WORKSHOP MANUAL

RONIN Series

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GOLDONI

Tractors for Life

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Chapter 1 : Introduction

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Section 1 : Reading this manual

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1.1 Introduction

The purpose of this workshop manual is to provide all the essential information necessary, explain operating principles and describe the adjustments 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)

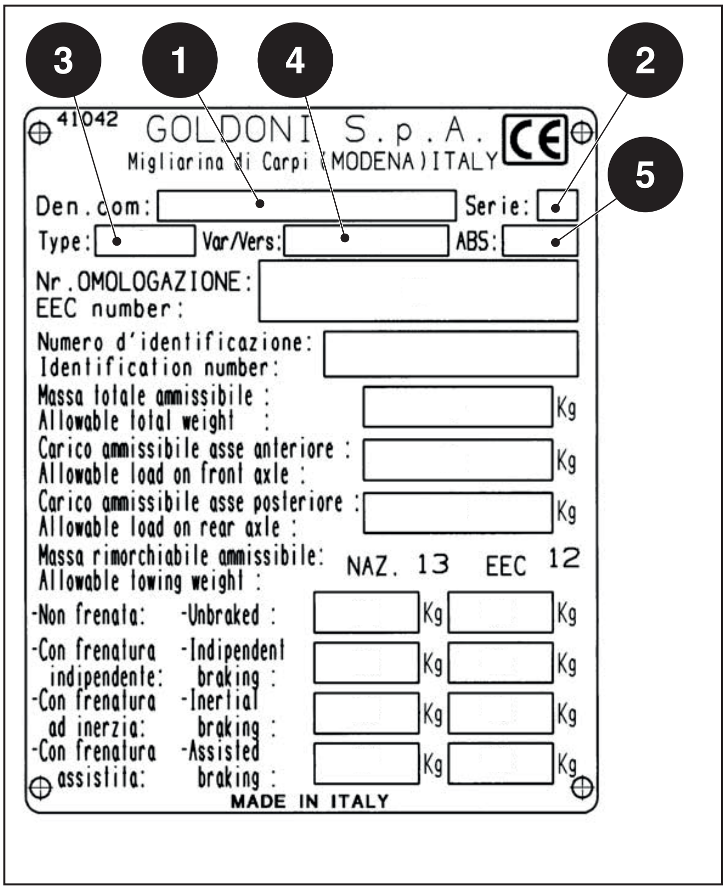

Fig. 1.1

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)

Fig. 1.3

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

Section 2 : Safety rules

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2.1 Essential preventive guidelines

The premises, installations and implements 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: **ATTENTION!** 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).

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.).

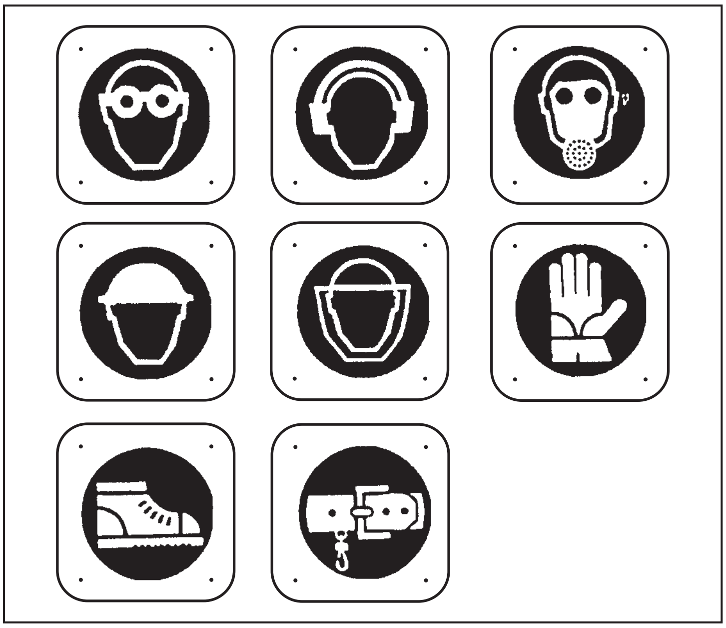


Fig. 1.4

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 Electricity

- 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 proximity or 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 labels.

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

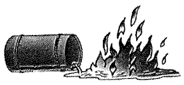
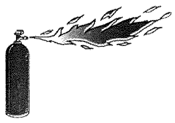
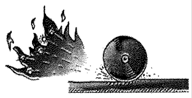
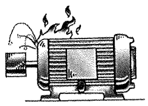
	Agente estinguente				
Classe di fuoco	Acqua	Polvere	CO^2	Schiuma	Polveri speciali
 combustibili solidi ordinari	✓	✓	✓ Solo per incendi di piccole dimensioni	✓	✗
 liquidi infiammabili	✗ Tranne che utilizzando attrezzature adatte	✓	✓	✓	✗
 gas infiammabili	✗	✓	✓	✗	✗
 metalli combustibili	✗ Possono reagire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

Fig. 1.5

2.1.2 Tools

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 implements 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, hoisting 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.

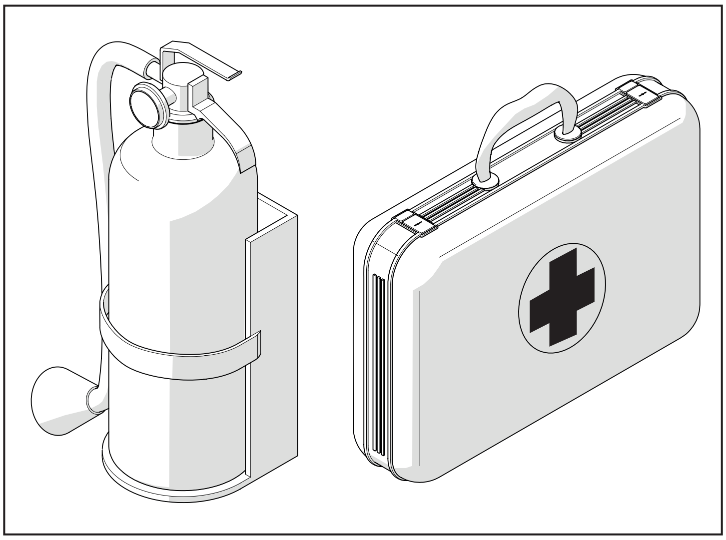


Fig. 1.6

2.1.4 Safety rules regarding the tractor

Attention
Read the use and maintenance manual 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 starting 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 flames and incorrectly connected cables may cause explosions.

2.1.4.4 Hydraulic system

- A 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 belts 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 or 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 seat belts. If the ROPS structure has been removed, the tractor must be equipped with a new ROPS and seat belts. 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.

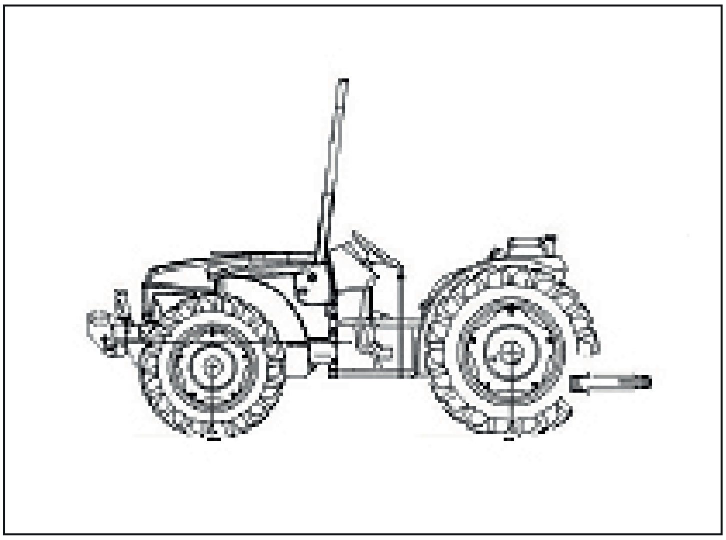


Fig. 1.7

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 belts if the tractor is not equipped with an ROPS safety roll bar or a cab.

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

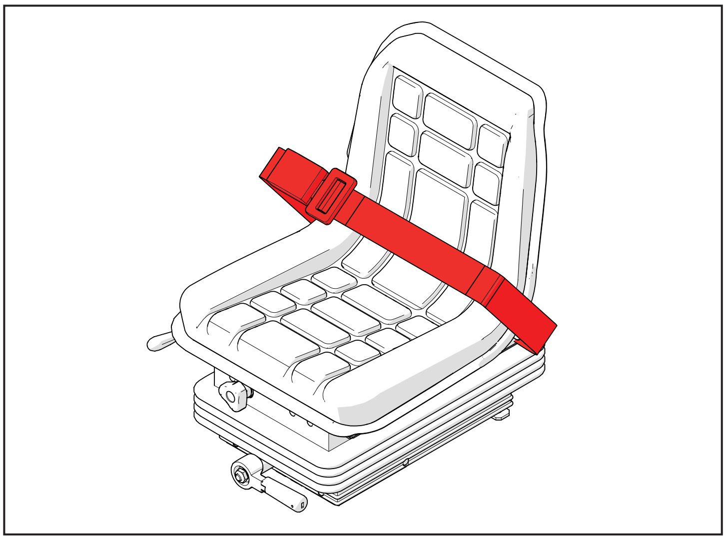


Fig. 1.8

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 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.

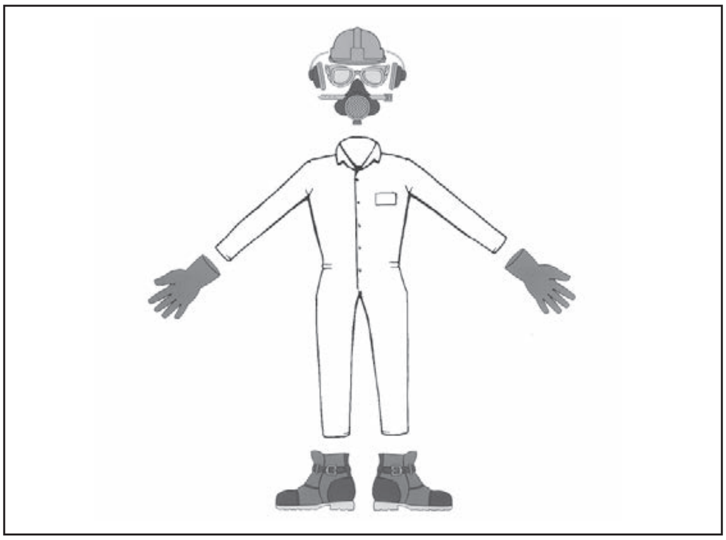


Fig. 1.9

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

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 implements 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 tractor 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

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4.1 Engine

Ronin	40	50
Engine Type	LDW 1603 step 3A	LDW 2204 step 3A
Power at rated speed	28 kW / 38 HP - 2800 rpm	35.3 kW / 48 HP - 2800 rpm
Cylinders	3, naturally aspirated	4, naturally aspirated
Cooling	Water	Water
Displacement	1649 cm3	2199 cm3
Torque rise	9%	8%
Fuel tank	45 litres	45 litres

4.2 Transmission

Ronin	40	50
Number of speeds	12+12 with reverse shuttle + Fast Reverse (4WD)	12+12 with reverse shuttle + Fast Reverse (4WD)
Clutch	9" dry clutch	9" dry clutch
Reverse shuttle	Synchronised	Synchronised
Rear differential lock	Mechanical	Mechanical
Speed	30 Km/h	30 Km/h

4.3 Brakes and steering

Ronin	40	50
Brake type	Mechanically actuated multi-disc wet brakes	Mechanically actuated multi-disc wet brakes
Steering type	Hydrostatic	Hydrostatic
Steering angle	55°	55°

4.4 Rear Power Take Off

Ronin	40	50
Type	independent 540/1000 rpm PTO, clockwise rotation synchronised with gearbox speed, anticlockwise rotation	independent 540/1000 rpm PTO, clockwise rotation synchronised with gearbox speed, anticlockwise rotation
Clutch	Independent, mechanical dry clutch	Independent, mechanical dry clutch
Operation	mechanical	mechanical

4.5 Front Power Take Off

Ronin	40	50
Type	independent 1000 rpm PTO, anticlockwise rotation	independent 1000 rpm PTO, anticlockwise rotation
Clutch	electromagnetic	electromagnetic
Operation	mechanical	mechanical

4.6 Rear lift

Ronin	40	50
Type	up / down	up / down
Type	with position and draft control	with position and draft control
Lifting capacity	1600 kg	1600 kg
3-point linkage	Cat. 1	Cat. 1

4.7 Front lift

Ronin	40	50
Type	up / down	up / down
Lifting capacity	350 kg	350 kg
3-point linkage	Cat. 1N	Cat. 1N

4.8 Hydraulic circuit

Ronin	40	50
Pump delivery	33 l/min.	33 l/min.
Number of rear hydraulic distributors	2	2
Rear hydraulic distributor type	Double acting with lever return spring	Double acting with lever return spring
Front hydraulic distributors	1 double acting distributor (in engine block) + 2 double acting distributors + 4th float mode position (available if tractor is not equipped with front lift and belly mower deck)	1 double acting distributor (in engine block) + 2 double acting distributors + 4th float mode position (available if tractor is not equipped with front lift and belly mower deck)

4.9 Belly lift

Ronin	40	50
Type	double acting with float mode	double acting with float mode

4.10 Driver zone

Ronin	40	50
Platform	full sized, on silicone oil filled silentbloc mounts	full sized, on silicone oil filled silentbloc mounts
ROPS	yes	yes
Cab	GL 12 HOT TOP FULL GLASS	GL 12 HOT TOP FULL GLASS
		GL 12 COLD TOP FULL GLASS
Instrument	analogue	analogue
Driver seat	with elastic suspension	with elastic suspension
Towing hitch	Type B/EEC	Type B/EEC

4.11 Weights and dimensions

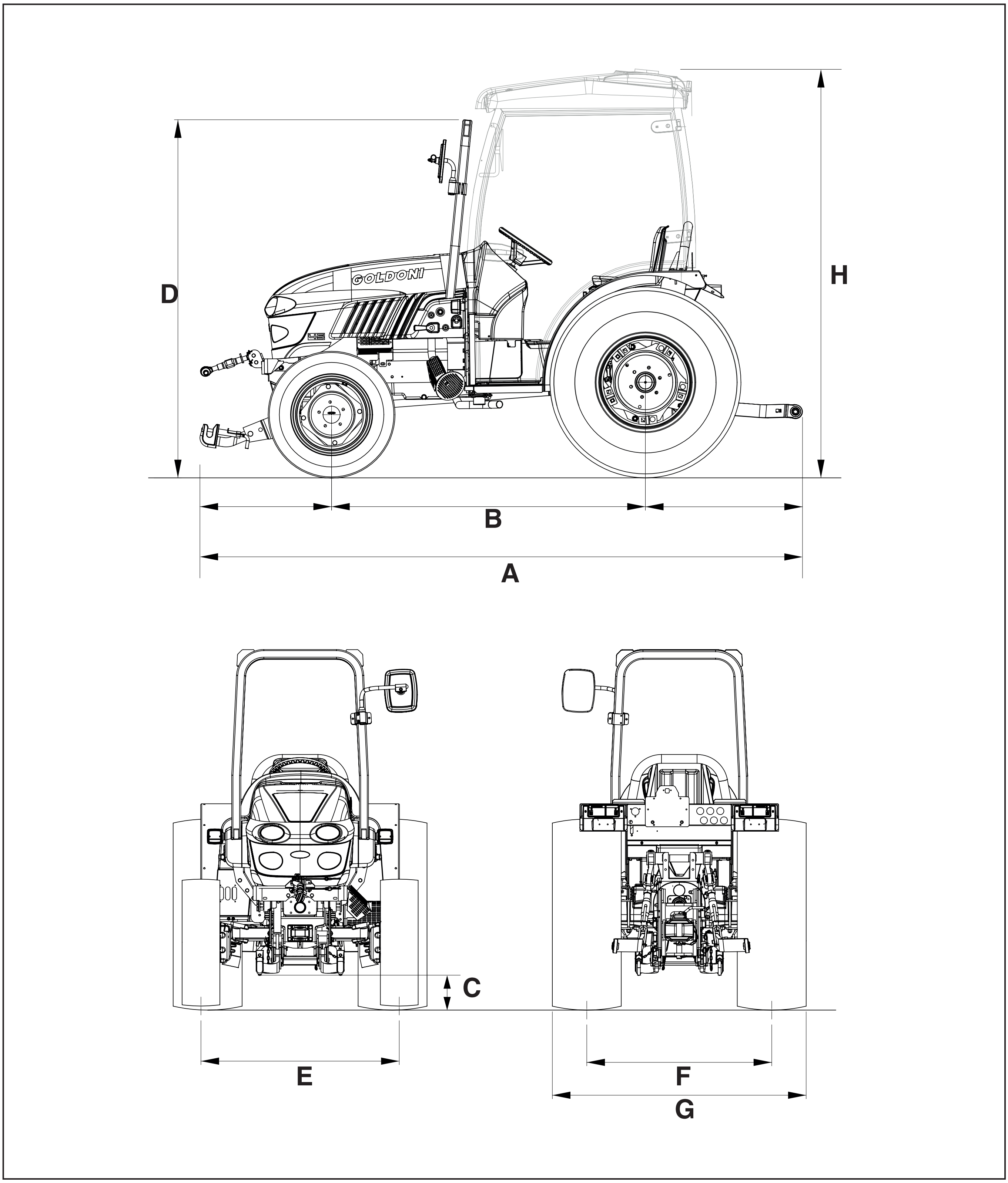

Fig. 1.10

Values given are for tractor with 320/70-R24" rear tyres and 280/70-R20" front tyres

Reference	Description	Ronin 40	Ronin 50
A	Length (min. / max.)	2849 mm	2949 mm
G	Width (min. / max.)	1309-1500 mm	1309-1500 mm
G	Min. width, "V" version	1090 mm	1090 mm
D	Height at frame (min. / max.)	1885-1940 mm	1885-1940 mm
H	Height at cab (min. / max.)	2090-2180 mm	2090-2180 mm
C	Ground clearance (min. / max.)	300-316 mm	300-316 mm
B	Wheelbase	1623 mm	1723 mm
E	Front track width (min. / max.)	964-1154 mm	964-1154 mm
F	Rear track width (min. / max.)	980-1134 mm	980-1134 mm
-	Minimum turning radius with brakes	3.1 m	3.2 m
-	Weight with ROPS	1440 kg	1475 kg
-	Weight with cab	1610 kg	1645 kg

4.11.1 Available tyres

Rear—Front

Ronin	40	50
Rear — Front	280/85R20 — 200/70R16	280/85R20 — 200/70R16
	360/70R20 — 11.0/65x12"	360/70R20 — 11.0/65x12"
	38/14.00x20 — 27/8.50x15 (Garden)	38/14.00x20 — 27/8.50x15 (Garden)
	320/70R24 — 240/70R16	320/70R24 — 240/70R16
	8.3-24 — 200/70R16	8.3-24 — 200/70R16

4.11.2 Maximum axle load

For information on maximum permissible axle loads, see the **certificates of conformity** accompanying the machine.

	Load capacity	**Maximum axle load (Kg)**	**Total mass**
Tyres	**Kg**	**Rear** **Front**	**Kg**
280/85R20 200/70R16	1120 670	1650 1100	2500
360/70R20 11.0/65x12"	1360 670	1650 1100	2500
38/14.00x20 27/8.50x15	1850 1170	1650 1100	2500
320/70R24 240/70R16	1400 660	1650 1100	2500

⚠ Attention
Values may be subject to modification. Always refer only to the maximum permissible load values specified on type approval plate and in registration documents.

4.12 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

4.13 Speed

Speed values are for an engine speed of 2800 rpm and with tractor fitted with 360/70-R20" tyres (values are indicative only).

Gear	Forward	Reverse, Reverse Shuttle
1st speed, slow range	0.78 Km/h	0.78 Km/h
2nd speed, slow range	1.14 Km/h	1.15 Km/h
3rd speed, slow range	1.61 Km/h	1.61 Km/h
4th speed, slow range	2.13 Km/h	2.14 Km/h
1st speed, normal range	3.12 Km/h	3.13 Km/h
2nd speed, normal range	4.57 Km/h	4.59 Km/h
3rd speed, normal range	6.43 Km/h	6.45 Km/h
4th speed, normal range	8.54 Km/h	8.56 Km/h
1st speed, fast range	10.66 Km/h	10.70 Km/h
2nd speed, fast range	15.64 Km/h	15.69 Km/h
3rd speed, fast range	21.98 Km/h	22.05 Km/h
4th speed, fast range	29.18 Km/h	29.28 Km/h

Gear	Reverse, Fast Reverse (4WD)
First speed	4.13 Km/h
Second speed	6.05 Km/h
Third speed	8.51 Km/h
Fourth speed	11.30 Km/h

4.14 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

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.
Thread sealant	Hydraulic and pneumatic	Loctite 542	For sealing threaded connectors 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.
Cleaning	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

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.

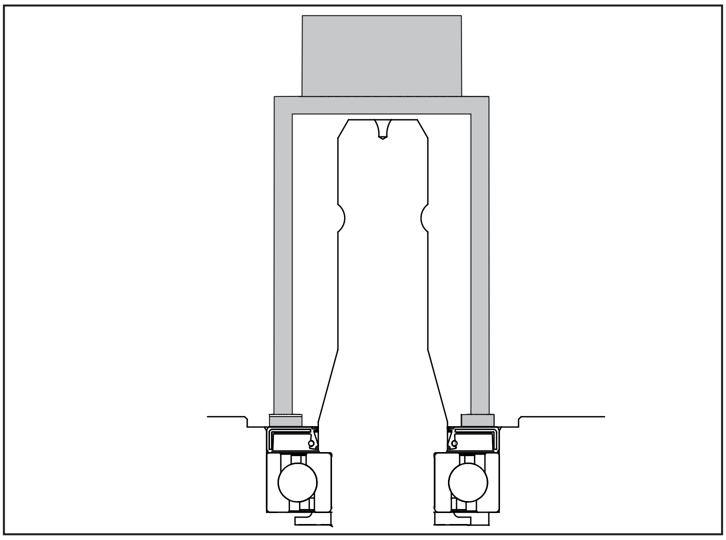

Fig. 1.11

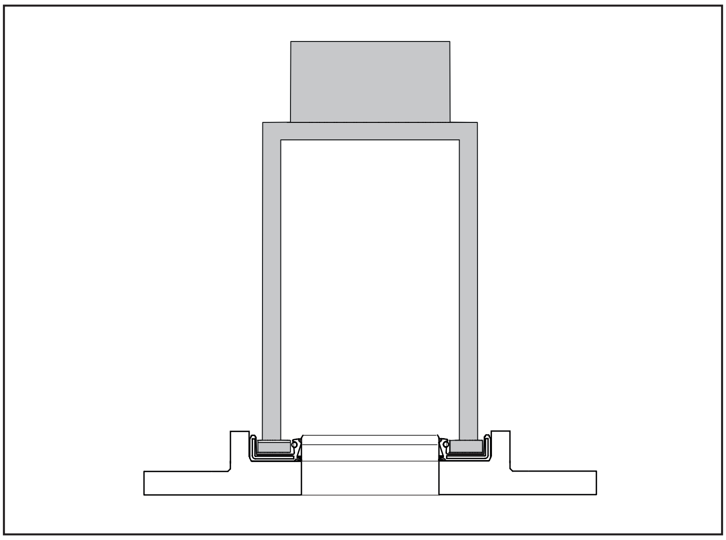

Fig. 1.12

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.

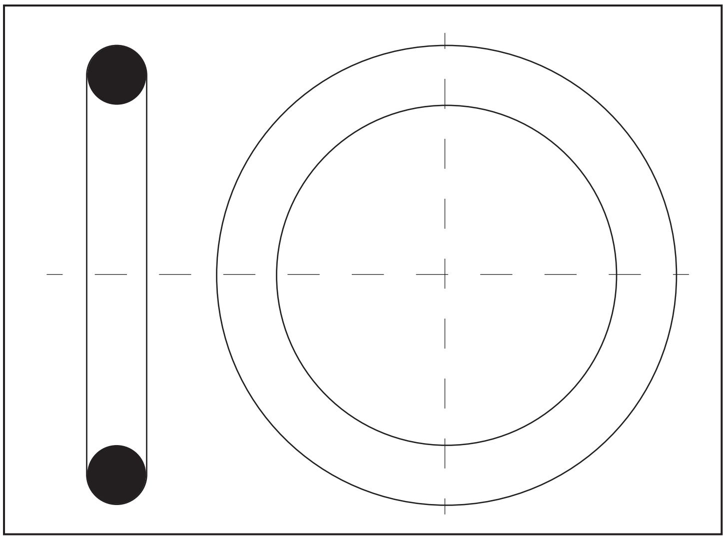

Fig. 1.13

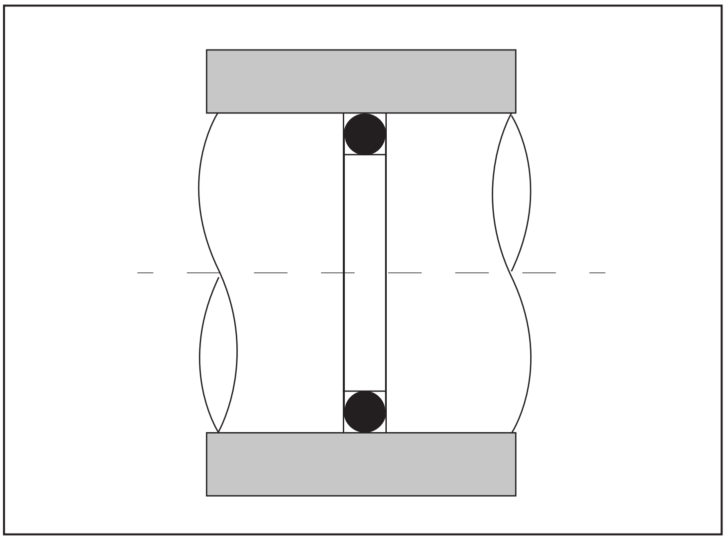

Fig. 1.14

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 implements 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. 1.16) 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. 1.17). 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.

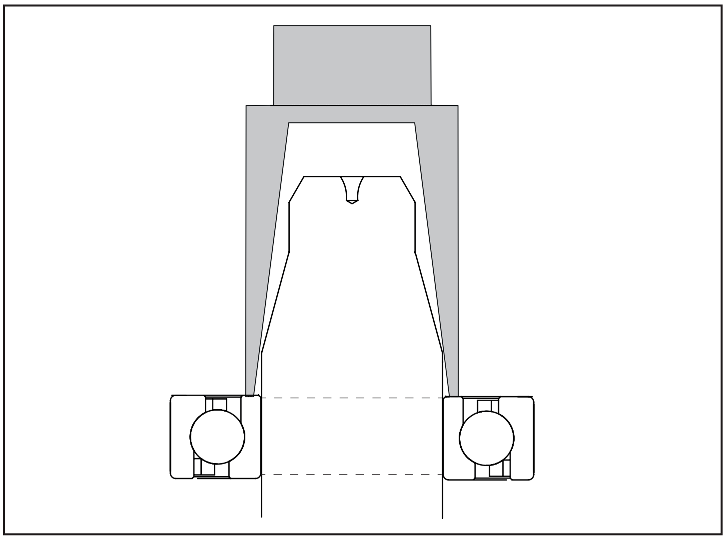

Fig. 1.15

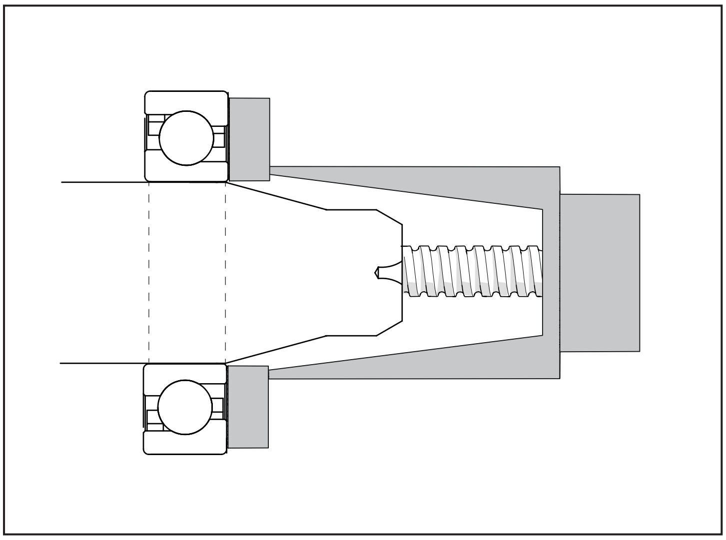

Fig. 1.16

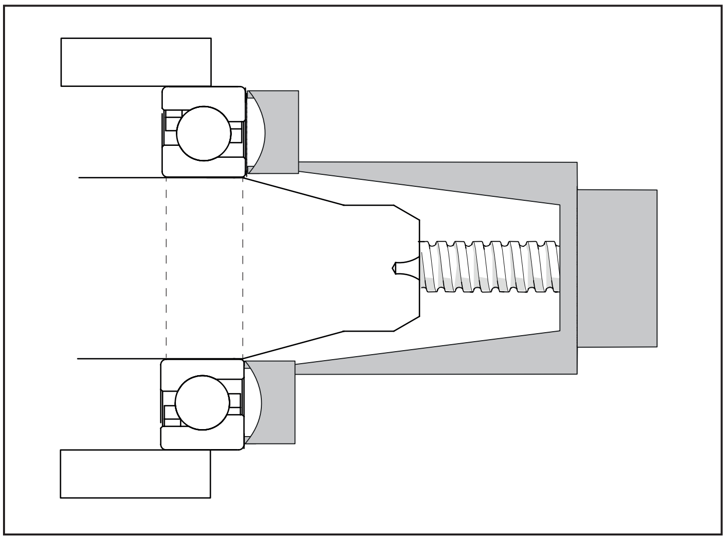

Fig. 1.17

- 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.

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.

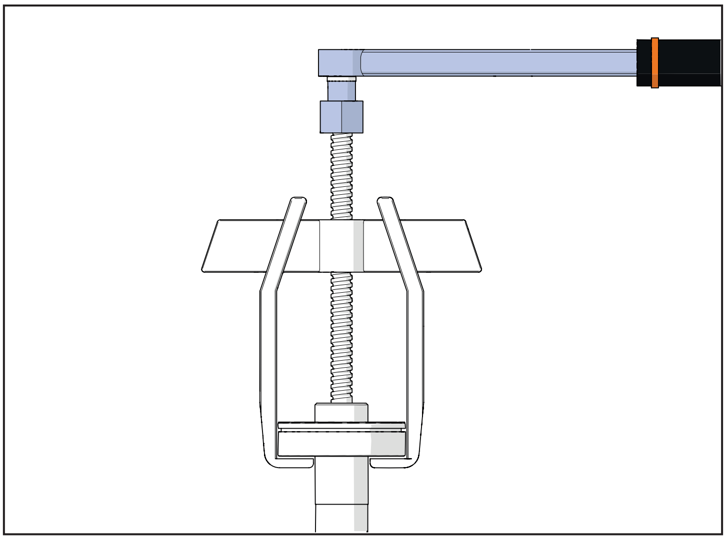

Fig. 1.18

Chapter 2 : Engine

Index

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

	RONIN 40	RONIN 50
Brand	Lombardini	Lombardini
Model	LDW 1603	LDW 2204
Fuel system	Direct diesel injection	Direct diesel injection
Bore	88 mm	88 mm
Stroke	90.4 mm	90.4 mm
Fuel system	Direct diesel injection	Direct diesel injection
Power N*	30.0 KW	38.0 KW
Power NB**	27.6 KW	34.5 KW
Power NA***	25.4 KW	32.0 KW
Emissions compliance	STEP 3A	STEP 3A
Number of cylinders	3	4
Intake	Naturally aspirated	Naturally aspirated
Rated speed	2800 rpm	2800 rpm
rpm	3000	3000
Cooling	Liquid	Liquid
Displacement	1649 cm3	2199 cm3
Specific fuel consumption (at max. torque engine speed)	250 g/KWh	260 g/KWh
Maximum torque	113Nm @ 1600 rpm	144Nm @ 2200 rpm
Torque rise	8.2 %	7.4 %
Tank capacity	45 litres	45 litres
Dry weight	156 kg	192 kg
Engine bonnet	GRP (glass reinforced plastic)	GRP (glass reinforced plastic)

* - (80/1269/EEC - ISO 1585 - DIN 70020) AUTOMOTIVE RATING: Intermittent operation with variable speed and variable load.

** - (ISO 3046 - 1 IFN - DIN 6270) RATING WITH NO OVERLOAD CAPABILITY: Continuous light duty operation with constant speed and variable load.

*** - (ISO 3046 - 1 ICXN - DIN 6270) CONTINUOUS RATING WITH OVERLOAD CAPABILITY: Continuous heavy duty with constant speed and constant load.

Section 3 : Removing and refitting the engine

Index

3.1 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.

Bonnet, roll bar hoop and roll bar mount covers.

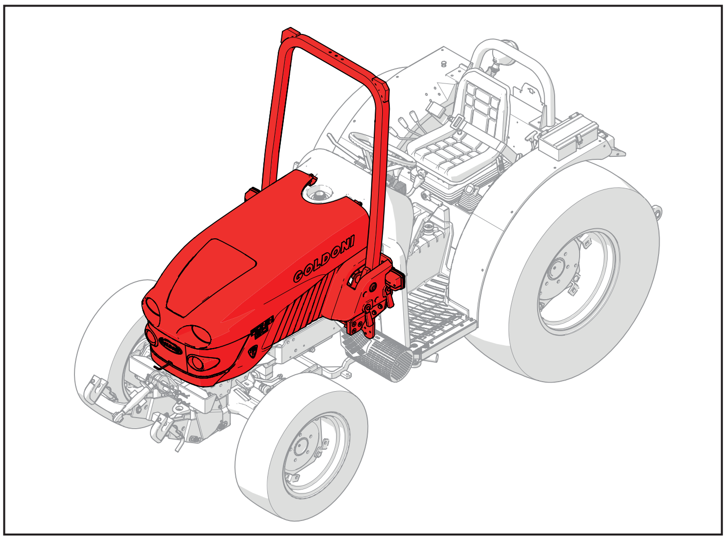

Fig. 2.1

Filter and radiator with fan.

Note
Drain the radiator before removal.

Remove the engine drive belts.

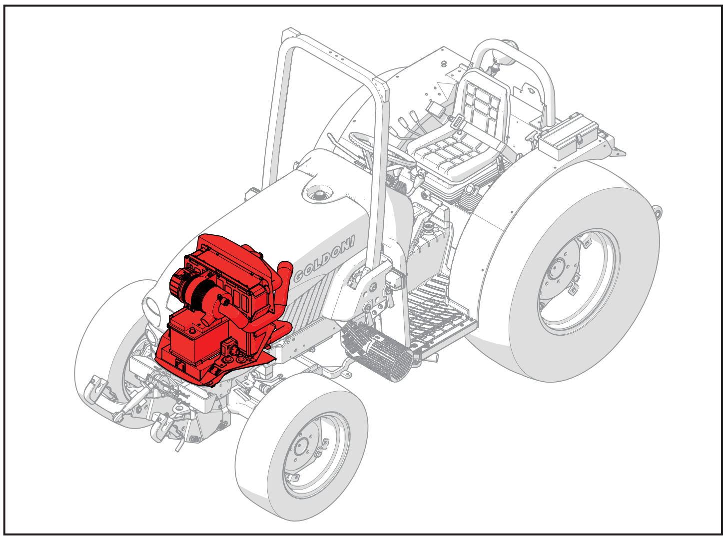

Fig. 2.2

Seat.

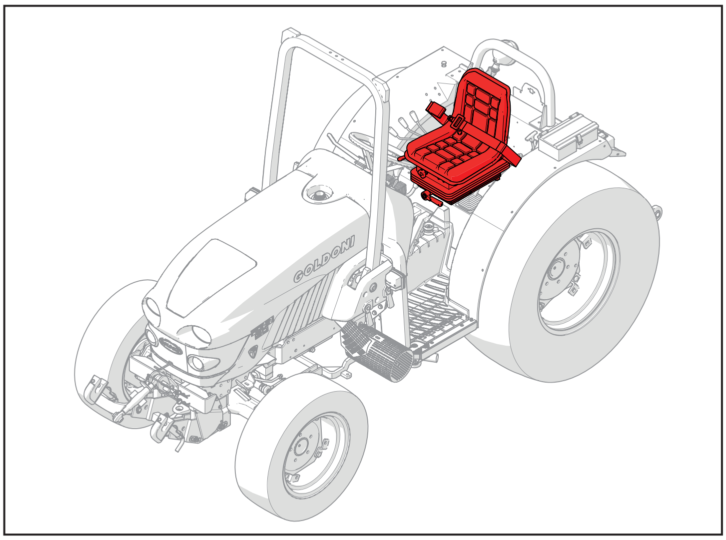

Fig. 2.3

Footboard.

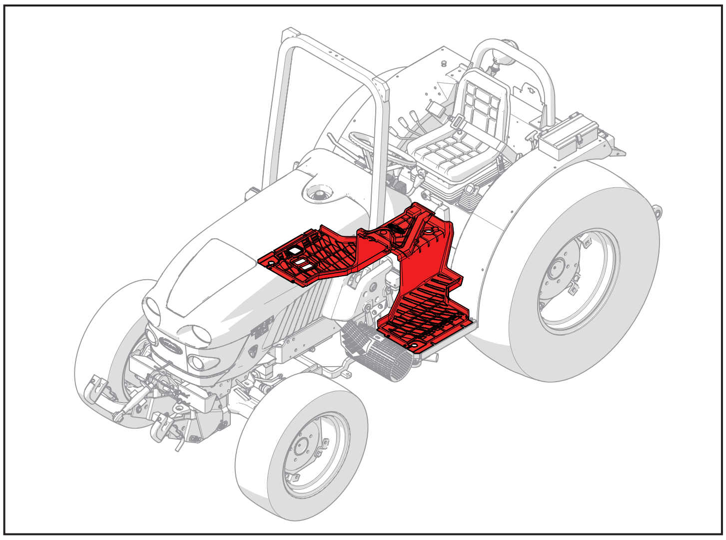

Fig. 2.4

Platform (see chapter "Platform").

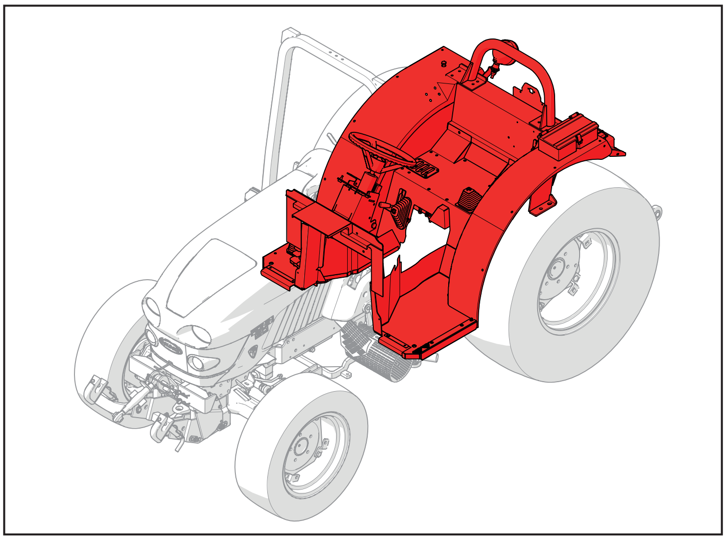

Fig. 2.5

4WD shaft.

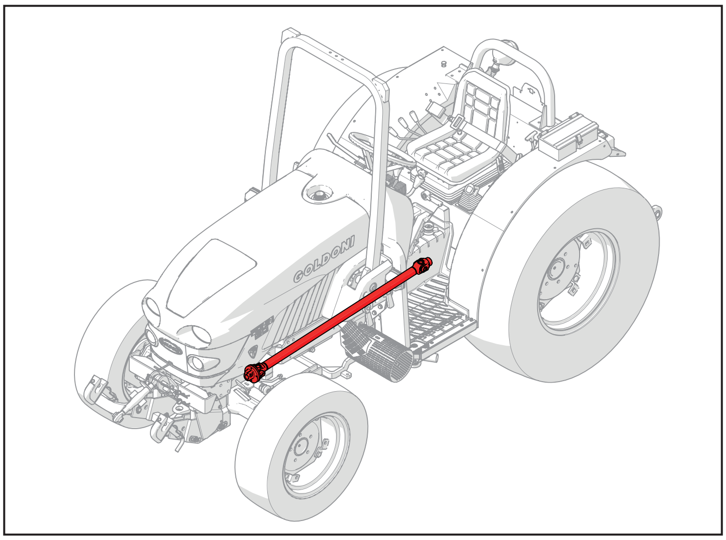

Fig. 2.6

3.2 Removal

Remove the bumper mount (1).

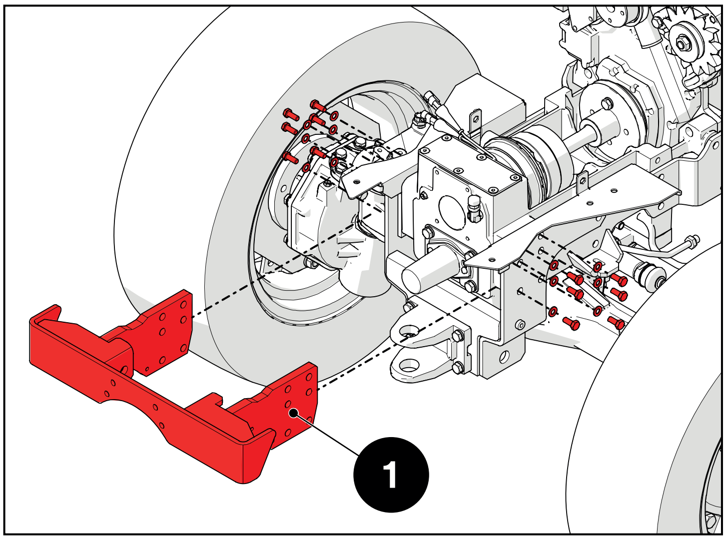

Fig. 2.7

Remove the towing hitch carrier (2) and the radiator mounts (3) and (4).

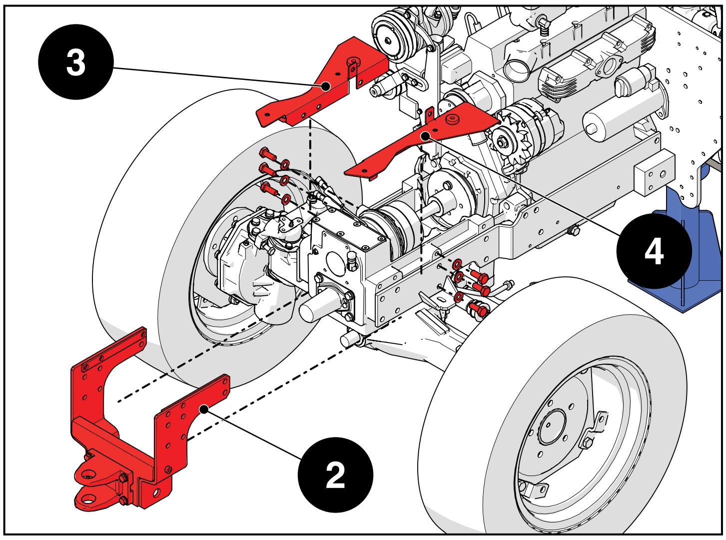

Fig. 2.8

Secure the engine safely with a hoist of adequate lifting capacity.

Danger
Check that the hoist used is in perfect working order and is of adequate lifting capacity for the load.

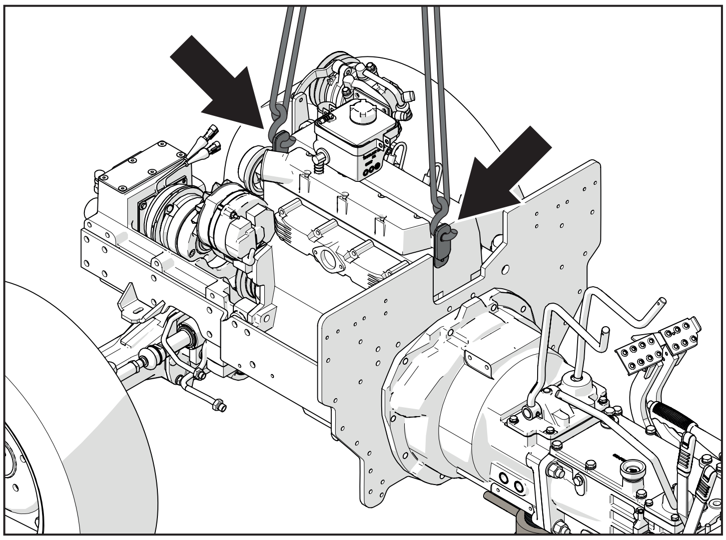

Fig. 2.9

Secure the axle carrier casing (5) safely by placing a stand of adequate load capacity under the front PTO shaft.

Note
Use a trolley stand.

Danger
Check that the hoist used is in perfect working order and is of adequate lifting capacity for the load.

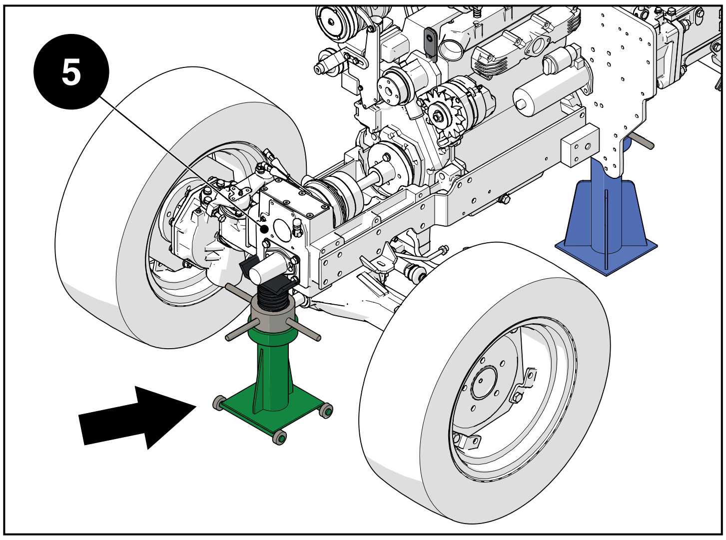

Fig. 2.10

Remove the axle carrier brackets (6) and (7).

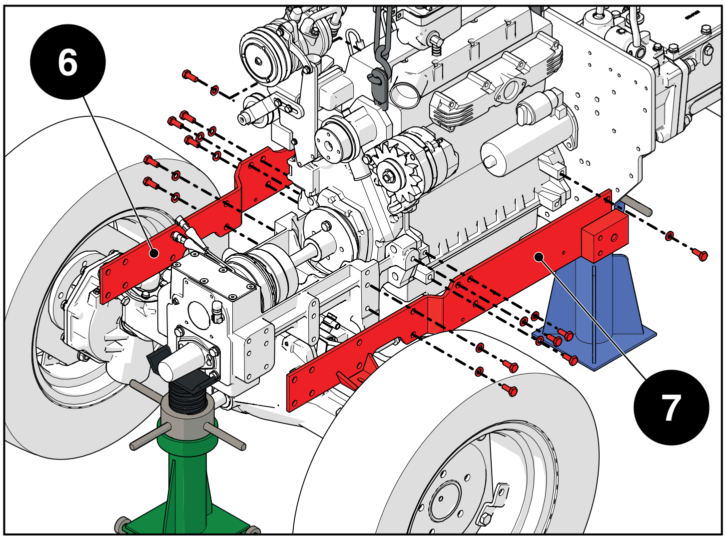

Fig. 2.11

Undo the nuts (8) with the conical washers (9), and separate the carrier casing (5), complete with axle, from the engine.

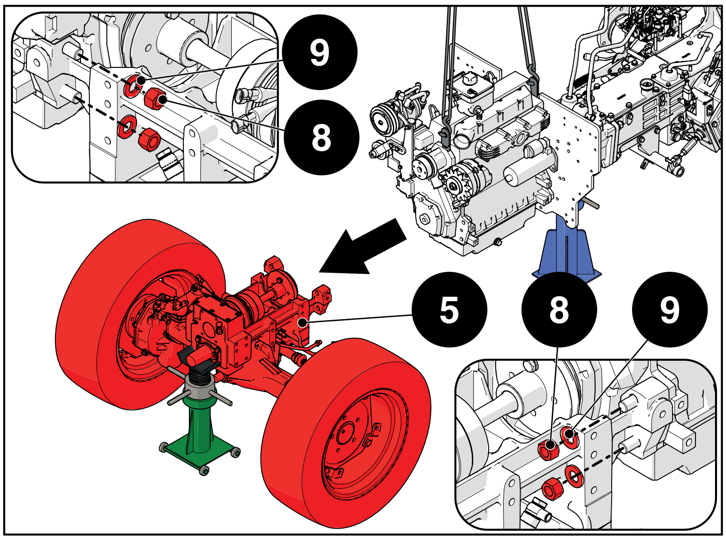

Fig. 2.12

Undo the screws (10) fastening the clutch housing to the engine, removing the washers (11).

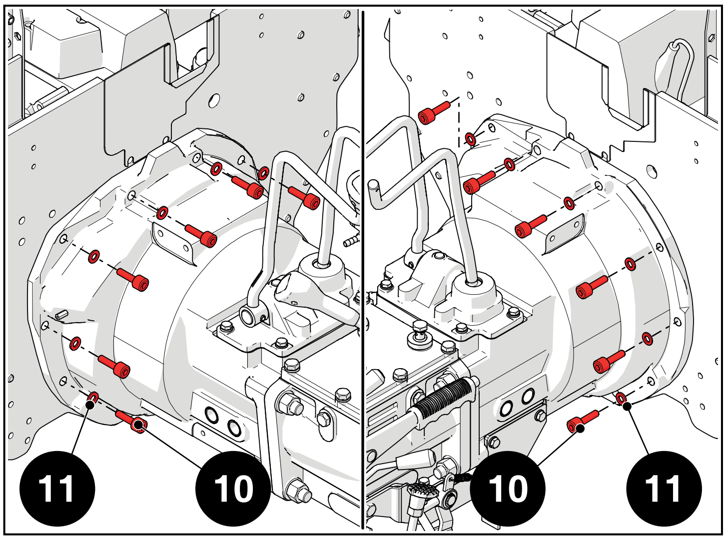

Fig. 2.13

Separate the assemblies.

Warning
Check that all wiring looms have been disconnected, all connectors have been loosened and disconnected and all other impediments have been removed before separating the assemblies.

Note
Silicone sealant is applied between the assemblies.

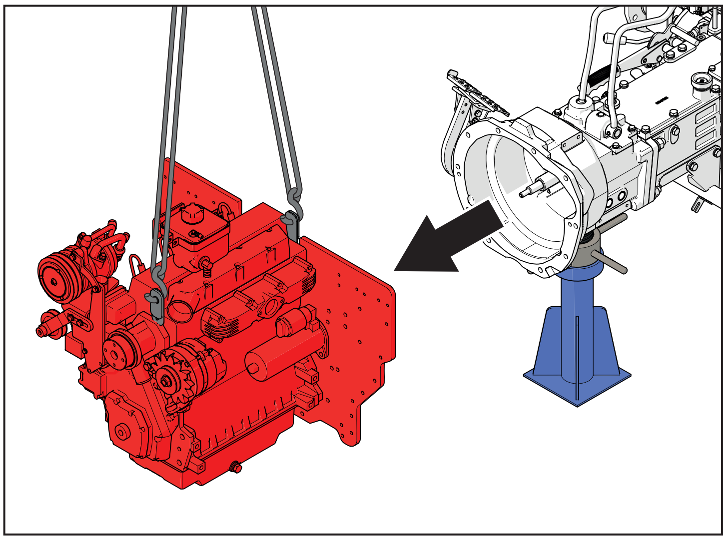

Fig. 2.14

Fit the tool (A-07007171) and secure the clutch assembly safely with a hoist.

Undo and remove the screws fastening the clutch (12), together with the washers (13).

Remove the complete clutch assembly.

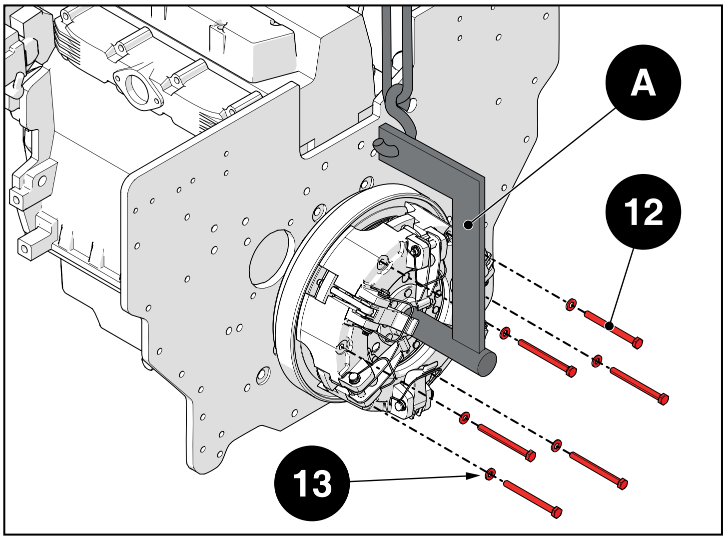

Fig. 2.15

3.3 Refitting

Danger
All other persons must keep 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.

Warning
Check that the fan turns freely.

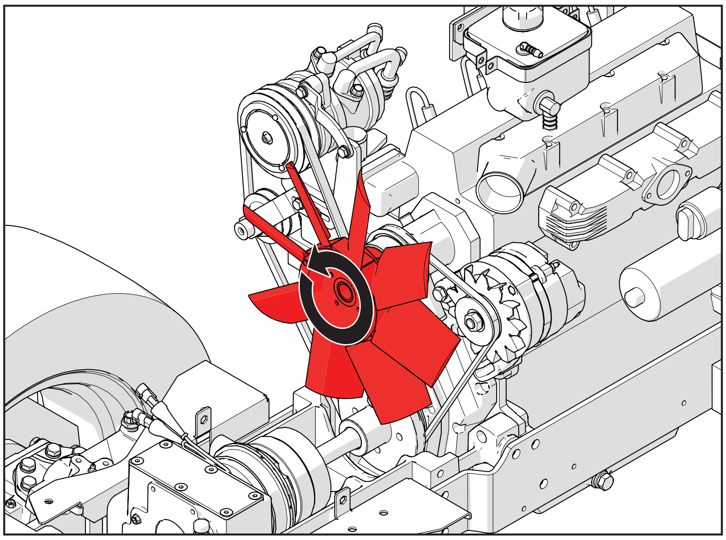

Fig. 2.16

Section 4 : Tightening torques

Index

4.1 Tightening torques

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

Tightening torque	Nm	Kgm
Axle carrier casing - engine fastener screw	180	18
Clutch assembly - engine flywheel fastener screw	35	3.5
Engine - clutch housing fastener screw	80	8

Section 5 : Implements necessary

Index

5.1 Implements necessary

p/n	Description	Quantity
07007171	Clutch plate alignment pin	1

Chapter 3 : Clutch housing

Index

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

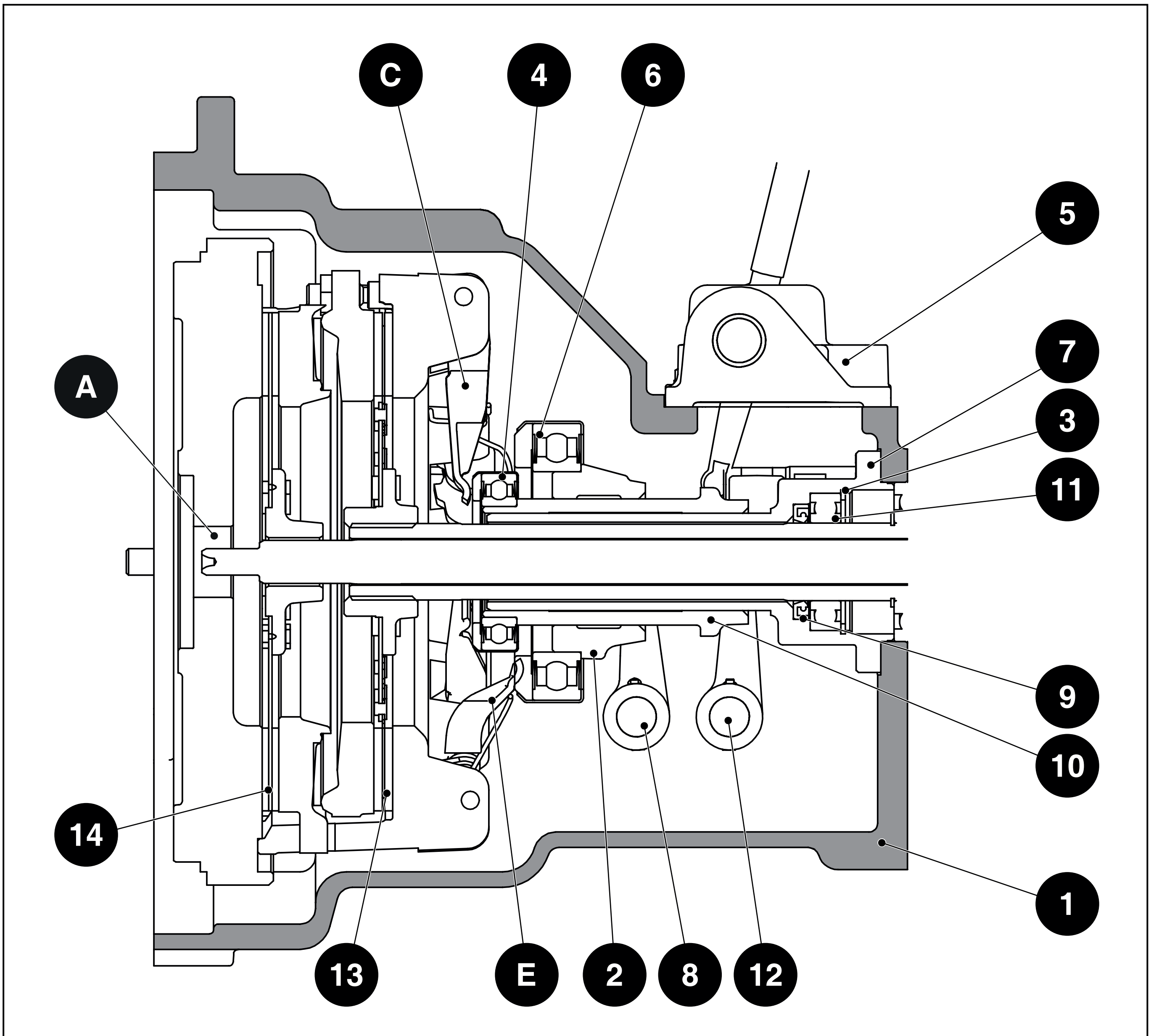

Fig. 3.1

1 - Clutch housing
2 - PTO clutch sleeve
3 - Circlip
4 - Thrust bearing
5 - Cover
6 - Thrust bearing
7 - Sleeve guide cover
8 - PTO clutch control lever
9 - Oil seal
10 - Transmission clutch sleeve
11 - Bearing
13 - Transmission clutch plate
14 - PTO clutch plate
A - PTO shaft guide bearing
C - Transmission clutch lever
E - PTO clutch lever

Section 3 : Technical characteristics

Index

3.1 Technical characteristics

Clutch Type

Transmission	Single plate dry clutch, 9" diameter
Power Take Off	Independent, mechanical dry clutch

Clutch control

Transmission	Mechanical with pedal
Power Take Off	Mechanical with lever

Section 4 : Disassembly

Index

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.

Bonnet, roll-bar hoop and RH and LH fibreglass covers

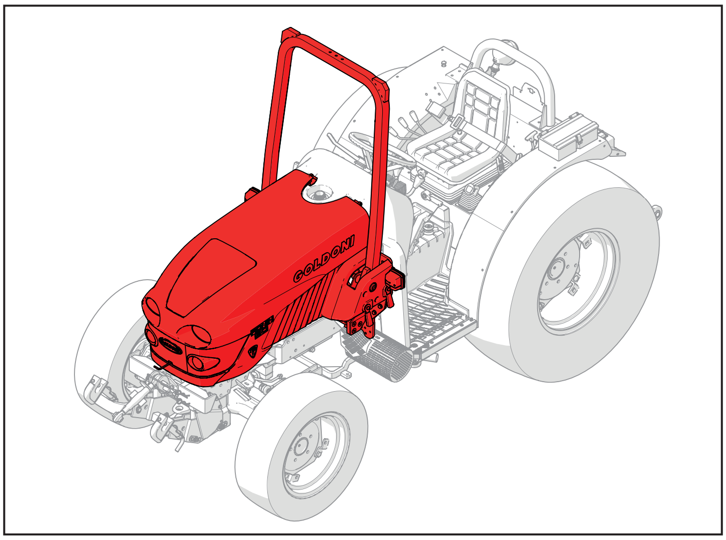

Fig. 3.2

Seat

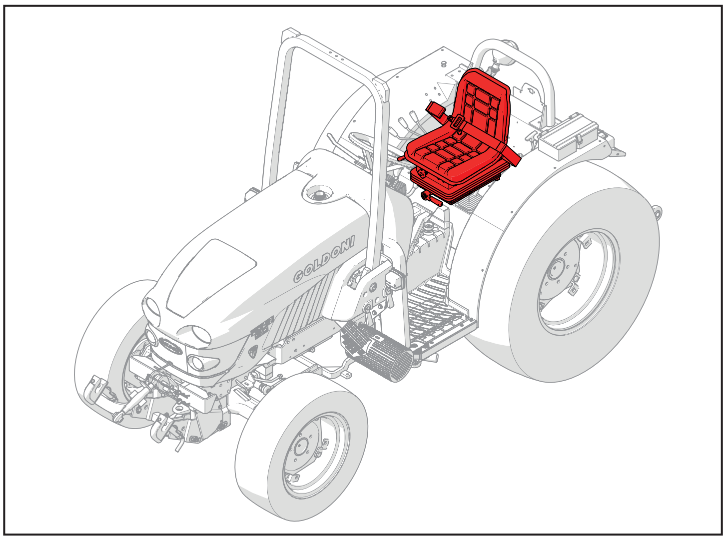

Fig. 3.3

Footboard

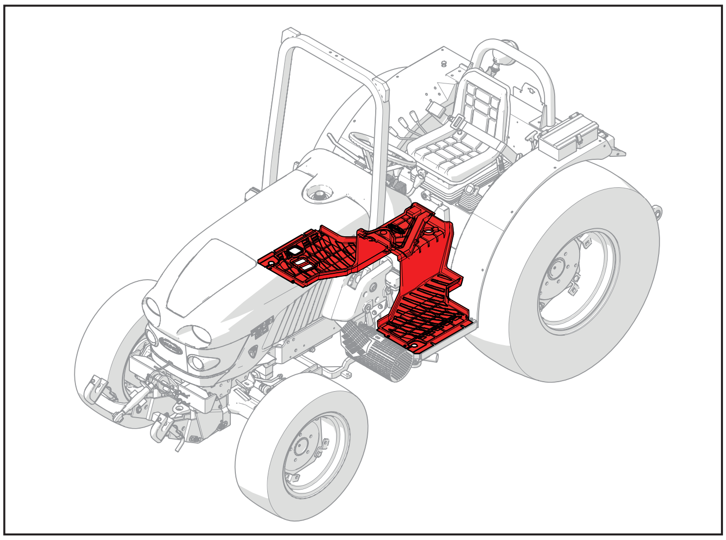

Fig. 3.4

Platform

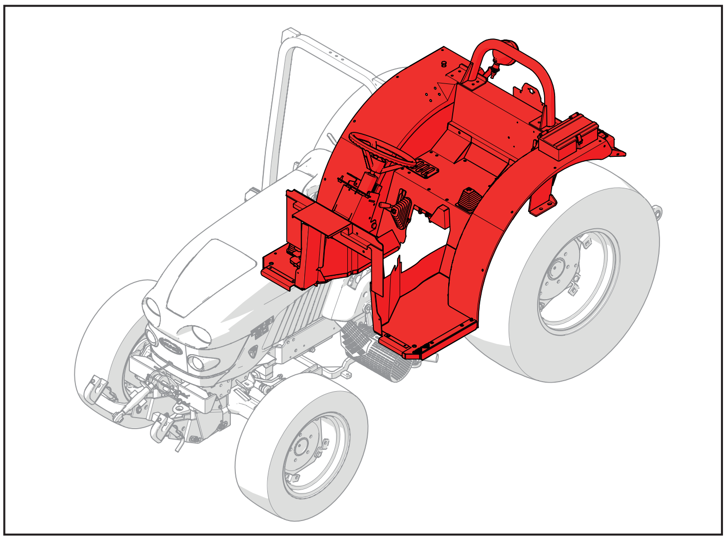

Fig. 3.5

4WD shaft

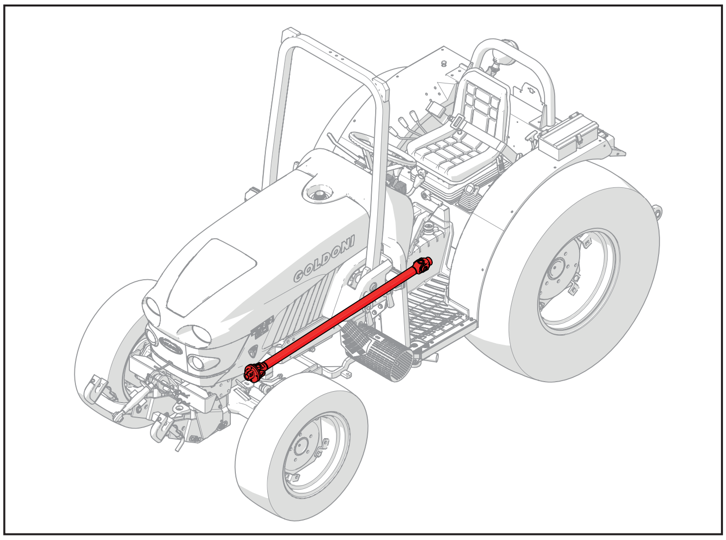

Fig. 3.6

4.2 Removing the Clutch

Undo the nut.

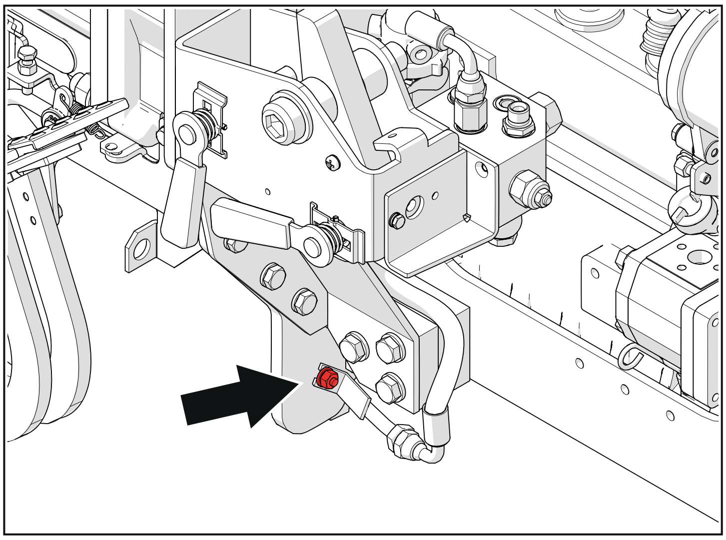

Fig. 3.7

Undo the hydraulic connectors.

Note
Place a pan for collecting oil underneath.

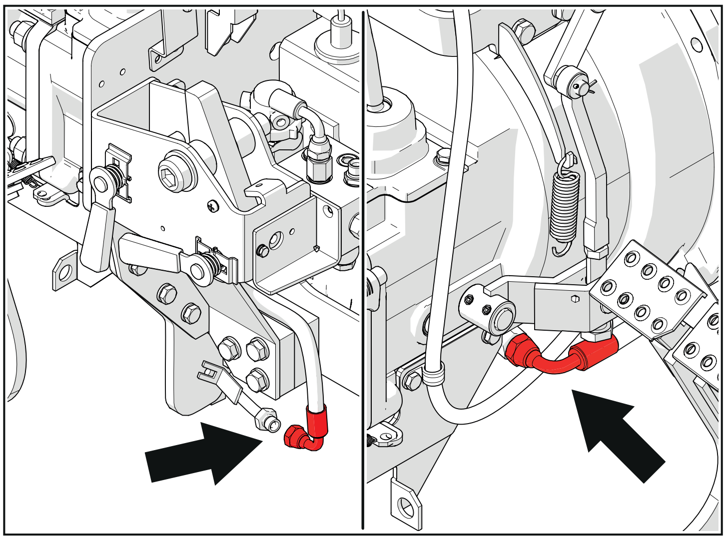

Fig. 3.8

Undo the hydraulic oil delivery line connectors for the steering cylinder and the clamp.

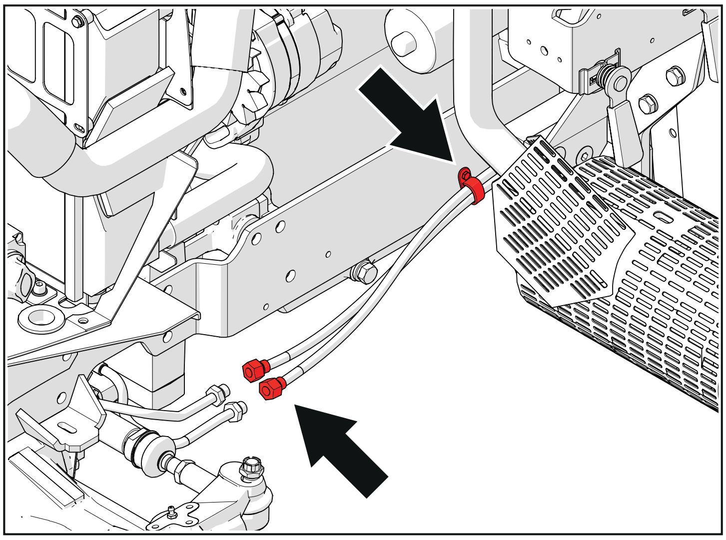

Fig. 3.9

Remove the pump suction pipe connector.

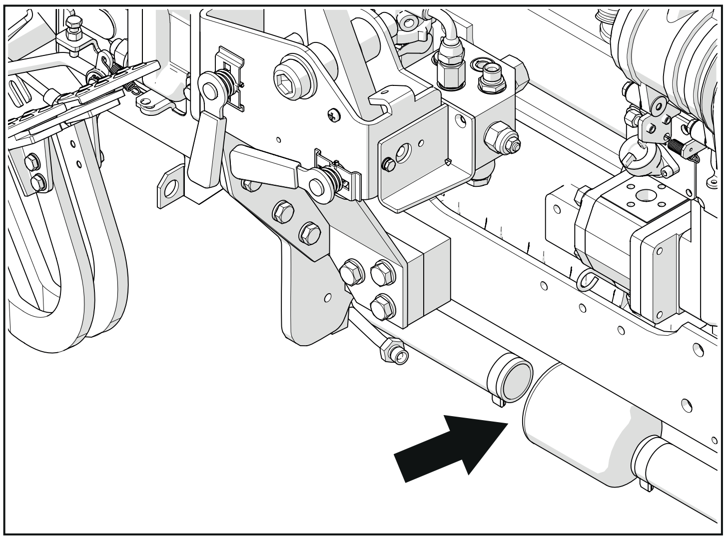

Fig. 3.10

Loosen the screw (14) of the PTO clutch control lever link rod.

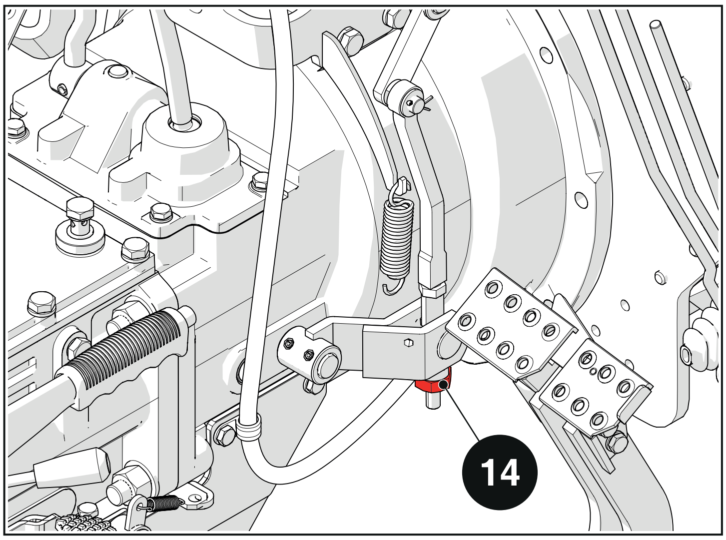

Fig. 3.11

Undo the screws and remove the protective plate.

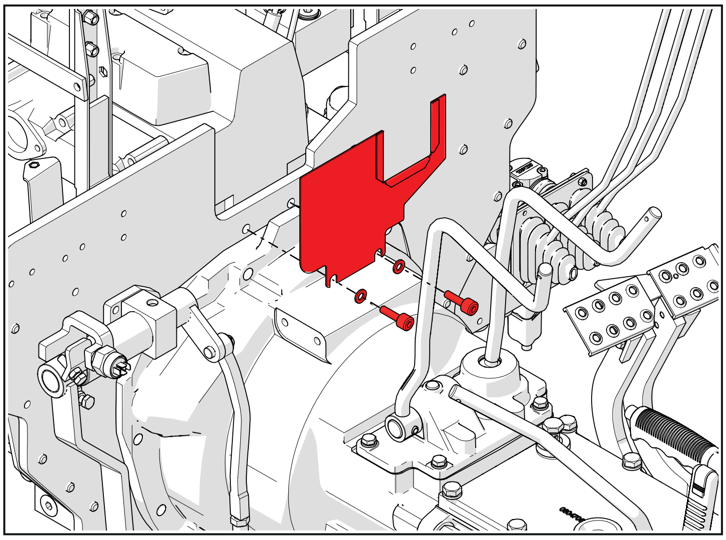

Fig. 3.12

Undo the clamp and undo the connector of the pipe on the hydraulic steering unit.

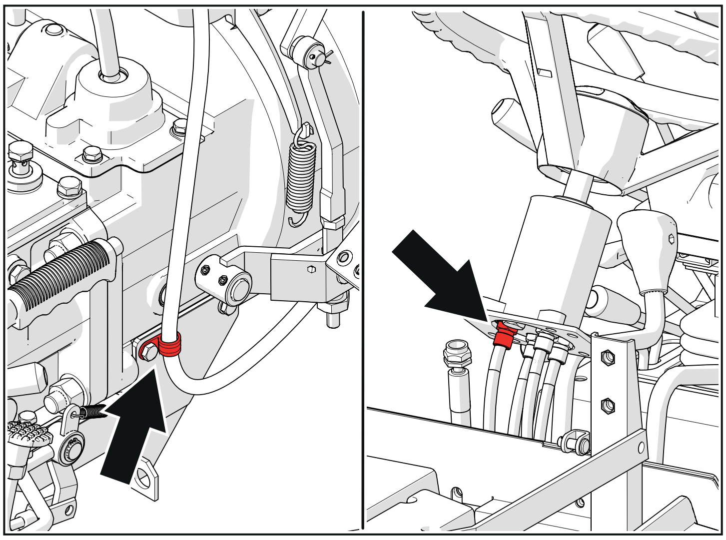

Fig. 3.13

Undo the screw (16) and remove the spring (17).

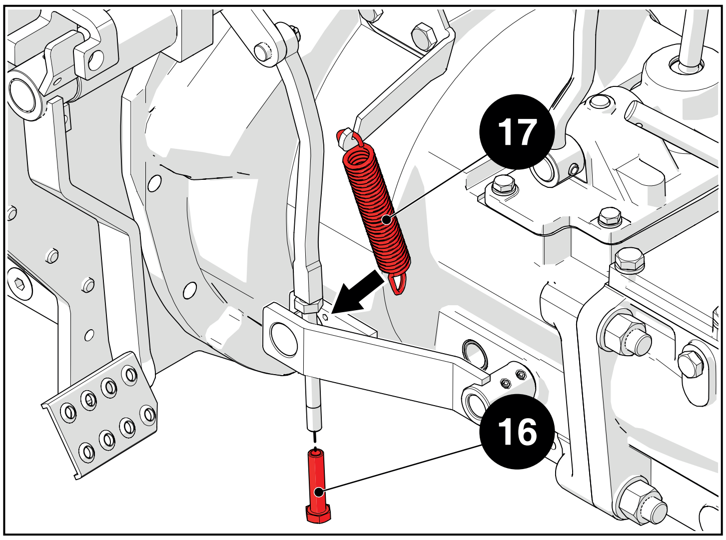

Fig. 3.14

Fasten the engine hoisting bracket to the threaded hole on the engine.

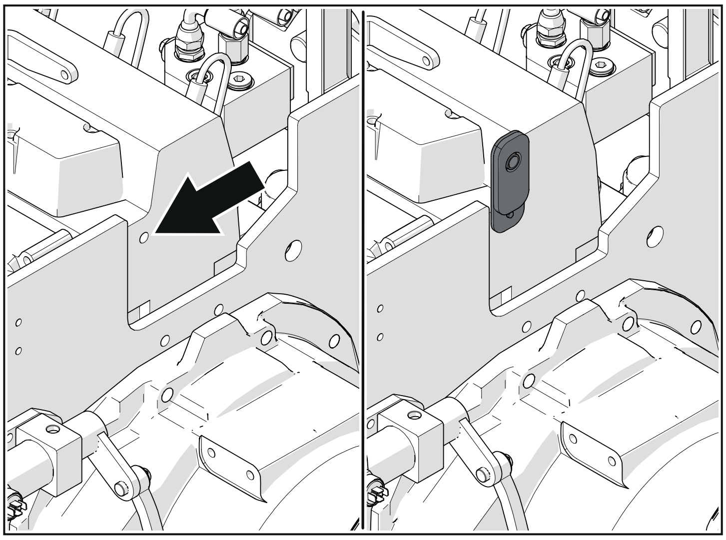

Fig. 3.15

Secure the engine safely with a hoist of adequate lifting capacity.

Danger
Check that the hoist used is in perfect working order and is of adequate lifting capacity for the load.

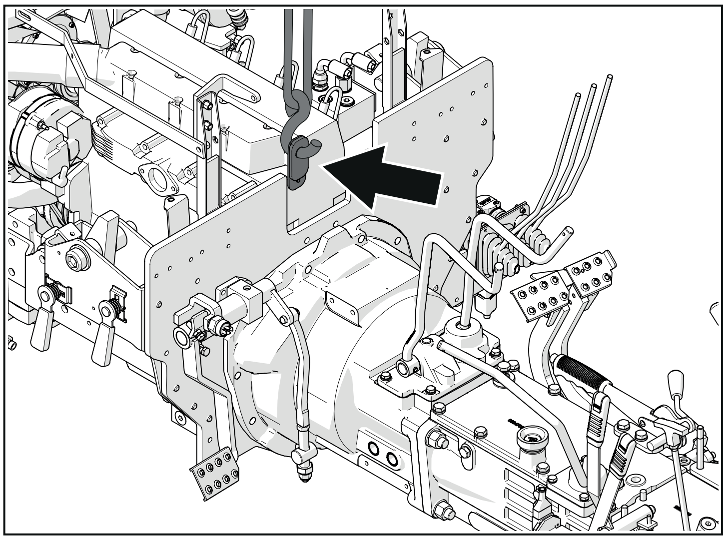

Fig. 3.16

Place support stands under the gearbox assembly.

Danger
The maximum load capacity of the stands must be adequate for the weight of the assembly. Make sure that the stands hold the assembly steadily and cannot move during maintenance work on the tractor.

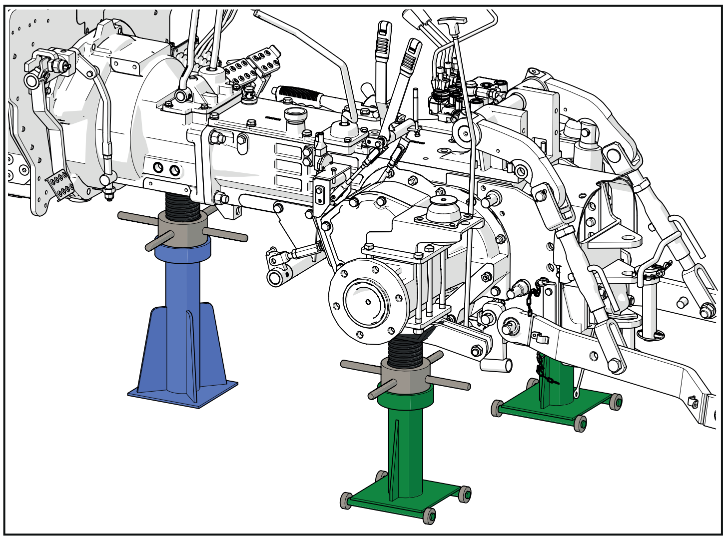

Fig. 3.17

Undo the screws (18) fastening the clutch housing to the engine, removing the washers (19).

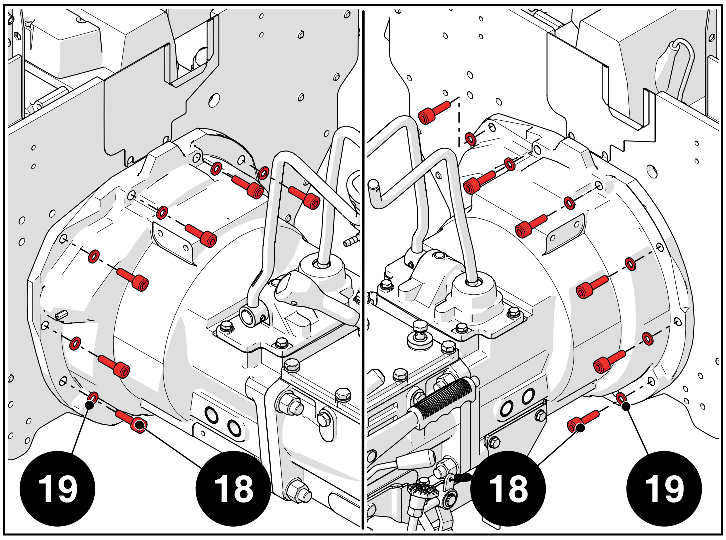

Fig. 3.18

Separate the assemblies.

Warning
Check that all wiring looms have been disconnected, all connectors have been loosened and disconnected and all other impediments have been removed before separating the assemblies.

Note
Silicone sealant is applied between the assemblies.

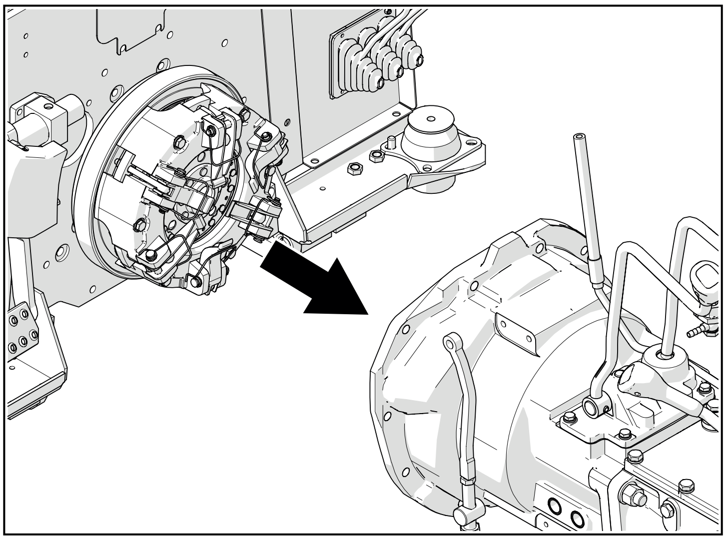

Fig. 3.19

Undo the screws (20) fastening the clutch to the engine, removing the washers (21).

Remove the clutch complete with PTO guide bearing (A).

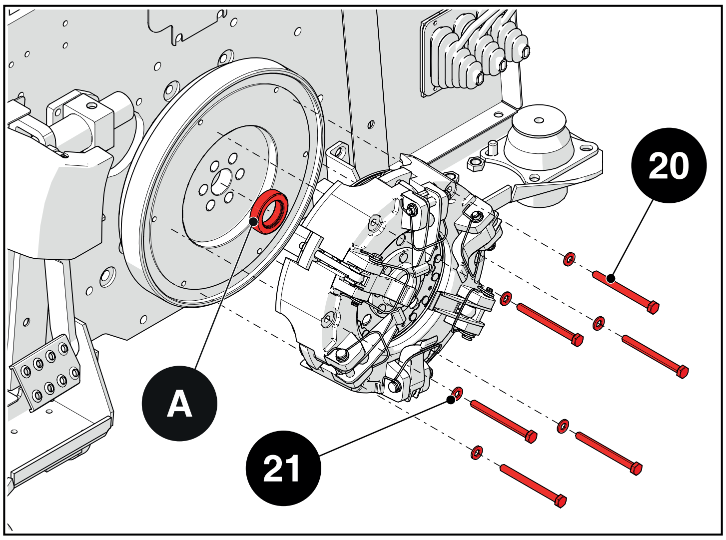

Fig. 3.20

Section 5 : Main inspection, reassembly and adjustment procedures

Index

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.

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

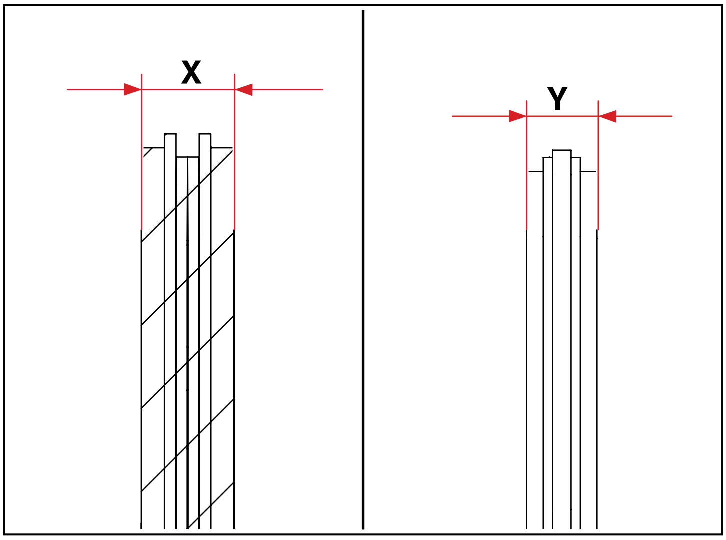

Fig. 3.21

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.

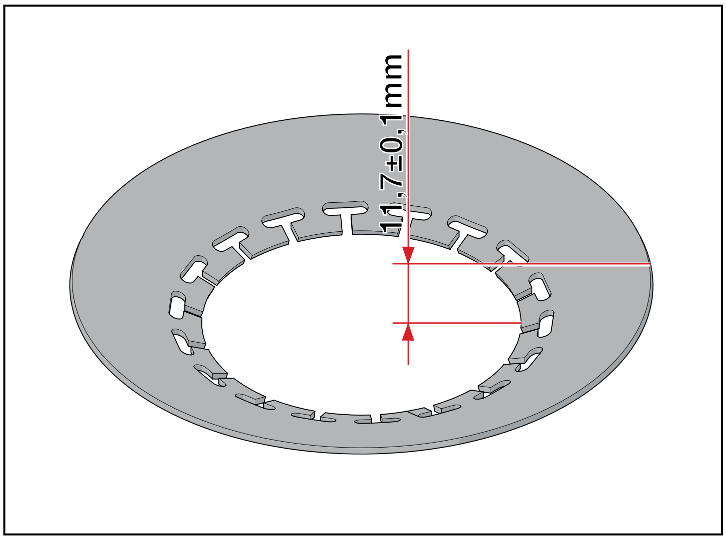

Fig. 3.22

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 set the transmission clutch correctly, adjust the levers (C) to obtain a measurement X of 37 mm.

Loosen the check nuts and tighten or loosen the nuts (D) as necessary to obtain a measurement X of 37 mm.

Tighten the check nuts after adjusting.

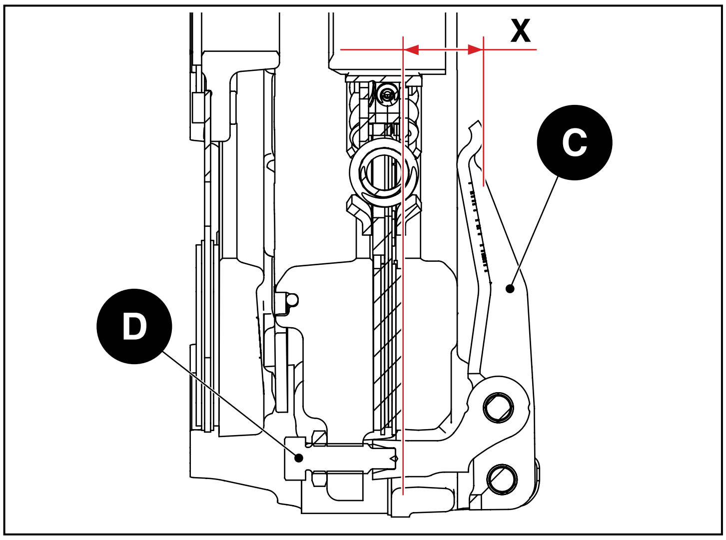

Fig. 3.23

To set the PTO correctly, adjust the levers (E) to obtain a measurement Y of 60 mm.

Tighten or loosen the nuts (F) as necessary to obtain a measurement Y of 60 mm.

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

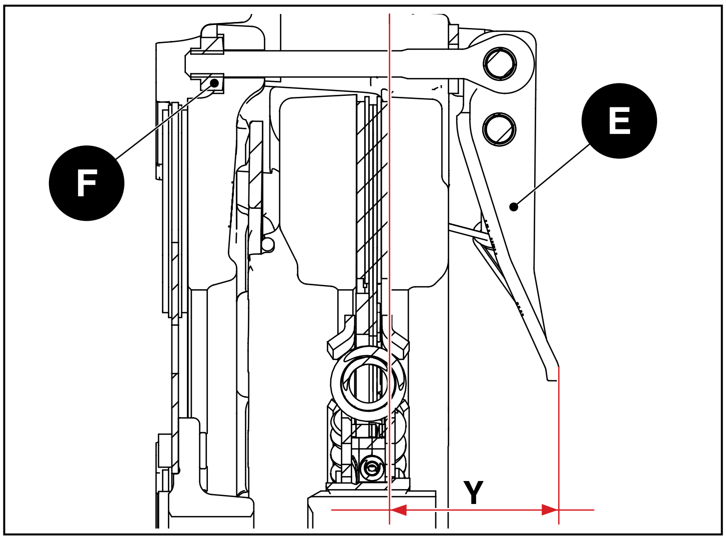

Fig. 3.24

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.

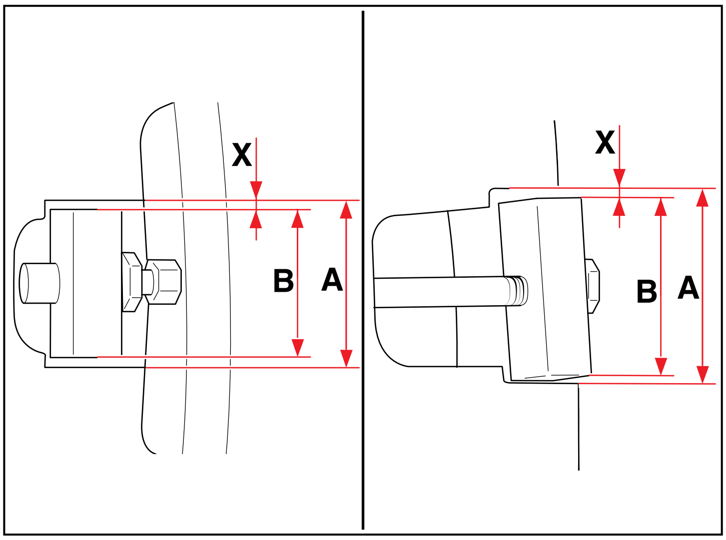

Fig. 3.25

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

Warning
Ensure that the PTO guide bearing (A) is in the correct position.

Fit the washers (21) and tighten the screws (20) fastening the clutch to the engine to a torque of 35 Nm (3.5 kgm).

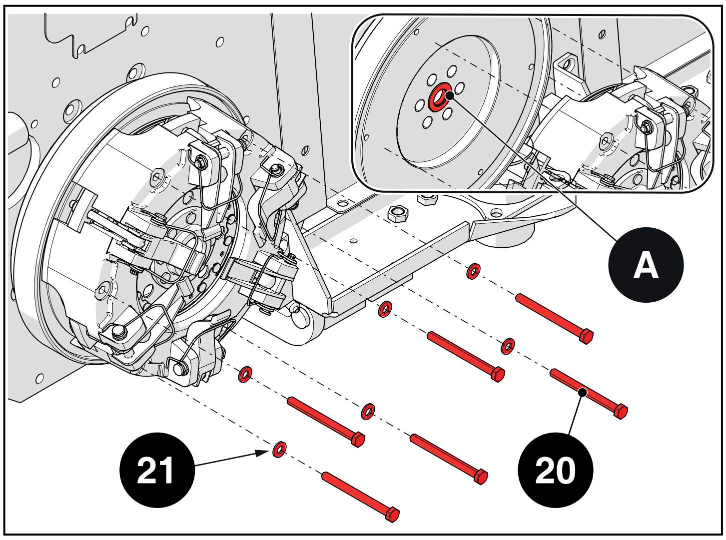

Fig. 3.26

Prefit the sleeve guide cover (7), installing the oil seal (9) and the bearing (11) with a bearing punch tool of suitable diameter.

Secure the assembly with the circlip (3).

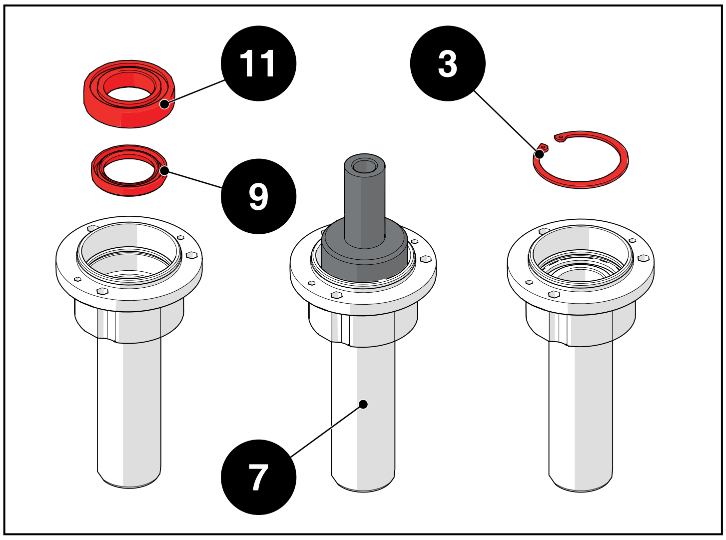

Fig. 3.27

Apply a layer of silicone sealant to the mating surface of the sleeve guide cover (7).

Apply a layer of silicone sealant on the mating surface of the clutch housing on the transmission.

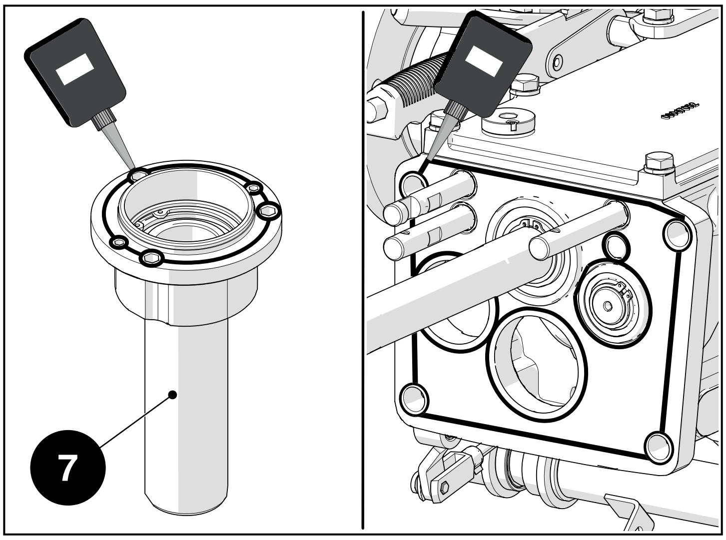

Fig. 3.28

Fit the clutch housing (1) and the sleeve guide cover (7), aligning correctly with the transmission.

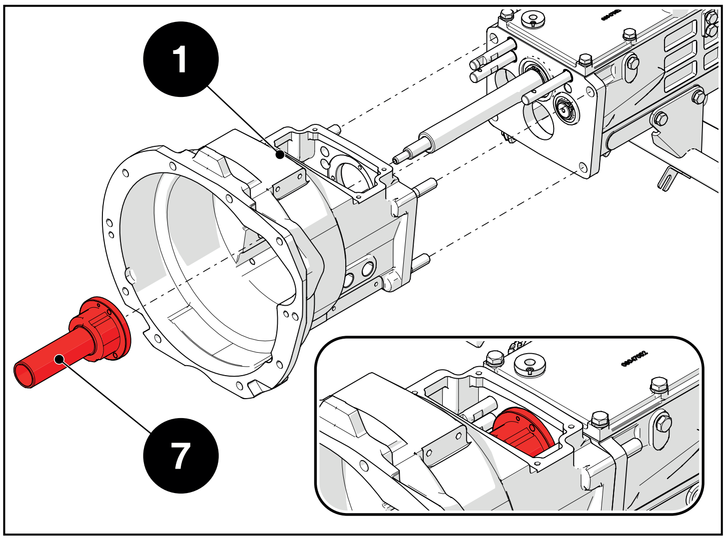

Fig. 3.29

Fit the conical washers (22) and tighten the nuts (23) fastening the clutch housing to a torque of 100 Nm (10 kgm).

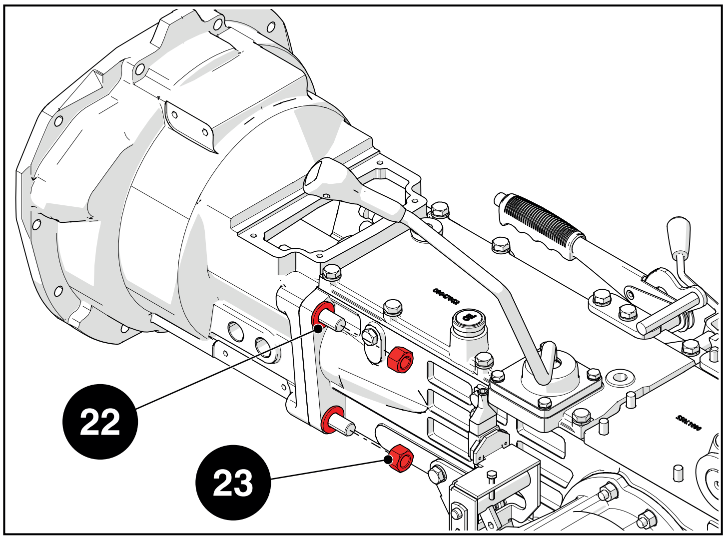

Fig. 3.30

Fit the washers (24) and tighten the screws (25) fastening the cover.

Warning
Apply a coating of Teflon to the threads of the screws.

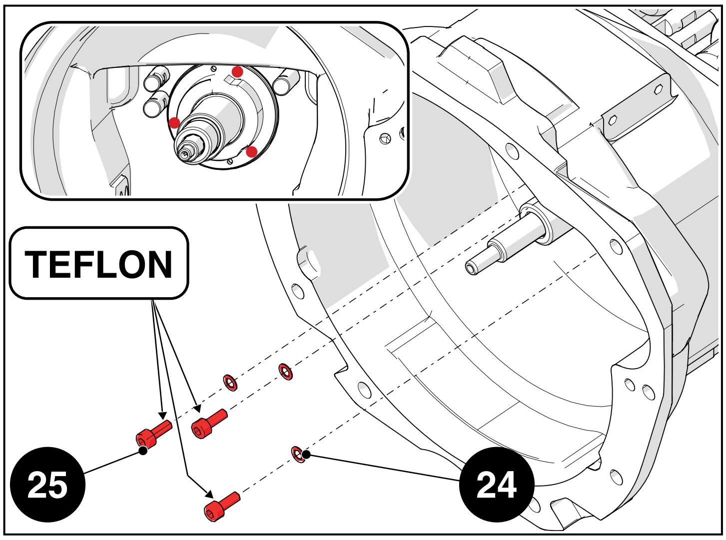

Fig. 3.31

Fit the sleeve (26) and secure in place with the pin (27).

Fit the pin (28), which will act as a guide for the upper rod.

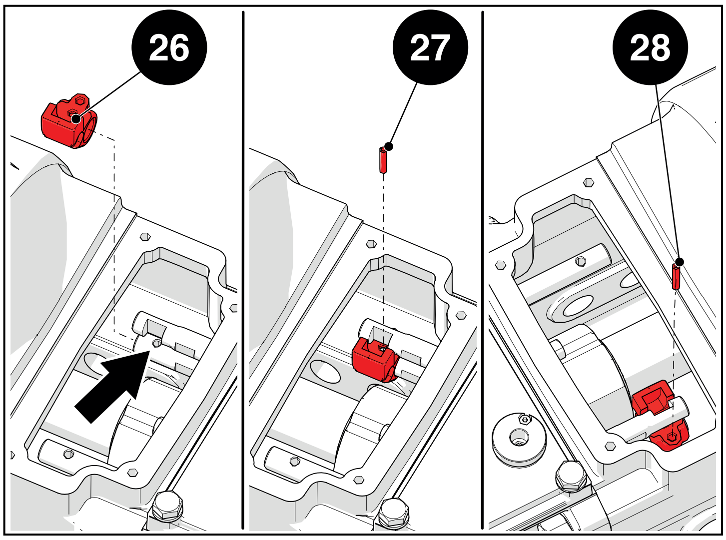

Fig. 3.32

Preassemble the transmission clutch sleeve (10) with the PTO clutch sleeve (2) and the thrust bearings (6) and (4).

Warning
Grease the sleeves so that slide more easily into place.

Warning
The PTO clutch sleeve must be fitted with the round part facing downwards.

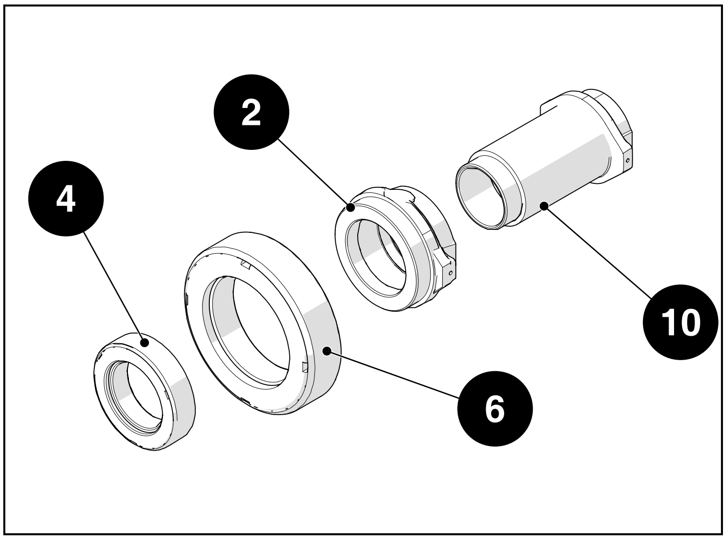

Fig. 3.33

Fit the assembled sleeves in the clutch housing, aligning correctly with the forks (8) and (12).

Fasten the sleeves to the forks by fitting the springs (29).

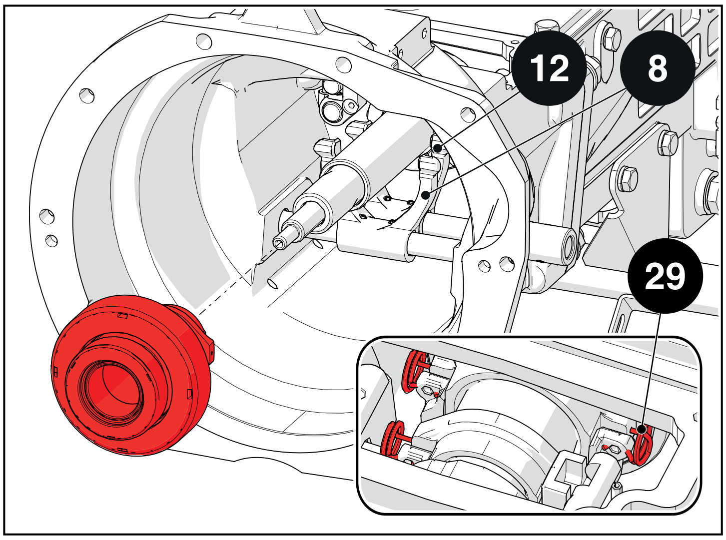

Fig. 3.34

Fit the sleeve (30) of the reverse shuttle lever and secure in place with the pin (31).

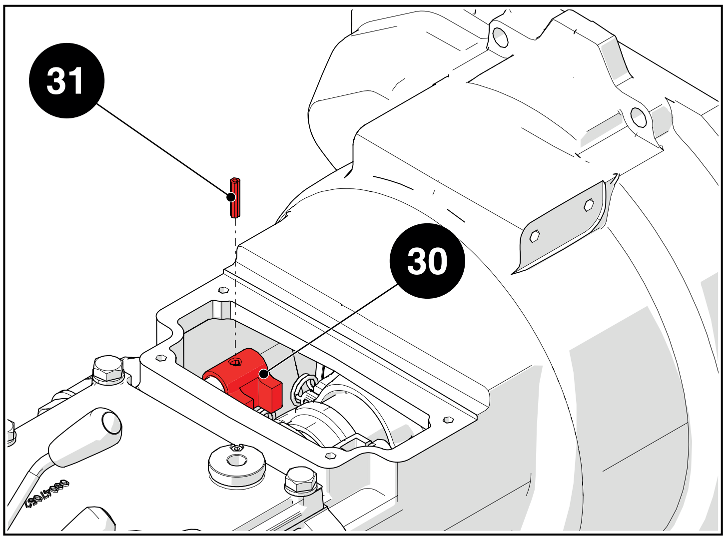

Fig. 3.35

Fit the PTO clutch lever (32) and secure in place with the spring pins (33).

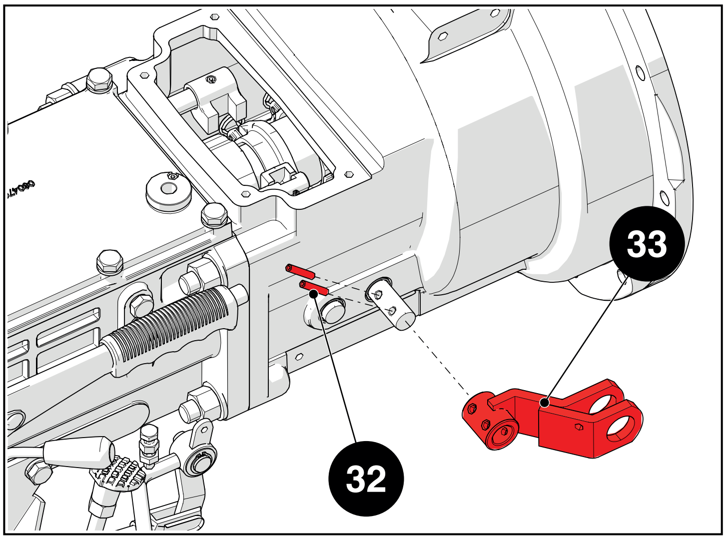

Fig. 3.36

Apply a layer of silicone sealant on the mating surface of the cover.

Fasten the cover (5) by fitting the washers (34) and tightening the screws (35) to a torque of _____Nm (______kgm).

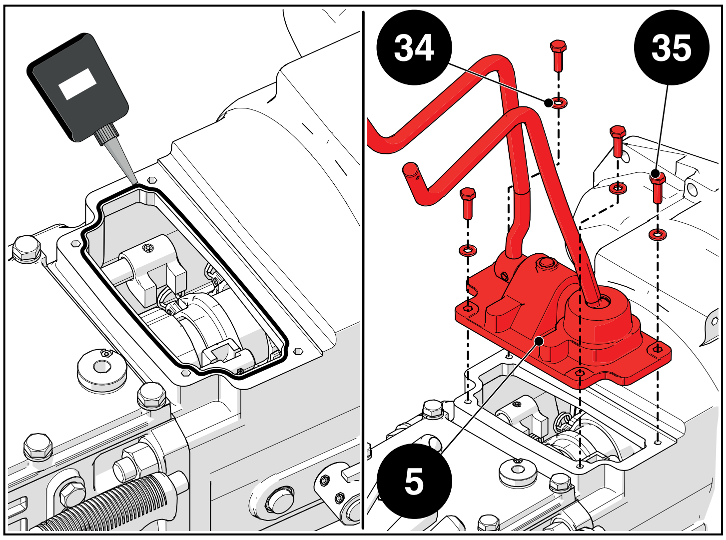

Fig. 3.37

Apply a layer of silicone sealant on the mating surface of the clutch housing.

Mate the engine assembly with the clutch housing.

Danger
Lift the engine assembly with a hoist of adequate load capacity.

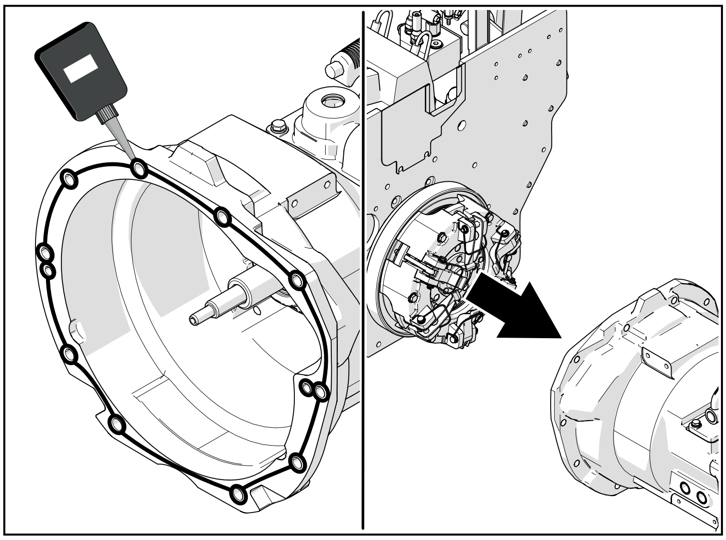

Fig. 3.38

Fit the washers (19) and tighten the screws (18) fastening the clutch housing to the engine to a torque of 80 Nm (8 kgm).

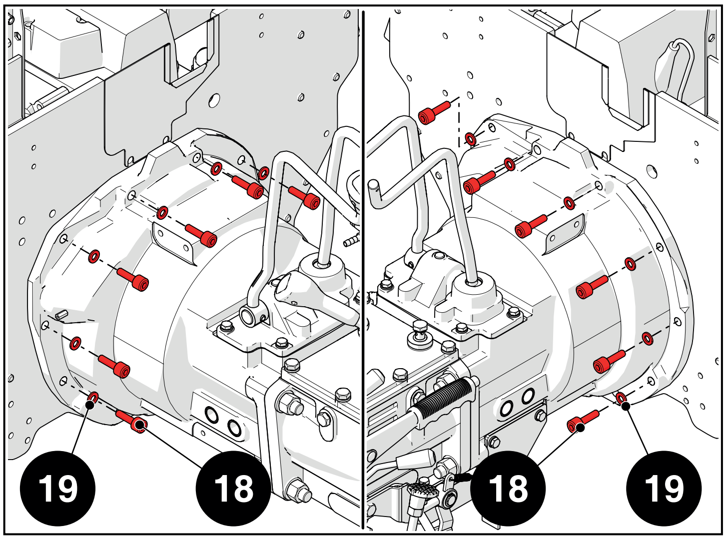

Fig. 3.39

Fasten the PTO clutch lever mount (36) to the clutch housing, fitting the washers (37) and tightening the screws (67).

Fit the spring pin (39) on the pin (40) and then fit the pin on the lever mount together with the spacer (41).

Warning
The spacer (41) must be of suitable thickness to keep the lever in the centre of the lever mount (36). Use an appropriate number of spacers to eliminate any free play between the lever and the pin.

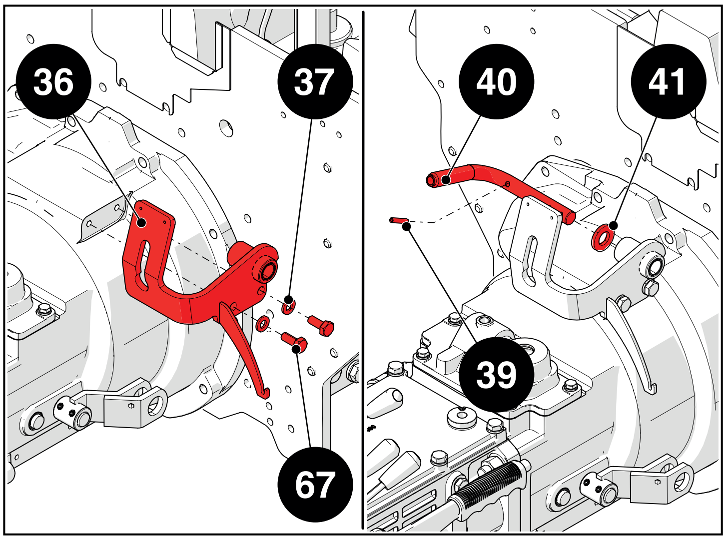

Fig. 3.40

Fit the link lever (42) and fasten onto the pin with the spring pins (39).

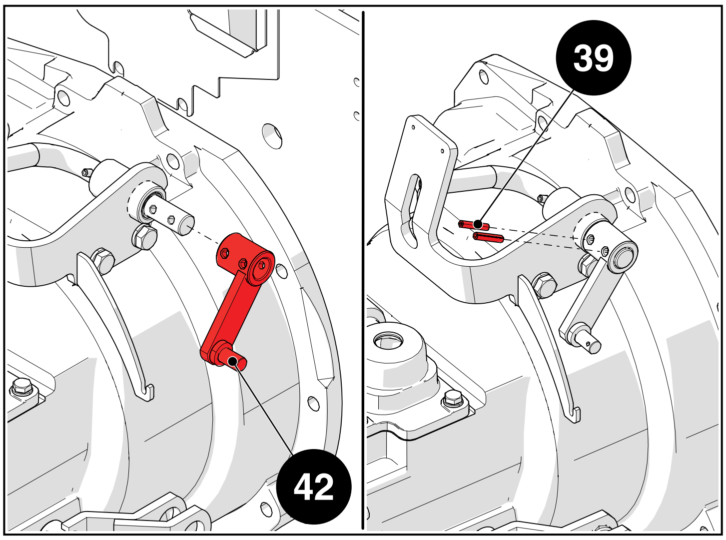

Fig. 3.41

Fit the ferrule (46).

Fit the link rod (43 and the spacer (44) and fasten with the split pin (45). Tighten the screw (14).

Attach the spring (48).

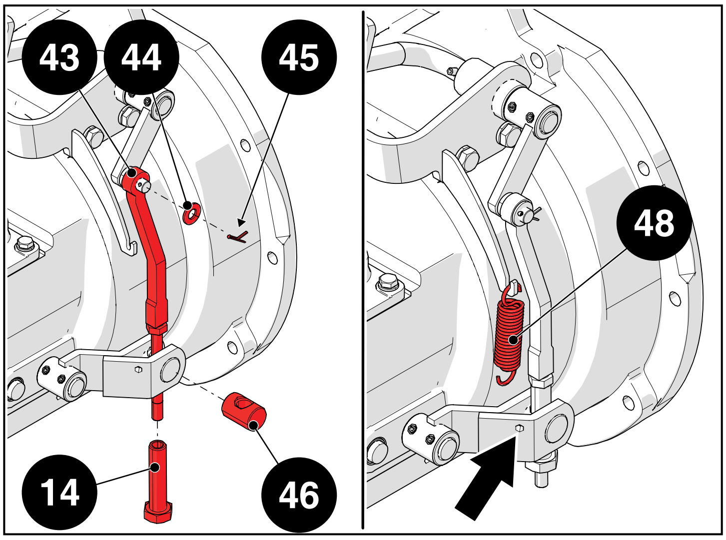

Fig. 3.42

Preassemble the transmission clutch lever (49), fitting it onto the pin (50) and fastening with the spring pin (51).

Fut the bushes (52) on the clutch pedal mount (53) and then fit the mount onto the pin (50).

Fit the link lever (54) onto the pin and fasten with the spring pin (55).

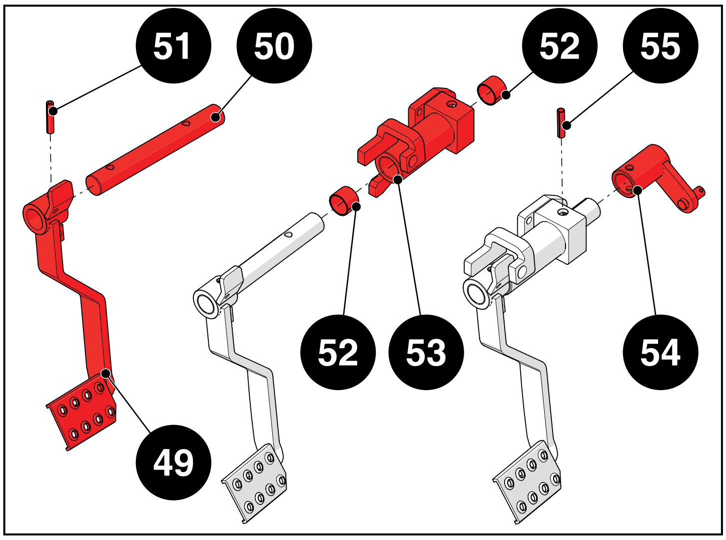

Fig. 3.43

Fasten the spring bracket (58) with the relative screws.

Fasten the external clutch lever (59) with the pins (60).

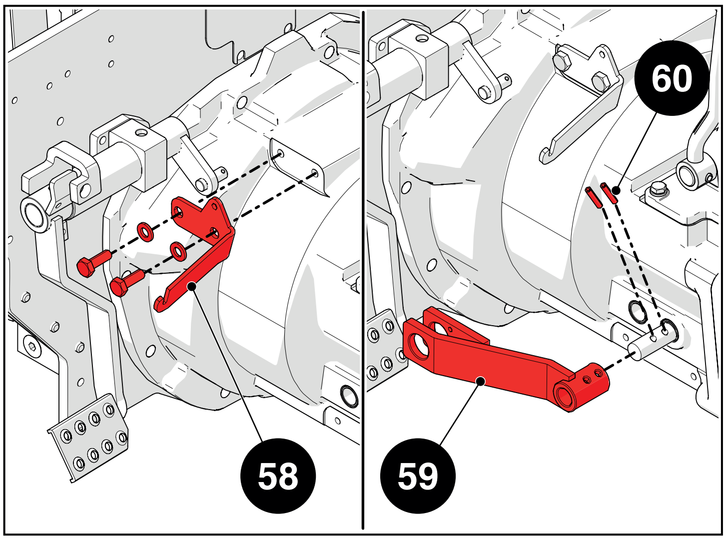

Fig. 3.44

Lower the platform into place.

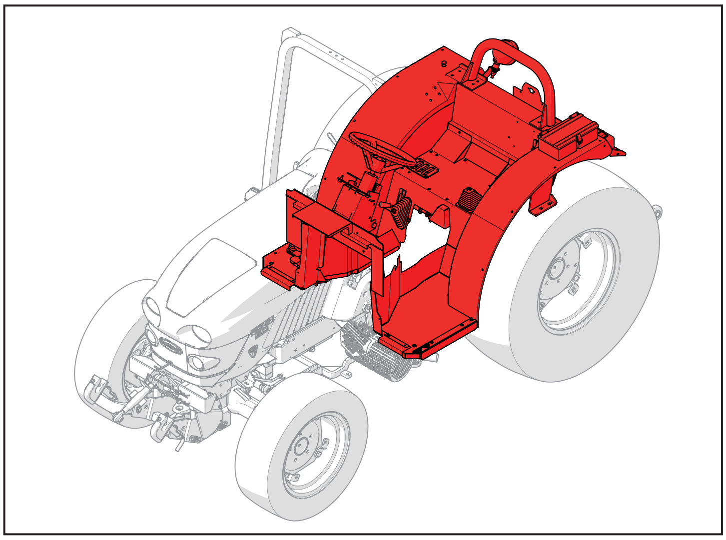

Fig. 3.45

Fasten the clutch pedal onto the flange, fitting the washers (56) and tightening the screws (57).

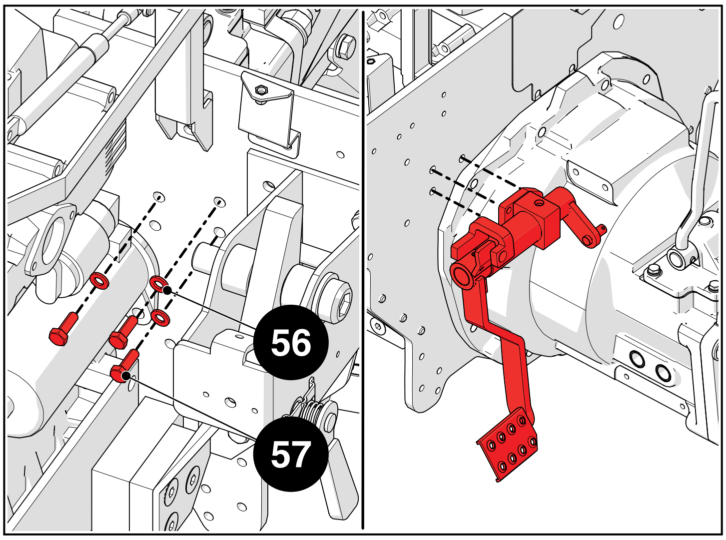

Fig. 3.46

Fit the ferrule (61).

Fit the link rod (63 and the spacer (64) and fasten with the split pin (65).

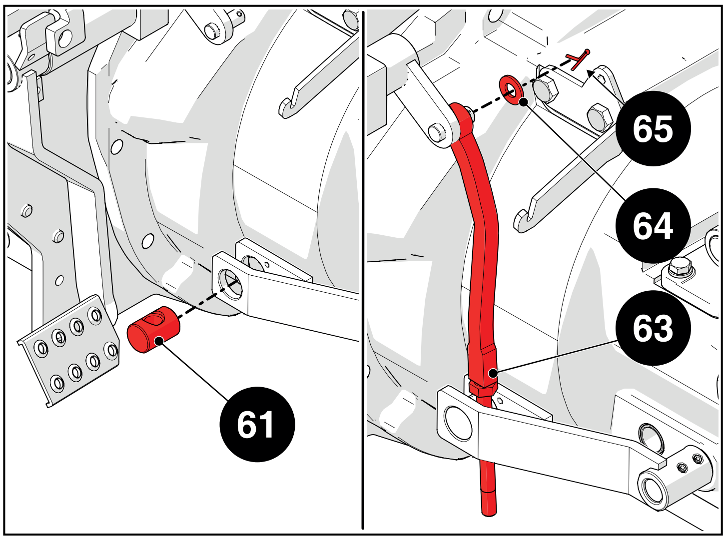

Fig. 3.47

Tighten the screw (16).

Attach the spring (17).

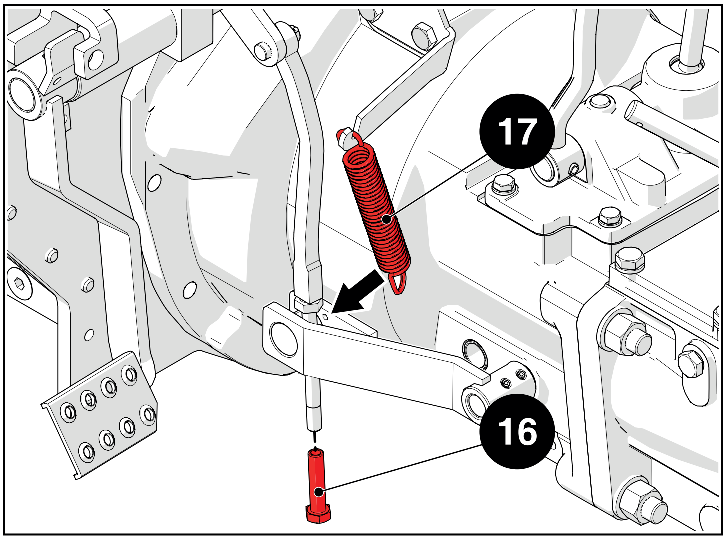

Fig. 3.48

5.2.2 Adjusting the PTO clutch lever

Tighten or loosen the screw (14) to set a lever dead zone of 20 mm.

Check that the dead zone is correct and secure the link rod with the check nut (66).

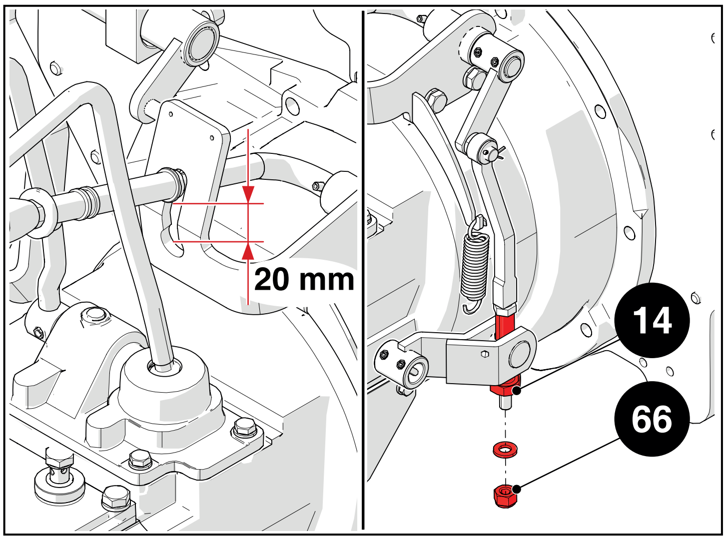

Fig. 3.49

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 release point (67), engage point (68) and dead zone (16) setting screws to obtain the correct values.

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.

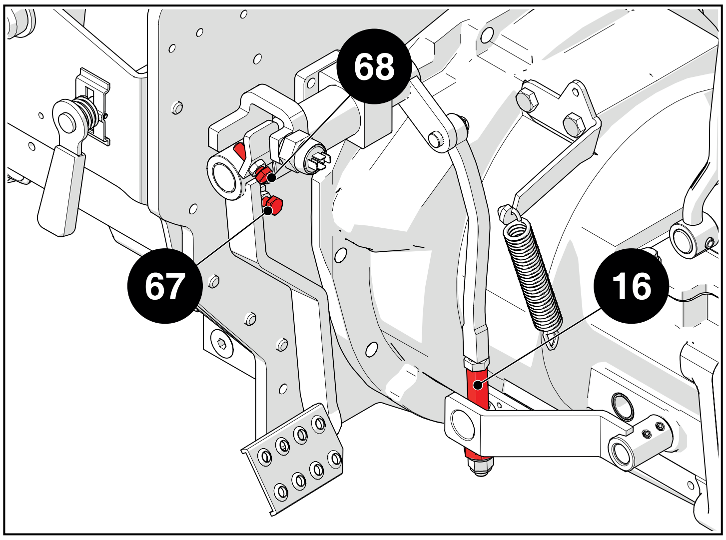

Fig. 3.50

Pedal rest position (A)	168 mm
Pedal engage point (B)	153 mm
Pedal release point (C)	71 mm

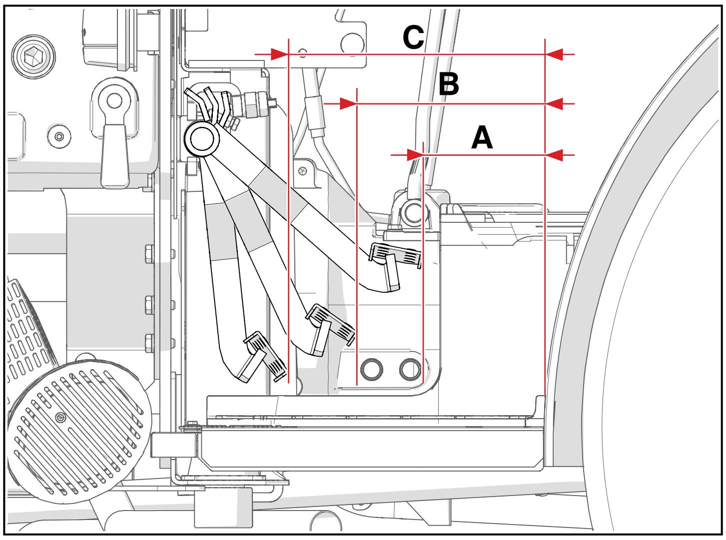

Fig. 3.51

Section 6 : Tightening torques

Index

6.1 Tightening torques

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

Tightening torque	Nm	Kgm
Clutch assembly - engine flywheel fastener screw	35	3.5
Clutch housing - gearbox casing fastener nut	100	10
Engine - gearbox fastener screw	80	8
Cover - lever fastener screw		

Section 7 : Implements necessary

Index

7.1 Implements necessary

p/n	Description	Quantity
-	-	-

Chapter 4 : Transmission and Rear Power Take Off

Index

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.

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 of gearbox

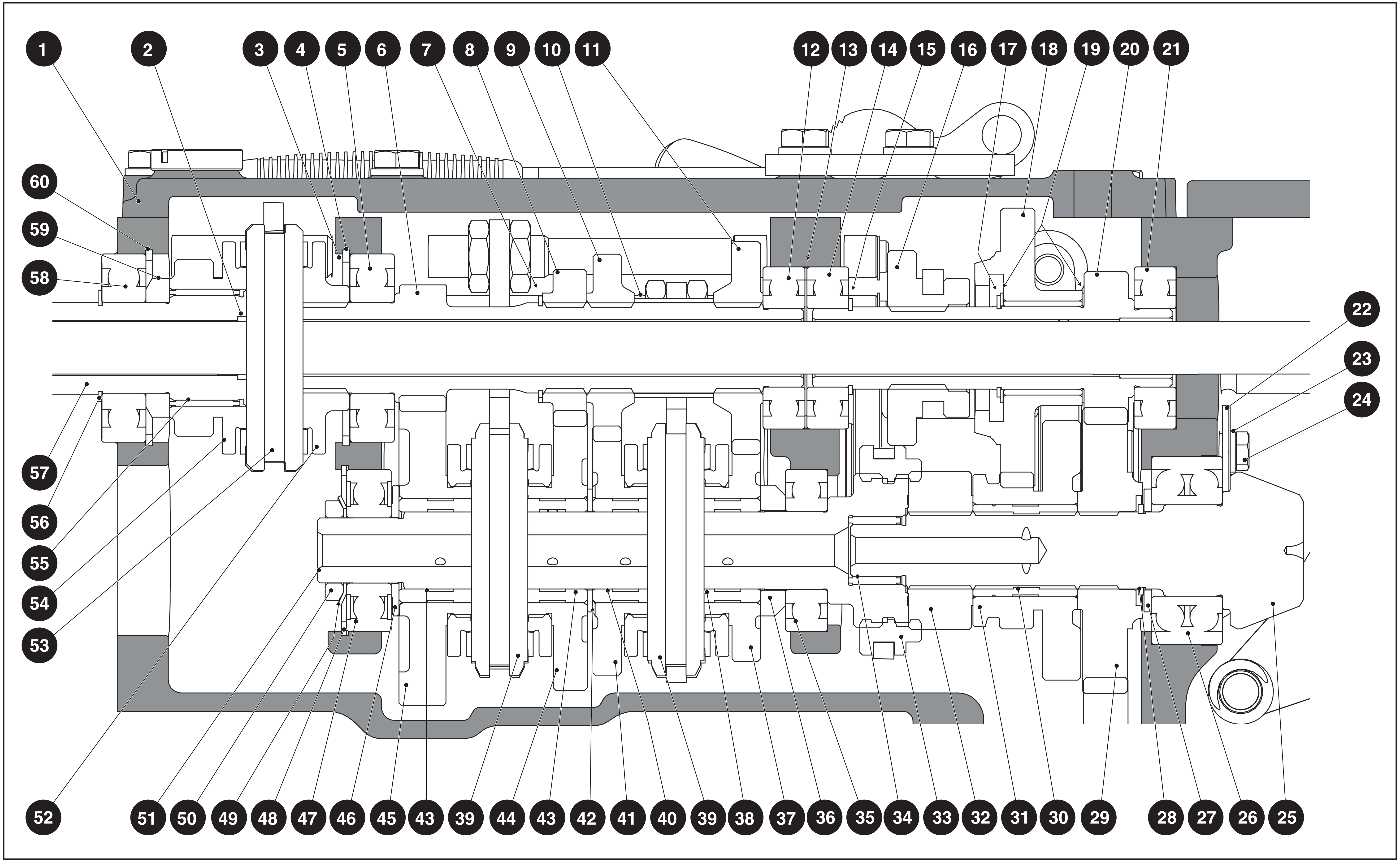

Fig. 4.1

1 - Cover
2 - Guide ring
3 - Spacer
4 - Circlip
5 - Bearing
6 - Primary shaft
7 - Circlip
8 - 2nd speed drive gear
9 - 3rd speed drive gear
10 - Spacer
11 - 4th speed drive gear
12 - Bearing
13 - Spacer
14 - Bearing
15 - Circlip
16 - Reverse/Slow range selector gear
17 - Circlip
18 - Slow range gear
19 - Spacer
20 - Slow range idler shaft
21 - Bearing
22 - Spacer
23 - Washer
24 - Screw
25 - Bevel pinion
26 - Bearing
27 - Spacer
28 - Circlip
29 - Medium-Slow range gear
30 - Splined bush
31 - Slow range idler gear
32 - Splined spacer
33 - Slow-Medium range selector sleeve
34 - Roller bearing cage
35 - Bearing
36 - Spacer
37 - Bush
38 - 4th speed gear
39 - Synchroniser
40 - Bush
41 - 3rd speed gear
42 - Spacer
43 - Bush
44 - 2nd speed gear
45 - 1st speed gear
46 - Spacer
47 - Bearing
48 - Circlip
49 - Ring nut retainer washer
50 - Ring nut
51 - Secondary shaft
52 - Reverse shuttle driven gear
53 - Synchroniser
54 - Reverse shuttle drive gear
55 - Roller bearing cage
56 - Circlip
57 - Gearbox input shaft
58 - Bearing
59 - Spacer
60 - Circlip

2.2 Assembly drawing of intermediate shafts

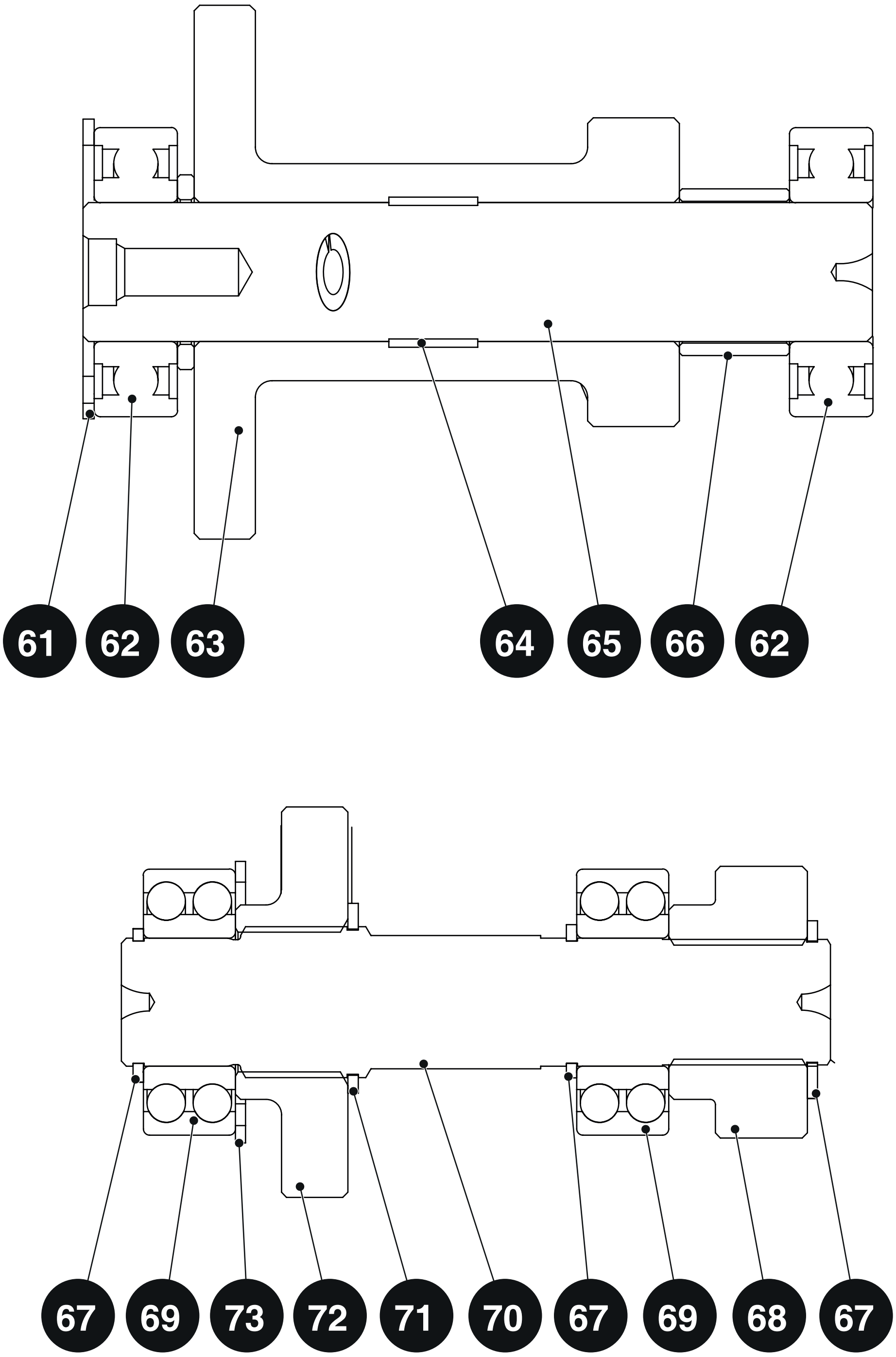

Fig. 4.2

61 - Circlip
62 - Bearing
63 - Gear
64 - Spacer
65 - Reverse shaft
66 - Spacer
67 - Circlip
68 - Reverse shuttle gear
69 - Bearing
70 - Reverse shuttle shaft
71 - Circlip
72 - Reverse shuttle gear
73 - Circlip

2.3 Assembly drawing of rear differential

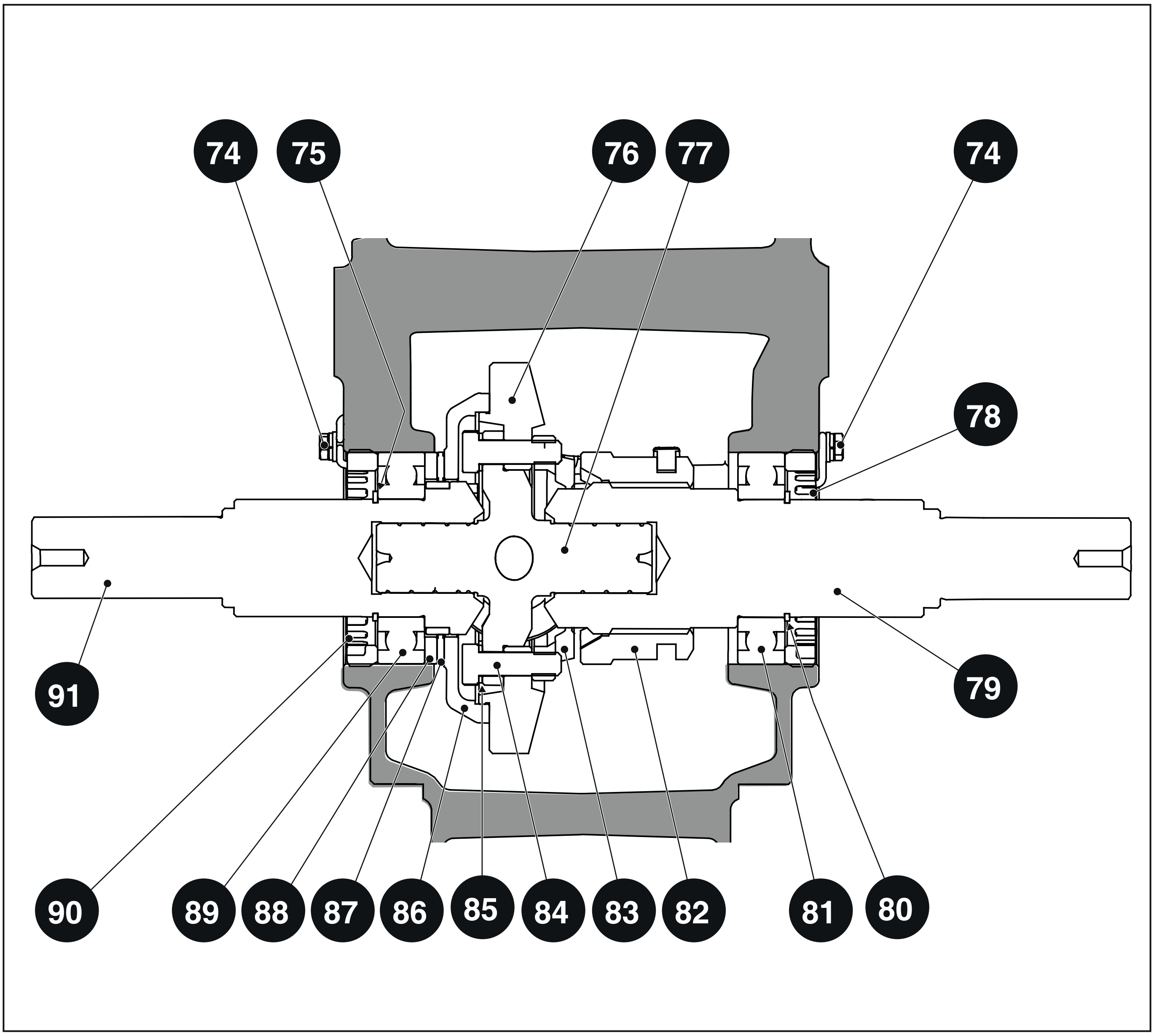

Fig. 4.3

74 - Ring nut retainer
76 - Conical crown wheel
77 - Differential centre shaft
78 - Ring nut
79 - Sun gear
80 - Circlip
81 - Bearing
82 - Differential lock pinion
83 - Differential lock fixed ring
84 - Screw
85 - Washer
86 - Spacer
87 - Roller bearing cage
88 - Spacer
89 - Bearing
90 - Roller bearing cage
91 - Sun gear

2.4 Assembly drawing of rear PTO and 4WD unit

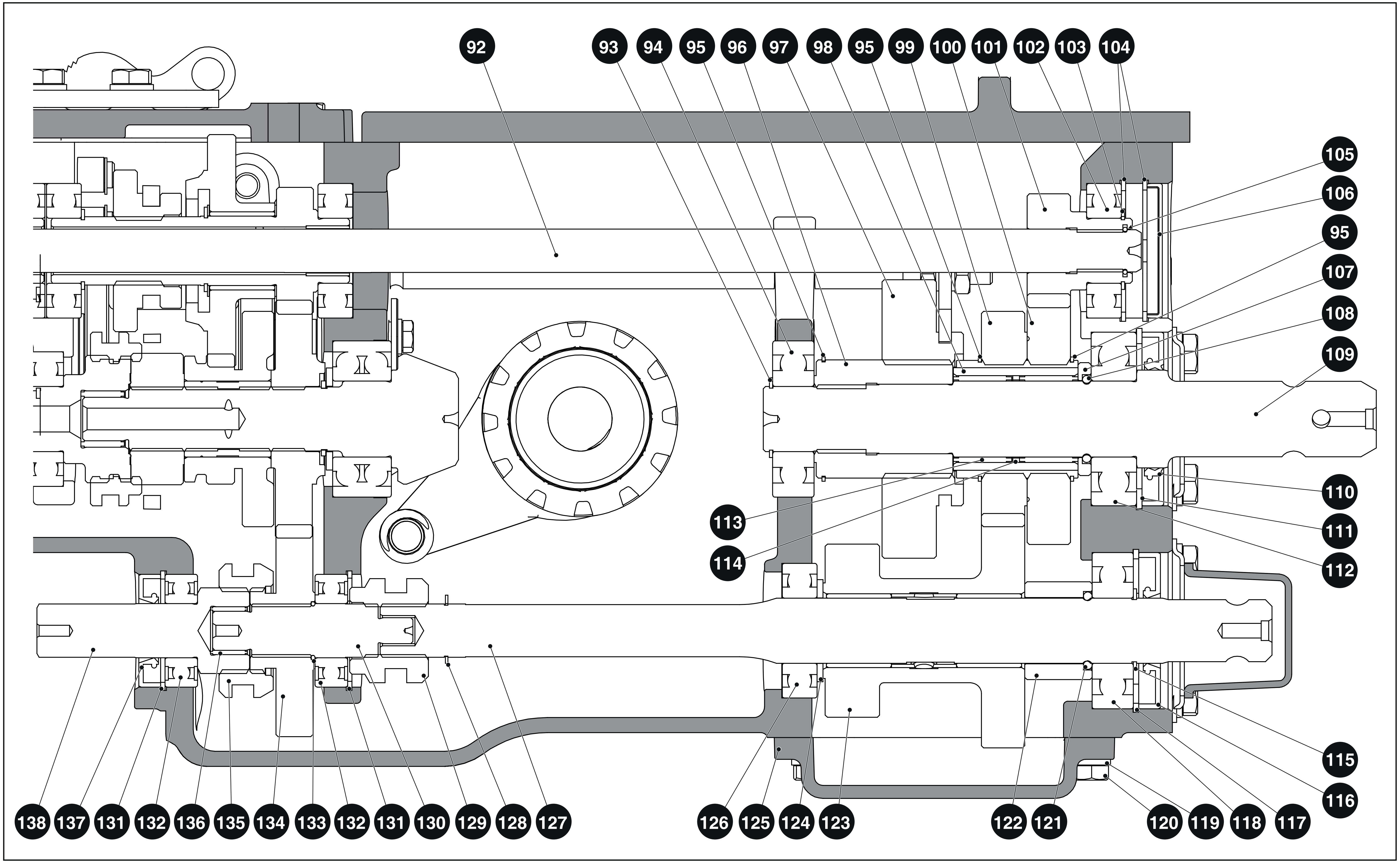

Fig. 4.4

92 - PTO primary shaft
93 - Circlip
94 - Bearing
95 - Thrust washer
96 - Splined spacer
97 - PTO selector gear
98 - Splined spacer
99 - Drive gear
100 - PTO driven gear
101 - PTO drive gear
102 - Bearing
103 - Circlip
104 - Circlip
105 - Ring
106 - Cover
107 - Spacer
108 - Circlip
109 - Upper PTO shaft
110 - Oil seal
111 - Circlip
112 - Bearing
113 - Roller bearing cage
114 - Spacer
117 - Circlip
118 - Bearing
119 - Washer
120 - Screw
121 - Circlip
122 - Spacer
123 - PTO idler gear
124 - Spacer
125 - Lower cover
126 - Bearing
127 - Ground speed PTO shaft
128 - Circlip
129 - Sleeve
130 - Shaft
131 - Circlip
132 - Bearing
133 - Circlip
134 - 4WD idler gear
135 - Sleeve
136 - Roller bearing cage
137 - Oil seal
138 - 4WD idler shaft

Section 3 : Technical characteristics

Index

3.1 Transmission

Transmission type	Mechanical transmission, four wheel drive
Gearbox type	12+12+4 Fast Reverse
Shift control system	Mechanical with levers at front
Safety	PUSH & START device on clutch pedal
Reverse shuttle type	Mechanical, synchronised
Reverse shuttle control	Lever
Rear differential lock	Mechanical
Front axle	Four-wheel drive
4WD engagement control	Mechanical
Minimum speed	0.7 Km/h
Maximum speed (homologated)	30 Km/h
Quantity of oil	20 litres
Oil type	SAE 15-40W

Warning

The bushes on the shaft are lubricated via the hole in the shaft itself.

