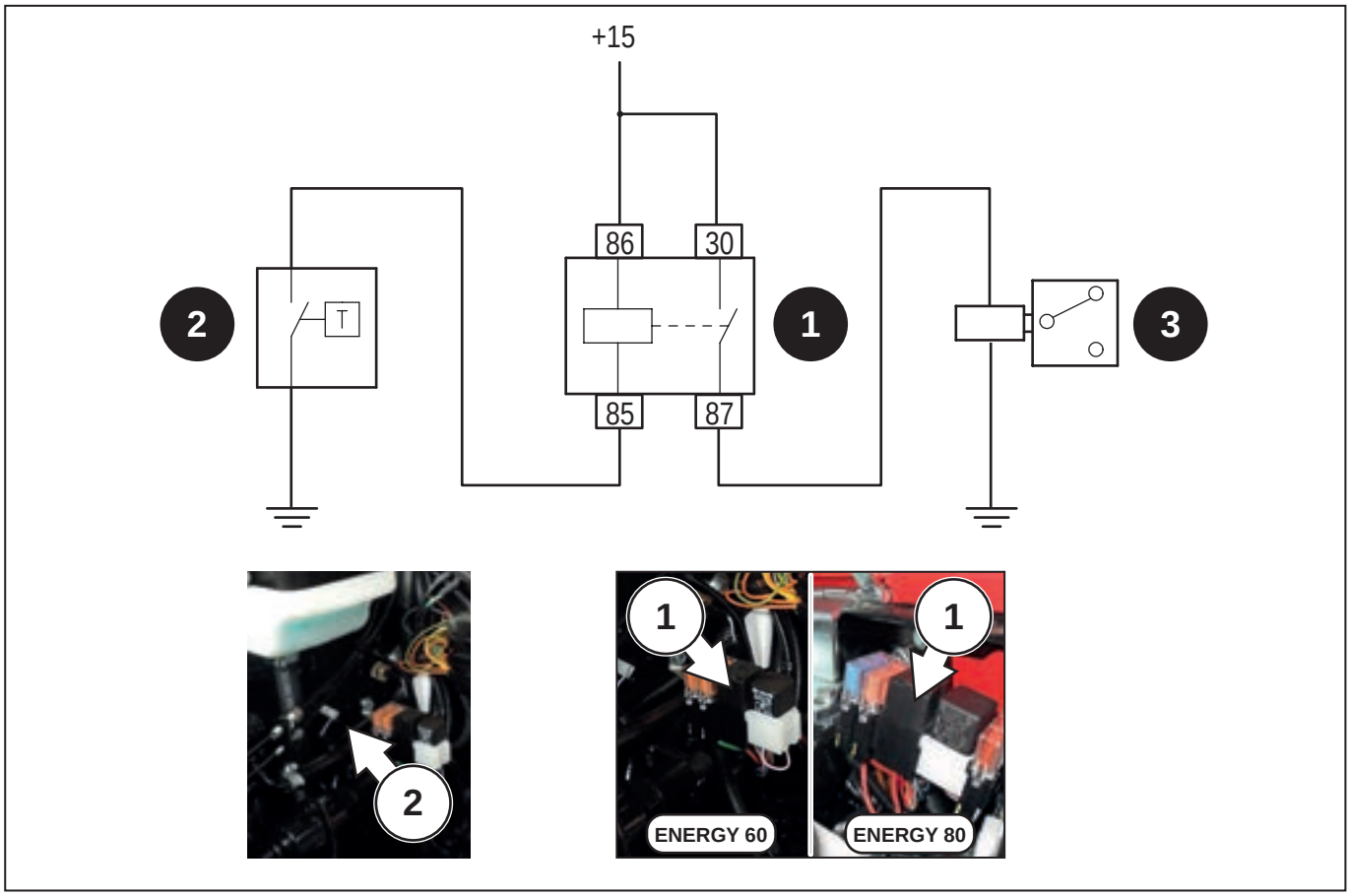


Fig. 17.40

The KSB relay (1) receives current from the +15 ignition switched power circuit on both the coil (86) and the contact (30). In this state, no components are powered.

When the engine temperature sensor (2) detects that the temperature has reached 60°C, the internal contact closes, closing the circuit powering the relay coil (1). As a result, the internal relay contact is closed and the circuit of the KSB coil (3) receives power, causing the coil to change state.

Section 5 : Energy 60 wiring looms

Index

5.1 02003123 - Engine 17-34

5.2 02003404 - Platform 17-36

5.1 02003123 - Engine

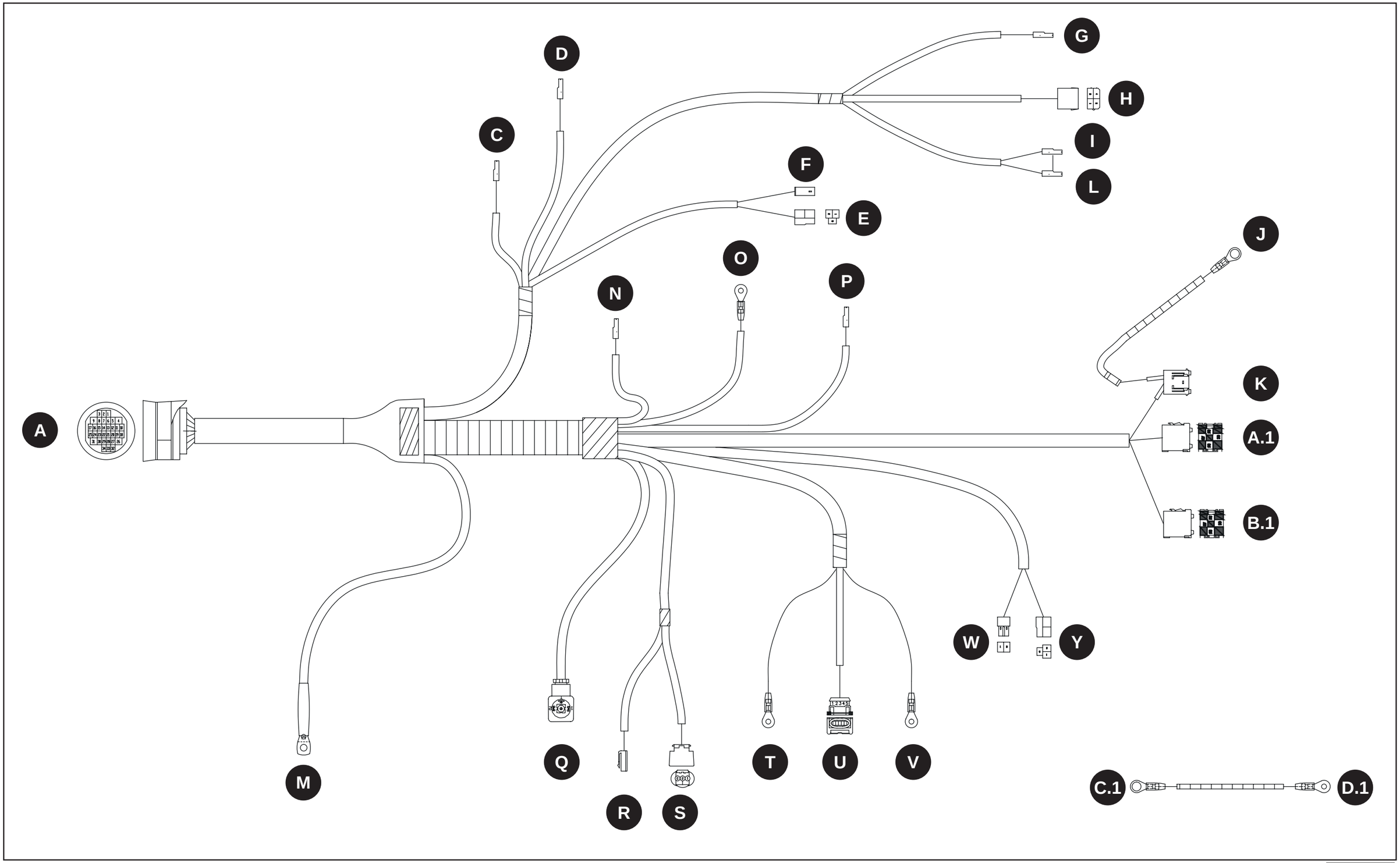


Fig. 17.41

A - 34-pole connector for Engine/Instrument Panel line
A.1 - Electrostop relay
B.1 - Starter relay
C - Engine oil pressure sensor
C. 1 - Preheat glow plug bridge
D - 12V battery
D.1 - Preheat glow plug bridge
E - Connection for sidelights and LH front turn indicator
F - Provision for cab power feed
G - Horn
H - 4-pole connector for engine/headlamps line
I - Air filter clogged sensor
J - Starter motor
K - System protection Maxi-fuse
L - Air filter clogged sensor
M - Earth connector
N - Engine coolant temperature sensor
O - Glow plug preheat
P - Oil filter clogging sensor
Q - Electrostop connector
R - Alternator
S - Alternator
T - Preheat glow plug ECU
U - Preheat glow plug ECU
V - Preheat glow plug ECU
W - Rotating beacon connection
Y - Connection for sidelights and RH front turn indicator

5.2 02003404 - Platform

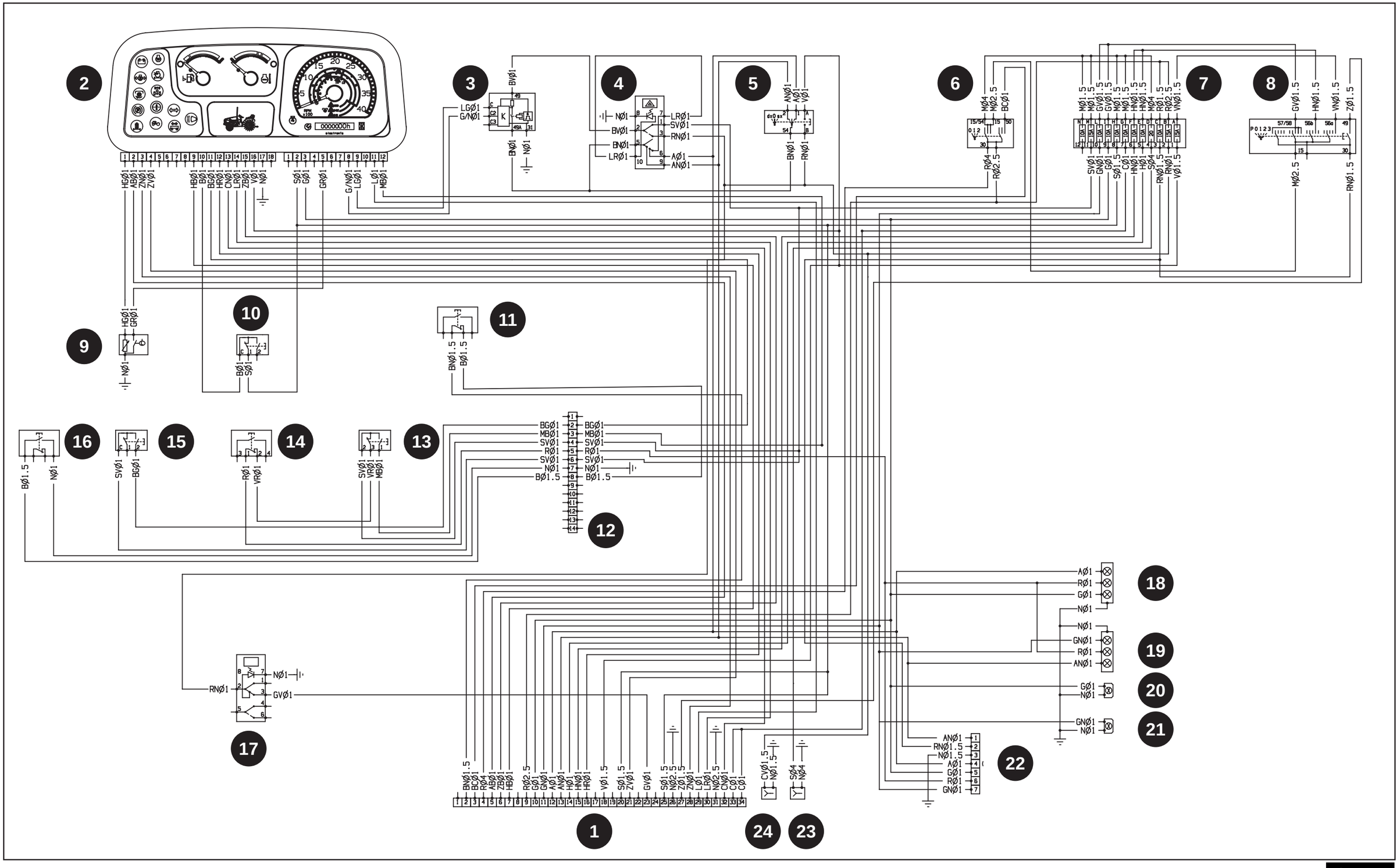


Fig. 17.42

1 - 34-pole connector for Engine/Instrument Panel line
2 - Analogue multifunction instrument
3 - Turn indicator flasher unit
4 - Hazard warning light rocker switch
5 - Turn indicator stalk
6 - Starter switch
7 - Fuse box
8 - Lights selector
9 - Fuel level sensor
10 - PTO clutch switch
11 - Clutch engine start enable sensor
12 - 14-pole connector for Instrument Panel/Brake lights and park brake line
13 - Parking brake switch
14 - Brake switch
15 - Dual Traction Switch
16 - PTO switch
17 - Rocker switch for rotating beacon
18 - RH tail light
19 - LH rear light
20 - RH number plate light
21 - LH number plate light
22 - 7 pole socket
23 - +30 1-pole 12V socket
24 - 12V power socket (+15)

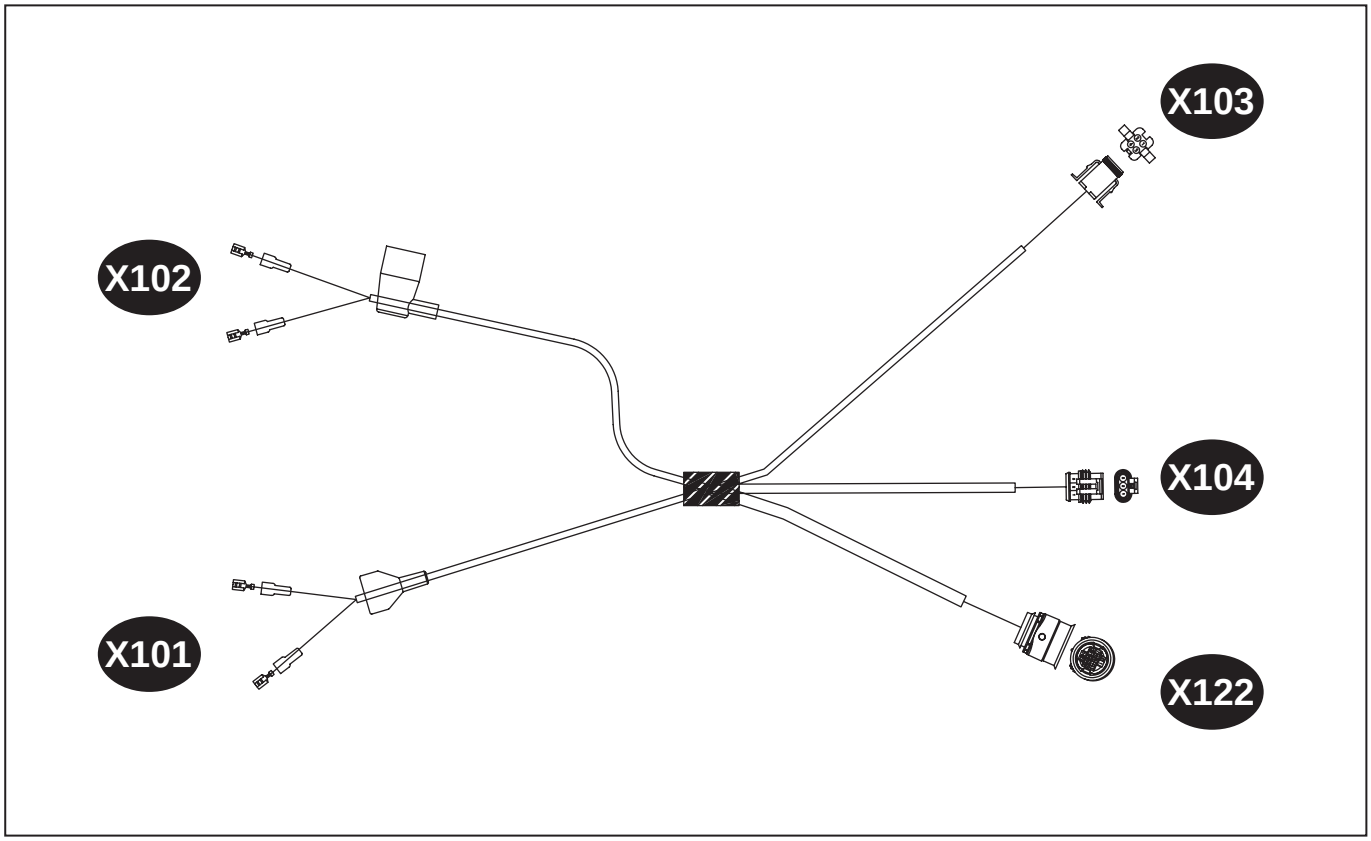


Fig. 17.43

X101 - Dual Traction Switch
X102 - PTO switch
X103 - Stop lever
X104 - Parking brake
X122 - 34-pole connector for Platform line

