MAHINDRA
TRACTORS

SERVICE MANUAL
'35' Series 4WD
3535 / 4035 / 4535 / 5035
GEAR

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Mahindra Tractors
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Safety Notes

SAFETY - ALERT SYMBOL AND TERMS

This Safety Alert Symbol means ATTENTION!
BE ALERT! YOUR SAFETY IS INVOLVED!

The safety alert symbol identifies important safety messages on machines, safety signs, in manuals, or elsewhere. When you see this symbol, be alert to the possibility of personal injury or death. Follow the instructions given in the safety messages.

Why is SAFETY important to you?

★ ACCIDENTS DISABLE AND KILL
★ ACCIDENTS ARE COSTLY
★ ACCIDENTS CAN BE AVOIDED

Remember that YOU are the key to safety. Good safety practices not only protect you, but also the people around you. Study the features in this manual and make them a working part of your safety program. Keep in mind that this safety section is written only for this type of machine. Practice all other usual and customary safe working precautions, and above all - REMEMBER - SAFETY IS YOUR RESPONSIBILITY. YOU CAN PREVENT SERIOUS INJURY OR DEATH.

SAFETY - DANGER, WARNING and CAUTION

Whenever you see the words and symbols shown below, used in this book and on decals, you MUST take note of their instructions.

DANGER : The symbol and the word DANGER indicates an imminently hazardous situation with, if not avoided, will result in DEATH OR SERIOUS INJURY.

WARNING : The symbol and the word WARNING indicates a potentially hazardous situation. If the instructions or procedures are not correctly followed it could result in PERSONAL INJURY, OR LOSS OF LIFE.

CAUTION : The symbol and the word CAUTION identifies special instructions or procedure which if not strictly observed, could result in DAMAGE, DESTRUCTION OF EQUIPMENT, OR PERSONAL INJURY.

NOTE : The word NOTE indicates points of particular interest for more efficient and convenient repair or operation.

Work Safely – Follow these Rules

1. Always wear safety glasses when using a hammer, chisel or other tools that may cause chips to fly.
2. Keep work area organized and clean. Wipe up oil or spills of any kind. Keep tools and parts off of the floor. Eliminate the possibility of a fall which could result in a serious injury.
3. Be sure to reinstall safety devices, guards or shields after adjusting and/or servicing the machine.
4. After servicing, be sure all tools, parts, or servicing equipment are removed from the machine.
5. Use a safety catch on all hoist hooks. Do not take a chance, the load could slip off the hook.
6. Electrical storage batteries give off explosive hydrogen gas when charging and continue to do so for some time after receiving a steady charge. Do not under any circumstances allow an electric spark or an open flame near the battery. Always disconnect a battery cable before working on the electrical system. Always wear safety goggles when servicing batteries.
7. Use proper tools to make repairs, using hammers and chisels or punches when pullers should be used increases the probability of injury.
8. Be careful when using compressed air to dry parts. Use approved air blow guns, do not exceed 30 psi, wear safety glass or goggles and use proper shielding to protect everyone in the work area.
9. Do not wear rings, wrist watches or loose fitting clothing when working on machinery because they could catch on moving parts causing serious injury. Wear sturdy, roughsoled work shoes. Never adjust and/or service a machine with bare feet or while wearing sandals or sneakers.
10. Exhaust gases are highly poisonous! Therefore, do not start the engine in closed rooms unless adequate ventilation is ensured.

Group-A

General

Safety Notes

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3. Be sure to reinstall safety devices, guards or shields after adjusting and/or servicing the machine.
4. After servicing, be sure all tools, parts, or servicing equipment are removed from the machine.
5. Use a safety catch on all hoist hooks. Do not take a chance, the load could slip off the hook.
6. Batteries give off explosive hydrogen gas when charging and continue to do so for some time after receiving a steady charge. Do not under any circumstances allow an electric spark or an open flame near the battery. Always disconnect a battery cable before working on the electrical system. Always wear safety goggles when servicing batteries.
7. Use proper tools to make repairs, using hammers and chisels or punches when pullers should be used increases the probability of injury.
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B. INSPECTION & REPAIR

The following notes should be used as a general guide for inspection and repair. Where a special procedure is necessary for a component or assembly, full details will be found in the relevant section of the group.

B-1 Bearings

Inspect for evidence of overheating, cracks, scores, pitting and general wear. Replace if necessary. Soak in oil, wrap and cover with grease proof paper until required for assembly.

B-2 Pins & Bushes

Inspect for damage, scoring and pitting, check with mating parts for wear. Replace if necessary.

B-3 Clevis, Clevis Pins and Circlips

Check with mating parts for wear. It is usually advisable to replace such pins/circlips while overhauling.

B-4 Gears & Spline

Check for cracks, pitting, burrs, broken chipped teeth. Check for excessive wear with mating parts. Dress off burrs from gears and splines with a fine carborundum stone; care must be taken to remove the burr only. DO NOT interfere with the tooth or spline profile. REPLACE all parts which show signs of damage or excessive wear.

B-5 Welds

Check all welded assemblies for cracks, twisting & misalignment. Information concerning the use of special welding rods or welding procedure is detailed, where relevant, in the appropriate section of the group.

B-6 Castings

Check castings for cracks and distortion.

B-7 Fuel Tanks

Check for leaks.

B-8 Fuel, Oil and Coolant Pipes and Hoses

Check unions for leaks, stripped threads or other faults. Check pipes for cracks or chafing, hoses for chafing, twisting or other damage.

B-9 Lubrication Fittings

Check for damage of missing fittings and replace. Check that grease and oil galleries are clear.

B-10 Gaskets & Seals

During installation, take care not to damage seals or gaskets. Pack lip type seals with grease and use sleeve when a seal has to be passed over splines or threads.

Always use new gaskets seals, cotter pins during assembly.

C. STANDARD NUT AND BOLT

C-1 Torque Data

The following table is applicable to all standard nuts and bolts providing :-

I. All threads are clean and lubricated with engine oil or chassis grease.

II. Standard height nuts are used on tapped holes contains an equivalent amount of threads.

III. No gaskets or compressionable materials are used.

Where a special torque, differing from the table, is required for a particular application, this is mentioned in the section concerned.

BOLT SIZE	TYPE 2 Min. - Max. (lb.-ft.)	TYPE 4 Min. - Max. (lb.-ft.)
1/4"	9 - 10	12 - 14
5/16"	18 - 21	25 - 28
3/8"	32 - 36	45 - 50
7/16"	51 - 57	72 - 81
1/2"	75 - 85	110 - 125
9/16"	110 - 125	160 - 180
5/8"	155 - 175	220 - 245
3/4"	270 - 310	385 - 435
7/8"	405 - 455	625 - 700
1"	600 - 700	950 - 1050

Scale for tightening bolts with quality specification 8G

Diameter of bolt		Coarse thread (NC)	
Inch	mm	lb-ft	kg-m
1/4	6.35	008.0 to 009.4	01.1 — 01.3
5/16	7.94	015.9 to 018.1	02.2 — 02.5
3/8	9.52	027.5 to 030.4	03.8 — 04.2
7/16	11.11	043.4 to 047.0	06.0 — 06.5
1/2	12.70	061.5 to 068.7	08.5 — 09.5
9/16	14.29	086.7 to 097.6	12.0 — 13.5
5/8	15.88	115.5 to 130.0	16.0 — 18.0
3/4	19.05	195.0 to 217.0	27.0 — 30.0
7/8	22.22	296.0 to 332.0	41.0 — 46.0
1	25.40	441.0 to 491.0	61.0 — 68.0

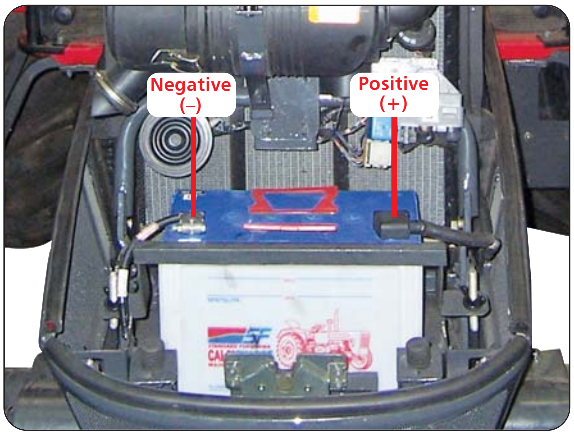
Diameter of bolt		Fine thread (NF)	
Inch	mm	lb-ft	kg-m
1/4	6.35	006.5 to 008.0	00.9 — 01.1
5/16	7.94	013.7 to 015.2	01.9 — 02.1
3/8	9.52	021.7 to 023.9	03.0 — 03.3
7/16	11.11	035.4 to 039.1	04.9 — 05.4
1/2	12.70	043.4 to 050.6	06.0 — 07.0
9/16	14.29	068.7 to 076.0	09.5 — 10.5
5/8	15.88	083.2 to 094.0	11.5 — 13.0
3/4	19.05	145.0 to 159.0	20.0 — 22.0
7/8	22.22	224.0 to 246.0	31.0 — 34.0
1	25.40	290.0 to 325.0	40.0 — 45.0

Metric standard designation	Metric thread lb-ft	kg-m
M-4	001.5 to 002.2	00.2 — 00.3
M-6	005.8 to 007.2	00.8 — 01.0
M-8	014.5 to 016.6	02.0 — 02.3
M-10	029.0 to 032.5	04.0 — 04.5
M-12	047.7 to 055.0	06.6 — 07.6
M-14	076.0 to 086.7	10.5 — 12.0
M-18	159.0 to 181.0	22.0 — 25.0

C-2 The following table gives conversion factors for use in converting the British specifications to their metric equivalents:

To Convert From	To	Multiply By
inch	cm	2.54000
lb	kg	0.45360
ounce	kg	0.02835
lb-ft	kg-m	0.13821
lb-in	kg-m	0.01152
lb/sq in	kg/sq.cm.	0.07031
imp gallons	litre	4.54609
imp pint	litre	0.56826

SI Unit	English Equivalent
mm - Millimeter	0.039 inches
cm - Centimeter	0.39 inches
cm^3 - Cubic Centimeter	0.06 cubic in.
m^3 - Cubic Meter	35.31 cubic ft.
l - Litre	1.057 quarts
kg - Kilogram	2.205 pounds
kPa - Kilo Pascal	0.145 psi
MPa - Mega Pascal	145.00 psi
N - Newton	0.225 pounds force
DaN - Deka Newton	2.25 pounds force
Nm - Newton Meter	0.738 foot pounds force
DaNm-Dekanewton meter	7.38 foot pounds force
^{O}C degrees - Celsius	$1.8x^{O}C+32$ Fahrenheit
kW - Kilowatt	1.34 horse power
l/min - liter/minute	0.219 gallon per minute
km/h - Kilometer/hour	0.621 mile per minute



HANDLING PRECAUTIONS FOR ELECTRICAL PARTS AND WIRING

To ensure safety and prevent damage to the Machine and surrounding equipment, the following precautions needs to be taken while handling electrical parts & wiring.

IMPORTANT :

- Check electrical wiring for damage and Loosened connection every week.
- Do not attempt to modify or remodel any electrical parts and wiring.
- When removing the battery cable, disconnect the negative wire first. When Installing the battery cable, connect the positive first.
- After connecting cables to battery terminals apply petroleum jelly to them and securely install terminal covers on them.
- Do not allow dirt and dust to get collected on battery.

CAUTION :

- Take care not to let battery liquid spill on your skin and cloths. If contaminated, wash it in water immediately.
- Before recharging the battery, remove it from the machine.
- Before recharging, remove cell caps.

FUSE

- Use fuses with Specified capacity. Never use steel or copper wire in place of fuse.

CONNECTOR

- For connector with Lock, push lock to separate. In separating connector do not pull with harness.
- Do not throw or drop electrical parts and wire harness.
- Do not pour water on electrical parts such as main switch and alternator.

OIL, DUST AND DIRT

- If flammable material such as fuel, or Lubricant spills, wipe it off with dry piece of cloth, Do not approach it with an open flame.
- Replace fuel pipe that is aged.
- Remove dirt and dust accumulated on heated parts, wiring harness battery etc.
- Use sand paper to remove corrosion, rust from terminal.
- Repair deformed terminal. Make sure there is no terminal being exposed or displaced.
- Make sure certain plastic cover is large enough to cover whole connector.

Notes

Operational safety and efficient performance are the qualities required for a farm tractor. If it is to fulfil its essential function of replacing manpower and rationalizing farm economy.

This does not only call for a good demonstration when the tractor is handed over to the customer, but also for the ever-ready service of a dealer who is quick to spot the source of any trouble that might develop and take corrective measures in quick time.

Every dealer who sells tractors has the obligation of having well trained servicemen to take care of the machines in operation and keeping an adequate stock of service parts.

The purpose of this Serviceman's Manual is to supplement information given in the Operator's Manual which is supplied with every tractor. It is, therefore, advisable to keep both these manuals in the same place.

After carefully studying this book every serviceman should be able to overhaul a tractor completely in his workshop equipped with special tools.

Single Parts Repair, Off-Season Inspection or General Overhaul

Overhauling a tractor could be essentially different in the following respects :

1) The repair of individual parts that has failed during operation. This kind of repair is by no means as easy as it may seem at first sight, for replacing the defective part may call for elaborate and extensive dismantling and reassembly procedures. Another disadvantage of a “single parts repair” is that it may have to be carried out during the working season when the tractor is most urgently needed. When taking the preventive maintenance measures as outlined below these “single parts repairs” should, to a great extent, be eliminated.

2) A fundamentally different procedure is the “off-season inspection” when all parts of the machine are checked over. This procedure covers mainly the following : Thorough cleaning of the machine, re-setting and adjusting of all units subject to a certain amount of wear, replacing those parts which still function but show such a degree of wear that they are not likely to survive the ensuing working season. Off-season inspection is a thorough preventive maintenance measure. It calls for a well trained serviceman with a detailed knowledge of the tractor and the functioning of the various units.

   Off-season inspection is the best guarantee for trouble free and efficient performance. Repairs as described in foregoing and following chapters can be prevented. The term “off-season” applies generally to the winter months when the tractor is seldom required to do any work. During this period service stations do not have much to do as a rule and can give better service than during the peak periods.

3) A rather expensive reconditioning job is the “general overhaul”. It becomes necessary when the tractor has been kept on the job by “make-shift” repairs without observing fundamental maintenance rules. Worn parts fail and other, potentially good parts are often broken as a result of these failures.

   Apart from being a costly affair it very often happens that this sort of repair has to be made during the operating season when work is pressing. A general run down condition, moreover, often causes small fissures and cracks which can be overlooked and are then the source of fresh trouble.

   Off-season inspection is the most important measure of preventive maintenance. The frequency of this inspection should be determined by the number of operating hours and by operating conditions.

General Recommendation for disassembly and assembly operations

Before the tractor is accepted in the workshop, all external surfaces must be thoroughly cleaned.

The service station must be clean and well lit. Strict cleanliness must be observed when engine, transmission and hydraulic systems are repaired.

A tractor repair shop should not be without at least one good lifting crane so that engines and transmissions can be removed and installed without hazard. Suitable wooden mounting blocks, easily accessible from all sides, on which engines and transmissions can be placed, should be available. They can easily be made locally.

Before dismantling, drain all water, fuel and oil from the tractor.

It is good practice to check compression of each cylinder before dismantling the engine to get general ideal on the condition of the compression building elements, such as pistons, sleeves, gaskets, etc.

A comparison of compression readings of these figures will disclose errors or show improvements.

Whenever reference is made to "Cleaning" in the various sections of this book it should be taken mean thorough cleaning i.e. complete removal oil, grease, impurities, foreign matter and burr etc. Even the smallest contaminants may cause serious trouble!

Follow the disassembly and assembly procedures in this book. They are based on years of practical experience and provide the quickest reliable repair procedure.

After removing oil, grease, etc., arrange parts on a clean table in the order in which they belong to prevent confusion later. A suitable installation to remove oil, grease, dirt etc. from parts should be available in every tractor repair shop.

A small boiler and a good solvent are ideal for this purpose.

Before reassembly, carefully inspect all parts whether they can be re-used. Ball and roller bearings must be washed in kerosene. Before reassembly, carefully inspect all parts to see whether they can be re-used. Replace if necessary.

Ball bearings must be thoroughly cleaned and well dried before inspection. To determine the degree of wear on a ball bearing, hold the inner race with your hand and spin the outer race. The sound emitted by a good ball bearing is very weak and similar to that of finger tips gliding over glossy paper. A badly worn bearing makes a rattling, chain-like noise.

Do not remove the original oil paper wrapping from new ball bearings until just before sliding them on shafts. The grease coating applied by the bearing factory must not be removed unless this is necessary for cleanliness reasons.

Warm press-fit ball bearings in clean 80^{0}C (175^{0}F) oil and slide them on shafts as quickly as possible.

When assembling, apply some transmission oil to all moving parts, especially to bearings, to provide an oil film until the regular pressure feed lubrication takes over.

In order to eliminate errors all steps, such as adjustments, settings, and the various phases of assembly and disassembly procedures, must be considered without haste and with common sense. It is better to check three times than commit one error.

Put all new felt seals and gaskets in 50^{0}C. (122^{0}F) warm oil and allow to soak before installing them.

Apply some soft soap or soap solution to all rubber hose connections before installation.

Always install oil seal with the sealing lip towards the oil side. Prior to assembly apply some engine oil to the sealing lip. Generally oil seals are a press fit in their bores and the steel casing is slightly compressed in assembly. Used oil seals have lost tension and the required pressfit can no longer be obtained. For this reason, never reuse oil seals even though the sealing lip may still be in good condition. Should an emergency arise, install the reused oil seal with some liquid sealer.

Expansion plugs should be oil tight. Use some sealing compound and fit the plug with its concave side out. Spread the plug by driving carefully on its center with suitable installing tool.

Secure all nuts by using good spring lock washers or external tooth lock washers except for cylinder head, brass and castellated nuts, which are secured by special methods.

Gaskets and O-rings must be replaced during reassembly. Apply grease to new O-rings or oil seals before assembling. See the figure left side.

When reassembling external snap rings or internal snap rings, they must be positioned so that sharp edge faces against the direction from which a force is applied. See the figure left side.

To prevent damage to the hydraulic system, use only specified fluid or equivalent.

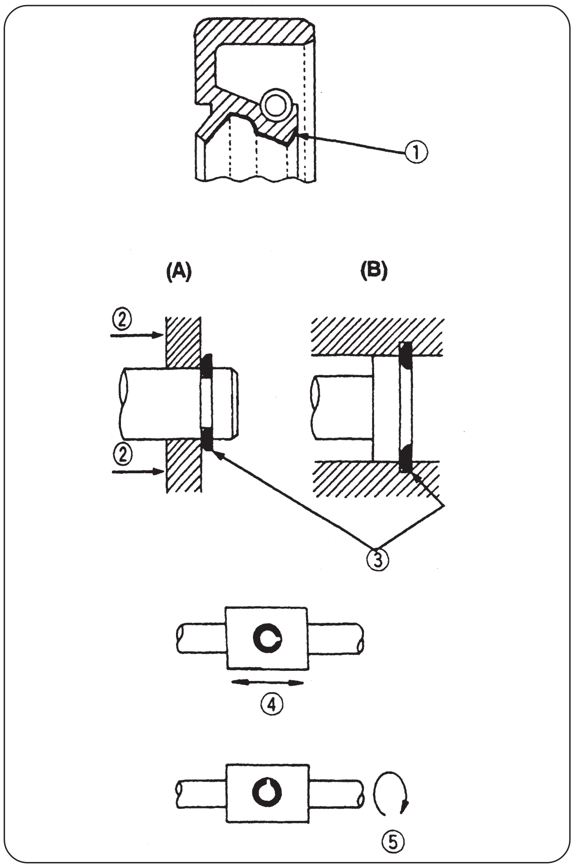
Castellated nuts must be carefully secured with cotter pins. Spread cotter pins as shown on the right nut below. Be sure that pins seat tightly so that they will not work loose.

When reassembling external snaprings or internal snaprings, they must be positioned so that sharp edge faces against the direction from which force is applied. (See fig.) When inserting spring pins, their splits must face the direction from which a force is applied. (See fig.)

After every overhaul or major repair the tractor should be given new coat of paint. The importance of this should not be underrated, as moisture, rust and corrosion have access where bolts and nuts were loosened and the original paint coat has been broken. The original paint (Tractor Red) is available at all Establishments.

For all procedures described in this manual a certain amount of skill and craftsmanship is required.

Wherever the terms RIGHT and LEFT are used they are understood to mean the right and left sides when facing forward in the tractor seat. Reference to FRONT indicates the radiator end of the tractor and REAR the drawbar end.



1. Grease
2. Force
3. Sharp Edge
4. Axial Force
5. Rotating Movement

A. External Snap Ring
B. Internal Snap Ring

Priming the Lubrication System

NOTE : Diesel engines must not be rotated when priming with oil; otherwise, they are likely to start running.

When assembling the overhauled engine, it is necessary to thoroughly lubricate the various running parts with clean engine oil to assure initial lubrication when engine is first started. However, to further make certain that complete initial lubrication is available, the engine lubricating system should be pressure primed or charged with oil. Attach the line from a priming device to a suitable fitting located in the main oil gallery, filter header or oil cooler of the engine and inject sufficient oil into the engine to fill the oil filters and charge the entire system. Use only clean engine oil in accordance with Operator's Manual. New or overhauled engines that have been in storage over an extended period should also be primed in a similar manner.

After the priming procedure is completed, make certain that the oil level is checked before the engine is put into service. Do not overfill the engine; neither should engine be short of oil as a result of using the pressure priming procedure.

Priming the engine will minimize the possibility of scuffing or heat build-up in the running components which could lead to immediate or low hours of use failures.

Engine Run-in Schedule

NOTE : Do not run the engine at low or high idle speeds for long period after installing new rings or sleeves, as rings will not seat during idle operation.

Start

Prior to starting make sure, that

a) all bearings are pre-lubricated

b) the crankcase is filled with specified engine oil

c) the cooling system is filled correct level

d) Precautions for alternator operation are observed.

Run-in

1. Start and run engine at 3/4 rated engine speed with no load, until operating temperature (80-85^{0}C) (164-172^{0}F) is reached, cover the radiator if necessary, DO NOT run for over 10 Minutes.

2. Retorque cylinder head bolts.

IMPORTANT : DO NOT run the engine longer than 15 Minutes, before retorquing cylinder head bolts.

3. Continue according to the following chart.

with Dynamometer		
Engine RPM	Load %	Time minutes
1400	40	5
2000	50	5
rated speed	80	10
100 below rated speed	50	10

without Dynamometer (In-Vehicle Run-in Procedure)		
Engine RPM	Load %	Time minutes
3/4 of rated	light	5
3/4 of rated	medium	15
rated speed	full	20

After Running-in

Retighten manifold bolts and/or stud nuts.

Re Torque the cylinder bolts and check valve clearance and readjust as necessary.

Handing over the Engine

In the presence of the operator check engine oil level and coolant level. Test run the engine. Point out to the operator that the overhauled engine is to be treated in the same way as a new one.

CHECK AND MAINTENANCE

CAUTION :

Be sure to check and service the tractor on a flat and clean place with engine shut off, parking brake on and blocked wheels.

(1) Daily check

To prevent trouble from occurring, it is important to know the condition of the tractor, check the following items.

CHECKING

- **Checking areas where previous trouble was experienced.**
- **Walk around the tractor.**

1. Check the tire pressure and check for wear and damage.
2. Check for oil and water leakage.
3. Check the engine oil level.
4. Check Transmission fluid level.
5. Check coolant level.
6. Check and clean the radiator screen and grill.
7. Check the condition of ROPS attaching hardware.
8. Check the bolts & Nuts of the wheels.
9. Condition of danger, warning and caution labels.
10. Clean around the exhaust manifold and the muffler of the engine.
11. Check fan belt tension.

- **While sitting in the operator's seat**

1. Check the working condition of the throttle pedal, brake pedals and clutch pedal.
2. Check the parking brake.
3. Check the steering wheel play.

- **After Turning the switch Key**

1. Check the Headlights, taillights and hazard lights clean it necessary.
2. Check the performance the meters and gauges.

- **After Starting the engine**

1. Check the colour of the Smoke.
2. Check the brakes for proper operation.

CHECK POINTS

Wheel Mounting nuts checking

- Never operate tractor with untightened rim wheel.
- Check all bolts and nuts frequently and keep them tight.

Checking Radiator hoses and clamps.

- If hose clamps are loosen or water leaks, tighten clamps securely.
- If radiator hoses are swollen, hardened or cracked replace hoses and clamps.
- Check all power steering line, fuel line, clamps and hoses.
- If these found damage, replace them.

Oil Specifications Chart

Sr. No.	Application	Capacity Gallon / Litres	Anticipated minimum air temperature				
			–40 to +88^{0}F	–22 to +88^{0}F	–4 to +122^{0}F	+32 to +104^{0}F	+50 to +122^{0}F
1.	Crankcase	3 Cyl. 1.58 / 6.34 4 Cyl. 2 / 8.03	SAE 15W40	SAE 15W40	SAE 15W40	SAE 15W40	SAE 15W40
2.	Transmission & Hydraulics	9.2 / 36.8	SAE 75W UTTO		SAE 80W UTTO listed above.		
3.	Lubrication Fittings	C. L.	NLGI No. as recommended				
4.	Front Axle - 3535	1.71 / 6.84	SAE75W90EP		SAE80W140EP	SAE80W90EP	SAE80W140EP
	4035, 4535 & 5035	2.24 / 8.98	SAE80W90EP listed above for ambient temperature range - 4^{0}F to 104^{0}F				

Front Axle - Front Wheel "Toe-in" Check

In the event of the tie rod setting, then it is necessary to adjust the TOE-IN. Before measuring and adjusting the TOE-IN, ensure the front wheels are in the straight ahead position and the front axle is not tilted.

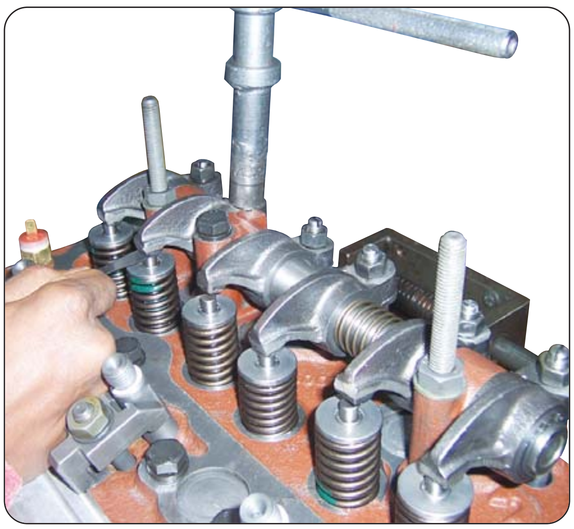
After adjusting the front wheel tread and with all connections secured, the front wheel Toe-in shall be as follows,

	Toe-in Value	
35 Series	Inch	mm
4WD	0 – 0.23	0 – 6

Measure the distance between the outer edges of the wheel rims at the same height as the hub caps. Mark the point measured and turn the wheels half revolution so that the marked points are at the rear. Measure again the distance between these two points and this distance must be the same as measured before without variance. To adjust the TOE-IN shorten or extend the tie rod clockwise or anti-clockwise.

CAUTION :

When the TOE-IN adjustments have been made the tractor should be jacked-up and the axle tilted to its maximum tilt position. In this position the wheels should be turned to the full left-hand lock and at this angle the welded stop on the steering knuckle pivot pin sleeve should be hard against the stop on the steering knuckle.



Adjusting Valve Clearance

Adjusting Engine valve clearance at every 800 hours. To check valve clearance use the simplified procedure as out lined in the following.

All Values can be adjusted by cranking the engine only twice.

No 1 Piston at T.D.C. (Compression)

Adjust Valves (Engine Warm)

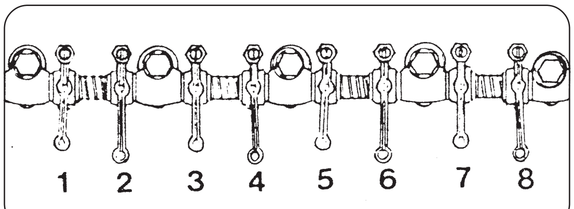
1 2 4 5

No 4 Piston at T.D.C Compression

Adjust Valves (Engine warm)

3 6 7 8

Inlet	0.010 inch (0.25mm)
Exhaust	0.012 inch (0.3mm)



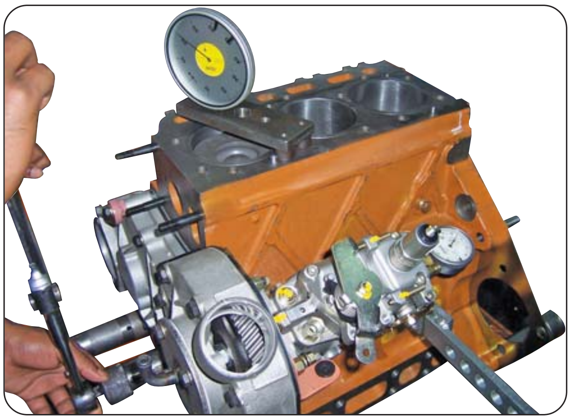


Fig. 1

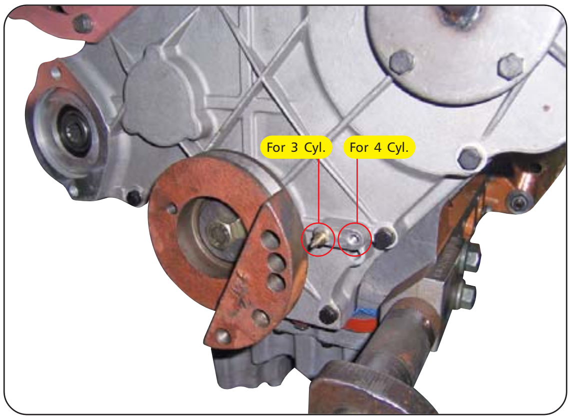


Fig. 2

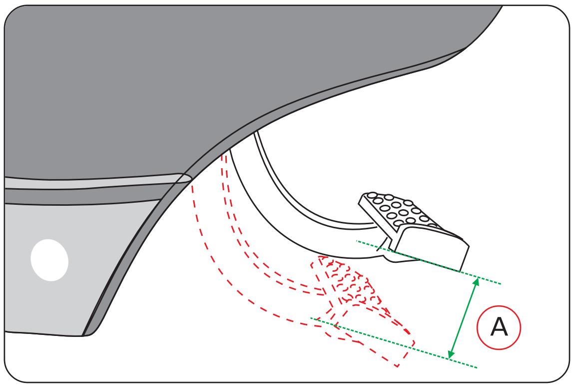
SOP for Rotary FIP timing checking on tractor

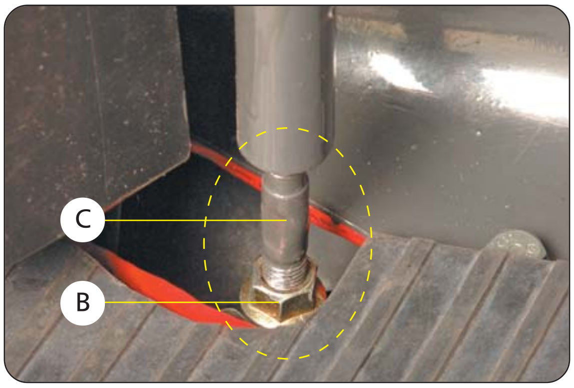
1. Remove engine starter.
2. Ensure that the position of timing pointer on front cover which mets with crank pulley punched line.
3. Remove high pressure pipe at Fuel injection pump end.
4. Remove special plug provided at backside of FIP & insert dial (ASN0600G013) with adapter as shown in Fig.1.
5. Rotate crankshaft pulley in clockwise direction (as seen from flywheel side) till the pointer matches with crankshaft pulley groove. Ensure first cylinder piston at compression TDC.
6. Set dial gauge to read zero at above match position.
7. Rotate pump gradually to upward / downward direction till dial gauge showing specified reading.

Injection Timing (mm@tdc)

For 4035 / 3535 — 0.95 ± 0.02 mm

For 4535 / 5035 — 1.00 ± 0.02 mm



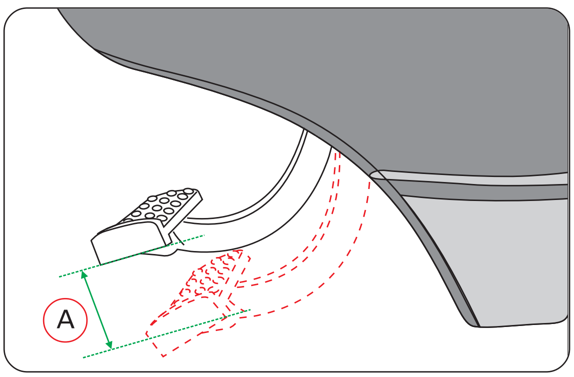


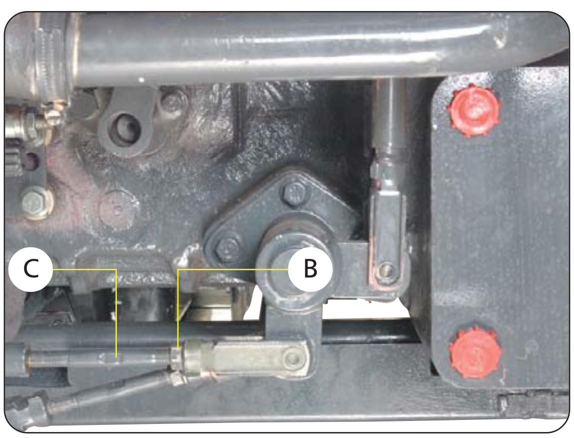
SOP for adjusting Clutch Pedal Free Play

Measure free play of pedal stroke (A). Ensure free play is within specified limits. If free play is not within specified limits, adjust clutch linkage as shown below.

Free Play - Distance 0.78 to 0.98 inch (20 to 25 mm)

1. Loosen jam nut (B).
2. Turn the turn buckle (C) anticlockwise (from eyesight view) to decrease play and clockwise to increase play.



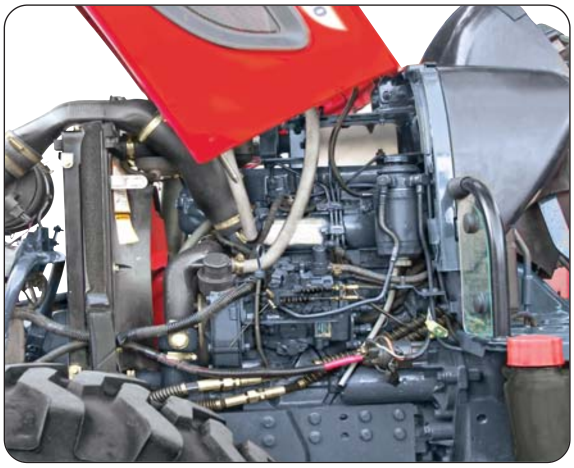


SOP for adjusting Brake Pedal Free Play

Measure free play of pedal stroke (A). Ensure free play is within specified limits. If free play is not within specified limits, adjust brake linkage as shown below.

Free Play - Distance 1.57 to 1.77 inch (40 to 45 mm)

1. Loosen jam nut (B).
2. Turn the Turn Buckle (C) anticlockwise to increase play and clockwise to decrease play.



Flushing cooling system and changing coolant

CAUTION :

Do not remove the radiator cap when the engine is hot. After cooling the engine, loosen the cap slightly (one step) to relieve excess pressure before removing cap completely.

1. Stop the engine and let it cool down.
2. To drain the coolant, loosen the radiator cap slightly first to allow pressure to reduce. Then remove radiator cap completely. Open the drain plug at bottom RH side of radiator to drain the coolant. Place a tray to collect the coolant.
3. After all coolant is drained, install the hose securely.
4. Fill with clean water and cooling system cleaner solution.
5. Follow direction of the cleaner instruction.
6. After flushing, fill with clean water and anti freeze until the coolant level is just below the port.
7. Fill with clean water and anti freeze up the upper line of surge tank.
8. Install the radiator cap (1) securely.
9. Start and operate the engine for few minutes.
10. Stop the engine check coolant level and add coolant if necessary.

NOTE :

- Do not start engine without coolant
- Use clean water and anti freeze to fill the radiator as per abient temperature mixing ratio.
- Securely tighten the cap. If the cap is loose or Improperly fitted, water may lead out and cause the engine overheating.

Anti Freeze

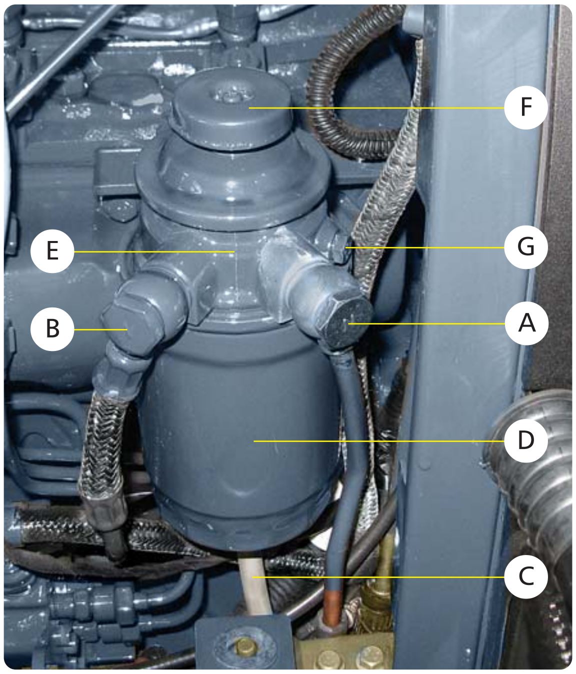
Frozen water can damage the cylinders and radiator. It is necessary, if ambient temperature falls below 0^{0}C (32^{0}F) to remove cooling water after operating or to add anti freeze to it.

Refer to SAE J1034 and SAE J814C for the procedure of mixing water and antifreeze.

NOTE :

- When the cooling water level drops add only clear water. In case of leakage, add anti freeze and water is the specified mixing ratio.
- Anti freeze absorbs moisture keep unsealed anti freeze in the lightly sealed container.
- Do not use radiator clearing solution when anti freeze has been added to the cooling water. (Anti freeze contains an anti corrosive agent, which will react with radiator cleaning agent forming sludge which will affect the engine parts)

Vol % Anti Freeze	Freezing Point		Boiling Point	
	^{0}C	^{0}F	^{0}C	^{0}F
40	– 24	– 12	106	222
50	– 37	– 35	108	226




Tractor Front

Note : Drain water once in a week or earlier if water contamination is excessive. Continued driving with water accumulation in fuel filter will cause damage to fuel pump / other fuel system components.

Note : Replace fuel filter at the recommended period or whenever it gets clogged. Discard the old filter and do not repair or clean the filter.

Always fit the spin-on filter dry.

CAUTION :

Do not hold key at engine start position for more than 10 seconds continuously. If more engine cranking is needed try again after 30 seconds.

Always close the air vent screw except for bleeding fuel lines other wise, engine will run irregularly or stall frequently.

BLEEDING FUEL SYSTEM

Air must be removed

1) When the fuel filter or lines are removed.
2) When water is drained from fuel filter.
3) When tank is completely empty.
4) When tractor is not used for a long period of time.

Fuel filter provides clean, moisture free fuel for the injection process. A hand primer is provided to manually remove excess air from the fuel filter and fuel lines.

Major Components:

- Hand Primer (F)
- Air Bleeding Screw (G)
- Fuel Filter (D)

Fuel enters the filter at inlet (A) and flows through the filter element separating water if contents before flowing through outlets (B) to the fuel injection pump.

Since water and contaminants settle at the bottom of the sediment bowl, a drain plug is provided at the bottom of the filter. Drain water in fuel, by loosening drain plug once every 50 hrs. of operation.

To drain water in fuel, loosen the drain plug upto 1 or 2 turns. During loosening drain plug, place a small tray to collect the water coming from pipe (C). Retighten the drain plug by hand.

Servicing the fuel filter

1. It is recommended to replace the fuel filter every 500 hrs.
2. To remove Filter, unscrew the filter (D) from adaptor (E).
3. Check O'rings of fuel filter for any crack / damage. Smear oil on the new O'ring before installation.
4. Clean the adaptor with clean diesel from inlet and outlet. Ensure no dirt, foreign particles entangled in flap valves or filter head.
5. Assemble the new filter. Do not over tighten.
6. Prime the system and bleed the filter. Tighten the bleeding screw.

CHECK POINTS	Perio- dically	10 Hrs. or Daily	50 Hrs.	100 Hrs.	150 Hrs.	200 Hrs.	250 Hrs.	300 Hrs.	350 Hrs.	400 Hrs.	450 Hrs.	500 Hrs.	550 Hrs.	600 Hrs.	650 Hrs.	700 Hrs.	750 Hrs.	800 Hrs.	850 Hrs.	900 Hrs.	950 Hrs.	1000 Hrs.	Since then
ENGINE																							
Check Oil Level and top-up if necessary		●																					Daily
Change Oil and Filter Element				#		■				■				■				■				■	Every 200 Hrs.
Tighten Cylinder Head Bolts to specified torque and adjust Valve Clearance																						■	Every 1000 Hrs.
Check and adjust Injector Pressure																						■	Every 1000 Hrs.
Radiator Descaling																						■	Every 1000 Hrs.
Change Rubber Clutch Gear Hydraulic Pump																						■	Every 1000 Hrs.
AIR CLEANER																							
Clean dust collector	●	●																					Daily
Check Air-cleaner connections and tighten if required						■				■				■				■				■	Every 200 Hrs.
Clean Primary Element								■						■						■			Every 300 Hrs.
Change Primary Element																				■			Every 900 Hrs.
Change Safety Cartridge																				■			Every 900 Hrs.
FUEL SYSTEM																							
Drain Water from Fuel Filter (every 15 days)	*																						Periodically
Change Fuel Filter (earlier, if required) Spinon Element						■				■				■				■				■	Every 200 Hrs.
COOLING SYSTEM																							
Check Coolant Level in Radiator & top-up if necessary			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Every 50 Hrs.
Check Radiator Hose Connections & tighten if required			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Every 50 Hrs.
Check Fan Belt Tension and adjust if necessary			#			■				■				■				■				■	Every 200 Hrs.
Flush Cooling System																						■	Every 1000 Hrs.
ELECTRICAL SYSTEM																							
Clean Battery Terminals						■				■				■				■				■	Every 200 Hrs.
Check Starter Motor and Alternator Carbon Brushes and replace if necessary																						■	Every 1000 Hrs.
TRANSMISSION / HYDRAULIC SYSTEM																							
Check Oil Level and top-up if necessary			#			■				■				■				■				■	Every 200 Hrs.
Change Transmission Oil																						■	Every 1000 Hrs.
Change Suction Filter Element			#							■								■					Every 400 Hrs.
Clean Strainer (During every oil change)			#																			■	Every 1000 Hrs.
Change Strainer																							Every 2000 Hrs.
AXLES, WHEELS AND TIRES																							
Check Tire Pressure and inflate if necessary	*		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Every 50 Hrs.
Torque Wheel Nuts			#			■				■				■				■				■	Every 200 Hrs.
Check Front Axle Oil Level						■				■				■				■				■	Every 200 Hrs.
Change Front Axle Oil																						■	Every 1000 Hrs.
STEERING																							
Check Steering Wheel Play												■										■	Every 500 Hrs.
Set Toe-in												■										■	Every 500 Hrs.
CLUTCH AND BRAKES																							
Check and adjust Brake Pedal Free Play	*																						Periodically
Check and adjust Clutch Pedal Free Play	*																						Periodically
GREASE ALL NIPPLES	*		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Every 50 Hrs.

* Depends upon the conditions in which the tractor is being operated.
# Indicates that this must be done initially at specified hrs.

■ Activity due.
● Repeat the activity.

Group-B

Splitting the Tractor

SPLITTING BETWEEN THE FRONT AXLE AND ENGINE

1. Using the special tool - Rail & Trolley Jack - support the Engine assembly. Apply Tractor parking brakes and place wedges to hold the rear wheels. Drain the water from the Radiator, from two places :
   a. Engine Block side drain plug.
   b. Radiator bottom tank drain plug.

2. Open the hood.

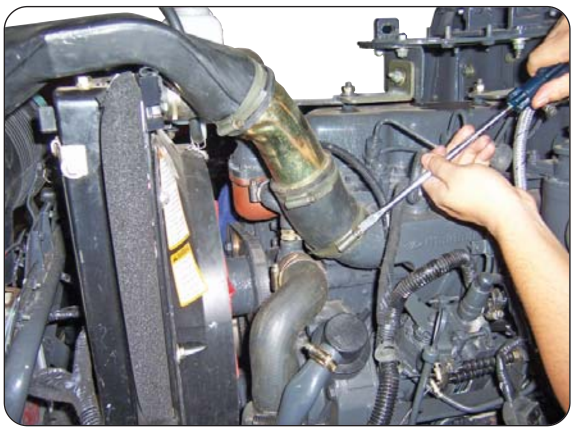
3. First remove the battery cable from its negative terminal & then remove battery cable from positive terminal. Remove the battery.

NOTE : Always disconnect the negative terminal first.

Splitting Between Front Axle & Engine

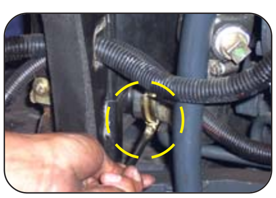
4. Disconnect the gas spring from hood and then remove hood from hinge assembly.

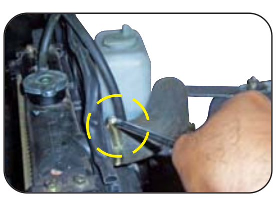
5. Remove side panels from locating points.
6. Disconnect horn.



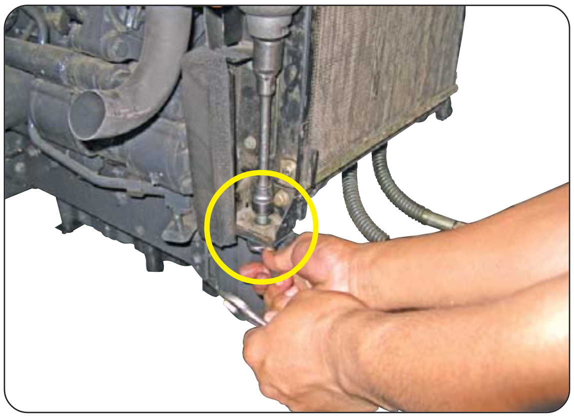
7. Loosen the Air cleaner inlet hose, connections from the intake manifold and air cleaner.

8. Remove air cleaner by removing it from bracketaries.



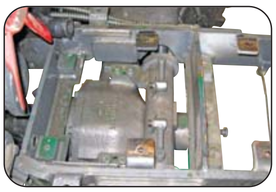


9. Remove the radiator inlet and outlet hoses.



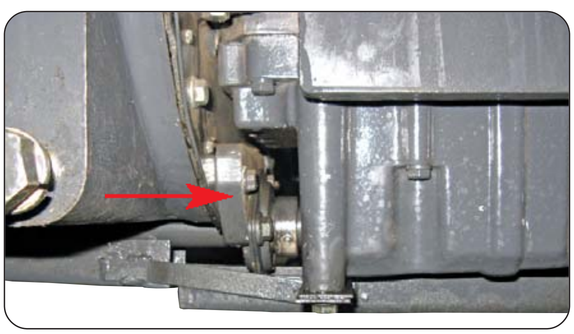
10. Remove the radiator mounting bolts and remove the radiator.