To ensure that the gears and bushes are lubricated correctly, the oil level in the transmission case must reach the correct marking on the oil dipstick.

3.2 Upper Power Take Off

PTO speed selector lever	Direction of rotation	Ratio	PTO rpm	Engine rpm
540	Clockwise	4.66	540	2516
1000	1-3/8" profile with 6 splines	2.50	1000	2500

3.3 Ground Speed Power Take Off

Note

Values indicated are PTO revolutions per wheel revolution.

PTO speed selector lever	Profile	Ratio
540	1-1/8" with 6 splines	19.12
1000		

Section 4 : Disassembly

Index

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.

Bonnet

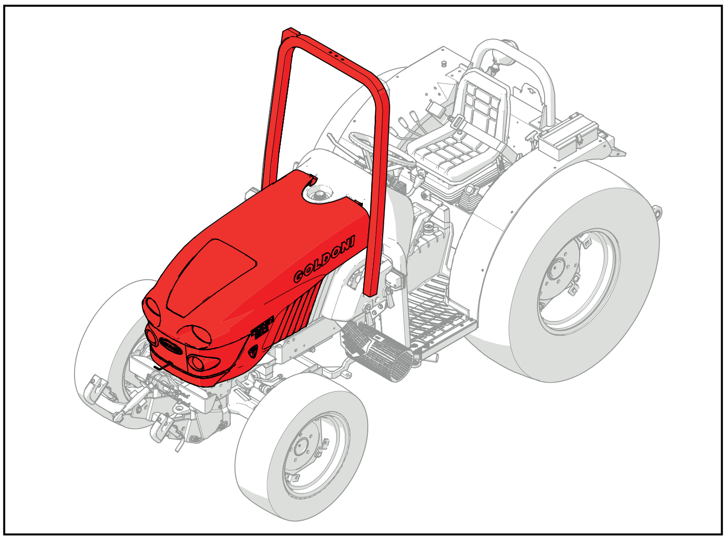

Fig. 4.5

Seat

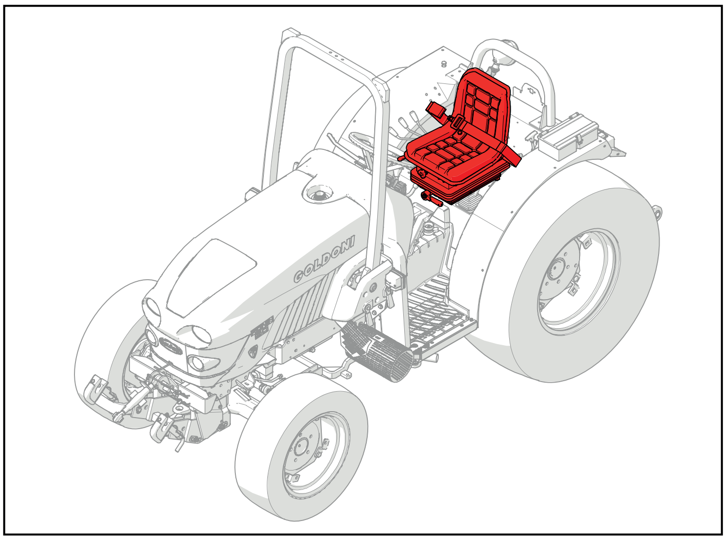

Fig. 4.6

Footboard

Warning
The transmission levers and the relative sleeves and covers may be accessed by removing the footboard only. The preliminary operations described as follows are not necessary when performing maintenance on these components.

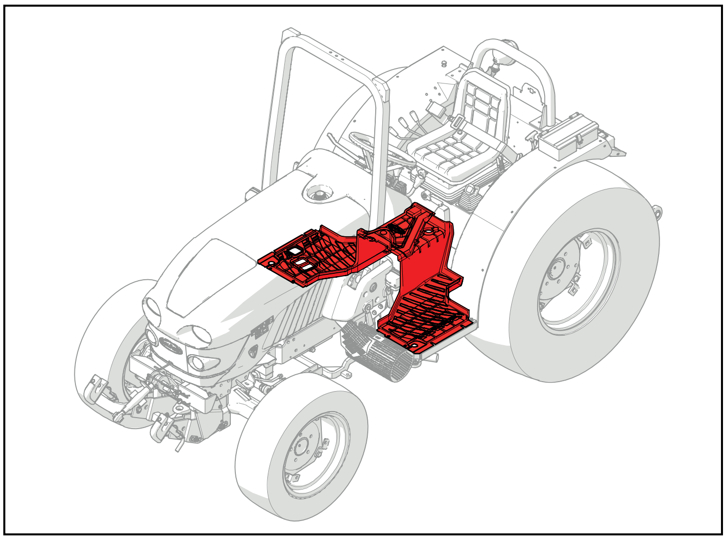

Fig. 4.7

Platform

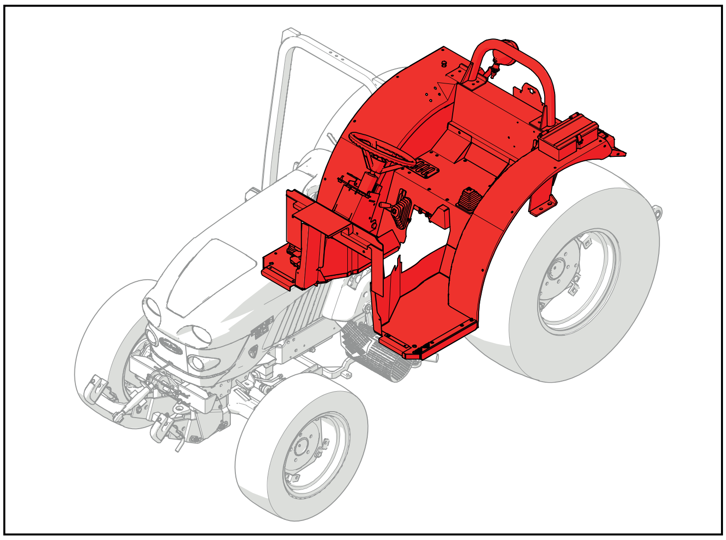

Fig. 4.8

4WD shaft

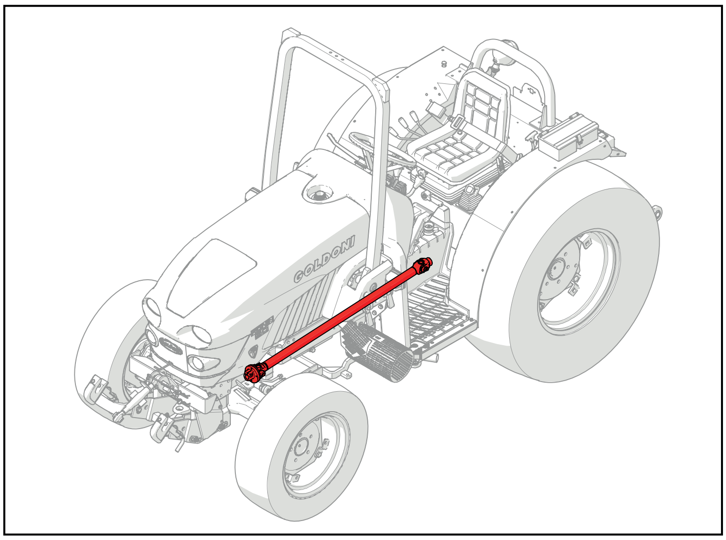

Fig. 4.9

Rear final drive units

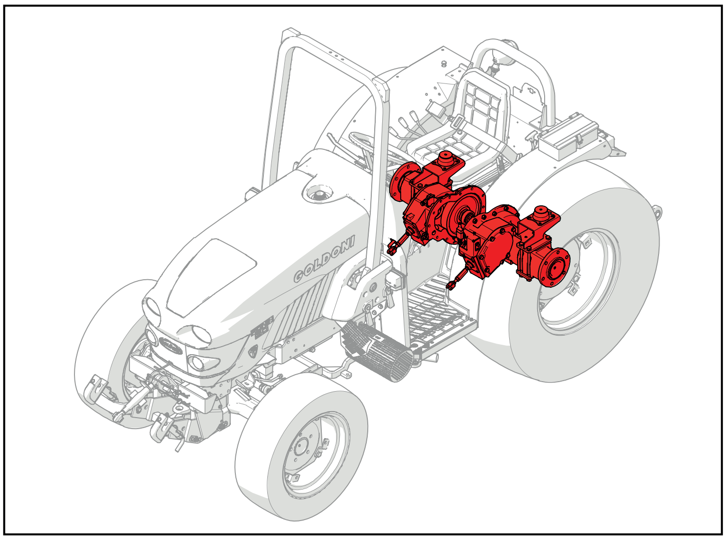

Fig. 4.10

4.2 Disassembly

Undo the screws (139) and remove the washers (140), and then remove the cover complete with lever (141).

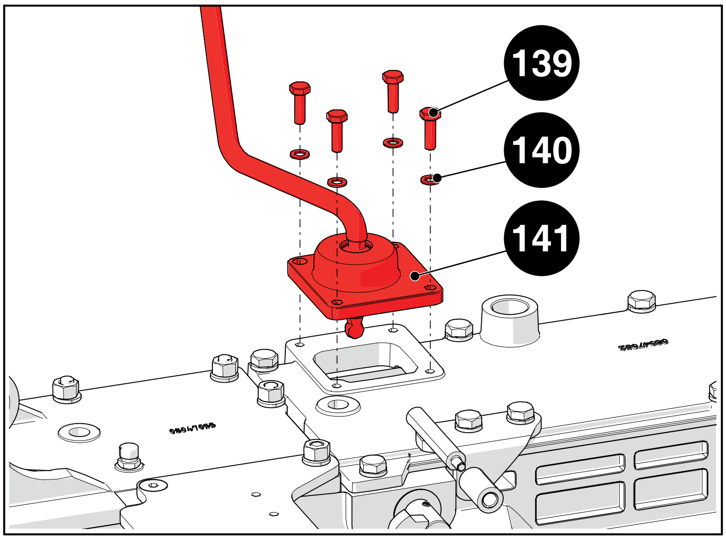

Fig. 4.11

Remove the plugs (142) and (144) from the transmission covers.

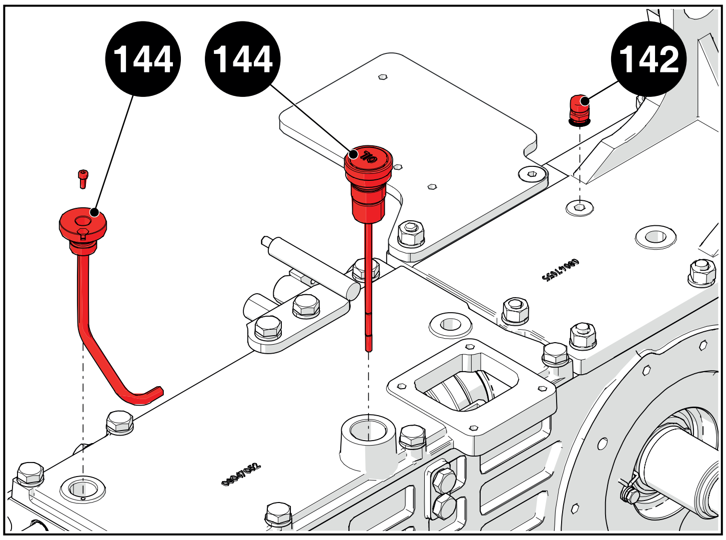

Fig. 4.12

Undo the screws (143) and the nuts (145) and remove the washers (119).

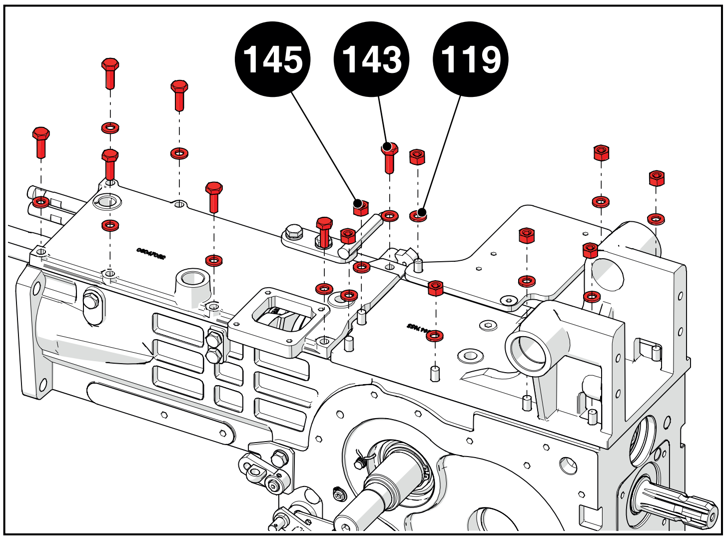

Fig. 4.13

Undo the screws (146) and (147), remove the washers (148) and then remove the parking brake carrier (142).

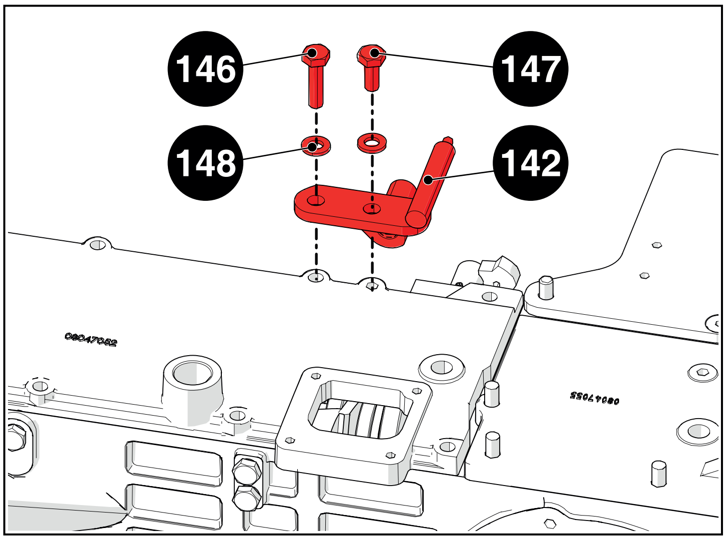

Fig. 4.14

Undo the screw (149) and remove the distributor mounting plate (150).

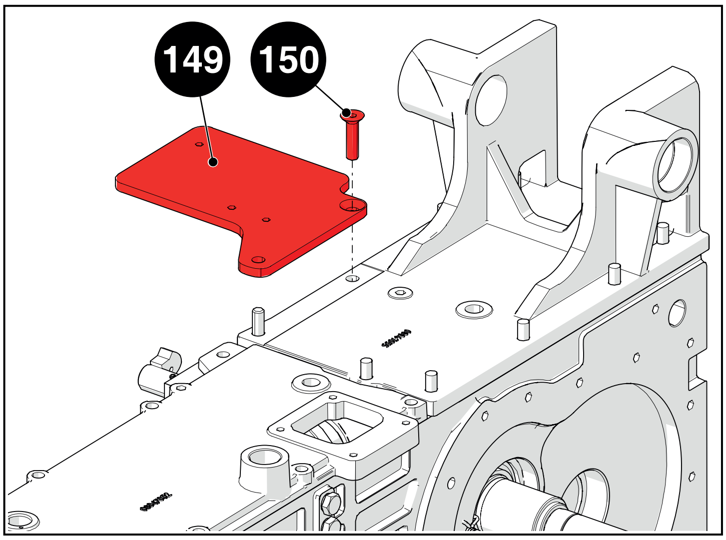

Fig. 4.15

Remove the cover (1) and the lift cover (151).

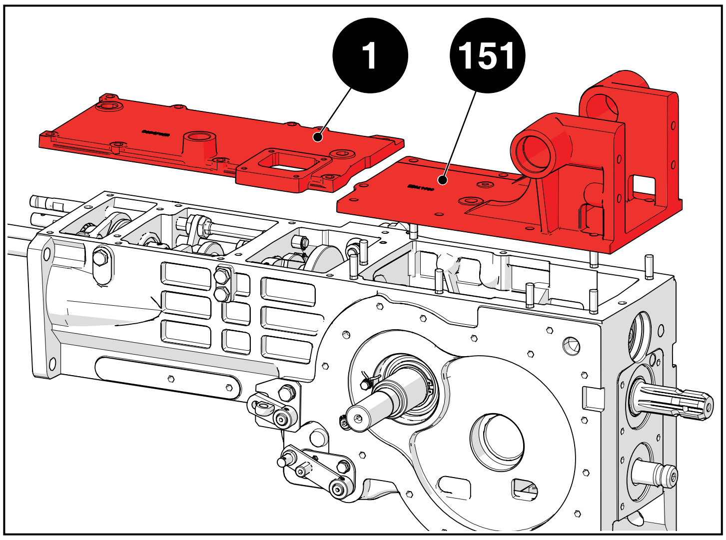

Fig. 4.16

Remove the complete PTO shaft (92).

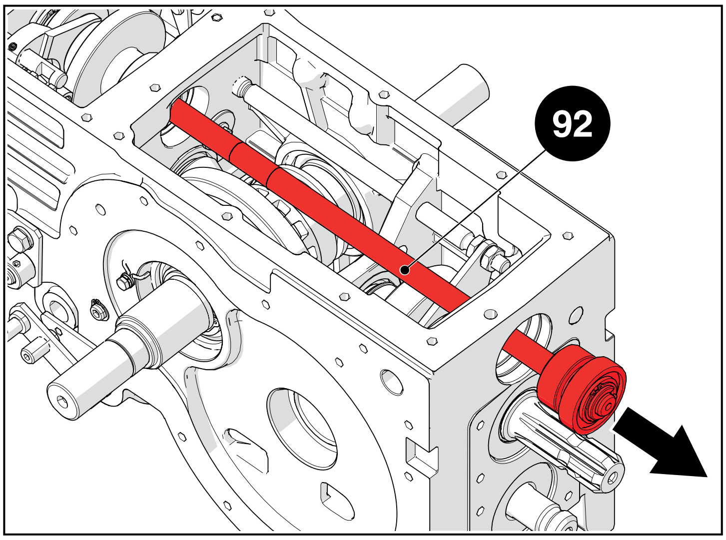

Fig. 4.17

Remove the ring (105), the circlip (103), the bearing (102) and the gear (101) from the PTO shaft.

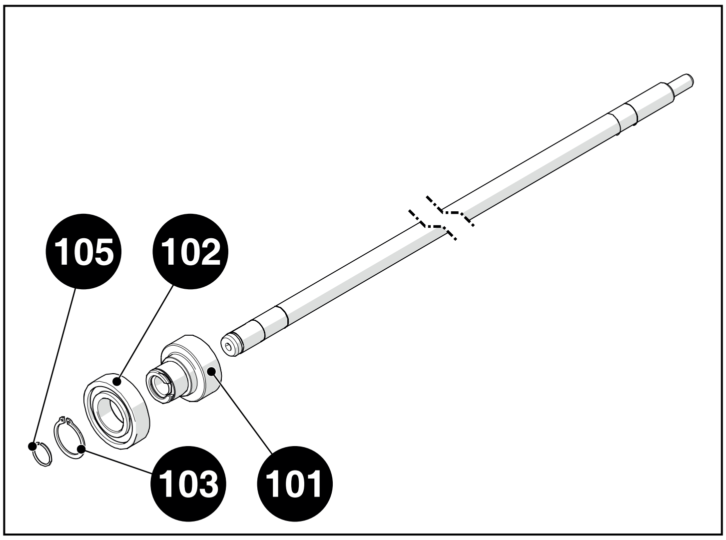

Fig. 4.18

Remove the seal rings (153) and (152).

Remove the plug (154).

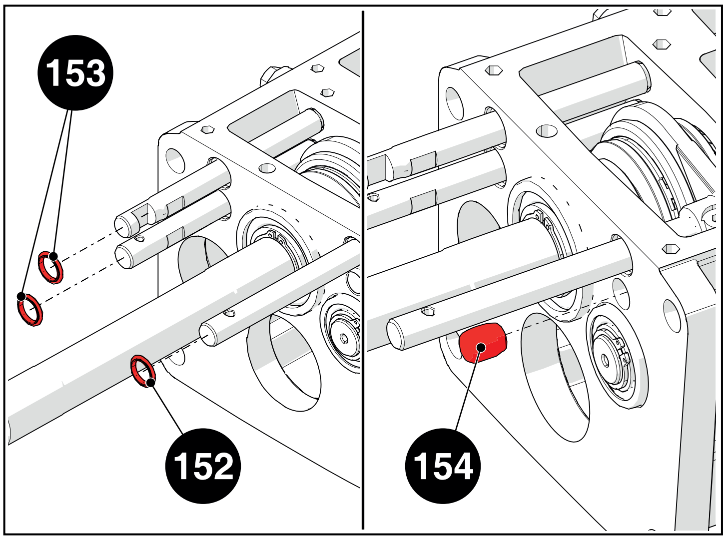

Fig. 4.19

Remove the plug (217), the copper washer (218), the spring (216) and the ball (211).

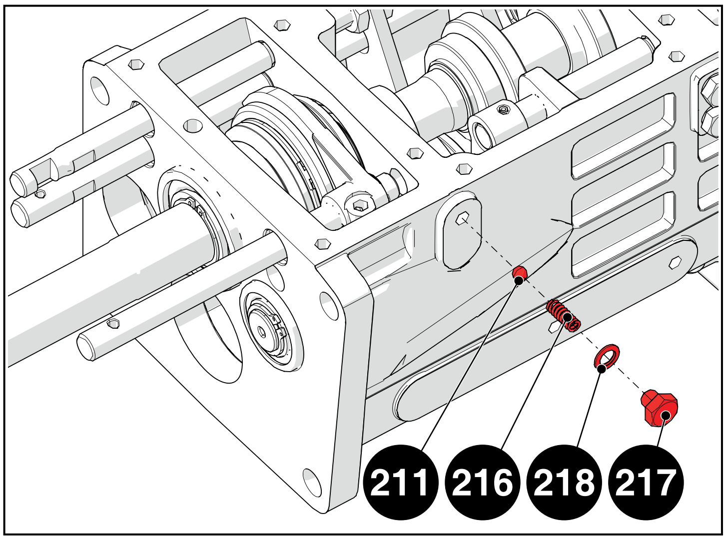

Fig. 4.20

Remove the spring pin (208) and then remove the pin (213) complete with bush (214) and circlip (215).

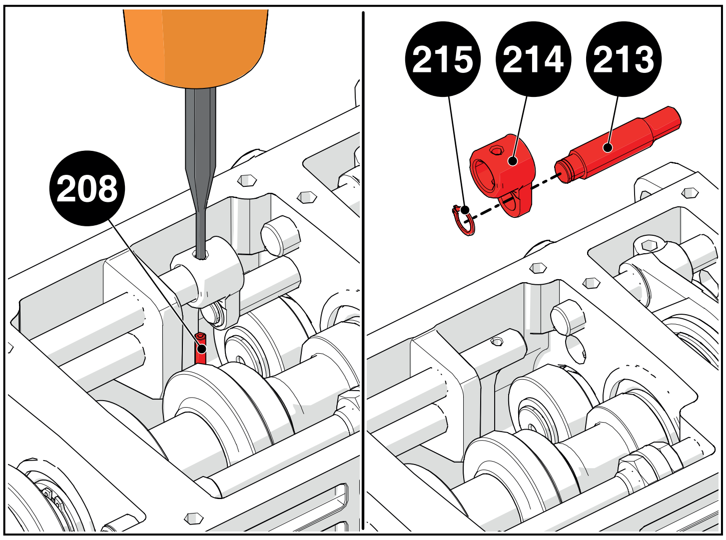

Fig. 4.21

Remove the rod (212) and the fork (210) and then remove the ball (211).

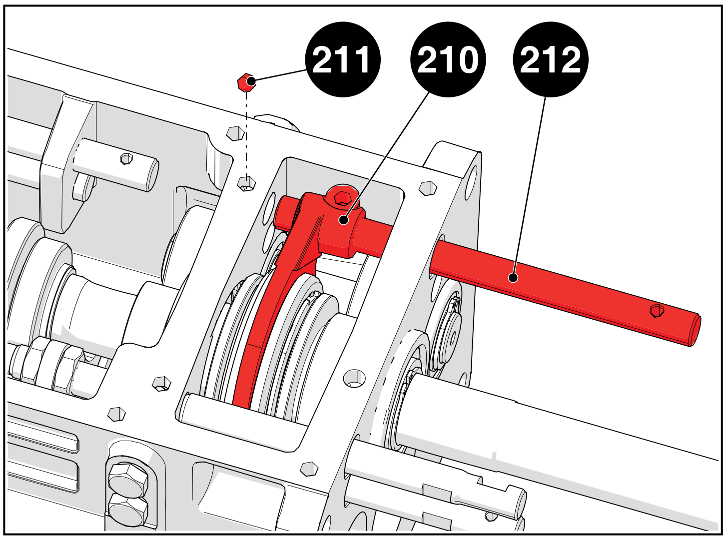

Fig. 4.22

Detach the circlip (71) to free the gear (72) on the shaft.

Remove the circlip (67) to free the gear (68) on the shaft.

Detach the circlip (67).

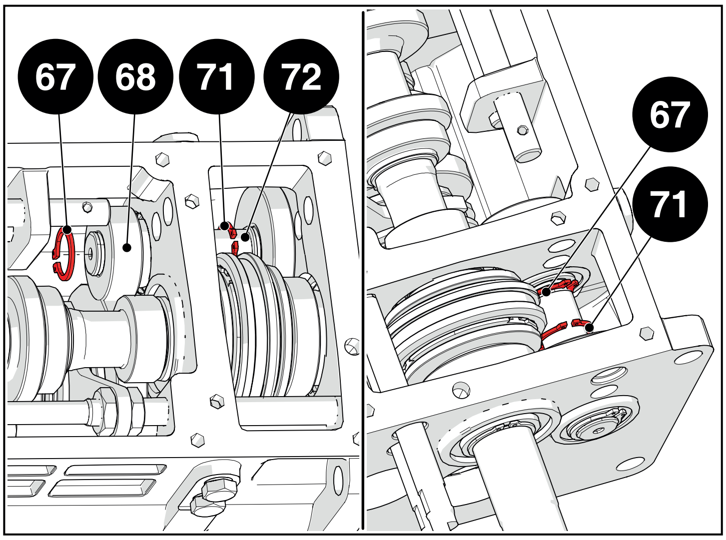

Fig. 4.23

Pull out the reverse shuttle shaft (70) complete with bearing (69). Remove the gear (68) from the opposite end.

Retrieve the circlip (67) and the circlip (71) detached previously on the shaft.

There is not enough space to remove the gear (72). Leave it inside the casing and remove it later.

Disassemble the shaft removed from the casing, removing the bearing (69) and the circlip (67).

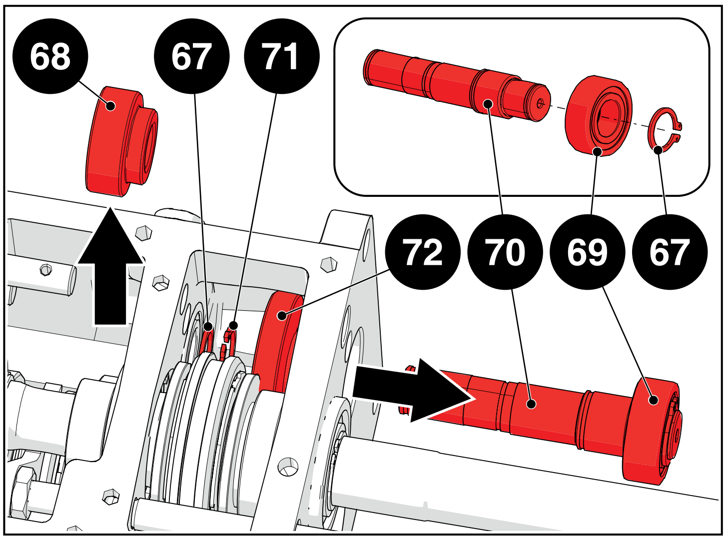

Fig. 4.24

Remove the circlip (73) and remove the bearing (69) in the direction indicated.

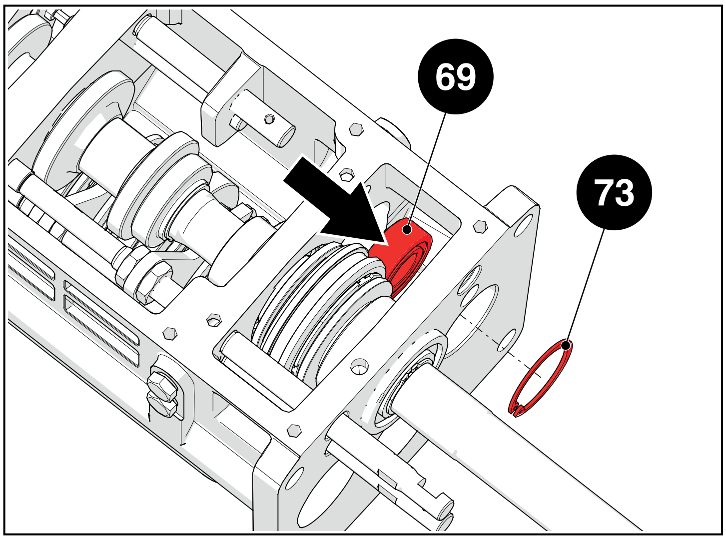

Fig. 4.25

Remove the plugs (209).

Remove the plug (188), the copper washer (189), the spring (187) and the ball (186).

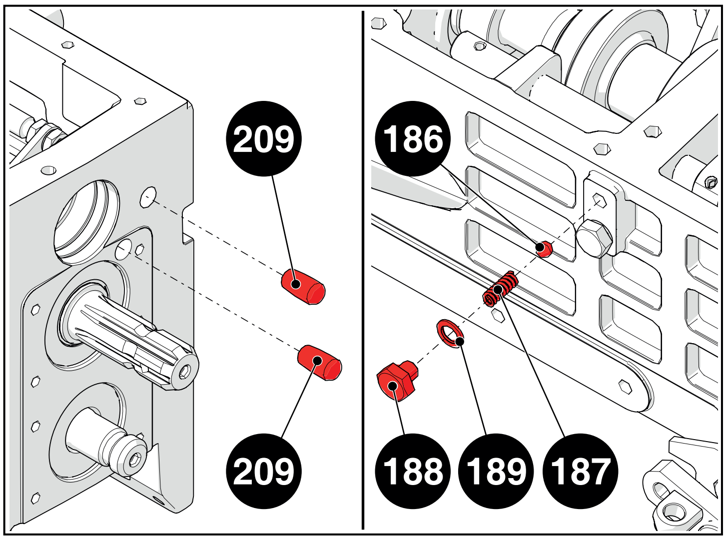

Fig. 4.26

Remove the spring pin (208) and then remove the rod (207), the fork and the ball (186).

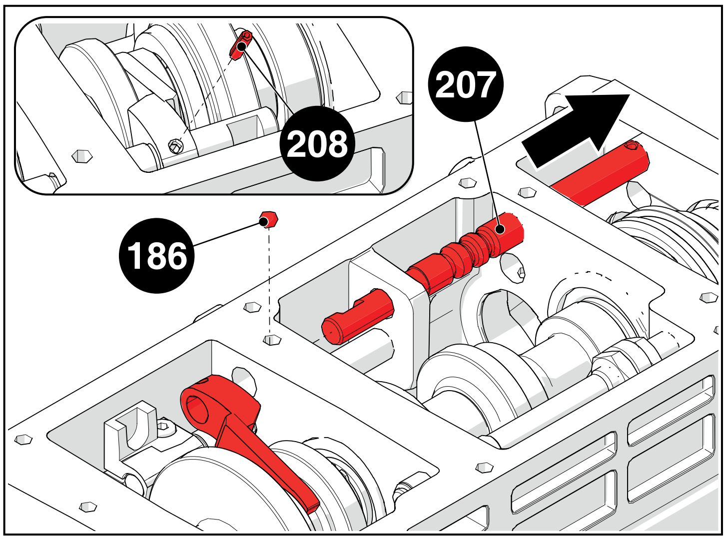

Fig. 4.27

Pull out the complete shaft (57) from the transmission casing.

Disassemble the shaft, which consists of the following components:

- Ring (2);
- Oil seal (205);
- Roller bearing cage (55);
- Spacer (59);
- Bearing (58);
- Circlip (56);

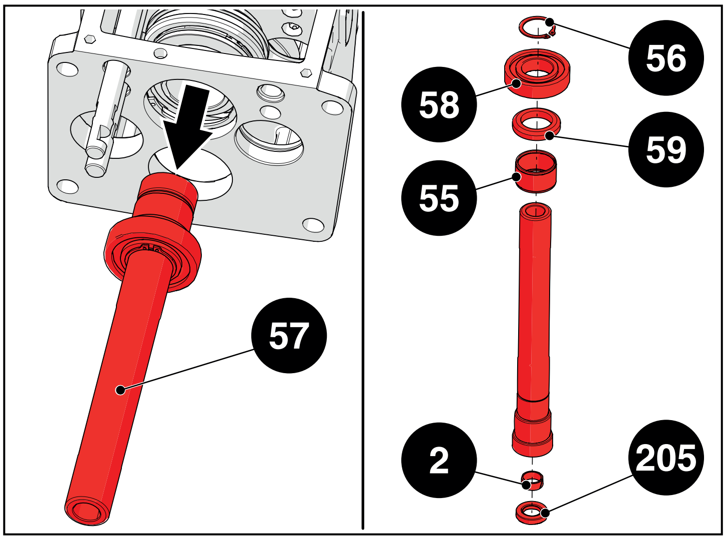

Fig. 4.28

Remove the reverse shuttle pack complete with:

- Synchroniser (53);
- Driven gear (54);
- Reverse shuttle gear (52);

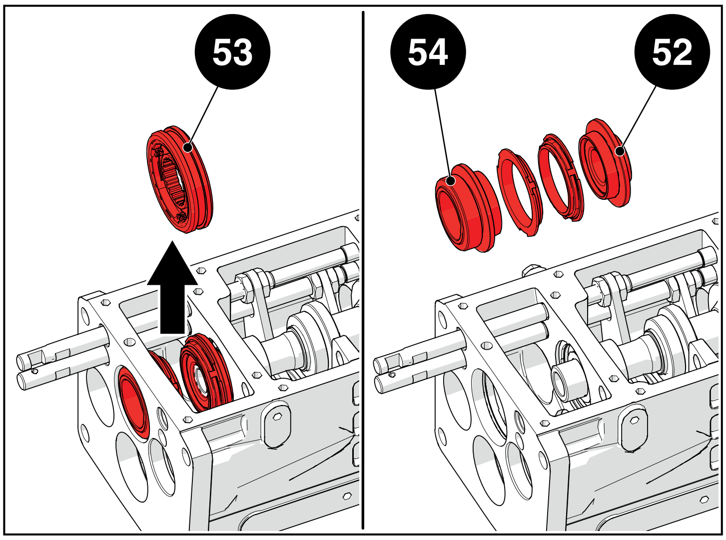

Fig. 4.29

Remove the shoulder circlip (60) and the shim pack (204).

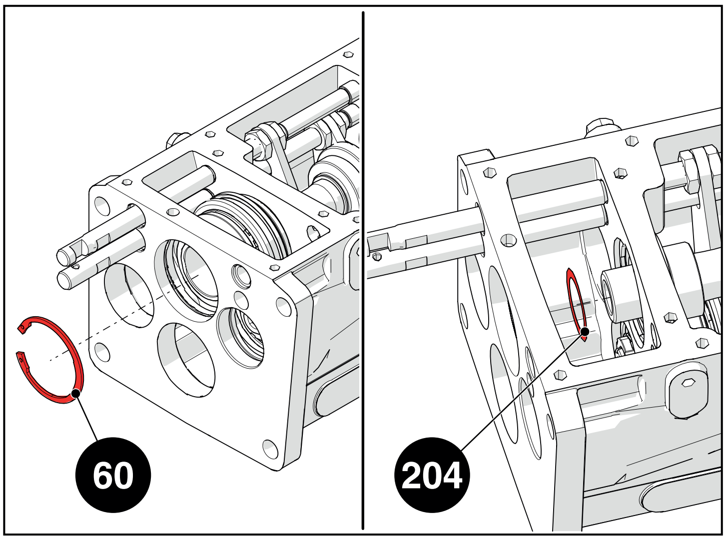

Fig. 4.30

Remove the gear (72).

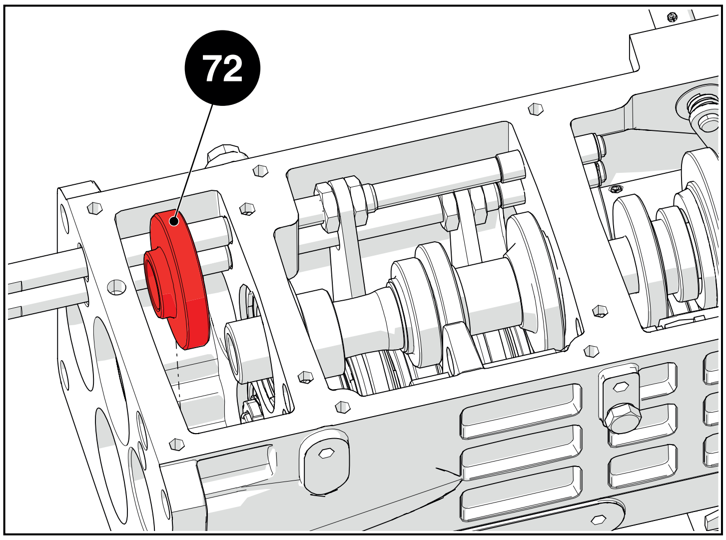

Fig. 4.31

Remove the circlip (4), the spacers (3) and the bearing (5).

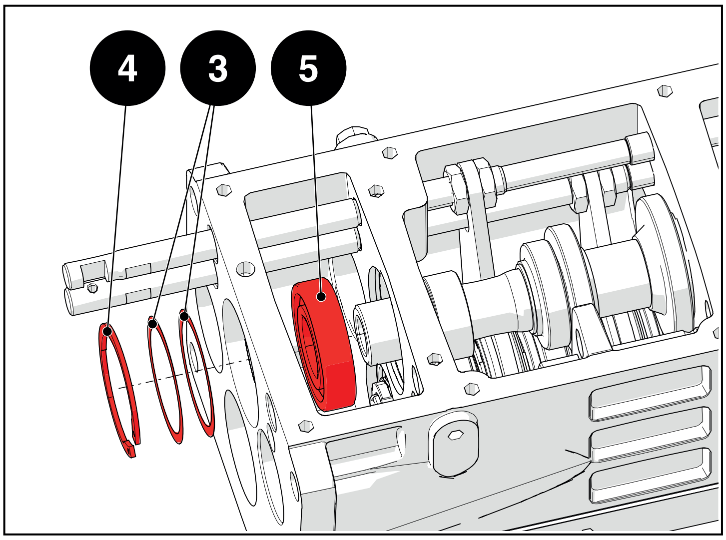

Fig. 4.32

Remove the circlip (7) from its seat.

Note
The circlip (7) cannot be removed from the shaft at this point in the procedure.

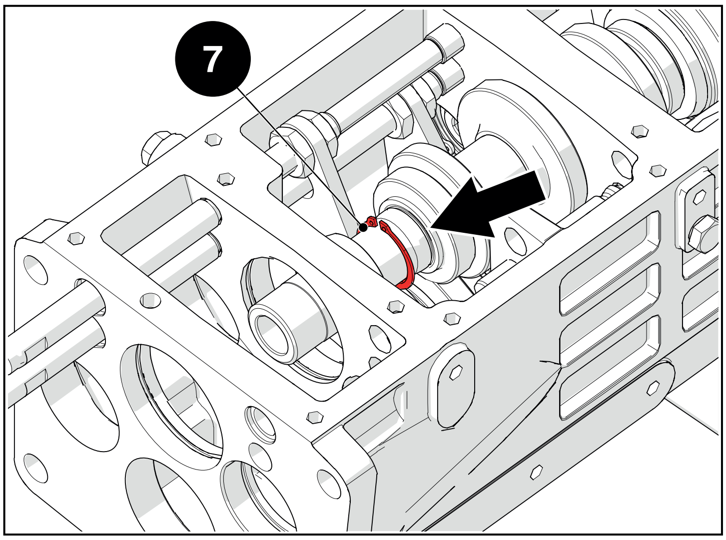

Fig. 4.33

Removing the complete primary shaft from the casing (6) together with the following components:

- Gear (11);
- Spacer (10);
- Gear (9);
- Gear (8);
- Circlip (7);

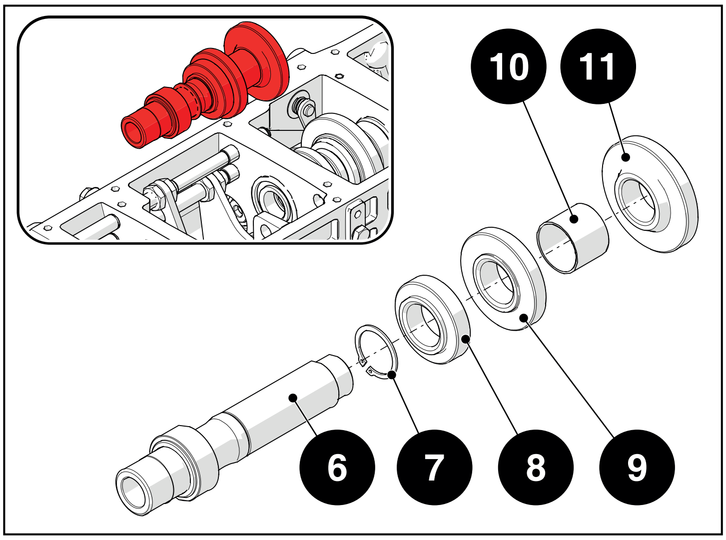

Fig. 4.34

Undo the plug (201) and remove the copper washer (202), the spring (200) and the ball (199).

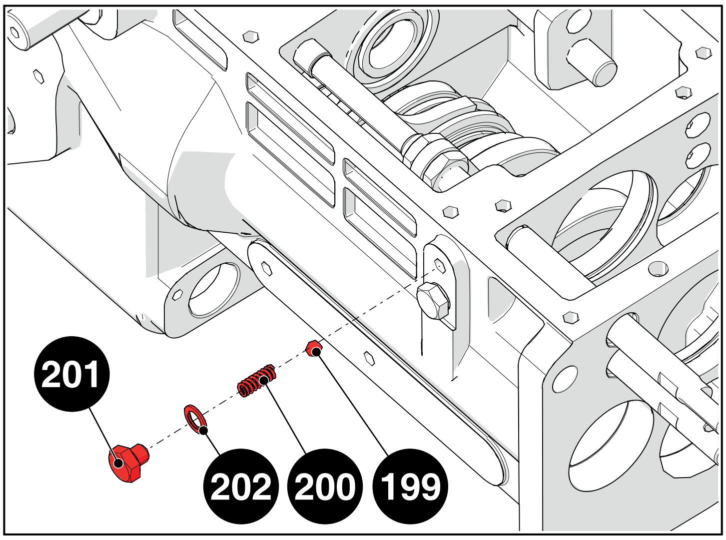

Fig. 4.35

Remove the circlip (198) and remove the bush (197).

Undo the nuts (196) and remove the rod (203).

Remove the ball (199).

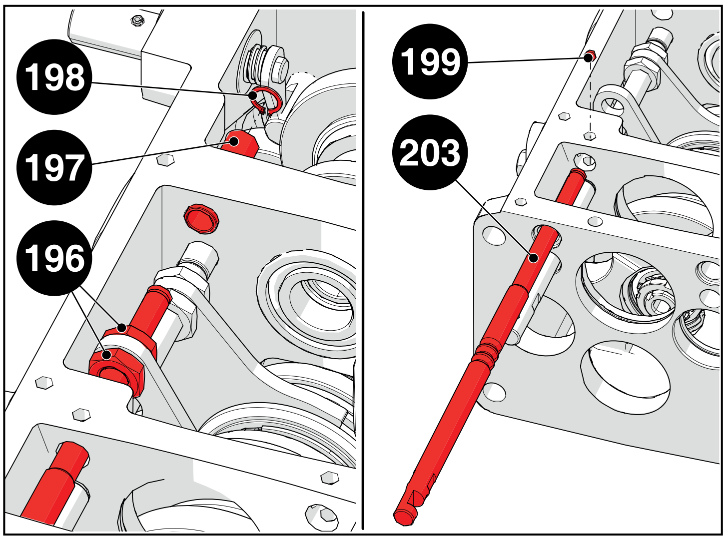

Fig. 4.36

Undo the plug (201) and remove the copper washer (202), the spring (200) and the ball (199).

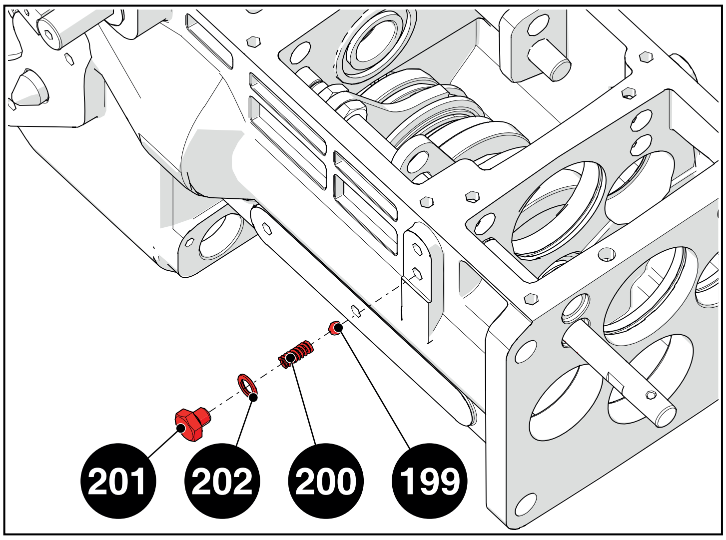

Fig. 4.37

Remove the circlip (198) and remove the bush (197).

Undo the nuts (196) and remove the rod (195).

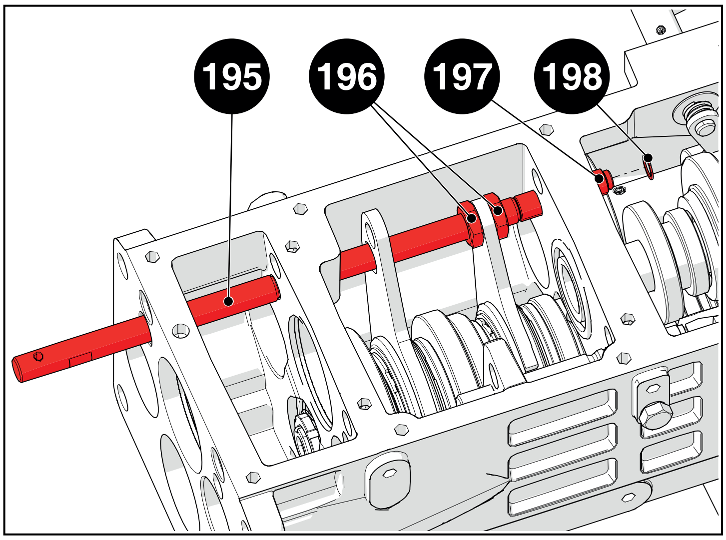

Fig. 4.38

Remove the forks (193) and (194).

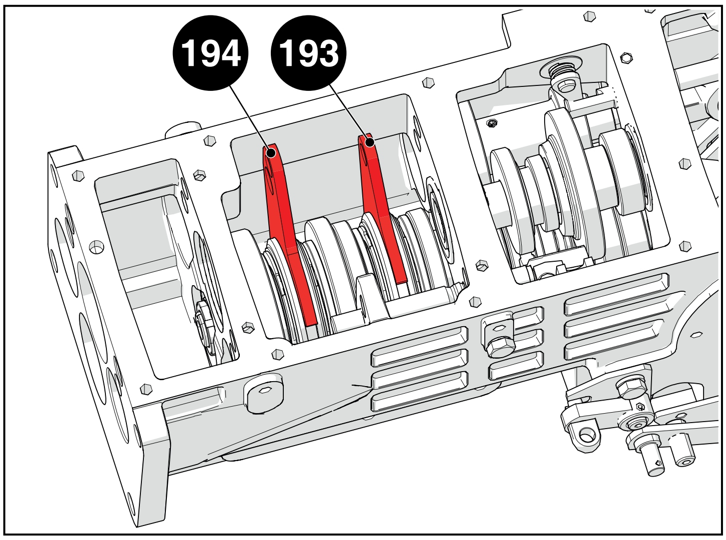

Fig. 4.39

Remove the bearing (12) and the spacer (13).

Remove the second bearing (14).

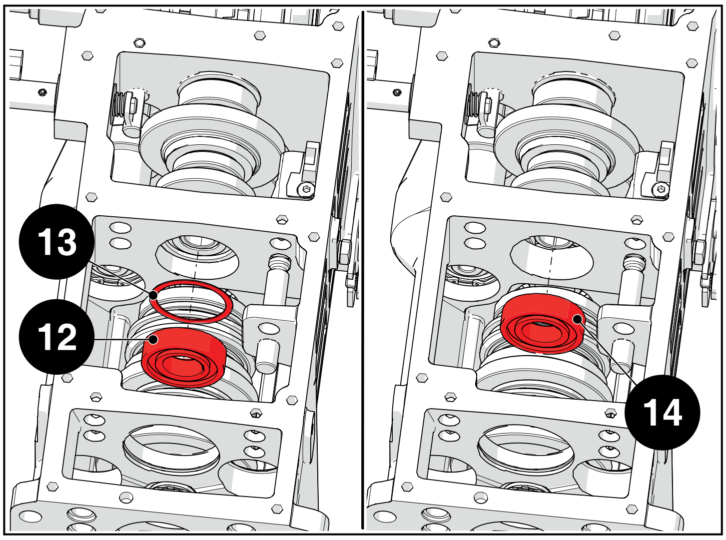

Fig. 4.40

Remove the complete shaft (20) from the transmission casing.

Remove the second bearing (14).

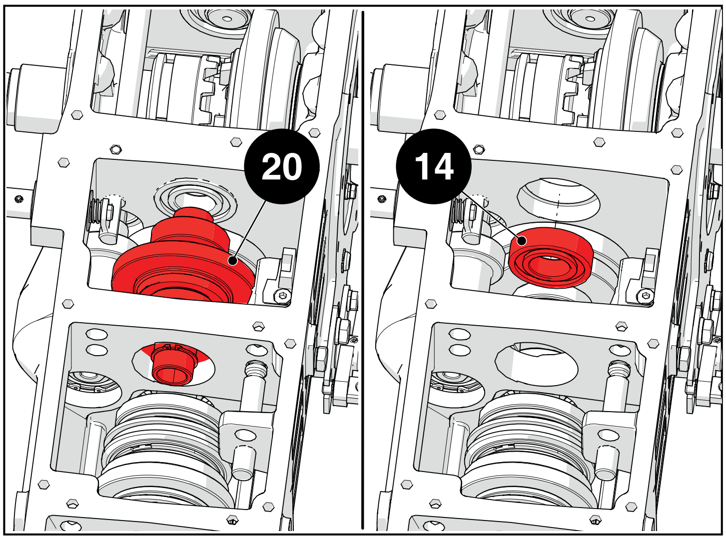

Fig. 4.41

Disassemble the primary shaft (20), removing the following parts in the order indicated:

- Circlip (15);
- Gear (16);
- Circlip (17);
- Spacer (19);
- Gear (18);
- Spacer (19);

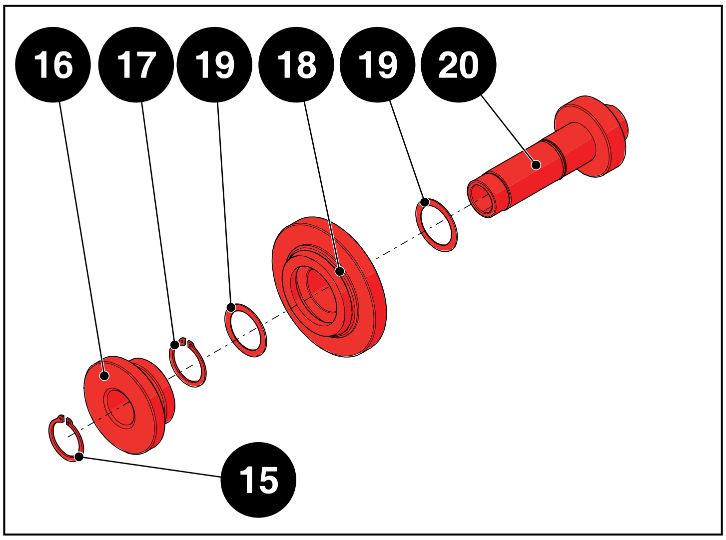

Fig. 4.42

Undo the stop screw (190).

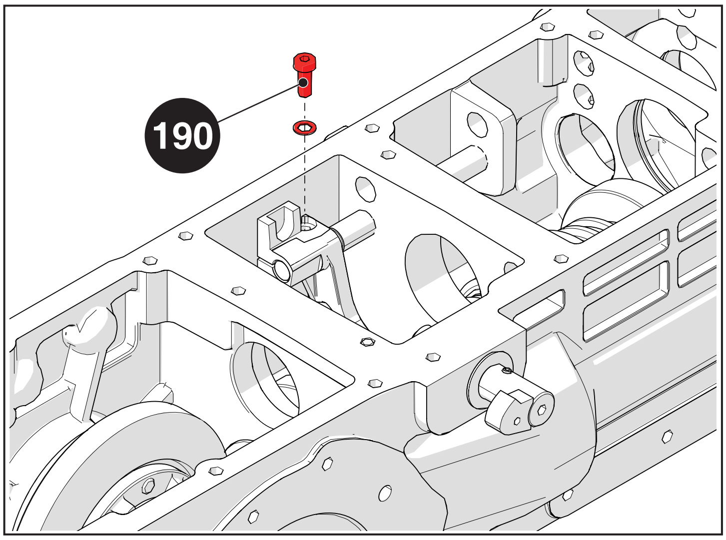

Fig. 4.43

Undo the plug (188) and remove the copper washer (189), the spring (187) and the ball (186).

Remove the complete fork (184) and the rod (185).

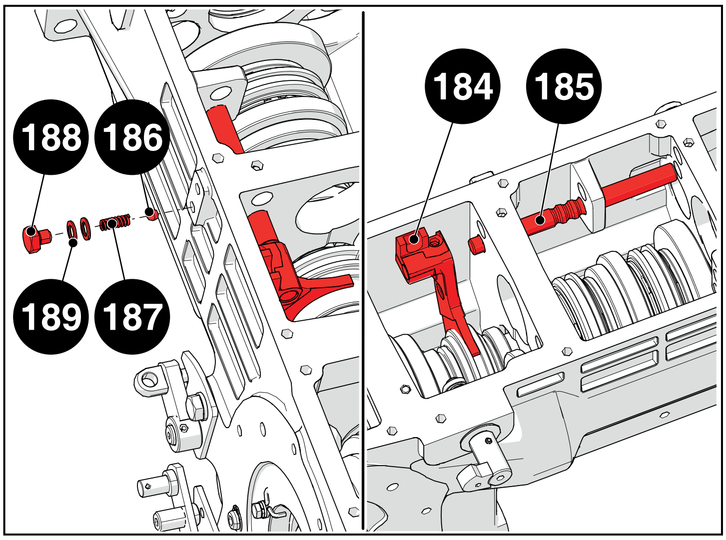

Fig. 4.44

Remove the spring pin (183), the sleeve (182) and the spacers (181) and then remove the oil seal (180).

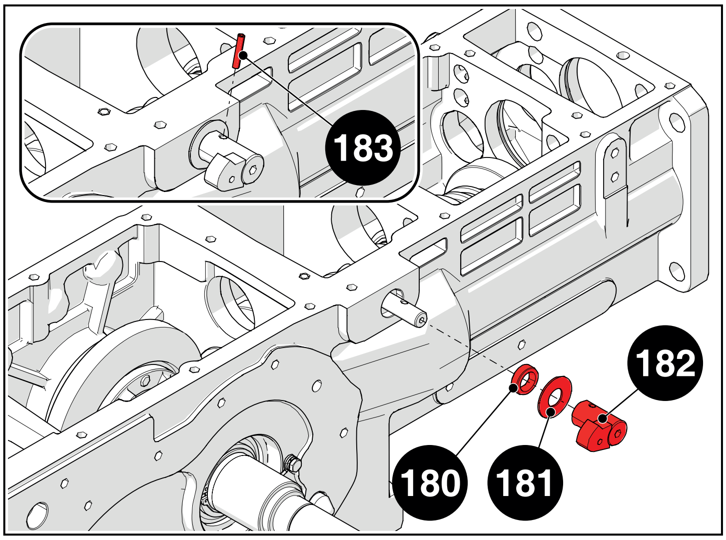

Fig. 4.45

Undo the nuts (177), and then remove the knurled washers (178) and the fork (179).

Remove the pin (176), the spring (175) and the ball (174).

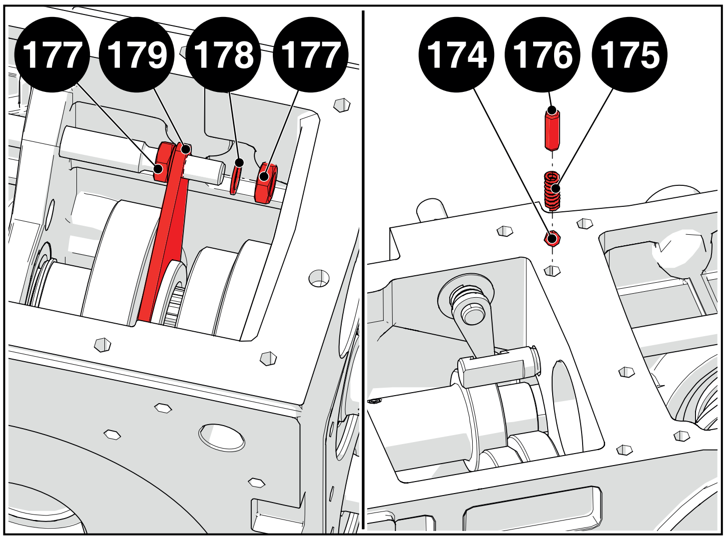

Fig. 4.46

Remove the rod (170), the lever (173), the spring (171) and the spacer (172).

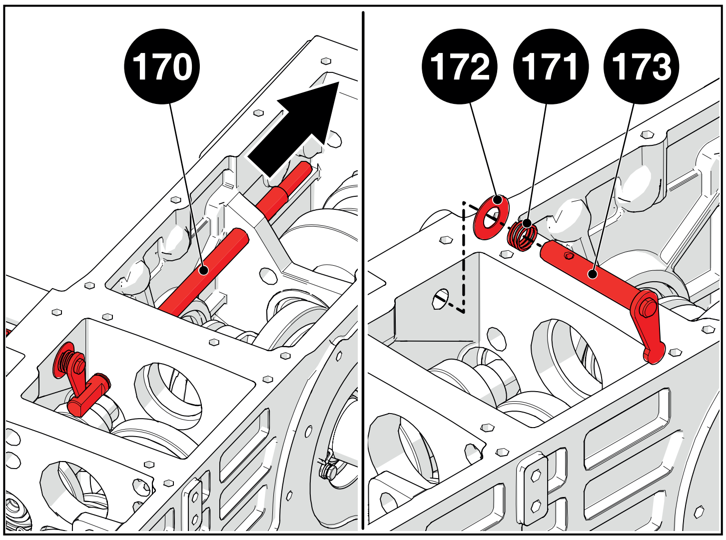

Fig. 4.47

Undo and remove the ring nut retainers (74) on both sides.

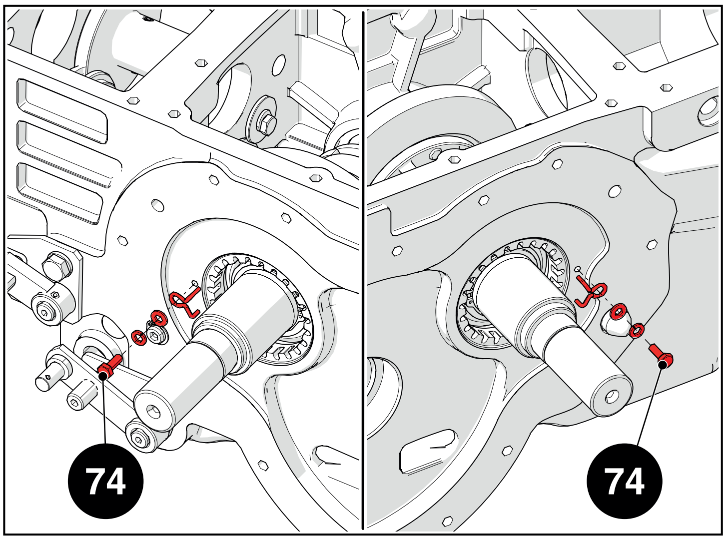

Fig. 4.48

Remove the ring nuts (78) and (90).

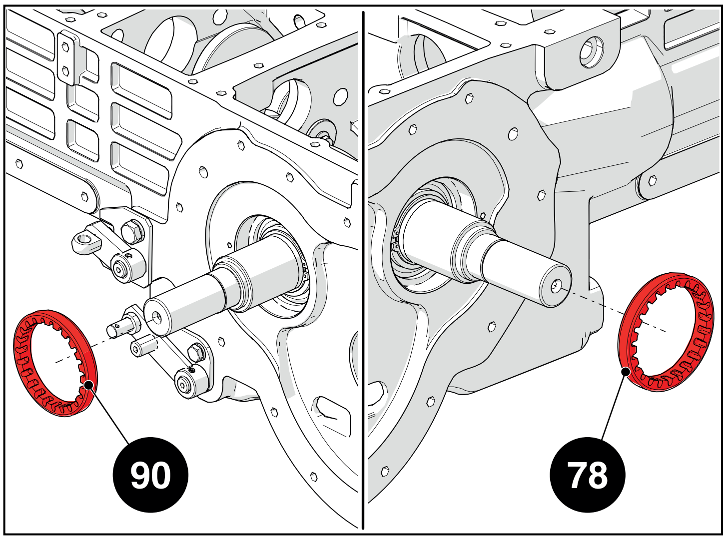

Fig. 4.49

On the side opposite the crown wheel, remove the planetary gear spindle (79) complete with bearing (81) and circlip (75).

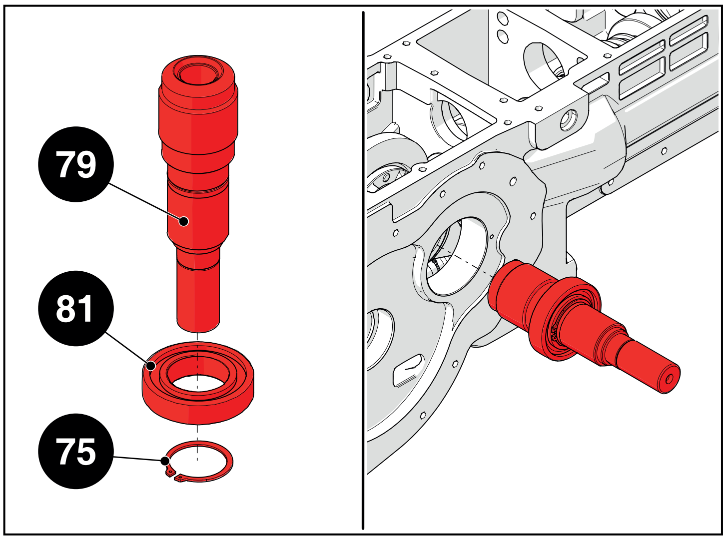

Fig. 4.50

From the crown wheel side, remove the planetary gear spindle (91) from the casing, together with the roller bearing cage (87), the spacer (88) and the bearing (89) secured by the circlip (75).

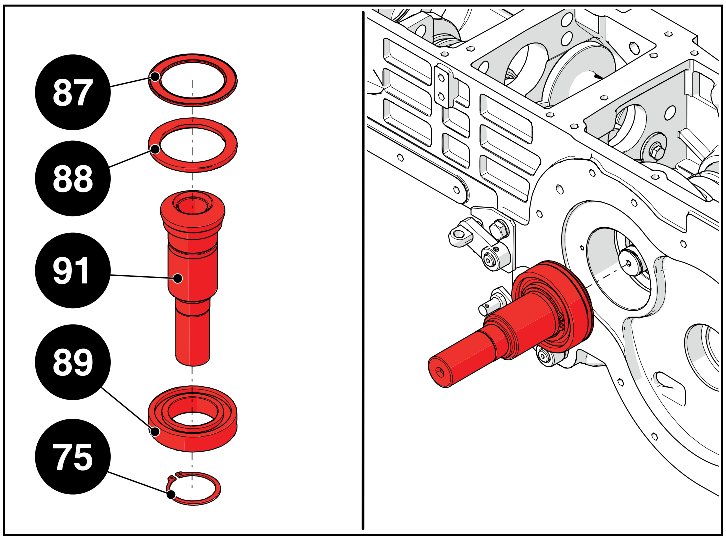

Fig. 4.51

Remove the complete crown wheel from the transmission casing, complete with the spacer (86) and the differential lock pinion (82).

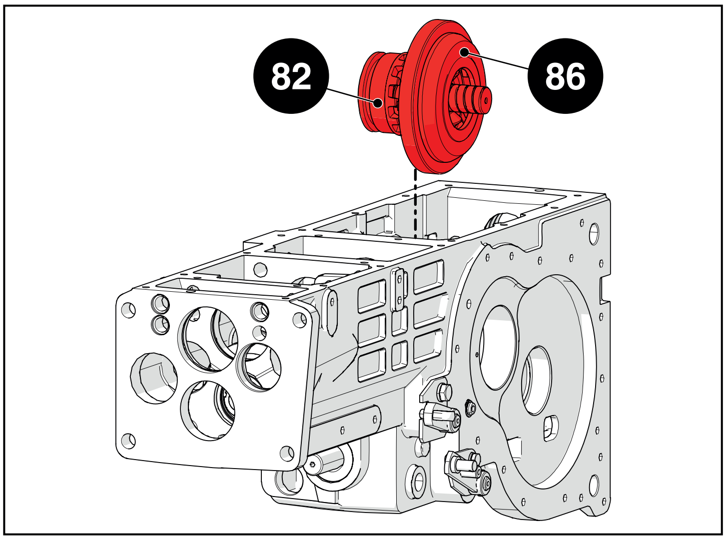

Fig. 4.52

Remove the circlip (168) and then remove the rod (167), the spring (166) and the fork (165) from the transmission casing.

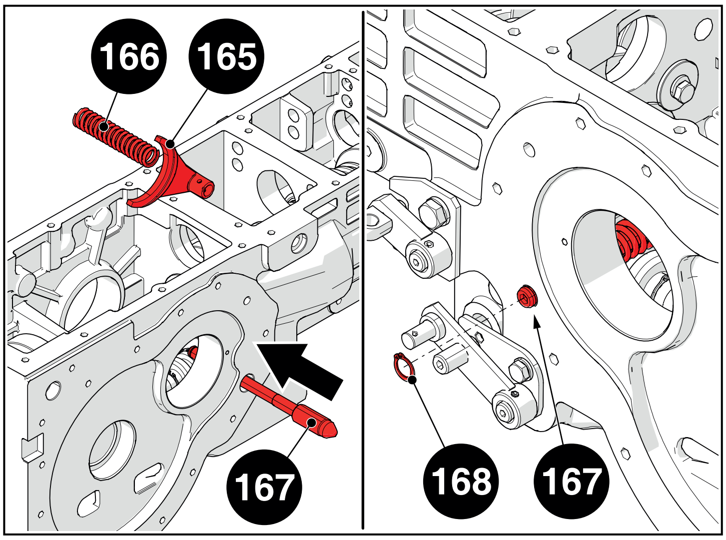

Fig. 4.53

Remove the oil seals (110), (137) and (116).

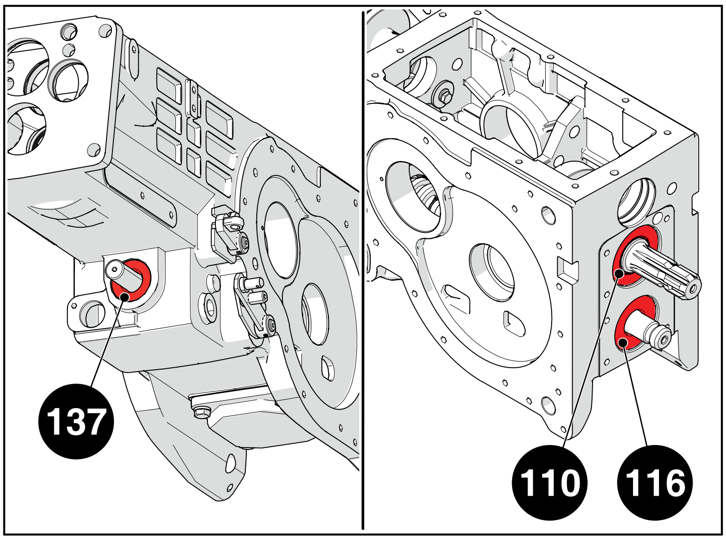

Fig. 4.54

Remove the circlips (111) and (93) securing the upper PTO shaft.

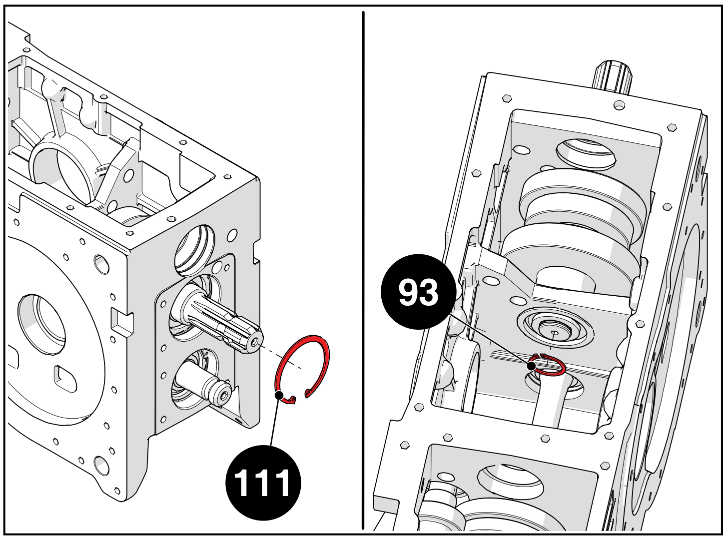

Fig. 4.55

Remove the complete upper shaft (109) together with the splined bushes (96) and (98).

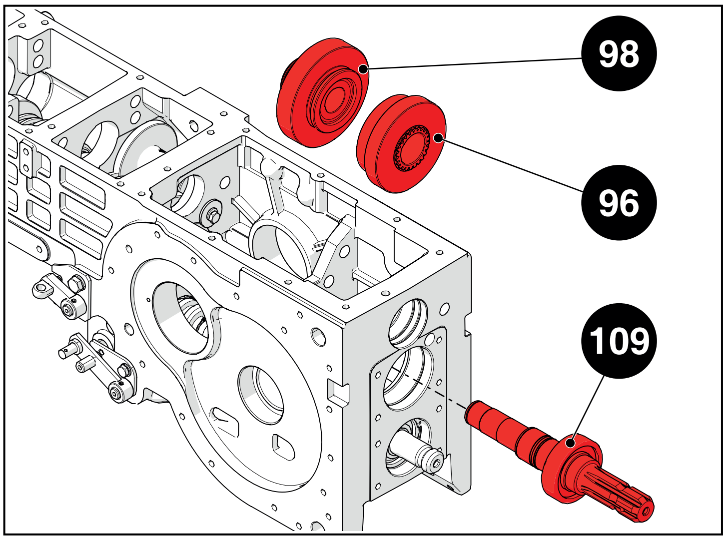

Fig. 4.56

Disassemble the splined bush (98), removing the circlip (95), the PTO driven gear (100), the PTO drive gear (99) and the circlip (95).

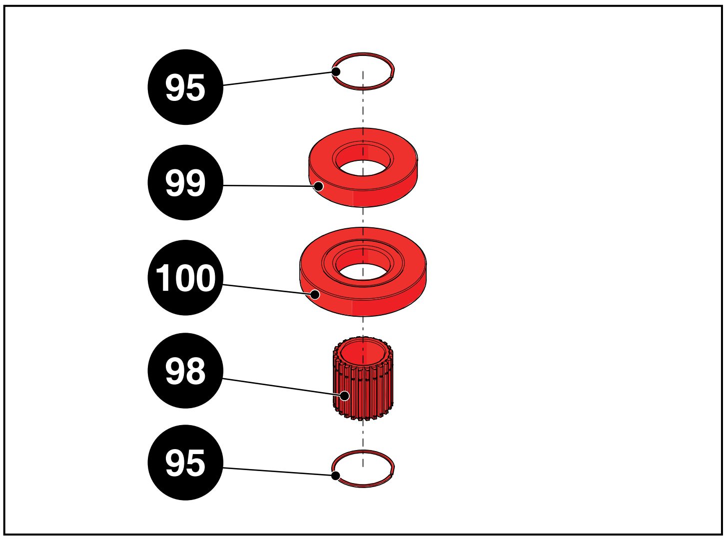

Fig. 4.57

Disassemble the splined bush (96), removing the circlip (95) and the PTO selector gear (97).

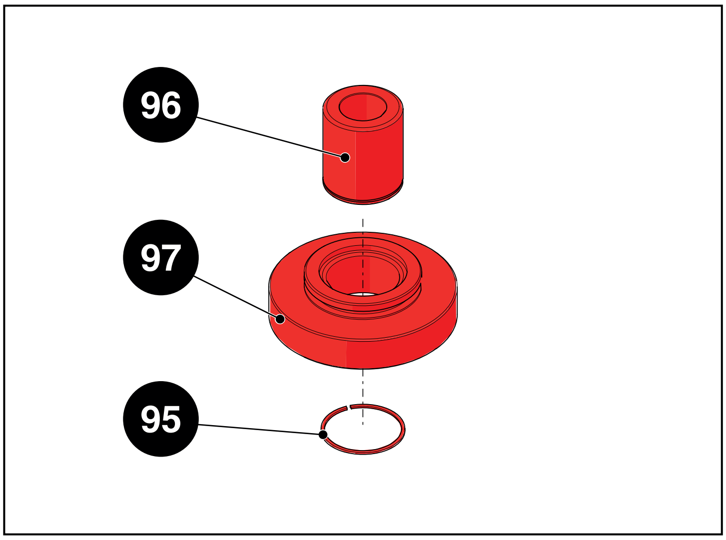

Fig. 4.58

Disassemble the upper PTO shaft (109), removing the roller bearing cage (113), the spacer (114) and the second roller bearing cage (113)

Then remove the spacer (107), the circlip (108) and the bearing (112).

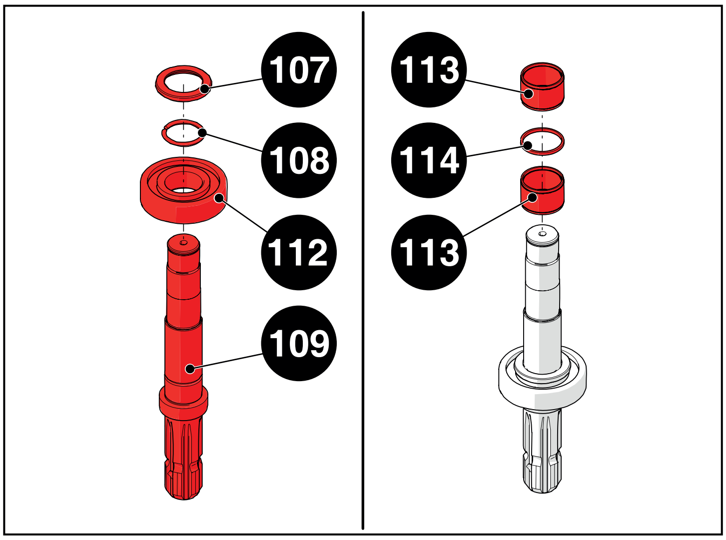

Fig. 4.59

Remove the bearing (94) from the transmission casing.

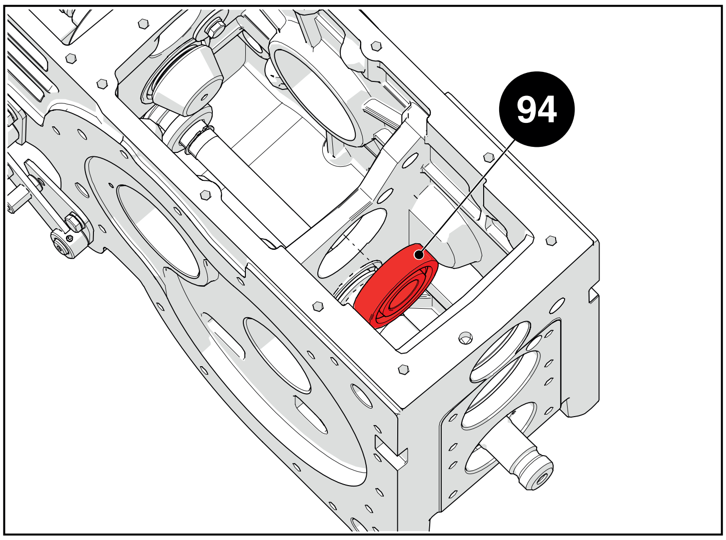

Fig. 4.60

Undo the screw (24) and remove the washer (23) and the spacer (22).

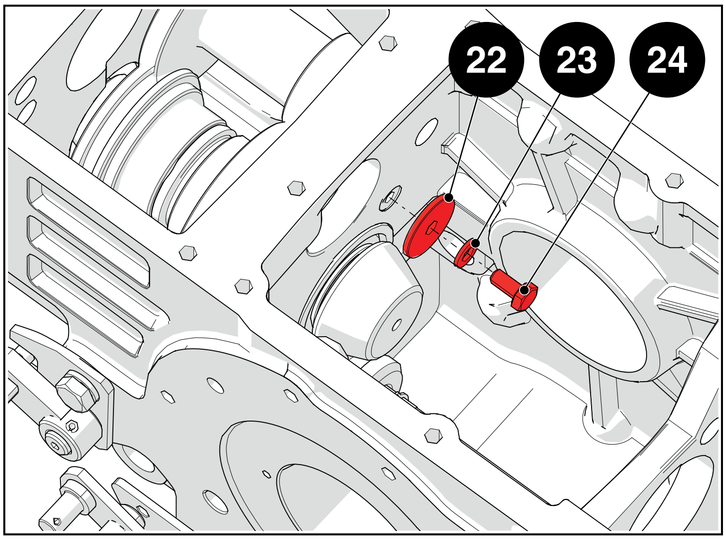

Fig. 4.61

Remove the complete pinion (25).

Remove the gear pack consisting of the following components:

- Gear (32);
- Sleeve (33);
- Gear (31);
- Bush (30);
- Gear (29);

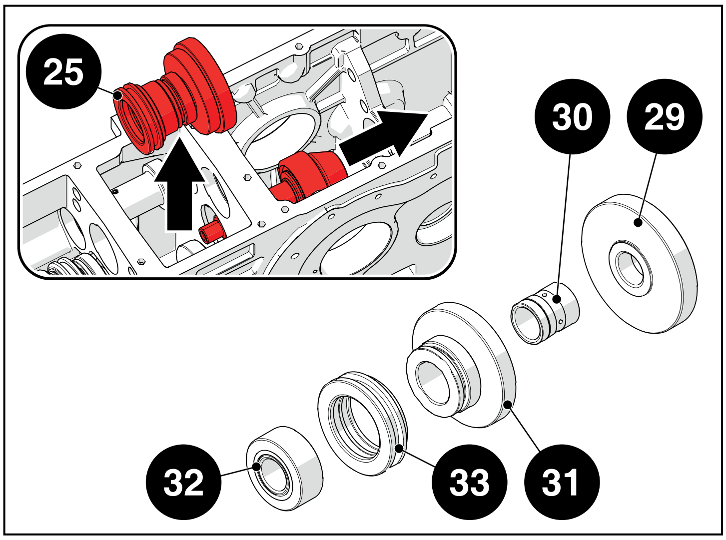

Fig. 4.62

Remove the roller bearing cage (34) from the secondary shaft.

Disassemble the pinion (25), removing the following parts in the order given:

- Circlip (28);
- Spacer (27);
- Bearing (26);

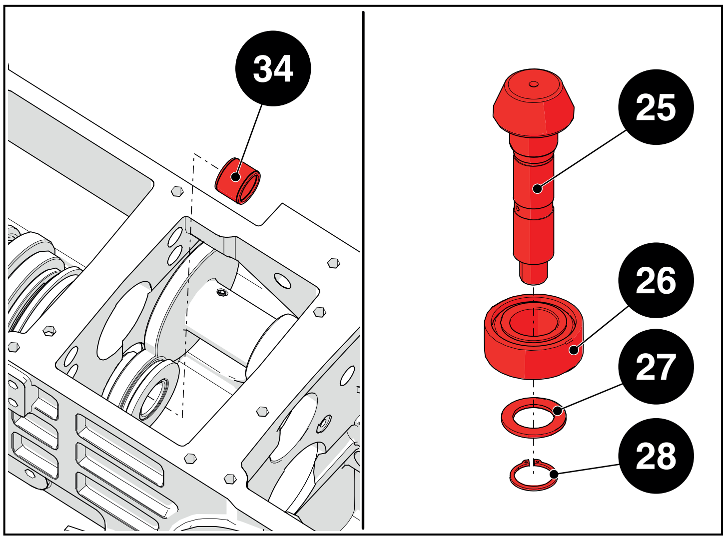

Fig. 4.63

Remove the spacer (230) and the circlip (48).

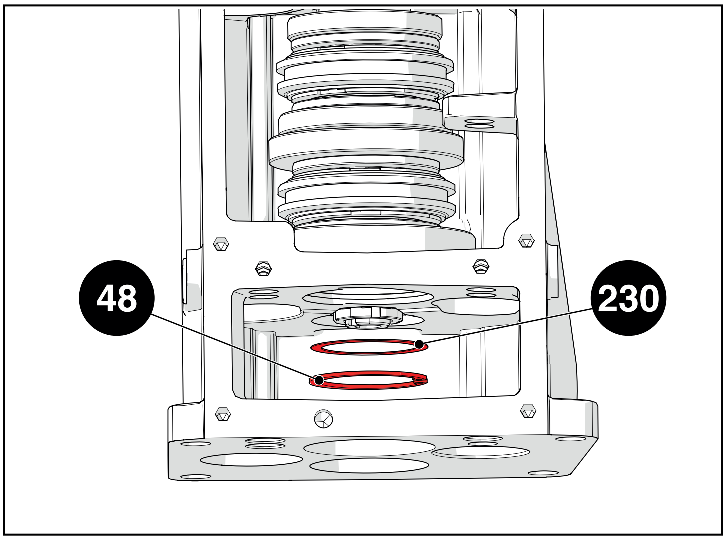

Fig. 4.64

Use the tool (F-07007332) to prevent the shaft from rotating and then undo the ring nut (50).

Remove the ring nut (50) and the ring nut retainer (49).

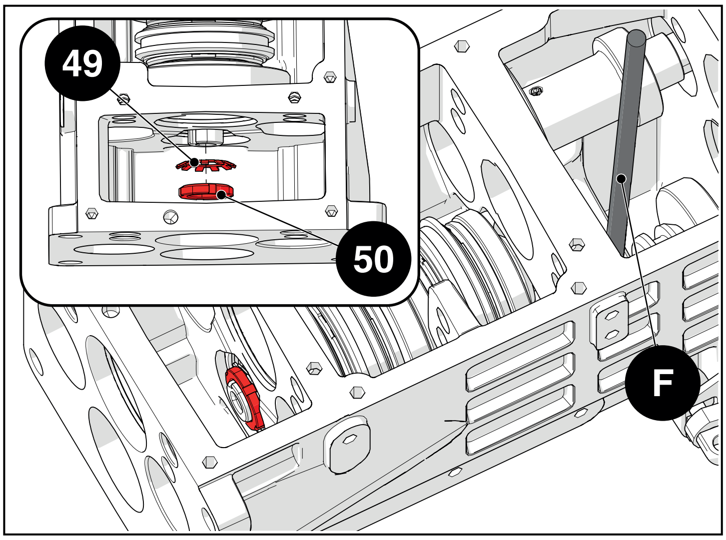

Fig. 4.65

Pull the shaft (51) out from the transmission casing.

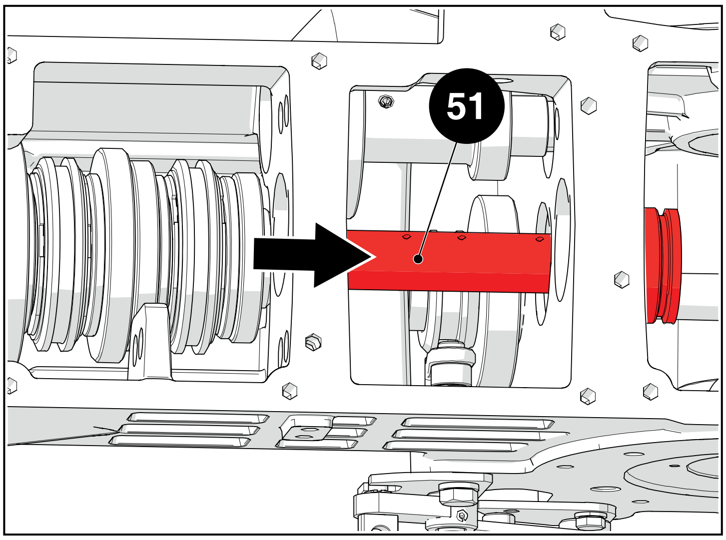

Fig. 4.66

Remove the gearbox gear pack, consisting of the following components, from the transmission casing:

- Bush (40);
- 1st speed gear (41);
- Synchroniser (39)
- Bush (37);
- 2nd speed gear (38);
- Spacer (42);
- Bush (43);
- 3rd speed gear (45);
- Synchroniser (39);
- Bush (43);
- 4th speed gear (44);

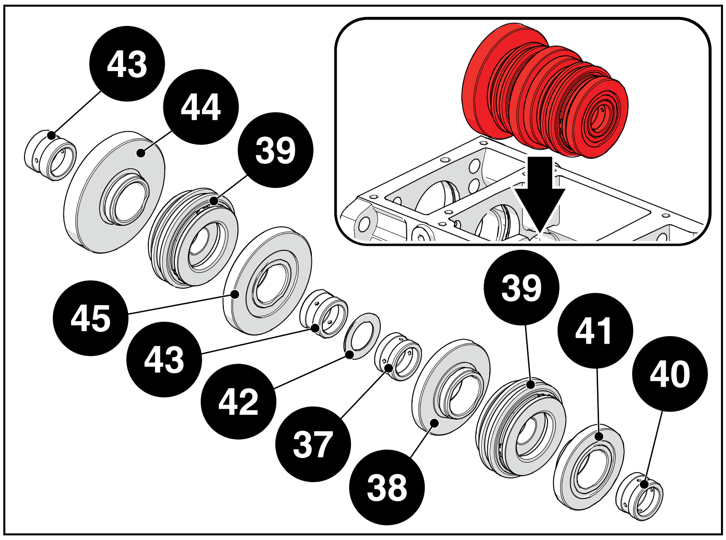

Fig. 4.67

Remove the bearing (47), the spacer (46) and the bearing (35).

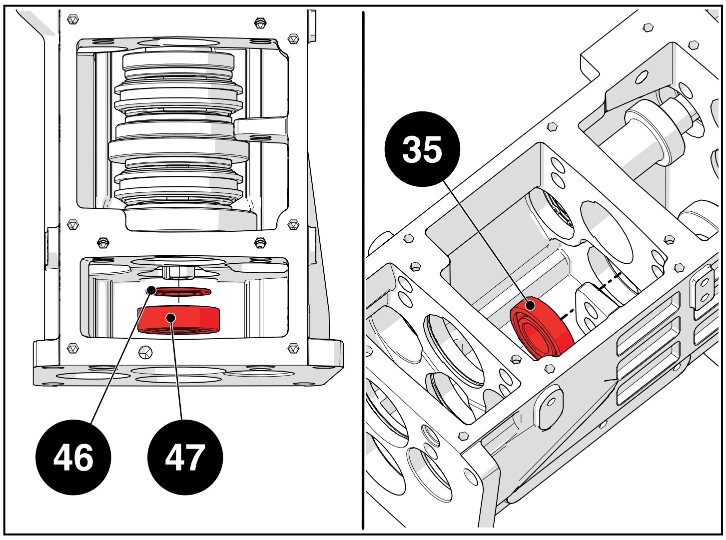

Fig. 4.68

Remove the circlip (61), the bearing (62) and the spacer (64).

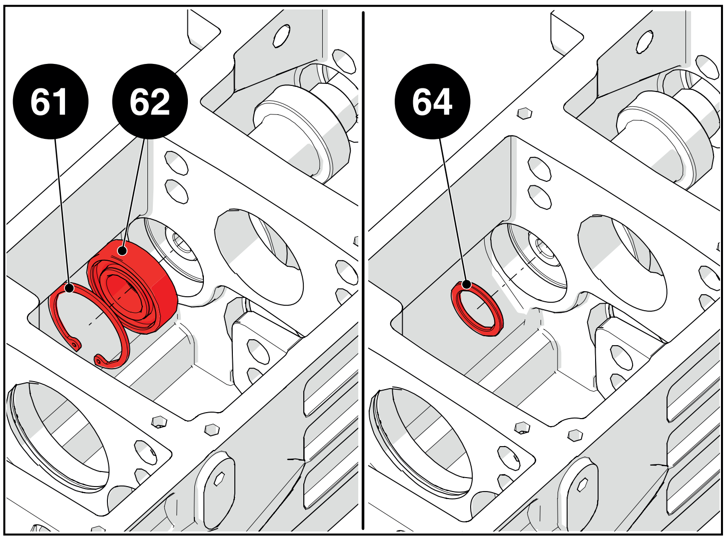

Fig. 4.69

Remove the spring pin (164).

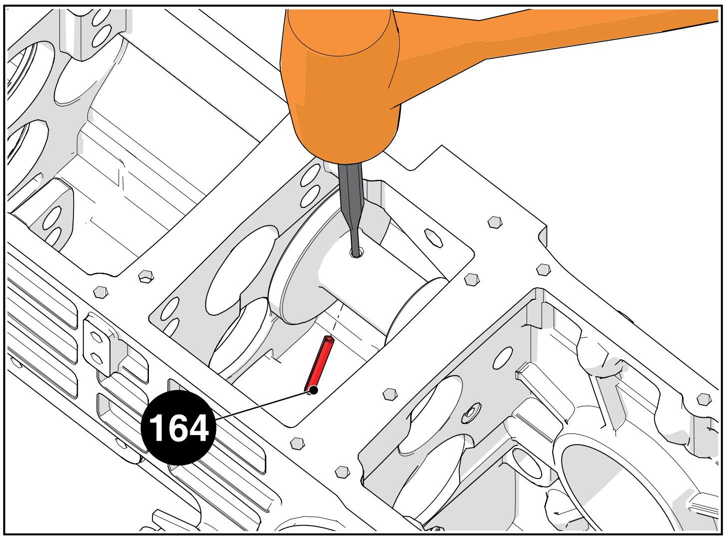

Fig. 4.70

Remove the reverse shaft (65), the gear (63) and the spacer (66).

Remove the bearing (62) from the casing.

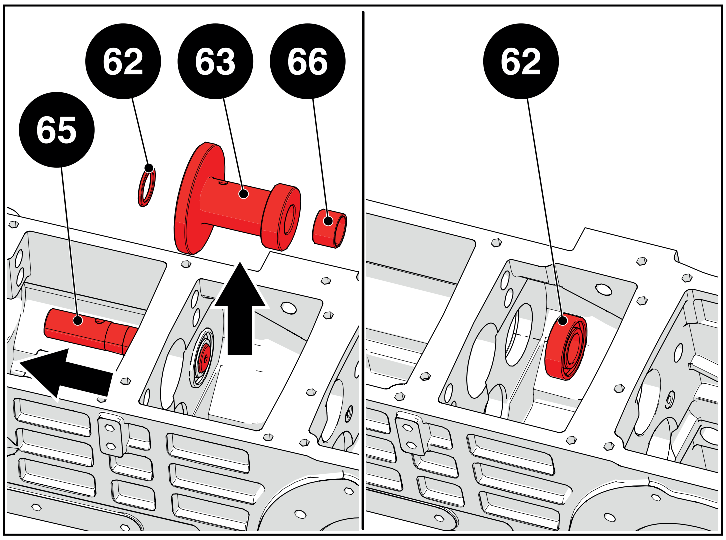

Fig. 4.71

Remove the spring pins (225) and (229) and remove the levers (223) and (228).

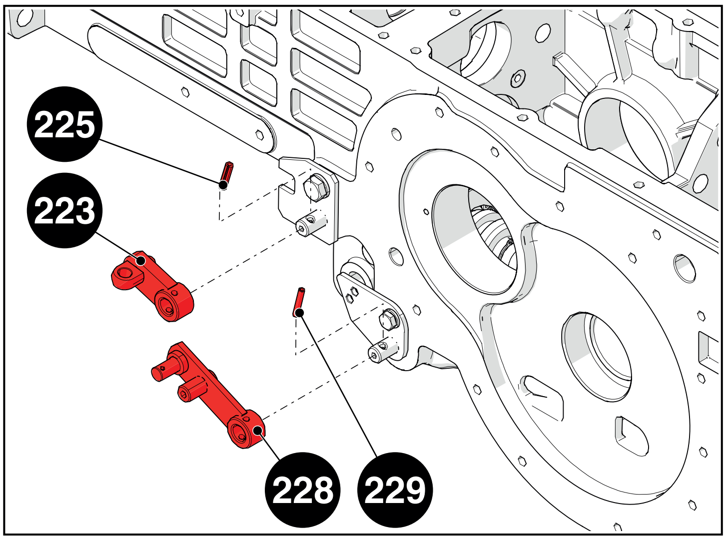

Fig. 4.72

Undo the screws (221) and remove the washers (220) and the plates (219).

Remove the oil seals (161) and (163).

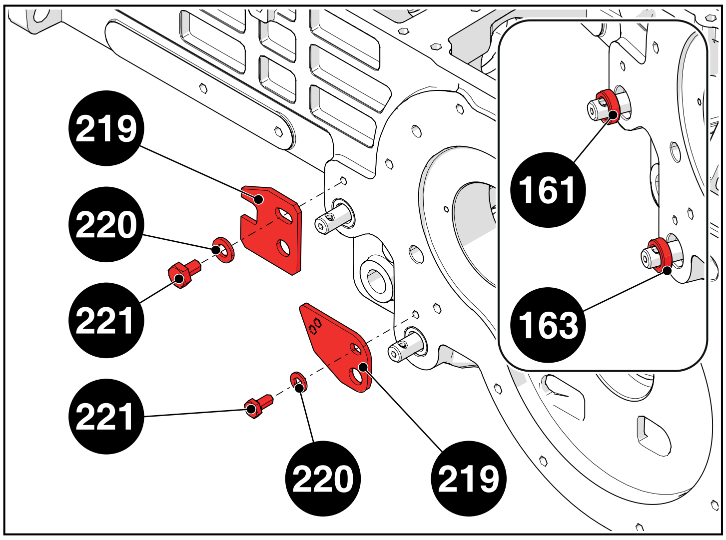

Fig. 4.73

Screw the tools (A-p/n 07007163) onto the threads of the levers and tighten to compress the springs.

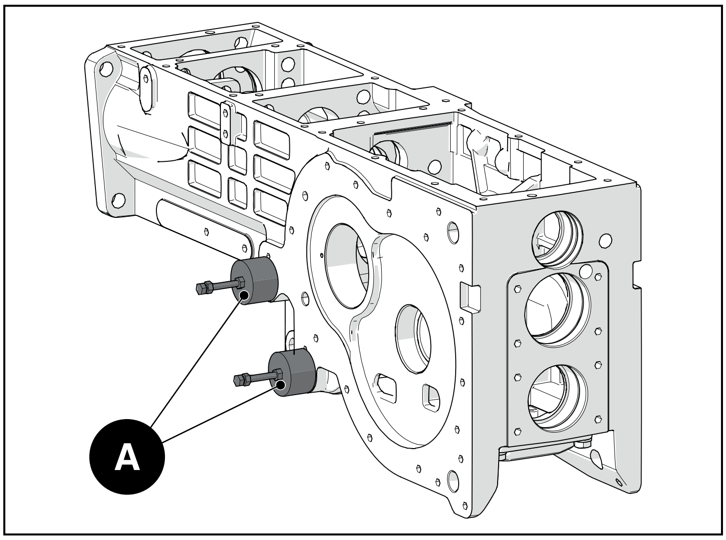

Fig. 4.74

Remove the circlip (117).

Pull out the complete shaft (127) while simultaneously removing the circlip (128), the spacer (124) and the PTO idler gear (123).

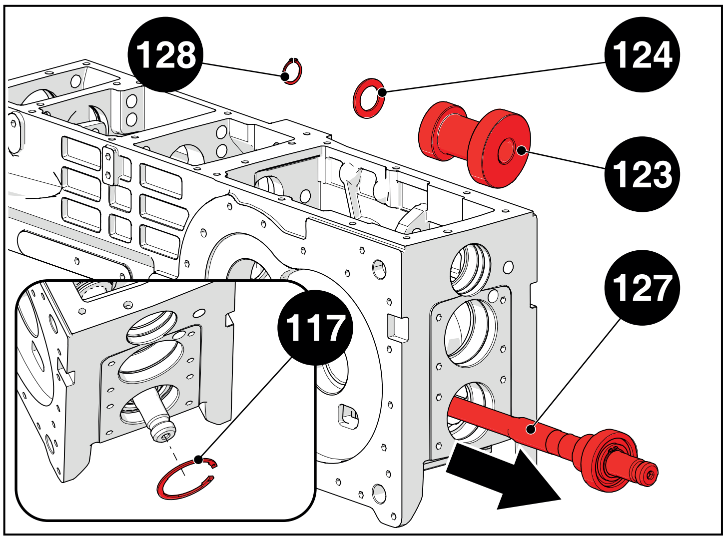

Fig. 4.75

Disassemble the Ground speed PTO shaft (127), removing the circlip (115), the bearing (118), the bush (122) and the ring (121)

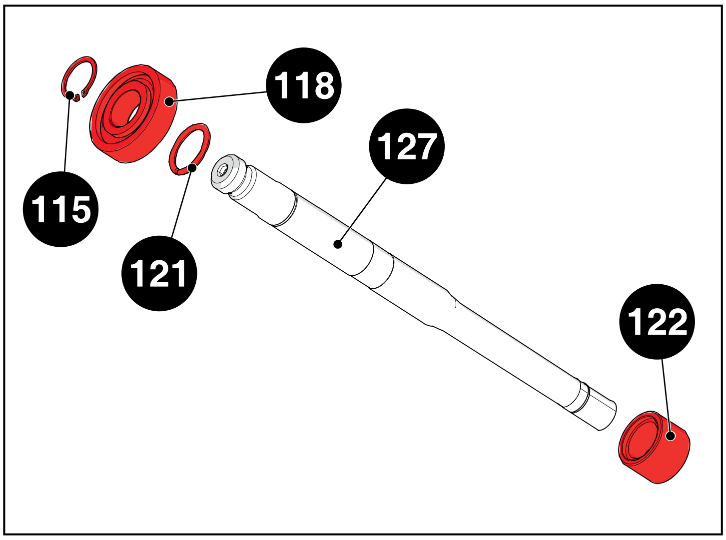

Fig. 4.76

Remove the sleeve (129).

Remove the circlips (131) and the bearings (132).

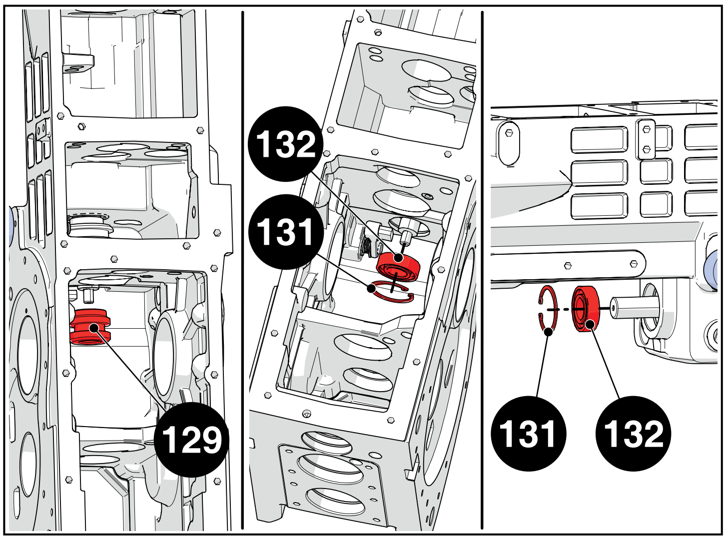

Fig. 4.77

Remove the belly PTO shaft (138).

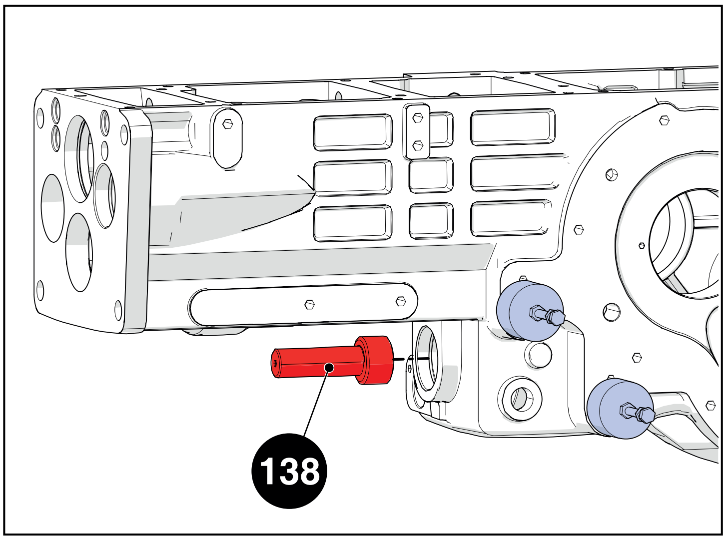

Fig. 4.78

Remove the sleeve (135), the gear (134) and the shaft (130).

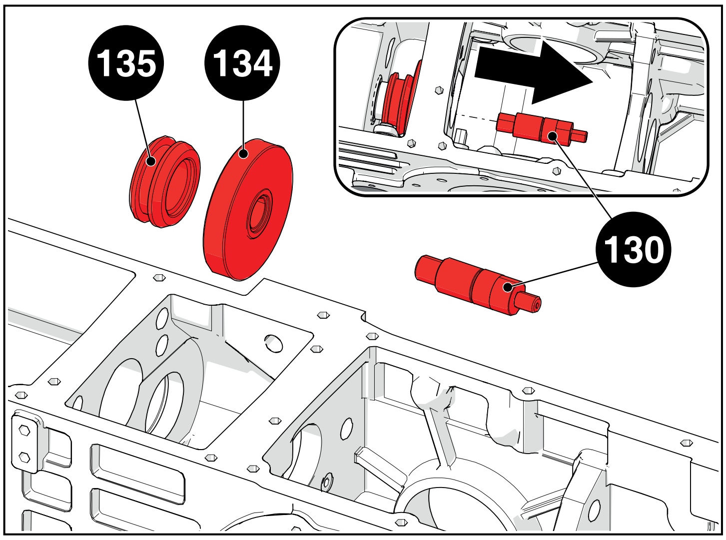

Fig. 4.79

Remove the circlip (133) from the shaft (130).

Remove the roller bearing cage (136) from the belly PTO shaft (138).

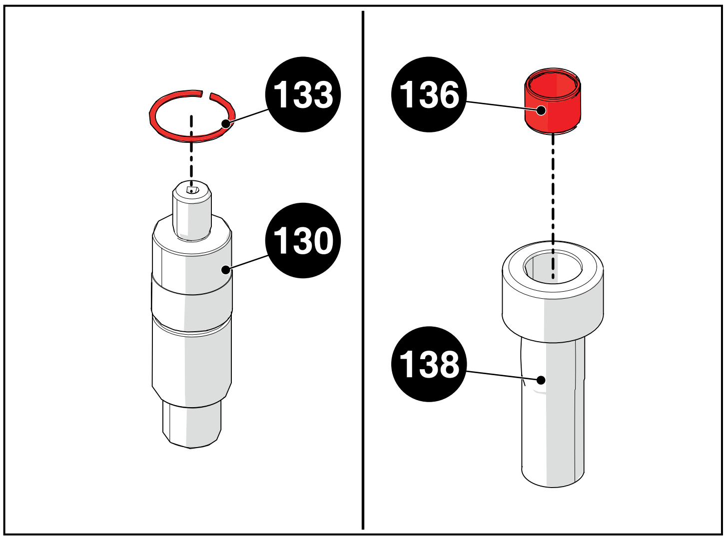

Fig. 4.80

Remove the tools (A-p/n 07007163).

Remove the levers (159) and (155) from the transmission casing.

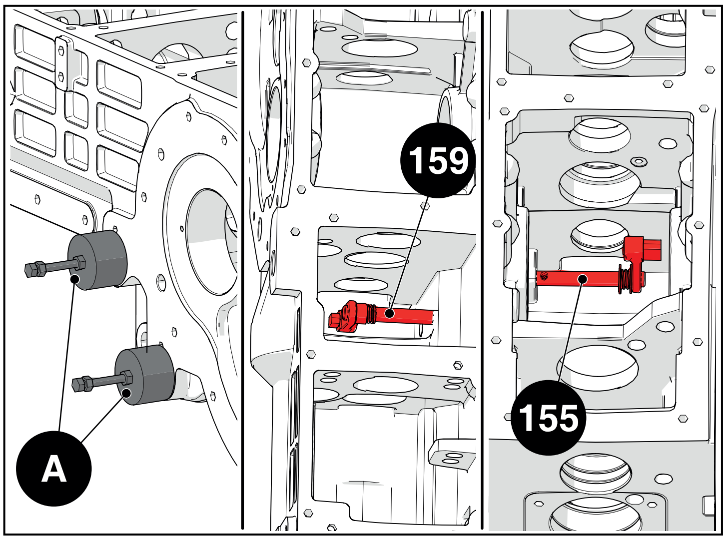

Fig. 4.81

Undo the screws (120) and remove the washers (119) and the cover (125).

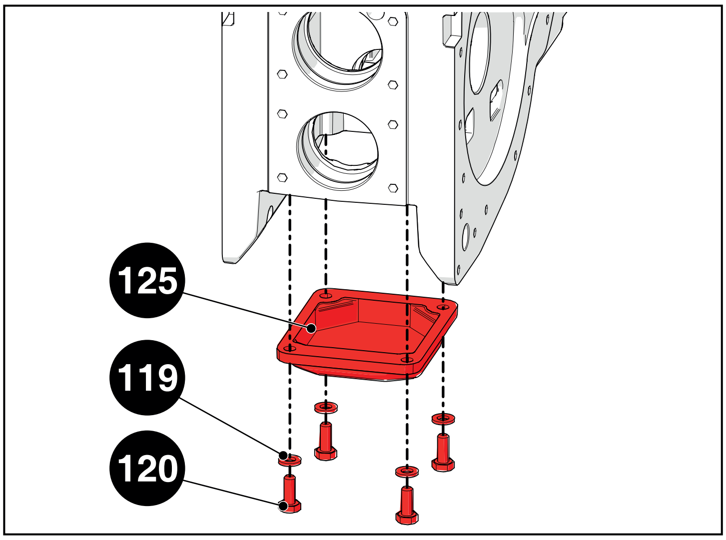

Fig. 4.82

4.2.1 Disassembling/Assembling the differential crown wheel

Disassembly

Use a scalpel to bend back the plate (85) and free the screws (84).

Undo the screws (84) and remove the plates (85).

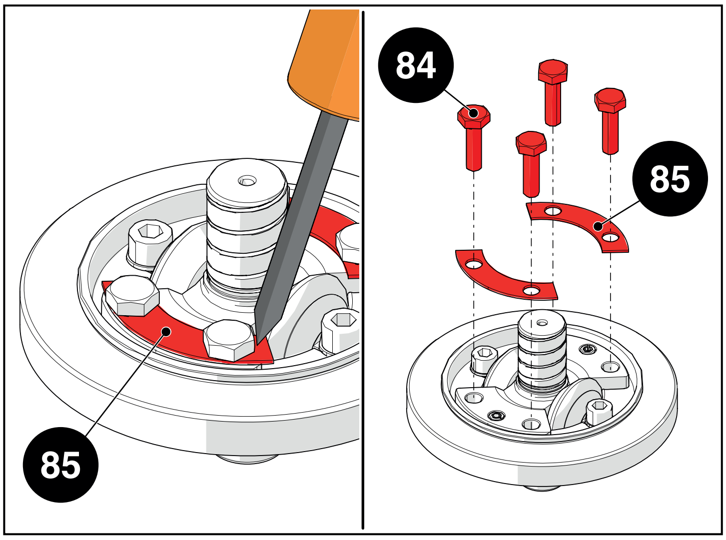

Fig. 4.83

Remove the crown wheel (76).

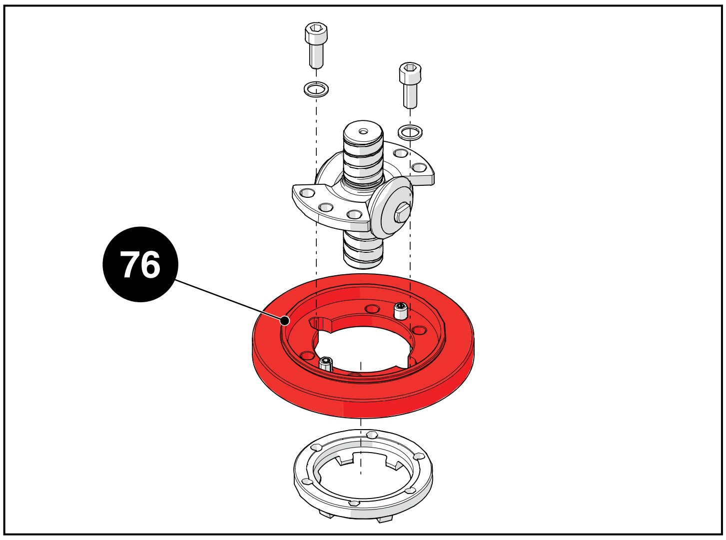

Fig. 4.84

Remove the pins (231) from the crown wheel (76).

Remove the planet gears (233) and the centre shaft (232) of the differential.

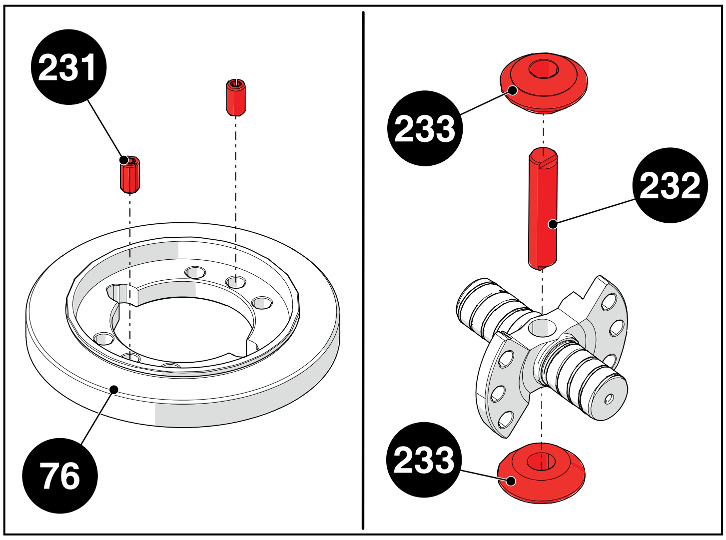

Fig. 4.85

Assembly

Fit the planet gears (233) and the centre shaft (232) of the differential.

Fit the pins (231) on the crown wheel (76).

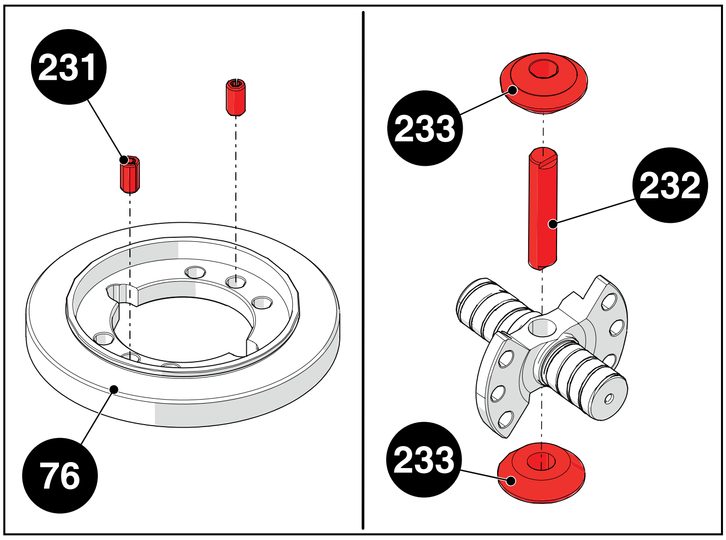

Fig. 4.86

Fit the two assemblies together, aligning the pins (231).

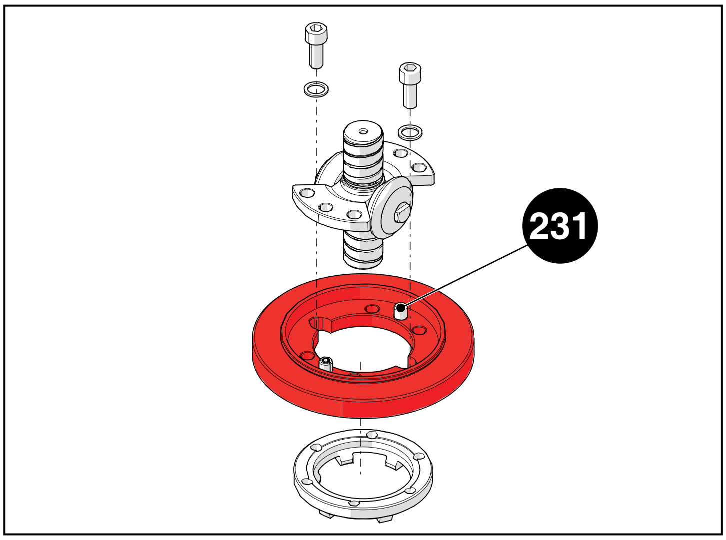

Fig. 4.87

Fit the plates (85).

Tighten the screws (84) to a torque of 90 Nm (9 Kgm).

Use a hammer and a scalpel to bend up the ends of the plates against the heads of the screws (84).

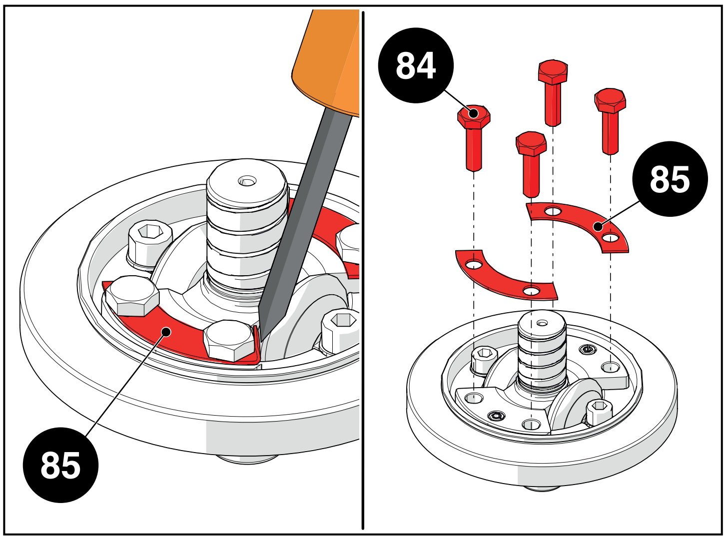

Fig. 4.88

Section 5 : Main inspection, reassembly and adjustment procedures

Index

5.1 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".

Apply a layer of silicone sealant on the mating surface of the lower cover (125).

Warning
Only fill the 2 holes indicated in the figure with silicone sealant.

Fit the washers (119) and tighten the screws (120) to a torque of ___ Nm (___kgm)

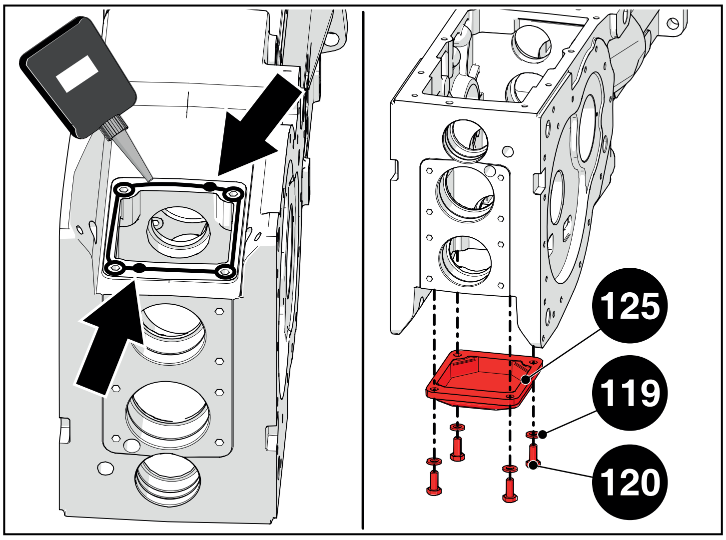

Fig. 4.89

Preassemble the lever (155), fitting the spring (156), 2 spacers (157) and the selector peg (158).

Fit the lever in the transmission case.

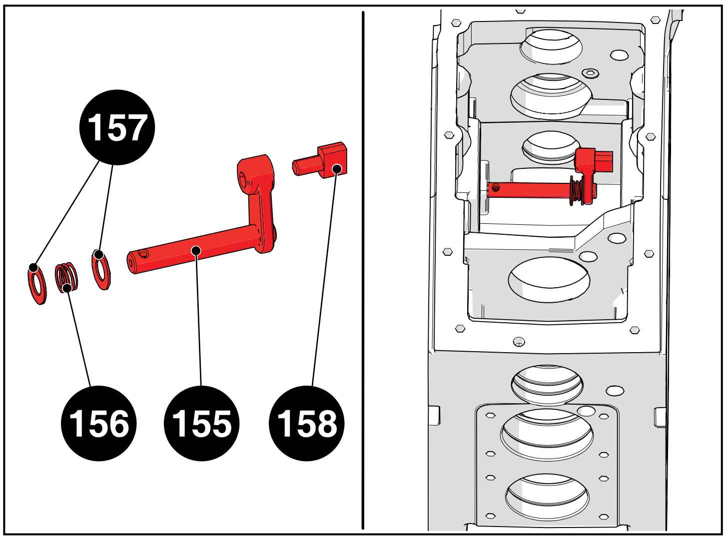

Fig. 4.90

Preassemble the lever (159), fitting the spring (160), the spacer (161) and the selector peg (162).

Fit the lever in the transmission case.

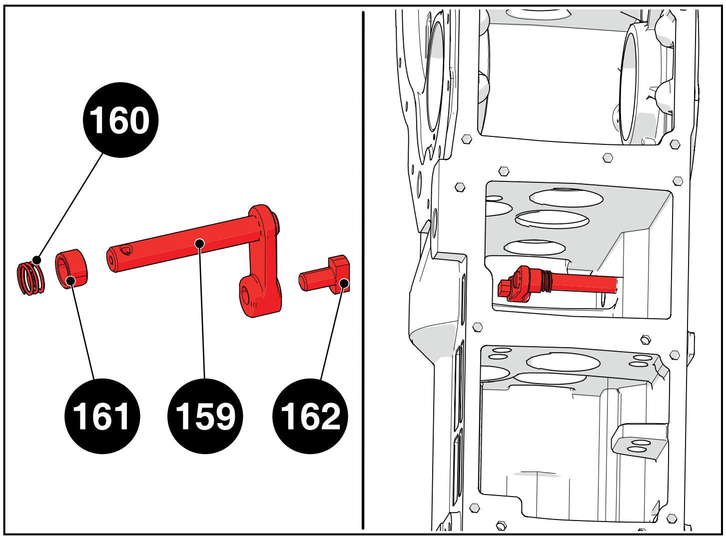

Fig. 4.91

Screw the tools (A-p/n 07007163) onto the threads of the levers and tighten to compress the springs.

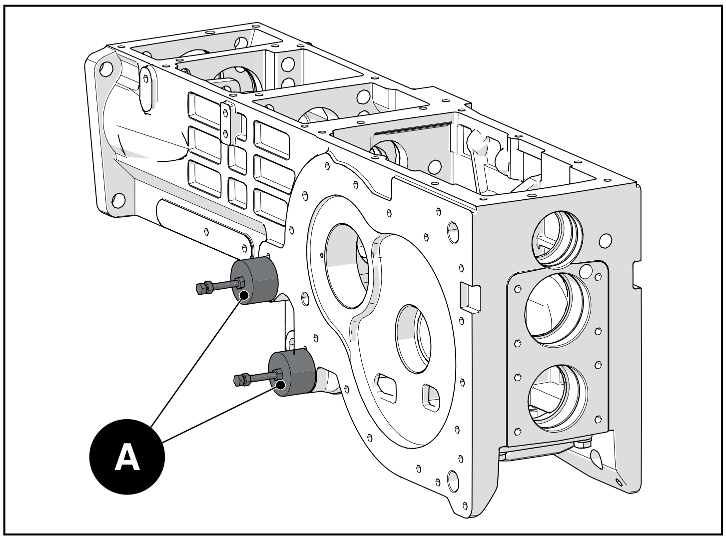

Fig. 4.92

Fit the roller bearing cage (136) onto the belly PTO shaft (138).

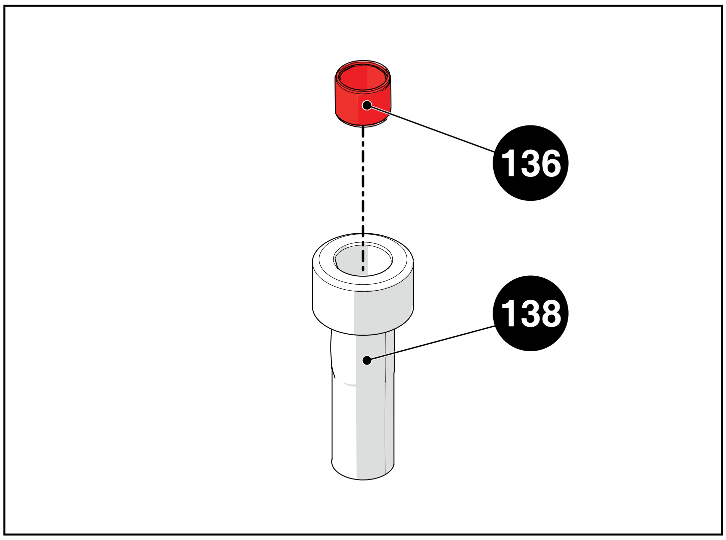

Fig. 4.93

Use the tool (B-p/n________) to fit the circlip (133) onto the shaft (130).

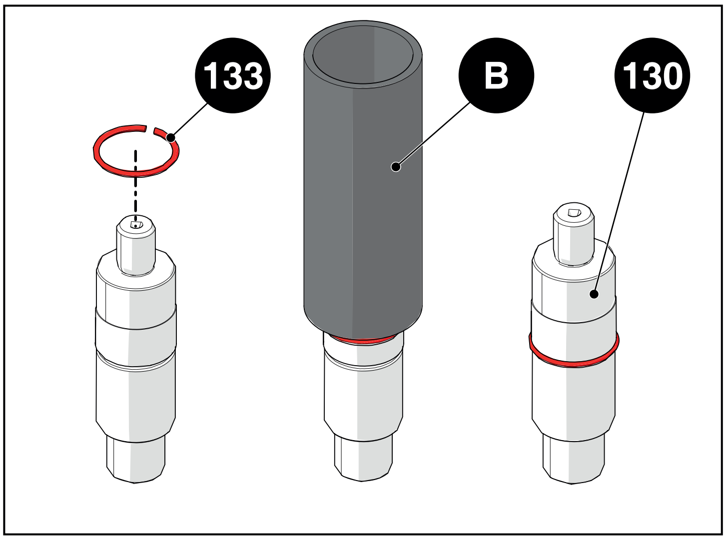

Fig. 4.94

Fit the shaft (130) in the casing, mating with the gear (134) and the sleeve (135).

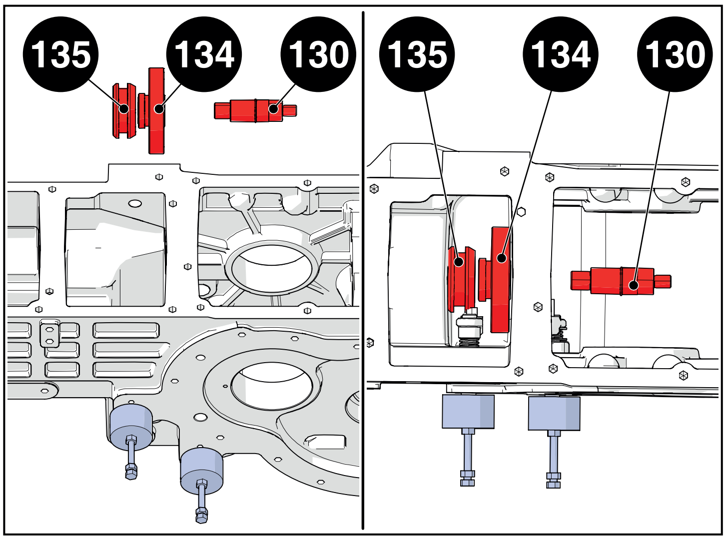

Fig. 4.95

Fit the belly PTO shaft (138) in the transmission casing, engaging correctly with the sleeve (135).

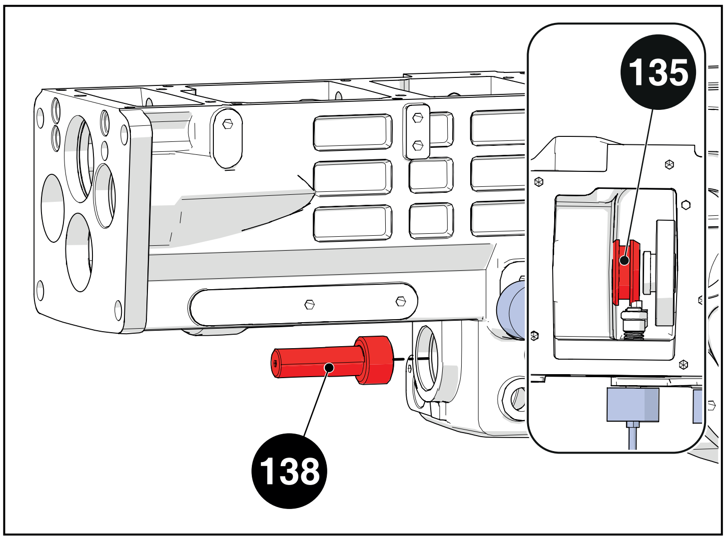

Fig. 4.96

Fit the bearings (132), driving them fully into their seats with a bearing punch tool of suitable diameter, and then secure them in place with the circlips (131).

Fit the sleeve (129).

Warning
Check that the shaft moves freely.

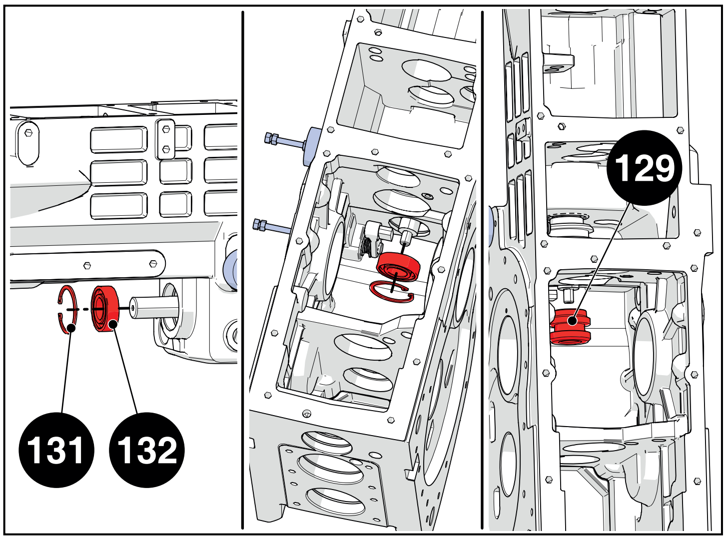

Fig. 4.97

Preassemble the Ground speed PTO shaft (127), fitting the ring (121), the bearing (118) and the circlip (115).

Fit the bush (122).

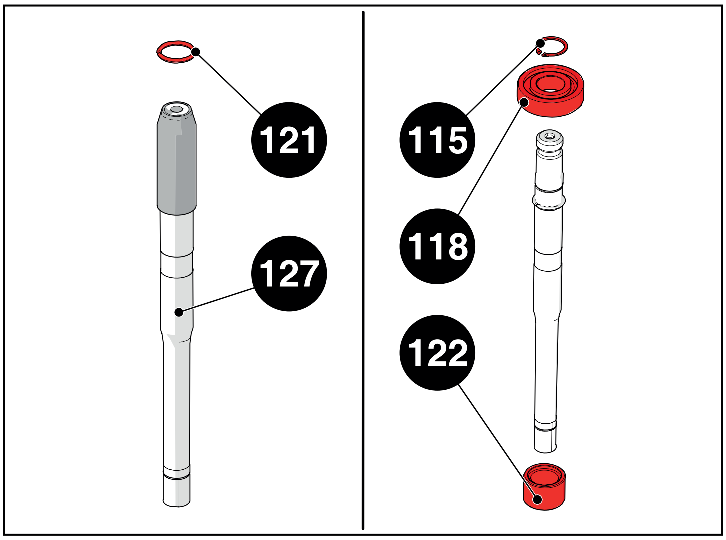

Fig. 4.98

Use a bearing punch tool of suitable diameter to drive the bearing (126) into the casing.

Fit the preassembled shaft in the transmission casing, aligning correctly with the idler gear (123) and the spacer (124).

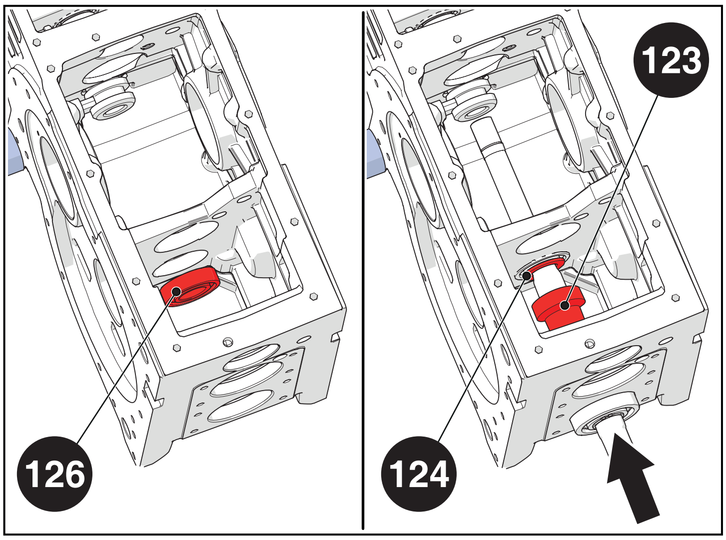

Fig. 4.99

Continue installing the shaft in the casing. Fit the circlip (128) and engage the shaft with the sleeve (129).

Secure the shaft in the casing by fitting the circlip (117).

Warning
Check that the idler gear (123) moves freely.

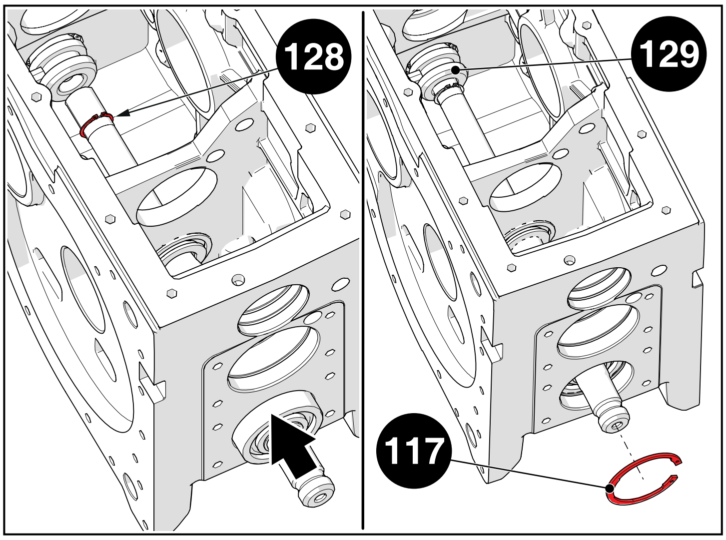

Fig. 4.100

The tools (A-p/n 07007163) may now be removed.

Using the tool (C- p/n_____) as a guide, fit the oil seals (161) and (163) onto the levers with a punch of suitable diameter.

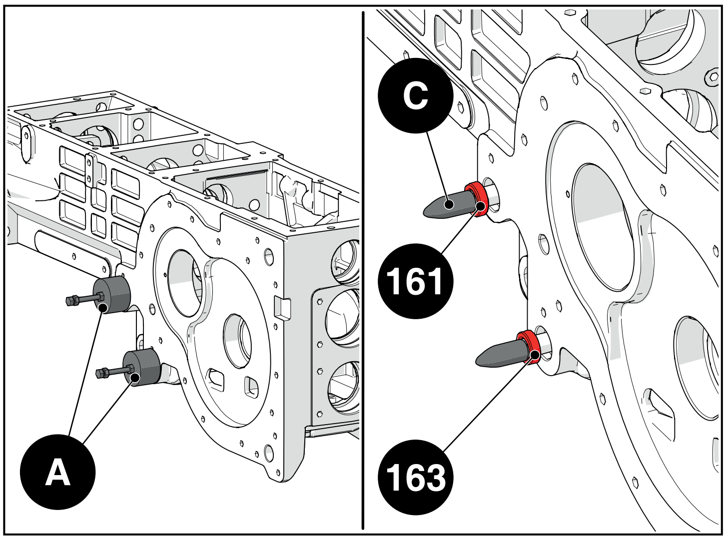

Fig. 4.101

Fit the plates (219) and secure by fitting the washers (220) and the screws (221).

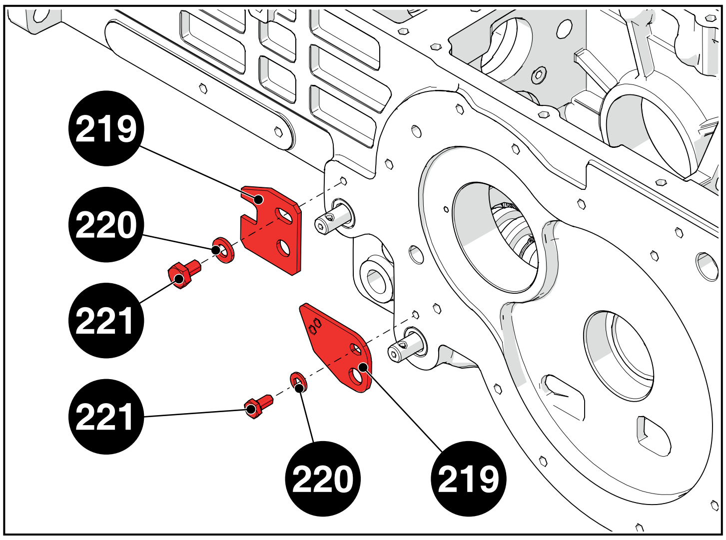

Fig. 4.102

Fasten the pin (222) on the lever (223) with the circlip (224), and then fasten the lever with the pin (225).

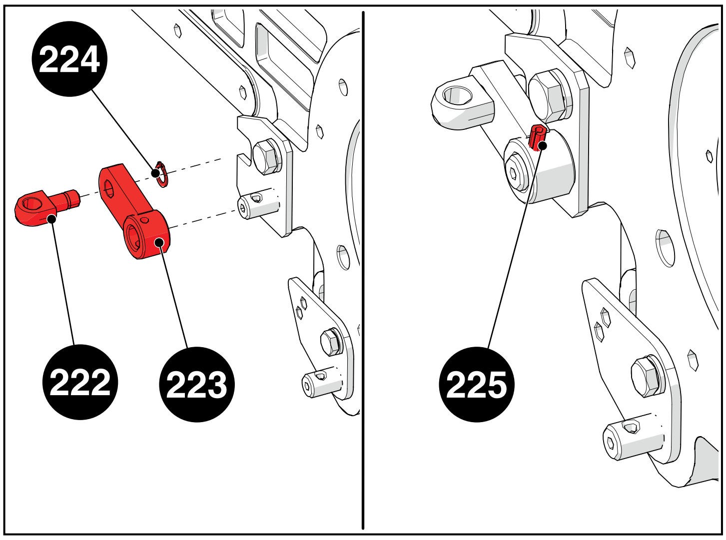

Fig. 4.103

Fit the selector pin (226) and the spring (227) into the lever (228) and then fasten the lever with the pin (229).