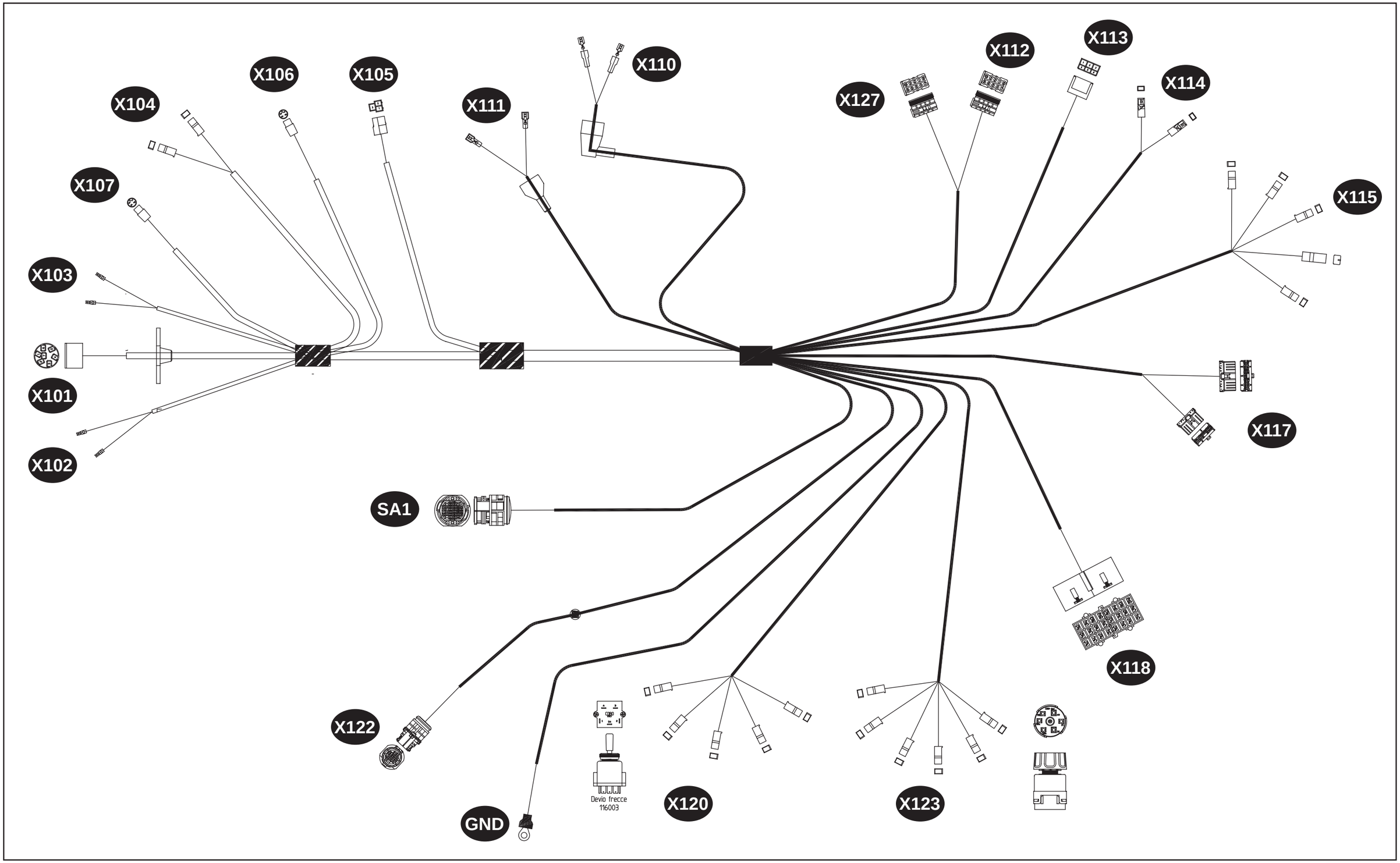

X101
X102
X103
X104
X105
X106
X107
X110
X111
X112
X113
X114
X115
X117
X118
X120
X122
X123
X127
SA1
GND
Devio frecce
116003

Fig. 17.44

GND - Electric circuit ground
X101 - 7 pole socket
X102 - RH number plate light
X103 - LH number plate light
X104 - 1-pole 12V socket
X105 - Fuel level sensor
X106 - LH rear light
X107 - RH rear light
X110 - Clutch engine start enable switch
X111 - PTO clutch lever switch
X112 - Hazard warning light switch
X113 - Turn indicator flasher unit
X114 - 12V power socket
X115 - Starter switch
X117 - Multifunction instrument panel connector
X118 - Fuse box
X119 - 34-pole connector for Engine/Instrument Panel line
X120 - Turn indicator/high beam selector stalk switch
X122 - 14-pole connector for Rear/Platform line
X123 - Lights and horn stalk selector
X127 - Rotary beacon

Section 6 : Energy 80 wiring looms

Index

6.1 02002737 - Front Power Take Off 17-42

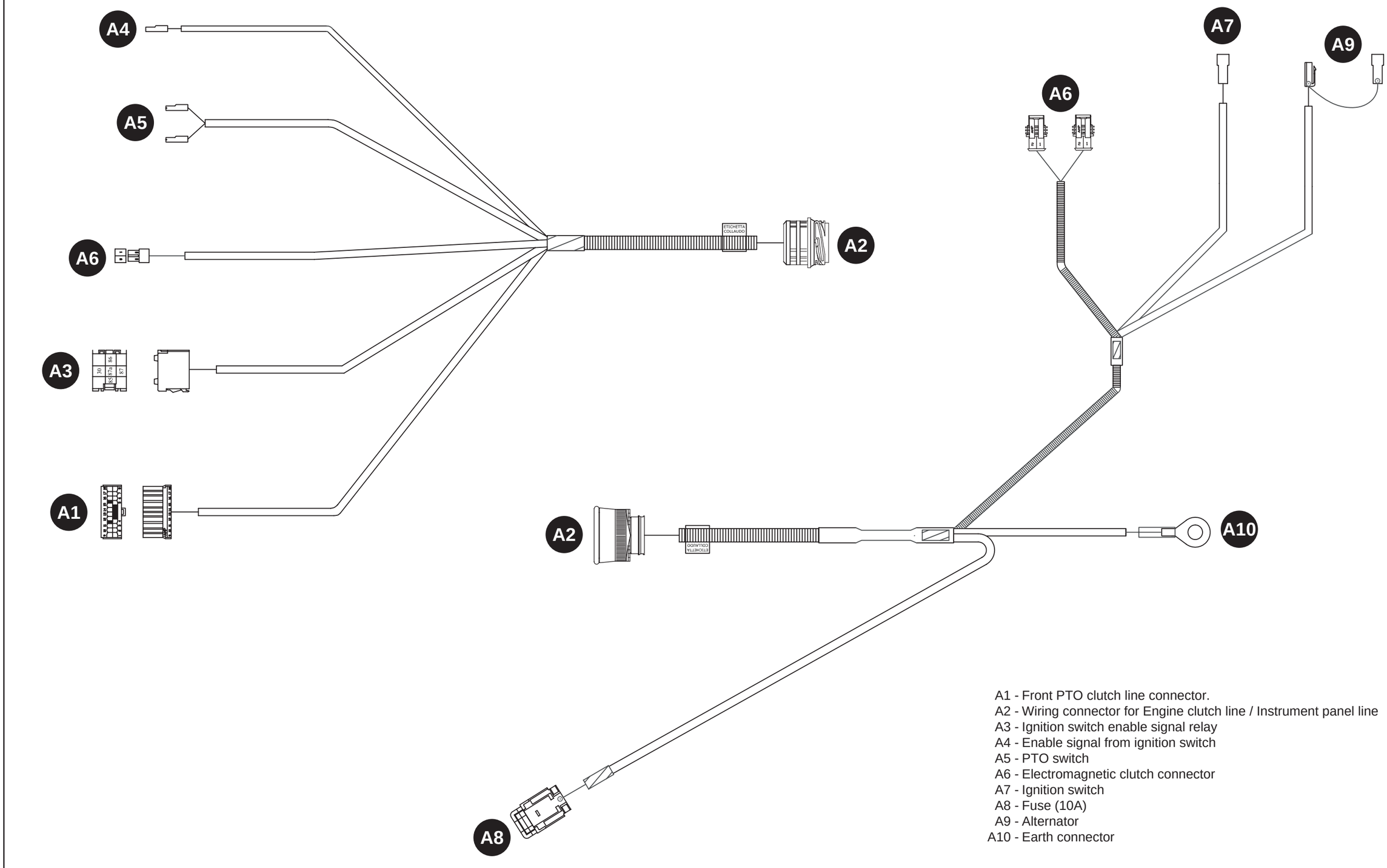
6.2 02003403 - Engine (30 Km/h version) 17-44

6.3 02003404 - Platform 17-48

6.4 02003405 - Engine 17-52

6.5 02003406 17-56

6.1 02002737 - Front Power Take Off



A1 - Front PTO clutch line connector.
A2 - Wiring connector for Engine clutch line / Instrument panel line
A3 - Ignition switch enable signal relay
A4 - Enable signal from ignition switch
A5 - PTO switch
A6 - Electromagnetic clutch connector
A7 - Ignition switch
A8 - Fuse (10A)
A9 - Alternator
A10 - Earth connector

Fig. 17.45

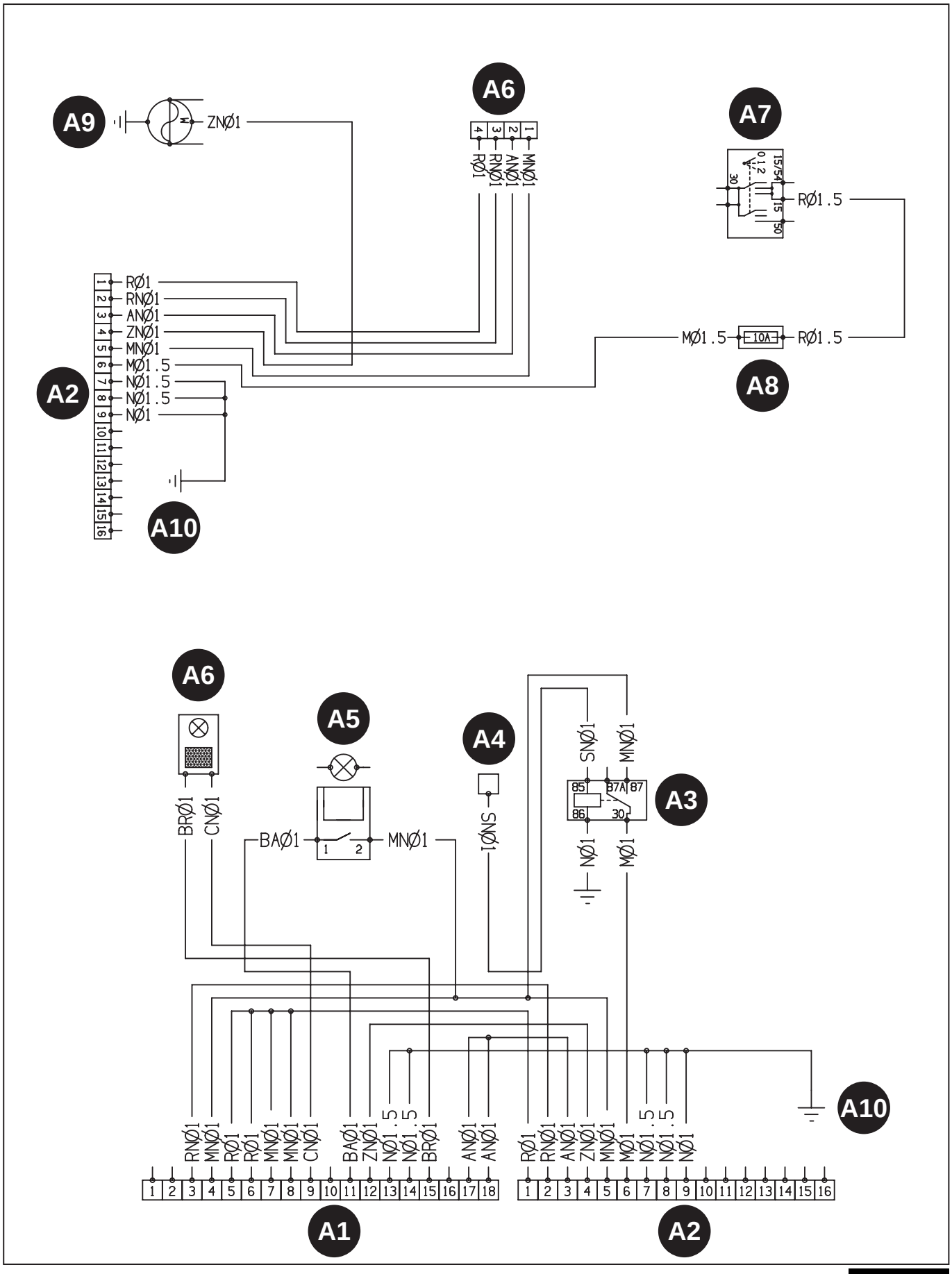

A9
ZNØ1
A6
MNØ1
ANØ1
RNØ1
RØ1
A7
15/54
30
RØ1.5
15
50
A2
RØ1
RNØ1
ANØ1
ZNØ1
MNØ1
MØ1.5
NØ1.5
NØ1.5
NØ1
MØ1.5
10A
RØ1.5
A8
A10
A6
BRØ1
CNØ1
A5
BAØ1
MNØ1
A4
SNØ1
SNØ1
MNØ1
85
87A
87
86
30
A3
NØ1
MØ1
A10
RNØ1
MNØ1
RØ1
RØ1
MNØ1
MNØ1
CNØ1
BAØ1
ZNØ1
NØ1.5
NØ1.5
BRØ1
ANØ1
ANØ1
RØ1
RNØ1
ANØ1
ZNØ1
MNØ1
MØ1
NØ1.5
NØ1.5
NØ1
A1
A2

Fig. 17.46

6.2 02003403 - Engine (30 Km/h version)

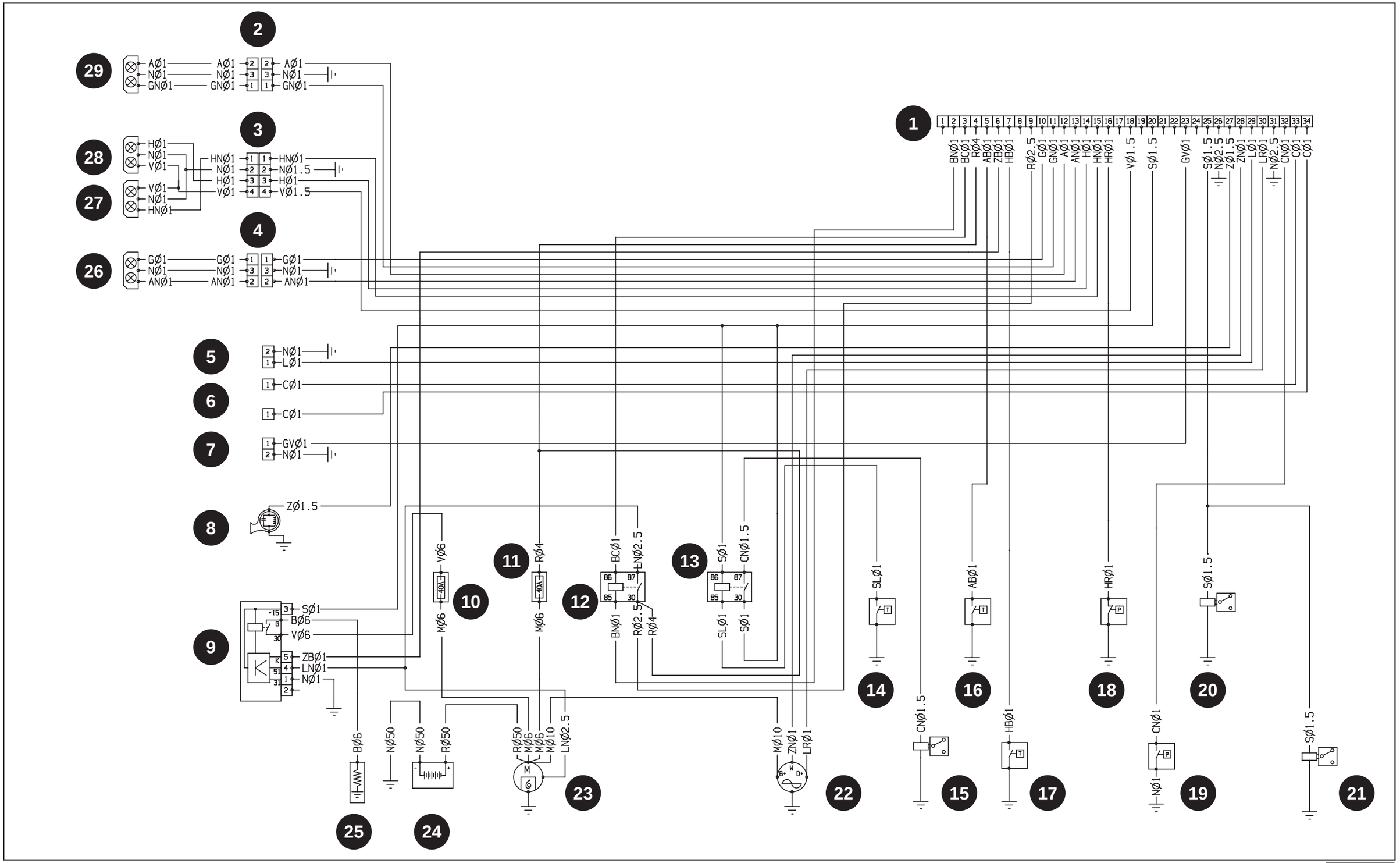


Fig. 17.47

1 - 34-pole connector for Engine/Instrument Panel line
2 - Extension for RH turn indicator-sidelight
3 - 4-pole connector for Engine/Headlamps line
4 - Extension for LH turn indicator-sidelight
5 - Roll bar limit switch
6 - Provision for cab power feed
7 - Provision for rotating beacon connection
8 - Horn
9 - Preheat glow plug ECU
10 - Preheat glow plug Maxi fuse
11 - System protection Maxi-fuse
12 - Starter relay
13 - Cold start relay
14 - KSB variable advance unit sensor
15 - Variable advance unit solenoid valve
16 - Variable advance unit temperature sensor
17 - Hydraulic oil temperature sensor
18 - Engine oil pressure sensor
19 - Air filter clogged sensor
20 - Diesel filter solenoid valve
21 - Engine cutoff solenoid valve
22 - Alternator
23 - Starter motor
24 - 12V battery
25 - Preheat glow plugs
26 - LH turn indicator-sidelight
27 - High beam-low beam headlight
28 - RH turn indicator-sidelight

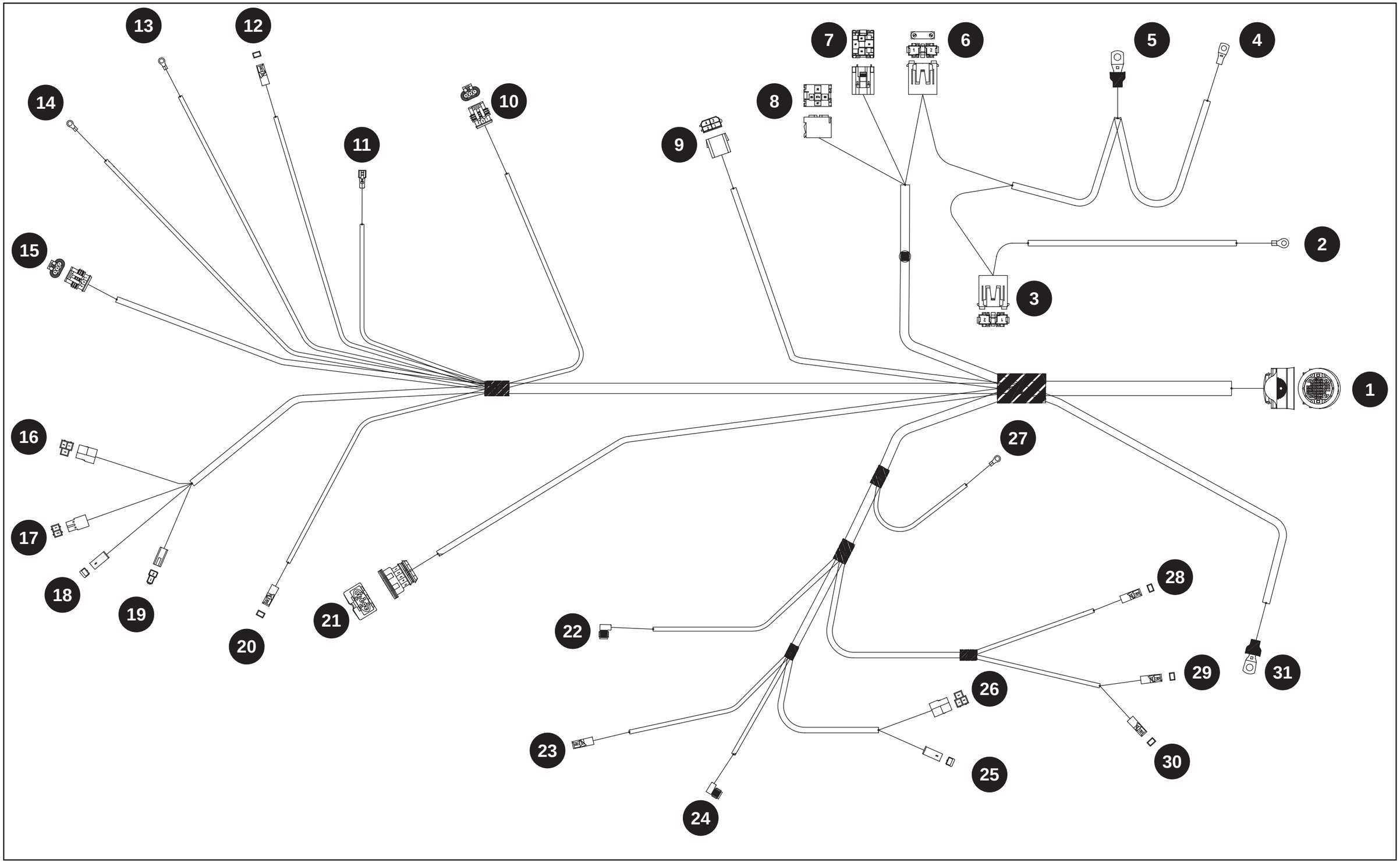

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31

Fig. 17.48

1 - Instrument panel connection
2 - +30 glow plugs
3 - Maxi-fuse for glow plugs
4 - + B
5 - + 30 starter motor
6 - Maxi-fuse for system
7 - Starter relay
8 - KSB relay
9 - Headlamps
10 - Engine speed sensor
11 - Water thermostat
12 - KSB variable advance unit
13 - Engine cut-out
14 - Variable advance unit
15 - Speed sensor
16 - LH headlamp
17 - Roll Bar lowered
18 - +15 enable signal, cab
19 - Rotary beacon
20 - Diesel filter
21 - Glow plug ECU
22 - Hydraulic oil thermostat
23 - + 50
24 - Engine oil pressure switch
25 - + 15 enable signal, cab
26 - RH headlight
27 - Alternator
28 - Horn
29 - Air cleaner
30 - Air cleaner
31 - Earth connector