11. Remove the front bottom grill and bonnet locking bracket.

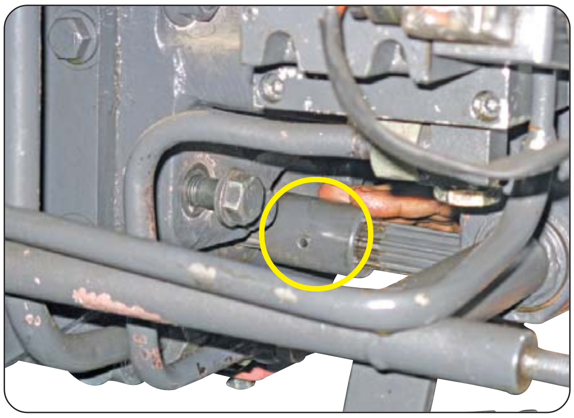


12. Disconnect the LH / RH hoses to the power steering cylinder and plug the hoses to prevent oil spillage.

13. Remove the propeller shaft guards.

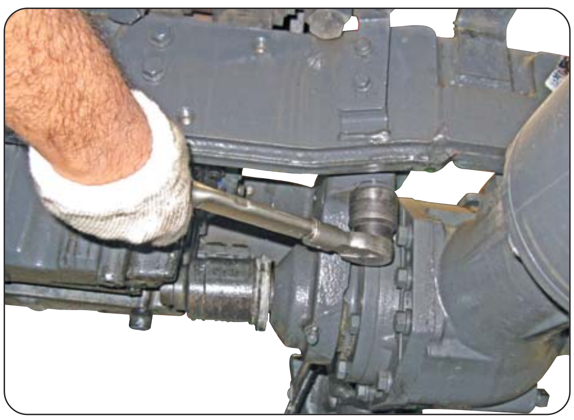


14. Remove the propeller shaft bearing from support bracket.



15. Drive out rear coupling roll pin by suitable punch.
16. Remove the propeller shaft.
17. Support the Engine by placing a Jack below Engine Oil sump.
18. Support the semi chassis by using the crane.

19. Remove the semi chassis bolts from the engine.
20. Move the assembly of Front Axle & Semi chassis away from the engine.
21. Support the Front Axle with a suitable crane / jack.



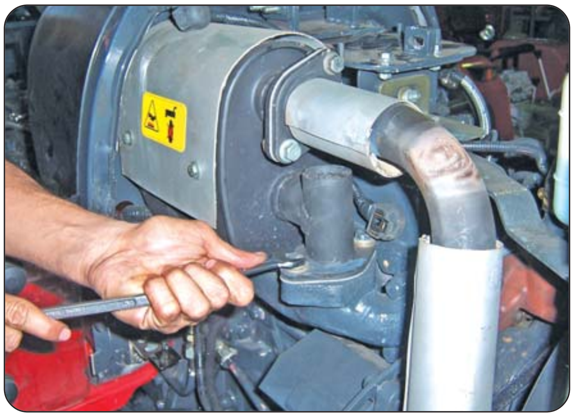
22. Remove the bolts connecting the Front Axle & Semi chassis in pillow block.
23. Move the semi chassis away from the front axle.

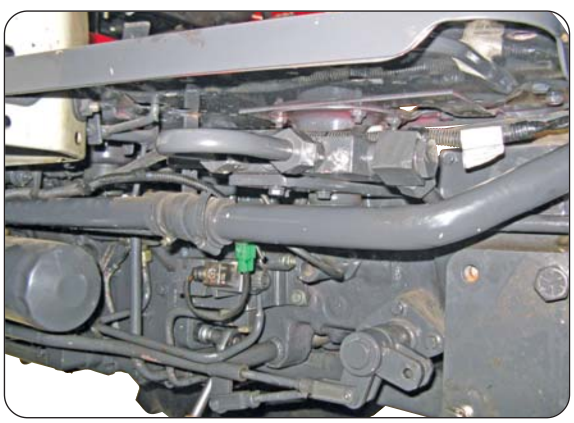
ASSEMBLING OF FRONT AXLE TO THE ENGINE ASSEMBLY

1. Follow the reverse sequence of removal, to assemble the Front axle assembly to the Engine assembly. Tighten the Mounting bolts.
2. Start Engine and rotate the steering wheel in both directions for few times until the Air trapped in the pipelines is expelled. Check for steering noise and vibrations.

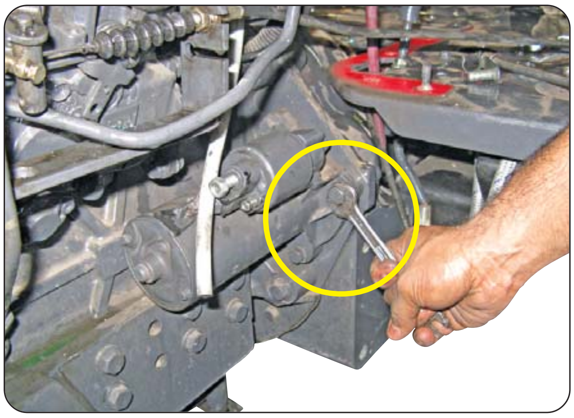
SPLITTING BETWEEN ENGINE AND TRANSMISSION

1. Refer the procedure (1-20) of splitting between Front Axle and Engine.
2. Support the engine using the rail-jack and transmission case using tractor splitting track.
3. Remove the hood hinging bracket from Hood mounting support (HMS).
4. Dismantle the exhaust muffler.
5. Remove the mud splash guards.





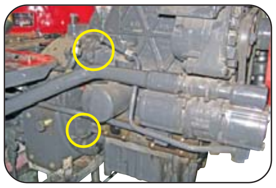
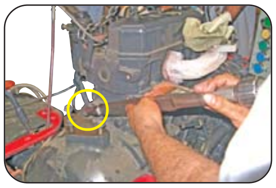
6. Disconnect the following hydraulic oil connections & Plug the pipes to prevent oil spillage.
   a) Hydraulic pipe from filter to Hydraulic pump.
   b) Hose from Hydraulic pump to HSU.
   c) Hose from HSU to PTO solenoid valve.
   d) Pipe from Hydraulic pump to Auxiliary valve.
7. Disconnect accelerator cables from engine.
8. Disconnect front wiring harness, Starter motor wiring harness.
9. Disconnect rear wiring harness, Alternator, F/R Neutral switch, Fuel line wiring harness from central wiring harness.
10. Disconnect wiring harness to the relay box.
11. Disconnect the fuel lines between Fuel filter & fuel tank.



12. Dismantle the Starter motor.

13. Dismantle the instrument cluster & disconnect the wiring harness to the instrument cluster.

14. First remove the steering wheel cap and steering wheel nut. Remove the steering wheel by loosening nut and use steering wheel puller to remove the steering wheel.
15. Dismantle the steering column cover, disconnect the wiring harness to PTO engaging switch.
16. Dismantle the scuttle cover.
17. Disconnect the clutch, brake Vertical linkage connections below front platform.
18. Disconnect the F/R cable from HSU mounting bracket.
19. Remove the wiring harness from firewall clamps completely.
20. Dismantle the Fire wall assembly from front platform.
21. Dismantle hood mounting support bracket.
22. Dismantle Dust cover from clutch hosing.

23. Dismantle the bolts which are connecting engine & clutch housing.
24. Move the engine assembly away from tractor.

REJOINING THE ENGINE ASSEMBLY AND TRANSMISSION

1. Follow the reverse sequence of Splitting for rejoining the Engine assembly with the Transmission.
2. Align the engine with housing.

CAUTION : Do not forcibly fit and tighten the mounting bolts of engine to clutch housing until the two mounting faces meet. Forcible tightening of bolts can result in serious damage to both Engine and clutch housing. Clutch housing needs to be held in place with external support.

Check the freeplay of clutch and brake pedals.

NOTE : First align the PTO input shaft in the pilot bearing. Align PTO damper and PTO input shaft splines. Turn the flywheel and main shaft hollow shuttle section at the same time while pushing the Engine towards clutch housing. Allow the splines of clutch plate to align with those on the main shaft hollow shuttle section.

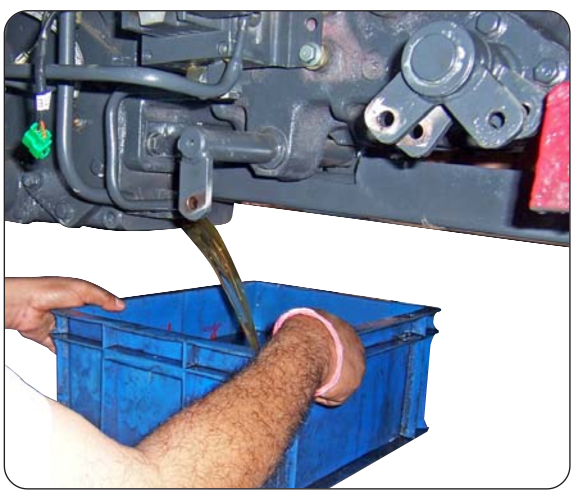
SPLITTING BETWEEN TRANSMISSION AND REAR AXLE

1. First remove the battery cable from its negative terminal & then remove battery cable from positive terminal.
2. Support the tractor by using tractor splitting rail and jack.
3. Remove the rear LH & RH wheels.
4. Disconnect the LH, RH fender wiring harness to P & T lamp, plow lamp & remove the wiring harness from fender clamps.

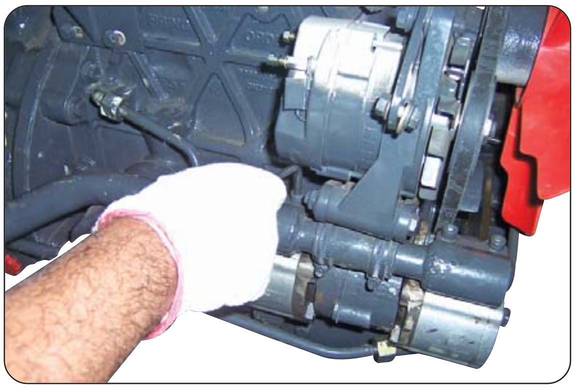
5. Dismantle the ROPS Fender connecting bracket.
6. Remove the LH, RH fenders.
7. Remove the LH, RH lower link & stabilizers of 3 point linkage.

8. Remove the ROPS.
9. Remove the lower link support brackets LH & RH.

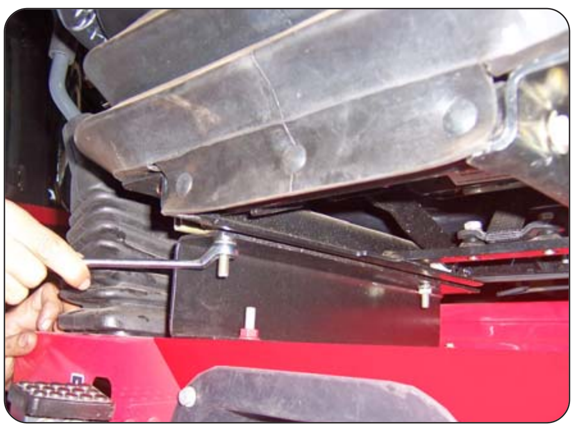
10. Drain the oil completely from the transmission housing using drain plug.
11. Disconnect the fuel lines between fuel filter & fuel tank.
12. Remove the LH side foot step .



13. Remove the fuel tank from mounting brackets.
14. Disconnect wiring harness of fuel level sensing float.



15. Disconnect the pipe from suction manifold to hydraulic filter, Filter to oil pump & plug the pipes.
16. Dismantle the oil filter.
17. Disconnect the brake linkages at brake actuating lever.

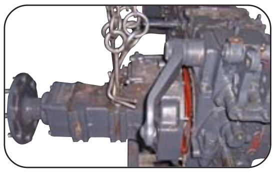


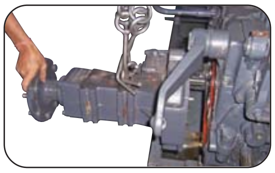
18. Remove the seat from mounting channels with LH & RH mounting channels.

Removing of Control Levers Knob

19. Remove the PC, DC, Range, Speed lever knobs & slow fast valve knob.
20. Remove the differential lock foot pedal.

21. Remove the isolator mounting bolts from Rear platform.
22. Dismantle the rear platform.
23. Dismantle the isolator mounting bracket from Rear Axle.





24. Support the Rear Axles by using trolley jack.

25. Remove the bolts which are connecting the transmission housing and Rear Axle.

27. Move the rear axles away from the transmission case.

REJOINING THE TRANSMISSION AND REAR AXLE

1. Follow the reverse sequence of Splitting for rejoining.

A. ROLL OVER PROTECTIVE STRUCTURE (ROPS)

Mahindra USA Inc. tractors are fitted with a frame for the protection of tractor operators to minimize serious operator injury resulting from accidental roll over. These frames, known as ROPS, form a safety zone within which the operator is offered some protection in the event that the tractor turns over. It is mandatory that the tractor operator fasten the seat belt around him/her to be protected by the ROPS. The mounting structure and fasteners forming the mounting connection with the tractor are part of the ROPS. (ROPS)

B. MAINTENANCE AND INSPECTION

The ROPS has been certified to industry and/or government standards. Any damage or alteration to the ROPS, mounting hardware or seat belt voids the certification and will reduce or eliminate protection for the operator, in the event of a roll-over.

The ROPS, mounting hardware and seat belt should be checked after the first 100 hrs. of machine operation and every 500 hours thereafter for any evidence of damage, wear or cracks. In the event of damage or alteration the ROPS must be replaced prior to further operation of the machine. The seat belt must be worn during machine operation when it is equipped with a certified ROPS. Failure to do so will reduce or eliminate protection of the operator in the event of a roll-over.

Substitution of mounting hardware, seat belt etc. with components not equal to or superior to the original certified components will void the certification and will reduce or eliminate protection for the operator in the event of a roll-over.

C. DAMAGE OF THE ROPS

If the Tractor has rolled over or the ROPS has been damaged (such as striking an overhead object during transport), it must be replaced to provide the original protection. After an accident, check for damages to the 1. ROPS 2. Seat 3. Seat belt & seat mountings. Before you operate a Tractor, replace all damaged parts.

When improperly operated, a tractor can roll over. For low clearance storage only, the roll bar (top half foldable portion of ROPS) may be folded. No protection is provided when the tractor is operated with the roll bar in the folded position. Always raise the roll bar immediately after low clearance storage. Always use the seat belt when the roll bar is raised. Seat belt save lives when they are used. Do not use the seat belt when the roll bar is lowered.

Never attach chains or ropes to the ROPS for pulling purposes; this will cause the tractor to tip backwards. Always pull from the tractor drawbar. Be careful when driving through door openings or under low overhead objects. Make sure there is sufficient overhead clearance for the ROPS. If the ROPS is removed or replaced, make certain that the proper hardware is used to replace the ROPS and the recommended torque values are applied to the attaching bolts. Always wear your seat belt if the tractor is equipped with a ROPS.

A - ROPS rollbar

B - Quick-lock Pins

C - Headed Pins

D - Knob

ROPS Folded

D. OPERATING FOLDABLE ROPS

To Fold-Down ROPS Rollbar (A):

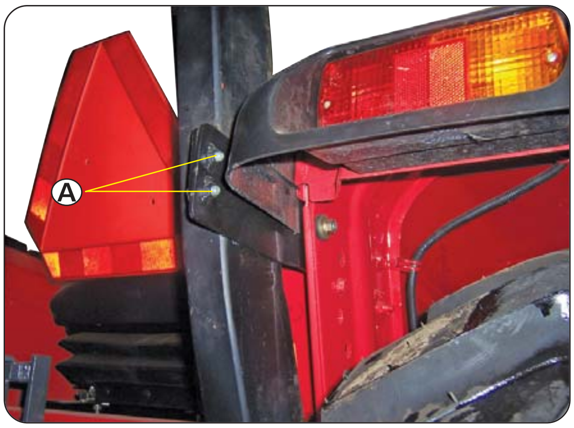
1. Remove quick-lock pins (B) and headed pins (C).
2. Loosen the knob (D).
3. Turn the rollbar (A) of ROPS till it stops.
4. Reinstall pins (C and B) into its position on ROPS

To Raise ROPS in Operating Position:

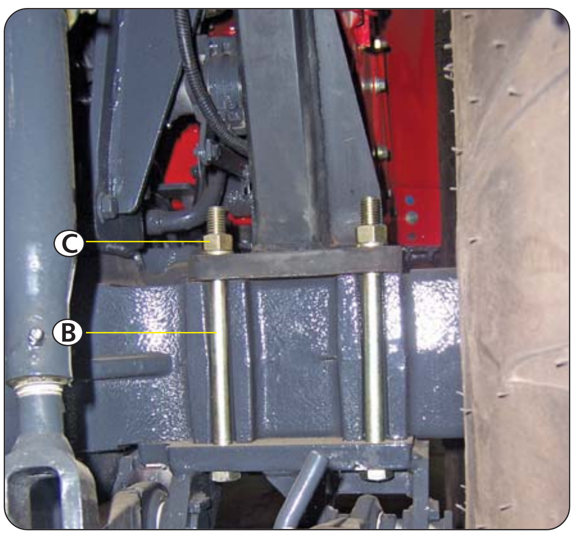
1. Remove quick-lock pins (B) and headed pins (C).
2. Loosen the knob (D).
3. Turn to raise the rollbar (A) of ROPS.
4. Install pins (C) and quick-lock pins (B).
5. Tighten the knob (D).

E. REMOVAL AND REFITMENT OF ROPS

1. Apply the tractor parking brakes and place wedges to hold the rear wheels.
2. Remove wiring connections of P&TS lamps mounted on ROPS.



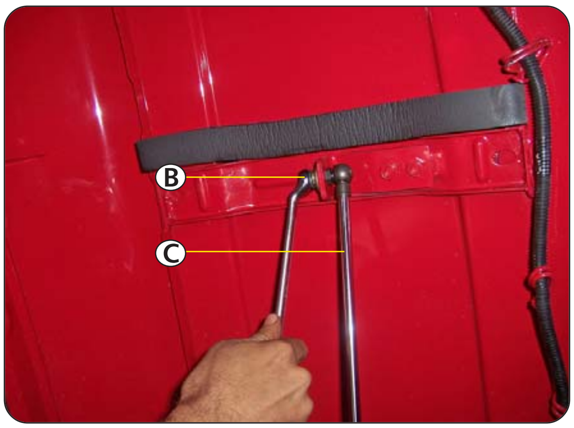
3. Loosen bolts (A) from ROPS fender connecting brackets.
4. Support the ROPS rollbar to avoid any injury.



5. Loosen bolts (B) & nuts (C) from ROPS mounting from both rear axle carrier.
6. Follow the reverse sequence of removal for refitment of ROPS.

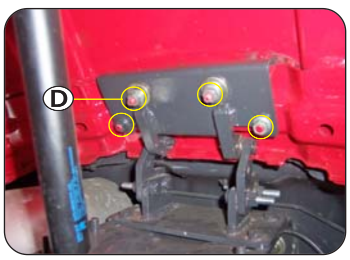
Removal & Refitment of Hood

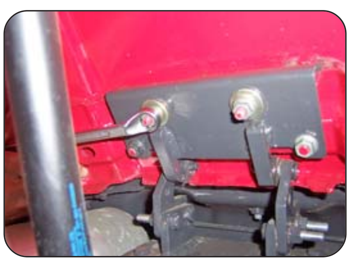
1. Pull the knob (A) and lift the hood.
2. Disconnect the Battery negative & positive terminals.
3. Disconnect the wiring harness to the head lamp & remove the wiring harness from hood clamps.



4. Loosen the nut (B) of gas spring (C) & remove gas spring.

CAUTION : The hood needs to be held in place with external support.





5. Remove the 4 nuts (D) of hood bracket & gently take out hood.
6. Hold the hood firm before attempting its removal.

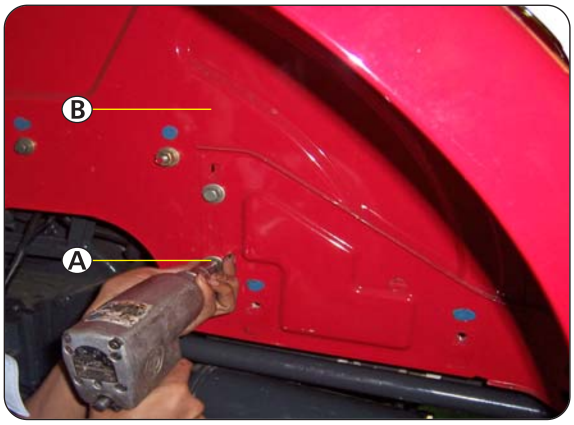
WARNING : Improper / inadequate supporting/holding the hood in place during its removal can cause injury.

7. Follow the reverse sequence of removal for refitment.

IMPORTANT : Align the hood resting area equally and properly, before tightening the four hood mounting nuts.

Removal & Refitment of Fender

1. Using the special tool - Rail & Trolley Jack - support both rear axle. Apply Tractor parking brakes and place wedges to hold the rear wheels.
2. Remove rear wheels of RH and LH side to access fenders.
3. First remove the battery cable from its negative terminal & then remove battery cable from positive terminal.
4. Disconnect fender wiring harness & remove from fender clamps.



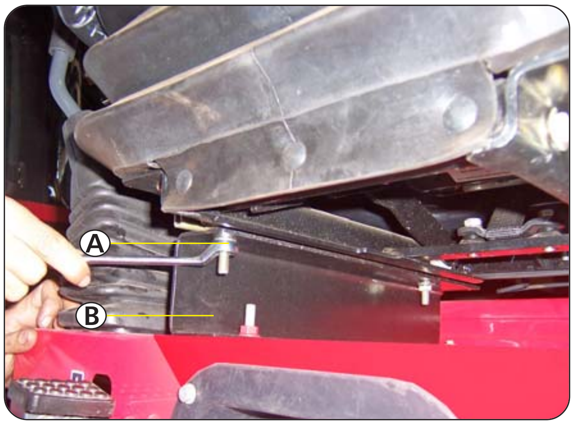
5. Loosen the fender mounting bolts (A).
6. Hold the fender (B) firmly before attempting its removal.

CAUTION : The fender needs to be held in place with external support.

WARNING : Improper / inadequate supporting/holding the fender in place during its removal can cause injury.

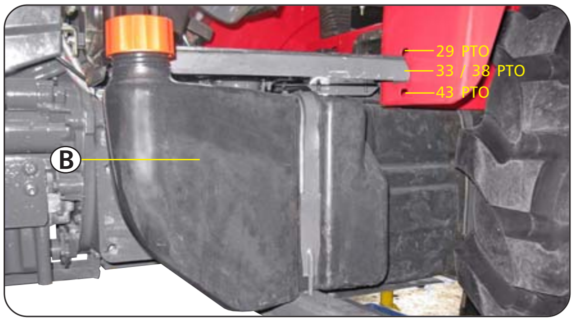
7. Refit the fender in the reverse sequence of removal.

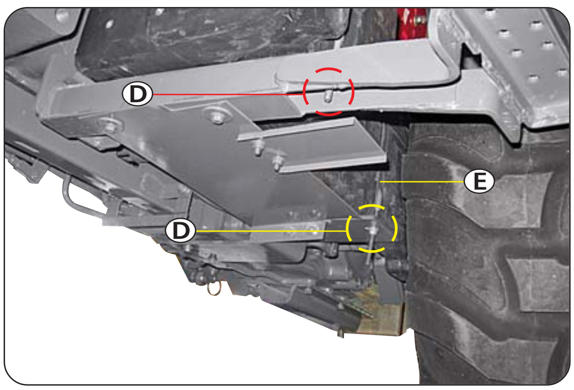
IMPORTANT : Align the fender resting area equally and properly, before tightening the fender mounting nuts.



Removal & Refitment of Seat

1. Loosen the seat mounting nuts (A) from the bracket (B).
2. Remove the seat.
3. Refit the removed parts in the reverse sequence of removal.





DESCRIPTION

The fuel tank is bolted on the mounting bracket on the LH side and the bracket is bolted to clutch housing & Transmission case at the base. The filler cap incorporates an air vent hole and a gasket. A float type electrical fuel level indicator is mounted from top. A rheostat type sensor converts mechanical motion of float into electrical signals, which are indicated on the fuel level gauge. At the bottom of the tank wing bolt is provided for water trap, in which water and heavier dust particle settle down. The water drain trap screw is located in rear left hand corner of the fuel tank.

Removal of the Fuel Tank

1. Support the LH side rear axle by using suitable jack. Apply Tractor parking brakes and place wedges to hold the rear wheels.
2. Remove rear wheel of LH side (A) to access the fuel tank (B).

NOTE : In case of 29 / 33 / 38 PTO HP tractor - LH side fender required to be removed to access fuel tank. For 43 PTO HP tractor - No need to remove LH side fender, only remove rear wheel LH side (A) to access the fuel tank (B). Model-wise fender mounting positions identified on figure.

3. Drain the tank completely either through water trap or through fuel drain plug (C).
4. Open the hood & disconnect the fuel lines between fuel filter and fuel tank.
5. First remove the battery cable from its negative terminal & then remove battery cable from positive terminal.
6. Remove the nuts (D) from fuel tank mounting strap (E), and gently take out fuel tank.
7. Disconnect fuel tank gauge wire.

Cleaning and Inspection

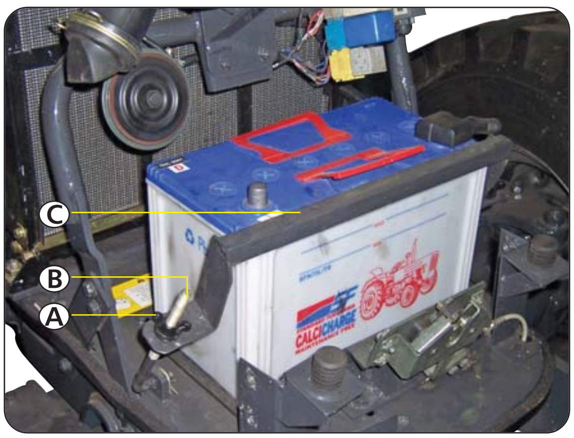
1. Clean out the tank thoroughly with clean fuel.
2. Check the tank for leakages.
3. Check hose and clamps.
4. Check the "Tank Unit" fuel gauge sensor is working properly.

Refitment of the Fuel Tank

1. Reverse the removal procedure.
2. Fill the tank with clean fuel and bleed the system.

Removal of the Battery

1. Open the hood.
2. Remove the battery cable from its negative terminal and then positive terminal.

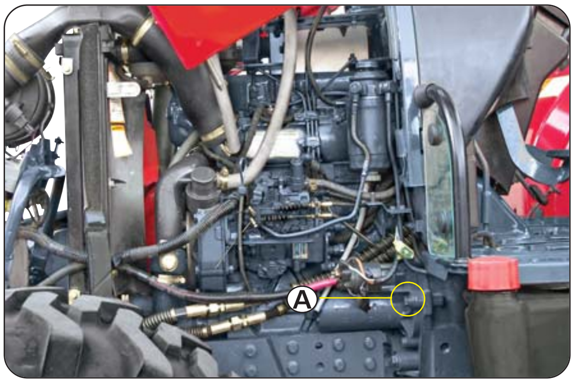


3. Remove the wing nut (A) of the Battery holding bracket stay rods (B), and remove the bracket (C).
4. Remove the battery.

Refitment of the Battery

1. Refit the removed parts in the reverse sequence of removal.

2. Refit the Battery Negative cable only at the end of assembly.

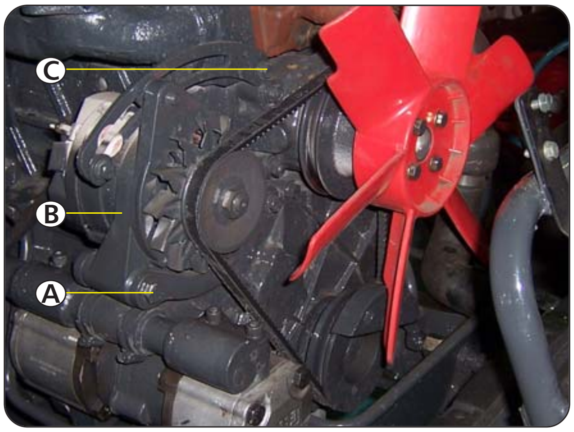


Removal of the Starter Motor

1. Pull the knob, unlock the Hood lock and lift the hood.
2. Remove LH side panel.
3. First remove the battery cable from its negative terminal & then remove battery cable from positive terminal.
4. Disconnect the cables connected to the Starter motor.
5. Dismantle the Starter Motor mounting bolts (A), slide it forward and remove from the engine.

Refitment of the Starter Motor

1. Refit the removed parts in the reverse sequence of removal.
2. Refit the Battery Negative cable only at the end of assembly.



Removal of the Alternator

1. Pull the knob, unlock the Hood lock and lift the hood. Remove RH side panel.
2. First remove the battery cable from its negative terminal & then remove battery cable from positive terminal.
3. Disconnect the cables connected to the Alternator.
4. Loosen the nut and bolt (A) of the Alternator (B).
5. Remove cap screw (C) securing that Alternator brace to the engine housing.
6. Push the Alternator towards the engine to slacken belt tension. Remove the drive belt from the pulley.
7. Remove the mounting bracket, nut and bolt (A) and supporting the Alternator with right hand, withdraw mounting bolt towards rear of engine.
8. Assemble the removed parts in the reverse sequence of removal.

NOTE: **Alternator maintenance / Repair should be done by Authorized Dealer / Distributor.**

ROUTINE MAINTENANCE - ALTERNATOR

GENERAL

Keep the Alternator reasonably clean and ensure that ventilation slot or air space are clear and unobstructed check mounting bolts for tightness.

BELT

1. Ensure that the driving belt on the Alternator is in good condition and is neither too slack nor too tight.
2. If necessary the fan belt tension should be adjusted to obtain approximately ½"-¾" deflection of belt when pressed at midway of the longest point between pulleys.

NOTE: **A slack belt will rapidly wear and because of slip may not drive the Alternator for the required speed.**

Too tight a belt will impose severe side thrust on the bearings and seriously shorten their life.

REMOVING THE ALTERNATOR BELT

1. Loosen the Alternator mounting bracket bolt and bolt locking the adjustable brace.
2. Push the Alternator towards the engine to slacken the belt tension and remove the belt from the Alternator pulley.
3. Remove the belt from main drive pulley.
4. Take out the belt from Radiator cowl, top slot space and fan blades.

ALTERNATOR INSTALLATION

1. Install the Alternator drive belt by reversing the procedure.
2. Refit the removed parts in the reverse sequence of removal.
3. Refit the Battery Negative cable only at the end of refitment.

ADJUSTING TENSION DRIVE BELT

1. Check the drive belt tension by pressing with the thumb midway between the pulleys.
2. The belt slack should be approximately ¼”.

   If the belt tension is found to be incorrect then adjust the belt tension as below:

a. Loosen the Alternator mounting bolt and bolt locking the adjustable brace.

b. Move the Alternator away from the engine to increase belt tension or push it towards the engine to decrease the tension.

c. When the required tension is obtained, retighten the Alternator mounting bracket bolt and the adjustable brace locking bolt.

NOTE: **To avoid damage to charging system, service precautions should be observed as follows. Never make or break any of the charging circuit connections, including the battery when engine is running never short any of charging components to ground.**

Do not use a slave battery of higher than 12 volts nominal voltage. Always disconnect the battery ground cable before carrying out arc welding on the tractor or any implements attached to the Tractor.

Removal & Refitment of Air Cleaner

A. AIR CLEANER

All air entering the engine must pass through the air cleaner before entering the inlet manifold and cylinders. To provide an engine with clean and adequate volume of air, is of utmost importance. The entire system is so designed that even in extreme dusty conditions and low Engine R.P.M. the engine is not starved of dust free air. In this Engine, Dry Type Air Cleaner is placed horizontally in front of radiator.

The curved blades on the periphery of precleaner shield direct the entering air to take a spiral path. On entering the body tube, due to this motion of air, bigger impure particles are thrown away rapidly from the body tube. After passing from hopper slot, they fall in the dust collector. The precleaned air then passes through paper filter element before entering the engine.

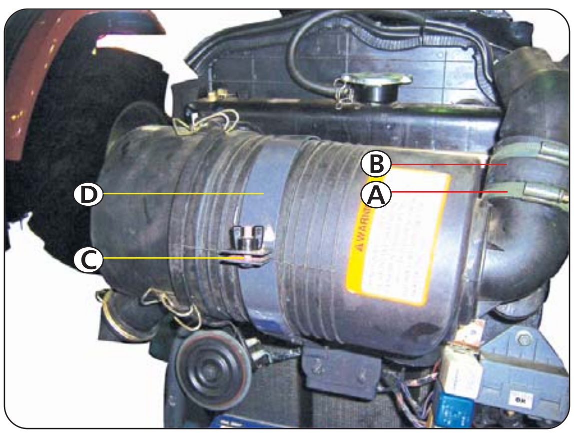
A safety cartridge is provided within the boundaries of paper element. This can filter particles upto 120μ and is of use only in case of any leakage or rupture of paper element. Also paper element is removed for cleaning. A mechanical filter clog indicator is provided which is mounted on air cleaner itself. Whenever red band of the clog indicator becomes visible, the air cleaner needs to be cleaned.

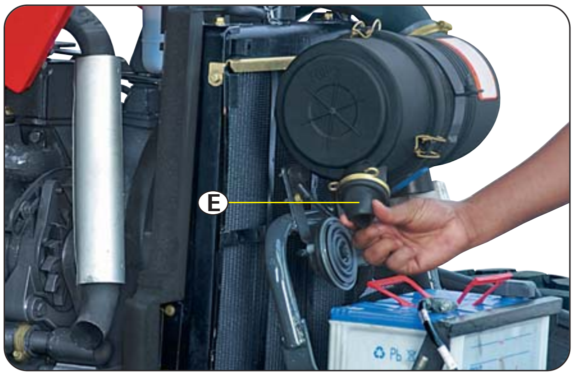
NOTE: Never remove cartridge when paper element is removed for cleaning.

B. REMOVAL & INSTALLATION INSTRUCTIONS

For Air cleaner Replacement Proceed as follows:

1. Open the hood.
2. Loosen the hose clips (A) of hose (B) as well as respective pipes.
3. Loosen the wing nut (C) & turn the clamp (D).
4. Remove air cleaner.

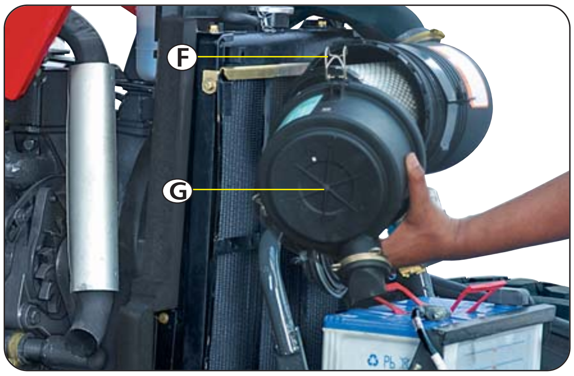




Dust Unloader

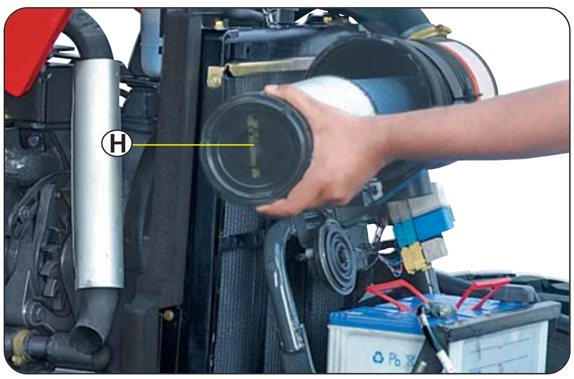
For Air cleaner Servicing Proceed as follows:

6. Open the hood.
7. Check the dust unloader valve (E) and clean if necessary.



Cyclopack

8. Turn the clamp (F) of air cleaner (G).
9. And remove cover (H).

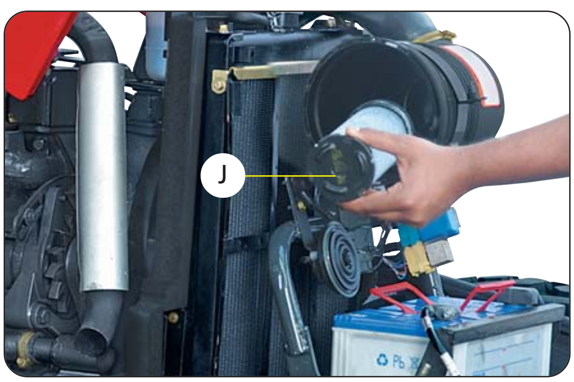


Primary Element Filter

10. Remove Primary Element (I).

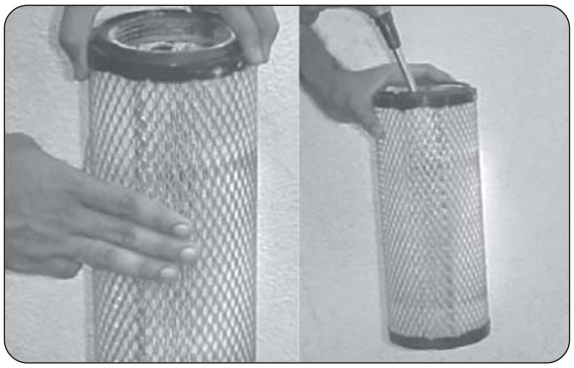
IMPORTANT: Remove Secondary Element (Inner Element) ONLY if it is to be replaced. DO NOT attempt to clean Secondary Element.

If Secondary Element is replaced, install new element immediately to prevent dust from entering air intake system.



Safety Cartridge

11. Replace Secondary Element (J), if dirty or damaged.



Cleaning Primary Element

C. Cleaning Primary Element

a. Tap Primary Element with palm of your hand, NOT ON HARD SURFACE.

b. Clean element with compressed air (below 130 kPa or 1.3 Bar). Hold nozzle next to inner surface, and move up and down pleats

IMPORTANT: DO NOT direct air against outside of element, as it might force dirt through to inside.

c. Inspect element before reinstalling.

D. Washing Primary Element

DO NOT wash element in fuel oil, oil, gasoline or solvent. DO NOT use compressed air to remove water from element.

E. Inspecting Element

a. Hold a bright light inside element and check carefully for holes. Discard any element which shows the slightest hole.

b. Be sure outer screen is not dented. Vibration would quickly wear a hole in filter.

c. Be sure rubber sealing surfaces are in good condition on both ends. If damaged, replace element.

d. Before you install Primary Element, clean the inside of air cleaner housing & unloader valve with a damp cloth.

e. Ensure that dust unloader valve is facing downward. (With 30 Deg. Vertical axis)

f. Install Primary Element & cover and shut bonnet.

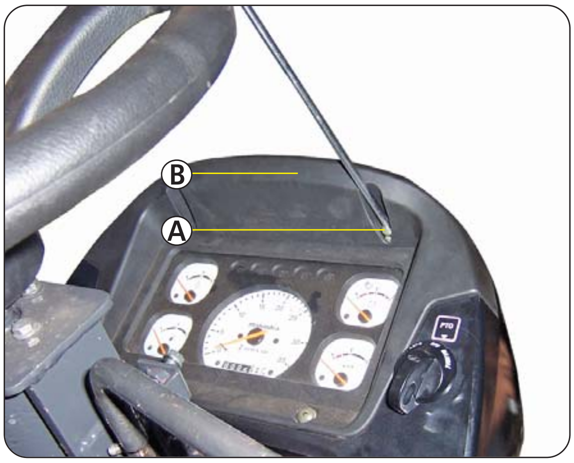
F. SERVICE INSTRUCTIONS

1. Check functioning of auto unloader of the dust collector regularly.
2. Paper element of air cleaner should be cleaned with compressed air every 300 hrs. or earlier if required.
3. Paper element of air cleaner should be replaced after every 2 cleanings or 900 hrs. or even earlier if required.
4. Safety Cartridge should be replaced after every 900 hrs. or earlier if required.

G. STORING ELEMENT

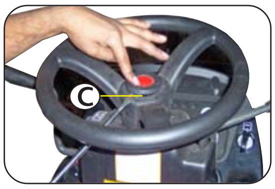
If element is not installed on tractor, seal element in a plastic bag and store in its original shipping container to protect against dust and damage.

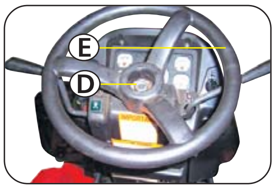
Removal & Refitment of Instrument Cluster, Scuttle & Steering Column Cover



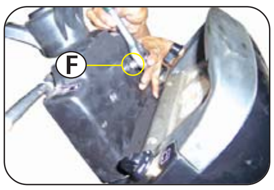
REMOVAL OF INSTRUMENT CLUSTER & SCUTTLE COVER

1. First remove the battery cable from its negative terminal & then remove battery cable from positive terminal.
2. Remove screws (A) of Instrument cluster & separate the cluster (B) by disconnecting the wiring harness.





3. Open the steering wheel cap (C). Remove the Steering Wheel Nut (D) and take out the Steering wheel (E) with the help of puller.



4. Loosen the steering column cover bolts (F).
5. Disconnect the wiring harness to PTO engaging switch.

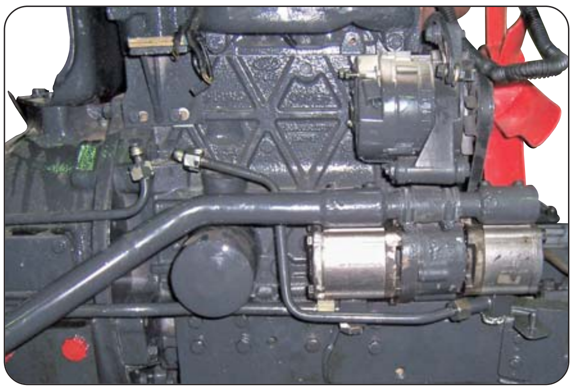
Steering Column Cover Removed

6. Take out the top & bottom steering column covers.
7. Disconnect wiring harness to switches in the scuttle.
8. Loosen the scuttle bolts and take out the scuttle.

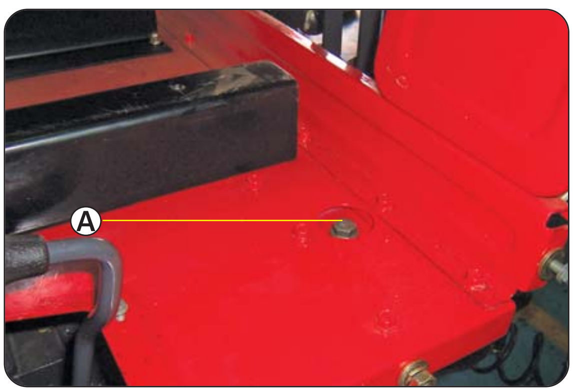
REFITMENT OF INSTRUMENT CLUSTER & SCUTTLE COVER

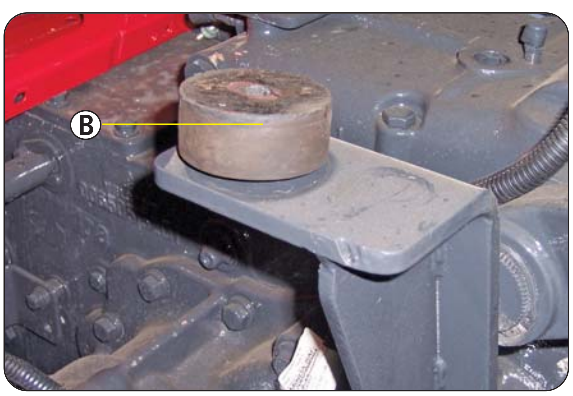
1. Refit the removed components in the reverse sequence of removal.
2. Ensure that the connectors are connected properly and in correct positions. Finally connect the battery positive cable.

Removing of Control Levers Knob



Disconnecting Power Steering Connections





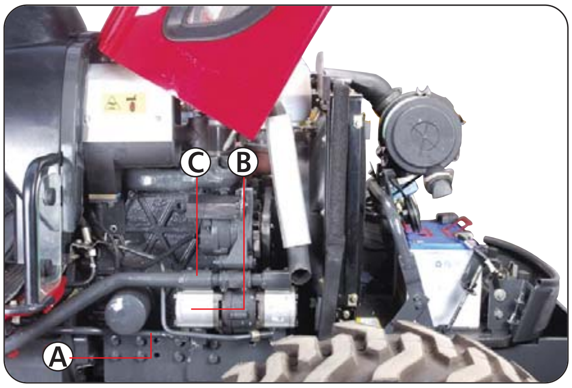
REMOVAL OF FLOORING AND LINKAGES

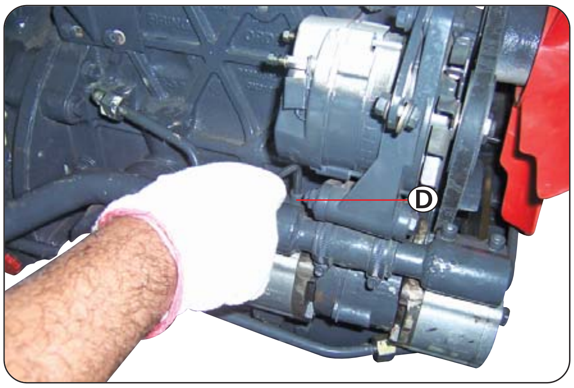
1. First remove the battery cable from its negative terminal & then remove battery cable from positive terminal.
2. Support the tractor by using tractor splitting rail – jack.
3. Remove the rear LH and RH wheels.
4. Disconnect the LH, RH fender wiring harness to P & T Lamp, Plow Lamp and remove the wiring harness from fender clamps.
5. Dismantle the ROPS fender connecting bracket.
6. Remove LH and RH fenders.
7. Remove seat from mounting channels.
8. Remove LH & RH mounting channels.
9. Remove the PC, DC, Range, Speed Lever & Slow Fast Valve Knobs.
10. Remove the differential lock foot pedal.
11. Dismantle the instrument cluster, Steering wheel, scuttle & steering column covers.
12. Disconnect the front / rear wiring harness from the central wiring harness and remove the wiring harness from the firewall clamps.
13. Disconnect the power steering hoses of HSU to steering cylinder, HSU to PTO Control Valve and Pump to HSU.
14. Disconnect the clutch and brake linkages & remove it.
15. Disconnect the Forward / Reverse, Hand & Foot Accelerator cables.
16. Remove foot accelerator pedal.
17. Dismantle the fire-wall assembly.
18. Remove the front and rear platform isolator mounting bolts (A) and take out isolator (B).
19. Remove the front and rear platform.

REFITMENT OF FLOORING AND LINKAGES

1. Reassemble the removed components in the reverse sequence of removal.

Ensure that the connectors are connected properly and in correct positions. Finally connect the battery positive cable.





REMOVAL & REFITMENT OF HYDRAULIC PUMP

Removal of the Hydraulic Pump

1. Pull the knob, unlock the Hood lock and lift the hood.
2. Remove RH side panel.
3. First remove the battery cable from its negative terminal & then remove battery cable from positive terminal.
4. Disconnect the Hydraulic Pump Pressure Line (A) of Hydraulic Pump (B) by loosening adapter connections.
5. Disconnect the Suction Line (C) by loosening the cap screws (D).

NOTE: Plug the pipes to prevent oil spillage.

6. Remove both Pumps for further repairs or replacement.

Refitment of the Hydraulic Pump

IMPORTANT: Always use new O'Rings. Using damaged or used O'Rings will lead to leakage.

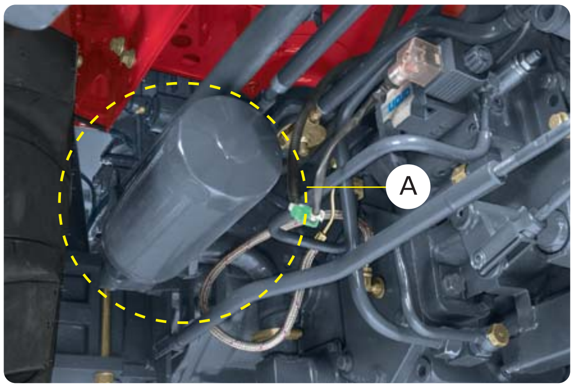
1. Place new O'Rings on pump flange. Install pump on engine.
2. Install cap screws for connecting the Hydraulic Suction Lines.
3. Connect the Steering Lines and Hydraulics Pressure lines.

NOTE: Hold adapters when tightening Hydraulics / Steering lines to eliminate overtightening of adapters on pump.

4. Connect the Battery connections.
5. Fit the RH side panel and close the hood.
6. Start engine and operate hydraulics. Check all connections for leaks.
7. Check oil level, add if necessary with the recommended grade of oil.

Service Recommendation:

It is not recommended to repair pump. Pump should be completely replaced, if internal problem suspected.