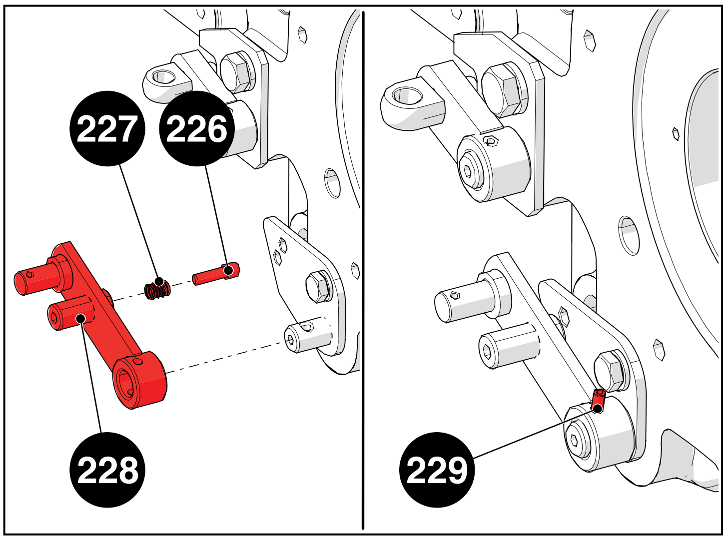

Fig. 4.104

Adjust both levers, tightening the fastener screws so that the sleeve has a play of 1.5 to 2 mm on both sides.

Note
Setting the free play of the levers correctly will prevent wear of the sleeves, gears and selector pegs.

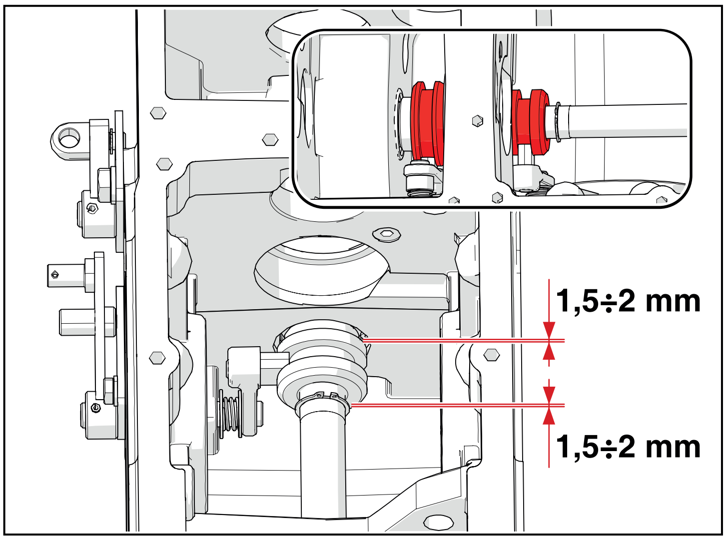

Fig. 4.105

Fit the bearing (62) in the casing.

Fit the spacer (64), the reverse shaft (65), the gear (63) and the spacer (66) in the transmission casing.

Warning
Align the hole on the shaft with the hole on the gear.

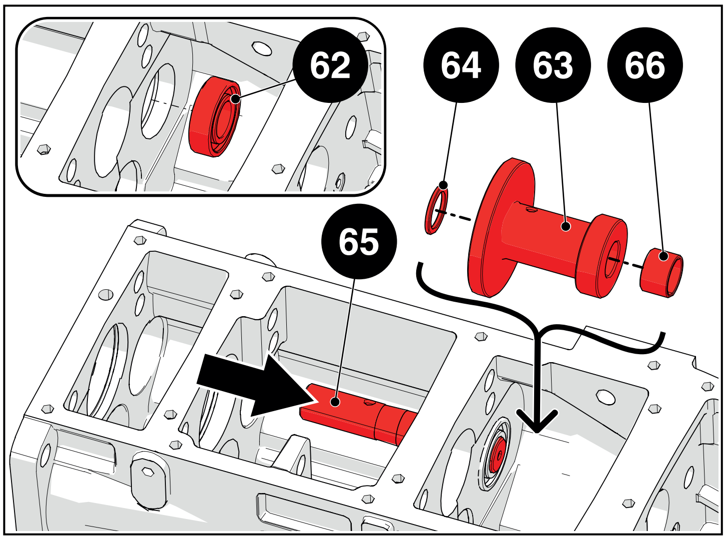

Fig. 4.106

Fit the centring pin (164).

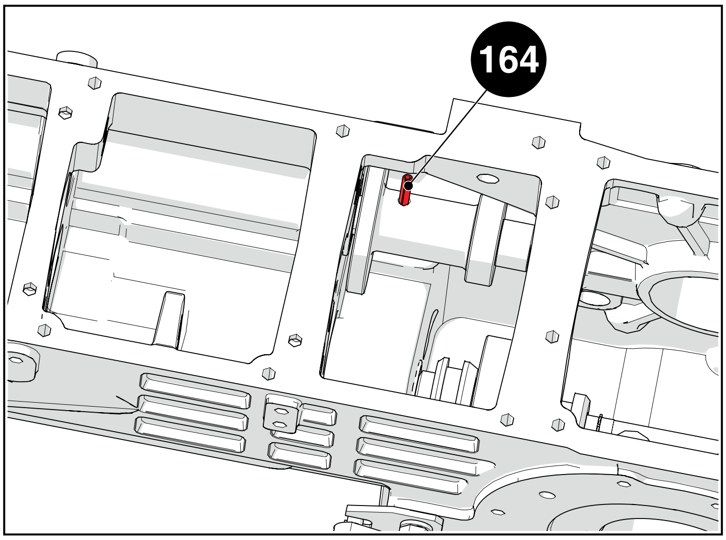

Fig. 4.107

Fit the spacer (64) and the bearing (62) and secure in place with the circlip (61).

Warning
Check that the reverse shaft moves freely.

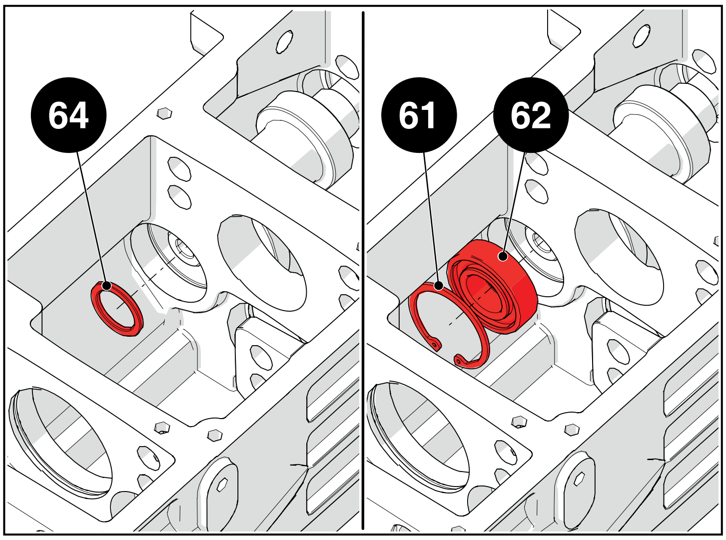

Fig. 4.108

Fit the bearing (35) in the transmission casing.

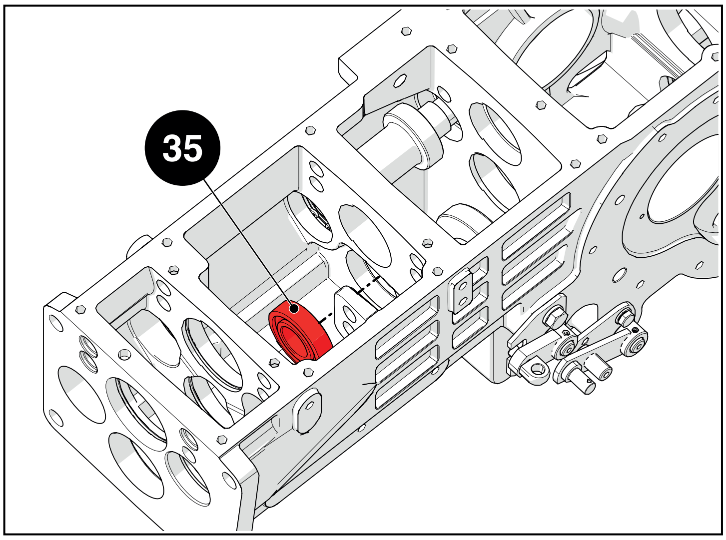

Fig. 4.109

Fit the gearbox gears in the transmission casing in the following order:

- Bush (40);
- 1st speed gear (41);
- Synchroniser (39)
- Bush (37);
- 2nd speed gear (38);
- Spacer (42);
- Bush (43);
- 3rd speed gear (45);
- Synchroniser (39);
- Bush (43);
- 4th speed gear (44);

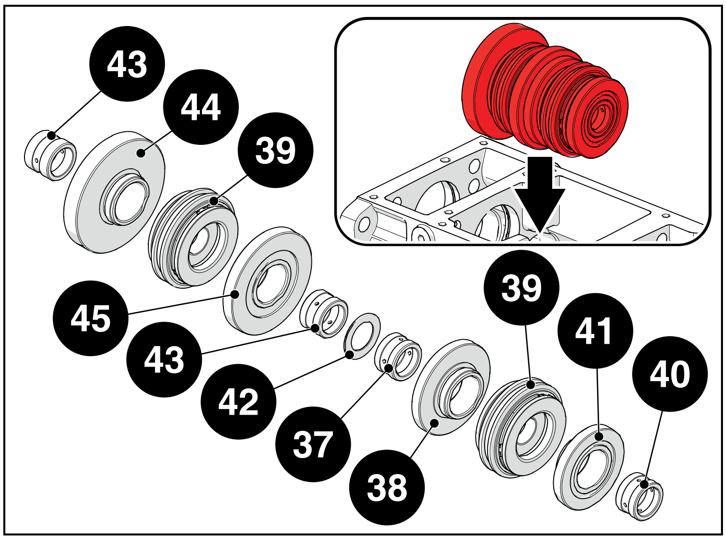

Fig. 4.110

Warning
Use the tool (D-p/n 07004010) to keep the gearbox gears and the spacer axially aligned within the transmission casing.

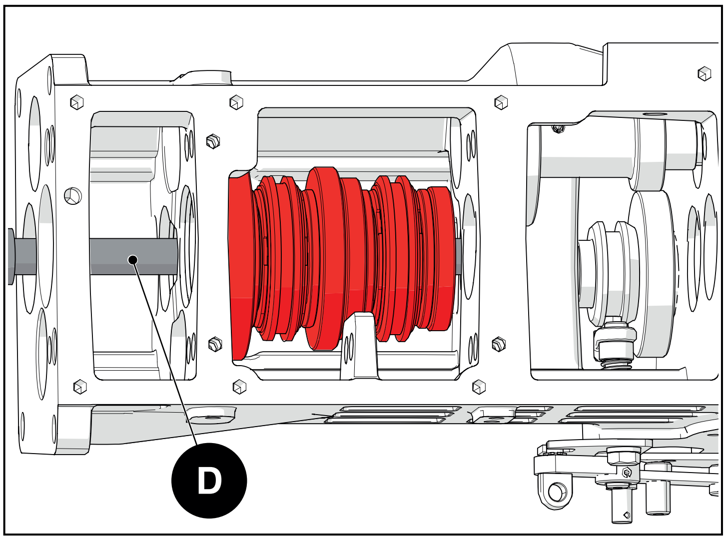

Fig. 4.111

Fit the spacer (36);

⚠ Warning
The groove on the spacer must face towards the bearing to permit lubrication of the bearing itself.

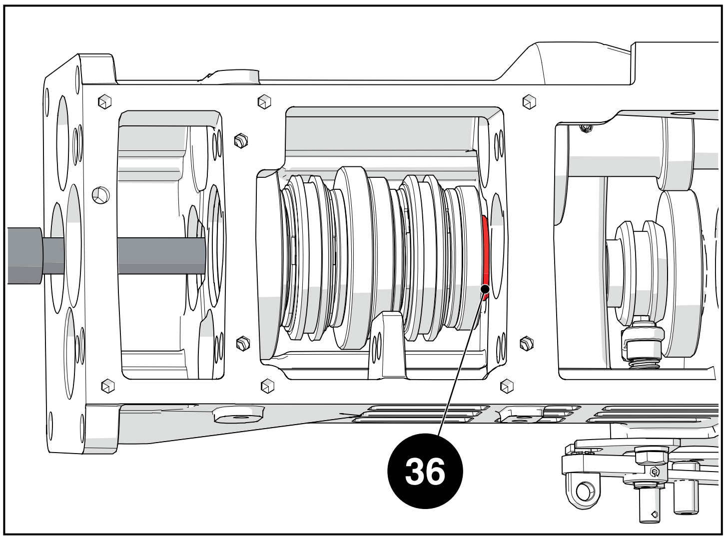

Fig. 4.112

Slide the shaft (51) into the gear pack, pushing out the alignment tool (D-p/n 07004010);

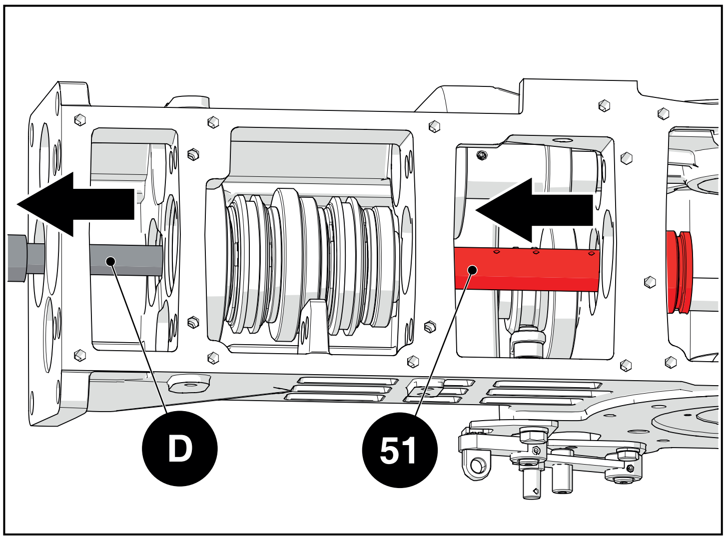

Fig. 4.113

Fit the spacer (46) and the bearing (47);

⚠ Warning
The groove on the spacer must face towards the bearing to permit lubrication of the bearing itself.

Using the tool (E-07007333) to immobilise the shaft, drive the bearing into its seat with a bearing punch tool of suitable diameter.

Remove the tool once the operation is complete.

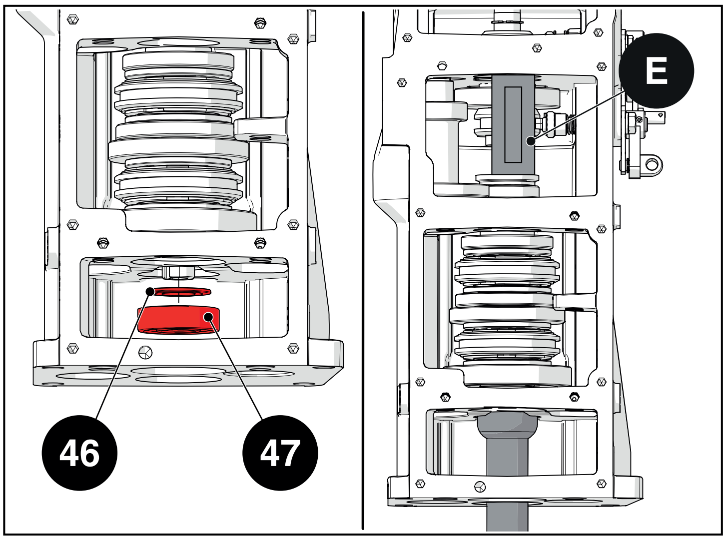

Fig. 4.114

Fit the ring nut retainer (49) and the ring nut (50).

Use the tool (F-07007332) to prevent the secondary shaft from rotating.

Tighten the ring nut with the tool (J-p/n______) to a torque of _______ Nm (______kgm).

Remove the tool (F-07007332) after tightening the ring nut.

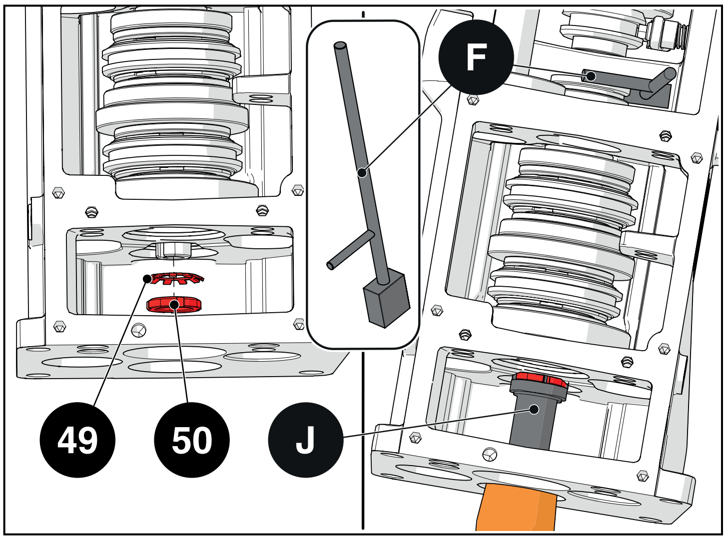

Fig. 4.115

Bend the tooth of the ring nut retainer (49) into the notch and punch a dot on the ring nut (50) near the relative spline on the shaft.

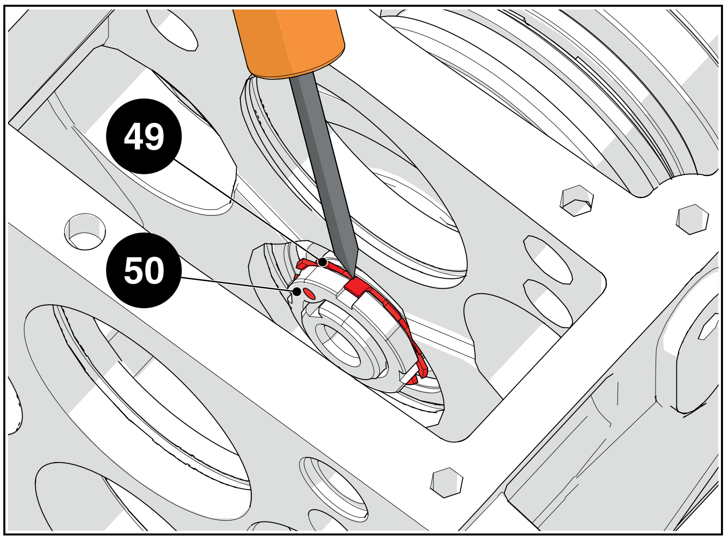

Fig. 4.116

Fit the spacer (230) and the secure the bearing with the circlip (48).

⚠ **Warning**
Apply a drop of grease to the spacer to hold it in its seat.

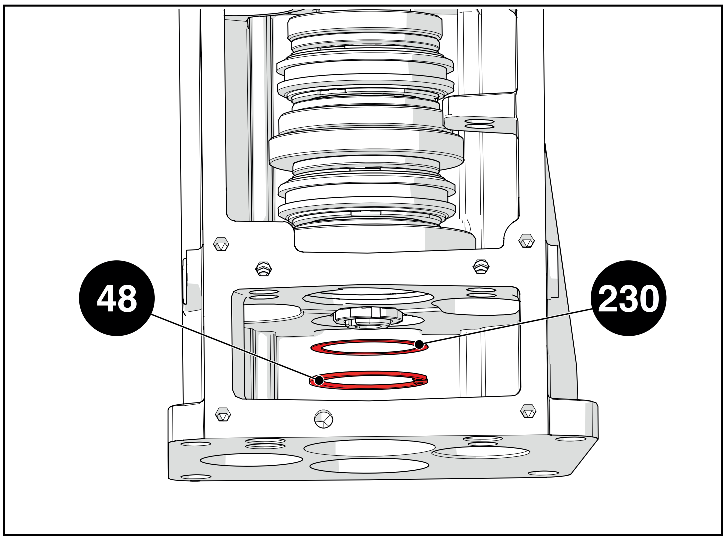

Fig. 4.117

Preassemble the pinion (25), fitting the following parts in the order given:

- bearing (26);
- spacer (27);
- circlip (28);

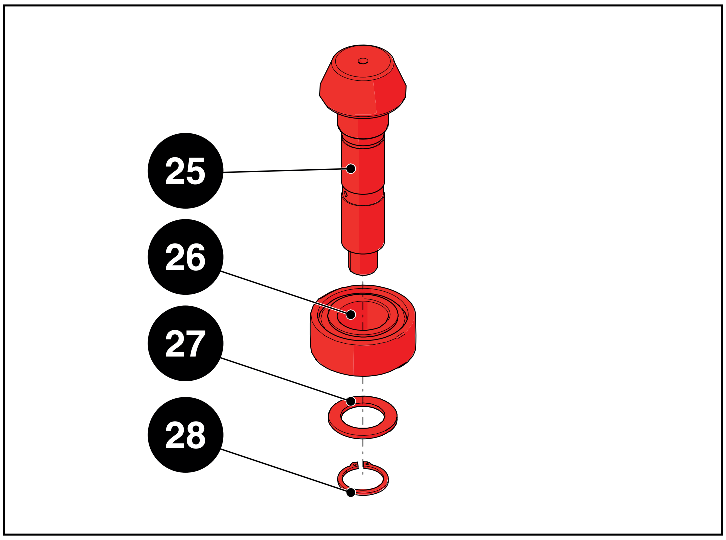

Fig. 4.118

Fit the roller bearing cage (34) on the secondary shaft.

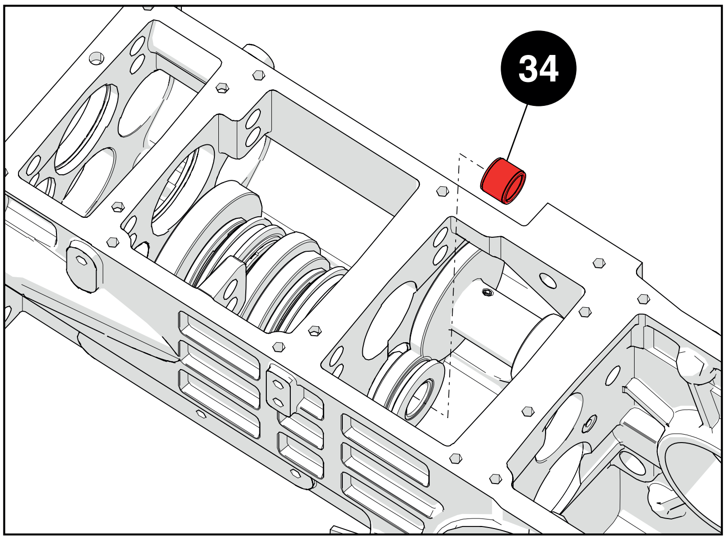

Fig. 4.119

Fit the preassembled pinion in the transmission casing, fitting it into the following components in the order given:

- Gear (29);
- bush (30);
- Gear (31);
- Sleeve (33);
- Gear (32);

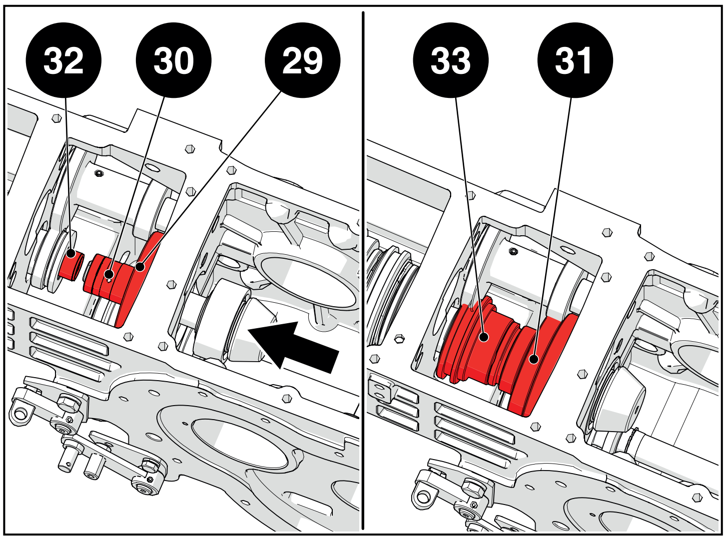

Fig. 4.120

Secure the axial position of the pinion by fitting the spacer (22) and the washer (23) and tightening the screw (24) onto the casing.

Note
The spacer (22) acts as the stop for the bearing behind the pinion.

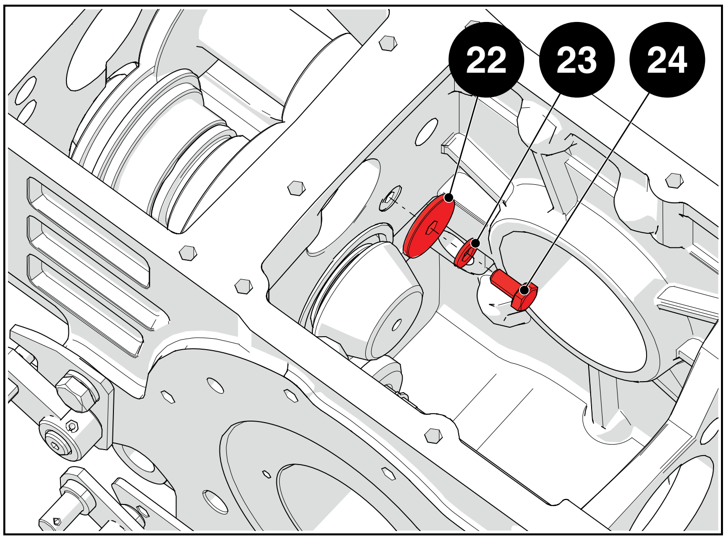

Fig. 4.121

Hold the sleeve (33) on the bearing to prevent it from moving and rotate the gear pack.

Check that the pack rotates freely. If not, replace the spacer (230) with a thinner component.

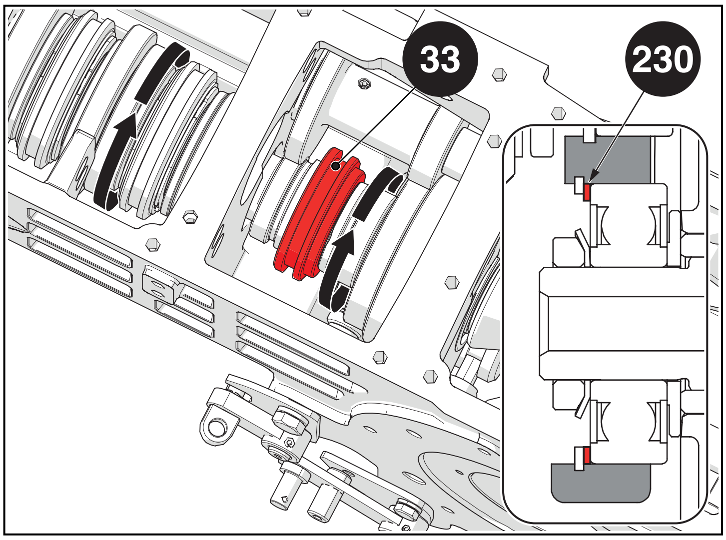

Fig. 4.122

Preassemble the splined bush (98), fitting the circlip (95), the PTO driven gear (100) and the PTO drive gear (99).

Warning
The grooves on the gears must face towards each other to facilitate lubrication.

Secure the gears by fitting the second circlip (95).

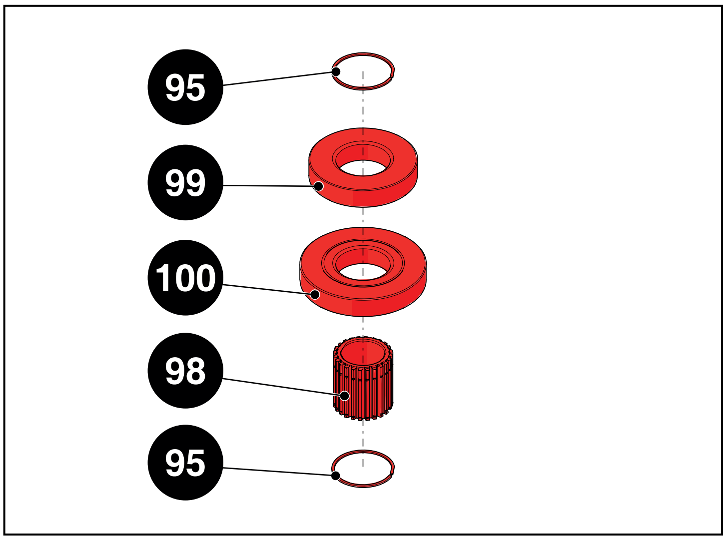

Fig. 4.123

Preassemble the second splined bush (96), fitting the circlip (95) and the PTO selector gear (97).

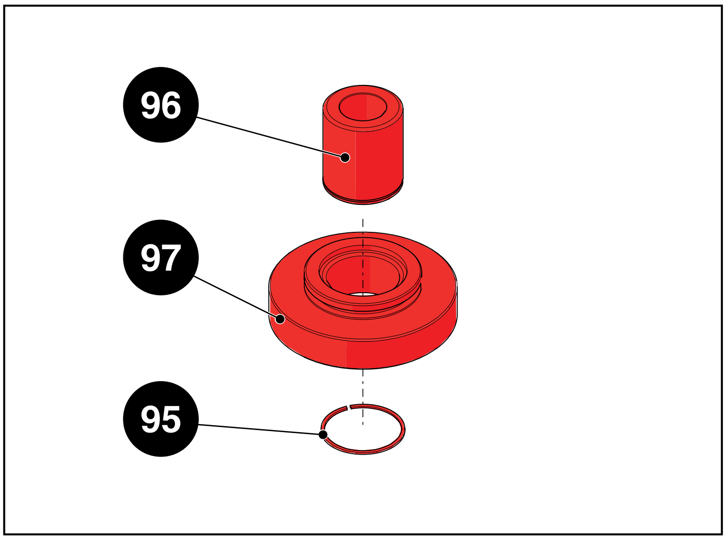

Fig. 4.124

Preassemble the upper PTO shaft (109), fitting the bearing (112), the circlip (108) and the spacer (107).

Then assemble the roller bearing cage (113), the spacer (114) and the second roller bearing cage (113) on the shaft.

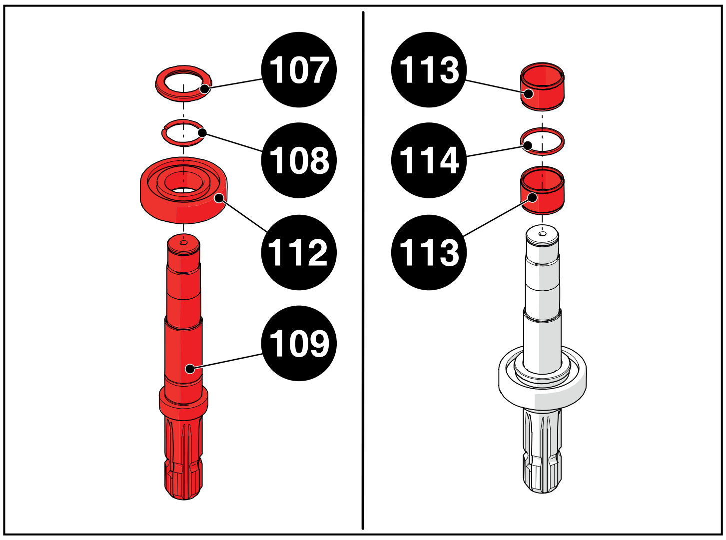

Fig. 4.125

Install the bearing (94) in its seat on the transmission casing and then fit the tool (L-p/n ________) to secure it in place.

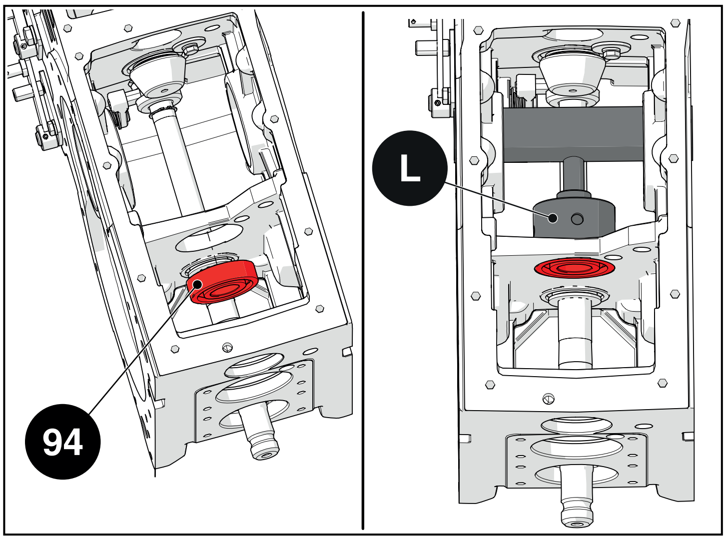

Fig. 4.126

Fit the complete upper shaft (109) in the transmission casing, fitting it into the splined bushes preassembled previously.

Tap the shaft to drive it fully into its seat and then remove the tool (L-p/n _______).

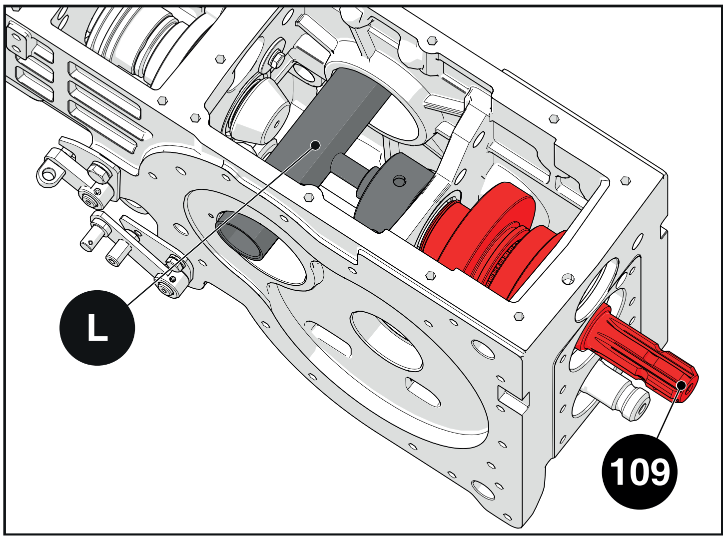

Fig. 4.127

Secure the upper PTO shaft with the circlips (111) and (93).

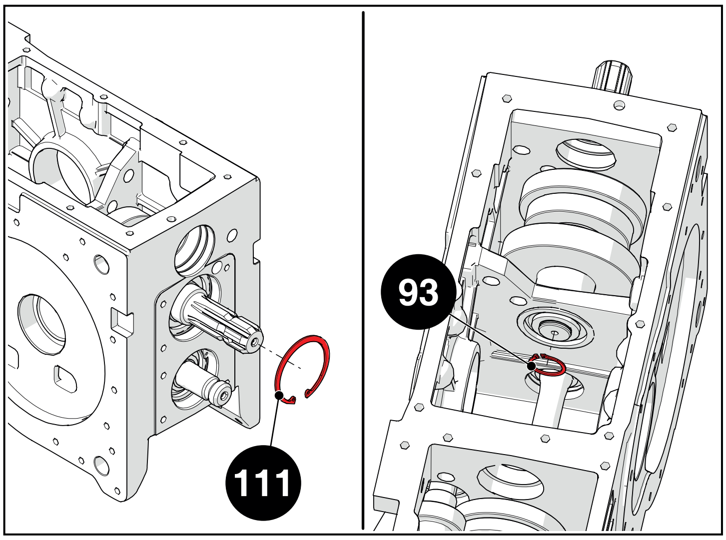

Fig. 4.128

Use a punch of suitable diameter to install the oil seals (110), (137) and (116) in their seats.

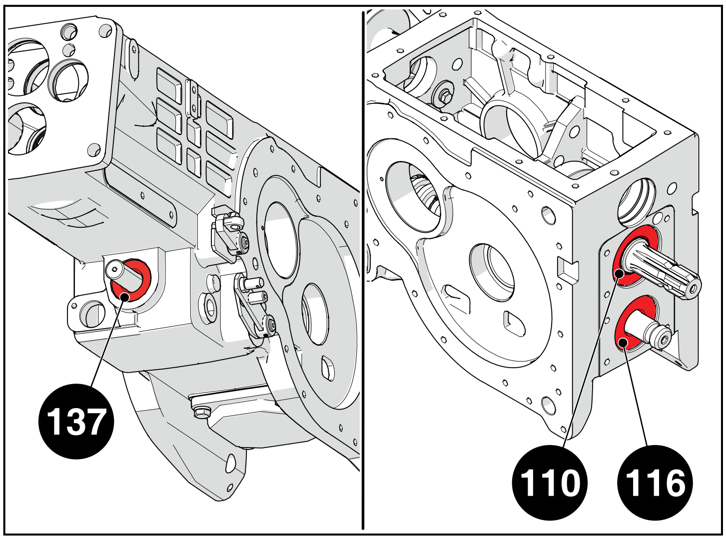

Fig. 4.129

Fit the fork (165), the spring (166) and the differential lock rod (167) in the casing and secure in place with the circlip (168).

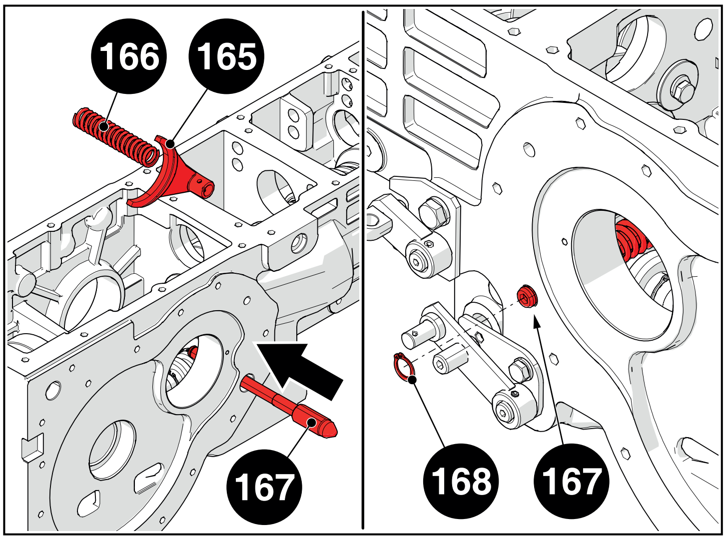

Fig. 4.130

Fit the complete crown wheel assembly in the transmission casing together with the spacer (86).

Fit the differential lock pinion (82).

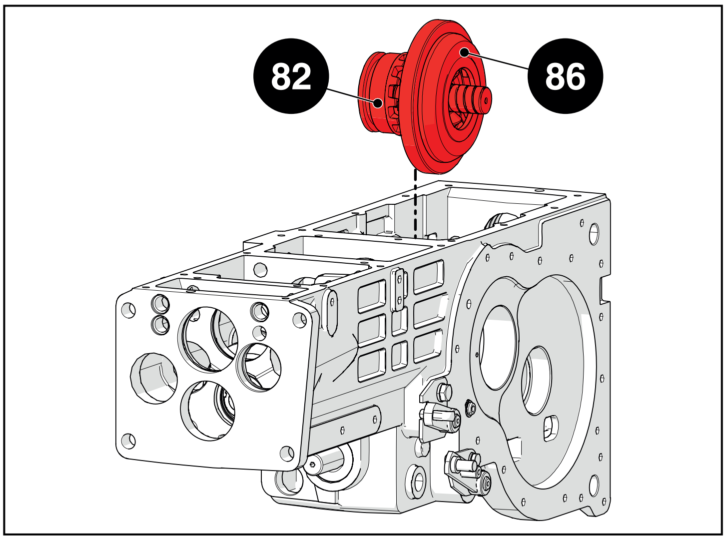

Fig. 4.131

From the crown wheel side, fit the planetary gear spindle (91) in the casing, together with the roller bearing cage (87), the spacer (88) and the bearing (89) secured by the circlip (75).

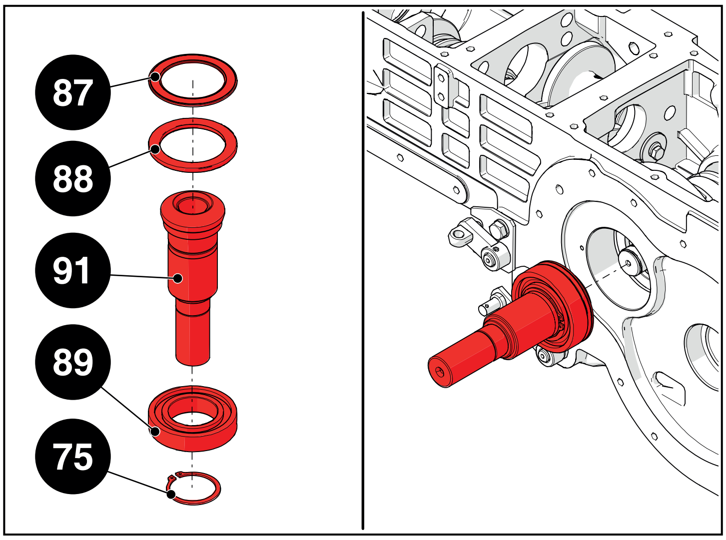

Fig. 4.132

On the side opposite the crown wheel, fit the planetary gear spindle (79) complete with bearing (81) and circlip (75).

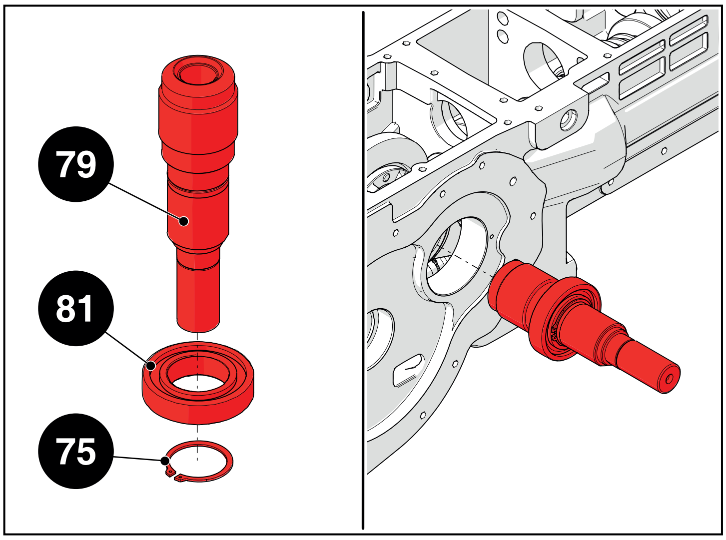

Fig. 4.133

Use the tool (G-p/n 07000115) and tighten the crown wheel side ring nut (90) completely.

Note
Tightening the crown wheel side ring nut completely eliminates the backlash between the teeth of the crown wheel and the teeth of the pinion.

Warning
Align any of the slots on the ring nut with the hole for fitting the ring nut retainer.

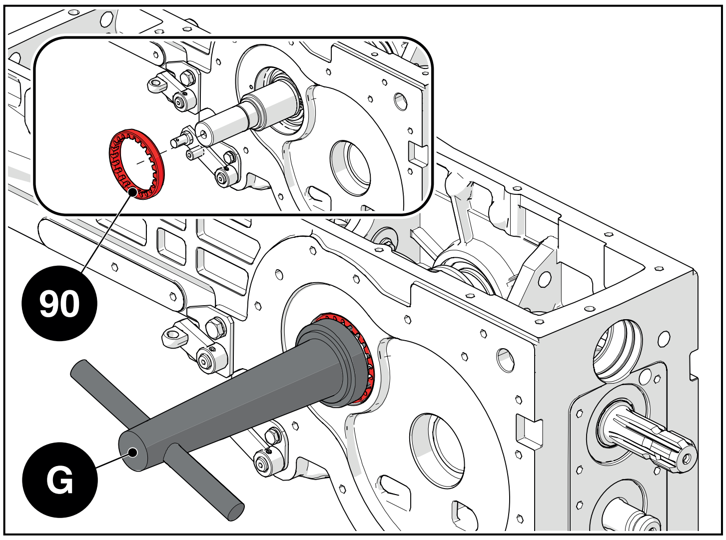

Fig. 4.134

Use the tool (G-p/n 07000115) to tighten the ring nut (78) on the side opposite the crown wheel to a torque of 20 Nm (2 kgm).

Warning
Align any of the slots on the ring nut with the hole for fitting the ring nut retainer.

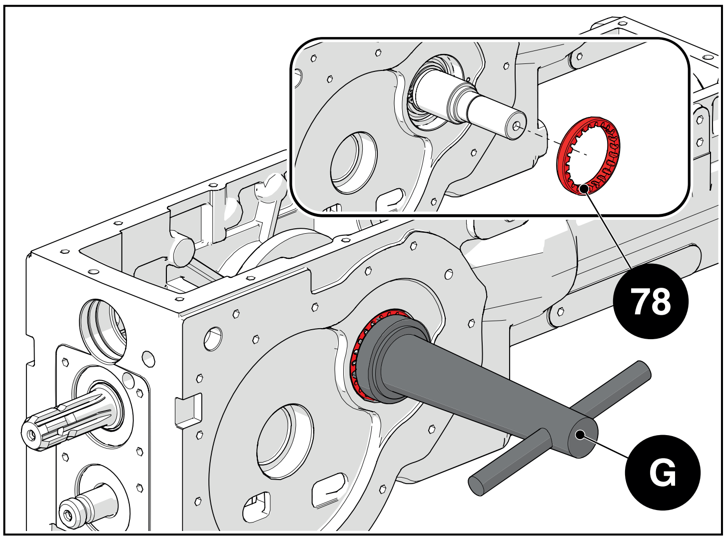

Fig. 4.135

Loosen the crown wheel side ring nut (90) by 3 splines, using the ring nut retainer hole as reference.

Note
This creates backlash between the pinion and crown wheel teeth.

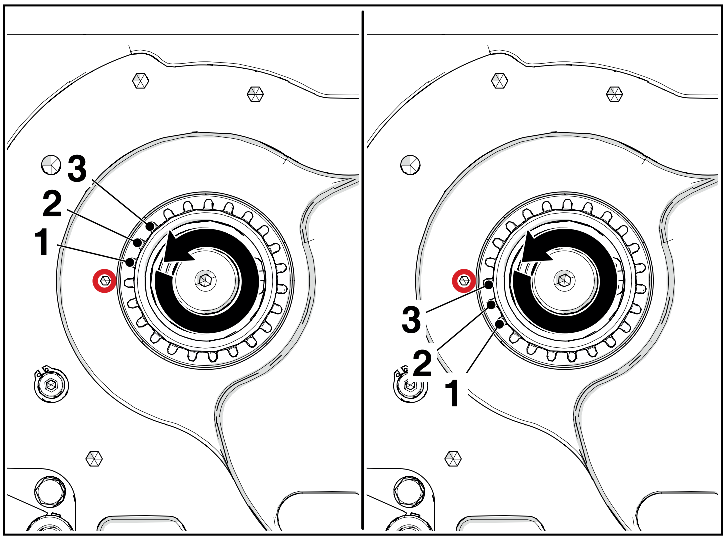

Fig. 4.136

Apply the probe of a dial gauge with a magnetic base against one of the teeth of the crown wheel and reset the dial gauge.

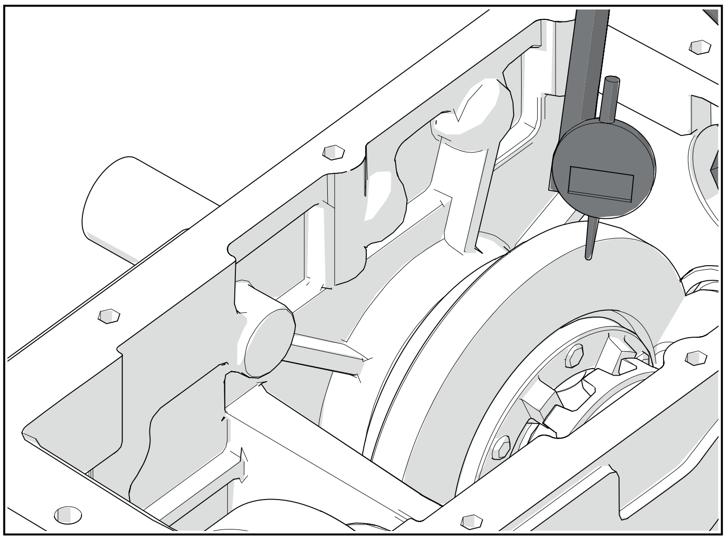

Fig. 4.137

Move the crown wheel gently to measure the backlash relative to the pinion teeth.

The backlash between the teeth of the crown wheel and the pinion must be 0.10 to 0.20 mm.

Warning
Measure in at least 4 different positions on the crown wheel.

Warning
If the backlash is not within the indicated range, tighten or loosen the crown wheel side ring nut (90) until the backlash is correct.

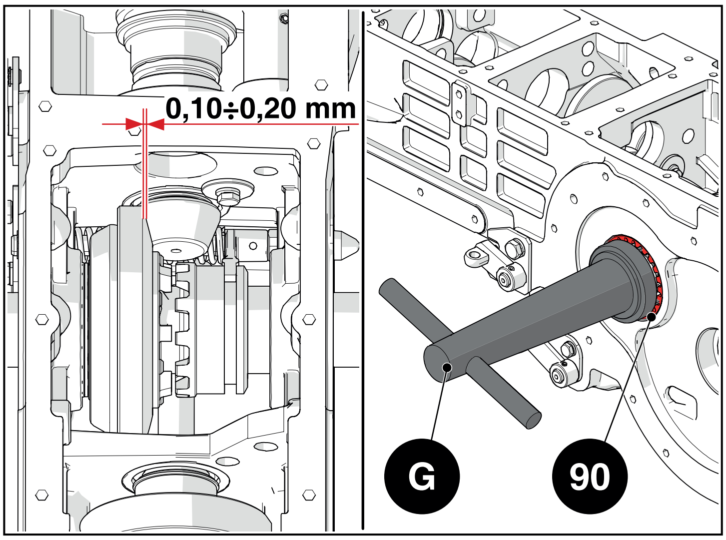

Fig. 4.138

Loosen the ring nut (78) on the side opposite the crown wheel by 5 splines, using the ring nut retainer hole as reference.

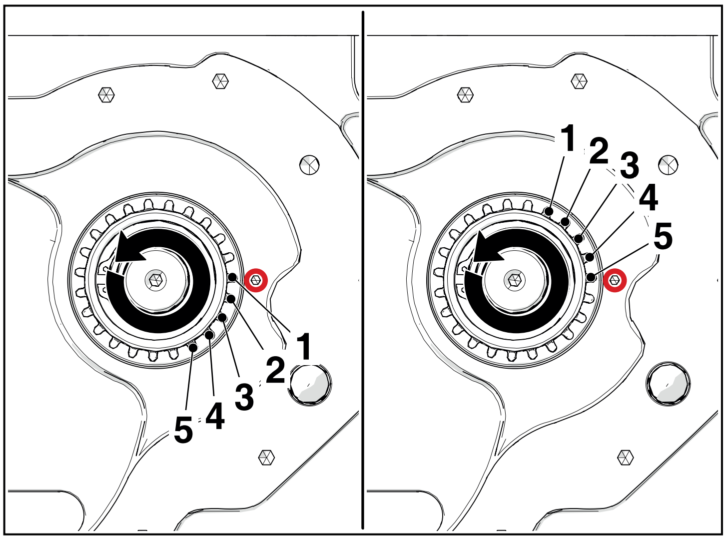

Fig. 4.139

Apply leverage with a screwdriver to force the planetary gear spindle assembly (79) against the ring nut loosened in the previous step.

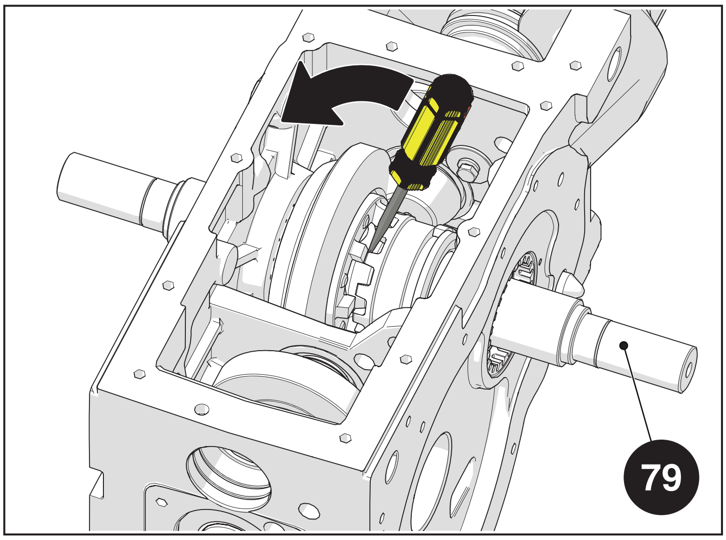

Fig. 4.140

Tighten the ring nut retainers (74) on both sides.

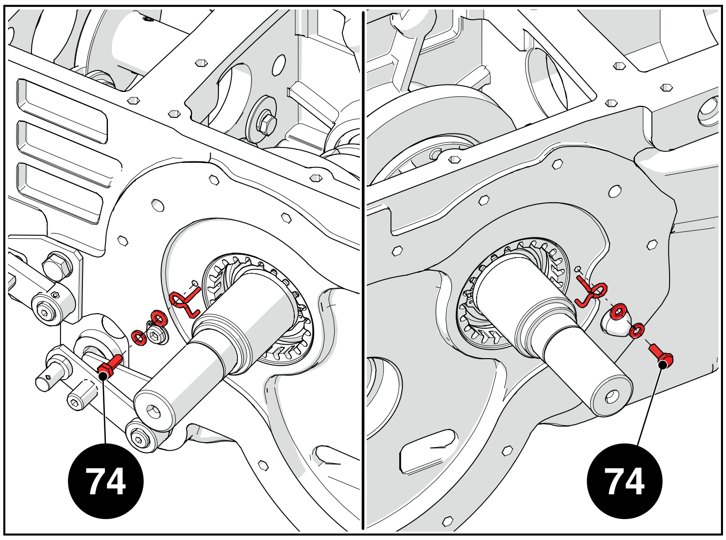

Fig. 4.141

Fit the rod (170).

Fit the spring (171), the spacer (172) and the PTO selector lever (173).

Engage the rod (170) with the lever (173).

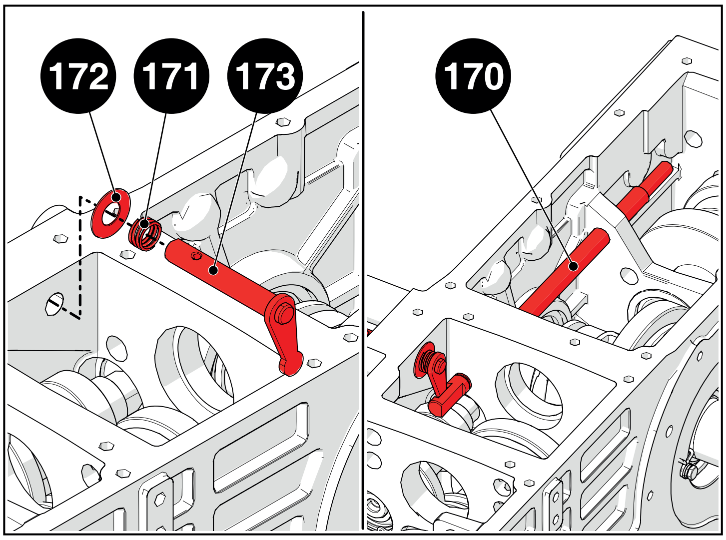

Fig. 4.142

Fit the ball (174), the spring (175) and the pin (176) in the hole on the transmission casing.

Tighten the tool (H-00007565) onto the casing to keep the spring compressed.

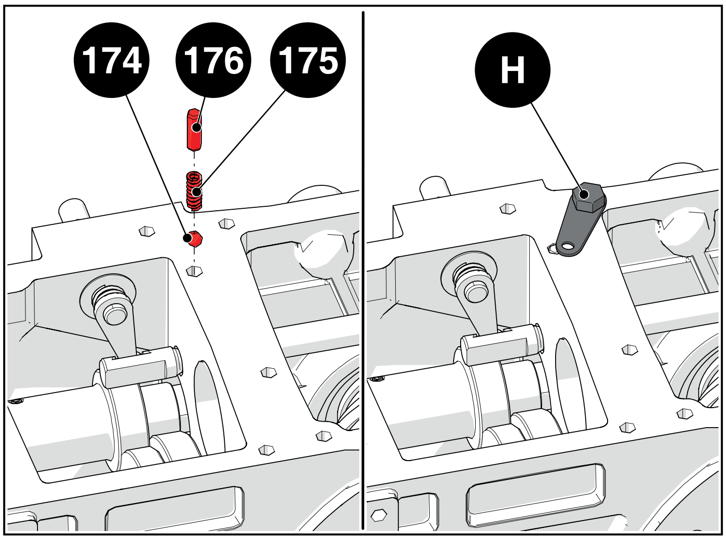

Fig. 4.143

Fit the nut (177), the knurled washer (178), the fork (179), the second knurled washer (178) and the check nut (177) on the rod (170).

Warning
The knurled sides of the washers must face towards the respective nuts.

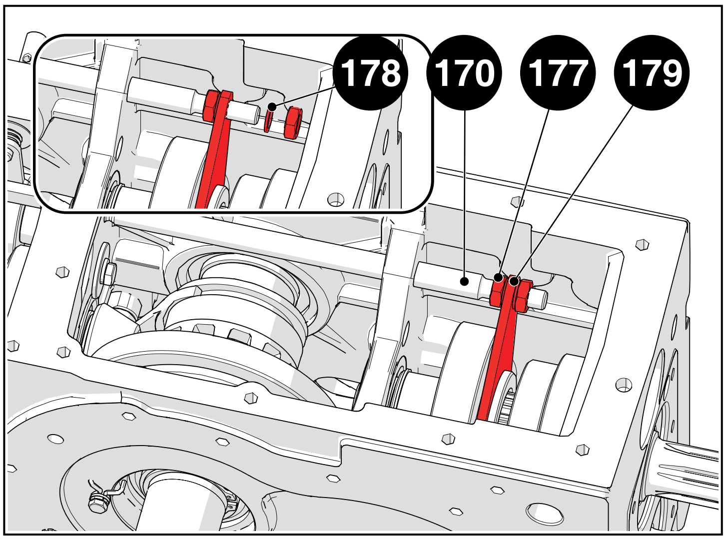

Fig. 4.144

Move the fork in both directions and check that the free play is the same on both meshing sides of the gear (97).

Tighten or loosen the nut (177) to adjust the free play correctly and then secure with the check nut (177).

Push the gear (97) against the gear (99) and check that the gears (99) and (100) can turn freely.

Remove the tool (H-p/n 00007565 shown in figure 4.143).

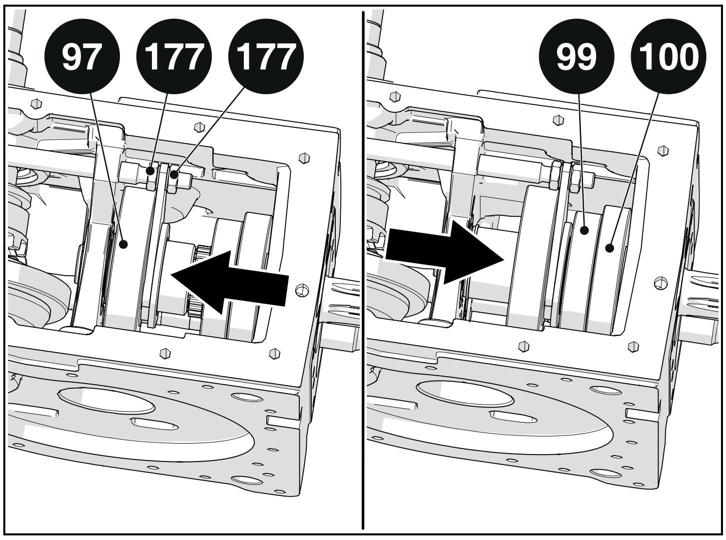

Fig. 4.145

Using a guide tool, fit the oil seal (180) onto the rod with a punch of suitable diameter.

Warning
Lubricate the outer seat of the oil seal before fitting the seal.

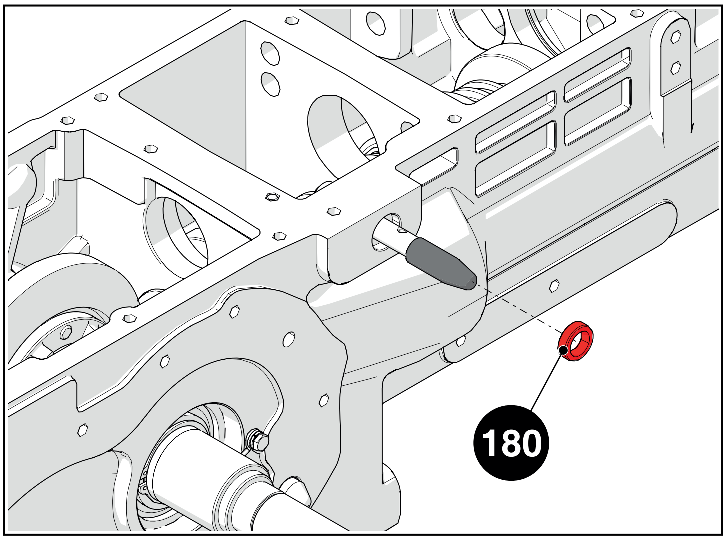

Fig. 4.146

Fit the spacers (181) and then the sleeve (182) and secure in place with the pin (183).

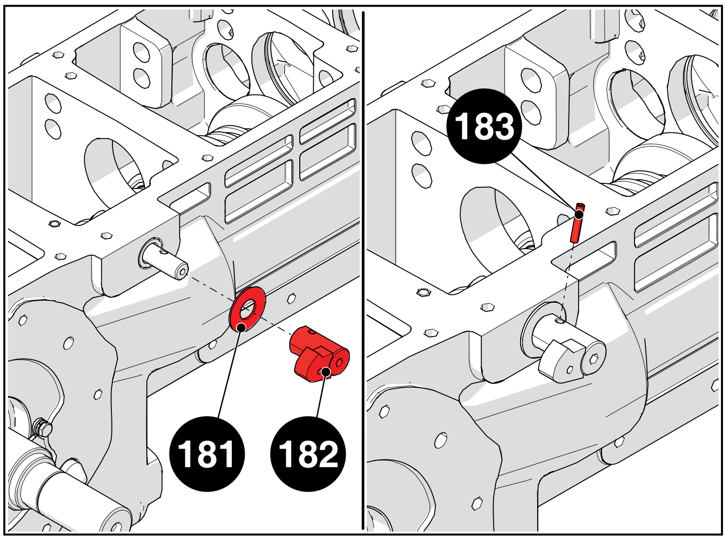

Fig. 4.147

Fit the complete fork (184) on the sleeve and then engage the rod (185).

Fit the ball (186) and the spring (187), and then fit and tighten the plug (188) together with the copper washers (189).

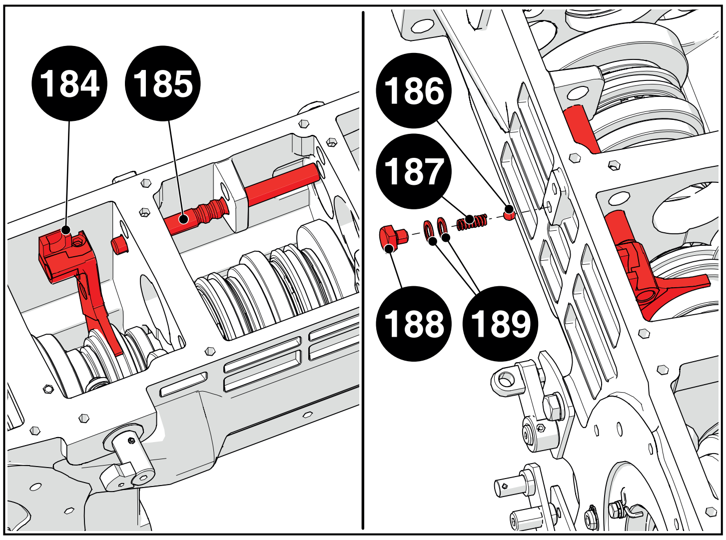

Fig. 4.148

Secure the fork (184) in place by tightening the screw (190), ensuring that the fork is in the middle of the gear.

Move the fork towards the front of the tractor, then undo the travel stop screw (191) until it touches the transmission casing. Tighten the check nut (192) to secure the screw.

Note
The positions of the fork and of the relative stop screw must be set correctly to prevent the fork from being continuously under strain.

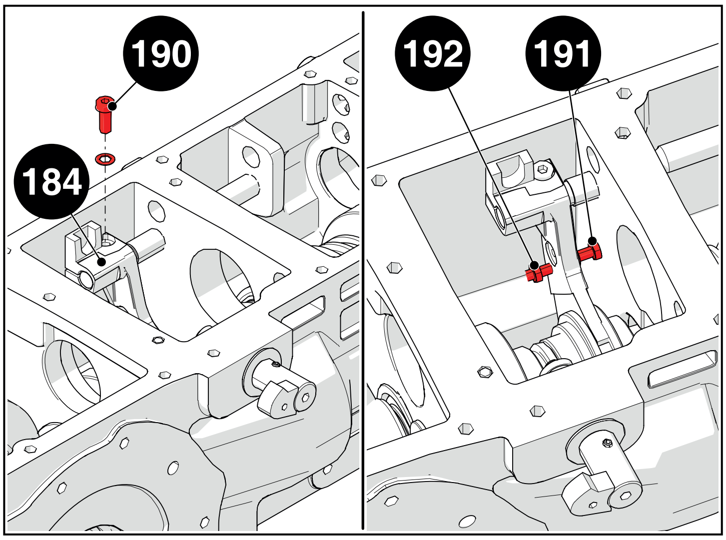

Fig. 4.149

Preassemble the primary shaft (20), fitting the following parts in the order indicated:

- Spacer (19);
- Gear (18);
- Spacer (19);
- Circlip (17);
- Gear (16);
- Circlip (15);

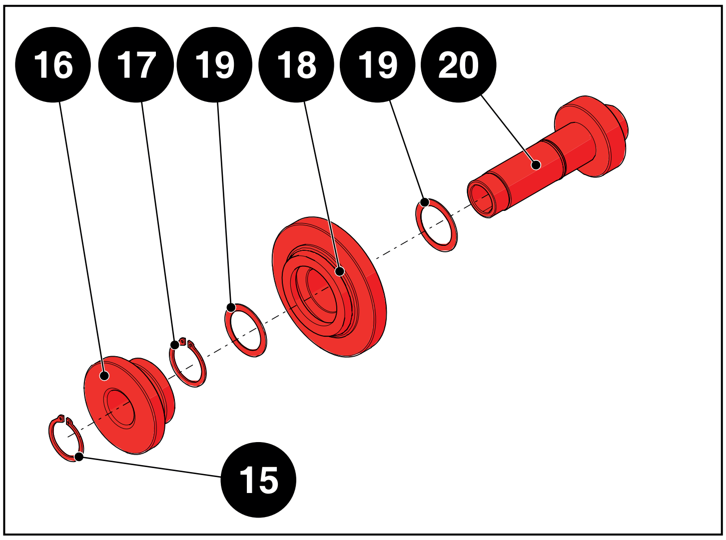

Fig. 4.150

Fit the first bearing (14) in the transmission casing.

Fit the complete shaft in the transmission casing and drive it fully into the bearing.

Warning
Use a punch of suitable diameter to drive the shaft and the bearing into the transmission casing.

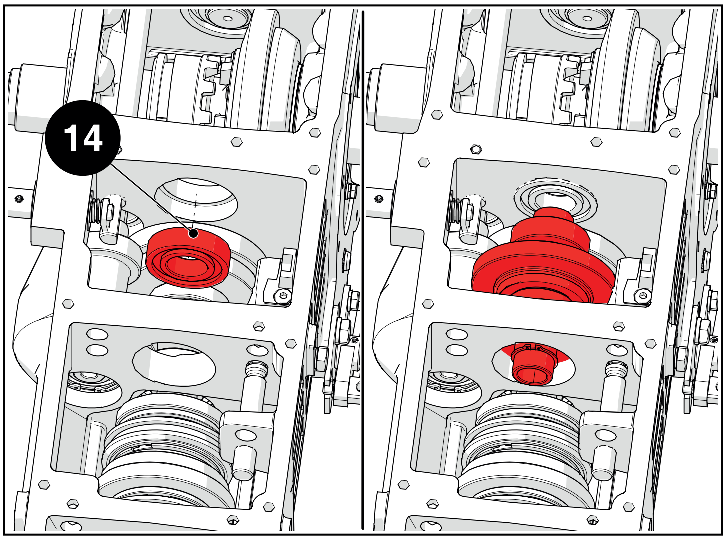

Fig. 4.151

Fit the second bearing (14) in the transmission casing.

Fit a spacer (13) and the third bearing (12).

Warning
Use a bearing punch of suitable diameter to drive the bearings into the transmission casing.

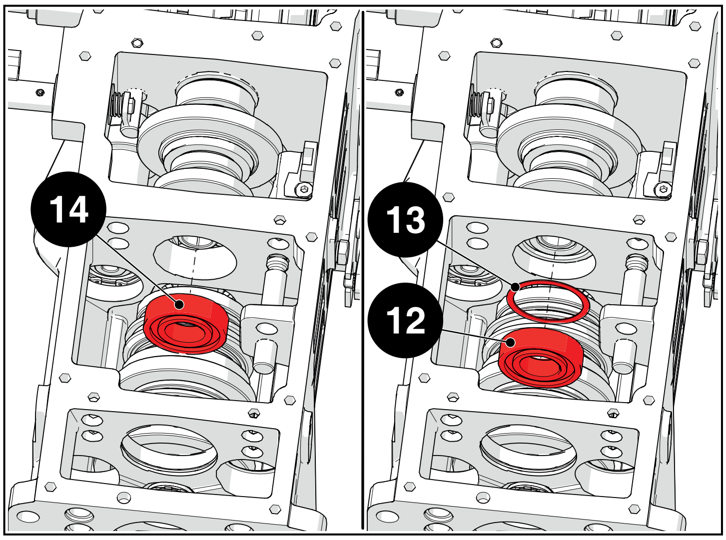

Fig. 4.152

Fit the forks (193) and (194) onto the gear selector forks.

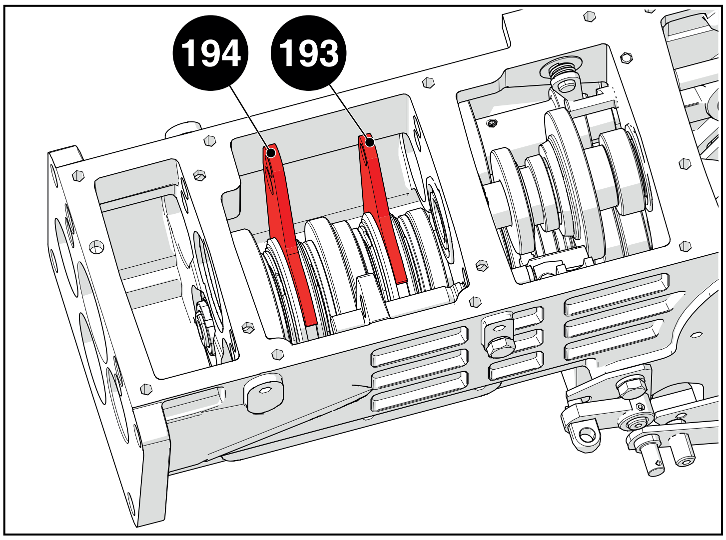

Fig. 4.153

Fit the rod (195), inserting through the holes in the forks.

Also fit the nuts (196) and the bush (197) while fitting the rod, and then secure the rod in place with the circlip (198).

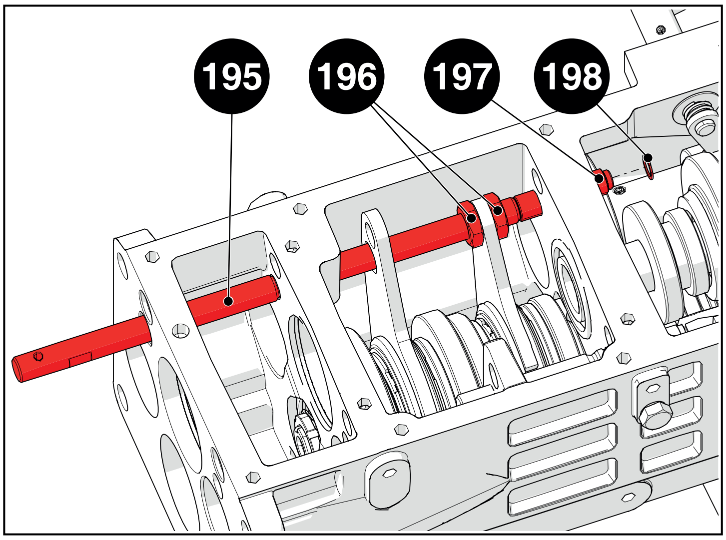

Fig. 4.154

Fit the ball (199) and the spring (200), and then fit and tighten the plug (201) together with the copper washer (202).

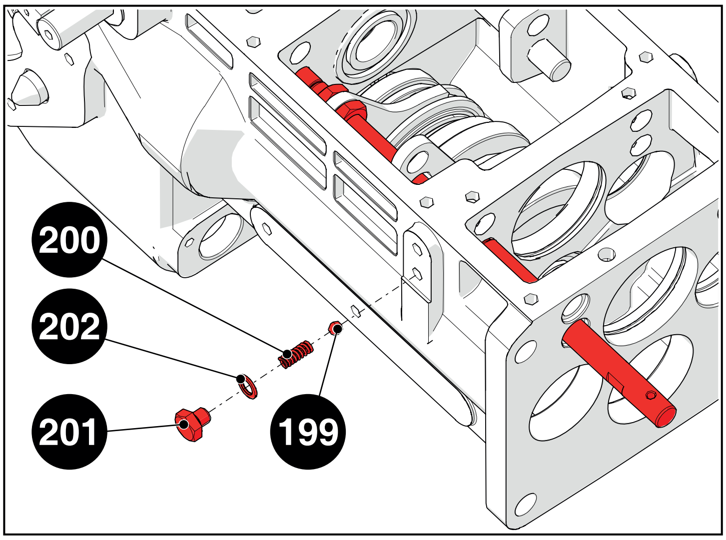

Fig. 4.155

Move the fork in both directions.

Tighten or loosen the nuts (196) until the fork has the same free play on both sides.

Warning
Keep the rod hole facing upwards to facilitate the subsequent steps in the assembly procedure.

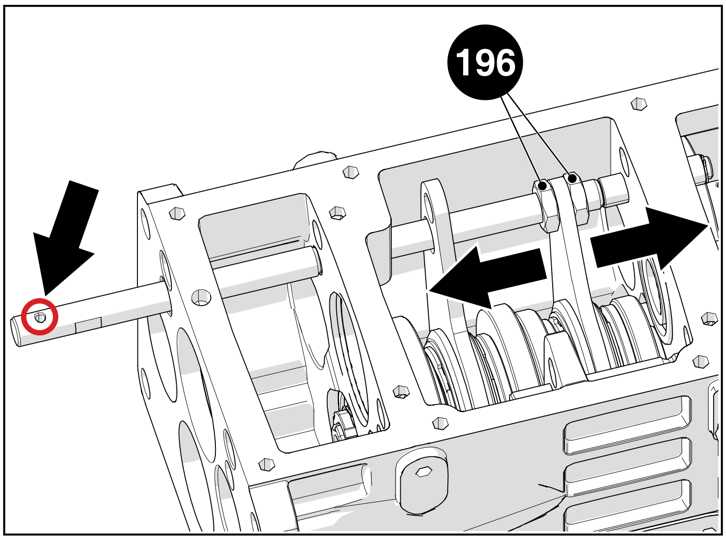

Fig. 4.156

Fit the ball (199) and the rod (203), inserting the rod through the holes in the forks.

Also fit the nuts (196) and the bush (197) while fitting the rod, and then secure the rod in place with the circlip (198).

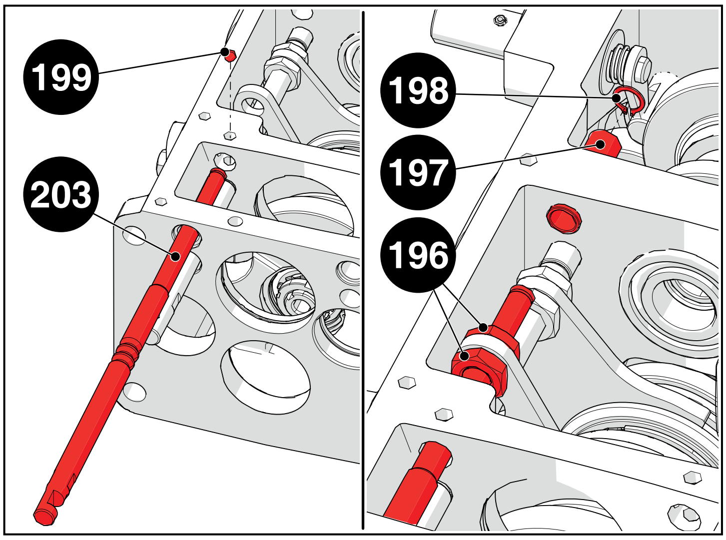

Fig. 4.157

Fit the ball (199) and the spring (200), and then fit and tighten the plug (201) together with the copper washer (202).

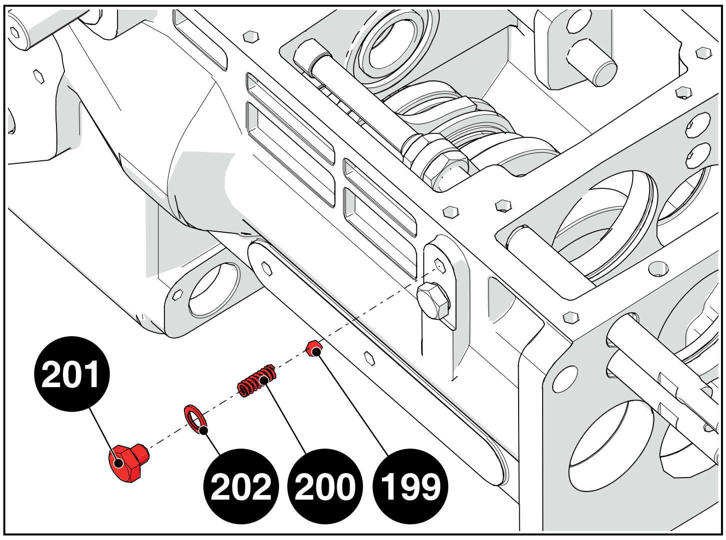

Fig. 4.158

Move the fork in both directions.

Tighten or loosen the nuts (196) until the fork has the same free play on both sides.

Warning
Keep the rod hole facing upwards to facilitate the subsequent steps in the assembly procedure.

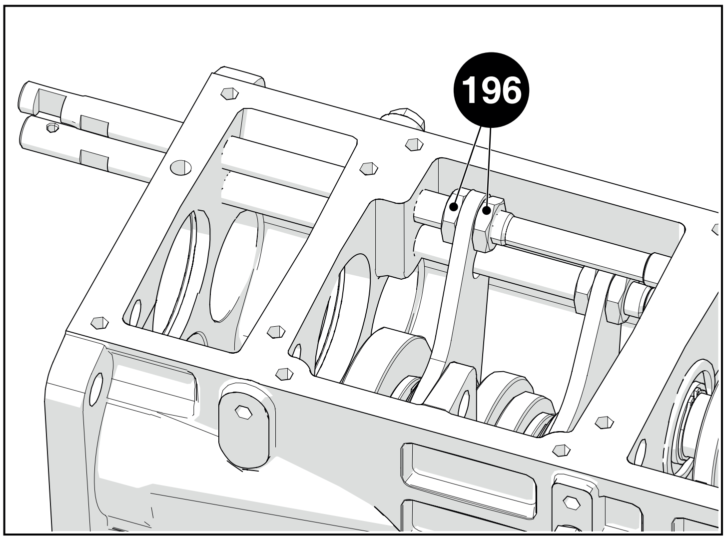

Fig. 4.159

Preassemble the primary shaft (6), fitting the following parts in the order indicated:

- Circlip (7);
- Gear (8);
- Gear (9);
- Spacer (10);
- Gear (11);

Warning

Fit the gear (8) with the groove facing towards the front of the tractor.

Fit the gear (9) with the groove facing towards the rear of the tractor.

Fit the gear (11) with the groove facing towards the front of the tractor.

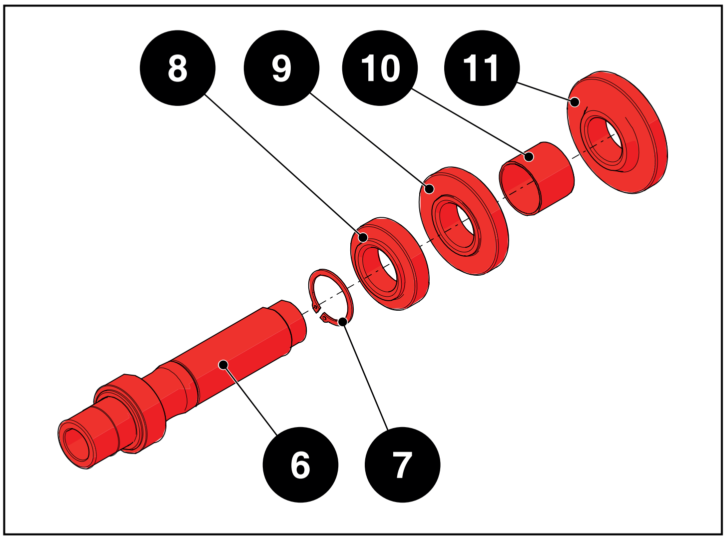

Fig. 4.160

The shaft is assembled with the relative gears inside the casing.

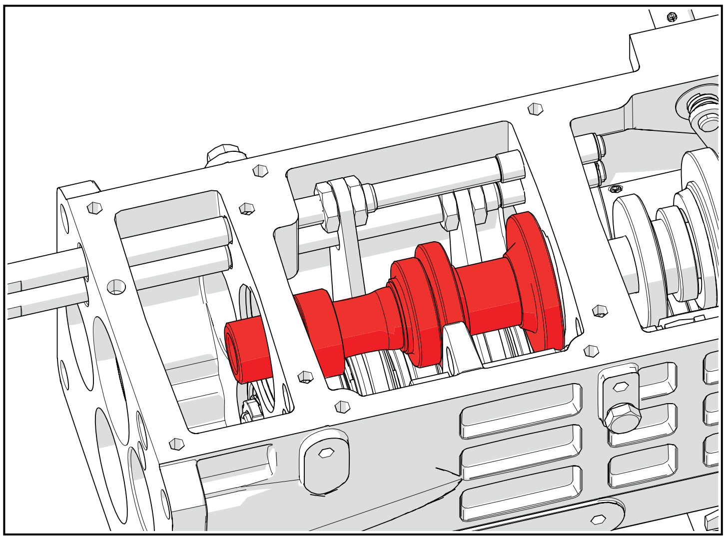

Fig. 4.161

Fit the bearing (5) in the transmission casing, driving it into its seat with a bearing punch tool of suitable diameter.

Fit two 0.4 mm spacers (3) and secure in place with the circlip (4).

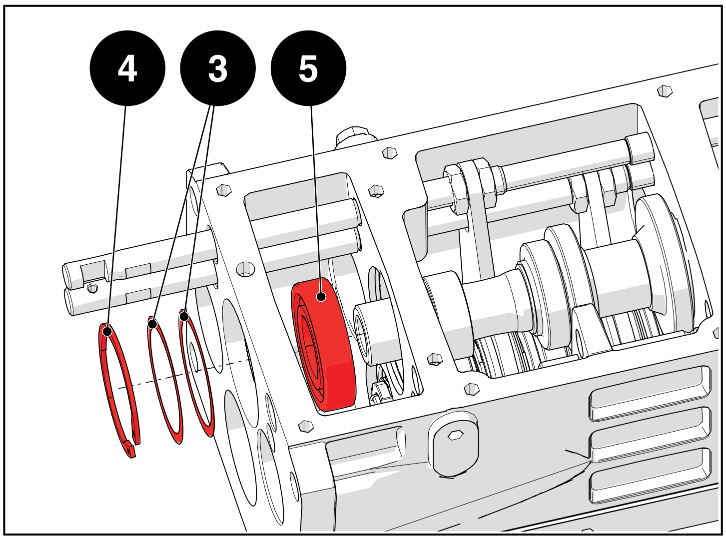

Fig. 4.162

Fit the gear (72) in the casing, with the groove facing towards the front of the tractor.

Warning
The gear must be fitted before the synchroniser as it will not be possible to install it later.

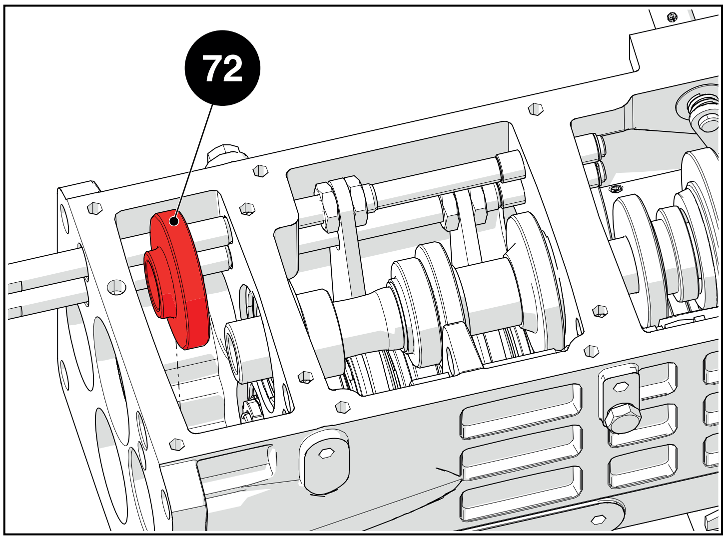

Fig. 4.163

Fit a shim pack (204) with a total thickness of 1.3 mm.

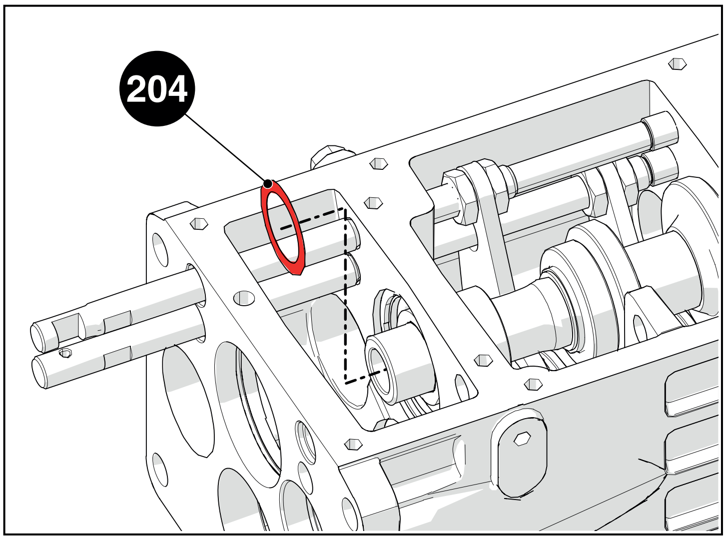

Fig. 4.164

Fit the reverse shuttle gear (52), the synchroniser (53) and then the driven gear (54).

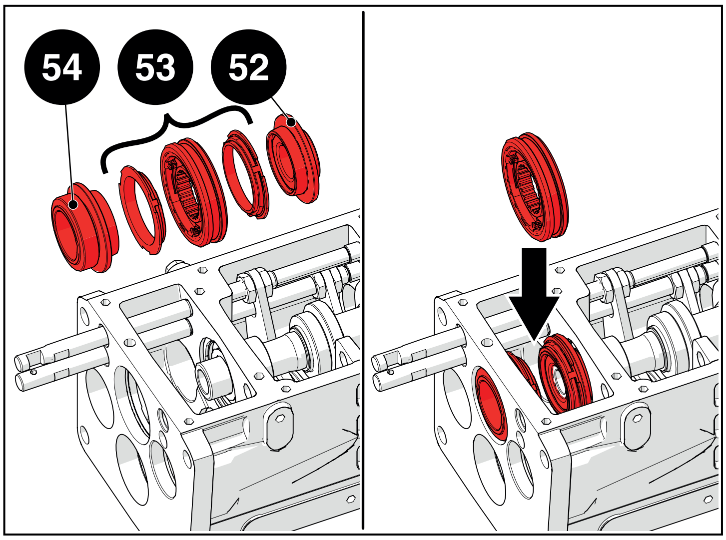

Fig. 4.165

Preassemble the shaft (57), fitting the following parts in the order indicated:

- Ring (2);
- Oil seal (205);
- Roller bearing cage (55);
- Spacer (59);
- Bearing (58);
- Circlip (56);

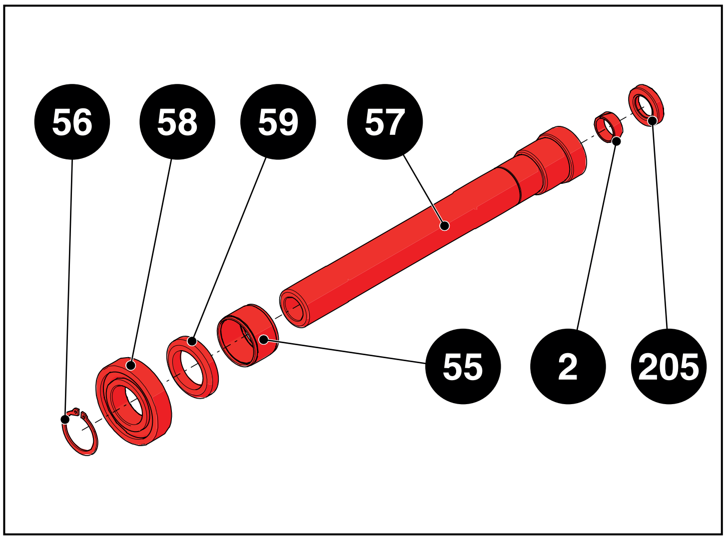

Fig. 4.166

Fit the retainer circlips (60) in the transmission casing and then fit the preassembled shaft.

Warning
Take care not to damage the oil seal while installing the shaft.

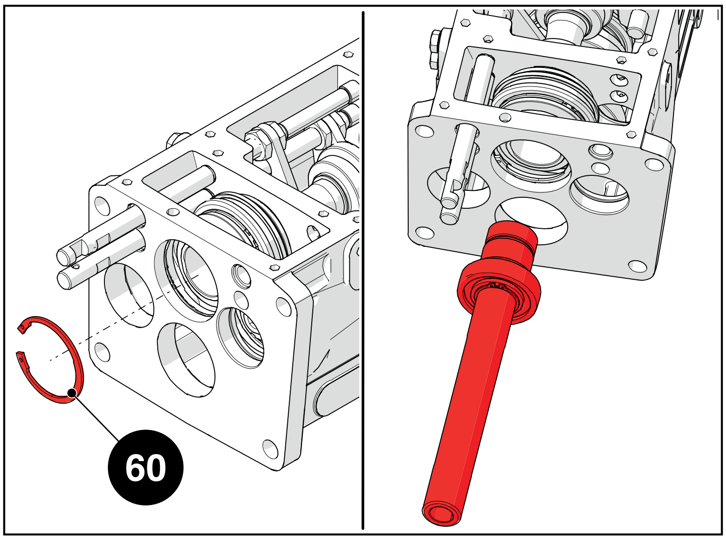

Fig. 4.167

Determining shim size for upper primary shaft

To ensure the correct free play for the synchroniser (53), there must be a distance (X) of 0.2 mm between the spacer (59) and the driven gear (54).

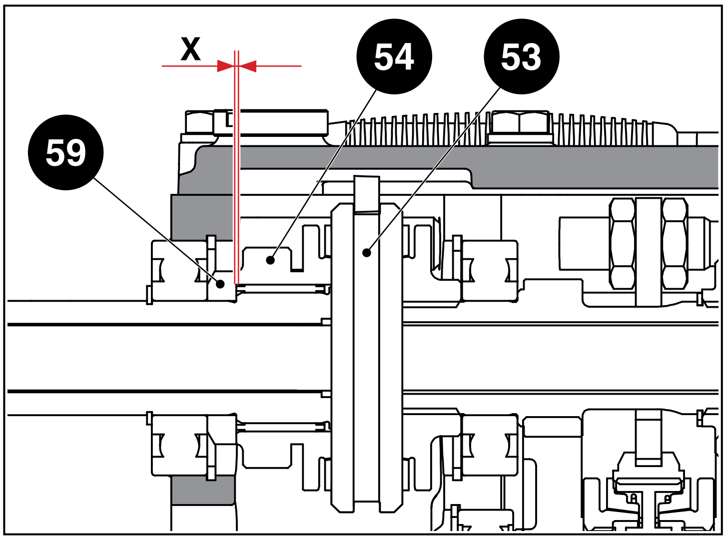

Fig. 4.168

Fit the tool (I-p/n __________) to simulate the clutch housing and check if the primary shaft is shimmed correctly.

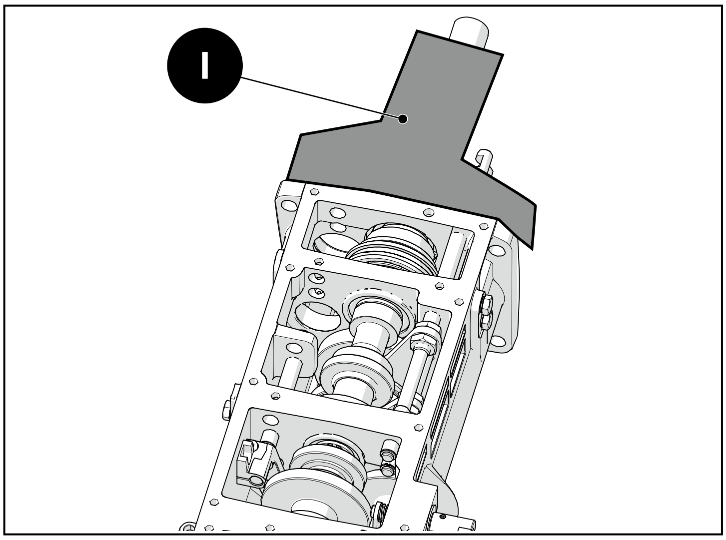

Fig. 4.169

Select both forward and reverse with the reverse shuttle to widen the pack.

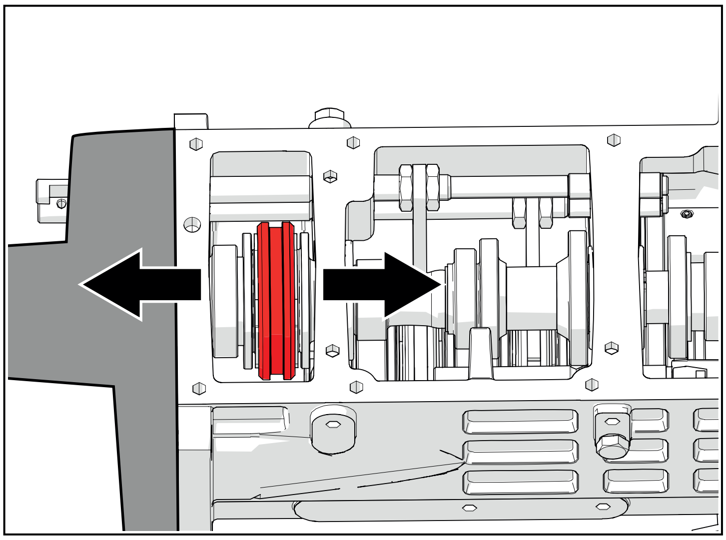

Fig. 4.170

Check that the distance (X) between the spacer (59) and the driven gear (54) is 0.2 mm.

If not, adjust the shims (204) to obtain the correct value.

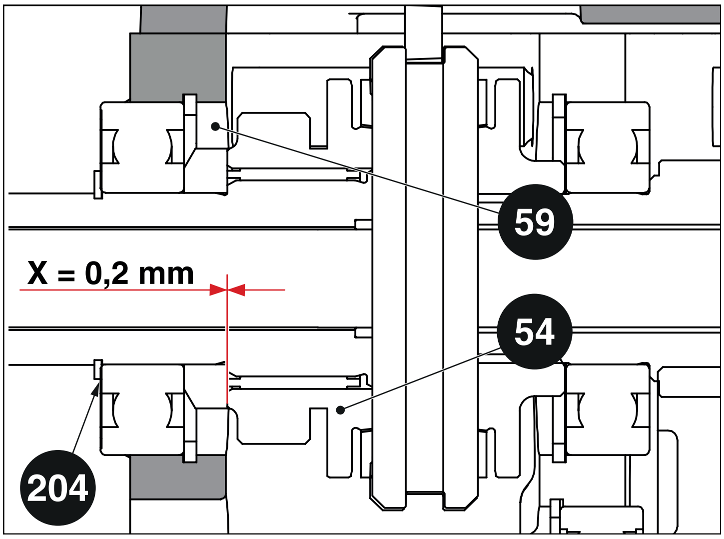

Fig. 4.171

Remove the tool (I-p/n__________).

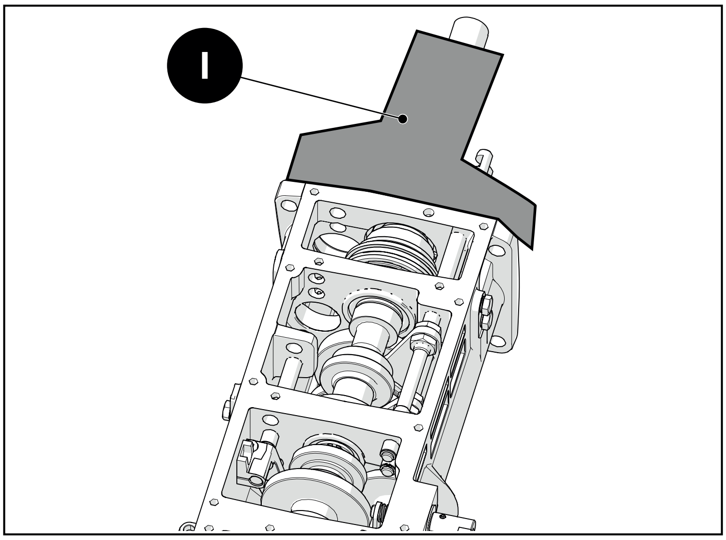

Fig. 4.172

Fit the fork (206), the ball (186) and the rod (207).

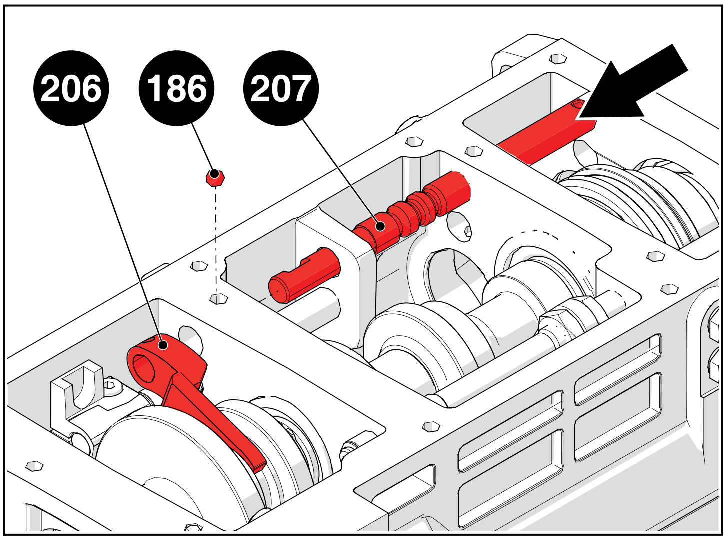

Fig. 4.173

Fit the ball (186) and the spring (187), and then fit and tighten the plug (188) together with the copper washer (189).

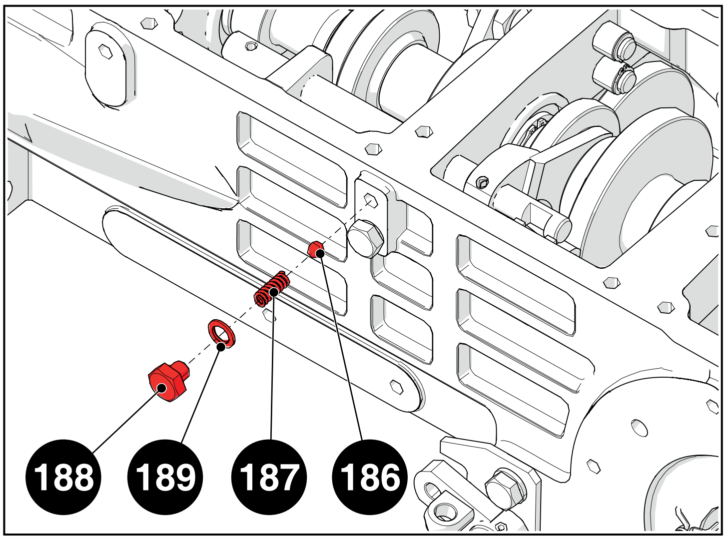

Fig. 4.174

Fit the spring pin (208) to secure the fork on the rod.

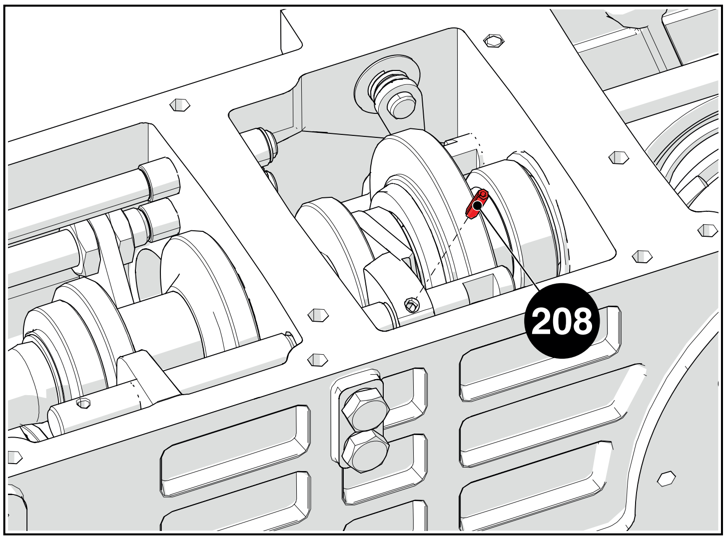

Fig. 4.175

Apply a coating of mastic sealant on the outer circumference of the plugs (209) before fitting them into the transmission casing.

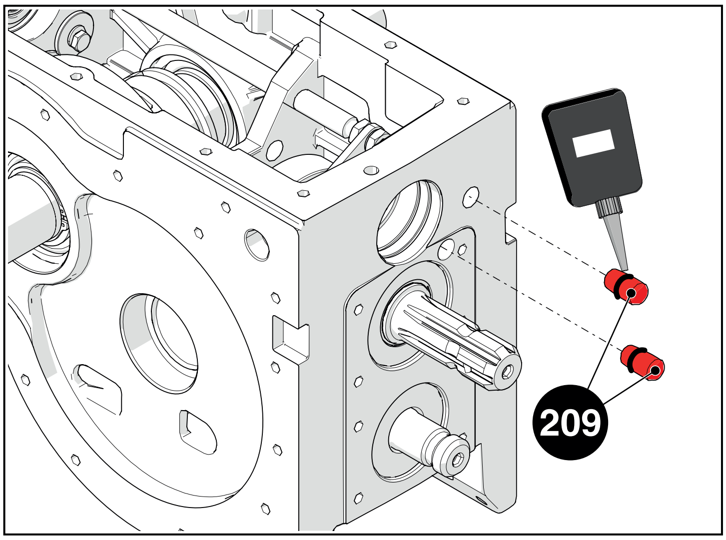

Fig. 4.176

Fit the bearing (69) on the intermediate shaft (70) and secure in place with the circlip (67).

Fit the circlip (73) and the bearing (69) in the transmission casing.

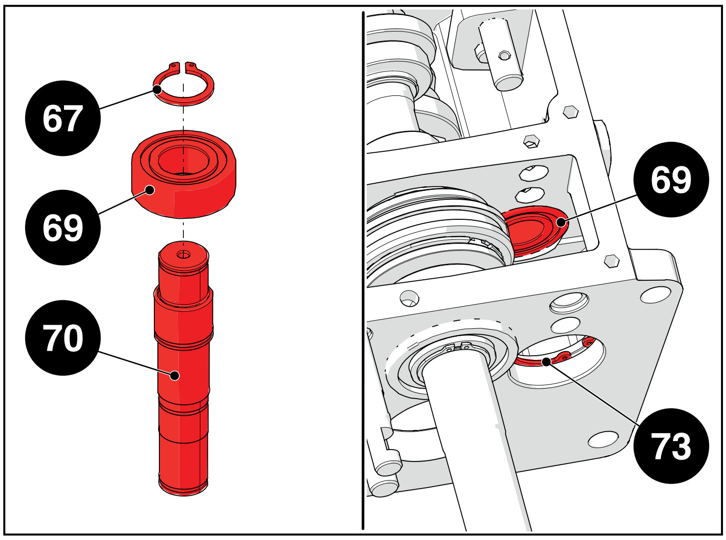

Fig. 4.177

Fit the complete shaft in the transmission casing, also fitting the gear (72), the circlip (71) and the circlip (67).

Warning
The gear (72) has already been fitted into the transmission casing in a previous step. Fit the gear (72) with the groove facing towards the front of the tractor.

Warning
The circlip (71) must be left loosely on the shaft. The circlip (67) must be fitted in its seat.

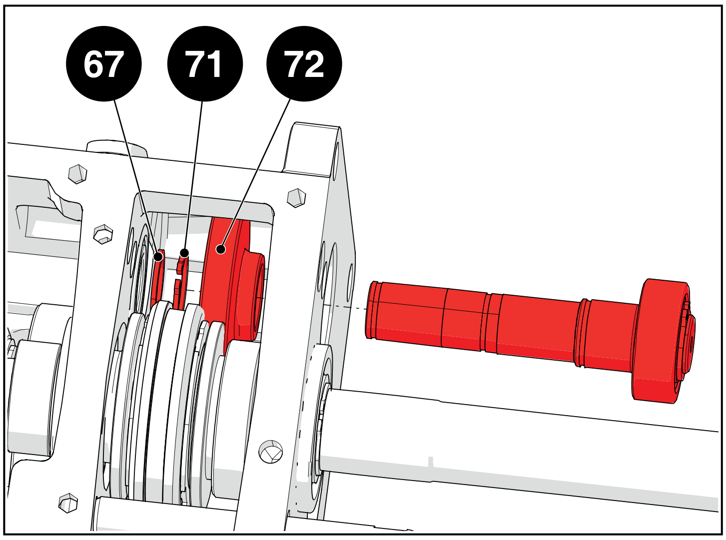

Fig. 4.178

Fit the gear (68) and drive the complete shaft completely against the circlip (73).

Warning
Fit the gear (68) with the groove facing towards the front of the tractor.

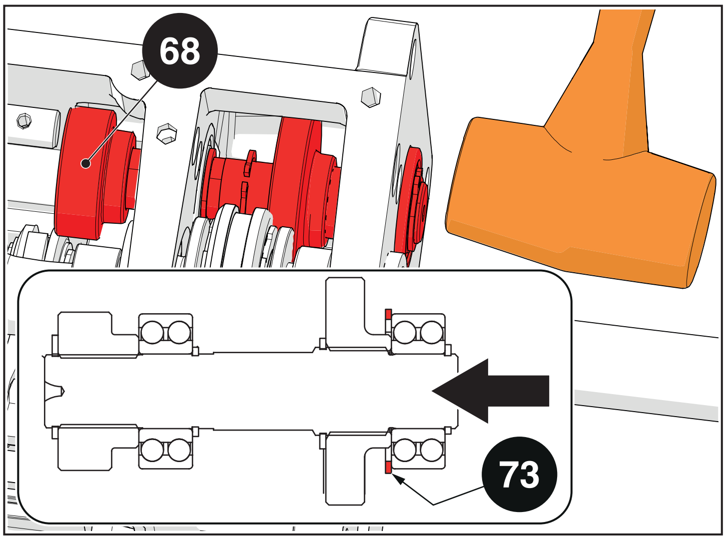

Fig. 4.179

Secure the gear (72) on the shaft by fitting the circlip (71), left loosely on the shaft, into its seat.

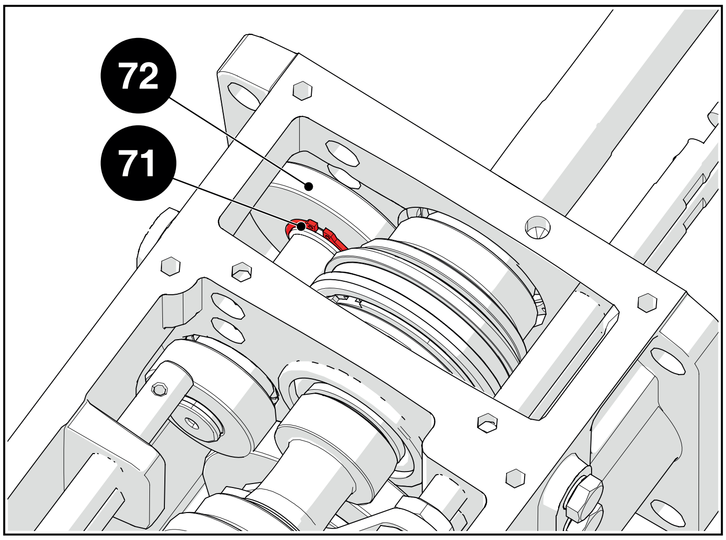

Fig. 4.180

Tap the gear (68) to drive the bearing (69) fully against the circlip (67).

Fit the circlip (67).

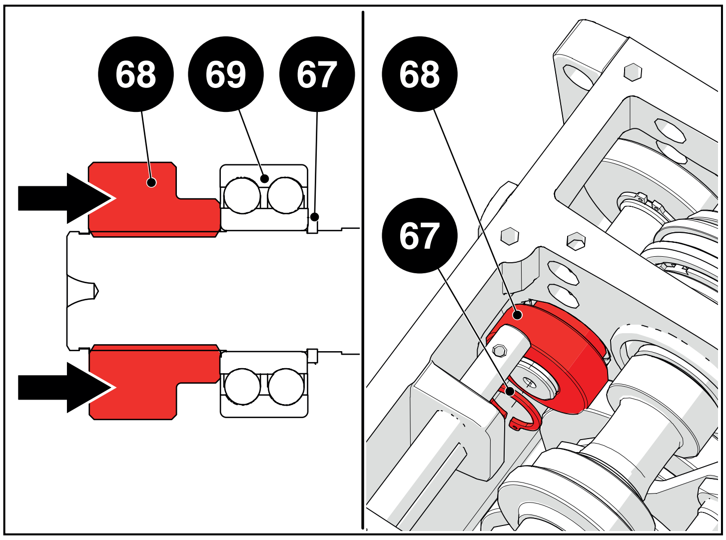

Fig. 4.181

Fit the fork (210), the ball (211) and the rod (212).

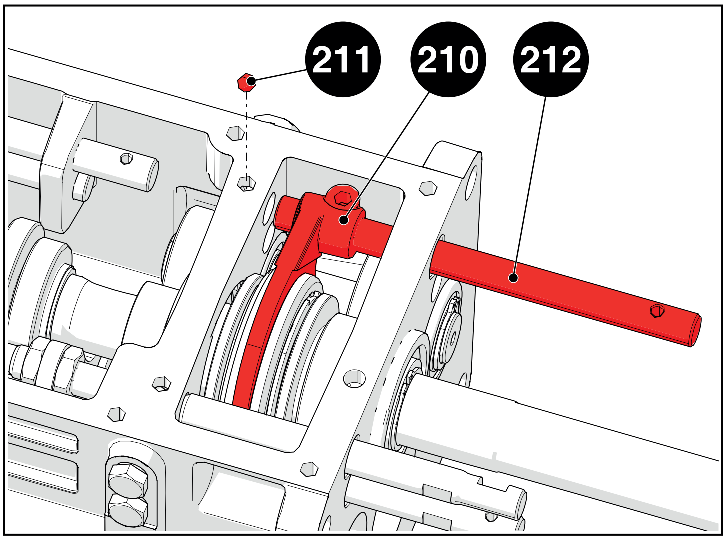

Fig. 4.182

Fit the pin (213) on the bush (214) and secure in place with the circlip (215), and then fit the assembly on the rod (207) in the transmission casing.

Secure in place with the spring pin (208).

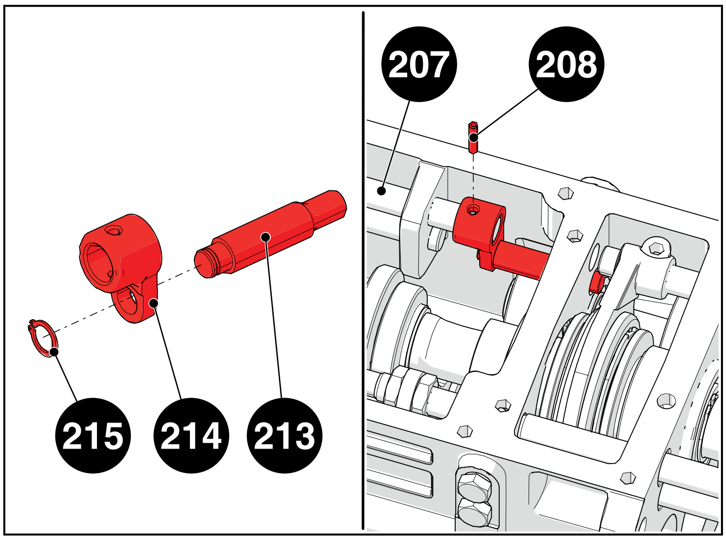

Fig. 4.183

Fit the ball (211) and the spring (216), and then fit and tighten the plug (217) together with the copper washer (218).

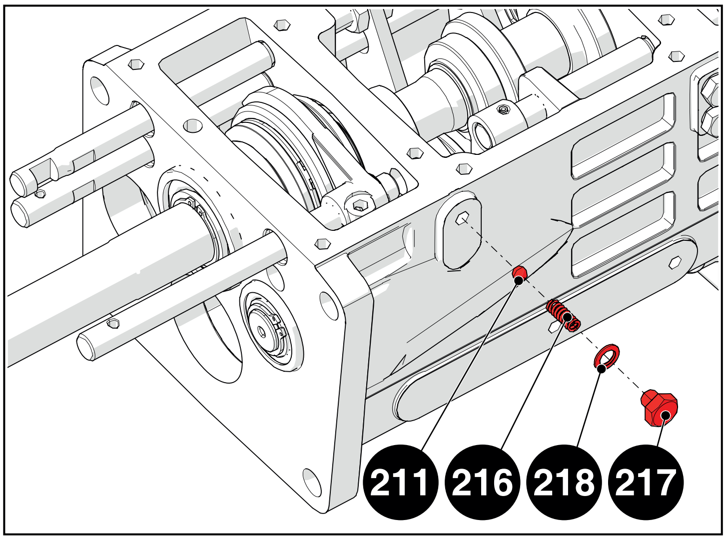

Fig. 4.184

Apply a coating of mastic sealant on the outer circumference of the plug (154) before fitting into the transmission casing.

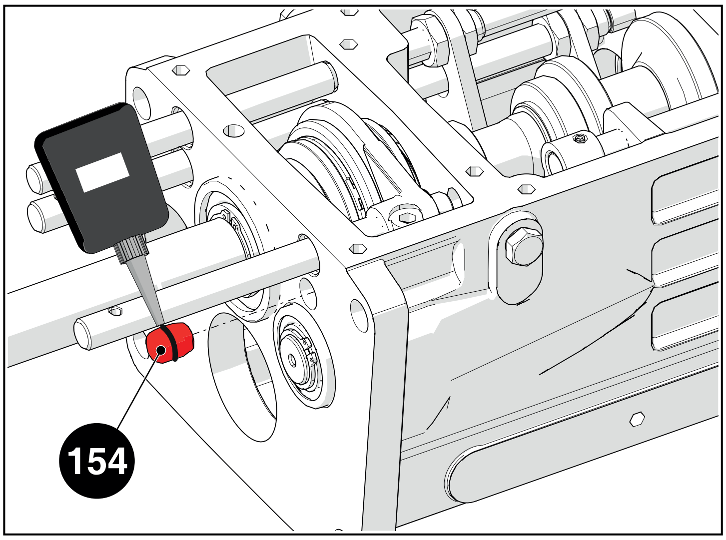

Fig. 4.185

Using a guide tool, fit the seal rings (153) (152) on the rods with a punch.

Warning
Oil the rods to facilitate installation.

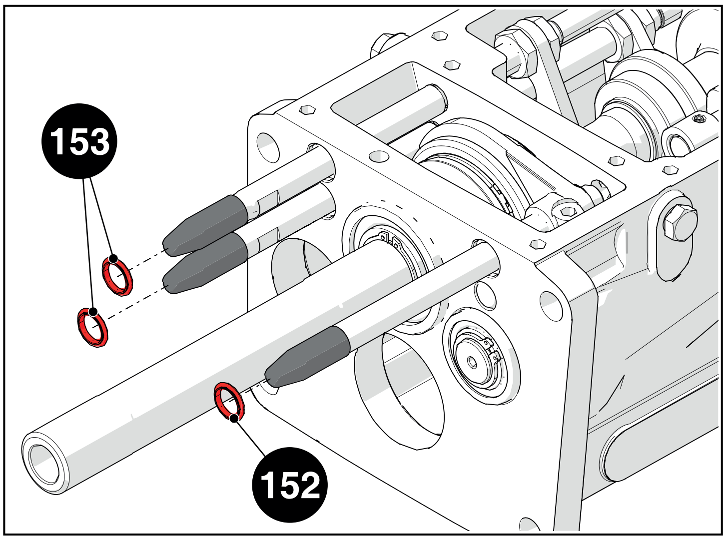

Fig. 4.186

Preassemble the independent PTO shaft, fitting the bearing (102) onto the gear (101) with a bearing punch and securing in place with the circlip (103).

Fit the circlip (105) inside the gear.

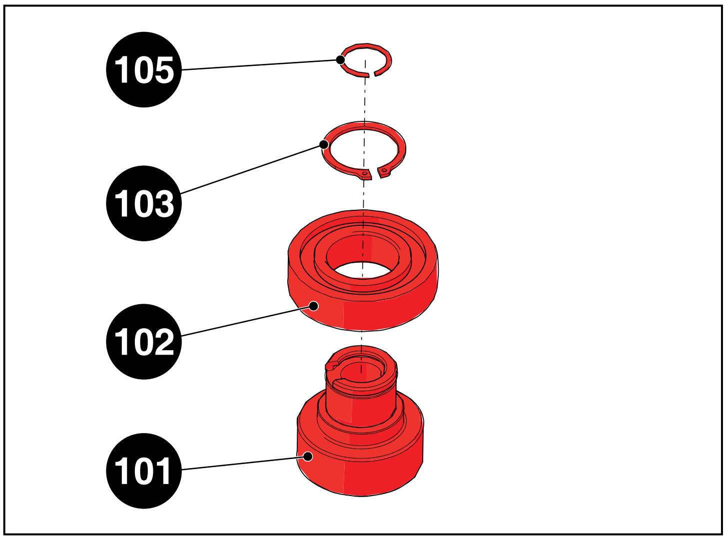

Fig. 4.187

Fit the complete gear on the PTO shaft (92). Widen the ring (105) and simultaneously tap the gear to drive the ring into its seat.

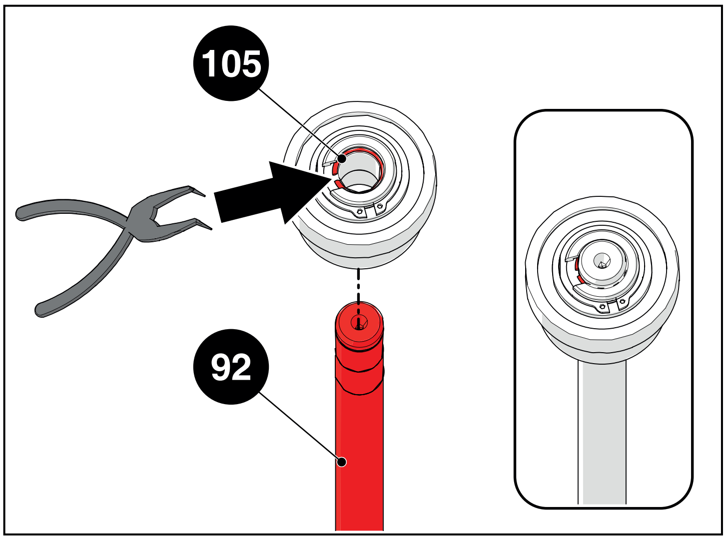

Fig. 4.188

Fit the preassembled shaft in the transmission casing, fitting it into the gears.

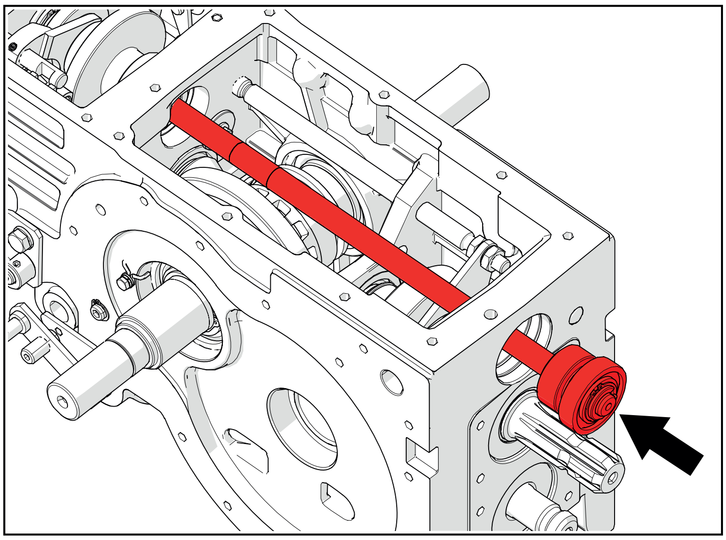

Fig. 4.189

Apply a coating of silicone sealant to the mating surfaces of the covers.

⚠ Warning
Fill the holes indicated in the figure with silicone sealant.

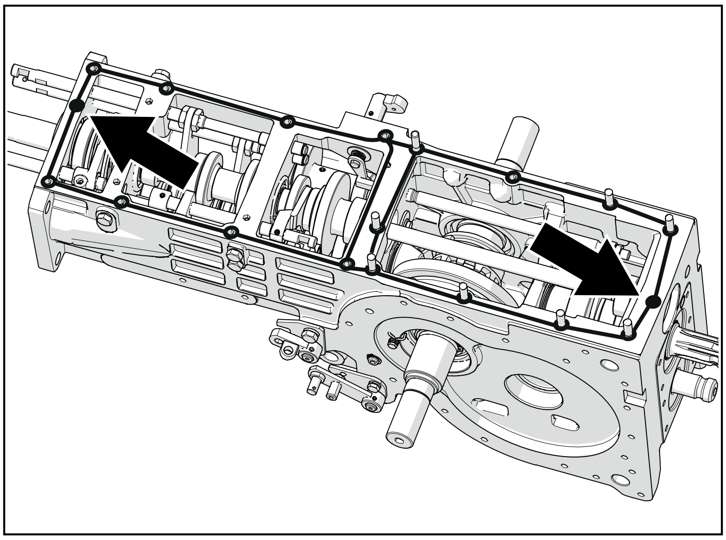

Fig. 4.190

Fit the cover (1) and the lift cover (151).

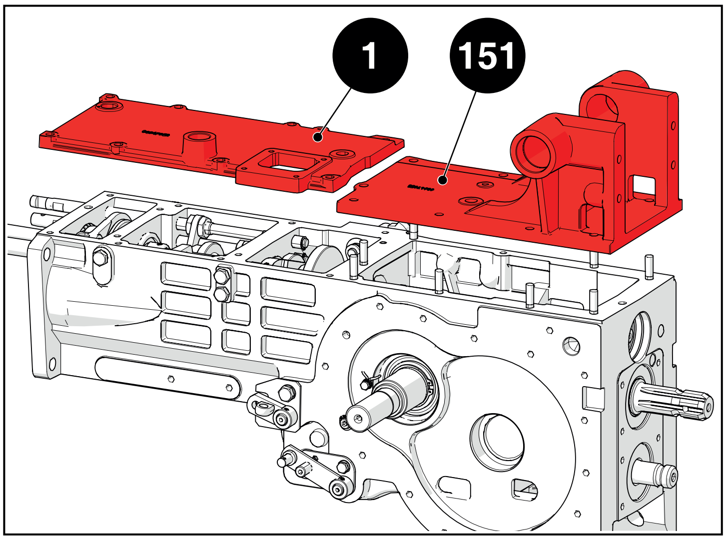

Fig. 4.191

Fit the distributor mounting plate (150) and fasten with the screw (149).

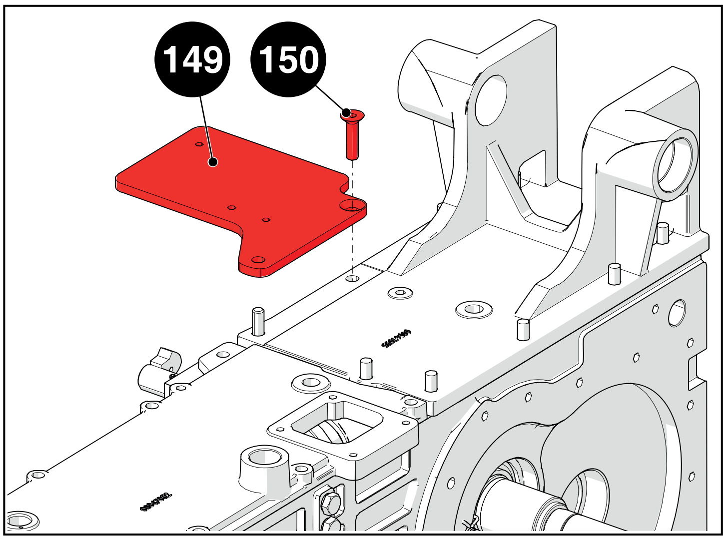

Fig. 4.192

Fit the parking brake carrier (142) and fasten with the screws (146) and (147) and the washers (148).

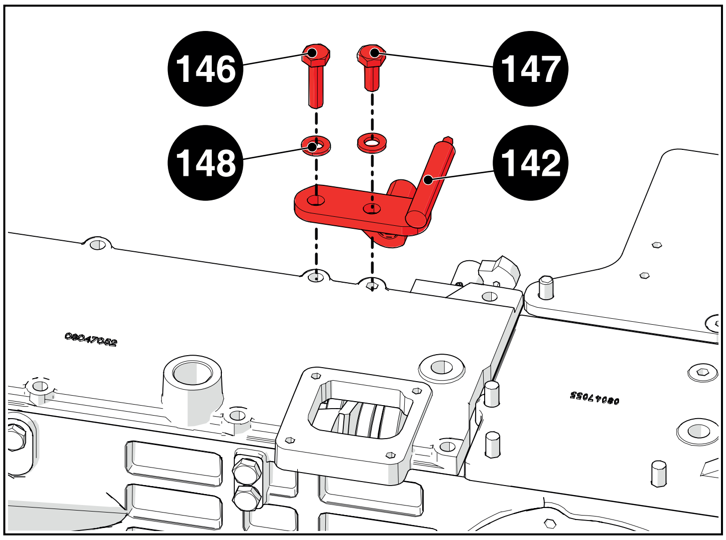

Fig. 4.193

Fit the conical washers (119) and tighten the nuts (145) and the screws (143) to a torque of ______Nm (_______kgm).

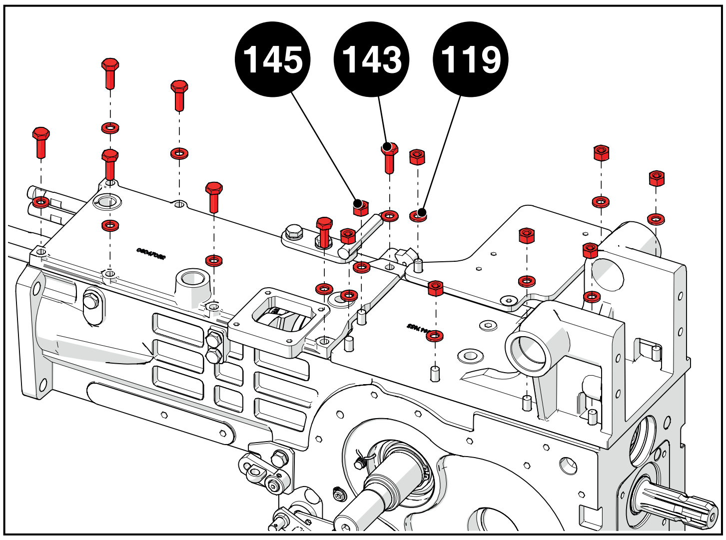

Fig. 4.194

Apply a coating of Teflon to the threads of the plugs (142) and (144) and tighten them onto the covers.

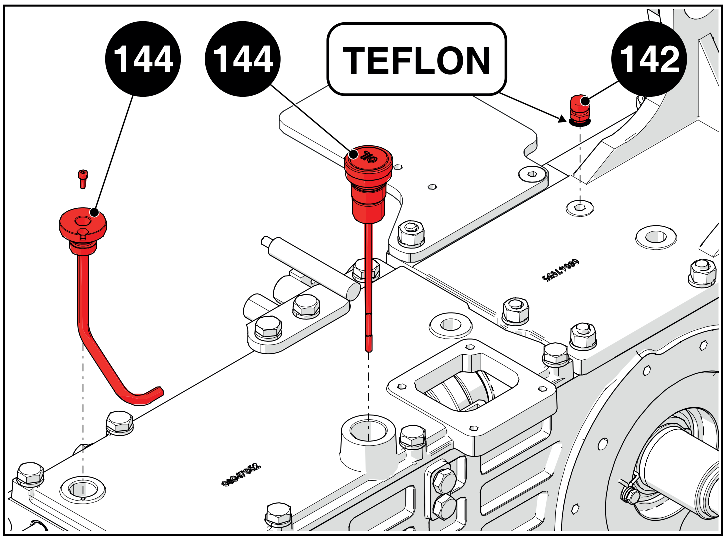

Fig. 4.195

Apply a layer of silicone sealant to the mating surface of the cover (141).

Warning
Check that the two rods are in the neutral position

Fit the cover, complete with lever, fit the washers (140) and tighten the screws (139).

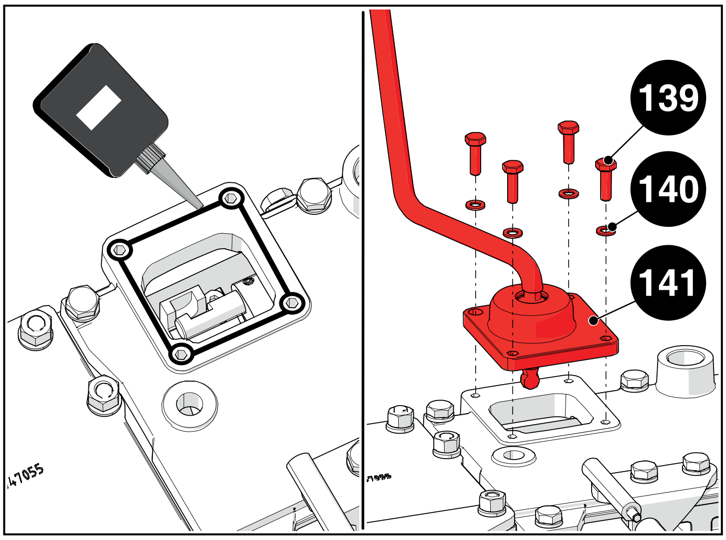

Fig. 4.196

Section 6 : Tightening torques

Index

6.1 Tightening torques

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

Tightening torque	Nm	kgm
Crown wheel mount screws	90	9
Lower PTO cover screws	-	-
Secondary shaft fastener ring nut	-	-
Differential ring nut	20	2
Lift cover screws	-	-

Section 7 : Implements necessary

Index

7.1 Implements necessary

p/n	Description	Quantity
A-p/n 07007163	Rod restraint pin	2
B-p/n ________	Circlip installation guide	1
C-p/n______	Rod oil seal guide tool	1
D-p/n 07004010	Secondary shaft guide	1
E-p/n 07007333	Secondary shaft immobiliser tool	1
F-p/n 07007332	Secondary shaft retainer	1
G-p/n 07000115	Wrench for rear differential ring nut	1
H-p/n 00007565	Spring compressor bracket	1
I-p/n __________	Dummy clutch housing	1
L-p/n __________	Bearing restraint tool	1
J-p/n __________	Wrench for secondary shaft ring nut	1

Chapter 5 : Rear brakes and final drive units

Index

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

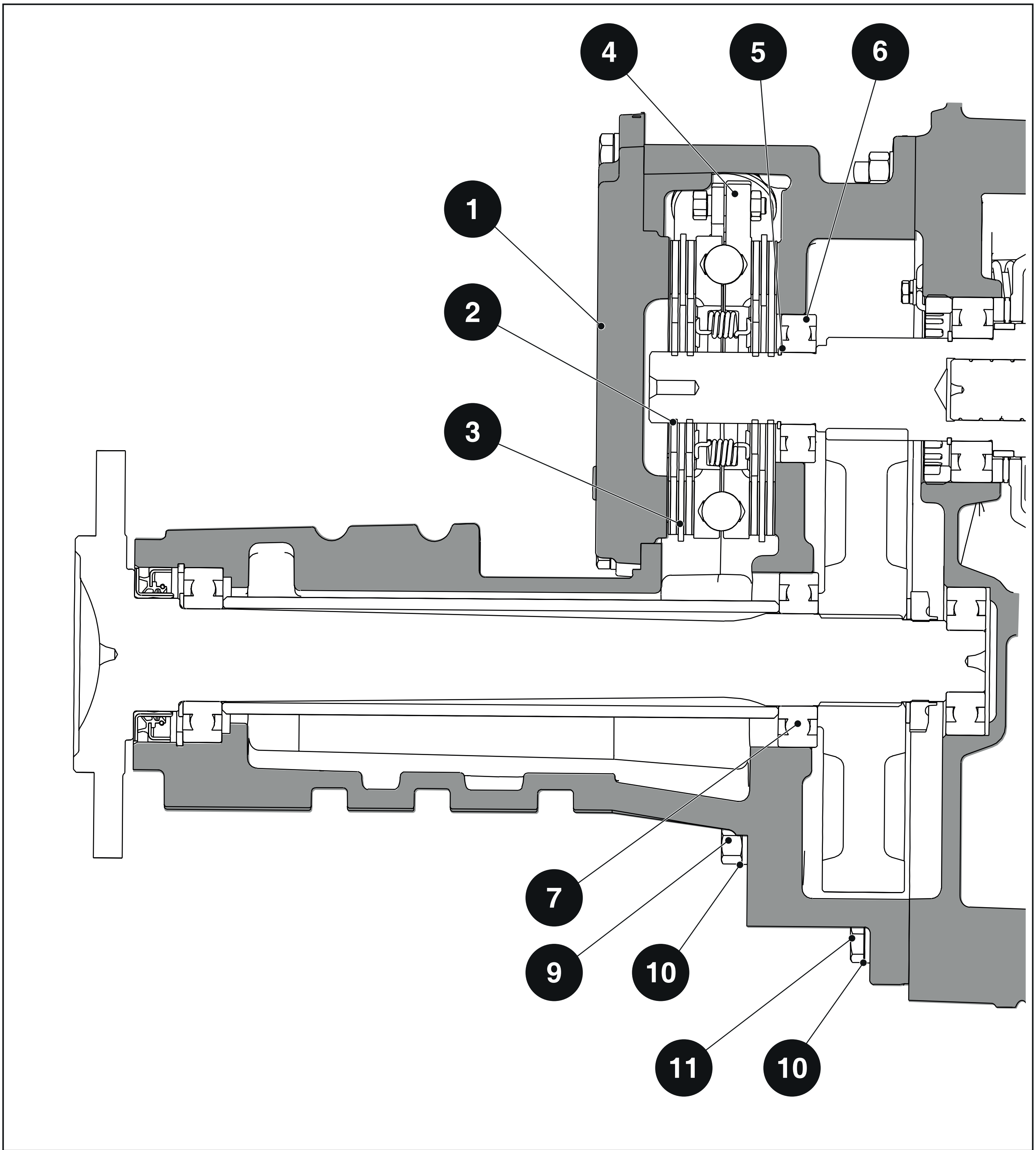

Fig. 5.1

1 - Cover
2 - Friction disc
3 - Steel disc
4 - Braking plate
5 - Circlip
6 - Bearing
7 - Bearing
9 - Screw
10 - Washer
11 - Nut

Section 3 : Disassembly

Index

3.1 Disassembly

Attention
The following instructions are applicable for both final drive units. Note however that the ring nut on the left hand final drive unit has a left handed thread while the ring nut on the right hand final drive unit has a right handed thread. The left hand axle shaft is also shorter than the right hand axle shaft.

Warning
The final drive unit must be removed in order to remove the brake discs.

Undo the screws (13) and (14) and remove the washers (9) and (10).

Remove the cover (1).

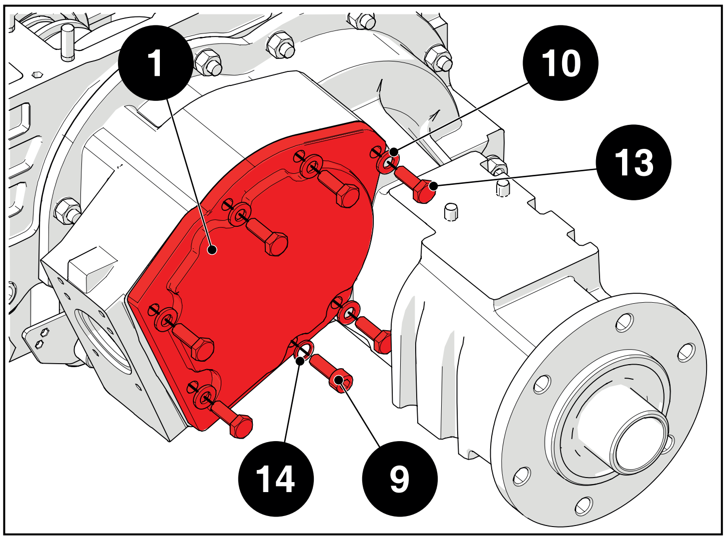

Fig. 5.2

Remove the split pins (52) and remove the pins (51) on both sides.

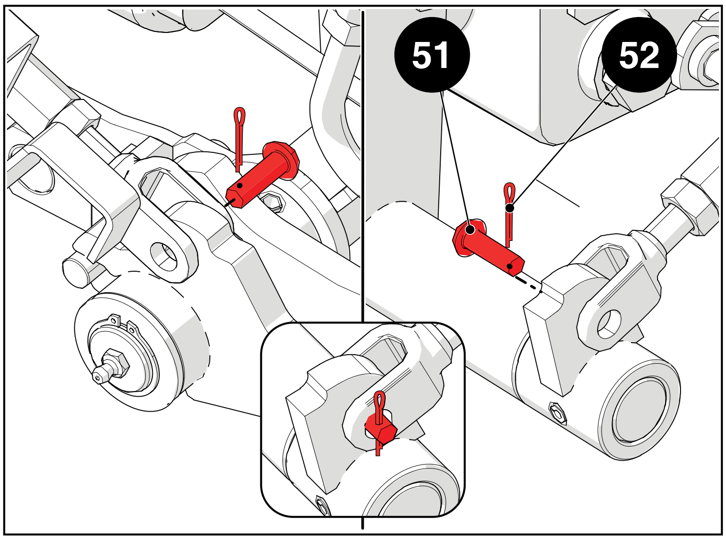

Fig. 5.3

Remove the friction discs (2), the steel discs (3) and the braking plate (4).

If necessary, remove the brake centring pins (12).

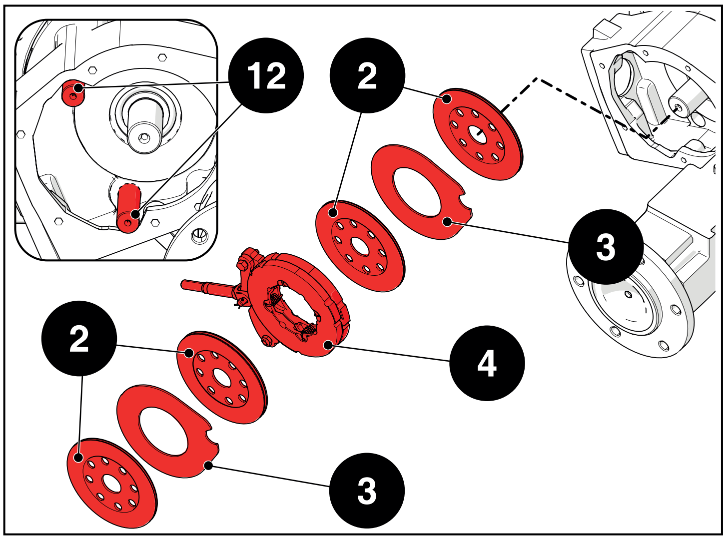

Fig. 5.4

Remove the circlip (5).