6.3 02003404 - Platform

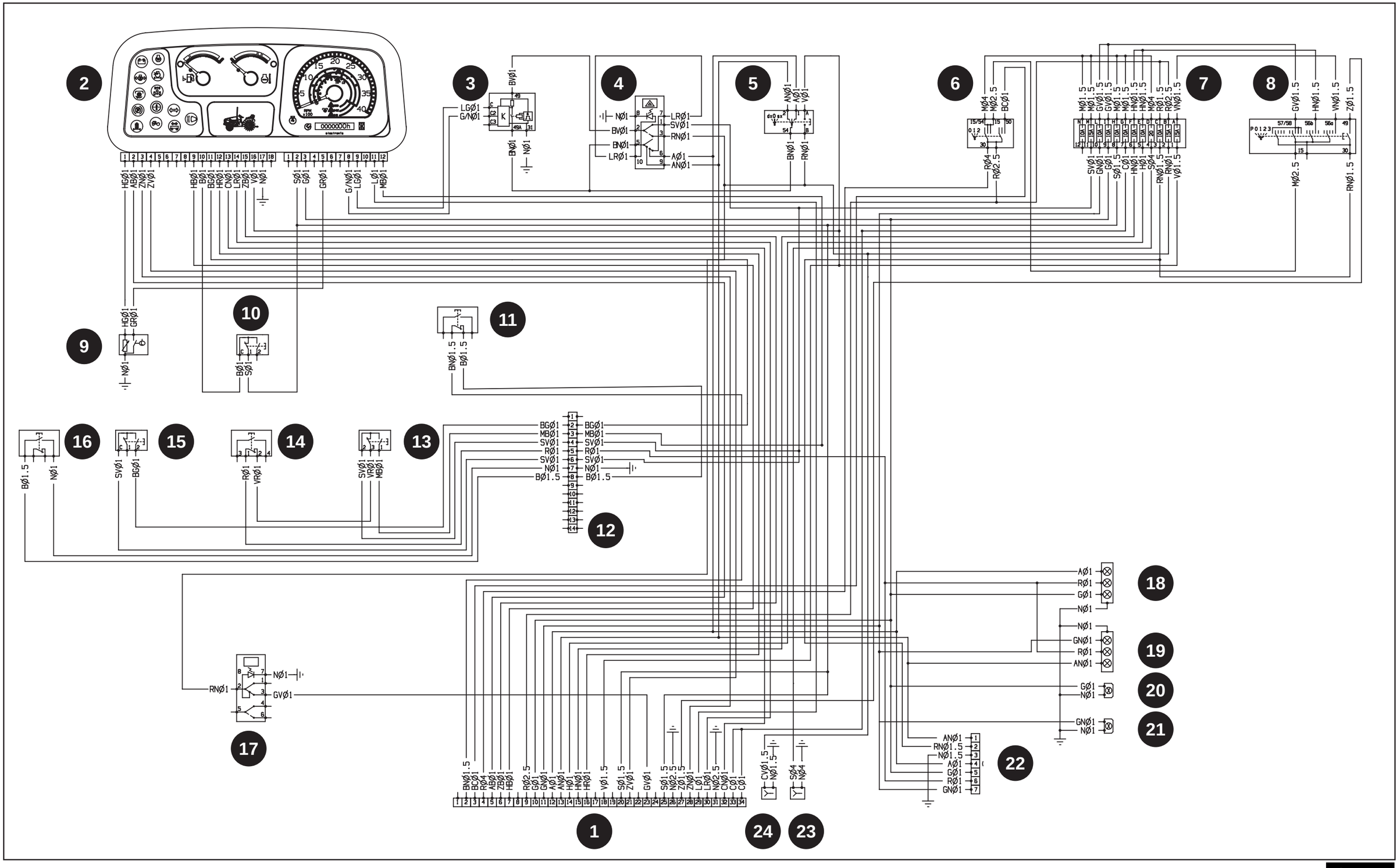


Fig. 17.49

1 - 34-pole connector for Engine/Instrument Panel line
2 - Analogue multifunction instrument
3 - Turn indicator flasher unit
4 - Hazard warning light rocker switch
5 - Turn indicator stalk
6 - Starter switch
7 - Fuse box
8 - Lights selector
9 - Fuel level sensor
10 - PTO clutch switch
11 - Clutch engine start enable sensor
12 - 14-pole connector for Instrument Panel/Brake lights and park brake line
13 - Parking brake switch
14 - Brake switch
15 - Dual Traction Switch
16 - PTO switch
17 - Rocker switch for rotating beacon
18 - RH tail light
19 - LH tail light
20 - RH number plate light
21 - LH number plate light
22 - 7 pole socket
23 - +30 1-pole 12V socket
24 - 12V power socket (+15)

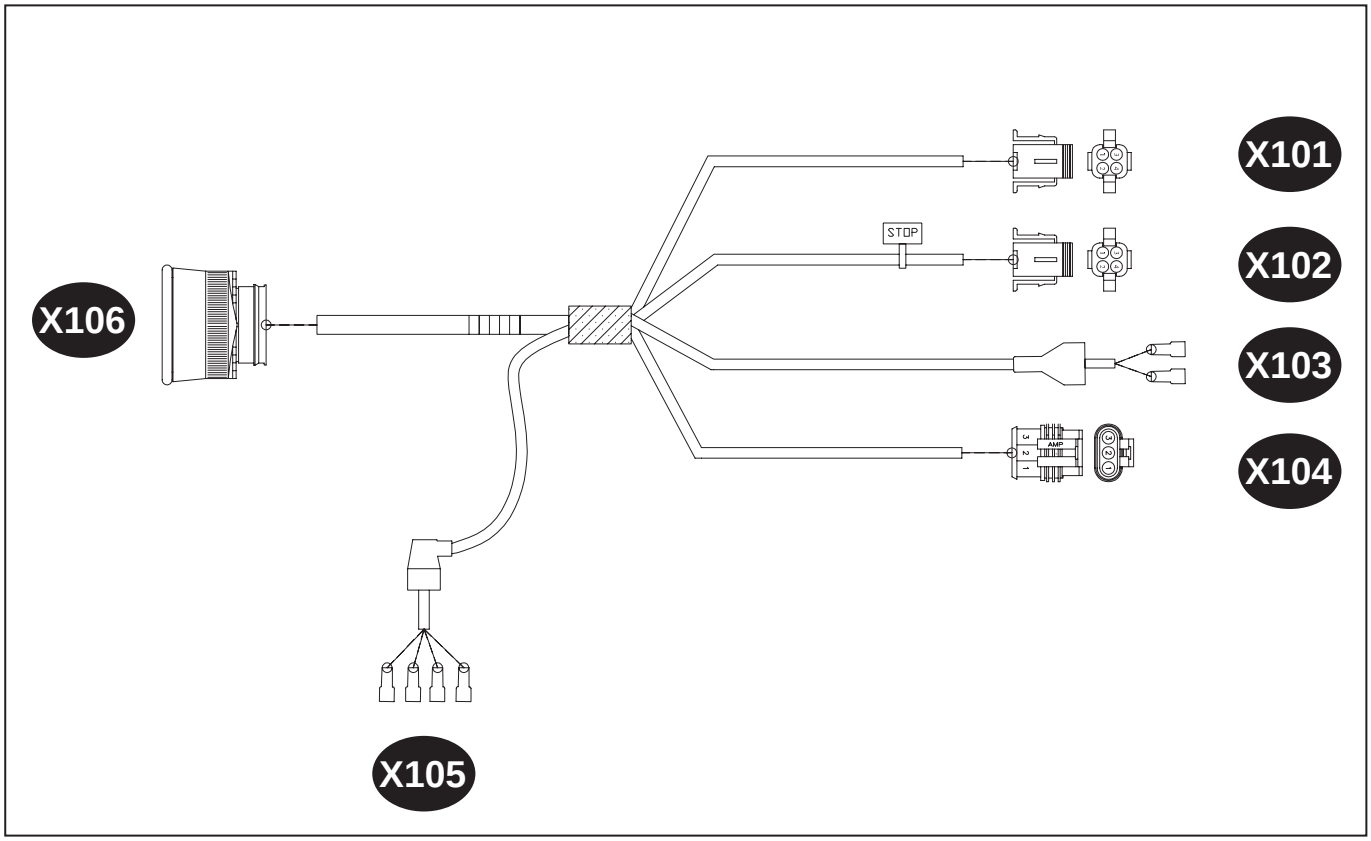


Fig. 17.50

X101 - IST switch
X102 - Brake switch
X103 - PTO speed selection on instrument panel
X104 - Parking brake
X105 - PTO disable
X106 - 14-pole connector for Platform line

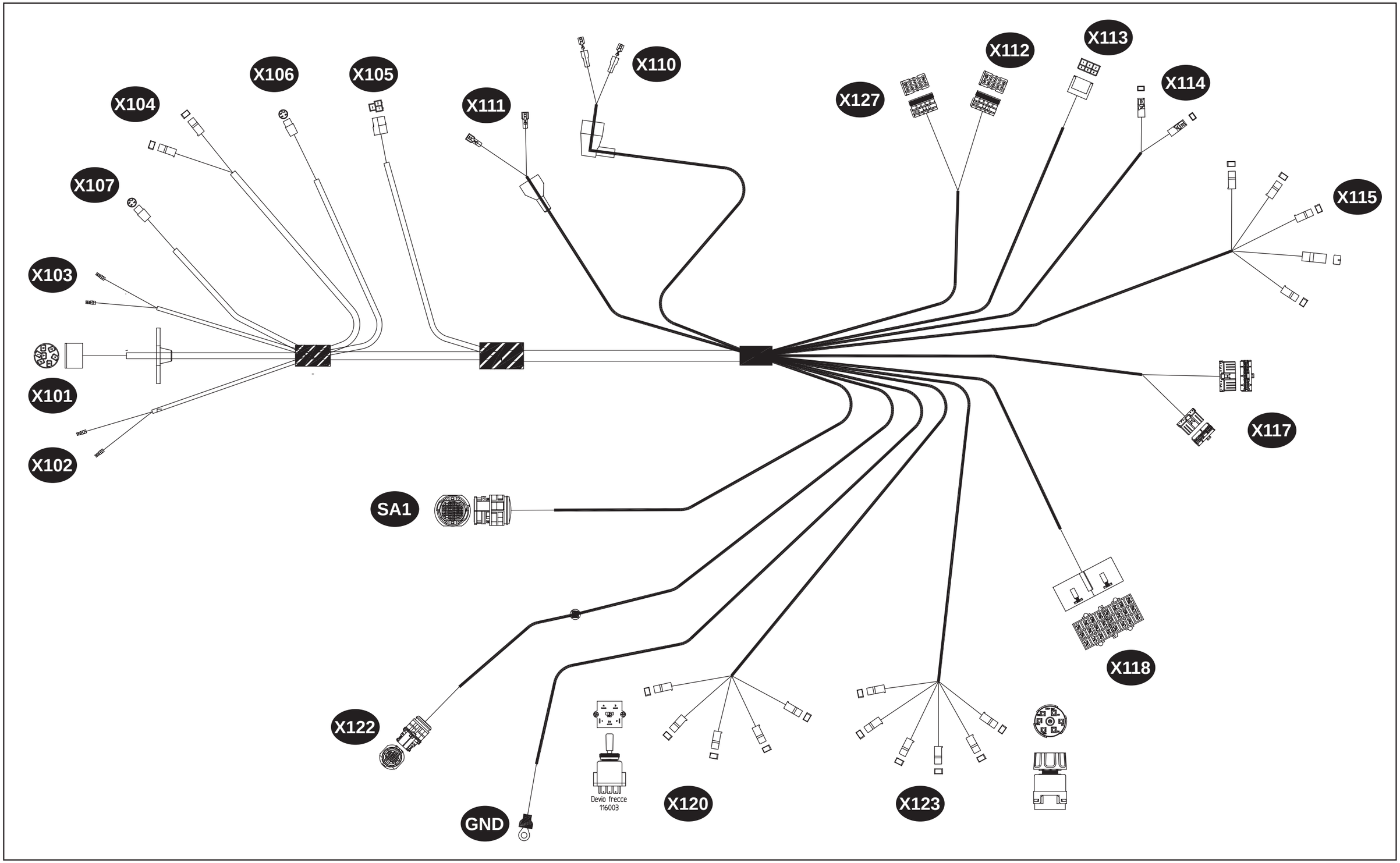

X104
X106
X105
X111
X110
X127
X112
X113
X114
X107
X115
X103
X101
X102
X117
SA1
X118
X122
Devio frecce
116003
X120
X123
GND

Fig. 17.51

GND - Electric circuit ground
X101 - 7 pole socket
X102 - RH number plate light
X103 - LH number plate light
X104 - 1-pole 12V socket
X105 - Fuel level sensor
X106 - LH rear light
X107 - RH rear light
X110 - Clutch engine start enable switch
X111 - PTO clutch lever switch
X112 - Hazard warning light switch
X113 - Turn indicator flasher unit
X114 - 12V power socket
X115 - Starter switch
X117 - Multifunction instrument panel connector
X118 - Fuse box
X119 - 34-pole connector for Engine/Instrument Panel line
X120 - Turn indicator/high beam selector stalk switch
X122 - 14-pole connector for Rear/Platform line
X123 - Lights and horn stalk selector
X127 - Rotary beacon

6.4 02003405 - Engine

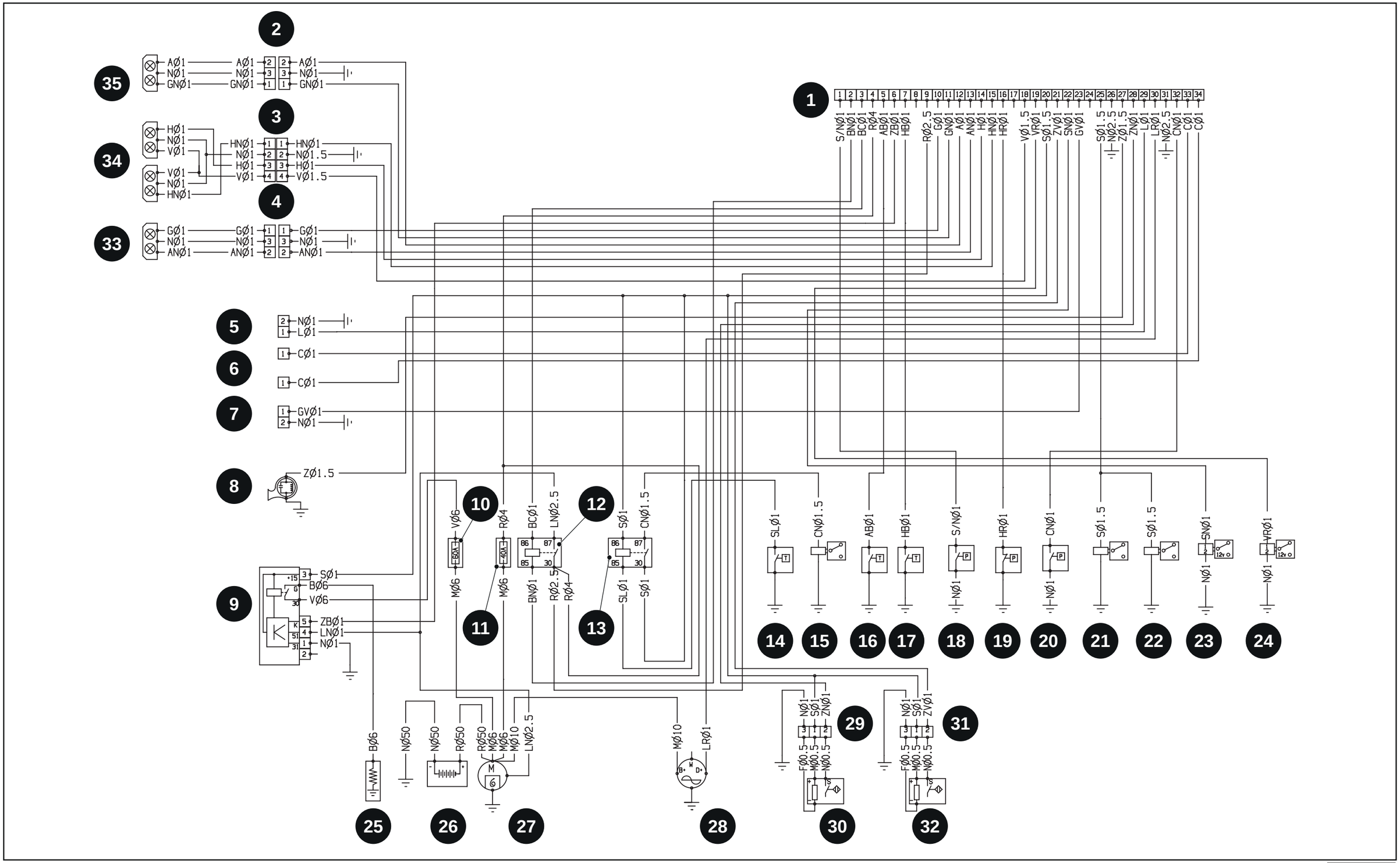


Fig. 17.52

1 - 34-pole connector for Engine/Instrument Panel line
2 - Extension for RH turn indicator/sidelight
3 - 4-pole connector for engine/headlamps line
4 - Extension for LH turn indicator/sidelight
5 - Roll bar limit switch
6 - Provision for cab power feed
7 - Provision for rotating beacon connection
8 - Horn
9 - Preheat glow plug ECU
10 - Preheat glow plug Maxi fuse
11 - System protection Maxi-fuse
12 - Starter relay
13 - Cold start relay
14 - KSB variable advance unit sensor
15 - Variable advance unit solenoid valve
16 - Variable advance unit temperature sensor
17 - Hydraulic oil temperature sensor
18 - Accumulator pressure switch
19 - Engine oil pressure sensor
20 - Air filter clogged sensor
21 - Diesel filter solenoid valve
22 - Engine cutoff solenoid valve
23 - Accumulator solenoid valve
24 - Four-wheel drive solenoid valve
25 - Preheat glow plugs
26 - 12V battery
27 - Starter motor
28 - Alternator
29 - 3-pole connection for engine speed sensor
30 - Engine speed sensor
31 - 3-pole connection for speed sensor
32 - Speed sensor
33 - LH turn indicator/sidelight
34 - High beam/low beam headlight
35 - RH turn indicator/sidelight