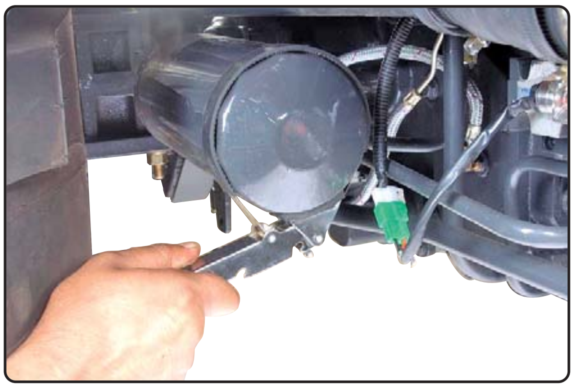


Hydraulic and Transmission Suction Oil Filter

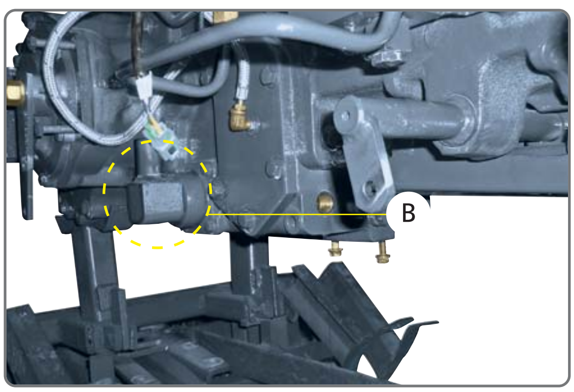
Change Hydraulics and Transmission oil filter (A) initially at 50 hrs. and subsequently at every 400 hrs. of operation.

These Spin-on type filters are located behind on RH side of the tractor. Remove old spin-on filters.

Prime the new spin-on filter with clean oil, and fit them.



Place a tray under filter to collect the oil. Remove this filter by using adjustable belts strap.

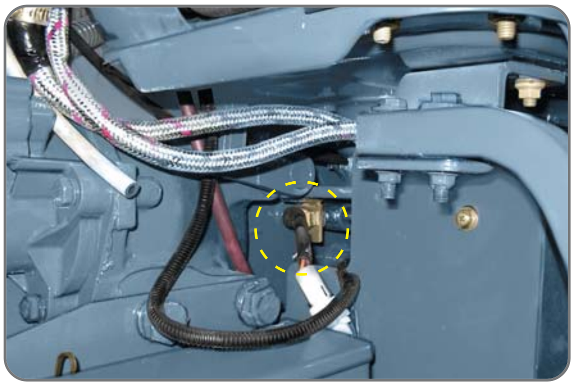


Hydraulic and Transmission Strainer

Clean suction strainer during every oil change. The suction strainer (B) is located on RH side of rear housing and can be removed as follows:

1. Remove suction filter of Hydraulic & Transmission.
2. Remove the Cover Plate (B) by unscrewing four bolts.
3. Pull the suction strainer out from housing.
4. Clean the strainer in clean diesel fuel, using a soft brush, then blow dry with compressed air.
5. Refit the strainer.
6. Refit the cover plate and suction filter.

For Service / Replacement of strainer contact your Mahindra Dealer.



Remove & Refitment of Safety Neutral Switch

In order to prevent starting of the tractor in gear or when PTO is engaged, unknowingly, which can lead to accident, a safety feature is provided. The starting system of the tractor is linked with the switch on forward / reverse shuttle shifting and PTO system. Hence tractor can be started only if forward / reverse shuttle shifting and PTO are in neutral.

CAUTION : Do not start the tractor by shorting at starter motor as this will bypass neutral system and can lead to accident

Removal of Neutral Safety Switch

1. To remove the switch, first remove the battery cable from its negative terminal & then remove battery cable from positive terminal.
2. Disconnect wiring harness from neutral switch.
3. Loosen the nut holding the switch to the bracket and remove the switch.

NOTE: After removal of the switch preserve the shims.

Refitment of Neutral Safety Switch

1. Position forward/ reverse lever in neutral position.
2. Refit the switch by using removed shims. For new switch add / remove shims, so that the tractor starts in neutral position only.
3. After ensuring startability in neutral position, tighten all hardwares to complete the assembly.

NOTE: Incase forward / reverse pivot is removed during any repairs; first reassemble the forward / reverse pivot on transmission shaft. Reconnect the forward / reverse cable with pin, cotter pin and washer. Place the forward / reverse in neutral position. Refit the switch by adding / removing shims, so that the tractor starts in neutral position only. After ensuring startability in neutral position, tighten all hardwares to complete the assembly.

When front isolator bracket LH is to be fitted, setting of neutral switch is to be carried out after bracket fitment as per "Refitment of Neutral Safety Switch" mentioned above.

Group-C

Engine

CHAPTER - 1

INTRODUCTION

5035 / 4535 / 4035 / 3535 SPECIFICATION

Tractor Model

Engine Model	**5035 / 4535**	**4035 / 3535**
GENERAL		
Number of cylinder	4	3
Bore (mm)	88.9	88.9
Stroke (mm)	101.6	101.6
Displacement (cc)	2520	1892
Compression ratio	19.5:1	19.5:1
Compression pressure (Bar) at 350 Engine rev/min	35-38	35-38
Firing order	1-3-4-2	1-3-2
Max. Rated Horse Power (H.P. @ 2800)	(5035 - 49.5, 4535 - 45)	(4035 - 40, 3535 - 35)
Max. Torque @ rpm (Nm)	145@1900~2100 (5035) 131@1900~2100 (4535)	116@1900~2100 (4035) 102@1900~2100 (3535)
ENGINE SPEED (rpm)		
Rated rpm	2800	2800
High idle	2975 ± 50	2975 ± 50
Low idle	1000 ± 50	1000 ± 50
Injection Nozzle Opening Pressure	3510 - 3742 PSI	3510 - 3742 PSI
FUEL	Diesel	Diesel

Parts Description	**5035 / 4535 / 4035 / 3535**
MANIFOLDS, CYLINDER HEAD & VALVES	
INLET VALVES	
Number of per cylinder	1
Stem diameter (mm)	Ø8.695 / Ø8.707
Head diameter (mm)	Ø38.25 / Ø38.50
Clearance in guide (mm)	0.051 / 0.025
Valve seat angle	$45^{\circ}\ ^{-20'/+0'}$
Tappet clearance (mm)	0.25 - Inlet (Hot & Cold), 0.30 - Exhaust (Hot & Cold)
EXHAUST VALVES	
Number of valves per cylinder	1
Stem diameter (mm)	Ø8.675 / Ø8.687
Port diameter (mm)	26.06
Head diameter (mm)	Ø35.80 / Ø36
Clearance in guide (mm)	0.076 / 0.051
Valve seat angle	$45^{\circ}\ ^{-20'/+0'}$
Tappet clearance (mm)	0.25 - Inlet (Hot & Cold), 0.30 - Exhaust (Hot & Cold)
VALVE GUIDE	
Length - inlet (mm)	59.94
Length - exhaust (mm)	59.94
Inside diameter (mm)	8.763 / 8.738
VALVE SPRINGS	
Initial length (mm)	42
Initial load (N)	250.0 N ± 10%
Final length (mm)	32.6
Final load	439.0 ± 10%
Free length (mm)	54.40 approx.
Spring rate (at 30-70% of final load) N/mm	20.1 ± 0.8

VALVE TAPPETS	
Diameter (mm)	14.224 / 13.97
Running clearance (mm)	0.013 / 0.076
VALVE PUSH RODS	
Diameter (mm)	Ø9.530D x 1.9 THK Hollow Push Rods
Length (mm)	248.3
VALVE TIMING	
Inlet opens	9° bTDC ± 2°
Inlet closes	35° aBDC ± 2°
Exhaust opens	46° bBDC / 42° bBDC
Exhaust closes	10° aTDC ± 2°
CONNECTING RODS, PISTONS AND CYLINDER SLEEVES	
CONNECTING RODS	
Material	EN - 16C / S48C
Bearing (big end) type	Replaceable Steel Backed Bimetal
Material	Steel Backed Overlay Plated
Small end (bearings)	Replaced
Type	Bush
Material	Cu-Lead
Small end bush dia. (mm)	Ø30.950 / Ø30.975
PISTON RINGS	
Number of rings per piston	3
Type	**Cam Ground Oval**
Top	Keystone, CKS Plated
Middle	Taper faced
Bottom	Chromium Plated Conformable Oil Ring
Width (Axial) (mm)	
Top	2.568 / 2.607
Middle	2.47 / 2.495
Bottom	3.97 / 3.995
Ring Gap (mm)	
Top	0.25 to 0.45
Middle	0.70 / 0.95
Bottom	0.25 / 0.50
PISTON	
Type	
Material	Aluminium Alloy
Graded (gms)	Weight difference should not be more than 5 gms.
Cavity Volume	26.23 ± 0.25 cc
Cylinder dia	Ø 88.9
Dia at skirt (Ø D1) mm	Ø 88.81 ± 0.007
Dia at just below oil control ring (Ø D2) mm	Ø 88.750 ± 0.009
Dia at top land (Ø D3)	Ø 88.400 ± 0.015
Piston pin bore (mm)	28.003 / 28.009
Number of ring grooves	3
Width of ring groove	
Top groove	(3) Reference Value
Middle groove	2.550 / 2.570
Bottom groove	4.020 / 4.040

Clearance in grooves	
Middle groove	0.055 / 0.100
Bottom groove	0.025 / 0.070
PISTON PINS	
Diameter (mm)	Ø27.995 / Ø28
Clearance in piston (mm)	0.014 / 0.003
Length (mm)	66.5 / 67
CYLINDER SLEEVES	
Type	Wet Liners
Material	C.I.
Wall thickness (mm)	9.99
Sleeve O.D (mm)	98.8 / 99
Sleeve I.D (mm)	88.9 / 88.92
Flange stand out / liner protrusion (mm)	0.051 above face to 0.025 below face.
Flange width (mm)	5.715 / 5.705 (for spare)
Max. taper (mm)	0.013
Max. ovality (mm)	0.013
Sleeve I.D Discard limit (mm)	88.976 and above
LUBRICATION SYSTEM	
PRESSURE REGULATING VALVE	
Location	**On oil pump**
Spring free length (mm)	63.5 ± 0.010
Spring Initial length (mm)	44.5
Spring Initial load (N)	17 LBS ± 6%
Opening pressure (PSI)	30-35
VALVE clearance in bore (mm)	0.127 / 0.0889
OIL PUMP	
Clearances	
Gears to housing (mm)	0.135 / 0.211
Gears to end plate (mm)	0.05 / 0.1
Drive shaft to body (mm)	0.038 / 0.089
Drive Pinion to Body (mm)	0.051 / 0.102
COOLING SYSTEM	
Water pump	
Impeller shaft dia (mm)	
Front	Ø78.8$^{\pm 0.3}$
Rear	Ø78.8$^{\pm 0.3}$
Thermostat	
Range	80° - 96°
CAMSHAFT	
Material	Monochrome cast iron
Number of bearings	5

Bearing journal diameter (mm)	
Front	46.787 / 46.761
Centre	46.025 / 45.999
Rear	38.1 / 37.846
Running clearance (mm)	0.089 / 0.038
Exhaust cam lift	6.325
Inlet cam lift	6.274
TIMING GEARS	
Number of teeth	
Crankshaft gear	33
Cam shaft gear	66
Injection pump gear	66
Idler gear	46
Tandem pump gear	
Backlash between any pair of gear (mm)	0.23 / 0.132
Idler gear end clearance (mm)	0.127 - 0.254
Idler gear end float (mm)	0.127 - 0.254
CRANKSHAFT	
Material	EN25FQ or EN29B
Main journal diameter (mm)	Ø53.99 / Ø54.02
Running clearance main journal (mm)	0.076 / 0.018
Crank pin diameter (mm)	Ø53.97 / Ø53.99
End clearance (Float) (mm)	0.203 / 0.102
Slide clearance main journal (mm)	0.203 / 0.102
Running clearance crank pin (mm)	0.076 / 0.025
Rear end oil seal dia (mm)	91.999
MAIN BEARINGS	
Type	Replaceable, Shell
Material	Steel backed babbit

TORQUE LOADING (TIGHTENING TORQUE) CHART

Description	Torque (Lbs-Ft)
Crankcase Sub-assembly	
Pipe Plug1/4" For Main Oil Gallery	16 to 20
Pipe Plug1/8" For Main Oil Gallery	8 to 10
Crankcase Water Drain Plug 1/4" (G 6.3mm)	14 to 16
Back Plate To Crankcase Mounting Bolt M6x12	6 to 8
Spin-on Filter Adapter	20 to 25
Adapter Oil Level Gauge	18 to 22
Water Pump Mounting Stud 3/8" UNC	12 to 14
Front Plate Assembly	
Crankcase Front Plate Mounting Bolt G 7.938mm X 19.05 mm	18 to 22
Crankcase Front Plate Mounting Bolt 1/4" UNC X 3/4	8 to 12
Crankcase Front Plate Mounting Screw	4 to 6

TORQUE LOADING (TIGHTENING TORQUE) CHART

Description	Torque (Lbs-Ft)
Crankshaft Assembly	
Crankshaft To Crankcase Main Bearing Cap Bolt 1/2"-13 UNC	90 to 95
Piston Assembly	
Connecting Rod Assembly Bolt 3/8"-24 UNF3A	40 to 45
R.O.S.R. Fitment	
Crankshaft Rear Oil Seal Retainer Bolt 5/16" UNC x 25	18 to 22
Idler Shaft Fitment	
Idler Gear Shaft Bolt 1/2" UNF X 1-7/8 Hex Head	65 to 75
Camshaft Assembly	
Camshaft Thrust Plate Bolt 3/8"-16 UNC	20 to 25
Fitment Of Rotary FIP	
Injection Pump To Adapter Stud M8x1.25x38	10 to 12
Injection Pump To Adapter Plate Mounting Flanged Nut M8x1.25	18 to 22
FIP Add. Plate To Front Plate Bolt	15 to 18
FIP Hexagonal Nut	55 to 65
FIP Support Bracket Flanged Nut M8x1.25	18 to 22
FIP Support Bracket Flanged Bolt G7.938mm X 19.05mm	18 to 22
Fitment Of Front Cover	
Front cover To Crankcase Mounting Bolt G 7.938x50.8 mm Hx Hd	18 to 22
Front Cover To Crankcase Mounting Bolt G7.938x63.5 Hx Hd-v	18 to 22
Alternator Mounting Bracket on Front Cover To Crankcase Bolt G7.938x63.5	18 to 22
Alternator To Alternator Mounting Bracket on Front Cover (M8x1.25x85mm)	18 to 22
Alternator To Brace Bracket bolt M10x1.5x25mm	20 to 25
Alternator With Bracket M10x1.5x85mm	35 to 37
Timing Mark Pointer On Front Cover	4 to 6
IPG Cover Bolt	12 to 16
Fan Drive Pulley To Crankshaft Mounting Bolt	120 to 140
Water Pump Mounting Nut 3/8" UNC	25 to 30
Alternator Brace Bracket To Cylinder Head (M8x30 mm)	18 to 22
Alternator Brace Bracket To Alternator with Belt Guard Nut (M10)	18 to 22
Heat Shield Nut With Alternator Mounting Bolt	
Heat Shield Bolt Nut M10x1.5	25 to 30
Tube Thermostat Bypass	8 to 10
Oil Sump & Adapter Plate Fitment	
Lubricating Oil Pump To Crankcase 3/8" UNC X 1-1/8	25 to 30

TORQUE LOADING (TIGHTENING TORQUE) CHART

Description	Torque (Lbs-Ft)
Oil Pump Screen Mounting Bolt G6.35 x 12.7 mm	6 to 8
Adapter Plate To Front Cover (5/16" 1-1/8 Size)	13 to 15
Adapter To ROSR Mounting Bolt G 7.938 (5/16" 1-1/8)	18 to 22
Oil Sump Adapter Mounting Bolt 5/16 UNC-2B x 2"	18 to 22
Oil Sump C/Csae Mounting Bolt 5/16-2B x 100	18 to 22
Oil Pan Drain Lug 7/8"-18 NS-2	20 to 25
Cylinder Head Sub Assembly	
Injector Mounting Stud M10	12 to 14
Injector Mounting Clamp Nut M10 x 1.5	18 to 22
Water Temperature Sensor M14 x 1.5	18 to 22
Thermostat Housing Cover Bolt M8 x 1.25 x 22-H3	18 to 22
Thermostat Housing Cover Bolt With Lifting Bracket M8x30 mm Long	18 to 22
Thermostat Cover Bolt M8 x 1.25 x 22long	18 to 22
Rocker Arm Mounting Stud	12 to 14
Cylinder Head To Crankcase Mounting Bolt 7/16" UNC - Short	60 to 65
Rocker Arm Mounting On Cylinder head Bolt 7/16" UNC Long	60 to 65
Rocker Arm Mounting Nut M10 x 1.5	25 to 30
Injector Spill Pipe Banjo M6	4 to 6
Air Intake Manifold Mounting Bolt M8 x 1.25 x 45	18 to 22
Heater For Cold Start M22 x 1.5	18 to 22
Tube Oil Level Gauge	12 to 15
Exhaust Manifold Sub-assembly	
Exhaust Manifold M10 x 1.5 x 45	25 to 30
High Pressure Pipes, Low Pressure Pipes	
FIP High Pressure Pipe Nut Pump End M12 x 1.5	17 to 20
FIP High Pressure Pipe Nut Injector End 14 x 1.5	18 to 22
Clamps For High Pressure Pipes M6	2 to 4
Fuel Filter Mounting nut Flanged M8 x 1.25	18 to 22
Fuel Pipe Banjo Bolt M12 - on Pump Inlet	12 to 15
Fuel Pipe Banjo Bolts M14	18 to 22
Flywheel To Crankshaft Mounting bolt 7/16" UNF	60 to 70
Spin-on Lub Oil Filter	8 to 12
Valve Housing Cover Nut M10x1.5 mm	8 to 10
Hose Clip For FIP Overflow Pipe	2 to 4
Bolt Banjo M8 X1, Spill Over & Overflow Pipe	12 to 15

Cross Section of Engine (side view)

1) Thermostat, opens at 82⁰C (167⁰F) and allows coolant to circulate. Not repairable, replace if not functioning properly.

2) Valve Rocker arm shaft, diam. rocker arm 19 mm (3/4") drilled oil passage through valve lever shaft center bracket and valve rocker arm shaft to valve rocker arms.

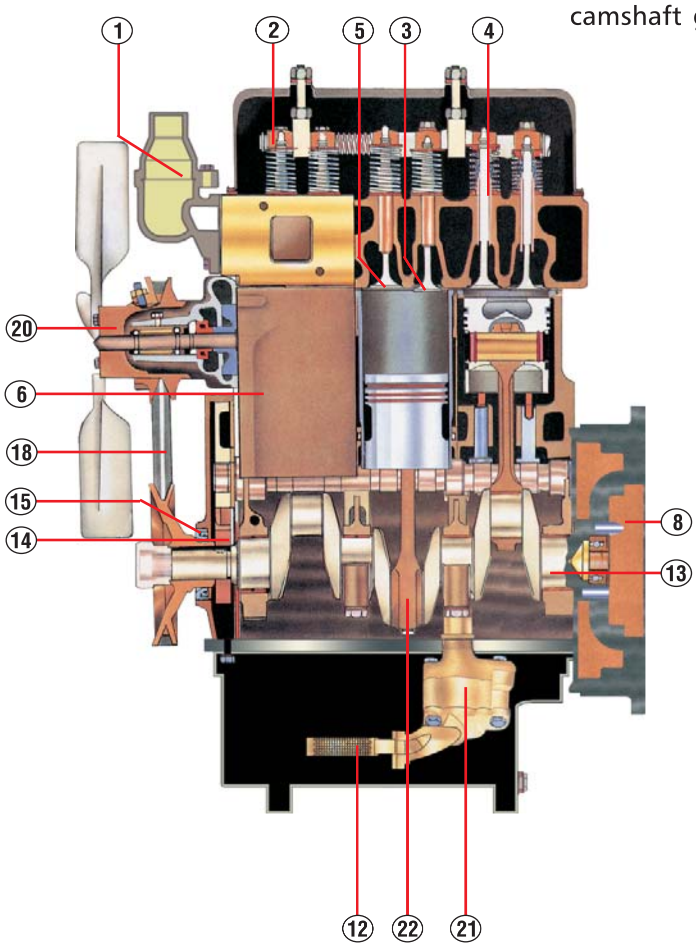
3) Intake valve.

4) Valve guides, for intake and exhaust valves.

5) Exhaust valve.

6) Cylinder sleeves, and pistons are factory mated.

7) Cylinder sleeve packing ring, replace when removing cylinder sleeves. Thoroughly clean grooves and apply some soft soap or soap solution when installing new rings.



8) Flywheel, assembled with six bolts. When flywheel reassembled retorque again.

9) Crankshaft rear oil seal, install carefully in accordance with special instructions otherwise oil leakage will result.

10) Crankshaft rear bearing, takes end thrust.

11) Flywheel ring gear, replaceable.

NOTE: In overall Engine Section, 3 cylinder pictures shown.

12) Floating screen for oil pump, before installing thoroughly wash in gasoline.

13) Crankshaft, four bearings.

14) Crankshaft pinion, 33 teeth, when installing be sure mark lines up with mark on camshaft gear.

15) Crankshaft front oil seal, when installing apply a mixture of heavy oil and graphite to the sealing lip.

16) Camshaft drive gear, 66 teeth, removable.

17) Idler gear, when installing be sure that marks line up with those on crankshaft gear and injection pump gear.

18) V-Belt, for alternator pulley, water pump pulley & main drive crank pulley.

19) Injection pump drive gear, 66 teeth, adjustable hub.

20) Water pump, fan belt driven, permanent packings.

21) Oil pump, fitted on the crankcase with bolt.

22) Connecting rod, when installing apply engine oil and see that the number mark at pump side.

A. GENERAL

Mahindra 35 Series Tractors have 3 & 4 cylinder direct injection water cooled diesel engines with rotary fuel injection pumps and overhead valves. These engines have superior specific fuel consumption and meet US Tier-IV < 50 Hp emission norms.

B. CONSTRUCTION

i) Cylinder Block

The block is reinforced with ribs so it easily acts as part of the frame connecting the front axle (semi-chassis) and clutch housing.

The engine block is the main body of the engine, around which the engine is built. It is a one piece casting and webs integral with it form the upper halves of the main bearing supports. The lower half bearing supports are in the form of caps machined to mate with the webs in the crankcase.

The crankshaft is supported in 5 & 4 main bearings for 4 & 3 cylinders engine respectively with end thrust on the rear. The bearings are of the steel backed insert type and do not require fitting on assembly. The bearing caps, which hold the lower bearing inserts in position, are not interchangeable and each one is stamped with its location in the crankcase. No.1 is at the front.

During manufacture main bearing caps are rough machined, then assembled to the crankcase prior to being line reamed. This results in each bearing cap being fitted for only one position, therefore, finished bearing caps cannot be supplied individually for service due to the necessity for line reaming to fit the particular bore where it is intended to mate.

The crankshaft supports the connecting rods and pistons along its length and converts the reciprocating movement of the pistons into the rotary movement required to drive the transmission. At the front end of the crankshaft is the gear which drives the timing gear train and the pulley which drives the fan and water pump. The flywheel is mounted on the rear of the crankshaft and to this is mounted the clutch which forms the link between the engine and transmission. The purpose of the flywheel is to oppose and moderate, by its inertia, any fluctuation in the speed of the engine. It counteracts varying torques during the stroke of the engine and provides a rotating balance weight which carries the crankshaft over dead centres. The flywheel is secured to the crankshaft by six bolts. Dowels are provided in the crankshaft flange for accurate location. The starting ring gear is a shrink fit on the flywheel and is replaceable. The cylinder sleeves are replaceable wet type with cooling water running around them.

The cooling water is sealed in the Crankcase water jackets with the help of two 'O' Rings at the lower end. The top end of the water jacket is sealed when the head gasket is installed and pressed between the head and the sleeve collar.

Sleeves can be obtained as individual items or with graded crankcase.

CAUTION : Never let cylinder sleeve fall this may cause out of round with subsequent scoring, or in extreme cause seizure of the piston.

ii) Crankshaft

The Crankshaft is forged from Alloy Steel with Bearing Journals and Pins induction hardened for increased strength and wearing properties. The main journals are supported in Steel Backed Alloy Bearing Shells.

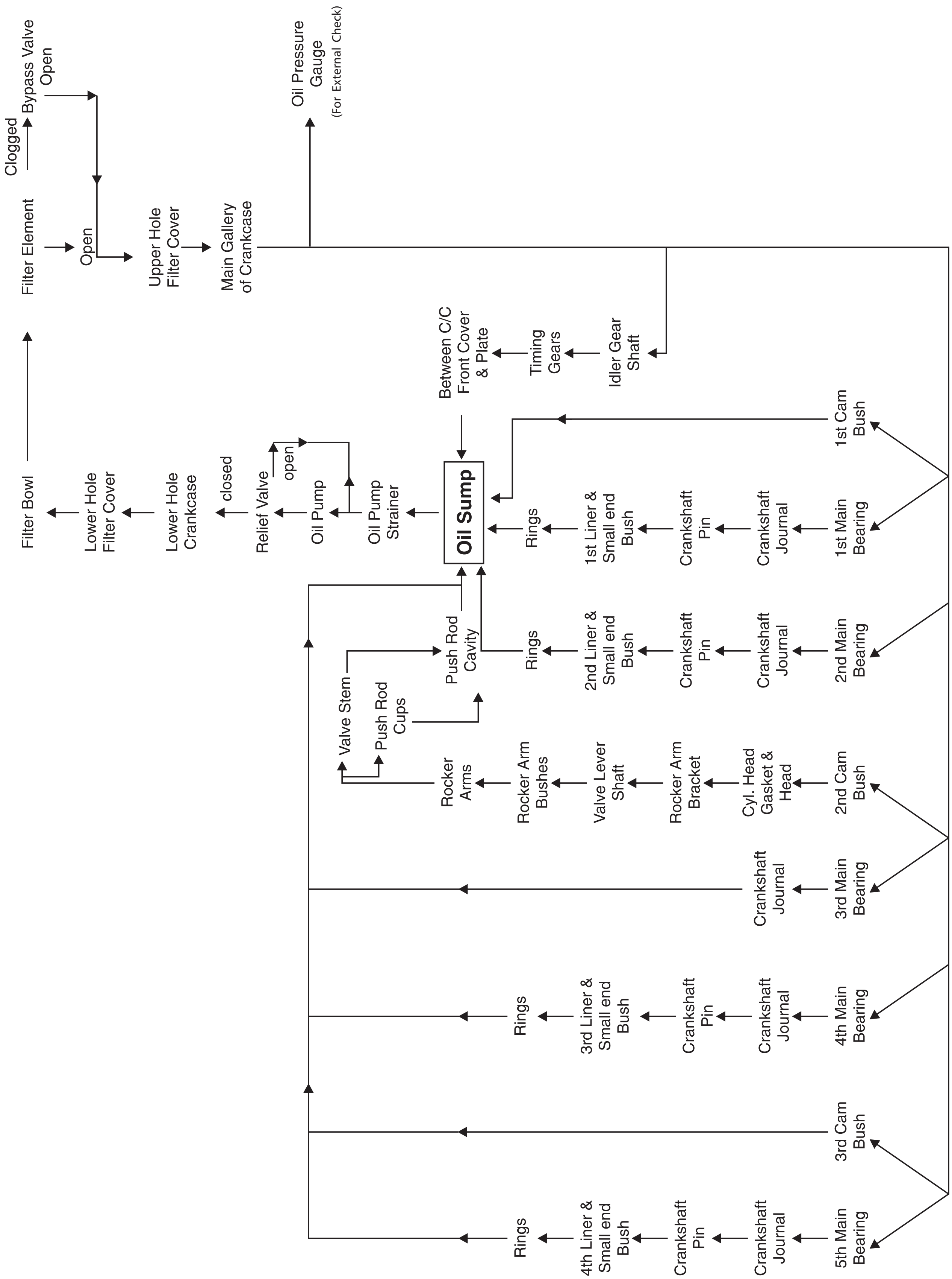
The end thrust or end float of the Crankshaft is controlled at the last rear main bearing having a collared shell.

NOTE: All Crankshafts are dynamically balanced in the factory and do not carry any additional balancing weights.

iii) Camshaft

The Camshaft is made of special cast iron and is supported in babbit lined bearings. Thrust is taken on the locating plate mounted between the camshaft front journal and the driving gear. The drive for the camshaft is taken from the crankshaft gear.

LUBRICATION CIRCUIT DIAGRAM



iv) Pistons

The Aluminium Alloy Pistons are cam ground and are fitted with two compression rings and one conformable oil control ring. The have a cavity in the piston crown itself to make a combustion chamber.

The fully floating piston pins are held in place by Circlips at both ends.

Each piston is filled with two compression rings made of cast iron. The top ring is chrome plated. There is one oil control ring. The purpose of oil control ring is to provide an even circulation of lubricating oil giving all over lubrication and cooling action for the piston and sleeves. Excess oil is wiped down to the sump by the lands of the ring.

v) Connecting rod

The I section connecting rods are forged steel and carry a bronze bush at the small end for installation of the piston pins. The big end is mounted on the crankshaft over steel backed alloy replaceable bearing inserts. The big end bearing caps for each connecting rod are matched fit and the matching parts are numbered to ensure correct assembly.

vi) Flywheel is mounted on the rear of the crankshaft secured by six bolts. The replaceable ring gear is shrink fit on the fly wheel.

vii) Lubrication System

Lubricating oils is stored in the engine oil pan bolted to the bottom of the crankcase. Oil is sucked through a fine mesh screen and pick-up tube into the inlet of a 4 lobe internal gear pump. The pump is driven by a gear on the camshaft. The pump has a build in relief valve to limit maximum pressure. Oil is forced from the pump through the filter into the engine lubrication passages. The filter has a bypass valve designed to prevent loss of lubricating oil flow if the filter becomes stagged. Oil from the filter enters the crankcase main oil gallery. A drilling carried oil flow it to the idler drive gear on the front of the engine to lubricate the gear bearing and provide oil flow necessary to splash lubricate the other gears, then drilling carry oil to each camshaft bearing and crankshaft bearing. The number two camshaft bearing journal has a slot cut in it to provide metered oil flow to the valve rocker arm shaft. When the slot is aligned with the drilling from the main oil gallery and the drilling to the valve rocker arm shaft to metered amount of oil is forced to the shaft. Each crankshaft main journal is drilled to the rod journals and the main bearing links have circumferential grooves to provide continuous oil flow to each rod bearing. The rods are designed with side clearance to provide oil flow necessary to splash lubricate the connecting rod small end (wrist) pin bearing and the cylinder walls.

viii) Cooling System

Coolant is circulated through passages located in the crankcase and the cylinder head, by a centrifugal pump mounted in the front of the crankcase. The drive for the water pump is taken from the crankshaft by a belt and pulley system. A thermostat situated in the water outlet ensures that the coolant is not circulated until it has reached the efficient operating temperature.

For complete details refer service manual.

ix) Fuel System

The fuel system consists of fuel lines, fuel filter, fuel injection pump, high pressure pipes, and the fuel injection nozzles. The fuel injection pump is controlled by a Mechanical Governor, which governs the engine speed from idling to full load. For complete detailed servicing information on diesel fuel system components, refer to the fuel injection system service manual.

Fig. 1

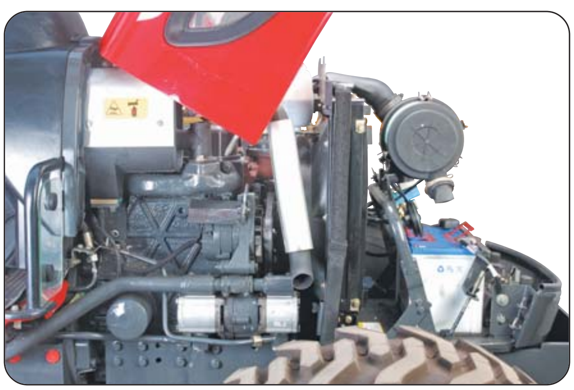


Fig. 2

1. ENGINE

1a. Removal :

1. Raise the hood.
2. Disconnect the battery earth cable before disconnecting any electrical system.
3. Unclip the main cable harness from the bottom of the radiator.
4. Disconnect head lamp and horn cable.
5. Remove the hood pivot bolts and remove the hood.
6. Drain the radiator and crankcase.
7. Disconnect the radiator brace and fan shroud from radiator.
8. Loose and hose clips and remove inlet and outlet hose pipes of the radiator.
9. Remove the two nuts from the bolts securing the radiator to the front axle support. Lift the radiator and rubber pads off. Place the wooden block between axle and axle support prevent tilting.
10. Lock the brakes and securely block the rear wheels.
11. Disconnect the drag link. If power steering is fitted, disconnect the power steering oil pipes (two) at starter side.
12. Support the front of the tractor to take most of the weight off the front tires. Unbolt the radius arm bracket fit from the clutch housing.
13. Remove the front support securing cap screws from both sides. Raise tractor engine until crank shaft pulley will clear support then roll out front axle support with front axle and tires.
14. Disconnect the generator / alternator leads, the oil pressure pipe, and release the harness from the securing clips situated around the front of the engine.
15. Disconnect the starter motor supply cable, solenoid wire and main harness feed wire from the starter (1-1).
16. Disconnect the high and low pressure pipes at the Hydraulic pump removing two socket head (if power steering fitted. Remove dual pump socket) cap screws on each connection.

17. Remove the temperature transmitter from the head.
18. Remove the fuel feed pipe from fuel injection pump and close the fuel-shut-off tap and disconnect fuel supply line.
19. Remove the cap screws and lock washer securing the flywheel dust cover.
20. Sling the engine securely and with a suitable hoist tension the ling.
21. Remove the 7 cap screws and attaching the engine to the clutch housing.
22. Ease the engine away from the clutch housing as explained below. Take care that the transmission drive shaft is withdrawn squarely from the pilot bearing and clutch assembly.
23. Use MST-H3-MP-070 special service tool for removal of engine (Fig-3) as follows :
    - Keep the rail under the tractor (Fig-4).
    - Place jack & support of engine below oil sump.
    - Place mini jacks between front axle & front axle support & lock to avoid swinging of engine.
    - Place transmission jack below transmission case rectangular part.
    - Raise the jacks till they bear the load.
24. Remove all connections to the engine with clutch housing and vertical loads as described earlier.
25. Take care that the transmission drive shaft is withdrawn squarely from the pilot bearing and clutch assembly.

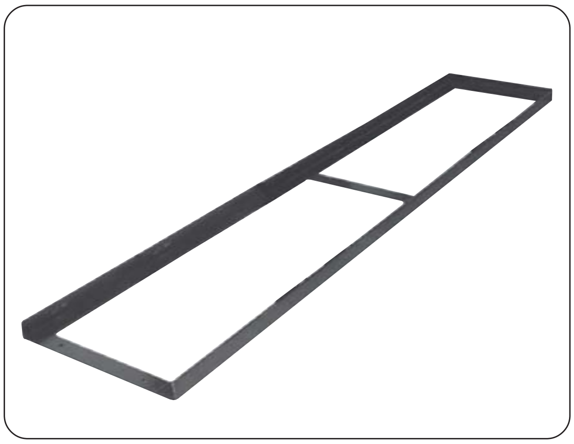


Fig. 3

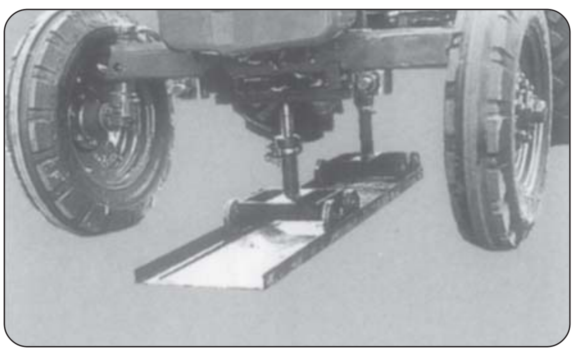


Fig. 4

2C. INSTALLATION OF ENGINE :

1. Install the clutch driven disc by passing aligning tool through the drive member and insert spigot end into the pilot bearing. Place the “flywheel” side toward the flywheel.
2. Place the drive disc (flywheel side mark toward the flywheel) and clutch cover assembly over the aligning tool. Line up the dowel holes in the cover over the dowels in the flywheel. Insert the six bolts and lock washer and tighten up evenly. Withdraw the aligning tool.

NOTE: It is recommend that new gaskets and O’Rings be used on installation.

3. Sling the engine securely. Hoist the engine into position in front of the clutch housing and enter the transmission drive shaft into the clutch assembly.

4. Move engine back turning the transmission and P.T.O. drive shaft to engage the splines of the clutch driven members, until the shaft is located in the pilot bearing and the clutch housing is located on the crankcase dowels.

NOTE: When engine is removed from tractor. Chassis for overhauling always take out the starter motor the alternator & the hydraulic pump and send them for testing.

5. Insert, and tighten the attaching bolts.

NOTE: To assist assembly, two longer bolts may be used to guide and to draw the engine upto the clutch housing.

6. Installation is now the reversal of the removal procedure by using new parts with kit.

7. Fill the cooling system and check the air cleaner oil, engine oil, hydraulic oil, fuel and then bleed the diesel fuel system.

CHAPTER - 2

MANIFOLDS, CYLINDER HEAD & VALVES

Cylinder Head

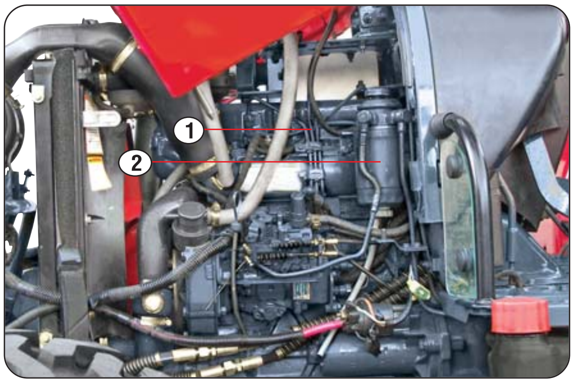
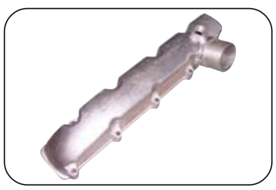


Fig. 1



Intake Manifold

Exhaust Manifold

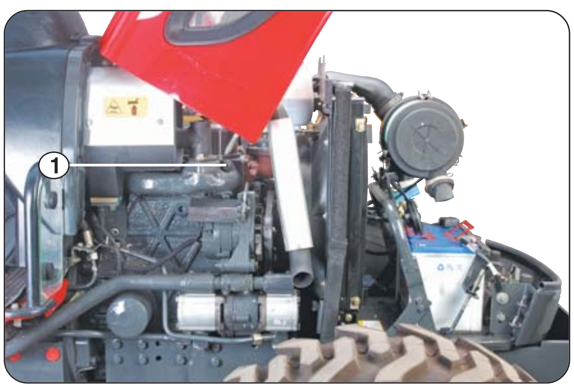


Fig. 2

1. DESCRIPTION

1a. MANIFOLDS

Manifolds are used in various designs depending on engine type and application. Inspect manifold for tight sealing, whenever the engine is overhauled. Two manifolds are used on diesel engines. The intake manifold being bolted to left side of the cylinder head and the exhaust manifold being bolted to the right hand side.

The exhaust manifold for 3 & 4 cylinder Tier IV < 50 Hp engines is same for all models.

1b. CYLINDER HEAD AND VALVES

The cylinder head is cast in one piece and houses the intake and exhaust valves. Valve guides are press-fit. Valves are operated by rocker arms shaft mounted on the cylinder head. Lubrication for the valve operating mechanism is provided through rifle drilled passages in the crankcase and cylinder head.

The valve rocker arm shaft assembly, thermostat housing inlet & exhaust manifolds are fitted on the cylinder head.

The crankcase filler cap, mounted on front cover, also serves as a breather to the cylinder head. The breather cap outlet is connected back to intake manifold through PCV valve.

2. MANIFOLDS

2a. REMOVAL :

i) Intake & Exhaust Manifold Removal :

a) Drain and remove the power steering reservoir.

b) Remove the fuel filter (2-1).

c) Remove the injector lines (1-1).

d) Remove the manifold bolts & lift it off.

e) Exhaust manifold can be removed by removing the four bolts (1-2).

NOTE: In overall Engine Section, 3 cylinder pictures shown.

2b. INSTALLATION :

a) Reverse the removal procedure.

b) It is always advisable to replace the Inlet & exhaust manifold gaskets with new ones.

c) Torque the mounting bolts at the specified torque to avoid leakage of gases.

2c. CLEANING, INSPECTION & REPAIR

Clean the manifold and inspect for cracks and distortion. Replace the manifold with New one, whenever distortion is more than 0.4 mm (.016 in) per 250mm (10 inch) length. Inspect Air Hose & Clamps. Inspect retainer bolts and their washers, replace damage parts.

3. VALVE ROCKER ARM SHAFT ASSEMBLY

3a. REMOVAL :

Thoroughly clean the engine externally.

a) Remove the radiator brace, clamps/stiffener and rubber washer. Then remove the valve housing cover and the gasket.

b) Remove the PCV.

c) Remove the two nut (1-3) from studs (4-3) from the outer valve lever shaft bracket. Which hold the valve lever shaft brackets cylinder head.

d) Remove the bolt (2-3) from the centre (long valve lever bracket.

e) Lift of the valve rocker arm shaft and brackets.

f) Lift out the push rods marking them so that they may be returned to their original positions.

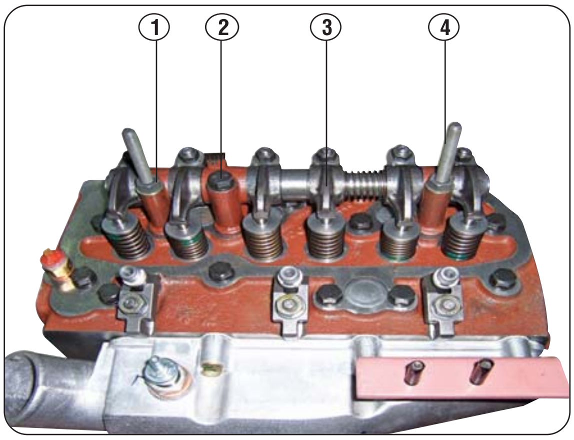


Fig. 3

3b. DISMANTLING :

Rocker Arm shaft

a) Remove circlip from both ends of the shaft and take out Rocker Arms and other parts (10 to 25-7).

b) To shift from centre bracket remove the roll pin and remove the shaft. Identify the rocker arms so that the can be installed in their original position.

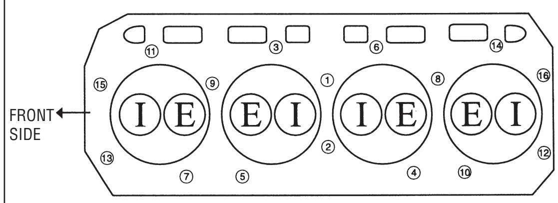
3c. INSPECTION & REPAIRS

a) Thoroughly clean all components in Kerosene or Diesel and blow using compressed air.

Be sure all oil passages are free from sludge and sediment.

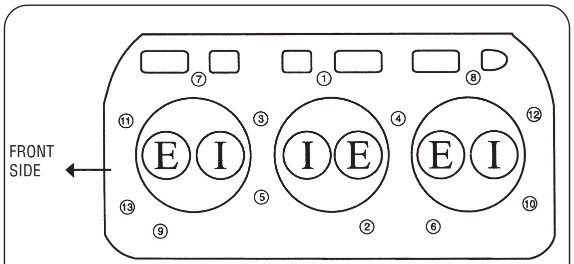
b) Check the valve lever shaft expansion plugs.

c) Check the clearance between the valve rocker arm shaft and valve rocker arm bushings.



Tightening sequence for 4 Cylinder Engines

Fig. 4



Tightening sequence for 3 Cylinder Engines

Fig. 4

d) Check the valve lever bracket for wear in the bore.

e) Replace valve rocker arms that show excessive wear of hammering at the ends (2-3) which contact the valve, remove only enough material to give an even face on the end of the valve lever and take care that the rounding is maintained lengthwise to ensure perfect grinding action on valve stem.

NOTE: Replace worn screw & nut with new ones.

f) Check expansion plugs on both ends of the lever shaft for leakage and replace plugs, if necessary, using sealer.

g) Check valve lever springs against specifications and replace with new ones if signs of corrosion chafing or fatigue show.

3d. ASSEMBLY :

Engine valve rocker arm (Ref. Fig .7).

a) Position the shaft in the center bracket ensuring that the oil hole in the shaft is towards the bottom of the bracket. Secure it with a new groove pin.

b) Assemble rocker arm spacer, rocker arm, spring rocker arm bracket, rocker arm to the shaft and secure them with a washer and retaining ring.

3e. INSTALLATION :

a) Loosen the lock nuts on each valve lever and back off the adjusting screws.

b) Install the value rocker arm shaft assembly on the studs as shown in Fig. 7 and install the nuts (1-3) finger tight.

c) Install the bolt in the centre bracket then tighten the nuts to the correct torque.

d) Adjust the valve clearance as detailed in para "ADJUSTMENTS".

e) Install the valve housing cover using a new gasket and rubber washers.

f) Install the nuts over the clamps/stiffener (over valve housing). Then tighten them to the specified torque.

3f. ADJUSTMENTS :

a) Tappet clearance must be set after the cylinder head cap screws have been tightened to the correct torque.

b) Move each piston in the firing order to top dead center on the compression stroke. This can be ascertained by watching the valves of No.4 cylinder until intake valve just beginning to open and

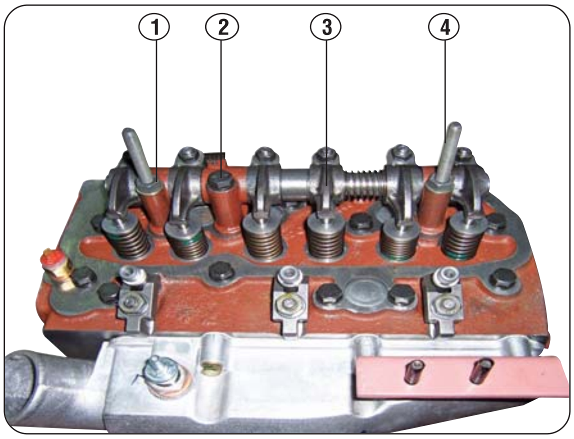


Fig. 3

exhaust valve is just closing. No. 1 piston is now at T.D.C. on compression stroke.

c) Slacken off the valve adjusting screw locknuts and turn the screw until to the specified clearance (inlet 0.25mm, exhaust 0.3mm) feeler gauge is just snug fit between the end of the valve stem and the valve lever.

d) Hold the screw in this position and tighten the locknut.

e) Similarly adjust the valve clearance of the remaining cylinder in firing order by bringing each piston to top dead center on the compression stroke in sequence.

4. CYLINDER HEAD

4a. REMOVAL

1) Remove the manifolds as detailed earlier.

2) Remove the valve rocker arm shaft assembly as detailed earlier in para 3a.

3) Remove the push rods and identify them so they can be installed in their original positions.

4) Remove the thermostat housing by pass hose.

5) Remove the three bolts then remove the thermostat housing.

6) Remove the fuel injector pipes. It is not advisable to disconnect them at the injector only. They may become distorted.

7) Remove the cylinder head bolts progressively in the reverse order to the tightening sequence Ref. Fig.4.

8) Remove the cylinder head and gasket.

NOTE:

1. Clean the Engine externally. Mark dismantled parts such as valves, Valve stem guides and springs and place them on a table in removal order to facilitate reassembly.

2. Always cap all exposed openings of injector pump, injector pipes, fuel lines and nozzle holders to prevent entry of dirt into the fuel system.