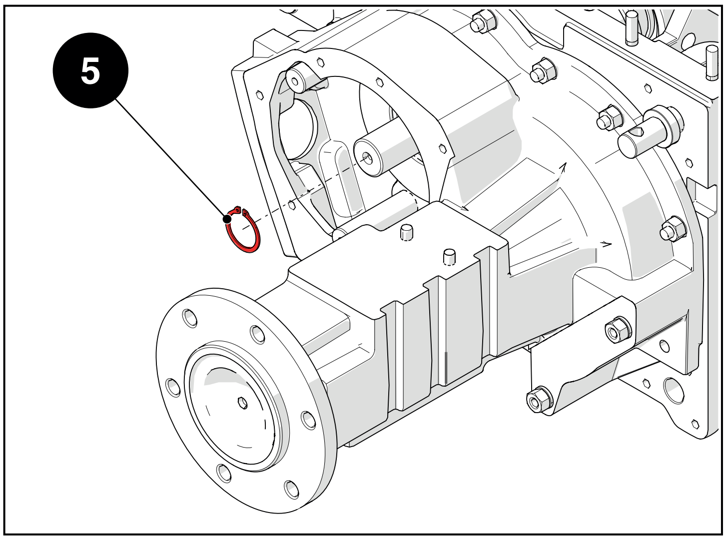

Fig. 5.5

Tighten the tool (A-p/n __________) onto the hub to secure it safely.

Undo the nuts (11) and the screws (9) and (13).

Remove the conical washers (10) and (14).

Danger
Secure the assembly to a hoist before undoing the screws and the nuts.

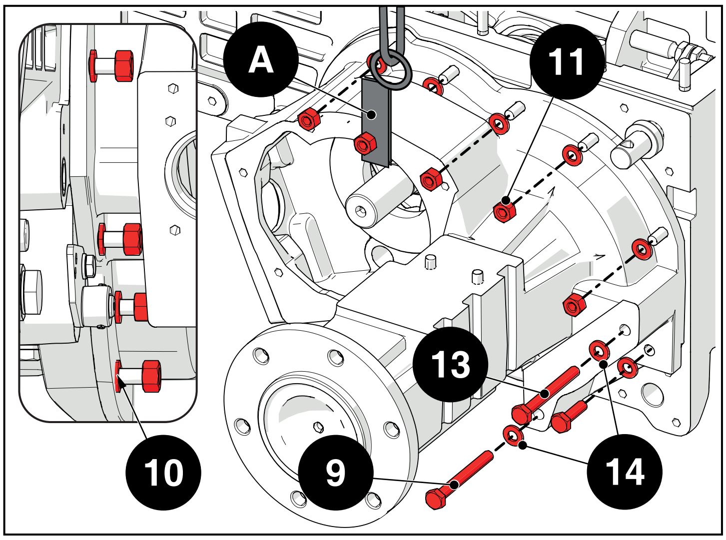

Fig. 5.6

Lift the hub with a hoist of adequate load capacity and separate it from the transmission.

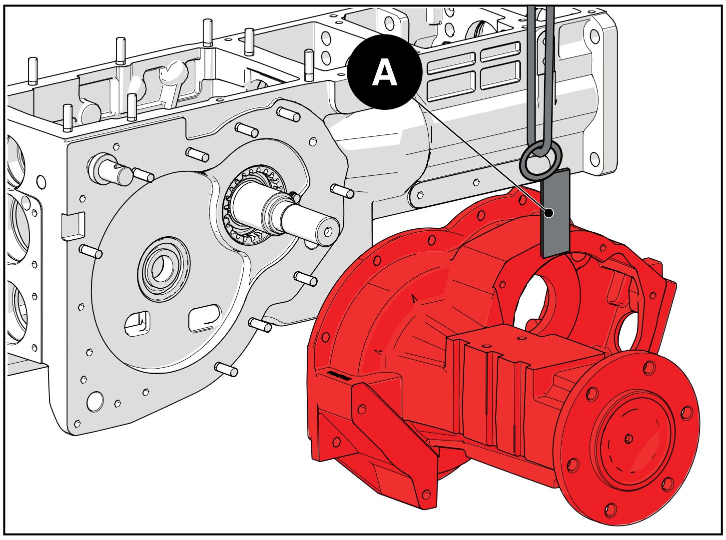

Fig. 5.7

Section 4 : Main inspection, reassembly and adjustment procedures

Index

4.1 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 lateral bearings in the transmission casing (7) with a bearing punch tool of suitable diameter.

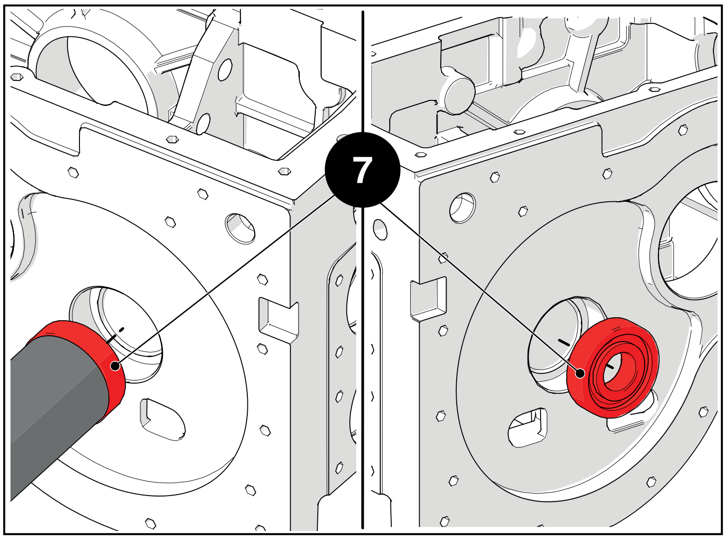

Fig. 5.8

Fit the differential lock pin (15) on the right hand hub, ensuring that the notch is facing towards the transmission.

Warning
If the pin is not fitted in the correct position, the rear differential lock will not engage.

Fasten the seal cover (61) with the screws (62) and the washers (63).

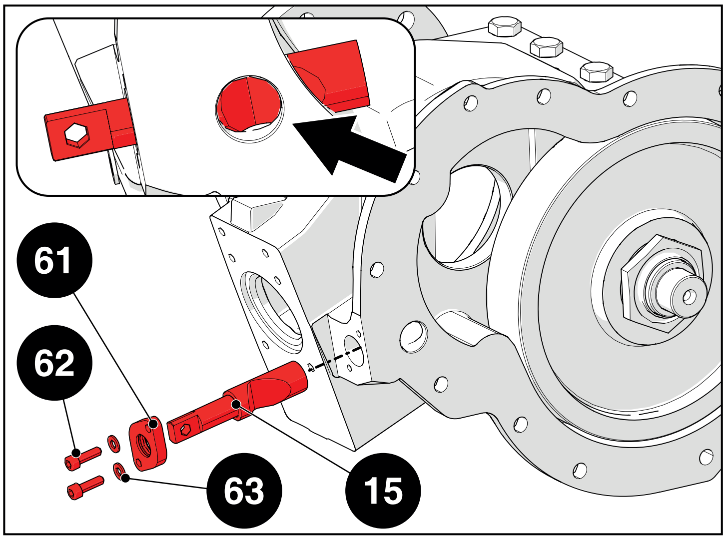

Fig. 5.9

Apply a coating of silicone sealant to the mating surfaces of the hubs.

Tighten the tool (A-p/n __________) onto the hub in order to be able to lift it.

Lift the hub with a hoist of adequate load capacity and mate it with the transmission, aligning the centring pins correctly.

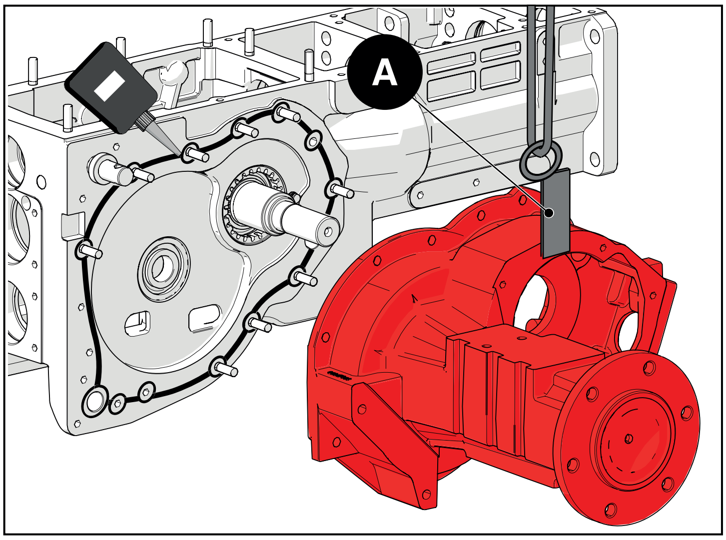

Fig. 5.10

Fit the differential lock pedal mount (16) on the right hand hub and fasten it with the nuts (17).

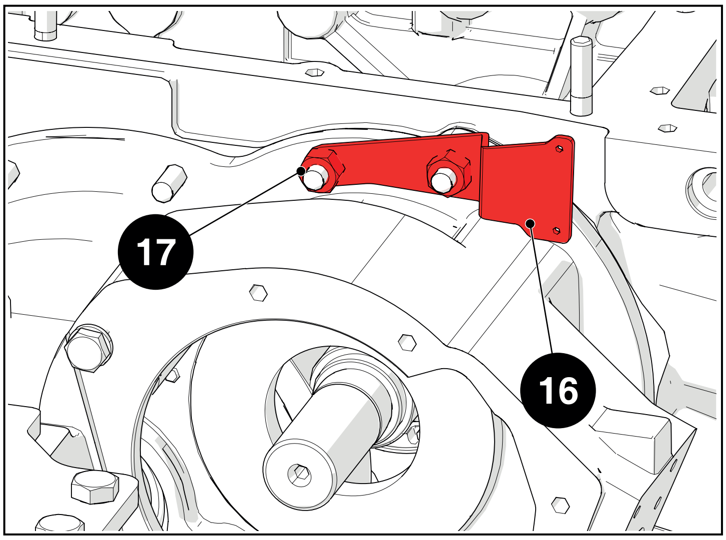

Fig. 5.11

Fit the conical washers (10) and (14).

Tighten the nuts (11) and the screws (9) and (13) to a torque of _______Nm (_______kgm).

Remove the tool (A-p/n__________).

Danger
Tighten all the screws before removing the tool.

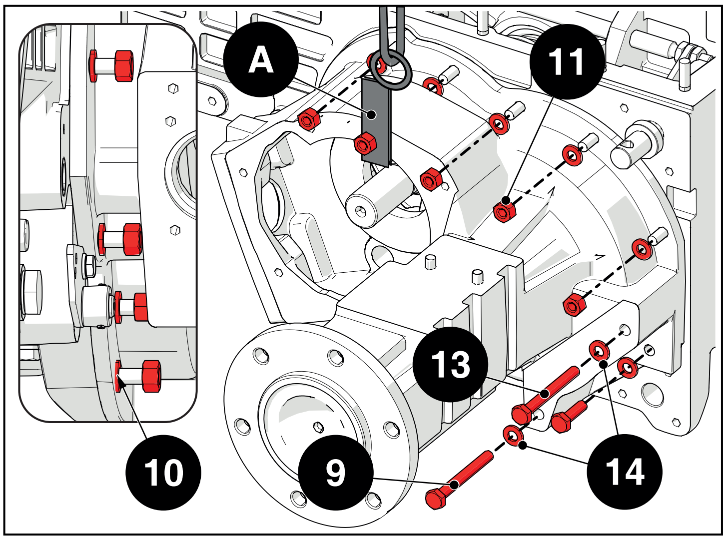

Fig. 5.12

Fit the bearing (7) with a bearing punch tool of suitable diameter.

Fit the circlip (5).

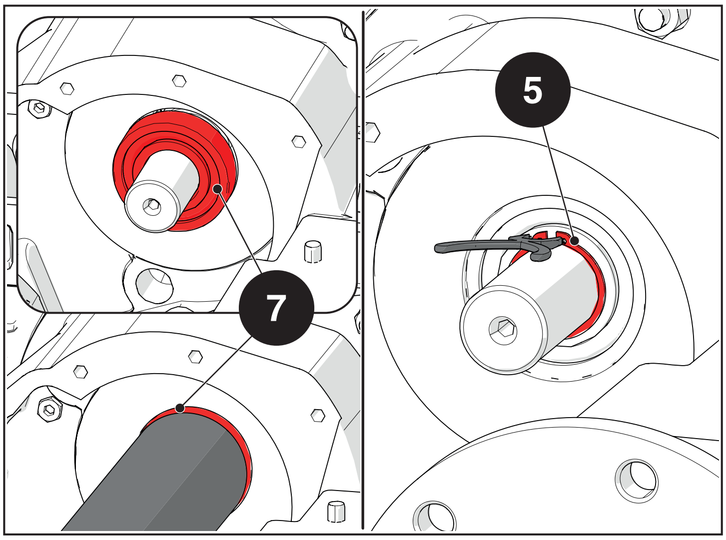

Fig. 5.13

Fit the brake centring pins (12).

Fit the steel discs (3), the friction discs (2) and the braking plate (4).

Note
In all, 2 steel discs and 4 friction discs are installed on each side.

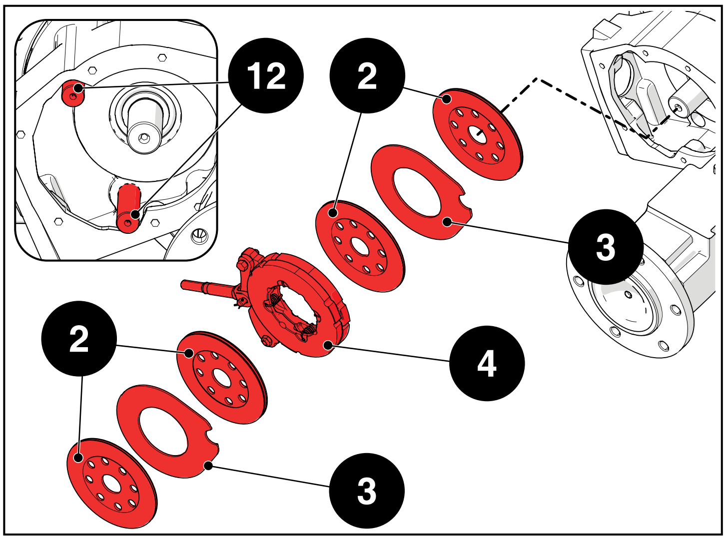

Fig. 5.14

Apply a layer of silicone sealant on the mating surface of the cover (1).

Fit and fasten the cover, fitting the washers (10) and (14), and tightening the screws (9) and (13) to a torque of ______Nm (_______kgm).

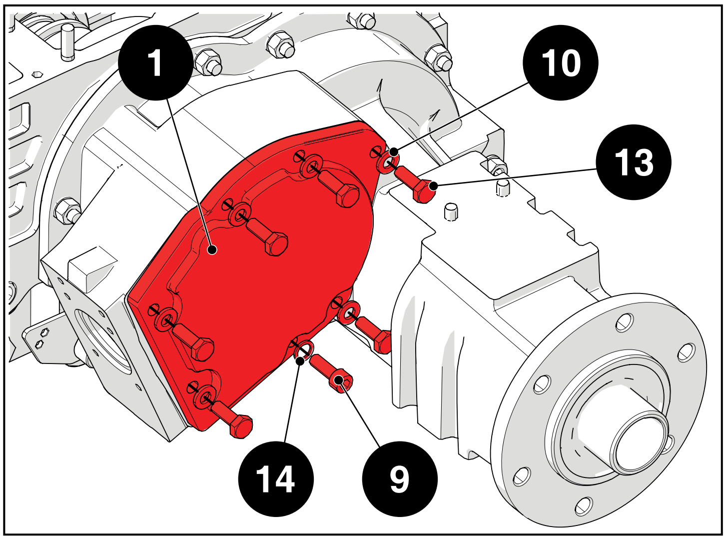

Fig. 5.15

Fit the O-Ring (18) on the assembled protective cover (19).

Fit the assembled protective cover onto the pin of the braking plate.

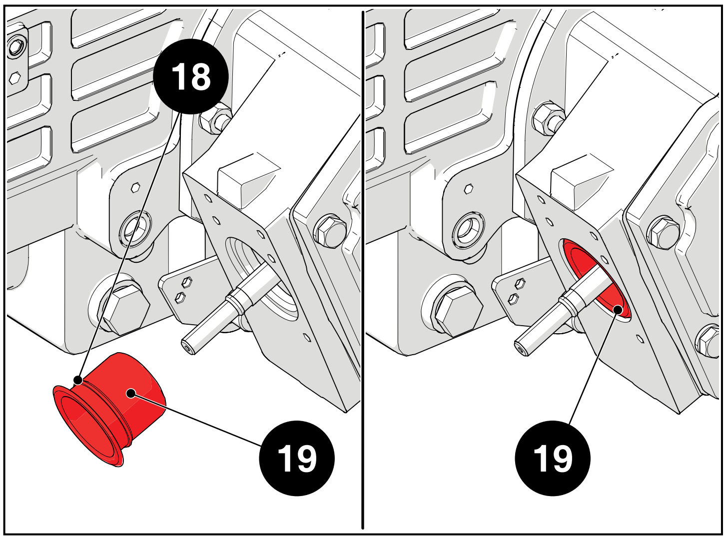

Fig. 5.16

Fit the dust cover (20), fastening with the ring (21).

Fit the flange (22), the bracket (23) and the brake switch mount (24), and fasten the assembly with the washers (25) and the screws (26).

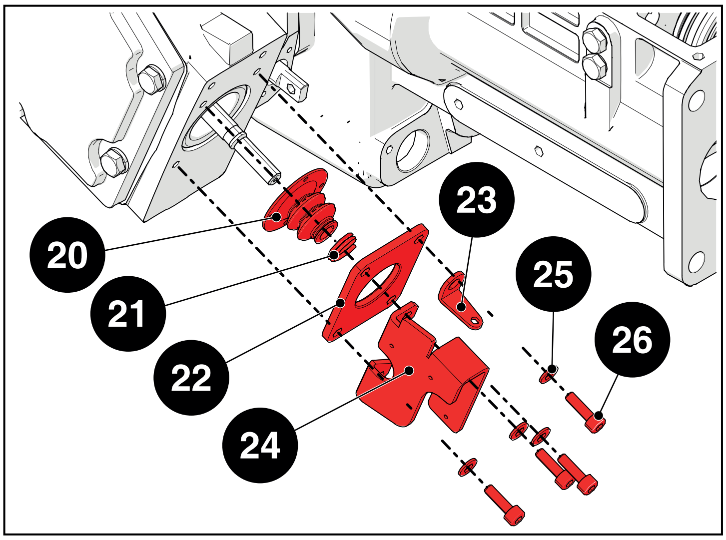

Fig. 5.17

Fit the assembled brake pedal mount (8) and fasten with the screws (28) and washers (27).

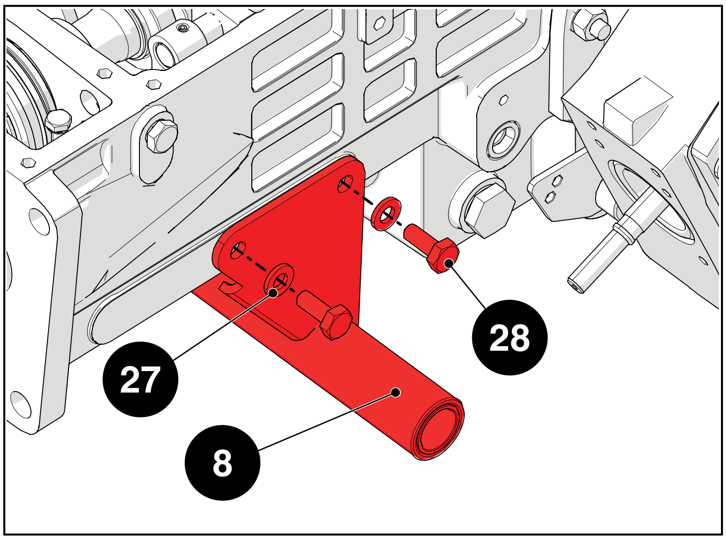

Fig. 5.18

Fit the differential lock pedal mount (16) and fasten with the screws (31) and (32) and the washers (29) e (30).

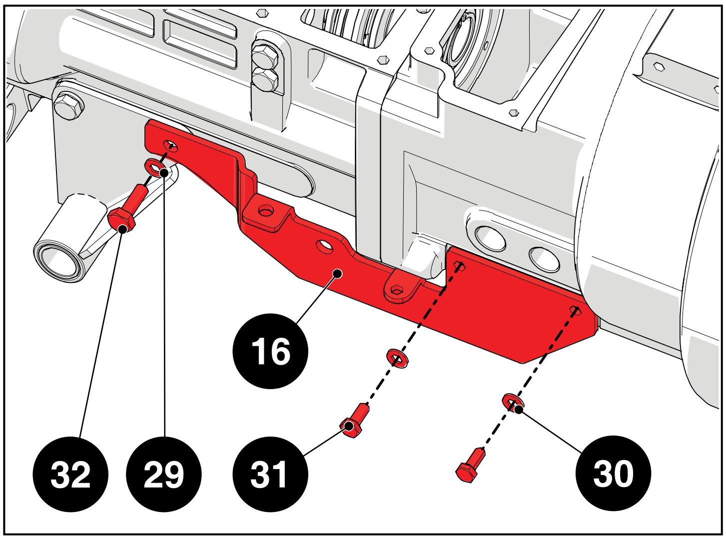

Fig. 5.19

Fit the differential lock pedal (33), the spacer (34) and the circlip (35).

Attach the spring (36).

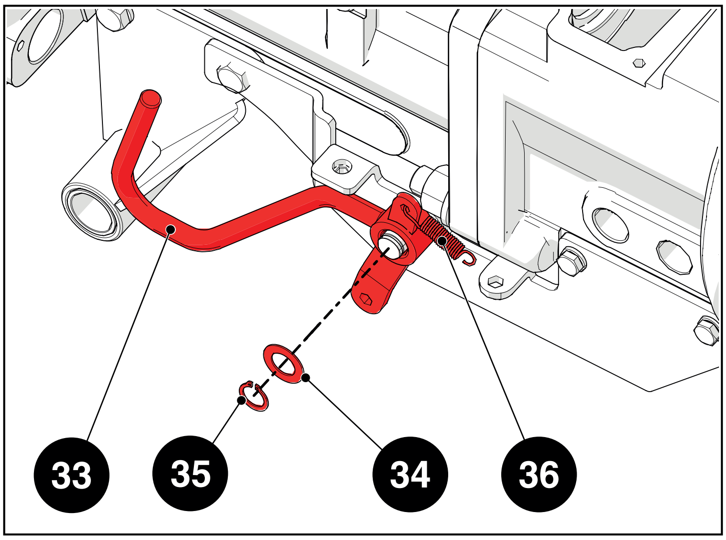

Fig. 5.20

Fit the differential lock link rod (37) and fasten at both ends.

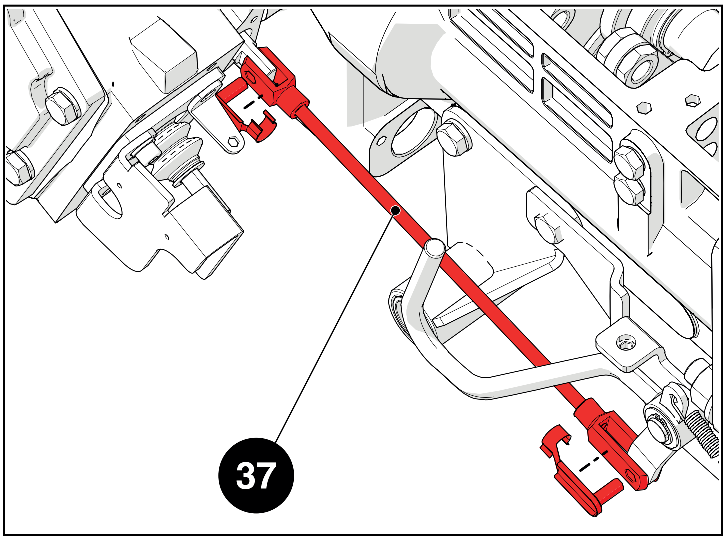

Fig. 5.21

Fit and tighten the assembled brake link rods (38).

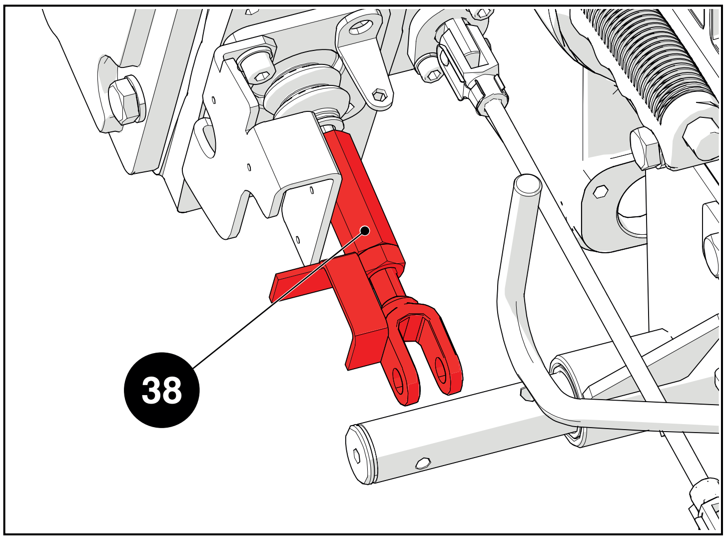

Fig. 5.22

Fit the parking brake lever (39) onto the lever mount on the transmission.

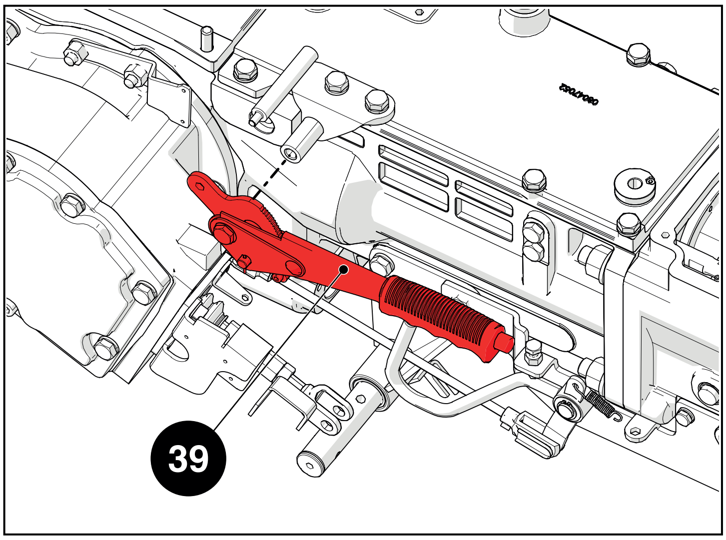

Fig. 5.23

Preassemble the brake pedal assembly by fitting the spacer (41), the lever (42), the pedal (43), the spacer (44), the pedal (45), the spacer (41), the circlip (46) and the grease nipple (47) on the pin (40).

Fit the spring pin (48) to secure the pedals on the pin.

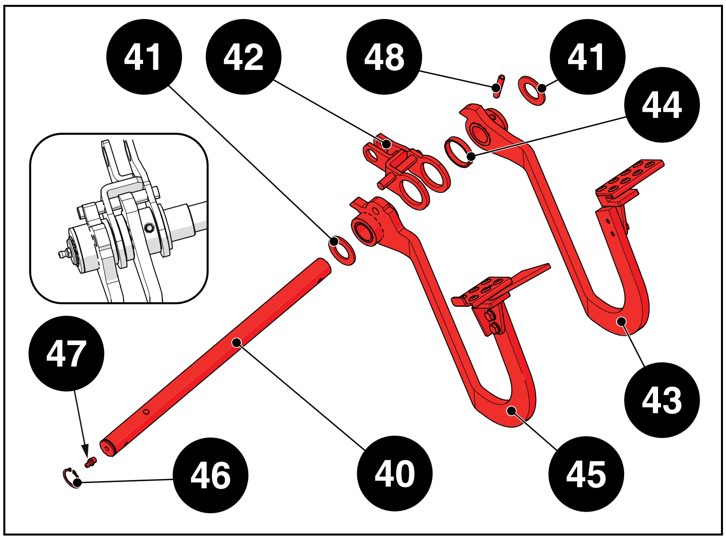

Fig. 5.24

Fit the complete pedal assembly onto the brake pedal mount.

Fit the lever (49) and fasten onto the pin with the spring pin (50).

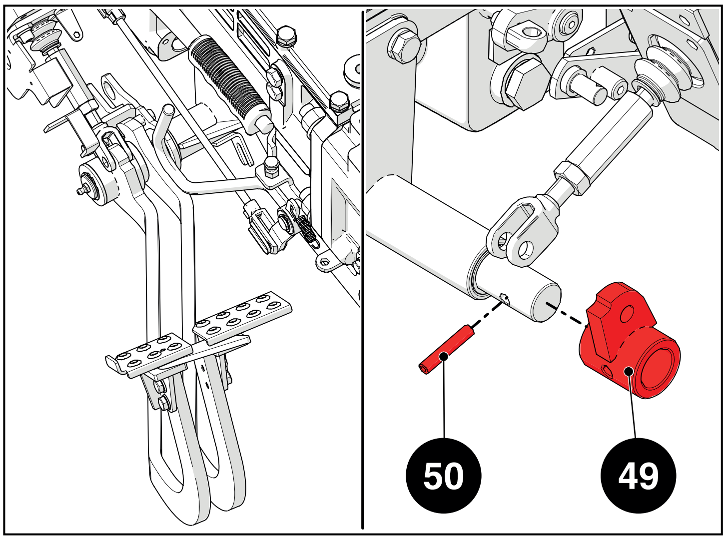

Fig. 5.25

Secure the brake link rods with the pins (51) and the split pins (52) on both sides.

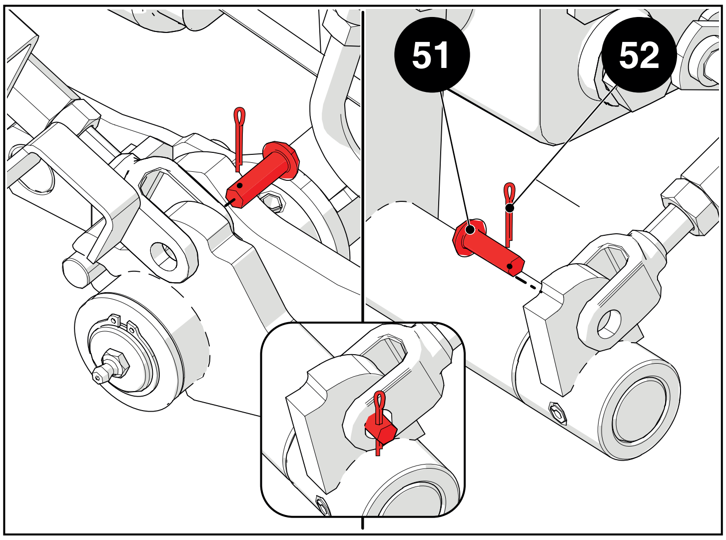

Fig. 5.26

Attach the brake return springs (53).

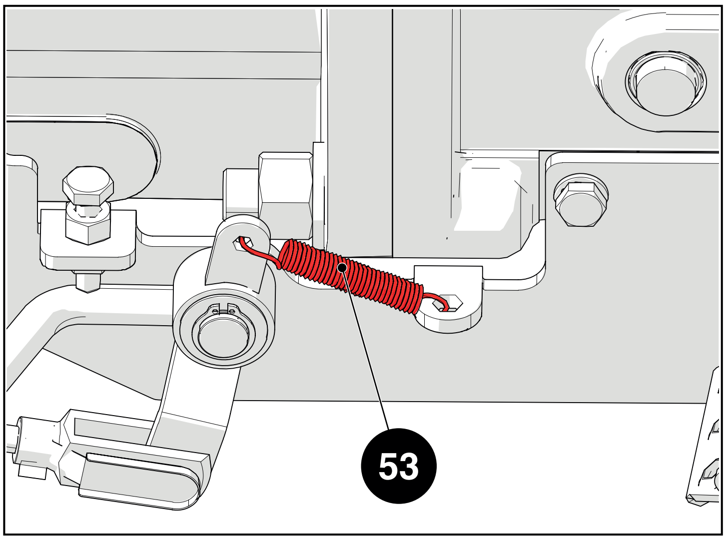

Fig. 5.27

Fit the parking brake link rod (54) and fasten with the pin (55) and the split pin (56).

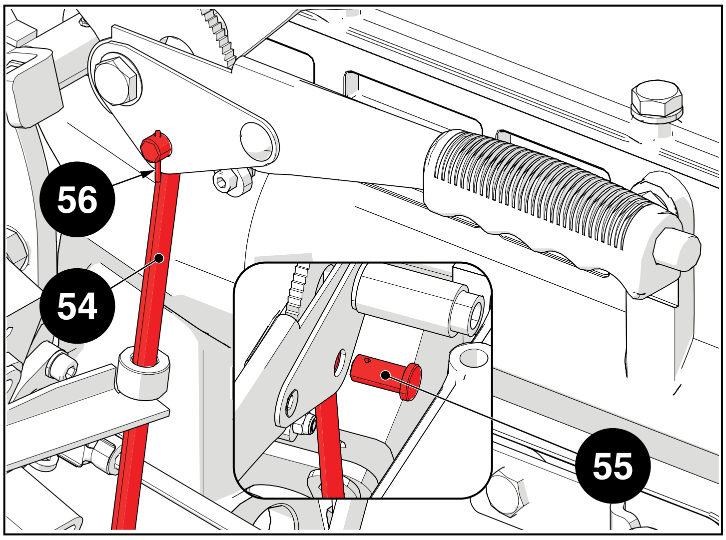

Fig. 5.28

Fit the spring (57), the ferrule (58), the nut (59) and the check nut (60) on the parking brake link rod.

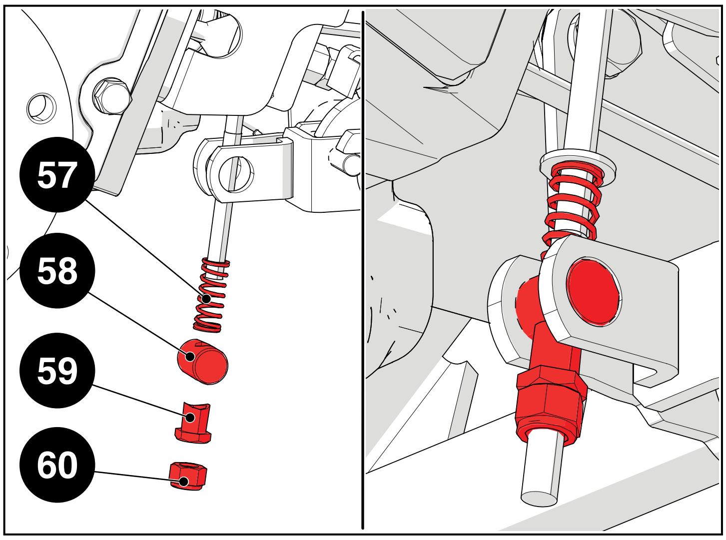

Fig. 5.29

Section 5 : Tightening torques

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5.1 Tightening torques

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

Tightening torque	Nm	Kgm
-	-	-

Section 6 : Implements necessary

Index

6.1 Implements necessary

p/n	Description	Quantity
A-p/n __________	Hoisting hub	1

Chapter 6 : Front axle

Index

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 : Technical characteristics

Index

2.1 Technical characteristics

Front axle swing angle	11°
Front differential lock	Mechanical

Section 3 : Removal

Index

3.1 Removal

Undo the fastener screws of the 4WD shaft guard casing on both sides.

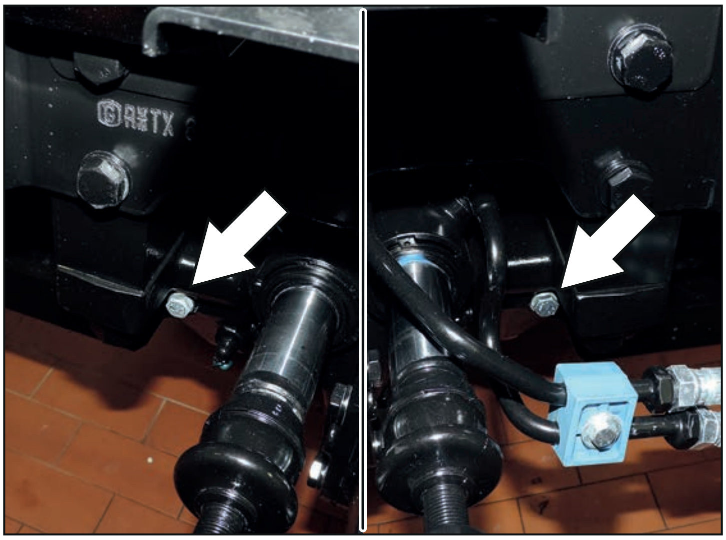


Fig. 6.1

Remove the 4WD shaft guard casing.

Fig. 6.2

Undo the fastener screws of the 4WD shaft, then pull the shaft out from the rear and remove.

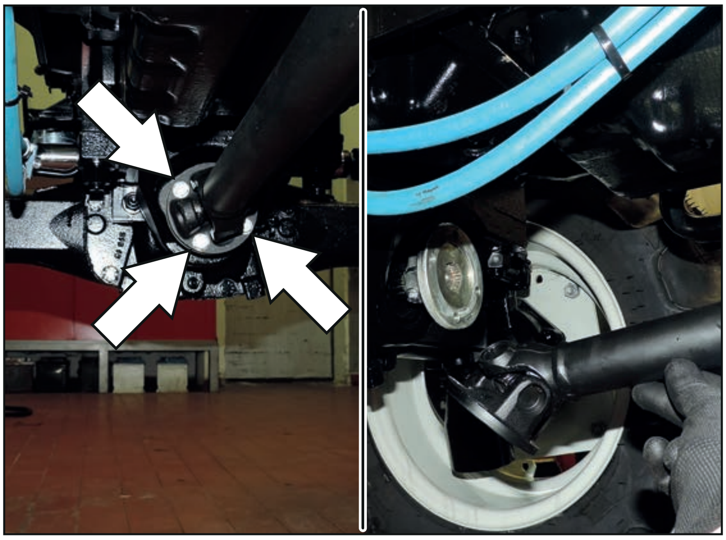


Fig. 6.3

Pull the 4WD shaft out from the rear and remove.

Fig. 6.4

Undo the hydraulic oil delivery line connectors for the steering cylinder and the clamp.

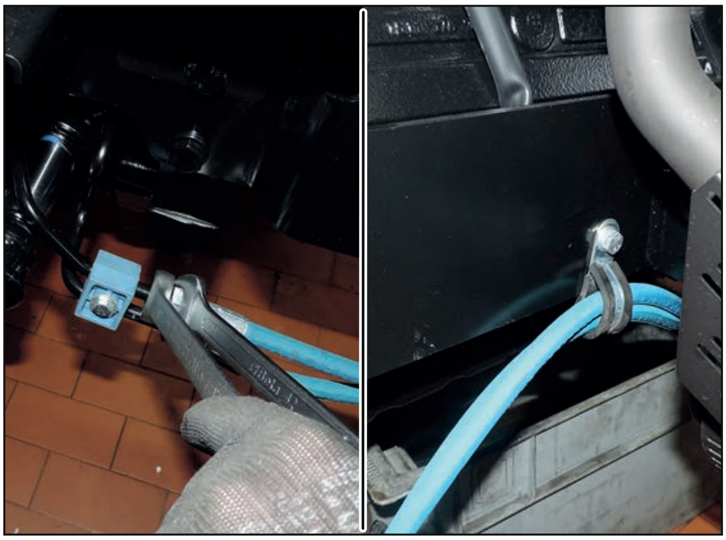


Fig. 6.5

Lift the front of the tractor with a hoist of suitable load capacity.

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

Danger
Engage the parking brake to immobilise the tractor.

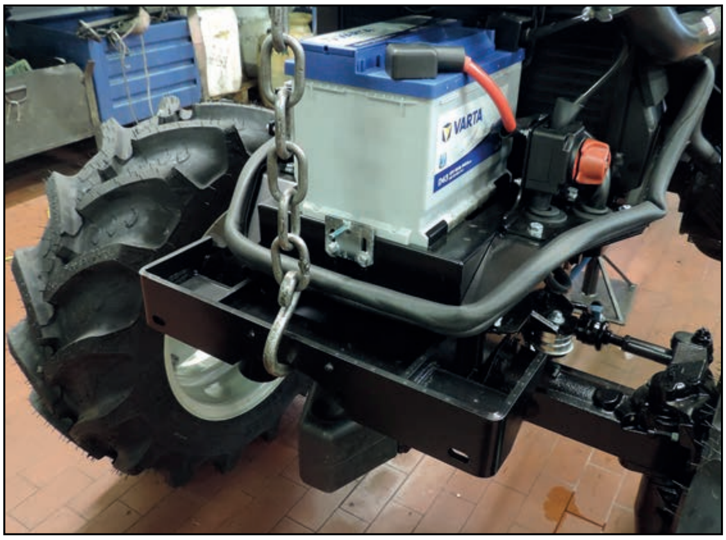


Fig. 6.6

Undo the rear nuts fastening the front axle.

Fig. 6.7

Undo the front nuts fastening the front axle.

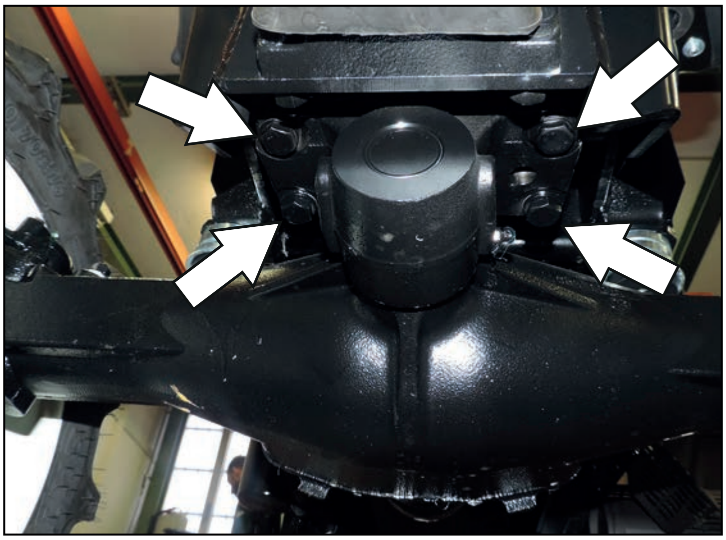


Fig. 6.8

Lift the tractor, detach the front axle and then remove the axle.

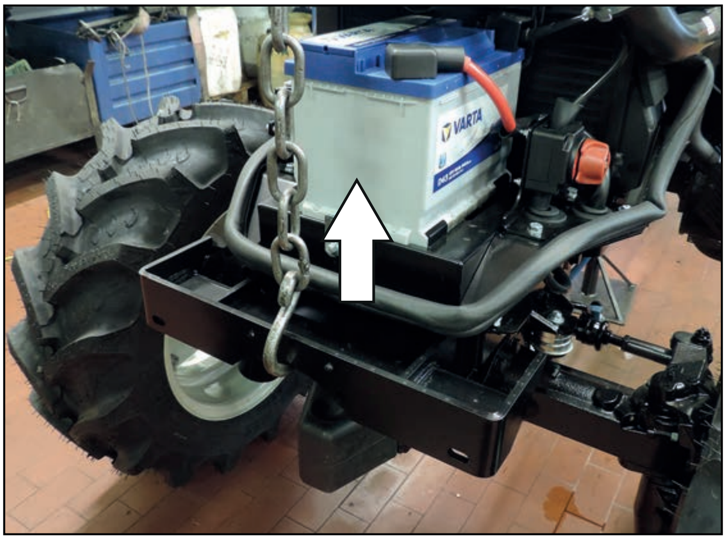


Fig. 6.9

Remove the split pin and undo the stop nut.

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

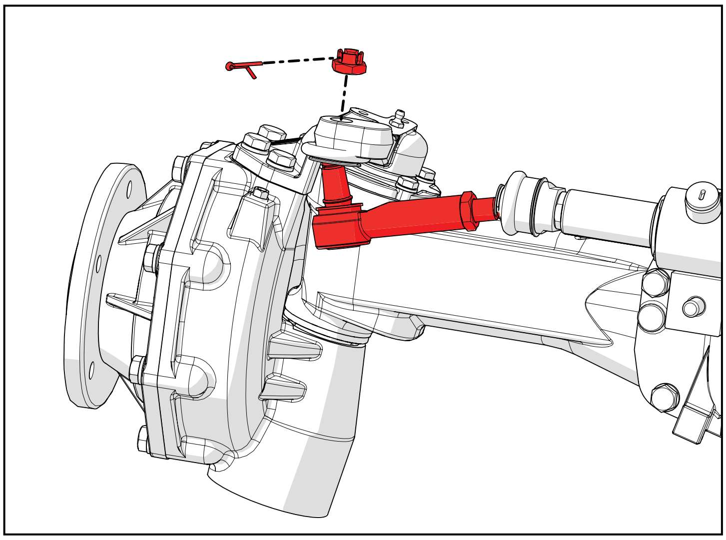


Fig. 6.10

Undo the self-locking nuts (86) fastening the steering cylinder to the front axle and remove the flat washers (85).

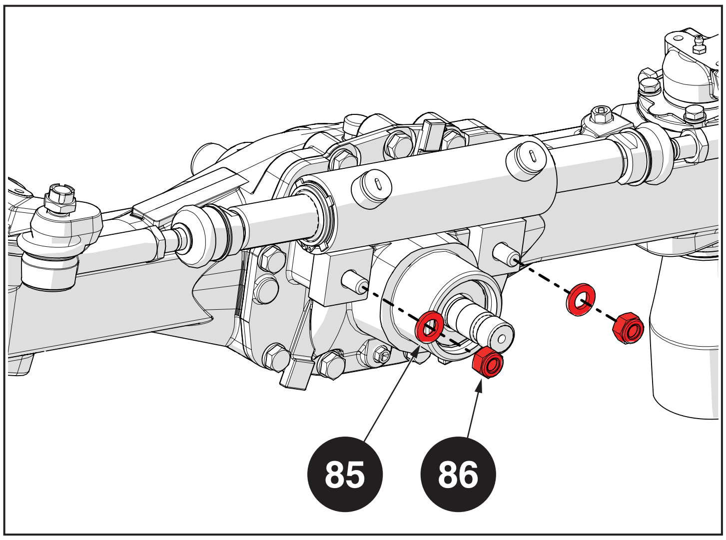


Fig. 6.11

Remove the complete steering cylinder.

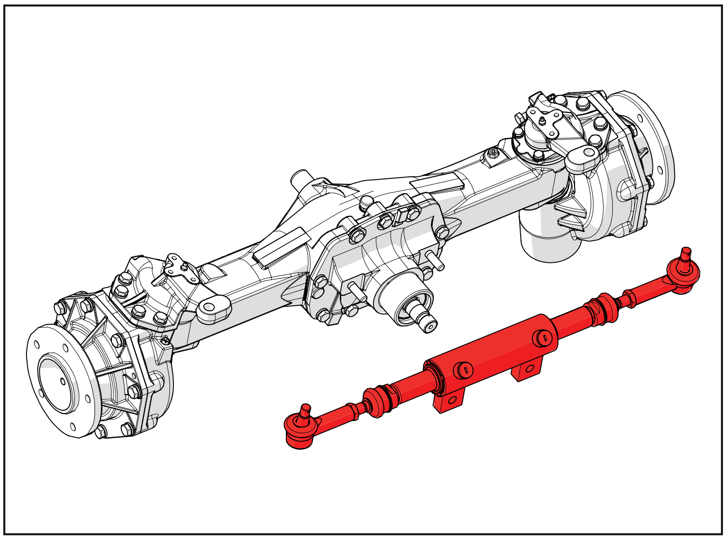


Fig. 6.12

Fit 2 hoisting eye-bolts onto the front differential and secure them to a hoist of adequate load capacity.

Unscrew and remove the screws (76) and the washers (77).

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.

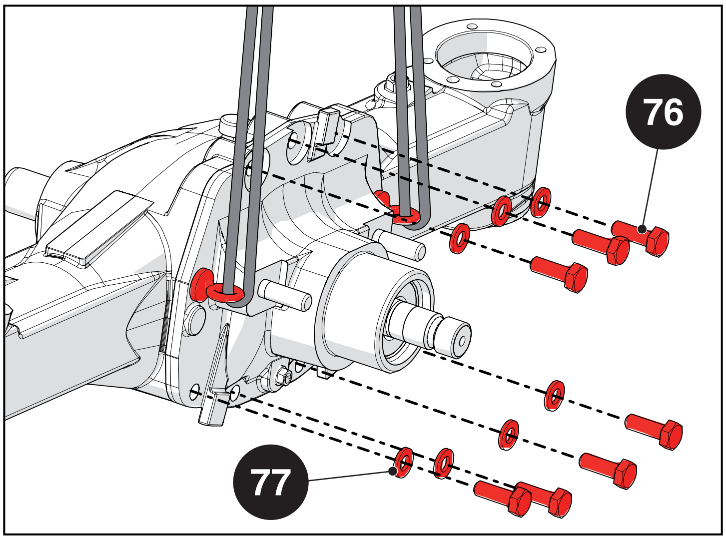


Fig. 6.13

Separate the complete differential casing from the front axle.

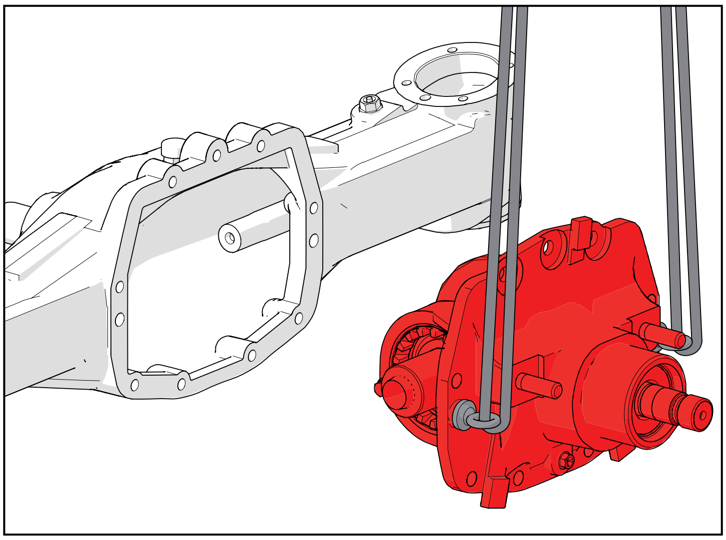


Fig. 6.14

Remove the grease nipple (23).

Undo the screws (21) and remove the washers (22).

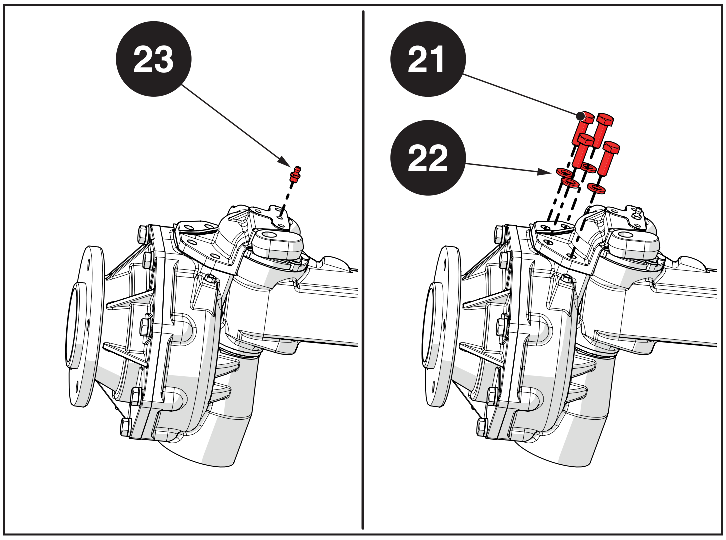


Fig. 6.15

Remove the steering lever (25) complete with bush (26).

Remove the plate (17).

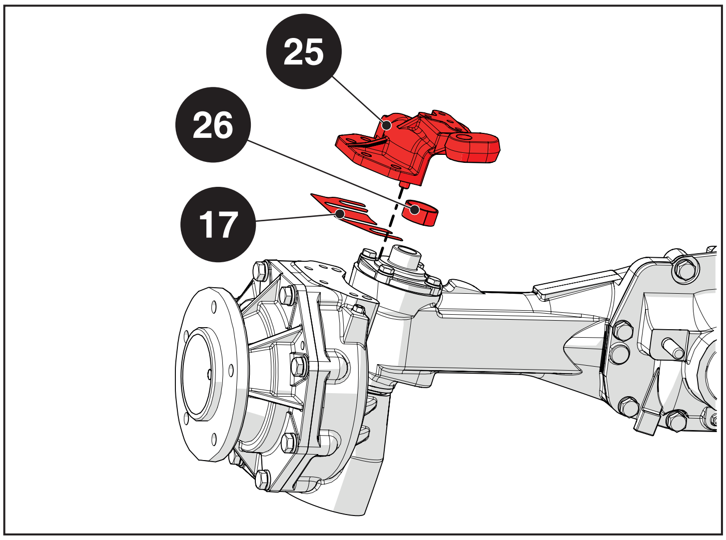


Fig. 6.16

Undo the screws (38) and remove the washers (37) and then remove the cover (36).

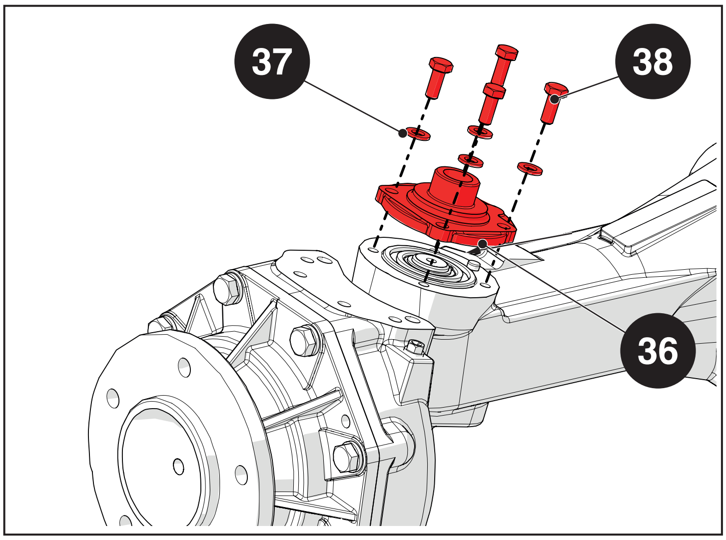


Fig. 6.17

Remove the oil seal (29) and the circlip (30).

Remove the shaft (32) with the bearing (31).

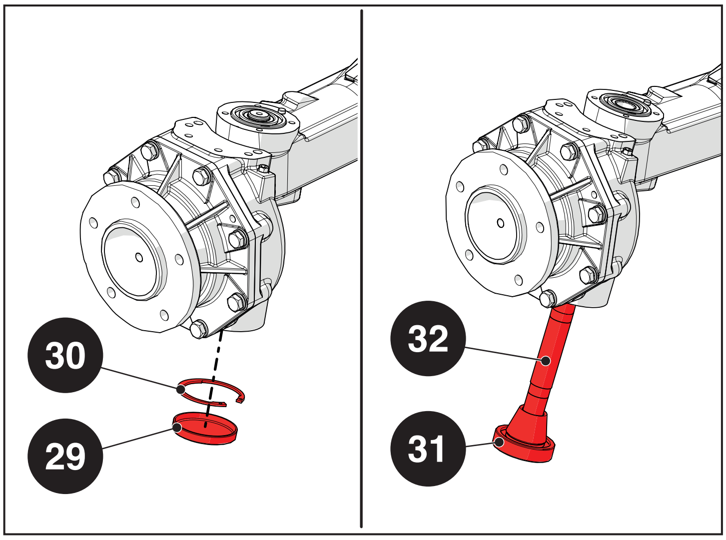


Fig. 6.18

Remove the complete final drive unit from the front axle.

Remove the oil seal (20), the roller bearing cages and the spacers (19).

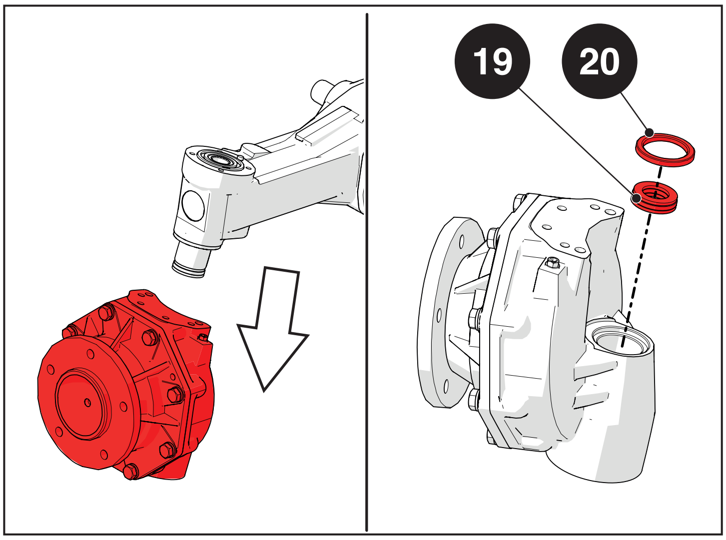


Fig. 6.19

Remove the plug (39).

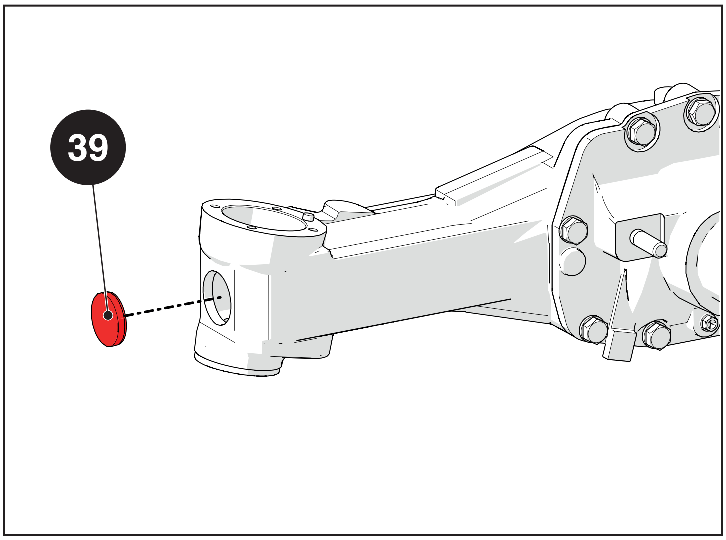


Fig. 6.20

Remove the upper gear (33), complete with bearing (34), from the front axle.

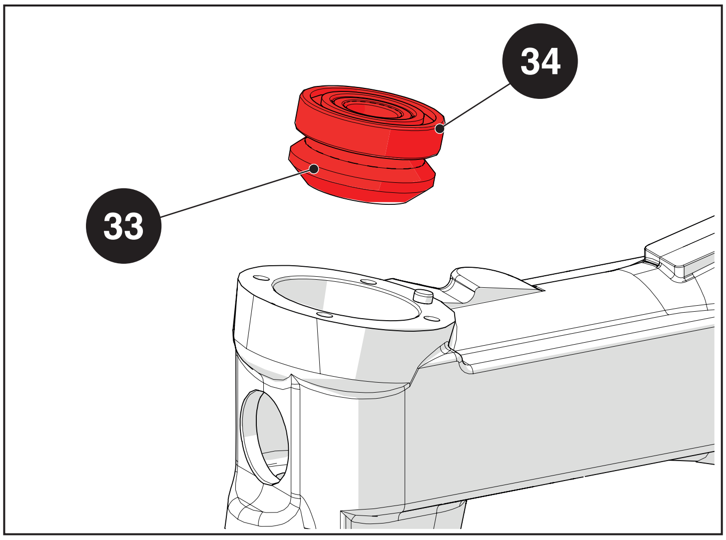


Fig. 6.21

Remove the circlip (40) and the gear (41).

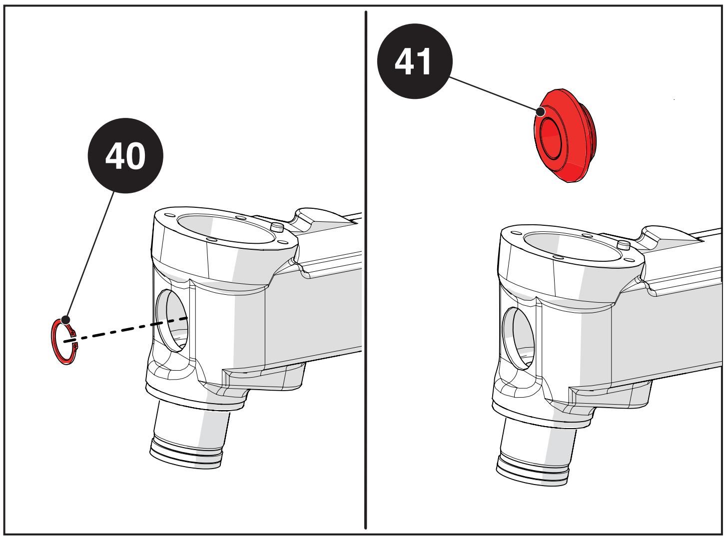


Fig. 6.22

Remove the bearing (43) and the axle shaft (42).

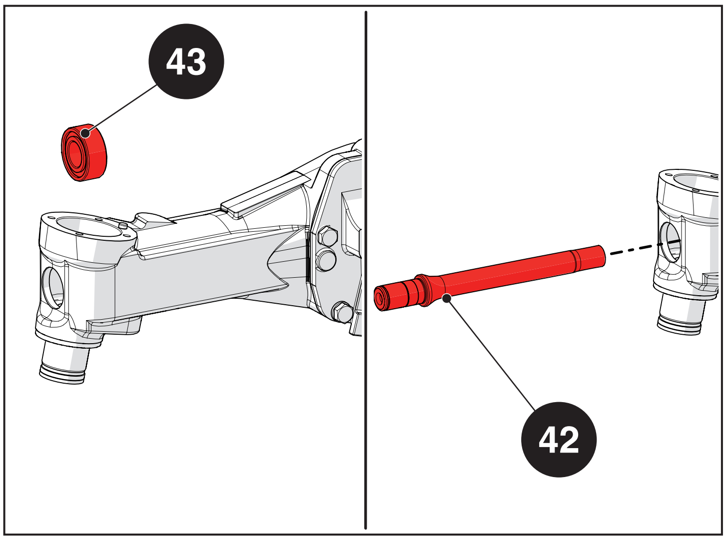


Fig. 6.23

Remove the bushes (83) complete with O-rings (82).

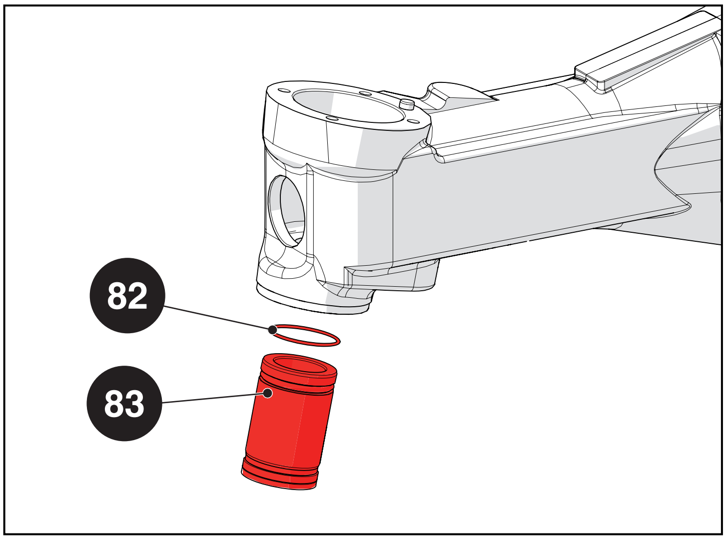


Fig. 6.24

Section 4 : Main components

Index

4.1 Front differential

4.1.1 Assembly drawing and main components

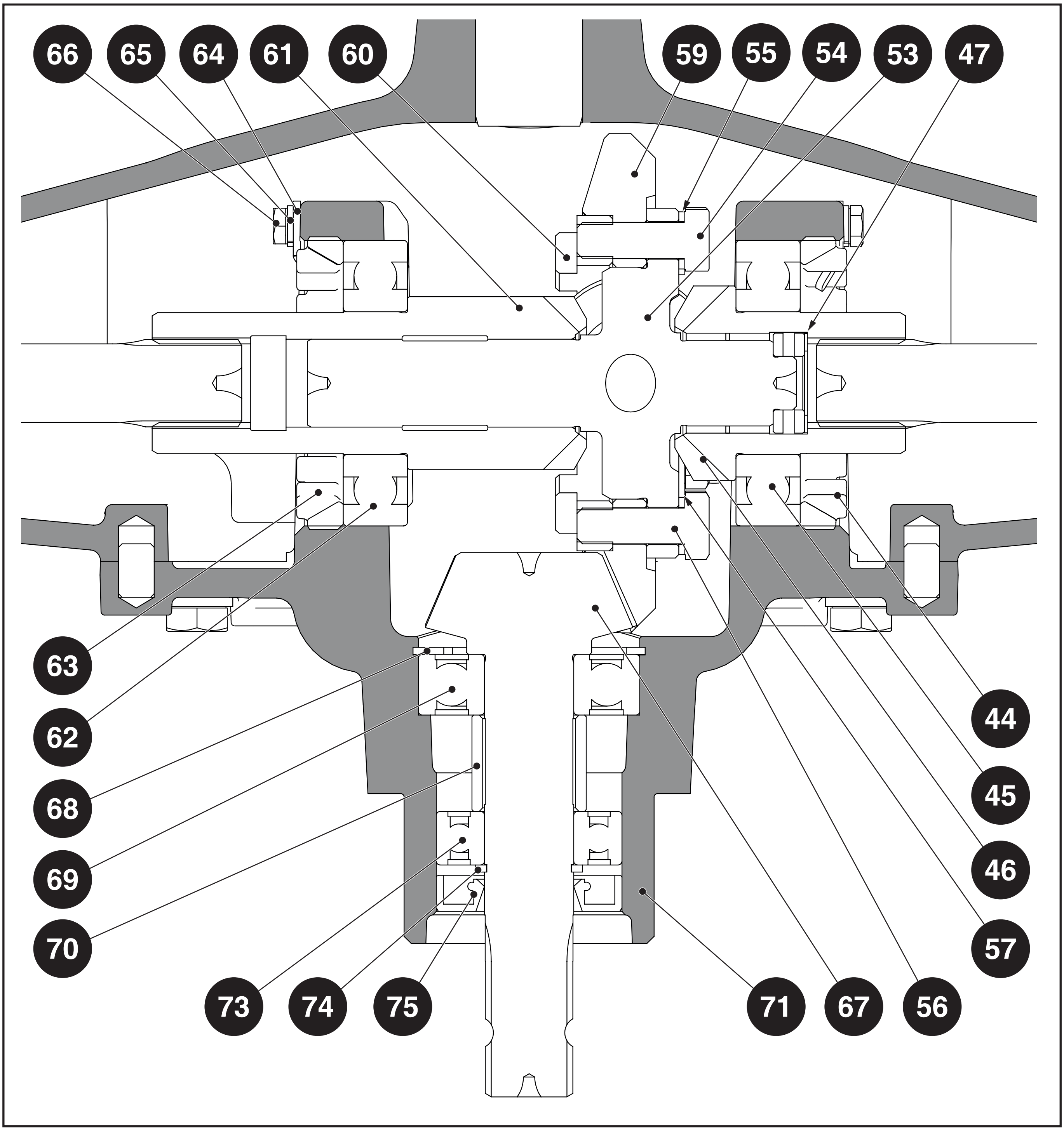


Fig. 6.25

44 - Ring nut
45 - Bearing
46 - Planetary gear
47 - Spacer
53 - Front differential centre shaft
54 - Screw
55 - Washer
56 - Screw
57 - Plate
59 - Crown wheel
60 - Differential lock fixed ring
61 - Planetary gear
62 - Bearing
63 - Ring nut
64 - Ring nut retainer
65 - Washer
66 - Screw
67 - Pinion
68 - Circlip
69 - Bearing
70 - Spacer
71 - Differential case
73 - Bearing
74 - Circlip
75 - Oil seal

4.1.2 Disassembly

Remove the screws (66), the washers (65) and the ring nut retainers (64).

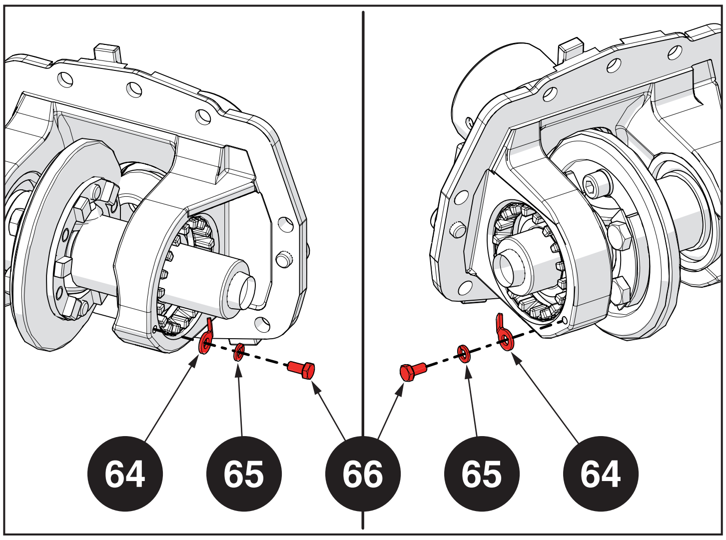


Fig. 6.26

Undo the ring nuts (44) and (63) using the tool (A-07000243).

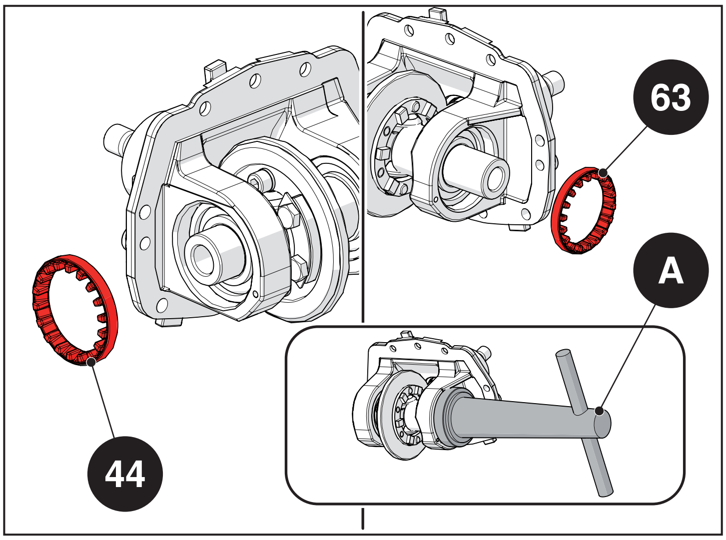


Fig. 6.27

Remove the planetary gear assemblies (46) and (61), complete with bearings (45) and (62).

Remove the complete crown wheel from the front differential case.

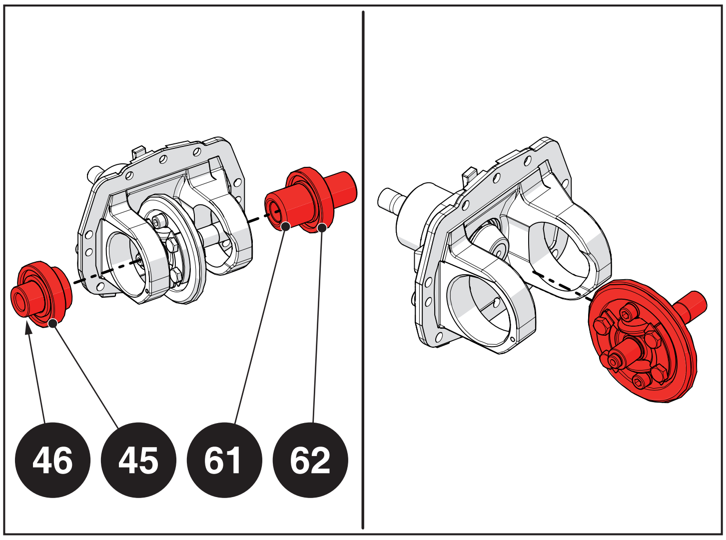


Fig. 6.28

Use an extractor tool to remove the bearings (45) and (62) from the planetary gear assemblies

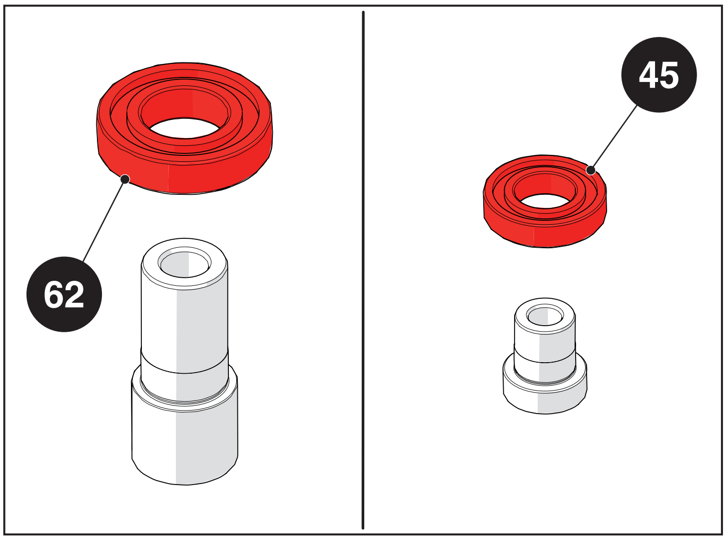


Fig. 6.29

Remove the following components from the planetary gear assembly (46) in the order given:

- roller bearing cage (50);
- spacer (48);
- roller bearing cage (49);
- second spacer (48);
- spacer (47).

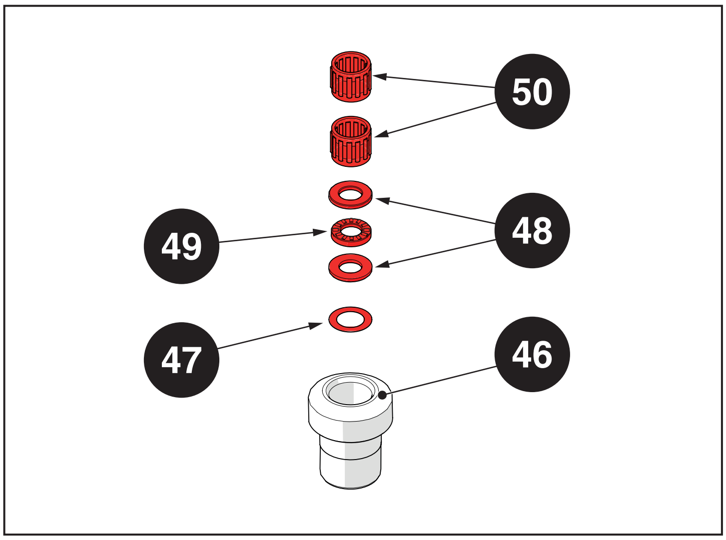


Fig. 6.30

Remove the screws (56) and the plates (57).

Remove the complete differential centre shaft (53).

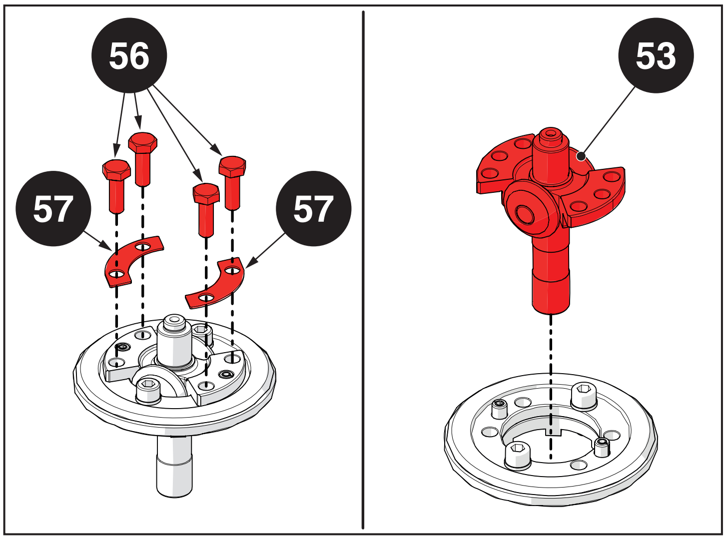


Fig. 6.31

Remove the planet gears (52) and the pin (51).

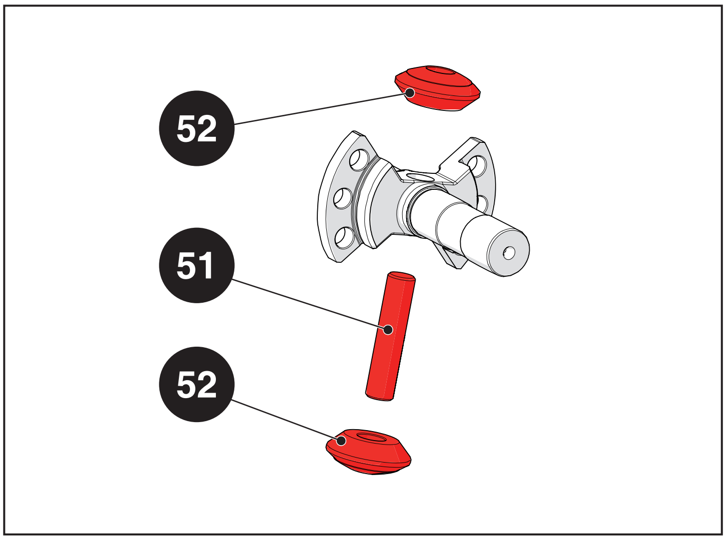


Fig. 6.32

Undo the screws (54), remove the washers (55), and separate the crown wheel (59) from the fixed ring of the differential lock (60).

Use a pin punch to drive out the pins (58).

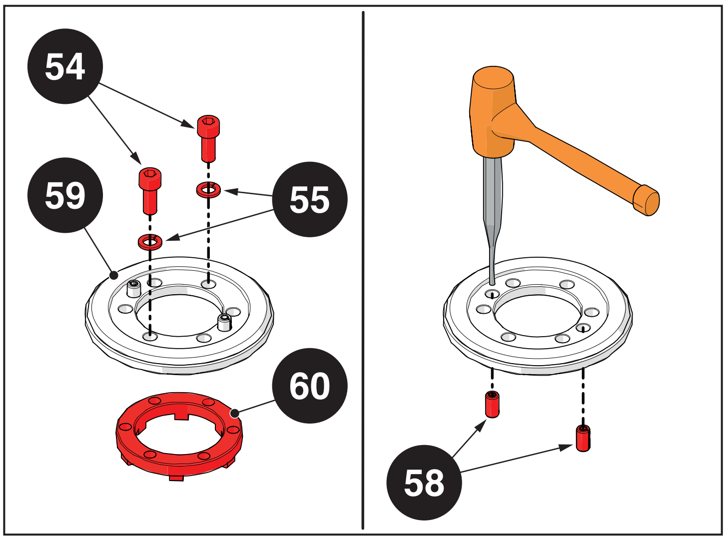


Fig. 6.33

Remove the pinion (67).

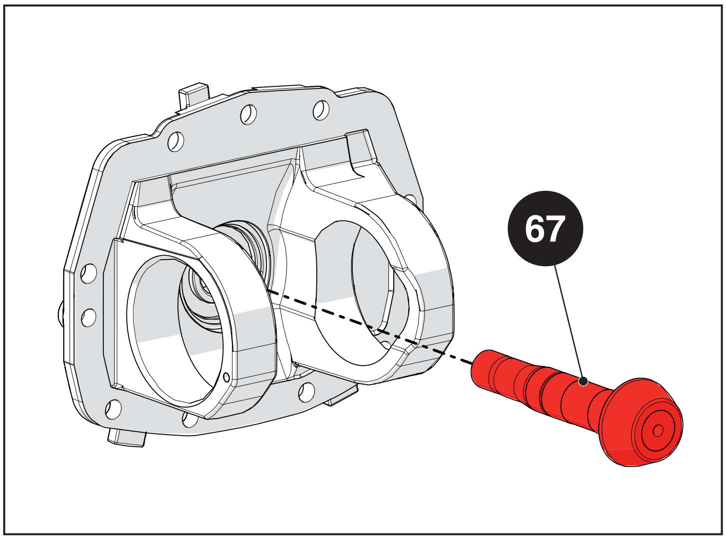


Fig. 6.34

Remove the circlip (68), the bearing (69) and the spacer (70).

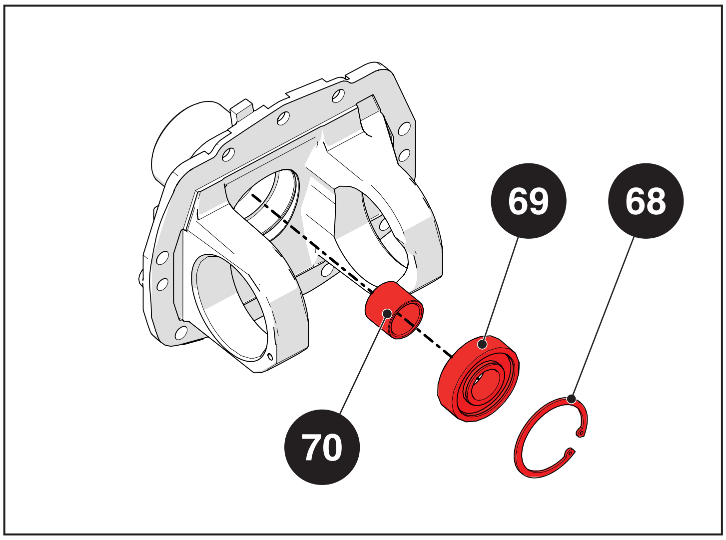


Fig. 6.35

Remove the oil seal (75), the circlip (74) and the bearing (73).

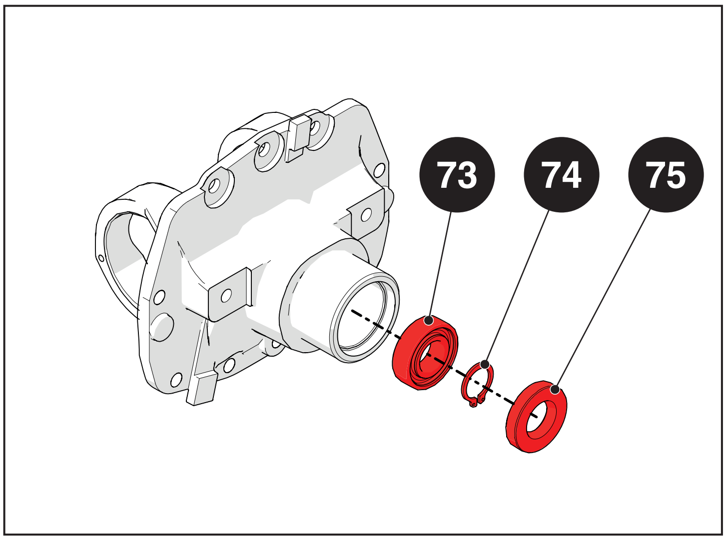


Fig. 6.36

4.1.3 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 bearing (69) using a bearing punch tool of suitable diameter.

Warning
Lubricate the bearing seat before fitting the bearing.

Fit the circlip (68).

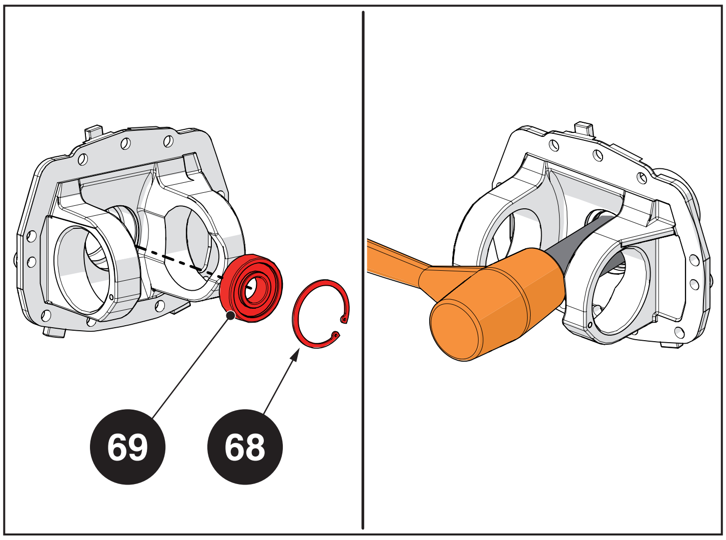


Fig. 6.37

Fit the pinion shaft (67).

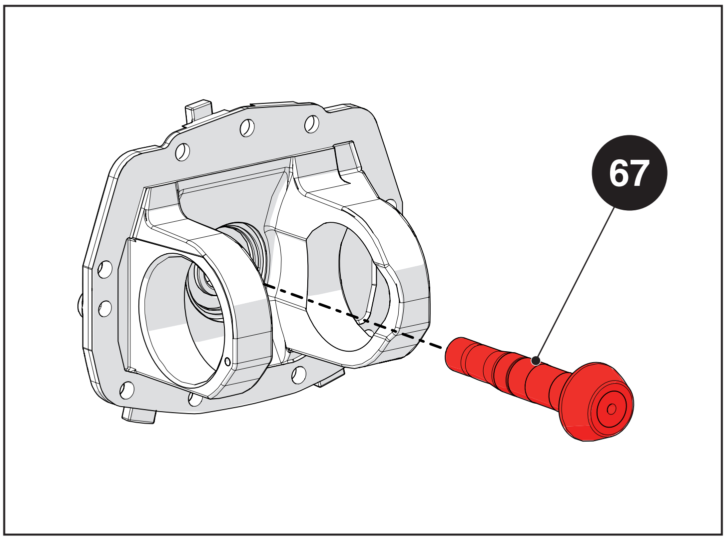


Fig. 6.38

Fit the spacer (70) and the bearing (73), driving into its seat with a punch.

⚠ Warning
Lubricate the bearing seat before fitting the bearing.

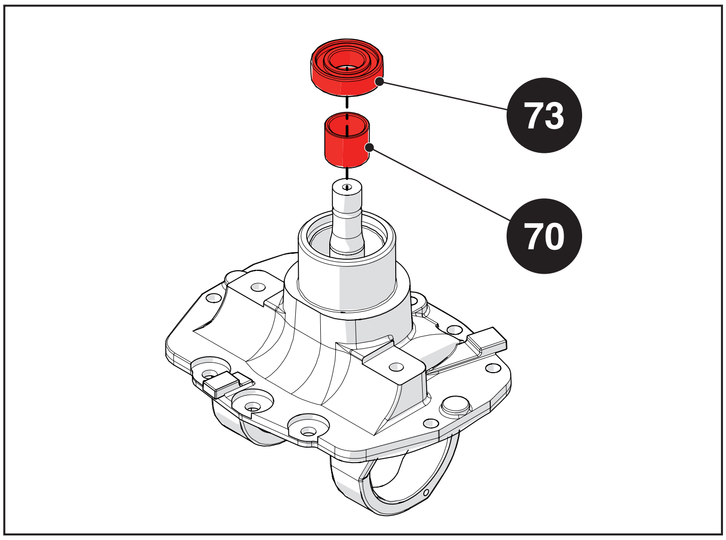


Fig. 6.39

Fit the circlip (74).

Fit the oil seal (75) using a punch tool of suitable diameter.

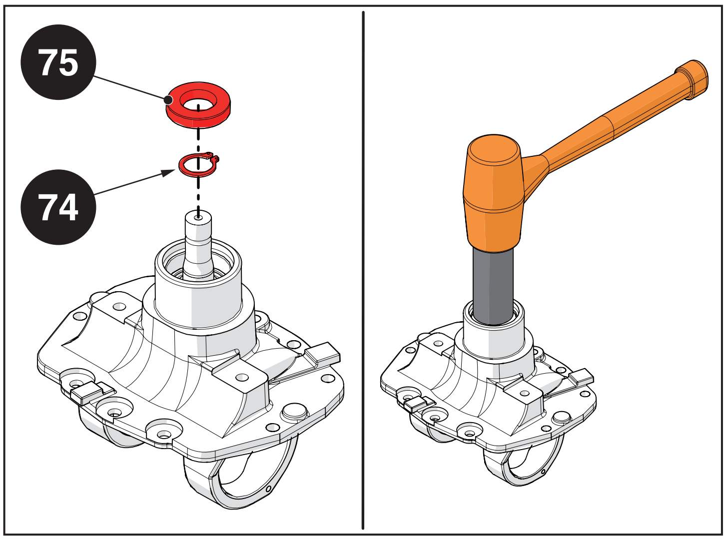


Fig. 6.40

Fit the pin (51) and the planet gears (52) on the differential centre shaft (53).

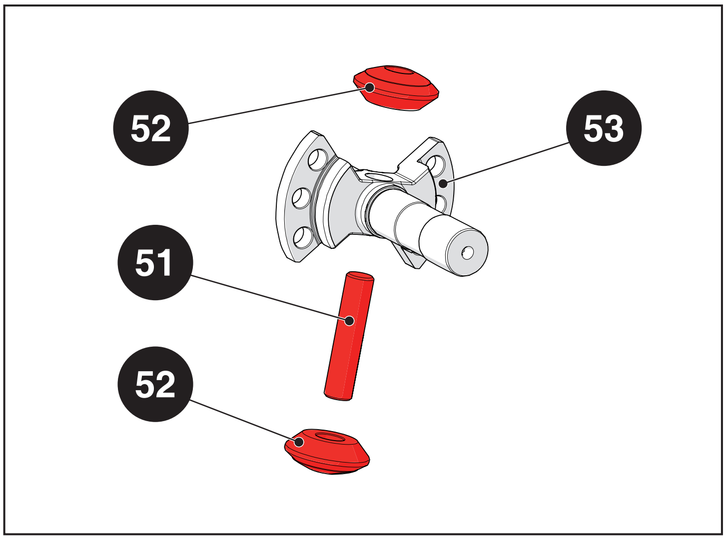


Fig. 6.41

Fasten the fixed differential lock ring (60) to the crown wheel (59), fitting the washers (55) and tightening the screws (54) to a torque of 80 Nm (8 kgm).

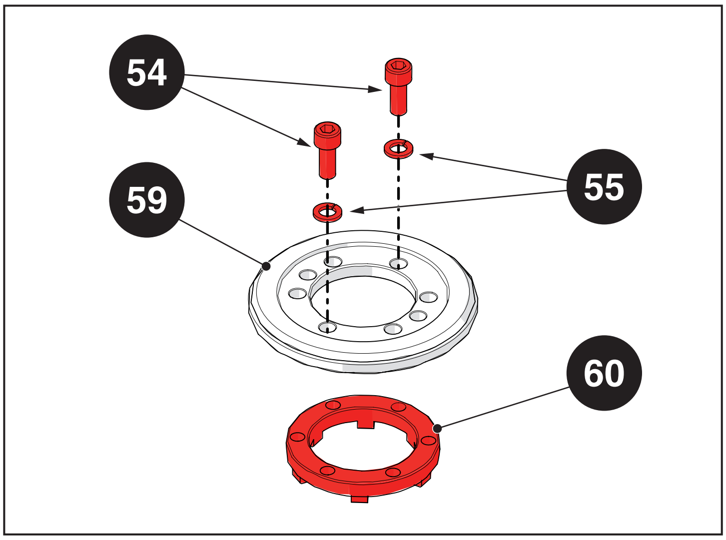


Fig. 6.42

Assemble the complete centre shaft (53) with the fixed differential lock ring (60) and the crown wheel (59).

Fit the centring pins (58).

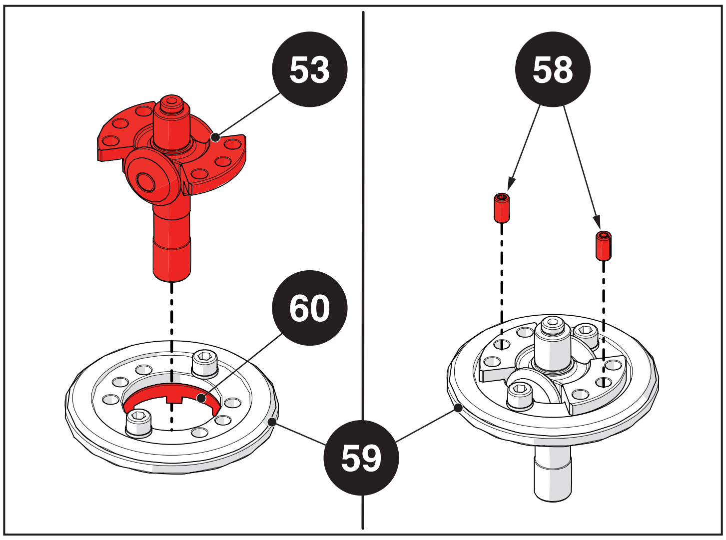


Fig. 6.43

Fit the plates (57) and tighten the screws (56).

Use a scalpel to bend up the ends of the plates (57) to secure the screws.

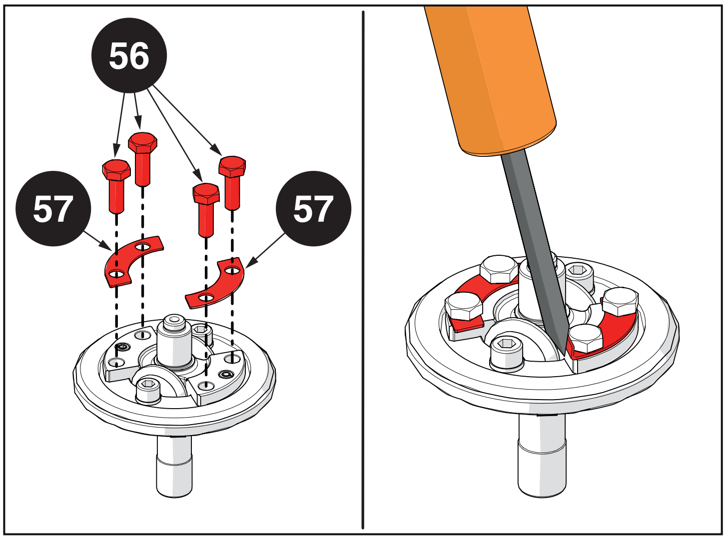


Fig. 6.44

Fit the bearings (45) and (62) on the planetary gear spindles (46) and (61)

Warning
Lubricate the bearing sliding surfaces on the planetary spindles. Use a press or a bearing punch tool of suitable diameter to install the bearings in their seats.

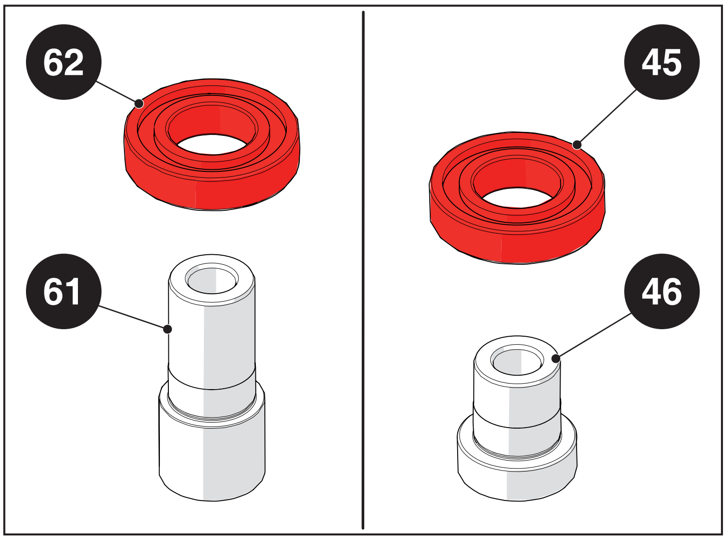


Fig. 6.45

Fit the spacer (47), the spacers (48) and the roller bearing cage (49) in the planetary gear assembly (46).

Warning
Ensure that the spacers are installed the right way around. The flat sides of the spacers must face towards the roller bearing cage.

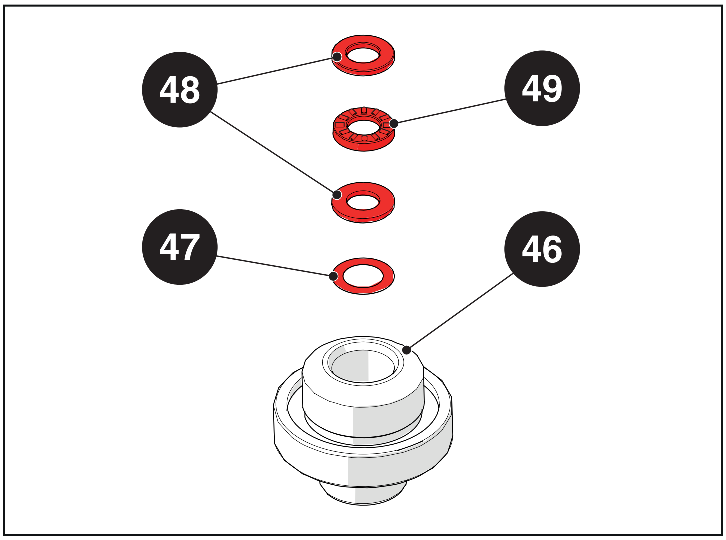


Fig. 6.46

Fit the roller bearing cage (50) inside the planetary gear assembly (46).

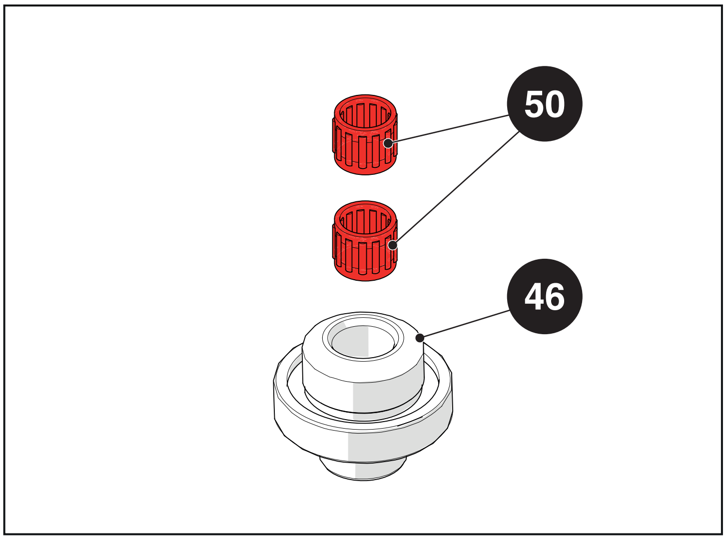


Fig. 6.47

Fit the complete crown wheel in the differential case (71).

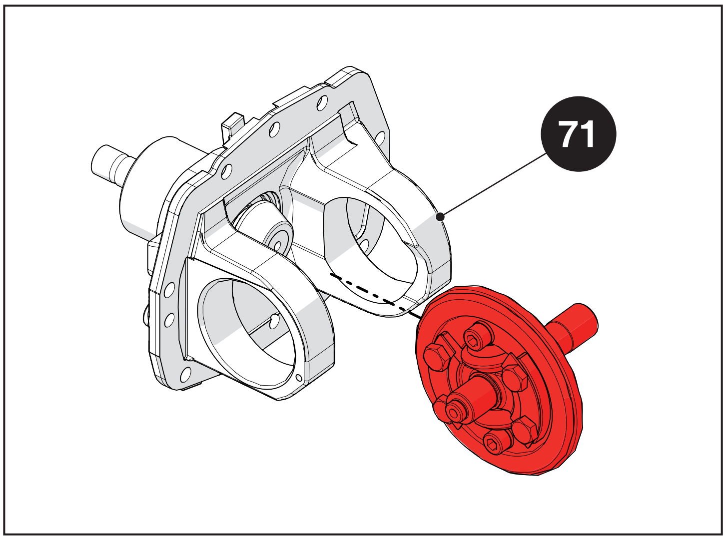


Fig. 6.48

Fit the pre-assembled planetary gears (46) and (61) in the differential case, and drive them into their seats with a punch tool of suitable diameter.

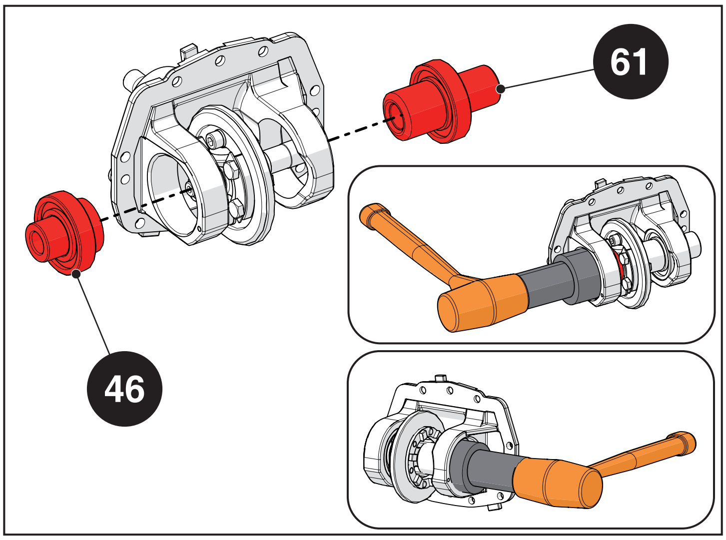


Fig. 6.49

Tighten the ring nut (44) completely using the special tool (A-07000243).

Note
This eliminates all backlash between the crown wheel and pinion teeth.

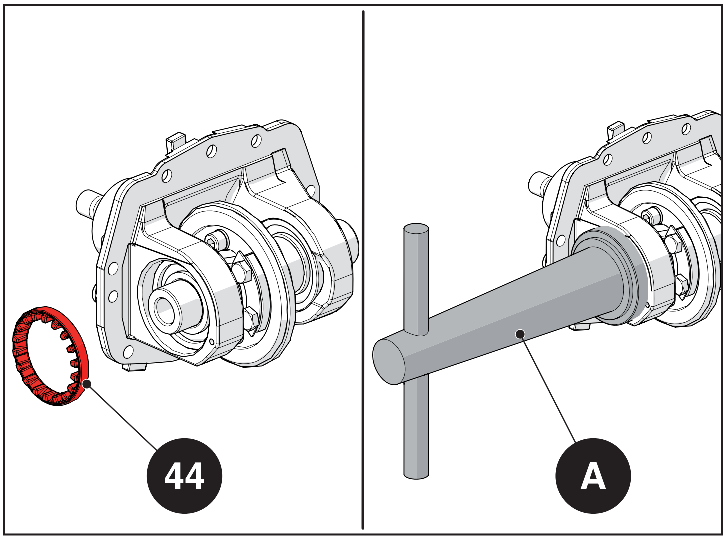


Fig. 6.50

Fit and completely tighten the ring nut (63) using the special tool (A-07000243).

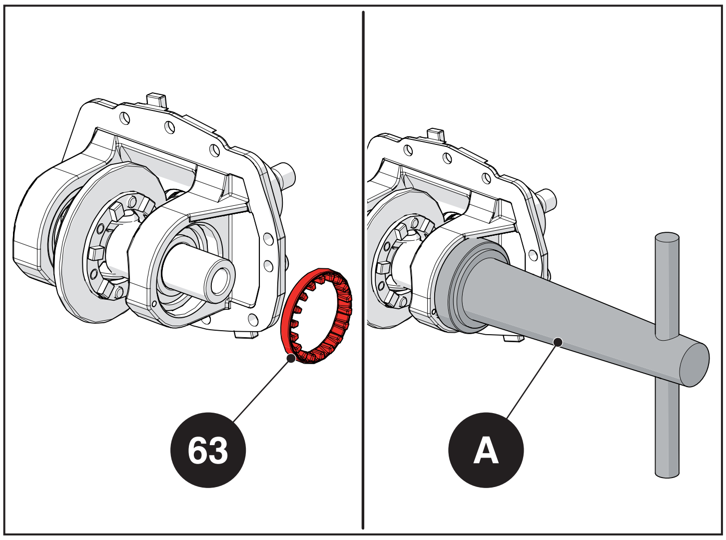


Fig. 6.51

Loosen the ring nut (44) by 3 splines, using the ring nut retainer hole as reference.

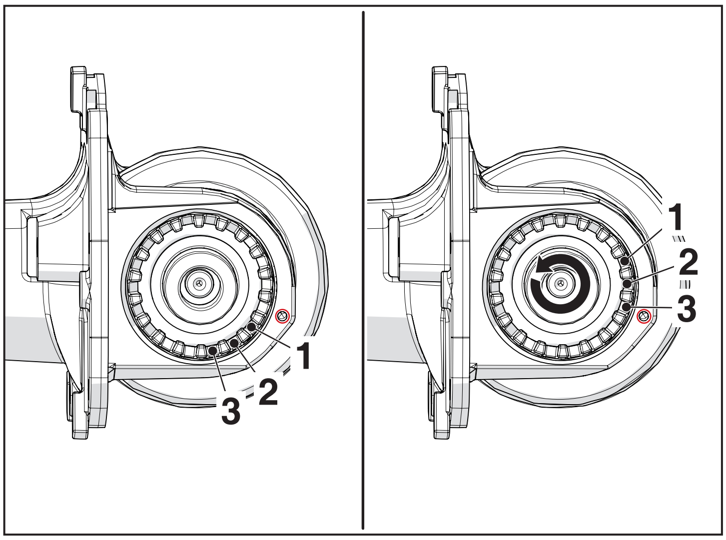


Fig. 6.52

Fit a dial gauge on the teeth of the crown wheel and reset the reading.

Restrain the pinion and move the crown wheel gently to measure the backlash relative to the pinion teeth.

The backlash between the teeth of the crown wheel and the pinion must be 0.10 to 0.18 mm.

Warning
Measure in at least 4 different positions on the crown wheel. If the backlash is not within the indicated range, tighten or loosen the crown wheel side ring nut (44).

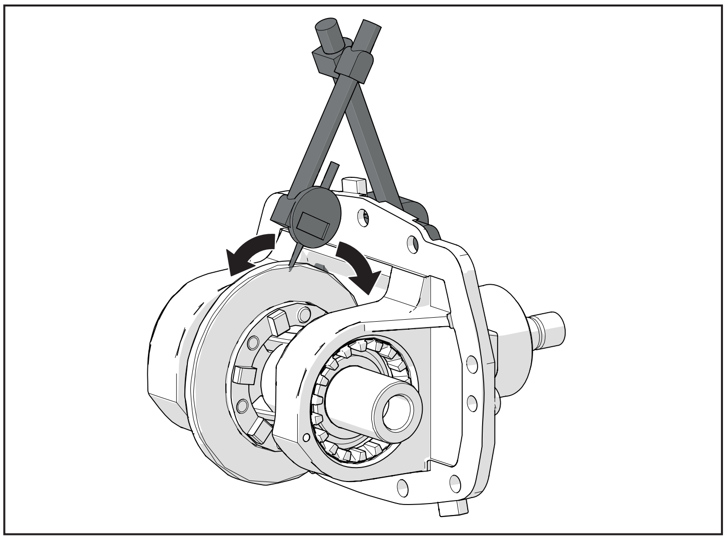


Fig. 6.53

Loosen the ring nut (63) by 3 splines, using the ring nut retainer hole as reference.

The backlash between the teeth of the sun gear (61) and the planet gear (52) must be 0.16 - 0.17 mm.

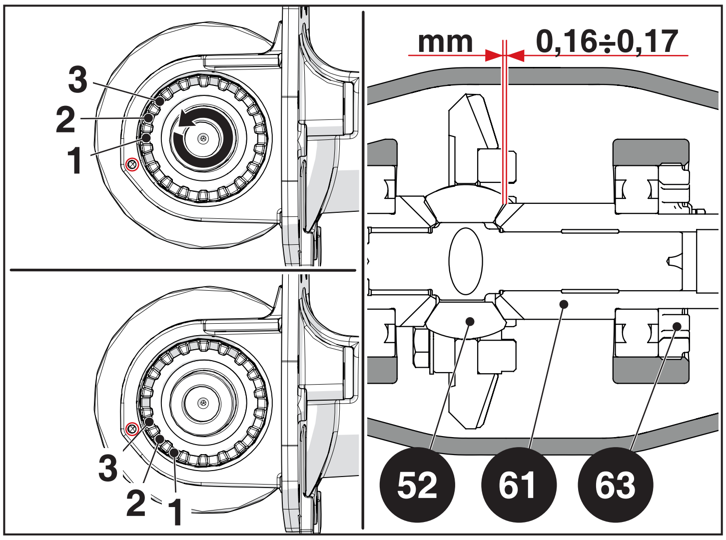


Fig. 6.54

Check that the backlash between the teeth of the sun gear (46) and the planet gear (52) is between 0.16 and 0.17 mm.

If the backlash is not within the indicated range, correct the thickness of the spacer (47).

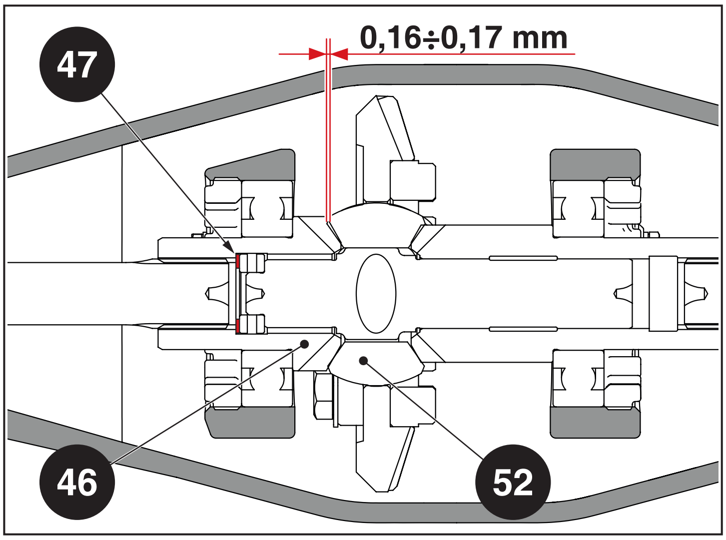


Fig. 6.55

Fit the ring nut retainers (64) and fasten with the screw (66) and the washer (65).

Engage the ring nut retainer hooks (64) in the slots.

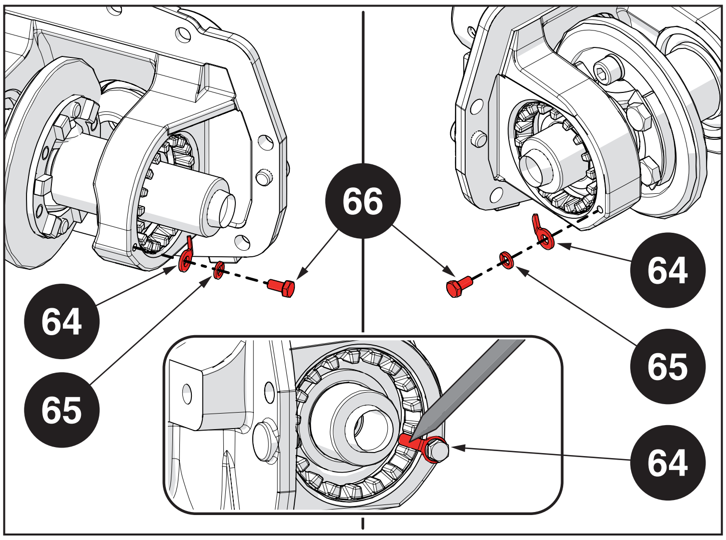


Fig. 6.56

4.2 Final drive unit

4.2.1 Assembly drawing and main components

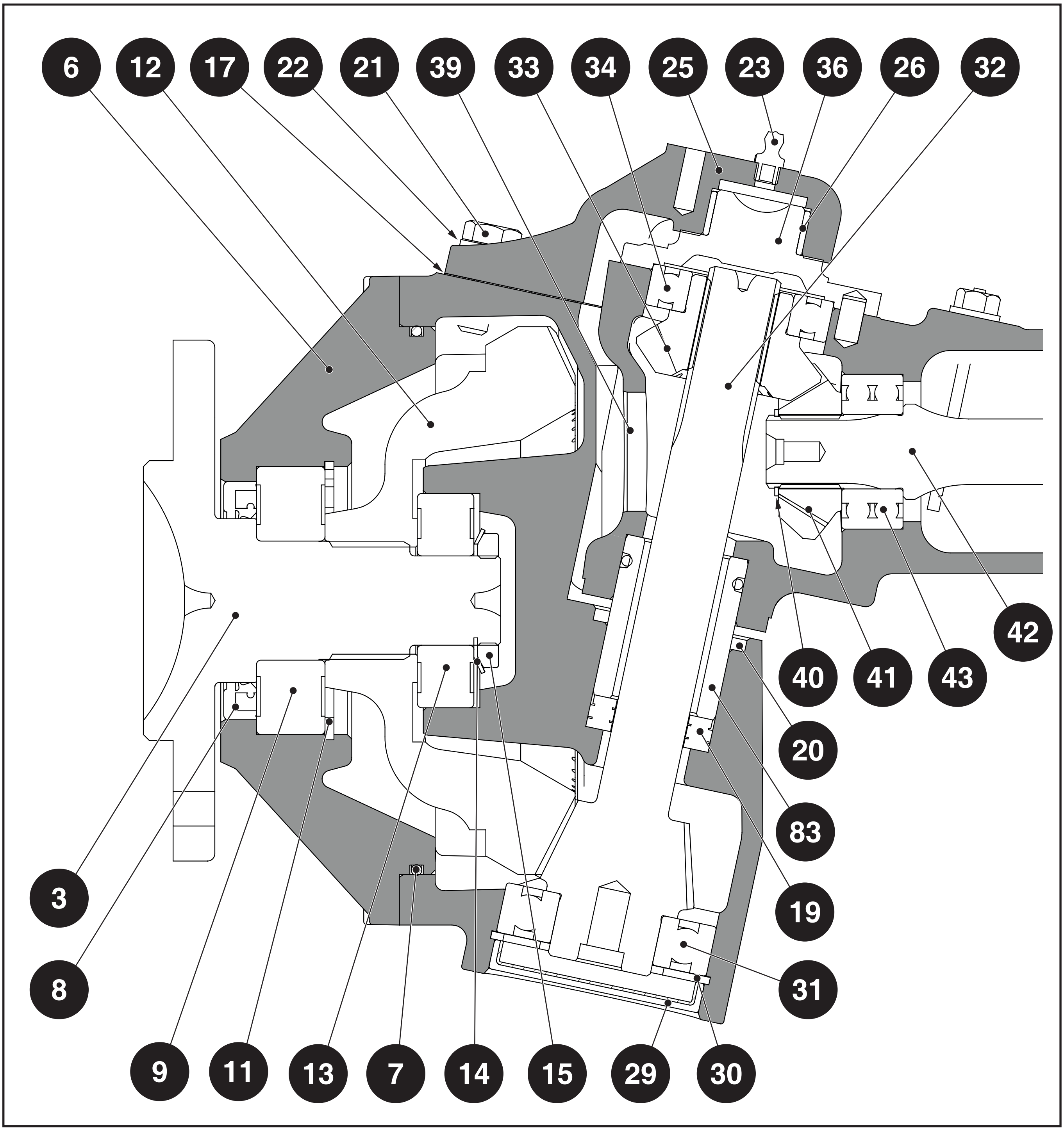


Fig. 6.57

3 - Half shaft
6 - Reduction gear cover
7 - O-ring
8 - Oil seal
9 - Bearing
11 - Circlip
12 - Crown wheel
13 - Bearing
14 - Ring nut retainer
15 - Ring nut
17 - Spacers
19 - Spacers
20 - Oil seal
21 - Screw
22 - Washer
23 - Grease nipple
25 - Steering lever
26 - Bush
29 - Oil seal
30 - Circlip
31 - Bearing
32 - Shaft
33 - Upper gear
34 - Bearing
36 - Cover
39 - Plug
40 - Circlip
41 - Gear
42 - Half shaft
43 - Bearing
83 - Bush

4.2.2 Disassembly

Undo the screws (4) and remove the conical washers (5).

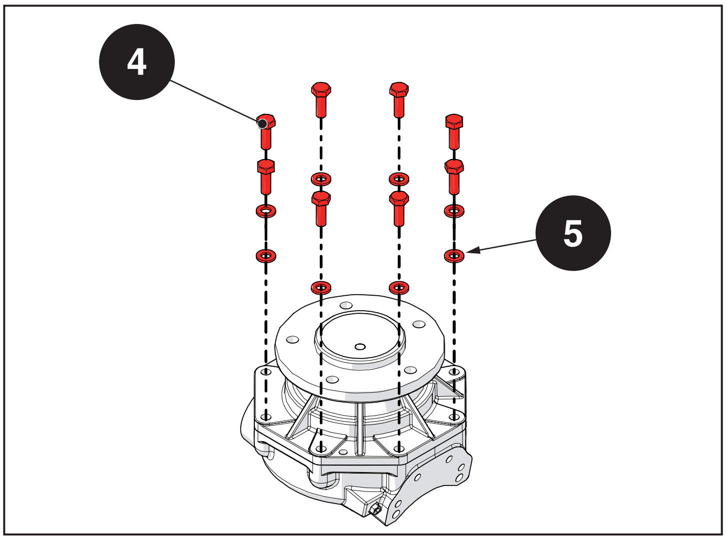


Fig. 6.58

Fit 2 screws into the extraction holes, and then tighten them to remove the final drive gear cover (6).

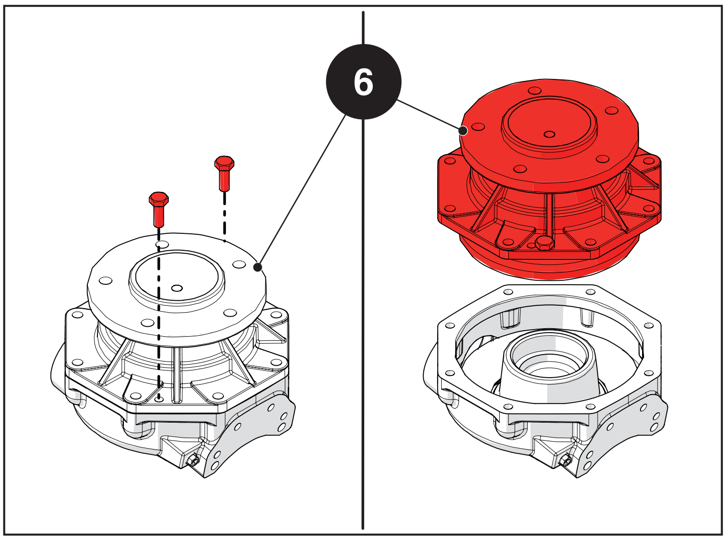


Fig. 6.59

Remove the O-ring (7).

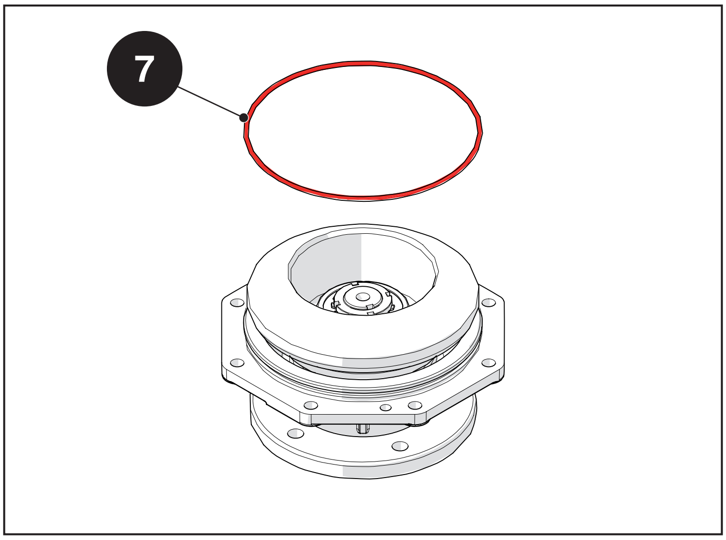


Fig. 6.60

Bend back the tooth of the ring nut retainer (14).

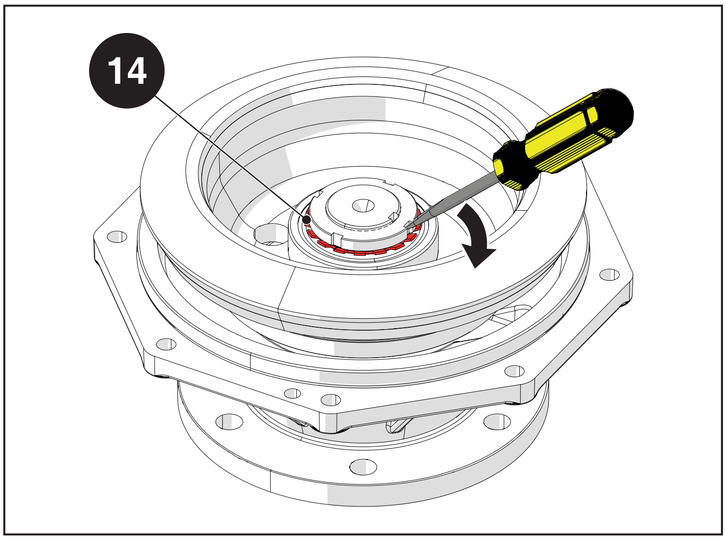


Fig. 6.61

Use the special tool (F-07000234) to undo and remove the ring nut (15).

Remove the ring nut retainer (14).

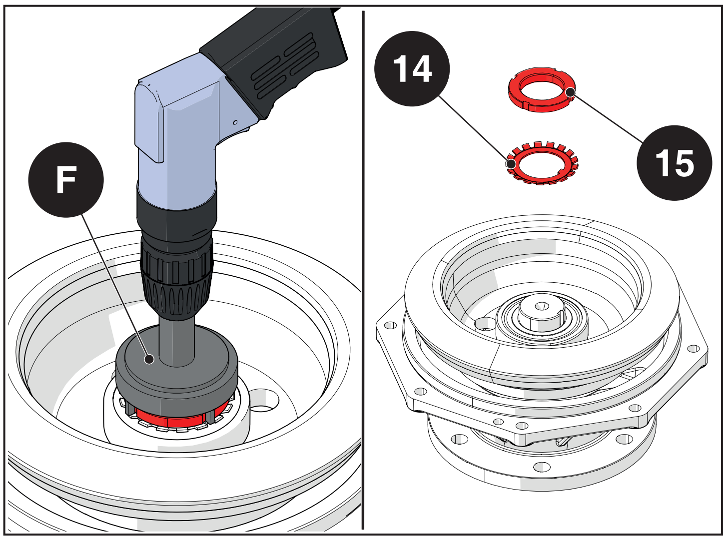


Fig. 6.62

Tap the half axle with a soft mallet to detach the bearing (13) and the crown wheel (12).

Remove the half axle (3) from the cover (6).

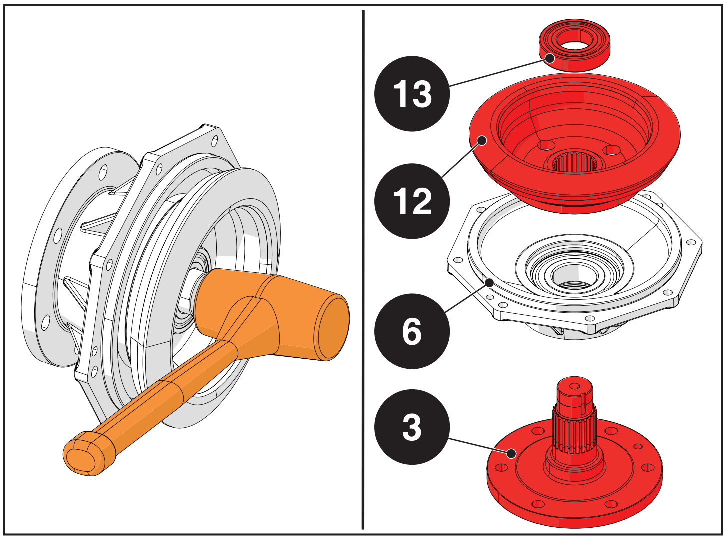


Fig. 6.63

Remove the circlip (11).

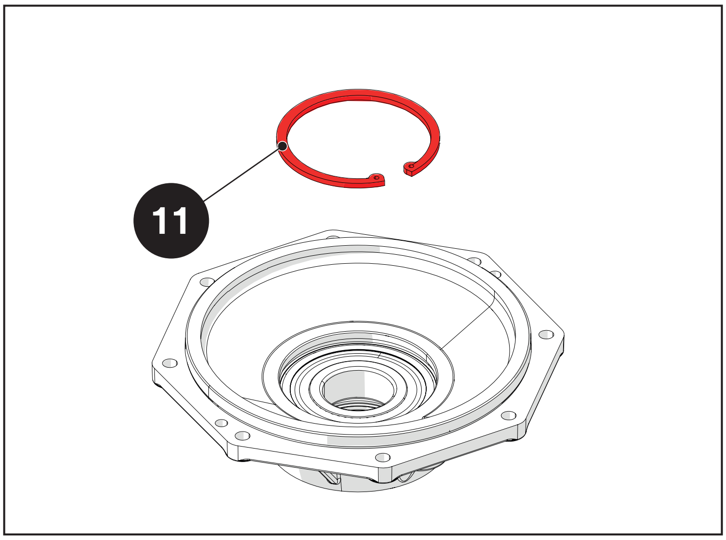


Fig. 6.64

Remove the oil seal (8).

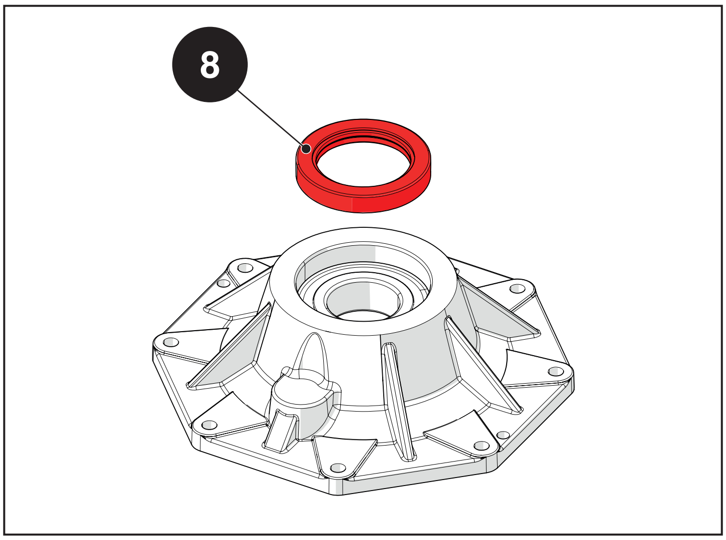


Fig. 6.65

Use a bearing punch tool to remove the bearing (9).

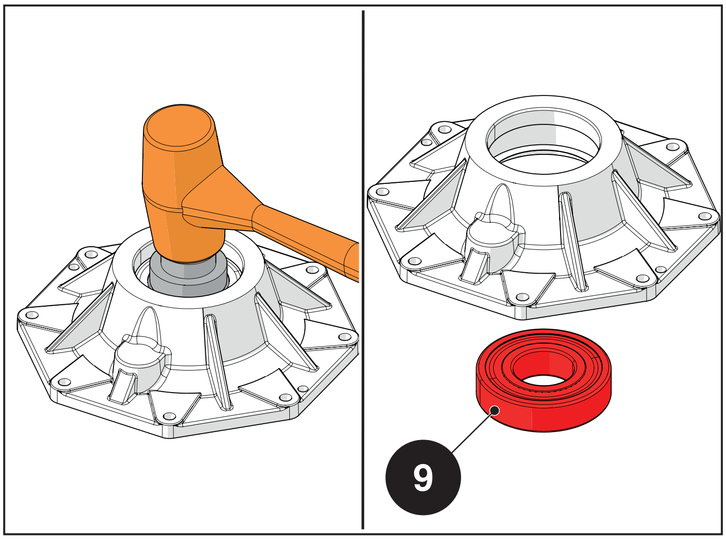


Fig. 6.66

4.2.3 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".

Use a bearing punch tool to install the bearing (9).

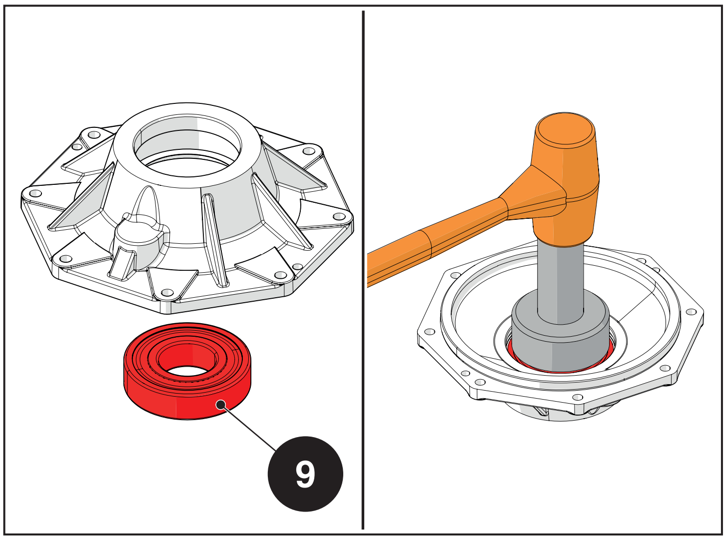


Fig. 6.67

Fit the circlip (11) in its seat.

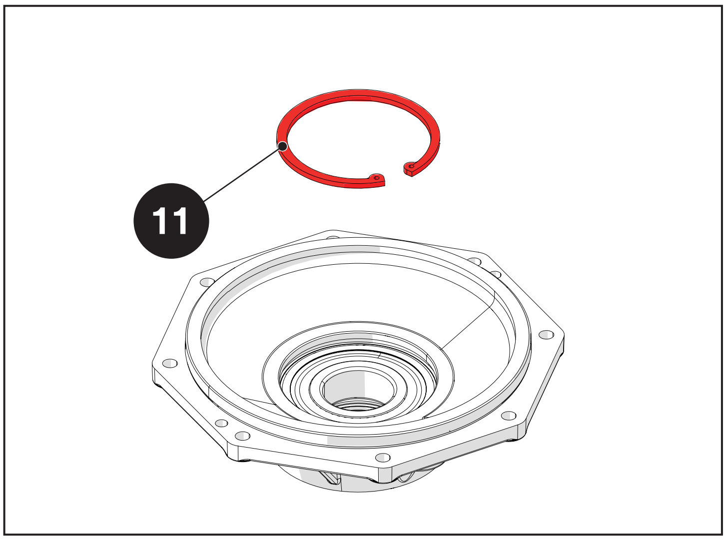


Fig. 6.68

Fit the oil seal (8), applying a layer of mastic sealant around its perimeter.

Note
Replace the oil seal (8) with a new component when reassembling.

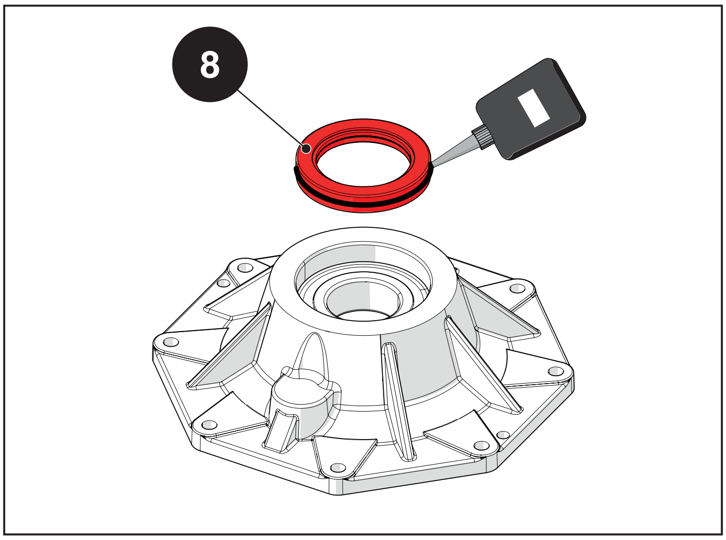


Fig. 6.69

Fit the axle shaft (3), the crown wheel (12) and the bearing (13).

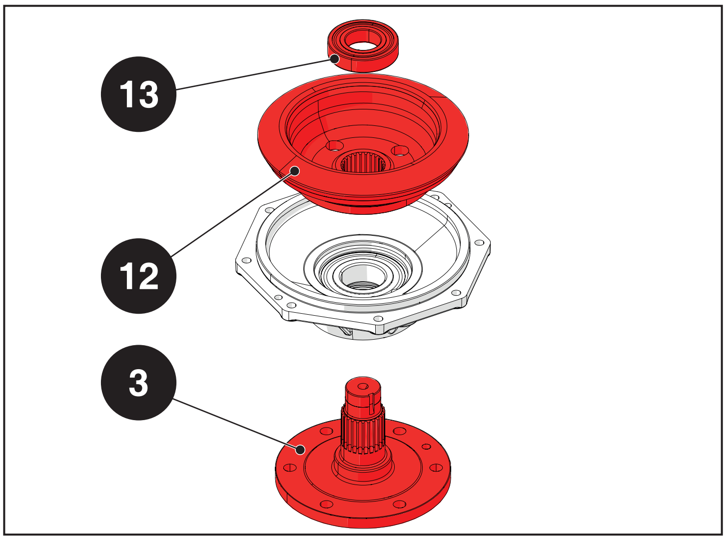


Fig. 6.70

Fit the ring nut retainer (14) and the ring nut (15).

Use the special tool (F-07000234) to tighten the ring nut (15) to a torque of 150 Nm (15 kgm).

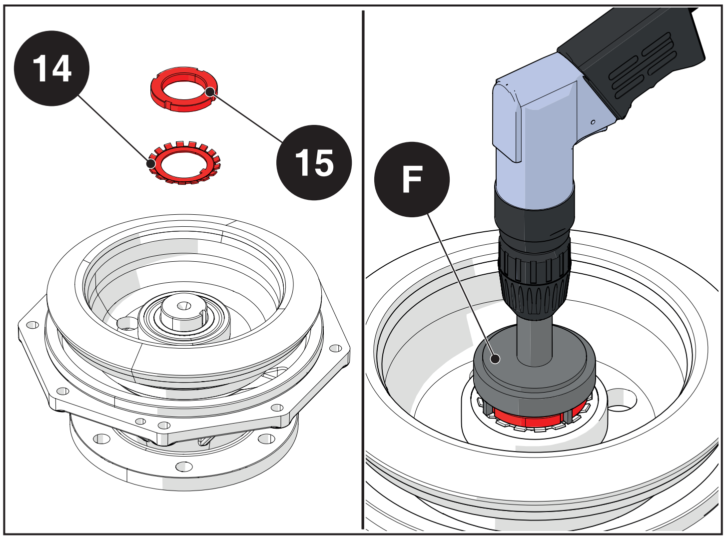


Fig. 6.71

Bend up the tooth of the ring nut retainer (14) to lock the ring nut (15).

Punch a dot on the ring nut (15) as an additional safety measure.

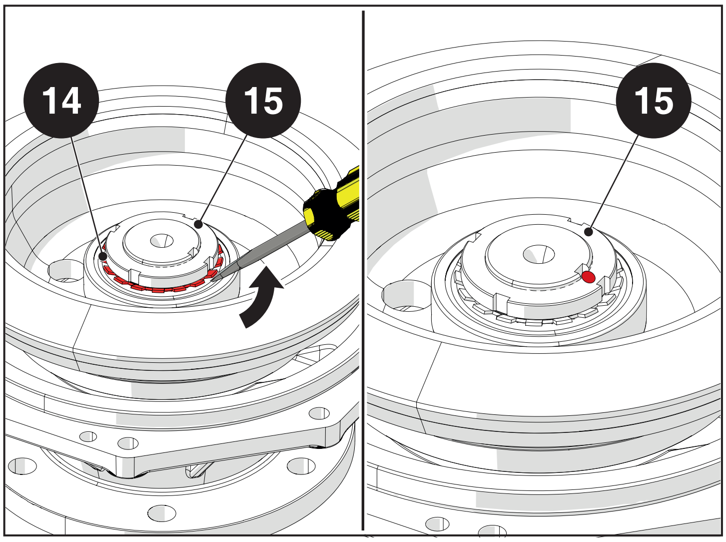


Fig. 6.72

Apply a layer of grease and then fit the O-ring (7) in its seat.

Apply a coating of silicon sealant to the O-ring (7) after fitting.

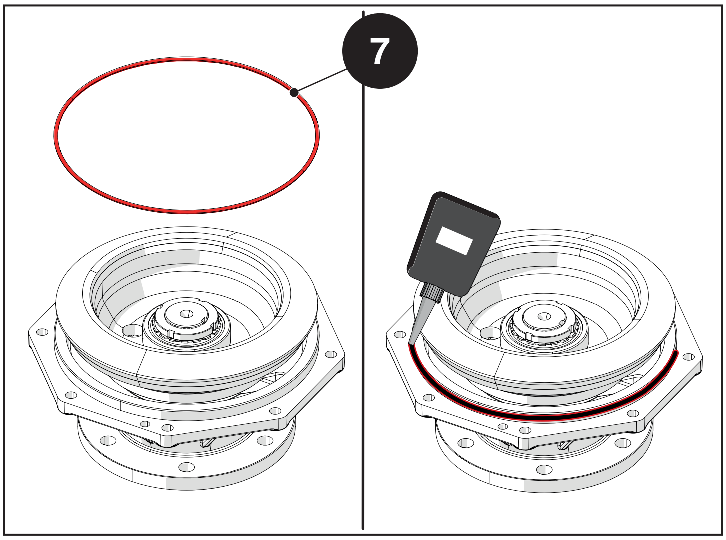


Fig. 6.73

Fit the conical washers (5) and tighten the screws (4) to a torque of 60 Nm (6 kgm).

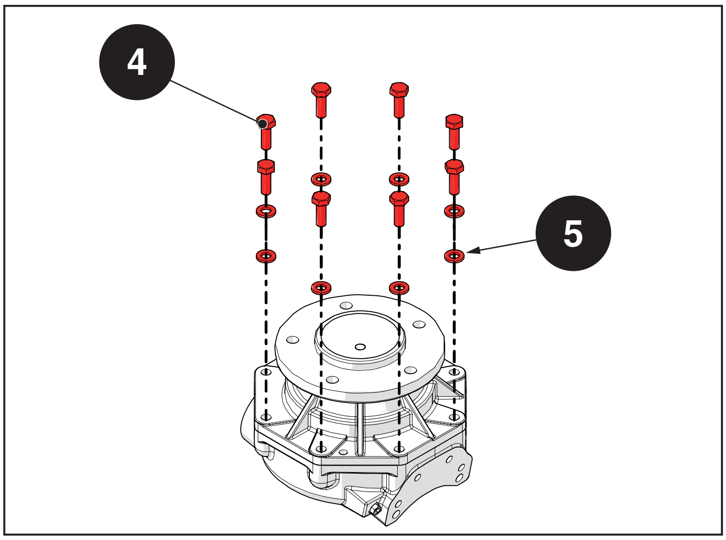


Fig. 6.74

Section 5 : Refitting

Index

5.1 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".

Fit the bushes (83), complete with O-rings (82), in the front axle.

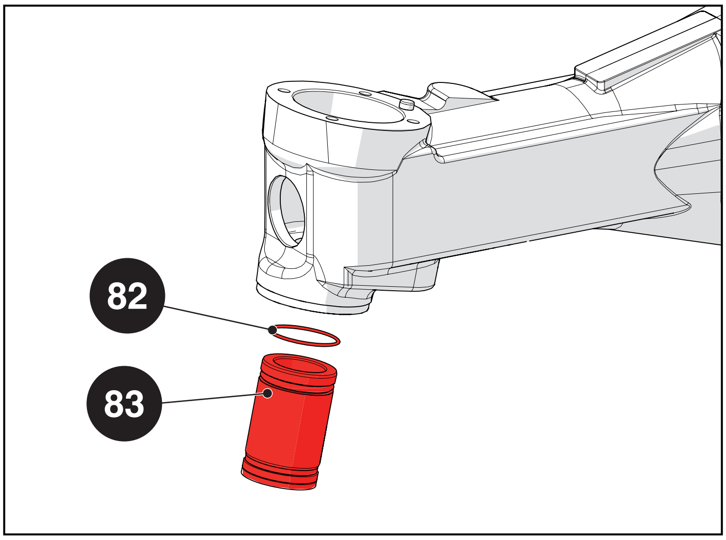


Fig. 6.75

Apply a coating of silicone sealant to the mating surface of the differential case.

Fit the complete differential case, aligning the centring pins.

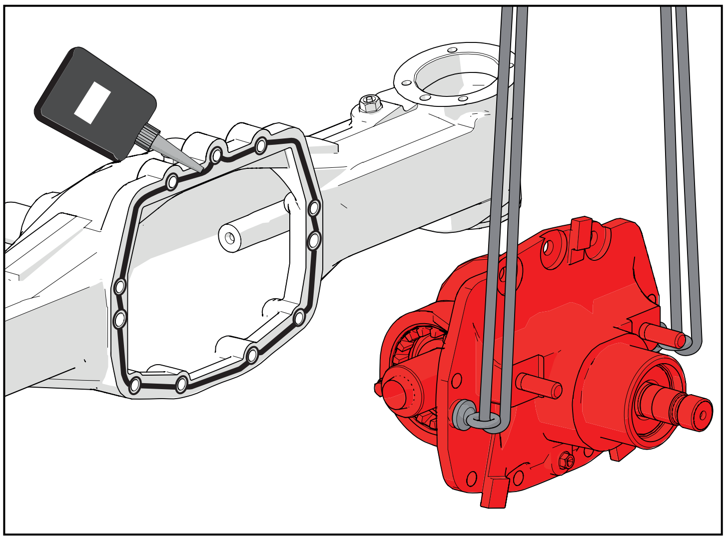


Fig. 6.76

Fit the washers (77) and tighten the screws (76) to a torque of 60 Nm (6 kgm).

⚠ Warning
Do not tighten the screw onto which the hydraulic pipe mounting plate will be fitted later.

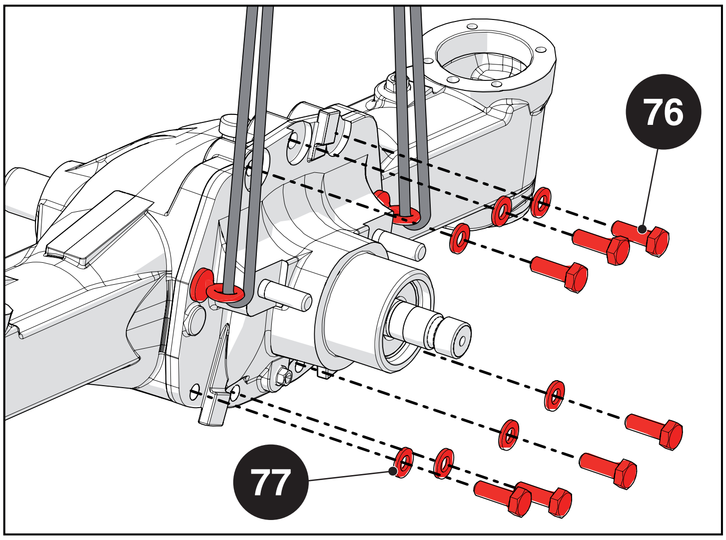


Fig. 6.77

Fit the axle shaft (42) in the front axle.