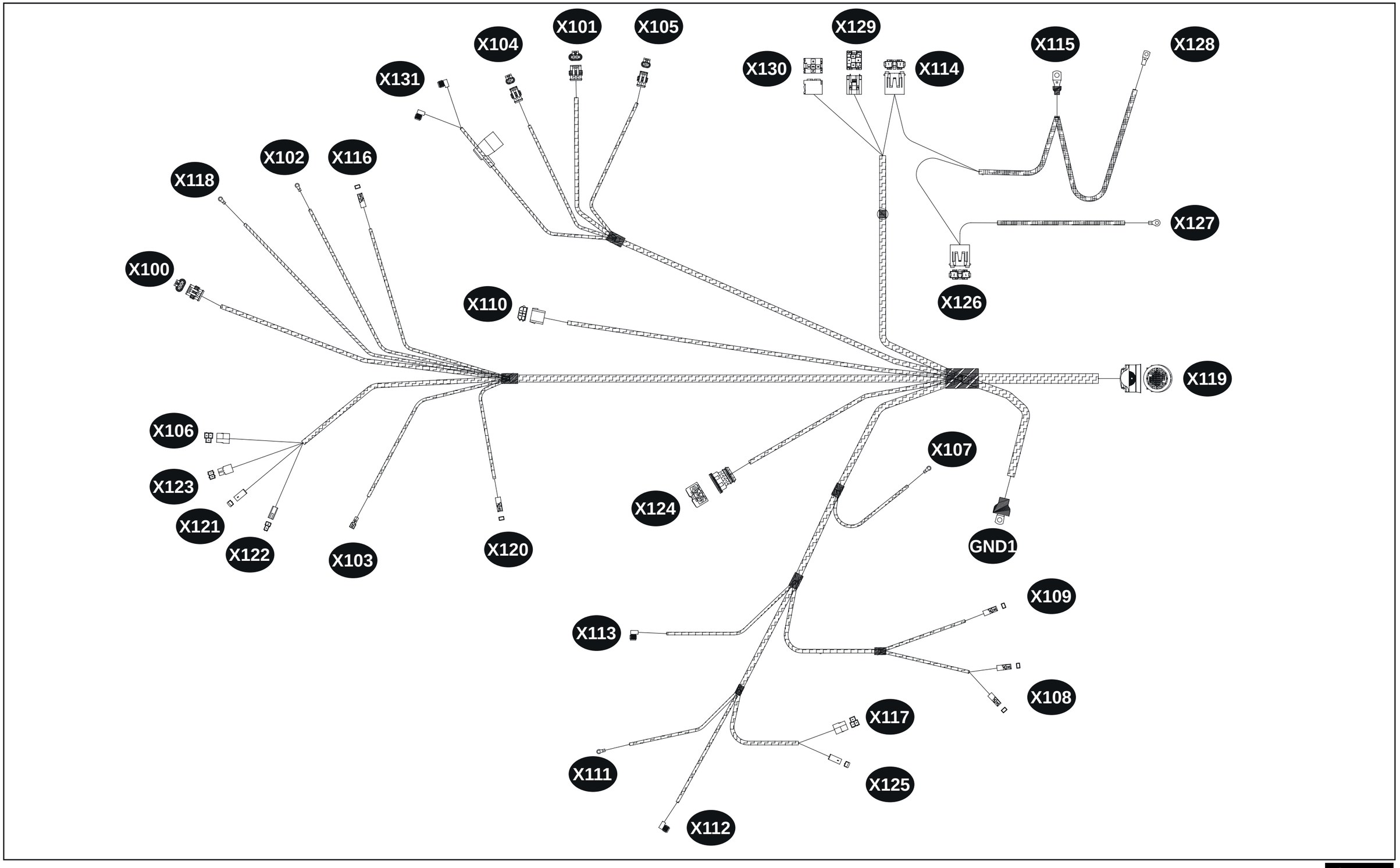

X101
X105
X104
X131
X129
X130
X114
X115
X128
X102
X116
X118
X100
X127
X126
X110
X119
X106
X123
X121
X122
X103
X120
X124
X107
GND1
X109
X113
X108
X117
X111
X125
X112

Fig. 17.53

GND1 - Electrical system ground
X100 - Speed sensor
X101 - Engine speed sensor connection
X102 - Engine cut-out
X103 - Engine coolant temperature bulb
X104 - Accumulator solenoid valve connection
X105 - Four wheel drive solenoid valve connection
X106 - LH turn indicator-sidelight
X108 - Air filter clogged sensor
X109 - Horn
X110 - 4-pole connector for engine-headlamps line
X111 - 12V battery
X112 - Engine oil pressure bulb
X113 - Hydraulic oil filter clogging sensor bulb
X114 - System protection Maxi-fuse
X115 - Starter motor
X116 - KSB variable advance unit sensor
X117 - RH turn indicator-sidelight
X118 - Variable advance unit solenoid valve
X119 - 34-pole connector for Engine/Instrument Panel line
X120 - Fuel filter ECU
X121 - Provision for cab power feed
X122 - Rotary beacon
X123 - Roll bar lowered warning lamp
X124 - Glow plug preheat ECU
X125 - Provision for cab power feed
X126 - Glow plug preheat Maxi fuse
X127 - Glow plug preheat
X128 - Alternator
X129 - Starter relay
X130 - KSB relay (cold start)
X131 - Nitrogen accumulator pressure switch

6.5 02003406

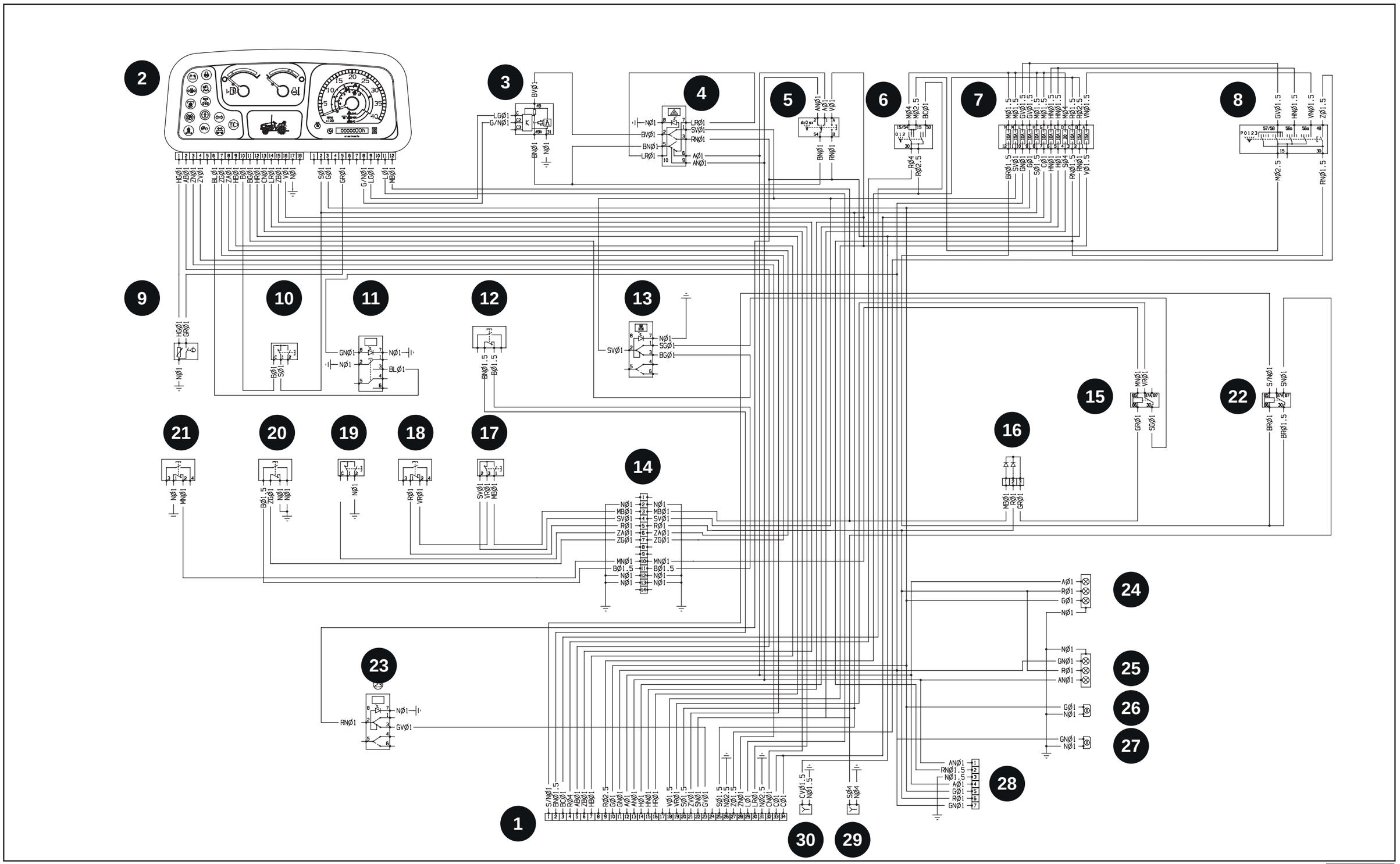


Fig. 17.54

1 - 34-pole connector for Engine/Instrument Panel line
2 - Analogue multifunction instrument
3 - Turn indicator flasher unit
4 - Hazard warning light rocker switch
5 - Turn indicator stalk
6 - Starter switch
7 - Fuse box
8 - Lights selector
9 - Fuel level sensor
10 - PTO clutch switch
11 - Display selector switch
12 - Clutch engine start enable sensor
13 - 4WD rocker switch
14 - 14-pole connector for Instrument Panel/Brake lights and park brake line
15 - 4WD select relay
16 - 4WD relay enable diode connector
17 - Parking brake switch
18 - Brake switch
19 - PTO Fast/Slow switch
20 - PTO switch
21 - Dual Traction Switch
22 - Accumulator control relay
23 - Rotating beacon rocker switch
24 - RH rear light
25 - LH tail light
26 - RH number plate light
27 - LH number plate light
28 - 7 pole socket
29 - +30 1-pole 12V socket
30 - 12V power socket (+15)

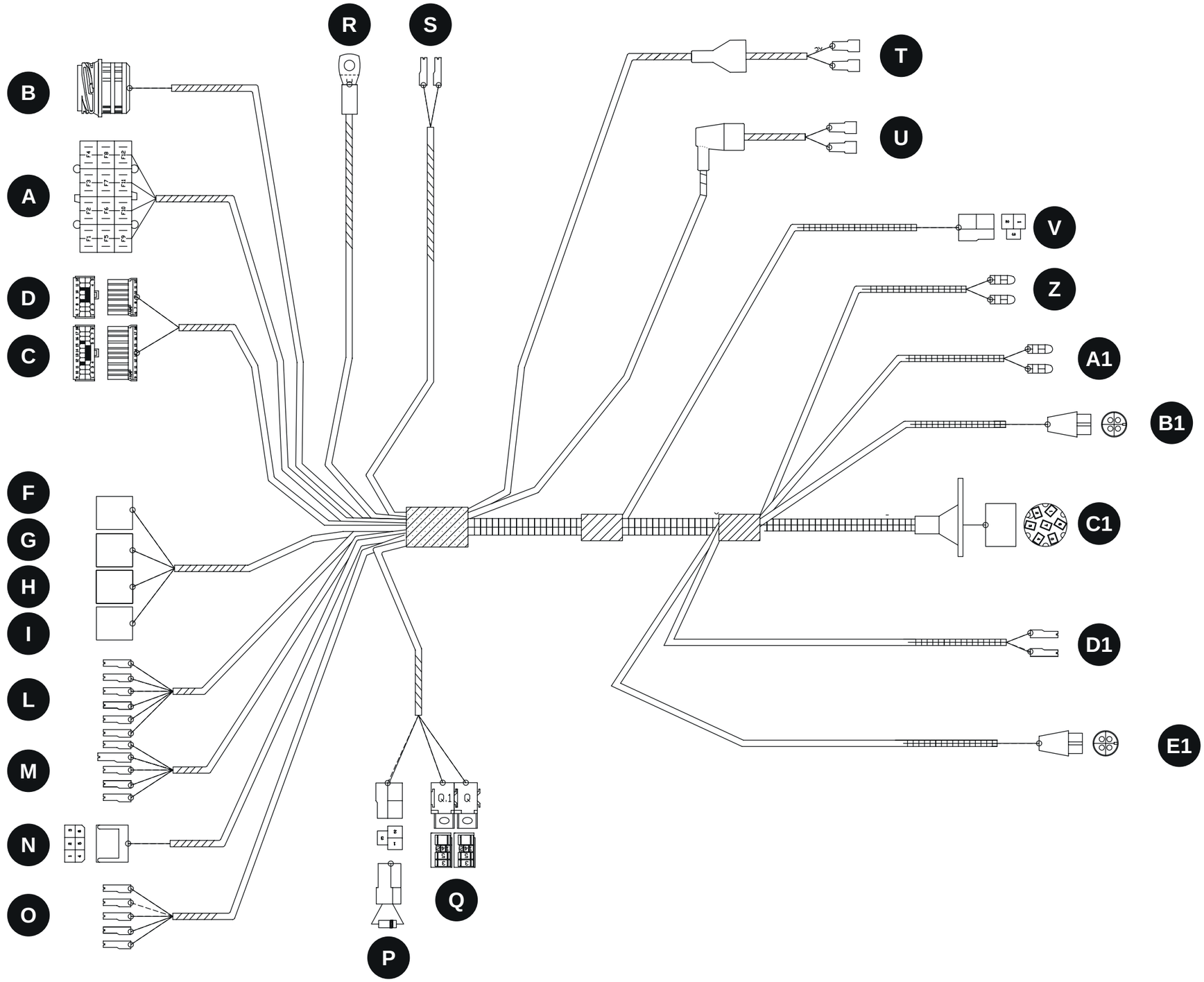


Fig. 17.55

A - Fuse box
A1 - LH number plate light
B - 34-pole connector for engine line + instrument panel line
B1 - RH rear light
C - Multifunction instrument panel connector
C1 - 7 pole socket
D - Multifunction instrument panel connector
D1 - 1-pole 12V socket (+30)
E1 - LH rear light
F - Hazard warning light switch
G - Rotary beacon switch
H - Dual traction switch
I - Km/h - PTO speed selector switch
L - Lights panel switch
M - Starter switch
N - Turn indicator flasher unit
O - Turn indicator/high beam selector stalk switch
P - 4WD relay enable diode
Q - 4WD select relay
R - Circuit ground
S - 1-pole 12V socket (+30)
T - PTO clutch lever switch
U - Clutch engine start enable sensor
V - Fuel level sensor
Z - RH number plate light

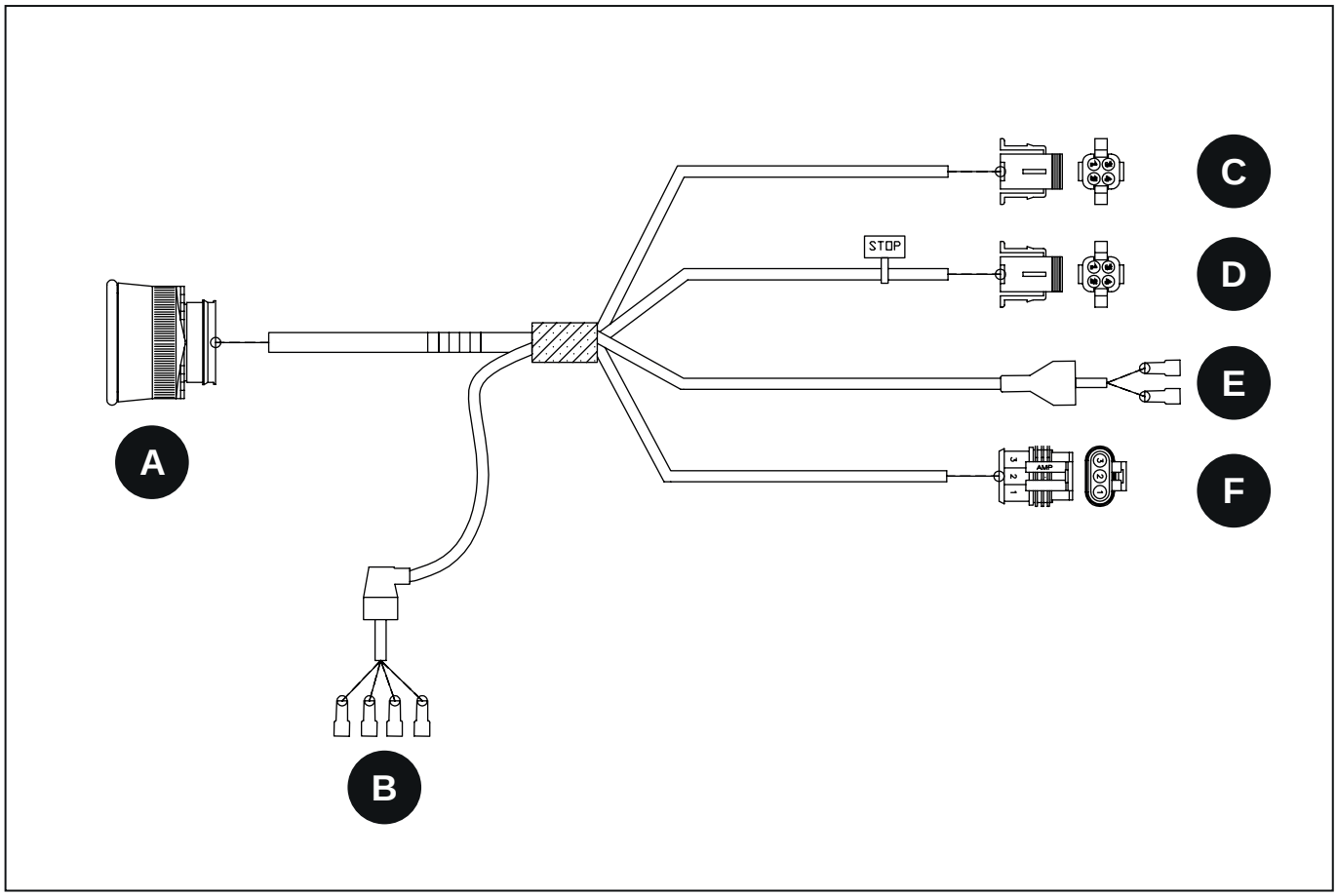


Fig. 17.56

A - 14-pole connector for Instrument Panel/Brake lights and park brake line
B - PTO engine start enable switch
C - Dual Traction Switch
D - Brake switch
E - PTO Fast/Slow switch
F - Parking brake switch