3. To avoid warpage do not remove cylinder head bolts unless the engine has cooled down.

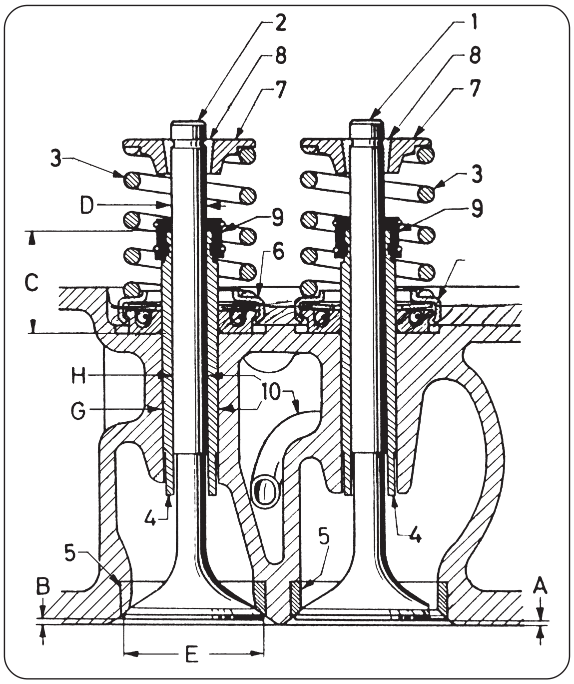


Fig. 5

1. Intake valve
2. Exhaust valve
3. Valve spring
4. Valve stem guide
5. Valve seat insert
6. Valve spring retainer cup lower
7. Valve spring locks upper
8. Valve stem
9. Coolant jet

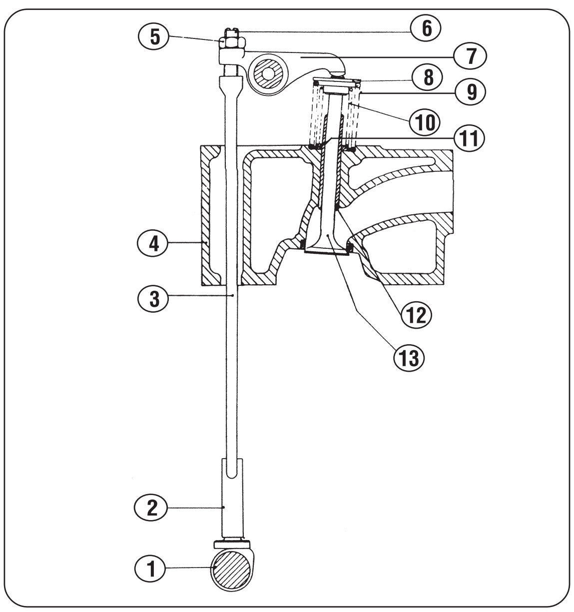


Fig. 6

1. Camshaft
2. Tappet
3. Push rod
4. Cylinder head
5. Adjusting screw locknut
6. Adjusting screw
7. Rocker arm
8. Valve spring retainer upper
9. Valve spring - one spring only
10. Valve spring - one spring only
11. Valve spring seat
12. Valve guide
13. Valve

4b. DISMANTLING

1) Remove the four nuts and conical washers securing the injector clamps. Carefully withdraw the injector and copper washers from the cylinder head. Keep the injectors in a clean place free from dirt and dust.

NOTE: Before disassembly of injectors, inspection or repair of nozzles, contact BOSCH dealer/service.

2) Using a valve spring compressor, compress the valve spring sufficiently to allow removal of the collet (8-5).

3) Release the pressure then remove the retainer (2-5) and spring (3-5) the valve seat should also be removed.

4) Remove the valve (2-5) and identify them so that they can be installed in the original positions.

5) If necessary press out the valve guides from the under side of the head using pusher slightly smaller than the guide to prevent it jamming in the bore.

4c. CLEANING, INSPECTION & REPAIR

(a) CLEANING

1. Wash all parts in a suitable solvent and blow dry with compressed air.
2. Remove any old gasket material from the faces of the cylinder head.
3. Blow through all oil passages to ensure that they are clear.
4. Remove all carbon deposits from the cylinder head and valves.
5. Remove any carbon deposits from the valve guides, using a wire brush. Blow out loose carbon with compressed air.

NOTE: Guides require careful cleaning because any remaining carbon will deflect the pilot of a valve seat refacing tool.

(b) INSPECTION

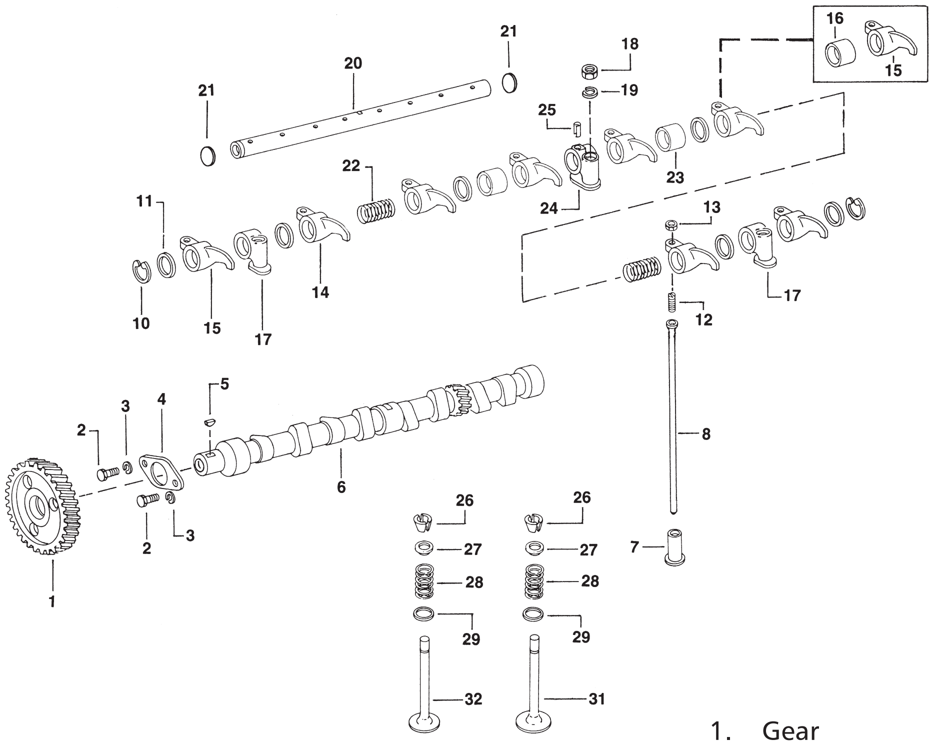
1. The Cylinder Head

   a. Inspect the casting for cracks and burnt metal around the valve ports.

   b. Check the valve seats for cracks and pitting.

   c. Position a lamp underneath the valve guides and examine the bore of the guide for burning, cracks or signs of excessive wear.

   d. Check the diameter of the guides at several points against the dimensions given in SPECIFICATIONS.



1. Gear
2. Screw
3. Washer
4. Plate
5. Key
6. Camshaft
7. Tappet
8. Rod
9. Rocker
10. Circlip
11. Washer
12. Screw
13. Nut
14. Arm, rocker
15. Arm, rocker
16. Bush
17. Bracket
18. Nut
19. Washer
20. Shaft
21. Plug
22. Spring
23. Spacer
24. Bracket
25. Pin
26. Lock
27. Cup
28. Spring
29. Washer
30. Set
31. Valve
32. Valve

Fig. 7

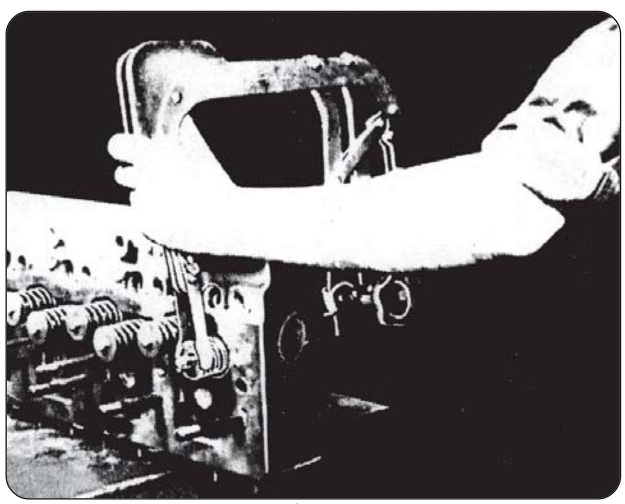


Fig. 9
Removing valves

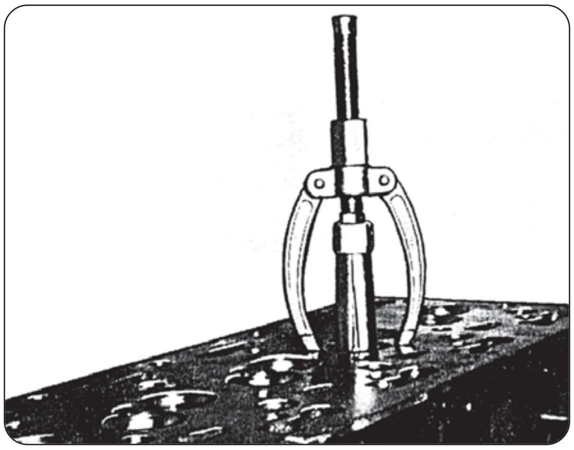


Fig. 10

Removing valve seat inserts

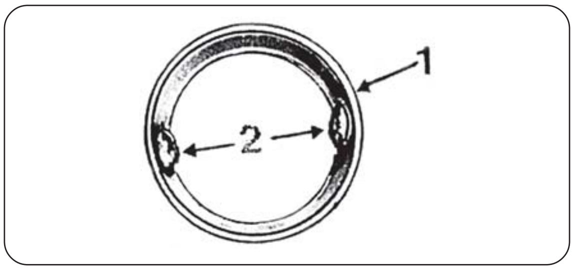


Fig. 11

1. Exhaust valve seat insert   2. Welded lugs

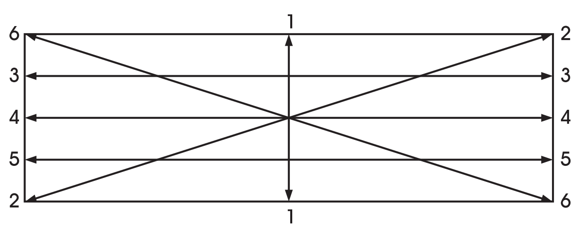


Fig. 12

Checking pattern, cylinder head and crankcase

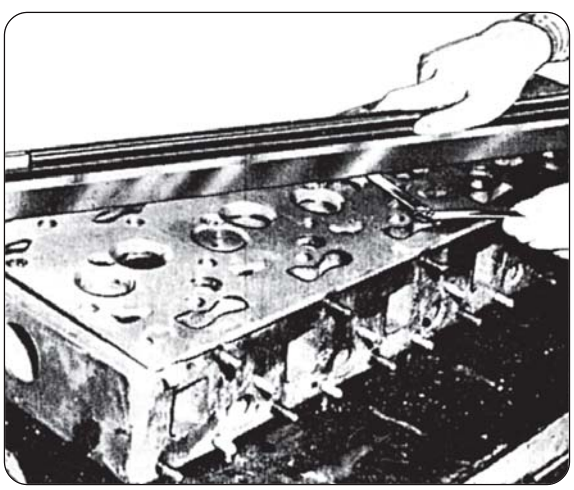


Fig. 13

If the running clearance between valve and valve guide exceeds 0.2 mm (0.008 in) the valve guide should be replaced.

e. Inspect the cylinder head and crank case for warpage if engine has been run with a blown head gasket.

4d. BEFORE REWORK

NOTE:

Check whether the cylinder height permits reworking.

Check to see if nozzle tip protrusion will retain within specified limits after rework.

(Nozzle protrusion of 2.3/1.8 mm/0.90"/0.70" is to be ensured)

To remove valves compress valve springs with compressor tool and take out spring retainer locks. Fig. 9.

To remove valve seat inserts, first weld two opposite lugs (2) Fig. 11 to provide puller grip.

4e. CLEANING, INSPECTION AND REPAIR

Clean the cylinder head thoroughly.

Remove carbon deposits from the bottom of the cylinder head and out of exhaust valve ports.

Flush out the water jacket to remove scale and dirt.

NOTE: Make sure water passages are free of obstructions, rust or scale.

Inspect the cylinder head (and the crankcase) for warpage if engine has been run with a blown head gasket. Fig. 13.

Observe checking pattern, fig. 12 see "Specification".

f) Check the valve stems for bends, wear, pitting or mushrooming of the ends. Check the collet grooves in the stems to ensure they have not lost their shoulders.

g) Check that the valve heads are not excessively worn or pitted.

h) Check the valve springs for rust, pitting or cracks and against the loads given in specification.

i) Check the retainers for rust and cracks.

j) Check and replace valve seals.

k) Check the outside face and the ribs inside the collects for wear. It is advisable to always use new collets.

l) If the new valve guides are replaced, ream the valve guides to the dimensions given in specifications.

m) If the valve seat inserts are to be replaced, take a fine cut, if necessary, from the bottom of the counter bore, to ensure a square seat for the replacement insert. (See fig. 10&11)

n) Thoroughly chill the new valve seat inserts at -60°C in dry ice before installation. This prevents metal scraping from the side of the counterbore, ensuring full contact of the insert on the bottom and side of the counterbore. After installation inserts peen over the edge of the inserts around it's entire circumstance. The inserts should be recessed in the Head 0.006" to 0.014"

When using carbon dioxide or dry ice, strictly adhere to instructions to avoid injuries. Do not touch deep frozen parts with bare hands.

o) Reface the valve seats to the correct angle seat that are too wide after refacing should be narrowed by grinding the top edge of the seat with a stone of a similar angle (15^0 angle preferred). Refer Fig. 14

p) Mount a dial indicator on the pilot shank and check that seat run out does not exceed 0.003".

q) Reface the valves but reject valves that grind down to a fine edge.

r) Using carborundum paste lap-in the valves. Ensure that all carborundum paste is removed from the valve and valve seats after lapping. Excess paste must be removed with a cloth and the head washed in the solvent and blown dry with compressed air.

s) Check the valves in their seats using engineers blue. A complete ring of contact must be shown on both faces.

t) If the end of the valve stems are found to have developed indentation (due to constant hitting of rocker arm) the same should be removed by fine grinding the tips and removing sufficient metal so as to give flat & smooth finish. However either valves or the rocker arms which have deep indentations should not be salvaged.

4f. ASSEMBLY :

a) Coat the valve stems with clean engine oil and install them in their original position.

b) Install the valve spring seat and valve seals.

c) Install valve springs and retainer. Using valve spring compressor, compress the spring and fit the new collets.

d) After assembling the valves, ensure that the valve depression below the cylinder head mating face is as per the following specifications :

	DEPRESSION	
	MM	IN
Inlet	0.89 / 0.48	0.035 / 0.019
Exhaust	1.20 / 0.78	0.047 / 0.031

e) Install the injectors and tighten the nuts to the specified torque.

f) Check to see if nozzle protrusion will remain specified limits after rework. Nozzle protrusion of 1.8 to 2.3 mm (0.070" to 0.090") is to be ensured.

4g. INSTALLATION :

a) Apply a light coating of clean engine oil to the cylinder head mating face and install new gasket.

b) Install the guide studs as shown in Fig.15 in the cylinder block to hold the gasket in place and ensure the correct alignment of the cylinder head while installation.

c) Install the cylinder head

Before installation the cylinder head check cylinder sleeve protrusion.

If protrusion is not within specification remove the sleeve and follow the complete procedure.

d) Install the centre rocker arm lever shaft bracket on cylinder head and insert the long bolt.

e) Remove the guide studs then insert the remaining bolts.

f) Tighten the bolts progressively in the order shown in Fig.4 to the specified torque.

NOTE: Be sure there is no oil i.e. the bottom cylinder head bolt holes to prevent hydraulic lock when the bolts are torqued.

g) Remove the long bolt from the centre valve rocker arm shaft bracket and remove the bracket.

h) Install the push rods in their original position.

i) Assemble the valve rocker arm assemblies as detailed. Loosen the lock nuts on each valve lever and back of the adjusting screw.

j) Install the valve rocker arm assembly as detailed.

Replace the longer cap screw through the center bracket and retorque to the correct figure.

k) Install the thermostat housing.

l) Install the thermostat bypass hose.

m) Reassemble the fuel injection pipes.

n) Refit the intake and exhaust manifolds.

o) Adjust the tappet clearance after the cylinder head is tightened to the correct torque for adjustments.

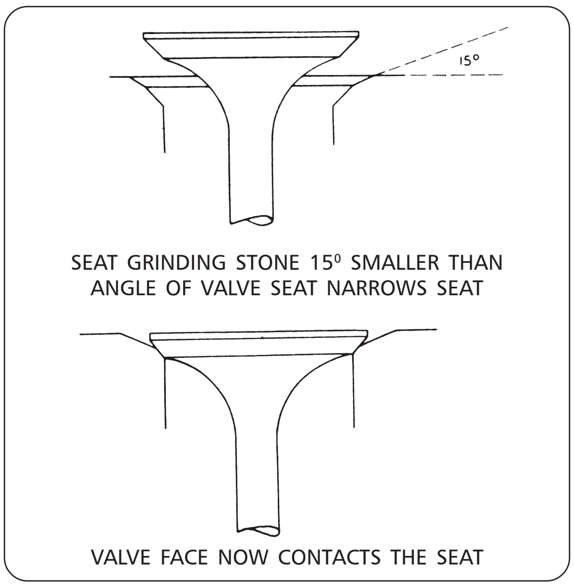


Fig. 14

Replacing the valve seat

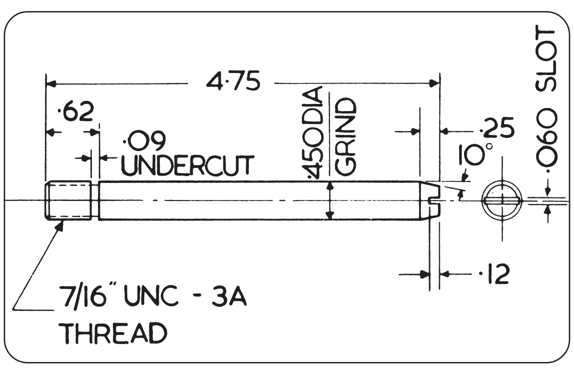


Fig. 15

The Guide Stud

Tips for service of cylinder head

1) During cylinder head overhaul, Nozzle protrusion (protrusion of nozzle tip from head bottom face) should be checked thoroughly as it affects the fuel spray pattern of the nozzle.

2) Excessive carbon deposition on valve neck and valve stem indicates engine oil consumption due to excessive clearance between stem and valve guide.

3) Discard valve springs if they have lost tension or are broken.

4) Always replace valve collects whenever valves are opened for inspection or repairs.

5) Improper valve spring tension, valve lapping, tappet setting, timing or excessive cam lobe wear will cause valve seat damage and subsequent leakage.

6) While replacing piston rings ensure that the valve seats are ground/lapped for perfect seating to avoid oil throw from the exhaust.

7) While regrinding the valve maintain it's concentricity with the guide to ensure proper seating.

8) Never remove the cylinder head in hot condition.

CHAPTER - 3

CONNECTING RODS, PISTONS & CYLINDER SLEEVES

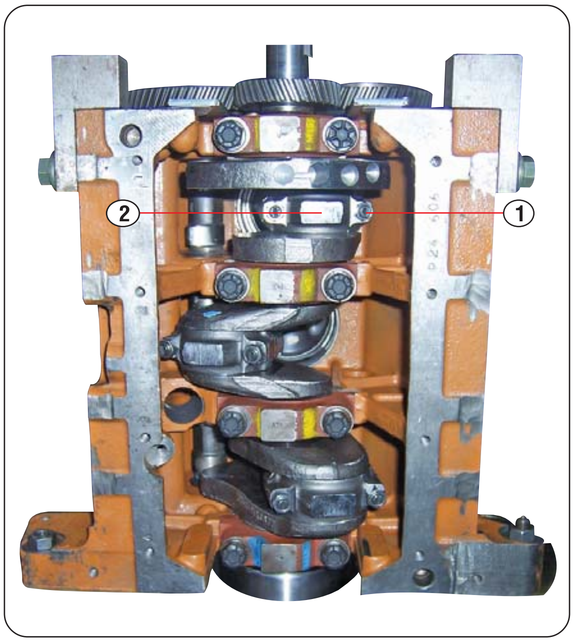


Fig. 1

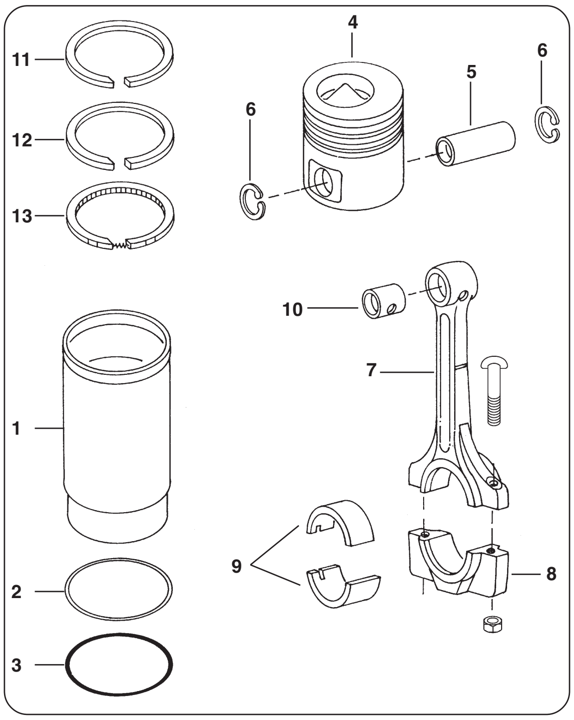


Fig. 2

1. Sleeve
2. 'O' Ring Top-Red
3. 'O' Ring Bottom-Black
4. Piston
5. Pin
6. Circlip
7. Connecting Rod
8. Conn. Rod Cap
9. Conn. Rod Bearing
10. Conn. Rod Small End Bush
11. Compression Ring
12. Compression Ring
13. Oil Ring

1. DESCRIPTION

The I-section connecting rods are forged steel and carry a bronze bush at the small end for installation of the piston pins. The big end is mounted on the crankshaft over steel backed alloy replaceable bearing inserts. The big end bearing caps for each connecting rod are matched fit and the matching parts are numbered to ensure correct assembly.

2. CONNECTING ROD AND PISTON ASSEMBLY

a) REMOVAL :

1) Remove the cylinder head.

2) Remove the carbon ridge at the top of each sleeve.

3) Remove all the bolts securing the oil pan to the crankcase and pull out the oil pan. Remove the gasket from the crankcase and discard it.

4) Remove the bolt securing the oil pump to the crankcase and carefully withdraw the oil pump. Take care not to damage the teeth in the pinion gear.

5) Take off connecting rod bearing caps (2-1) with bearings and lift out pistons with connecting rods, by pushing up and out of the sleeve.

6) Replace inserts (9-2) in bearing caps (8-2) on connecting rods to prevent mixing up.

7) With long-nose pliers remove piston pin retainer springs by squeezing pronged ends, fig. 4.

NOTE: If the cylinder sleeve has been worn so that there is a ridge in the sleeve at the upper end of the piston travel, this must be removed before the piston is withdrawn, to prevent damage to the ring lands and rings during removal of piston.

3. INSPECTION AND REPAIRS :

NOTE:

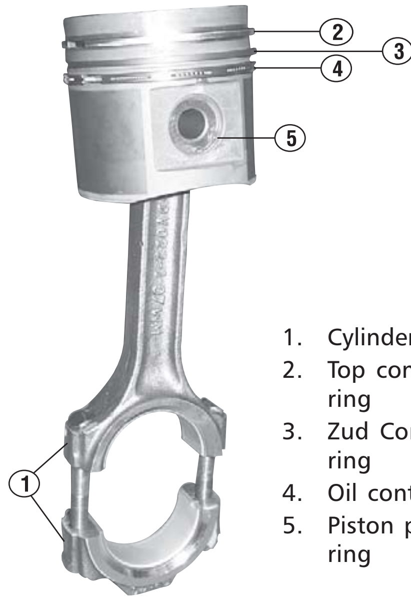
i) Do not hold the piston in a vice.

ii) Always service/change the piston and piston pin as a set.

iii) It is advisable that, whenever the piston and the connecting rod assembly is removed from the sleeve new piston rings be installed while re-assembling.

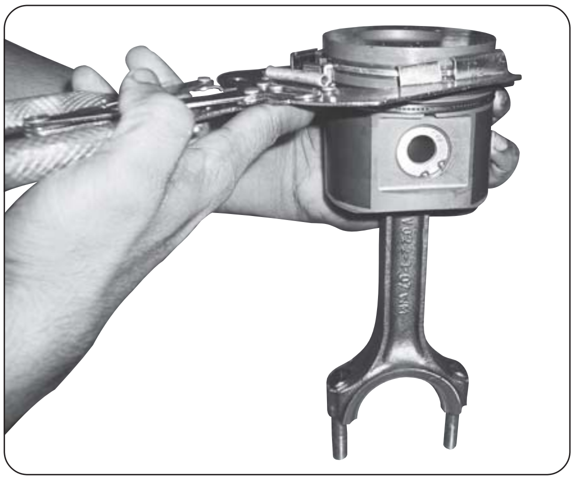
a) Check the piston ring grooves for wear, using new ring and feeler gauges (Fig. 5). See specifications for acceptable clearance.

b) Check the pistons for seizure or/and overheating marks.



1. Cylinder number
2. Top compression ring
3. Zud Compression ring
4. Oil control rings
5. Piston pin snap ring

Fig. 3
Connecting Rod & Piston Assembly



Removing or installing piston rings with ring expander

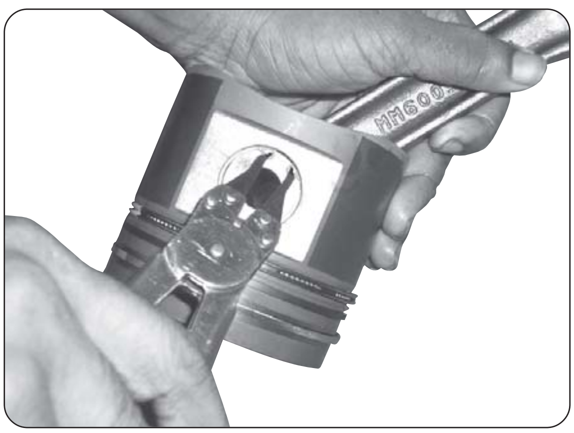


Fig. 4
Removing or installing piston pin circlips

c) Check the connecting rods for alignment (Fig.6). The bores must be square and parallel with each other in all planes within +0.12 (+0.005 inch) (L-6) measured 127 mm (5 inches) each side of the centre line (A-6), if necessary realign by straightening the connecting rod or replace them.

d) Check the threads in the connecting rod big end for wear and damage.

e) Check the wear and condition of the connecting rod bushings. If replacement is necessary proceed as follows :

   1. Press out the old bushing (10-2).

   2. Align the oil hole in the new bushing with the oil hole in the connecting rod and, using a pilot dolly, press the bushing into the rod.

   3. Ream the bushing to the dimension given in specifications and check the fit of the piston pin.

f) Check the piston pin for wear or corrosion.

g) If the piston pin is a slack fit in an otherwise serviceable piston, the piston bore and connecting rod bushing can be reamed to take an oversize piston pin. Refer the specifications for dimensions.

h) Insert piston ring in bore and use a piston without ring to it square in the bore. Check the ring gap (Fig. 7).

i) Repeat operation (h) with each piston ring and reject anywhere the gap exceeds. (0.030 inch).

j) Check new rings in the same manner, as detailed in operation (h) and check the gap to specifications. The ends of the ring may be filled carefully to bring the gap within the limits.

k) Check the clearance between the connecting rod bearings and the crankshaft as follows :-

NOTE: Do not rotate the crankshaft while this check is being made.

   1) Assemble the insert to the connecting rods and caps.

   2) Lay a length of plastigauge across the bearing cap insert.

   3) Install the connecting rod on the crankshaft all the main rod and tighten bolts to the correct torque.

   4) Remove each bearing cap and measure thickness of the plastigauge to determine the bearing clearance.

   Remove the connecting rod from the crankshaft.

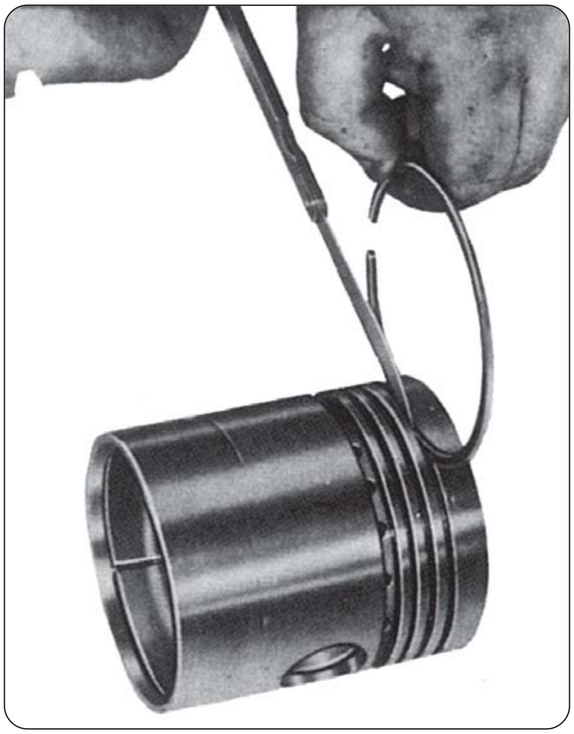
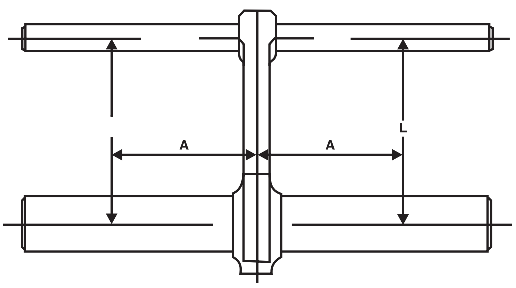


Fig. 5



Connecting Rod Alignment

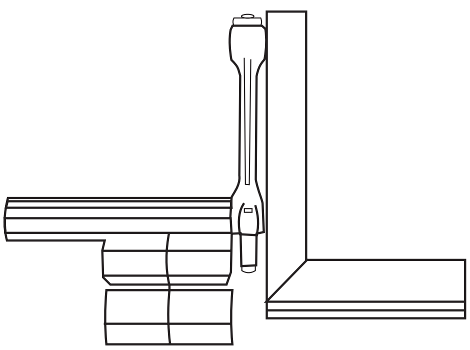


Fig. 6
Checking connecting rods for squareness

4. ASSEMBLY :

a) Push the piston pin into boss of the piston.

b) Position the connecting rod inside the piston and align the bushing with the piston pin.

During the assembly of the piston and the connecting rod, ensure that the combustion cavity in the piston is towards the F. I. Pump side.

c) Before installing sleeve, check that the counterbore at the top and sealing ring groove at the bottom are clean and free from foreign material. All sleeves should enter crankcase bores full depth and should free to rotate by hand. (without sealing ring)

NOTE: The cylinder head gasket forms the upper cylinder sleeve seal, and excessive sleeve standout will result in coolant leakage. To test lower sealing rings for proper installation, fill crankcase water jacket with cold water and check for leaks near bottom of sleeves.

d) Push the piston pin into the other boss and install the circlips on both sides of the piston securely. The piston pin can be pushed with slight hand pressure.

e) Using piston ring expander fit the rings to the piston starting the bottom ring and working up.

NOTE: Multi-piece oil control rings should be fitted to the top oil control groove. The expander (1-8) must be installed first, followed by the two flat rings (2-8) either side of the expander. The gaps in the flat rings must be at 180^0 to each other.

Piston Rings

Check piston ring gap using a feeler gauge.

NOTE: To check piston ring gap the ring must be placed squarely in a new cylinder sleeve (Fig. 7). Replace piston ring as a set only.

Piston Clearance to Cylinder Sleeve

Check the piston clearance in the sleeves using a 0.10 mm (0.004 inch) ribbon gauge 12 mm (0.005 inch) wide with a tension scale Fig.10 in the following manner;

a) Position the ribbon in the cylinder bore so that it extends the entire length of the piston, 90 degrees from the piston pin location.

b) Invert the piston and install it in the bore so that the end of the piston is about 38 mm (1.5 inch) below the top of the cylinder block and the piston pin is parallel to the crankshaft axis.

c) Hold the piston and slowly pull the scale in a straight line with the ribbon, noting the pull required to remove the feeler ribbon. Do not bend or kink the ribbon gauge.

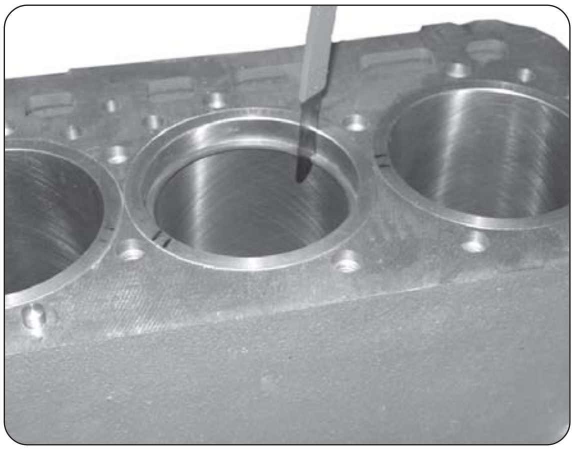


Fig. 7

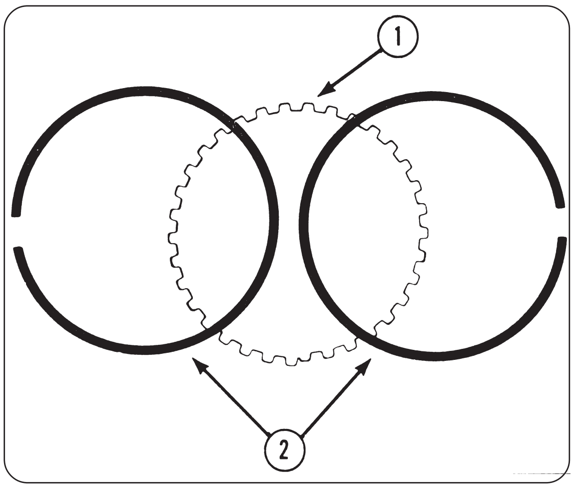


Fig. 8

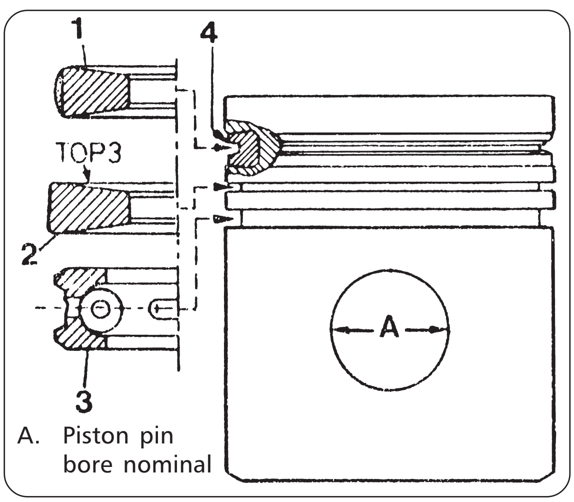


Fig. 9

Agreement of piston rings (Piston with insert 4)

1. 1st compression ring
2. 2nd compression ring
3. Oil control ring
4. Insert

d) Measure and check the clearance with the piston pin at right angles to the crankshaft axis. (Refer to "Specifications")

It should require 2 to 6 lbs. pull to move the ribbon gauge.

5. INSTALLATION :

a) Immerse the piston assembly in clean engine oil and fit a ring compressor over the piston.

b) Place the connecting rod in the correct cylinder and push down steadily on the piston until it is completely in the cylinder.

c) Wipe the crankshaft bearing end of the rod to remove and dirt gathered during installation. Wipe the bearing upper half clean then fit it to the connecting rod. Apply oil to the bearing surface and position the connecting rod on the crankshaft with the number to the F.I. Pump side.

d) Wipe the bearing cap and lower half bearing clean then assemble together. Apply oil to the bearing surface and install the cap on the connecting rod with the number to the F.I. Pump side.

e) Tighten the bolts to the specified torque.

f) Proceed as detailed in ops. (a) to (e) for the remaining piston assemblies.

NOTE: When correctly positioned, the connecting rod cap bearing half will stand out 0.7 mm (0.030 in) above the cap surface and will engage inside the connecting rod half bore. Failure to position correctly will result in the bearing halves being out of line when the bearing cap bolts are torqued.

g) Install the oil pump.

h) Install the cylinder head.

6. DISMANTLING :

Using a piston ring expander, remove the piston rings in the following order. First, remove the top compression ring (Fig 11-2); then remove the second compression ring (Fig 12-2) and finally remove the third oil control ring (Fig. 13-2) and the expander. Remove the two circlips (Fig 6-2) and push out the piston pin (Fig 5-2) out of the pin boss. The pin can be pushed out by applying a slight hand pressure. Identify the piston pin and the piston (Fig 4-2) with a paint mark or a tag. Do not interchange pins and pistons while assembling.

The connecting rod can be removed and installed without having to separate the engine from the clutch.

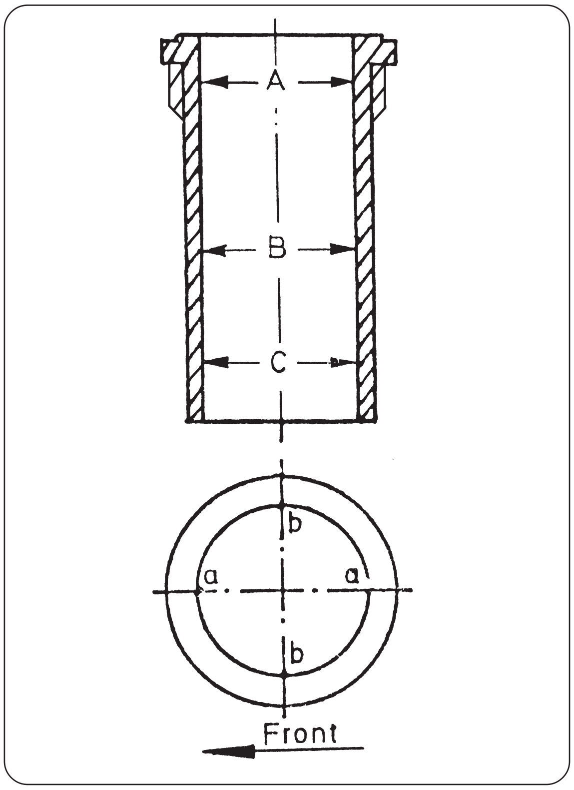


Fig. 10

The weight of con-rod at the crankshaft and piston is balanced and no material should therefore be removed or added as this would disturb the balance.

Connecting rods are classified by different weight groups of which only the medium group is available for service.

Care should be taken when replacing connecting rods, that all connecting rods of the engine are of same weight group, to keep the crank shaft assembly well balanced.

NOTE: Weights refer to complete connecting rods with bushing, bearing cap and bolts but less securing wire and without bearing halves.

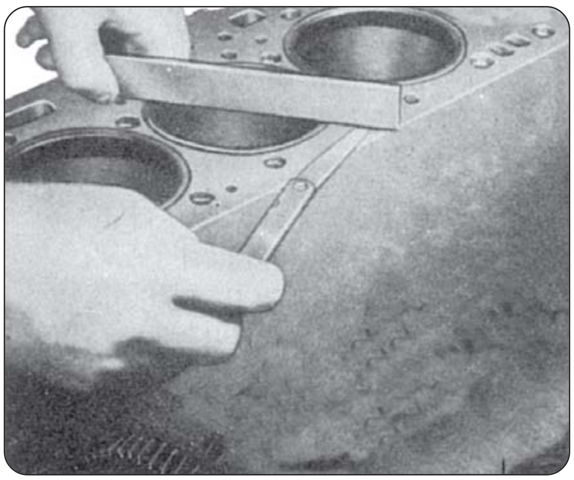


Fig. 11

7. CYLINDER SLEEVES

1. REMOVAL

Check cylinder sleeve wear before removal see fig.10.

NOTE: Removal on the cylinder sleeves need only be carried out if inspection proves this necessary.

a) Remove the piston assemblies as detailed in para 2a.

b) Using a suitable sleeve puller withdraw the cylinder sleeves (fig. 13).

c) Remove the sealing ring from the groove in the crankcase bore. And discard it.

2. INSPECTION AND REPAIR (See fig.10)

a) With the sleeves in the crankcase measure the bores at the top (A) and the bottom (B&C) at 90^0 to the crankshaft to determine the amount of taper.

b) Compare the readings from op. (a) with those from op. (b) to determine the amount of ovality as per specification.

The cylinder sleeves should be renewed when out of round exceeds 0.20mm and taper exceeds 0.13mm. The old cylinder sleeve should be removed with the help of special service tool

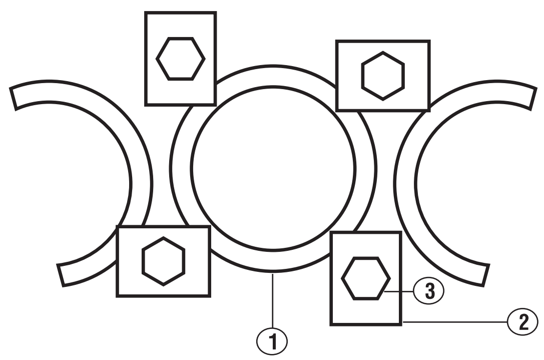


Fig. 12

1. Sleeve 2. Holding plate 3. Bolt

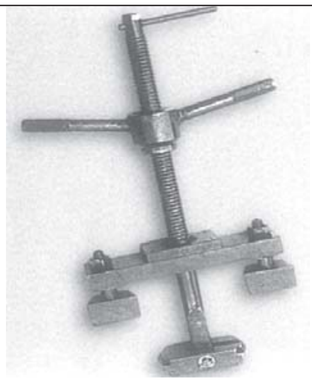


Fig. 13

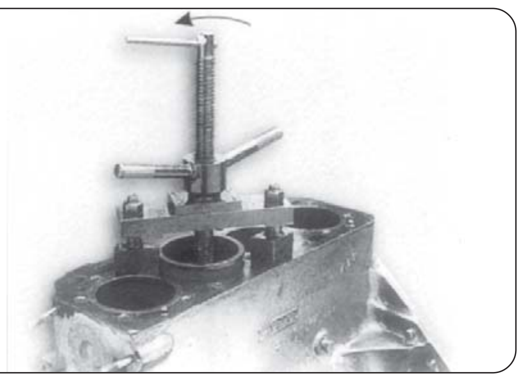


Fig. 14
Image is representative

MST-H1-EN-1 (fig.13) as follows :

- Insert the sleeve puller from the top of the crankcase (fig.14).
- Fix the thrust plate sides at lower portion of cylinder sleeve. The bigger side of thrust plate is suitable for DI Engine.
- Position the bracket on top of the crankcase and tighten the nut over the bracket of puller bar, by rotating handle, the sleeve will be pulled out while tightening the nut.

c) Before installing sleeve, check the counter bore at top and sealing ring groove at the bottom are clean and free from foreign material. All sleeves should enter crankcase bores full depth and should free to rotate by hand (without sealing ring).

NOTE: The cylinder head gasket forms the upper cylinder sleeve seal, and excessive sleeve stand out will result in coolant leakage. To test lower sealing rings for proper installation, fill crank case water jacket with cold water and check for leaks near bottom of sleeves.

d) Check the sleeves for scoring or signs of corrosion.

3. INSTALLATION

a) Dip each cylinder sleeve packing ring in a soap solution and install it in the groove in the crankcase bore.

b) Coat bottom of each sleeve with soap solution and press the sleeve into the crankcase bore.

NOTE: Weights refer to complete connecting rods with bushing, bearing cap and bolts but less securing wire and without bearing halves.

c) Check from below to ensure that the packing rings have not been sheared or pushed out of position.

d) Check the cylinder sleeve protrusion (Fig.11) to specifications. The top face of the sleeve can be 0.05 mm above the cylinder block face or 0.03 mm below the cylinder block face. To ensure the above dimension, the cylinder sleeve and the cylinder block should be matched.

NOTE: Check cylinder sleeve protrusion according to checking sleeve protrusion procedure given below :

e) Install the piston assemblies.

1. Place the sleeve in the crankcase with out 'O' Ring.
2. Clamp the sleeve down using four holding adapters/plate shown in fig.12 place sleeve holding plate locally.

Space the bolts to obtain uniform pressure on the sleeve flange as shown in figure. Torque the bolts equally in three stage as specified torque.

3. Place a dial indicator with block, across the cylinder sleeve.

4. With dial indicator pointer set on the flange of the cylinder sleeve. Adjust the indicator to zero.

   Move the indicator block until the pointer drops to the crankcase deck and check the reading.

5. Take a reading three or four points around the sleeve and use the average reading normally the top of sleeve will extend 0.076mm - 0.18mm above the cylinder block surface.

6. Mark each sleeve before removing so that it can be reinstalled in the same bore and in the same position.

CHAPTER - 4

LUBRICATION SYSTEMS

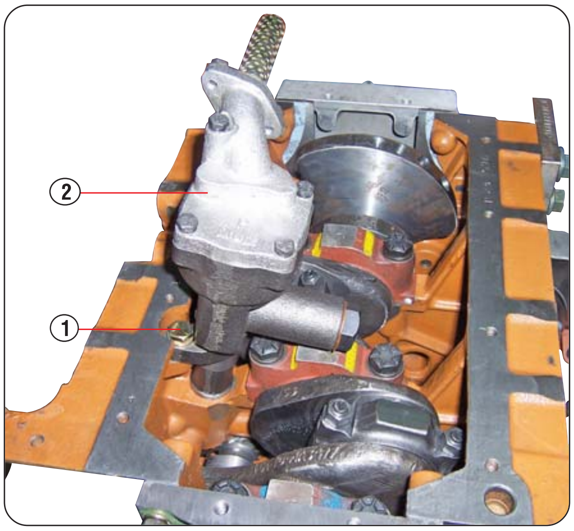


Fig. 1

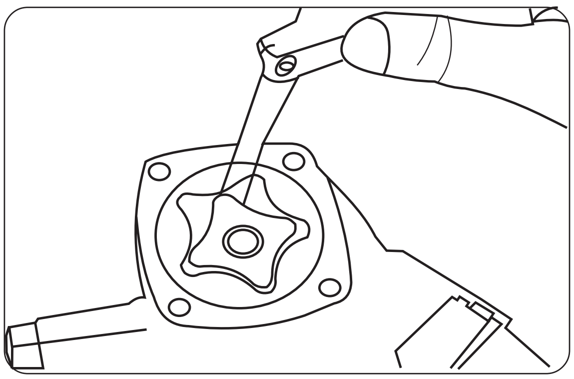


Fig. 2
Checking clearance between rotors

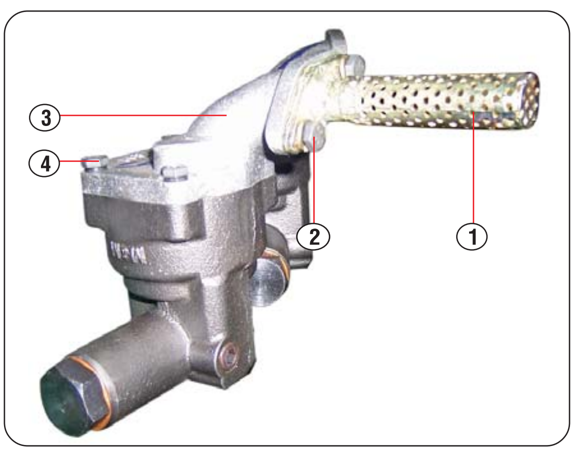


Fig. 3

A. DESCRIPTION

Lubricating pump is a four lobe internal gear pump. The pump is driven by a gear on the camshaft. The pump has a build-in relief valve to limit maximum pressure.

B. OIL PUMP

1. REMOVAL

a) Remove the oil pan drain plug and drain the oil while the engine is warm.

b) Install the drain plug then remove the bolts securing the oil pan to the crankcase and, remove the oil pan and adapter plate.

c) Remove the bolt (1-1) securing the oil pump (2-1) to the crankcase and withdraw the oil pump.

2. LOBE TYPE

a) Remove the two bolts (2-3) which secure the oil pump screen (1-3) to the pump body cover (3-3) and remove the screen.

b) Drive out roll pin (3-4) then remove the coupling (2-4) and pinion (4-4) from the shaft.

c) Remove bolts (4-3) which secure the cover to the body.

d) Remove cover (12-4).