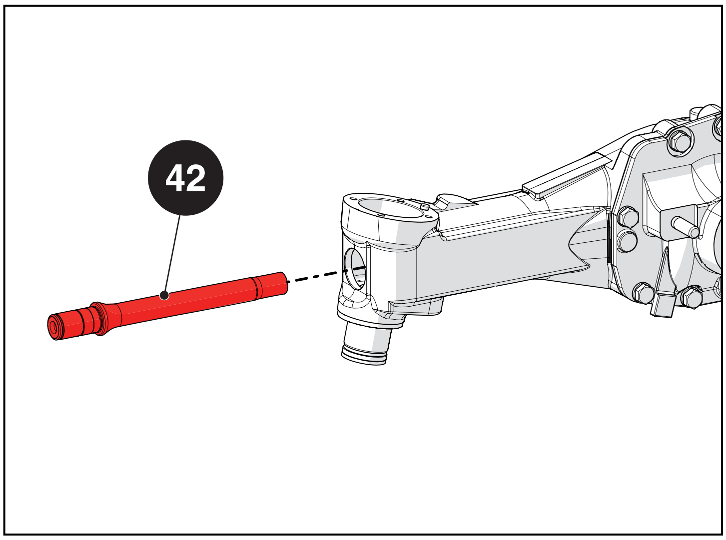


Fig. 6.78

Fit the bearing (43) on the axle shaft. Restrain the axle shaft with an open end wrench and drive the bearing into its seat with a bearing punch of suitable diameter.

⚠ Warning
Use a pin to keep the axle shaft parallel with the axle.

Fit the axle shaft (42) into the planetary gear in the differential.

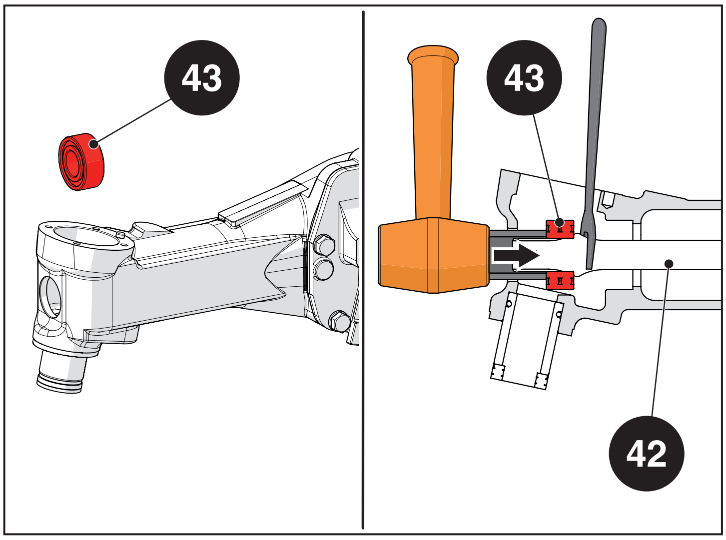


Fig. 6.79

Fit the gear (41) and secure with the circlip (40).

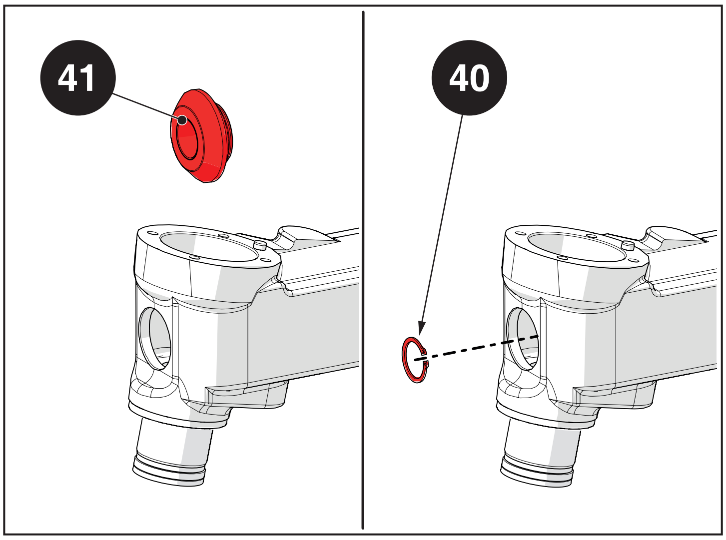


Fig. 6.80

Use a press of suitable capacity to drive the bearing (34) onto the upper gear (33).

Fit the complete upper gear onto the axle using a punch of suitable diameter.

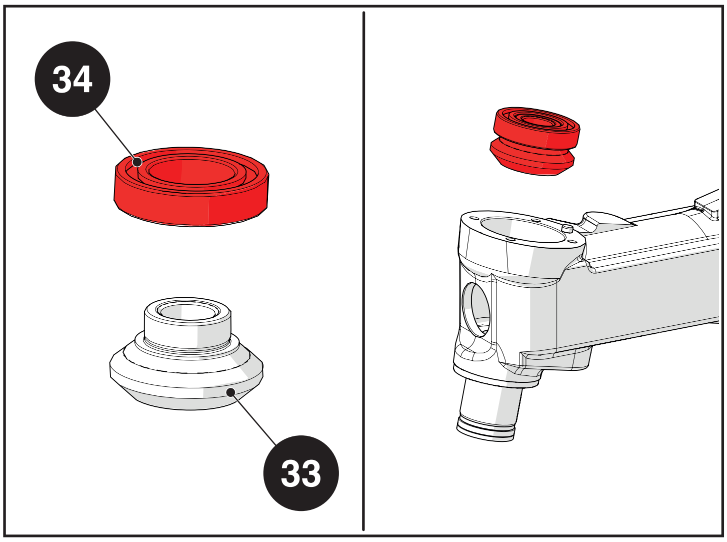


Fig. 6.81

Fit the plug (39).

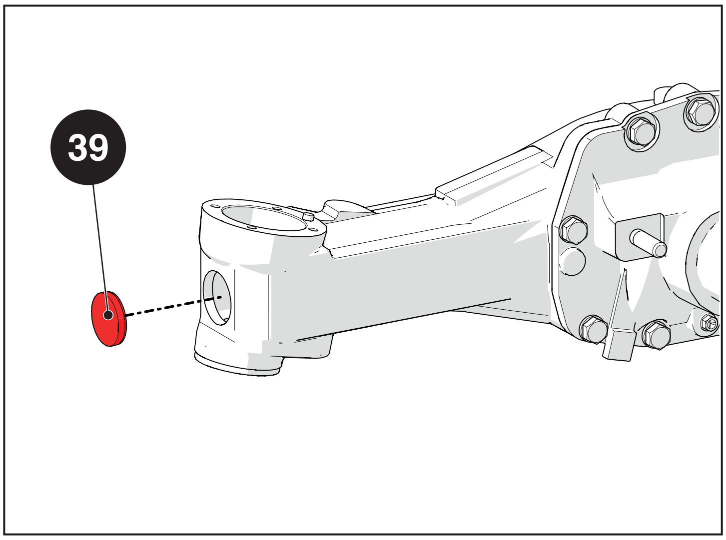


Fig. 6.82

Fit the roller bearing cages and the spacers (19), and then fit the oil seal (20).

Fit the complete final drive unit on the front axle.

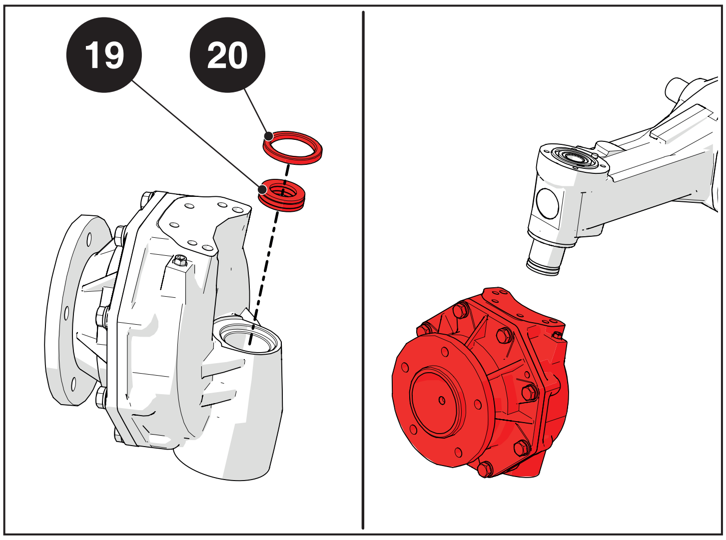


Fig. 6.83

Preassemble the shaft (32) with the bearing (31), and then fit into place, engaging with the bevel gears.

Fit the circlip (30) and the oil seal (29).

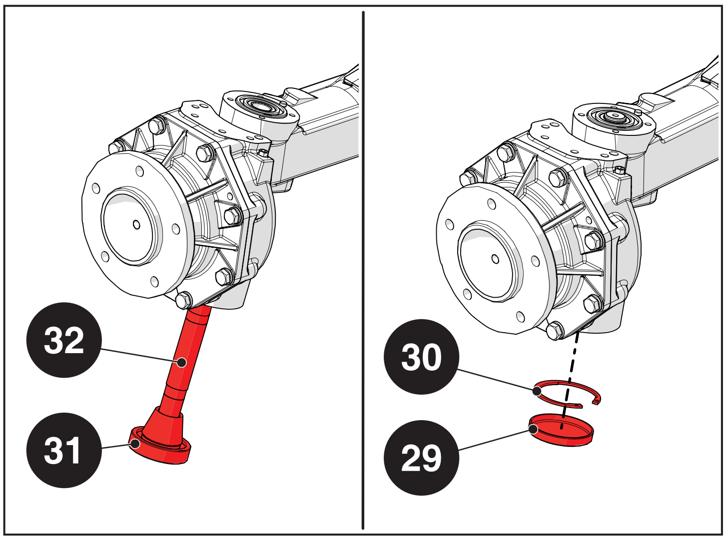


Fig. 6.84

After fitting both upper gears, rotate the pinion and check that the axle shafts turn freely.

Warning
If one of the axle shafts is stiff, this means that the teeth of the upper gear (33) are not meshed correctly with the teeth of the gear (41). To increase the backlash between the teeth, pull out the gear (33) and its bearing (34) by a few millimetres.

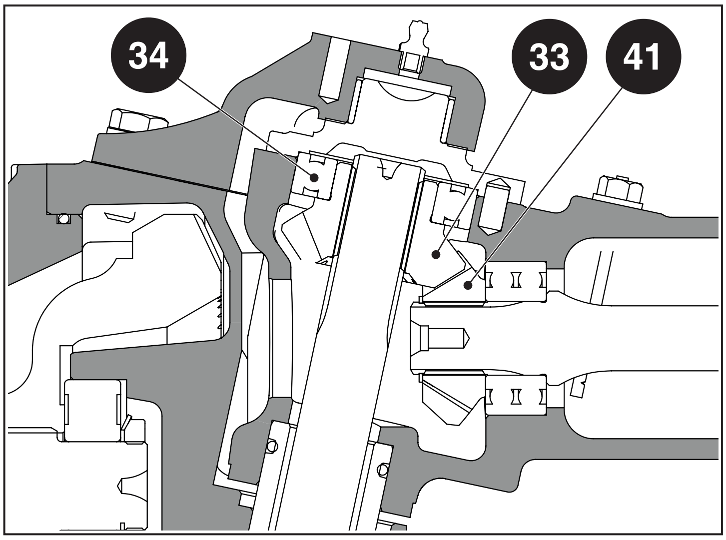


Fig. 6.85

Apply a layer of silicone sealant to the mating surface of the cover (36).

Fit the cover, aligning the centring pins. Fit the washers (37) and tighten the screws (38) to a torque of ______Nm (_____kgm).

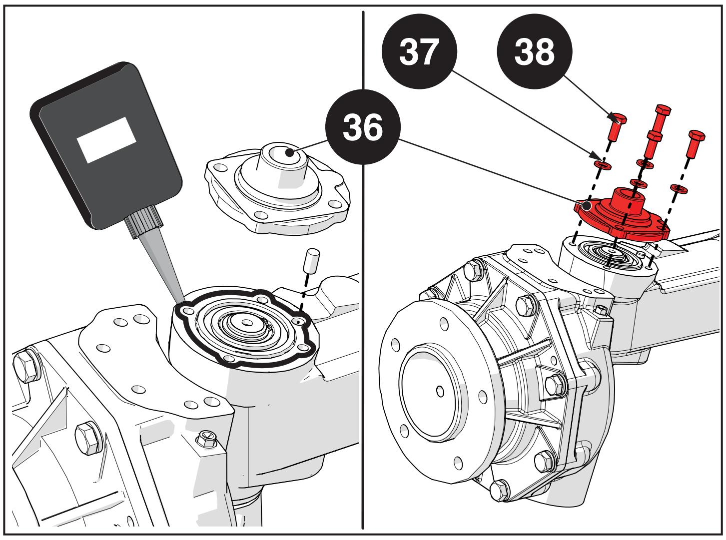


Fig. 6.86

⚠ Warning
Apply a coating of grease to the pins of the final drive unit.

Fit the steering lever (25) complete with bush (26) and plate (17).

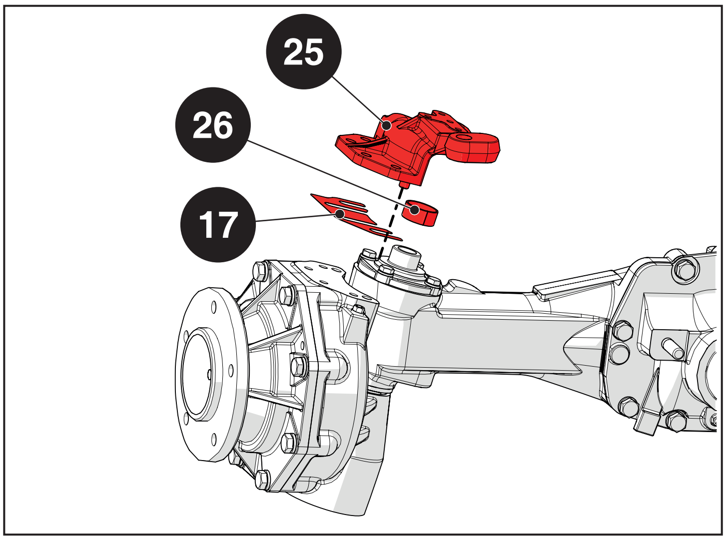


Fig. 6.87

Fit the grease nipple (23).

Fit the washers (22) and tighten the screws (21) to a torque of ______Nm (_____kgm).

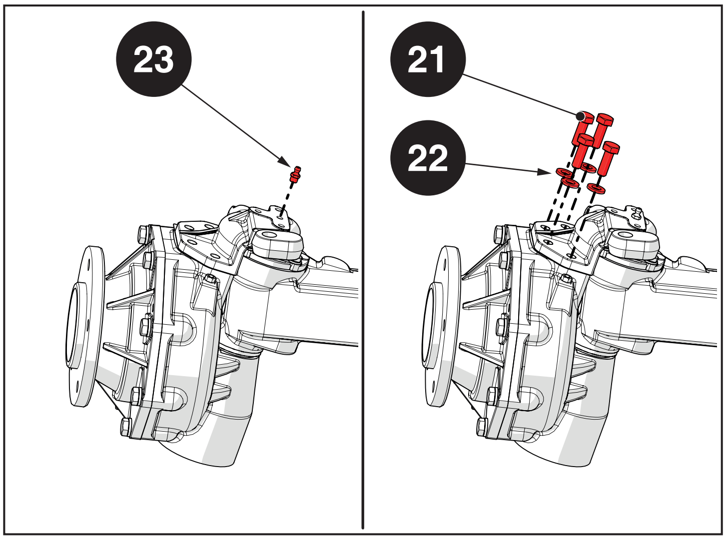


Fig. 6.88

Tighten the nut (27) and the adjuster screw (28).

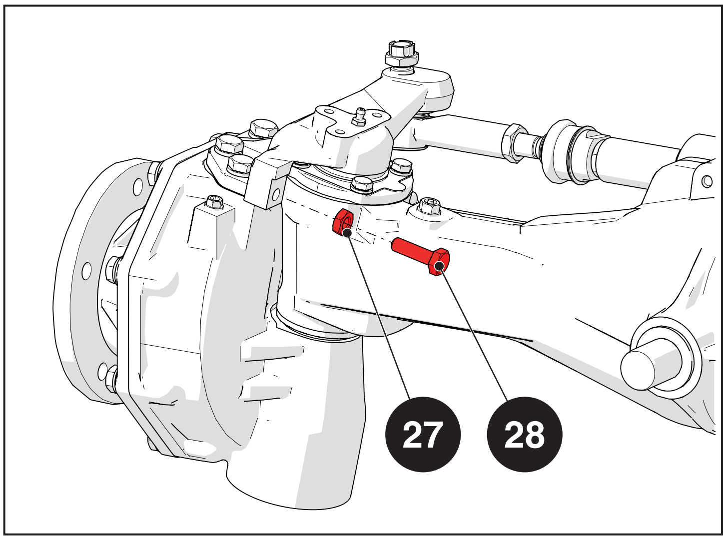


Fig. 6.89

Apply a coating of Loctite 270 to thread of the stud bolts (84), and then tighten the stud bolts.

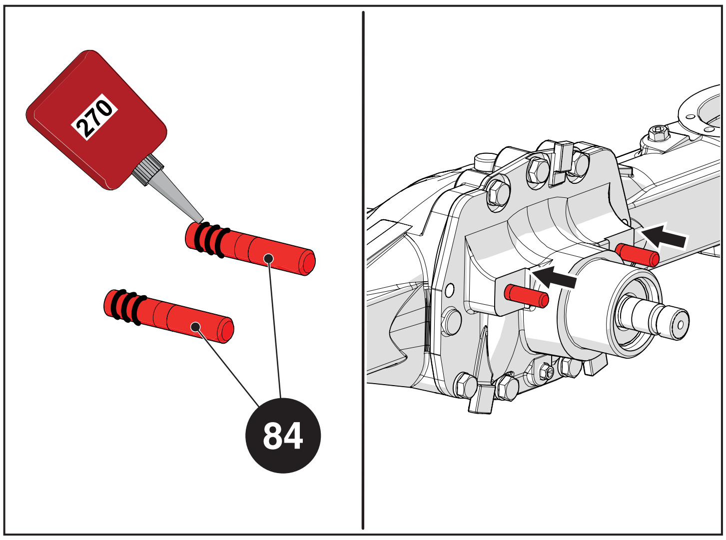


Fig. 6.90

Fit the complete steering cylinder.

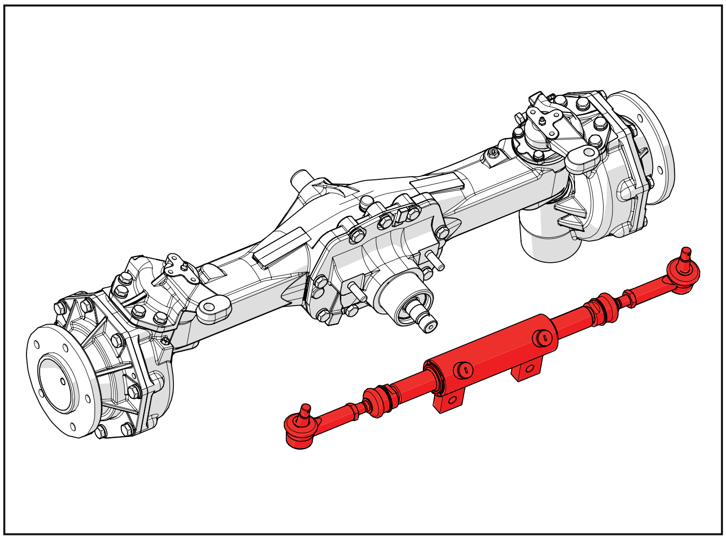


Fig. 6.91

Fit the flat washers (85) and fit and tighten the self-locking nuts (86) fastening the steering cylinder to the front axle.

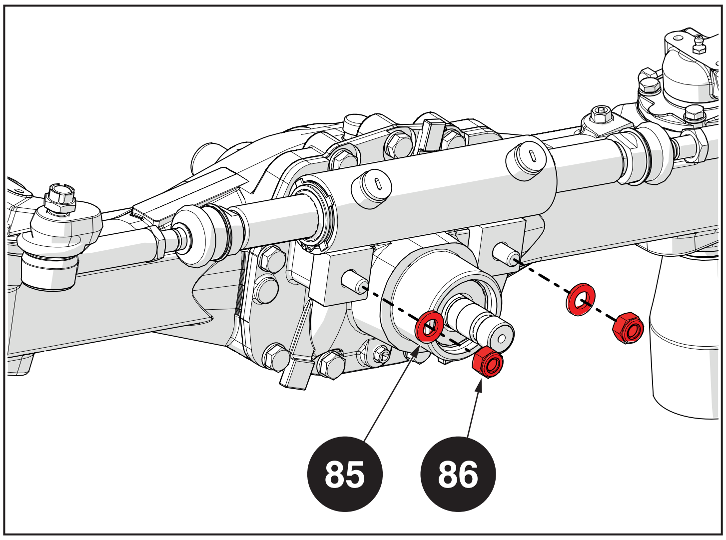


Fig. 6.92

5.1.1 Adjusting the steering cylinder

Adjust the toe angle to ensure even tyre wear and correct steering geometry.

Fit the steering cylinder pin in its seat.

Tighten the stop nut and secure with the split pin.

Warning
Perform this procedure on both sides.

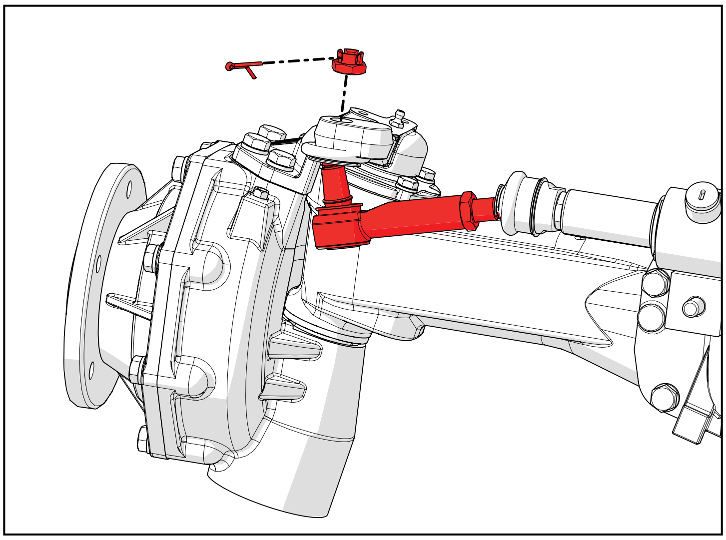


Fig. 6.93

Tighten the fastener nuts of the steering pins.

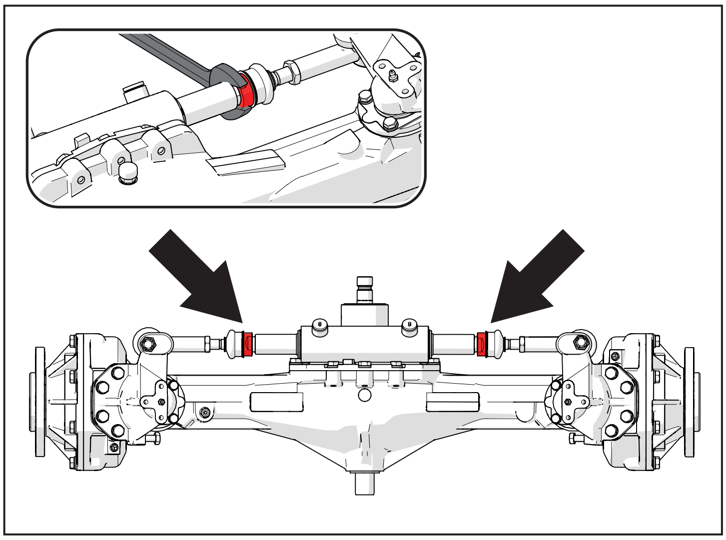


Fig. 6.94

Fit and tighten the special tools (G-07007180) for adjusting the cylinder on the final drive unit half axles.

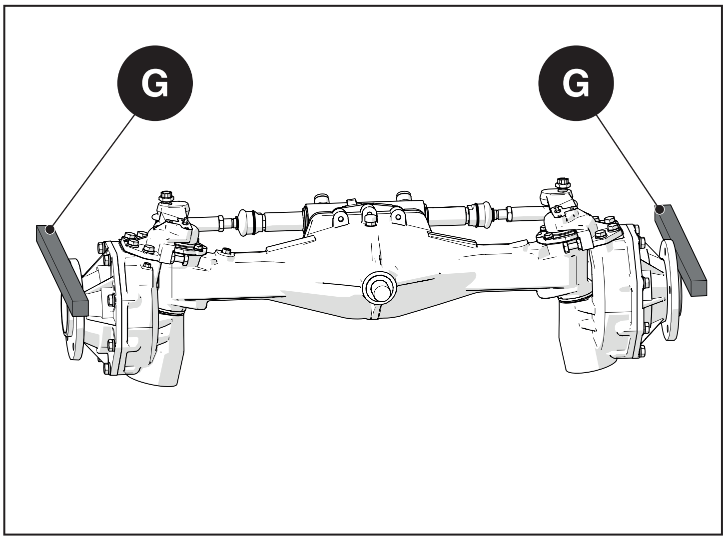


Fig. 6.95

Fit the special tools (G-07007180) at right angles relative to the half axles.

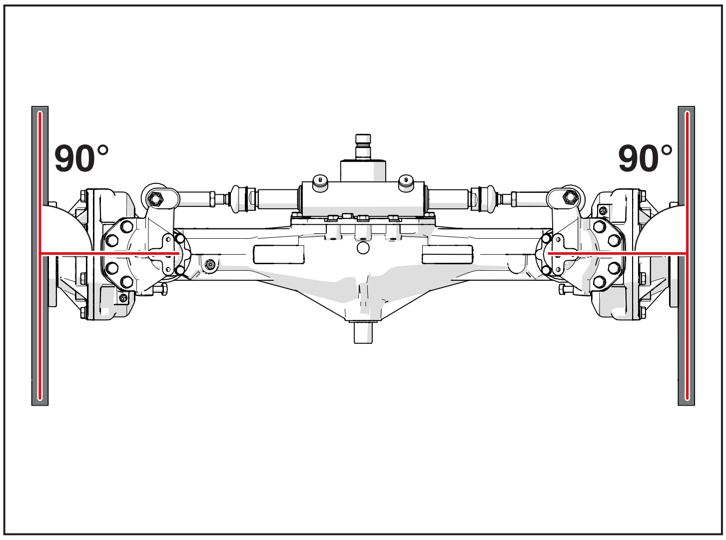


Fig. 6.96

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 + 4 to 6 mm

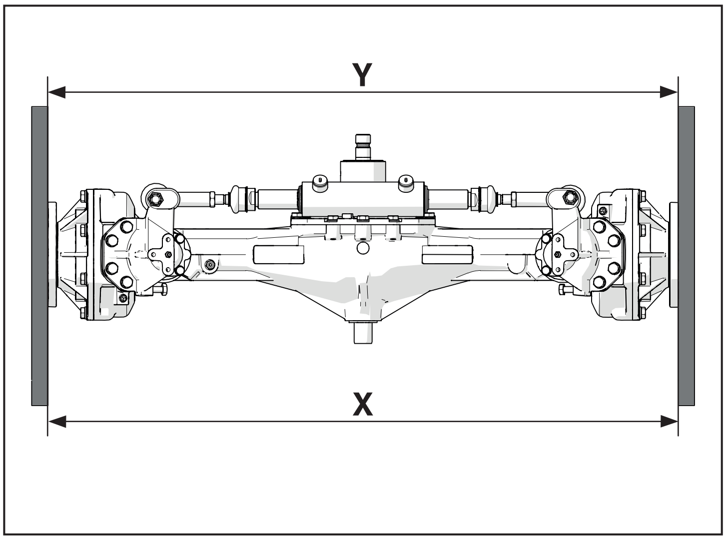


Fig. 6.97

Tighten or loosen the nuts of the steering cylinder pins to increase or decrease the distance between the half axles.

⚠ **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.

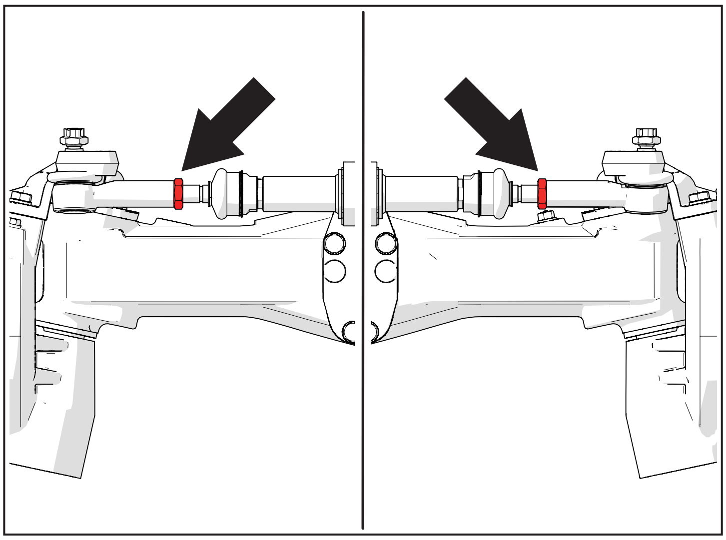


Fig. 6.98

Reassemble by following the procedure for disassembly in reverse order.

Section 6 : Tightening torques

Index

6.1 Tightening torques

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

Tightening torque	Nm	Kgm
-	-	-

Section 7 : Implements necessary

Index

7.1 Implements necessary

p/n	Description	Quantity
07000234	Wrench for ring nut 06340273	1
07000243	Wrench for ring nut	1
07007180	Toe angle measurement tool	1

Chapter 7 : Belly Power Take Off

Index

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.

Section 2 : General introduction

Index

2.1 Assembly drawing

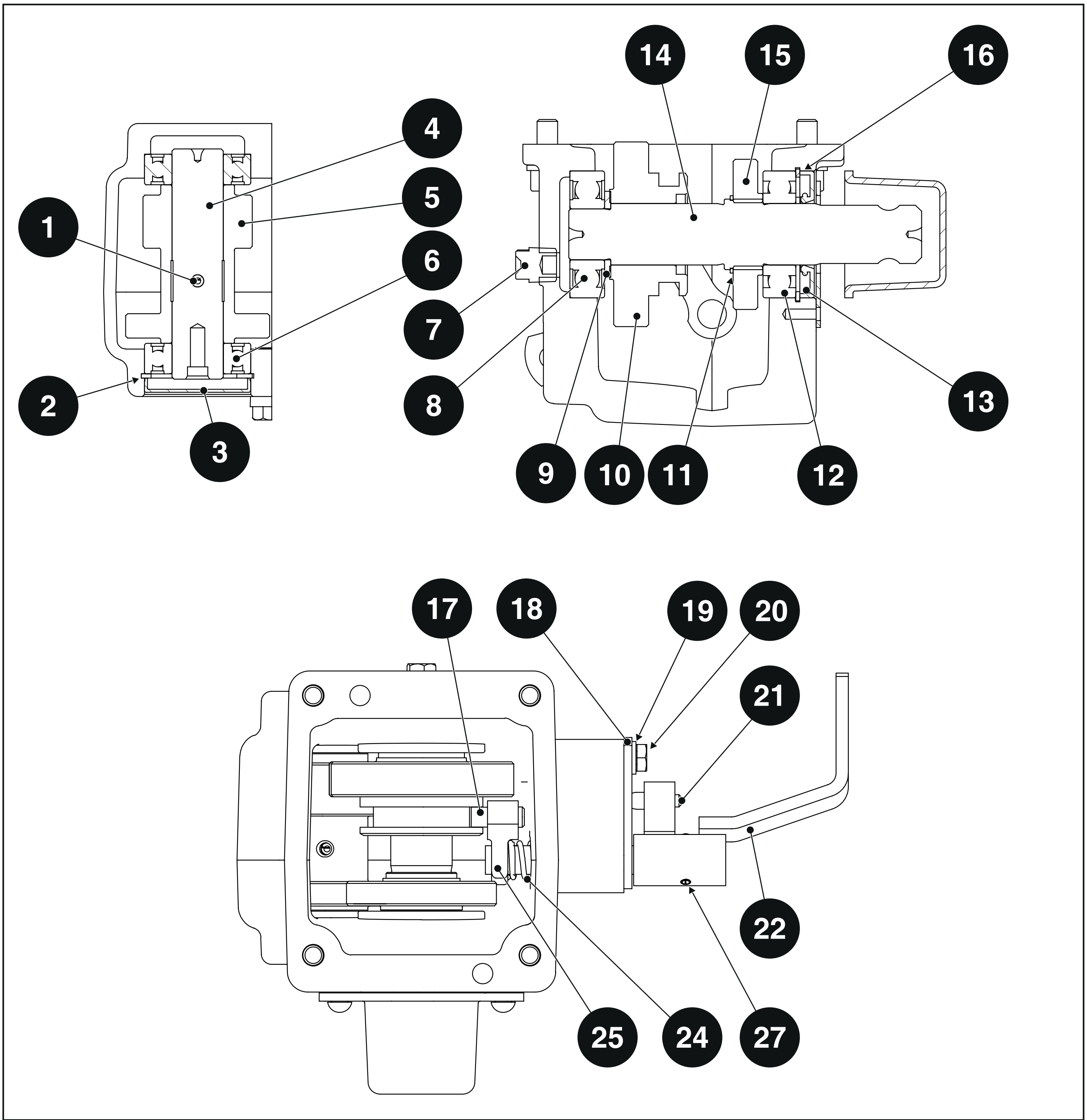


Fig. 7.1

1 - Spring pin
2 - Circlip
3 - Plug
4 - PTO transfer shaft
5 - PTO transfer gear
6 - Bearing
7 - Plug
8 - Bearing
9 - Spacer
10 - PTO gear
11 - Thrust washer
12 - Bearing
13 - Oil seal
14 - Belly PTO shaft
15 - PTO gear
16 - Circlip
17 - Drive control pin
18 - PTO selector plate
19 - Washer
20 - Screw
21 - PTO selector pin
22 - Belly PTO selector lever
24 - Spring
25 - Belly PTO selector rod
27 - Spring pin

Section 3 : Technical characteristics

Index

3.1 Technical characteristics

Type	Single shaft, independent
PTO speeds independent of ground speed	2000 rpm
Clutch	Independent, mechanical dry clutch
Operation	Mechanical

Section 4 : Disassembly

Index

4.1 Disassembly

Undo the plug (7) and drain and collect the oil from the unit.

Warning
Place a container underneath the unit to collect oil.

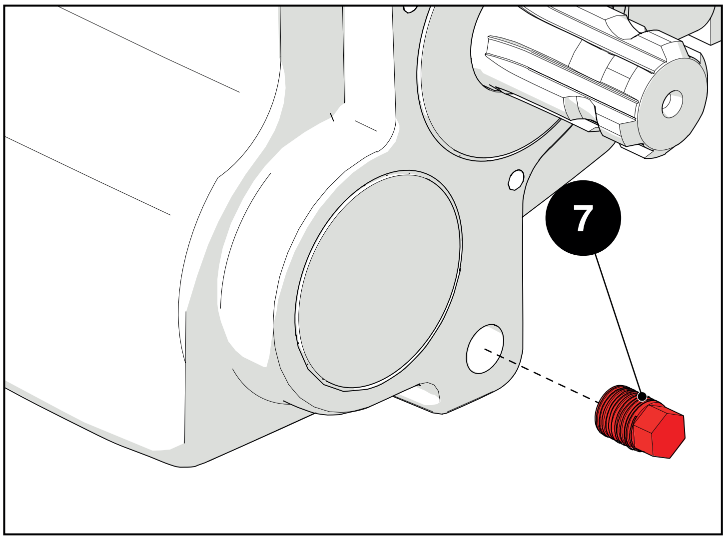


Fig. 7.2

Undo the screws (29) and remove the washers (28).

Danger
During removal of the assembly, leave two screws in opposite positions in place for safety. Only remove these screws after securing the assembly to a hoist or after fitting support blocks in place.

Remove the complete assembly from the transmission casing.

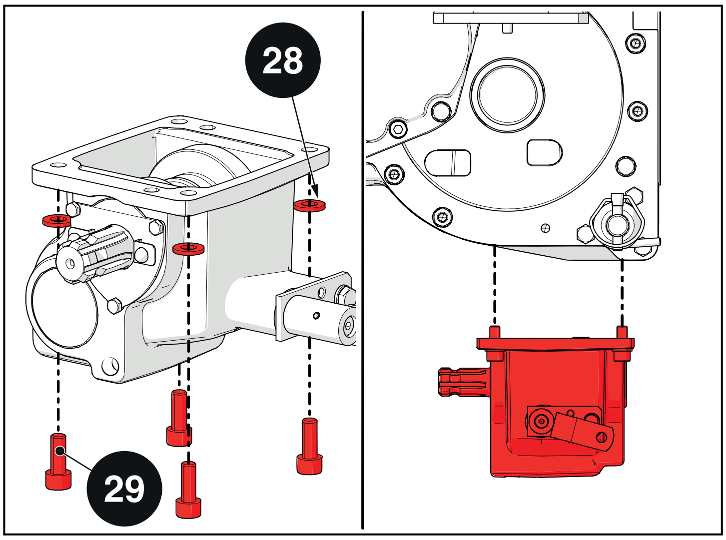


Fig. 7.3

Undo the screws (30) and remove the washers (23).

Remove the flange (31).

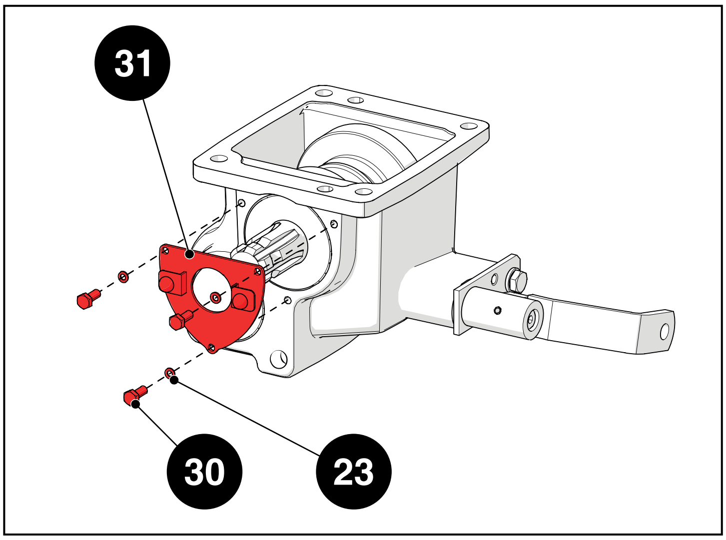


Fig. 7.4

Remove the plug (3) and the oil seal (13).

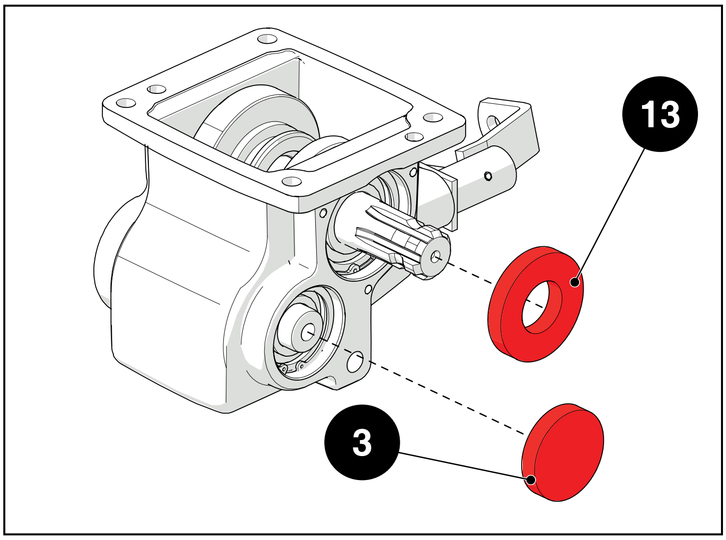


Fig. 7.5

Remove the centring pin (27).

Undo the screw (20) and remove the washer (19).

Remove the belly PTO selector lever (22) complete with selector pin (21).

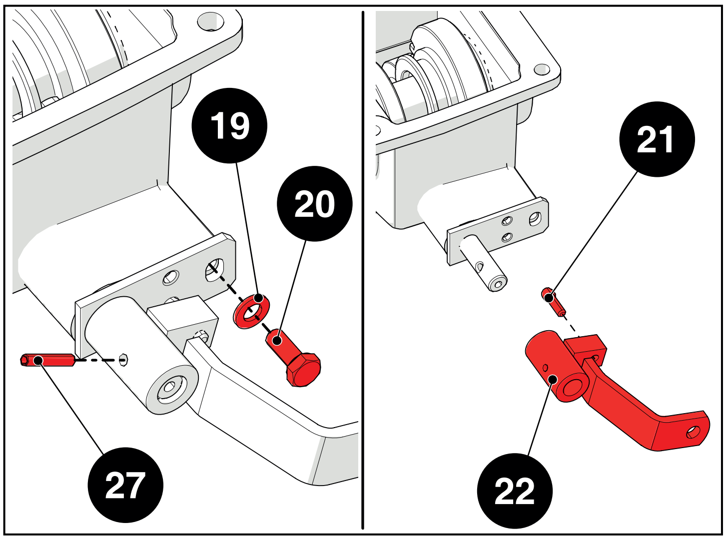


Fig. 7.6

Remove the plate (18) and the oil seal (26).

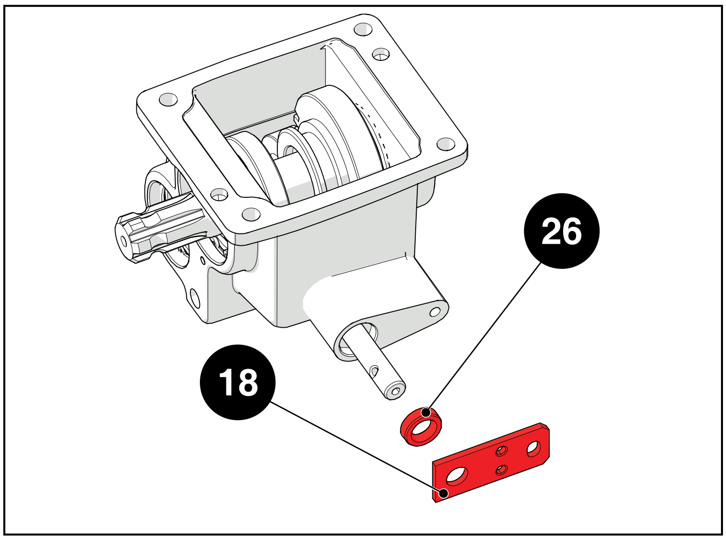


Fig. 7.7

Remove the circlip (16) and the bearing (12).

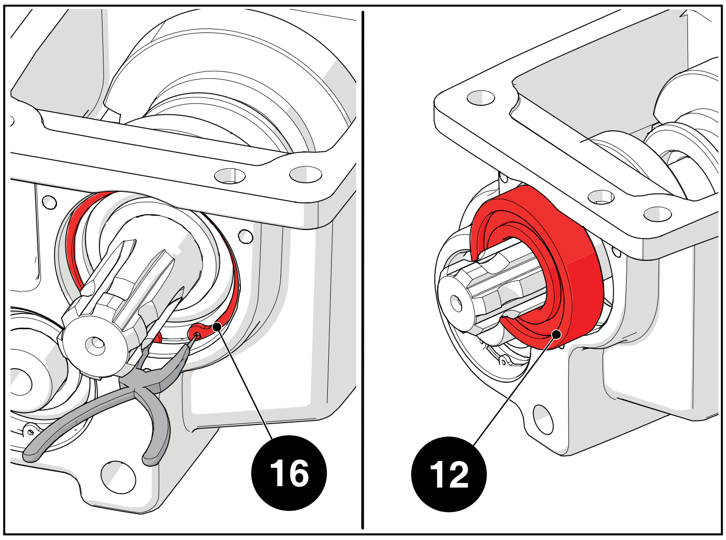


Fig. 7.8

Remove the ring (11).

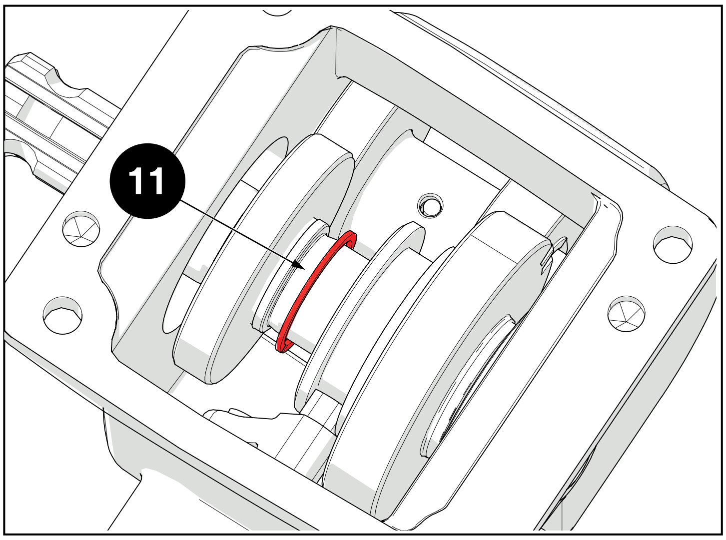


Fig. 7.9

Remove the shaft (14) and simultaneously remove the following components in the order indicated:

- ring (11);
- gear (10);
- spacer (9);
- gear (15);

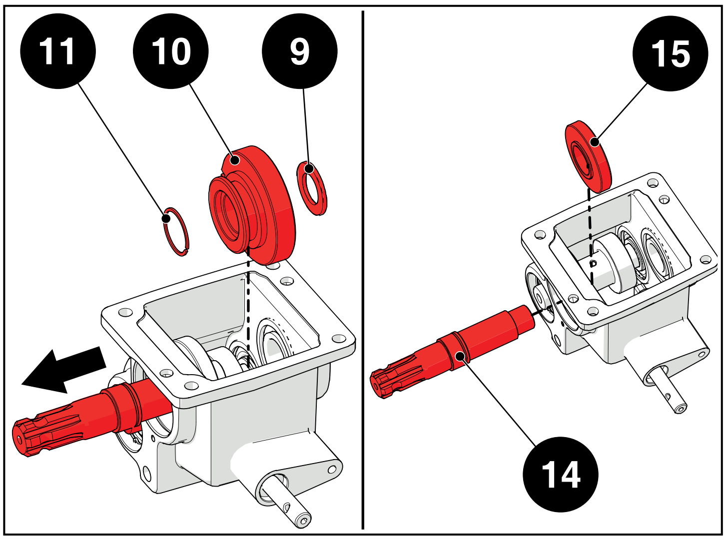


Fig. 7.10

Remove the circlip (2) and the peg(17).

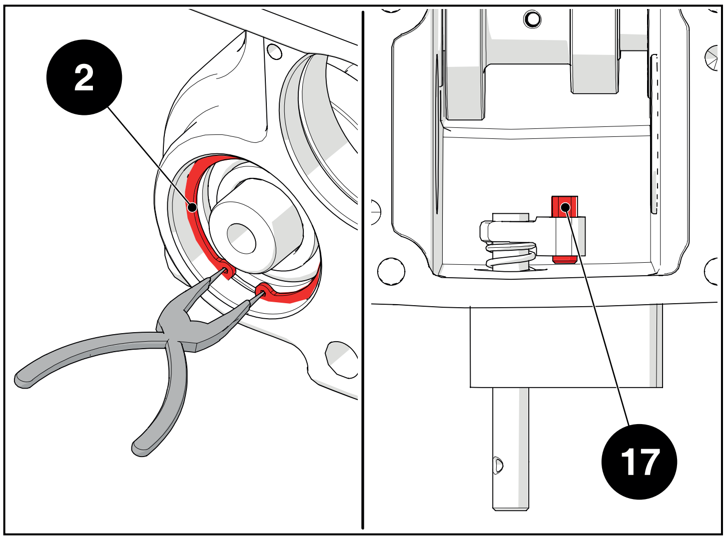


Fig. 7.11

Remove the spring pin (1) and the bearing (6).

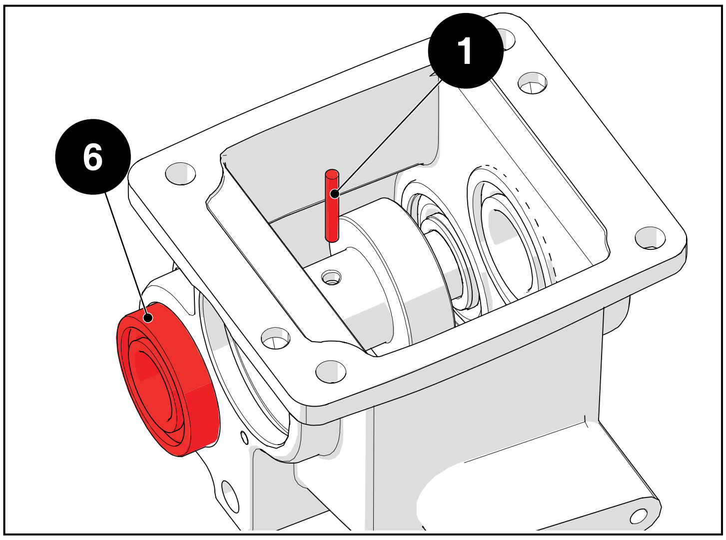


Fig. 7.12

Remove the PTO transfer gear (5) and the transfer shaft (4).

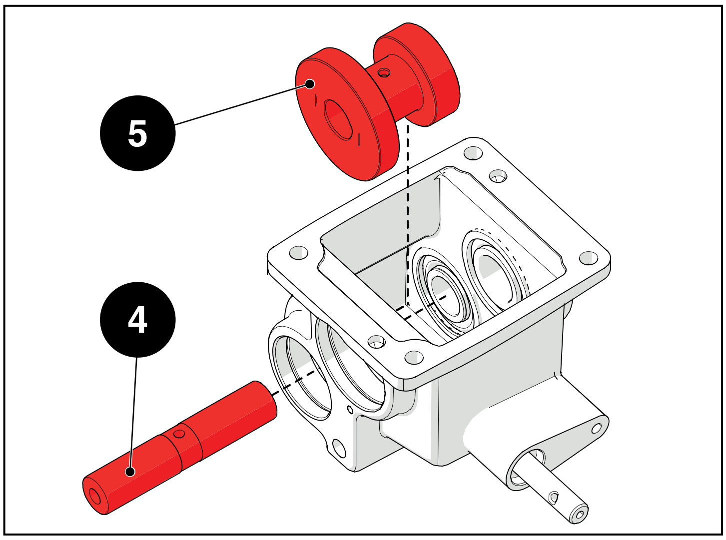


Fig. 7.13

Remove the rod (25) and the spring (24).

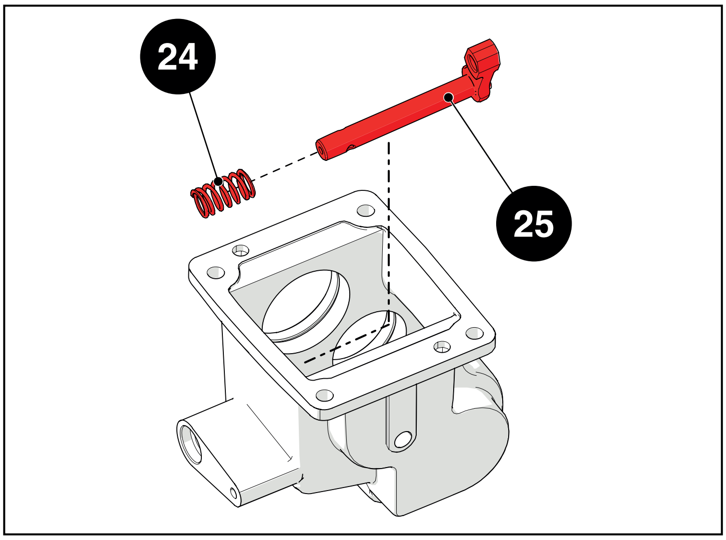


Fig. 7.14

Remove the bearings (8) and (6) from the casing.

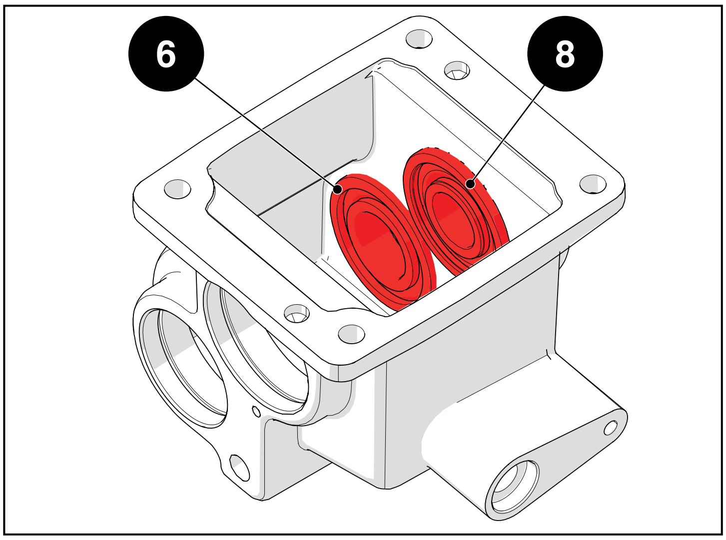


Fig. 7.15

Section 5 : Main inspection, reassembly and adjustment procedures

Index

5.1 Reassembly

Fit the bearings (8) and (6) in the casing with a bearing punch tool of suitable diameter.

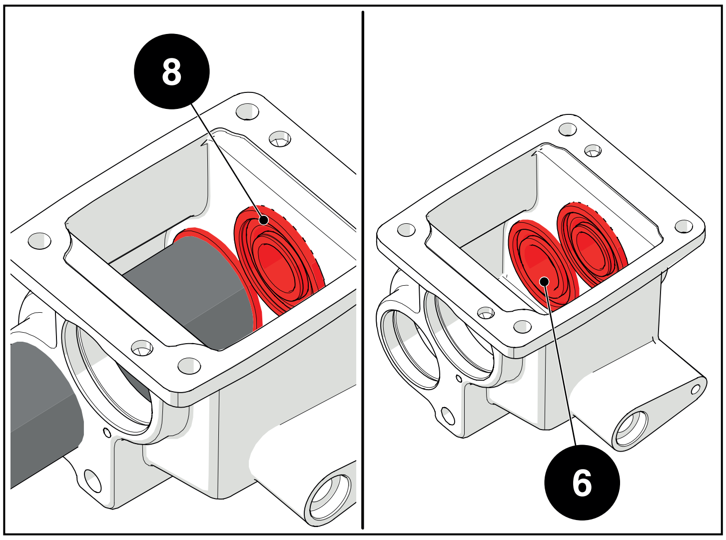


Fig. 7.16

Fit the spring (24) on the rod (25).

Fit the rod (25) in the casing.

Warning
Oil the levers to facilitate installation.

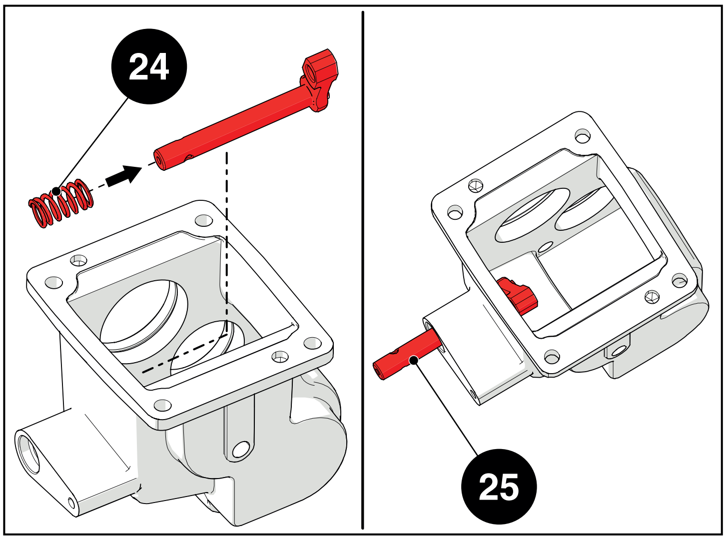


Fig. 7.17

Fit the PTO transfer gear (5) and then the transfer shaft (4).

Warning
Fit the transfer shaft with the end with the threaded hole facing outwards.

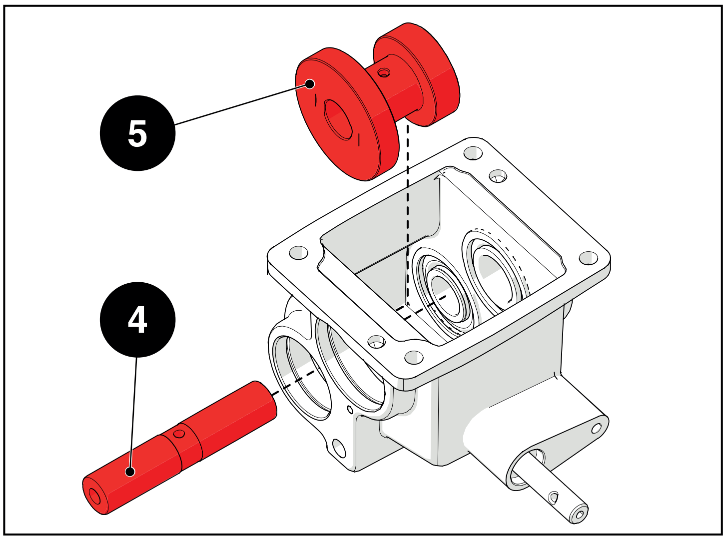


Fig. 7.18

Turn the shaft (4) to align the hole with the hole in the gear (5) and permit installation of the pin (1).

⚠ Warning
Immobilise the shaft and the gear with by inserting a pin punch in the hole.

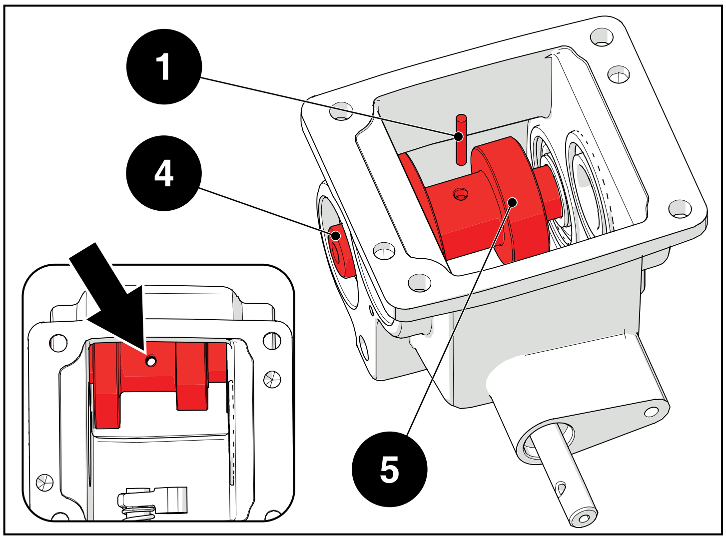


Fig. 7.19

Use a bearing punch of suitable diameter to drive the bearing (6) slightly into its seat and keep the shaft axially aligned.

Fit the pin (1) to secure the shaft.

Drive the bearing (6) completely into its seat.

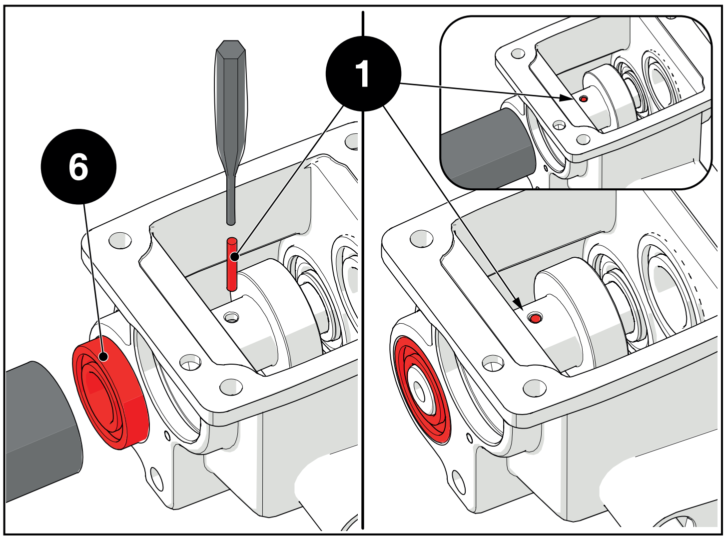


Fig. 7.20

Fasten the bearing by fitting the circlip (2).

Fit the peg (17) onto the lever.

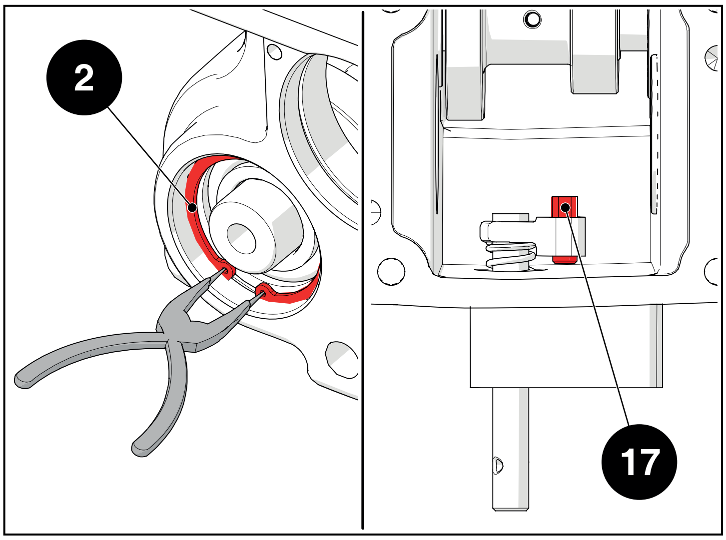


Fig. 7.21

Fit the shaft (14) and the gear (15), assembling correctly inside the casing.

Warning
Fit the gear with the grooved side facing towards the front.

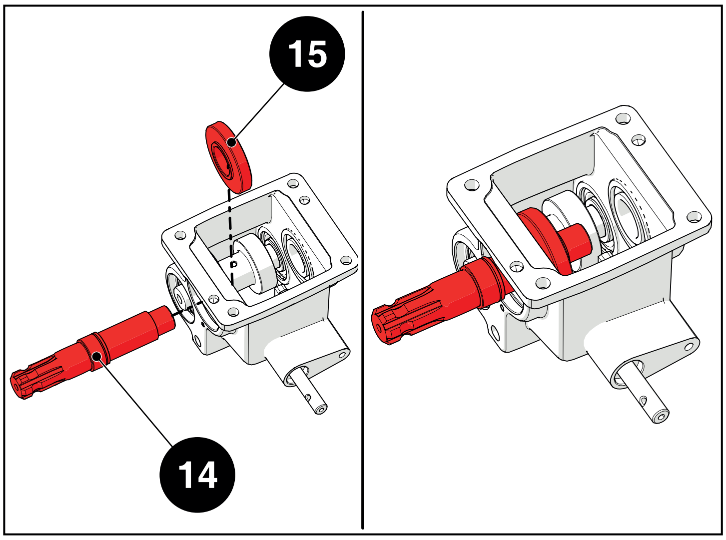


Fig. 7.22

Fit the circlip (11) and the gear (10).

Fit the spacer (9).

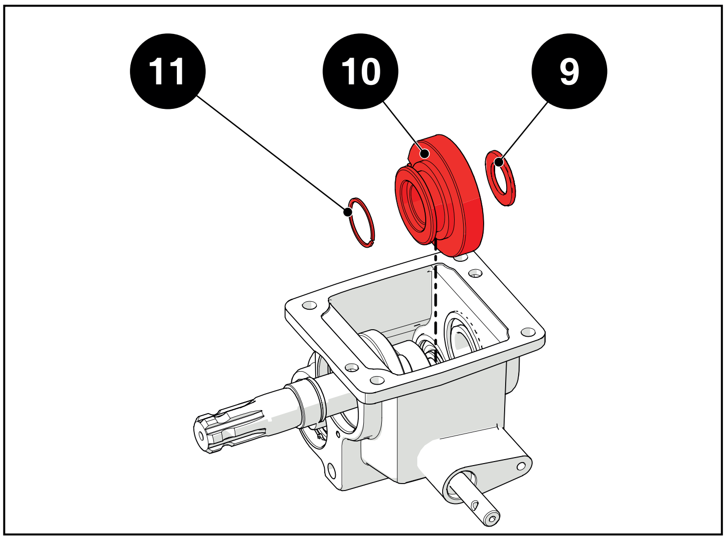


Fig. 7.23

Use a lever to force the gear (10) down, compressing the springs and engaging the gear itself (10) correctly with the peg (17).

Once the shaft (14) and the gear (15) are mated correctly, tap the shaft with a hammer to expose the seat of the circlip (11).

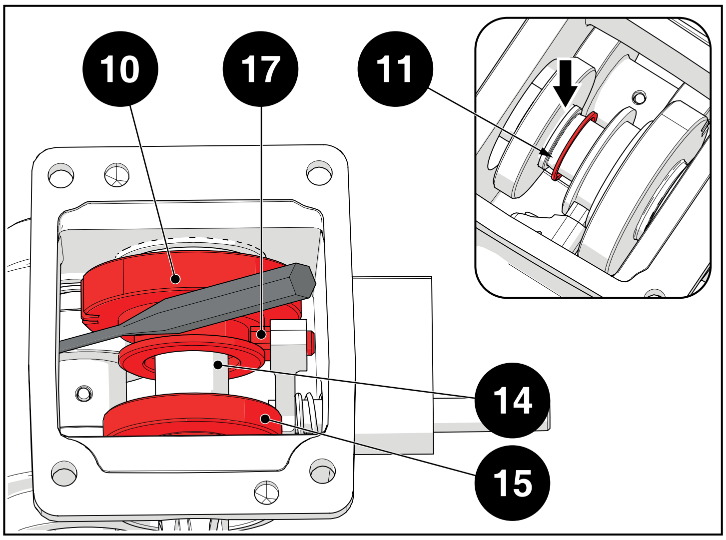


Fig. 7.24

Fit the circlip (11) on its seat on the shaft.

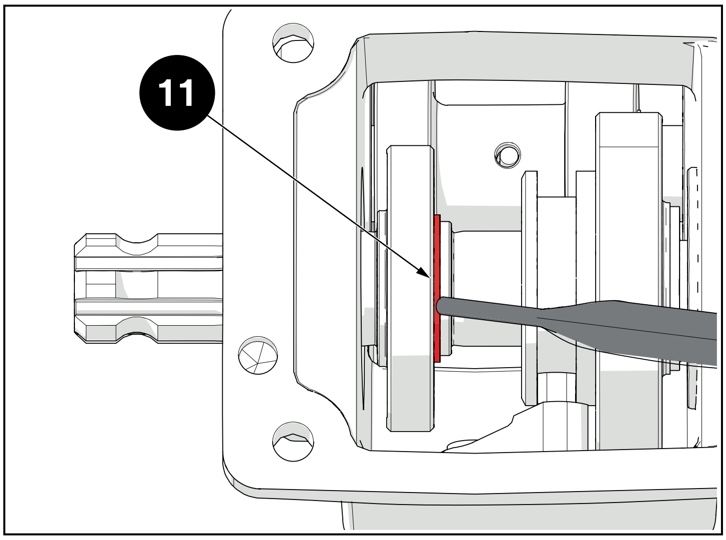


Fig. 7.25

Fit the bearing (12) with a bearing punch tool of suitable diameter and secure in place with the circlip (16).

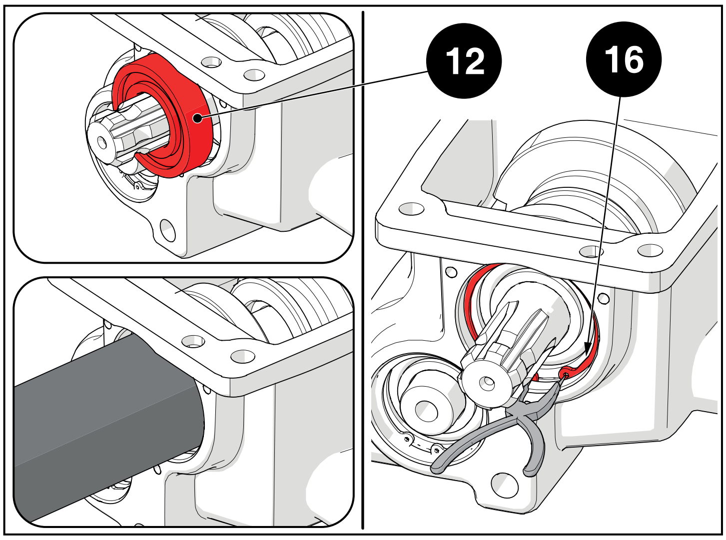


Fig. 7.26

Fit the oil seal (26) using a punch tool of suitable diameter.

Warning
Oil the seat of the oil seal to facilitate installation.

Fit the plate (18).

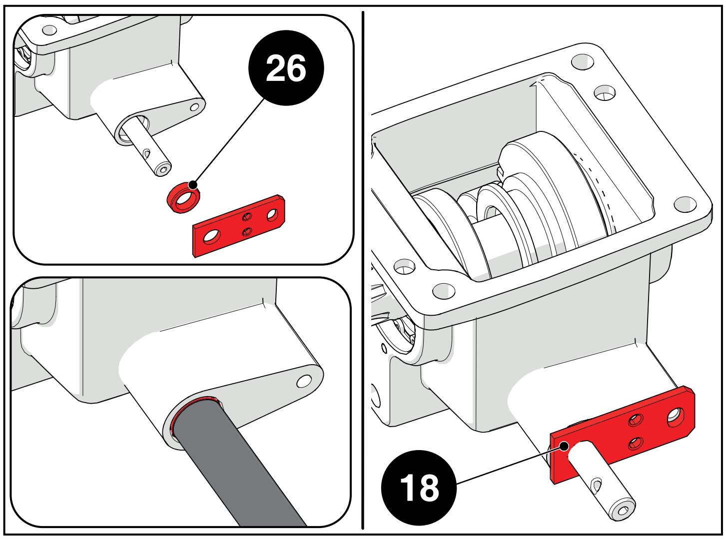


Fig. 7.27

Fit the belly PTO selector lever (22) complete with selector pin (21).

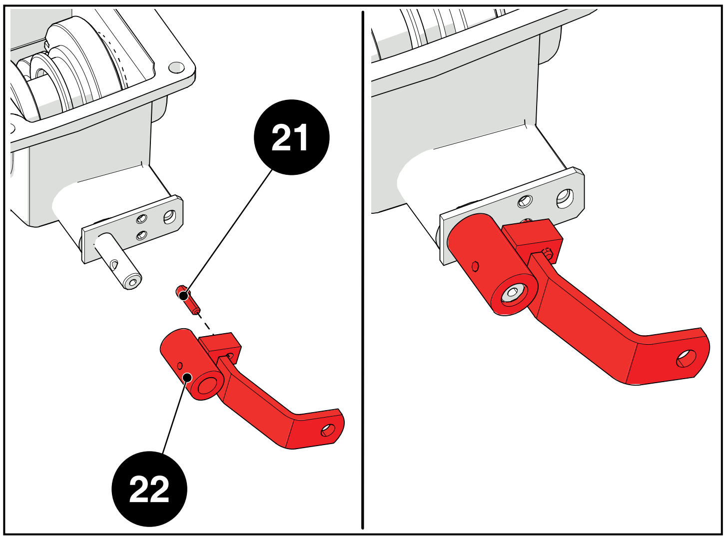


Fig. 7.28

Compress the spring by fitting a spacer between the peg and the gear to align the hole on the rod (25) with the hole on the lever (22).

Fit the centring pin (27) and then fasten the plate by fitting the washer (19) and tightening the screw (20).

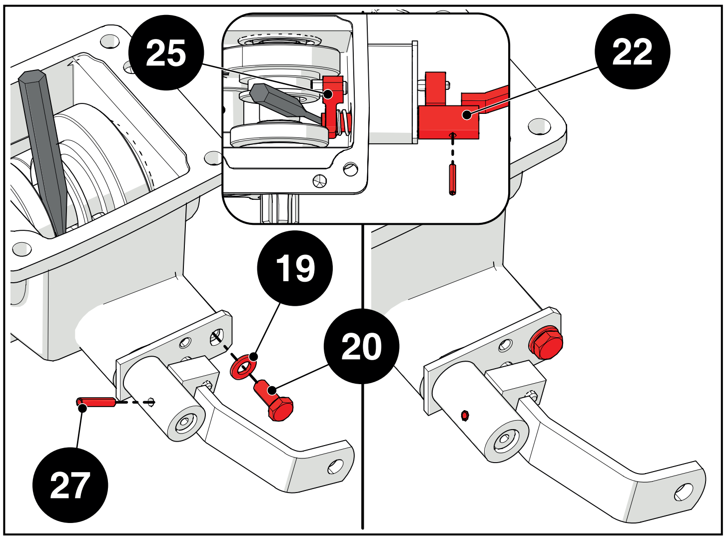


Fig. 7.29

To ensure that the belly PTO engages correctly, it is necessary to check that the free play of the gear is correct on both sides.

Move the lever to one side and measure the free play X between the gear and the bearing.

Move the lever in the opposite direction and check that the free play is the same.

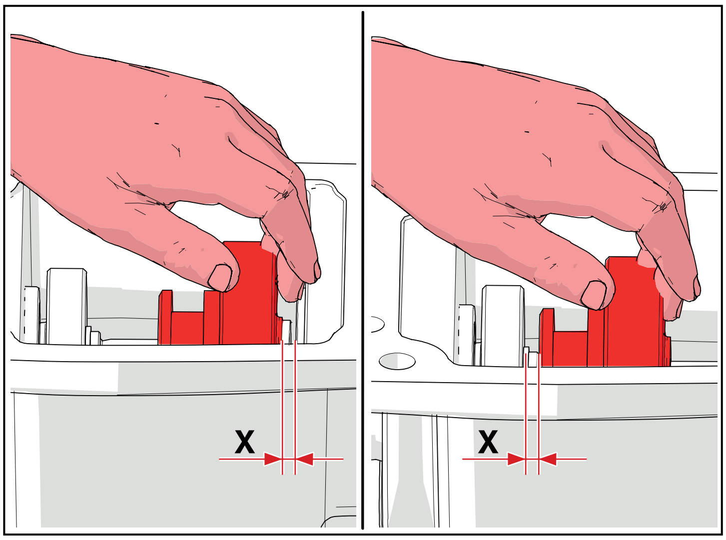


Fig. 7.30

Undo the screw (20) and adjust the position of the plate (18) as necessary to achieve the correct measurement.

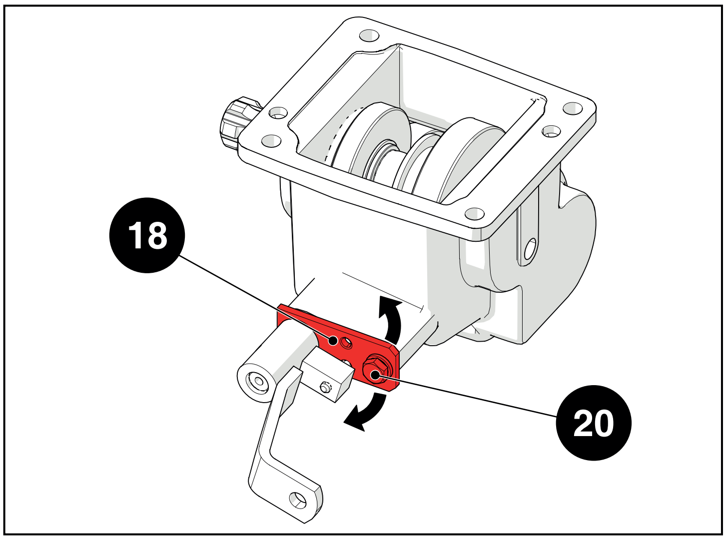


Fig. 7.31

Fit the plug (3) and the oil seal (13).

Warning
Apply a coating of mastic sealant to the outer circumference of the plug and the oil seal.

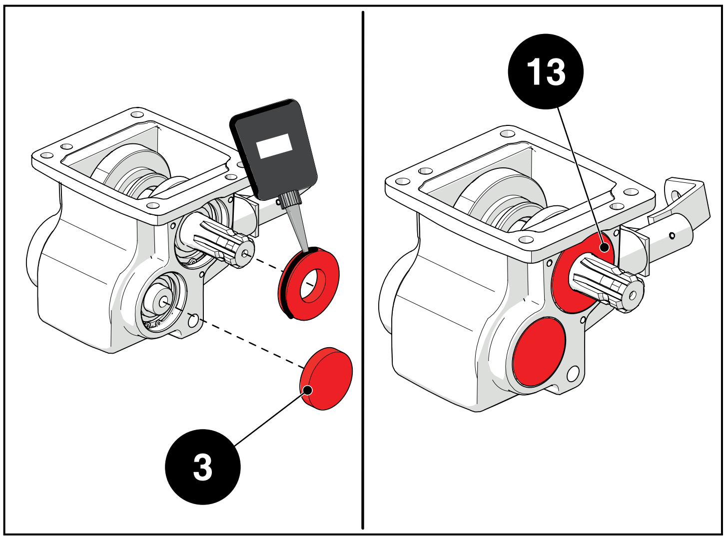


Fig. 7.32

Refit plug (7) by screwing it back into place.

Warning
Apply a coating of Teflon to the thread of the plug.

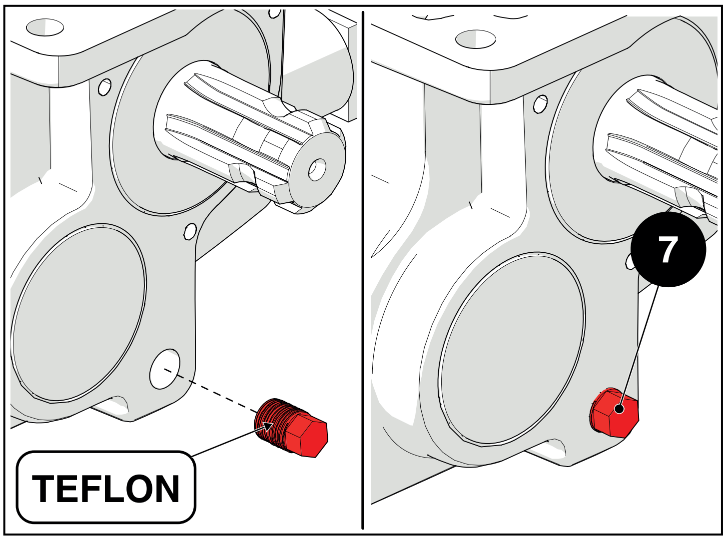


Fig. 7.33

Fit the flange (31) and the washers (23) and tighten the screws (30).

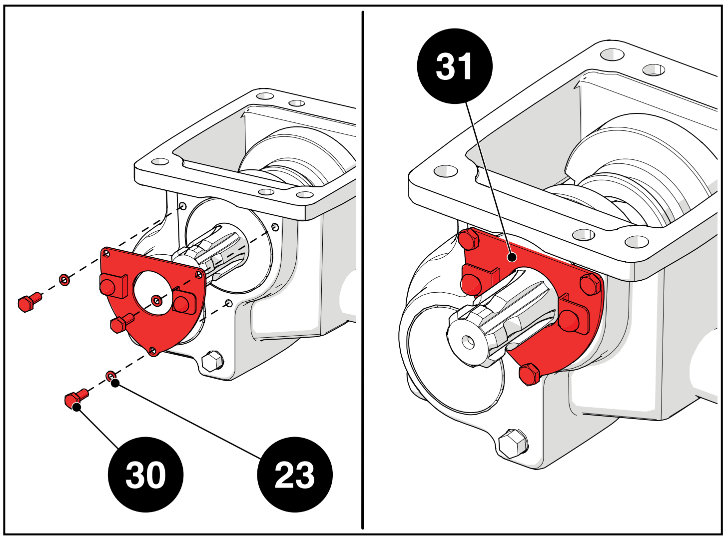


Fig. 7.34

Apply a coating of silicone sealant to the mating surface of the belly PTO casing, and then fit the washers (28) and tighten the screws (29) to a torque of ____ Nm (_____kgm).

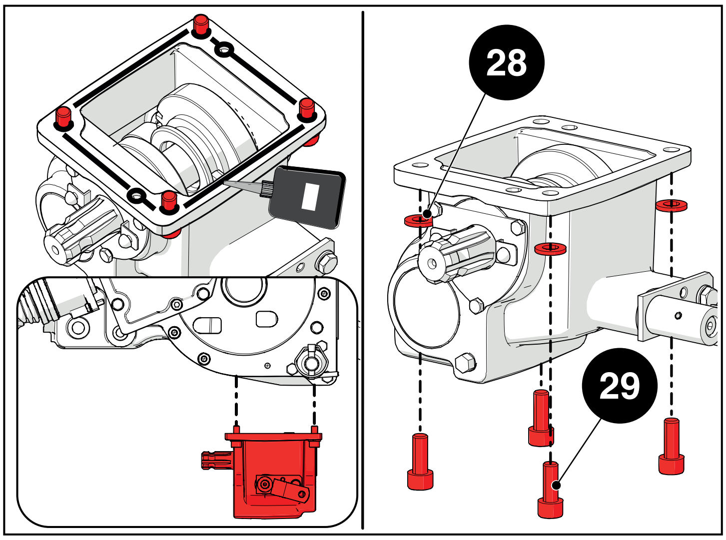


Fig. 7.35

Section 6 : Tightening torques

Index

6.1 Tightening torques

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

Tightening torque	Nm	Kgm
-	-	-

Chapter 8 : Front Power Take Off

Index

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.

Section 2 : General introduction

Index

2.1 Assembly drawing

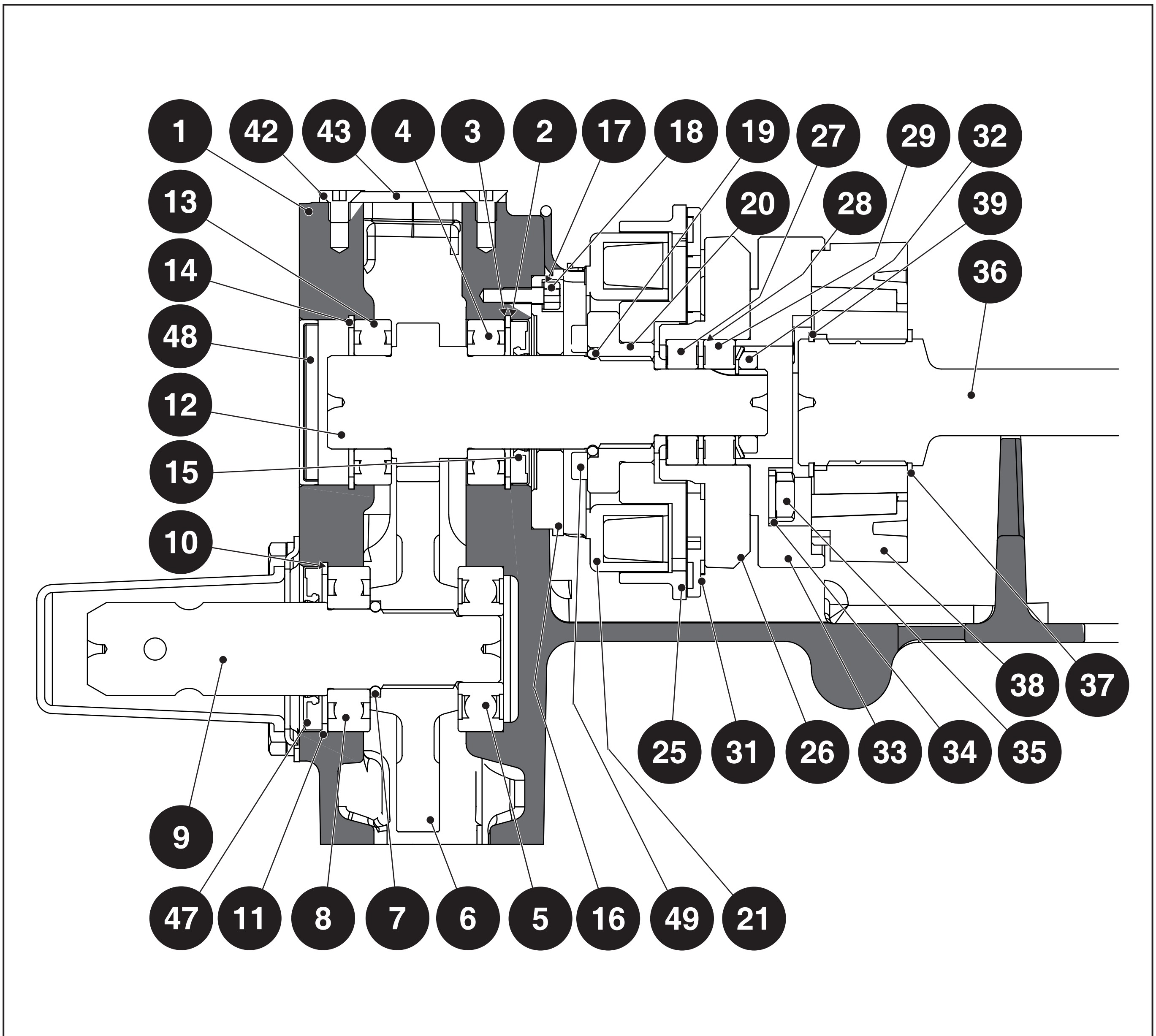


Fig. 8.1

1 - Axle carrier
2 - Circlip
3 - Spacer
4 - Bearing
5 - Bearing
6 - Gear
7 - Bearing
8 - Ring
9 - Shaft
10 - Spacer
11 - Circlip
12 - Shaft
13 - Bearing
14 - Circlip
15 - Oil seal
16 - Clutch connector flange
17 - Washer
18 - Screw
19 - Circlip
20 - Splined flange
21 - Magnet
25 - Clutch housing
26 - Bearing carrier flange
27 - Bearing
28 - Spacer
29 - Bearing
31 - Clutch plate
32 - Ring nut
33 - Spacer
34 - Washer
35 - Screw
36 - PTO drive shaft
37 - Circlip
38 - Flexible joint
39 - Circlip
42 - Screw
43 - Cover
47 - Oil seal
48 - Plug
49 - Screw

Section 3 : Technical characteristics

Index

3.1 Technical characteristics

Type	Single shaft, independent
PTO speeds independent of ground speed	1000 rpm
Direction of rotation (looking at PTO)	Anticlockwise
Profile	1-3/8" with 6 splines
Clutch	Electromagnetic
Clutch control	Electric

Section 4 : Disassembly

Index

4.1 Preliminary operations

The following components must be removed in order to access the front PTO:

Note
See the relative chapters for specific disassembly and reassembly procedures.

Bonnet

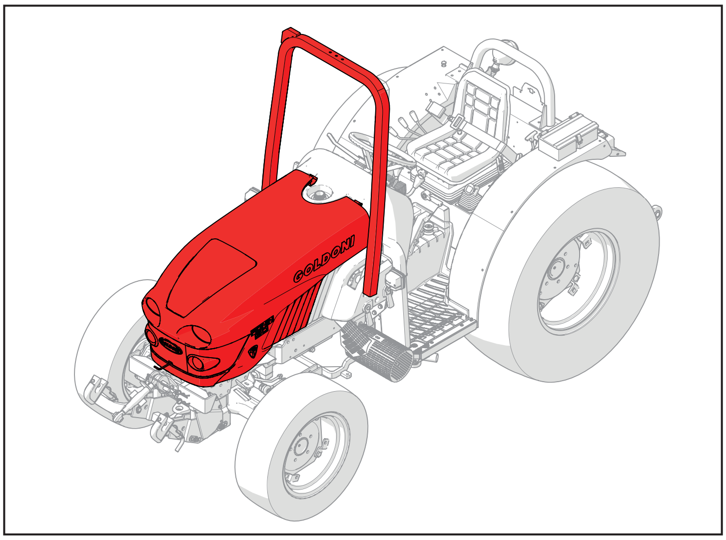


Fig. 8.2

Remove the radiator, air filter, battery and protective plates.

Warning
If the plates are difficult to remove, lifting the machine with the front axle in a tilted position may facilitate the procedure. Setting the axle into a tilted position frees the space necessary to remove the plates.

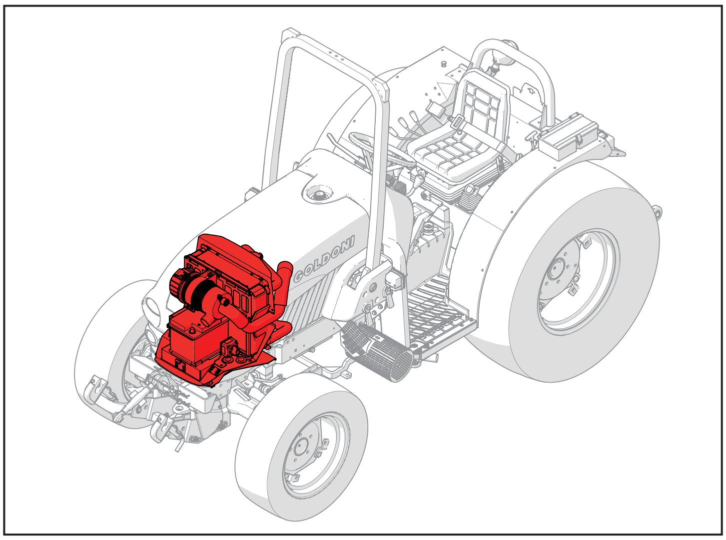


Fig. 8.3

4WD shaft

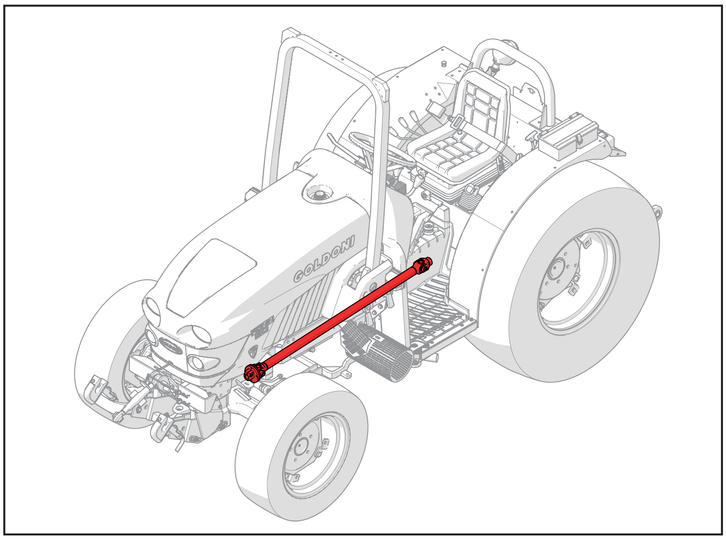


Fig. 8.4

Front axle

Note
It is only necessary to remove the front axle when removing the entire assembly from the tractor. For inspection purposes, it may be left on the tractor.

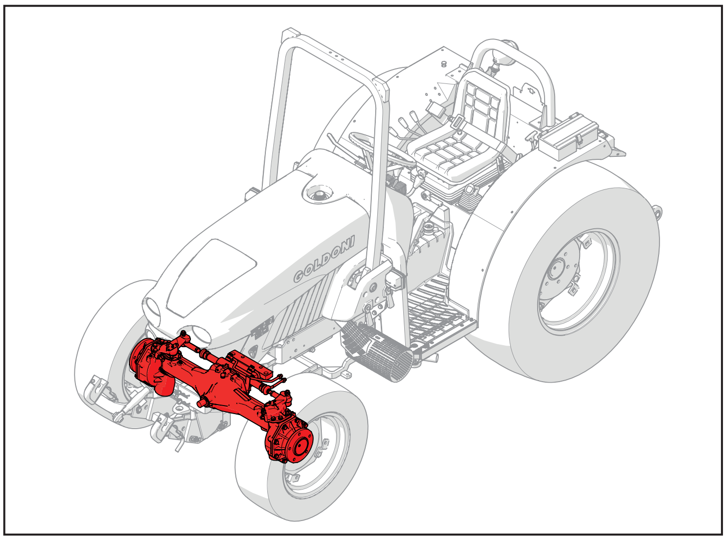


Fig. 8.5

Front lift

Note
It is only necessary to remove the front lift when removing the entire assembly from the tractor. For inspection purposes, it may be left on the tractor.

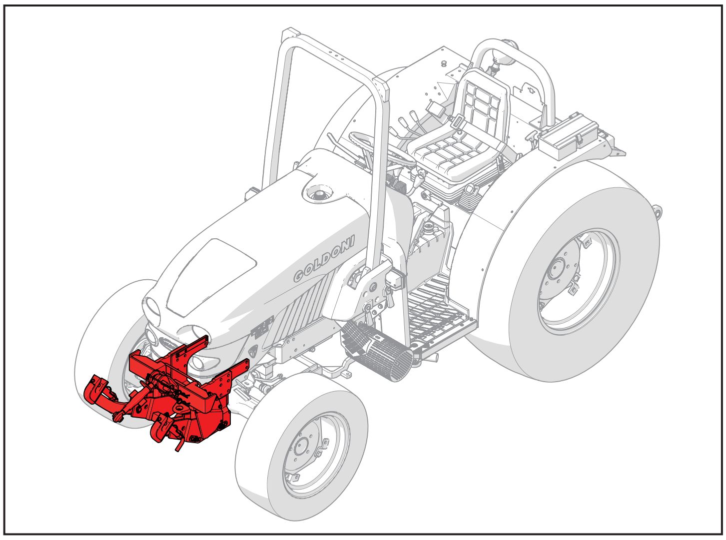


Fig. 8.6

4.2 Adjusting the clutch

The clutch must be adjusted appropriately for the front PTO to function correctly.

Use a feeler gauge to measure the gap between the discs (25) and (31). This gap should measure between 0.6 and 1.2 mm.

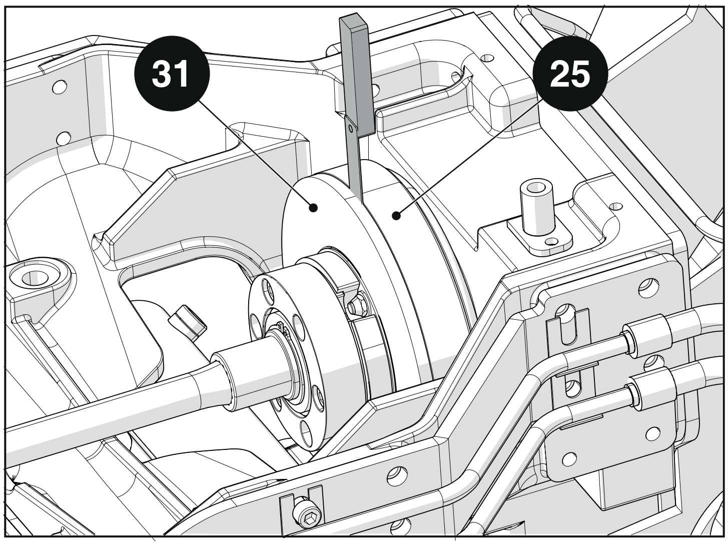


Fig. 8.7

Undo the screws (41) and remove the washers (40).

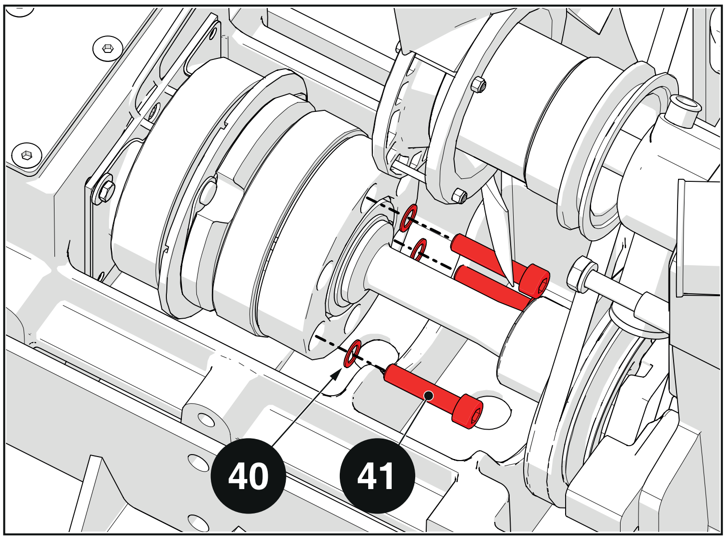


Fig. 8.8

Remove the shaft (36), together with the flexible coupling (38), towards the engine.

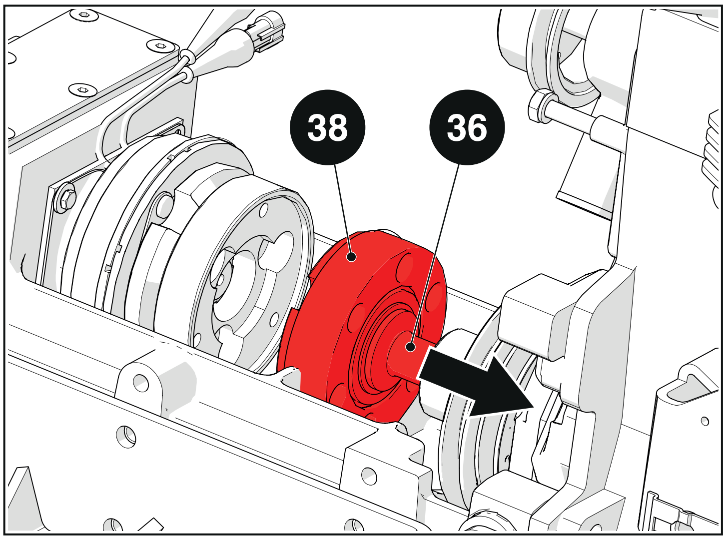


Fig. 8.9

Remove the screws (35) and washers (34) and remove the spacer (33).

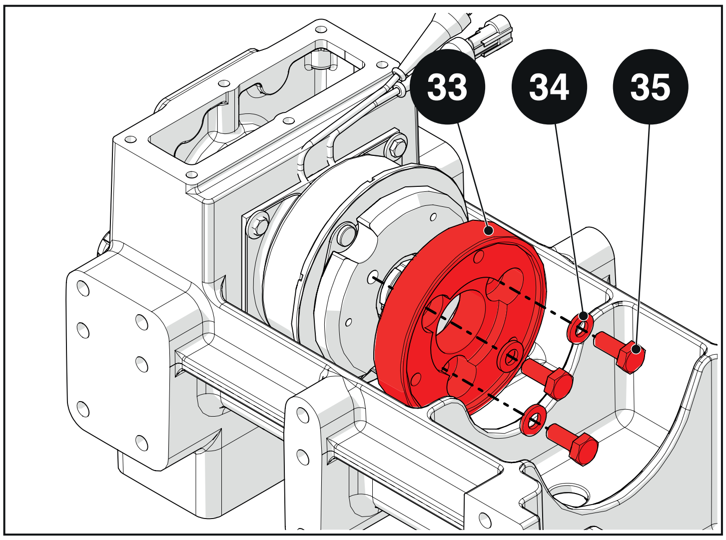


Fig. 8.10

Undo the ring nut (32).

Remove the complete clutch disc (31).

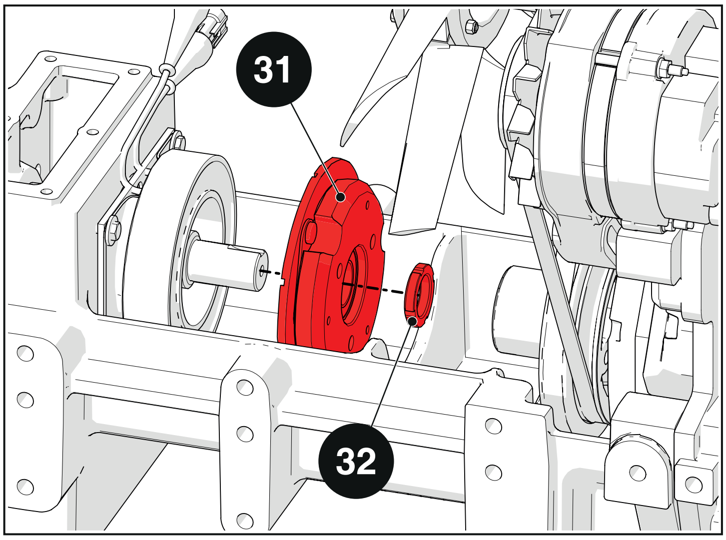


Fig. 8.11

Separate the clutch disc (31) from the bearing carrier flange (26), undoing the screws (45) and removing the washers (44).

Note
When reassembling, tighten the screws (45) to a torque of 10.5 Nm (1 Kgm).

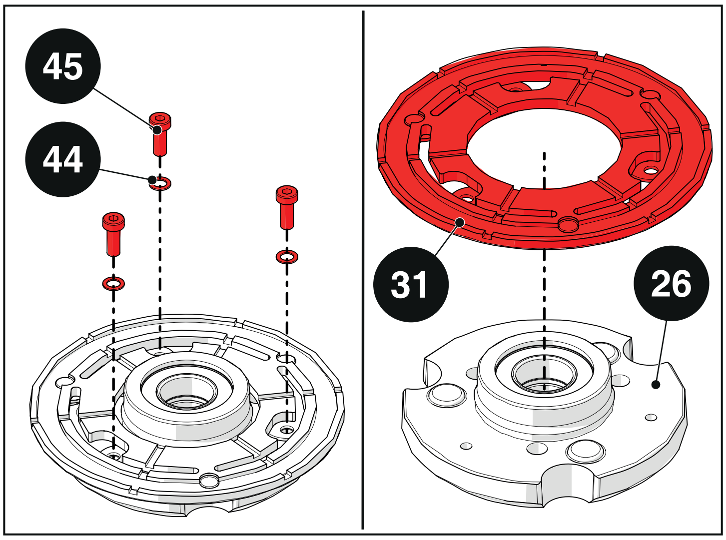


Fig. 8.12

Measure and note the thickness of the disc (31).

Warning
If the disc (31) measures less than 6.4 mm in thickness, the clutch must be replaced.

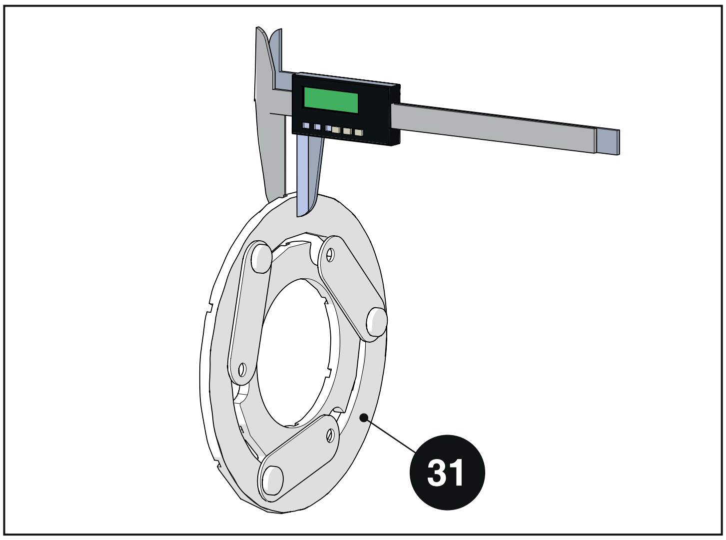


Fig. 8.13

Section 5 : Reassembly

Index

5.1 Reassembly

Place the axle carrier (1) in an upright position.

Fit the circlip (2) and the spacers (3).

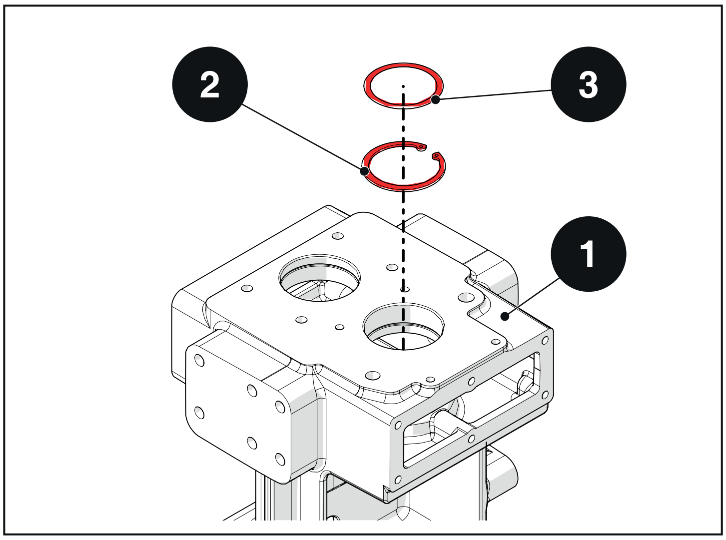


Fig. 8.14

Fit the bearings (4) and (5) and drive them into their seats with a bearing punch tool of suitable diameter.

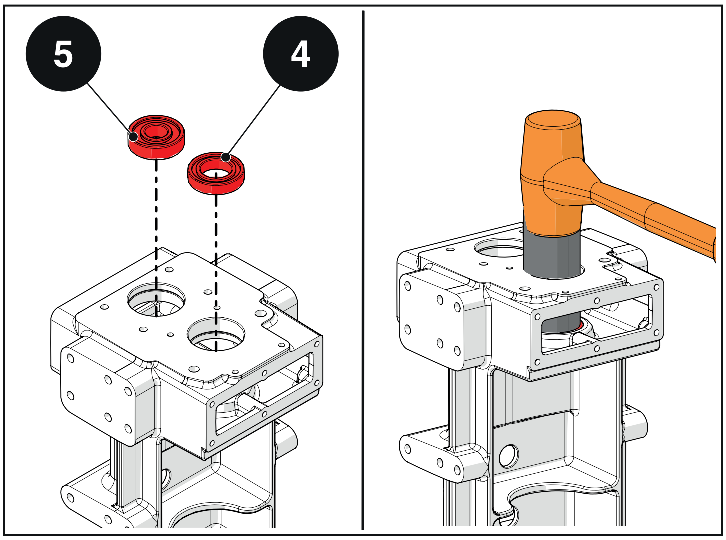


Fig. 8.15

Fit the gear (6).

Warning
Ensure that the gear is installed the right way around. The flat part must face towards the rear.

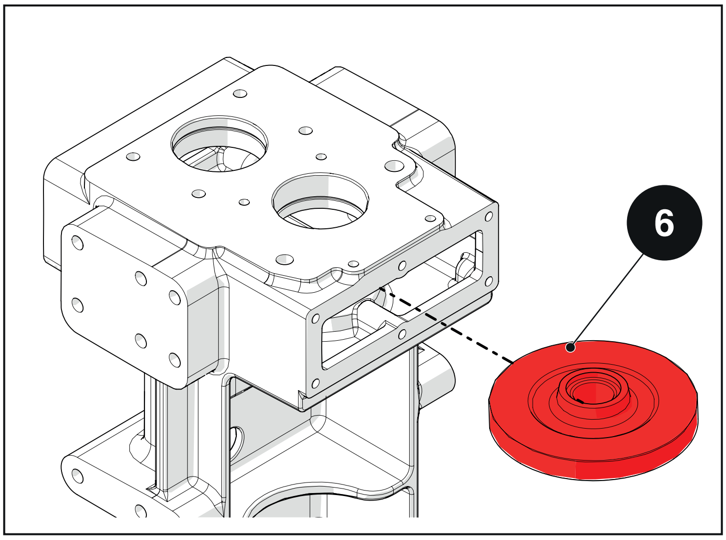


Fig. 8.16

Preassemble the shaft (9), fitting the ring (7) and the bearing (8).

Warning
Use a bearing punch tool to drive the bearing (8) into its seat on the shaft.

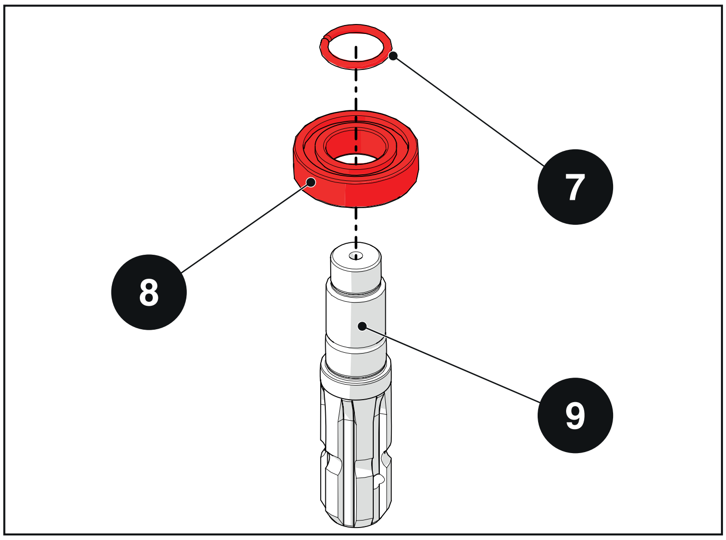


Fig. 8.17

Fit the complete shaft (9) in the axle carrier, fitting it into the gear and driving the bearing completely into its seat.

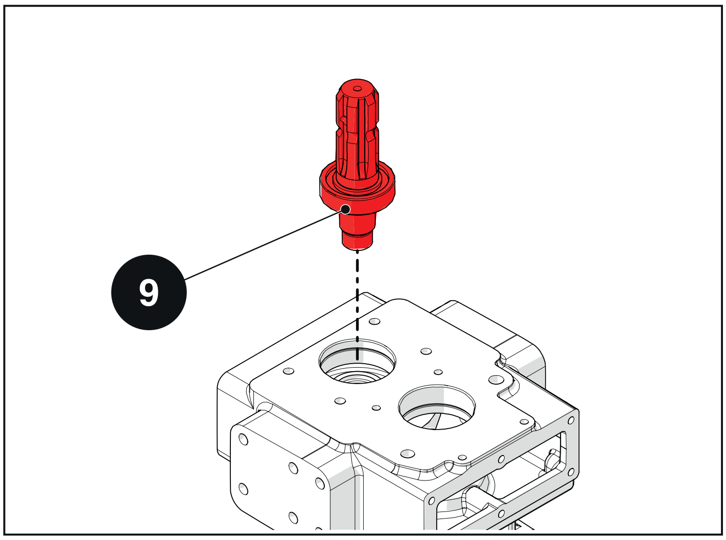


Fig. 8.18

Fit the spacer (10) and the circlip (11).

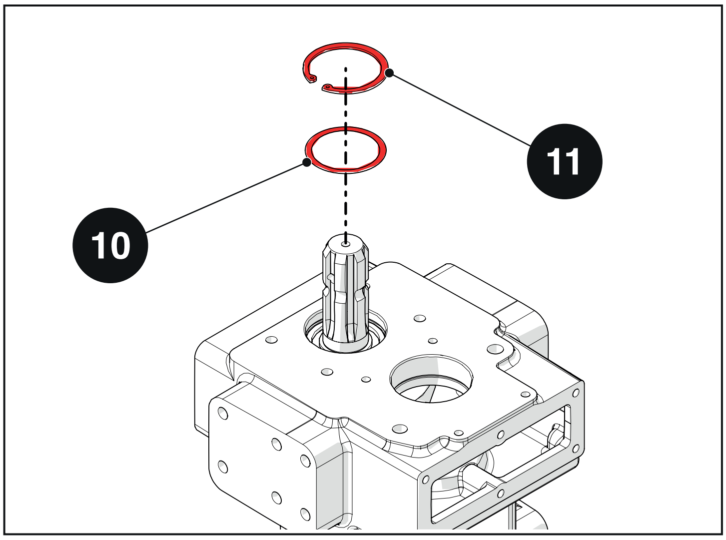


Fig. 8.19

Fit the shaft (12), engaging it with the gear.

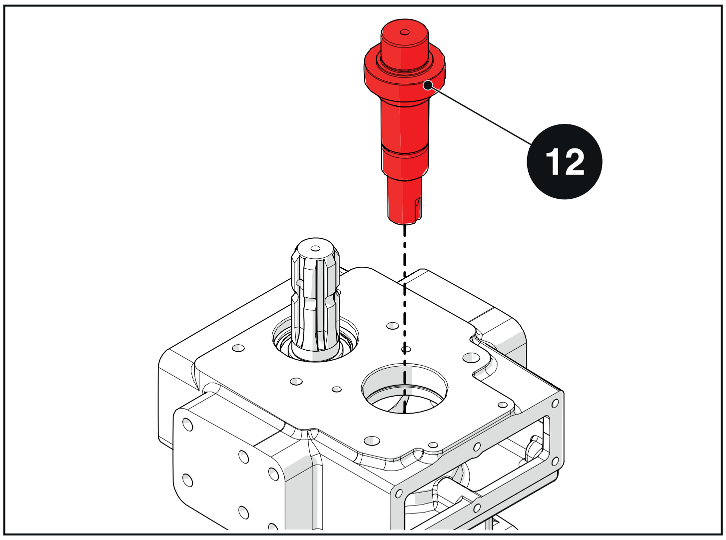


Fig. 8.20

Fit the bearing (13) with a bearing punch tool of suitable diameter and secure in place with the circlip (14).

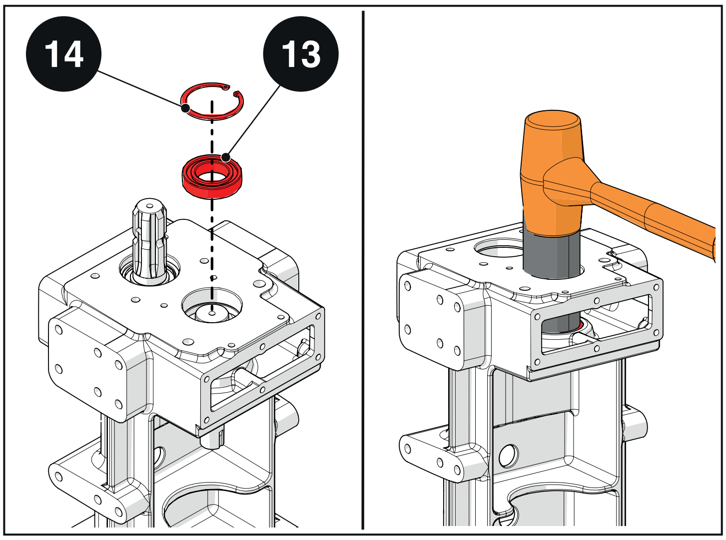


Fig. 8.21

Turn the assembly into a horizontal position.

Using a guide to position the oil seal (15) correctly, drive the oil seal into its seat with a punch.

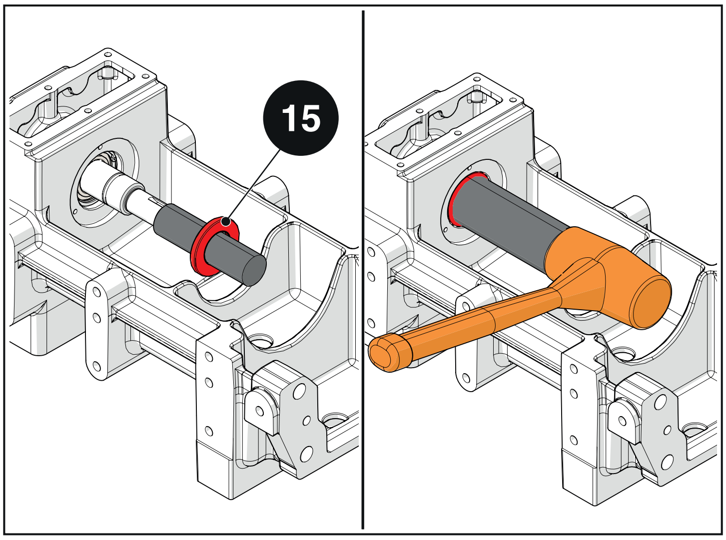


Fig. 8.22

Fit the clutch connector flange (16) and fasten with the screws (18) and washers (17), tightening the screws to a torque of 10.5 Nm (1 kgm).

Warning
Apply a coating of LOCTITE 270 to the screw threads.

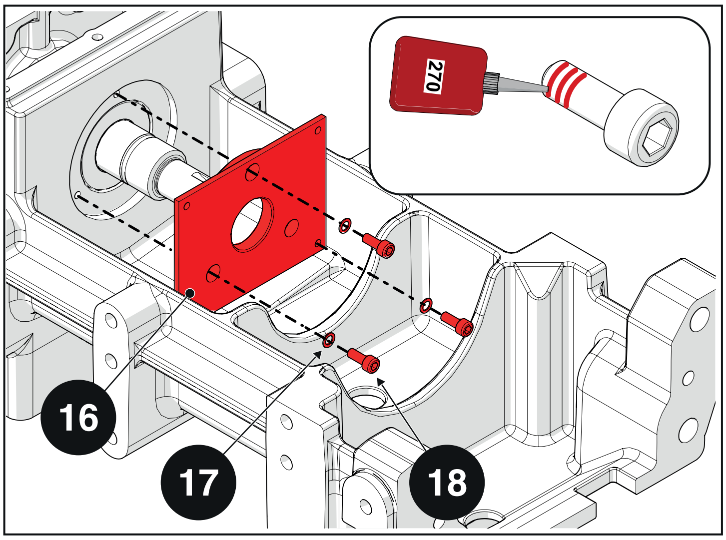


Fig. 8.23

Fit the circlip (19) on the shaft using flat nosed pliers.

Warning
Straighten the circlip before fitting.

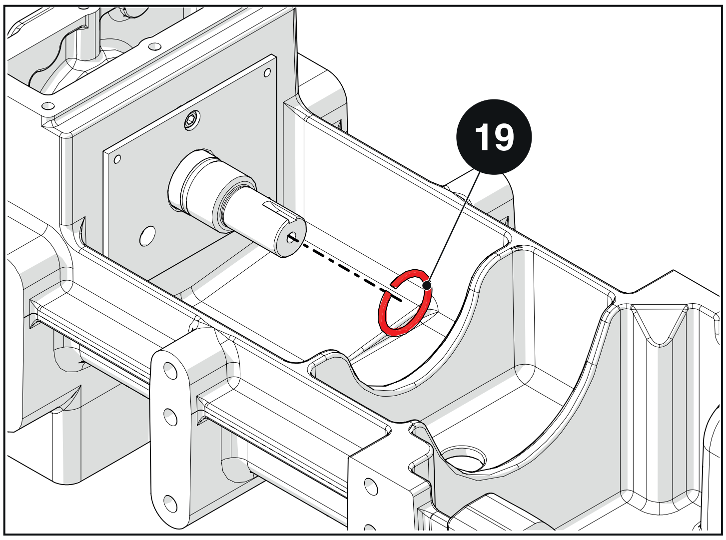


Fig. 8.24

Drive the splined flange (20) against the circlip.

Rotate the shaft and check that the rotation of the flange is perfectly perpendicular to the ground.

Warning
If the rotation of the splined shaft is not perfectly perpendicular relative to the ground, remove the circlip and straighten again. If it is not straightened correctly, the clutch disc will not rotate correctly once the clutch has been assembled completely.

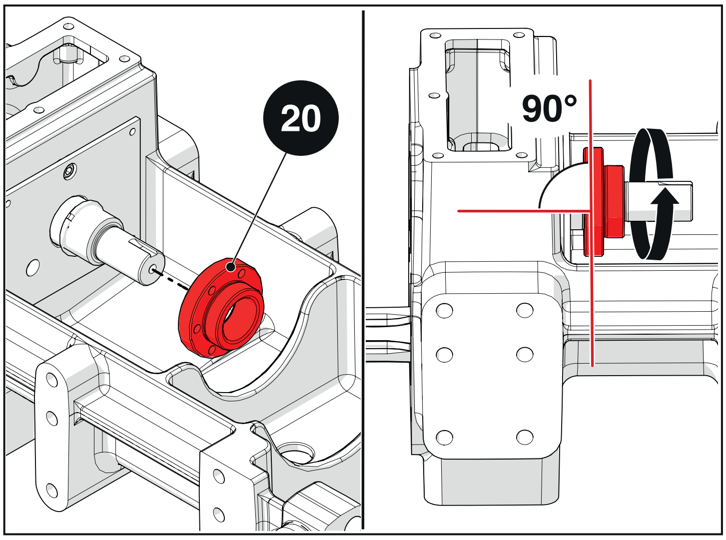


Fig. 8.25

Remove the flange (20) and fit the magnet (21).

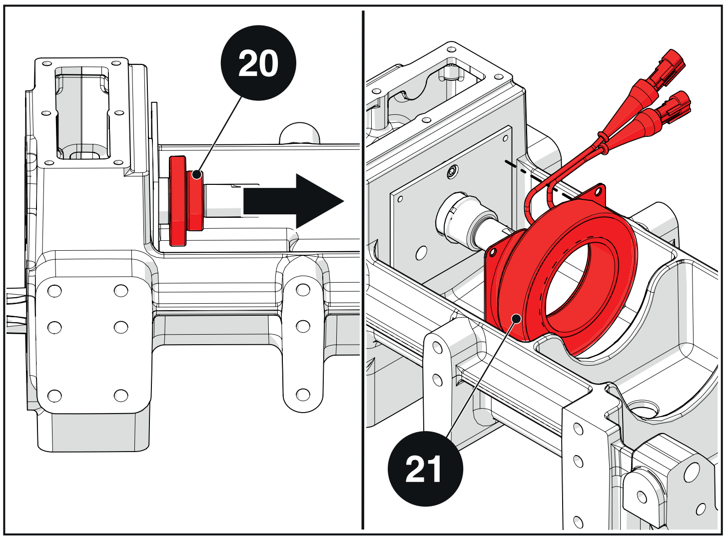


Fig. 8.26

Note

The tool (A-p/n _____) consists of two parts of different thickness for two different functions.

Fit the thicker part of the tool (A-p/n ________) into the magnet to keep the magnet axially aligned.

Fit the grover washers (22) and the flat washers (23), and tighten the screws (24) to fasten the magnet. Apply a tightening torque of 10.5 Nm (1 kgm).

Warning

Apply a coating of LOCTITE 270 to the screw threads.

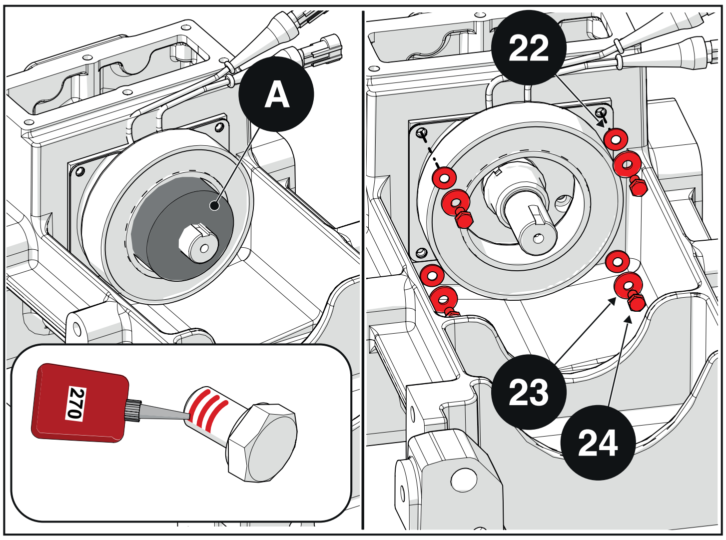


Fig. 8.27

Turn the tool (A-p/n ________) over and fit the thinner part in the magnet, and then rotate the tool and check that it turns freely within the magnet.

Warning

If the tool comes into contact with the magnet, undo the fastener screws (24) and refit the magnet in the correct position.

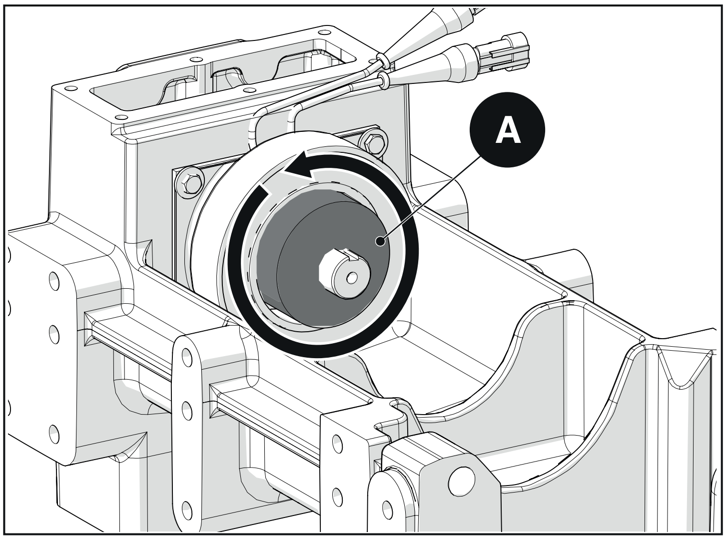


Fig. 8.28

Remove the tool and then fit the splined flange (20) in the clutch housing (25), fastening with the screws (49) tightened to a torque of 10.5 Nm (1 kgm).

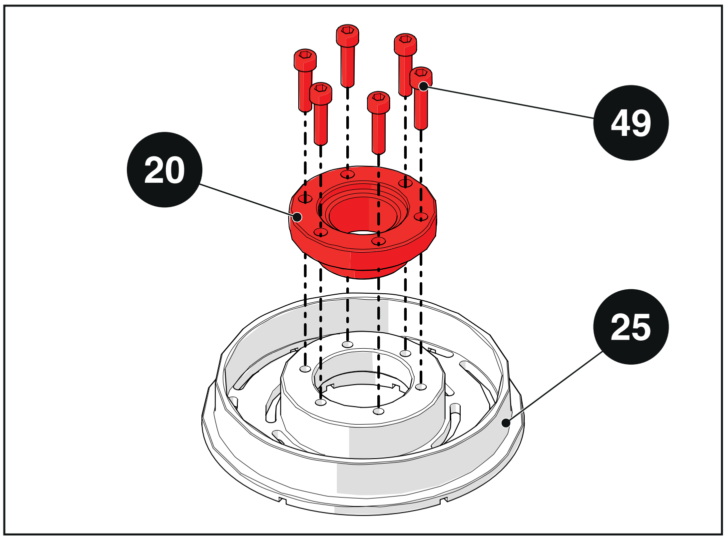


Fig. 8.29

Fit the shielded bearing (27) and the spacer (28) in the bearing carrier flange (26).

Warning
Make sure that the spacer (28) is fitted the right way around. The flat part must face towards the rear.

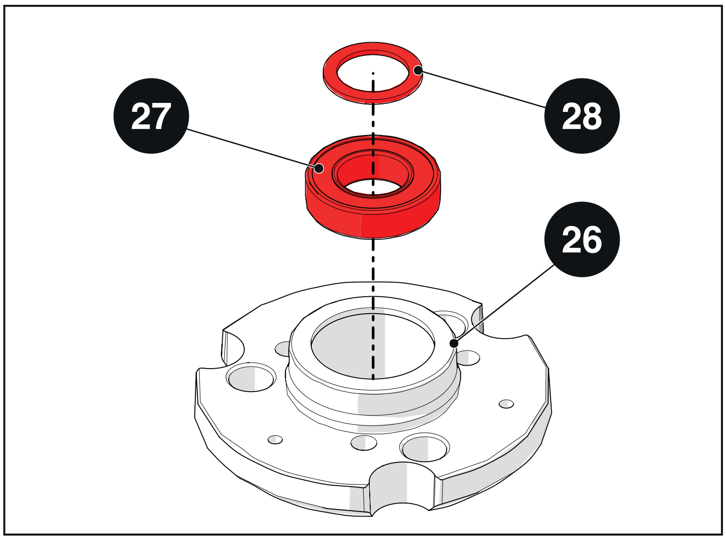


Fig. 8.30

Fit the second shielded bearing (29) in the flange and drive it fully into its seat with a bearing punch tool of suitable diameter.

Warning
Check that the spacer (28) is perfectly at the centre of the 2 bearings.

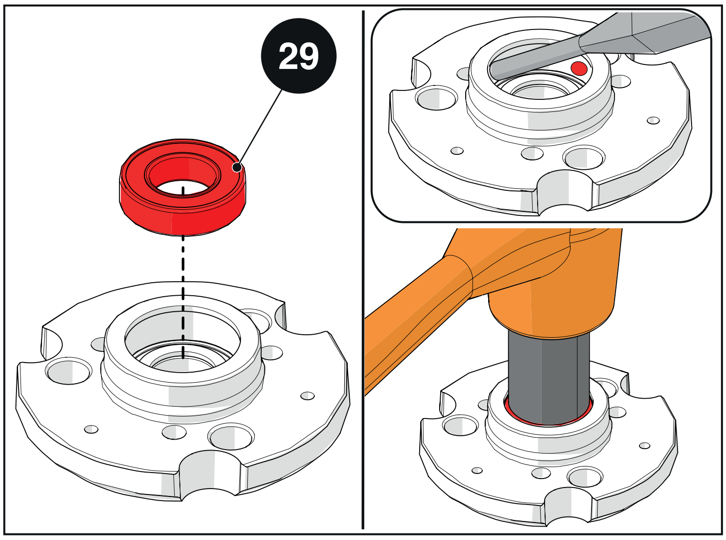


Fig. 8.31

Fit the plugs (30) on the flange.

⚠ Warning
The protrusion of the three plugs must be as identical as possible to prevent the clutch from rotating off-centre.

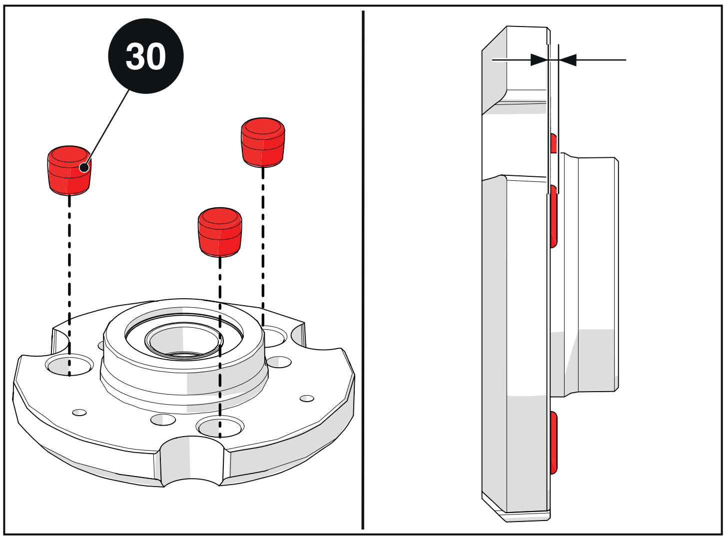


Fig. 8.32

Fit the clutch disc (31) on the bearing carrier flange.

Fit the washers (44) and tighten the screws (45) to a torque of 10.5 Nm (1 kgm).

⚠ Warning
Apply a coating of LOCTITE 270 to the screw threads.

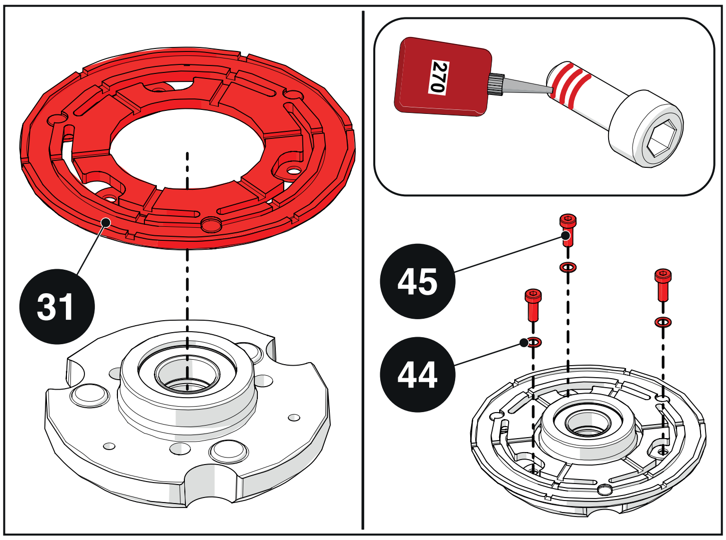


Fig. 8.33

Use a punch tool to drive the complete clutch disc (31) onto the shaft.

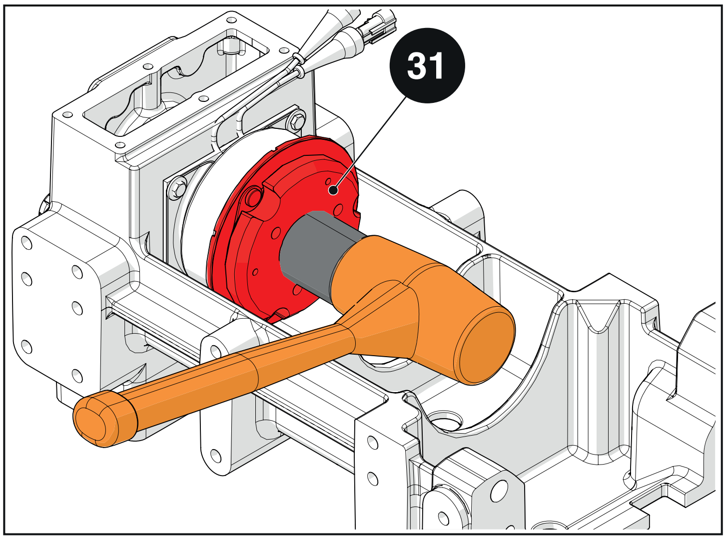


Fig. 8.34

Use a feeler gauge to check that the gap between the disc (31) and the magnet (21) is between 0.6 and 1.2 mm.

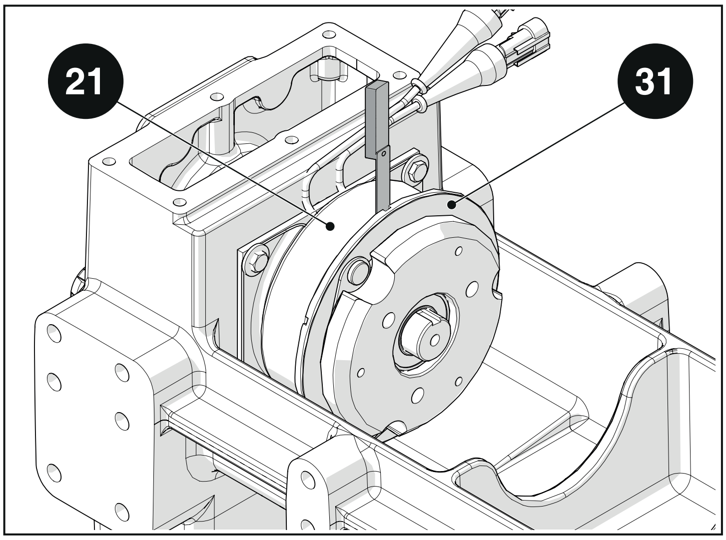


Fig. 8.35

Tighten the ring nut (32) to a torque of 130 Nm (13 Kgm).

Warning
Apply a coating of LOCTITE 270 to the threads of the ring nut (32).

Punch a dot on the ring nut.

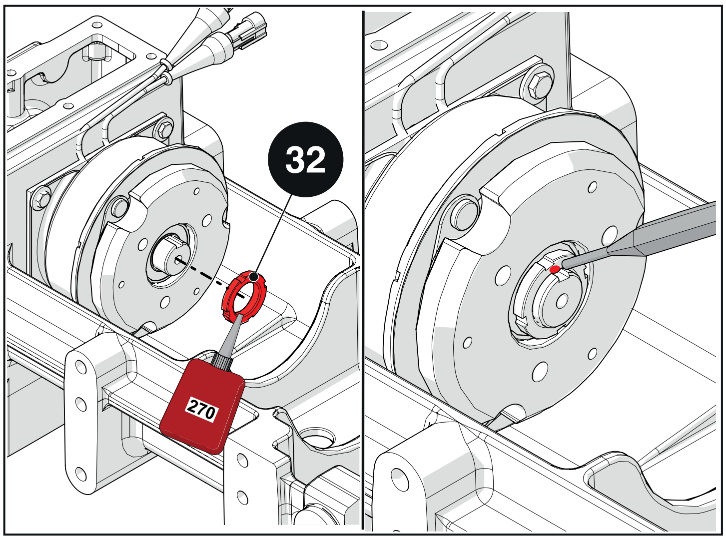


Fig. 8.36

Fit the spacer (33).

Fit the washers (34) and tighten the screws (35) to a torque of 55 Nm (5.5 kgm).

Warning
Apply a coating of LOCTITE 270 to the screw threads.

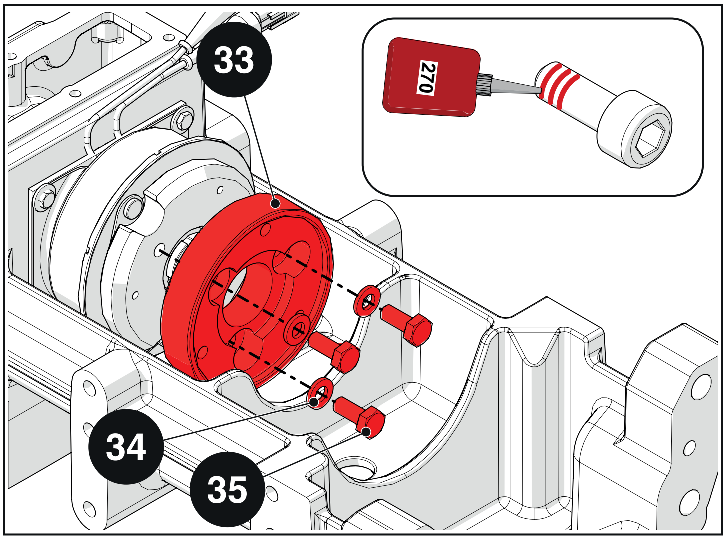


Fig. 8.37

Preassemble the PTO drive shaft (36), fitting the circlip (37) and the flexible coupling (38), and then securing with the circlip (39).

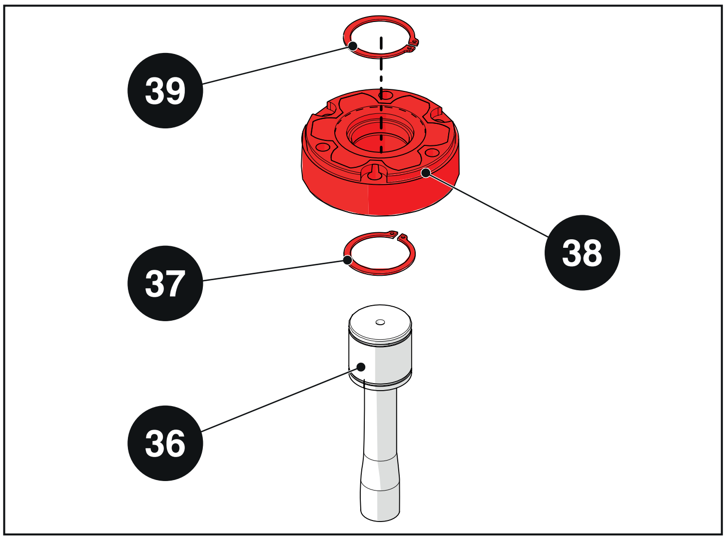


Fig. 8.38

Fit the washers (40) and tighten the screws (41) to a torque of 55 Nm (5.5 kgm).

Warning
Apply a coating of LOCTITE 270 to the screw threads.

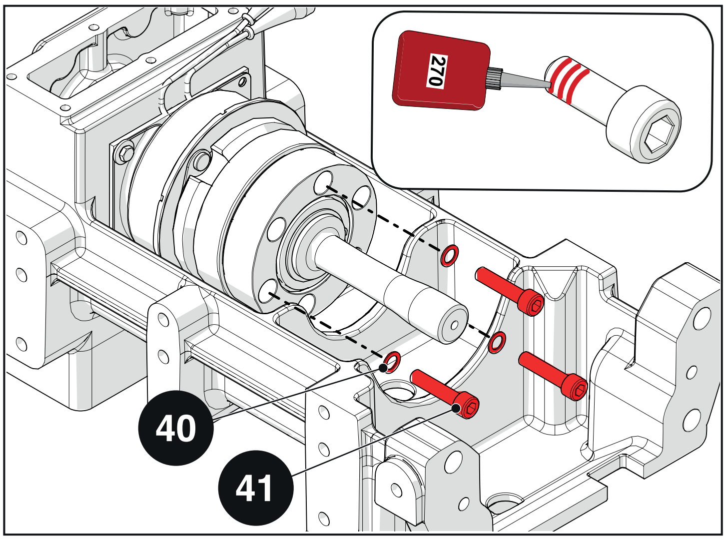


Fig. 8.39

Apply a coating of silicone sealant to the mating surface of the cover (42), and then fasten the cover to the axle carrier by tightening the screws (43); apply a tightening torque of 3 Nm (0.3 kgm).

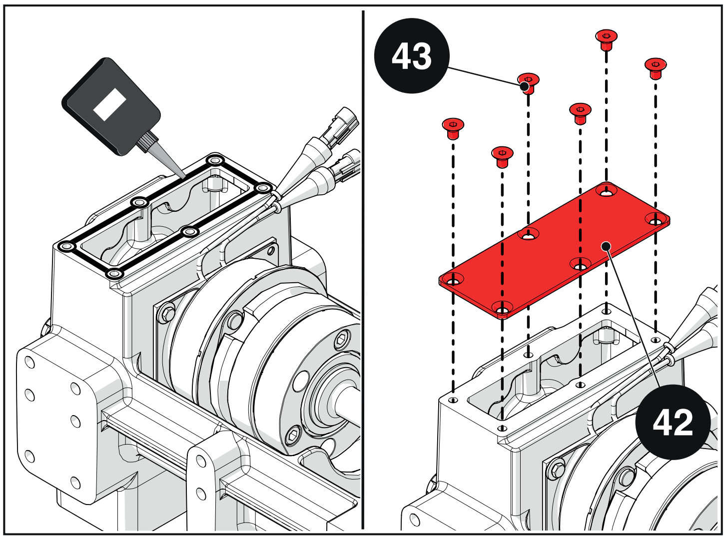


Fig. 8.40

Fit the elbow union (44) with the washer (45), and fit the plug (46).