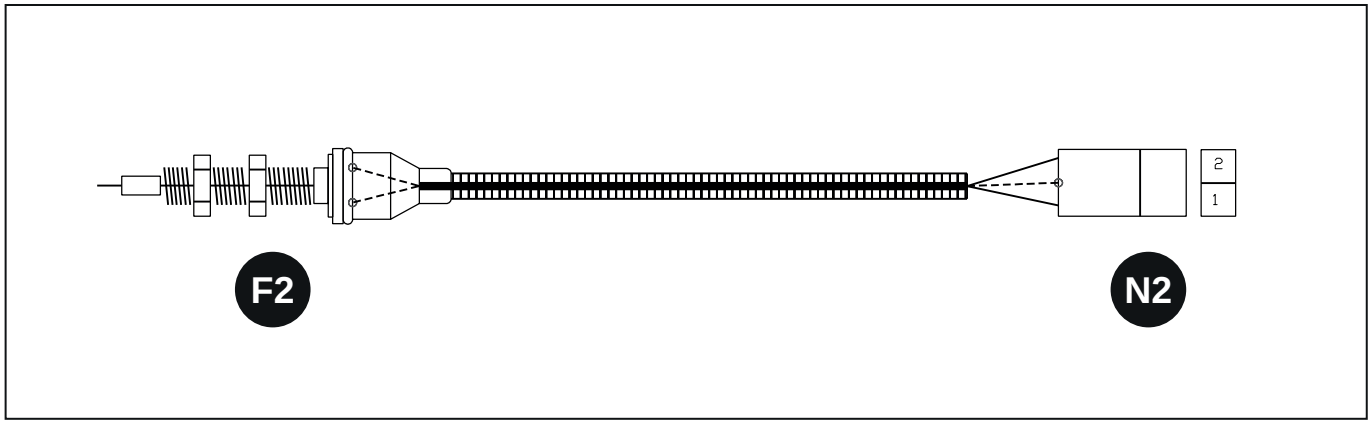


Fig. 17.57

F2 - Roll bar limit switch wiring harness
N2 - Connection to Platform line

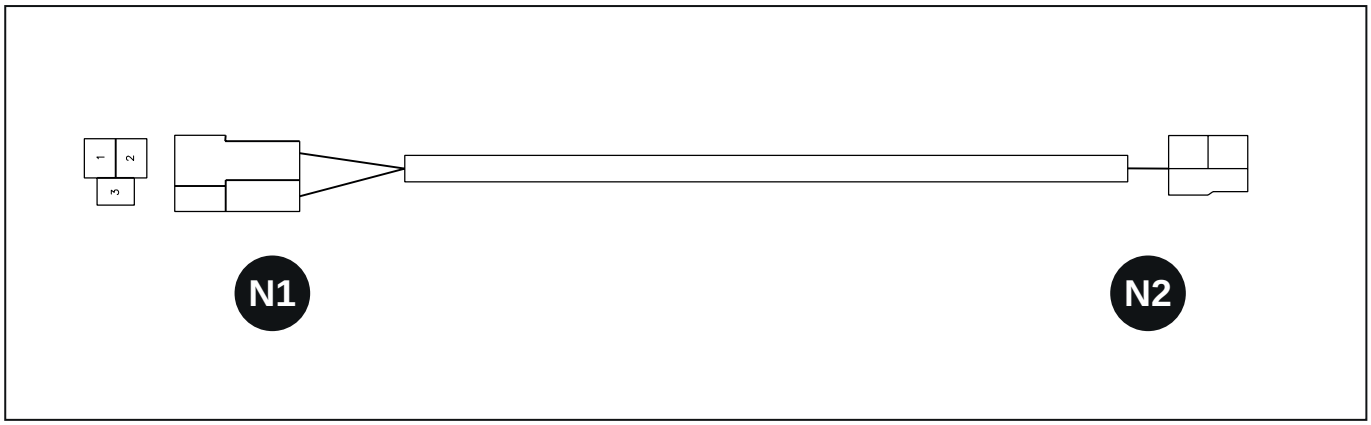


Fig. 17.58

N1 - Sidelights and turn indicators wiring harness
N2 - Connection to Platform line

Chapter 18 : Troubleshooting

Index

Section 1 : Engine 18-2

Section 2 : Reverse shuttle 18-2

Section 3 : Clutch - Transmission 18-2

Section 4 : Gearbox 18-3

Section 5 : Rear differential 18-3

Section 6 : Rear final drives 18-3

Section 7 : Drive transmission 18-4

Section 8 : Power take-off 18-4

Section 9 : Front axle 18-5

Section 10 : Front final drives 18-5

Section 11 : Brakes 18-5

Section 12 : Hydraulic circuit 18-6

Section 13 : Steering system 18-6

Section 14 : Electrical system 18-7

Section 15 : Platform 18-7

Section 16 : Hitch 18-8

Section 1 : Engine

Fault	Possible causes	Remedies
Poor engine performance.	Fuel filter clogged	Replace the filter
	Injector return line partially clogged	2.Remove the obstruction
	Air in the circuit	Make the circuit airtight
	Incorrect injector settings	Overhaul or replace the injectors
	Air filter clogged	Clean the filter and replace the cartridge if necessary
Engine starts badly	Incorrect injection pump setting	Overhaul or replace the pump
	Incorrect injector settings	Overhaul or replace the injectors
	Incorrect operation of KSB or glow plugs	Check operation of glow plugs and KSB system
The engine fails to start	Faulty electrostop	Replace the electrostop
	Fuse blown	Check the fuse box, eliminate the cause that short-circuited the fuse and replace it
	Ignition enabling relay	Replace the relay

Section 2 : Reverse shuttle

Fault	Possible causes	Remedies
The reverse shuttle grinds	Badly adjusted clutch	Adjust the clutch as described
	Worn synchromeshes	Disassemble the gearbox and replace the synchromesh
Reverse shuttle feels stiff when engaged	Make sure the external linkages are properly greased	Grease the external linkages
Reverse shuttle fails to engage	Check linkages	Adjust external linkages and, if necessary, the internal ones

Section 3 : Clutch - Transmission

Fault	Possible causes	Remedies
The clutch slips	Clutch plate dirtied by oil	Eliminate any oil leaks, thoroughly clean the flywheel and replace the clutch plate
	Clutch play incorrect	Adjust the clutch pedal
	Worn clutch plate	Replace the clutch plate
Clutch fails to disengage	Clutch disengaging lever does not move	Replace the spring pins of the clutch disengaging lever
	Pressure plate levers not adjusted properly	Make sure that the levers are not worn. Adjust them if they are not worn
	Clutch plate jammed onto flywheel	Start the machine, block it with the brakes, repeatedly engage and disengage the clutch. If no appreciable result is obtained, disassemble the clutch and clean it
	Clutch with too much play	Adjust external linkages and, if necessary, the internal ones

Section 4 : Gearbox

Fault	Possible causes	Remedies
The gears grind	Worn synchromeshes	Disassemble the gearbox and replace the synchromeshes
	Incorrectly adjusted clutch	Adjust the clutch as described
The gearbox is noisy when operating	Oil level too low	Check the oil level
	Worn bearings	Replace the bearings
	Damaged gears	Open the cover and replace the damaged gears
The speed gears disengage	Pack of synchromeshes and speed selection gears with excessive float	Adjust to the required level of play
	Sliding speed engaging sleeve and selection gear with worn teeth causing the synchromesh to function badly	Replace the complete synchromeshes and selection gears
The speed gears fail to engage	Clutch fails to engage	Adjust the clutch as described
	Synchromesh with worn brake ring	Replace the brake rings
The final drive - reverse shuttle disengage	Insufficient selection spring load	Increase the load on the selection spring
The final drive - reverse shuttle fails to engage	Clutch fails to disengage	Adjust the clutch as described
	Broken linkage spring pin.	Remove the gearbox cover and replace the spring pin

Section 5 : Rear differential

Fault	Possible causes	Remedies
Noisy axle	Badly adjusted diff lock internal linkage	Adjust the linkages
	Bevel gear pair not adjusted	Adjust the bevel gear pair
	Worn bearings	Replace the bearings
The diff lock fails to engage	Pressure too low	Restore the correct pressure level. Make sure that push-button functions correctly
	Badly adjusted diff lock internal linkage	Adjust the linkages
The diff lock fails to disengage	Solenoid valve locked in the open position	Release the solenoid valve and make sure that push-button functions correctly
	Diff lock ram blocked	Overhaul the differential lock ram

Section 6 : Rear final drives

Fault	Possible causes	Remedies
Noisy wheels	Loose flange and rim fastening screw	Tighten screws to the correct torque value
	Noisy bearings	Replace the bearings

Section 7 : Drive transmission

Fault	Possible causes	Remedies
Drive disengages	Faulty solenoid valves	Check the solenoid valves as described
	Faulty electrical system	Check drive engaging switches. Check relays under fixed bonnet
	Fault in the drive engaging housing	Overhaul the drive engaging unit after having performed the inspections described above
Drive remains engaged	Pressure too low	Restore the correct pressure level
	Faulty cylinder seals	Replace all the seals
	Mechanical fault in drive unit	Overhaul the unit
	Electrical system or solenoid valves are not operating	Check the fuses, check valve supply, check components of electrical system (4WD switch, relays, etc...) as shown on circuit diagram
	4WD solenoid valve defective	Replace 4WD solenoid valve
Noisy drive	Tyre pairing incorrect	Comply with indicated pairing
	Tyre pressure wrong	Inflate tyres to correct pressure
	Worn transmission sleeve	Replace sleeves

Section 8 : Power take-off

Fault	Possible causes	Remedies
The P.T.O. disengages	Independent or synchronized P.T.O. selection control badly adjusted	Adjust as described
	Tractor-trailer load excessive	Make sure that tractor-trailer ratio is correct
The P.T.O. fails to engages	Clutch fails to disengage	Adjust the clutch as described
	Independent or synchronized P.T.O. selection control badly adjusted or blocked	Adjust as described
	Selection pad broken	Replace the pad
Noisy P.T.O.	When implements that turn in an irregular way and require low draft are hitched	There is no remedy for faults concerning interventions on implements
	Selection of 540-750- 1000 rpm rate not proportional to that of the application	Select an appropriate rate
	P.T.O. shaft float	Adjust the shaft as indicated and make sure that the couplings connected to it slide smoothly

Section 9 : Front axle

Fault	Possible causes	Remedies
Noisy axle	Oil level low	Check oil level
	Axle bearing bushes with excessive play	Replace the bushes of the support and the transmission sleeve
	Worn transmission sleeve	Replace the sleeve and check alignment of transmission shaft
	Bevel gear pair not adjusted	Adjust the bevel gear pair - ring gear correctly
	Defective No-Spin system	Check operation and replace if required

Section 10 : Front final drives

Fault	Possible causes	Remedies
Noisy wheels	Loose flange and rim fastening screw	Tighten screws to the correct torque value
	Noisy bearings	Replace the bearings

Section 11 : Brakes

Fault	Possible causes	Remedies
The machine fails to brake	Badly adjusted brakes	Adjust the parking and emergency brakes
	Worn brake discs	Replace the discs
Machine remains braked	Badly adjusted brakes	Adjust the parking and emergency brakes
	Broken return springs	Replace the springs
	Stiff controls because they have not been lubricated	Lubricate them to ensure they function smoothly
Irregular braking action	Badly adjusted brakes	Adjust the main brakes and make sure that they operate contemporaneously

Section 12 : Hydraulic circuit

Fault	Possible causes	Remedies
Pump overheats	Excessive pressure	Reduce pressure to the correct value
	Cavitation	Clean the suction components and check the unions
	Too much back pressure owing to installation of incorrect hydraulic components	Replace the hydraulic components with others of the correct type
	Control valves engaged	Disengage
Pump with zero pressure	Pump plunger broken	Replace the pump
	Sleeve connection ruined	Replace sleeve
	Insufficient oil	Check oil level and suction circuit
Noisy pump	Cavitation	Clean the suction components and check the unions
	Imperfect seal on pump shaft	Replace oil retainer
	Pump casing not tight	Tighten the screws of the pump casing and replace the retention rings
Oil in circuit becomes frothy and increases in volume in an abnormal way	Air in the circuit	Check oil level and prevent air from entering
	Pump cavitation	Clean the suction components and check the unions
	Oil contaminated by water	Replace oil and filters

Section 13 : Steering system

Fault	Possible causes	Remedies
Loss of control when driving the machine	Steering cylinder with worn retention rings	Replace the retention rings on the cylinder
	Power steering system with incorrectly calibrated anti-shock valves	After thoroughly cleaning the valves, make sure that the pressure values are as required. If these values cannot be obtained, replace the power steering system
	Air in the circuit	Check the clamps and unions of the oil intake circuit
Oil leaks from the power steering system	Loosened unions	Tighten the unions
	Worn retention rings	Make the power steering system oil tight
	Outlet from power steering system obstructed	Check condition of discharge pipe and operation of hitch control valve
Steering difficult	Low pressure in power steering system	Check and restore maximum pressure in the circuit
	Air in the circuit	Thoroughly clean the intake circuit and make sure it is tight
	LS priority valve badly adjusted	Clean and carefully reassemble the valve. Check for wear and make sure it functions smoothly
	Poor gear pump efficiency	Overhaul or replace the pump
	Tarnished steering column	Disassemble and lubricate the steering column
	Excessive load on front axle	Check load on front axle

Section 14 : Electrical system

Fault	Possible causes	Remedies
The starter motor fails to turn	Battery low or faulty	Recharge the battery. Replace it if it fails to remain charged
	Starter motor defective	Overhaul the starter motor or replace it
	Ignition switch defective	Replace the switch
	Battery cables tarnished or broken at the terminals	Clean the tarnished terminals or replace them
	Ignition enabling switches on machine badly adjusted	Adjust the ignition enabling switches or replace them if necessary
	Independent PTO engaged	Disengage the power take-off
	Clutch pedal not depressed	Depress the clutch pedal
Generator indicator light fails to go out even at a high engine rate	Regulator inefficient	Replace the alternator
	Alternator fails to charge sufficiently	Replace the alternator
The battery becomes misshapen	Battery has been charged too much	Replace the alternator
Revolution counter fails to function	Supply pulse fails to arrive	Repair the circuit
	Instrument with irregular setting	Adjust the instrument
	Faulty instrument	Adjust the instrument
	Engine speed sensor defective	Replace the engine speed sensor
The solenoid valves of the diff lock or 4WD fail to magnetize	Faulty control switches	Replace the switch
	Faulty solenoid valve coils	Replace the coils
	Electrical system interrupted in some point	Restore the continuity of the electrical system

Section 15 : Platform

Fault	Possible causes	Remedies
Platform vibrates	Contact between bodywork and chassis	Eliminate contact
	Contact between bodywork and hitch	Insert spacers between the bodywork and its supports
	Inefficient Silent-Blocks	Replace the Silent-Blocks

Section 16 : Hitch

Fault	Possible causes	Remedies
The hitch lifts in a jerky way	Hydraulic pump suction filter clogged	Clean the filter and replace it if necessary
	Air in the suction pipe of the hydraulic pump	Tighten the unions of the intake circuit and find out if there are any leaks
	Faulty four-wheel drive circuit (50 l version)	Check operation of 4WD circuit
The hitch fails to function or does not lift very much.	Pilot valve jammed	Remove the valve system and release the pilot valve
The hitch starts to lift but stops as soon as it senses the load, without the overpressure valve having activated	Badly adjusted draft rod	Adjust the draft control
The hitch does not lower to its full extent	Badly adjusted position control lever	Adjust the position control lever
The hitch fails to lower	Hydraulic lock cock closed	Open the cock
The hitch fails to reach the indicated lifting capacity	Worn control valve unit retention rings	Remove the valve unit and replace the external retention rings
	Badly regulated safety and overpressure valves	Calibrate the valves
	Poor gear pump efficiency	Overhaul the pump
	Worn springs and other mechanical components	Overhaul the control valve unit
The hitch has difficulty in supporting the load: it swings rhythmically when the engine is running, while the load lowers when the engine is off.	Worn piston rings	Replace the retention rings on the cylinders if leaks from the cylinders are noted
	Cylinder overpressure valve badly adjusted	Remove the valve system unit and calibrate the pilot valve
	Check valve badly adjusted	Remove the valve system unit and calibrate the valve
	Valve system unit with dirty valves	Remove the valve system unit and clean the valves
When the engine is running, rhythmic swinging occurs with the links at the end of upward travel. The load fails to lower when the engine is off.	Incorrect hitch sensitivity adjustment	Adjust the sensitivity as indicated in the manual
Draft control fails to function: the hitch can only lift and lower by means of the position control lever	Badly adjusted draft control lever	Adjust the draft control lever
	3-point hitch with play	Eliminate the play and restore the lever + link adjustment
Position control fails to function: the hitch can only lift and lower by means of the draft control lever	Position control lever not adjusted	Adjust the position control lever
	Faulty internal linkages	Overhaul the internal linkages

Chapter 19 : Special tools

Index

Section 1 : List of tools 19-2

Section 1 : List of tools

Code:	07000215
Description:	Gearbox - base unit support
Chapter:	Chap.7 Front axle

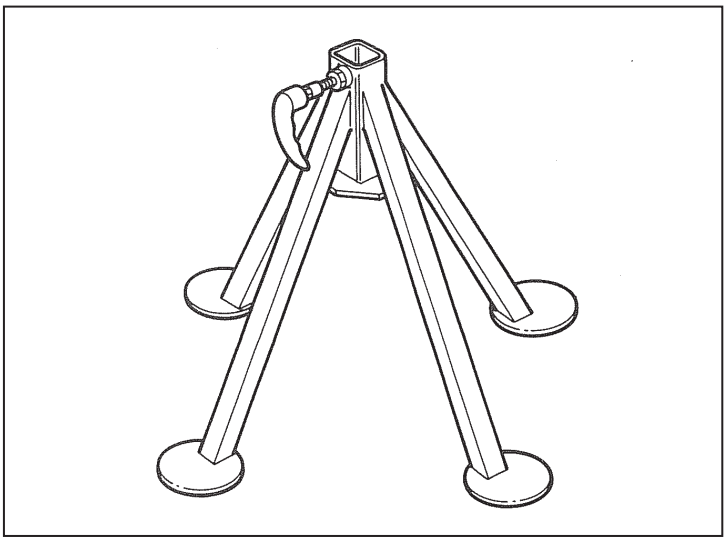


Fig. 19.1

Code:	07000227
Description:	Ring nut wrench
Chapter:	Chap.6 Rear final drives

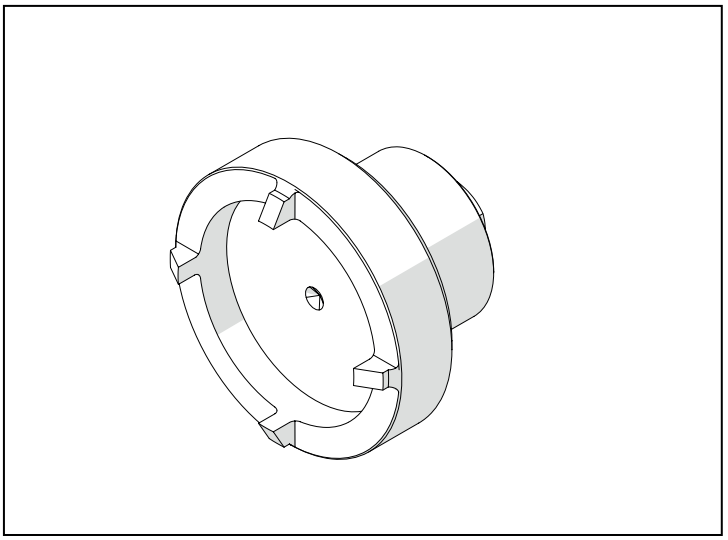


Fig. 19.2

Code:	07000234
Description:	Ring nut wrench 06340273
Chapter:	Chap.7 Front axle

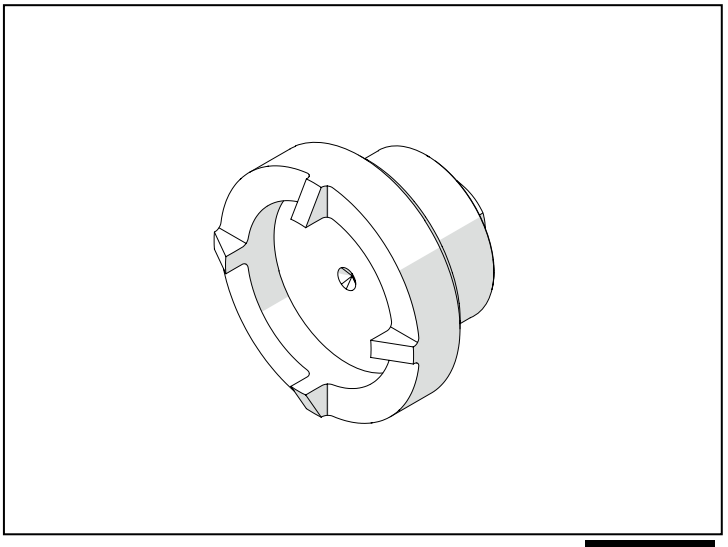


Fig. 19.3

Code:	07000237
Description:	Ring nut wrench - 1363
Chapter:	Chap.5 Rear differential
	Chap.7 Front axle