(e) Remove the shaft assy. (7-4) from the pump body (5-4).

(f) Remove Retainer plug (19-4) then lift out regulating spring (17-4) and relief valve (16-4) and gasket (18-4).

3. INSPECTION & REPAIR

Check the oil pressure regulating valve spring. Check the oil pressure regulating valve and seat for wear, pitting, or corrosion. Check the drive shaft to pump body clearance. Check the drive spin-on for wear or damage. Check the clearance between the lobes of the rotor (Refer Fig.2). It should not be more than 0.25 mm. Check the clearance on the end of the rotors. Check the clearance between outer rotor and rotor pocket (Refer Fig.2). The clearance should not be more than 0.3 mm. Always service/replace the inner and outer rotors as an assembly.

4. INSPECTION AND REPAIR

a) Check the oil pressure regulating valve spring (17-4) against the loads given in specifications.

b) Check the oil pressure regulating valve (16-4) and seat for wear pitting or corrosion.

Fig. 4

c) Check the drive shaft to pump body clearance to specifications.

d) Check the drive pinion for wear or damage.

e) Check the gears for wear, damage or pitting. Burrs can be removed from the gears using a fine carborundum stone. The oil pump plate can if necessary be ground flat using surface and carborundum paste.

f) Check the backlash between the gears to specifications.

g) Check the clearance between the gears and end plate as follows :

   1. Install the gear case on the pump body using a new gasket.

   2. Install the gears, then place a length of plastigauge across the top of each gear.

   3. Install the end cover using a new gasket and tighten the bolts to the specified torque.

   4. Remove the cover and measure the thickness of the plastigauge. This must not exceed the dimension given in specifications.

h) All sealing rings and gaskets must discarded. If the clearance is excessive check the end plate using a straight edge and feeler gauges. If necessary, the end plate can be ground flat using a sheet of crocus paper on a surface plate. Assemble the end plate and re-check the clearance.

i) If no clearance exists, insert one additional gasket and re-check the clearance.

j) Check the clearance between the oil pump drive pinion and the body after the pump is assembled (Fig. 4).

6. ASSEMBLY : LOBE TYPE PUMP

Install the rotor shaft assembly in the oil pump body. Fit the key in to the shaft and press in the drive gear with that in the shaft. Drive in a new roll pin. Install the outer rotor. Install the pump end over and tighten the bolts to the correct torque. Assemble the screen to the pump and tighten the bolts to the correct torque. Assemble the relief valve inside the pump body and install the spring. Tighten the retaining bolt using a new washer.

Engine Oil Filter

7. INSTALLATION

a) Install the oil pump in the crankcase then tighten the bolt to the correct torque.

b) Use liquid gasket (loctite 584) and Adapter plate. Install the crankcase oil pan, tightening the bolts to the correct torque.

c) Fill the crankcase with the correct grade of lubricating oil to the oil level mark on the dipstick.

8. LUBRICATING OIL FILTERS

1. REMOVAL

a) Unscrew the spin-on oil filter from filter head and install new filter.

NOTE: Engine Oil and filter element must be changed after every 200 hours of engine operation.

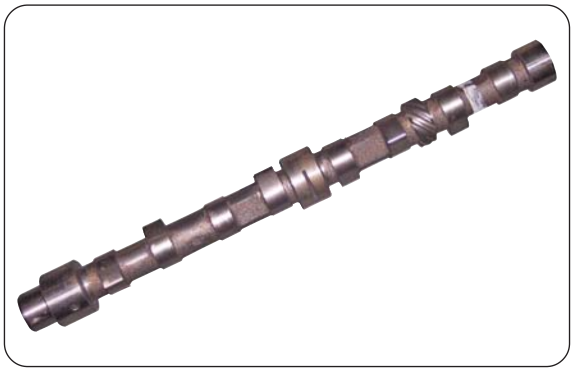
b) **Service Schedule :**

For new tractor and overhauled engine first service - Oil filter replacement after 200 hrs.

It is highly detrimental to engine reliability, if cartridge is reused by reflushing with cleaning solvent. Dispose off immediately.

CHAPTER - 5

TIMING GEAR TRAIN, FRONT COVER & CAMSHAFT



Camshaft

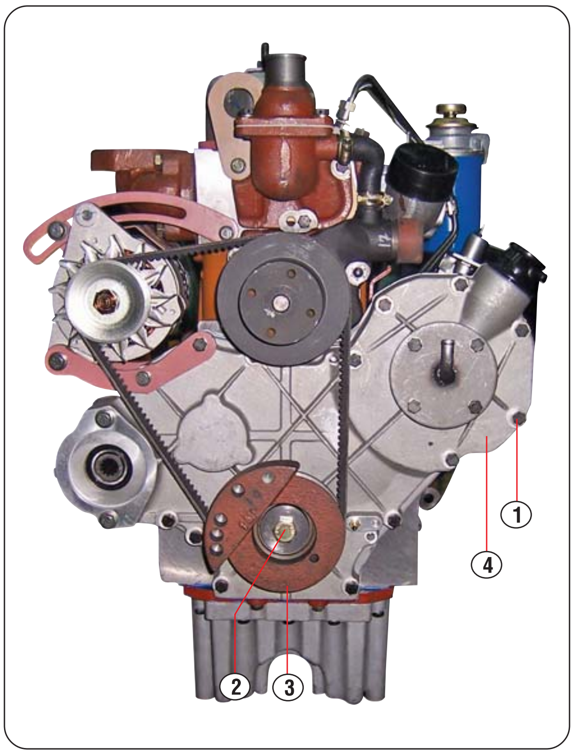


Fig. 1

A. DESCRIPTION

1. GEAR TRAIN

The timing gear train consists of four gears. The Crankshaft pinion, the camshaft gear, the idler gear and the injection pump gear. These gears are mounted on the front plate face of the engine and are covered with the aluminium casting crankcase front cover. Each gear is punch marked for timing purpose.

2. CAMSHAFT

The special cast iron/forged camshaft runs in babbit lined bushes in the right hand side of the crankcase. The camshaft bushes are replaceable and are supplied for service in a semi-finished bored condition and must be line reamed to size after filling. A gear integral with the camshaft provides the drive for the oil pump.

The camshaft is driven from the front end of the crankshaft through a train of gears. All gears are punch marked to ensure correct timing. End float is controlled by thrust washer plate (4-3). The drive gear is key shrunk to the camshaft end.

B. FRONT COVER

1. Removal

a) Remove the fan belt and fan as detailed in cooling system.

b) Remove the bolt (2-1).

c) Remove front side hydraulic pump mounting bolts pull hydraulic pump out somewhat and move slightly towards the outside.

d) Pull the fan driver pulley (3-1) off the crankshaft and remove the key.

e) Remove alternator and alternator bracket.

f) Remove the bolts from the front cover bottom and adapter plate.

g) Remove the bolts (1-1) securing the front cover (4-1) then remove the cover and gasket.

NOTE: Check the backlash between the gears to specifications if necessary.

2. DISMANTLING

Press out the oil seal if inspection proves it necessary.

3. ASSEMBLY

Press in a new oil seal with the lip facing inward until it is flush with the outside face of the front cover.

4. INSTALLATION

Reverse the removal procedure.

C. TIMING GEARS

1. REMOVAL

a) Timing Gear Cover

To remove the timing gear cover, first remove the front support, axle and radiator assembly as follows : Drain cooling system, raise hood and disconnect headlight and horn wires at junction on front support, then unclip loom from radiator. Remove hood pivot bolts and remove hood. Do not lose the pivot bolt spacers. Disconnect radiator brace. Disconnect upper and lower hoses from radiator. Disconnect the drag link. If tractor is equipped with hydrostatic steering, disconnect the steering cylinder hoses, then cap and plug all openings to prevent dirt from entering system.

Then, on all tractors, place wood blocks between steering gear housing and axle to prevent tipping. Using a suitable jack, support tractor under clutch housing. Unbolt stay rod bracket from clutch housing and steering gear housing from front of engine. Raise engine until crankshaft pulley will clear front axle support. Then roll out from axle support with front axle and tires.

b) Remove the front cover.

c) Remove the nut (1-2) then remove the injection pump gear (2-2).

d) Remove the idler gear shaft bolt (3-2) then remove the idler gear (4-2) and shaft.

e) Using a suitable puller remove the crankshaft pinion and key.

f) Remove the camshaft gear (6-2).

2. INSPECTION AND REPAIR

a) Inspect the gears for wear and cracked or chipped teeth. Remove any burrs on the gears with a fine carborundum stone.

b) Inspect the fan drive pulley for wear or cracking.

c) Check the fit of the idler gear and shaft to specifications.

d) Check the condition of the idler gear shaft bolt thread insert in the front of the crankcase. If inspection proves if necessary remove the thread insert and fit a new one.

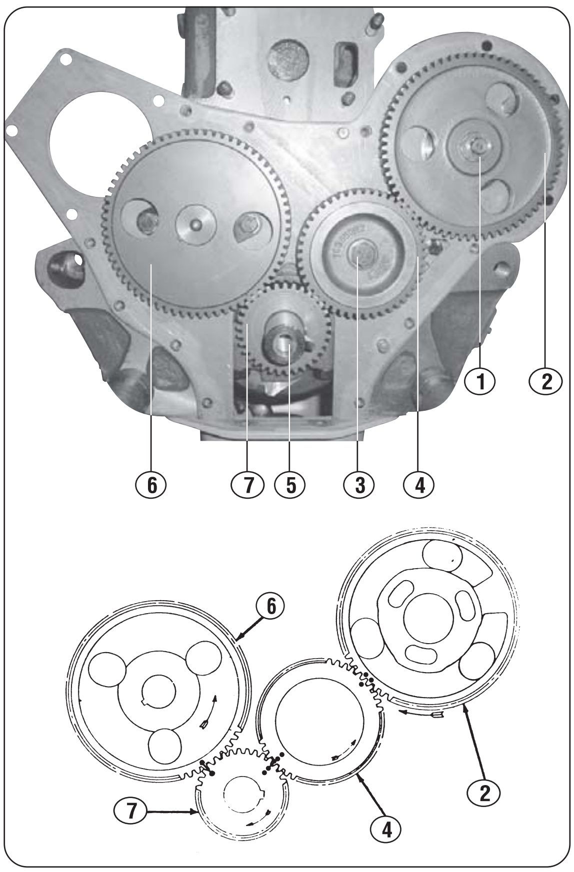


Fig. 2
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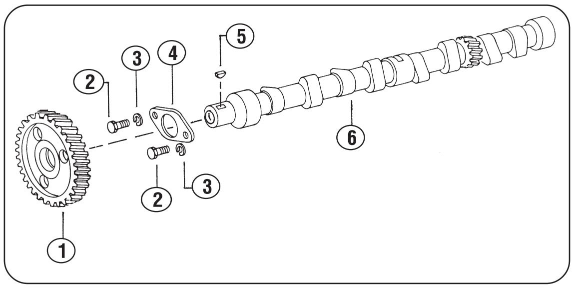


Fig. 3

1. Gear
2. Screw
3. Washer
4. Plate
5. Key
6. Camshaft

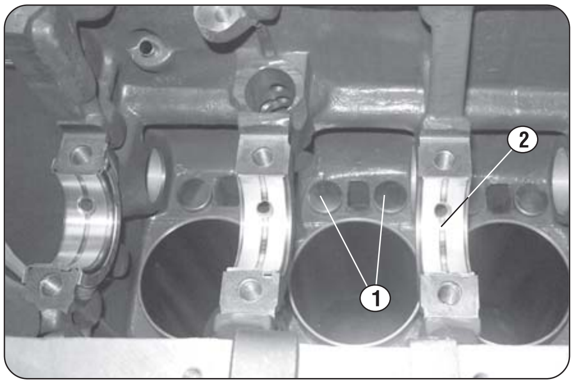


Fig. 4

3. INSTALLATION

a) Fit a new key to the crankshaft then press the crankshaft pinion on to the crankshaft.

b) Assembly the idler gear and shaft, install it on the crankcase ensuring that the double marks on the idler gear line up with the double marks on the crankshaft pinion. Tighten the bolt to the specified torque.

c) Install the camshaft and camshaft gear.

d) Install the injection pump gear ensuring that the double marking on the injection pump gear is in register with the single marking on the idler gear, install the three bolts and tighten to the correct torque.

D. CAMSHAFT

1. REMOVAL

NOTE 1: Before camshaft removal check

a. Backlash of camshaft drive gear

b. Camshaft end float

c. Cam lobe lift

NOTE 2: Cam lobe lift may be checked by means of a dial indicator gauge.

Rest the stylus of the dial indicator on one of the push rods.

Rotate the engine one revolution and note dial indicator reading. Compare reading with "specifications".

a) Remove the valve rocker arm shaft assembly.

b) Lift out the valve push rods and identify them so they can be installed in their original positions.

c) Remove the crankcase front cover.

d) Remove the oil pump.

e) Invert the engine then turn the camshaft until the cored holes in the gear line up with the bolts (7-2) securing the camshaft thrust plate then remove the bolts and lockwashers.

f) Withdraw the camshaft with gear from the crankcase.

g) Remove the valve tappets (1-4) and identify them so they can be installed in their original positions.

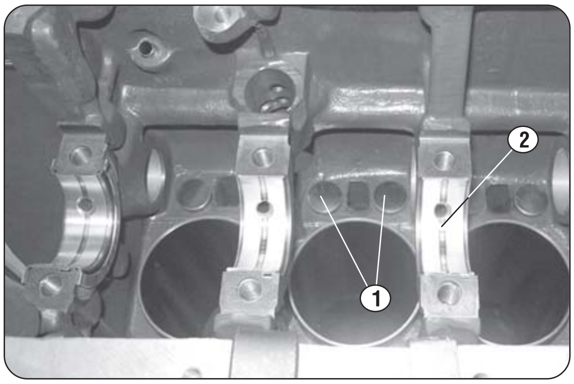


Fig. 4

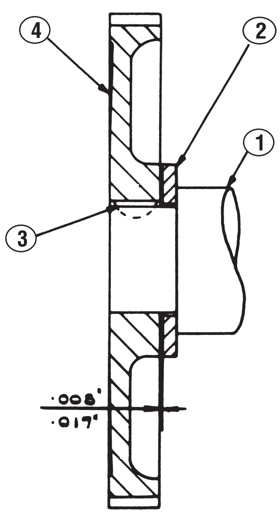


Fig. 5

2. DISMANTLING

a) Press the camshaft out of the gear then remove the key and thrust plate from the camshaft.

3. INSPECTION AND REPAIR

a) Inspect the cam lobes and camshaft journals for wear to specifications.

b) Inspect the oil pump drive gear, if excessive wear is found, the camshaft must be replaced.

c) Place the camshaft between centres and with a dial indicator against the centre journal check that the run-out does not exceed 0.002 inch.

d) Check the camshaft gear and thrust plate for wear which will produce excessive end clearance.

e) Check the camshaft running clearance against the dimensions given in specifications. If inspection proves it necessary, remove the camshaft bearing .

f) Inspect the valve tappets for wear to specifications.

4. ASSEMBLY

a) Install the thrust plate on the camshaft.

b) Fit a new key to the camshaft then press on the camshaft gear to leave a clearance of 0.008"-0.017" between the gear hub rear face and the thrust plate. Ensure that the thrust plate is located against its abutment shoulder when checking this clearance (Fig.5)

5. INSTALLATION

a) Install the valve tappets in their original positions.

b) Coat the camshaft and camshaft bearings with clean engine oil.

c) Install the camshaft in the crankcase taking care not to damage the bearings and engage the camshaft gear with the crankshaft pinion ensuring that the single timing marks are in register.

d) Secure the thrust plate to the crankcase with the bolts and lockwashers and tighten the bolts to the specified torque.

e) Invert the engine and install the oil pump.

f) Install the front cover.

g) Install the valve push rods in their original positions.

h) Install the valve rocker arm shaft assembly.

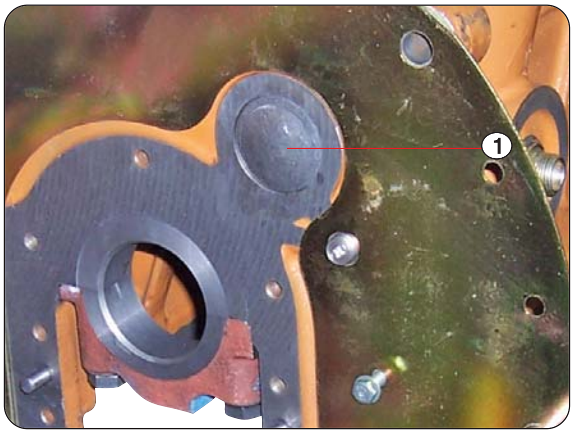


Fig. 6

E. CAMSHAFT BEARING

1. REMOVAL

a) Remove the camshaft.

b) Remove the flywheel.

c) Remove backplate by loosening its bolts.

d) Use a long bar from the front of the crankcase and drive out the expansion plug (1-6).

e) Remove the camshaft bearings (2-4) from the crankcase.

2. INSTALLATION

a) Press the centre bearing into position aligning the hole in the bearing with the hole in the crankcase.

b) Press the front and rear bearings into position ensuring that the edge marked "FRONT" is to the front of the crankcase and that the holes in the bearings line up with those in the crankcase.

c) Line bore the bearings to the dimensions in specifications.

d) After reaming, blow out the crankcase and oil ways to remove all foreign material.

Note: Ensure that the rear bearings is pressed in flush with the front of the bore in the crankcase.

Note: Bearings supplied for service are supplied semi-finished and must be line reamed to specified dimension after assembly.

a) After reaming thoroughly blowout the casting and oil ways to ensure that there is no metal deposit left.

b) Examine the tappet for signs of wear.

c) Do not attempt to straighten or repair the camshaft. If any parts are suspect they must be replaced.

Note: When the engine is in the upright position the tappet must be inserted one at a time as the camshaft is installed into the engine because the tappets are held in position by the camshaft. Possible the engine should be supported in an inverted position.

a) Place tappet in position.

e) Install the rear bearing expansion plug (1-6) expansion plug using a good quality sealer on the plug and seat.

f) Install the flywheel.

g) Install the camshaft in the crankcase taking care not to damage the bearings. Engage the camshaft gear with the crankshaft pinion to ensure that single timing marks are in line with each other. Secure the thrust plate to the crankcase with bolts and lock washers and tighten to the same specified torque.

CHAPTER - 6

CRANKCASE, CRANKSHAFT, MAIN BEARINGS & FLYWHEEL

A. DESCRIPTION :

The engine block is the main body of the engine, around which the engine is built. It is a one piece casting and webs integral with it form the upper halves of the main bearing supports. The lower half bearing supports are in the form of caps machined to mate with the webs in the crankcase. On the upper face of the crankcase are replaceable heli-coil thread inserts for the cylinder head capscrews. These inserts are manufactured from stainless steel which will not rust or corrode. Through accuracy in manufacture, frictional loss between the capscrew thread and the insert is reduced, resulting in an increased clamping pressure on the cylinder head gasket for a given torque on the bolts.

The crankshaft is supported in 5 main bearings for 4 cylinder engine with end thrust on the rear and for 3 cylinder engine it is supported in 4 main bearings. The bearings are of the steel backed insert type and do not require fitting on assembly. The bearing caps, which hold the lower bearing inserts in position, are not interchangeable and each one is stamped with its location in the crankcase No.1 is at the front. The caps are secured to the crankcase by capscrews and lockwires in early models and by "Place" bolts, which do not require any locking mechanisms, in later models.

During manufacture main bearing caps are rough machined, then assembled to the crankcase prior to being line reamed. This results in each bearing cap being fitted for only one position, therefore, finished bearing caps cannot be supplied individually for service due to the necessity for line reaming to fit the particular bore where it is intended to mate.

The crankshaft supports the connecting rods and pistons along its length and converts the reciprocating movement of the pistons into the rotary movement required to drive the transmission. At the front end of the crankshaft is the gear which drives the timing gear train and the pulley which drives the fan and water pump. The flywheel is mounted on the rear of the crankshaft and to this is mounted the clutch which forms the link between the engine and transmission. The purpose of the flywheel is to oppose and moderate, by its inertia, any fluctuation in the speed of the engine. It counteracts varying torques during the stroke of the engine and provides a rotating balance weight which carries the crankshaft over dead centres. The flywheel is secured to the crankshaft by six capscrews with locking plates. Dowels are provided in the crankshaft flange for accurate location. The starting ring gear is a shrink fit on the flywheel and is replaceable.

CAUTION : Extreme care must be taken to assure perfect cleanliness of the crankcase, crankshaft and bearings after service has been completed.

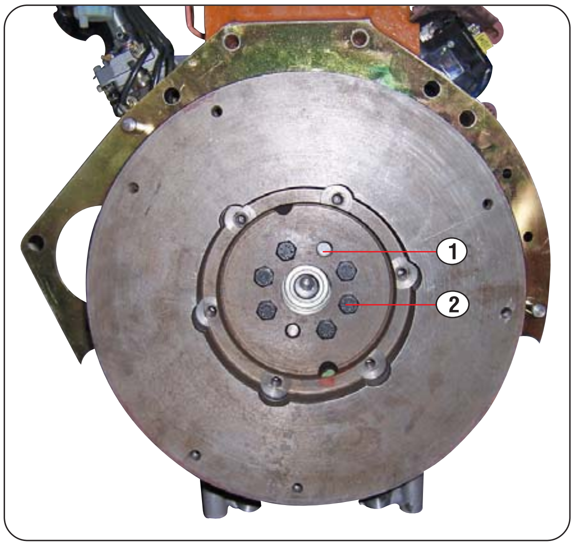


Fig. 3

Whenever possible, the crankshaft should be removed when new bearings are being installed in order to clean the crankcase thoroughly. All bearing surface must be free of grit and burrs.

B. FLYWHEEL

1. Removal

a) Removal of the flywheel required removal of the Engine.

b) Remove the clutch assy.

c) Remove the six bolts (2-3).

d) Using a suitable sling to support it lever the flywheel off the dowels.

2. Inspection and Repair

a) Inspect the flywheel ring gear for excessive wear, chipped and broken teeth.

b) If inspection proves it necessary replace the flywheel ring gear as follows :

CAUTION :

1. Be sure the flywheel is exactly centered when rotating it. The friction surface must be parallel with the dial face, deviation of more than 0.05 mm (0.002 in) are not permissible.

CAUTION :

2. If ring gear has worked loose on the flywheel, do not attempt by welding remove the loose gear and replace with a new one or replace flywheel with ring gear.

    1. Remove the ring gear by heating with a torch or splitting with a chisel and driving off.

    2. Heat a new ring gear to 400-550^{0}F and install it ensuring that it is hard against the shoulder on the flywheel. The ring gear must be installed with the lead on the teeth towards the crankcase on diesel engines (1-1). Permissible out of true of ring gear = 0.3 mm (0.012 in).

c) Inspect the clutch friction surface for ridges, scores, grooves, cracks and burn spots.

d) Using a straight edge and feeler gauges check the friction face for hollows or high spots. The friction face must be flat and true within 0.006 inch. If necessary, the friction face should be ground to this condition. If suitable grinding equipment is not available the flywheel can be mounted in a lathe and the friction face dressed with emery cloth. If the surface is very rough take a fine cut with a lather tool before dressing the friction face with emery cloth.

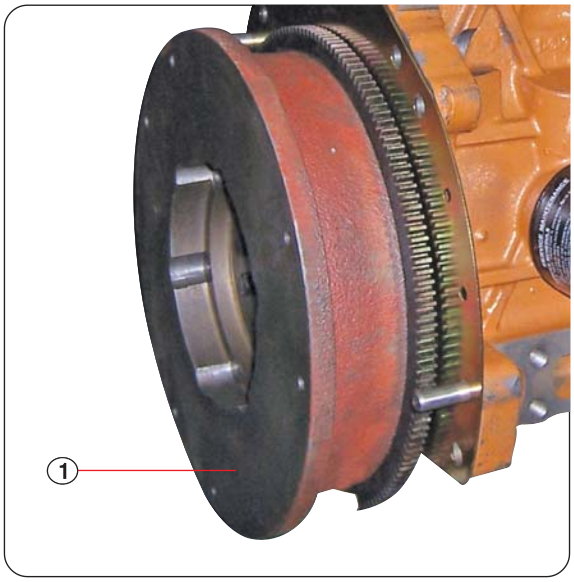


Fig. 2

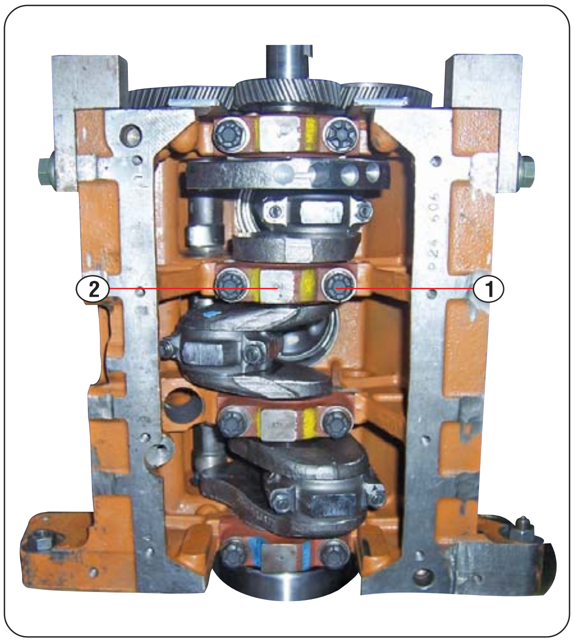


Fig. 4

3. INSTALLATION

a) Install the flywheel on the crankshaft lining up the dowel holes.

b) Install the bolts and tab washers then tighten the bolts to the specified torque.

c) Mount a dial indicator on the crankcase and check that friction face run-out does not exceed 0.001 inch per 1-1/2 inches of radius. If run-out exceeds this figure remove the flywheel and check the mounting faces on the flywheel and check the mounting faces on the flywheel and crankshaft for burrs or foreign matter.

d) If run-out is within the figure in op. (c) bend up the tabs to secure the bolts. On current engine the locktabs are deleted.

C. CRANKSHAFT BEARINGS AND CRANKSHAFT

1. REMOVAL

a) Crankshaft removal required removal of engine from tractor.

b) Remove the clutch, flywheel.

c) Remove the timing cover.

d) Invert the engine.

e) Remove oil pan and adapter plate.

f) Remove the rear oil seal retainer by removing 7 cap screws (2-1).

g) Remove the bearing cap bolts (1-4).

Then remove the bearing caps (2-4) and bearing inserts and identify them if them if they are to be re-used.

h) Lift the crankshaft from cylinder block and remove the bearing inserts.

2. INSPECTION AND REPAIR

a) Clean all parts in a suitable solvent and dry with compressed air.

b) Discard the front and rear oil seals. Discard all gaskets and remove any gasket material remaining on mating faces.

c) Check in the crankcase for sludge deposits. These should be removed and the crankcase thoroughly cleaned.

d) Use liquid gasket (loctite 584) on crankcase, adapter and oil pan joints.

3. THE BEARINGS AND CRANKCASE

1. Inspect the bearings for wear and evidence of uneven bearing support. If such evidence is present, examine the bearing caps and supporting surfaces of the crankcase for high spots and burrs.

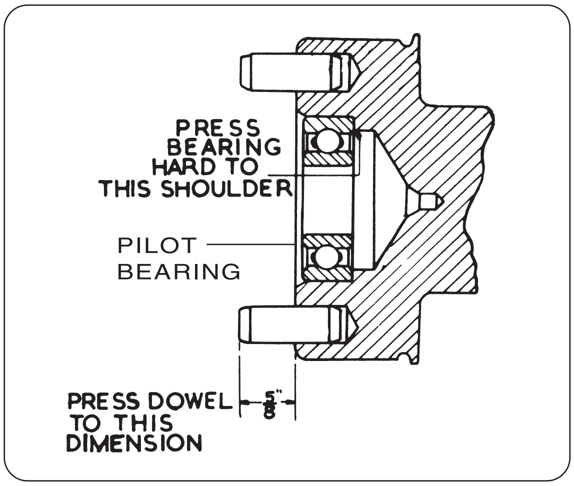


Fig. 5

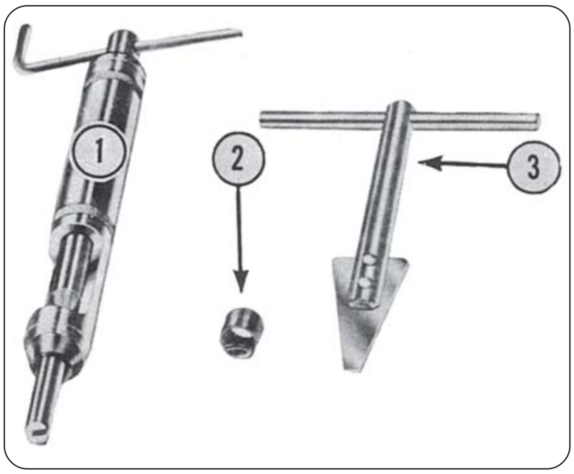


Fig. 6

2. Inspect the crankcase for trueness, using the crankshaft as follows :

   a) Wipe the bearing supports of the crankcase free of oil with a lint free cloth. The crankcase should be bottom side up and levelly supported.

   b) Install the upper halves of the bearings to the crankcase. If the original bearings are being reinstalled, ensure that they are fitted to the positions from which they were removed. The location nibs of the bearings must fit into the notches in the main bearings supports.

   c) Smear blueing on the crankshaft main journals and lower it carefully and evenly on to the bearings. Do not install the bearing caps and lower bearings.

   d) Rotate the crankshaft back and forth through approximately 180^0, remove the crankshaft evenly and inspect the upper bearing for an even transfer of blueing from the journals to the bearings.

      1) Any bearings that do not show all over even blueing should be replaced by new. It is advisable to replace all bearings by new ones if an original one is faulty.

      2) Clean the blueing off the crankshaft and bearings.

      3) Checking main bearing running clearance.

      4) Install the upper bearing halves.

      5) Place the crankshaft in position.

      6) Lay a length of plastigauge along the crankshaft journals.

      7) Fit the bearing lower halves to the bearing caps and assemble the caps to the crankcase.

   e) Fit the capscrews and tighten to the torque detailed in SPECIFICATIONS. Do not rotate the crankshaft.

   f) Remove the bearing caps and measure the thickness to which the plastigauge has been crushed. This thickness should be as detailed in SPECIFICATIONS.

   g) If the clearance is excessive, it may be necessary to grind the crankshaft and install undersize bearings. These bearings are available in sets of +0.030” and +0.015”. See para. 3c for details of re-grinding crankshaft.

4. Check the crankshaft end float

a) Assemble the crankshaft with the main bearings in position.

b) Lever the crankshaft towards the front of the engine so that the thrust face is tight against the rear thrust flange of the rear main bearing.

NOTE: Bearing cap bolts should be slackened off slightly to facilitate this operation.

If the clearance is excessive the rear main bearings must be replaced.

D. THE CRANKSHAFT

1. Examine the journals for excessive scoring.

2. Measure the diameter of each journal at various points to check any out of round tendencies. If the journals are excessively worn it will be necessary to re-grind the crankshaft and fit undersize bearings. Limits for undersize grinding are given in fig. 7.

NOTE: Maximum allowable taper on crank pins and journals is 0.00015” per inch of length. Crank pins and journals must be polished and must not be more than 0.00015” out of round. Run-out on centre main bearing journals must not exceed 0.0008”, total indicator reading with the shaft mounted on V blocks at the front and rear journals.

3. Examine the clutch shaft pilot bearing for excessive wear or corrosion. If necessary pull the bearing from the crankshaft and replace with new.

4. Examine the flywheel dowels for wear and looseness of fit. If necessary press in new dowels to the dimensions shown in fig.5.

5. Ensure that the oil ways in the crankshaft are clear.

1. REMOVAL

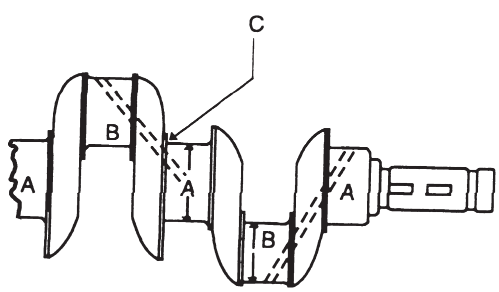
a) Place the special tool (3-6) into the insert and turn in an anti-clockwise direction. Never reuse an insert which has been removed.

2. INSTALLATION

a) Fit a new insert (2-6) into the driver (1-6) with the driving lug to the bottom.

b) Screw the insert into the tool guide until it is flush with the end of the tool.

c) Place the inserting tool over the tapped hole in the crankcase and turn the handle in a clockwise direction until the insert leaves the tool. Care must be taken not to drive the insert in too deeply (refer to SPECIFICATIONS).



DIM	STANDARD	0.010” U/S	0.015” U/S	0.020” U/S	0.030” U/S
1.	2.1247	2.1147	2.1097	2.1047	2.0947
	2.1257	2.1157	2.1107	2.1057	2.0947
2.	1.7502	1.7402	1.7352	1.7301	1.7202
	1.7507	1.7407	1.7357	1.7307	1.7207
3.	1.314	1.319	1.3215	1.324	1.3200
	1.316	1.321	1.3235	1.326	1.3310
4.	2.420	2.422	2.4240	2.420	2.4200
	2.432	2.436	2.4360	2.438	2.4390
5.	0.125	0.125	0.125	0.125	0.125
	0.135	0.135	0.135	0.135	0.135
6.	MUST BE CONCENTRIC WITHIN 0.004” T.I.R.				
7.	These holes must be clean and free of chips and burrs after grinding. Remove sharp edges.				
8.	1.313	1.316	1.321	1.323	1.328
	1.317	1.322	1.325	1.327	1.332

Permissible width of all Main Journal and Crank Pins except at No. 5 Journal ‘C’ listed above.

Fig. 7

Undersize Limits for Crankshaft Regrinding

3. INSTALLATION

a) THE MAIN BEARINGS AND CRANKSHAFT

1. Wipe clean the upper bearing half supports in the crankcase, wipe the bearing faces with oil and install the upper bearing halves with the locating nibs in position.

2. Wipe the crank pins and journals clean and lay the crankshaft in position.

3. Coat the lower bearing halves and caps in oil and assemble the bearings to the caps.

4. Install the bearing caps and bearings in their correct positions and secure with the capscrews. Tighten the capscrews to the torque detailed in SPECIFICATIONS and install the lockwires if the capscrew heads are drilled.

NOTE: If it is necessary to replace one of the bearing cap capscrews with a "Place" bolt, both must be replaced as the heads of "Place" bolts are not drilled.

5. Pull the connecting rods down on to the crankshaft, lubricate the bearing faces and assemble the caps in the correct positions. Secure with the capscrew, tightening them to the torque detailed in SPECIFICATIONS.

NOTE: When correctly positioned, the main bearing half will stand out 1/32" either side above the cap surface and engage inside the crankcase half bore. Failure to position correctly will result in bearing halves being out of line when cap bolts are torqued down.

6. Press a new oil seal into the rear oil seal retainer with the lip towards the front of the engine. The seal must be pressed hard against the shoulders of the retainer to ensure squareness.

7. Use jointing compound and fit a new horseshoe gasket to the rear face of the crankcase, lining up the holes in the gasket with the bolt holes.

8. Apply a light coating of grease to the oil seal and fit it over the end of the crankshaft, taking care not to damage the lip of the seal. Use a seal assembly sleeve for this operation if possible. Ensure that the garter spring is fitted and in position. Locate the retainer on the dowels.

9. Fit the five retainer bolts and tighten to the correct torque by stages to ensure even seating on the gasket.

NOTE: The bottom face of the retainer, after assembly, must align with the face of the crankcase within 0.020".

10. Trim the rear oil seal retainer gasket flush with the bottom of the crankcase.

11. Assemble the crankcase front cover.

12. Assemble adapter plate on crankcase using four bolts and apply liquid gasket.

13. Assemble the flywheel to the crankshaft (a & b).

14. Install the lubricating oil pump.

15. Use liquid gasket (loctite 584) between oil pan and adapter plate joint.

16. Fill the crankcase with the correct grade of oil to the level mark on the dipstick.

CYLINDER BLOCK

INSPECTION & REPAIR :

Thoroughly clean the cylinder block. Remove the oil sludge deposits on the inner surfaces of the cylinder block. Remove the old gasket materials from the cylinder head, thermostat, water pump, rear oil seal, oil pan and oil filter mating faces. Check the cylinder head mating face for warpage using a straight edge and a feeler gauge. If inspection proves it necessary, remove the studs and cylinder head guide dowels. While installing the cylinder head guide dowels, ensure that the dowel projects 5.85 mm (0.23 in) above the face of the block. Clean the lubricating oil galleries using wire brush. While installing expansion plugs, ensure that shellac/sealer is present around the edges as well as inside the plugs.

CONDITIONING SCHEDULE

GENERAL :

After the installation of new sleeves, pistons or piston rings, the engine must be run-in before being operated at full speed and load. The first phase of running-in must be gentle enough to prevent excessive pressure and temperatures. But too gentle operation may result in cylinder wall glazing due low combustion temperatures. Improper running-in procedure may result in shorter engine life, loss of power and high oil consumption.

1. PREPARATION :

Check and fill the cooling system. Check the level of oil in the crankcase. Bleed the fuel system using the hand primer pump located on fuel filter. Start the engine and run with the throttle at 1/4 position until the engine attains the operating temperature.

2. DISMANTLING

a) Remove the crankshaft spin-on and clutch shaft pilot bearing if inspection proves this necessary.

b) Remove the oil seal from the rear oil seal retainer.

3. INSPECTION AND REPAIR

a) Check the main journals and crankpins for wear and taper. Grind if necessary to the dimensions shown in Fig. 7.

b) Check the dowels for wear or damage, replace if necessary pressing into the dimension shown in Fig. 5.

c) Check the clutch shaft pilot bearing for wear or damage, replace if necessary pressing into the dimension shown in Fig. 5.

d) Check that the oil ways are clear.

4. ASSEMBLY

a) Install the clutch shaft pilot bearing if it was removed.

b) Install the dowels if they were removed.

c) Install a new key and the crankshaft spin-on if they were removed.

d) Press a new oil seal into the rear oil seal retainer with the lip toward the front of the crankcase. The seal must be pressed hard against the shoulders of the retainer.

5. INSTALLATION

a) Install the upper half bearing inserts and lubricate them.

b) Carefully install the crankshaft and spin it by hand.

c) Install the main bearing caps.

d) Install the connecting rods, connecting rod bearings and bearing caps to the crankshaft with the identification numbers to the fuel injection pump side then tighten the bolts to the specified torque.

e) Check the connecting rod side clearance to specifications.

f) Use jointing compound and fit a new horseshoe gasket to the rear face of the crankcase lining up the holes in the gasket with the bolt holes.

g) Apply a light coating of grease to the oil seal and fit the oil seal retainer over the end of the crankshaft taking care not to damage the lip of the seal. If possible use a sleeve for this operation. Ensure that the seal garter spring is in position.

h) Locate the retainer on the dowels, install the bolts and to ensure even seating of the gasket, tighten the bolts by stages to the specified torque.

NOTE: The bottom face of the retainer, after installation, must be in line with the bottom face of the crankcase within 0.020".

(i) Trim the horseshoe gasket flush with the bottom of the crankcase.

(j) Install adapter plate and oil pan, use liquid gasket (loctite 584) for these joints.

(k) Install the flywheel.

(l) Install the oil pump.

(m) Invert the engine.

(n) Install the crankcase front cover.

E. HELI-COIL THREAD INSERTS

1. REMOVAL

a) Place the extractor into the insert and turn in an anti-clockwise direction.

2. INSTALLATION

NOTE: Never use an insert that has been removed.

a) Place a new insert in the driver with the driving lug to the bottom.

b) Screw the insert into the tool guide until it is flush with the end of the tool.

c) Place the driver over the tapped hole and turn the handle clockwise until the insert leaves the tools, then break off the driving lug. Ensure that inserts are driven into the specified depth.

FUEL INJECTION PUMP

1. REMOVAL :

Remove the injection pump gear as detailed earlier. Remove rear support bracket of fuel injection pump. Remove the three nuts and washers securing the pump to the front cover plate adapter. Pull out the injection pump.

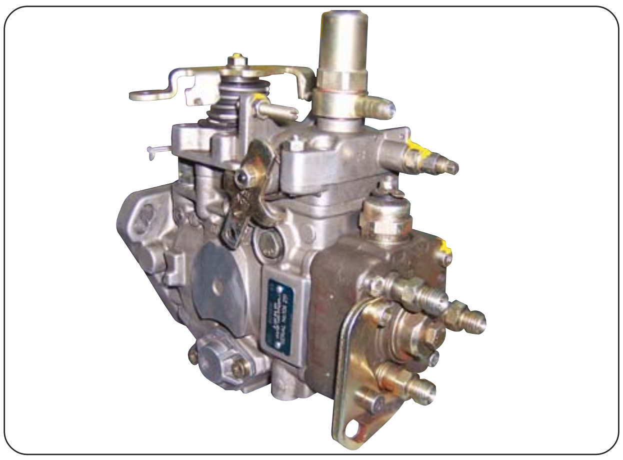
2. INSPECTION & REPAIR :

For servicing the fuel injection pump, contact BOSCH dealer / service. Test specifications - charts are given for your reference only.

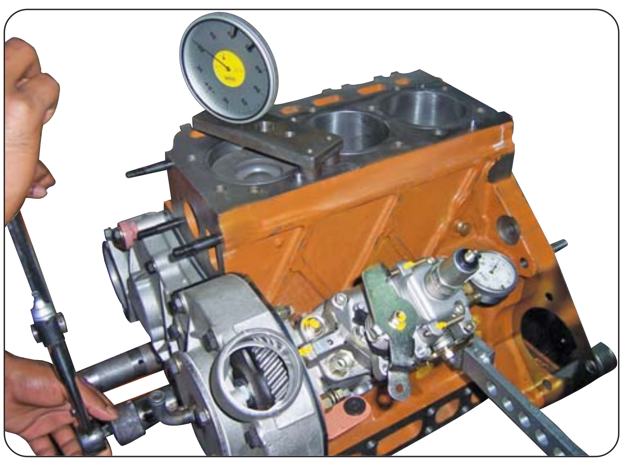
3. INSTALLATION :

Reverse the removal procedure. Ensure that the timing marks on the gears are properly set.

NOTE: The fuel injection pump of this engine is self lubricated by fuel (diesel). There is no connection with engine lubrication system.



Fuel Injection Pump - MICO



Fuel Timing Adjustment

SERVICE INSTRUCTIONS FOR FUEL INJECTION TIMING ROTARY FIP

Rotary Fuel Injection Pump Timing Setting :

1) Removal :

a) Remove the high Pressure Pipes from Fuel Injection Pump to Injector.

b) Remove Overflow Pipe - FIP To Tank.

c) Disconnect Pipe from Fuel Filter to Fuel Injection Pump.

d) Disconnect accelerator cables from Fuel Injection Pump.

e) Remove four bolts & washer securing Cover Injection Pump.

f) Rotate with Pump in Position and confirm the Chisel mark on Pump and Crankcase.

g) Remove nut & washer of gear injection Pump.

h) Remove Nut & bolt of Bracket Support - MICO Rotary FIP

i) Remove three Nuts of FIP mounting studs & pull out the Fuel injection Pump.

NOTE: Do not crank the Engine when FIP is removed and flywheel is locked vide inserting the locking pin.

2) Inspection & Repair :

For Servicing the Rotary Fuel Injection Pump, contact BOSCH dealer / Services.

3) Installation :

Reverse the removal procedure.

4) Adjustments :

The pump to be fitted Matching the mark. Match the TDC mark on main drive pulley with the pointer on front cover.

Scenario - I : Engine is fitted on Tractor and Crankshaft is rotated while FIP is in removed condition.

A - Rotate Crankshaft till TDC mark on main drive pulley matches with the pointer on front cover.

B - The 1st Cylinder Piston is now to TDC Position at compression.

C - If FIP mounting Studs are to be replaced, apply Loctite 577 to FIP mounting Studs & fix the same in Adapter

D - Torque the studs to 15-16 Lb. ft.

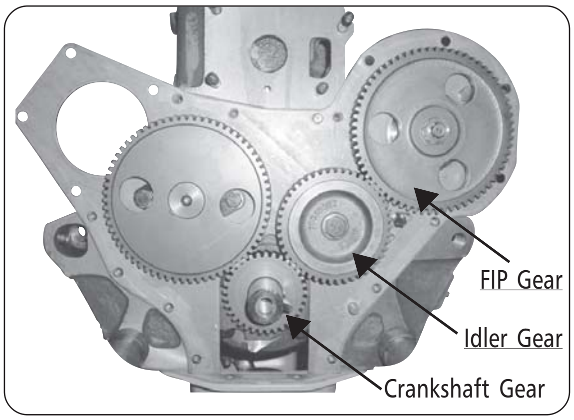


Fig. A

Image is Representative

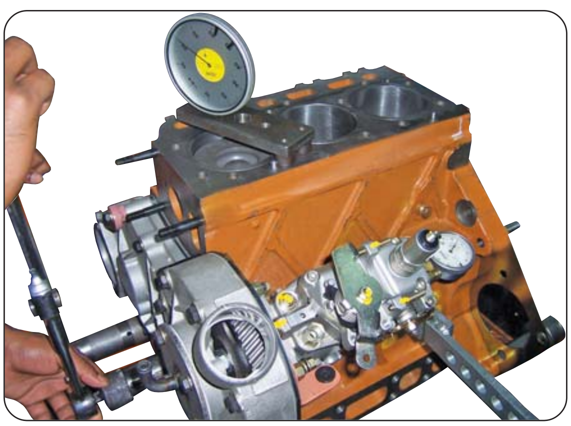


Fig. B

E - Place FIP mounting Gasket on machined face of the Adapter plate

F - Place Rotary fuel injection Pump on FIP Mounting studs located on crankcase. Slide the FIP drive shaft into FIP Gear by matching its Keyway.

Scenario - II : Engine is fitted on Tractor and Crankshaft is NOT rotated while FIP is in removed condition.

Follow steps C, D, E & F

Scenario - III : Engine is being overhauled in shop-floor and timing cover is in removed condition.

Achieve positions of Markings on gears as depicted in Fig.A.

Follow steps C, D, E & F

G - Tighten the mounting Nuts to hand tight limits,

H - Tighten FIP gear mounting nut with specified Torque of 55-65 Lb. ft.

K - Fix a dial indicator in Special Tool ensuring that the needle of Dial Gauge rests on NEEDLE of special tool with some PRE LOAD.

L - Further fix the assembly of dial indicator with Special Tool on the FIP camshaft (near a distributor) with the help of Nut provided at the center ensuring that the needle rests on PLUNGER of FIP as depicted in Fig.B.

M - Set the Dial to ZERO

N - Move the Rotary FIP towards or away from the Engine along the FIP mounting Studs till the Dial reads 0.95 ± 0.02 mm for 4035/3535, 1.0 ± 0.02 mm for 4535 / 5035. The Slot on FIP flange will permit such movement of FIP along the studs.

Model	5035 / 4535	4035 / 3535
Dial Reading (mm)	1.00 ± 0.02	0.95 ± 0.02

O - Torque the FIP mounting nuts to 18.44 ± 2.21 Lb. ft.

Assembly procedure for Heater Plug by Turn From Finger Tight Method (TFFT)

The proper method of assembling NPT threaded connectors is to assemble them finger tight and then wrench tighten further to the specified number of turns from finger tight (T.F.F.T.) given in Table A. The assembly procedure given below is recommended to minimize the risk of leakage and/or damage to components.

1. Inspect port and connectors to ensure that threads on both are free of dirt, burrs and excessive nicks.

2. Apply sealant (Teflon tape) / lubricant to male NPT threads (Pre-applied dry sealant are preferred over other sealants). With any sealant, the first one to two threads should be let uncovered to avoid system contamination. If PTFE tape is used it should be wrapped 1.½ to 2 turns in clockwise direction when viewed front the pipe thread end.

CAUTION : More than two turns of tape may cause distortion or cracking of the port.

3. Screw the connector into the port to the finger tight position.

Thread size NPTF	inch mm	Threads per inch	Pitch	D Ø	G Length	Assembly TFFT
3/4”	inch mm	14	0.071 1.81	1.05 26.56	0.34 8.6	2.0–3.0

Table A

4. Wrench tighten the connector to the appropriate T.F.F.T. Values shown in the table A, making sure that the tube end of a shaped connector is aligned to receive the incoming tube or hose assembly. Never back off (loosen) pipe threaded connectors to achieve alignment.