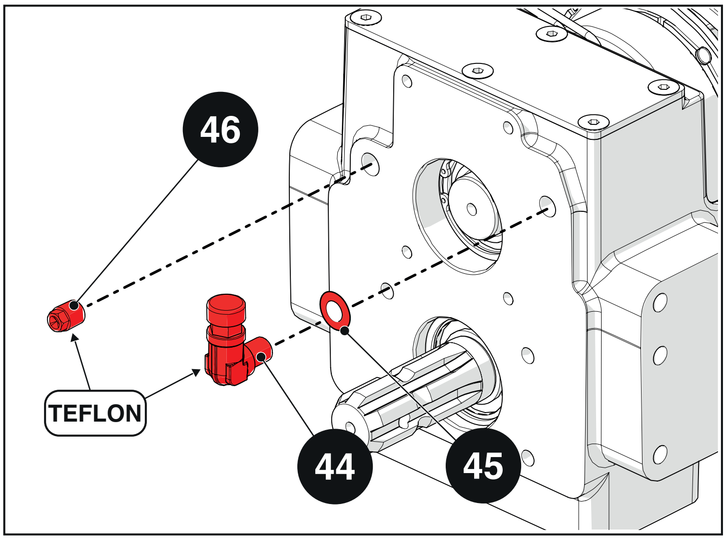


Fig. 8.41

Warning

Apply a coating of Teflon to the threads of the plug and the union.

Using a guide to position the oil seal (47) correctly, drive the oil seal into its seat with a punch.

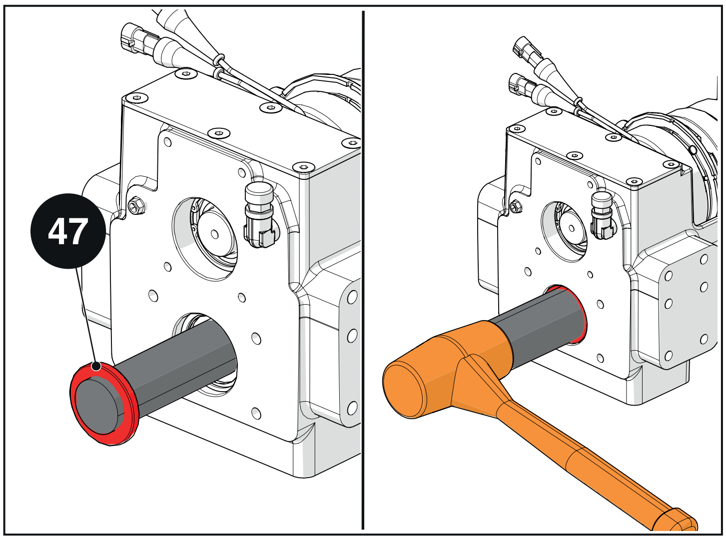


Fig. 8.42

Fit the plug (48) and drive it into its seat with a punch.

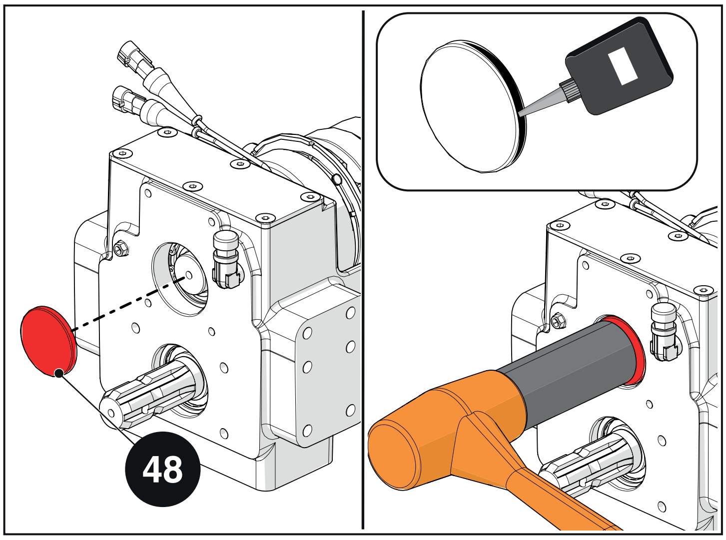


Fig. 8.43

Warning

Apply a coating of mastic sealant on the outer circumference of the plug.

Section 6 : Tightening torques

Index

6.1 Tightening torques

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

Tightening torque	Nm	Kgm
Screws fastening clutch plate onto bearing carrier flange	10.5	1
Screws fastening clutch connector flange	10.5	1
Screw fastening magnet	10.5	1
Screw fastening splined flange onto clutch housing	10.5	1
Ring nut fastening complete clutch disc	130	13
Screw fastening spacer	55	5.5
Screw fastening flexible coupling	55	5.5
Screw fastening cover	3	0.3

Section 7 : Implements necessary

Index

7.1 Implements necessary

p/n	Description	Quantity
A-p/n______	-	-

Chapter 9 : Hydraulic System

Index

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 General hydraulic circuit diagram

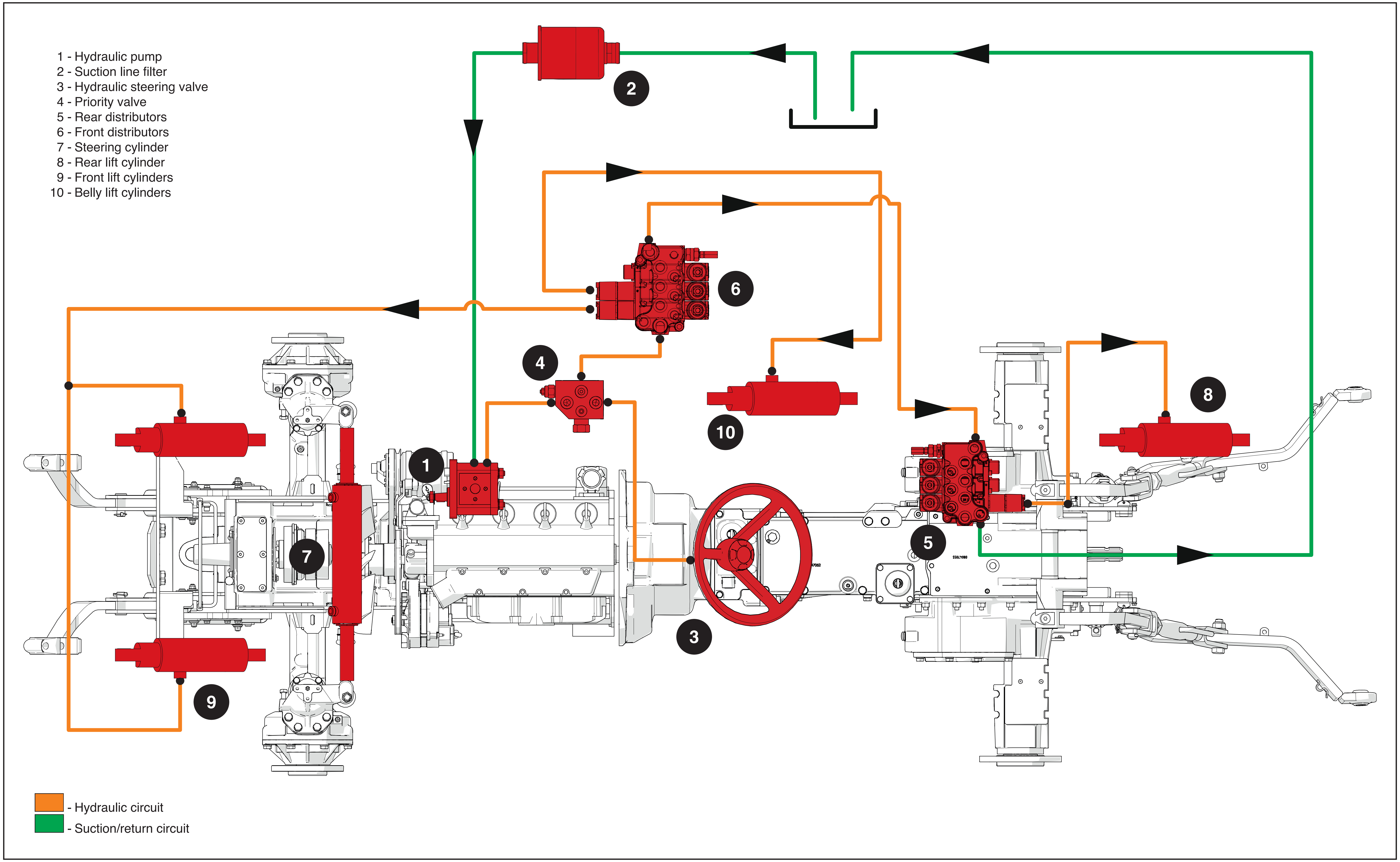


Fig. 9.1

2.1.1 General description

The hydraulic system consists of a single circuit fed by a pump driven by the timing system gears. A suction line filter cleans the oil aspirated by the pump.

The priority valve feeds the hydraulic circuit with oil received from the pump, giving priority to the steering system over other functions. A pressure relief valve calibrated to 180 bar is integrated in the priority valve housing.

Oil is then delivered to the front and rear auxiliary distributor blocks. The pressure relief valve within the front distributor block input flange is calibrated to 160 bar, while the pressure relief valve for the rear distributors is calibrated to 150 bar.

The rear distributor block also controls the Up / Down hydraulic lift by delivering oil to the cylinders via a throttle passage.

The front distributor block controls the front hydraulic lift and the belly hydraulic lift (if installed), delivering oil to the respective cylinders.

Oil that is not used by the auxiliary distributors is returned to the gearbox.

2.2 Hydraulic circuit diagram, lift with position and draft control

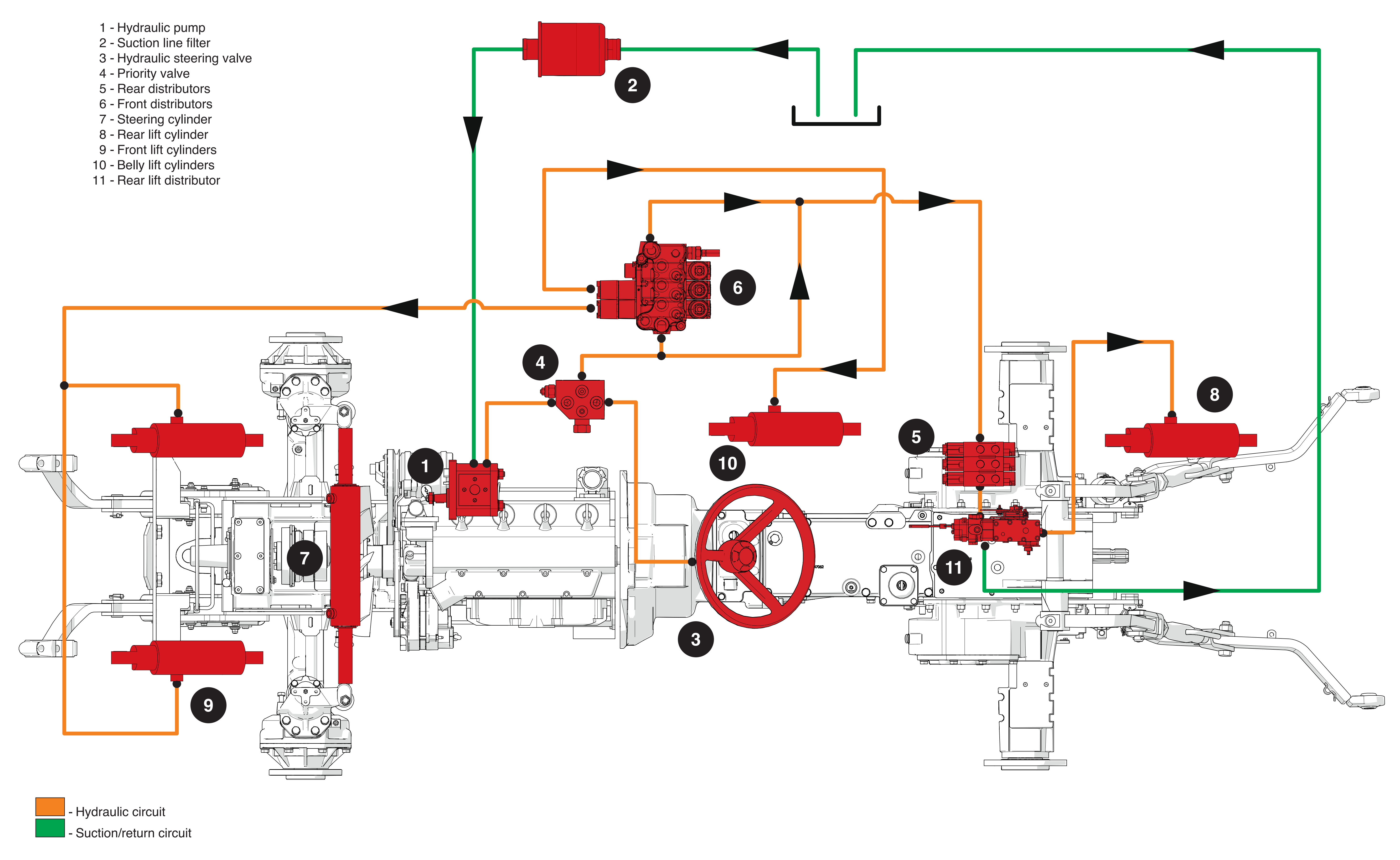


Fig. 9.2

2.2.1 General description

The hydraulic system consists of a single circuit fed by a pump driven by the timing system gears. A suction line filter cleans the oil aspirated by the pump.

The priority valve feeds the hydraulic circuit with oil received from the pump, giving priority to the steering system over other functions. A pressure relief valve calibrated to 180 bar is integrated in the priority valve housing.

Oil is then delivered simultaneously to the front and rear auxiliary distributor blocks. The pressure relief valve within the front distributor block input flange is calibrated to 160 bar, while the pressure relief valve for the rear distributors is calibrated to 180 bar.

The distributor of the position and draft control lift receives oil from the rear distributor block. Unused oil flow is returned to the gearbox.

The front distributor block controls the front hydraulic lift and the belly hydraulic lift (if installed), delivering oil to the respective cylinders.

Oil that is not used by the auxiliary distributors is returned to the gearbox.

2.3 Technical characteristics

Pump

Displacement	11 cc
Maximum pressure	210 bar
rpm	3000
Flow rate	33 l/min.

Hydraulic steering valve

Steering type	Hydrostatic
Steering angle	55°

Suction line filter

Filtration rating	160
Operating temperature	-20/+100 °C
Operating pressure	4 bar
Filtration material	100 mesh stainless steel mesh

Distributors

Coupler type	Front and rear quick couplings
Front distributor calibration valve	160 bar
Rear distributor calibration valve	150 bar

Rear lift

Type	Hydraulic, up / down
Lift capacity at lower link ends	1800 kg
3-point linkage category	Category 1
Mechanical top link arm	Category 1
Lower link arm type	Fixed
Right hand tie-rod type	Mechanical

Front lift

Type	Hydraulic, up / down
Lift capacity at lower link ends	350 kg
3-point linkage category	Category 1N
Mechanical top link arm	Category 1N

Belly lift

Type	double acting with float mode

Section 3 : Main components

Index

3.1 Hydraulic pump

The hydraulic pump is situated on the right hand side of the tractor. The pump is driven by the camshaft timing gear and delivers oil to the hydraulic system of the tractor. Oil from the gearbox and filtered by the suction line filter flows into the suction pipe (A). The pump delivers oil via (B) to the priority valve, which distributes oil to the other utilities. The oil is then sent to the gearbox lubrication circuit.

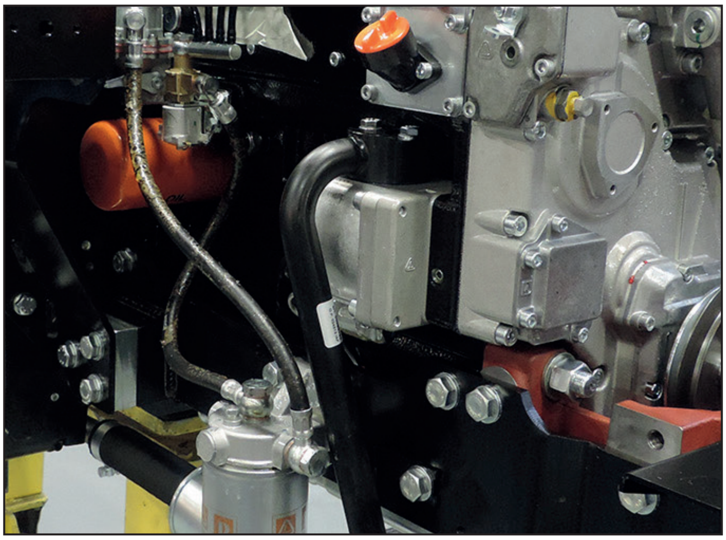


Fig. 9.3

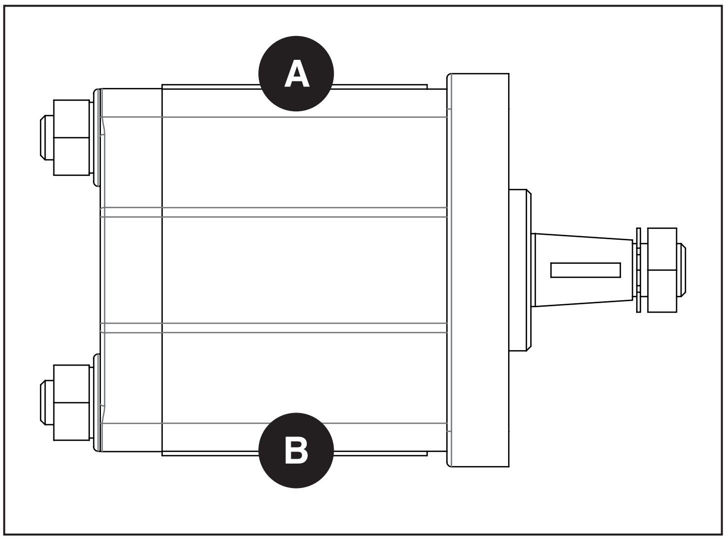


Fig. 9.4

3.2 Priority valve

The priority valve situated on the front right of the tractor receives oil directly from the hydraulic pump (O). When requested, oil flow is delivered with priority to the hydraulic steering unit, with the flow controlled by a flow regulator valve (P) with a maximum flow rate of 4 l/min. The remaining oil is delivered to the subsequent utilities in the system (Q).

A pressure relief valve (R) calibrated to 180 bar is integrated in the priority valve.

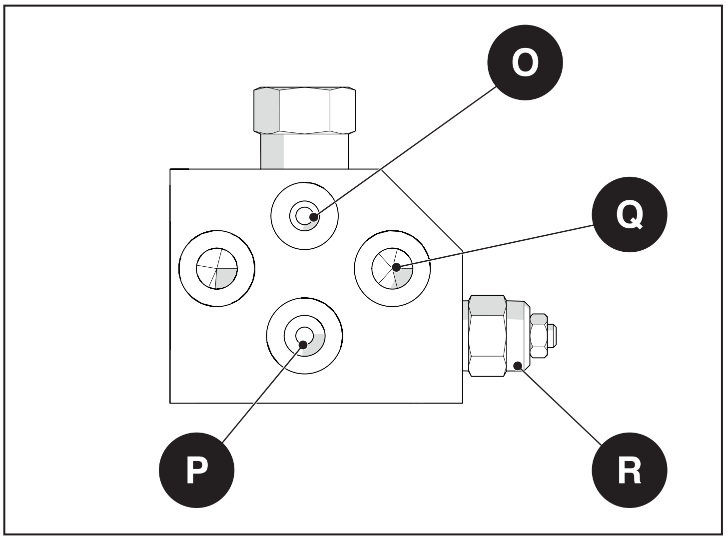


Fig. 9.5

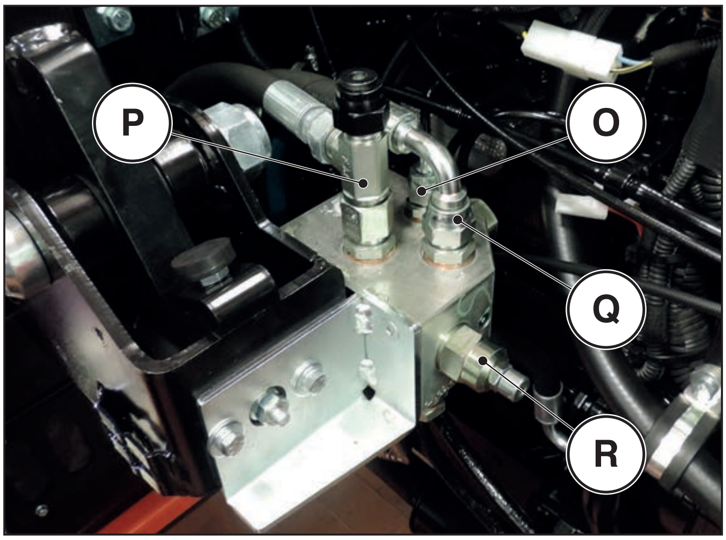


Fig. 9.6

3.3 Suction line filter

The suction line filter is situated at the front right of the tractor, between the oil tank and the hydraulic pump. The filter protects the hydraulic system and its components against damage caused by contaminants contained in the oil.

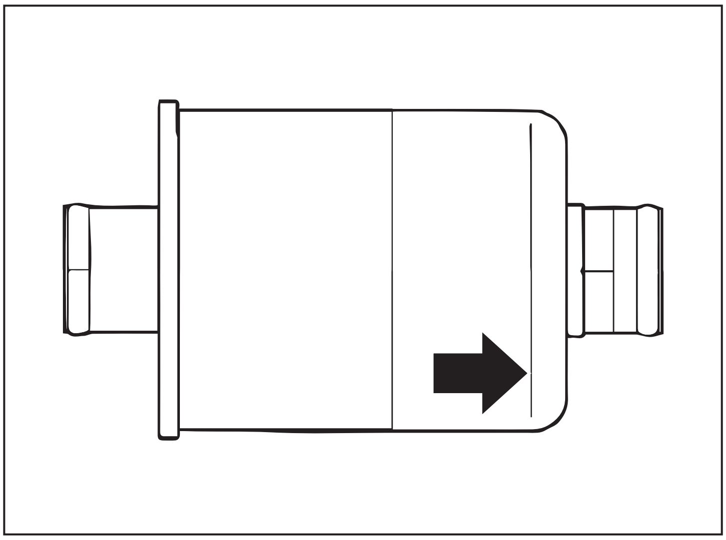


Fig. 9.7

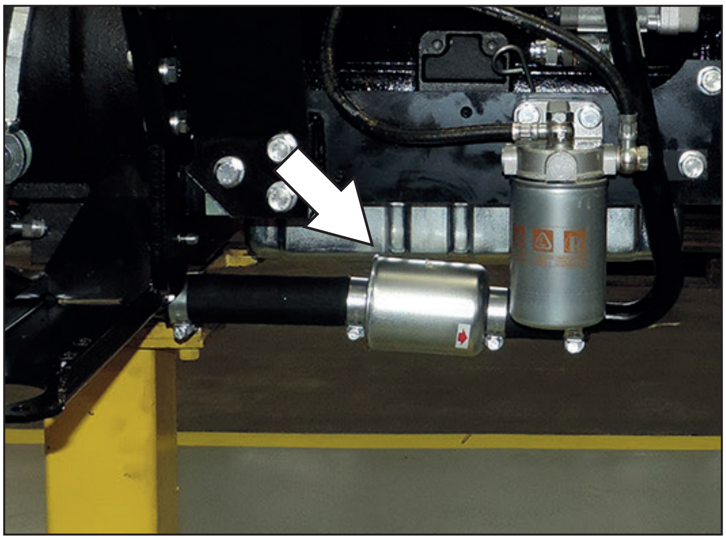


Fig. 9.8

3.4 Hydraulic steering valve

The hydraulic steering circuit receives the oil necessary to operate the double acting steering cylinders from the hydraulic circuit with priority over other utilities. The circuit includes a pressure relief valve calibrated to 90 bar and two overpressure safety valves protecting the cylinder and the hydraulic steering valve against accidental damage.

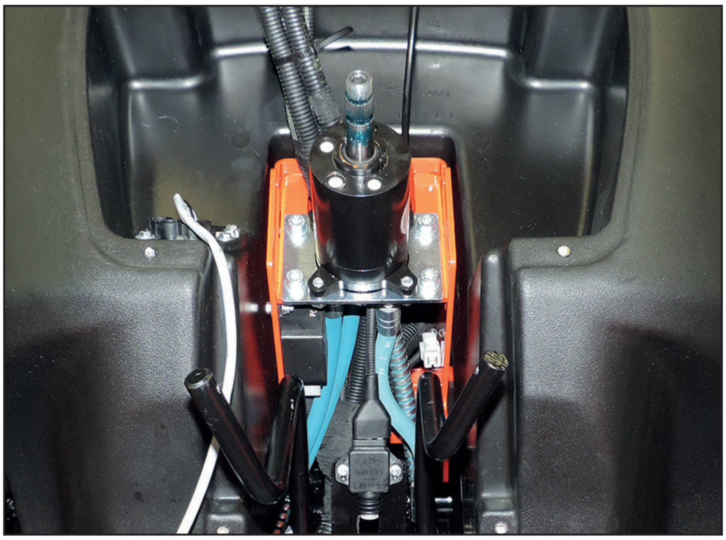


Fig. 9.9

3.5 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 with oil by the circuit downstream of the hydraulic steering circuit and, if installed, of the front distributors.

The machine may be equipped with up to two double acting distributors.

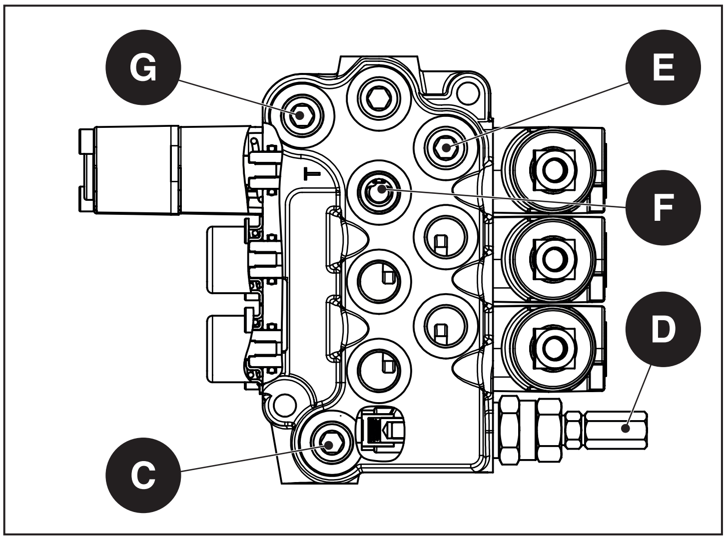


Fig. 9.10

Oil received from the priority valve flows into the inlet head (C), which is equipped with a pressure relief valve (D) calibrated to 150 bar. In response to movements of the distributor levers, oil is sent to the delivery (E) or return (F) hydraulic couplers, and then to the drain line (G).

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.

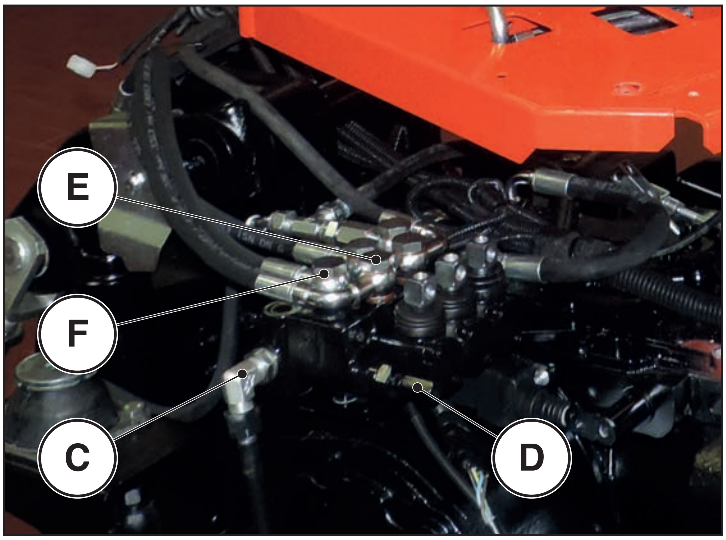


Fig. 9.11

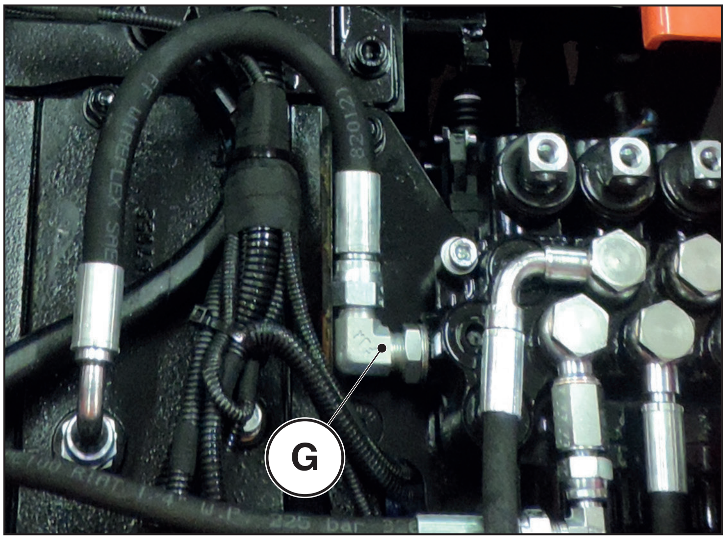


Fig. 9.12

3.6 Front hydraulic distributors

Depending on configuration, the tractor may be equipped with supplementary distributors situated at the front right of the machine. The distributors (if installed) are fed from the circuit with oil received from the hydraulic steering valve.

A number of different configurations with the following types of distributor are available:

- Double acting with valve return action;
- 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
Roll bar with front lift and belly lift	1
GL cab with front lift and belly lift	1

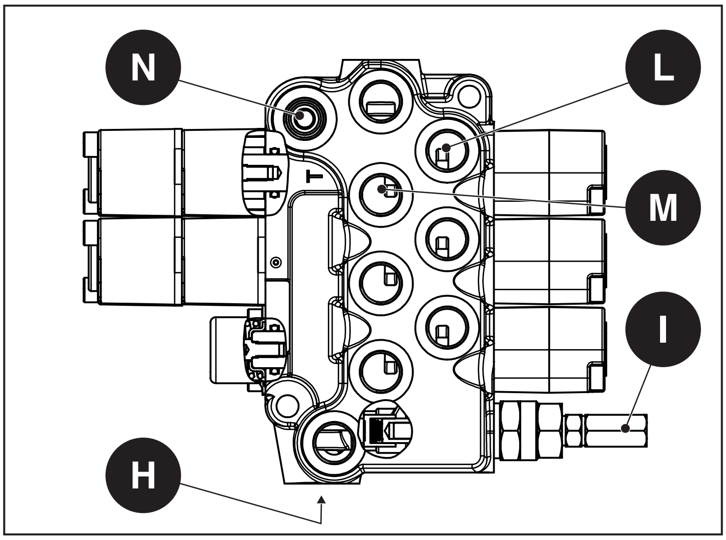


Fig. 9.13

Oil received from the priority valve flows into the inlet head (H), which is equipped with a pressure relief valve (I) calibrated to 150 bar. In response to movements of the distributor levers, oil is sent to the delivery (L) or return (M) hydraulic couplers. If no oil flow is requested from the distributors, the oil is sent to the rear auxiliary distributors (N, Fig. 9.13).

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.

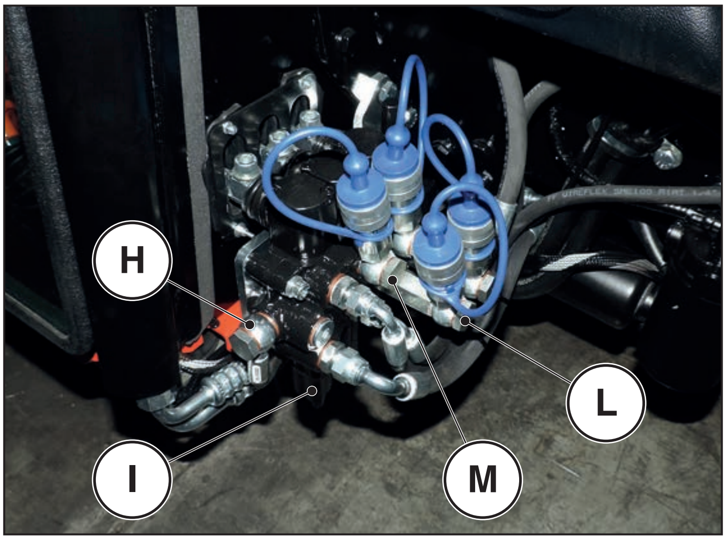


Fig. 9.14

3.7 Rear lift

These tractor models may be equipped with an up / down type rear 3-point linkage controlled from a lever which operates a distributor situated at the rear right of the tractor that determines the lift height of the lift itself.

Oil is sent to the two single acting cylinders via a 1.8 mm throttle passage within the rear distributor block.

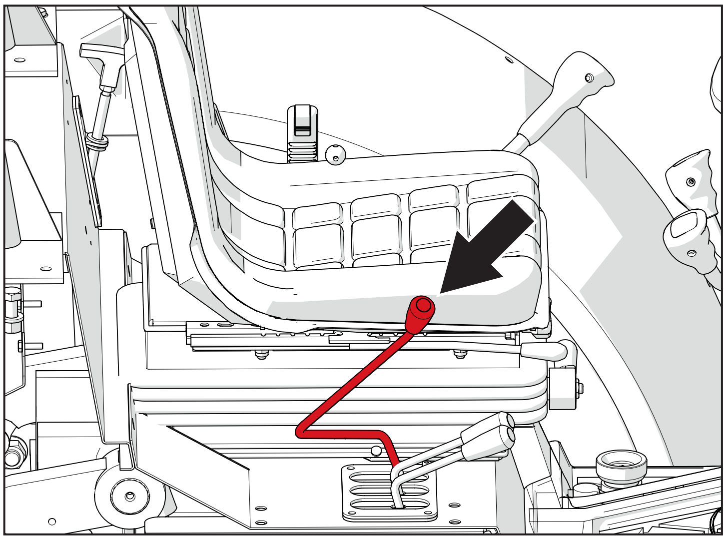


Fig. 9.15

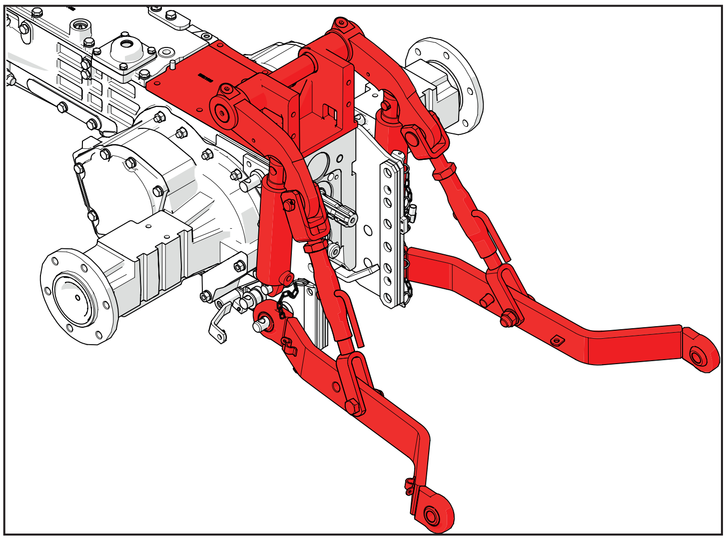


Fig. 9.16

3.8 Front lift

These tractor models may be equipped with an up / down type rear 3-point linkage controlled from a lever which operates a distributor situated at the front right of the tractor that determines the lift height of the lift itself.

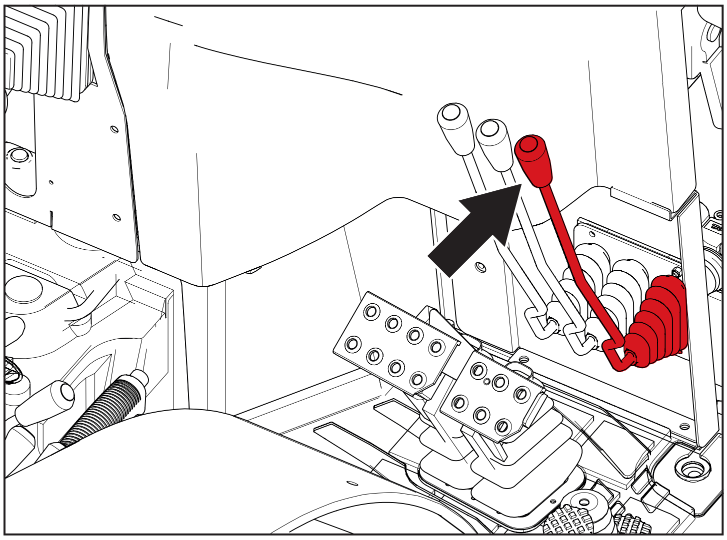


Fig. 9.17

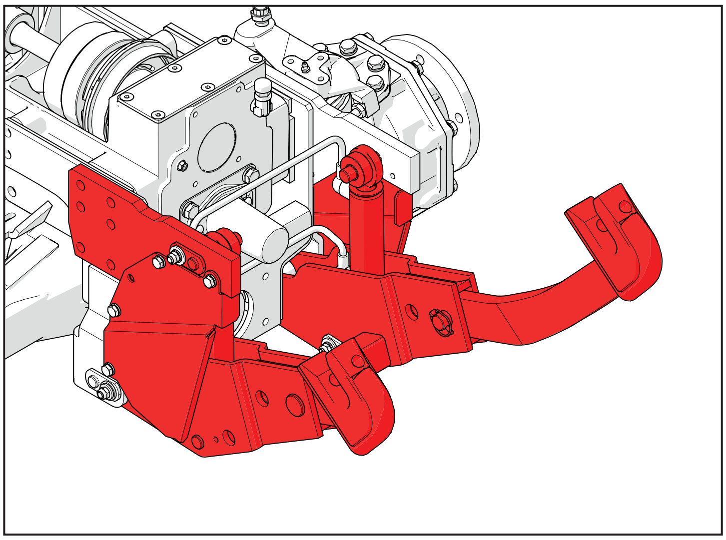


Fig. 9.18

3.9 Belly lift

These tractor models may be equipped with an up / down type rear 3-point linkage controlled from a lever which operates a distributor situated at the front right of the tractor that determines the lift height of the lift itself.

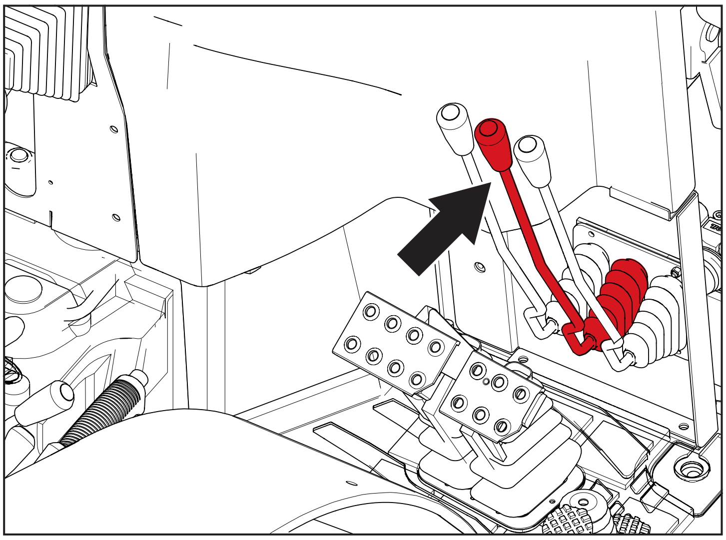


Fig. 9.19

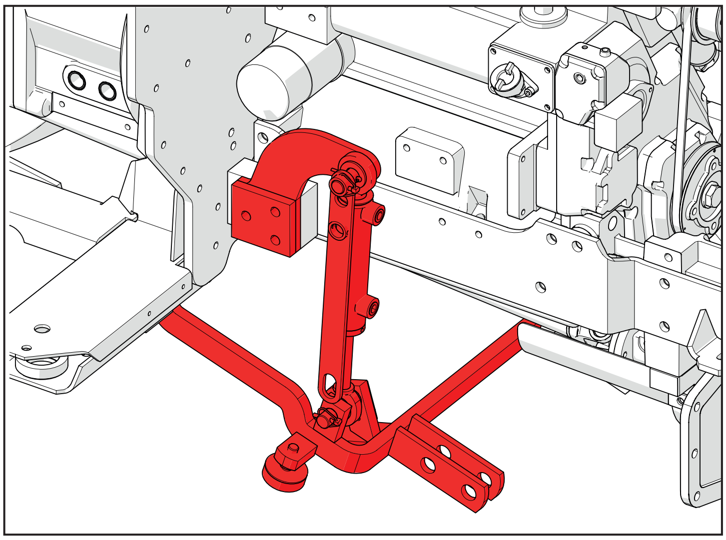


Fig. 9.20

Section 4 : Lift with position and draft control

Index

4.1 General introduction

4.1.1 General system diagram

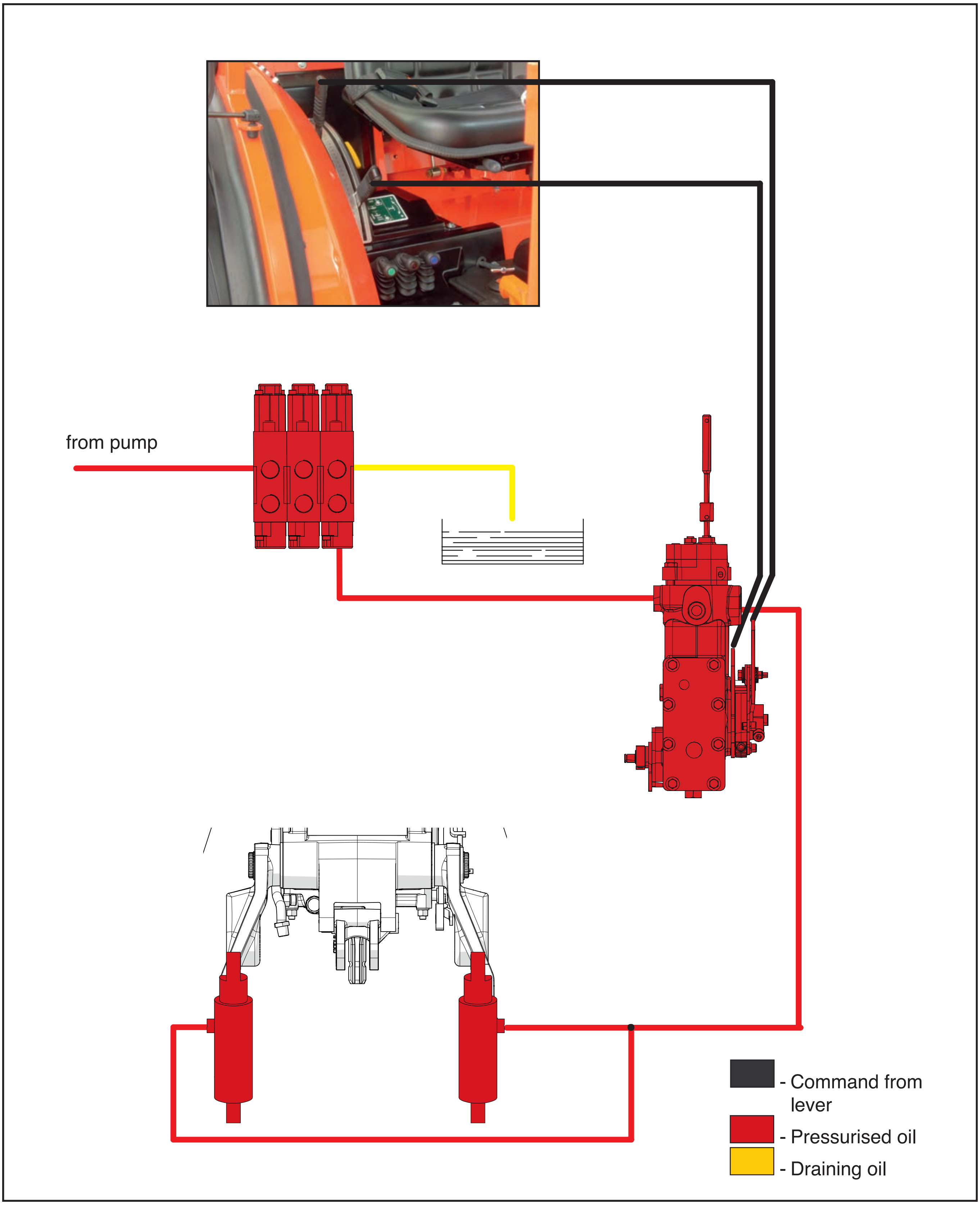


Fig. 9.21

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.

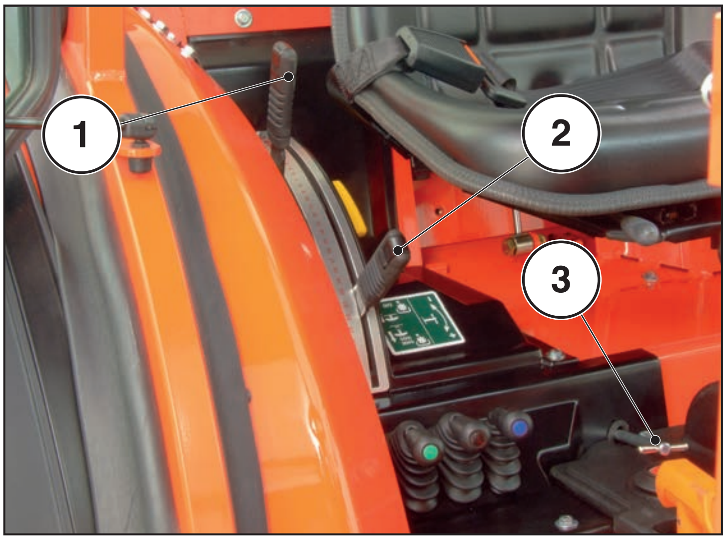


Fig. 9.22

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.

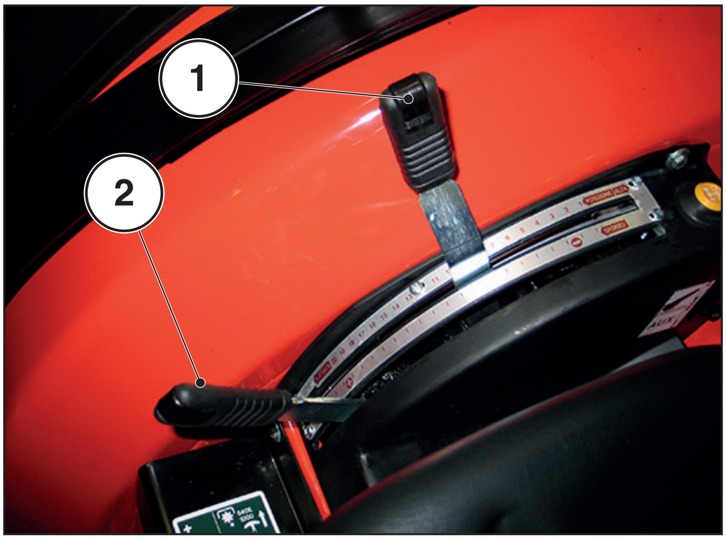


Fig. 9.23

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)

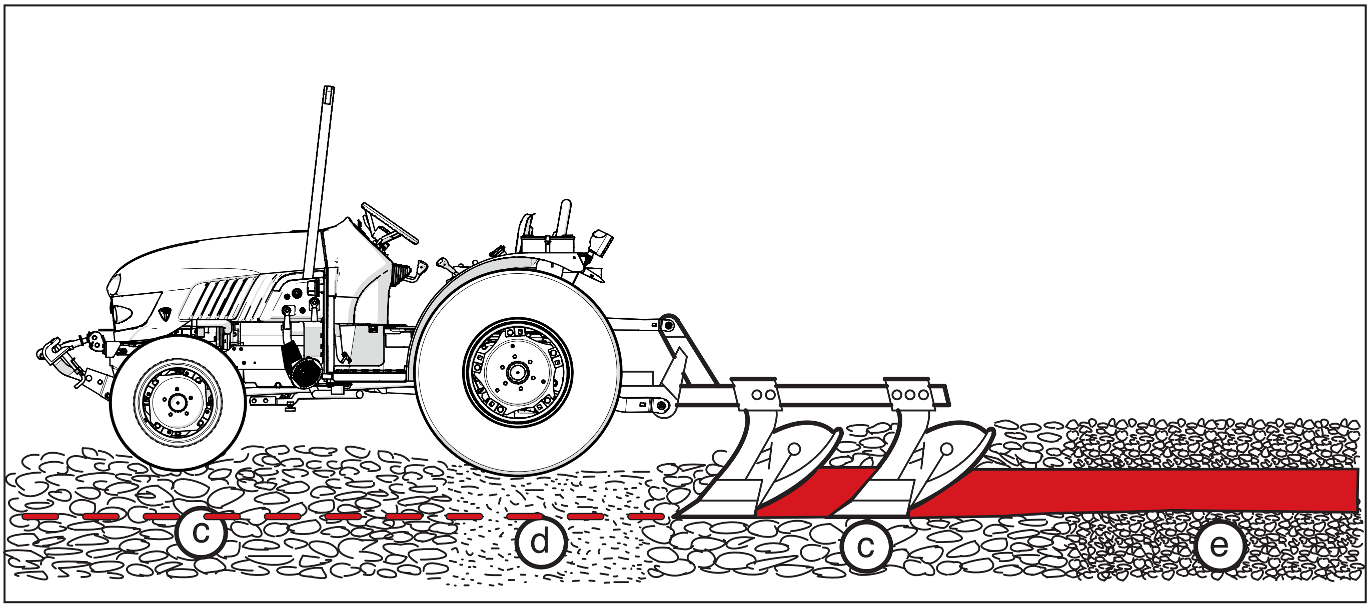


Fig. 9.24

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 working 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.

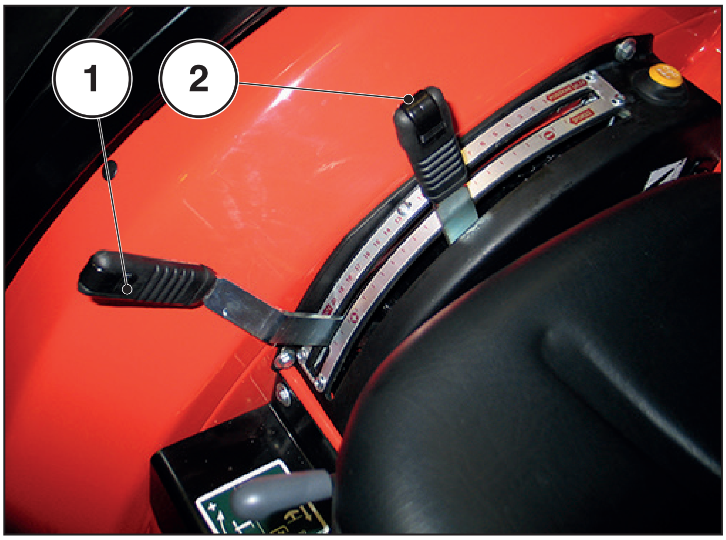


Fig. 9.25

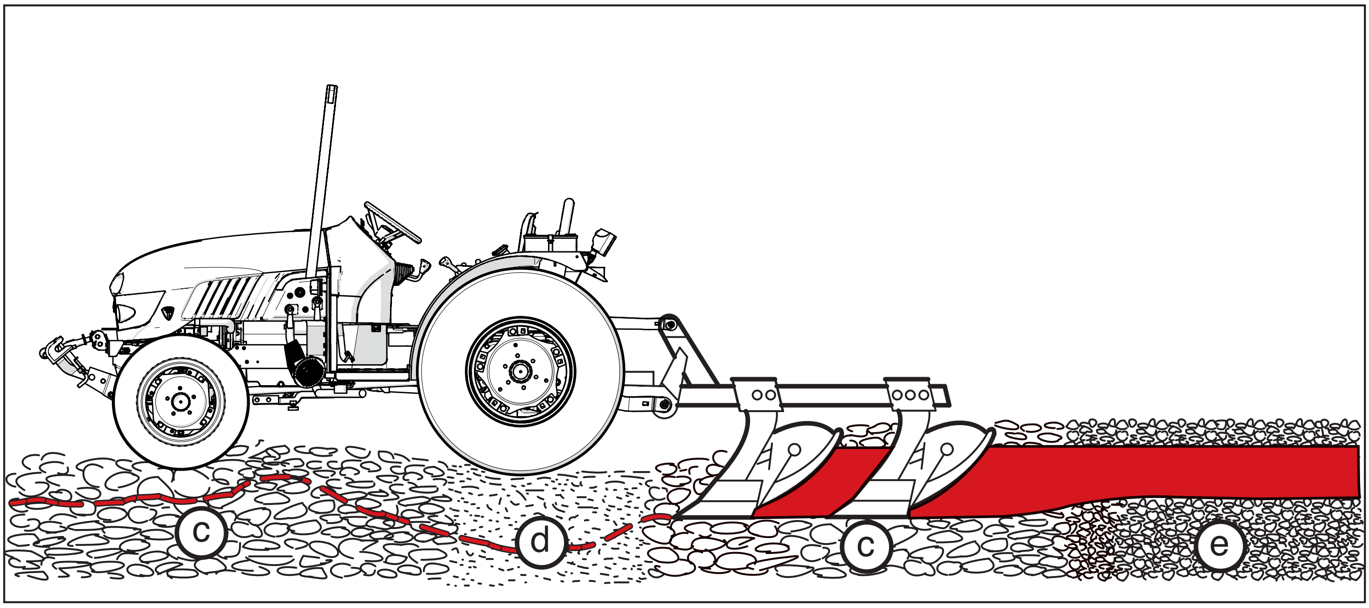


Fig. 9.26

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.

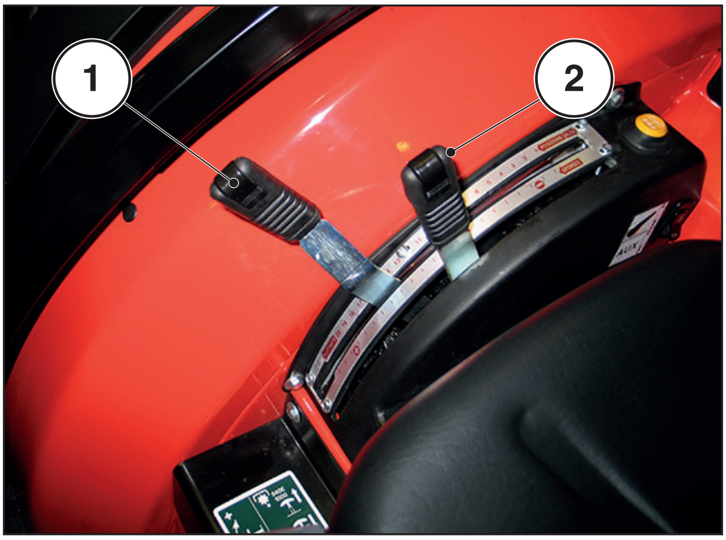


Fig. 9.27

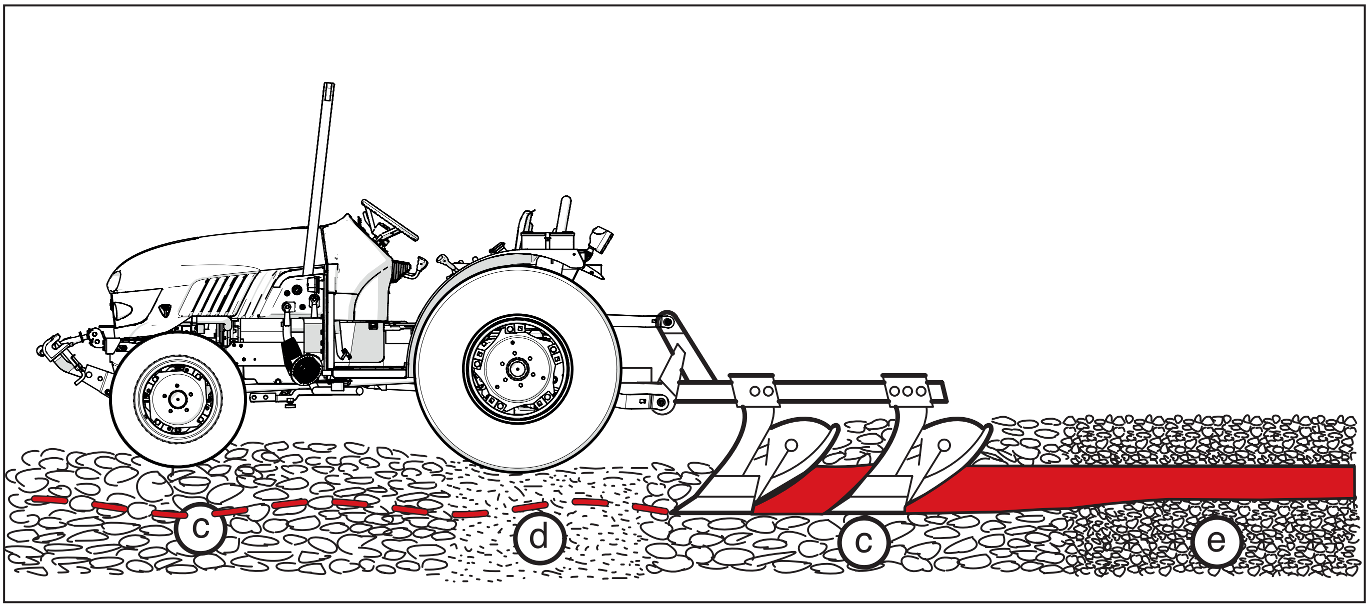


Fig. 9.28

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.

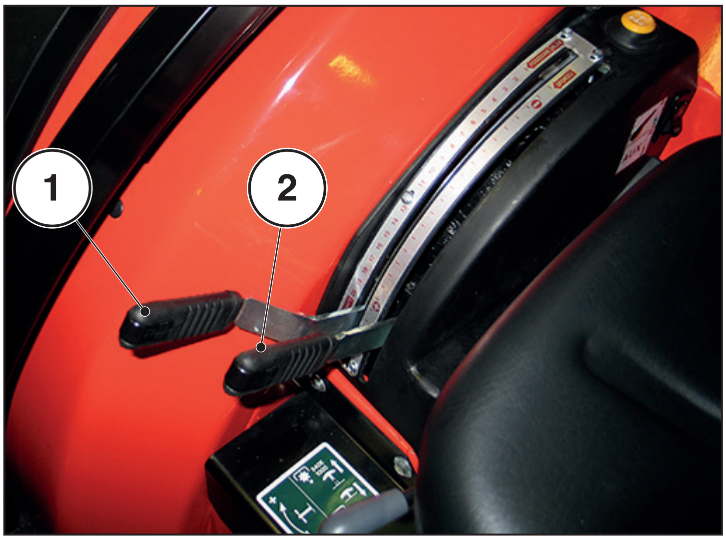


Fig. 9.29

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 Hydraulic circuit diagram

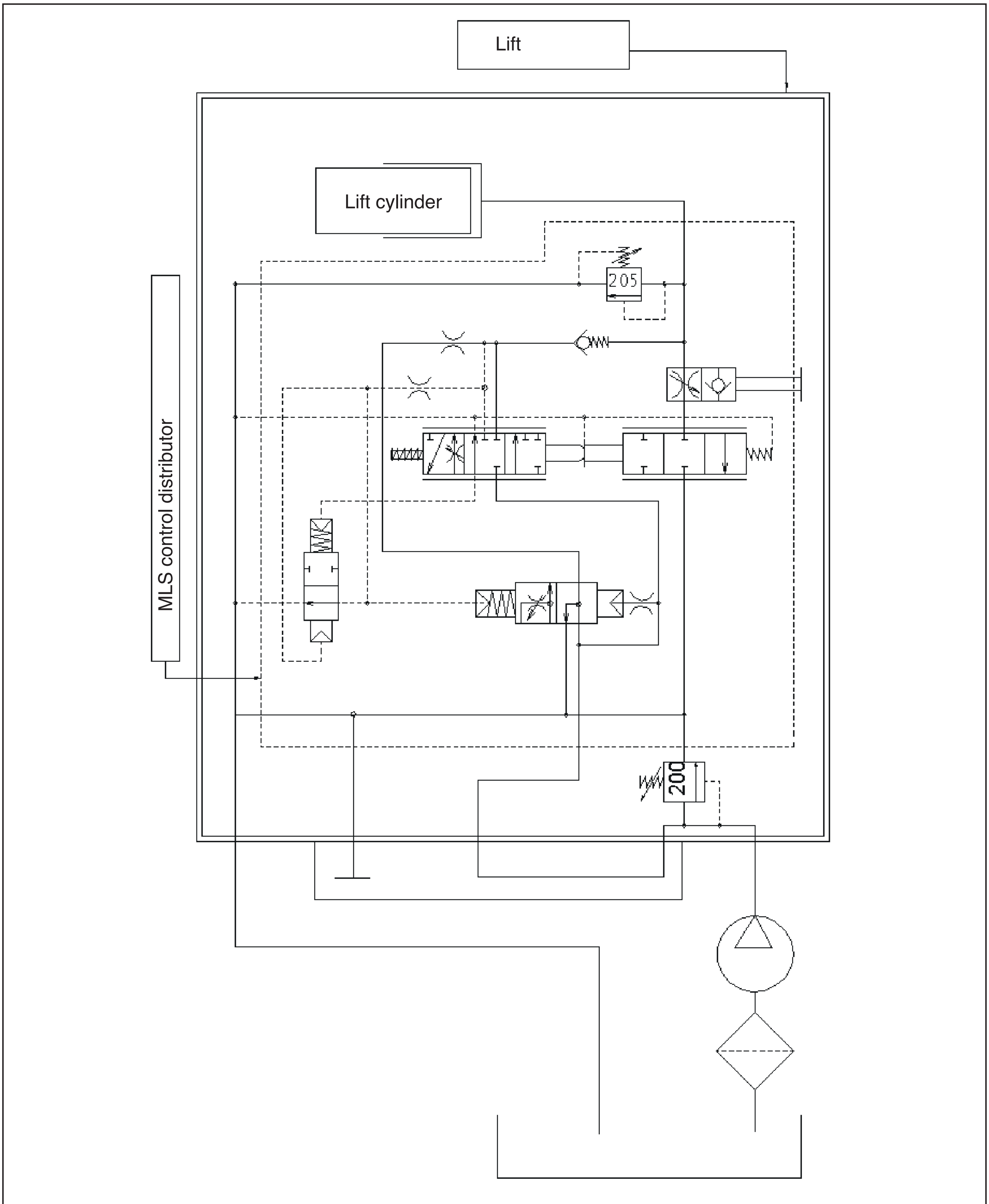


Fig. 9.30

4.4 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.

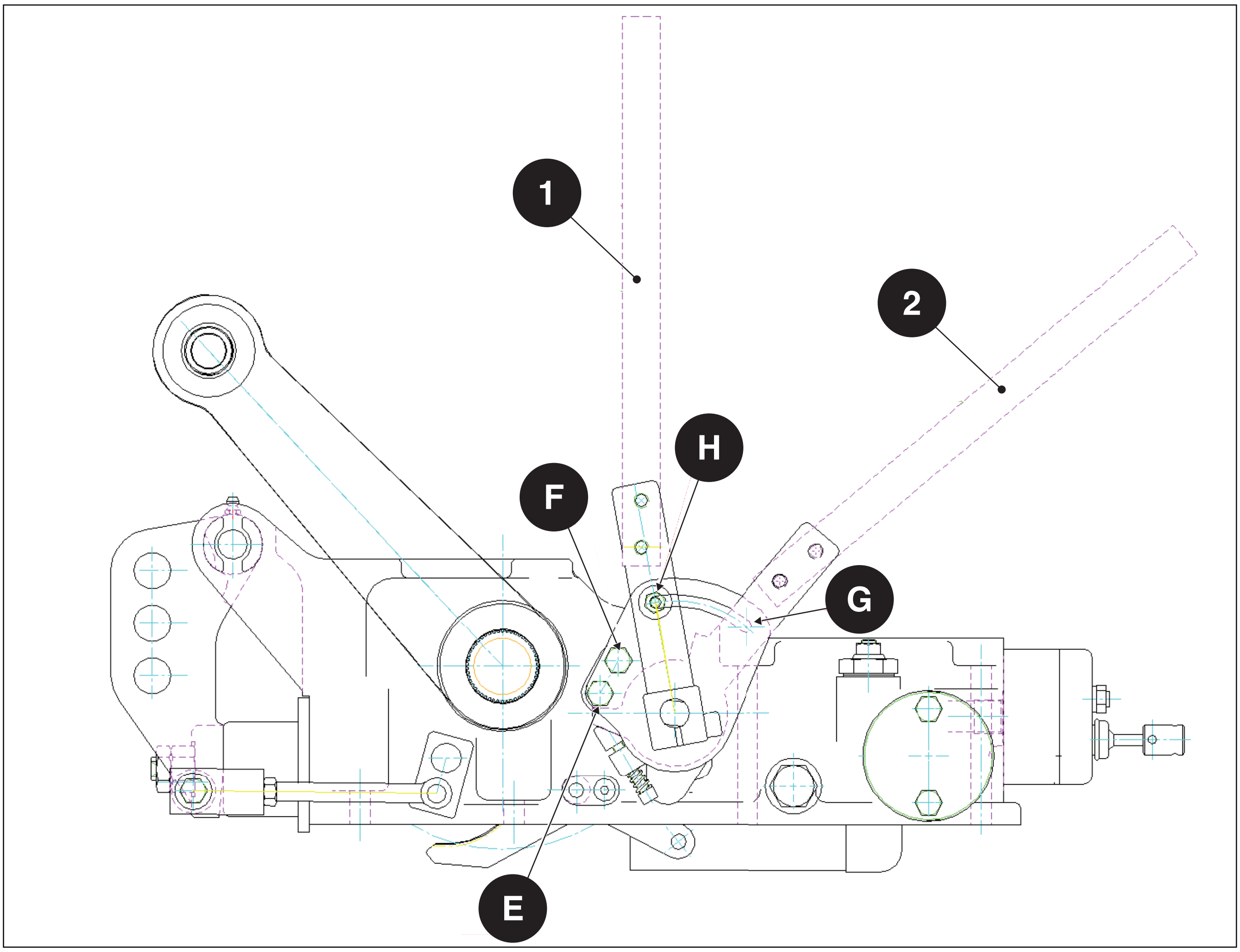


Fig. 9.31

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 the draft control lever (2) 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 the position control (1) 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 the 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 the draft control lever (2) 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 position control lever (1) 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.

4.5 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.

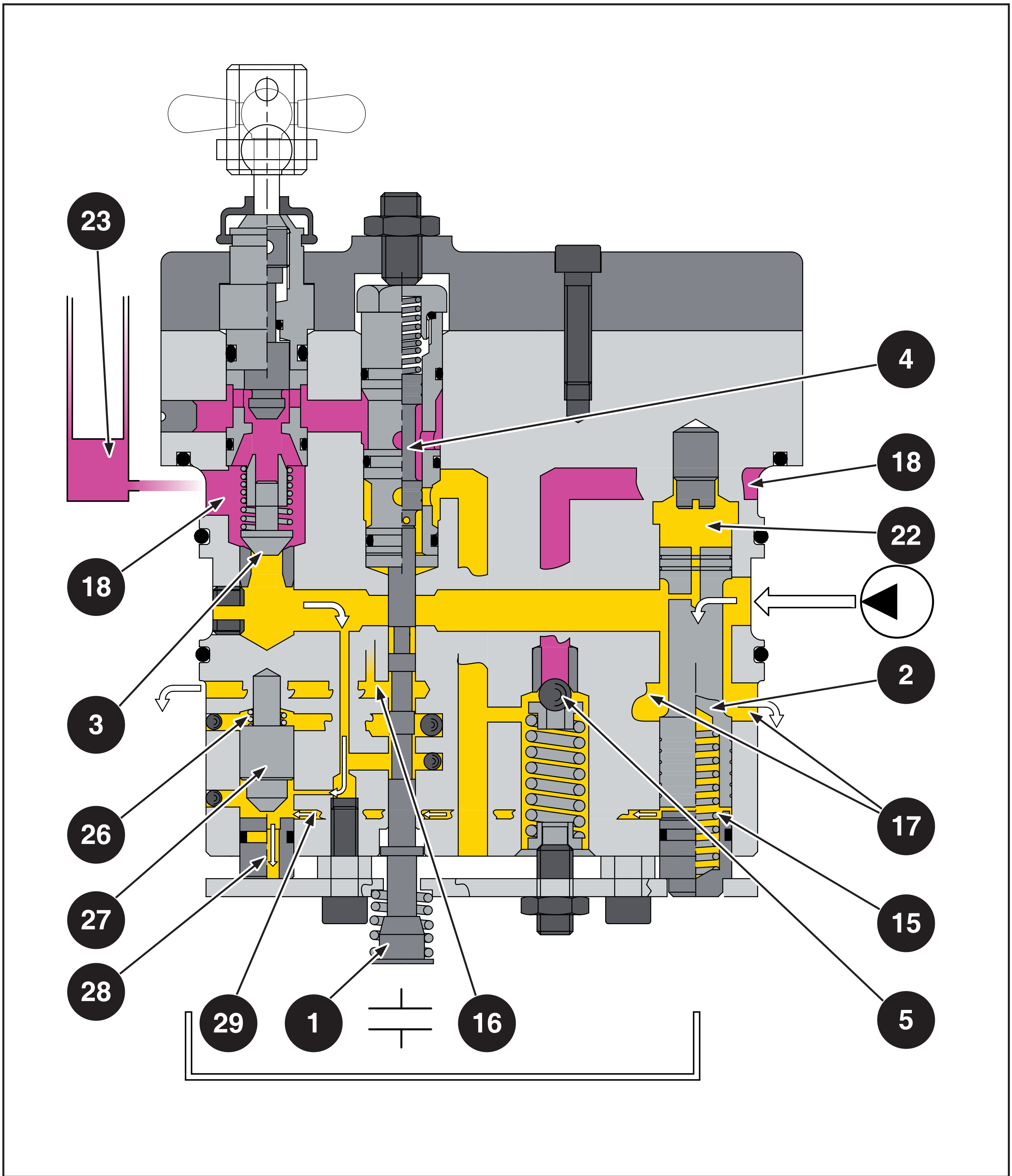


Fig. 9.32

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).

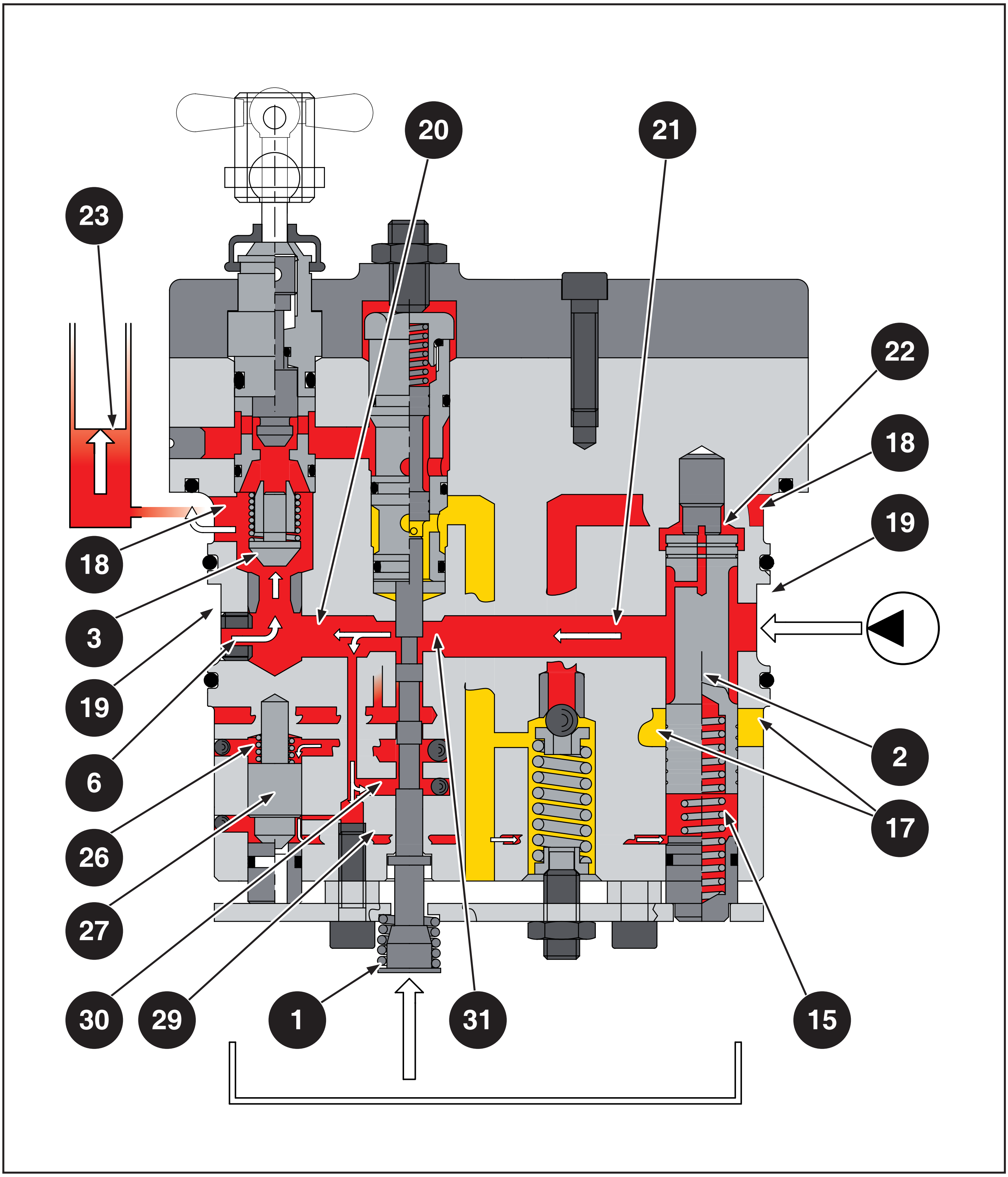


Fig. 9.33

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).

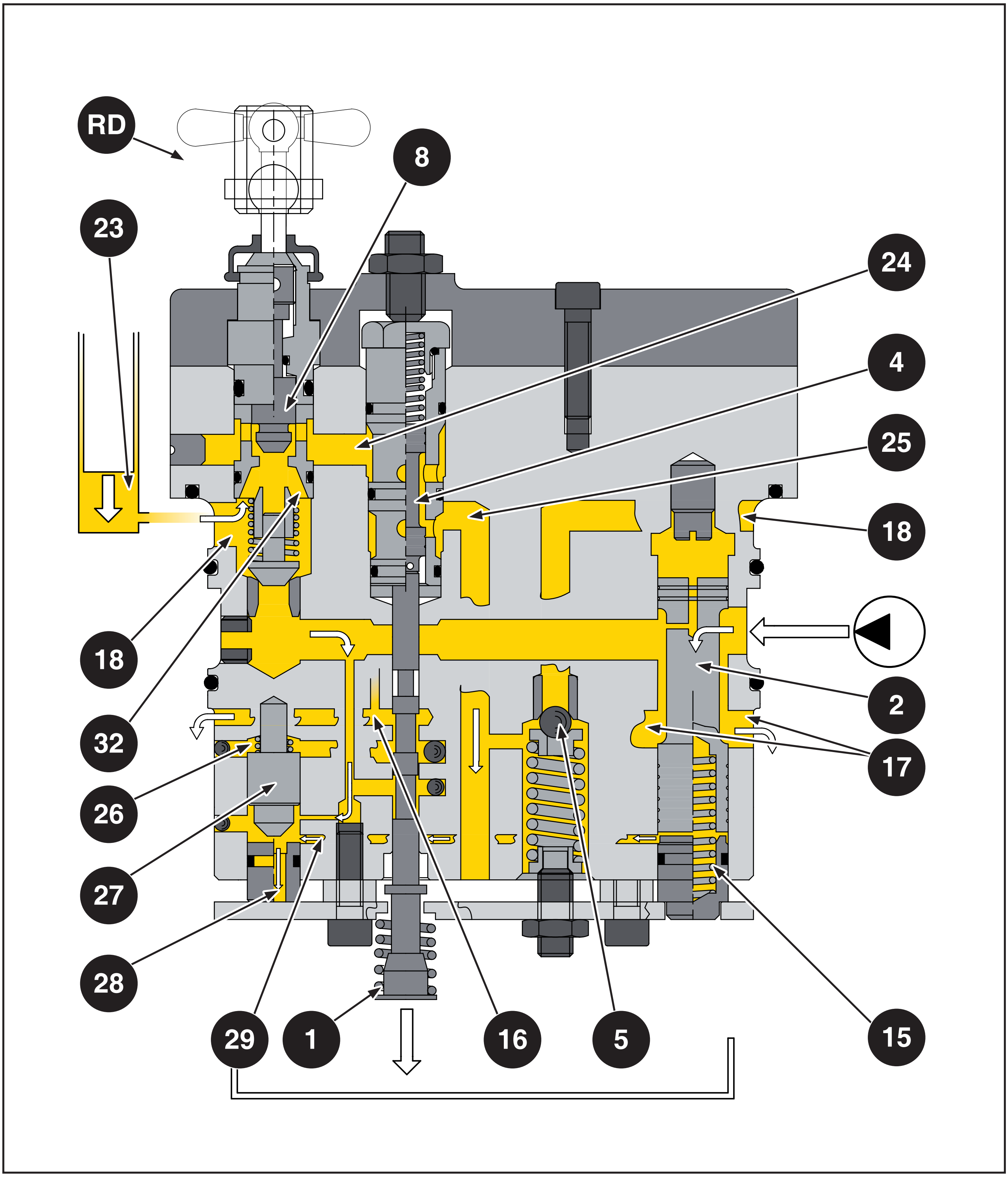


Fig. 9.34

4.6 Main adjustments

4.6.1 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.

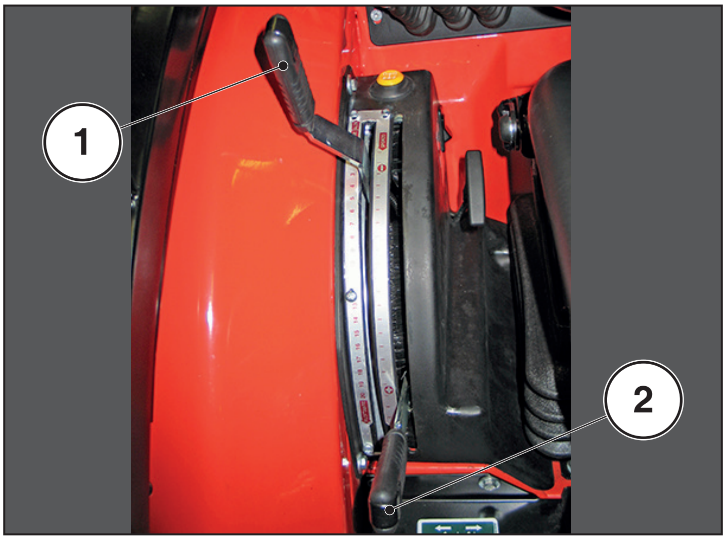


Fig. 9.35

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.

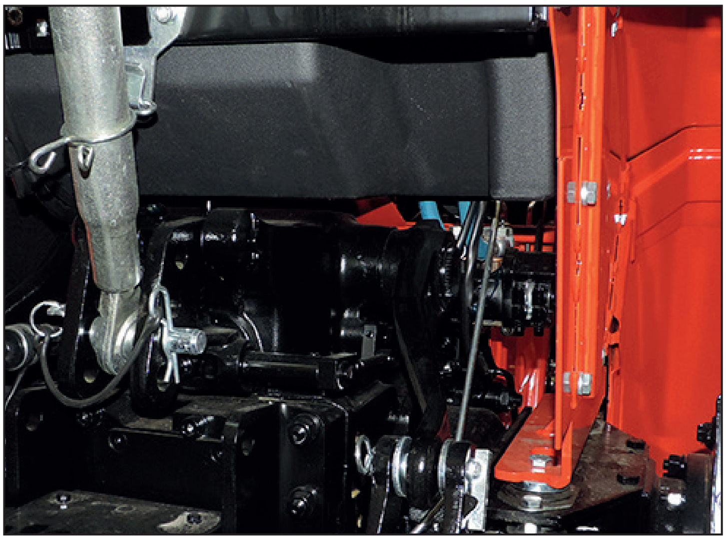


Fig. 9.36

Adjusting the draft lever tie-rod

Fit the tool (F-07000249) to pull the top link mount back.

⚠ Warning
The top link must have no free play.

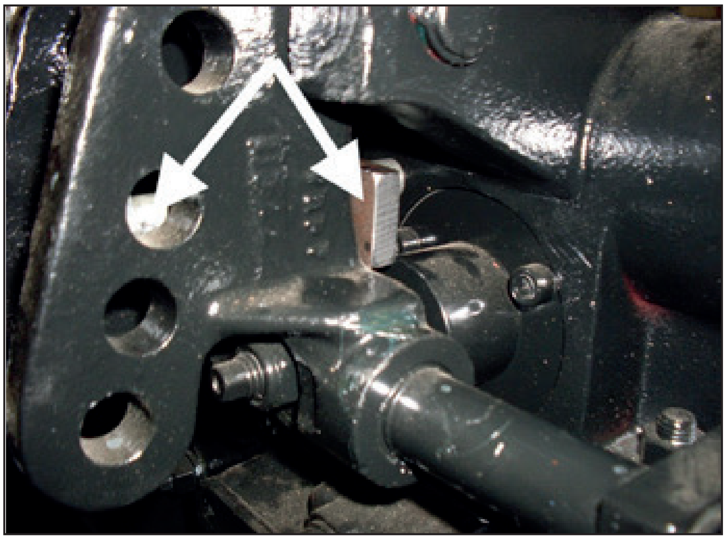


Fig. 9.37

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.

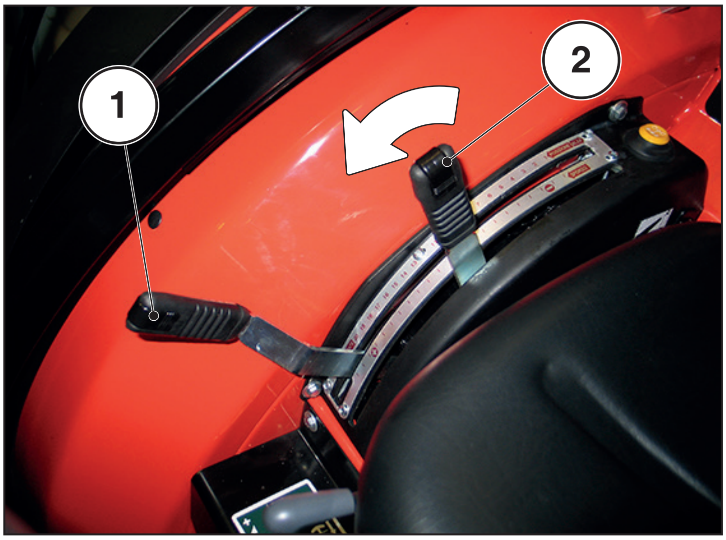


Fig. 9.38

Adjust the tie-rod on the top link mount until the lift just starts to lower, and then tighten the check nut.

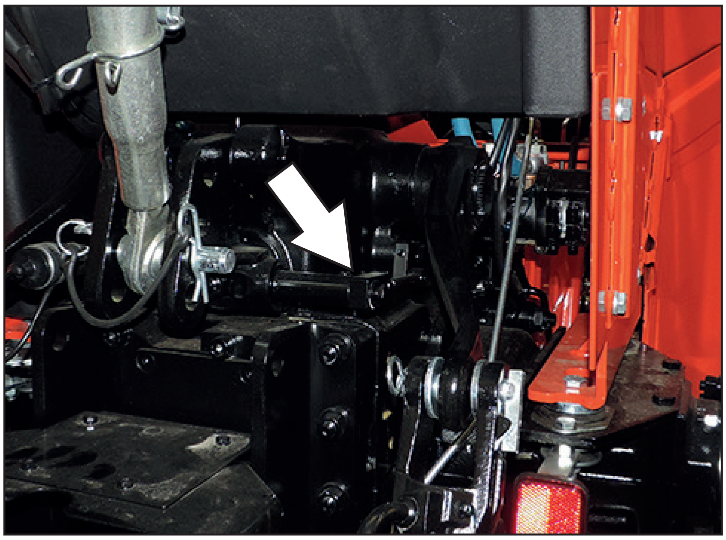


Fig. 9.39

4.7 Adjusting the lift

4.7.1 Adjusting the control distributor sensitivity

Move the lift arms into a neutral position, approximately halfway through their angular travel, applying a load.

Loosen the check nut (A), and turn the hex screw (B) anticlockwise until the lift arms start to bounce. Turn the screw (B) slowly clockwise to gently stop the lift arms from bouncing.

Once the arms stop bouncing, turn the screw (B) clockwise by 1/4 turn and the secure in position with the check nut (A). The control distributor is now set to maximum sensitivity.

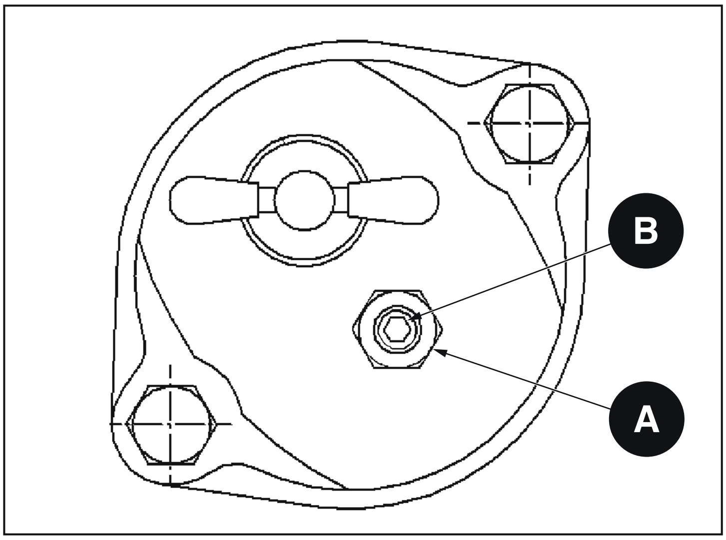


Fig. 9.40

4.7.2 Adjusting the position control lever

This setting determines the maximum lift height of the lift arms.

Lower the lift arms completely with a light load applied.

Loosen the lock screw (6) so that position control lever (1) is free to move relative to the shaft (5). With the draft control lever (2) moved downwards against the stop (E), move the position control lever (1) upwards against the stop (H) without rotating the shaft (5).

Restraining the levers (1) and (2) with a 13 mm wrench to prevent them from moving, turn the shaft (5) slowly anticlockwise to lift the arms until they are stopped at the maximum lift height position by the internal hydraulic limit switch.

To prevent the hydraulic limit switch from activating while the lift is in position control mode, an additional travel of approximately 10 to 15 mm for safety must be set for the lift arms. Then turn the shaft (5) slowly clockwise to lower the arms and annul the additional safety travel.

While preventing the shaft (5) from turning and holding the lever (1) against the stop (H), tighten the screw (6). After fastening the lever to the shaft, check that the setting is correct by raising and lowering the arms completely with the position control lever (1) and checking that the arms always stop in the same position.

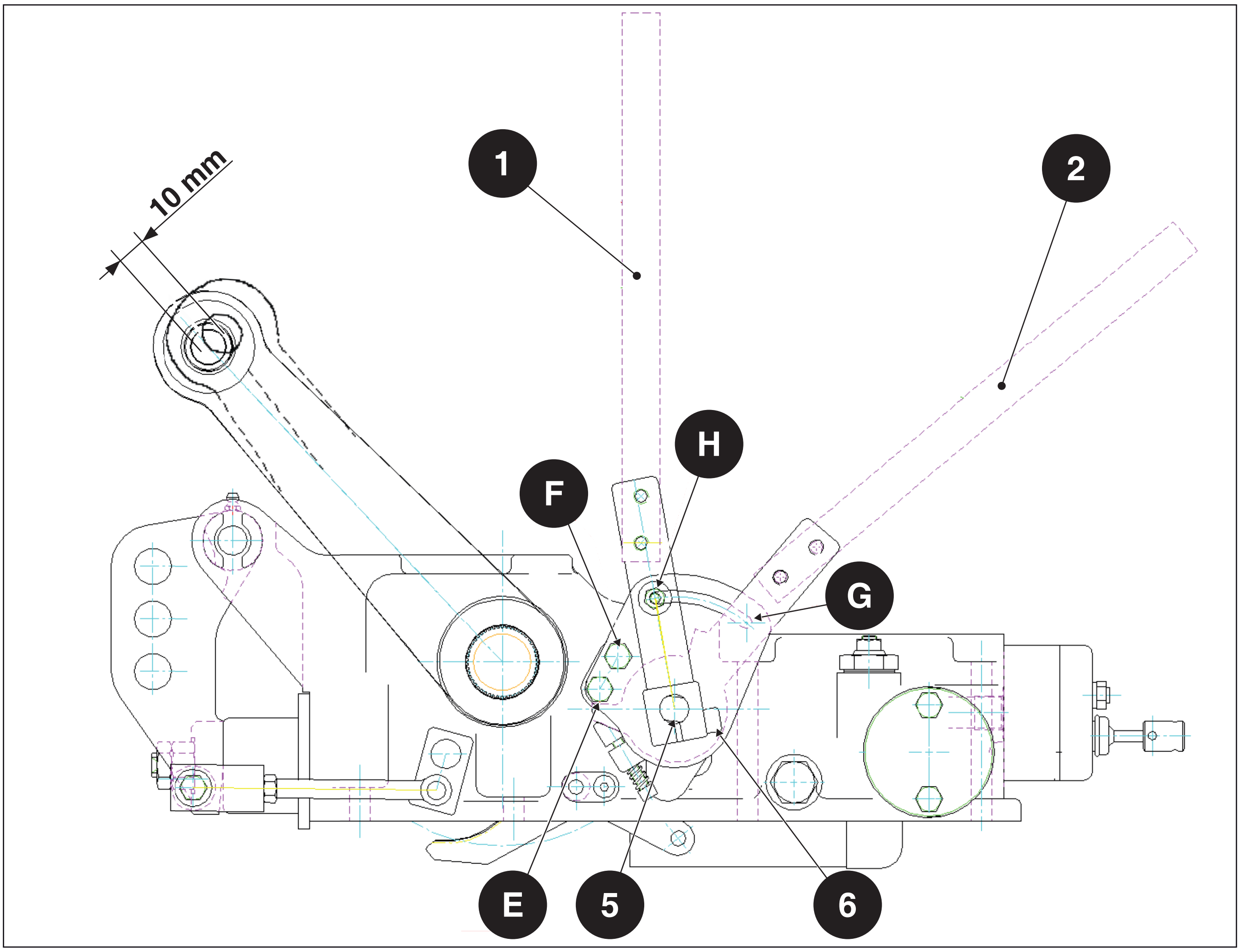


Fig. 9.41

4.7.3 Adjusting the draft control lever

Adjusting the draft control lever correctly is necessary to ensure that the travel of the lever corresponds exactly to the travel of the top link, so that the entire working excursion of the thrust spring is utilised.

This adjustment must be made with the top link (20) in a neutral position (with no load applied). Move the control levers (1) and (2) downwards against the stops (G) and (E) and then, with the engine at minimum speed, move the draft control lever (2) slowly towards the stop (F).

The lever is adjusted correctly when it raises the arms completely within 3 to 4 mm from the stop (F). If the measurement is incorrect, adjust the length (L).

Stop the engine for safety, and then loosen the check nut (8), undo the screw (9) and adjust the length (L) by turning the adjuster plate (10).

- If the draft control lever (2) raises the arms completely at a position further than 3 to 4 mm from the stop, shorten the length (L).
- If the draft control lever (2) does not raise the arms completely even once it reaches the stop (F), or raises the arms completely at a position closer than 3 to 4 mm from the stop, increase the length (L).

Once the correct setting is found, raise the arms completely several times and check that the fully raised position is always attained when the lever is 3 to 4 mm from the stop. To work safely, stop the engine before removing the extractor tool from the top link.

Note
The position of the lever (1) only determines the position of the arms and does not influence the setting of the draft control lever (2).

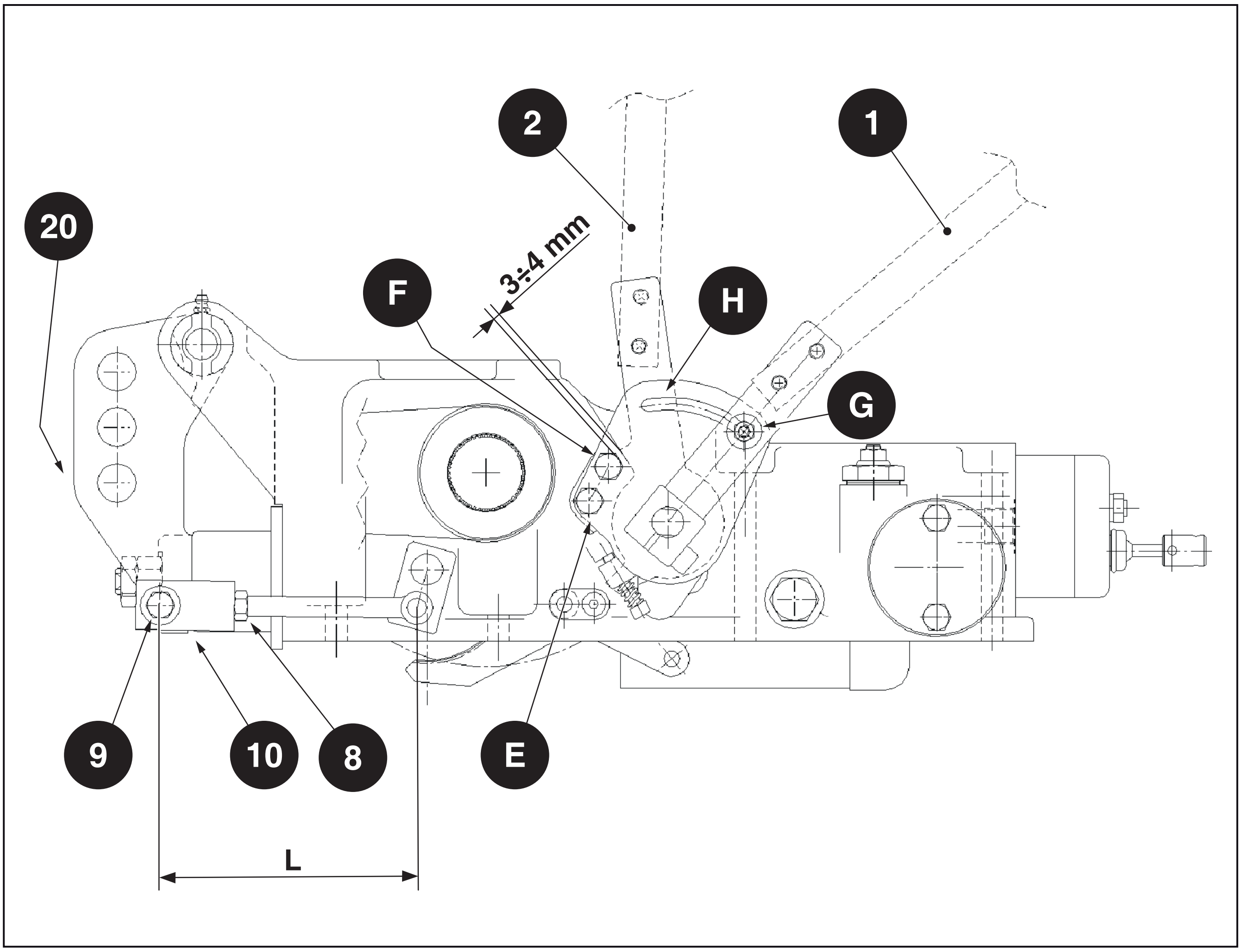


Fig. 9.42

4.7.4 Checking measurement of inner push rod

After removing the lift, before adjusting the setting (R) check that the distance X is between 10.5 and 11.0 mm (this is necessary to ensure that the push rod is refitted in the correct position), and check that the distance between the two 8 mm diameter pins of the accumulator is between 59.0 and 59.3 mm.

To check the distance of the push rod relative to the contact surface of the control distributor, after making all the adjustments necessary to the lift, proceed as follows. Lower the lift arms completely by setting the position (1) and draft (2) control levers against the respective stops (G) and (F).

In this position, push the push rod inwards and check, with the relative gauge, that the measurement is between 112.0 and 112.5 mm.

This measurement may be adjusted by modifying (R). In this case, however, the position and draft control levers must be adjusted again.

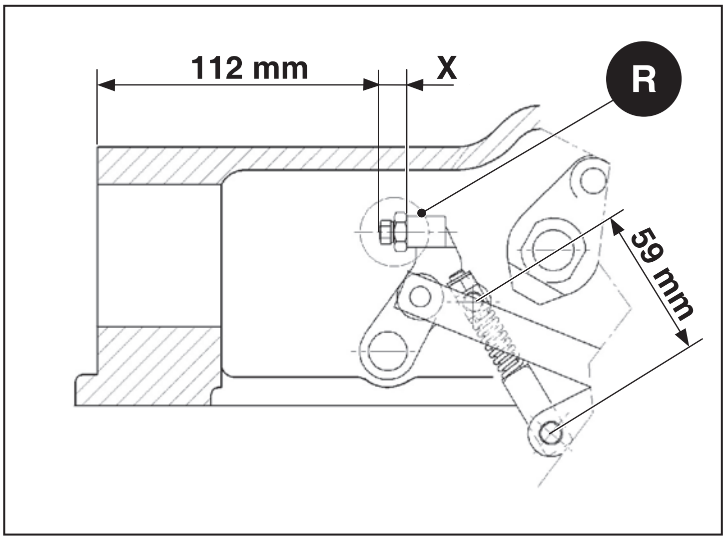


Fig. 9.43

4.7.5 Checking assembly of the thrust springs

For the lift to function correctly, the top link (20) must have no endfloat relative to the thrust spring in both directions.

If the components are installed correctly, the spring compressor (2) must be in contact with the lift casing (P), while the spring compressor cover (4) must be against the stop flange (3). In these conditions, the spring (1) is compressed by approximately 1 mm.

Before assembling the complete thrust assembly on the lift casing, preassemble the spring (1) so that the measurement (S) is approximately 12.5 mm.

After installing the thrust assembly, adjust definitively by restraining the screw (V) with an 8 mm wrench and tightening or loosening the nut (D) to eliminate any endfloat, and then tighten the check nut (D1).

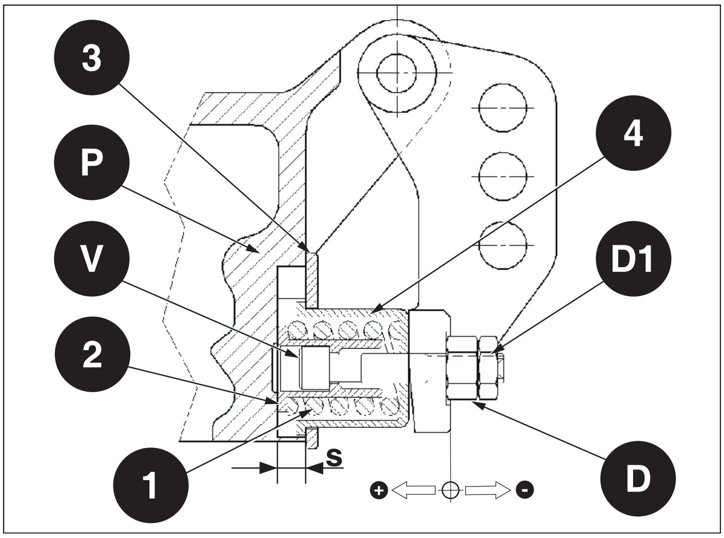


Fig. 9.44

4.8 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.

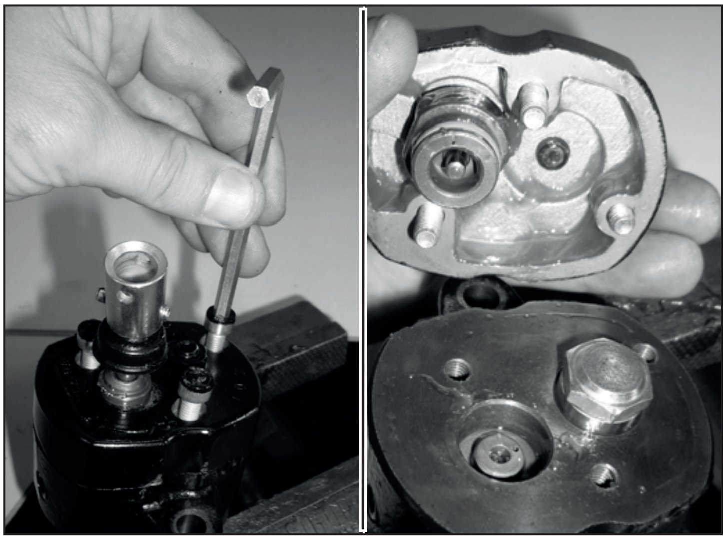


Fig. 9.45

The internal components of the distributor, grouped by utility channel, are shown in the figure.

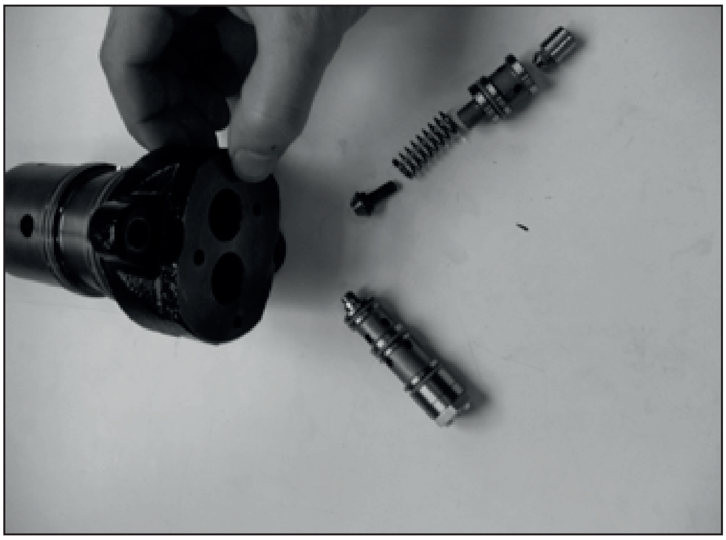


Fig. 9.46

4.9 Disassembling rear side of distributor

Undo the 3 screws and remove the spool retainer plate.

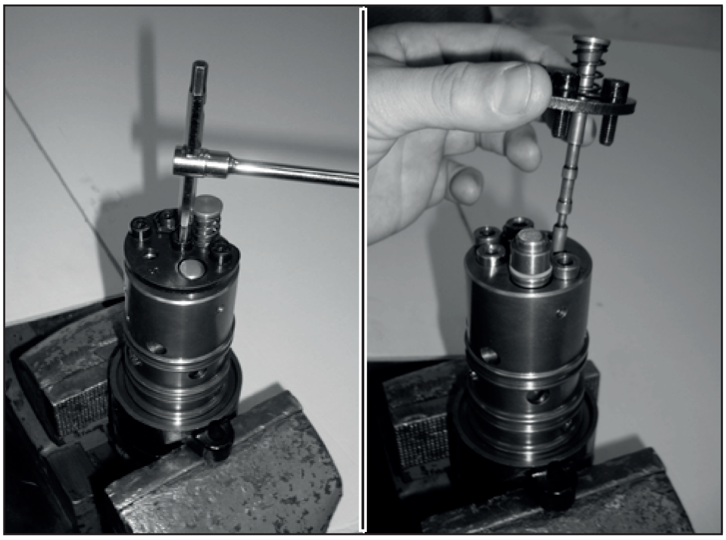


Fig. 9.47

Remove the spring, the ball and the two spacers.

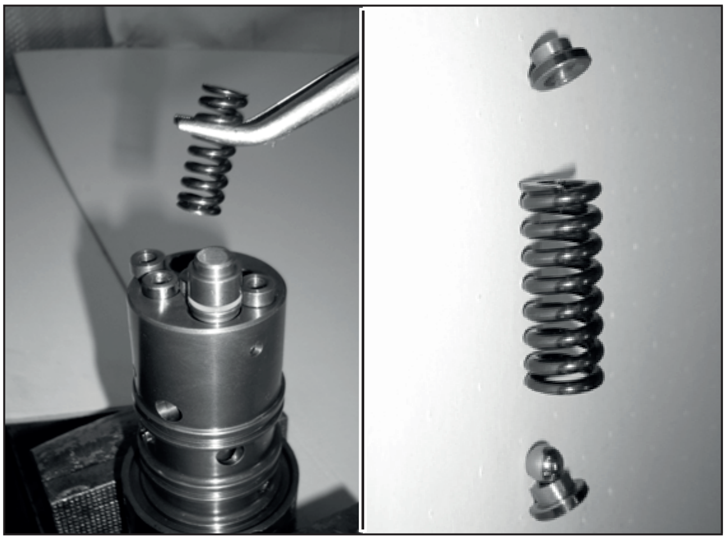


Fig. 9.48

Remove the valve seat, the valve and the relative spring.

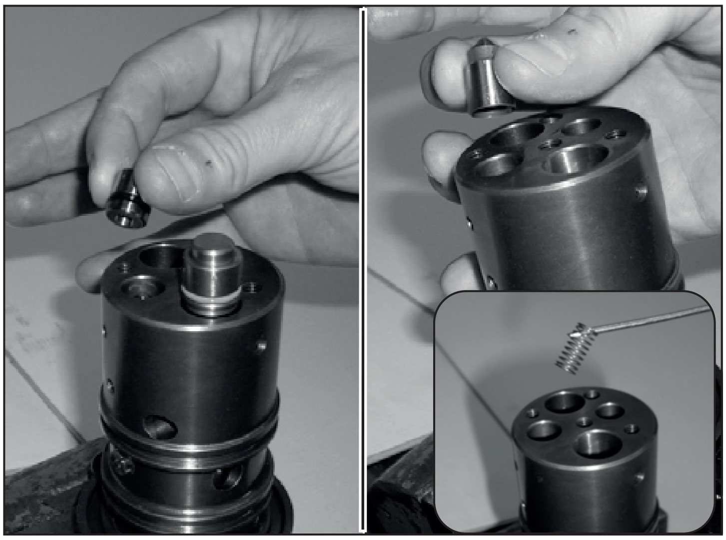


Fig. 9.49

Remove the spring holder cap and the valve seat.

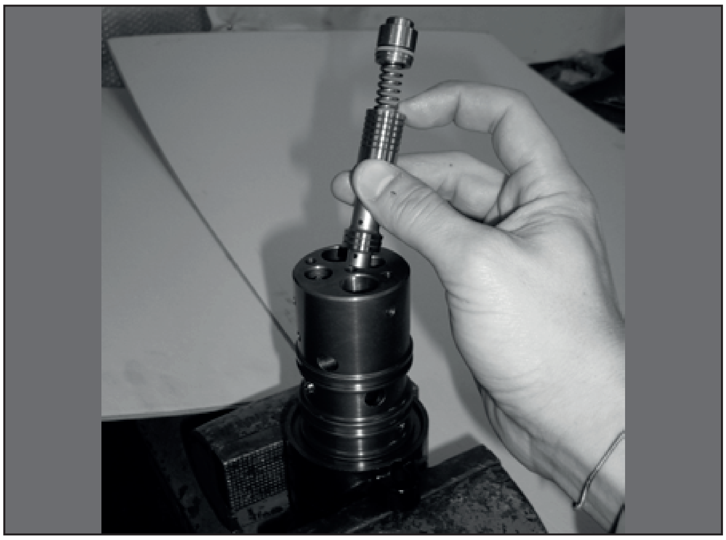


Fig. 9.50

The internal components of the distributor, grouped by utility channel, are shown in the figure.

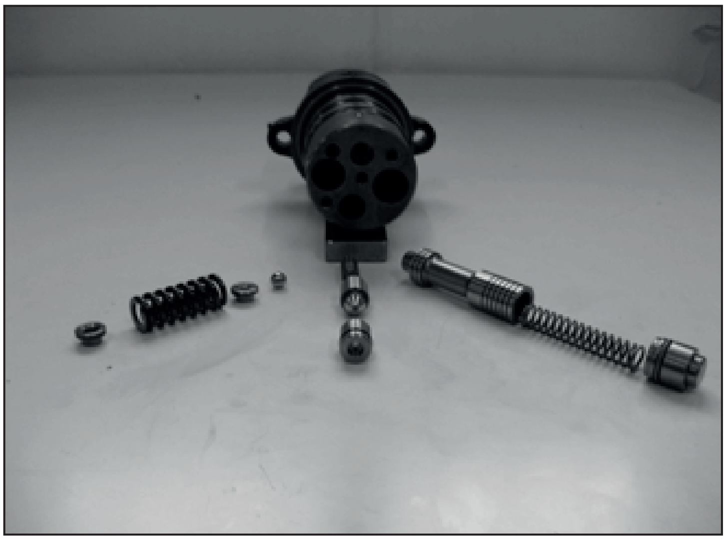


Fig. 9.51

The retainer plate, the three fastener screws with the relative spacers and the internal spool with the relative spring are shown in the figure.

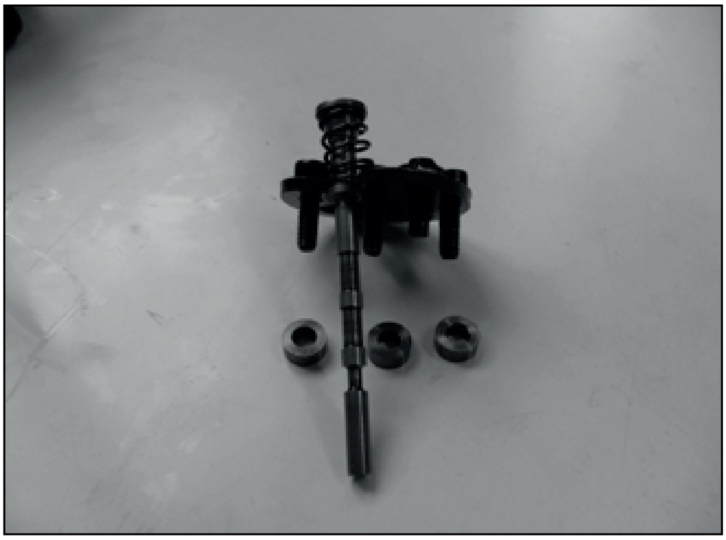


Fig. 9.52

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. 9.53

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.

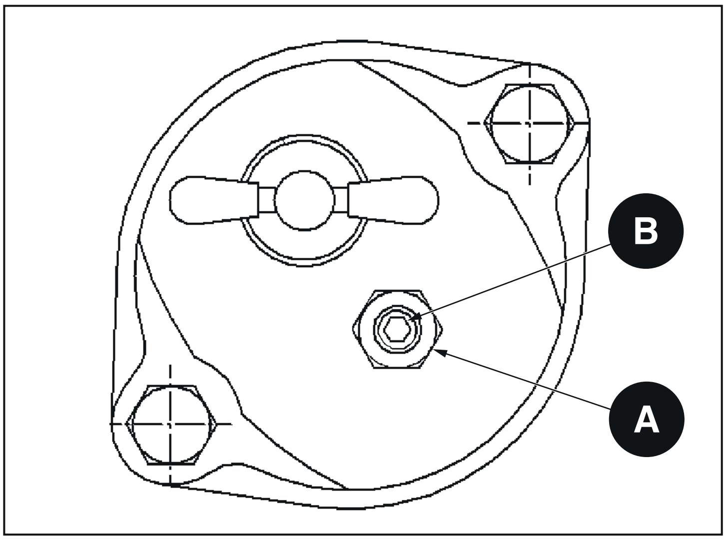


Fig. 9.54

Section 5 : Checking operating pressure values

Index

5.1 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, in the case of the lubrication pressure relief valve, may cause the transmission 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.

5.2 Checking the hydraulic steering unit pressure relief valve calibration pressure

The hydraulic steering unit pressure relief valve is calibrated to 90 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.

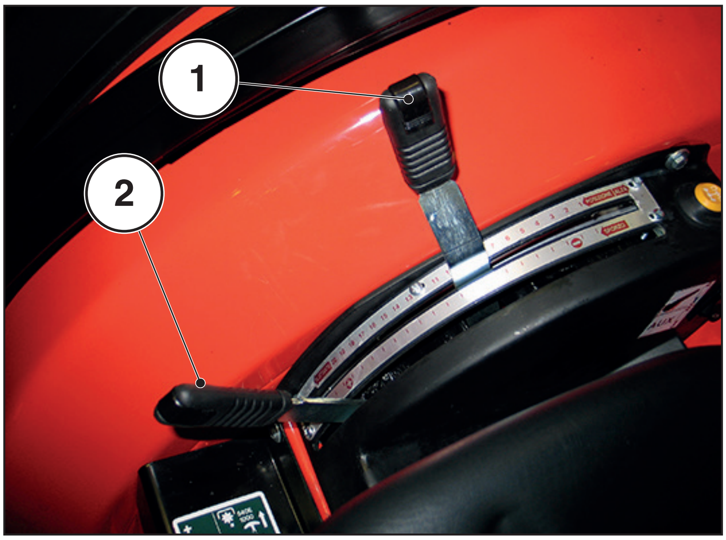


Fig. 9.55

Tighten or loosen the pressure relief valve to attain the correct pressure value.

Fig. 9.56

Warning

An incorrect pressure value measured on the steering cylinder is not necessarily indicative of a hydraulic steering valve malfunction.

Before servicing the hydraulic steering valve, check for blow-by inside the cylinder or leaks from the connectors on the hydraulic pipe.

5.3 Checking the pressure of the front 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 160 bar should be read on the pressure gauge.

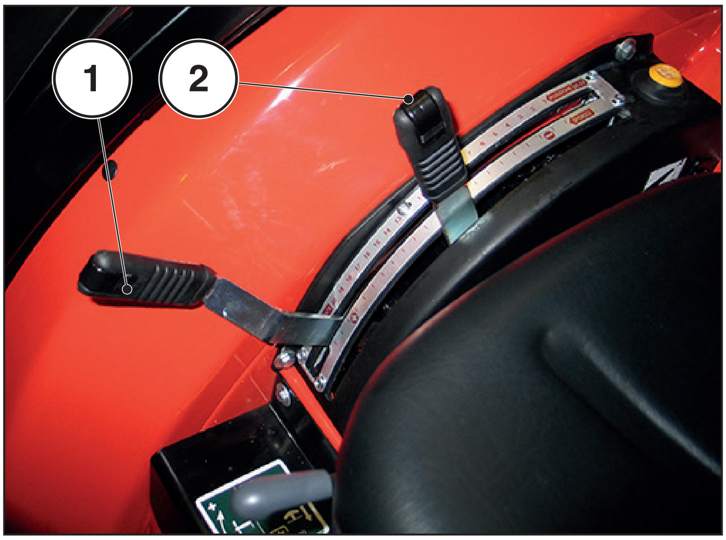


Fig. 9.57

Tighten or loosen the pressure relief valve to attain the correct pressure value.

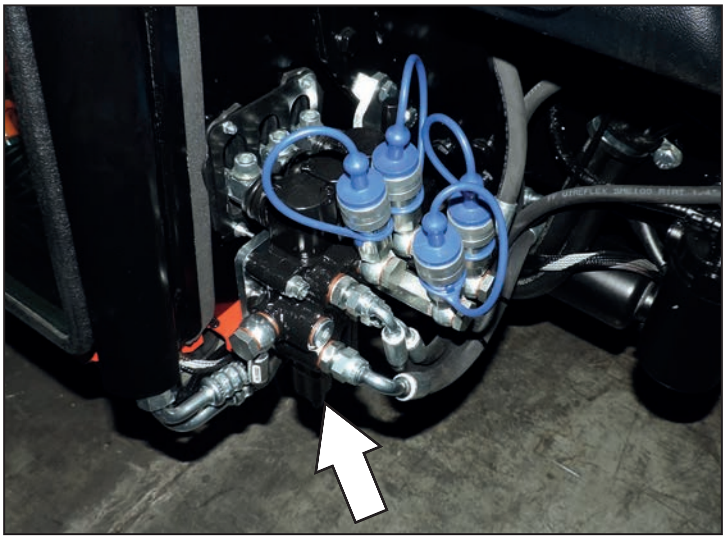


Fig. 9.58

5.4 Checking the pressure of the rear 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 150 bar should be read on the pressure gauge.

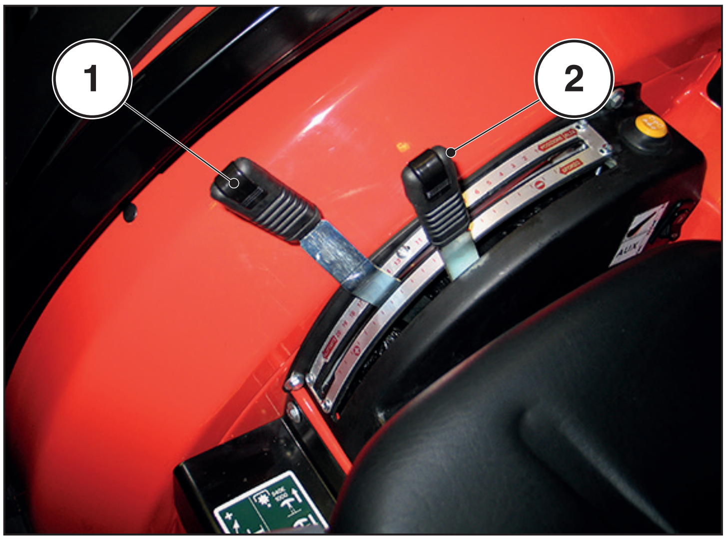


Fig. 9.59

Tighten or loosen the pressure relief valve to attain the correct pressure value.

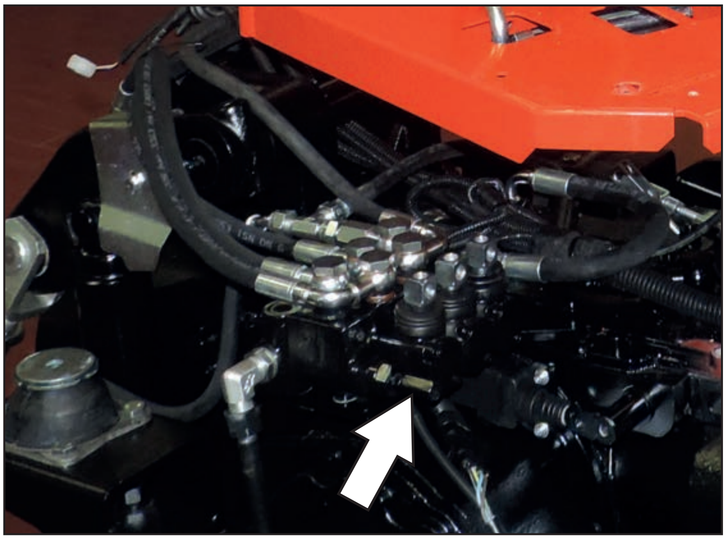


Fig. 9.60

5.5 Checking the priority valve pressure

Connect a pressure gauge to the delivery port of the priority valve.

With the engine running, check that the pressure indicated on the pressure gauge is 180 bar.

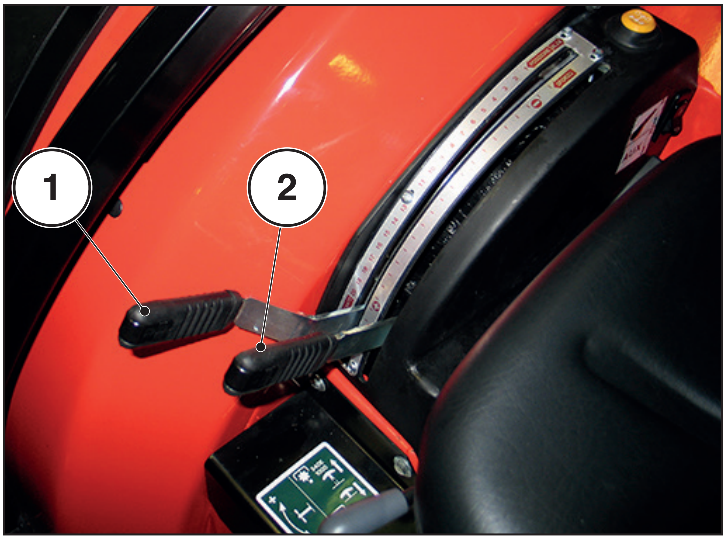


Fig. 9.61

Tighten or loosen the pressure relief valve to attain the correct pressure value.

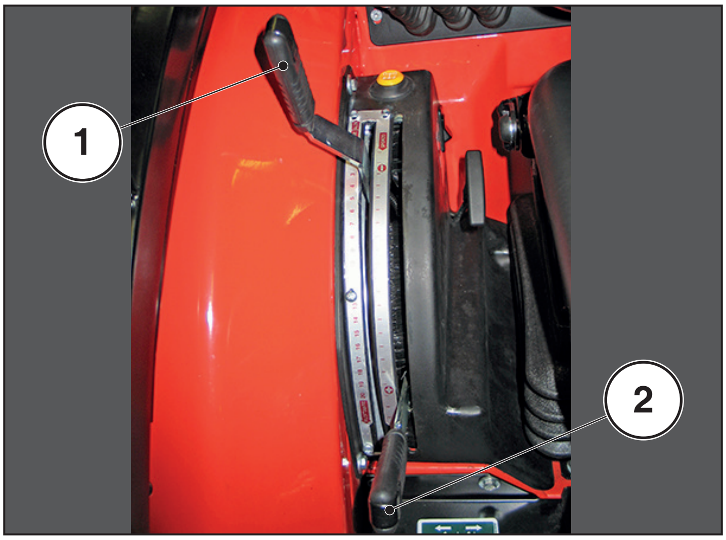


Fig. 9.62

Section 6 : Implements necessary

Index

6.1 Implements necessary

p/n	Description	Quantity
07000122	Pressure gauge	1

Chapter 10 : Electrical system

Index

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 Digital instrument panel

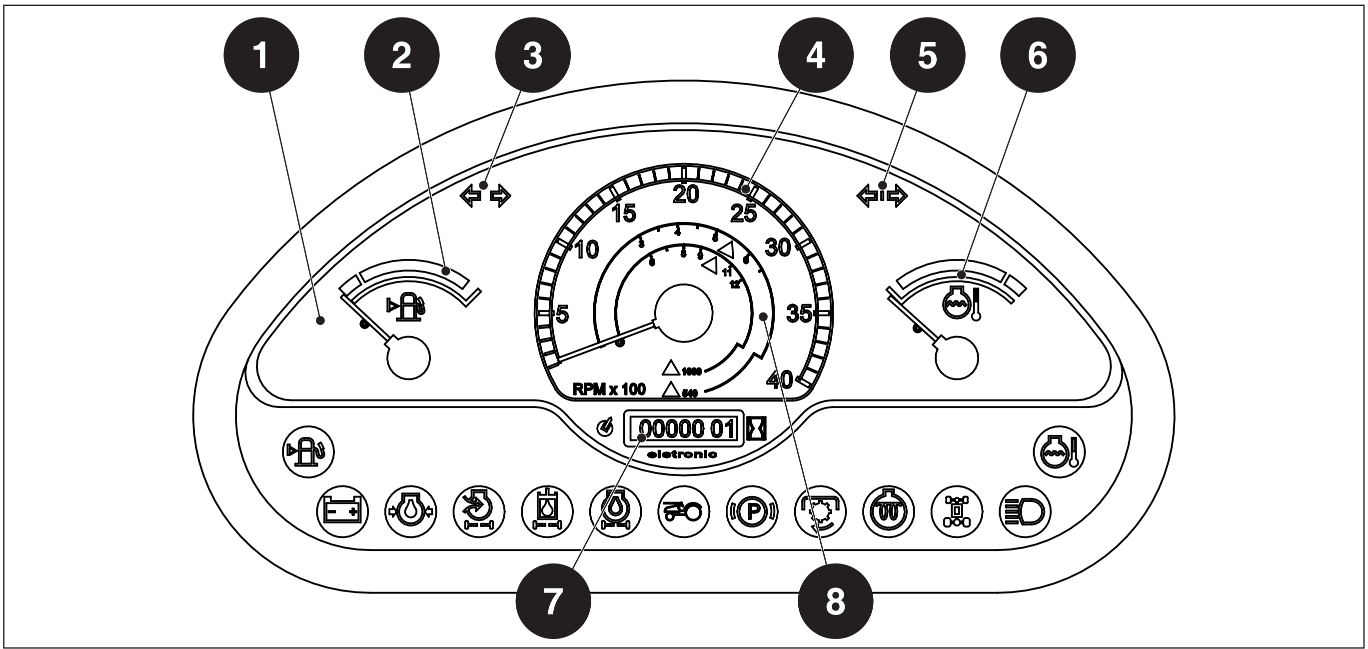


Fig. 10.1

1 - Indicator lamps
2 - Fuel gauge
3 - Turn signal indicator lamp
4 - Tachometer
5 - Turn indicator
6 - Coolant temperature
7 - Hour meter
8 - PTO speed indicator

2.2 Indicator lamps

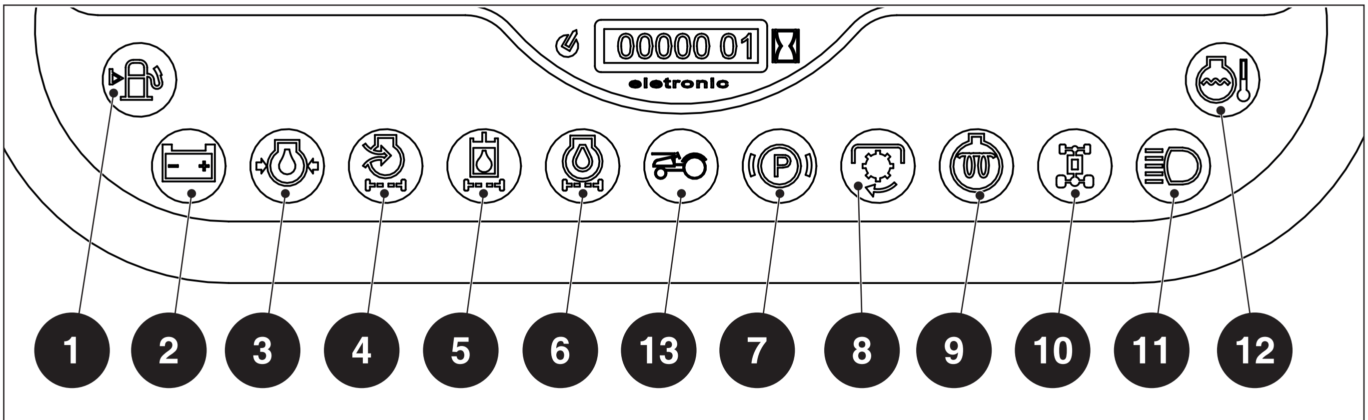


Fig. 10.2

1 - Reserve fuel warning lamp, yellow
2 - Low battery charge warning lamp, red
3 - Low engine oil pressure warning lamp, red
4 - Engine air filter clogged warning lamp, red
5 - Oil filter clogged warning lamp, red
6 - Low engine oil level warning lamp, red
7 - Parking brake engaged warning lamp, red
8 - PTO disengaged indicator lamp, red
9 - Engine preheat indicator lamp, yellow
10 - Front wheel drive engaged indicator lamp, yellow
11 - High beam headlights on indicator lamp, blue (only for version with high beam headlights)
12 - Engine coolant temperature warning lamp, red (sensor not connected)
13 - Roll bar lowered warning lamp

Section 3 : Main components

Index

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.

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.

Fig. 10.3

Check

Check that the battery is fastened correctly to the machine.

Cleaning

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).

3.2 Battery disconnector

This device disconnects the electrical system correctly and safely. It must be used prior to prolonged periods with the machine not on use or when it is necessary to work safely on the electrical system.

Fig. 10.4

3.3 Fuses

Functions of fuses:

A	1-pole socket power feed.	20A
B	Horn.	15A
C	LH rear sidelight. LH front sidelight.	5A
D	RH rear sidelight. RH front sidelight. Number plate light.	10A
E	PTO engaged indicator lamp, red. Front wheel drive engaged indicator lamp, yellow. Parking brake engaged warning lamp, red.	10A
F	Fuel pump.	10A
G	RH low beam headlight.	7.5A
H	LH low beam headlight.	7.5A
I	Seven pole socket.	10A
L	Power feed, hazard warning lights / turn indicator switch (+15).	10A
M	Power feed, hazard warning lights / turn indicator switch (+30). Rotary beacon switch.	10A
N	Free.	

Fig. 10.5

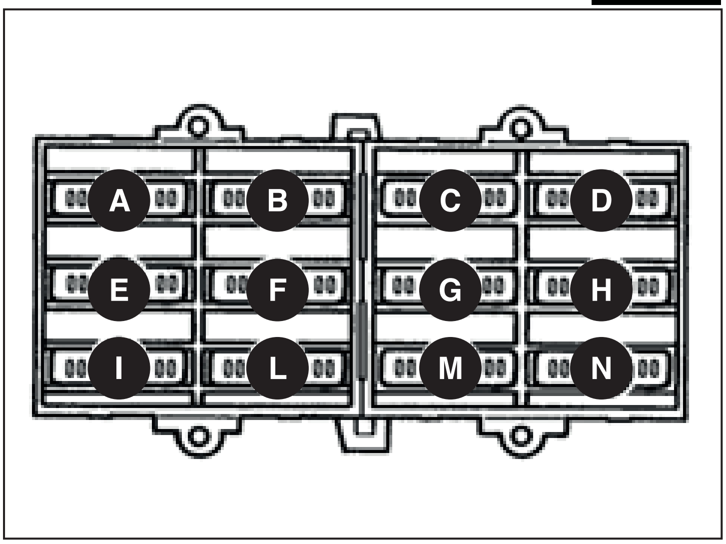


Fig. 10.6

Main fuses:

A	General electrical system protection.	50A
B	General cab electrical system protection (only for machines fitted with cab)	40A

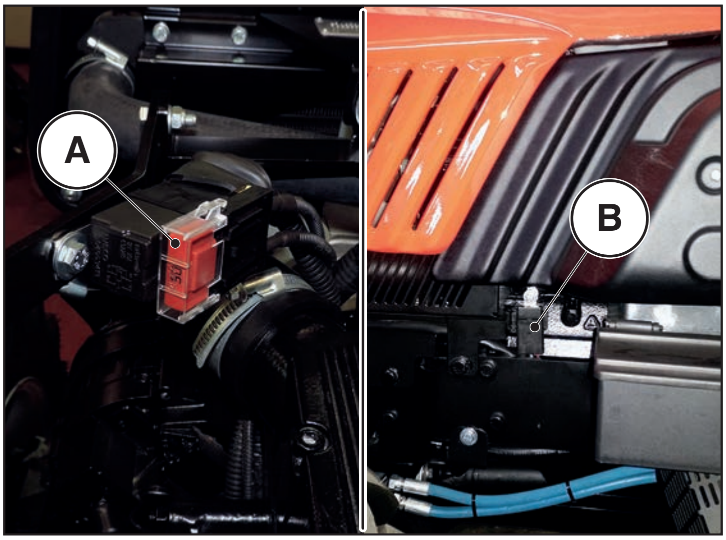


Fig. 10.7

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

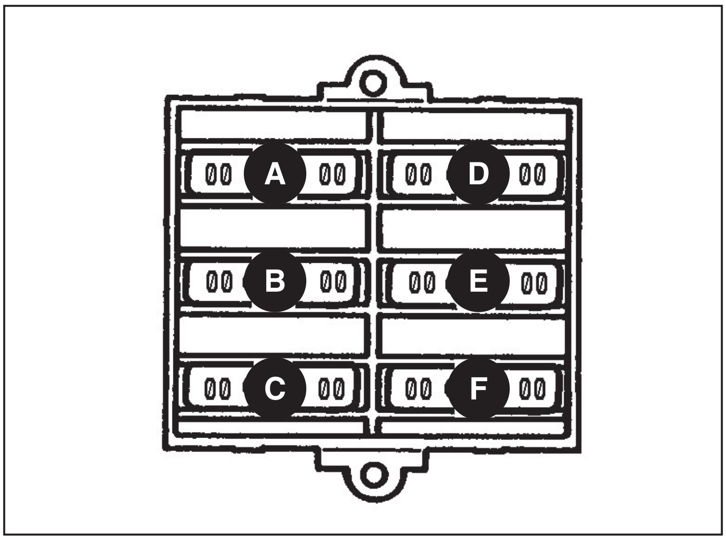


Fig. 10.8

Fig. 10.9

3.4 Sensors

Brake lights.

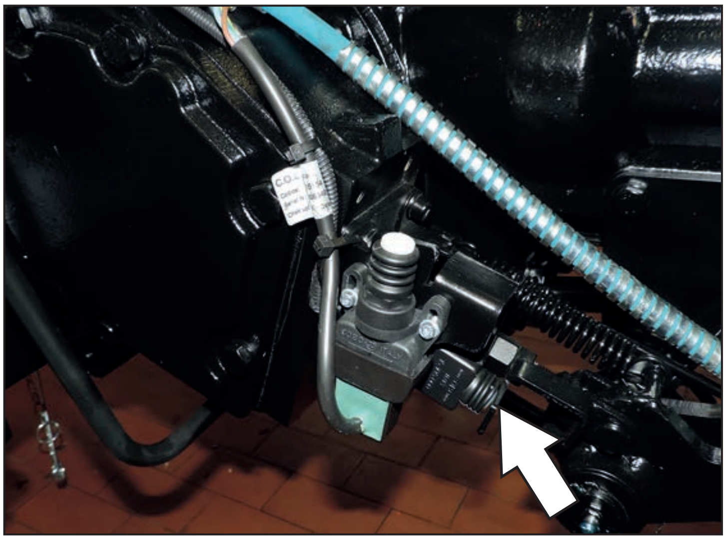


Fig. 10.10

Parking brake warning lamp on dashboard

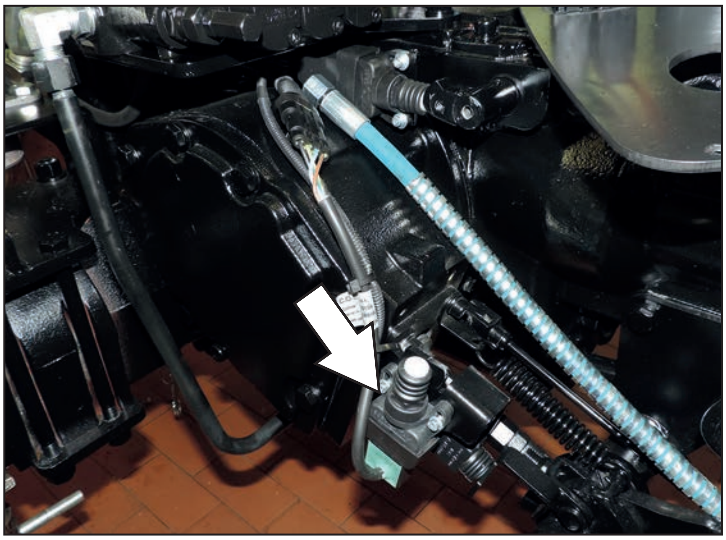


Fig. 10.11

PTO 540/1000, start enable

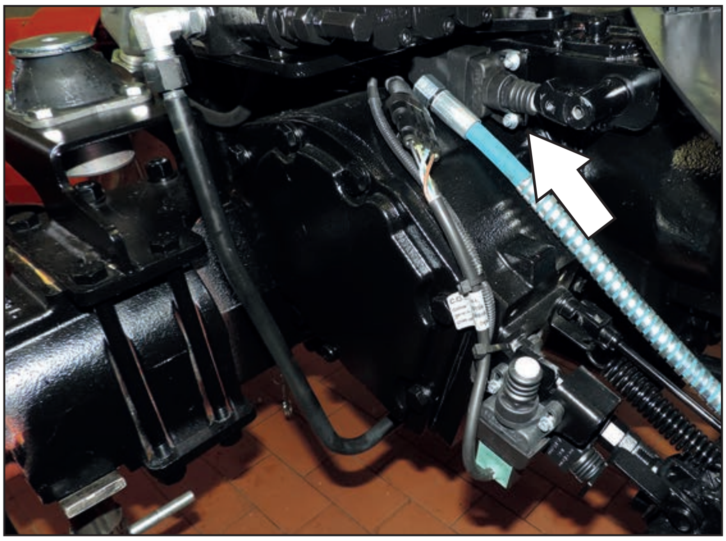


Fig. 10.12

Rear PTO clutch engaged indicator lamp

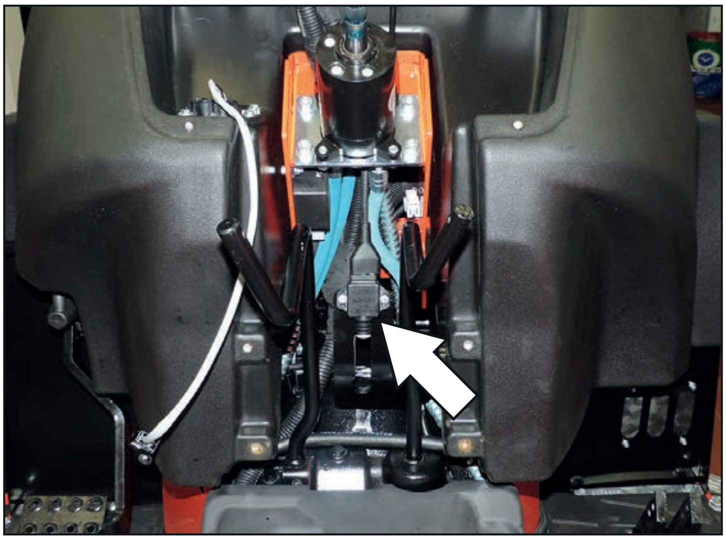


Fig. 10.13

Air filter sensor

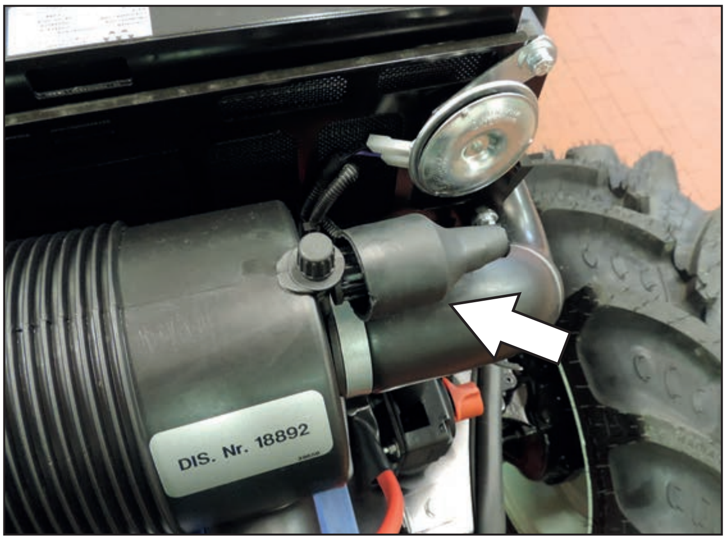


Fig. 10.14

Engine RPM

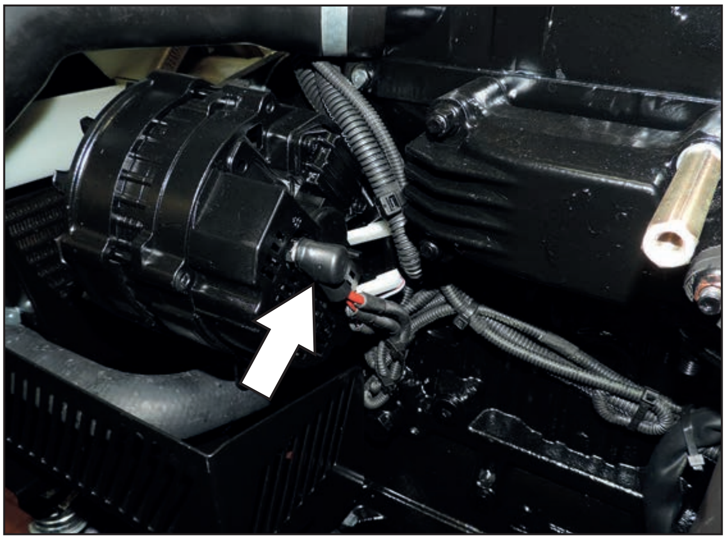


Fig. 10.15

Starter relay

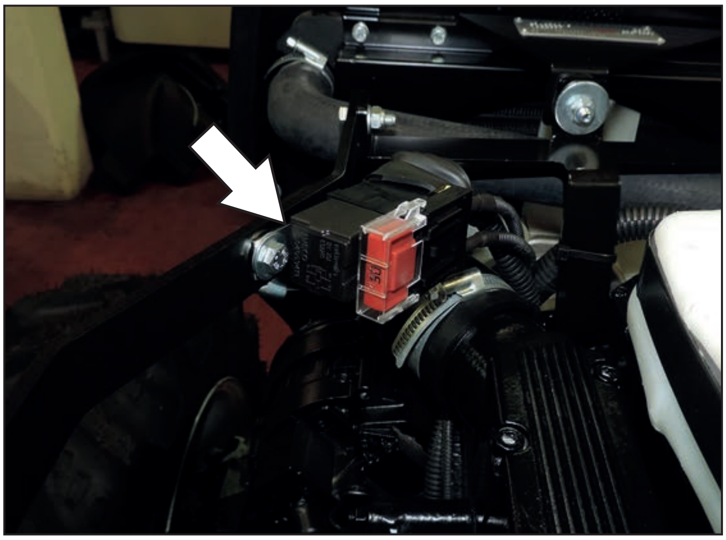


Fig. 10.16

Engine temperature sensor

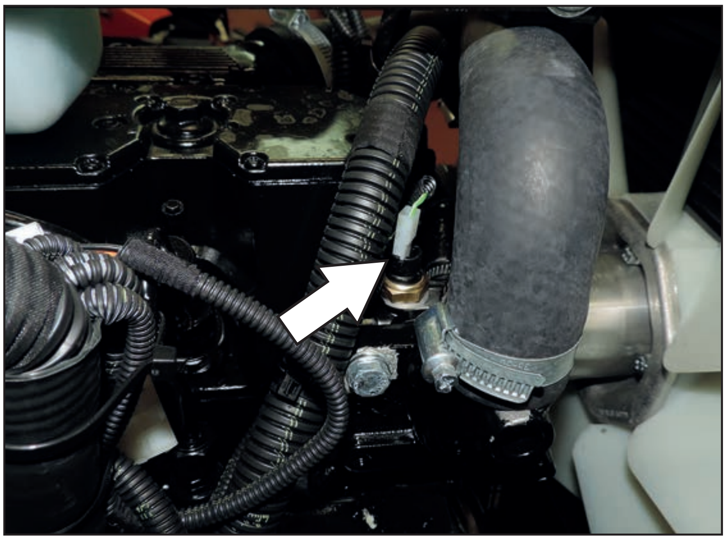


Fig. 10.17

Engine oil sensor

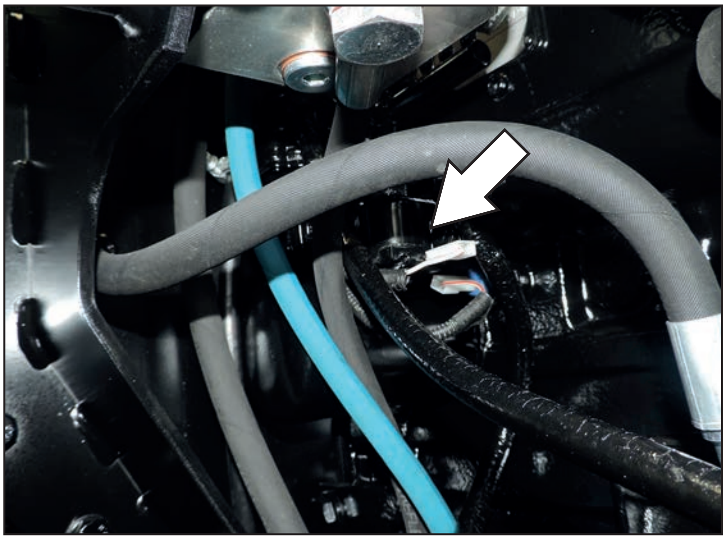


Fig. 10.18

Roll bar sensor

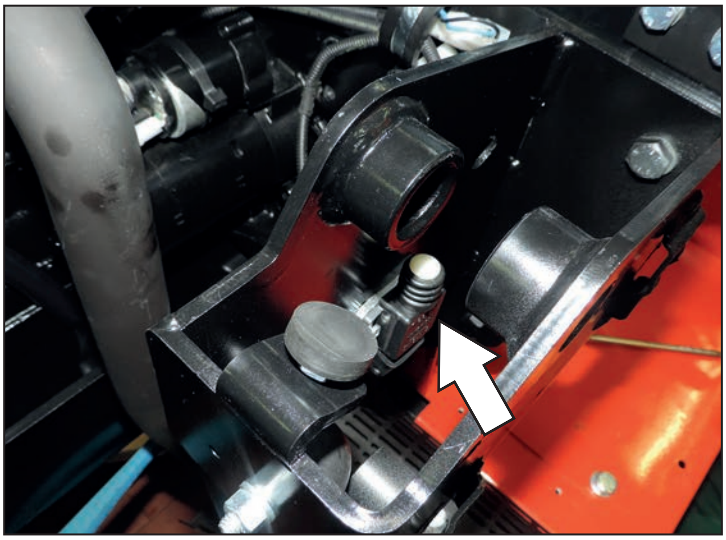


Fig. 10.19

Front wheel drive sensor

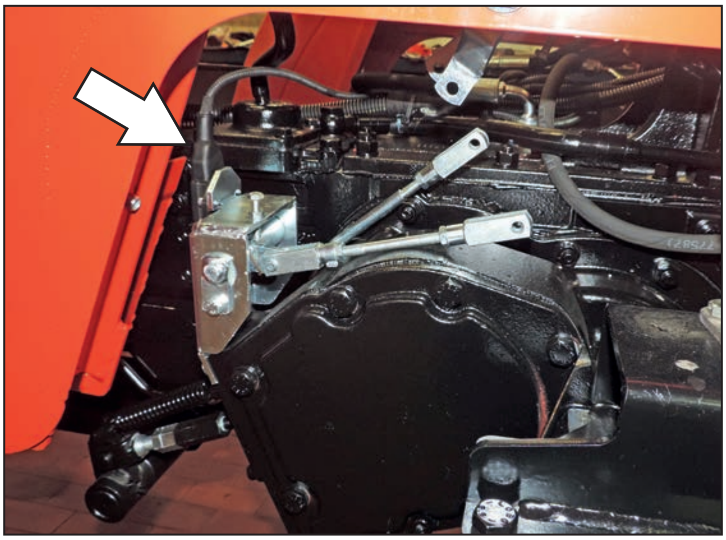


Fig. 10.20

3.5 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).