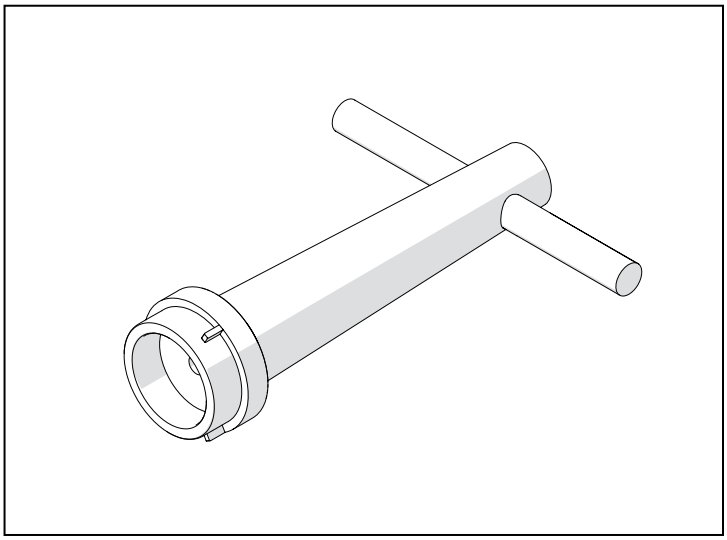


Fig. 19.4

Code:	07000239
Description:	Tool 1363/20 - 1363
Chapter:	Chap.5 Rear differential

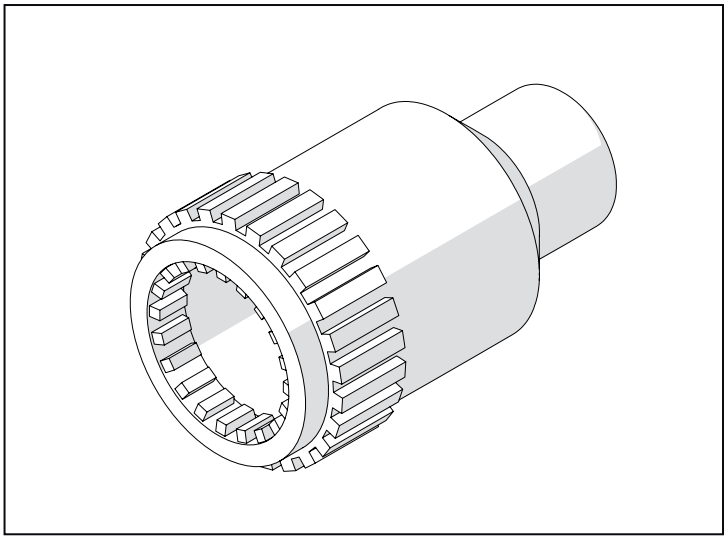


Fig. 19.5

Code:	07000240
Description:	Tool for removing/inserting ring nuts
Chapter:	Chap.4 Gearbox

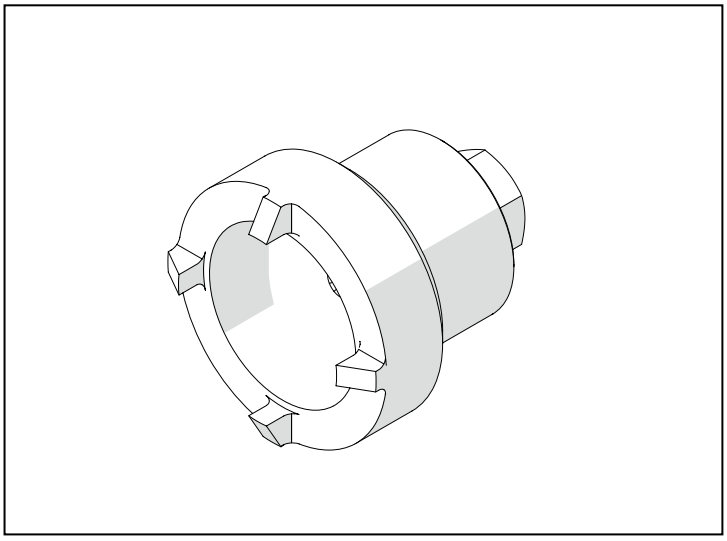


Fig. 19.6

Code:	07000241
Description:	1363 dist. test tool
Chapter:	Chap.12 Hydraulic circuit

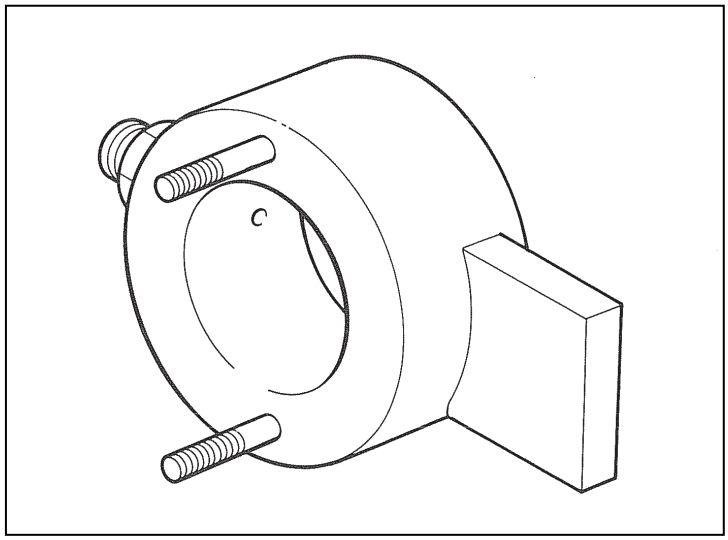


Fig. 19.7

Code:	07000243
Description:	Wrench for NoSPIN ring nut
Chapter:	Chap.7 Front axle

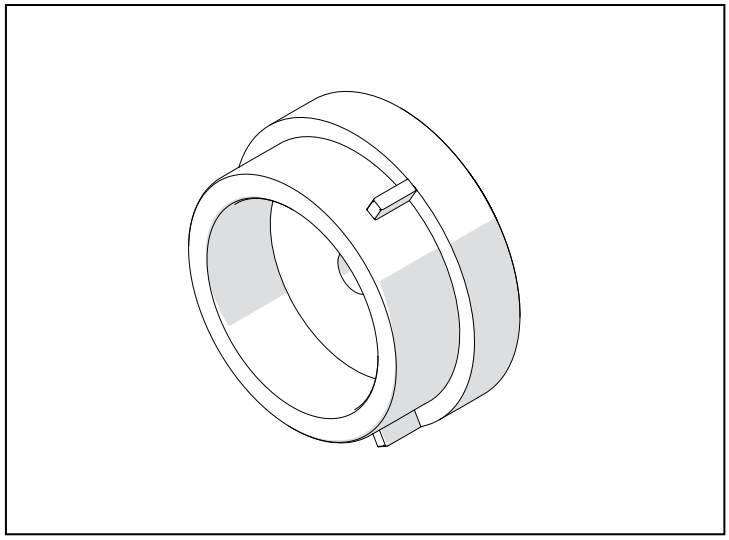


Fig. 19.8

Code:	07000245
Description:	Tractor splitting support
Chapter:	Chap.3 Clutch bowl

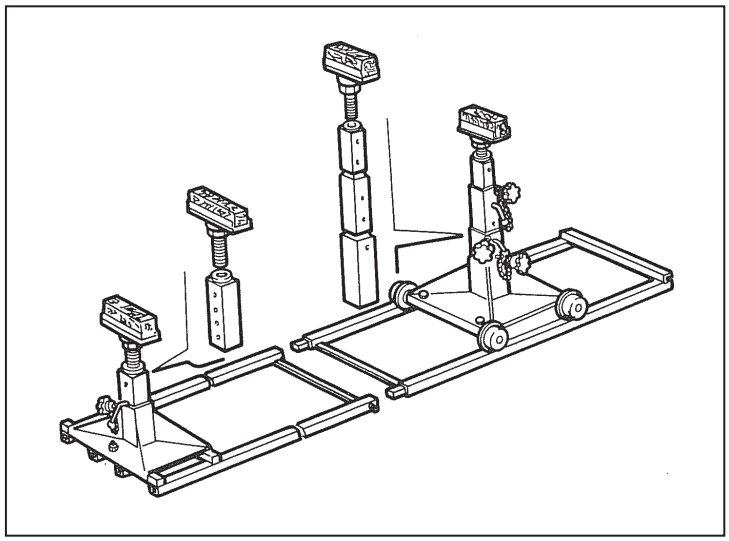


Fig. 19.9

Code:	07000246
Description:	Gearbox housing support
Chapter:	Cap.4 Cambio

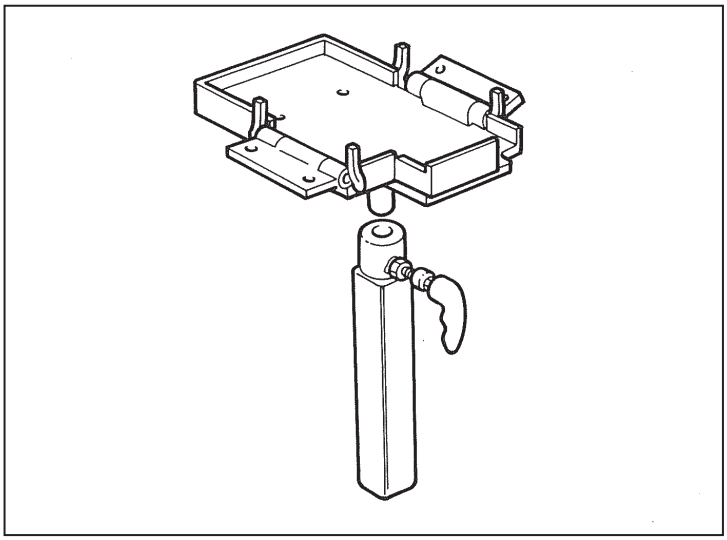


Fig. 19.10

Code:	07000247
Description:	Differential support
Chapter:	Chap.5 Rear differential

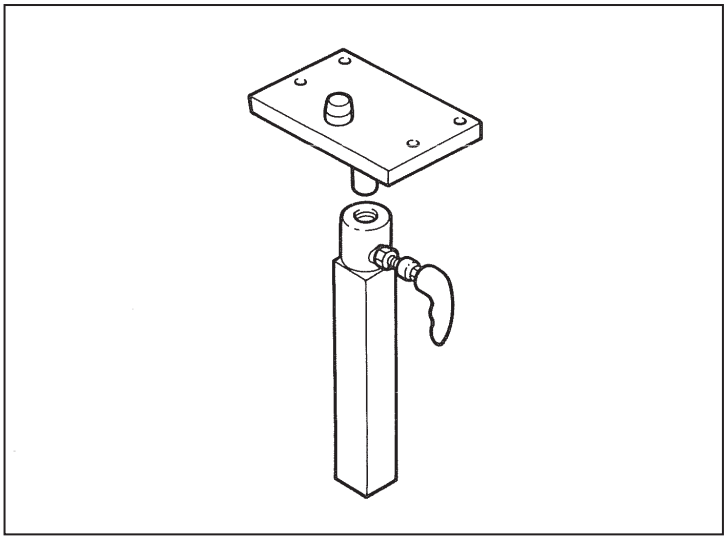


Fig. 19.11

Code:	07000249
Description:	Hitch draft adjuster tool
Chapter:	Chap.12 Hydraulic circuit

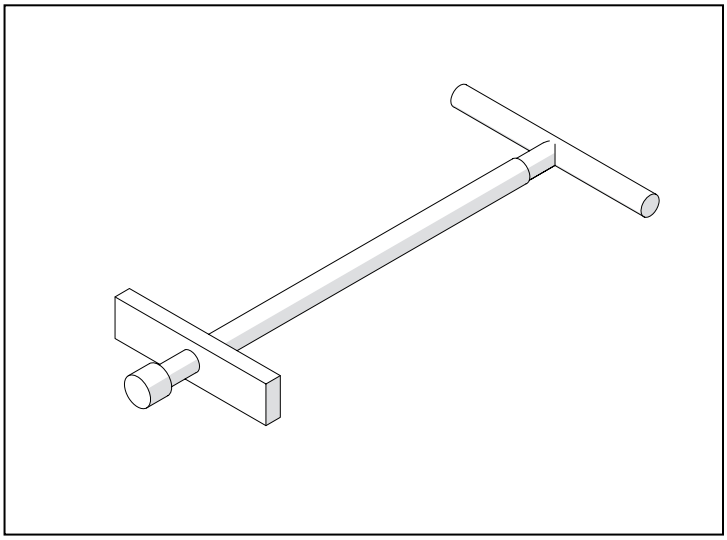


Fig. 19.12

Code:	07000303
Description:	Pressure gauge
Chapter:	Chap.12 Hydraulic circuit

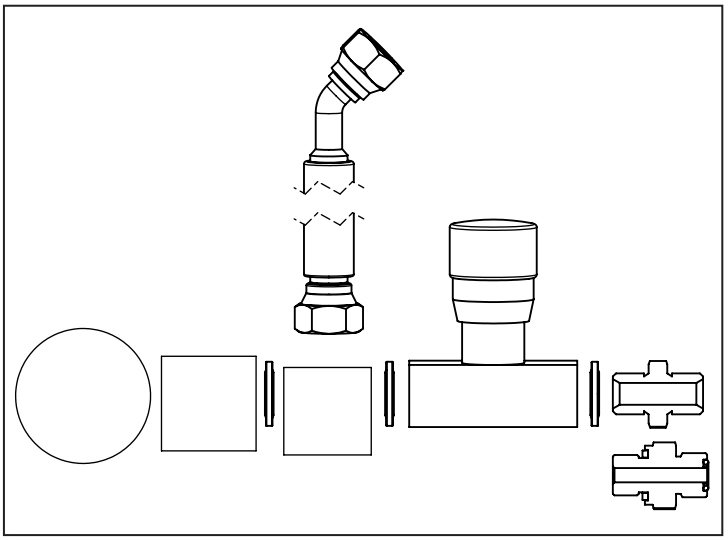


Fig. 19.13

Code:	07000306
Description:	Tool for removing reverse shuttle shaft
Chapter:	Chap.4 Gearbox

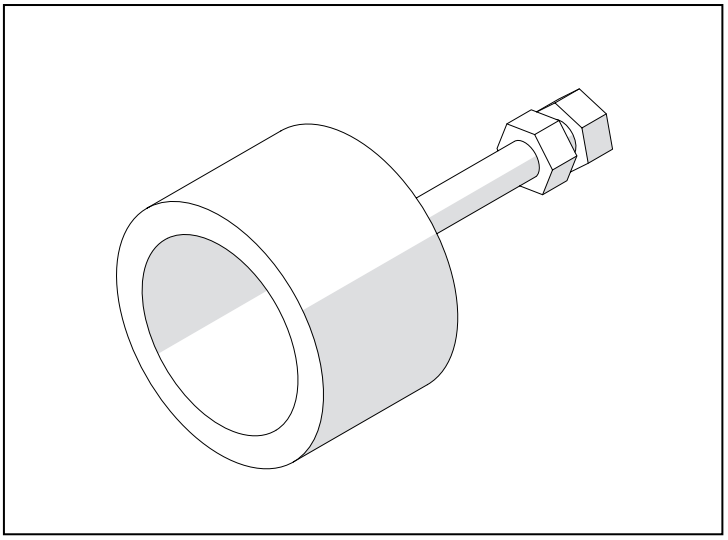


Fig. 19.14

Code:	07001643
Description:	P.T.O. selection lever adjuster tool
Chapter:	Chap.5 Rear differential

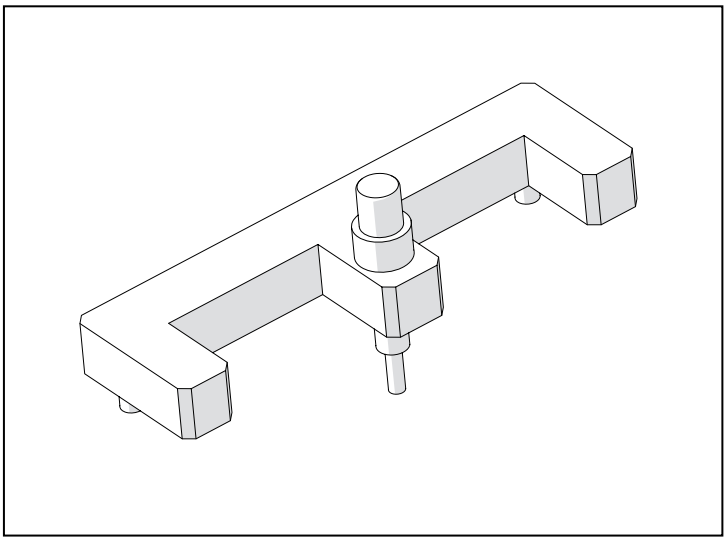


Fig. 19.15

Code:	07002765
Description:	Spacer for bearing assembly
Chapter:	Chap.8 Drive transmission