5. If leakage persists after following the above steps, check for damaged threads and total number of threads engaged.

   If threads on the fitting are badly nicked or galled, replace the fitting. If port threads are damaged, re-tap, if possible, or replace the component. If the port is cracked, replace the component.

CHECKING COMPRESSION

Use compression gauge to check compression in all cylinders of the engine individually. (It is advisable to check cylinder compression before overhauling. Comparison of these figures will disclose errors or show improvements.)

To check the cylinder compression, screw in a plug port adapter in place of the injector of the respective cylinder and connect with compression. Draw up both connections tight.

Close the vent valve of the compression gauge and crank the engine briefly by means of the starting motor. Only a few cycles of the engine are required to obtain a satisfactory reading. After taking the reading retard the pointer on the dial all the way by opening the vent valve. Close the valve again and repeat the check to make sure that the reading is correct.

Check compression in all cylinders of the engine as described above. The compression shown on the gauge is 16½ atu. (235 lbs. per sq. in.) each graduation mark being 2 atu. (28½ lbs. per sq. in.). With the engine warmed up, normal compression in the cylinders is 16 to 18 atu. (228 to 256 lbs. sq. in.) at the speed of 100 r.p.m. (starting motor speed).

Compression pressure should be nearly equal in all four cylinders of the engine. When a reading is taken that deviates considerably from the above specifications, as for example 14 atu. (200 lbs. p. sq. in.) and below, the cause must be determined and the trouble remedied.

Check for leaking valves, faulty piston rings and worn pistons or cylinder sleeves.

RUNNING-IN AFTER OVERHAULING

A completely overhauled tractor should undergo a thorough check over before leaving the service station.

Make sure that all parts are properly installed and all bolts are drawn up tight. Carefully inspect all units, check adjustments as far as accessible and correct if necessary. Remember, it is better to check three times than commit one error.

Fill the transmission case with specified lubricant and grease the tractor liberally in accordance with the lubrication guide of the “Operators Manual”. Be sure that all instruments and controls function properly before preparing the engine for running-in.

Fill the engine crankcase, the fuel injection pump and the governor housing with specified lubricant. Fill the cooling system.

Fill the fuel tank with Diesel fuel and vent the fuel system properly. Start the engine in the conventional manner and let it run at medium speed for about five minutes. Closely observe the engine to see that all parts work freely and the engine operates smoothly.

Check the oil pressure.

With the engine stopped check the crankcase oil level and make sure the pressure feed lubrication functions properly and no bearing is starved. Restart the engine and let it run at medium speed for approximately one hour.

If new cylinder sleeves and pistons were installed it is necessary to run-in for another hour during which the engine is accelerated to full speed for short periods.

Closely observe the engine during the running in time and note any faults for later correction.

When time is up, stop the engine and readjust as follows:

Retighten injection nozzle stud nuts.

Check fan belt tension.

Check oil in engine crankcase.

Draw up all bolts and nuts in accordance with the tightening scale.

Check for evidence of oil leakage and inspect all hose and pipe connection for leaks.

Correct faults observed during the running-in time.

Finally, a trial run is made to test chassis and transmission.

This trial run should last at least 15 minutes and consist of the following tests:

Testing the engine clutch.

Testing the five forward speeds and the reverse speed.

Testing the steering.

Testing the brakes.

Testing the electrical system.

Make a final test with tractor under load.

It is important that faults revealed by these tests be remedied without delay.

After an overhaul every part or unit of the tractor should function properly and be up to the standards and requirements described in the various sections of this manual. Only then can you expect ready and efficient performance and trouble-free operation the year round.

CHAPTER - 7

SPECIAL NOTES & TROUBLE SHOOTING

SPECIAL NOTES

PAINT COATING

With the tractor run-in, nuts and bolts drawn up tight and all adjustments and corrections made, the tractor should be given a new coat of paint. The significant of this should not be underrated as moisture, rust and corrosion have access where bolts and nuts were loosened and the original paint coat has been broken.

A paint spray gun is very useful for this purpose. It saves time and facilitates painting as with it, odd corners can be reached without difficulty.

The original paint for tractors (Tractor red) is available at all Establishments. Be sure to remove oil and grease from all parts to be painted.

HANDING OVER THE TRACTOR

Grease as per the recommendations.

Check front wheel bearings regularly during the first week and readjust if necessary.

Keep front axle extension clamps drawn up tight.

Check "toe in" of front wheels and adjust to "0" mm 0 as described in the "Operators Manual".

After 50 hours of operation check front wheels and adjust again if necessary.

ENGINE TUNE-UP

a. **General**

The following steps outline the operations in an engine tune-up. These steps point out the parts of the engine to be cleaned, checked, timed or repaired.

b. **Diesel Engine**

1. **AIR CLEANER**

a. Check the air cleaner, hoses and clamps for looseness or leaks.

b. Clean & replace the elements as the recommendations.

2. **DIESEL ENGINE**

Operate the engine and observe its smoke levels, power and sound. If it misses, smokes excessively or is low on power, check the following :

a. Check and adjust the intake and exhaust valves. (Tappet setting)

b. Check the injectors by removing them and checking the nozzle opening pressure (NOP), spray pattern and leakage. Service or replace as necessary.

c. Check engine compression while the injectors are removed. If the compression is low on one or more cylinders, make the necessary repairs. If only one cylinder is low, squirt some engine oil on top of the piston and recheck. If the pressure goes up worn rings are indicated; if it doesn't go up valve leakage is indicated.

d. If "c." above didn't indicate any mechanical problems, install the serviced injectors and operate the engine again. If the engine still runs roughly or lacks power, then check the injection pump timing. If the timing is correct, remove the pump and have it serviced by an authorized Bosh dealer.

e. Check and adjust low and high idle speeds as needed.

3. **FILTERS**

a. Replace the engine oil filter & Fuel filters elements as per the recommendatations.

4. **COOLING SYSTEM**

a. Check the cooling system for leaks, worn hoses, loose clamps or plugged cooling fins and clean or repair as needed.

b. Check the water pump for leaks and repair as needed.

c. Flush the cooling system and fill with low silicate antifreeze solution that meet GM 6038 formulation specification. A partial list of acceptable antifreeze product is listed in the Operator's Manual.

d. Check the fan drive belt for wear and tension.

5. **ALTERNATOR**

a. Check the alternator drive belt for wear and tension.

b. Check alternator output. Service it if output is low.

c. Check bearing smoothness and replace them if they are rough.

6. **STARTER MOTOR**

a. Check the brushes for wear and sticking and repair as needed.

b. Check and clean the commutator as needed.

c. Check the drive for wear and replace as needed.

d. Lubricate the bushings.

7. **ELECTRICAL WIRING**

a. Examine all wires for corrosion, damage or loose connections.

b. Check all switches for proper operation.

8. **BATTERY**

a. Check the battery with a hydrometer for charge.

b. Bring the electrolyte up to full with distilled water.

TROUBLE SHOOTING

Much can be learned about the condition of an engine if a good visual inspection is performance before the actual cleaning operations begin.

After cleaning, the exterior of the engine should once more be inspected carefully and a note made of any parts such as brackets, covers, etc., that are bent, broken, rusted or missing completely. The crankcase or cylinder block should be checked for evidence of freezing around core plugs or for actual breaks in the water jacket.

Probable Cause	Remedy
Engine Fails to Turn	
1. Batteries too low to turn engine ------------	Charge batteries or install new ones.
2. Starting switch inoperative ----------------	Inspect for faulty cables an terminals. Replace starting switch if necessary.
3. Cranking motor inoperative ---------------	Refer to Service Manual “Electrical Equipment”.
4. Engine oil too heavy ---------------------	Use correct grade of lubricating oil as specified in the operator’s manual.
5. Internal seizure -------------------------	Hand crank the engine. If the engine does not turn easily, seizure due to internal damage; including gear train, pistons, sleeves, connecting rods or main bearings, is indicated.
6. Hydrostatic lock ------------------------	Remove all the injection nozzles and crank the engine. Check for fuel or coolant in the cylinder.
Engines Does Not Start / Engine Start But does not Develop Full Power	
1. Low or no fuel pressure	
a. Insufficient fuel ----------------------	Check fuel tank.
b. Fuel oil filter clogged ------------------	Replace filters.
c. Fuel filter gaskets defective (air being drawn into fuel) --------------	Replace gaskets.
d. Moisture in fuel tank ------------------	Drain entire system and fuel filter. Refill with clean fuel, and vent the air from the system.
2. Poor fuel ------------------------------	Use a good grade of fuel.
3. Air cleaner clogged ---------------------	Remove and service air cleaner as described in operator’s manual
4. Injection pump not properly timed to the engine -------------------------	Check timing.
5. Fuel line clogged or air in line -------------	Clean fuel line and vent fuel system. Refer operator’s manual.
6. Injection pump not operating properly -------	Remove injection pump and test it. Refer to Service Manual “Fuel System” for test specifications.
7. One or more fuel injection nozzles not operating properly -------------------	Replace the injection nozzles.
8. Loose or broken fuel lines or fittings between injection pump and injection nozzles --------	Tighten or repair.
9. Loose or broken connections or leaking gaskets at intake manifold or exhaust manifold ------	Tighten or repair.
10. Improper valve settings ------------------	Reset as necessary. If out of adjustment an excessive amount, check for bent push rods.
11. Lack of compression ---------------------	Refer to “Poor Compression”

Probable Cause	Remedy
Engine Turns But Will Not Start	
1. No fuel delivery to injection nozzles	Check fuel supply, air in system, plugged filter elements and injection pump.
2. Intake or exhaust system clogged	Remove air flow restriction and clean exhaust system. Service the air cleaner.
3. Improper adjustment on pump linkage and controls	Readjust as necessary.
Poor Compression	
1. Piston rings worn, broken or cracked	Install new rings.
2. Cylinder sleeve worn	Install new sleeves.
3. Valves damaged or worn	Install new valves.
4. Broken valve spring	Install new springs.
5. Worn cylinder head gasket	Install new gasket.
6. Valve seats worn or cracked	Grind valve seats. If cracked, install new valves.
7. Worn pistons	Install new pistons.
8. Excessive valve guide wear	Install new valve guides.
9. Sticking valves or bent valves stems	Free stem and correct cause. Replace valves with bent stems.
10. Faulty valve action	Adjust valve clearance.
Engine Overheats	
1. Water pump air bound	Vent air from water pump and thermostat housing.
2. Insufficient coolant in cooling system	Check level and add if necessary. Check hose connections for leaks.
3. Dirt & trash on outside of Radiator	Clean between the tube fins with air or water pressure.
4. Cooling system clogged	Drain and flush cooling system.
5. Hose connection leaking or collapsed	Change hose.
6. Insufficient oil	Maintain proper oil level.
7. Engine oil diluted with fuel	Change oil. Inspect for loose fuel line connections on the injection nozzles. Check for defective injection pump.
8. Radiator cap not sealing or defective	Replace
9. Defective thermostat	Remove and test thermostat. Replace if necessary.
10. Water pump defective	Repair pump.
11. Clogged oil filter	Replace oil filter element.
12. Fan belt slipping	Adjust belt tension.
13. Engine overloaded	Reduce load.
14. Cylinder head gasket/leaking	Install new head gasket properly using sealing compound.

Probable Cause	Remedy
Engine Misses on One or More Cylinders	
1. Insufficient air to engine	Remove and clean air cleaner and air cleaner pipe.
2. Defective injection nozzles	Replace with serviceable unit.
3. Air lock in the injection pump or fuel filter	Vent air from system and check all fuel lines and connections for leaks.
4. Poor fuel	Use good grade of fuel.
5. Air leaks around intake manifold	Remove and install new manifold gasket.
6. Injection pump not operating properly	Remove injection pump and test it.
7. Injection pump not properly timed to the engine	Check and adjust timing if necessary.
Excessive Oil Consumption	
1. Piston rings worn or broken	Install new rings.
2. Oil level in crankcase too high	Maintain proper oil level.
3. Crankcase oil pan gasket leaking	Install new gasket.
4. Worn valve guides	Install new valve guides.
5. Cylinder sleeves worn	Install new sleeves.
6. Front and rear crankshaft oil seal leaking	Install new oil seals.
7. Piston rings not seating	Install new rings.
8. Clogged oil ring	Remove and inspect and, if necessary, replace.
9. Oil pan drain plug loose or worn	Install new drain plug and gasket tighten plug.
10. Overheating	Refer to “Engine Overheats” on previous page.
11. Excessive oil poured into crankcase	Drain oil and fill to correct level only.
12. Wrong specification oil used	Install oil meeting specifications in the operator’s manual.
13. Air cleaner clogged	Disassemble & clean air cleaner.
Engine Does Not Idle Properly	
1. Injection Nozzle defective	Test Nozzle and repair and reset as per MICO.
2. Restriction to fuel delivery or leaking fuel lines	Inspect fuel lines and valves; inspect for proper level in fuel tank.
3. Poor compression	See poor compression problems.
4. Slicking valves	See values sticking problem.
5. Improper adjustment of injection pump linkage and controls	Readjust
4. Valve and spring assembly in operative	Repair and install parts needed.

Probable Cause	Remedy
Engine Knocks	
1. One or more cylinders misfiring	Locate and correct cause. Disconnect the injection lines at the valve housing one at a time and check for rpm drop of each cylinder.
2. Loose connecting rod	Tighten connecting rod.
3. Poor grade of fuel, or water in fuel	Use good grade of fuel and check for water in fuel.
4. Incorrect engine temperature	Keep temperature in work range of heat indicator. Check thermostat for proper operation.
5. Injection pump timing not correct	Time the injection pump correct. Refer fuel injection system manual.
Excessive Smoke	
1. Air cleaner clogged	Service air cleaner as described in the operator's manual.
2. Engine overloaded	Reduce load.
3. Improper fuel	Use good grade of fuel.
4. Defective injection nozzle	Install new injection nozzle.
5. Worn pistons, rings and sleeves	Install new parts.
6. Incorrect valve adjustment	Adjust valves properly.
7. Incorrect injection pump timing	Time injection pump Refer Group
8. Leaking manifold gaskets	Install new gaskets.
9. Incorrect lubricating oil	Use grade of oil specified in operator's manual.
Bearing Failure	
1. Low oil level	Maintain proper oil level.
2. Lack of oil	Maintain proper oil level.
3. Engine runs too hot	Keep engine at normal operating temperature.
4. Loose bearings	Install new bearings.
5. Use of improper lubricating oil	Use grade of oil specified in operator's manual.
6. Foreign materials entering engine	Use clean oil containers when filling engine with oil and see that there no leaks in the air cleaner or in the air induction system.
7. Oil lines clogged	Clean all oil passages.
8. Connecting rod bent	Align rod or install new.
9. Crankshaft out of alignment	Install new crankshaft.
Valves Sticking	
1. Valve springs weak	Install new springs.
2. Valve springs broken	Install new springs.
3. Gummy deposits from inferior fuel or oil	Clean and use proper fuel or oil.
4. Valve stems scored or carboned	Clean if necessary, install new valves.
5. Insufficient clearance between valve stem and guide	Ream valve guides for proper clearance.

Probable Cause	Remedy

Piston and Cylinder Sleeve Wear

1. Oil of unsuitable grade of viscosity ----------	Use oil meeting operator's manual / specifications.
2. Piston rings stuck or broken ---------------	Install new rings.
3. Lack of oil ----------------------------	Keep oil at proper level.
4. Foreign materials entering engine -----------	Inspect and service air cleaner. Proper care of air cleaner is very important.
5. Piston rings not fitter properly to cylinder-----	Install new rings and fit properly.
6. Dirty containers used for lubricating oil ------	Lubricating oil must be kept in a clean place and clean containers used when filling engines.

Improper Fuel Pressure

1. Fluctuating fuel pressure -----------------	Inspect fuel injection pump.
2. Fuel pressure too low --------------------	Check for clogged fuel filter, lines and defective fuel injection pump.
3. Air leaks on suction side of injection pump----	Tighten fuel lines. Check for defective fuel filter case gaskets.

Low Engine RPM

1. Governor control linkage binding or damaged -	Repair and install new parts needed.
2. Governor control rod improperly adjusted-----	Adjust rod to proper length.

Low Fuel Pressure

1. Dirty fuel filters ------------------------	Replace filters.
2. Broken fuel lines------------------------	Repair or install new line.
3. Clogged line ---------------------------	Clean or install new line.
4. Improper grade of fuel -------------------	Use correct fuel
5. Air leaks on suction side of injection pump----	Tighten fuel lines. Check for defective fuel filter case gaskets.

CHAPTER - 8

COOLING SYSTEM

1. SPECIFICATIONS

Capacity	-	US Gallon	2.24 (4DI), 1.84 (3DI)
Pump	-	Type	Centrifugal
	-	Direction of rotation viewed from front	Clockwise
Fan Belt	-	Type	Single V
	-	Slack between pulleys	3/8 - 1/2"
Thermostat	-	Opening temperature	82°C (180°F)

Operation :

PERIOD 1 (1 HOUR) :

Operate the engine with no load and with the throttle at 3/4 position.

PERIOD 2 (2 HOURS) :

Operate the engine with light load and with the throttle at 3/4 position.

PERIOD 3 (1 HOUR) :

Operate the engine with medium load and with the fuel rack at full position.

NOTE:

COOLING SYSTEM PROTECTION

Operate the engine with light load and with the fuel rack at 3/4 position.

% Anti Freeze / % Water	50/50	60/40
Freeze Protection	-34°F	-64°F
Boil over protection	+265°F	+275°F

(with 15 psi radiator cap)

Recommended change period : 1 year or when ever the radiator water is drained.

2. DESCRIPTION

1. The Cooling System is a closed type system which permits operation at extreme angles without loss of coolant through the overflow ripe and higher engine coolant temperature without boiling.

NOTE: The use of radiator caps with pressure relief valves allow the cooling system to operate at higher pressures. Higher pressures raise the boiling point of the coolant. The radiator cap relief valve is set at 0.9 Kg/cm^2 (13 PSI)

For satisfactory operation of a closed Cooling System, extra care must be taken to ensure that all connections are water tight.

The Cooling Functions as follows :-

The Radiator forms the heart of the Cooling System. The Coolant Water in the Radiator flows down through tubes to Radiator bottom tank. The Coolant is drawn from the bottom tank of the Radiator by the Engine's Water Pump which delivers the Coolant to the Cylinder Block. As the Coolant enter the Cylinder Block, it travels through cored water passages in the Cylinder Block absorbing the heat from the Cylinder Walls. The Coolant then flows into the Cylinder Head Water Jacket and to the Nozzle Tip Area. This flow within the Cylinder head Water Jacket provides sufficient Cooling at maximum temperature Cooling Points. The Coolant continues to flow through the Cylinder Head to the Thermostat. The thermostat is located at the front of the Cylinder Head in Thermostat Housing which is outlet of Engine.

If the Thermostat is closed, a recirculating bypass is provided, allowing a portion of the Coolant to recirculate from the Cylinder Head to Cylinder Block for faster warm up.

When the Thermostat is open, the hot Coolant delivered from the outlet connection of the Thermostat Manifold to the Top Tank of the Radiator, the hot water from Top Tank passes through the numerous tubes connected to the bottom tank to be circulated in the continuous process of Cooling. The tubes along with the fins which are exposed to the Cooler Air Temperature. The effect (Cooler Air) is increased by the draft produced by the fan as well as the air stream caused by the moving Tractor. This cycle is repeated to keep the Engine at a desired optimum/ working temperature.

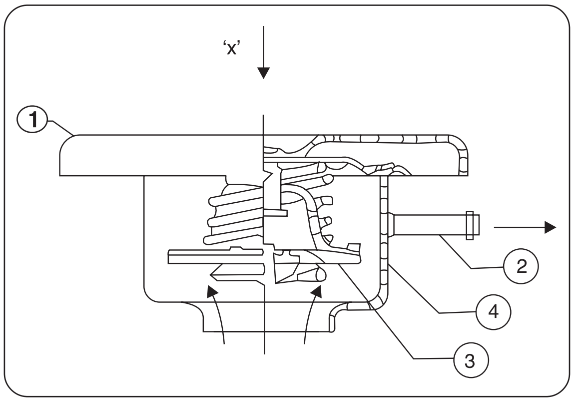


Fig. 1 - Operation of the Pressure adjusting valve

1. Cap top
2. Overflow tube
3. Rubber pad
4. Filler neck

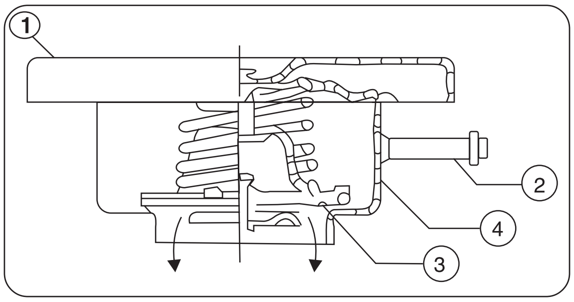


Fig. 1B - Operation of the vacuum release valve

1. Cap top
2. Overflow tube
3. Rubber pad
4. Filler neck

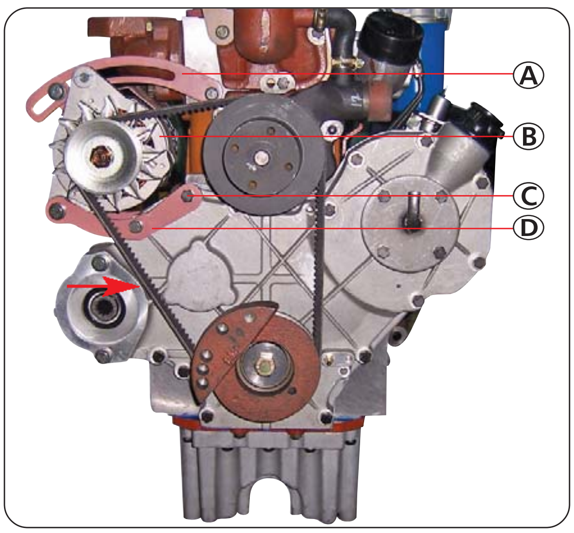


Fig. 2

A. Alternator Mounting
B. Alternator
C. Adjusting Bolt
D. Adjusting Bracket

3. RADIATOR

1. The Radiator is the flat tube type with the core and water tanks combined in one Integral Unit. It is enclosed within a Grille and fan housing which are removable for cleaning.

   Radiator cap is a pressure cap and is fitted on the filler neck. The pressure cap has the following functions

a) Pressures the System thus raising the boiling point of the Coolant.

b) To prevent the water vaporization of the Coolant.

c) The Cap releases excess pressure via the overflow tube in the filler neck when the pressure rises beyond the specified (13 PSI) pressure. The pressure inside the Radiator is always maintained within close limits of the Valve specified on the Cap.

d) The Cap also has a vacuum release valve which relieves vacuum created when the engine is cools and coolant temperature drop. The Valve opens and equalises the System Pressure with atmosphere via, overflow tube of the filler neck (see fig 1B).

NOTE: If the Radiator Cap is defective i.e. Rubber Seals and Valve Springs broken, replace it:

2. Removal

a. Drain the cooling system.

b. Remove the vertical exhaust silencer, precleaner and raise the hood.

c. Disconnect the battery earth cable before disconnecting any electrical system.

d. Unclip the main cable harness from the bottom of the radiator.

e. Disconnect the head lamp and horn cables if fitted.

f. Remove the bolts from the bottom of the radiator grille and remove the hood and radiator grille.

g. Open the Radiator and crankcase drain plugs and allow the system to drain.

h. Disconnect the radiator brace at the radiator end (5-4).

i. Loosen the clamps (1,2-4) on the radiator also remove hoses (3,4-4) and work the free of the inlet and outlet pipes of the radiator.

j. Remove the two nuts from the bolts securing the radiator to the front axle support and lift the radiator and rubber pads clear.

k. Remove the fan housing from the radiator.

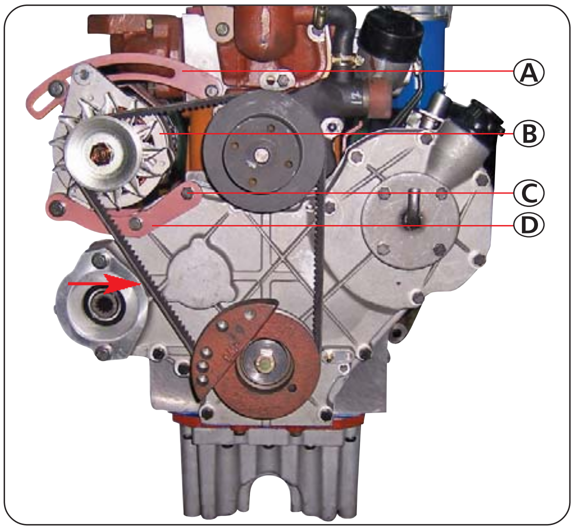


Fig. 3

A. Alternator Mounting
B. Alternator
C. Adjusting Bolt
D. Adjusting Bracket

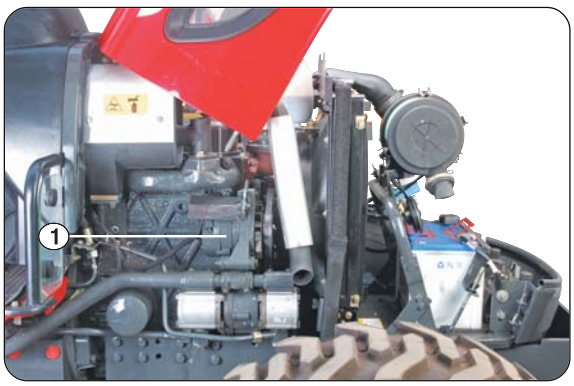


Fig. 4

3. Cleaning, Inspection and Repair

a. Flush out the core with water under pressure. If the interior is greasy, use steam cleaning equipment.

b. Clean the outside of the core with water under pressure. Flush out between the fins and tubes thoroughly.

c. Inspect the top and bottom tanks for cracks. Inspect the fins and tubes for damage. If soldering does not effect a satisfactory repair the radiator must be replaced.

NOTE: For the Engine to run efficiently, the radiator core should be clean and free from grease, rust and scales to allow free passage of the Cooling Medium and maximum heat transfer.

Cleaning out Dirt and Sludge

Drain cooling system as directed above. Fill the cooling system with a solution of 1.36 kgs. of ordinary baking soda to 10.19 litres (2.7 US Gallons) of water. Do not replace the radiator cap. Operate the engine until the water is hot. Drain, flush with clean water and refill with anti-freeze solution.

The system should be kept filled with clean water with a rust inhibitor or anti-freeze solution.

d. Method of De-Scaling and Flushing :

A Chemical Scale Remover is available in the Market like Brand Name “Core Guard” or some other names.

a) Remove the Radiator from the Tractor.

b) Block Inlet and Outlet Pipes with suitable adapters. Connected an air pressure hose to the inlet Adapter.

c) Close the drain cock and fill up the radiator with a Scale Remover Chemical.

d) Close the Radiator with Pressure Cap immediately and pressurise the Radiator to 5 PSI.

e) Open partially the drain cock allowing the chemical to drain slowly in the plastic bucket.

f) Once the Radiator is fully drained close the drain cook and repeat the procedure twice more. At the end of the 3rd round the radiator would have been thoroughly cleaned. Finally drain the system of chemical. Flush the Radiator with clean water.

Flushing the Radiator :

g) Thoroughly flush inside of the Radiator using good clean water.

The outside of the Core should be flushed well to remove the dust particles and impediments stuck to the fins and tubes.

The Radiator should then be blown dry with compressed air.

The Radiator is now ready for installation.

4. Installation

1. Assemble the fan housing to the radiator.
2. Position the radiator mounting pads on the front axle support over the radiator bolt holes. Lift the radiator into position and fit the nuts.
3. Reassemble the inlet and outlet hoses end tighten the clamps securely.
4. Reconnect the radiator brace.
5. Place the hood and radiator grille in position and secure with the two pivot bolts.
6. Connect the head lamp and horn cables.
7. Replace the main harness into the clip at the bottom of the radiator and secure the clip.
8. Connect the battery earth lead.
9. Fill the radiator with clean coolant solution.
10. Lower the hood into position and fit the exhaust silencer and precleaner.

5. FAN AND FAN BELT :

Little need be said about servicing the Fan but it should be checked occasionally for loose or bent blades. Either condition will usually make its presence felt by Fan vibration.

Damaged/unbalanced Fan Blades are to be replaced as they are difficult to balance.

The Fan Belt needs periodical inspection.

The belt tension is correct when it can be depressed 3/8" to 1/2" by thumb pressure midway between the pulleys (see fig. 2).

a. Raise the hood.

b. Remove the radiator to cylinder head cover brace.

c. To remove the fan belt, loosen alternator brace & pivot bolt. Start the belt over the outer flange of the main pulley (ALTERNATOR). Slowly crank the engine at the same time and the belt will work off the pulley. Withdraw the belt between the pulley and the bolster. The belt can now be worked over the fan blades.

d. Remove the six round headed capscrews (6-4) and their washers and nuts which secure the fan housing to the radiator and move the housing back towards the pulley as far as possible.

e. Remove the four capscrews which secure the fan to the pulley hub. To remove these capscrews work from the right hand side of the machine and ensure that each capscrew is rotated up to the 12 o'clock position as it is being removed. (See illust / Fig.4).

2. Installation

a. Insert the fan into position from the right hand side of the machine.

b. Attach the fan to the pulley hub with one capscrew loosely screwed down. Turn the fan and hub until the next hole is at the 12 o' clock position and insert the second capscrew and only half tighten down. Repeat this procedure for the following capscrew, then tighten the four capscrews down very carefully and securely.

c. Check and ensure that the fan blades do not foul the fan housing.

d. When replacing the belt, reverse the procedure outlined under "REMOVING THE FAN BELT" except that the belt can be started on the lower pulley (CRANKSHAFT) by hand. By slowly cranking engine, the belt will find the correct position.

6. WATER PUMP

The water pump circulates the Coolant at rates up to several thousand liters an hour. The water pump is a centrifugal type with self lubricated sealed two row ball bearings. The Impeller is an interference fit to the rear end of the spindle bearing shaft and pulley hub is an interference fitted to front end of it. The Spindle Shaft is provided with Seal. The Water Pump is fastened to the front end of the Crankcase. The Water Pump and Fan Assembly is Belt driven by the Engine Crankshaft Pulley.

NOTE: If you do carry out repairs, be sure to fit all new Seals and Gaskets when reassembling the Unit.

1. Removal

a. Drain the cooling system.

b. Remove the vertical exhaust silencer, precleaner and raise hood.

c. Remove the fan (Refer to para.5 REMOVAL).

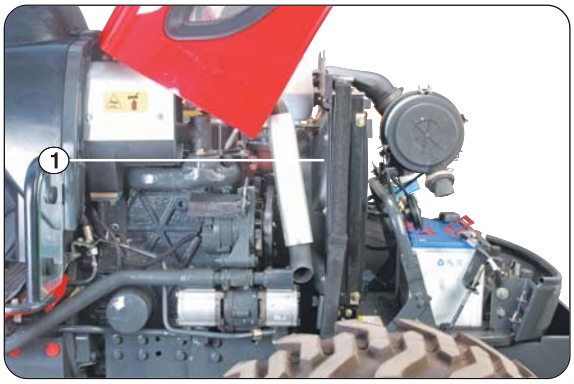


Fig. 5

1. Radiator

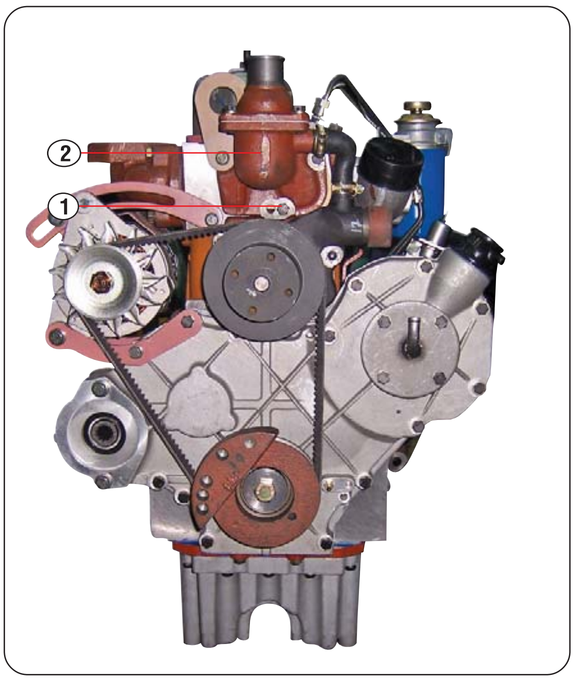


Fig. 7

d. Unscrew the generator mounting bolt & nut, loose the nut, bolt of generator adjustment brace. Slide oft the generator belt.

e. Loosen the inlet hose clamp which clamps the hose to the radiator inlet tube and work the hose free from the tube.

f. Disconnect the battery earth lead.

g. Loosen the outlet hose clamp which clamps the hose to the water pump and work the hose free from the pump. Slacken the two hose clips then remove the thermostat by pass hose.

h. Lift the fan housing clear of the tractor.

i. Remove the nut and setscrew which secures the adjustable pulley flange to the pulley hub and unscrew the flange from the hub. Slide off the drive belt.

j. Unscrew the four nuts (1-7) from the water pump mounting studs.

k. Withdraw the water pump as far as possible along the mounting studs and towards the radiator.

7. THERMOSTAT :

The Blocker type Thermostat is located in Thermostat Housing (2-7). The Thermostat controls the Engine operating temperature.

When the Engine is cold the Thermostat is closed, preventing circulation of Coolant until it reaches operating temperature. The thermostat is set to open at 82°C (180°F)

NOTE: When the Thermostat fails in the open position, the Engine runs too cold. Thereby the Cylinder Sleeves get glazed, leading to excessive consumption of Lubricating Oil. A Cold running Engine is damaged by combustion gas. 'Blow by', Crankcase condensation resulting in sludge formation in the Oil, High wear and corrosion of Engine parts and rapid clogging of the positive Crankcase ventilation system.

WARNING : Do not to remove the Thermostat from Tractors for any reason whatsoever except to replace a defective thermostat.

b. Removal

1. Drain the cooling system.
2. Loosen the clamps on the radiator upper hose and work the hose clear of the thermostat housing.
3. Remove the three capscrews (1-12) from the thermostat housing (2-12) and withdraw the thermostat.

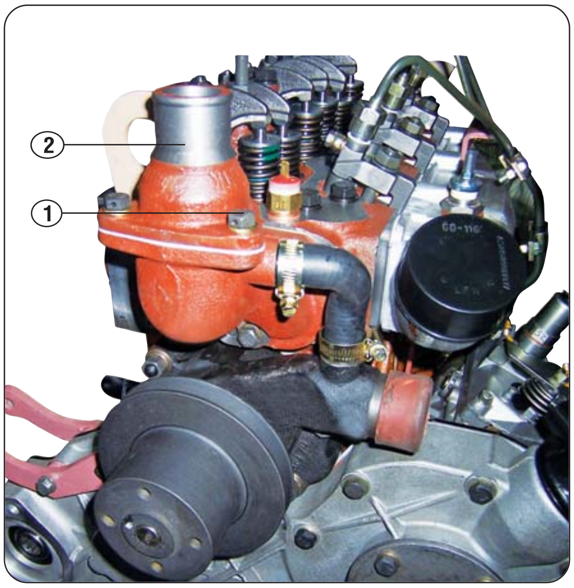


Fig. 8

2) **INSPECTION**

Suspend the thermostat and a thermometer in a pan of water until the thermostat opens. It should begin to open at 82^{O}C (180^{O}F) and fully open by 91^{O}C (196^{O}F).

(c) **Installation**

1. Insert the thermostat into its housing with the bellows end downwards and install new gasket.
2. Tighten the capscrews.
3. Work the hose back on to the thermostat housing and tighten the hose clamps securely.
4. Fill the radiator with clean water.

7. **HOSES**

Top and bottom hoses should be checked at least twice a year for deterioration. The main thing to look for are hardness or conversely, sponginess. In first case, hardness leads to lack of flexibility and cracking; the latter causing leakage and also allows the passage of small particles of rubber into the Radiator, blocking the cores. Sponginess leads to lining failure and eventual rupture of the Hose.

When installing new hoses, particular attention should be paid to the connections. If you want a first class job, the steel pipe connections should be cleaned and non hardening sealing compound used in conjunction with original/good quality Hose Clips always fitted with the Screw Heads in the most convenient position for adjustment with the Screw Driver. All new Hoses and their connection should be checked a couple of times subsequent to fitting. After the Engine has been in use, retighten all connections, as necessary.

8. TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
DEFECTIVE COOLING SYSTEM	1. Insufficient water	1. Acid water, inspect for leaks.
	2. Faulty Thermostat	2. Test, it necessary, replace.
	3. Dirty Water	3. Drain & clean system.
	4. Defective Connections.	4. Replace swollen, worn or loose hose connections.
	5. Radiator Defective	5. Repair. If necessary, replace.
	6. Fan Detective	6. Inspect Fan. If damaged, replace.
	7. Defective Radiator Cap.	7. Replace.
	8. Defective Water Pump.	8. Inspect water pump impeller & shaft. If necessary, replace.
	9. Dirty, Scad Coolant passages.	9. Clean & flush passages.
	10. Radiator Togged.	10. Flush out radiator.
	11. Fan Roll Slippage.	11. Check the tension; replace, it greasy or worn.

CHAPTER - 9

AIR CLEANER

A. AIR CLEANER

All air entering the engine must pass through the aircleaner before entering the inlet manifold and cylinders. To provide an engine with clean and adequate volume of air, is of most Importance. The entire system is so designed that even in extreme dusty conditions and low Engine R.P.M. the engine is not starved of dust free air. In Engine Dry Type Air Cleaner is placed horizontal just infront of radiator.

The curved blades on the periphery of precleaner shield direct the entering air to take a spiral path on entering the body tube due to this motion of air, bigger impurity particles are thrown away rapidly from the body tube and after passing from hopper slot, they fall in the dust collector the precleaned air then passes through paper filter element before entering the engine.

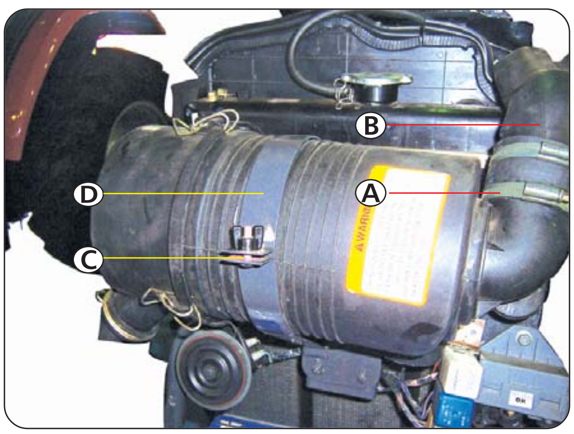
A safety cartridge provided within the boundaries of paper element. This can filter particles upto 120μ and is of use only in case of any leakage or rupture of paper element and also paper element is removed for cleaning an Air cleaner indicator is provided on dash board it will glow in case the filter element gets jammed.

NOTE: **Never remove cartridge when paper element is removed for cleaning.**

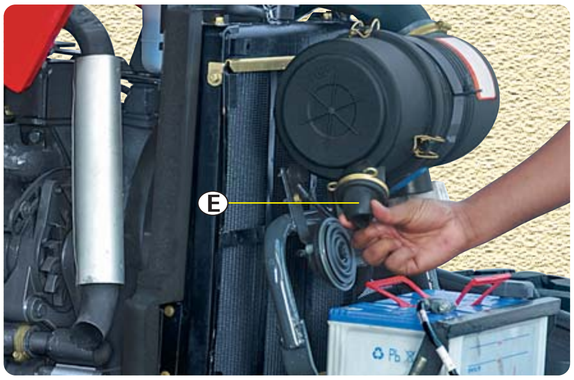
B. REMOVAL & INSTALLATION INSTRUCTIONS

For Air cleaner Replacement Proceed as follows:

1. Open the hood.
2. Loosen the hose clips (A) of hose (B).



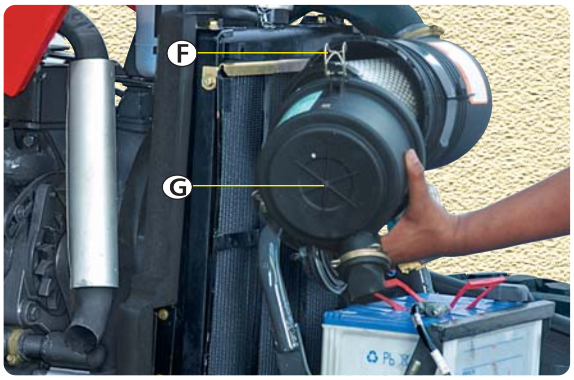
3. Loosen the wing nut (C) & turn the clamp (D).
4. Disconnect the Air Cleaner Clog Indicator Sensor wiring connections.
5. Take out air cleaner.



Dust Unloader

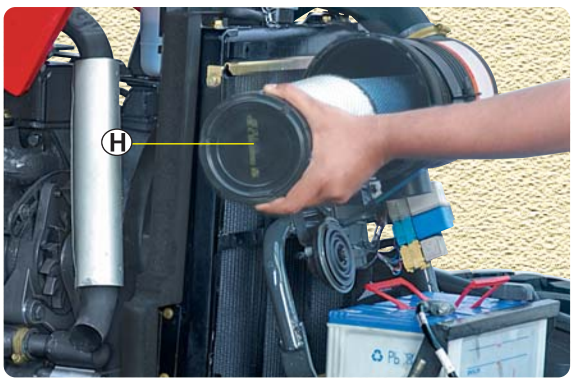
For Air cleaner Servicing Proceed as follows:

6. Open the hood.
7. Check the dust unloader valve (E) and clean if necessary.



Cyclopack

8. Turn the clamp (F) of air cleaner.
9. And remove cover (G).

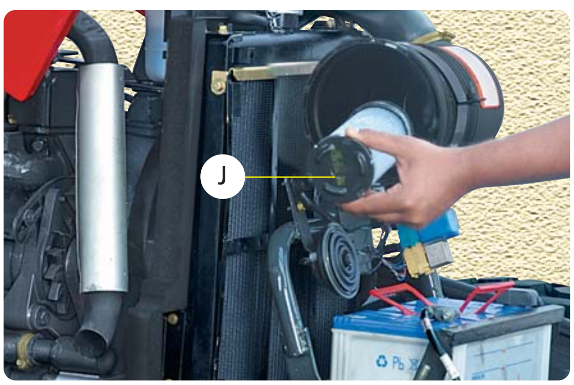


Primary Element Filter

10. Remove Primary Element (H).

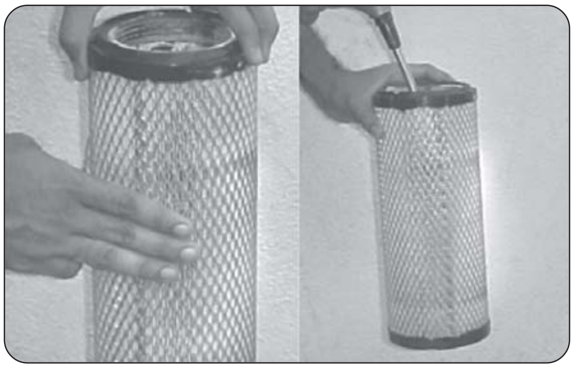
IMPORTANT: Remove Secondary Element (Inner Element) ONLY if it is to be replaced. DO NOT attempt to clean Secondary Element.

If Secondary Element is replaced, install new element immediately to prevent dust from entering air intake system.



Safety Cartridge

11. Replace Secondary Element (J), if dirty or damaged.



Cleaning Primary Element

C. Cleaning Primary Element

a. Pat Primary Element with palm of your hand, NOT ON HARD SURFACE.

b. Clean element with compressed air (below 130 kPa or 1.3 Bar). Hold nozzle next to inner surface, and move up and down pleats.

IMPORTANT: DO NOT direct air against outside of element, as it might force dirt through to inside.

c. Inspect element before reinstalling.

D. Washing Primary Element

DO NOT wash element in fuel oil, oil, gasoline or solvent. DO NOT use compressed air to remove water from element.

E. Inspecting Element

a. Hold a bright light inside element and check carefully for holes. Discard any element which shows the slightest hole.

b. Be sure outer screen is not dented. Vibration would quickly wear a hole in filter.

c. Be sure rubber sealing surfaces are in good condition on both ends. If damaged, replace element.

d. Before you install Primary Element, clean the inside of air cleaner housing & unloader valve with a damp cloth.

e. Ensure that dust unloader valve is facing downward. (With 30 Deg. Vertical axis)

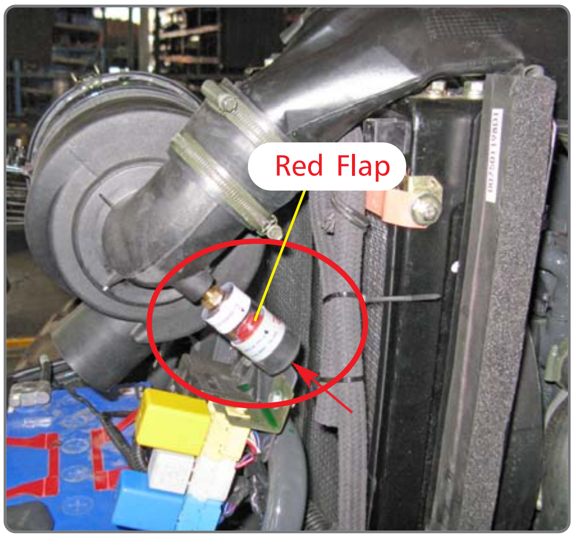
f. Install Primary Element & cover and shut bonnet.

F. SERVICE INSTRUCTIONS

1. Check functioning of auto unloader of the dust collector regularly.
2. Paper element of air cleaner should be cleaned with compressed air every 300 hrs. or earlier if required.
3. Paper element of air cleaner should be replaced after every 2 cleanings or 900 hrs. or even earlier if required. Refer Routine Service Schedule Chart.
4. Safety Cartridge should be replaced after every 900 hrs. or earlier if required.

G. STORING ELEMENT

If element is not installed on tractor, seal element in a plastic bag and store in its original shipping container to protect against dust and damage.



G. AIR CLEANER SERVICE INDICATOR

It is fitted on air cleaner outlet connecting to air intake manifold. This is a mechanical type indicator set to 80 milli-bar vacuum in intake system. The red band will be visible in the transparent cover, when the 80 milli-bar vacuum is reached. At this stage air cleaner has to be cleaned / Serviced.

After servicing, reset the clog indicator by pressing rubber cap. (As marked in the figure).

IMPORTANT: Ensure red band will move to the original position after resetting.

CHAPTER - 10

FUEL SYSTEM

(A) Description

The fuel tank is enclosed below sheetmetal platform and is bolted with side part support.

The filler cap incorporates an air vent hole and a gasket.

The tank is rubber mounted on front and which are bolted to the clutch housing.

At the rear, the scuttle panel, instrument panel and filler plate are all secured to the tank surrounds. A fuel gauge sender / Tank unit is fitted on the tank for fuel level gauge.

The steering column and governor control rod run through a tube in the fuel tank and are enclosed by the tank surrounds.

(B) Removal

1. Drain the tank completely, through either water drain tap.
2. Disconnect the fuel pipe at the tap or water trap and disconnect the fuel return pipe.
3. Raise the hood, and disconnect the battery.
4. Remove the battery.
5. Remove the scuttle panel and the filler plate.
6. Carefully free the instrument panel. Disconnect the oil pressure pipe from the gauge. The machine is fitted with a heat indicator, the transmitter must be removed from the cylinder head. Disconnect the tractor meter drive at the instrument panel.
7. Turn the steering wheel to the full left hand lock and remove the steering wheel retaining nut and washer. Remove the steering wheel from the keyed taper.
8. Remove the two cap screws securing the governor control bracket to the steering column. Disconnect the governor lever to cross shaft control rod and withdraw the governor control lever complete with bracket.
9. Remove / disconnect the wire connection from the Tank unit / Fuel gauge sender.
10. The tank is rubber mounted onto the front and rear scuttle supports. Free the slacken off the securing bolts and locknuts. Lift the tank upwards and away from the steering column housing. Remove the lower mounting pads.