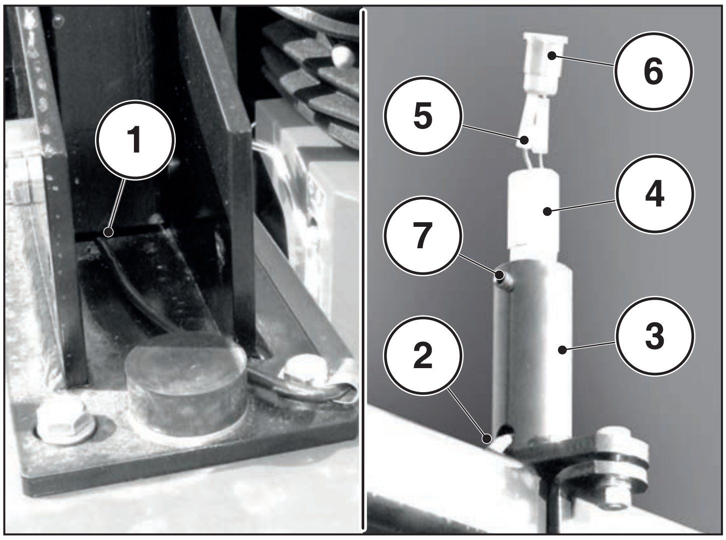


Fig. 10.21

Fasten the rotating beacon to the cylinder (4) and secure by tightening the screw (8).

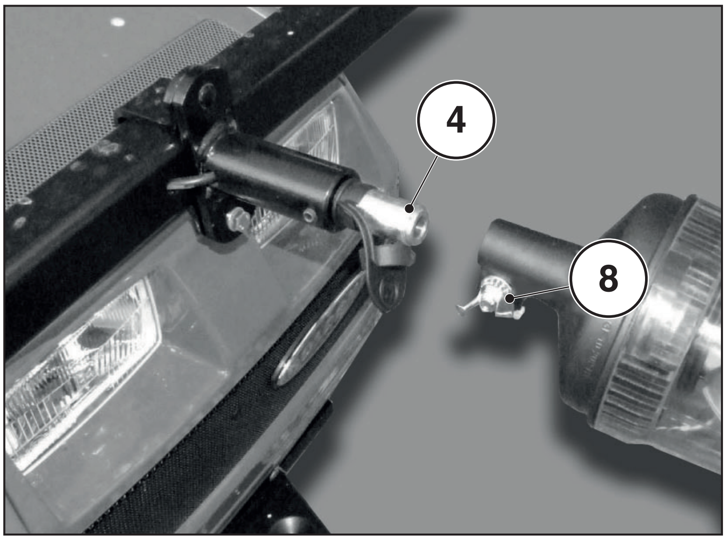


Fig. 10.22

Feed the cable through the cable guide (9) 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.

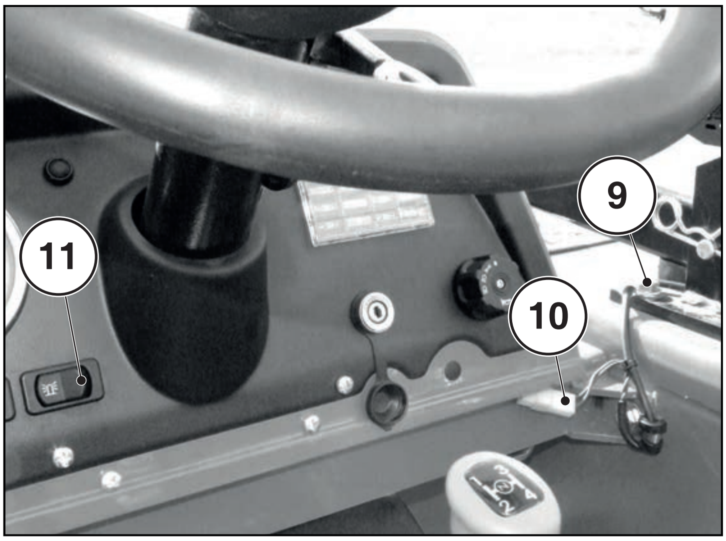


Fig. 10.23

Section 4 : Wiring looms

Index

4.1 02003667 - Front

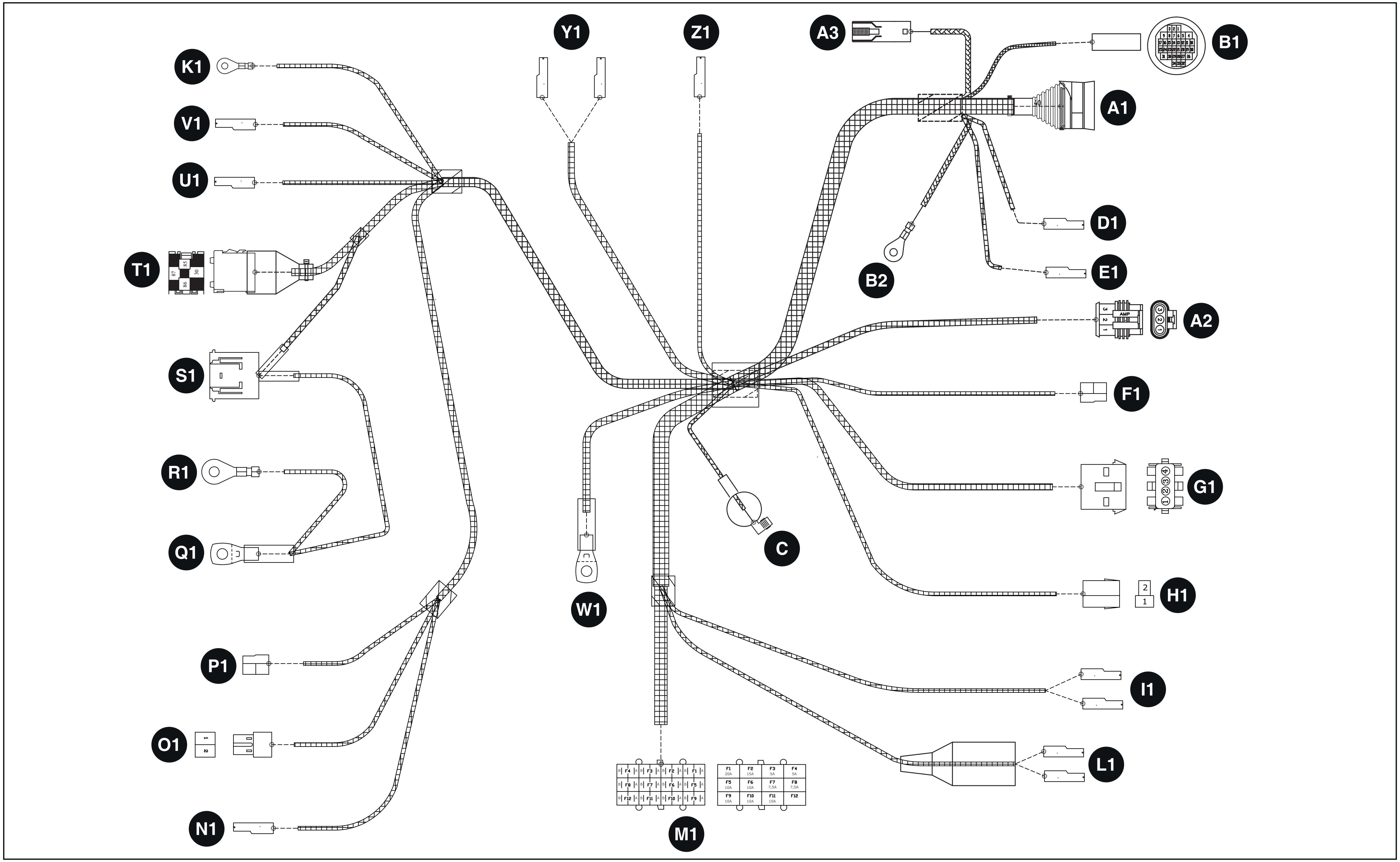


Fig. 10.24

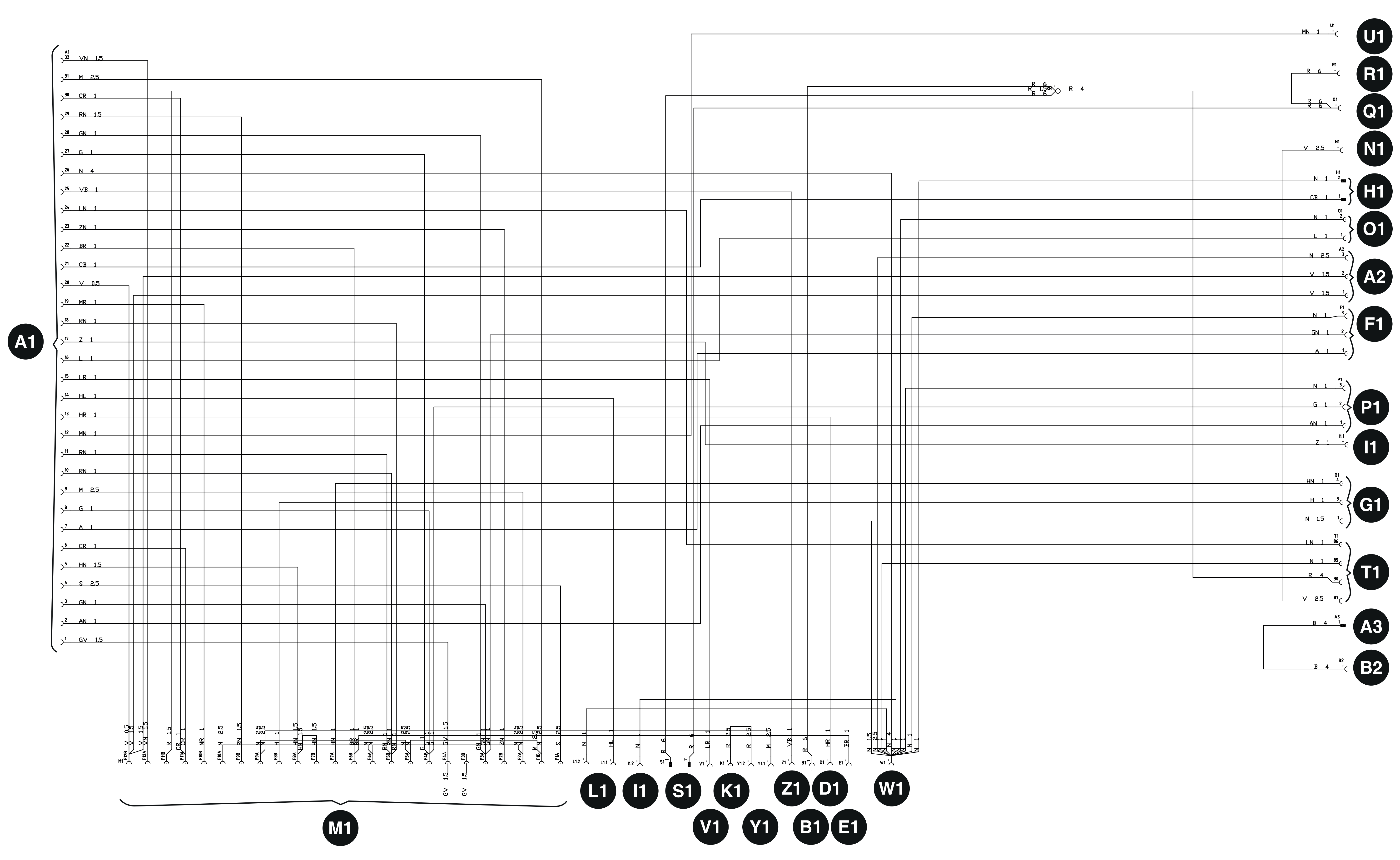

U1
R1
Q1
N1
H1
O1
A2
F1
P1
I1
G1
T1
A3
B2
A1
M1
L1
I1
S1
K1
Z1
D1
W1
V1
Y1
B1
E1

Fig. 10.25

A1 - Rear wiring loom connection
A2 - Provision for high beam headlights
A3 - Glow plug disconnect
B1 - Power feed connection
B2 - Glow plugs
C - Oil filter clogging sensor
D1 - Engine oil pressure switch
E1 - Fuel pump
F1 - RH headlight wiring loom connector
G1 - High beam headlights
H1 - Rotating beacon
K1 - Alternator
I1 - Horn
L1 - Air filter pressure switch
M1 - Fuse box
N1 - Starter motor coil
O1 - Roll bar sensor wiring loom connector
P1 - LH headlight wiring loom connector
Q1 - Starter motor
R1 - Alternator
S1 - Power feed Maxi fuse
T1 - Starter relay
U1 - Alternator
V1 - Alternator
W1 - Wiring loom ground
Y1 - Cab power supply
Z1 - Water temperature

4.2 02003667 - Rear

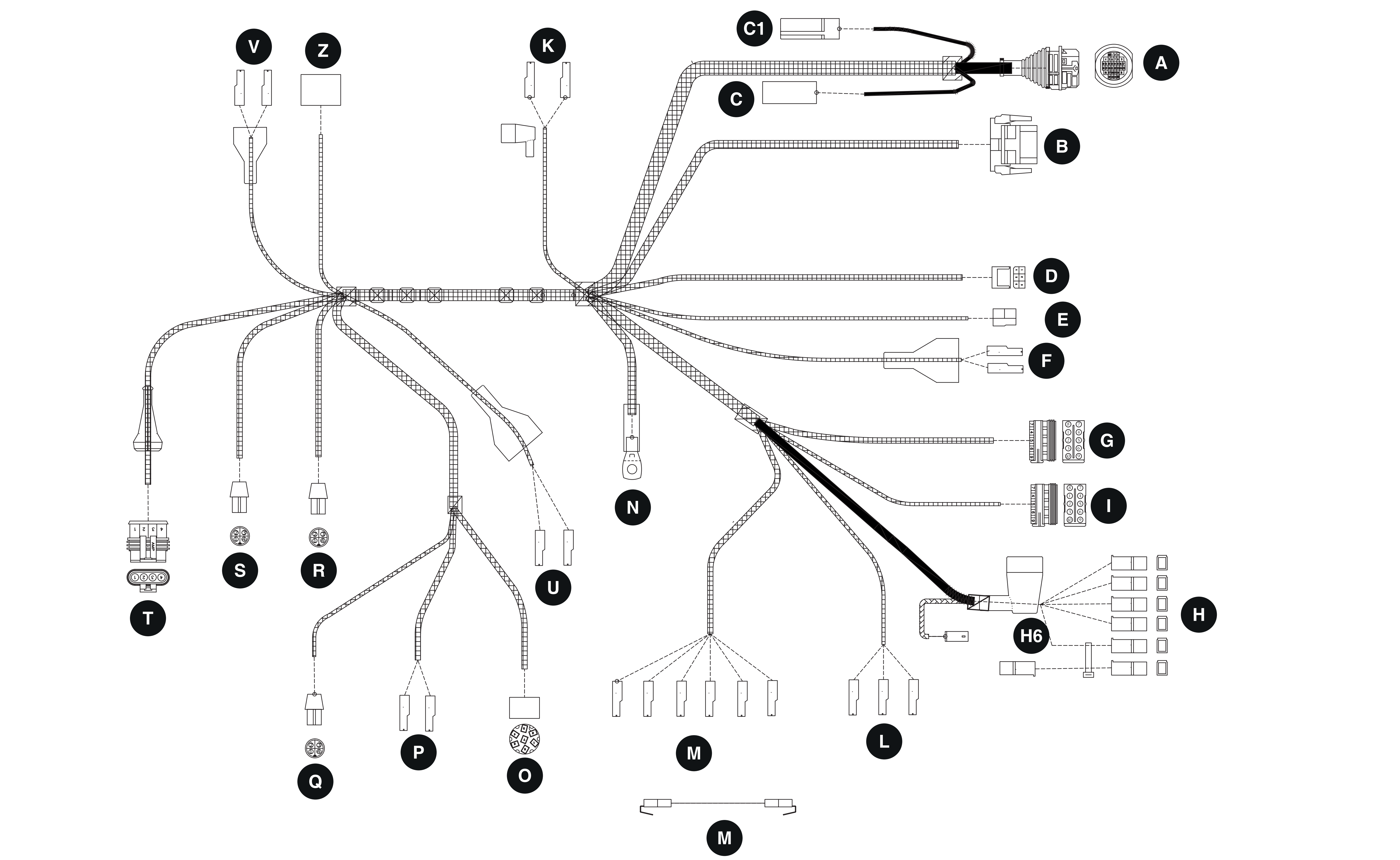


Fig. 10.26

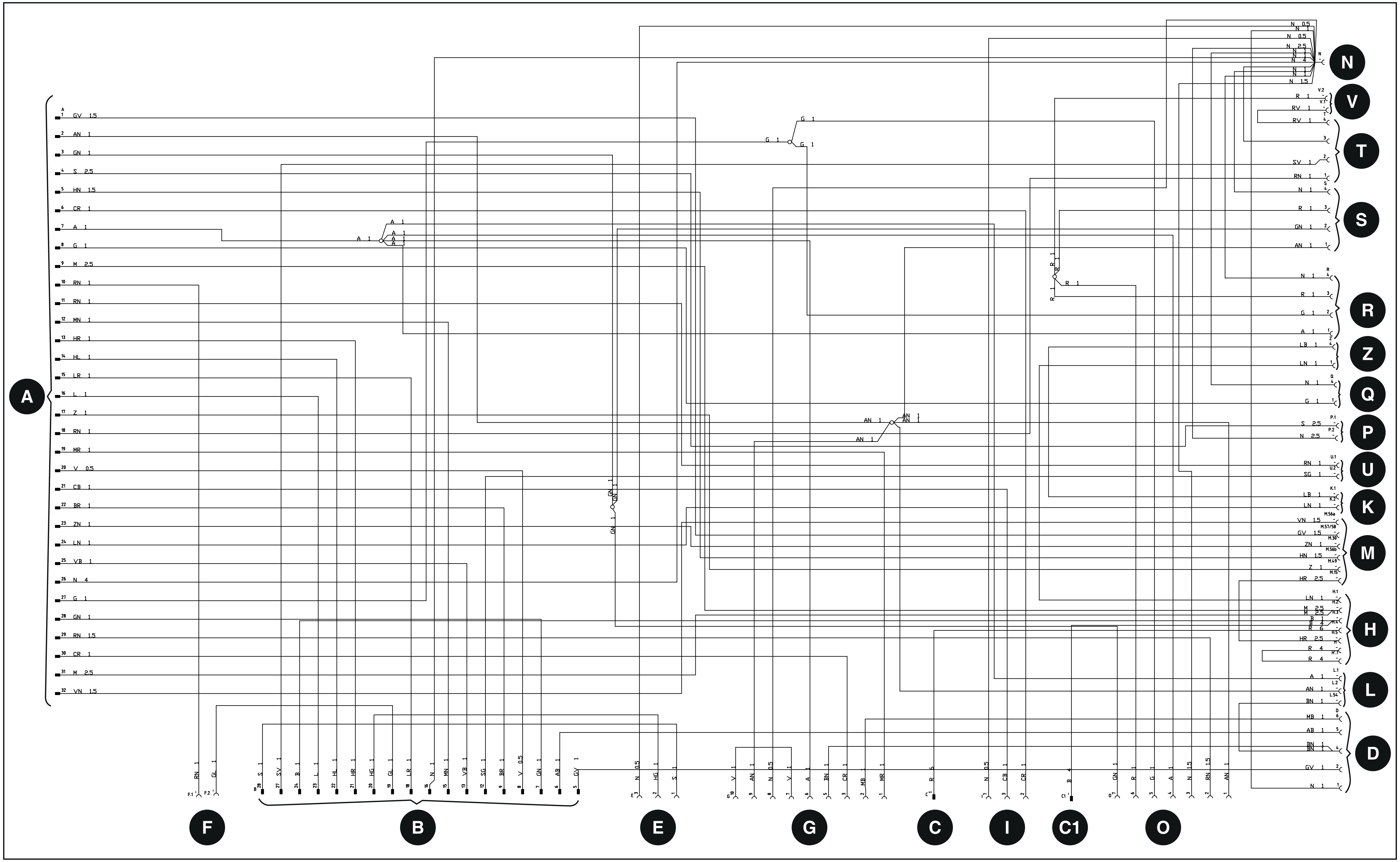


Fig. 10.27

A - Front wiring loom connection
B - Digital instrument
C - Oil filter clogging sensor
C1 - Glow plug disconnect
D - Turn signal flasher unit
E - Fuel level sensor
F - PTO engaged switch
G - Hazard warning lights switch
H - Front PTO
H6 - Power feed, front PTO
K - Start enable switch
I - Beacon light switch
L - Lights selector stalk
M - Lights switch.
N - Earth connector
O - 7 pole auxiliary socket
P - Auxiliary socket
Q - Number plate light wiring loom connector
R - RH rear light
S - LH rear light
T - Parking brake switch
U - Dual traction switch
V - Brake pedal light switch
Z - Clutch switch

4.3 02003667 - Wiring looms

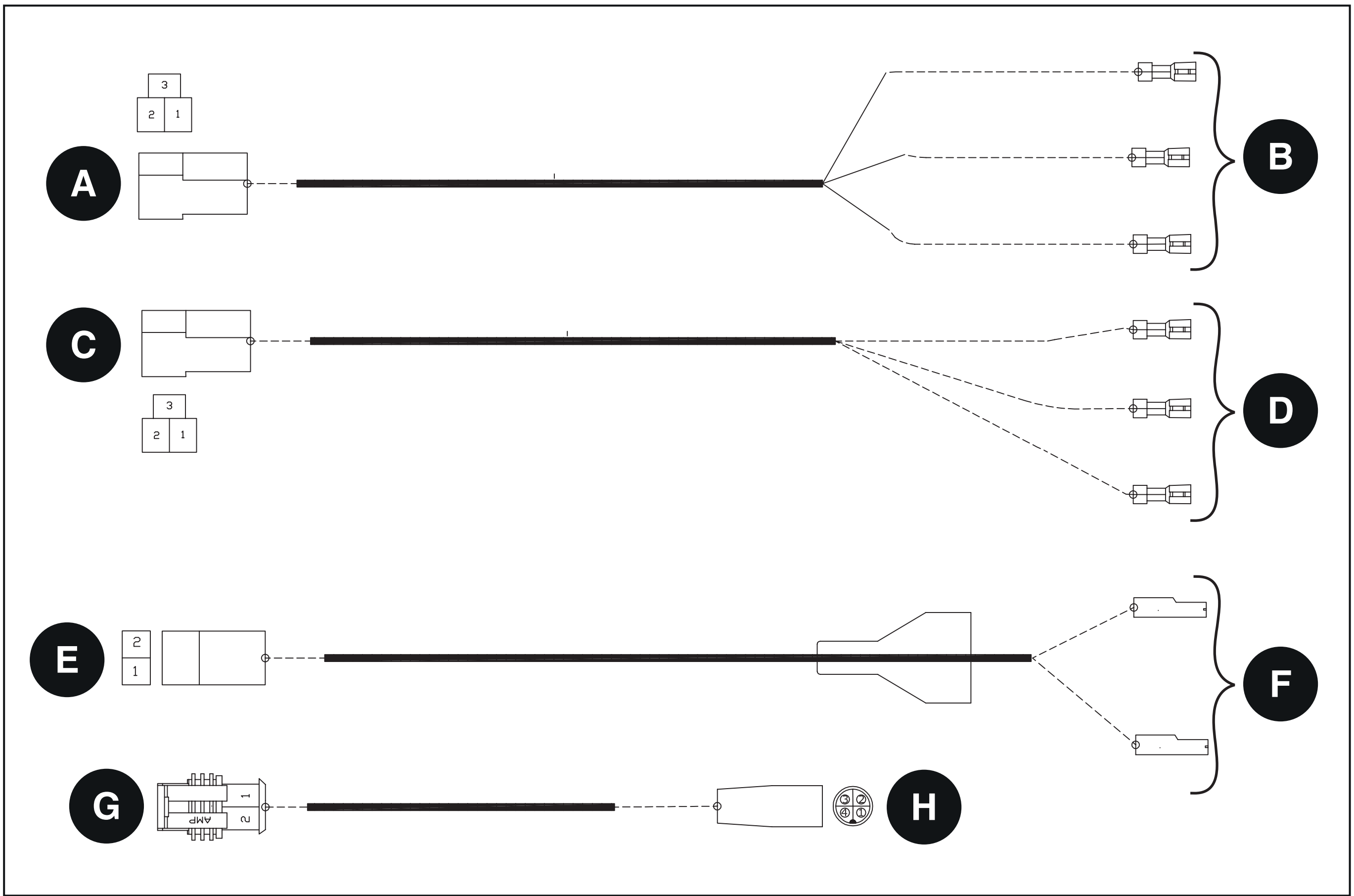


Fig. 10.28

A - Front wiring loom connection
B - RH headlamp, daytime running light and turn signal
C - Front wiring loom connection
D - LH headlamp, daytime running light and turn signal
E - Front wiring loom connection
F - Roll bar frame sensor
G - Number plate light
H - Rear wiring loom connection

4.4 02003668 - Front PTO wiring loom

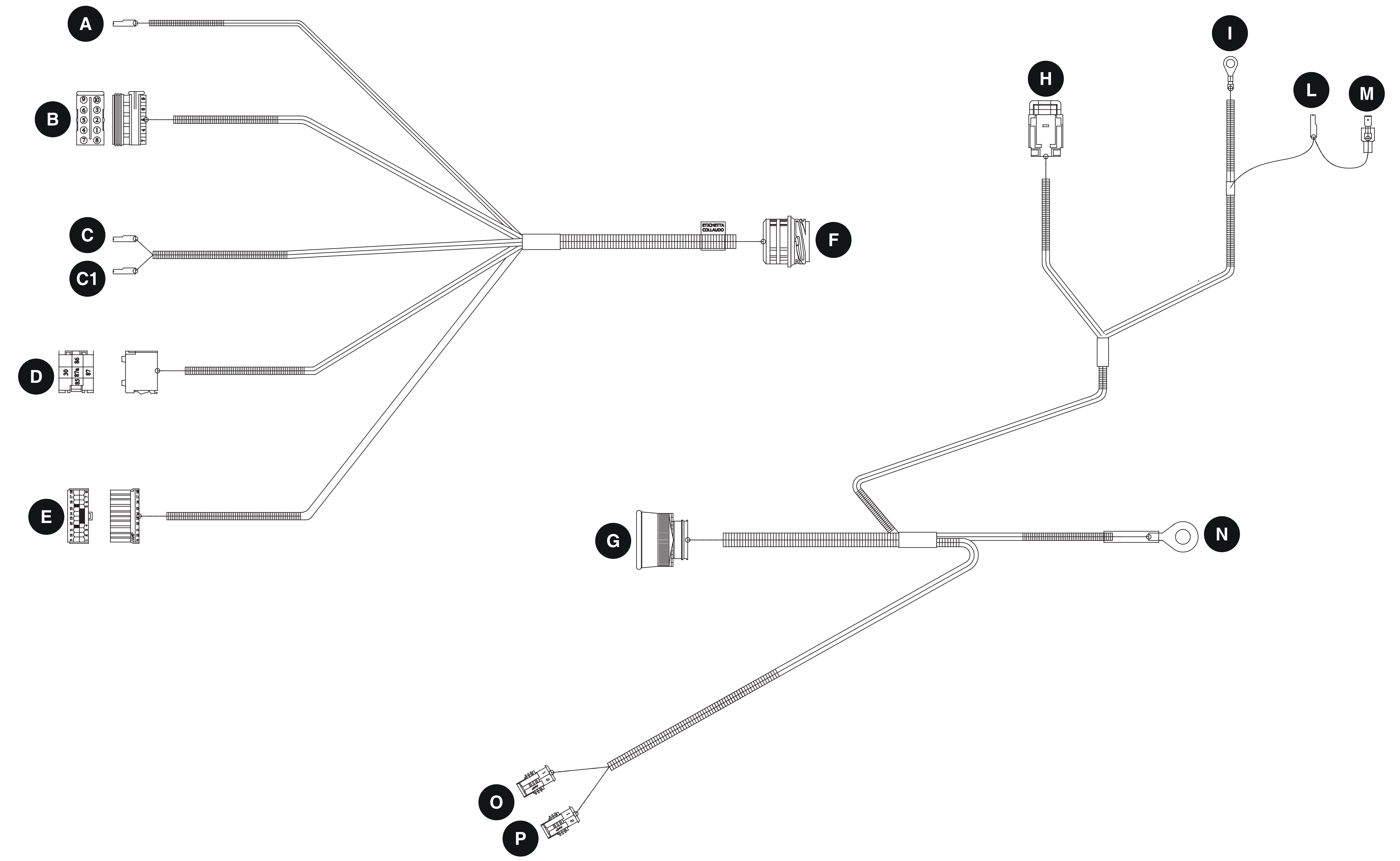


Fig. 10.29

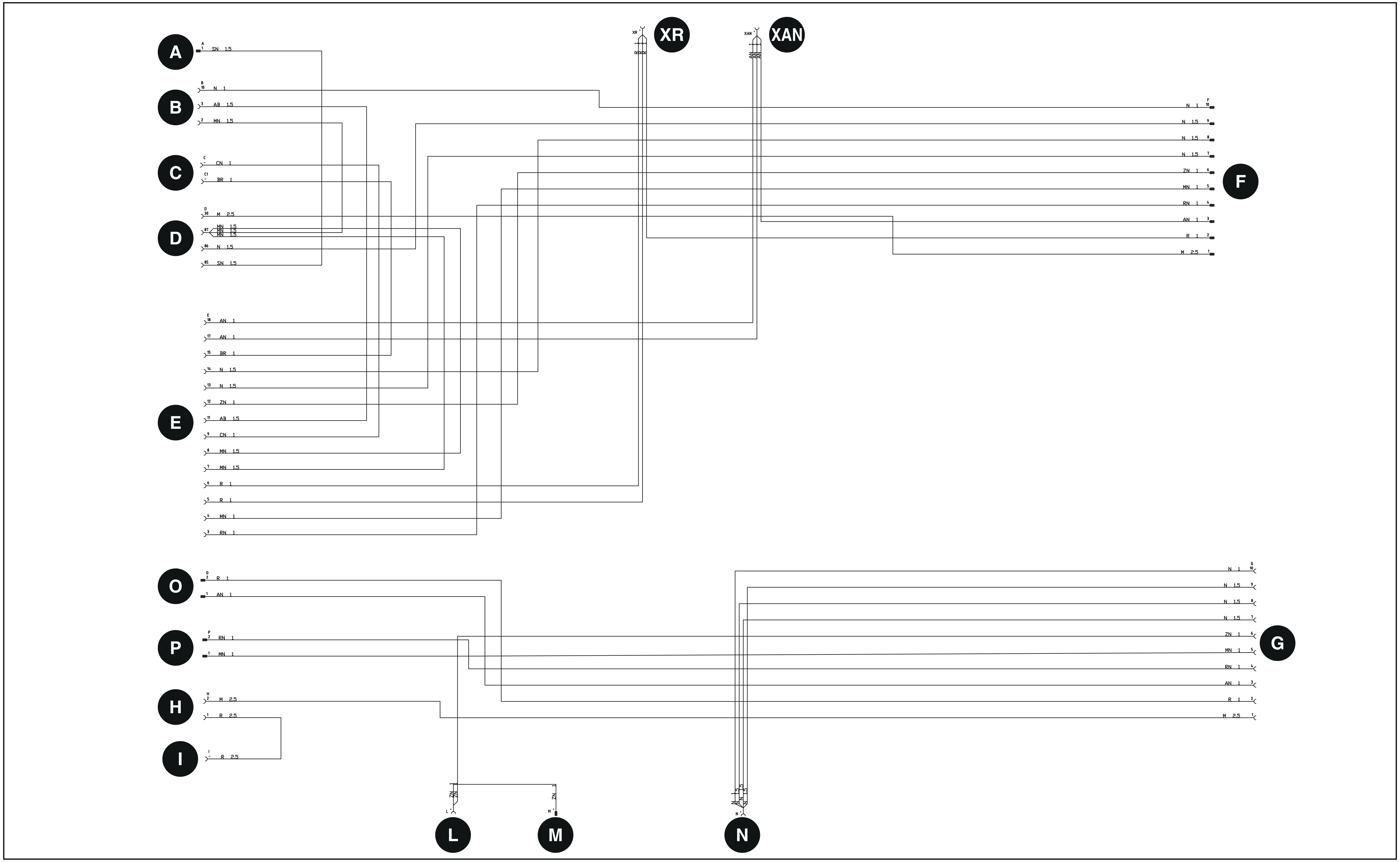


Fig. 10.30

A - +15 relay power feed
B - PTO switch
C - PTO indicator lamp
D - Wiring loom power feed relay
E - PTO control unit
F - Instrument side disconnector
G - PTO disconnector
H - Wiring loom protection fuse
I - +30 power feed, alternator
L - Alternator
M - Alternator
N - Earth
O - PTO connections
P - PTO connections
XR - Common junction
XAN - Common junction

4.5 02003822 - Bonnet lights line

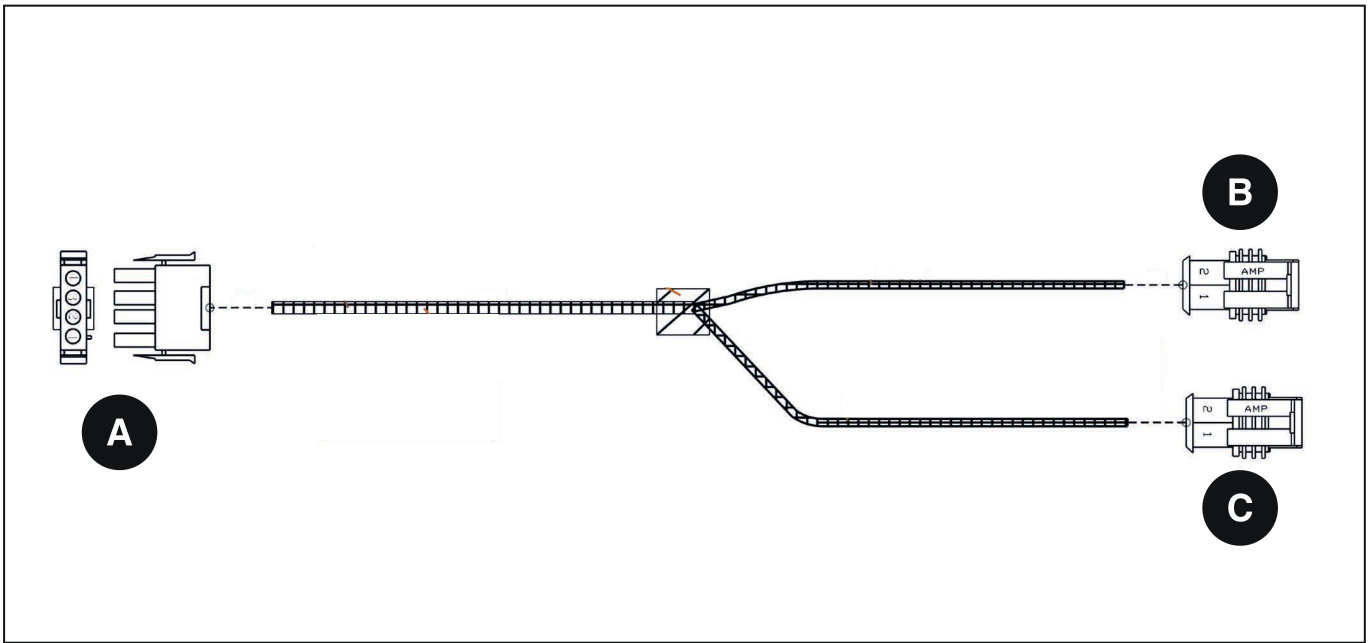


Fig. 10.31

A - +15 relay power feed
B - PTO switch
C - PTO indicator lamp

Chapter 11 : Cab

Index

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

When using adhesives or detergents, follow the safety and usage instructions provided by the manufacturer.

Danger

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

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.

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

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.

Danger

Always wear protective eyewear and gloves when handling refrigerant.

Avoid skin contact with refrigerant.

Danger

Implements used to handle refrigerant must be used in an adequately ventilated environment, in which the entire volume of air is exchanged at least four times every hour.

Danger

Do not use implements for handling refrigerant in the vicinity of unsealed or leaking recipients containing flammable substances.

Danger

Do not tamper with or modify the vent and safety valves of the containers and implements used for collecting and treating refrigerant.

Danger
Do not fill any recipient (cylinders, A/C system charging equipment or other storage containers) with refrigerant unless it is approved for this purpose and equipped with a suitable safety relief valve.

Danger
Never fill any storage container beyond 80% of its total capacity.

Danger
Use extreme caution when disconnecting the service lines as they may still contain pressurised refrigerant.

Section 2 : Technical characteristics

Index

2.1 Technical characteristics

Refrigerant

Type	R134
Quantity	0.8 kg

Section 3 : Removing and refitting

Index

3.1 Preliminary operations

Warning
Before removing the cab, discharge all the gas contained in the air conditioning system.

3.2 Removing procedure for GL12 cab

Remove the lateral covers (8).

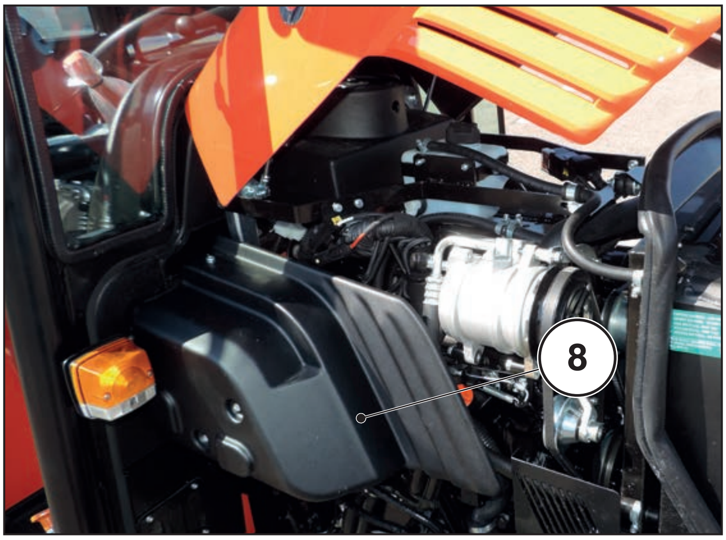


Fig. 11.1

Undo the four fastener screws of the cab (9). Two of these screws are situated at the front of the cab, the other two are at the rear.

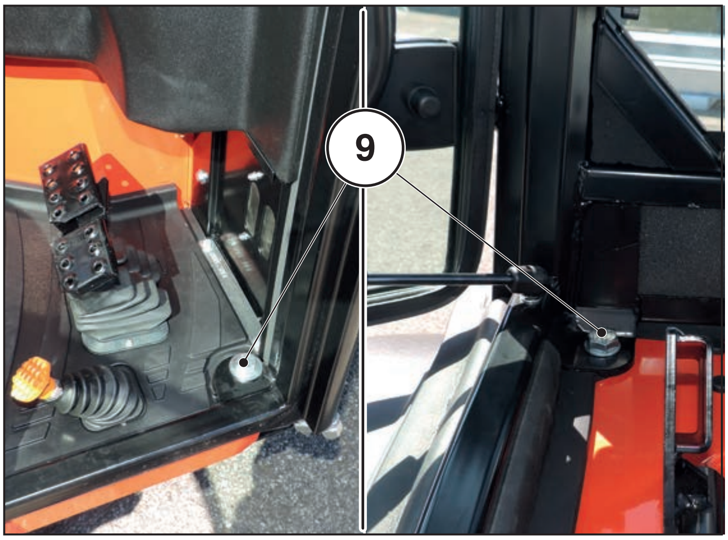


Fig. 11.2

Remove the compressor belt (10). Undo the screws fastening the compressor (11).

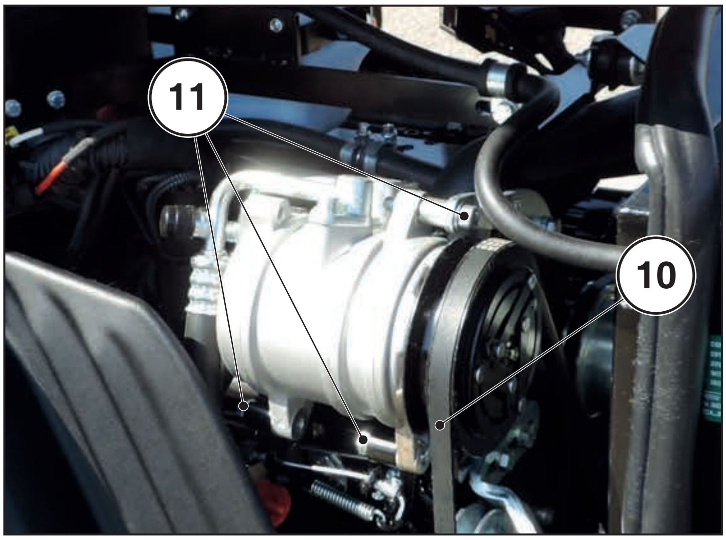


Fig. 11.3

Remove all the clamps fastening the A/C pipes (12) and the positive-negative cable (13).

Disconnect the water pipes.

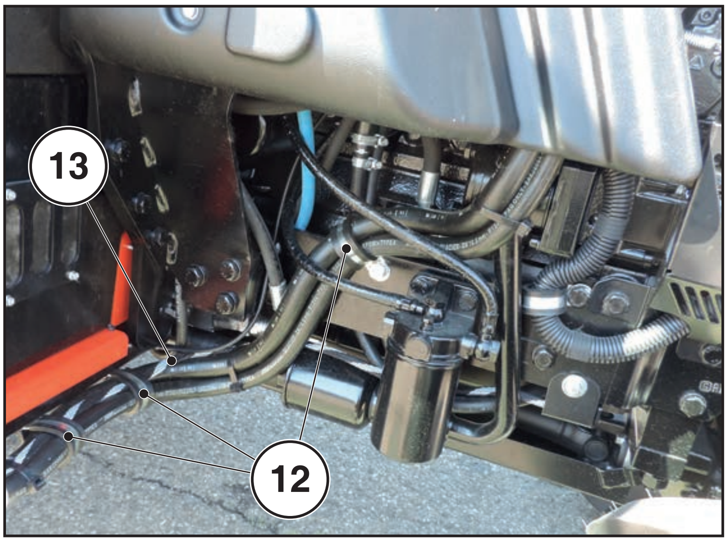


Fig. 11.4

Undo the nut (14) and remove the ground lug terminal.

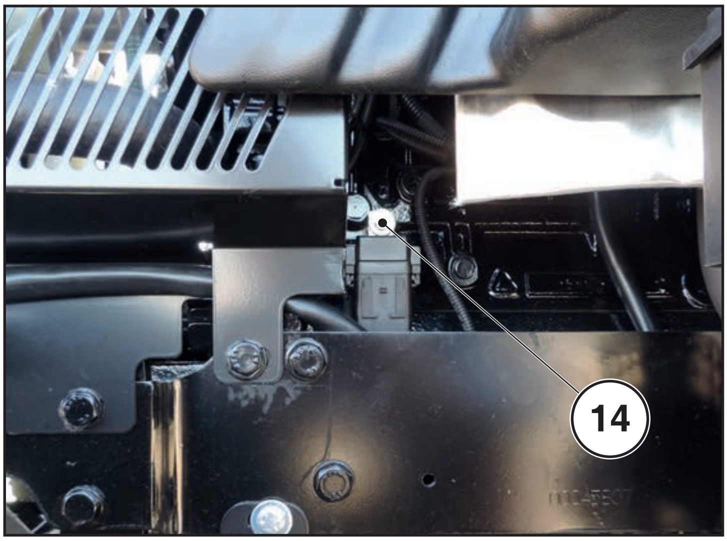


Fig. 11.5

Disconnect the positive cable (15).

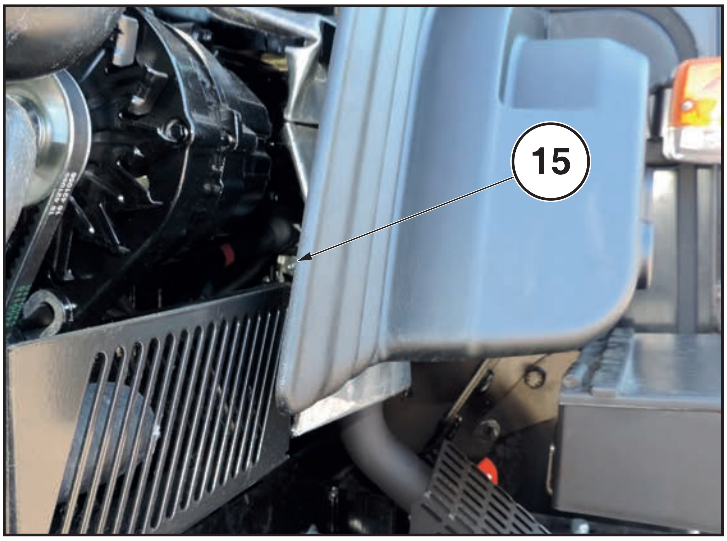


Fig. 11.6

Undo the four screws (16)

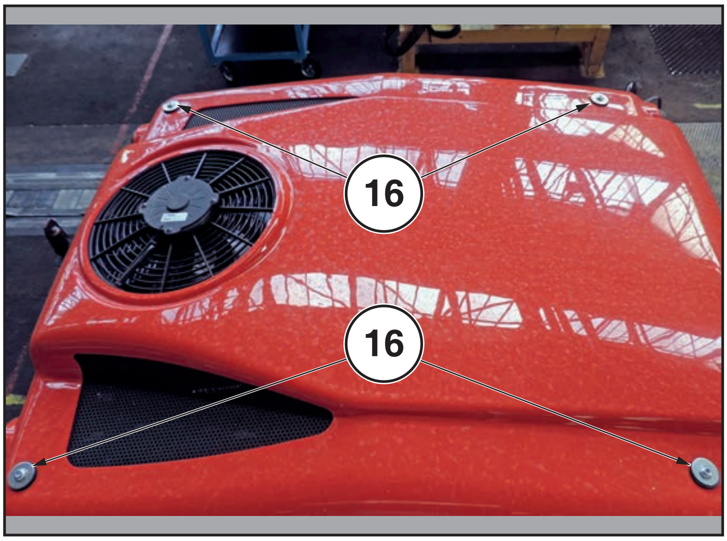


Fig. 11.7

Remove the cover (17).

Fit and tighten the four hoisting eye-bolts (18).

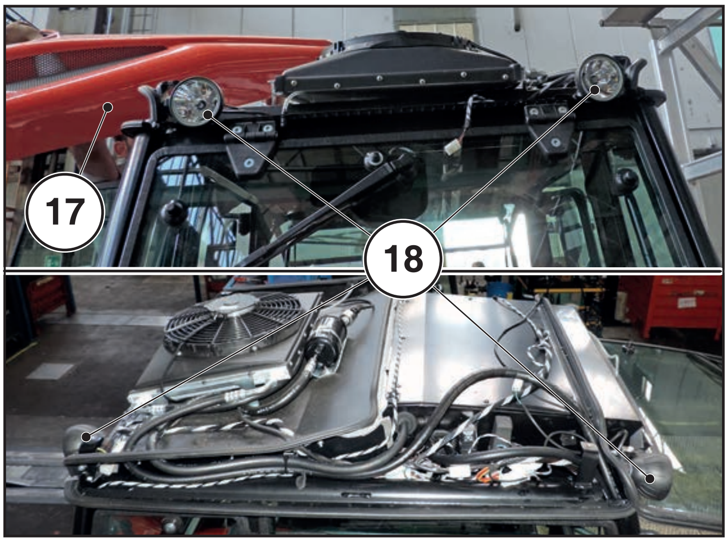


Fig. 11.8

Use the tool (A-07007181) to lift the cab.

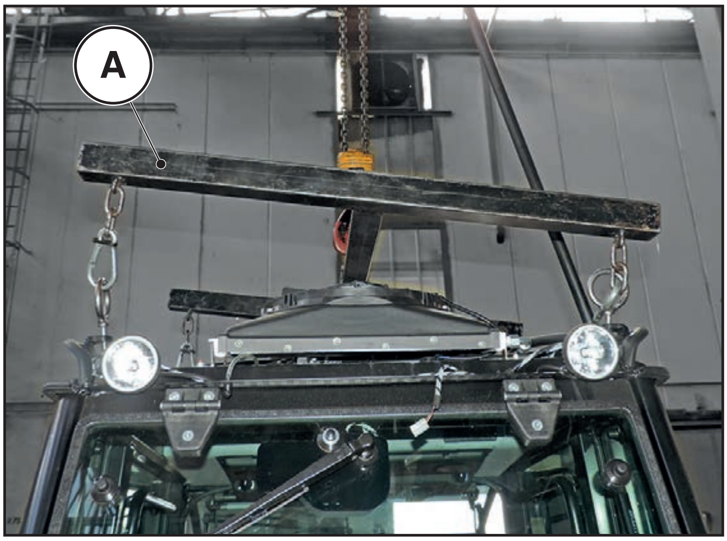


Fig. 11.9

3.3 Reassembly procedure for GL12 cab

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".

Refit the cab by following the procedure for removal in reverse order.

Section 4 : Air conditioning system

Index

4.1 General description

4.1.1 Basic concepts

4.1.1.1 Introduction

Before describing the practical and theoretical aspects of air conditioning and air conditioning systems, it has been decided to give a brief presentation of some of the most important basic principles of elementary physics.

Increasing numbers of tractors are now equipped with an air conditioning system. It is therefore crucial that today's repair technicians acquire an adequate theoretical understanding of the fundamental principles concerning refrigeration systems in order to repair and service these systems with the competence necessary.

4.1.1.2 Pressure

In general, **pressure** is a physical quantity defined by the ratio between a given force with a vector perpendicular to a surface and the area of the surface itself (e.g.: 1 Kg over 1 cm2 of horizontal surface).

The **atmospheric pressure** in any given point of the atmosphere is the weight of the air column of unitary cross section (e.g.: 1 cm2) extending upward from this point to the upper limit of the atmosphere itself. The atmospheric pressure therefore decreases as the altitude of the measurement point increases (e.g.: the atmospheric pressure in the mountains is lower than the atmospheric pressure at sea level).

The most commonly used unit of measurement for pressure in the past was the **atmosphere**, whereby one atmosphere is equal to the atmospheric pressure at sea level in 'Normal Atmospheric Pressure' conditions, and is equivalent to the pressure exerted by a column of mercury (Hg) of unitary cross section measuring 760 mm in height measured at 0°C, at sea level and at latitude of 45°. This unit of measurement is denominated "**physical atmosphere**" and is represented by the symbol **atm**.

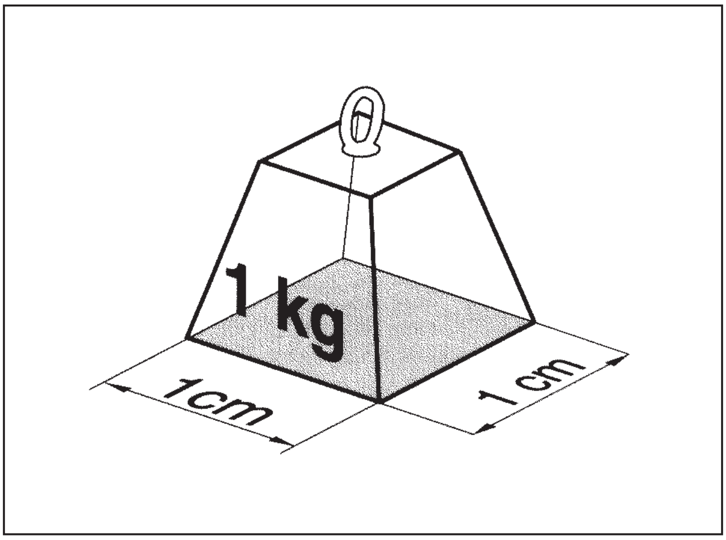


Fig. 11.10

The instrument used to measure the pressure of fluids is the pressure gauge (Fig.11.11).

Differential pressure gauges are normally used in technical applications, as they indicate the difference in pressure between the pressure of the environment measured and atmospheric pressure.

On a differential pressure gauge (regardless of the unit of measurement used), the “0” reading on the scale corresponds to atmospheric pressure. As a result, the pressure value read by the pressure gauge is denominated "relative pressure".

Conversely, on pressure gauges with a scale on which "0" corresponds to an absolute vacuum and "1" corresponds to normal atmospheric pressure, the pressure value read is denominated "absolute pressure".

Absolute pressure is therefore the sum of the indicated relative pressure and normal atmospheric pressure (by definition = 1).

A relative pressure lower than normal atmospheric pressure is called a negative pressure or vacuum. Negative pressures are measured with a vacuum meter (Fig.11.12).

Conversion factors between most commonly used 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

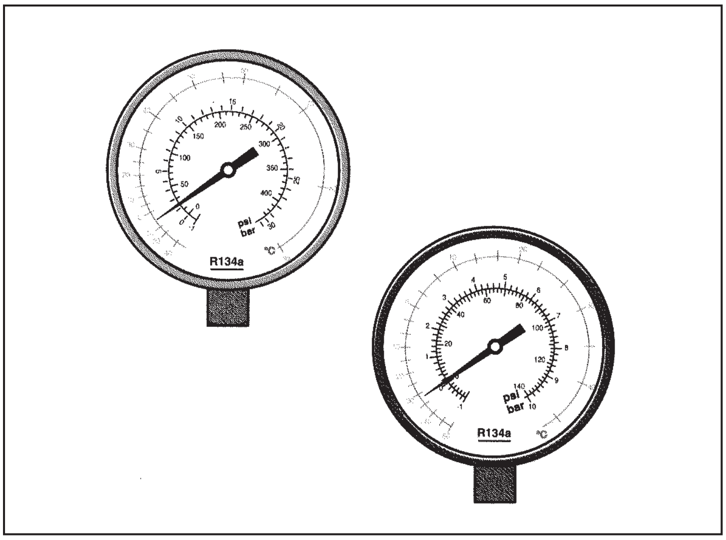


Fig. 11.11

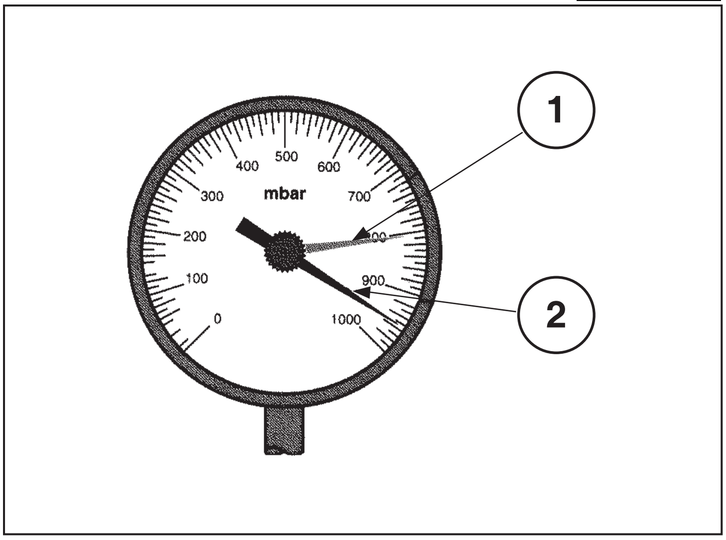


Fig. 11.12

1 - reference pointer
2 - pressure reading pointer

4.1.1.3 Heat and temperature

The terms heat and temperature are regularly used in daily life.

One may say, for example, that a flame or the sun gives heat, and that therefore, these are heat sources.

Or, one could say the temperature of a an object that feels hotter than another to the touch is higher than that of the other object.

To clarify the meanings of the terms heat and temperature, so that they may be used correctly, more precise definitions of these terms are given as follows, with explanations of their main properties. The units of measurement for heat and temperature (which are largely interdependent) are also indicated.

Heat

Heat is a form of energy (thermal energy) occurring, albeit in different quantities, in all objects in the natural world.

The quantity of heat exchanged between different bodies cannot be measured directly, and may only be determined on the basis of the effects caused (e.g. variation in temperature, change in physical state, chemical reactions, production of mechanical work etc.).

The traditional unit of measurement for heat is the small calorie (cal), which is defined as follows: the quantity of heat necessary to increase the temperature of 1 gram of distilled water by 1°C (from 14.5 to 15.5 °C) at normal atmospheric pressure and at sea level.

In practice, however, the large calorie (Cal) or kilocalorie (kcal = 1000 cal) is generally used. This is defined as: the quantity of heat necessary to increase the temperature of 1 kilogram of distilled water by °C (from 14.5 to 15.5 °C) at normal atmospheric pressure and at sea level.

The unit of measurement for heat in use in the UK and US is the British Thermal Unit (BTU):

1 BTU = 0.252 kcal

However, neither the calorie nor the BTU are accepted units of measurement in the International System of units (SI), according to which the unit of measurement for heat is the Joule (J):

1 J = 0.000239 kcal = 0.000948 BTU

Other conversion factors between the units of measurement indicated above are given as follows:

- 1 cal = 4.186 J
- 1 kcal = 4186 J = 4.186 kJ
- 1 kcal = 3.968 BTU
- 1 BTU = 1054.87 J

In refrigeration and air conditioning systems and in the refrigeration industry in general, the commonly used unit of measurement for heat is the frigorie, which is defined as a quantity of extracted heat equivalent to 1 kcal.

In the UK and the US, the unit of measurement for refrigeration is the ton of refrigeration (which equates to 288000 BTU of extracted heat per day). The relation between these units is as follows:

1 ton = 12000 BTU/h = 3027 kcal/h = 12672 kj/h = 3.52 kW.

Temperature

The temperature of a body indicates the concentration of heat contained within the body itself, provided that both the mass (quantity of matter) and volume of the body remain the same.

Temperature is generally expressed in degrees.

As temperature may be measured according to different scales, the interval of temperature corresponding to 1 degree is different for different scales.

The most commonly used scales are Celsius and Kelvin.

The Celsius scale was obtained by dividing the temperature interval between the melting point of ice (0°C) and the boiling point of water (100°C) (for distilled water at normal atmospheric pressure and at sea level) into 100 equal parts. The degree Celsius is represented by the symbol °C. On the Celsius scale, the temperature at which there is a complete absence of heat is –273.16 °C.

The Kelvin scale uses the same temperature intervals as the Celsius scale (i.e. the interval between the melting and boiling points of water divided by 100), but starts (0 K) at absolute zero (total absence of heat). As a result, the Kelvin scale is an absolute temperature scale. According to the Kelvin scale, the temperature of

melting ice is 273.16 K, while the temperature of boiling water is 373.16 K. The unit of measurement in the Kelvin scale is expressed with the symbol K.

In the UK and US, the Fahrenheit scale is used, according to which the temperature of melting ice is 32°F, the temperature of boiling water is 212°F and the temperature of absolute zero is – 459.67°F. The degree Fahrenheit is represented by the symbol °F.

Fig.11.13 compares a number of different temperature scales: Fahrenheit (°F), Celsius (°C), Réaumur (°r), Kelvin (K) and Rankine (°R).

The formulae for converting temperature values between different scales are given in this table.

scales	conversion formulae
°F > °C	°C = (°F-32) / 1.8
°F > °C	°F = (°C x 1.8) + 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

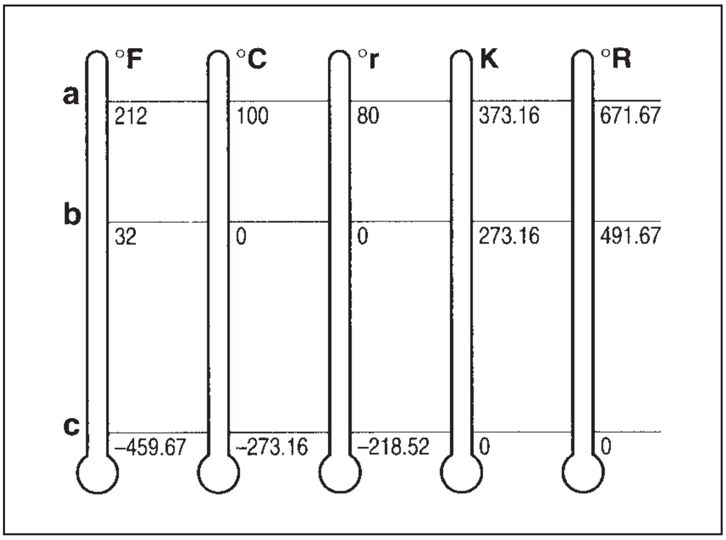


Fig. 11.13

a - boiling point of water
b - freezing point of water
c - absolute zero

Principles and modes of heat transfer

The main principle of heat transfer states that, between two bodies of different temperature, heat will move spontaneously from the body at a higher temperature to the body at the lower temperature or, within a single body of non-uniform temperature, heat will move spontaneously from warmer points to cooler points.

The transfer of heat from a cooler body to a warmer body can only occur if forced, and requires the expenditure of energy.

The quantity of heat which may be ran transferred over a unit of time from a warmer body to a cooler body is directly proportional to the difference in temperature.

There are three fundamental modes in which heat may be transferred between bodies at different temperatures:

- Conduction
  Takes place though contact between two bodies, without the movement of matter (typically between solid bodies).
- Convection
  Takes place through the movement of matter (typically in fluids).
- Radiation
  Takes place between different bodies that are not in contact through electromagnetic radiation (and infrared light in particular), even if there is a complete vacuum (no matter) between the bodies themselves.
  The most significant example of this in nature is how the sun's radiation heats the earth.

4.1.1.4 Influence of heat on transformations in the physical state of matter (at constant pressure)

To make the general considerations on the principles concerned in this topic discussed later in this chapter easier to understand, and illustrate how they are applicable in the operation of an air conditioning system, before moving onto the principles themselves, the following simple experiment is described as an example, in which it is possible to observe a number of physical phenomena occurring in a given substance (in this case water) when heat is applied.

This experiment takes place at sea level and at normal atmospheric pressure (760 mmHg = 1 Atm absolute), and requires a container, a source of heat (e.g. a flame), a thermometer and 1 kg of distilled water.

Experiment

Before the experiment starts, the water is placed in a freezer and allowed to transform into ice (solidify). The block of ice is then transferred to a container, the bulb of the thermometer is placed in contact with the ice and the container is placed on the flame (Fig.11.15 a-b).

At the start of the experiment, the thermometer indicates the temperature of the ice as it was removed from the freezer, e.g.: – 10°C.

As time passes, it is noted how applying heat causes the temperature of the ice itself to progressively rise, and the reading can be seen to increase, to –9°C, –8°C and so on up to 0°C.

Drops of liquid water now start to appear on the surface of the ice (Fig.11.15 c), indicating that the ice has started to melt. This process continues (Fig.11.15 d) until there is no remaining water in the solid phase and all the water in the container is in liquid state (Fig.11.15 e).

Observing the thermometer, it can be seen that the reading indicated remains at a steady 0°C throughout the entire duration of the melting process.

If heat is continued to be applied, while holding the bulb of the thermometer immersed in the water, the temperature reading will now rise continuously (Fig.11.15 f) until, as shown in (Fig.11.15 g):

- the thermometer indicates 100°C,
- while simultaneously, turbulent motion is generated in the water as a large quantity of steam is released.

The water has now started to boil (vaporise). This phenomenon continues until there is no trace of liquid water remaining.

If the bulb of the thermometer is held in contact with the boiling water during the interval of time from when the water starts to boil to when all the water has turned to vapour, it can be seen that the temperature indicated remains at 100°C.

If all the steam produced is collected in a suitable recipient (Fig.11.15 h) and we continue to apply heat, all the liquid will disappear (Fig.11.15 i), after which the temperature of the steam will progressively rise beyond 100 °C (Fig.11.15 l).

The different stages in the experiment are represented in the graph in Fig.11.14.

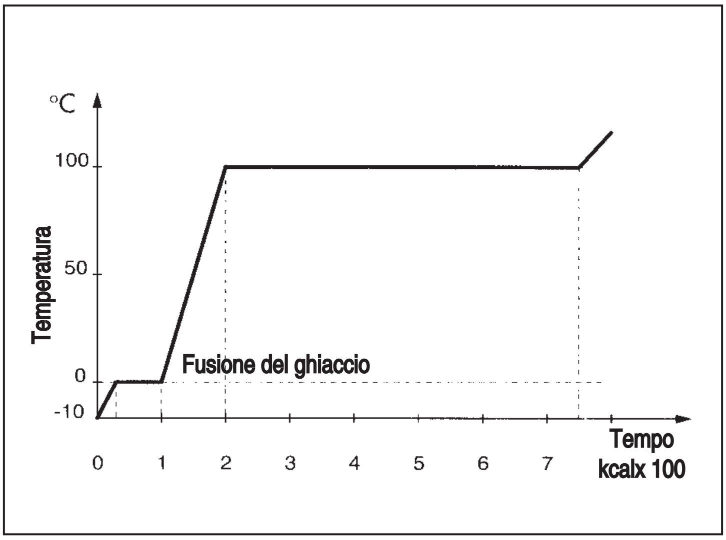


Fig. 11.14

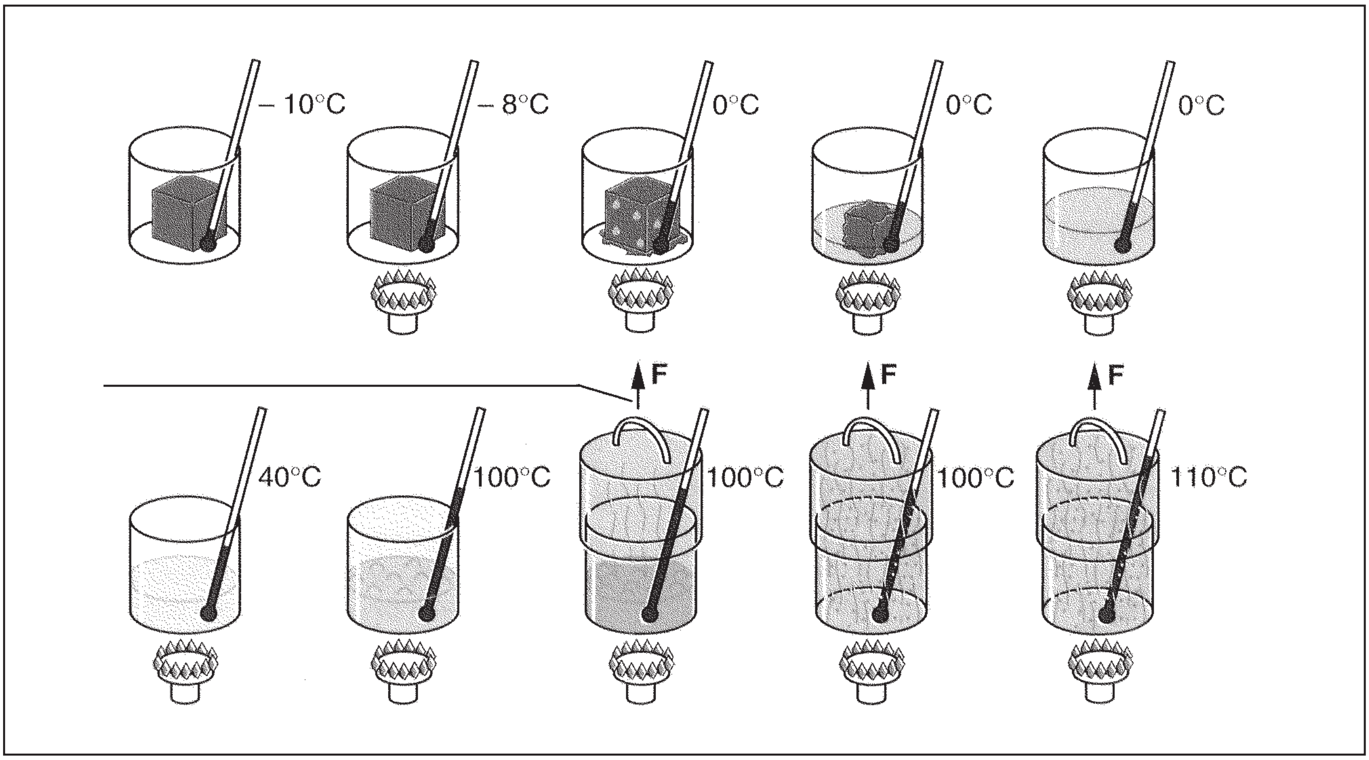


Fig. 11.15

During this experiment, two transformations in physical state were caused by applying heat only and without altering pressure:

- from solid (ice) to liquid —► fusion
- from liquid to vapour —► vaporisation

It was also observed that applying heat to the substance when in one phase only (solid, liquid or vapour) produced the following increases in temperature in the substance itself (water):

- from – 10°C to 0°C, for the solid phase (ice)
- from 0°C to 100°C, for the liquid phase
- beyond 100°C, for the steam (water in gaseous state).

The heat applied in these intervals, which produces a variation in temperature, is called sensible heat.

It was also noted that during the two transformations in physical state (fusion and vaporisation), the heat applied did not produce a variation in temperature, which remained at a steady:

- 0°C during fusion,
- and 100°C during vaporisation.

The heat exchanged in these intervals is called latent heat of fusion and of vaporisation. It is called latent, or hidden, because it causes no variation in temperature.

The vapour existing together with the liquid phase at the temperature of vaporisation is called saturated vapour.

Vapour existing without the liquid phase at temperatures above the temperature of vaporisation is called superheated vapour.

If this experiment is now repeated in reverse, starting with superheated vapour and subtracting heat, the water assumes the following states in the sequence indicated: saturated vapour at 100°C, liquid at 100°C, liquid at 0°C, solid (ice) at 0°C, solid at temperatures below 0°C (e.g. – 10°C).

The transformation from saturated vapour to liquid water is called condensation, and the heat subtracted is the latent heat of condensation.

The different transformations in physical state are summarised in Fig.11.16 and the relative forms of heat exchanged are shown in Fig.11.17.

If the experiment is performed using a constant heat source, and assuming that all the heat produced by this source is transferred to the substance, then the quantity of heat exchanged is proportional to time and, as a result, it can be seen (Fig.11.15) that the quantity of heat absorbed by the substance during the transformation of physical state from liquid to saturated vapour (latent heat) is significantly greater than the quantity of heat absorbed in heating the liquid substance from 0°C to 100°C (sensitive heat).

In the case of this example, 1 Kg of water: requires approximately 100 kcal (418.6 kj) of energy to increase in temperature from 0°C to 100°C; and approximately 540 kcal (2260 kj) to evaporate.

Analogous conclusions may be made if the experiment is performed in reverse, subtracting heat instead of applying heat.

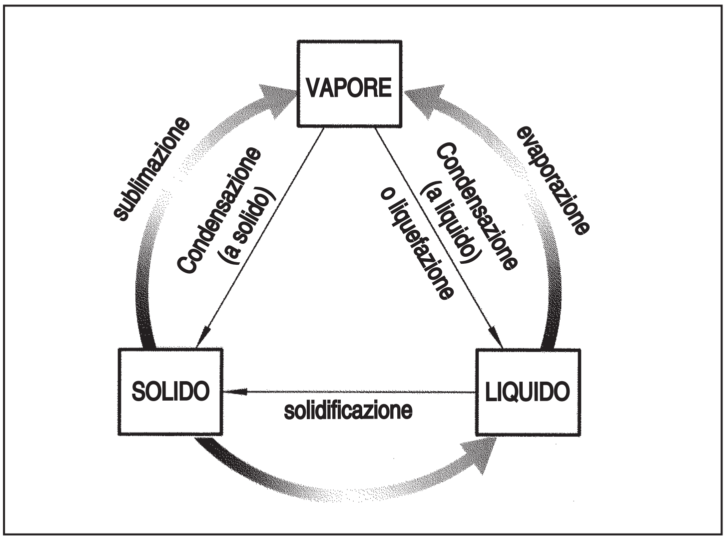


Fig. 11.16

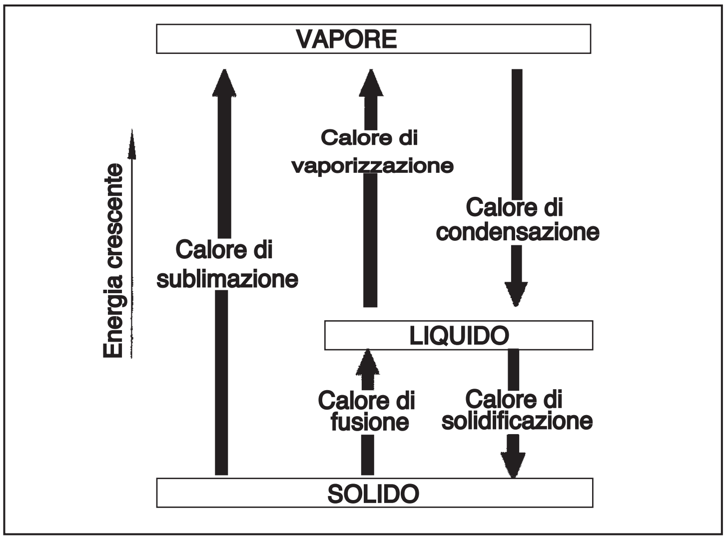


Fig. 11.17

Observations

From the above, it is evident that for a given mass of a given substance, the quantity of heat necessary to transform physical state, at constant pressure, much greater than the quantity necessary to change the temperature from the end of one state to the beginning of the next (e.g.: from the end of fusion to the start of vaporisation or vice versa).

This fundamental property of matter is used to make an air conditioning system work (refrigeration cycle).

Note: Solids which melt at a precise temperature (fusion point) are said to have a crystalline structure.
A non-crystalline or amorphous solid, on the other hand, (e.g. glass or plastic), softens gradually and changes to fluid state over a variable temperature interval when heated.

4.1.1.5 Influence of pressure on transformations in the physical state of matter

The experiment described in the previous paragraph demonstrated that if a given quantity of water is maintained at a constant pressure (p) of 1 bar absolute, it will boil when it reaches a temperature of 100°C (Fig.11.18 a).

If pressure is generated above the liquid the recipient – e.g. by applying a force F to a plunger sealed tightly against the walls of the recipient (Fig.11.18 b) - exceeding 1 atm abs, it will be seen that the water boils at a temperature higher than 100°C.

Conversely, if a pressure below 1 atm absolute (depression) is created in the recipient – e.g. by raising the piston (Fig.11.18 c) - the water will boil at a temperature lower than 100°C.

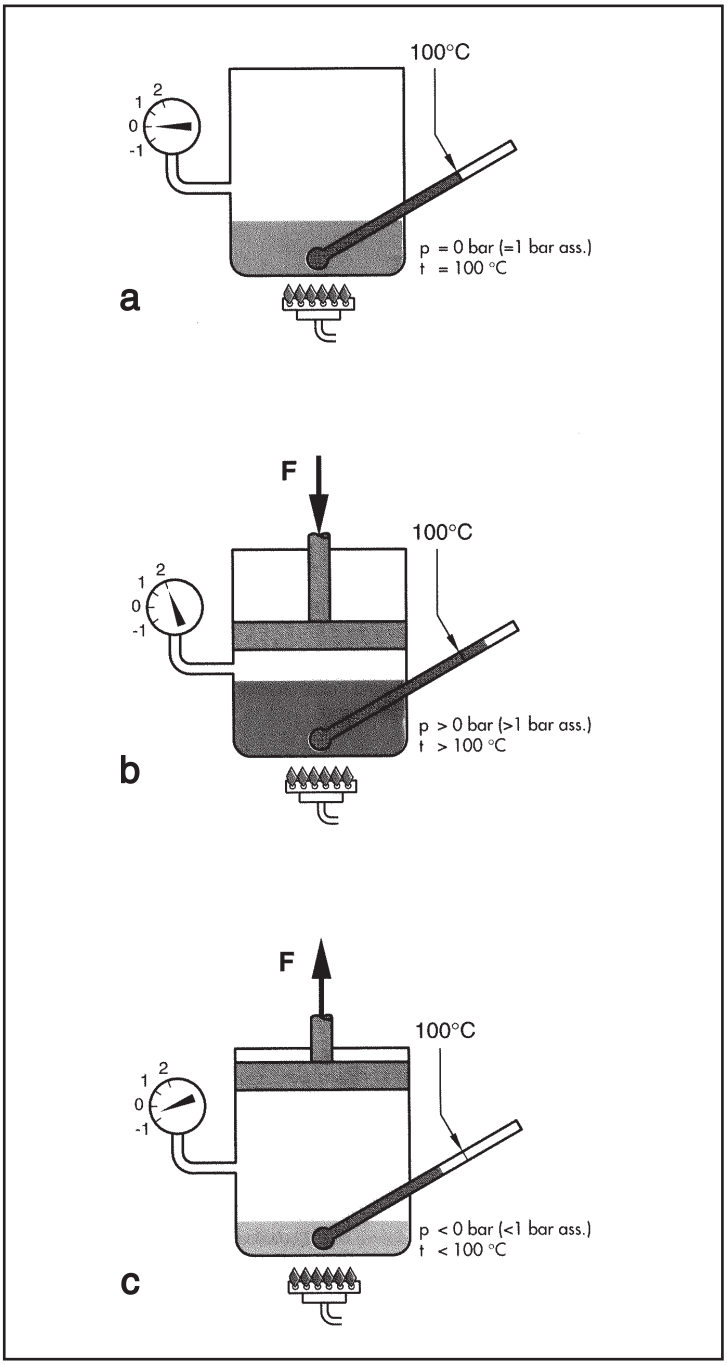


Fig. 11.18

This test may be repeated a significant number of times in different conditions to produce a graph (Fig.11.19), in which the curve (Z) represents all the temperature/pressure conditions in which the liquid state and the saturated vapour state of water are in equilibrium. In these combinations of pressure and temperature conditions, adding heat will transform the liquid into vapour, while subtracting heat will transform the vapour into liquid.

p - absolute pressure (bar)

t - temperature (°C)

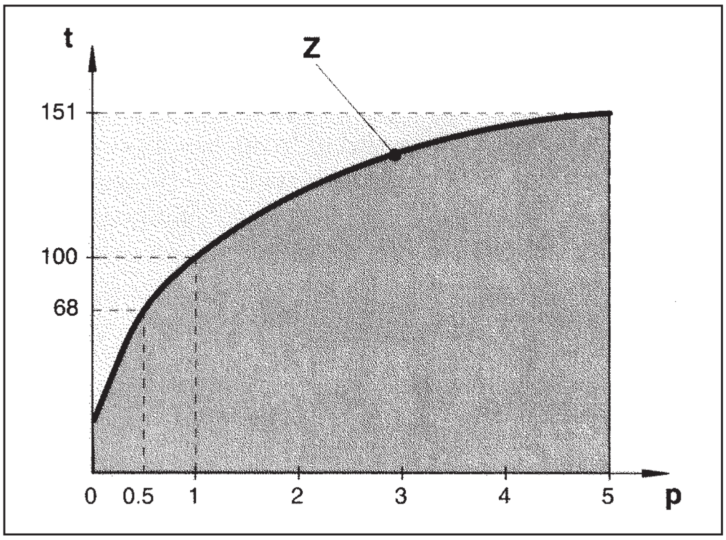


Fig. 11.19

4.1.1.6 Relation between temperature, pressure and volume in aeriform fluids

With regards to the aeriform fluids (gases and vapours) used in technical applications, a number of physical laws defined for ideal gases may be considered to apply, albeit with some degree of approximation.

These laws are summarised by the equation of state for an ideal gas:

$PV = RT$

where P = pressure, T = absolute temperature, V = volume, R = universal constant.

In practice, this means that altering any one of the quantities will change at least one of the other two.

The following principles are used in the refrigeration cycle:

- a reduction in volume (compression) causes an increase in pressure and temperature;
- an increase volume (expansion) causes a reduction in pressure and temperature.

Specifically, for a given mass of a given substance, this means that:

- at constant temperature,
  - an increase in volume reduces pressure;
  - a decrease in volume increases.
- at constant pressure,
  - an increase in temperature increases volume;
  - a decrease in temperature increases volume.
- at constant volume,
  - an increase in temperature increases pressure;
  - a decrease in temperature increases pressure.

4.1.1.7 Humidity

Generally, the term humidity is intended as the percentage ratio between the weight (or volume) of the water existing in a body and the weight (or volume) of the body itself.

Atmospheric air is a mixture of dry air and water vapour, and the quantity of this water vapour contained in the mixture is denominated atmospheric humidity.

Atmospheric humidity is measured with the following two different temperature values:

- dry bulb temperature (in °C), measured with a normal thermometer,
- and wet bulb temperature (in °C), measured with a thermometer, the bulb of which is covered in gauze soaked with water and ventilated.

The wet bulb temperature is always lower than the dry bulb temperature, as the water soaking the gauze evaporates, cooling the bulb itself.

These two temperature values may be used to determine:

- absolute humidity, defined as the mass of water vapour contained in a unit of volume of air, and expressed in grams of vapour per cubic meter of air;
- and relative humidity, defined as the percentage ratio between the mass of water vapour effectively existing in a given volume of air and the mass of vapour which would exist in the same volume of air in a saturated state, at the same temperature and pressure.

A relative humidity of 100% indicates a saturated state.

When saturated air cools, a proportion of the water vapour condenses, forming fog, rain or snow.

4.1.2 Operating principle of a refrigeration cycle

4.1.2.1 Description of the refrigeration and air treatment cycle

In this chapter, we will discuss the basic operating principle of an air conditioning system.

The extremely simplified schematic diagram in Fig.11.20 illustrates a closed circuit system consisting of the four indispensable components for the refrigeration cycle - evaporator (1), compressor (2), condenser (3) and expansion valve (4) - organised in their functional order, and of the tubing (5) connecting the components themselves.

The basic function of the system is to transfer heat from one environment (cabin) to another (the environment surrounding the vehicle). This is achieved by subjecting a refrigerant fluid, with which the system is filled, to a thermodynamic cycle consisting of pressure changes (in the compressor and expansion valve) and transformations in physical state (in two heat exchangers, namely the evaporator and condenser).

The basic principles of physics illustrated in the previous chapter may be used to explain each stage in this cycle. As an aid for understanding the concepts explained, another simplified circuit diagram (Fig.11.22), which is similar to the circuit shown in Fig.11.20, will be used as an example. Before continuing with the description of the cycle, however, to offer a clearer understanding of the pressure and temperature values mentioned, the pressure/temperature curve of R134a refrigerant - which is currently used in air conditioning systems for passenger vehicles and agricultural tractors - is given as a broadly generalised example (see Fig.11.21).

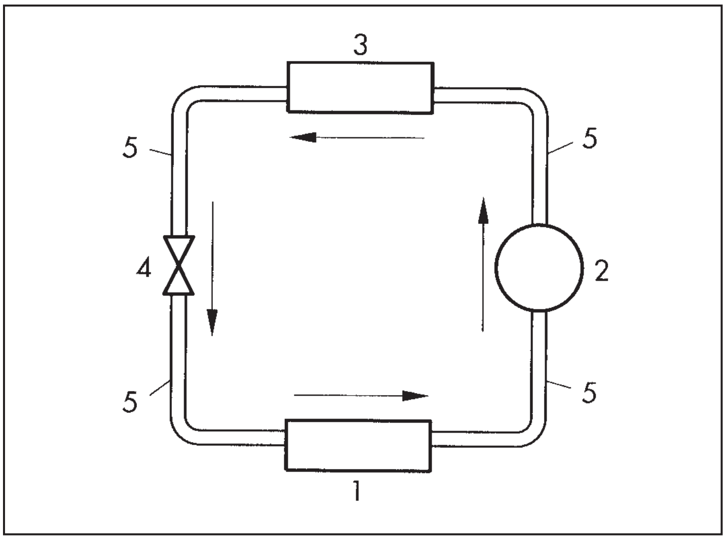


Fig. 11.20

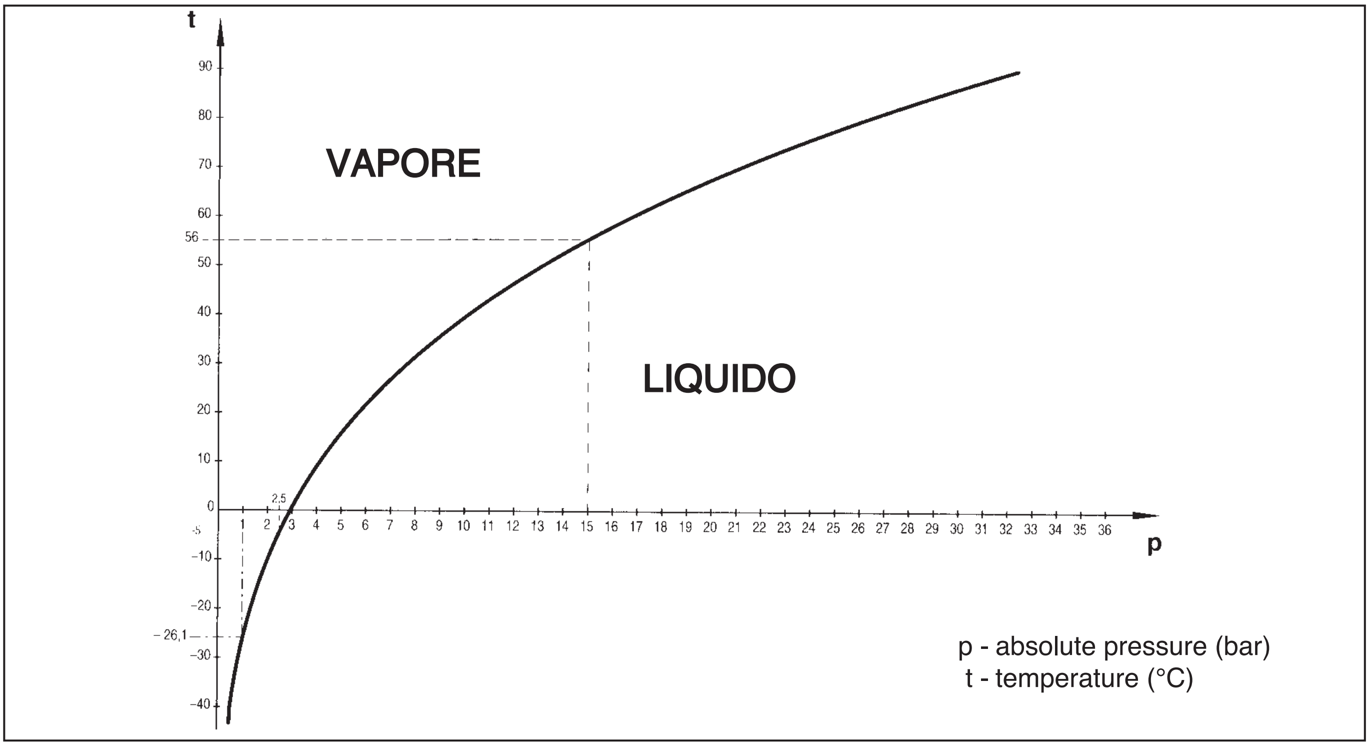


Fig. 11.21

While the subject of refrigerants will be dealt with in more detail in the next paragraph, from this diagram, it can already be seen that at a pressure of 1 bar abs. (atmospheric pressure at sea level), R134a has a boiling point of -26.1 °C and that therefore, very low temperatures may be obtained by expanding the refrigerant at low pressure. Conversely, even if compressed at relatively low pressures, the refrigerant can remain in a gaseous state at reasonably high temperatures (e.g.: p = 15 bar and t = 56 °C).

Another important characteristic of the refrigerant for this application is its high latent heat values of vaporisation and condensation (e.g. 51 kcal/kg at 1 bar abs.).

In essence, therefore, this substance has a number of characteristics that make it ideally suited to this application, as it allows an operating range from very low temperatures to relatively high temperatures and may be used at low pressure values, permitting the use of components that are not excessively heavy or bulky.

We shall now analyse the stages in the cycle, beginning from point A in the circuit (Fig.11.22), at the inlet side of the evaporator. As the function of the evaporator is to extract heat from the cabin, it may be situated within or be directly connected to the cabin. In order to extract heat, the temperature of the evaporator must be lower than that of the environment to be cooled, to allow heat to flow spontaneously from the (warmer) environment to the (cooler) evaporator. Suppose that at point A, the refrigerant is in liquid state at a pressure of 2.5 bar and, therefore, at a temperature of approximately -5 °C (Fig.11.21).

To cool the cabin:

- it must either be flushed with cold air
- or the air in the cabin must be extracted, cooled and returned to the cabin.

In the first case, external air is passed through the evaporator to cool it and then forced into the cabin to expel the hotter air.

In the second case, the air from the cabin is recirculated through the evaporator.

Consider a situation in which the external air surrounding the cabin is at a temperature of 25 °C.

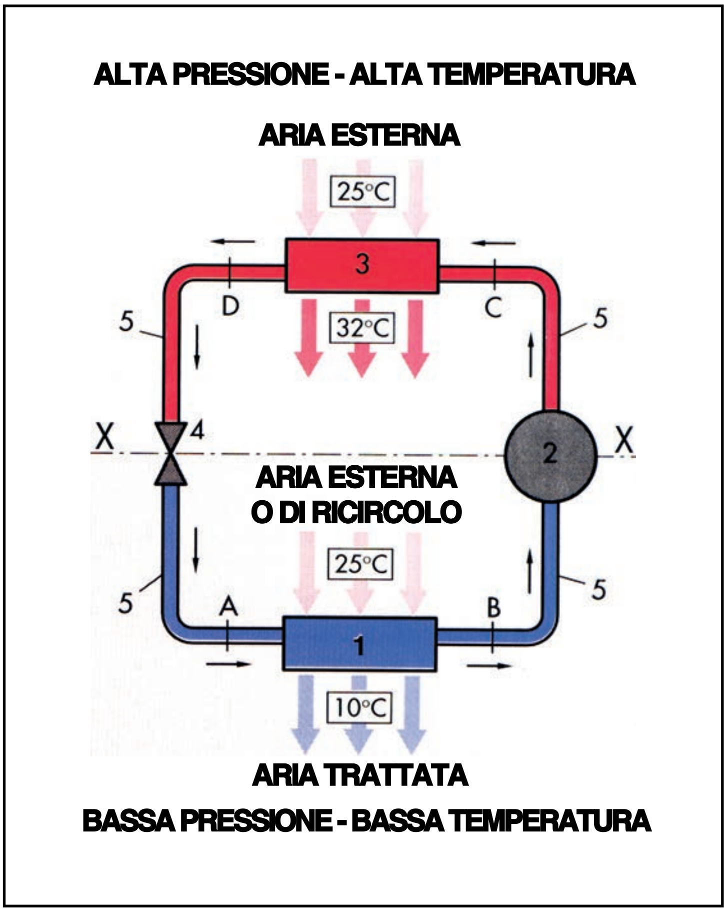


Fig. 11.22

Point A - p = 2.5 bar t = -5°C
Point B - p = 2.5 bar t = -5°C
Point C - p = 15 bar t = 56°C
Point D - p = 15 bar t = 56°C

The exterior air passes through the evaporator, the walls of which are at a temperature between 1 and 3 °C. As it is 22 to 24 °C warmer than the evaporator, the exterior yields part of the heat it contains to the evaporator itself, and cools from its initial temperature of 25 °C to 10 °C.

As it enters the cab, this treated air mixes with the existing air in the cabin, which is initially at 25 °C, and progressively lowers the air temperature.

Simultaneously, the refrigerant, which entered the evaporator with a pressure p of 2.5 bar and a temperature t of -5 °C, absorbs the heat extracted from the air at it passes through the evaporator, and transforms from liquid to gaseous state while remaining at the same pressure and temperature (latent heat).

At the outlet of the evaporator (Point B), the refrigerant is still at a pressure p of 2.5 bar and a temperature t of -5 °C, but is now in gaseous state and carries the quantity of heat yielded to it by the exterior air.

In order for the cycle to function continuously, as the circuit is sealed, the refrigerant leaving Point B must return to Point A in the same initial conditions (p = 2.5 bar, t = -5 °C).

For this to be possible, the refrigerant must first give up the heat it absorbed as it passed through the evaporator, and then returned to low pressure and low temperature.

The only way to give up this heat is to yield it the surrounding environment which, however, is at a higher temperature (25 °C). The temperature of the refrigerant must therefore be raised from –5 °C to a value greater than 25 °C, so that the heat itself may transfer spontaneously from the refrigerant to the exterior environment. This takes place in the compressor.

The compressor: aspirates the low pressure gaseous refrigerant received from the evaporator, compresses it and then delivers it to Point C at high pressure and high temperature (e.g. 15 bar, 56 °C).

The refrigerant, in gaseous state and still in approximately the same high pressure and temperature conditions in which it left the compressor, enters the second heat exchanger - the condenser - which yields the heat absorbed by the refrigerant in the evaporator to the exterior environment.

To ensure that this process occurs as efficiently as possible, the refrigerant transforms from gaseous state to liquid state at constant pressure and temperature, so that it is the latent heat of condensation that is released.

Note

While by extracting heat, the exterior air passing through the condenser increases in temperature (e.g. from 25 to 32 °C), it then mixes with the surrounding environment without perceptibly altering the conditions of the environment itself.

When it leaves the condenser at Point D, the refrigerant is in liquid state and no longer carries the heat absorbed previously. However, it is still at a higher pressure and temperature than the initial conditions at Point A. The expansion valve is used to reduce the pressure and temperature of the refrigerant.

This component essentially forms a constriction in the circuit, ahead of which the pressure and temperature of the refrigerant are high, whereas after the valve, as their is space for the refrigerant to expand, the refrigerant itself undergoes a drastic reduction in pressure (e.g. from 15 to 2.5 bar) and, as a result, in temperature (from 56 °C to -5°C), while remaining in liquid state (albeit nebulised).

The initial conditions have therefore been restored and the cycle may be repeated continuously as long as the compressor is running.

Note

From the above description, it can be seen that the system consists of a hot section and a cold section.

These two sections are separated by the theoretical line X-X shown in Fig.11.22, cutting through the compressor and the expansion valve.

This separation is one of the fundamental elements to be taken into consideration when testing or troubleshooting the circuit.

4.1.2.2 Notes and comments

The process described above is extremely simplified. As a result, a number of additional notes are given as follows to explain how the principles of physics described in the previous chapter apply, along with comments explaining, at least in elementary form, the main differences between this simplified process and a real system which may be encountered in practice.

Heat exchange

Heat is exchanged between the different bodies involved in the cycle (air, components of the A/C or climate control system) and within the bodies themselves in the following modes:

- from the air to the outer walls of the evaporator (by conduction)
- from the outer walls of the evaporator to the inner walls, and from the inner walls of the evaporator to the refrigerant (by conduction)
- within the refrigerant and during the transit of the refrigerant from the evaporator to the condenser
- via the compressor (by convection)
- from the refrigerant to the inner walls of the condenser (by conduction)
- from the inner walls of the condenser to the outer walls of the condenser (by conduction)
- from the outer walls of the condenser to the air flowing through the condenser, and from this air to the external environment (by convection and radiation).

  Note: Heat is also exchanged between the interior of the system and the surrounding environment through the walls of the pipes and filter. This heat exchange decreases the overall efficiency of the system, albeit by only a small degree.

Practical notes

For simplicity, the pairs of temperature and pressure values used as examples are considered to remain constant in both sides of the system (cold and hot) in relation to the conditions of the refrigerant.

In reality, however, the following considerations must be taken into account:

a - in heat exchangers, there is some difference in temperature between the inner and outer surfaces (e.g. an inner temperature of – 5 °C and an outer temperature of + 2 °C in the evaporator; an inner temperature of + 56 °C and an outer temperature of + 50 °C in the condenser)

b - there are differences between the temperature of the refrigerant entering and leaving the heat exchangers attributable to the fact that the components of the system are sized and calibrated to ensure that:
- the refrigerant leaves the evaporator and reaches the compressor in completely gaseous state (as the compressor is specifically constructed to work with gaseous substances only and not with liquids).
  To ensure this, the gaseous state refrigerant must be slightly superheated to a temperature slightly above the saturated vapour phase (e.g. – 2 °C instead of – 5 °C);
- the refrigerant leaving the condenser is completely in the liquid state, to optimise efficiency. As a result, the temperature of the refrigerant must be slightly lower than the condensation point temperature at the pressure considered (e.g. 52 °C instead of 56 °C: supercooled liquid);

c - other differences of a few degrees more on the cold side and a few degrees less on the cold side must be taken into account as a result of heat exchange occurring along the lines from the heat exchanger to the other (see previous note);

d - the refrigerant may sustain a loss in pressure along the circuit as a result of friction, turbulence etc. (loss of charge); additional positive or negative variations in pressure other than those produced by the expansion valve and the compressor are attributable to the aforementioned exchange heat taking place along the circuit and outside the heat exchangers;

e - The energy expended to operate the compressor (usually drawn from the engine of the vehicle) is transformed into heat. This is then yielded to the refrigerant and must be extracted together with the heat absorbed in the evaporator.

While the sequence of the components in the system will always be the same, in practice, their physical locations in the vehicle will be determined by the space available and by all other safety and functional constraints.

To prevent lost efficiency, however, it is vital that the expansion valve is placed within extreme proximity of the evaporator (to practically form a single unit).

The simplified diagram in Fig.15-12 shows the four main components of the system (evaporator, compressor, condenser and expansion valve), as, together with the refrigerant in the circuit, they are fundamental for the realisation of the thermodynamic cycle (refrigeration cycle).

In practice, however, the system contains another component - the receiver-drier - situated in series in the circuit between the condenser and the expansion valve. While this component performs a number of important functions, it is not involved in the thermodynamic cycle itself.

4.1.3 Main components of and air conditioning system

4.1.3.1 Refrigerant

This is the fluid used to fill the A/C or climate control system. It is the thermal vector which transports heat from the point in which it is extracted from the cabin (or, more correctly, from the air delivered to the cabin or recirculated within the cabin) by the evaporator, to the point in which it is yielded to the exterior environment by the condenser.

Up until a few years ago, the A/C systems of passenger vehicles generally used R12 refrigerant (which is still in use today, where available, for the maintenance of old systems), a product with the chemical formula CCl2+F2 (dichlorodifluoromethane) and by numerous manufacturers under a wide variety of brand names and product denominations.

Consisting of a molecule which includes chlorine (Cl), R12 belongs to the family of compounds (CFC) acknowledged as among the primary causes of the depletion of the stratospheric ozone layer and of the consequent damage to the global ecology, and which are therefore considered with particular concern by the international community object. Starting with the Vienna Convention 1985, and with the subsequent Montreal Protocol of 1987, the international community has set itself the goal of outlawing the aforementioned substances, with a progressive reduction in their use leading to a total ban in their production alongside the introduction of legislation defining their limited permitted applications.

The ban on the production of these substances is already in effect throughout Europe (implemented in Italy with Law 549 of 28/12/93) and in the majority of other nations, whereas their use, as mentioned above, is now limited by their extreme rarity on the market.

In response to this, the industry has identified alternative substances with analogous physical properties but which do not contain chlorine and, as a result, are not harmful for the stratospheric ozone layer.

In particular, R12 (CFC-12) has been replaced by the refrigerant R134a (HFC –134a), with the chemical formula CH2+FCF3+ (1, 1, 2 – tetrafluoroethane).

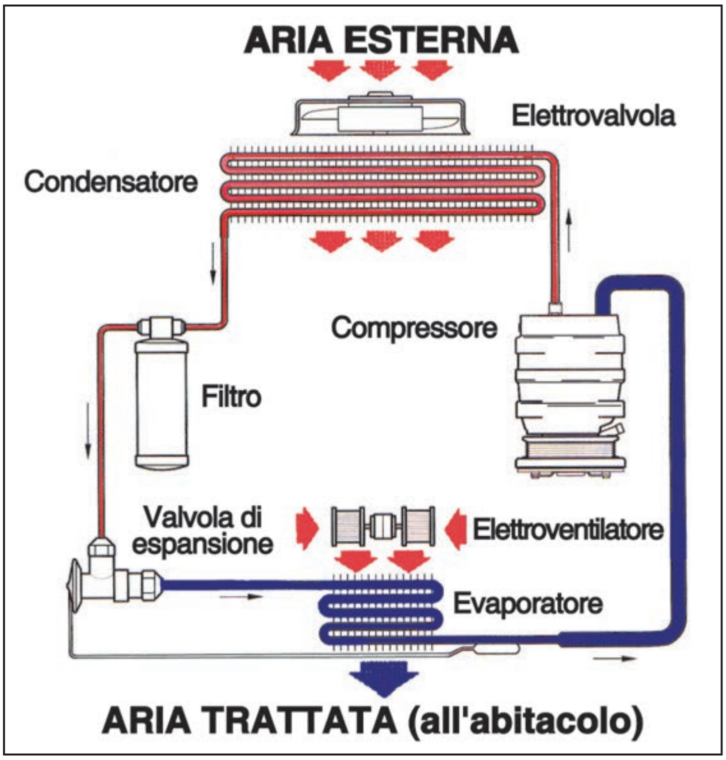


Fig. 11.23

- High pressure liquid
- High pressure gas
- Low pressure liquid
- Low pressure gas

The basic properties of this substance making it particularly suitable for use as a refrigerant are as follows:

- low boiling point, even at atmospheric pressure at sea level (-29.8 °C for R12 and –26.1 °C for R134a).

  This simplifies the construction of the cold body (evaporator) absorbing heat from the air in contact with it.
- high latent heat values of vaporisation and condensation in different temperature and pressure conditions.

4.1.3.2 Evaporator

As mentioned in the previous chapter, the evaporator is the component of the A/C system which extracts heat from the air delivered to the cabin (the relative modes of heat exchange have already been described).

Another very important function of the evaporator, which was not mentioned previously, is to dehumidify the air.

This takes place with the following process:

- in normal conditions, air contains a certain quantity of water vapour;
- this vapour condenses when it comes into contact with the cold surfaces of the evaporator;
- this water in liquid state (condensate) is collected in a tray and drained via specific pipes or ducts;
- the heat of condensation of this water vapour is yielded to the refrigerant via the walls of the evaporator, together with the heat extracted from the air to reduce its temperature.

As a result, the treated air leaving the evaporator and delivered to the cabin is not only at a lower temperature but also contains less humidity.

4.1.3.3 Compressor (F)

The compressor is the component which pumps and circulates the refrigerant around the A/C circuit.

The functions of the compressor are:

- circulate refrigerant around the circuit
- raise the pressure and, as a result, the temperature of the gaseous state refrigerant received at low pressure and low temperature from the evaporator.

To perform these functions, the compressor consists of the following basic parts:

- a housing, made up of a different components and equipped with brackets for fastening to the vehicle;
- an internal mechanism to actually pump the fluid;
- a system of valves to regulate the intake and output of refrigerant;
- connectors for connecting pipes;
- a pulley/clutch (electro-clutch) assembly to receive power;
- a quantity of oil.

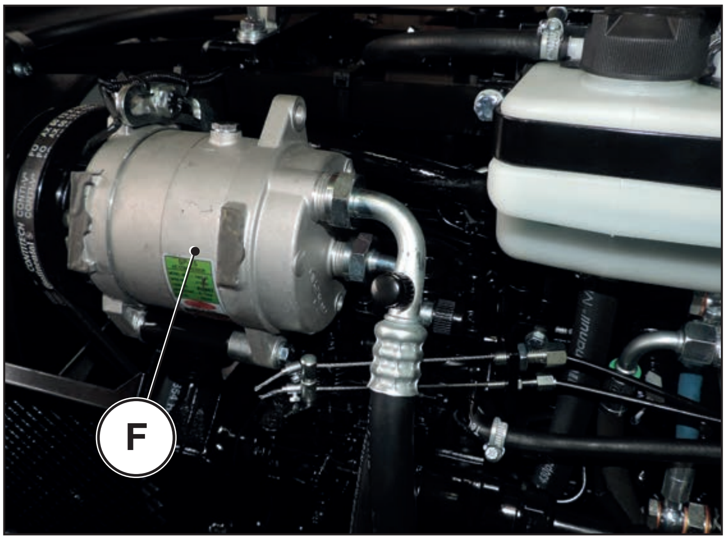


Fig. 11.24

4.1.3.4 Condenser (G)

The condenser is the heat exchanger which extracts the heat absorbed in the evaporator and the heat produced as a result of the energy expended to operate the compressor from the refrigerant circulating in the A/C system.

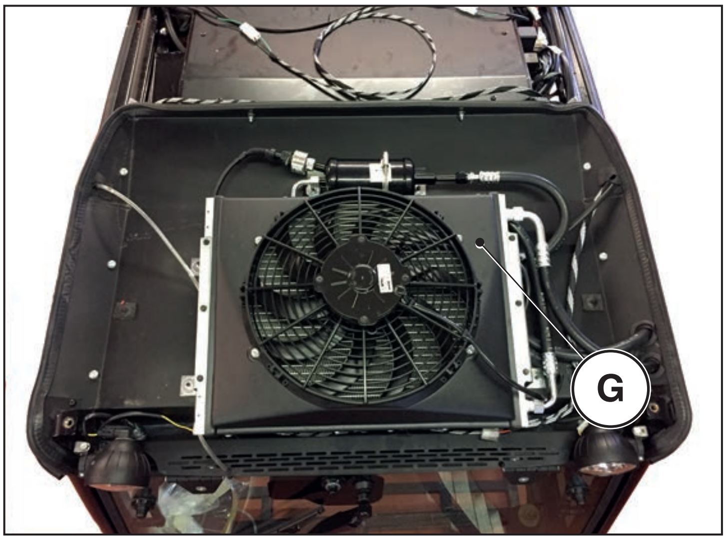


Fig. 11.25

4.1.3.5 Receiver drier (H)

While installed in series with the other components along the flow of refrigerant within the A/C system, the receiver drier performs no thermodynamic functions and therefore does not influence the transformation in state of the refrigerant or heat exchange.

However, as will be seen later, the receiver drier has numerous very important functions.

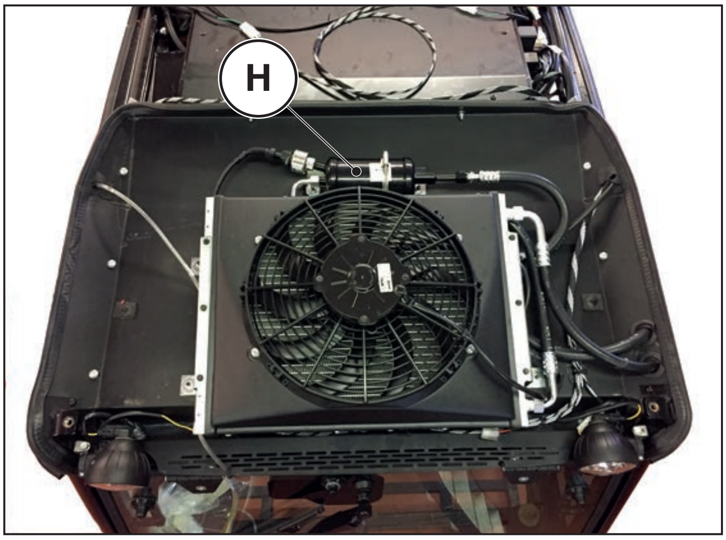


Fig. 11.26

4.1.3.6 Expansion or regulator valve

The expansion valve performs the following two essential functions in the A/C system:

1 - it drastically reduces the pressure and, therefore, the temperature of the liquid refrigerant received, via the receiver drier, from the condenser;

2 - it continuously regulates the flow of refrigerant to the evaporator so ensure that, in all possible thermal load conditions, the refrigerant evaporates completely as it passes through the evaporator and is superheated during the final part of the evaporator itself by just enough to ensure that it reaches the compressor in a completely gaseous state.

4.2 Discharging and charging the system

4.2.1 Safety rules

Always observe the following health and safety rules precisely when handling refrigerant.

a - Always wear protective eyewear and gloves when handling refrigerant.

In the event of contact with the eyes, refrigerant may cause damage to the sight or blindness.

b - Avoid skin contact with refrigerant. Refrigerant has a very low boiling point (approximately –26 °C for R134a and approximately –30 °C for R12 at ambient pressure and sea level) and may cause freezing.

c - Implements used to handle refrigerant must be used in an adequately ventilated environment, in which the entire volume of air is exchanged at least four times every hour. Prolonged inhalation of refrigerant vapour may be harmful to the health or even lethal.

d - Do not use implements for handling refrigerant in the vicinity of unsealed or leaking recipients containing flammable substances.

e - Do not tamper with or modify the vent and safety valves of the containers and implements used for collecting and treating refrigerant.

f - Do not fill any recipient (cylinders, A/C system charging equipment or other storage containers) with refrigerant unless it is approved for this purpose and equipped with a suitable safety relief valve.

g - Never fill any storage container beyond 80% of its total capacity.

h - Use extreme caution when disconnecting the service lines as they may still contain pressurised refrigerant.

4.2.2 Charging procedure

4.2.2.1 Introduction

An A/C or climate control system may be installed as original equipment during the assembly of the tractor itself on the production line, after production, on the assembled tractor before delivery to the customer, or as an aftermarket installation on a tractor already in use.

In all three cases, once it has been correctly and completely installed on the vehicle, an A/C or climate control system must be charged with refrigerant fluid before it can be operated. The following are described in the subsequent paragraphs:

- the essential implements necessary to charge the system (fill with refrigerant);
- the relative procedures;
- the functional and performance tests for the installation.

4.2.2.2 Basic implements

The basic implements for charging an A/C or climate control system consist of the following:

- a vacuum pump;
- a metering cylinder or scales for measuring the quantity of refrigerant (in weight) necessary;
- a pair of pressure gauges;
- a vacuum meter;
- a set of taps for making and handling the connections between the aforementioned components, the A/C system and the auxiliary refrigerant bottle;
- a set of service lines with relative connectors for connecting to the service valves of the system and of the auxiliary bottle.

The aforementioned components are usually grouped together in a housing to form a single station which may be used to perform all the operations involved in charging the system.

According to current legislation in Italy, Europe and the majority of other countries, it is no longer permitted to release refrigerant into the environment, and it is it is mandatory to recover all the refrigerant contained when discharging a system.

As a result, appropriate implements must be used to discharge A/C systems.

In addition to the specific components required for charging A/C systems indicated above, the R12 and R134a versions of the DVX recovery, recycling and recharging station and the Refmaticplus station (Fig.26-12) also include the following:

- a hermetically sealed compressor which aspirates the refrigerant discharged from the A/C or climate control system, recirculates it through an internal recycling system and then transfers it to a tank for subsequent reuse;
- a filter separating solid particulate, humidity and corrosive contained in the recovered refrigerant;
- a distiller for separating oil;

- a condenser unit for separating non-condensing gases, with relative automatic or manual venting device;
- an electronic scale for weighing the refrigerant;
- a microprocessor with keyboard and display for selecting and monitoring the different automatic cycles.

4.2.2.3 Procedure

This procedure consists of the following stages:

- evacuation of all the air in the system;
- dehydration;
- vacuum seal tightness test;
- charging with refrigerant;
- activating system and testing performance.

Evacuation of all the air in the system

All the air contained in the system must be evacuated:

- to ensure that the entire internal volume of the system is available for the refrigerant;
- to prevent air and the moisture its contains (even if only in very small quantities) from contaminating the refrigerant and altering its thermodynamic properties.

Air is aspirated from the system with the vacuum pump, connected to the LP and HP service connectors of the A/C or climate control system using the service connectors of the charging station, with the engine of the vehicle switched off.

This stage in the procedure is very short. During this stage, the readings on the HP and LP manometers on the charging station drop from 0 to almost -1.

Fig. 11.27

1 - Recovery manometer
2 - Charging manometer
3 - Display
4 - Start Recovery Cycle
5 - Start Vacuum Cycle
6 - Start Charge Cycle
7 - Start/Stop
8 - Alarm indicator
9 - Report
10 - menu +/-

Dehydration

This is a continuation of the previous stage, during which the vacuum pump continues to run and the pressure reading indicated by the manometers remains close to -1.

The recommended duration of this stage is 40 to 45 minutes, or even longer in the case of particularly large circuits. During this stage, any moisture that had not been evacuated together with the air and remained trapped in liquid state inside the system (in pits and recesses in the inner walls of parts such as hoses in particular, dissolved in the compressor oil, absorbed by the filter etc.), vaporises and is extracted in gaseous state by the vacuum pump.

Note: As explained earlier, the boiling point of water is dependent on pressure.

The temperature within a system as it is being prepared for charging is practically the same as the ambient temperature in the workshop. As this temperature may be very low, especially in winter (e.g. 10 to 15 °C), the only way to evaporate all the moisture in the system is to reduce the pressure, which is done using the vacuum pump.

The considerable length of this stage in the procedure is necessary to allow all the water vapour released from even the remotest parts of the circuit to reach the service valves and be extracted.

All the moisture contained in the system must be removed to prevent:

- the formation of corrosive acids as a result of chemical reaction with the refrigerant and oil, and the consequent damage to components;
- the formation of ice within the expansion valve, obstructing the calibrated hole and rendering the system inoperative.

Vacuum seal tightness test

The system must be tested to check that it is perfectly gas-tight before it is charged with refrigerant. To check the seal tightness of the system, once the dehydration cycle is complete, the tap connecting the A/C or climate control system to the vacuum pump is closed, the vacuum pump is stopped and the connection between the system and vacuum gauge is opened.

The pointer of the vacuum gauge now shows a reading close to -1. The reading is either noted or set with the reference pointer (vacuum meters often include a secondary, manually settable reference pointer). If the reading indicated has not changed noticeably after approximately 10 minutes, the system may be considered to be perfectly gas tight. The vacuum gauge connection tap is now closed and the system is charged.

If the vacuum gauge reading moves noticeably towards 0 during the test interval, this means that the system is not gas tight. A system that is not gas-tight will quickly lose refrigerant charge and, as a result, performance. In this case, the leak or leaks must be located and rectified and the procedure restarted from the beginning.

Charging with refrigerant

The quantity (weight) of refrigerant necessary for optimum operation of the A/C or climate control system is determined by the manufacturer and indicated in the respective use and maintenance manual.

If, for any reason, this value is not available, it may be determined empirically by charging the system gradually with refrigerant until optimum pressure values are obtained.

Where the correct weight of refrigerant necessary to charge the system is known, it must be measured out precisely.

There are essentially two different ways of doing this, depending on the implements available:

- from the difference in weight of the refrigerant container at the start and the end of the charging procedure, using an high electronic precision scale, as in the case of DVX Refmatic stations.
- indirectly, using the pressure (temperature) and volume of the refrigerant, measured with a conventional metering cylinder (as in the case of the DVX Fill Station), to determine the difference between the start and end weights.

The system may be charged with refrigerant:

in liquid phase

if the pressure in the metering container or cylinder is sufficiently high (8 to 10 bar) to permit the entire quantity of refrigerant necessary to be transferred to the system solely by the difference in pressure between the container and the A/C or climate control system.

In the case of a refrigerant container at a lower pressure (e.g. 5.7 bar), if the container is not in contact with any source of heat, the temperature inside the container is the same as the ambient temperature (e.g. 20 °C), and as a result, simply connecting one with the other will only produce the same pressure in the A/C or climate control system.

In this situation, due to the pressure equilibrium created between the container and the system, it will not be possible to charge the system completely with refrigerant in the liquid phase.

To increase the pressure within the container, the refrigerant is heated before it is transferred to the A/C or climate control system.

- This is done with a heater element applied to the metering cylinder (as in the case of the Fill Station);
- or with a compressor within the station itself (as in the case of the Refmatic).

> **Note**
>
> Charging with refrigerant in liquid phase is only possible by introducing refrigerant into the part of the circuit downstream of the compressor via the high pressure service valve.
>
> Introducing refrigerant in liquid phase upstream of the compressor would damage the compressor itself as soon as it is started.

In gaseous phase

The container is connected to the low pressure service valve, the engine of the vehicle is started and the refrigerant is aspirated into the system in pure gaseous state by the compressor of the system itself. Taps along the route of the refrigerant within the station from the container to the system are used to create throttles to ensure that all the refrigerant is in gaseous state.

In mixed phase

In this case, refrigerant is first transferred to the system in liquid phase until pressure equilibrium is attained, and then aspirated into the system in gaseous phase by the compressor.

In this case, the taps of the station must be opened and closed as necessary to ensure that liquid phase refrigerant is delivered downstream of the compressor and gaseous phase refrigerant is delivered upstream of the compressor.

Activating system and testing performance

Once the charging procedure is complete, with charging station still connected, the A/C system is activated and its performance is tested as follows:

- start the engine and set and maintain an engine speed of 1500 to 1800 rpm;
- set the controls of the A/C or climate control system for maximum cooling, with the lowest thermostat setting (if applicable) and the maximum fan speed setting;
- open the doors of the vehicle;
- leave the system running in these conditions for approximately 10 minutes;
- close the doors and windows;
- read the pressure values indicated on the HP (high pressure) and LP (low pressure) manometers;
- measure the temperature of the surrounding environment with a thermometer.

If the system is functioning correctly, the pressure values read, in relation to the ambient temperature measured, should be within the ranges indicated in Table 1.

R134a				
Ambient temperature (°C)	High Pressure manometer (kg/cm²)		Low Pressure manometer (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 interpret the manometer readings correctly, it is necessary to take into account the fact that the pressure readings themselves are influenced by atmospheric pressure which, minor differences due to weather aside, decreases progressively with increasing altitude above sea level.

To allow for these differences in pressure, the correction values given in Table 2 must be subtracted from the manometer readings.

Variation in pressure with altitude		
Altitude (m) asl	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 Functional tests

4.3.1 Implements necessary

The following implements are needed to check that the system is working correctly and diagnose any problems:

- Refrigerant recovery, recycling and charging station (Fig.11.28).
- Thermometer / hygrometer (Fig.11.29).
- Refrigerant leak detectors (Fig.11.30).
- Protective gloves and eyewear (Fig.11.31).

Fig. 11.28

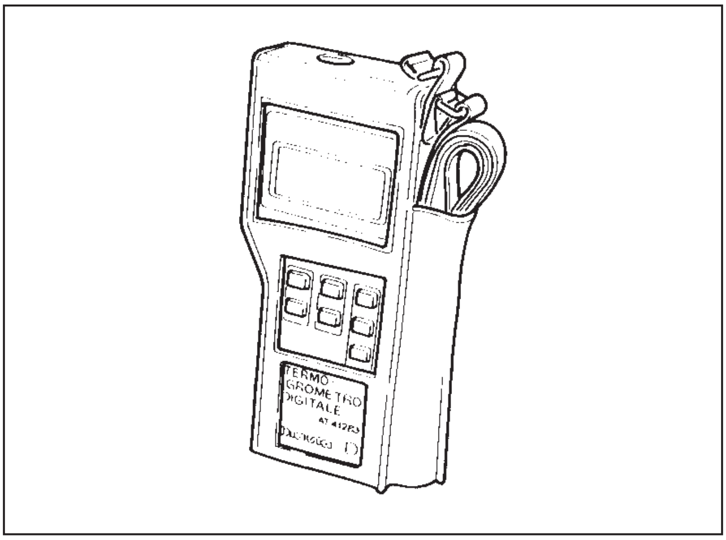


Fig. 11.29

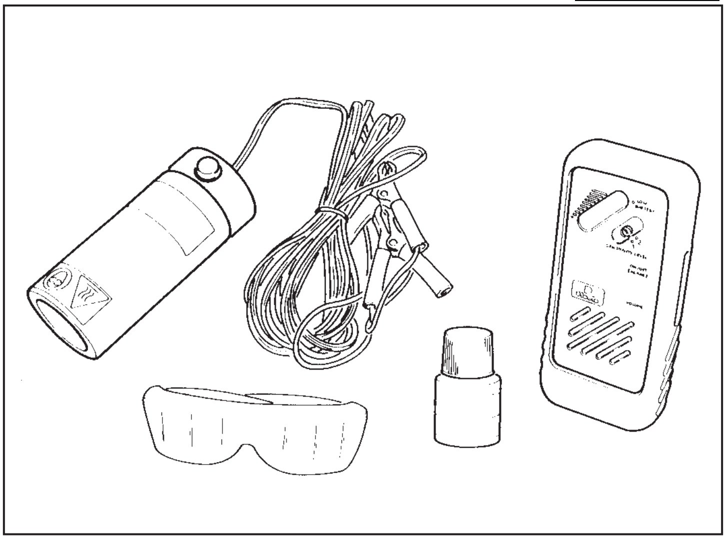


Fig. 11.30

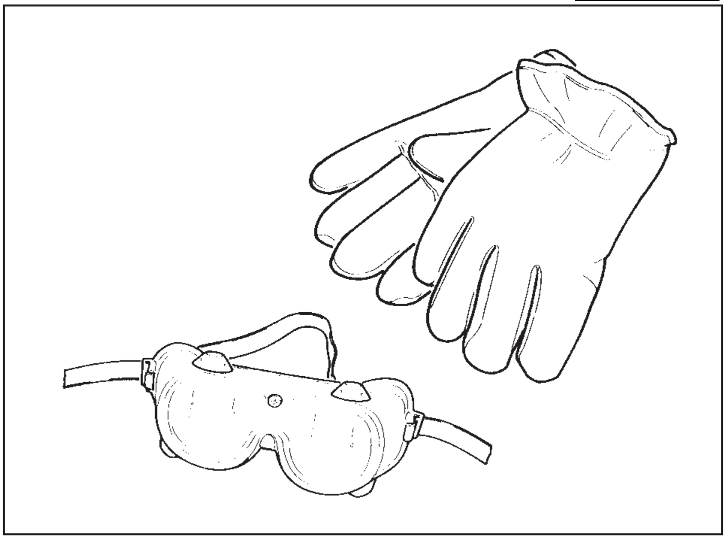


Fig. 11.31

4.3.2 Measuring temperature

After checking that the pressure values are correct and that all the filters are clean, a functional test of the system is carried out by measuring the temperature of the air delivered from the vents in the cab. Follow the procedure described below, referring to the following table.

Temperature table	
Temp. outside vehicle (°C)	Temp. of air exiting centre vents (°C) (average)
20°	6°-8°
25°	8°-10°
30°	8°-12°
35°	9°-14°
Table 3	

1 - Select the minimum temperature setting from the control panel and select an intermediate fan speed.

2 - If applicable, check that the thermostat setting is correct with the dial set one quarter of a turn from the coldest setting.

3 - Switch on the system and maintain an engine speed of 1500-1800 rpm.

4 - Measure the temperature with the thermometer probe held in front of the vents, and compare against the value indicated in the table.

If the air temperature in the cabin is higher than the exterior temperature, open the doors, allow the temperature to stabilise with the system running for 5 - 10 minutes and then measure the temperature values.

For any problems such as unpleasant odours, insufficient cooling power or abnormal noise, contact a service centre specialised in Delphi A/C systems.

4.3.3 Diagnosing the system

The procedures for correctly diagnosing and effectively resolving the most frequently encountered problems with an air conditioning system are described as follows.

Note
With external temperatures above 28°C, activate the recirculation function to prevent very hot air from entering the system

Step 1 - Test conditions / Preliminary operations

- Connect a recovery, vacuum pump and charging station to the low pressure (LP) and high pressure (HP) charging points of the A/C system.
- If applicable, check that the thermostat setting is correct with the dial set one quarter of a turn from the coldest setting.
- Start the engine and set and maintain an engine speed of approximately 1500 to 2000 rpm.
- Switch on the A/C system.
- Select an intermediate fan speed.
- Measure the ambient temperature in the workshop and the temperature inside the cabin of the vehicle with a thermometer.
- If the temperature inside the vehicle is **higher** than the external temperature:
  - Open the doors and windows of the vehicle and wait until the interior temperature stabilises at the same or approximately the same value as the exterior temperature.
  - Close the doors and windows.
- If the temperature inside the vehicle is **lower** than the exterior temperature:
  - Run the A/C system in these conditions for 5-10 minutes.
- Go to the step “Checking function of A/C system” - **Step 2**

Step 2 - Checking function of A/C system

- Only begin this step once the test conditions described in Step 1 are met.
- Measure the temperature of the air exiting the centre vents, holding the probe of the thermometer itself as close as possible to the vent. Compare the average value with the values indicated in Table 3 - Temperature Table.
- If the average temperature value is higher than the value indicated in the Temperature Table, refer to **Table A** to troubleshoot the problem.
- If the A/C system is excessively noisy, refer to **Table B** to troubleshoot the problem.
- If the A/C system produces an unpleasant odour, refer to **Table C** to troubleshoot the problem.
- If none of the problems described above are noted, the system is working correctly.

Step 3 - Checking function of A/C system

TABLE A A/C system is not cooling

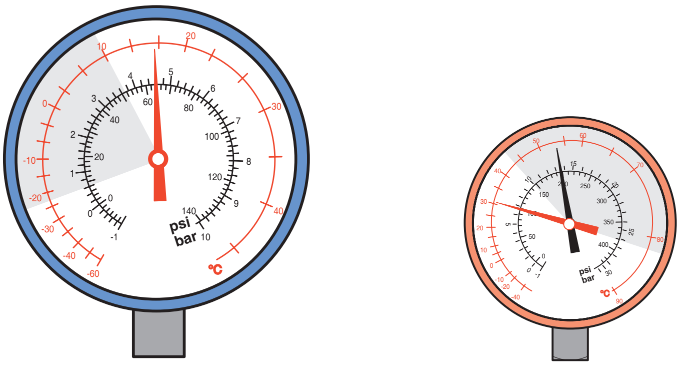
This table indicates the correct pressure values in different operating conditions of the A/C as reference for diagnosing the system. If the values measures are not within the relative range indicated in the table (Pressure reference table), this is probably due to a fault.

External temperature [°C]	Variable displacement compressor (V)				Fixed displacement compressor (F)							
	R134a				R134a				R12			
	LP [kg/cm2]		HP [kg/cm2]		LP [kg/cm2]		HP [kg/cm2]		LP [kg/cm2]		HP [kg/cm2]	
	min	max	min	max	min	max	min	max	min	max	min	max
15.5	1.5	2.3	9.5	13.0	0.5	3.0	9.5	13.0	0.5	3.0	8.5	12.0
21.0	1.5	2.3	12.5	17.5	0.5	3.0	12.5	17.5	0.5	3.0	10.5	17.5
26.5	1.5	2.3	14.0	20.5	0.5	3.0	14.0	20.5	0.5	3.0	12.5	19.0
32.0	1.5	2.5	16.0	24.0	0.5	3.5	16.0	24.0	0.5	3.5	14.0	22.0
38.8	1.5	2.5	18.5	25.5	0.5	3.5	18.5	25.5	0.5	3.5	16.0	23.0
43.0	1.5	2.5	22.0	28.0	0.5	3.5	22.0	28.0	0.5	3.5	19.0	25.0

The following is a list of the most probable faults, diagnosed on the basis of the pressure reading on the Low or High pressure manometer with the greatest discrepancy relative to the value in the reference table (the relative manometer is the larger of the two in each figure).

Key to applying the values given in TABLE A

- Example of manometer reading used as reference for diagnosis



- LP operating range (with exterior temperature between 15.5 and 43 °C) Grey zone

- HP operating range (with exterior temperature between 15.5 and 43 °C) Grey zone

- LP high

- HP normal (l) or low (s)

Fig. 11.32

The following "Probable causes" are listed in order of statistical probability.

- (V) Only for variable displacement compressors
- (F) Only for fixed displacement compressors

EFFECT

- LP high
- HP normal (l) or low (s)

PROBABLE CAUSES

- Inlet and outlet lines swapped on compressor (TROUBLESHOOTING TABLE 6)
- Electric clutch of compressor slipping or not engaging correctly (TROUBLESHOOTING TABLE 5)
- Expansion valve stuck open. With a variable displacement compressor, LP pressure reading shows small but rapid pressure fluctuations (TROUBLESHOOTING TABLE 3).
- (V) Compressor displacement control valve decalibrated or faulty (TROUBLESHOOTING TABLE 4)
- Compressor damaged (TROUBLESHOOTING TABLE 9)

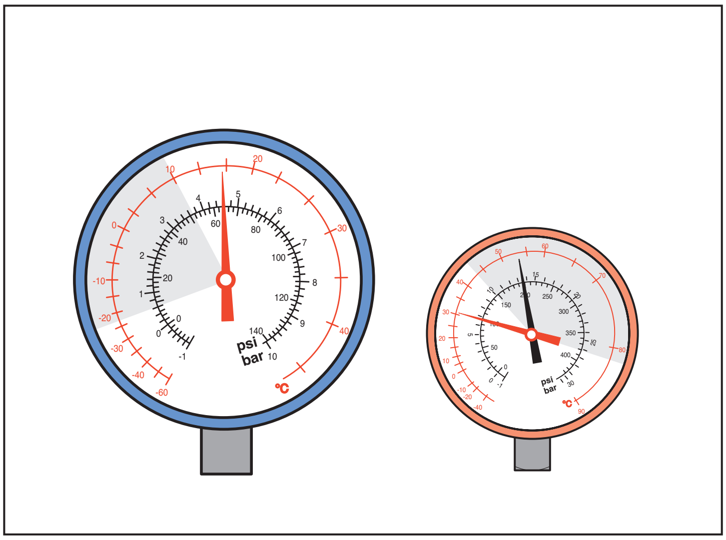


Fig. 11.33

EFFECT

- LP low
- HP high (H) or normal (l)

PROBABLE CAUSES

- (F) Thermostat faulty (TROUBLESHOOTING TABLE 8)
- (F) Expansion valve stuck closed or obstructed (TROUBLESHOOTING TABLE 3)
- Filter saturated with moisture (TROUBLESHOOTING TABLE 2)
- (V) Compressor displacement control valve stuck in maximum displacement position (TROUBLESHOOTING TABLE 4)
- (F) Obstruction in LP section or in HP section between filter and evaporator (TROUBLESHOOTING TABLE 7)

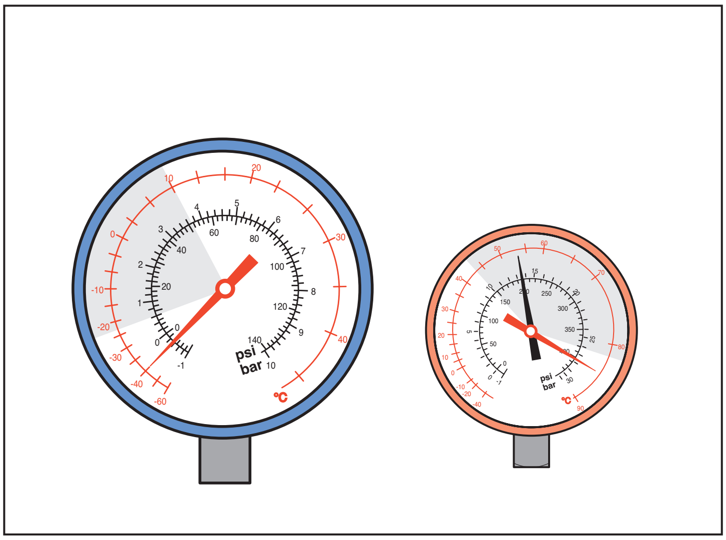


Fig. 11.34

EFFECT

- LP normal
- HP normal

PROBABLE CAUSES

- Hot air infiltrating into evaporator unit or cabin (TROUBLESHOOTING TABLE 10)
- Hot water infiltrating into heater (TROUBLESHOOTING TABLE 10)
- Ice forming on evaporator coil (TROUBLESHOOTING TABLE 8)

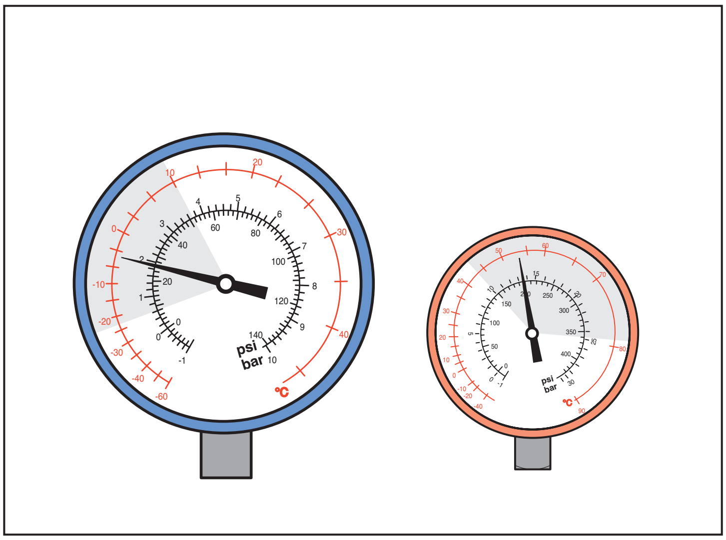


Fig. 11.35

EFFECT

- LP high (H) or normal (l)
- HP high

PROBABLE CAUSES

- Normal situation with very high ambient temperatures (> 43°C)
- Excessive quantity of refrigerant in system, 30-35% more than correct quantity (TROUBLESHOOTING TABLE 2)
- Condenser overheating (TROUBLESHOOTING TABLE 1)
- Air in A/C circuit (TROUBLESHOOTING TABLE 2)
- (V) Compressor displacement control valve faulty (TROUBLESHOOTING TABLE 4)
- Obstruction in HP section between compressor and condenser-filter line, but after HP measurement point (TROUBLESHOOTING TABLE 7)

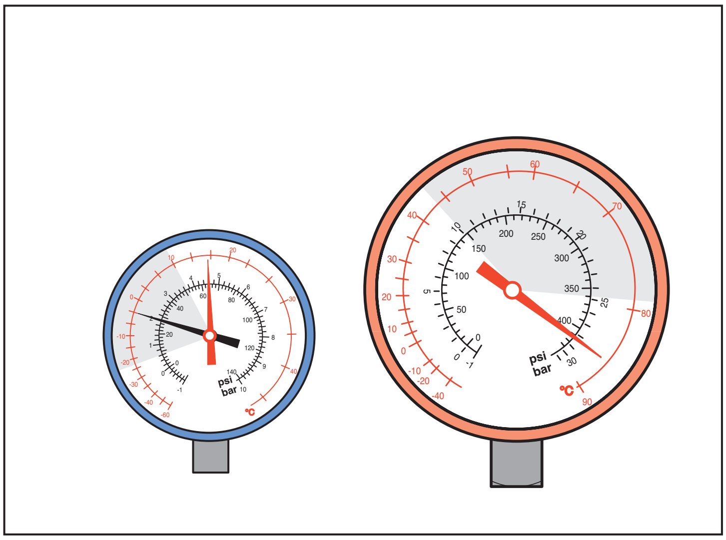


Fig. 11.36

EFFECT

- LP normal (l) or low (s)
- HP low

PROBABLE CAUSES

- Normal situation with very low ambient temperatures (< 5°C)
- Insufficient quantity of refrigerant in system, 70-75% less than correct quantity. Check for refrigerant leaks (TROUBLESHOOTING TABLE 2)
- (V) Expansion valve stuck closed or obstructed (TROUBLESHOOTING TABLE 3)
- (V) Obstruction in LP section or in HP section between filter and evaporator (TROUBLESHOOTING TABLE 7)
- Obstruction in HP section between compressor and condenser-filter line, but before HP measurement point (TROUBLESHOOTING TABLE 7)
- Compressor damaged (TROUBLESHOOTING TABLE 9)

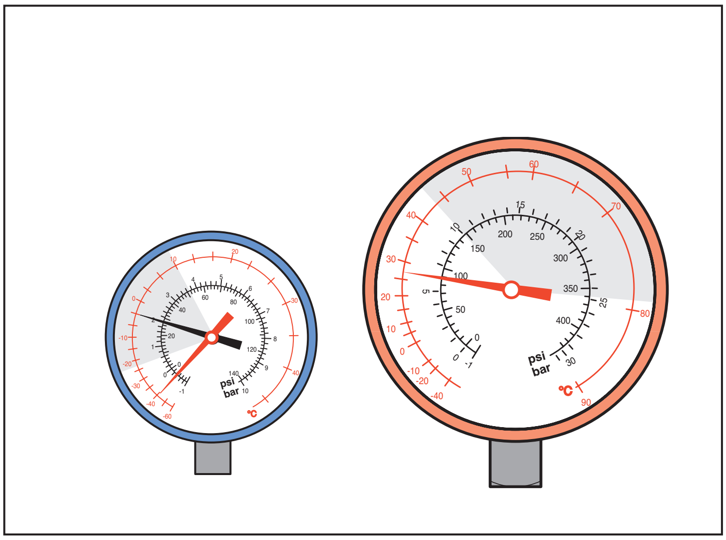


Fig. 11.37

EFFECT

- LP approximately the same as HP

PROBABLE CAUSES

- Compressor belt missing. This may be caused by pulley misalignment (see: assembly instructions)
- Electric clutch of compressor slipping or not engaging (TROUBLESHOOTING TABLE 5)
- Compressor damaged (TROUBLESHOOTING TABLE 9)
- (V) Compressor displacement control valve faulty

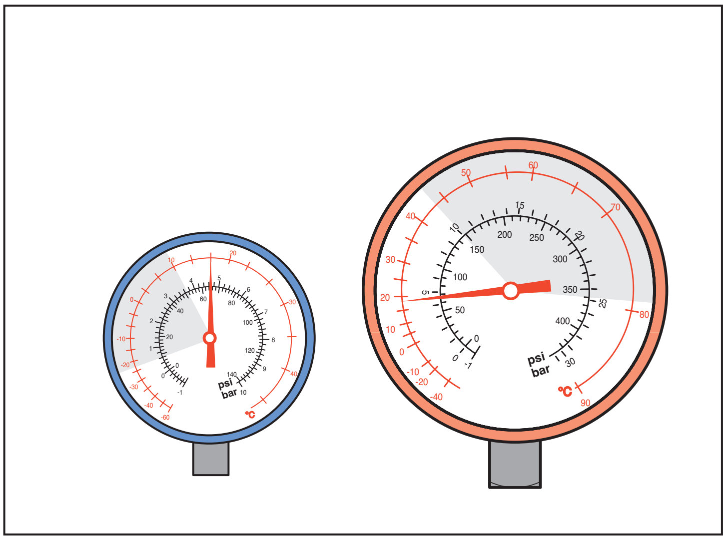


Fig. 11.38

TABLE B Noise from A/C system

Noise heard when the A/C system switches on is normal and not indicative of a fault. If the noise continues even for several minutes after the A/C is switched on, however, check for the following possible causes of malfunction and implement the relative solution.