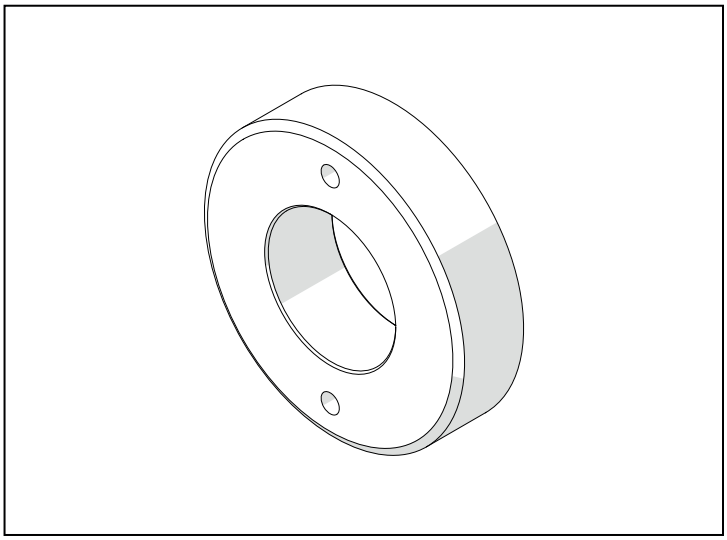


Fig. 19.16

Code:	07003831
Description:	4WD shaft guard
Chapter:	Chap.8 Drive transmission

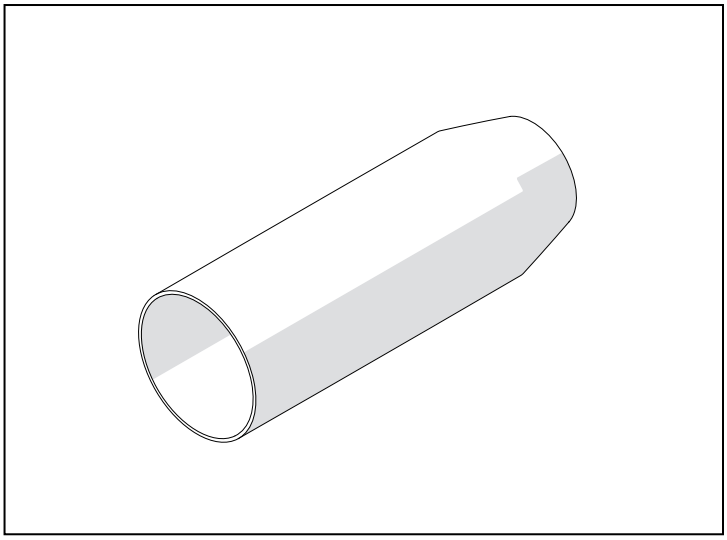


Fig. 19.17

Code:	07006128
Description:	Ring nut wrench
Chapter:	Chap.8 Drive transmission
	Chap.9 Rear power take-off

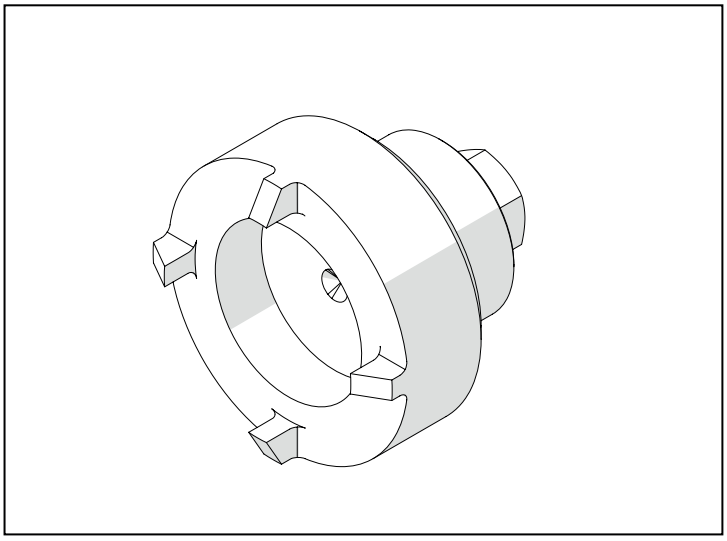


Fig. 19.18

Code:	07006220
Description:	Link retaining too
Chapter:	Chap.12 Hydraulic circuit

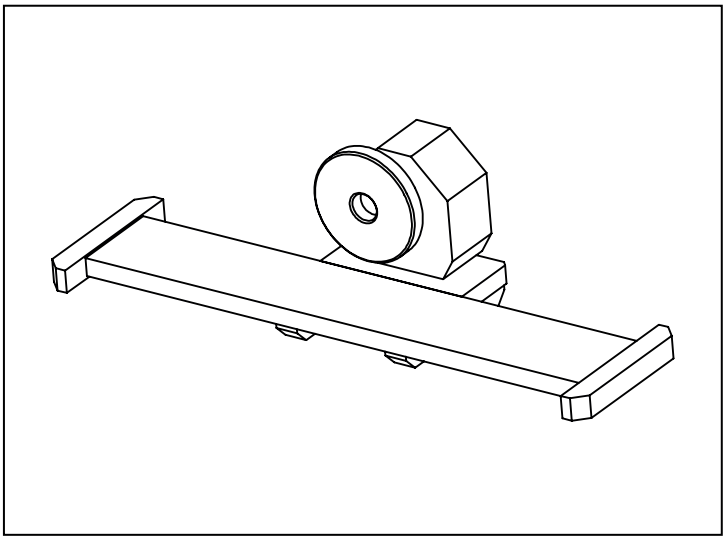


Fig. 19.19

Code:	07006221
Description:	Plug for multiple chiseling of pinion ring nut
Chapter:	Chap.5 Rear differential

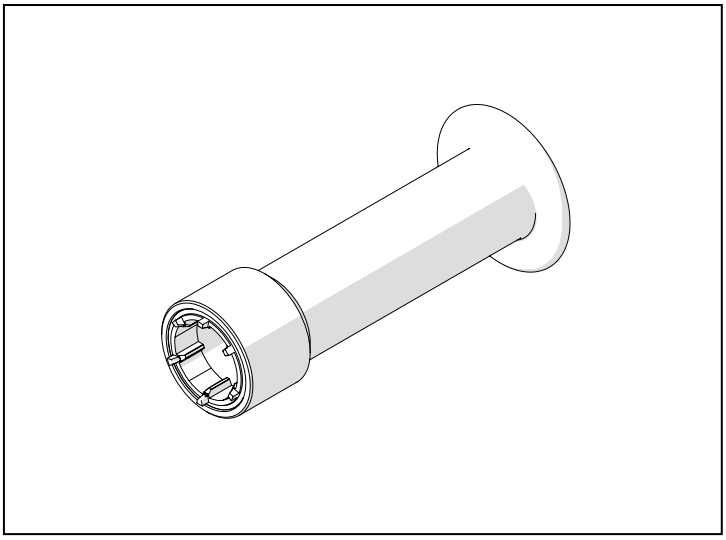


Fig. 19.20

Code:	07006223
Description:	Plug for assembling differential taper bearings
Chapter:	Chap.5 Rear differential

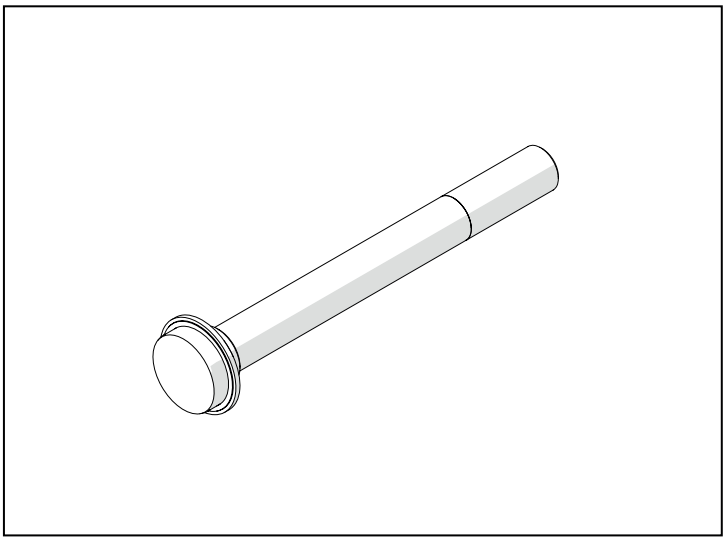


Fig. 19.21

Code:	07006224
Description:	Plug for assembling bevel pinion taper bearings
Chapter:	Chap.5 Rear differential

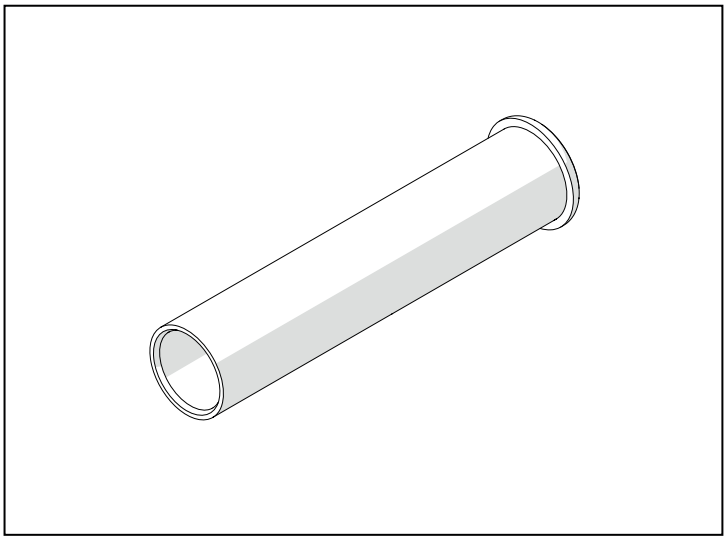


Fig. 19.22

Code:	07006225
Description:	Bevel pinion retainer tool
Chapter:	Chap.5 Rear differential

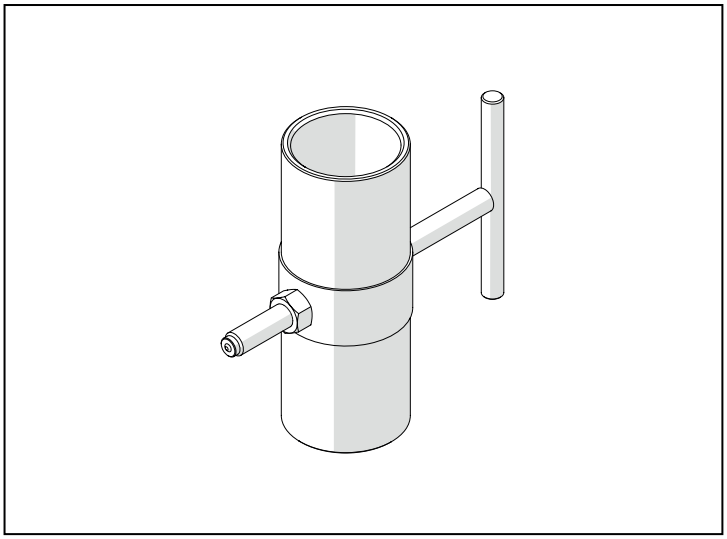


Fig. 19.23

Code:	07006226
Description:	Plug for assembling differential crown wheel bearing
Chapter:	Chap.5 Rear differential

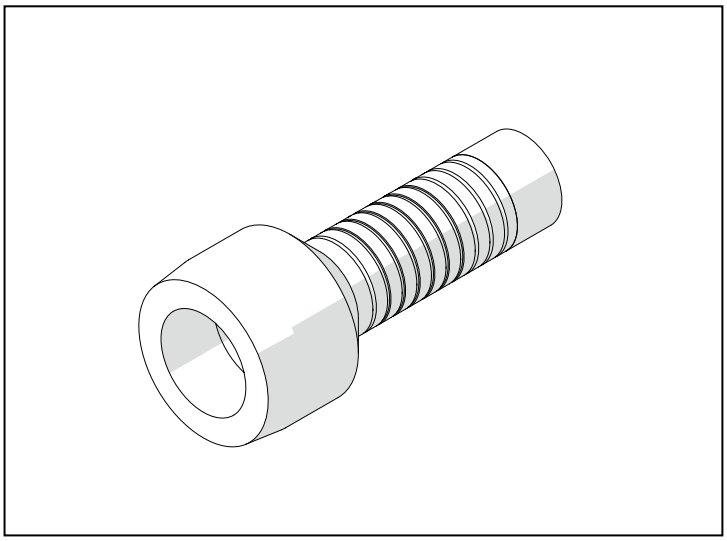


Fig. 19.24

Code:	07006208
Description:	Plug for assembling bearing
Chapter:	Chap.8 Drive transmission

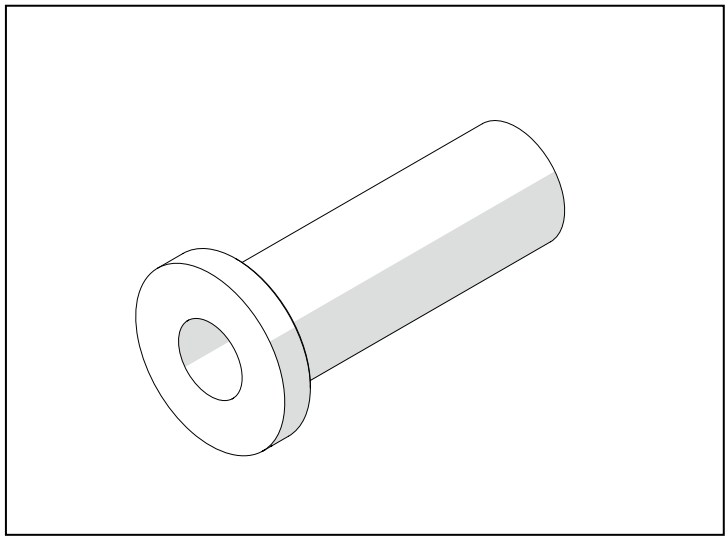


Fig. 19.25

Code:	07006209
Description:	Plug for assembling bearing
Chapter:	Chap.8 Drive transmission

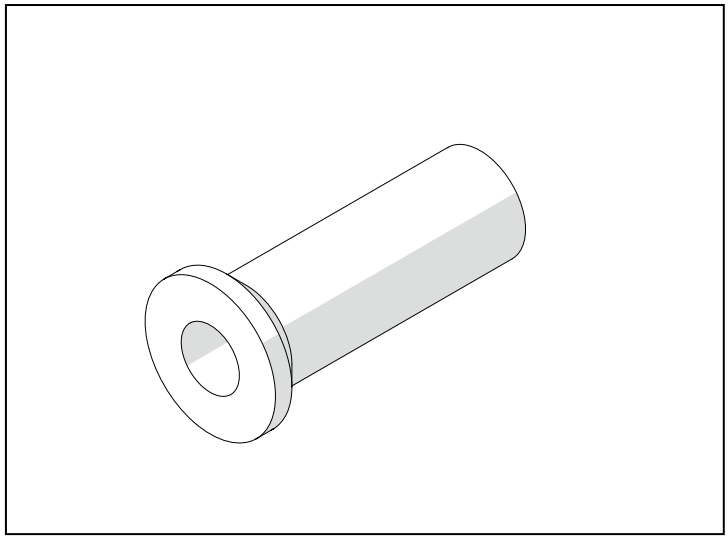


Fig. 19.26

Code:	07006210
Description:	Driver tool for installing flange in spring pack
Chapter:	Chap.8 Drive transmission

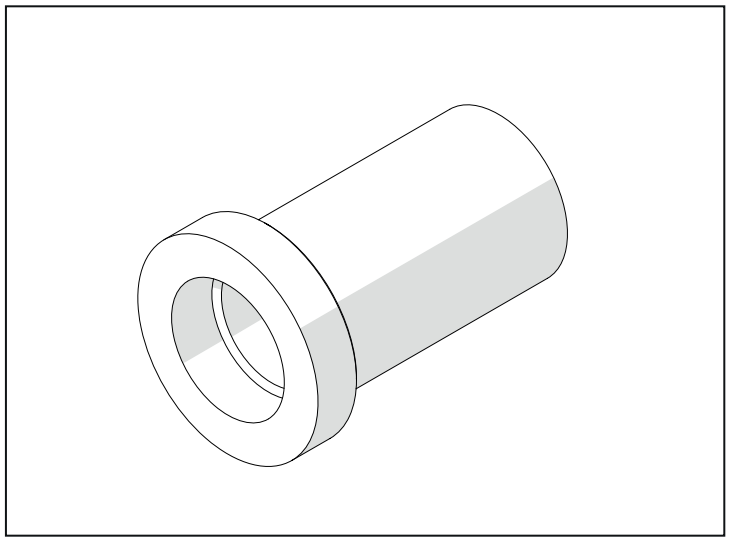


Fig. 19.27

Code:	07006211
Description:	4WD housing support
Chapter:	Chap.8 Drive transmission

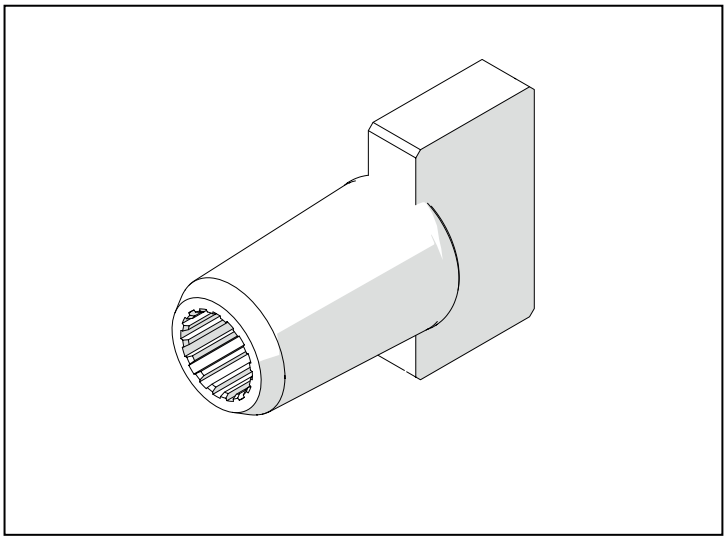


Fig. 19.28

Code:	07006212
Description:	Steering wheel puller
Chapter:	Chap.13 Platform

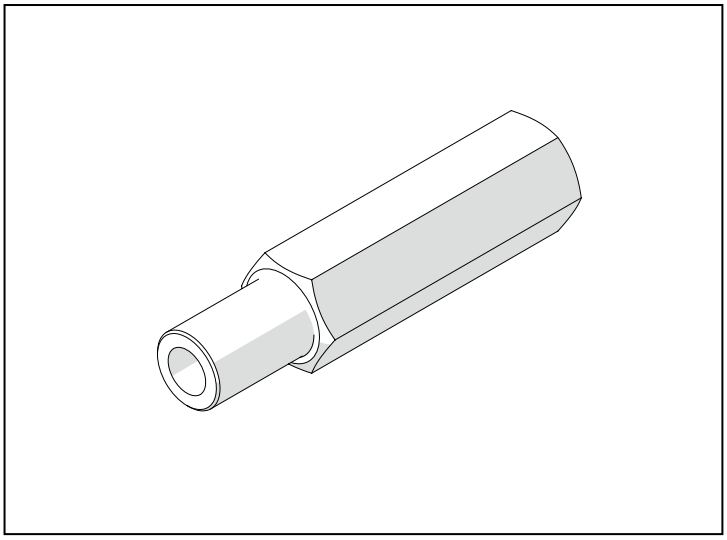


Fig. 19.29

Code:	07007078
Description:	Front bevel pinion retainer tool
Chapter:	Chap.7 Front axle