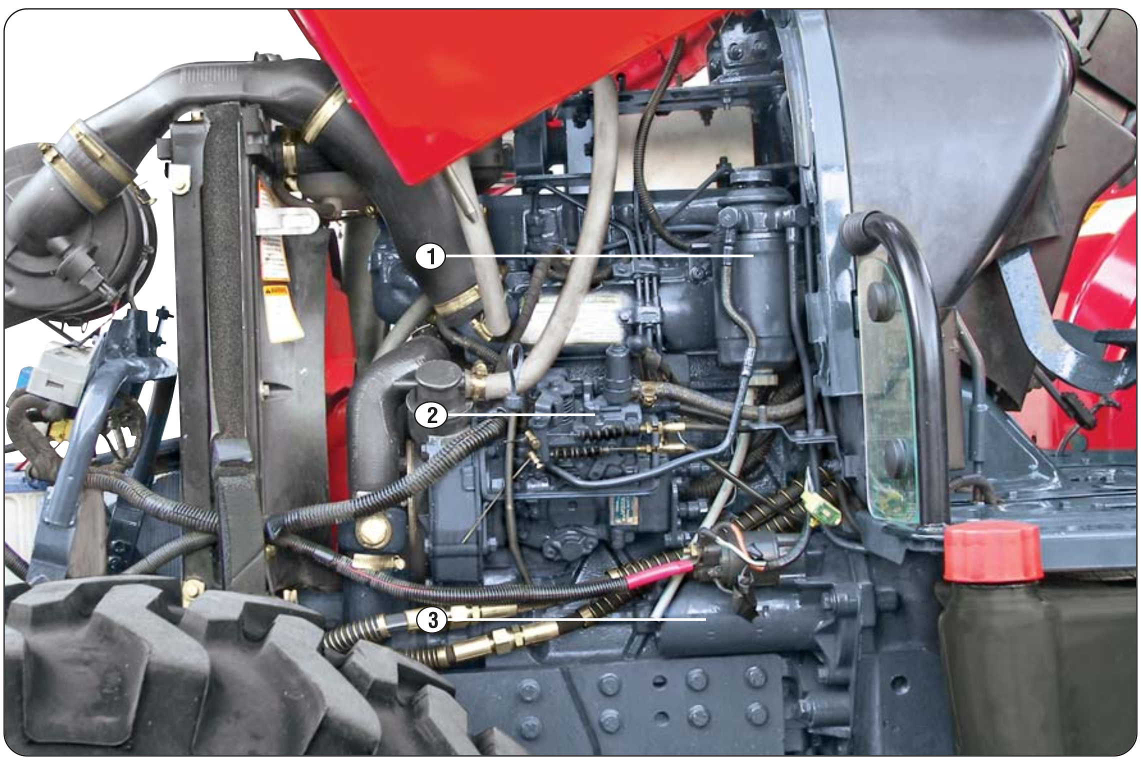


Fig.1 Left Hand view of Engine

1. Fuel Filter 2. Rotary Pump 3. Starter Motor

(C) Cleaning, Inspection and Repair

1. Clean out the tank thoroughly. Use clean fuel. Remove any signs of rust or corrosion.
2. Check the tank for leaks.
3. Ensure that the filler cap air vent is open and clean.
4. Check the 'Tank unit' Fuel gauge sender is working properly.

(D) Installation

1. Reverse the removal procedure.
2. Fill the tank with clean fuel and bleed the system in the following sequence.

(E) FUEL TAP (VALVE)

The Fuel Tap (1-2) is located between the Feed Pipe from tank to filter. The Screw type Valve arid Seal Assembly has two positions : off and on The fuel is allowed to flow while the valve is screwed out and vice versa.

Remove the fuel cock and blow with compressed air to clean it. Replace it after cleaning and check for any leakage.

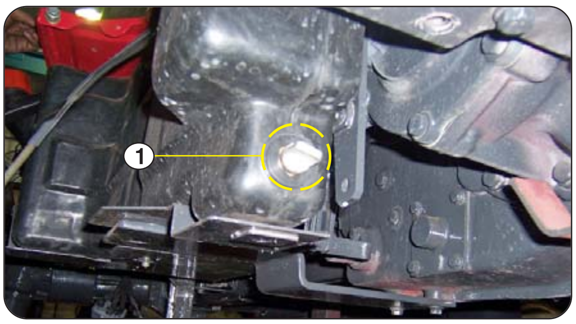


Fig.2

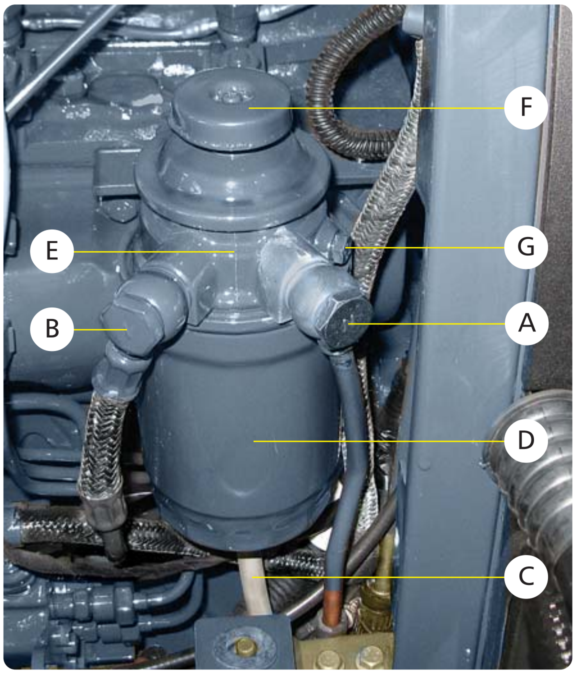


Fig. 3

A. Fuel Filter Inlet
B. Fuel Filter Outlet
C. Drain Pipe
D. Fuel Filter
E. Fuel Filter Adapter
F. Hand Primer
G. Air Bleeding Screw

NOTE: Drain water once in a week or earlier if water contamination is excessive. Continued driving with water accumulation in fuel filter will cause damage to fuel pump / other fuel system components.

NOTE: Replace fuel filter at the recommended period or whenever it gets clogged. Discard the old filter and do not repair or clean the filter.

Always fit the spin-on filter dry.

CAUTION :

Do not hold key at engine start position for more than 10 seconds continuously. If more engine cranking is needed try again after 30 seconds.

Always close the air vent screw except for bleeding fuel lines other wise, engine will run irregularly or stall frequently.

F. FUEL FILTER

1. Function

This filter provides clean, moisture free fuel for the injection process. A hand primer is provided to manually remove excess air from the fuel filter and fuel lines.

Major Components:

- Hand Primer (F)
- Air Bleeding Screw (G)
- Fuel Filter (D)

2. Theory of Operation

Fuel enters the filter at inlet (A) and flows through the filter element separating water if contents before flowing through outlets (B) to the fuel injection pump.

Since water and contaminants settle at the bottom of the sediment bowl, a drain plug is provided at the bottom of the filter. Drain water in fuel, by loosening drain plug once every 50 hrs. of operation.

Drain water in fuel, by loosening this plug once every 50 hrs. of operation.

3. Bleeding Fuel System

1. Loosen the air bleeding screw (G-3) on the filter and push hand primer (F-3) down. The hand primer automatically retain it's original position due spring & fuel will suck from the fuel tank.
2. Repeat priming till flow of fuel free of air is not observed.
3. Loosen fuel inlet connection on the injection pump and operate the hand primer pump untill all air is displaced. Tighten the connection.
4. Release the air bleed screw on the injection pump and again use the hand primer untill all air is displaced. Tighten the connection.
5. Repeat operation '1' to expel and air which may have been drawn in.
6. Turn the engine for one half revolution and repeat item 2 to ensure complete scavenging of transfer pump.
7. Loosen the connections on the high pressure pipes at the injection nozzle. Turn over the engine until fuel flows from pipe free of air, then re-tighten the connections.

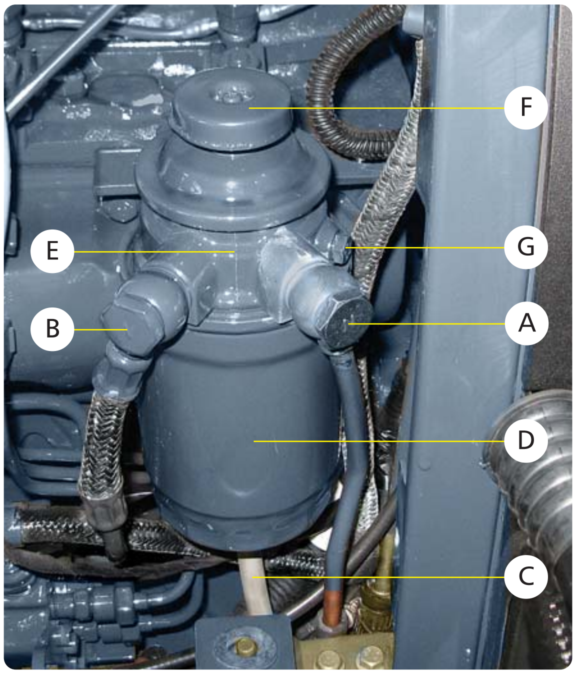


Fig. 3

4. Servicing the fuel filter

1. To drain water in fuel, loosen the drain plug upto 1 or 2 turns. During loosening drain plug, place a small tray to collect the water coming from pipe (C). Retighten the drain plug by hand.
2. It is recommended to replace the fuel filter every 500 hrs.
3. To remove Filter, unscrew the filter (D) from Adapter (E).
4. Check O'rings of fuel filter for any crack / damage. Smear oil on the new O'ring before installation.
5. Clean the Adapter with clean diesel from inlet and outlet. Ensure no dirt, foreign particles entangled in flap valves or filter head.
6. Assemble the new filter. Do not over tighten.
7. Prime the system and bleed the filter. Tighten the bleeding screw.

5. Removal

1. Close the fuel tap at the tank end.
2. Disconnect all fuel pipes at the filter.
3. Remove the cap screws securing the filter to the manifold and remove the filter.

6. Installation

1. Reverse the removal procedure.
2. Bleed the fuel system.

G. INJECTORS

1. Description

The performance of the modern High speed engine depends largely upon proper functioning of its fuel injection system. For efficient combustion and optimum engine performance it is imperative that the injection nozzles are always in functionally satisfactory condition so that accurately metered quantities of fuel from the injection pump are injected into the engine combustion chamber as follows :

a. A perfectly atomized condition for proper mixing of the fuel with compressed air. The fuel delivery is exactly timed.

b. Correct spray dispersion and pattern.

c. Under proper specified opening pressure & temp.

The injection nozzles are designed to ensure that fuel injected into the combustion chamber mixes with the compressed air. At the end of the injection the nozzles must not only close instantly but completely as otherwise any after - injection will lead to coking and will affect atomization and induce on irregular exhaust beat. Nozzle coking can also disturb spray from the prescribed directions.

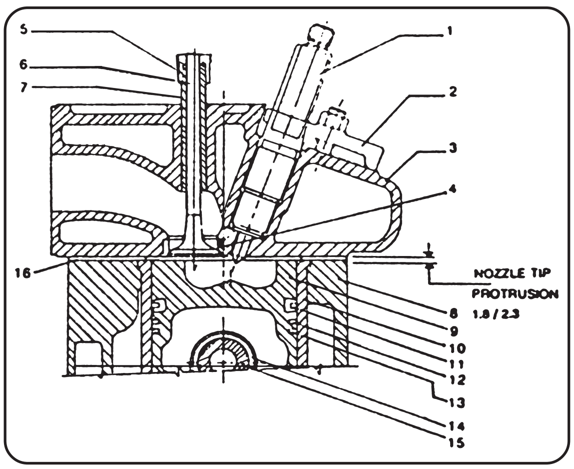


Fig. 4

Cross-Sectional View of Engine

1. Injector	9. Piston
2. Clamp	10. Liner
3. Cylinder Head	11. Keystone Ring
4. Valve Seat Insert	12. Bevelled Ring
5. Valve Seal	13. Oil Control Ring
6. Valve	14. Connecting Rod
7. Valve Guide	15. Piston Pin
8. Cylinder Block	16. Gasket

The needle seat of the nozzle body, which is exposed to exceedingly high pressures and temperatures, must not develop noticeable wear under the constant hammering action of the nozzle needle.

Although the nozzles have been designed to bear these severe working conditions, the nozzle needle and body seats affected over a prolong period of operation. Dribbling, incorrect opening pressures, improper spray patterns and leaky nozzles affect the engines performance. The clearly visible symptoms are :

1. Smoky exhaust i.e black or in some cases white.
2. Increased fuel consumption.
3. Overheating.
4. Loss of power.
5. Engine knocking, misfiring and uneven running However, complaints of the above nature may not be solely due to malfunctioning of the nozzles. Other contributory factors such as poor compression, injection timing cooling problems, exhaust / intake restriction, Lubrication systems problems, operating conditions, etc. should also be investigated.
6. Fuel filtration.
7. Quality of high pressure pipes.
8. Careless installation of injectors on the engine.

2. Injector Nozzle Removal

a. Disconnect the high pressure pipes connecting the nozzles and injection pump.

b. Disconnect the fuel leak off pipe assembly from the nozzle.

c. Remove the injector retaining nuts and conical washers securing the injector clamps.

d. Remove the injectors carefully and the sealing copper washer from the cylinder head.

NOTE: Cover the cylinder head openings and plug the inlet and leak - off openings of injectors with protection caps.

Wipe off dirt and loose carbon from each injector with a cloth and clean the tip with a brass wire brush.

3. Inspection and repair

For inspection and repair of nozzles contact MICO BOSCH / STANDADYNE Dealer / Service.

4. Installation

Reverse the removal procedure using New copper washer and tighten to the specified torque. Be sure that the fuel overflow banjo in the injector is towards the front of the engine.

After the assembly of the injector nozzles into the cylinder head is completed, nozzle protrusion of 1.7 to 2.3 mm is to be ensured. The cross sectional view of the engine showing the nozzle tip protrusion is show in fig.6.

FUEL INJECTION PUMP

a. Description

The diesel engine which is a compression ignition engine, utilizes the high temperature of highly compressed air to ignite the injected fuel charge.

Therefore, the fuel must be injected in to the combustion chamber within a precisely defined period of time.

The MICO BOSCH / STANDADYNE VE type rotary pump is flange mounted on the engine through adapter plate, with three studs and spring washers and flat washers and nuts.

Refer the calibration chart for calibration if performance deterioration is observed on account of Fuel Injection Pump malfunctioning

b. Lubrication of DI engine fuel injection pump

The pump is lubricated by the diesel in FIP.

c. Removal

1. Remove the fuel pipe to the injection pump and the return pipe from the injection pump to filter.
2. Remove the injection pipes from the injectors and pump.

NOTE: Disconnecting the pipes at the injection pump and bending the out of the way will cause faulty reassembly. They must be completely removed.

3. Disconnect the throttle rod and fuel shut-off rod at the injection pump.
4. Remove the injection pump gear cover.
5. Remove the nut securing the injection pump gear.
6. Remove the three nuts securing the injection pump to the adapter plate on the crankcase front plate and withdraw the pump.

NOTE: Kindly service your Fuel Injection System from Authorised Dealer before installation.

d. Installation

1. Reverse the removal procedure ensuring that the key in the gear is in engagement with the keyway in the pump flange and that the scribed mark on the pump mounting flange is mid-way between the marks on the crankcase front plate.
2. Bleed the fuel system.

NOTE: Calibration chart of Fuel injection Pump different models are given for your information only.

e. Adjustments

Refer Service Instructions for Fuel Injection Timing Rotary FIP.

f. Fuel Injection Equipment

Normal care and cleanliness are required in handling fuel and fuel injection equipment and some additional points are as follows :

IMPORTANT FACTORS ON PREVENTIVE MAINTENANCE :

(i) Daily drain any water or sludge accumulation from the filters through the drain plug provided in the filter bowl.

(ii) Do not run the vehicle or tractor with low fuel level in the tank to prevent airation in the fuel supply to the pump. It is very important to prevent the pump from running dry as the lubrication to the pump barrels plungers is through diesel oil only.

KSB DEVICE

This device helps engine for quicker start during the cold ambient temperature.

The KSB timer relay supplies 12 Volt electric current to solenoid. The Solenoid moves “Automatic Timing Device” piston against the spring pressure which increases fuel pressure. This effects advancing of injection timing.

The KSB timer remain “ON” for 20 minutes and run. It is switch “OFF” after 20 minutes restoring the normal timing. The KSB timer relay is switch “ON” everytime the tractor is switch “ON” from “OFF” condition.

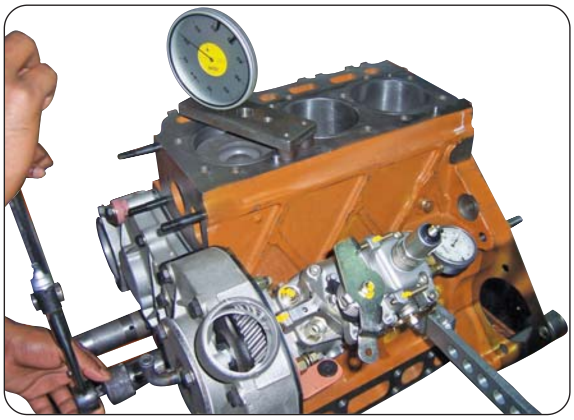


Fig. 5

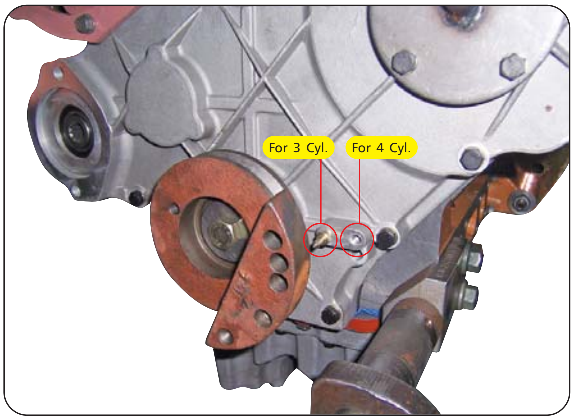


Fig. 6

SOP for Rotary FIP timing checking on tractor

1) Remove high pressure pipe at Fuel injection pump end.

2) Remove special plug provided at backside of FIP & insert dial (ASN0600G013) with adapter as shown in Fig.1.

3) Rotate crankshaft pulley in clockwise direction (as seen from flywheel side) till the pointer matches with crankshaft pulley groove. Ensure first cylinder piston at compression TDC.

4) Set dial gauge to read zero at above match position.

5) Rotate pump gradually to upward / downward direction till dial gauge showing specified reading.

Injection Timing (mm@tdc)

For 4035 / 3535 — 0.95 ± 0.02 mm

For 4535 / 5035 — 1.00 ± 0.02 mm

Points to consider in field on pumps fitted with IKSB

1. It is advised not to attempt to remove the IKSB unit or loosen it for priming purposes under any circumstances. Bleeder screw in the distributor head can be loosened to remove air trapped in FIP.

2. Ensure that 12V is connected to IKSB unit when abnormal smoke is seen in the field during cold operation.

3. When the IKSB unit is energized / de- energized, marginal difference in noise may be observed due to advance in cold and retardation in hot conditions – This is absolutely normal.

4. Do not attempt to handle the pump / lift it holding the IKSB unit.

5. When the vehicle fails to start in cold condition, check if the 12V is connected to IKSB solenoid. Check if battery voltage is 12V.

6. During hand priming using filter ensure that the ignition key is OFF, bleeder screw in filter is loose. DO NOT attempt to prime the system with ignition key ON as it may impart additional resistance to filter hand primer. As a last resort bleeder screw in the pump (center of DV ports) may be opened for priming purposes.

7. In case of suspected problem with the pump, the pump is to be handed over to the authorized BOSCH dealer in undisturbed condition, IKSB should be in undisturbed condition.

8. IKSB unit of one pump should in no circumstance be replaced on another pump without calibration of the pump.

Fuel Injection Pump Calibration Chart - 3535

Robert Bosch GmbH Stuttgart	Test Specification mecanically-governed Distributor pumps Kundendienstvorschrift	PV-No. ....: 1 469 423 044 Change............: 0 17.03.2008 Status...............: vorläufig gesperrt für KH / Intranet Page ....: 1 / 2 Date of print.....: 21.05.2008 10:45

pump ....: **0 460 423 044** — **VE 3 / 12 F 1400 R 2057-1**
Customer Drawing..........: **A460907349** — Engine..............: **CE 35 Tier- IV**
Power ....: **27,7** kW
Customer........................: **M&M - TD** — pist. swept vol..: **1,9** l
Customer Order no.........: — Application : **Tractor**

test conditions

calibr. nozzle-and-holder assembly.....: 1 688 901 114
test fuel-injection tubing.......................: ⌀a 6,00 x ⌀i 2,00 x 450 mm
calibrating oil.......................................: ISONORM
calibration-oil inlet pressure.................: 35,00 ± 5,00 kPa
calibration oil Overflow temperature....: 55 ± 1,00 °C
opening pressure ....: 20,7 ± 0,3 MPa
overflow restriction.......................⌀..: 1,10 mm

Test point	Index	n 1/min	Sollwert/ Tolerance	distribution	DA-Sollwert/ Tolerance	LDA-Pressure hPa	ELAB V	TV %	KSB V
overflow quantity at pump (l/h)									
USMO		1400	120,0 ± 12,0				12		0
supply pump pressure (MPa)									
PSEP		1200	0,64 ± 0,05				12		0
PSO		1400	0,68 ± 0,07				12		0
PSU		500	0,36 ± 0,07				12		0
PKO		650	0,67 ± 0,07				12		12
PKU		400	0,59 ± 0,07				12		12
timing device travel (mm) N									
SVEP		1200	1,5 ± 0,3				12		0
SVO		1400	2,3 ± 0,4				12		0
SVU		1000	0,9 ± 0,4				12		0
SVKO		650	1,6 ± 0,4				12		12
SVKU		400	0,8 ± 0,4				12		12
full-load start-quantity (mm³/H)									
STAM		100	60,0 ± 20,0				12		0
STO		250	53,0 ± 6,0				12		0
full-load (mm³/H)									
VEP		1400	36,1 ± 2,0				12		0
VU		400	34,3 ± 3,0				12		0
V1		1100	37,0 ± 3,0				12		0
V3		900	35,0 ± 3,0				12		0
speed regulation breakaway (mm³/H)									
ABEP		1475	30,0 ± 6,0				12		0
AB1		1530	1,5 ± 1,5				12		0
idle (mm³/H)									
LEP		500	10,0 ± 5,0	≤ 5,0			12		0
LK		580	1,5 ± 1,5				12		0
L3		425	35,0 ± 5,0				12		0
electric shut-off (mm³/H)									
SPE1		450	1,5 ± 1,5				0		0
mechanical shut-off (mm³/H)									
SPM1		1400	1,5 ± 1,5				12		0
LFB-quantity (mm³/H)									
Q3		1200	17,5 ± 1,0				12		0
DQ2		1200	-11,0 ± 1,0				12		0

Fuel Injection Pump Calibration Chart - 3535

Robert Bosch GmbH Stuttgart	Test Specification mecanically-governed Distributor pumps Kundendienstvorschrift	PV-No. ....: 1 469 423 044 Change...........: 0 17.03.2008 Status..............: vorläufig gesperrt für KH / Intranet Page ....: 2 / 2 Date of print.....: 21.05.2008 10:45

Test point	Index	n 1/min	Sollwert/ Tolerance	distribution	DA-Sollwert/ Tolerance	LDA-Pressure hPa	ELAB V	TV %	KSB V
LFB timing device travel (mm) N									
DS2		1200	-0,5 ± 0,4				12		0
DS3		1200	-0,8 ± 0,4				12		0
control lever spacing, -angle									
Ya			35,0 ± 2,0 mm						
Yb			52,0 ± 4,0 mm						

Remarks:
Pump with IKSB, Single Stage Retard LFB.

Changes:

Nr.	Change	Date	Dept.	Name
0	Layout Based on reference Pump RV16376-1(Sr.No 107 007)	17.03.08	MICO/EVE	MICO/EVE-AAW

Fuel Injection Pump Calibration Chart - 4035

Robert Bosch GmbH Stuttgart	Test Specification mecanically-governed Distributor pumps Kundendienstvorschrift	PV-No.: 1 469 423 042 Change: 0 17.03.2008 Status: vorläufig gesperrt für KH Page: 1 / 2 Date of print: 21.05.2008 10:49

pump ....: **0 460 423 042** — **VE 3 / 12 F 1400 R 2057**
Customer Drawing..........: **A460907349** — Engine.............: **CE 40 Tier- IV**
Power..............: **30** kW
Customer........................: **M&M - TD** — pist. swept vol..: **1,9** l
Customer Order no.........: — Application : **Tractor**

test conditions

calibr. nozzle-and-holder assembly.....: 1 688 901 114
test fuel-injection tubing......................: ∅a 6,00 x ∅i 2,00 x 450 mm
calibrating oil......................................: ISONORM
calibration-oil inlet pressure.................: 35,00 ± 5,00 kPa
calibration oil Overflow temperature....: 55 ± 1,00 °C
opening pressure ....: 20,7 ± 0,3 MPa
overflow restriction........................∅..: 1,10 mm

Test point	Index	n 1/min	Sollwert/ Tolerance	distribution	DA-Sollwert/ Tolerance	LDA-Pressure hPa	ELAB V	TV %	KSB V
overflow quantity at pump (l/h)									
USMO		1400	120,0 ± 12,0				12		0
supply pump pressure (MPa)									
PSEP		1000	0,70 ± 0,05				12		0
PSO		1400	0,78 ± 0,07				12		0
PSU		500	0,48 ± 0,07				12		0
PKO		650	0,72 ± 0,07				12		12
PKU		400	0,65 ± 0,07				12		12
timing device travel (mm) N									
SVEP		1000	1,8 ± 0,3				12		0
SVO		1400	3,6 ± 0,4				12		0
SVU		700	0,7 ± 0,4				12		0
SVKO		650	1,8 ± 0,4				12		12
SVKU		400	0,8 ± 0,4				12		12
full-load start-quantity (mm³/H)									
STAM		100	70,0 ± 20,0				12		0
STO		250	41,0 ± 6,0				12		0
full-load (mm³/H)									
VEP		1400	40,3 ± 2,0				12		0
VU		400	38,8 ± 3,0				12		0
V1		1000	39,2 ± 3,0				12		0
V3		800	37,6 ± 3,0				12		0
speed regulation breakaway (mm³/H)									
ABEP		1475	33,0 ± 6,0				12		0
AB1		1530	1,5 ± 1,5				12		0
idle (mm³/H)									
LEP		500	10,0 ± 5,0	≤ 5,0			12		0
LK		580	1,5 ± 1,5				12		0
L3		425	35,0 ± 5,0				12		0
electric shut-off (mm³/H)									
SPE1		500	1,5 ± 1,5				0		0
mechanical shut-off (mm³/H)									
SPM1		1400	1,5 ± 1,5				12		0
LFB-quantity (mm³/H)									
Q3		1000	20,0 ± 1,0				12		0
DQ2		1000	-10,0 ± 5,0				12		0

Fuel Injection Pump Calibration Chart - 4035

Robert Bosch GmbH Stuttgart	Test Specification mecanically-governed Distributor pumps Kundendienstvorschrift	PV-No.: 1 469 423 042 Change: 0 17.03.2008 Status: vorläufig gesperrt für KH Page: 2 / 2 Date of print: 21.05.2008 10:49

Test point	Index	n 1/min	Sollwert/ Tolerance	distribution	DA-Sollwert/ Tolerance	LDA-Pressure hPa	ELAB V	TV %	KSB V
LFB timing device travel (mm) N									
DS2		1000	-0,5 ± 0,1				12		0
DS3		1000	-1,2 ± 0,5				12		0
control lever spacing, -angle									
Ya			35,0 ± 2,0 mm						
Yb			51,0 ± 4,0 mm						

Remarks:
Pump with IKSB, Single Stage Retard LFB.

Changes:

Nr.	Change	Date	Dept.	Name
0	Layout Based on reference Pump RV16377-4(Sr.No 107 817)	17.03.08	MICO/EVE	MICO/EVE-AAW

Fuel Injection Pump Calibration Chart - 4535

Robert Bosch GmbH Stuttgart	Test Specification mecanically-governed Distributor pumps test specifications sheet	PV-No.: 1 469 424 463 Change: 0 10.10.2008 Status: vorläufig gesperrt für KH Page: 1 / 2 Date of print: 21.10.2008 14:28

pump ....: **0 460 424 463** **VE 4 / 12 F 1400 R 2062-1**
Customer Drawing..........: **A460907391** Engine ....: **MDI 2800 Tier- IV**
Power..............: **32** kW
Customer........................: **M&M - TD** pist. swept vol..: **2,5** l
Customer Order no.........: Application.......: **Tractor**

test conditions

calibr. nozzle-and-holder assembly.....: 1 688 901 114
test fuel-injection tubing ....: ∅a 6,00 x ∅i 2,00 x 450 mm
calibrating oil ....: ISONORM
calibration-oil inlet pressure.................: 35,00 ± 5,00 kPa
calibration oil Overflow temperature....: 55 ± 1,00 °C
opening pressure................................: 20,7 ± 0,3 MPa
overflow restriction............................: ∅ 1,10 mm

Test point	Index	n 1/min	Sollwert/ Tolerance	distribution	DA-Sollwert/ Tolerance	LDA-Pressure hPa	ELAB V	TV %	KSB V
overflow quantity at pump (l/h)									
USMO		1400	120,0 ± 10,0				12		0
USMU		500	90,0 ± 8,0				12		0
supply pump pressure (MPa)									
PSEP		1000	0,82 ± 0,05				12		0
PSO		1400	0,92 ± 0,05				12		0
PSU		500	0,50 ± 0,05				12		0
PKO		650	0,90 ± 0,05				12		12
PKU		400	0,80 ± 0,05				12		12
timing device travel (mm) I									
SVEP		1100	1,8 ± 0,4				12		0
SVO		1400	3,2 ± 0,5				12		0
SVU		700	0,8 ± 0,5				12		0
SVKO		650	2,2 ± 0,5				12		12
SVKU		400	1,0 ± 0,5				12		12
full-load start-quantity (mm³/H)									
STAM		100	93,0 ± 25,0				12		0
STO		250	46,0 ± 6,0				12		0
full-load (mm³/H)									
VEP		1400	37,8 ± 2,0				12		0
VU		500	38,7 ± 3,0				12		0
V3		1100	39,6 ± 2,5				12		0
speed regulation breakaway (mm³/H)									
ABEP		1500	15,0 ± 4,0				12		0
ABU		1450	37,0 ± 6,0				12		0
AB1		1550	1,5 ± 1,5				12		0
idle (mm³/H)									
LEP		500	16,5 ± 4,0	≤ 5,0			12		0
LK		580	1,5 ± 1,5				12		0
electric shut-off (mm³/H)									
SPE1		500	1,5 ± 1,5				0		0
SPE2		500	1,5 ± 1,5				0		0
mechanical shut-off (mm³/H)									
SPM1		1400	1,5 ± 1,5				12		0
LFB-quantity (mm³/H)									
Q3		1100	22,5 ± 0,5				12		0
DQ2		1100	-0,8 ± 4,0				12		0

Fuel Injection Pump Calibration Chart - 4535

Robert Bosch GmbH Stuttgart	Test Specification mecanically-governed Distributor pumps test specifications sheet	PV-No.: 1 469 424 463 Change: 0 10.10.2008 Status: vorläufig gesperrt für KH Page: 2 / 2 Date of print: 21.10.2008 14:28

Test point	Index	n 1/min	Sollwert/ Tolerance	distribution	DA-Sollwert/ Tolerance	LDA-Pressure hPa	ELAB V	TV %	KSB V
LFB timing device travel (mm) I									
DS2		1100	-0,5 ± 0,1				12		0
DS3		1100	-1,2 ± 0,4				12		0
control lever spacing, -angle									
Ya			35,0 ± 1,0 mm						
Yb			51,0 ± 4,0 mm						

Remarks:
Pump with IKSB, Single Stage Retard LFB.

Changes:

Nr.	Change	Date	Dept.	Name
0	Kopie von R2057(Layout Based on reference Pump RV1640334 Sr.No.108811)	10.10.08	DS/EVE-IN	DS/EVE32R-IN-

Fuel Injection Pump Calibration Chart - 5035

Robert Bosch GmbH Stuttgart	Test Specification mecanically-governed Distributor pumps test specifications sheet	PV-No.: 1 469 424 462 Change: 0 13.10.2008 Status: vorläufig gesperrt für KH Page: 1 / 2 Date of print: 22.10.2008 06:21

pump ....: **0 460 424 462** **VE 4 / 12 F 1400 R 2062**
Customer Drawing..........: **A460907391** Engine ....: **MDI 2800 Tier- IV**
Power ....: **37** kW
Customer........................: **M&M - TD** pist. swept vol..: **2,5** l
Customer Order no.........: Application : **Tractor**

test conditions

calibr. nozzle-and-holder assembly.....: 1 688 901 114
test fuel-injection tubing ....: ∅a 6,00 x ∅i 2,00 x 450 mm
calibrating oil ....: ISONORM
calibration-oil inlet pressure.................: 35,00 ± 5,00 kPa
calibration oil Overflow temperature....: 55 ± 1,00 °C
opening pressure................................: 20,7 ± 0,3 MPa
overflow restriction.............................: ∅1,10 mm

Test point	Index	n 1/min	Sollwert/ Tolerance	distribution	DA-Sollwert/ Tolerance	LDA-Pressure hPa	ELAB V	TV %	KSB V
overflow quantity at pump (l/h)									
USMO		1400	120,0 ± 10,0				12		0
USMU		500	90,0 ± 8,0				12		0
supply pump pressure (MPa)									
PSEP		1000	0,82 ± 0,05				12		0
PSO		1400	0,92 ± 0,05				12		0
PSU		500	0,50 ± 0,05				12		0
PKO		650	0,90 ± 0,05				12		12
PKU		400	0,80 ± 0,05				12		12
timing device travel (mm) I									
SVEP		1000	1,7 ± 0,4				12		0
SVO		1400	3,2 ± 0,5				12		0
SVU		700	0,8 ± 0,5				12		0
SVKO		650	2,2 ± 0,6				12		12
SVKU		400	1,0 ± 0,6				12		12
full-load start-quantity (mm³/H)									
STAM		100	100,0 ± 25,0				12		0
STO		250	55,0 ± 6,0				12		0
full-load (mm³/H)									
VEP		1400	41,0 ± 2,0	≤ 3,5			12		0
VO		1200	44,0 ± 2,5				12		0
VU		500	46,0 ± 3,0				12		0
speed regulation breakaway (mm³/H)									
ABEP		1500	16,0 ± 4,0				12		0
AB1		1550	1,5 ± 1,5				12		0
idle (mm³/H)									
LEP		500	10,0 ± 4,0	≤ 5,0			12		0
LK		580	1,5 ± 1,5				12		0
electric shut-off (mm³/H)									
SPE1		500	1,5 ± 1,5				0		0
SPE2		500	1,5 ± 1,5				0		0
mechanical shut-off (mm³/H)									
SPM1		1400	1,5 ± 1,5				12		0
LFB-quantity (mm³/H)									
Q3		1100	22,5 ± 0,5				12		0
DQ2		1100	-11,0 ± 4,0				12		0

Fuel Injection Pump Calibration Chart - 5035

Robert Bosch GmbH Stuttgart	Test Specification mecanically-governed Distributor pumps test specifications sheet	PV-No.: **1 469 424 462** Change: **0 13.10.2008** Status: **vorläufig gesperrt für KH** Page: 2 / 2 Date of print: **22.10.2008 06:21**

Test point	Index	n 1/min	Sollwert/ Tolerance	distribution	DA-Sollwert/ Tolerance	LDA-Pressure hPa	ELAB V	TV %	KSB V
LFB timing device travel (mm) I									
DS2		1100	-0,6 ± 0,1				12		0
DS3		1100	-0,9 ± 0,4				12		0
control lever spacing, -angle									
Ya			35,0 ± 1,0 mm						
Yb			51,0 ± 4,0 mm						

Remarks:
Pump with IKSB, Single Stage Retard LFB.

Changes:

Nr.	Change	Date	Dept.	Name
0	Kopie von R2062-1(Layout based on Reference pump RV16404-2,Sr.no 108846.)	13.10.08	DS/EVE-IN	DS/EVE32R-IN-

Group-D

Clutch

1. SERVICING SPECIFICATION

		SPECIFICATION (FACTORY)	ALLOWABLE LIMIT
A. Clutch disc main	Thickness	0.393 in.	0.295 in.
B. Pressure plate	Flatness	0.004 in.	0.006 in.
C. Diaphragm spring	Mutual difference	—	0.020 in.

2. SPECIFICATIONS

1. Make	Valeo
2. Type of clutch	Single Plate Diaphragm Spring Dry ceramic pad
3. Main drive member (in)	11″

Clearance

1. Release bearing to release finger	0.11 inch
2. Release lever height from flywheel (main drive)	1.71 ± 0.078 inch

Pedal setting

1. Pedal freeplay	1.6 to 1.8 inch

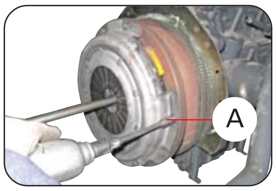
TORQUE

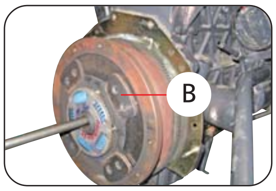
1. Clutch release fork bolt	41 - 50 Nm (30 - 37 lb.ft.)
2. Clutch assy. mounting bolt	21 - 25 Nm (15 - 18 lb.ft.)

2. REMOVAL & REFITMENT OF CLUTCH FROM TRACTOR

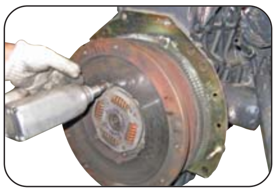
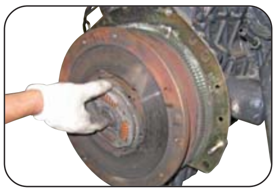
REMOVAL

1. Separate front axle with engine from clutch housing.





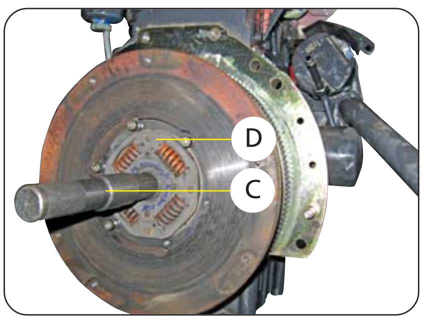
2. Remove clutch assembly by loosening bolts (A) and separate clutch assembly.
3. Remove main clutch plate (B).

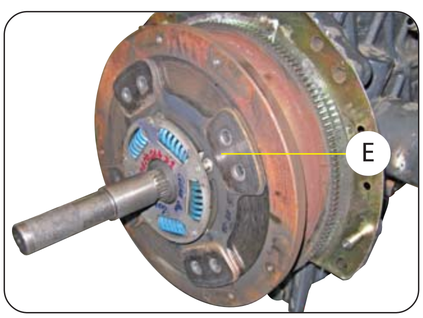
4. Remove PTO clutch damper.

REFITMENT

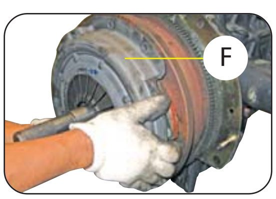
1. Place a guide shaft tool (C) during assembly of PTO damper.

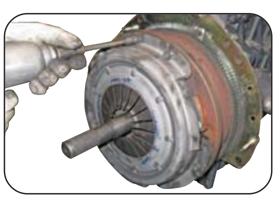


2. Fit PTO damper (D).



3. Slide the clutch plate (E).





4. Fit the clutch assembly (F) and tighten mounting bolts and remove guide shaft tool (C).

Fig. 1

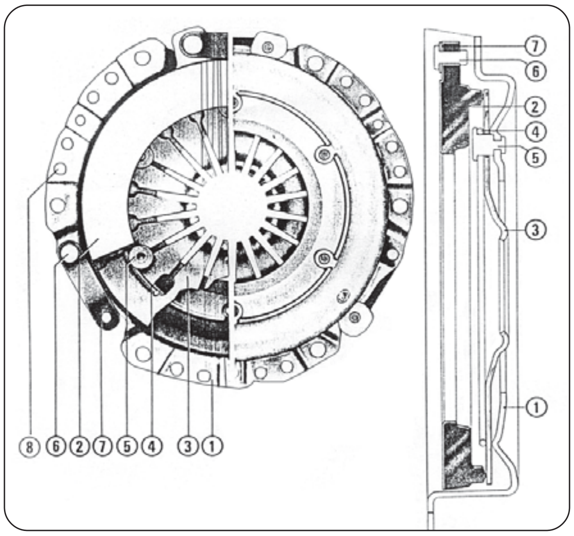


Fig. 2

1. Clutch housing
2. Pressure plate
3. Diaphragm spring
4. Ring
5. Pin
6. Pivot
7. Tangential drive strap
8. Balance hole

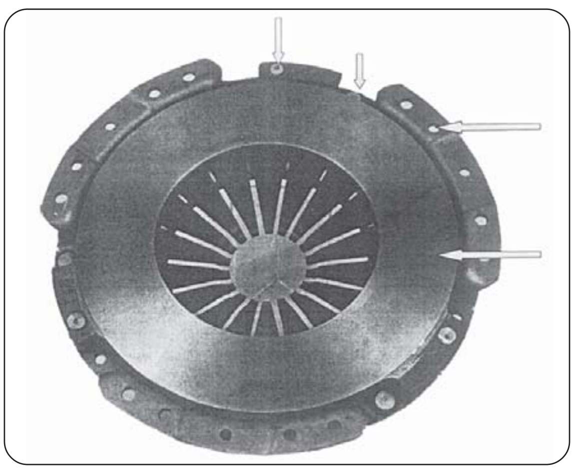


Fig. 3

3. SINGLE PLATE DIAPHRAGM CLUTCH

The single plate clutch is a foot operated dry plate type. It consists of a driven plate assembly, cover assembly and a release bearing assembly. The driven plate assembly is clamped between the flywheel rear face and the cover assembly which is bolted to the flywheel.

The cover assembly is composed of compress steel cover, a diaphragm, a pressure plate, a belleville washer, return spring and antidrop rivets and clutch assembly mounting bolts with washer. The cover assembly is bolted to the flywheel. The diaphragm is made of spring steel, a flat spring or belleville washer fingers are cut out in the center. When assembled to the cover the diaphragm is pressed to create tension in spring and load the pressure plate.

A tangential drivestrap (7-2) maintain the diaphragm against the fulcrum in the cover (C P type cover). The pressure plate is held against the diaphragm by return spring. The return springs are fasten by rivets (6-2) to the cover and pressure plate. Antidrop rivets are provided to prevent excessive movement of pressure plate.

4. REMOVAL

1. To remove the clutch engine must be separated from the clutch housing. Apply parking hand brake and wedge to rear tire.
2. For spliting the tractor between clutch housing and engine refer the procedure as detailed in “Spliting The Tractor”.
3. Punch the mark matching clutch cover and flywheel position to ensure that the clutch is installed in its original position.
4. Remove the cap screws securing the clutch cover assembly to the flywheel for single plate clutch ref. (fig.1).

5. DISMANTLING

a) Gently pierce out (by drilling) both end of the drive strap rivet and remove pressure plate from the cover assembly.

NOTE:

1. Ensure that the hole on the pressure plate and cover are not damaged.
2. Before doing drilling of operating clamp the job should be hold properly to avoid movement.

   Use service fixture as shown in the figure to do the assembly of pressure plate and drive strap. Use press to rivet the drive strap and pressure plate securely.

b) Pierce out (by drilling) cover rivets and remove pressure plate sub assembly.

c) Then gently pierce out (by drilling) delta rivet riveted head and remove diaphragm.

Fig. 4

1. Before doing drilling operation hold cover assy. properly to avoid movement and also care should be taken to avoid deformation on cover by excess load.
2. During drilling operation the holes on the cover should not get disturbed or enlarged.
3. Fit some of the bolts remove the guide studs if used, fit the remainder of the bolts and tighten them to specified torque.
4. Reverse procedure ‘a to m’.
5. Adjust the clutch linkage.
6. Check power steering reservoir oil level. If fitted.

Replacement of facing

Friction facing can be replaced by removing rivets by drilling. Use new set of facing and rivet it with cushion disc by riveting anvil. Ensure that all the rivets are properly riveted : Keep the disc assy. on between centers and check the face out of disc assembly. Face out should be within 1.0 mm.

NOTE:

1. Check for marks or digging of facing rivet on to pressure plate and flywheel face, if so re-machine flywheel face re-machine pressure plate. Machining can be done without dismantling the clutch cover assy. care to be taken to prevent the burrs entering into the assembly.
2. Remove 1.0 mm material from pressure plate face final finishing cut and then verify at H pointing. If all the check points are OK then use cover assy. as it is.

6. CLEANING, INSPECTION & REPAIR

a. Wash all parts thoroughly, except the clutch facings, in a cleaning solvent and blow dry with compressed air.

b. Inspect the facing of the driven member. If badly glazed, burnt, oil soaked or worn, replacement is necessary.

c. Check the hubs of the driven members for excessive wear. Loose rivets, excessive wear at this point is an indication of possible clutch misalignment. Replace, if necessary.

d. Inspect the steel discs of the driven members for cracks. If cracked, a new driven member must be installed. Check the vibration dampener springs of the driven members and see if they are loose or broken or have taken a set through heat. If any doubt exists, replace the driven member.

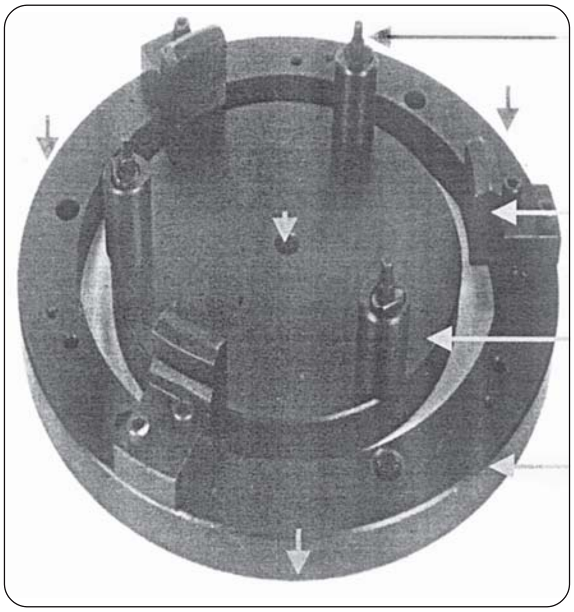


Fig. 5

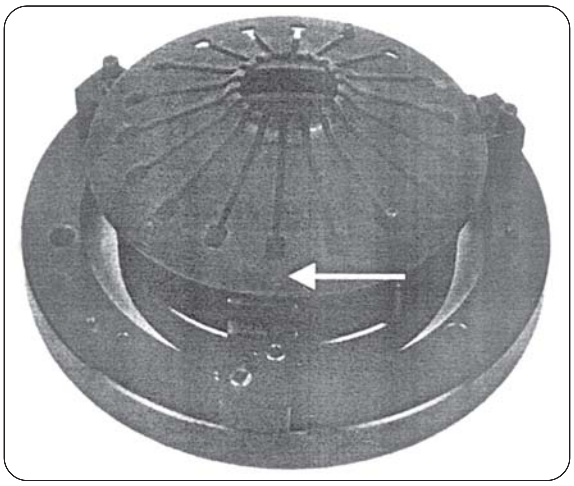


Fig. 6

e. Inspect the pressure plates for warping or heat cracks. To check the pressure plates, place a straight edge across the pressure plate and if a 0.15mm feeler cab be inserted anywhere between the plate and the straight edge the plate must be replaced.

f. Check the clutch release bearing, sleeve and carrier for wear.

g. Inspect the clutch shafts for wear, try the hubs of the driven members on the shafts and check that, both slide freely but without excessive play. Excessive wear of the clutch shaft splines is an indication of possible clutch misalignment. The clutch shaft should be a snug fit in the clutch shaft pilot bearing. If the bearing is worn, remove it with an extractor and install a new bearing.

h. Inspect the flywheel for signs of scoring. Place a straight edge across the machined face of a flywheel and if a 0.15 mm feeler cab be inserted anywhere between the flywheel face and straight edge in any of the checking positions repairs or replacement is necessary.

i. Machining can be made without disassembling the clutch cover. Care to be taken to prevent the burrs entering into the assembly.