CAUSE	SOLUTION
Belt slipping or worn	Check the belt for wear and check belt tension
Noisy belt tensioner bearing	Replace
Electric clutch disc slippage	Check that the distance between the compressor pulley and the electric clutch disc is between 0.3 and 0.5 mm
Vibration/resonance of compressor mounting plate	Check that the plate is fitted correctly and check that the relative fasteners are tightened correctly. Check pulley alignment.
Whistling noise from expansion valve	Replace the valve if the noise persists (see TROUBLESHOOTING TABLE 3)
Improperly configured condensate drain line	If the evaporator is equipped with an aspirating electric fan, install an anti-backflow valve on the end of the condensate drain line so that the condensate water drains correctly outside the system and is not sucked back by the fan, producing a gurgling sound.

⚠ Attention
In the following cases, faults affecting other components in the A/C system cause abnormal compressor intake and outlet pressures. The resulting compressor noise in these cases is therefore attributable to one of the following causes and NOT to the compressor itself.

CAUSE	SOLUTION
Incorrect quantity of refrigerant (30-35% too much or 70-75% too little)	See TROUBLESHOOTING TABLE 2
Expansion valve stuck closed or obstructed	See TROUBLESHOOTING TABLE 3
Compressor displacement control valve faulty (only for variable displacement compressors)	See TROUBLESHOOTING TABLE 4
Obstruction in A/C system circuit	See TROUBLESHOOTING TABLE 7
Filter saturated with moisture	See TROUBLESHOOTING TABLE 2

TABLE C A/C system produces an unpleasant odour

CAUSE	SOLUTION
In certain conditions, mould and bacteria normally carried in the air may accumulate on the surface of the evaporator coil, resulting in unpleasant odours perceptible in the cabin.	- Treat the evaporator with a specific antibacterial product or system. - Advise the customer to switch the air conditioner off a few minutes before stopping the vehicle and leave the fan running. This will allow the evaporator coil to dry, eliminating the moisture which could otherwise promote the proliferation of mould. - If the unpleasant odour persists even after performing the above, contact the TECHNICAL SUPPORT SERVICE.

TROUBLESHOOTING TABLE 1 Condenser not dissipating sufficient heat

CAUSE	SOLUTION
Obstruction in air flow caused by dirt accumulating on the following heat dissipating components: water radiator, condenser (this is very probable at mileages above 25-30,000 km)	Clean the radiator and the condenser thoroughly
Pressure switch or water thermostat bulb not activating at correct pressure and temperature values	Disable switch control with a suitable electrical connections. Replace the faulty part if necessary. (see electrical system diagram)
Electric fan not working	Power the electric fan directly. Replace the fan if it does not rotate when powered directly.
Incorrect electric fan operation (incorrect direction of rotation)	The fan must aspirate if it is situated between the heat dissipating components and the engine, and blow if it is situated between the heat dissipating components and the external air inlet.
Engine coolant water overheating	Check that the original water cooling system of the engine is working correctly
Incorrect condenser position	Check that the distance between the radiator and condenser is approximately 15-20 mm, and that the air ducts, if applicable, are fitted correctly

TROUBLESHOOTING TABLE 2 Incorrect quantity of refrigerant. Air, non-condensing gases or moisture in A/C system

CAUSE	SOLUTION
Incorrect quantity of refrigerant (30-35% too much or 70-75% too little). N.B. : It is not necessary to replace the filter Insufficient vacuum Contaminated refrigerant Filter saturated with moisture	- Recover the refrigerant from the AC system - Change the receiver drier - Evacuate non-condensable gases and moisture from the AC system by running the vacuum pump for at least 15 minutes - Test the vacuum seal tightness of the system with the pressure gauge. - Refill the AC system with the recommended quantity of refrigerant and with the same quantity of any oil recovered together with the refrigerant

TROUBLESHOOTING TABLE 3 Expansion valve faulty

Warning
The capillary tube must always be installed on the outlet pipe of the evaporator (larger 1/2” diameter pipe). For valves with an external capillary tube, perform the following test with the A/C system running: - Cool the thermostat capillary tube of the valve. A reduction in the LP and HP pressure readings should be noted. - Heat the thermostat capillary tube of the valve. An increase in the LP and HP pressure readings should be noted. - If the expansion valve does not respond to heating and cooling as described above, it is faulty. In this case, proceed as follows.

CAUSE	SOLUTION
Faulty valve thermostat capillary tube Mechanical part of valve stuck	- Recover the refrigerant from the AC system - Replace the expansion valve - Evacuate non-condensable gases and moisture from the AC system by running the vacuum pump for at least 15 minutes - Refill the AC system with the recommended quantity of refrigerant and with the same quantity of any oil recovered together with the refrigerant

TROUBLESHOOTING TABLE 4 Compressor displacement control valve faulty (only for variable displacement compressors)

CAUSE	SOLUTION
Valve stuck due to contaminants (the evaporator tends to form ice) Valve setting valves decalibrated	- Recover the refrigerant from the AC system - Replace the displacement control valve situated in the breech of the compressor - Evacuate non-condensable gases and moisture from the AC system by running the vacuum pump for at least 15 minutes - Refill the AC system with the recommended quantity of refrigerant and with the same quantity of any oil recovered together with the refrigerant

TROUBLESHOOTING TABLE 5 Electric clutch of compressor slipping or not engaging

CAUSE	SOLUTION
Very low quantity of refrigerant	- Check if there is a refrigerant leak (see TROUBLESHOOTING TABLE 2)
Electric clutch coil energising intermittently or not energising	- Disconnect the wire of the electric clutch from the electrical system and connect it to battery positive via a 7.5A fuse - Replace the clutch if it does not engage. If the clutch engages, check the: pressure switch, thermostat, A/C on/off switch and electrical connections in general.
Incorrect distance between compressor pulley and electric clutch disc	- Distance must be between 0.3 and 0.5 mm.

TROUBLESHOOTING TABLE 6 Inlet and outlet lines swapped on compressor

Note
In the case of systems with a fixed displacement compressor, this fault is diagnosable by the fact that the compressor activates rarely and for a few seconds only. With A/C systems with a variable displacement compressor, the compressor activates and deactivates rapidly.

CAUSE	SOLUTION
Incorrectly connected lines on compressor	- Check that the intake line leading from the evaporator is connected to the “SUC” connection of the compressor, and that the outlet line leading to the condenser is connected to the “DIS” connection - If the lines are swapped, recover the refrigerant from the AC system - Reconnect the lines correctly on the compressor - Evacuate non-condensable gases and moisture from the AC system by running the vacuum pump for at least 15 minutes - Refill the AC system with the recommended quantity of refrigerant and with the same quantity of any oil recovered together with the refrigerant

TROUBLESHOOTING TABLE 7 Obstruction in A/C system circuit

CAUSE	SOLUTION
Obstruction caused by a pinched line or contaminants	- Locate the obstruction by looking for an abnormal temperature variation (hot ahead of the obstruction, cold after the obstruction) - Recover the refrigerant from the AC system - Replace the obstructed part - In these cases, it is good practice to flush the A/C system completely with a specific product and replace the receiver drier to prevent the risk of residual contaminants remaining in the circuit. - Evacuate non-condensable gases and moisture from the AC system by running the vacuum pump for at least 15 minutes - Refill the AC system with the recommended quantity of refrigerant and with the same quantity of any oil recovered together with the refrigerant

TROUBLESHOOTING TABLE 8 Ice forming on evaporator coil

Note
This may also occur after several minutes of operation, causing a progressive reduction in the air flow from the vents With automatic climate control systems, perform self-diagnosis.

CAUSE	SOLUTION
Thermostat or anti-icing sensor (if applicable) malfunction	Check that the electrical connection of the thermostat or of the anti-icing sensor (if applicable) is in proper working order and that the sensor element is positioned correctly. Replace the faulty part if necessary.
Internal fan malfunction	When the A/C system is switched on, the fan must operate at least the first speed setting. If not, check the electrical system connection (see electrical circuit diagram)
Compressor displacement control valve faulty (only for variable displacement compressors)	Check that the compressor displacement control valve is working correctly (see TROUBLESHOOTING TABLE 4)

TROUBLESHOOTING TABLE 9 Compressor damaged

CAUSE	SOLUTION
Valves bent (N.B. : It is not necessary to flush the system Seizing	- Recover the refrigerant from the AC system - Remove the compressor - If the compressor is seized, flush the A/C system with a specific product and replace the receiver drier. - Install a new compressor - Evacuate non-condensable gases and moisture from the AC system by running the vacuum pump for at least 15 minutes - Refill the AC system with the recommended quantity of refrigerant and with the same quantity of any oil recovered together with the refrigerant (see assembly instructions or refrigerant quantity table)

TROUBLESHOOTING TABLE 10 Hot air infiltrating into cabin. Hot water infiltrating into heater

Note
With automatic climate control systems, perform self-diagnosis.

CAUSE	SOLUTION
The heater water tap (if applicable) is not closing completely	Check tap actuator linkage and/or motor. If necessary, disable the heater
Air mixer and/or recirculation shutters not sealing completely	Check shutter actuator linkage and/or motors
Evaporator poorly insulated	Check that the evaporator unit is tightly sealed and that the connections with the original heater unit are correctly made to prevent hot air infiltrating from the exterior

Quick reference table

LOW PRESSURE	
High	- Inlet and outlet lines swapped on compressor (TROUBLESHOOTING TABLE 6)
	- Electric clutch of compressor slipping or not engaging correctly (TROUBLESHOOTING TABLE 5)
	- Expansion valve stuck open (TROUBLESHOOTING TABLE 3). With a variable displacement compressor, LP pressure reading shows small but rapid pressure fluctuations.
	- (V) Compressor displacement control valve decalibrated or faulty (TROUBLESHOOTING TABLE 4)
	- Compressor damaged (TROUBLESHOOTING TABLE 9)
Low	- (F) Thermostat faulty (TROUBLESHOOTING TABLE 8)
	- (F) Expansion valve stuck closed or obstructed (TROUBLESHOOTING TABLE 3)
	- Filter saturated with moisture (TROUBLESHOOTING TABLE 2)
	- (V) Compressor displacement control valve stuck in maximum displacement position (TROUBLESHOOTING TABLE 4)
	- (F) Obstruction in LP section or in HP section between filter and evaporator (TROUBLESHOOTING TABLE 7)

HIGH PRESSURE	
High	- Normal situation with very high ambient temperatures (> 43°C)
	- Excessive quantity of refrigerant in system, 30-35% more than correct quantity (TROUBLESHOOTING TABLE 2)
	- Condenser overheating (TROUBLESHOOTING TABLE 1)
	- Air in A/C circuit (TROUBLESHOOTING TABLE 2)
	- (V) Compressor displacement control valve faulty (TROUBLESHOOTING TABLE 4)
	- Obstruction in HP section between compressor and condenser-filter line, but after HP measurement point (TROUBLESHOOTING TABLE 7)
Low	- Normal situation with very low ambient temperatures (< 5°C)
	- Insufficient quantity of refrigerant in system, 70-75% less than correct quantity. Check for refrigerant leaks (TROUBLESHOOTING TABLE 2)
	- (V) Expansion valve stuck closed or obstructed (TROUBLESHOOTING TABLE 3)
	- (V) Obstruction in LP section or in HP section between filter and evaporator (TROUBLESHOOTING TABLE 7)
	- Obstruction in HP section between compressor and condenser-filter line, but before HP measurement point (TROUBLESHOOTING TABLE 7)
	- Compressor damaged (TROUBLESHOOTING TABLE 9)

LOW and HIGH PRESSURE	
Normal	- Hot air infiltrating into evaporator unit or cabin (TROUBLESHOOTING TABLE 10)
	- Hot water infiltrating into heater (TROUBLESHOOTING TABLE 10)
	- Ice forming on evaporator coil (TROUBLESHOOTING TABLE 8)
Approximately the same	- Compressor belt missing. This may be caused by pulley misalignment (see: assembly instructions)
	- Electric clutch of compressor slipping or not engaging (TROUBLESHOOTING TABLE 5)
	- Compressor damaged (TROUBLESHOOTING TABLE 9)
	- (V) Compressor displacement control valve faulty (TROUBLESHOOTING TABLE 4)

Section 5 : Implements necessary

Index

5.1 Implements necessary

p/n	Description	Quantity
07007181	Cab hoisting tool	1

Chapter 12 : Platform

Index

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.

Attention

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

Section 2 : Removing and refitting the platform

Index

2.1 Removal

Place a stand under the right and left hand rear axle shafts.

Danger
Check that the stands are of suitable load capacity for the weight carried and are securely placed on the floor.

Undo the fastener screws and remove the rear wheels.

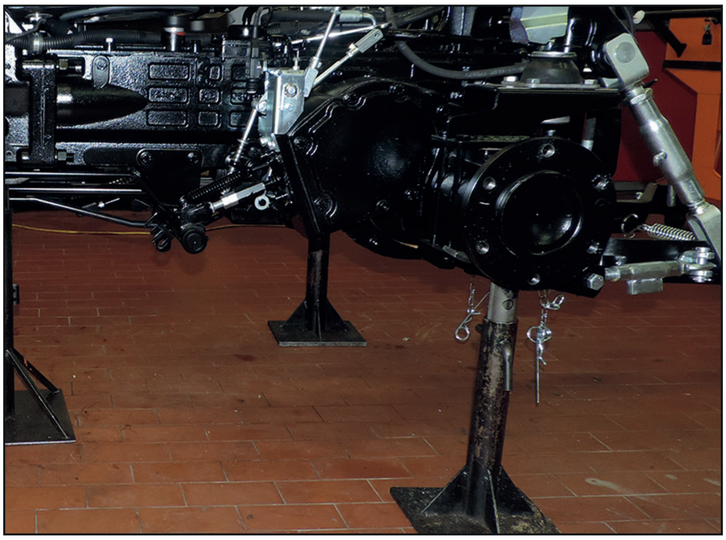


Fig. 12.1

Disconnect the connector.

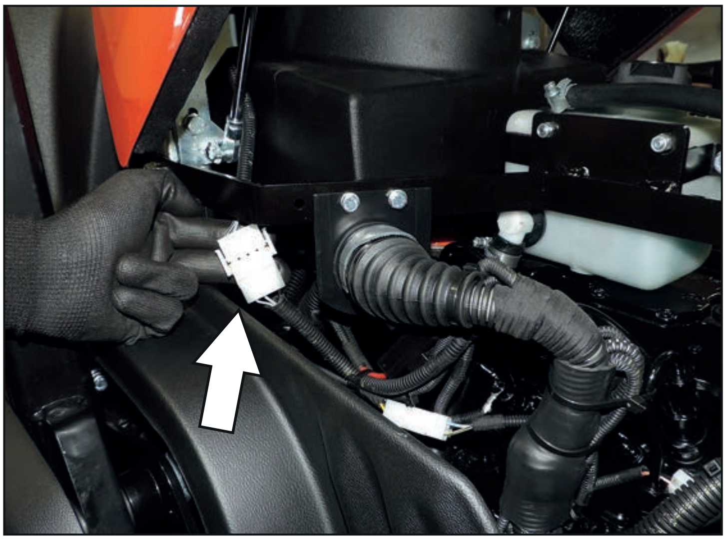


Fig. 12.2

Undo the fastener screws of the bonnet and remove the bonnet.

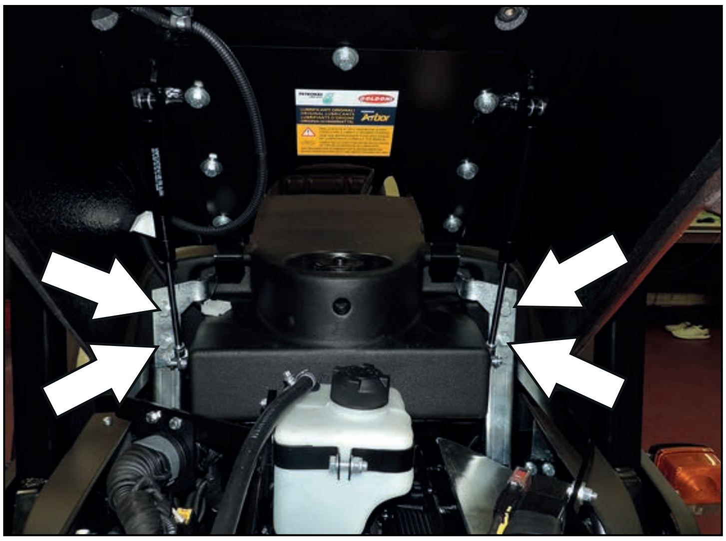


Fig. 12.3

Undo the front and rear fastener screws of the seat.

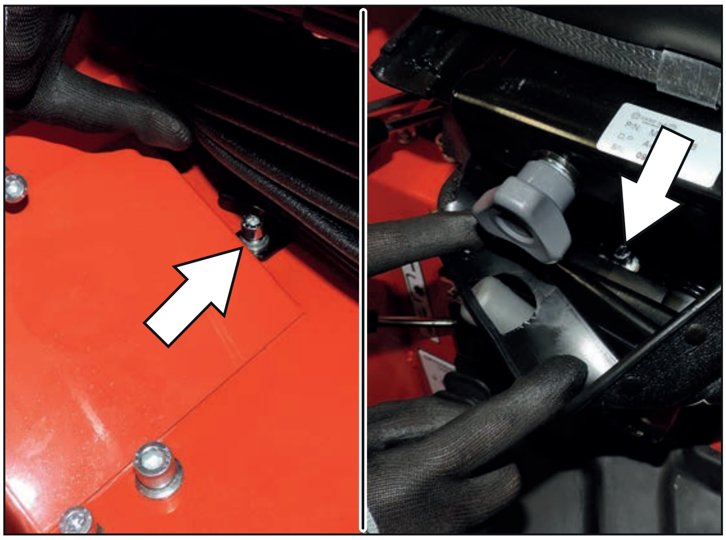


Fig. 12.4

Remove the complete seat.

Fig. 12.5

Undo all the fastener screws of the plate under the seat.

Remove the lever knobs, the covers and the boots.

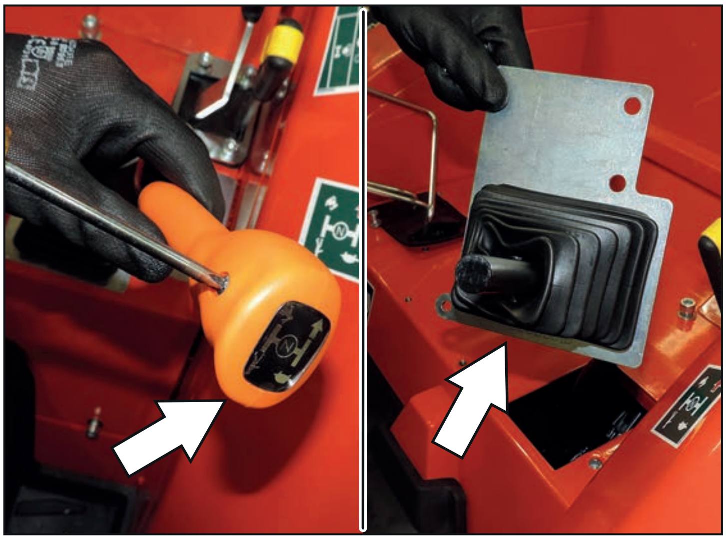


Fig. 12.6

Undo the screws of the rear distributor and lift control levers.

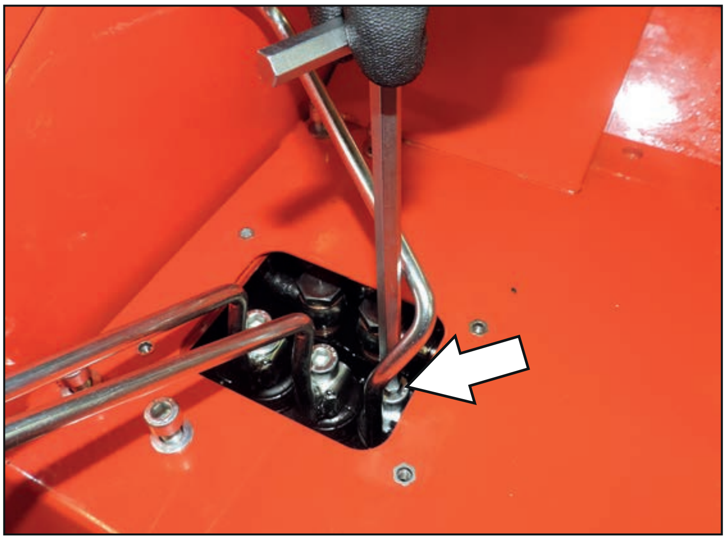


Fig. 12.7

Remove the knobs of the 4WD and rear PTO control levers.

Undo the screws and remove the cover.

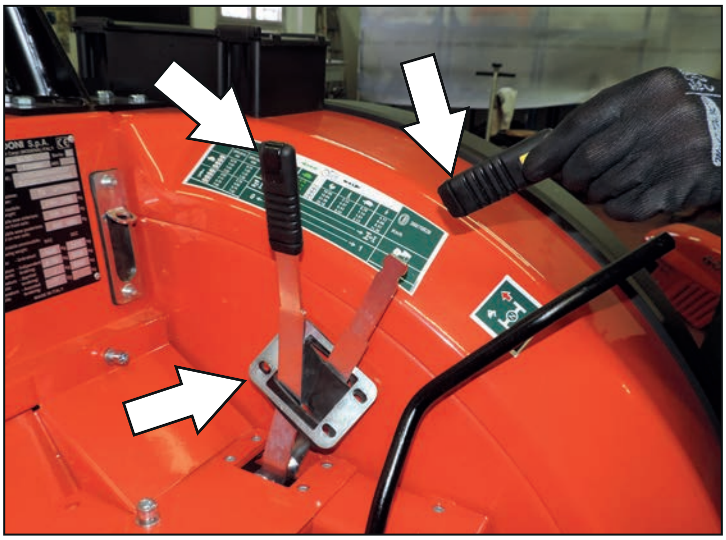


Fig. 12.8

Remove the knob of the PTO speed selector lever, undo the screws and remove the cover.

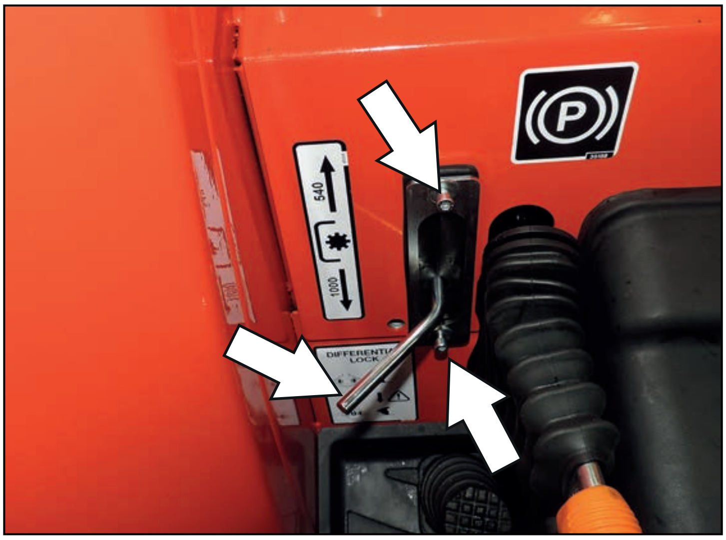


Fig. 12.9

Remove the plate situated under the seat.

⚠ Warning
It is not necessary to remove the centre tunnel cover for this procedure.

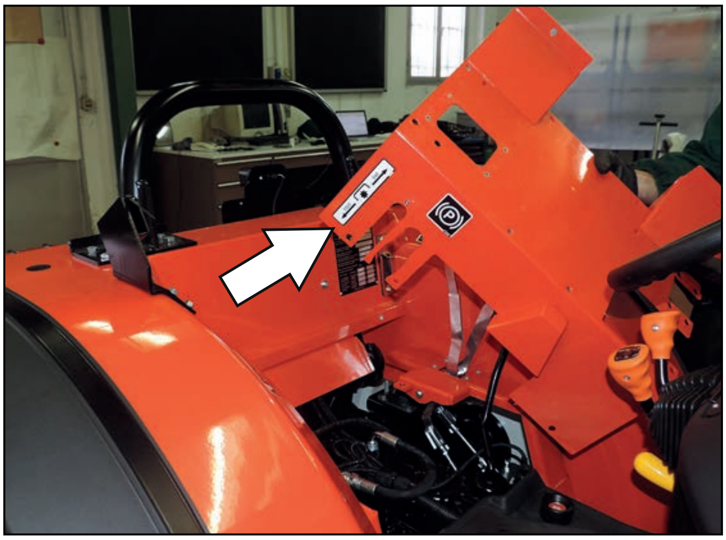


Fig. 12.10

Undo the fastener screws and remove the brake pedals.

Undo the fastener screws and remove the cover and the boot.

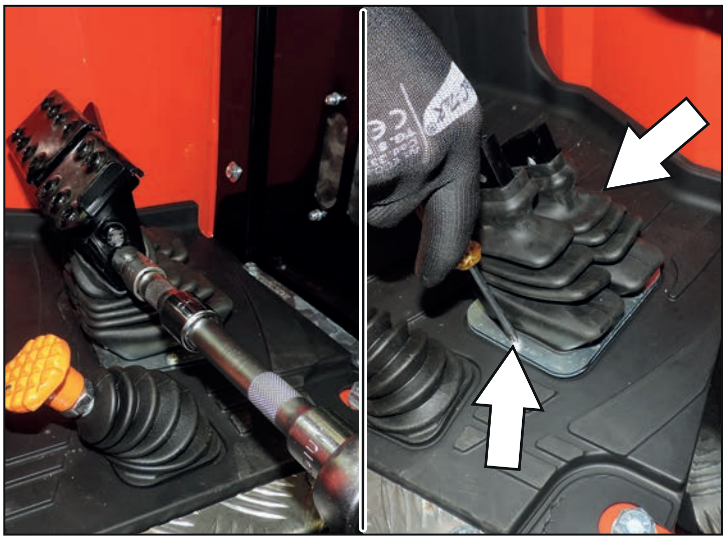


Fig. 12.11

Undo the relative fasteners and remove the brake and differential lock pedals.

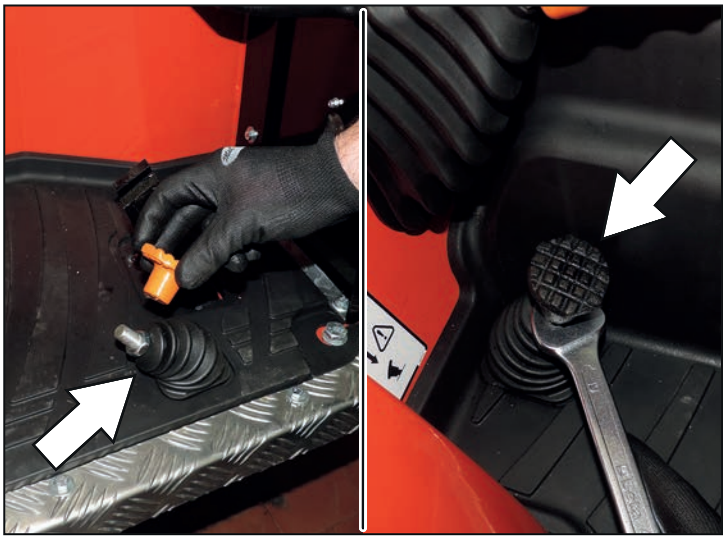


Fig. 12.12

Undo the fastener screws of the PTO speed selector lever and then remove the lever.

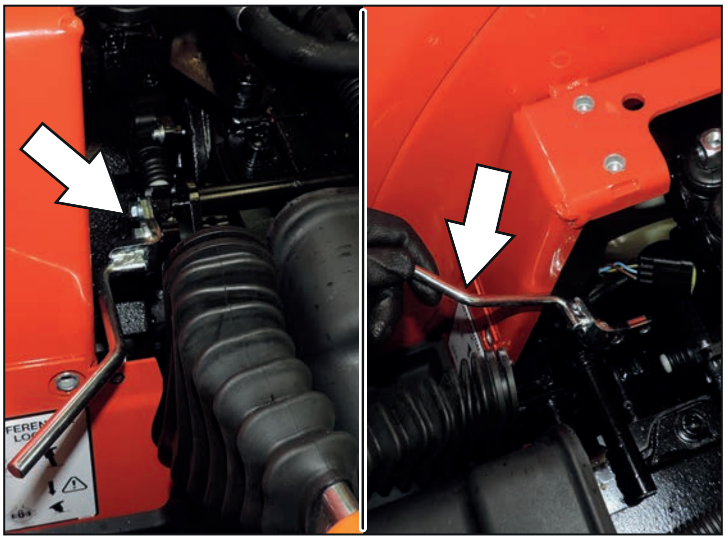


Fig. 12.13

Undo the fastener screws of the right and left hand mudguard seals.

Remove the mudguard seals.

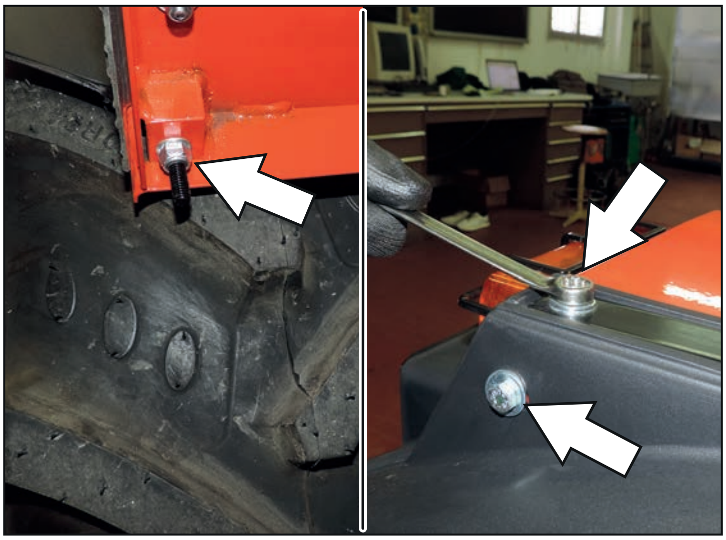


Fig. 12.14

Danger
Take care not do damage the seal fastener straps during removal.

Fig. 12.15

Undo the screws and remove the knobs of the gearbox and reverse shuttle levers.

Fig. 12.16

Remove the cap from the steering wheel boss.

Warning

Remember to refit the seal inside the cap when reassembling.

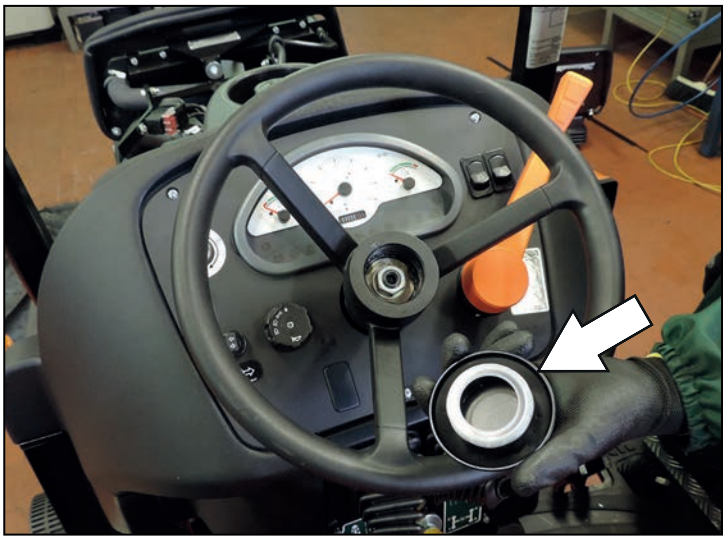


Fig. 12.17

Undo the fastener nut and remove the washer.

Remove the steering wheel using an extractor tool.

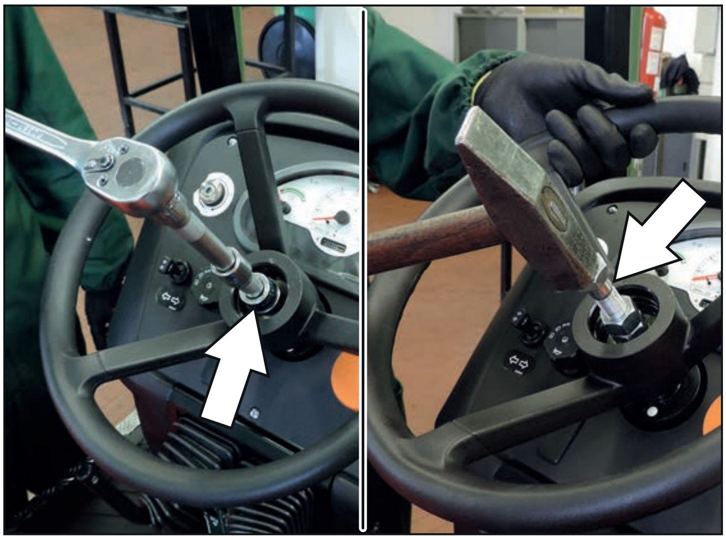


Fig. 12.18

Remove the cap and undo the fastener nut of the hand throttle lever.

Remove the lever and the spacer.

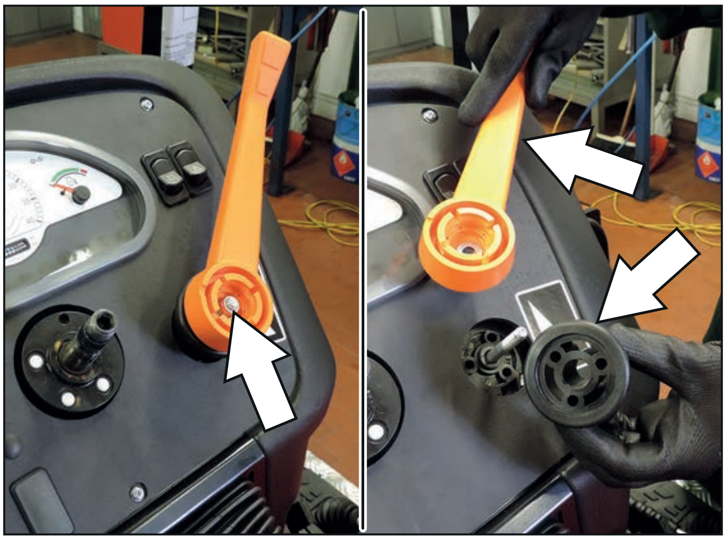


Fig. 12.19

Remove the boots of the gearbox and reverse shuttle levers.

Fig. 12.20

Remove the PTO clutch lever.

Fig. 12.21

Undo the screws and remove the covers.

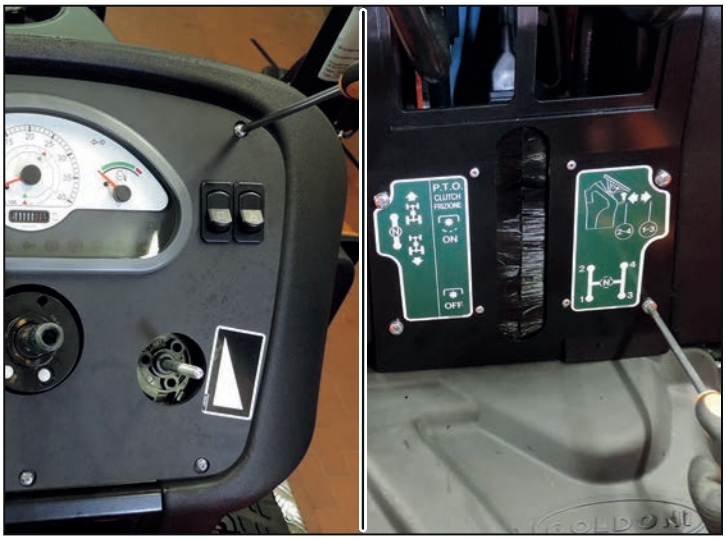


Fig. 12.22

Remove the dashboard.

Disconnect the float sensor connector.

Warning
Only disconnect the remaining connectors if necessary. It is not necessary to disconnect these connectors to remove the tank.

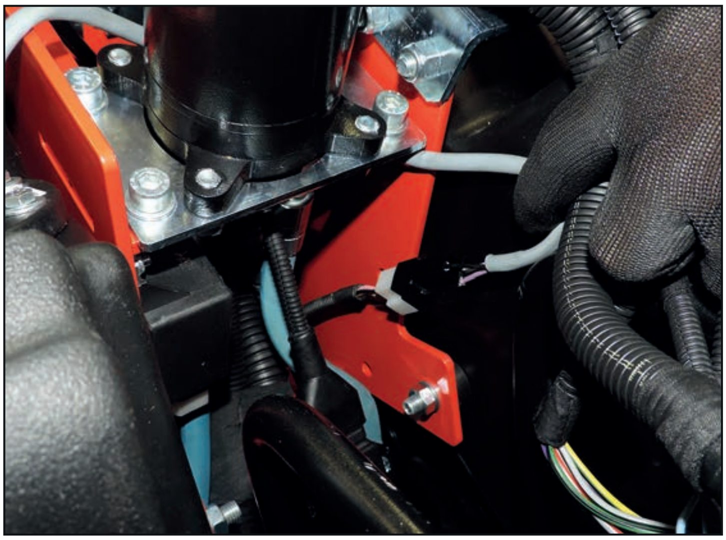


Fig. 12.23

Undo the screws and remove the washers.

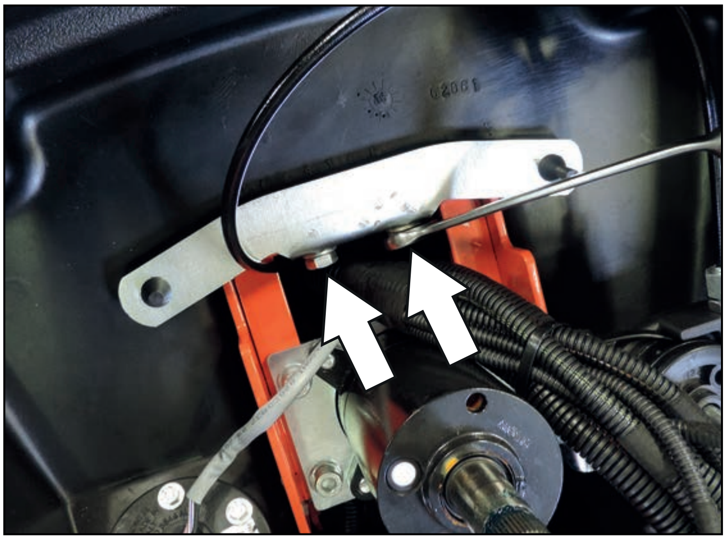


Fig. 12.24

Remove the tank fastener bracket.

Warning
Check the condition of the vibration damper plugs. Replace if worn.

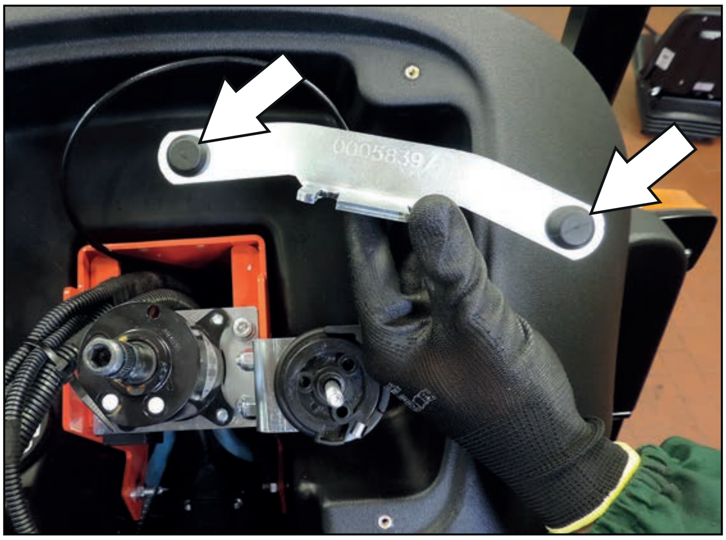


Fig. 12.25

Fold down the roll bar

Fig. 12.26

Undo the fastener screws of the right and left hand covers.

Remove the covers.

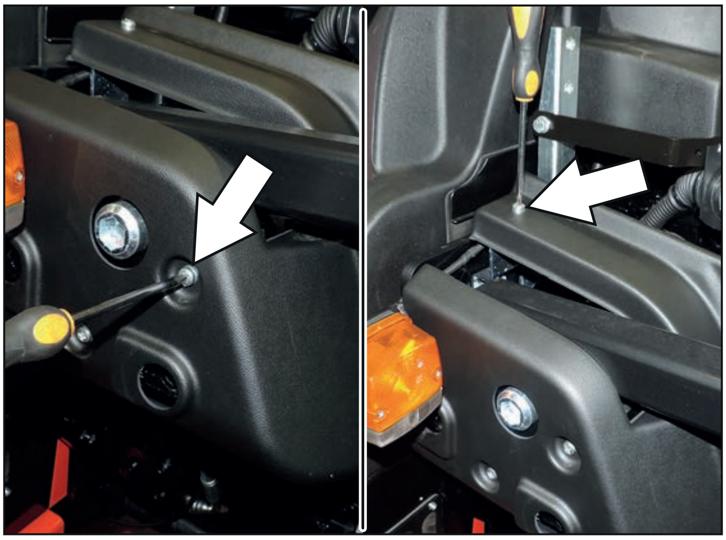


Fig. 12.27

Undo the fastener nuts of the hand throttle mounting plate.

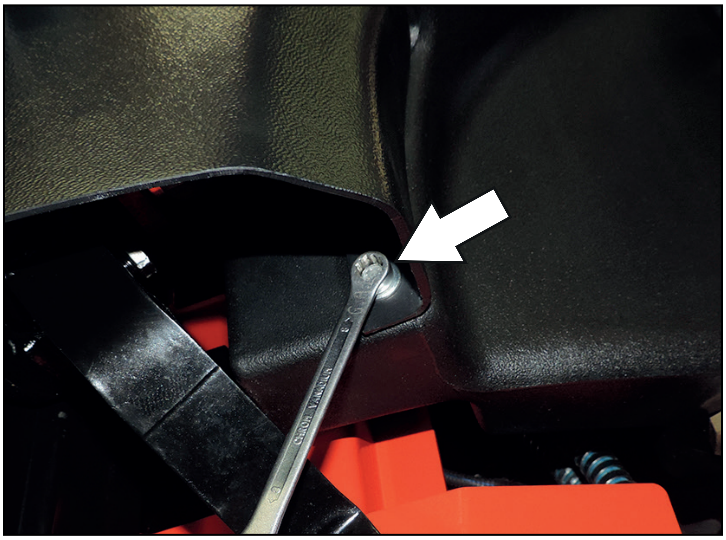


Fig. 12.28

Undo the fastener screws of the lateral tank cover.

Fig. 12.29

Undo the clamp and disconnect the fuel return pipe.

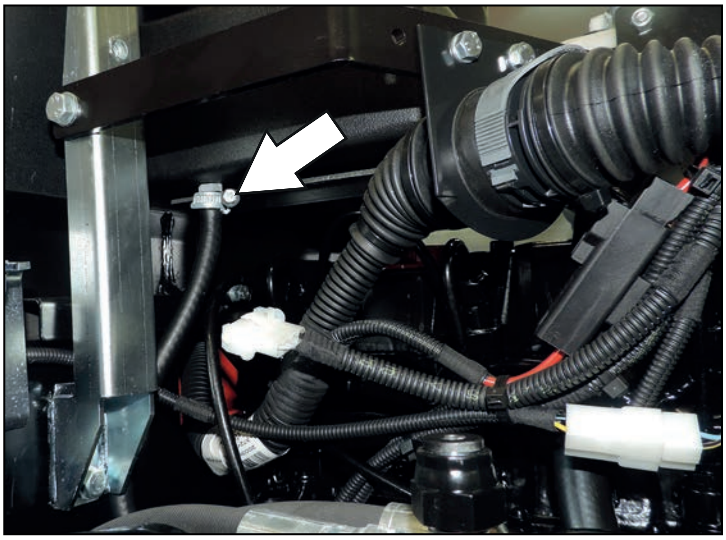


Fig. 12.30

Undo the lateral connectors of the fuel delivery pipes and remove the tank.

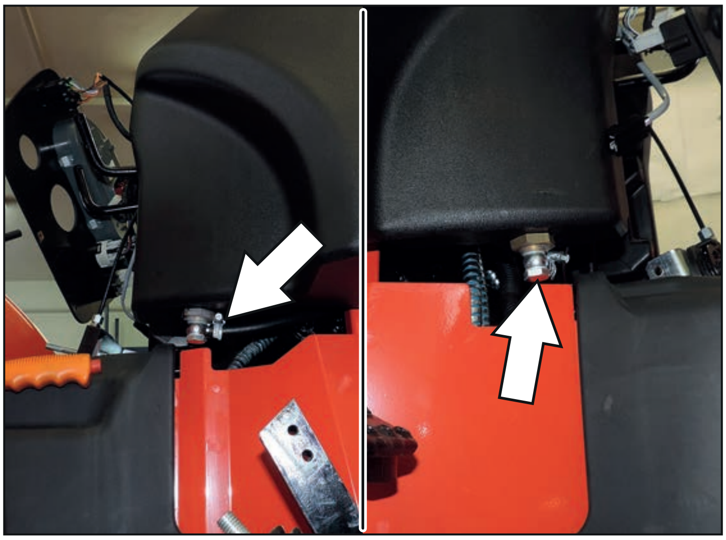


Fig. 12.31

Undo the fastener screws of the right and left hand lateral tank guards.

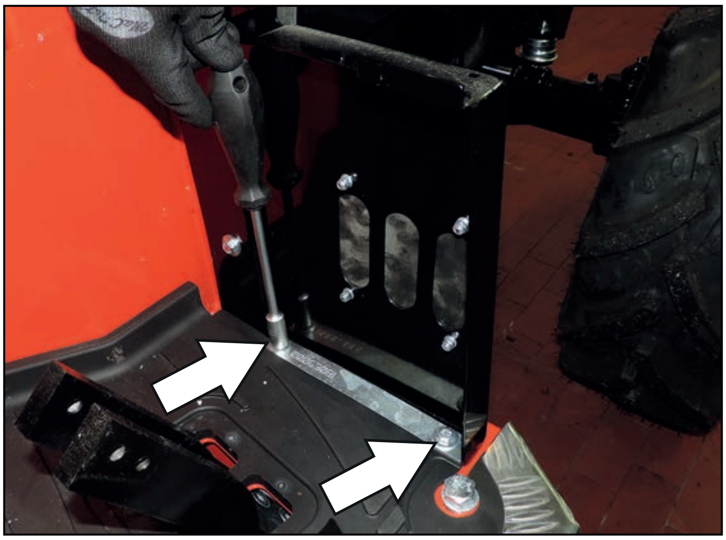


Fig. 12.32

Undo the fastener screws of the edge protectors and remove them.

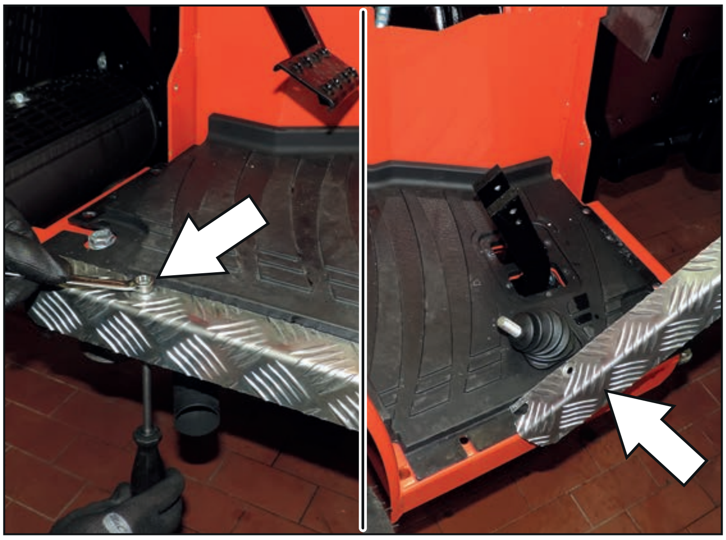


Fig. 12.33

Undo the oil cap and remove the footboard.

Warning
Refit and tighten the oil cap after removing the footboard to keep contaminants out of the tank.

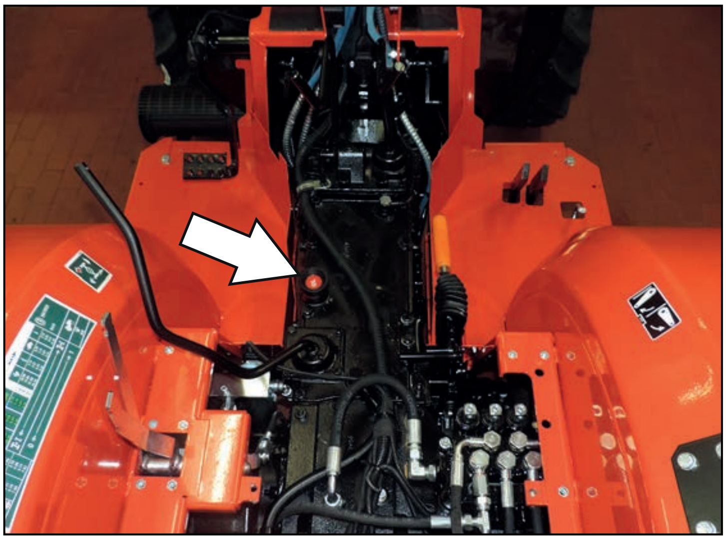


Fig. 12.34

Undo the fastener screws of the parking brake on the gearbox casing.

Undo the screw fastening the parking brake link rod on the brake pedal.

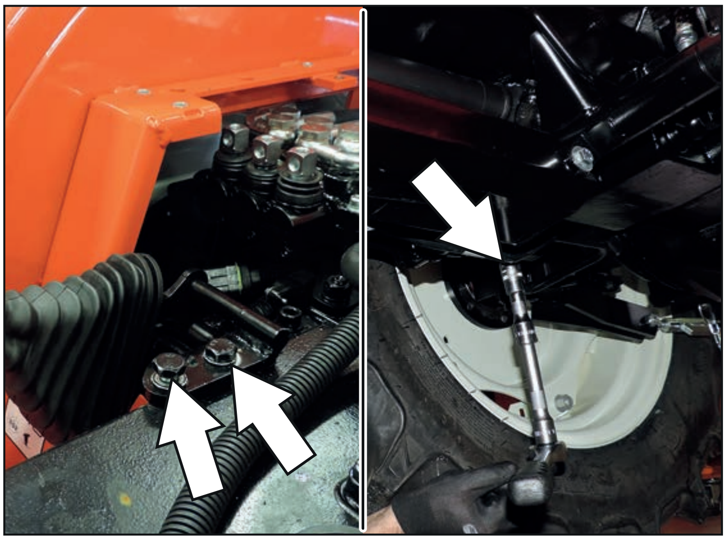


Fig. 12.35

Disconnect the 4WD and rear PTO lever link rods.

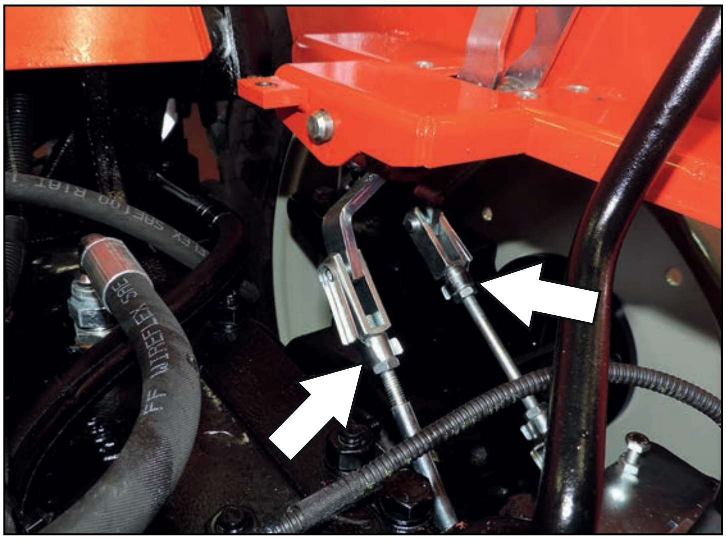


Fig. 12.36

Undo the hydraulic steering unit mount retainer screws.

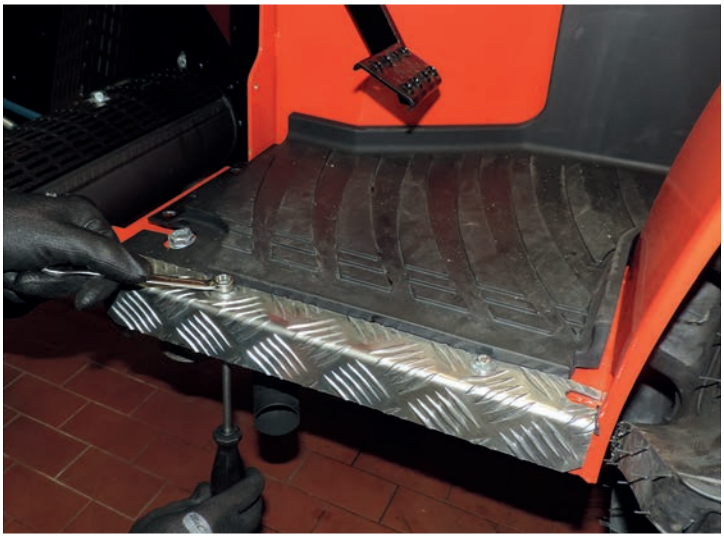


Fig. 12.37

Remove the split pin and the clutch lever link rod.

Remove the centring pin and remove the linkage rod and the clutch pedal.

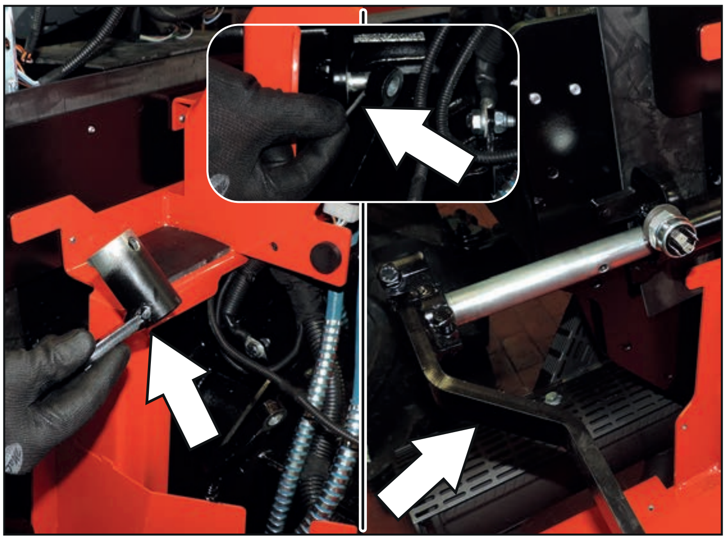


Fig. 12.38

Undo the front and rear fastener screws of the platform.

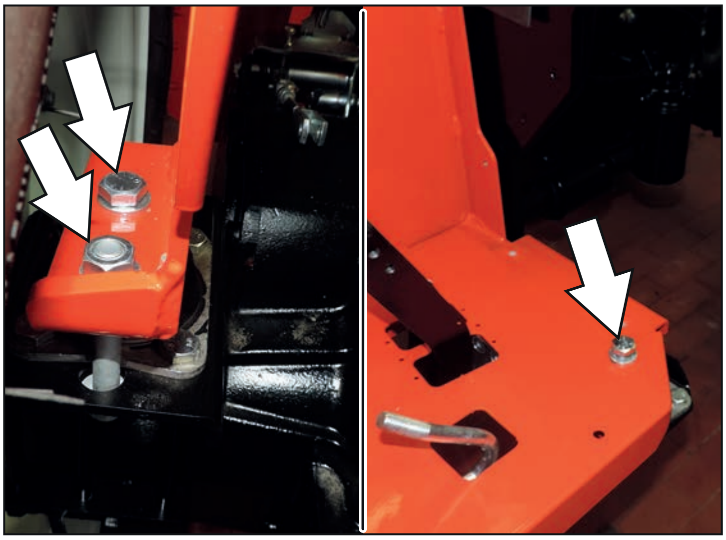


Fig. 12.39

Remove the circlips fastening the rear quick couplers.

Remove the quick couplers from their seats.

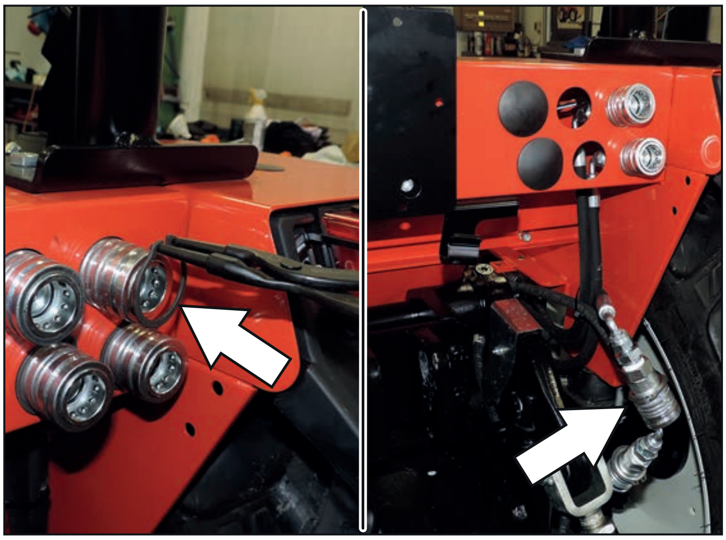


Fig. 12.40

Disconnect the wiring connectors at the front and pass them through the hole.

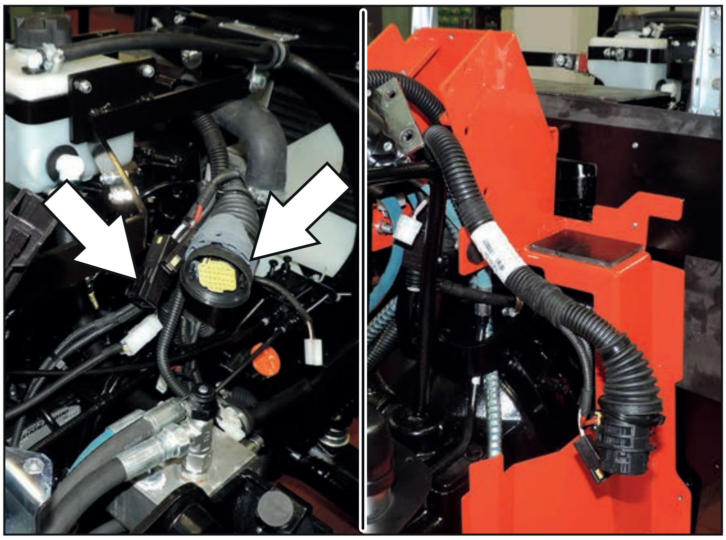


Fig. 12.41

Disconnect the connectors of the rear lights and trailer socket wiring harness connectors.

Undo the clamp.

Fig. 12.42

Undo the fasteners screws of the license plate holder, then disconnect the connector and remove the holder.

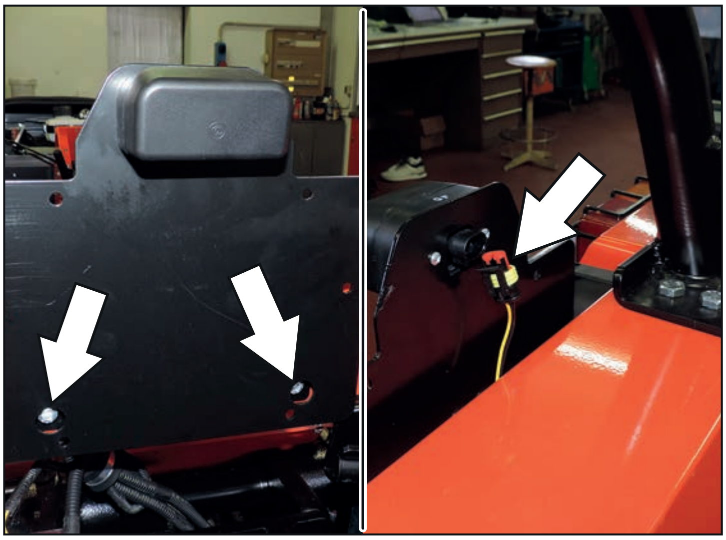


Fig. 12.43

Undo the trailer socket connector and remove it from its seat.

Fig. 12.44

Undo the retainers and pull out the hand and pedal throttle cables.

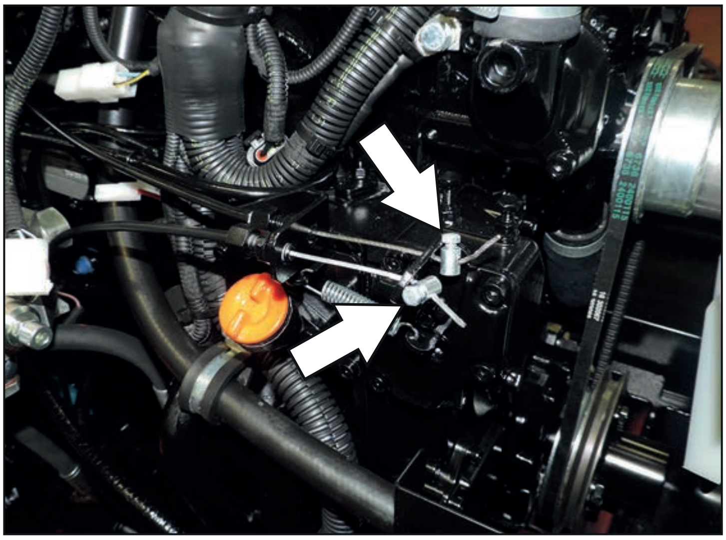


Fig. 12.45

Undo the fastener screws of the right and left hand tip-over protection devices.

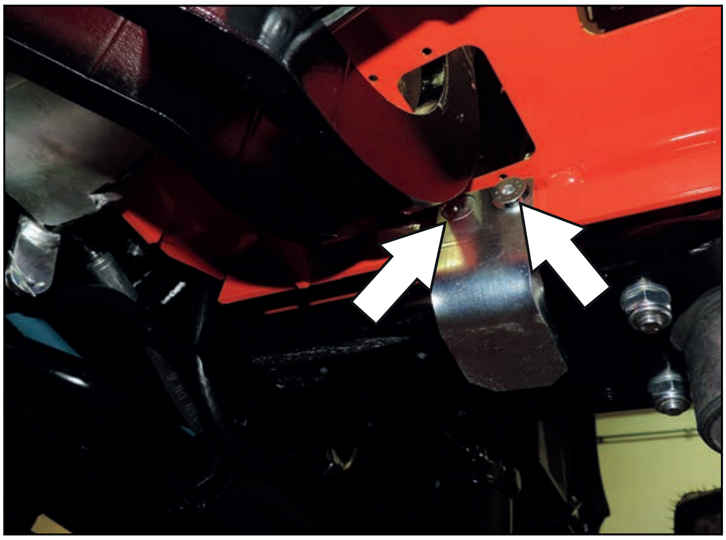


Fig. 12.46

Undo the fastener screws and remove the lateral engine guard.

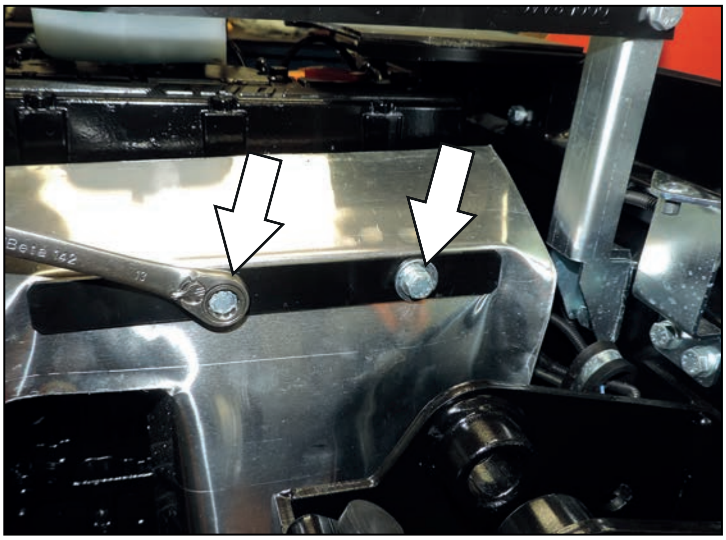


Fig. 12.47

Undo the screws fastening the clutch pedal mount.

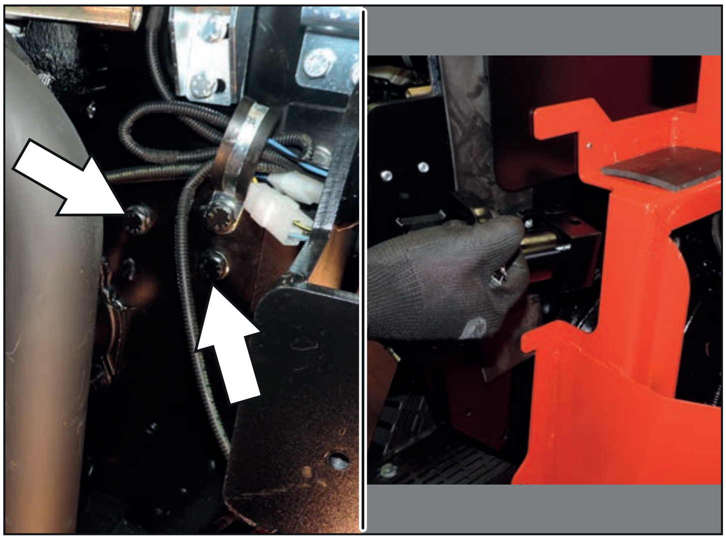


Fig. 12.48

Undo the fastener screws of the rear splash guards and remove the guards.

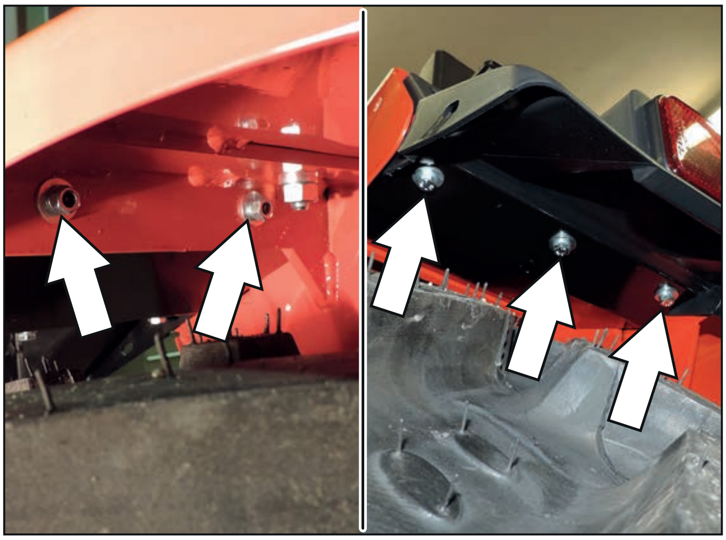


Fig. 12.49

Remove the toolbox.

Undo the screws fastening the rear roll bar and then remove the roll bar.

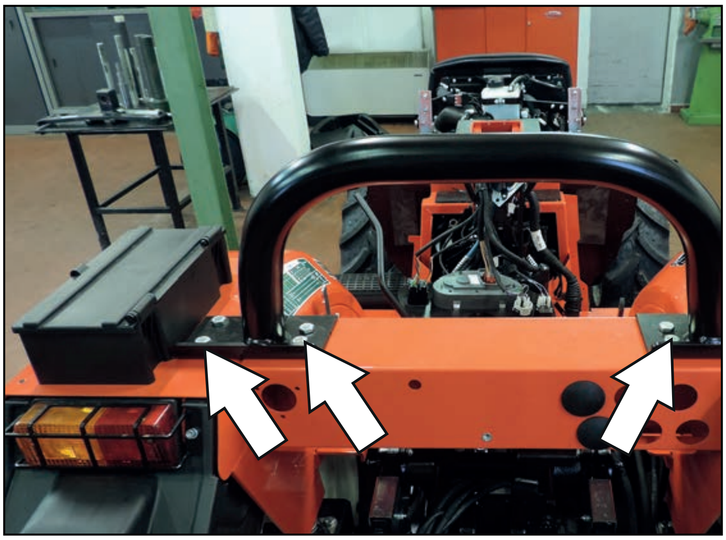


Fig. 12.50

Use the tool (A-p/n _________) connected to a hoist to secure the platform safely.

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

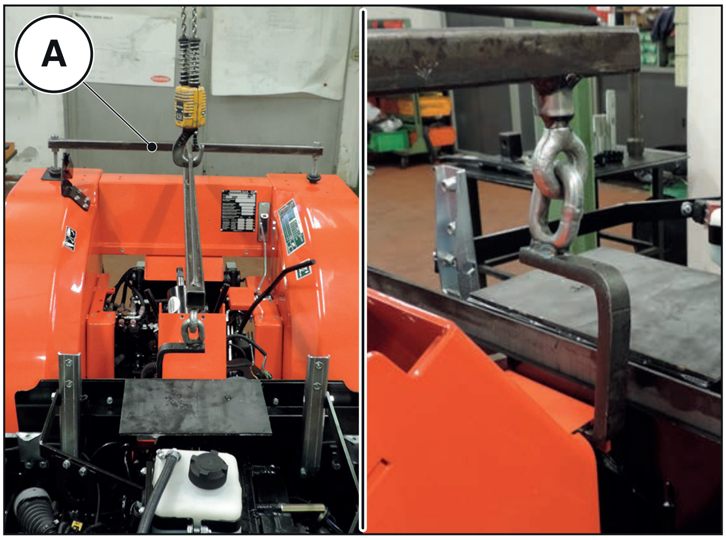


Fig. 12.51

Lift and remove the platform.

Fig. 12.52

2.2 Refitting

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".

Refit the platform by following the procedure for removal in reverse order.

Section 3 : Implements necessary

Index

3.1 Implements necessary

p/n	Description	Quantity
-	-	-

Chapter 13 : Front lift

Index

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 : Technical characteristics

Index

2.1 Technical characteristics

Type	Hydraulic, up / down
Lift capacity at lower link ends	350 kg
3-point linkage category	Category 1N
Mechanical top link arm	Category 1N

Section 3 : Fitting the front lift

Index

3.1 Steps in procedure for fitting the front lift

Undo the screws (1) with the washers (2), and remove the front tow hitch (3).

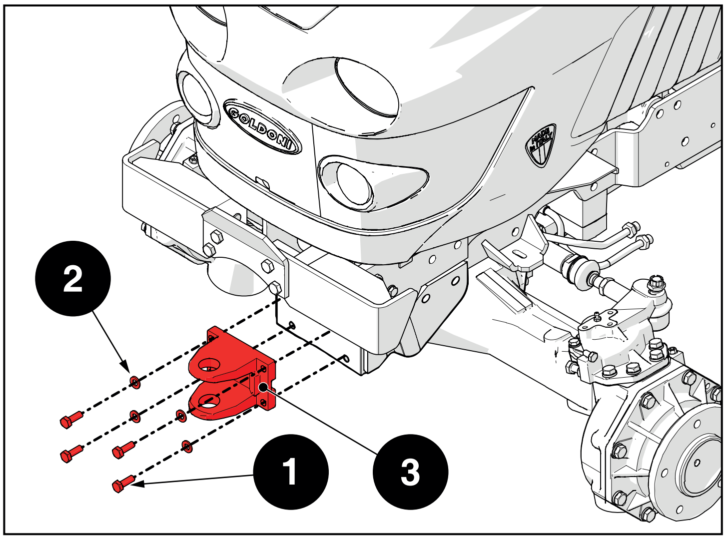


Fig. 13.1

Undo the screws (4) with the washers (5), and remove the hitch mounting bracket (6).

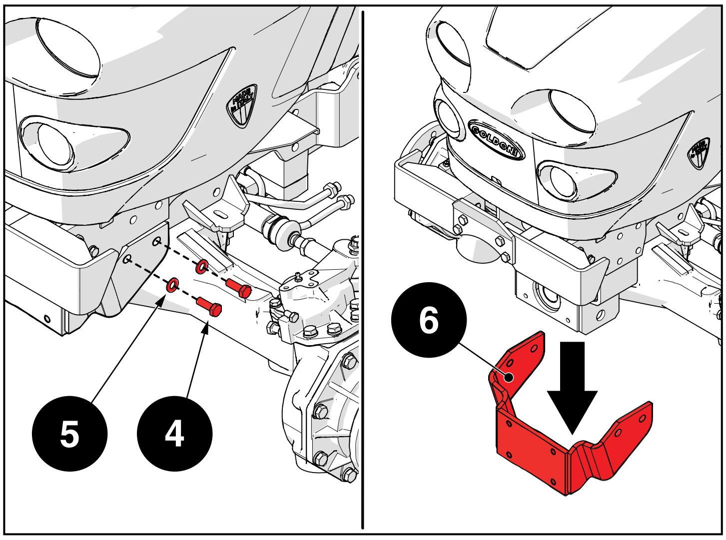


Fig. 13.2

Undo the screws (7) with the washers (8), and remove the bumper carrier (9).

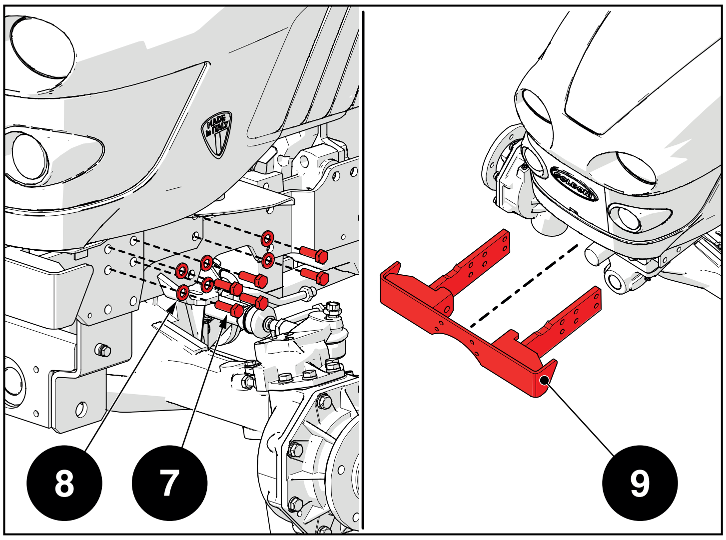


Fig. 13.3

Install the front lift bracket (10) and fasten it its seat with the screws (7) and the washers (8).

Note
Do not tighten the screws completely.

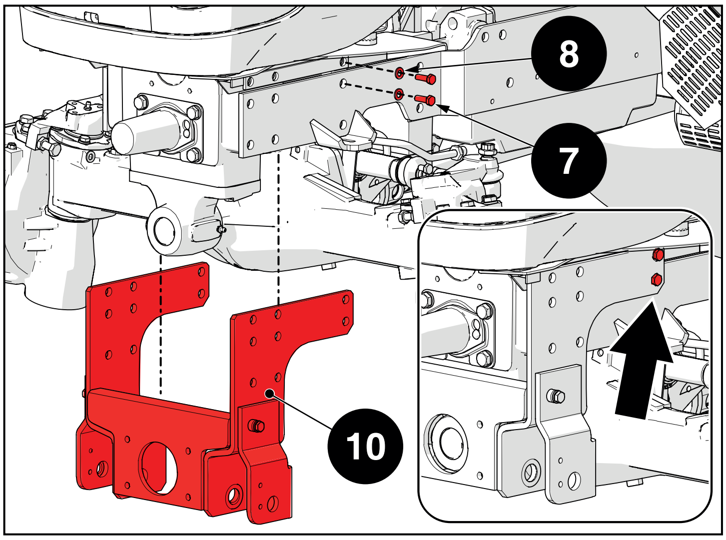


Fig. 13.4

Fit the front bumper carrier (9) and fasten it in its seat with the screws (7) and the washers (8).

Completely tighten all the screws, including the screws tightened partially in previous steps.

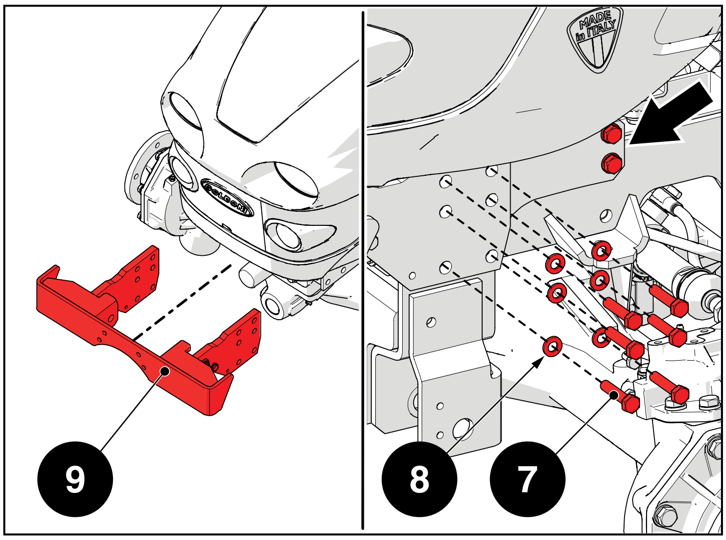


Fig. 13.5

Fit the top link mounting bracket (11) onto the bumper carrier and fasten with the screws (12), the washers (13) and the self-locking nuts (14).

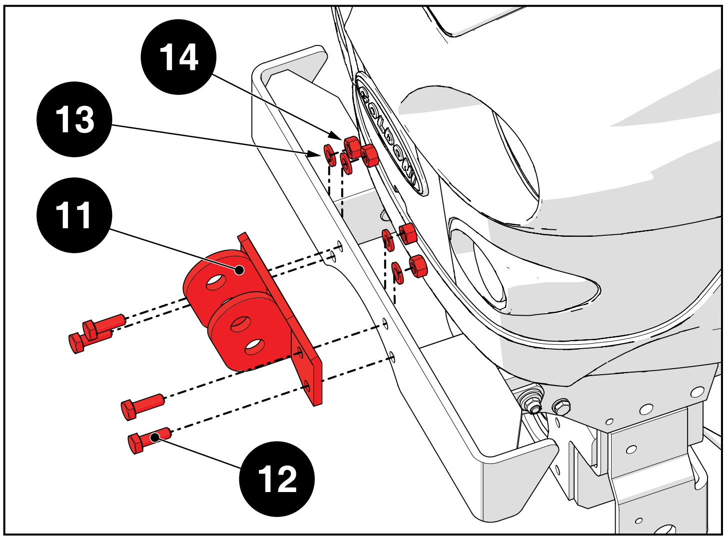


Fig. 13.6

Fasten the front towing hitch (3) to the lift bracket using the screws (1) and washers (2).

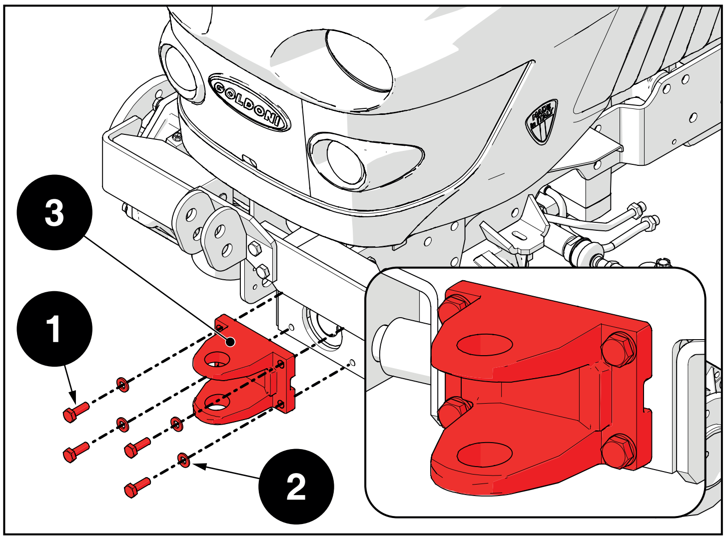


Fig. 13.7

Fit and tighten the stud bolt (15) and fit the bushes (16) on both sides of the bracket.

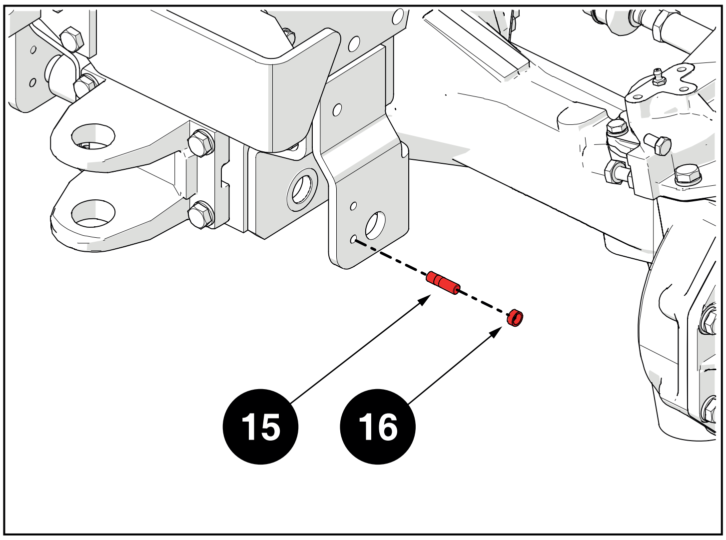


Fig. 13.8

Fit the front lift carrier (17), installing the spacers (18) correctly as shown in the figure.

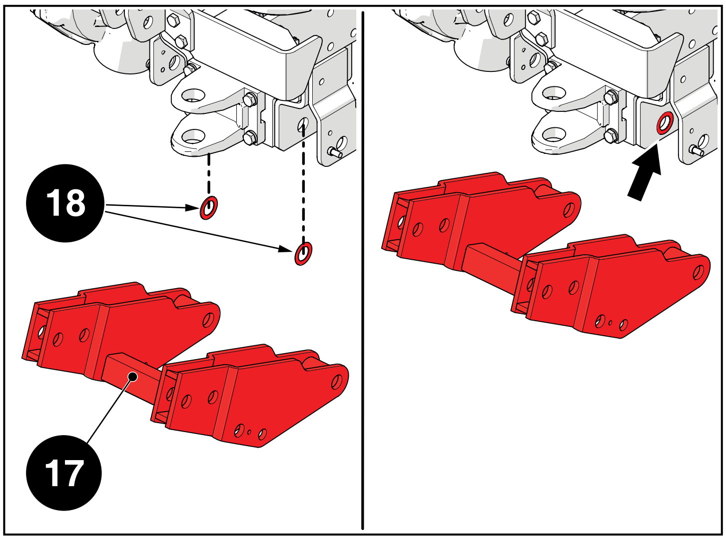


Fig. 13.9

Fit the fastener pins (19) of the arm carrier and secure in place by fitting and tightening the nuts (20) with the washers (21) and (22).

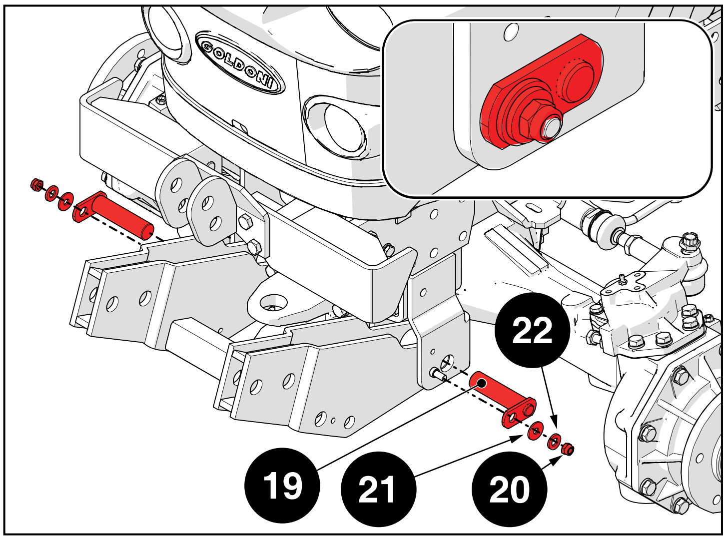


Fig. 13.10

Fit and tighten the stud bolts (15) and fit the bushes (16) on both sides of the bumper carrier and on the lift arm carrier.

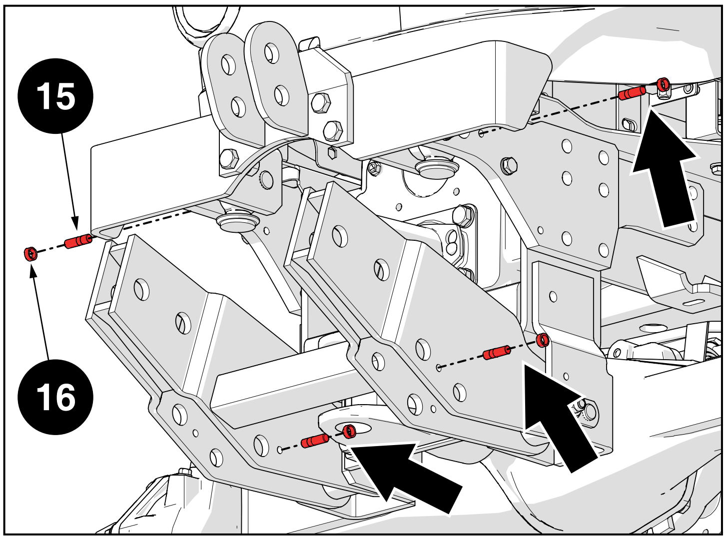


Fig. 13.11

Fit the cylinders (23), fitting the spacers (24) correctly as shown in the figure.

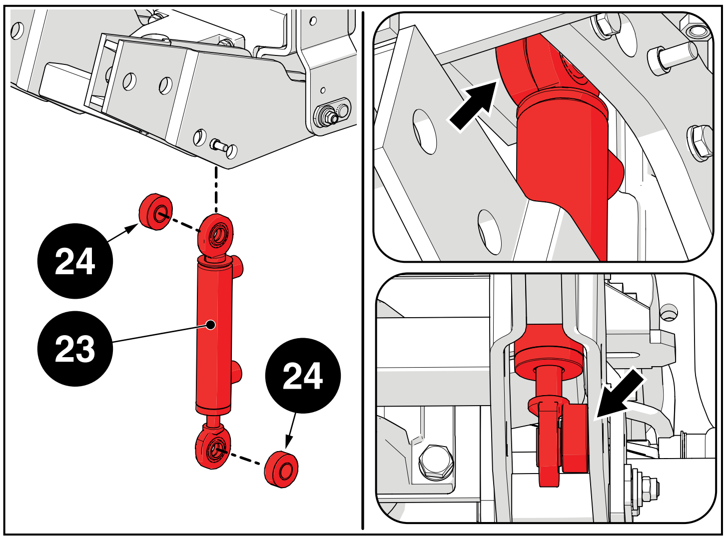


Fig. 13.12

Fasten the cylinders to the bumper carrier and to the lift arm carrier by fitting the pins (25).

Secure the pins (25) with the nuts (20) and the washers (21) and (26).

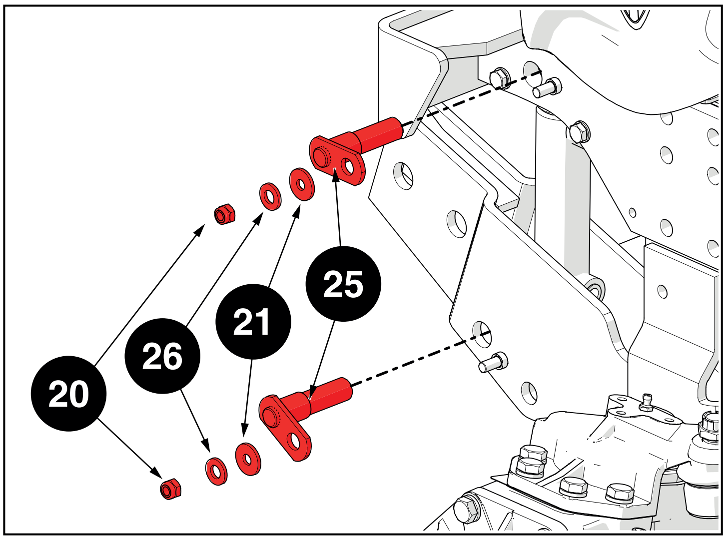


Fig. 13.13

Fit the pipe (27) onto the cylinders (23).

Warning
Make sure that all the copper gaskets (28) and the hydraulic connectors (29) and (30) are fitted correctly.

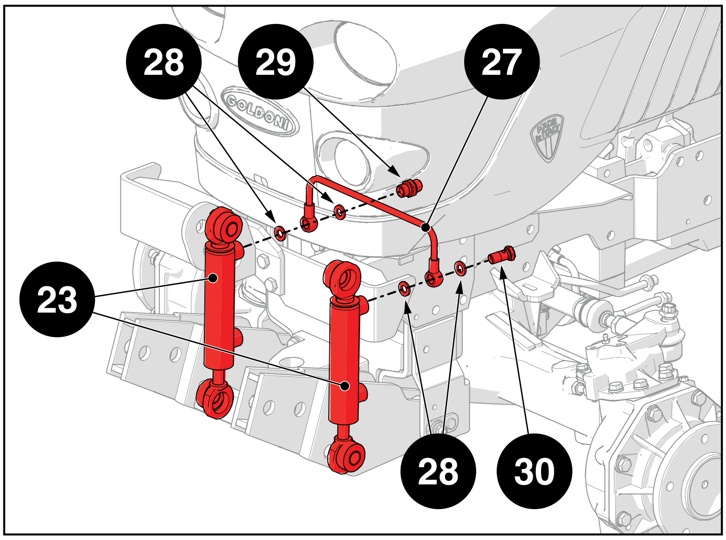


Fig. 13.14

Fit the pipe (31) onto the cylinders (23).

Warning
Make sure that all the copper gaskets (28) and the hydraulic connectors (30) are fitted correctly.

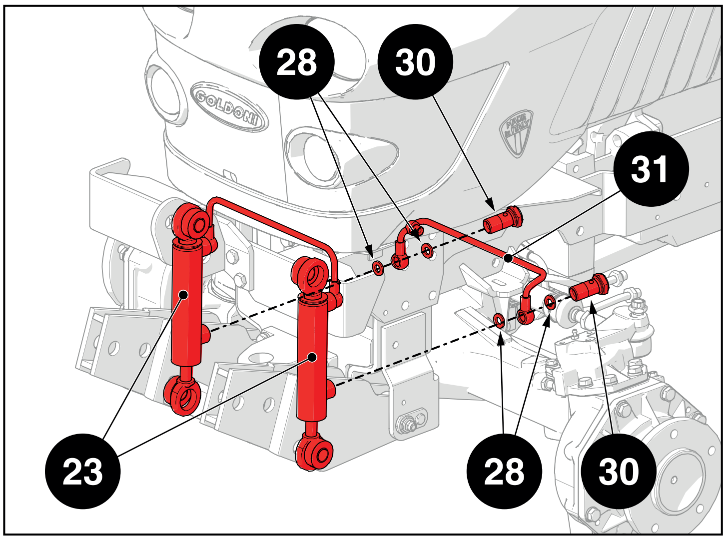


Fig. 13.15

Fasten the front lift arms (32) and (33) to the lift arm carrier, using the pins (34) and the spring clip pins (35).

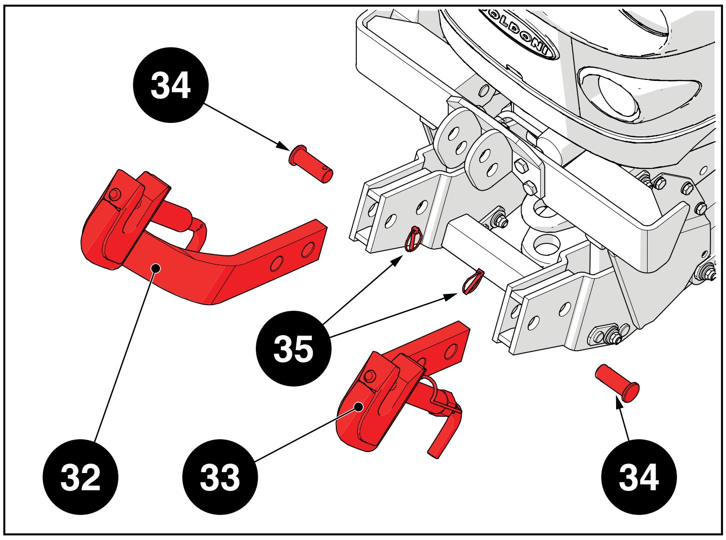


Fig. 13.16

Fit the top link arm (36) and fasten with the top link fastener pin (37).

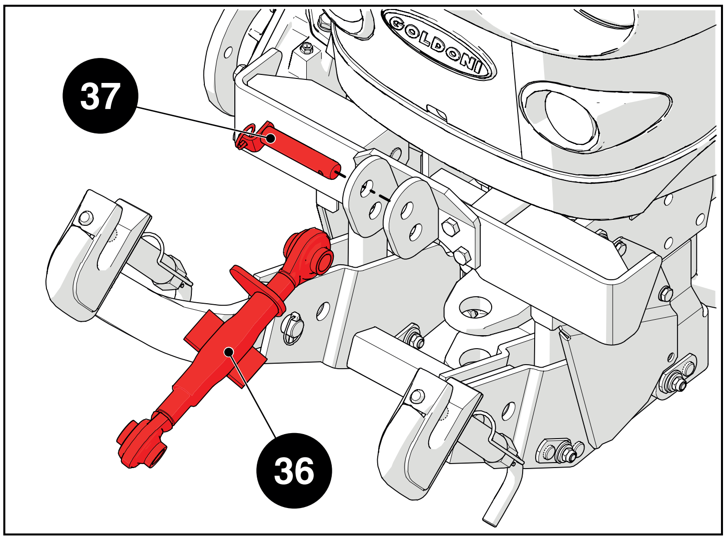


Fig. 13.17

Fasten the cylinder guards (38) on both sides of the tractor, using the screws (39) and the washers (40).

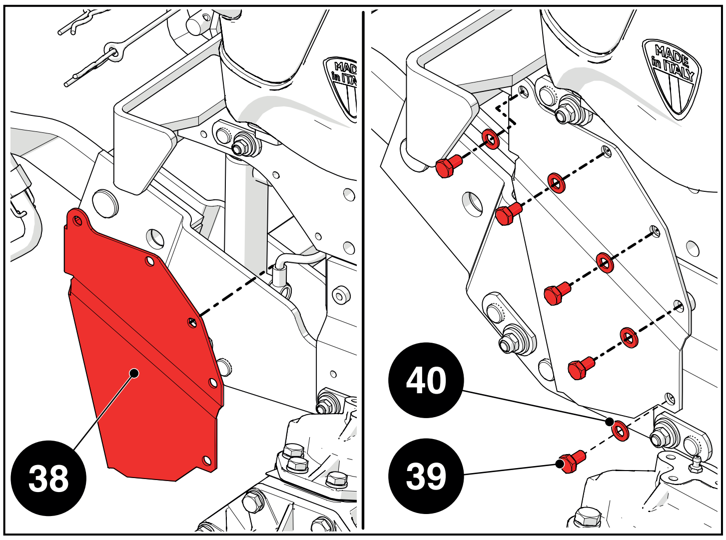


Fig. 13.18

3.2 Assembly procedure for front distributor with front lift

Fasten the front distributor block (41) to the tractor with the bracket (42).

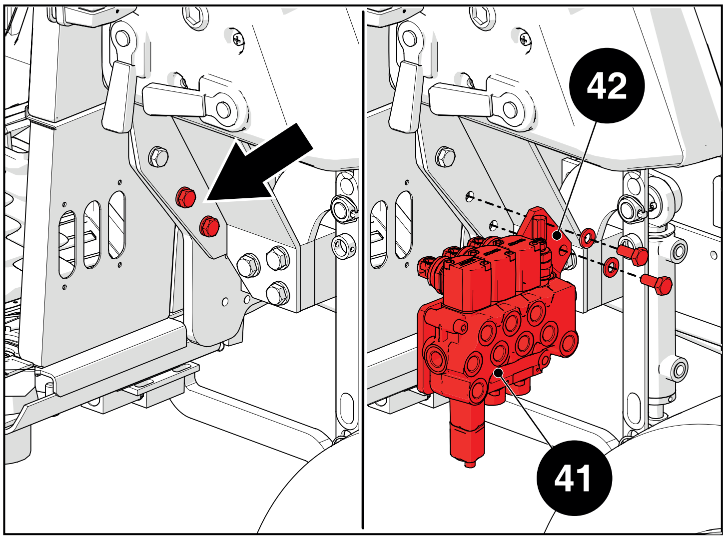


Fig. 13.19

Undo the pipe (43) leading from the priority valve (port B) where it joins the steel pipe leading to the rear distributors.

Warning
Oil will escape during this procedure. Place a container of suitable capacity under the connector. Wait until no more oil drains from the connector.

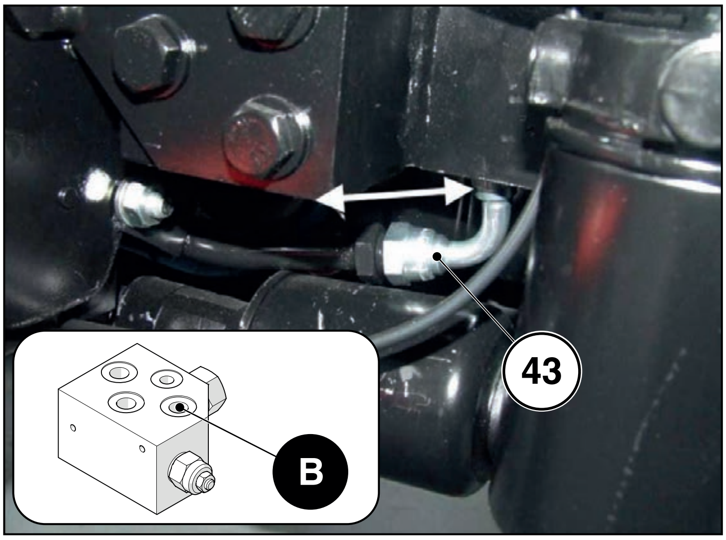


Fig. 13.20

Pull out the pipe (43) disconnected in the previous step and connect to the distributor block as shown in the figure.

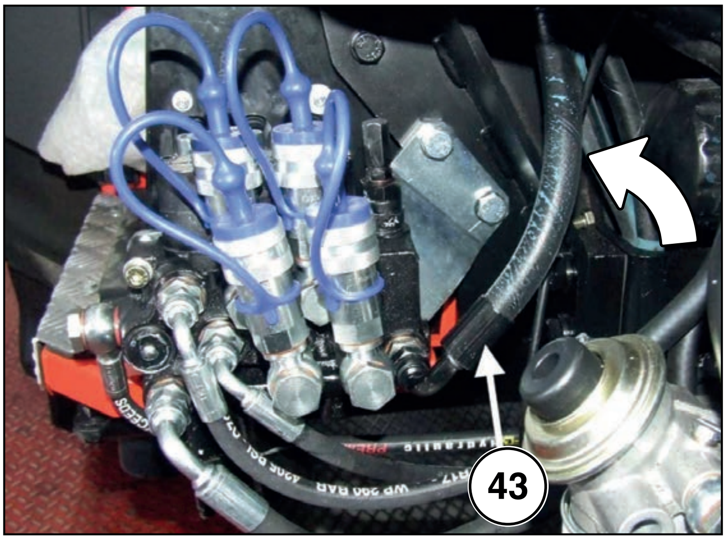


Fig. 13.21

Connect the pipe (44) between the CARRY OVER outlet of the front distributor and the steel pipe leading to the rear distributors (the same pipe from which the pipe shown in the figure was disconnected previously).

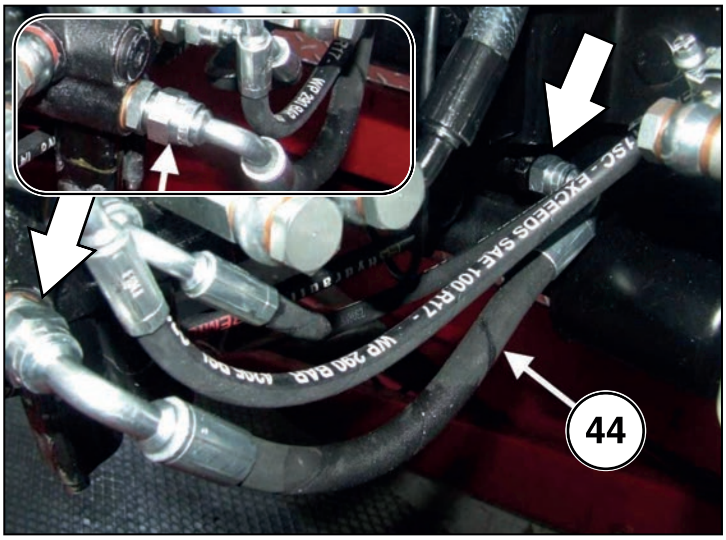


Fig. 13.22

Connect one end of the pipe (45) to the return outlet of the distributor.

Connect the other end of the pipe to the T union under the gearbox case (remove the plug tightened previously onto the union).

Warning
Oil will escape while connecting the pipe. Place a container of suitable capacity under the union.

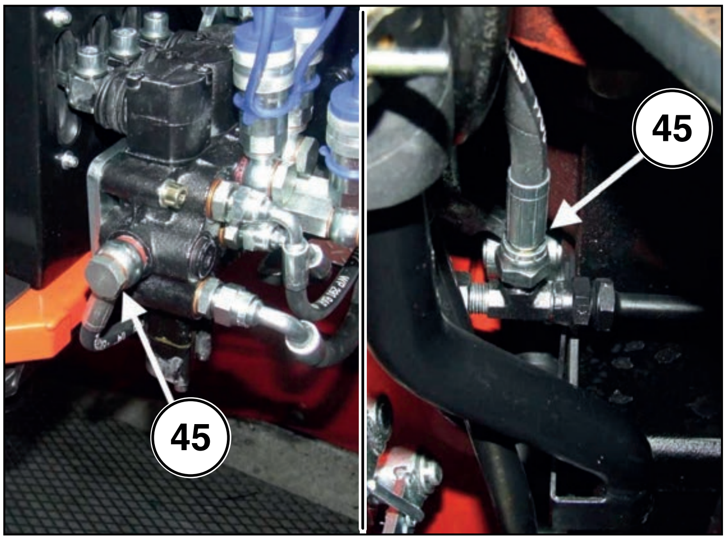


Fig. 13.23

Fit the quick couplers to the outlet ports of the distributors.

Note
The distributor kit contains 6 quick couplers. On tractors with the front lift, only 4 of these couplers are used.

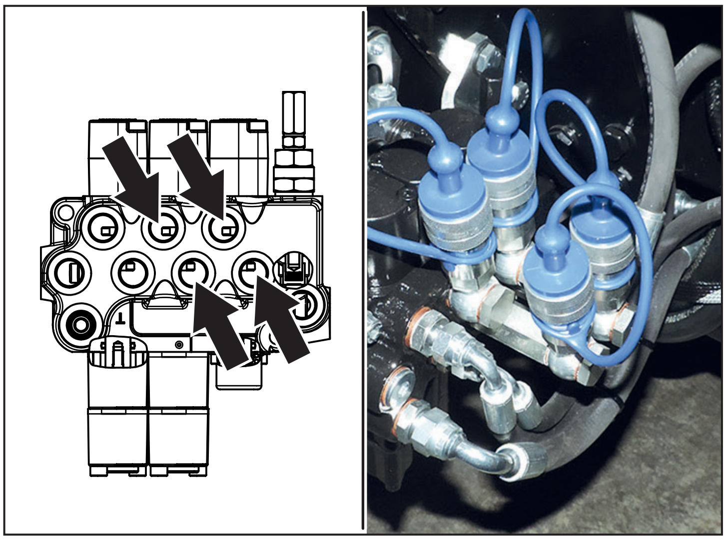


Fig. 13.24

Fit the levers and the protective boots as shown in the figure (remove the original protective rubber cover).

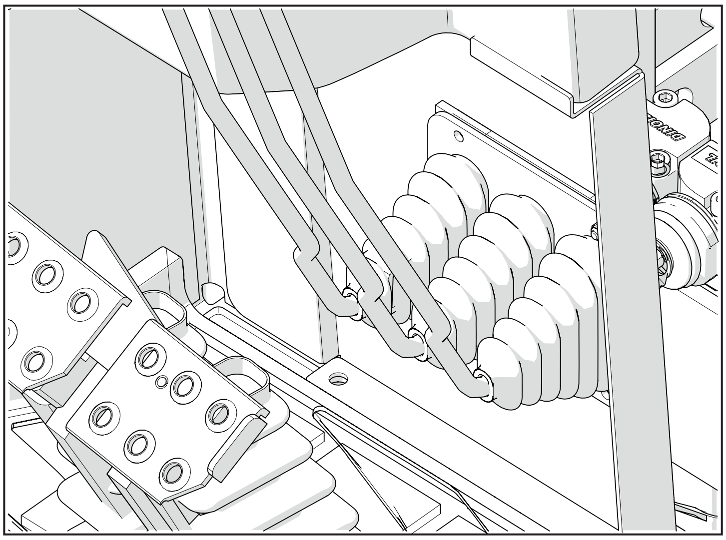


Fig. 13.25

Fit and tighten the nipples (46), complete with washers (47), to the distributors, and then connect the lift cylinder delivery pipes (48).

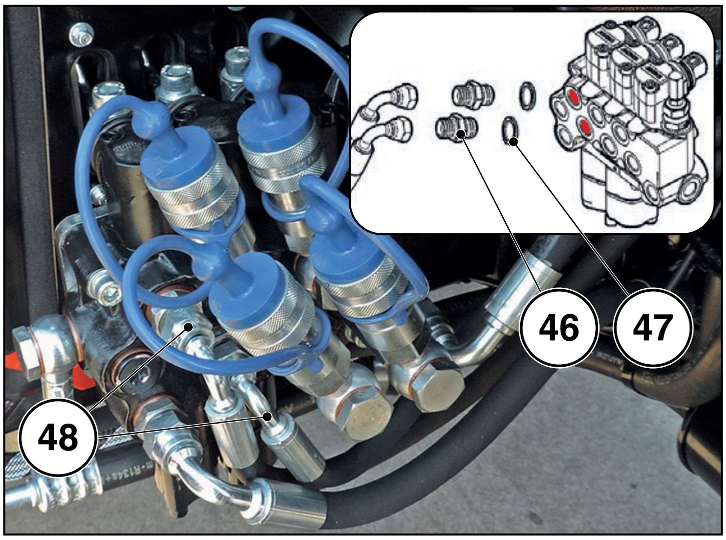


Fig. 13.26

Route the lift cylinder pipes as shown in the figure.

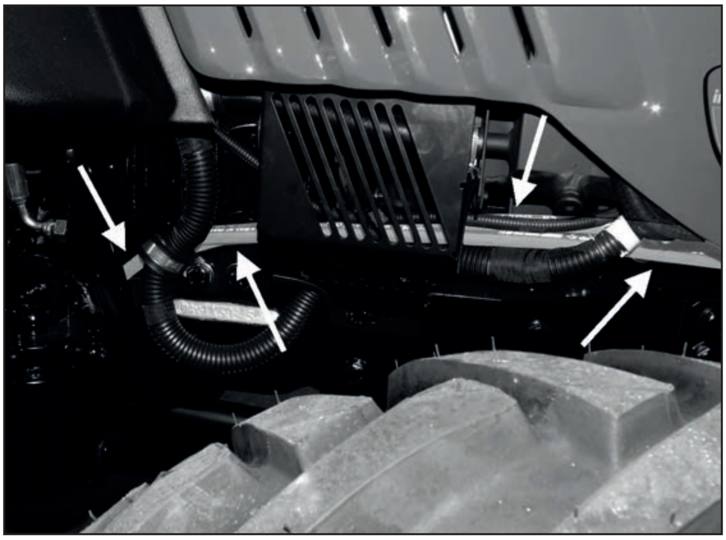


Fig. 13.27

Route the lift cylinder pipes as shown in the figure.

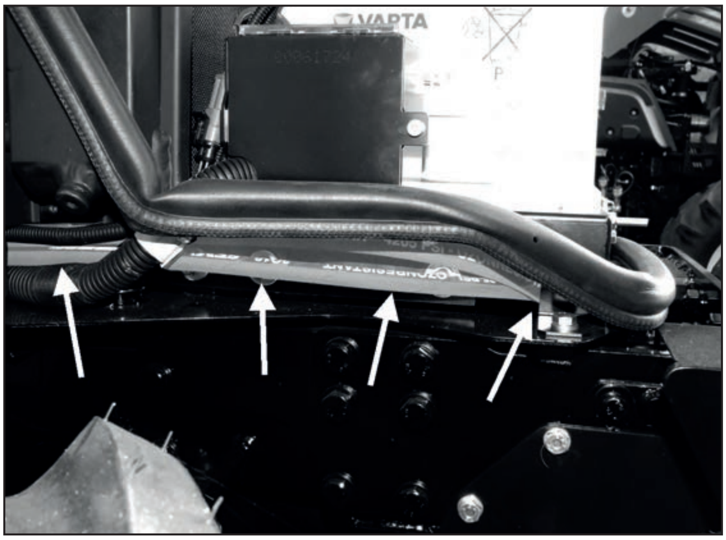


Fig. 13.28

Connect the flexible hoses (48A) and (48B) leading from the front distributors to the rigid cylinder delivery and return pipes.

⚠ Warning
Make sure that the pipes indicated with the letters "A" and "B" are connected correctly. The front lift will not function correctly if these pipes are connected incorrectly.

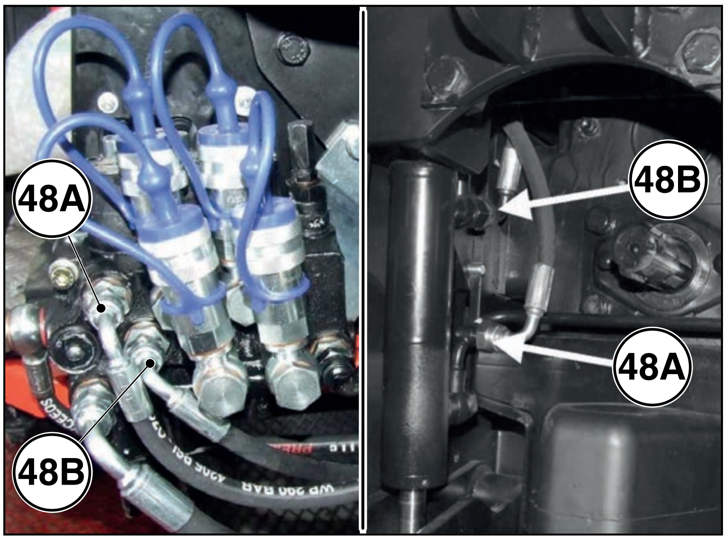


Fig. 13.29

Refill the gearbox with the oil drained and collected during assembly and then check the level.

Chapter 14 : Troubleshooting

Index

Section 1 : Clutch

Problem	Possible causes	Solutions
Clutch slips	Clutch judders	Adjust external control: adjust inner linkages if necessary
	Clutch fouled with oil	Rectify oil leak from crankshaft, primary shaft or rods. Replace discs with friction lining. See procedure for replacing gearbox rod seals for gearbox rods
	Insufficient diaphragm spring pressure	Replace the spring
	All linkages have stiffened, preventing lever or pedal from returning completely	Lubricate all linkage joints
	Clutch discs wear limit exceeded	Replace the discs
Clutch does not disengage	Excessive clutch free play	Adjust external control and adjust internal linkages if necessary
	Warped clutch disc	Replace clutch disc
	Clutch disc stuck to pressure plate due to prolonged period with machine not in use	Set off from a standstill with a fast range gear selected, disengage the clutch by pressing the pedal and press the brake pedals repeatedly while keeping the clutch pedal depressed. If this does not resolve the problem, disassemble and clean the clutch (see servicing the clutch)
	Internal controls not working correctly	(see procedure on spring pins of clutch control fork rod).

Section 2 : Brakes

Problem	Possible causes	Solutions
The machine does not brake	Brakes adjusted incorrectly	Adjust the emergency and parking brakes (see 'adjusting and bleeding brakes')
	Brake discs worn	Replace all discs (see 'servicing braking plates').
	Air in brake circuit	See 'adjusting and bleeding brakes' for bleeding procedure
	Drop in fluid level in brake fluid reservoir or brake pedals offering no resistance when pressed	See 'oil leaks in brake circuit' for resolving leaks

Section 3 : Gearbox

Problem	Possible causes	Solutions
Gears disengage	Excessive endfloat of synchroniser pack and selector gears	Set correct endfloat
	Gear selector rod and sliding selector sleeve not aligned correctly	Restore correct drivetrain power transmission by eliminating free play and, if necessary, replacing the selector rod, ball and spring
	Sliding gear selector sleeve and selector gear with worn teeth, causing synchroniser malfunction	Replace the complete synchronisers and the selector gears
Gears do not engage	Clutch does not disengage	Adjust the clutch as indicated
	Warped synchroniser brake rings	Replace brake rings
	Synchroniser brake preload springs too stiff	Replace the springs and grind the surfaces of the sliding sleeve in contact with the springs to eliminate edges
	Insufficient endfloat of synchroniser pack and speed selector gears	Set correct endfloat
	Worn override prevention stop	Check condition of stop (see procedure on gear selection prevention stops of internal gearbox selector rods)
Creeper gear/ reverse shuttle disengages	Creeper gear selector rod and sliding gear not aligned correctly	Restore correct drivetrain power transmission by eliminating free play and, if necessary, replacing the selector rod, ball and spring (see procedure on creeper gear range selection control)
Creeper gear/ reverse shuttle does not engage	Clutch does not disengage	Adjust the clutch as indicated (see 'servicing the clutch')
	Reverse shuttle not selectable	Check that the external reverse shuttle performs its entire travel correctly and is not impeded by the rubber boot Check that the reverse shuttle synchroniser has not developed excessive free play Check adjustment of the reverse shuttle fork and of the relative rod

Section 4 : Power Take Off

Problem	Possible causes	Solutions
PTO disengages	Independent or ground speed PTO selection controls misadjusted	Adjust the selector
PTO does not engage	Clutch does not disengage	Adjust the hand operated clutch as indicated
Creeper does not disengage	Creeper selector linkage poorly adjusted or stuck	Check adjustment of creeper gear selector linkage and grease mounting bushes
PTO does not work	Independent or ground speed PTO selection controls misadjusted	Adjust the selector as indicated

Section 5 : Hydrostatic steering

Problem	Possible causes	Solutions
Loss of steering control	Steering cylinder seal rings worn.	Replace seal rings on cylinder
Oil loss from hydraulic steering unit	Loosened connectors	Replace gaskets and tighten the connectors
	Loosened connectors	Restore seal tightness of hydraulic steering unit
	Hydraulic steering unit return line obstructed	Check condition of return line and test function of lift distributor
Steering wheel becomes stiff	Contamination in priority valve	Clean valve (see 'checking and cleaning priority valve')
Excessive steering play	Free play between steering column and steering box or hydraulic steering shaft	Replace worn parts

Section 6 : Hydraulic lift

Problem	Possible causes	Solutions
Lift is jerky when raised	Pump suction line filter clogged	Clean the filter or replace if necessary
	Air infiltrating into pump suction line	Check suction line and relative connectors and gaskets. Check oil level.
Pump overheats	Excessive pressure	Reduce pressure (see 'checking and adjusting oil pressure in hydraulic circuit')
	Cavitation	Clean suction line components (pipe or filter clogged)
Pump produces no pressure	Pump spindle failure	Replace pump
Noise from pump	Cavitation	Clean suction line components (pipe or filter clogged)
	Poor seal tightness of pump spindle	Replace oil seal ring
Oil level increases in circuit and overflows	Air aspirated into circuit	Check suction line and relative connectors and gaskets. Check oil level.
	Excessive oil	Check oil level
Lift does not raise and/or lower	hydraulic pump failure	replace pump
	lift distributor linkage misadjusted	adjust lift levers
Draft and/or sensitivity functions not working correctly	worn internal lift distributor control components	See workshop manual for lift distributor
	No oil reaching lift	See 'checking and cleaning priority valve'
Lift capacity lower than specified	Insufficient pressure in hydraulic system	See 'checking and adjusting oil pressure in hydraulic circuit'
Lift has difficulty sustaining load	Oil blow-by in hydraulic cylinder	See 'servicing lift cylinder due to oil leaks'

Section 7 : Front axle

Problem	Possible causes	Solutions
Vibration at wheels	Misadjusted toe angle	Adjust toe angle correctly
	Axle knuckle bushes worn	Replace bushes
	Steering ball heads worn	Replace relative parts and adjust toe angle

Section 8 : Bodywork

Problem	Possible causes	Solutions
Vibration on platform	Engine idle speed to low	Restore correct engine speed
	Platform silent-block mounts not fastened uniformly	Check tightness of silent-block fasteners
	Free play between pins and control levers on platform	Adjust correctly to eliminate free play

Section 9 : Electrical system

Problem	Possible causes	Solutions
Alternator warning lamp does not extinguish even at high engine speeds	Regulator malfunction	Service or replace the alternator
	Alternator not charging sufficiently	Service or replace the alternator
Hydraulic filter clogged warning lamp lit (if applicable)	Suction line filter clogged	Clean filter (see 'routine maintenance')
	faulty bulb in hydraulic circuit	Replace bulb
	Incorrect lubricant oil	Replace oil with product of recommended type
	Very low exterior temperature	Wait approx. 5-10 min. with the engine at idle speed before starting work
Air filter clogged warning lamp lit	Air filter clogged.	Clean or replace if necessary (see 'routine maintenance')
	air filter clogging sensor bulb faulty	Replace bulb
Engine oil warning lamp lit	Insufficient oil pressure	Top up to correct oil level and change filter (see 'routine maintenance')
	faulty bulb	replace bulb
Front wheel drive engaged indicator lamp lit	Linkage or switch misadjusted	Adjust linkage or switch correctly
	Switch faulty	Replace switch
PTO disengaged lamp lit	Control lever or switch misadjusted	Adjust lever (see 'routine maintenance') or switch

Section 10 : Fuel circuit

Problem	Possible causes	Solutions
Poor engine power	Fuel filter clogged	Replace filter (see 'routine maintenance')
	Air aspirated into circuit	Eliminate cause of air infiltration
	Misadjusted valve clearance and/or miscalibrated injectors	Adjust valve clearance and calibrate injectors correctly (see engine manual)
Engine has difficulty starting	Glow plugs not working	Replace glow plugs
	Miscalibrated injectors	Calibrate injectors correctly (see engine manual)
	AC electric fuel pump malfunction	Replace pump

Section 11 : Cooling circuit

Problem	Possible causes	Solutions
Engine overheats	Radiator clogged	Clean radiator thoroughly (see 'routine maintenance')
	Alternator/pump drive belt slack	Set belt tension correctly
	Engine overloaded for prolonged period of time	Select a more suitable ratio or use an appropriate implement
	Thermostat valve malfunction	Replace the valve
	Coolant leakage from cooling circuit	Check connections and gaskets of hoses, replace if necessary
	Air filter clogged	Clean filter (see 'routine maintenance')
	Water not circulating correctly due to pump malfunction	Service or replace pump

Chapter 15 : Special tools

Index

Section 1 : Tools list

p/n	07007171
Description:	Clutch plate alignment pin
Chapter:	Chap. 2 Engine

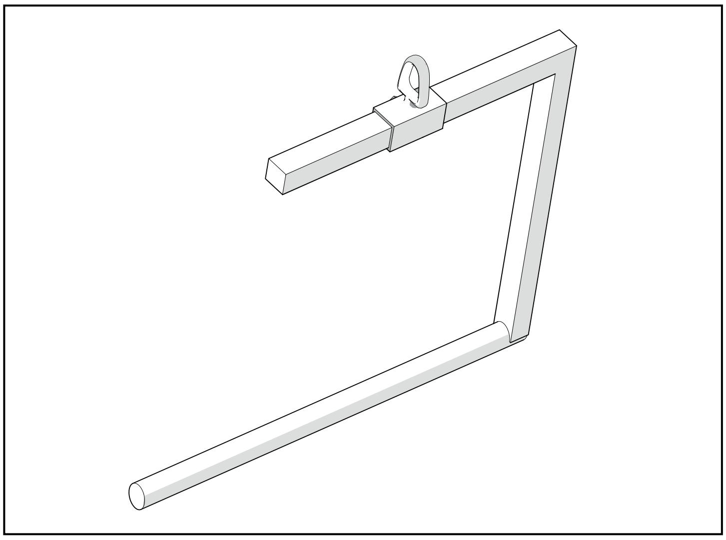


Fig. 15.1

p/n	07007163
Description:	Rod restraint pin
Chapter:	Chap.4 Transmission

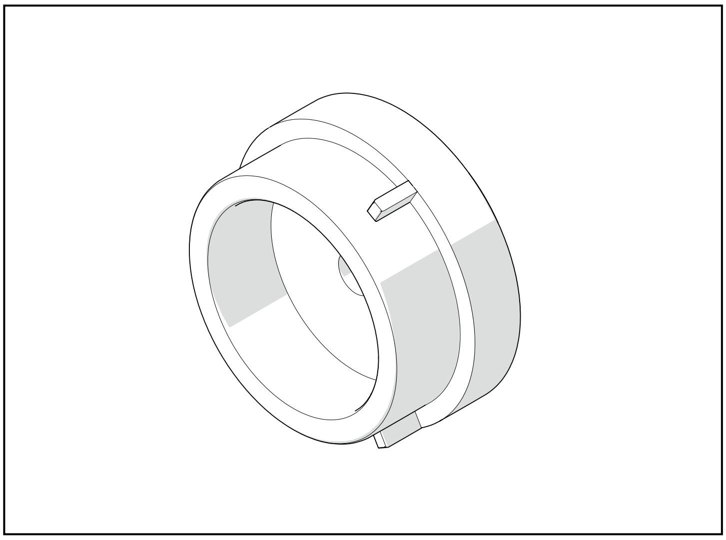


Fig. 15.2

p/n	-
Description:	Circlip installation guide
Chapter:	Chap.4 Transmission

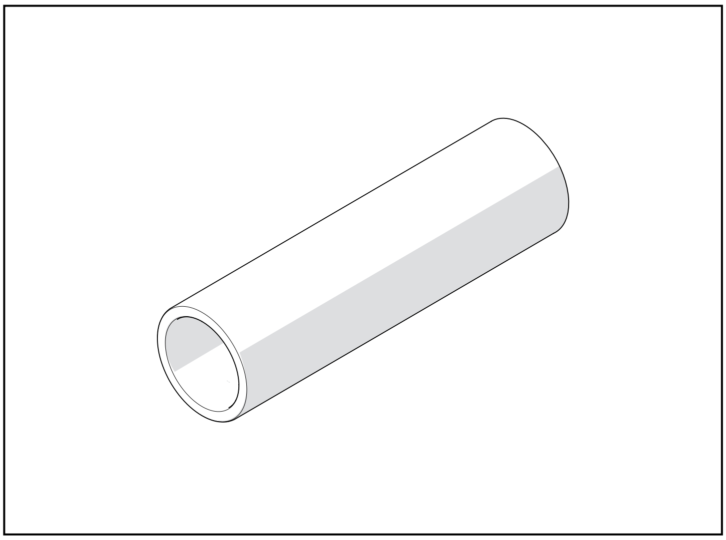


Fig. 15.3

p/n	-
Description:	Rod oil seal guide tool
Chapter:	Chap.4 Transmission

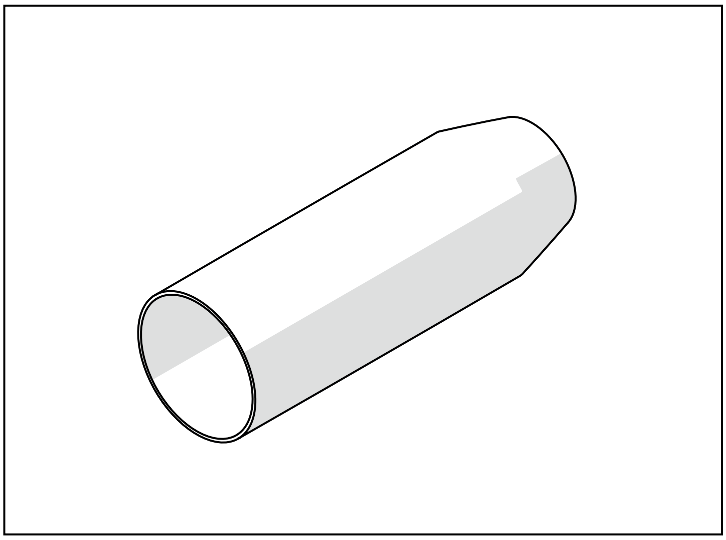


Fig. 15.4

p/n	07004010
Description:	Secondary shaft guide
Chapter:	Chap.4 Transmission

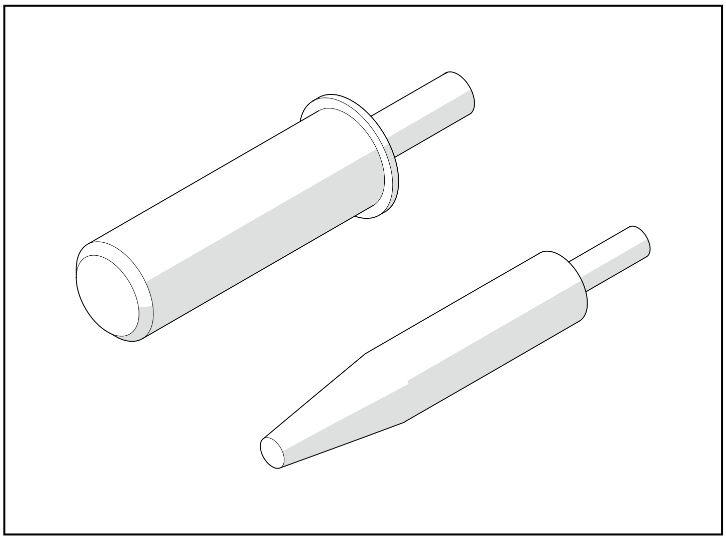


Fig. 15.5

p/n	07007332
Description:	Secondary shaft immobiliser tool
Chapter:	Chap.4 Transmission

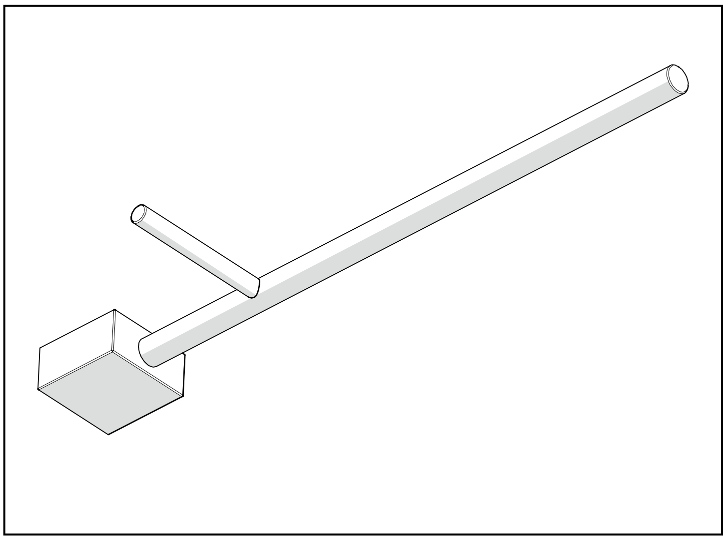


Fig. 15.6

p/n	07007333
Description:	Secondary shaft retainer
Chapter:	Chap.4 Transmission

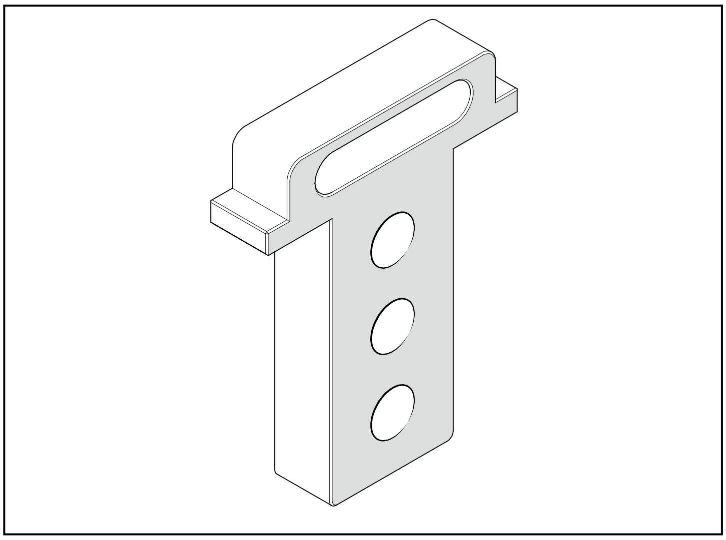


Fig. 15.7

p/n	07000115
Description:	Wrench for rear differential ring nut
Chapter:	Chap.4 Transmission

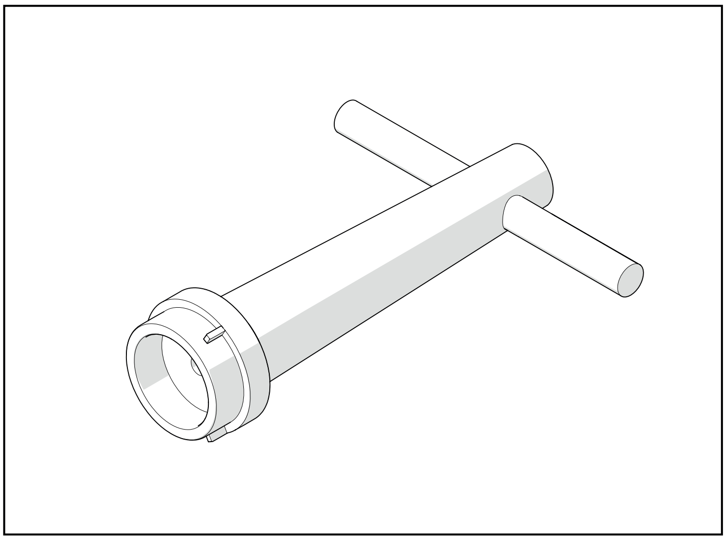


Fig. 15.8

p/n	00007565
Description:	Spring compressor bracket
Chapter:	Chap.4 Transmission

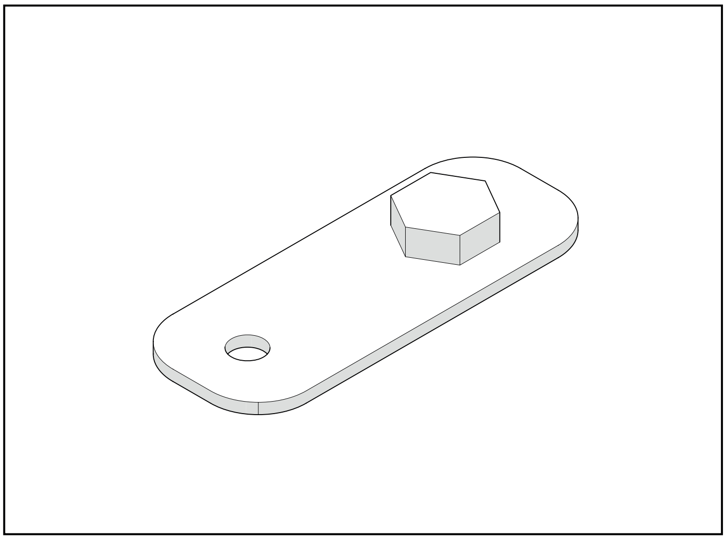


Fig. 15.9

p/n	-
Description:	Dummy clutch housing
Chapter:	Chap.4 Transmission

Fig. 15.10

p/n	-
Description:	Bearing restraint tool
Chapter:	Chap.4 Transmission

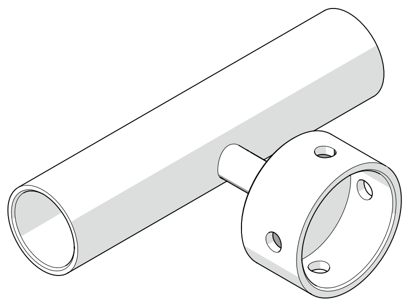


Fig. 15.11

p/n	-
Description:	Hub hoisting plate
Chapter:	Chap. 5 Rear brakes and final drive units

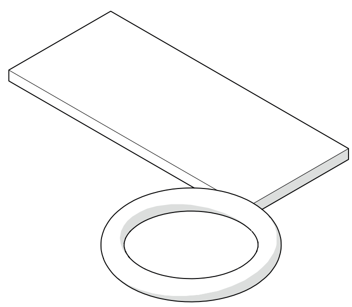


Fig. 15.12

p/n	07000234
Description:	Wrench for secondary shaft ring nut
Chapter:	Chap.6 Front axle

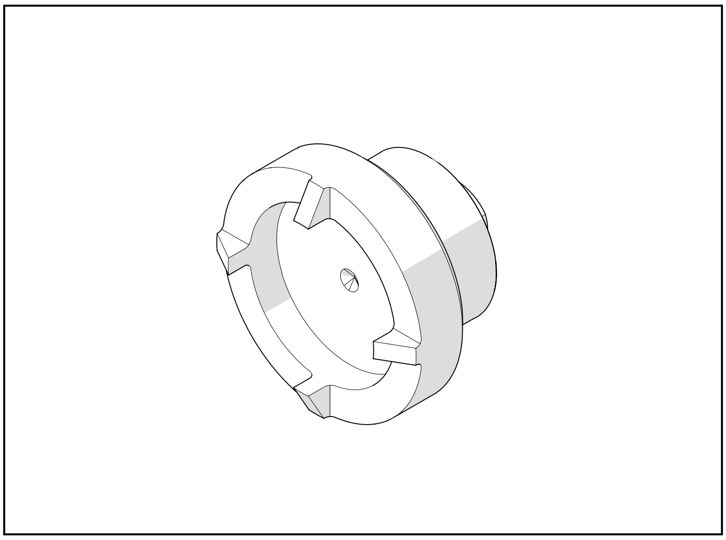


Fig. 15.13

p/n	07000243
Description:	Wrench for ring nut
Chapter:	Chap.6 Front axle

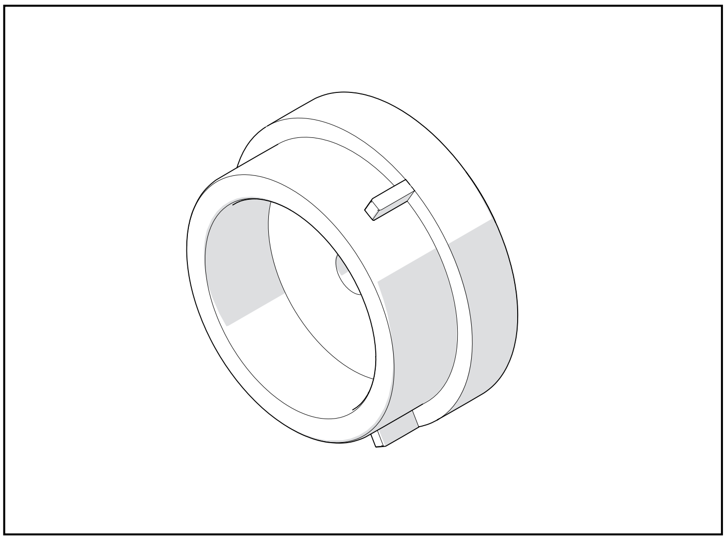


Fig. 15.14

p/n	07007180
Description:	Toe angle measurement tool
Chapter:	Chap.6 Front axle

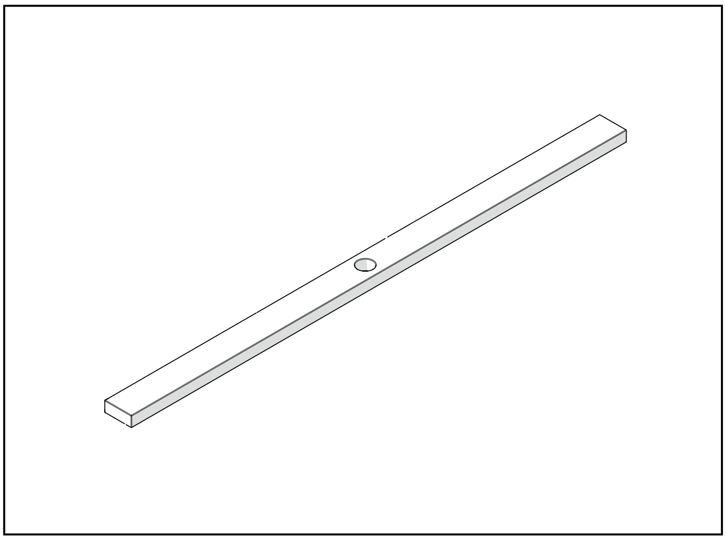


Fig. 15.15

p/n	-
Description:	Rotation checking spacer
Chapter:	Chap. 8 Front power take off

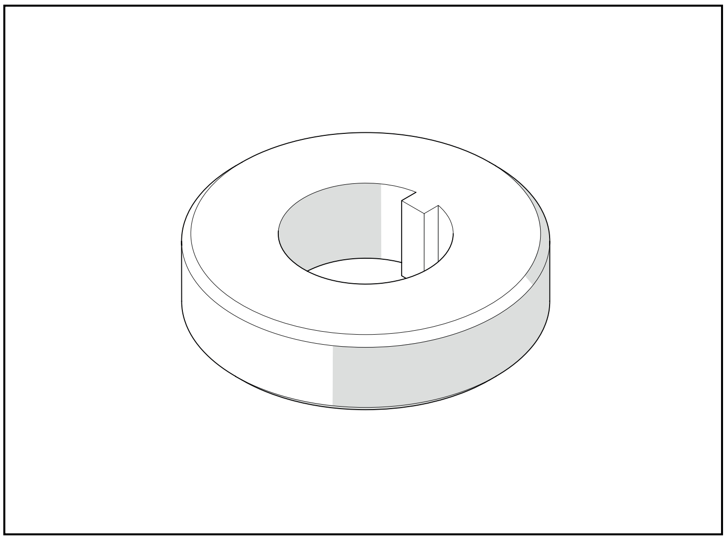


Fig. 15.16

p/n	07000122
Description:	Pressure gauge
Chapter:	Chap. 9 Hydraulic system

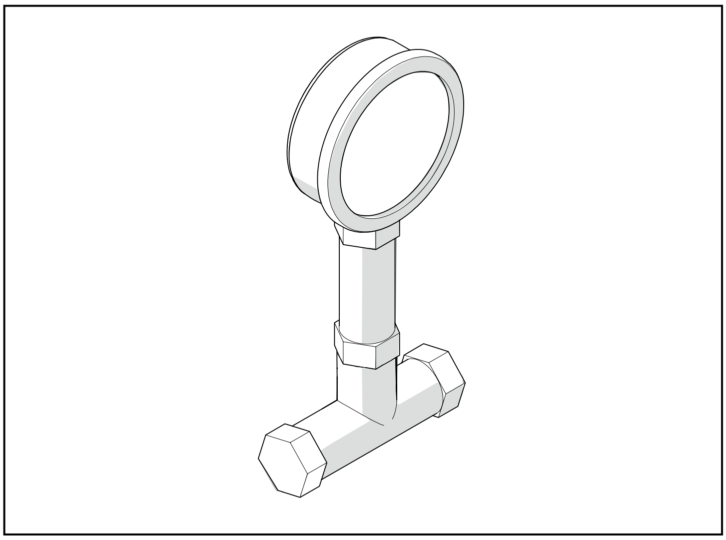


Fig. 15.17

p/n	07007181
Description:	Cab hoisting tool
Chapter:	Chap. 11 Cab

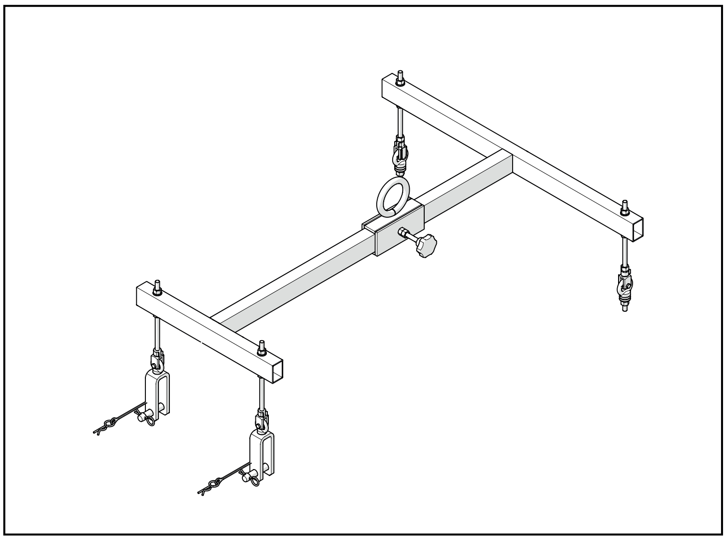


Fig. 15.18

p/n	-
Description:	Platform lifting tool
Chapter:	Chap. 12 Platform

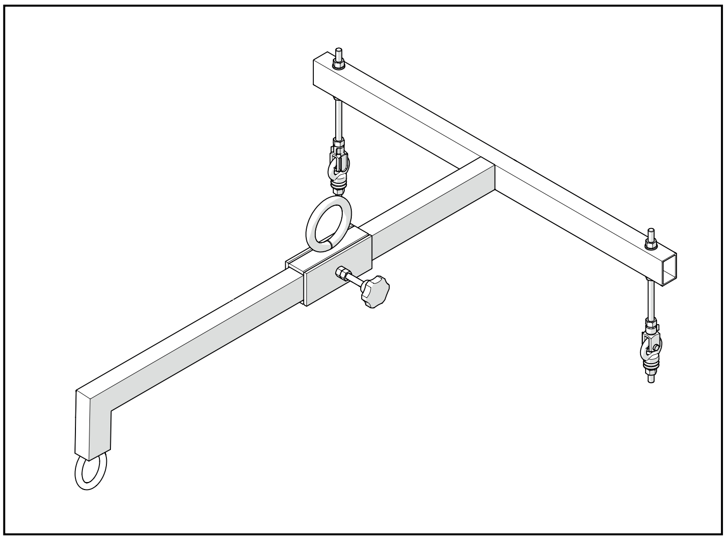


Fig. 15.19

WORKSHOP MANUAL

RONIN 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.

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