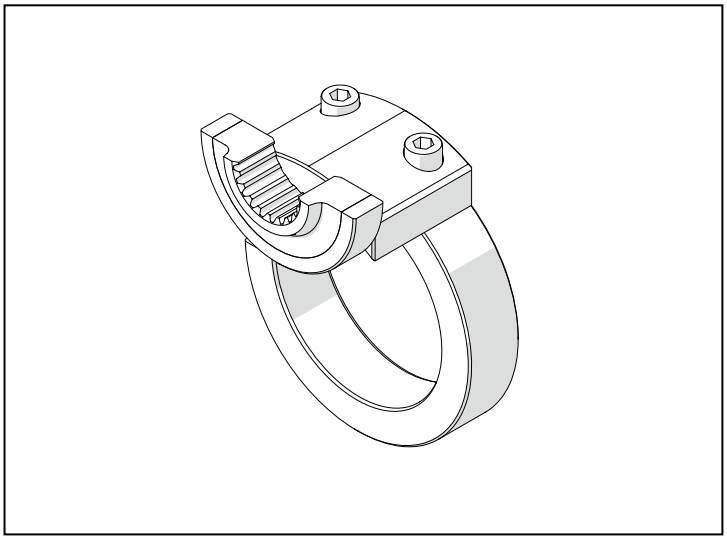


Fig. 19.30

Code:	07007171
Description:	STAR clutch plate dowel pin
Chapter:	Chap.3 Clutch bowl

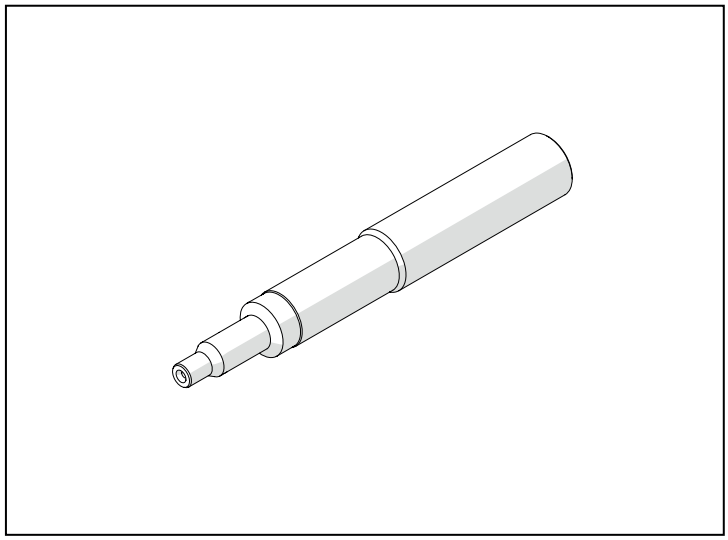


Fig. 19.31

Code:	07007176
Description:	Rear hitch shaft protection
Chapter:	Chap.15 Rear hitch

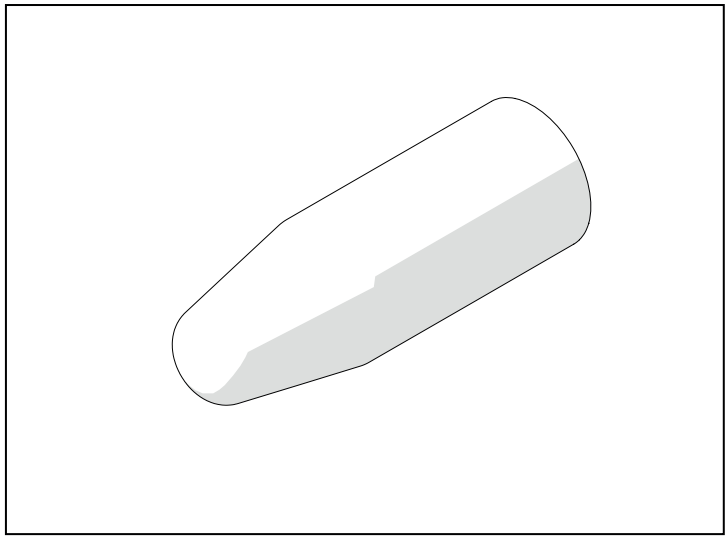


Fig. 19.32

Code:	07007179
Description:	NoSPIN control lever
Chapter:	Chap.7 Front axle

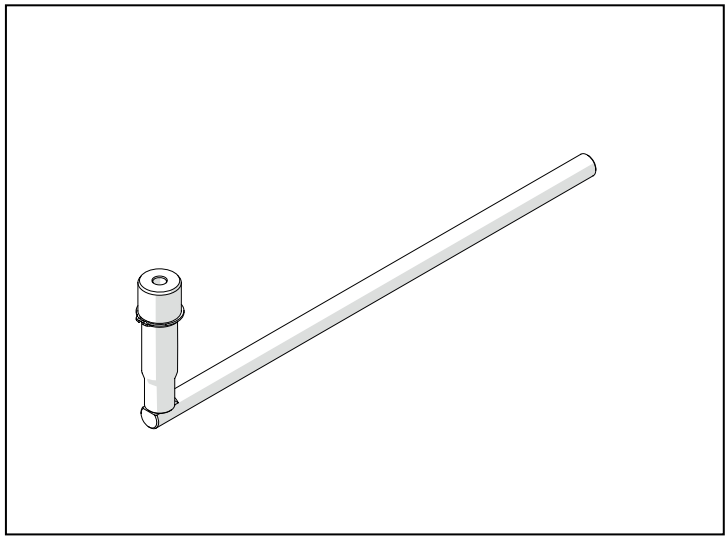


Fig. 19.33

Code:	07007180
Description:	Toe-in testing tool
Chapter:	Chap.7 Front axle

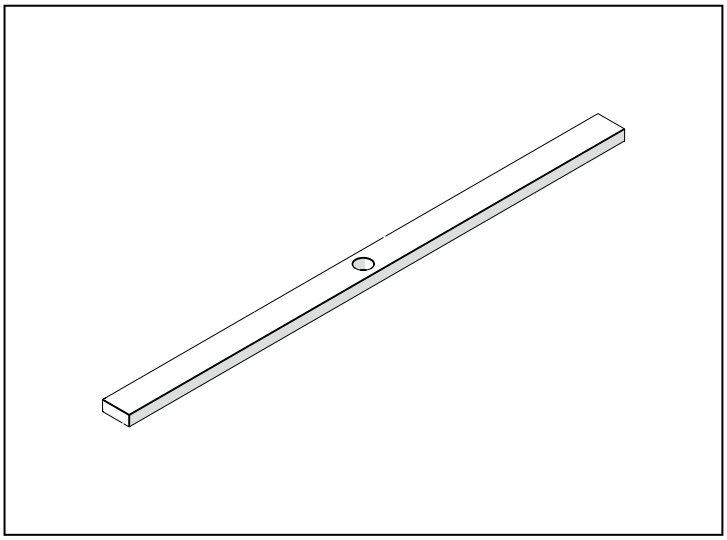


Fig. 19.34

Code:	07007181
Description:	Cab lifting tool
Chapter:	Chap.13 Platform
	Chap.14 Cab

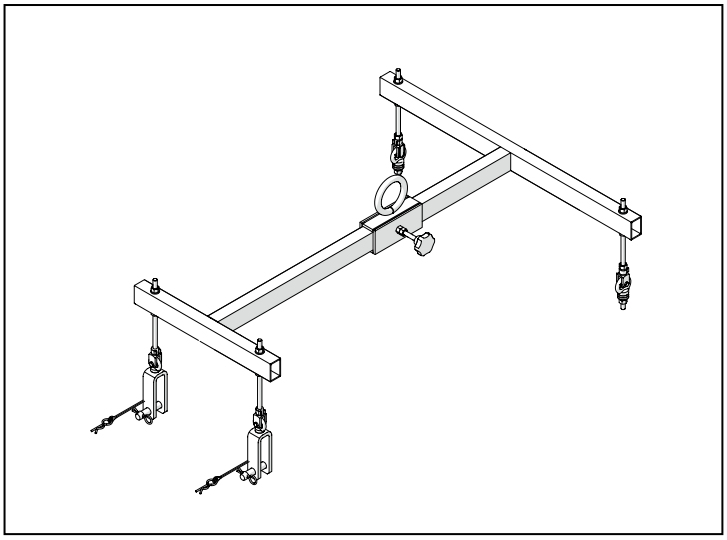


Fig. 19.35

Code:	07007182
Description:	Spring pre-loading tool
Chapter:	Chap.9 Rear power take-off

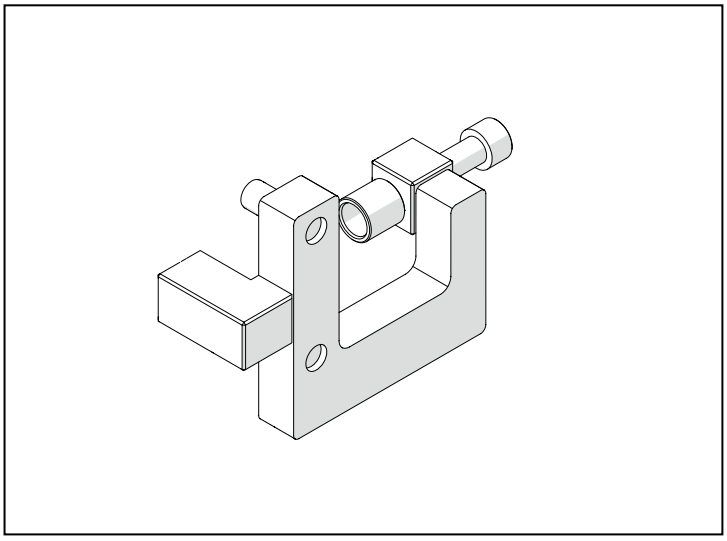


Fig. 19.36

Code:	07007183
Description:	Tool for assembling rear diff lock locking cylinder
Chapter:	Chap.5 Rear differential

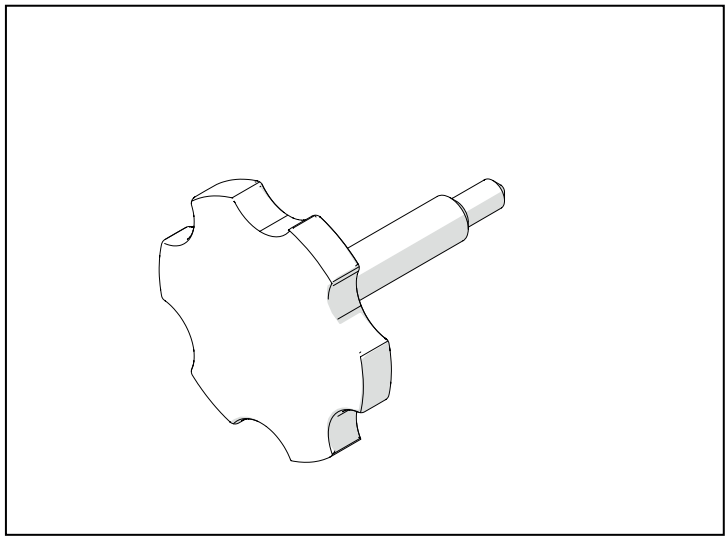


Fig. 19.37

Code:	07007184
Description:	Rear hitch oil retainer plug
Chapter:	Chap.15 Rear hitch

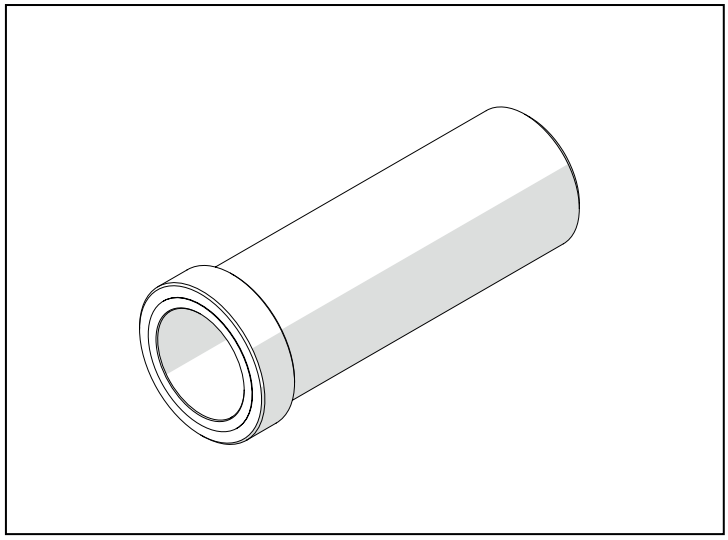


Fig. 19.38

Code:	07007953
Description:	Layshaft spacer tool
Chapter:	Chap.4 Gearbox

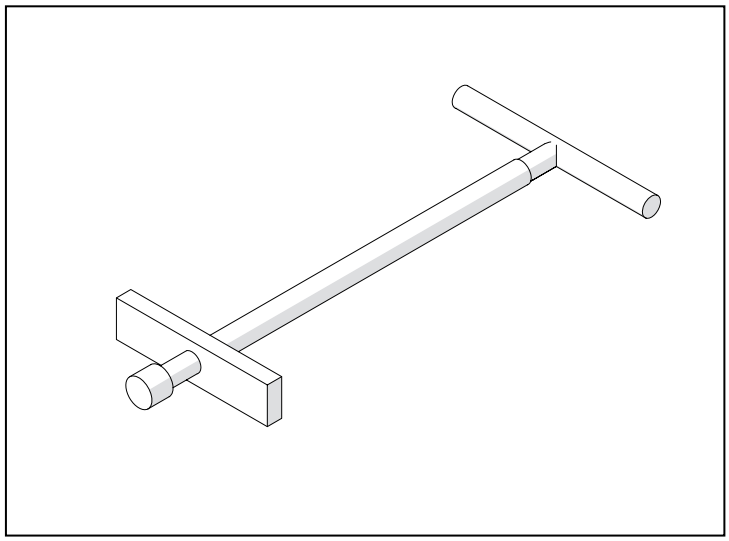


Fig. 19.39

Code:	07007954
Description:	Synchromesh locking tool
Chapter:	Chap.4 Gearbox

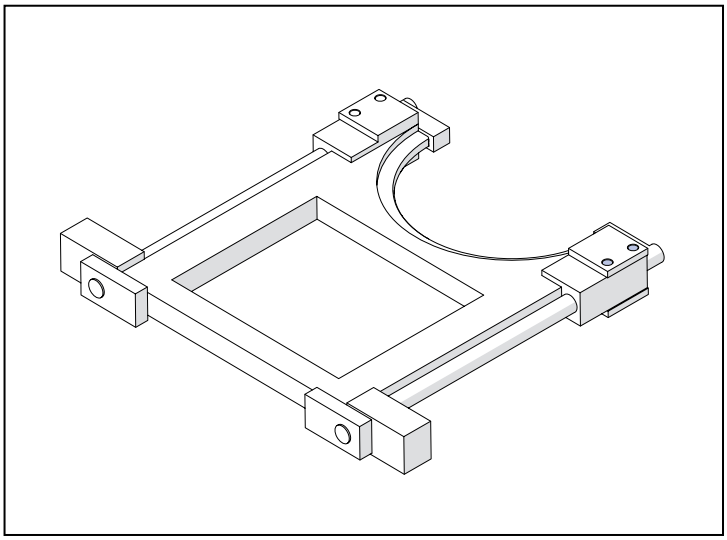


Fig. 19.40

Code:	07007955
Description:	Layshaft locking tool
Chapter:	Chap.4 Gearbox

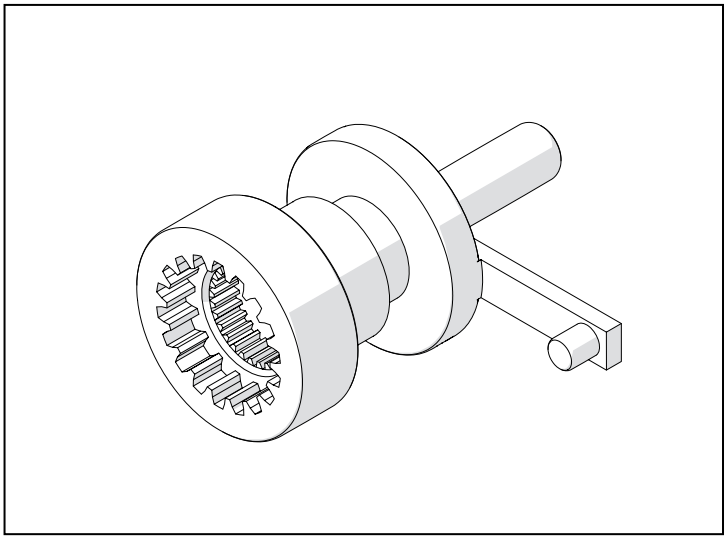


Fig. 19.41

Code:	07007956
Description:	Tool for fitting shaft into gearbox
Chapter:	Chap.4 Gearbox

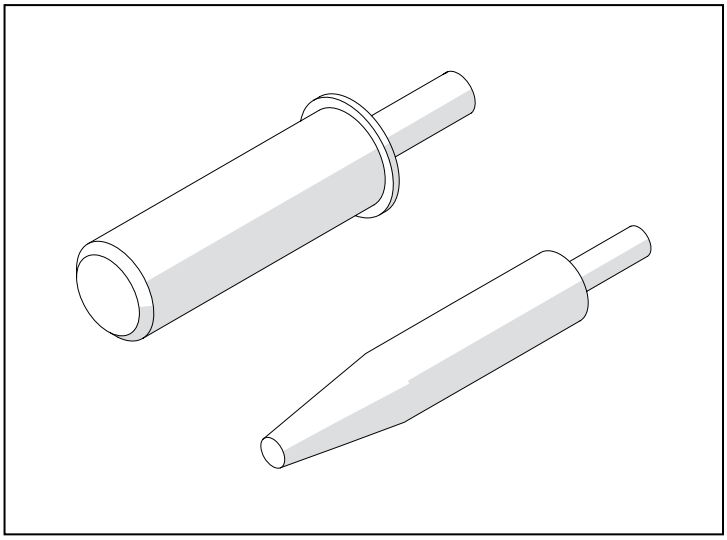


Fig. 19.42

Code:	07007957
Description:	Spacer inserting tool
Chapter:	Chap.4 Gearbox

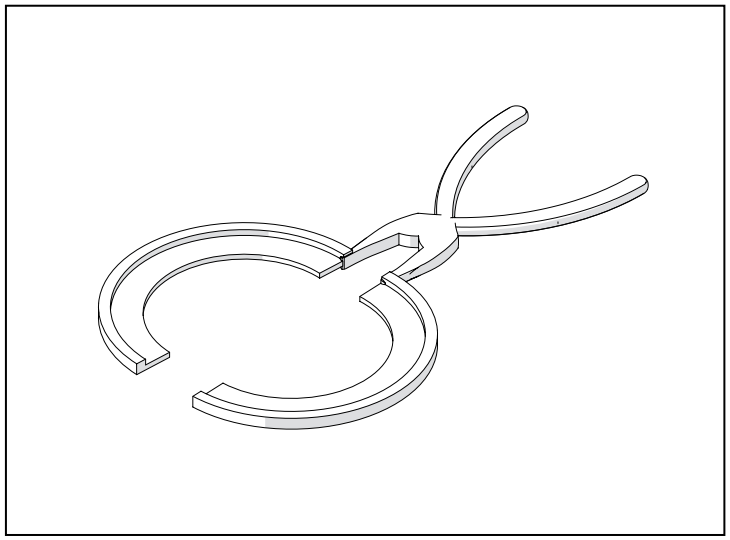


Fig. 19.43

WORKSHOP MANUAL

ENERGY 60/80 SERIES

Legal head office and factory: **GOLDONI S.p.A. a s.u.**
Via Canale 3, 41012 Migliarina di Carpi, Modena, Italy
+39 0522 640 111 Fax: +39 0522 699 002 info@goldoni.com
www.goldoni.com

Management and coordination:
LOVOL HEAVY INDUSTRY Co. LTD.

MADE in ITALY

GOLDONI

Tractors for **Life**