Remove 1.0 mm material from pressure plate face and it can be removed in the three phase two rough cut and one final finishing cut and then verify below 4 check points. If all the check points are OK, then use the cover assy. as it is.

NOTE:

1. Too much pedal travel excessively loads the release bearing against thrust spring and reduced travel can result into slippage of clutch plate.
2. Due to wear of lining, pedal play can reduce over a period of time because of lifting up release plate. Re adjustment should be done to avoid excessive wear of release bearing & Date.

7. ASSEMBLY

Use service assy. fixture as shown in the figure to assemble diaphragm to cover preferably use the press for riveting.

a) Assembly of diaphragm

1. Place the diaphragm over the fixture as shown in the fig.6.
2. Slots in the diaphragm should passes through the delta rivet.

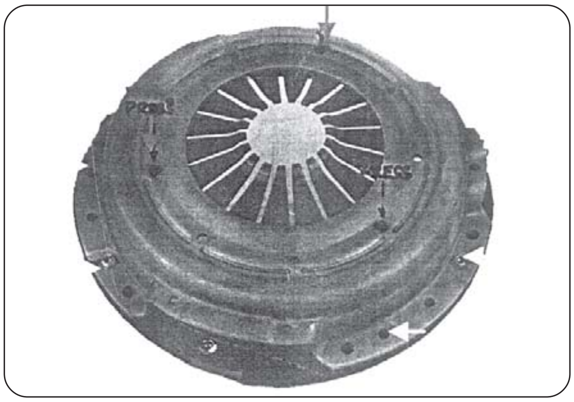


Fig. 7

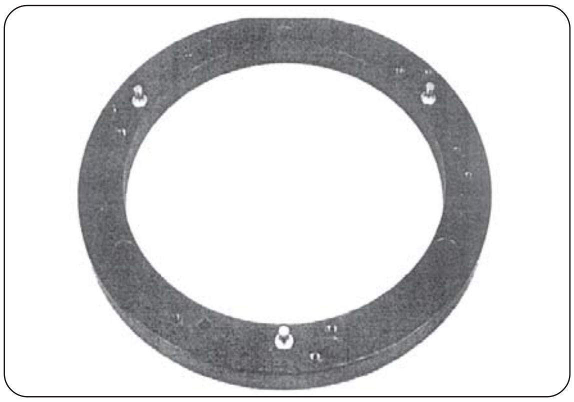


Fig. 8

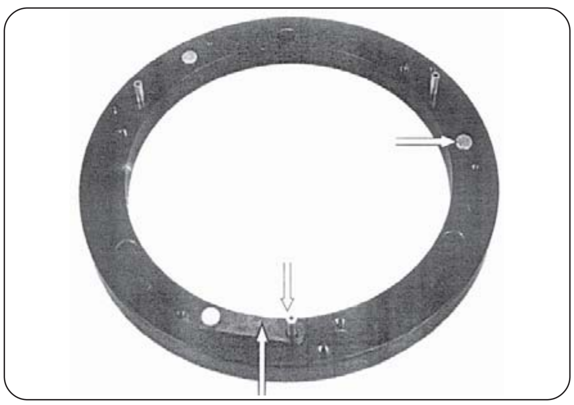


Fig. 9

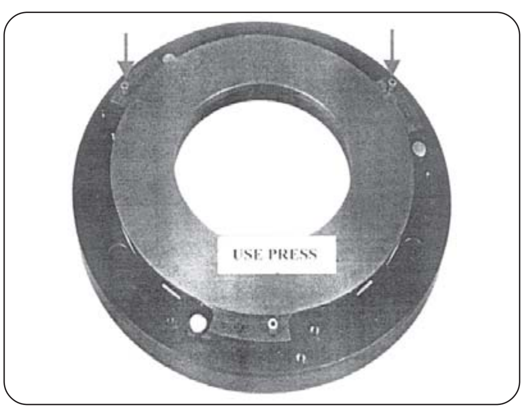


Fig. 10

NOTE: Apply high temperature grease over the belleville area of diaphragm spring both side.

3. Place the cover plate to keep it on the diaphragm and tighten the cover plate against outering.
4. There should not be any gap after fully tightening the cover plate.
5. Preferably use press to rivet the delta rivet.
6. Then loosen the mounting bolts and rotate the inner plate and keep the delta rivet for riveting. See fig.7.

The 9 rivets should be assembled on three stages. Then assemble the pressure plate subassembly into cover subassembly by riveting. The stage process are explained below :

1. Place the outer ring properly on the table.
2. Place pressure plate rivet correspondingly as shown in fig.8.
3. Take 4 nos. of drive strap together and insert it to the pressure plate rivet as shown.
4. By using alignment screw, screw it into the ring as shown (Fig.9). This is mainly to avoid dislocation all straps. The above process is for all the 3 locations.
5. Insert pressure plate on to the pressure plate rivet as shown in fig.10.
6. Use hand press to press all the pressure plate rivet.
7. Unscrew the alignment screws and take out pressure plate sub. assy.

NOTE:

1. Drive strap should not rotate freely after riveting.
2. Riveted (formed) head diameter should be 10 to 11 mm.

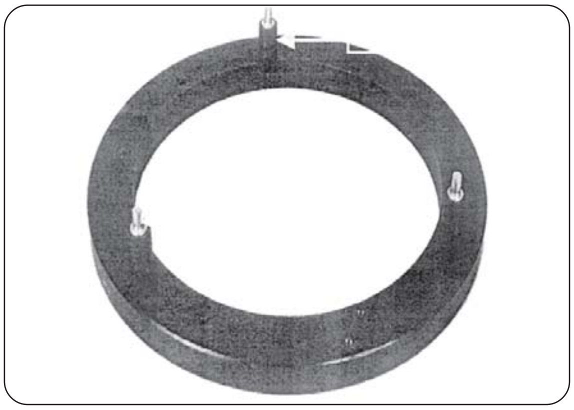


Fig. 11

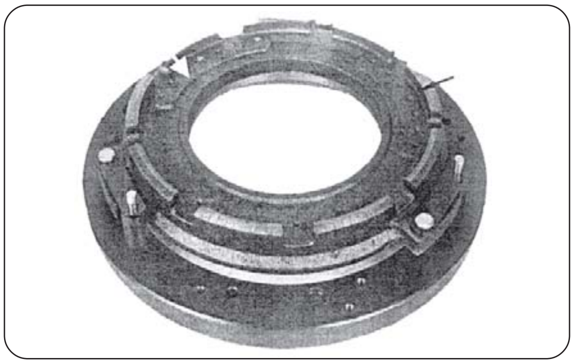


Fig. 12

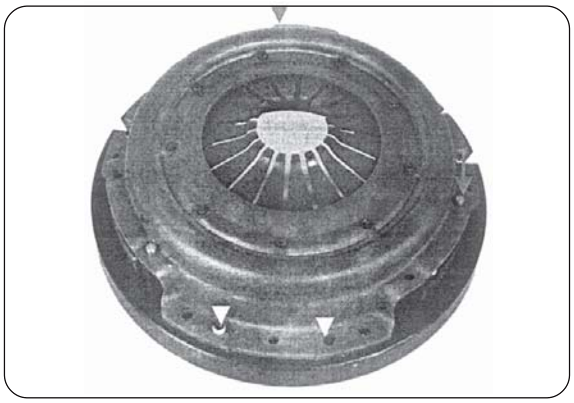


Fig. 13

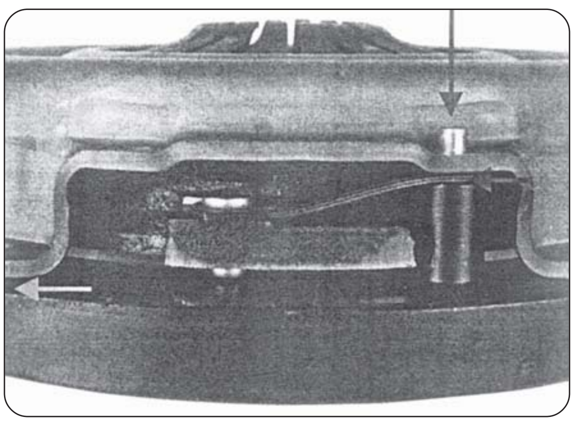


Fig. 14

8. Take 3 bushes and fix it on the outer ring fixture.
9. Keep the pressure plate fixture accordingly as shown in fig.11.
10. Take pressure plate sub. assy. and keep it over the fixture as shown fig.12.
11. Ensure that whether the drive straps are properly seated over rivet.
12. Place the cover & diaphragm sub-assy. over the pressure plate sub-assy. Then tighten the cover sub-assy. against the outer ring.
13. Cover the mounting holes locations are marked thus (fig.13).
14. Use press to rivet the cover.

    Finally loosen the mounting screws and take out clutch assy.

NOTE:

1. There should not be any gap between cover to fixture during assembly.
2. No gap between drive strap and rivet head after riveting.
3. Form riveted head dia 10-11 min.

8. INSTALLATION

a. THE SINGLE PLATE CLUTCH

1. A pilot tool which will slide through the bore of the driven member and locate in the pilot bearing of the flywheel will aid installation of the clutch.

NOTE: The end of a transmission shaft will serve for the single clutch, or a special tool is available. See special tool list.

2. Lift the clutch assembly with driven member, and position it on the flywheel dowel with the pilot tool located in the pilot bearing in the flywheel.
3. Align the punch marks on the cover and flywheel then insert and tighten the securing cap screws and lock washers.

NOTE: The clutch securing capscrews should be tighten a turn at a time by diagonal selection til secured to avoid distortion of the cover flange.

4. Withdraw the pilot tool.
5. Installation is now the reversal of the "REMOVAL" procedure.

9. TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
A. Tractor does not move.	(1) Engine Clutch Faulty (2) Transmission Faulty (3) Rear Axle Faulty (4) Differential Faulty	(1) Refer to 'Engine Clutch' Section (2) Refer to 'Transmission' Section (3) Refer to 'Axles' Section (4) Remove Differential, disassemble and inspect
B. Tractor moves but at reduced speed	(1) Engine Clutch Slips (2) Binding in Transmission (3) Binding in Differential (4) Binding in Rear Axle (5) Binding in Front Wheels	(1) Refer to 'Engine Clutch' Section (2) Refer to 'Transmission' Section (3) Remove, disassemble and inspect. (4) Refer to 'Axles' Section (5) Refer to 'Wheels' Section
C. Tractor will not turn	(1) Steering Mechanism Faulty (2) Brake Pedals Interlocked (3) Differential Faulty	(1) Refer to 'Steering Mechanism' Section (2) Release Pedal Lock (3) Remove, disassemble and inspect
D. Tractor moves but turns to one side.	(1) Brake Dragging on one side (2) Front Wheel Faulty (3) Steering Mechanism Faulty (4) Binding in Differential (5) Uneven Tire Inflation Pressure	(1) Adjust Brakes (2) Refer to 'Wheels' Section (3) Refer to 'Steering Mechanism' Section (4) Remove, Disassemble and inspect (5) Check Tire Pressure

Group-E

Transmission

CHAPTER - 1

TRANSMISSION

35 SERIES - TRANSMISSION

1. SPECIFICATION

Details	Backlash	
	Minimum	Maximum
Shuttle Gears		
Forward	0.006″	0.012″
Reverse	0.006″	0.012″
Speed Gears		
1st Pair	0.007″	0.012″
2nd Pair	0.007″	0.012″
3rd Pair	0.007″	0.012″
4th Pair	0.007″	0.012″
Range Gears		
Low	0.007″	0.012″
Medium	0.007″	0.012″
High	0.007″	0.012″
Bull Gear & Pinion	0.005″	0.010″

2. FLOATS

Sr. No.	Location	Float (in Inch)		Assembly Method
		Minimum	Maximum	
1.	Between gear reverse driving shuttle option & spacer.	0.004″	0.008″	Graded Spacer
2.	Between speed top-shaft rear bearing & speed bearing front	0.004″	0.008″	Graded Bush 1st Gear
3.	Between speed countershaft rear bearing & circlip	0.004″	0.008″	Graded Shim
4.	Between 4WD Idler Gear & the washer Front	0.011″	0.016″	Graded Washer

3. TORQUE CHART

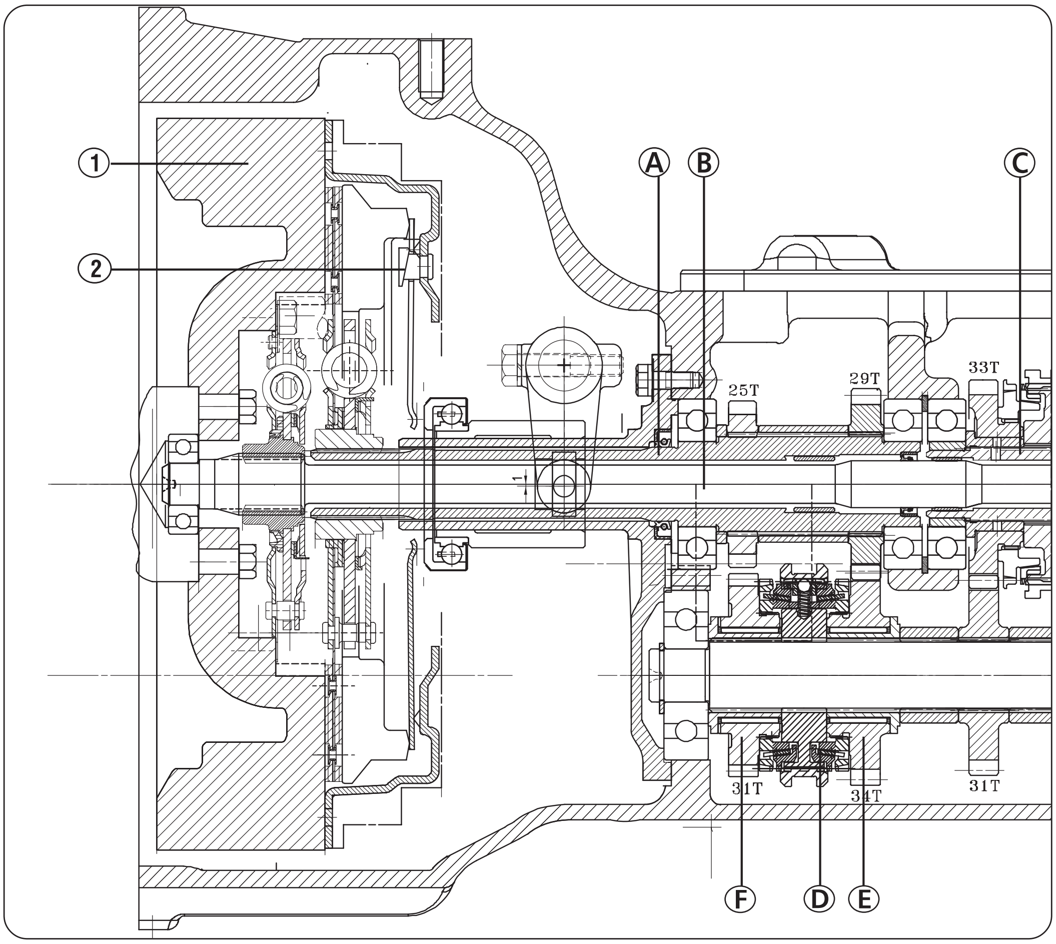
Sr. No.	Location	Size / Description	Min. Torque (N-m)	Max. Torque (N-m)
1	Retainer Main Drive Shaft To Clutch Housing	Flange Bolt – M8 x 16L x 1.25	21	25
2	Upper Cover Clutch Housing	Flange Bolt – M8 x 16L x 1.25	21	25
3	Clutch Window Cover	Flange Bolt – M8 x 16L x 1.25	21	25
4	Forward Reverse Shifting	Flange Bolt – M8 x 16L x 1.25	21	25
5	Speed 1-2, 3-4 Bush	Flange Bolt – M8 x 16L x 1.25	21	25
6	4WD Shifting	Flange Bolt – M8 x 16L x 1.25	21	25
7	Retainer Mid - PTO Bearing	Flange Bolt – M8 x 16L x 1.25	21	25
8	Retainer Main Drive Shaft To Clutch Housing	Flange Bolt – M8 x 16L x 1.25	21	25
9	Bearing Retainer Bull Shaft	Flange Bolt – M8 x 16L x 1.25	21	25
10	Carrier RH To Transmission Case	Flange Bolt – M8 x 16L x 1.25	21	25
11	Stopper Wet PTO Clutch	Flange Bolt – M8 x 16L x 1.25	21	25
12	Upper Cover Transmission Case	Flange Bolt – M10 x 25L	41	50
13	Rear Cover To Transmission Case	Flange Bolt – M10 x 25L	41	50
14	Retainer Rear Axle Carrier	M10 x 35L	41	50
15	Carrier Differential Case LH To Transmission Case	Bolt M12 x 1.25 x 30L	92	113
16	Rear Cover To Bearing Retainer	Bolt M8 x 16	21	25
17	Clutch Housing & Transmission Case Interface	Flange Bolt M12 x 40L	100	124
18	Transmission Case To Mid-PTO Housing	Flange Bolt M12 x 35L	100	124
19	Cover Mid-PTO To Transmission Case	Flange Bolt M12 x 35L	100	124
20	Differential Case To Ring Gear	Bolt M10 x 1.25 x 25.6	62	72
21	Clutch Housing To Transmission Case	Hex. Flange Bolt M14 x 1.5 x 40L	130	150
22	Clutch Housing To Transmission Case	Stud M14 x 50	55	65
23	Clutch Housing To Transmission Case	Flange Nut M14 x 1.5	115	130

Sr. No.	Location	Size / Description	Min. Torque (N-m)	Max. Torque (N-m)
24	Rear Axle Carrier To Transmission Case	Flange Bolt M12 x 85L	100	124
25	Rear Axle Carrier To Transmission Case	Flange Bolt M12 x 30L	100	124
26	Brake Cover Assembly LH & RH	Flange Bolt M10 x 30L	37	46
27	Rear Cover To RH Side Mounting Bracket	Flange Bolt M10 x 30L	37	46
28	Mid-PTO Bush	Flange Bolt M8 x 1.25 x 30	21	25
29	Carrier LH To Differential Retainer	Flange Bolt M8 x 1.25 x 30	21	25
30	Bull Gear To Rear Axle Bolt	Bolt 3/4” UNF x 1-5/8”	265	290
31	Fork Clutch Release Bearing	Bolt M10 x 1.5 x 50L	41	50
32	Bolt Special Shuttle Fork	M8	21	25
33	Bolt Spring Retention	M16 x 1.5	50	60
34	Bolt Hex M10 Idler Shaft 4WD & Reverse	M10 x 1.25	41	50
35	Bolt Special 4WD Shaft Retention	M8	21	25
36	Connector Dipstick	M33 x 1.5	50	60
37	Magnetic Drain Plug	1/2” – 14 NPTF	70	77
38	Breather Clutch Housing	1/2” – 14 NPTF	70	77
39	Lock Nut Counter Shaft	M24 x 2	110	120
40	VTU Mounting	Bolt M10 x 1.5 x 110	41	50
41	VTU Mounting	Stud M10 x 60	57	77
42	VTU Mounting	Bolt M10 x 1.5 x 30	41	50
43	Strainer Flange Removal Bolt	Bolt M8 x 1.25 x 22	21	25
44	Dummy Flange Bolt For Mounting Suction Strainer	Bolt M8 x 1.25 x 22	21	25
45	PTO Control Valve Mounting	Bolt M10 x 1.5 x 20	41	50
46	Rear Cover Transmission Case	Pipe Coupling 1/4” BSP	40	50
47	Rear Cover Transmission Case	Banjo Body M18x1.5	65	75

4. TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
1. Excessive Transmission Noise	• Transmission fluid insufficient • Improper backlash between differential pinion and side gear • Bearing Worn • Wrong grade of oil • Gear teeth broken/pitted • Contaminated Oil	• Replenish • Adjust • Repair • Change • Replace • Change	
2. Gear slip out of mesh	• Shifter fork worn or damaged • Shifter fork spring weaken or damage • Interlock pin fallen • Synchronizer unit damaged	• Replace • Replace • Replace • Repair or Replace	
3. Hard Shifting	• Shifter fork worn out or damaged • Shifter fork bent • Synchronizer unit damaged	• Replace • Replace • Repair or Replace	
4. Gears clash when shifting	• Improper Clutch Setting • Synchronizer unit defective • Clutch does not release • Wrong grade of oil	• Adjust or Repair • Repair or Replace • Adjust • Change	
5. Differential Lock can not be set	• Differential lock shifter fork damaged • Differential lock shifter fork mounting spring pin damaged • Improper movement of differential lock shifter fork.	• Replace • Replace • Adjust	
6. Differential Lock Pedal does not return	• Differential lock shaft spring weaken or damaged • Differential shift/lock ring pin damaged	• Replace • Replace	

FORWARD / REVERSE

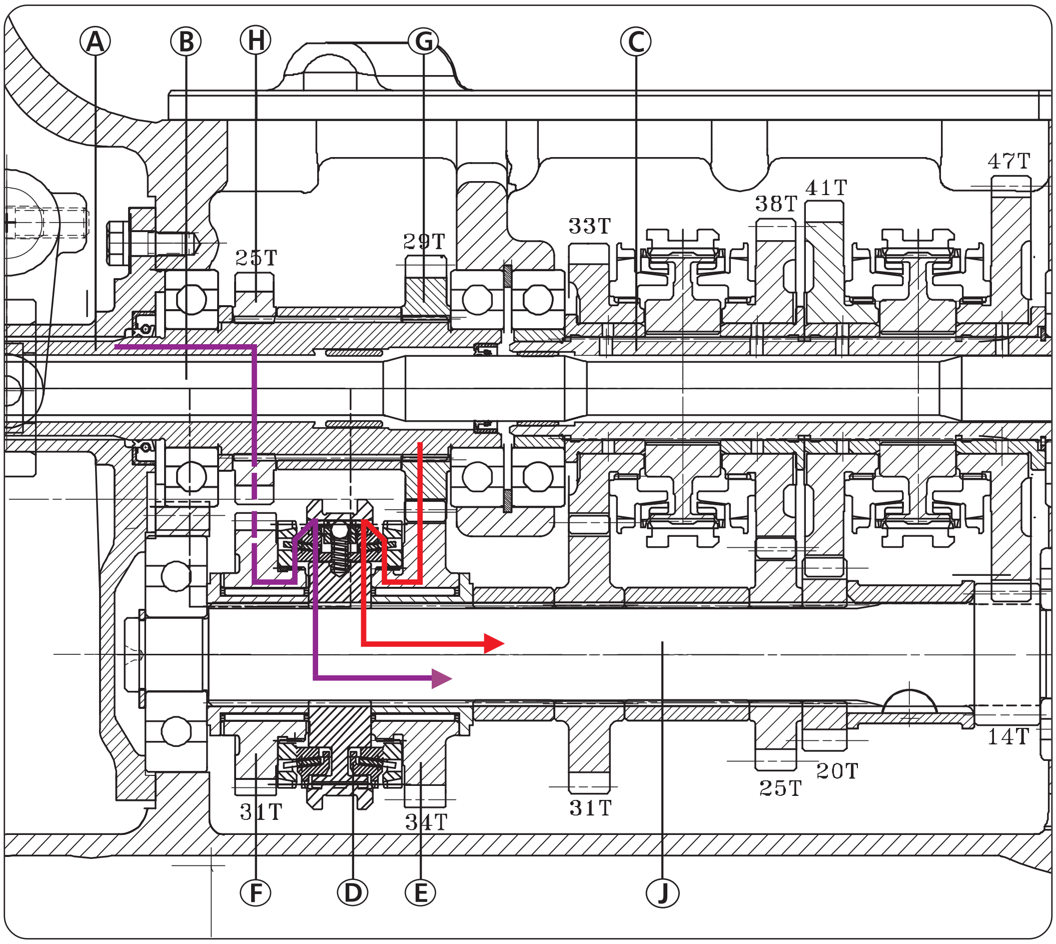


Major Components

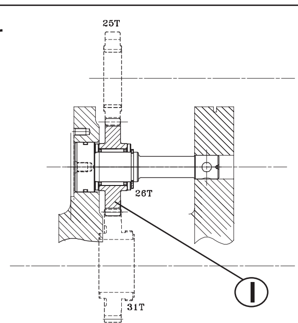
1. Engine Flywheel
2. Clutch Assembly

A. Transmission Drive Shaft
B. P.T.O. Drive Shaft
C. Speed Driving Shaft
D. Forward - Reverse Synchronizer
E. Forward Gear - Driven
F. Reverse Gear - Driven

TRANSMISSION POWER FLOW



Reverse Idler



Major Components

A. Transmission Drive Shaft
B. PTO Drive Shaft
C. Speed Driving Shaft
D. Forward - Reverse Synchronizer
E. Forward Gear Driven
F. Reverse Gear Driven
G. Forward Gear Driving
H. Reverse Gear Driving
I. Reverse Idler Gear
J. Counter Shaft

Forward Gear Power Flow :

Rotary Power from Transmission Driving Shaft (A) flows to Counter Shaft (J) as per following flow.

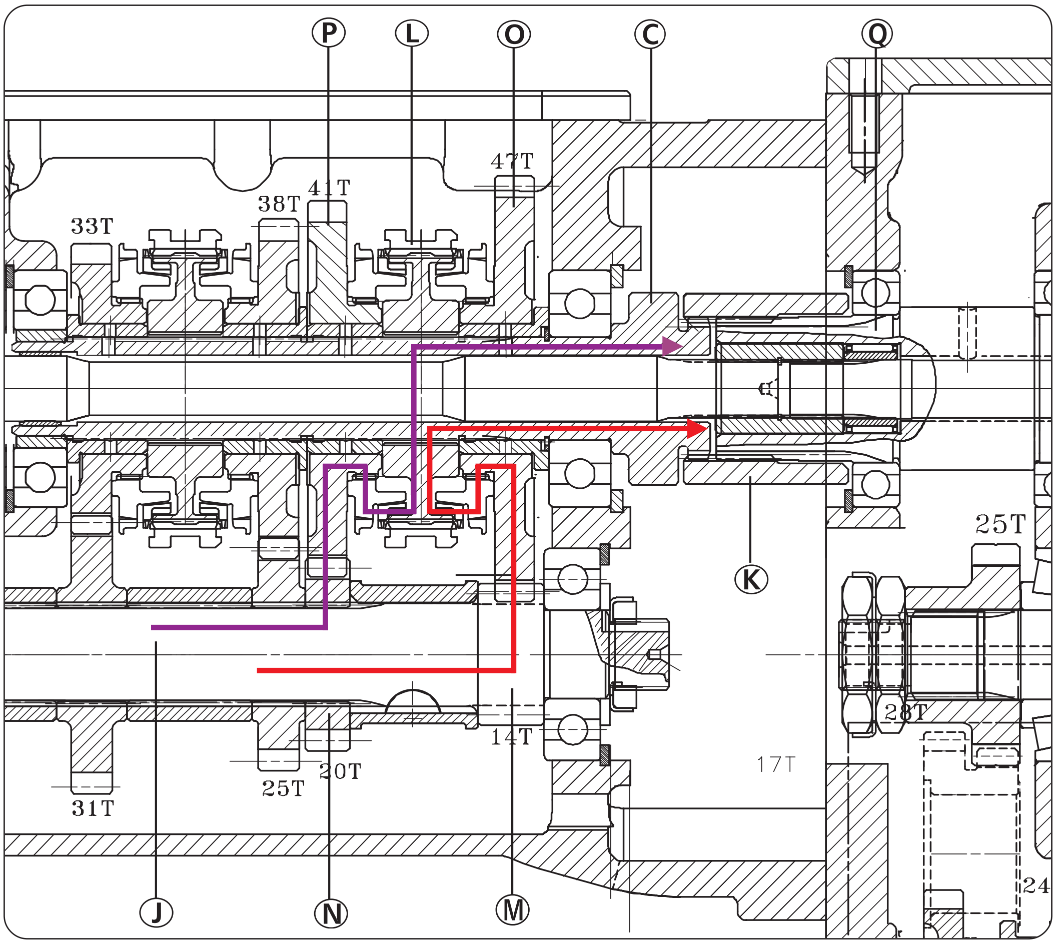
Transmission Driving Shaft (A) to Forward Driving Gear (G) to Counter Shaft Forward Gear Driven (E) then to Synchroniser (D) to Counter Shaft (J).

Reverse Gear Power Flow :

Rotary power from Transmission Driving Shaft (A) flows to Counter Shaft (J) as per following flow.

Transmission Driving Shaft (A) to Reverse Driving Gear (H) to Reverse Idler Gear (I) flows to Counter Shaft Reverse Gear (F) and then to Synchroniser (D) to Counter Shaft (J).

SPEED GEAR SECTION



Major components

J. Counter Shaft
C. Speed Driving Shaft
K. Coupling Range & Speed Shaft
L. 1st - 2nd Synchronizer
M. 1st Gear Driving
N. 2nd Gear Driving
O. 1st Gear Driven
P. 2nd Gear Driven
Q. Range Shaft

The power from Engine via forward and reverse gear rotates the Counter Shaft (J) and 1st - 2nd Synchronizer (L). It equalizes the speed of the involved shafts before the shifting ring engage.

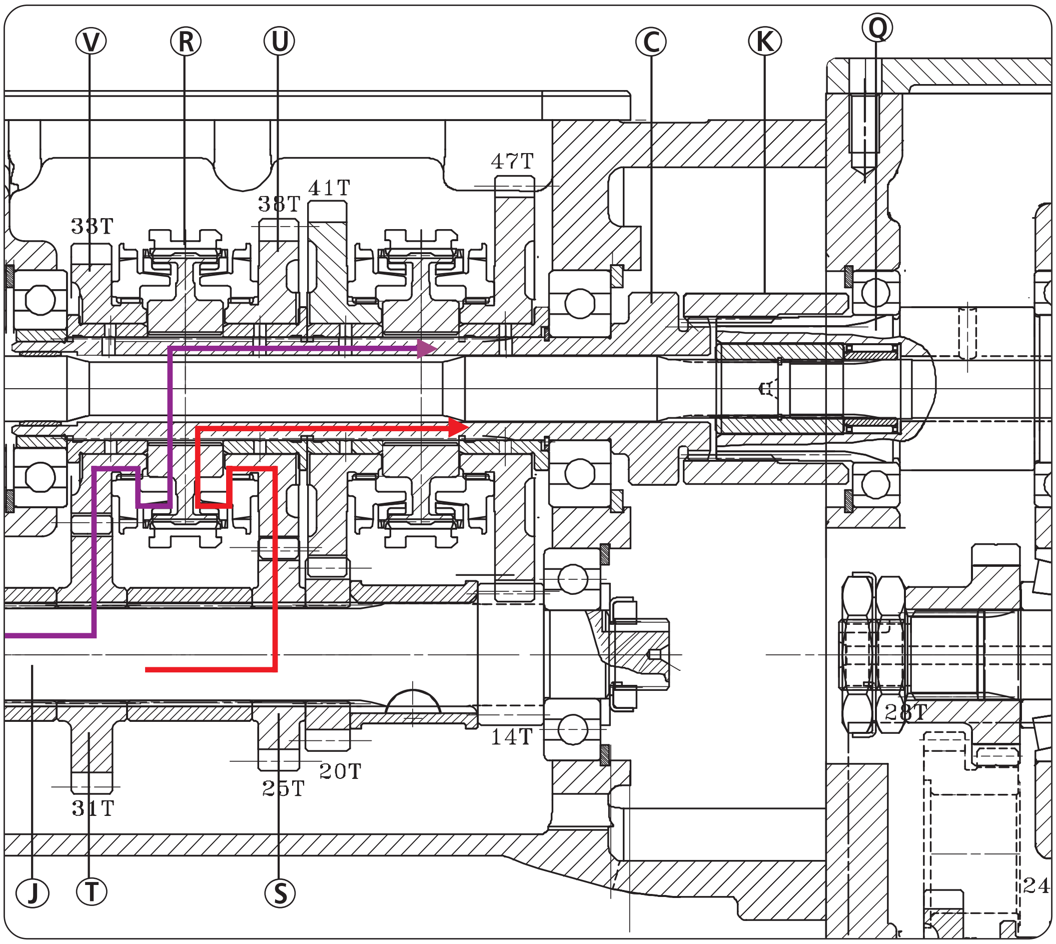
Shifting Ring engaged with 1st Gear

The power flows from Counter Shaft (J) integral gear 1st Gear Driving (M) to 1st Driven Gear (O) on Speed Shaft (C) to the Synchronizer (L) splined with Speed Shaft. Hence power goes to Range Shaft (Q) through coupling (K).

Shifting Ring engaged with 2nd Gear

The power flows from Counter Shaft (J), 2nd Gear Driving (N) to 2nd Driven Gear (P) on Speed Shaft (C) to the Synchronizer (L) splined with the Speed Shaft. Hence power goes to Range Shaft (Q) through coupling (K).

SPEED GEAR SECTION



Major components

J. Counter Shaft
C. Speed Shaft
K. Coupling
R. 3rd - 4th Synchronizer
S. 3rd Gear Driving
T. 4th Gear Driving
U. 3rd Gear Driven
V. 4th Gear Driven
Q. Range Shaft

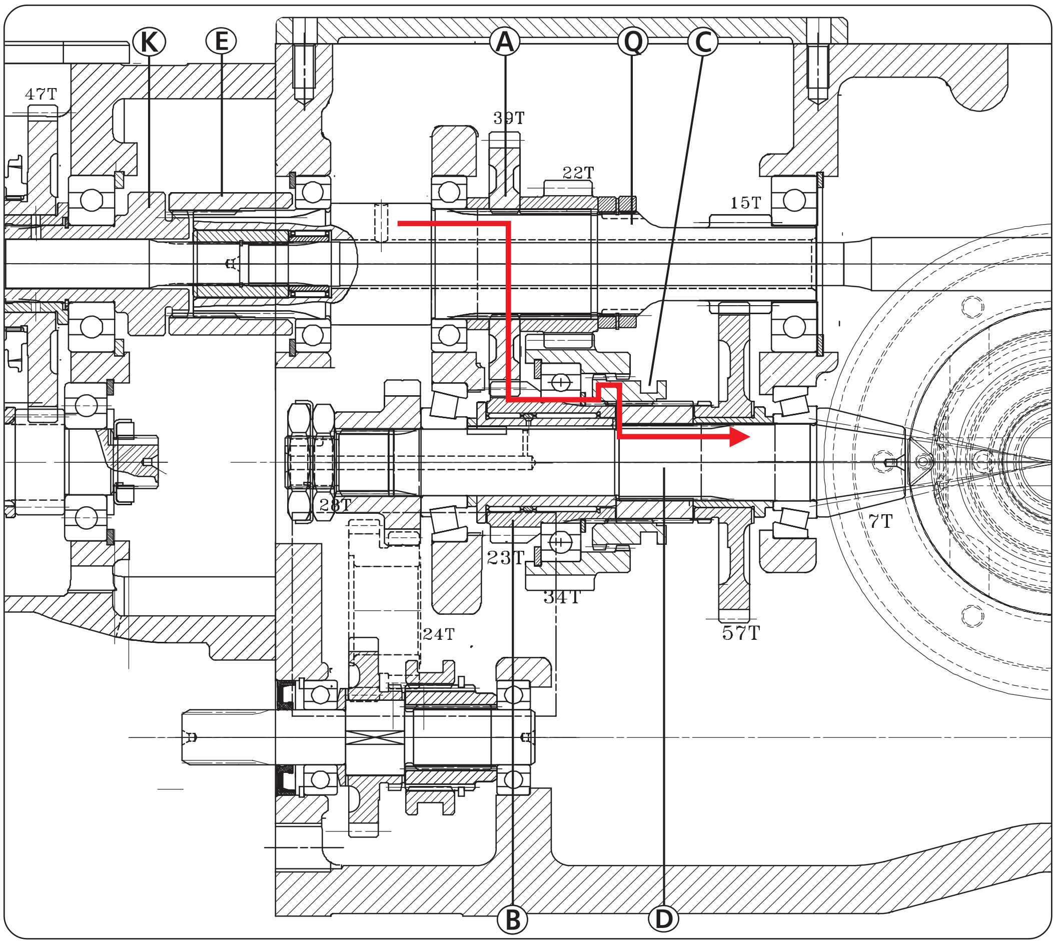
Shifter Ring engaged with 3rd gear

The power flows from Counter Shaft (J) 3rd Gear Driving (S) to 3rd Driven Gear (U) on Speed Shaft (C) to the Synchronizer (R) splined with the Speed Shaft. Hence power goes to Range Shaft (Q) through coupling (K).

Shifter ring engaged with 4th gear

The power flows from Counter Shaft (J), 4th Gear Driving (T) to 4th Driven Gear (V) on Speed Shaft (C) to the Synchronizer (R) splined with the Speed Shaft. Hence power goes to Range Shaft (Q) through coupling (K).

RANGE GEAR SECTION



Major Components

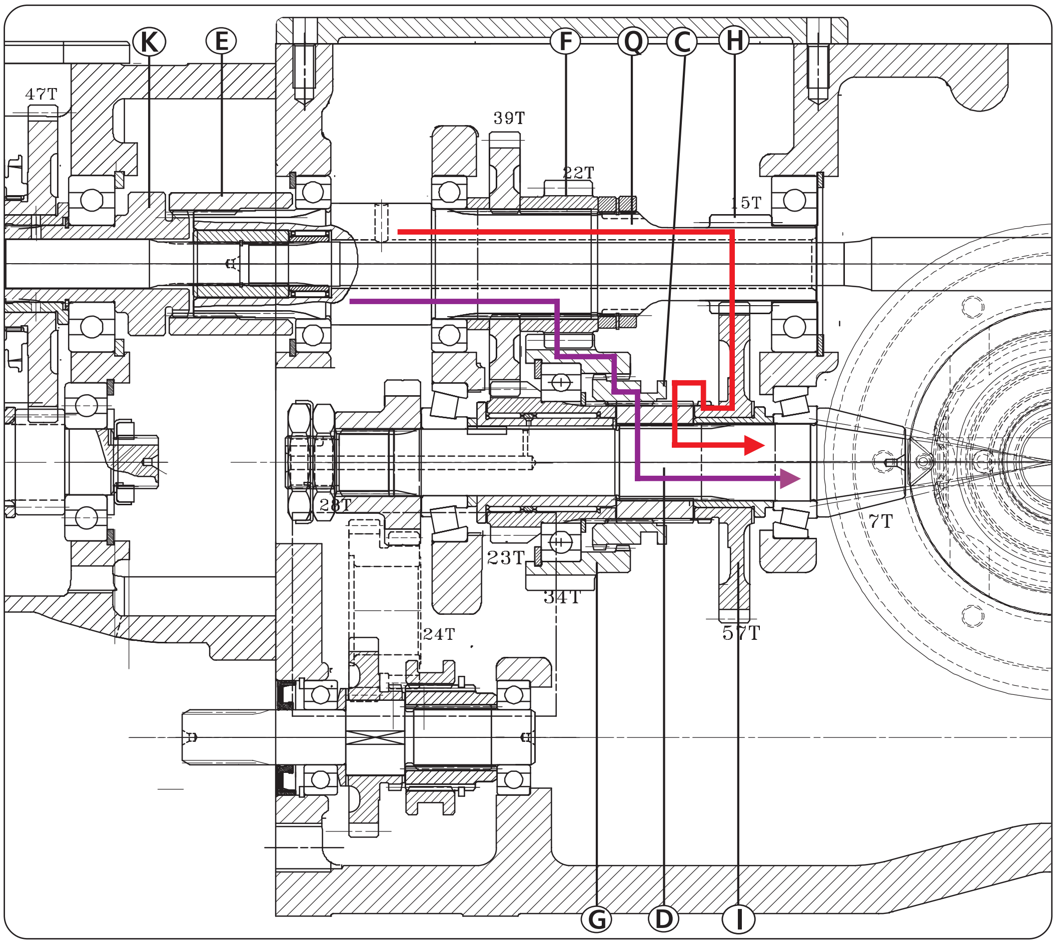
K. Speed Shaft
Q. Range Shaft
A. High Gear Driving
B. High Gear Driven
C. High-Low-Medium Coupling
D. Spline Shaft
E. Coupler

The Range Section arrangement is Constantmesh. The power from Speed Section comes through range shaft through range section. The High and Medium range driving gears are splined to Range Shaft and low gear is integral with the Range Shaft. All range driven gears are free to rotate in the neutral condition on shaft pinion.

Shift Coupling Engaged with high gear

The power from Range Shaft high driving gear (A) flows to high driven gear (B) through coupling (C) to the spline shaft (D) and splined collar.

RANGE GEAR SECTION



Major Components

K. Speed Shaft
Q. Range Shaft
C. High-Low-Medium Coupling
D. Spline Shaft
E. Coupler
F. Medium Gear Driving
G. Medium Gear Driven
H. Low Gear Driving
I. Low Gear Driven

Shift Coupling Engaged with Medium gear

The power from Range Shaft medium driving gear (F) flows to medium driven gear (G) through Coupling (C) to the spline shaft (D).

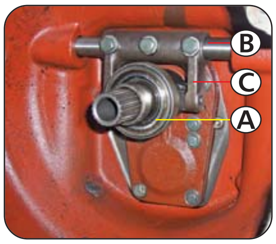
Shift Coupling Engaged with Low gear

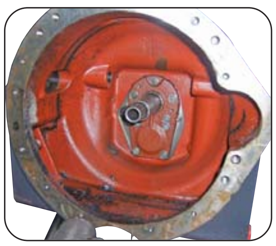
The power from Range Shaft low driving gear (H) flows to low driven gear (I) through Coupling (C) to the spline shaft (D).

SPEED SECTION

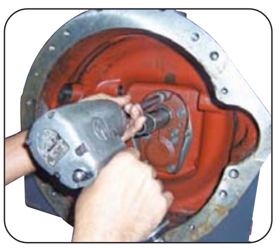
A. Dismantling

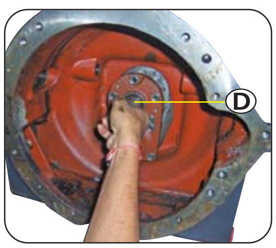
1. Separate clutch housing from engine (Refer splitting Section).
2. Remove steering, return oil supply to top cover.
3. Remove steering gear and brake linkages as well as shifting linkages and other fitment.
4. Support the clutch housing with suitable arrangement.
5. Remove clutch release bearing (A), shaft (B) and fork (C).





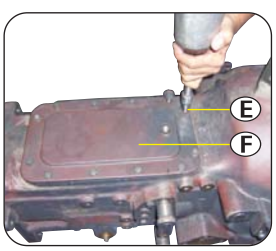
6. Remove front retainer (D).

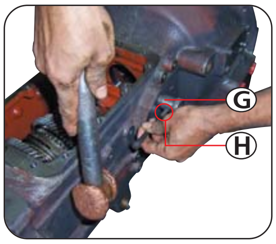


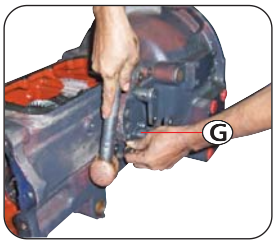


7. Remove PTO input shaft, remove transmission driving hollow shaft along with front bearing. Hold the gears and spacers in position. Remove gears and spacers.

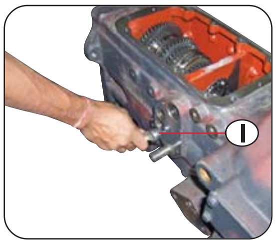
8. Remove top cover (E) by loosening bolt (F).

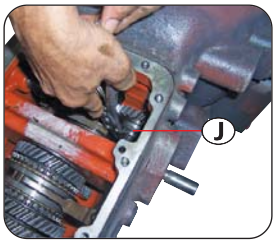




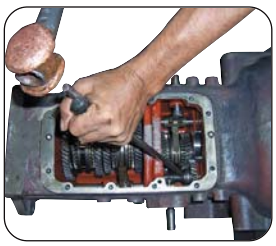


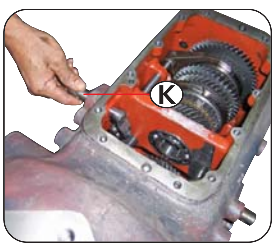
9. Remove forward / Reverse and speed shifting arms (G) by removing spring pin (H).



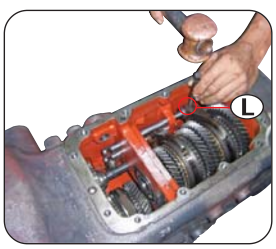


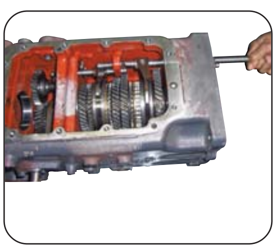
10. Remove forward / Reverse idler shaft positioning bolt (I) and remove idler circlip (J) and assembly by slight tapping.





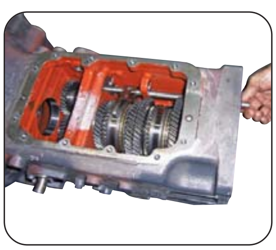
11 Remove forward / Reverse and speed levers (K).

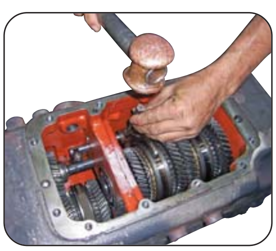




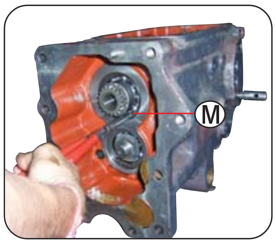
12. Separate forward / Reverse and speed forks removing spring pin (L) by using special tool.

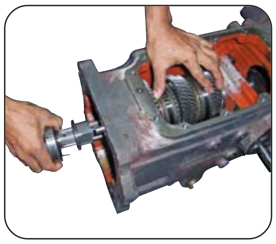
13. Remove speed rail detention bolt, springs and balls, remove forks and rails.





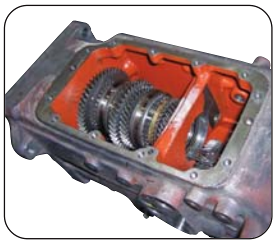
14. Remove middle wall ball bearing by removing circlip top shaft.

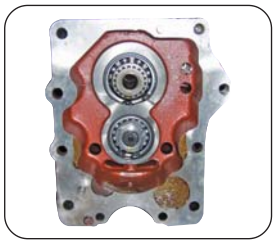




15. Remove speed Top Shaft from rear side by removing circlip (M).

16. Push center bearing through rod from rear side.





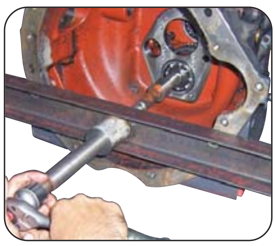
17. Remove 1^{st} and 4^{th} gear bushes.

18. Slide 4^{th} gear towards front and 1^{st} gear towards rear.

19. Push top shaft assembly to front or rear.

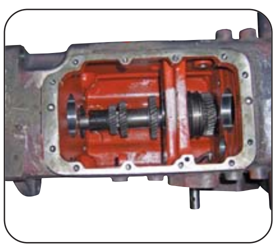
20. Take out 1^{st} or 4^{th} gear.

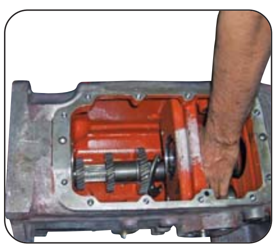
21. Take out Synchro assembly one by one.



22. Remove rear nut, lock washer, spacer. Remove rear bearing internal circlip and bearing by special tool.

23. Remove front external circlip on counter shaft. Keep it in secured place.





24. Tap the counter shaft slowly, during pushing the countershaft towards rear. Try to rotate countershaft for ease of dismantling. Remove shaft and forward / Reverse gears, Synchro assembly and speed driving gears (3 nos.) and splined bushes.

B. Cleaning and Inspection

1. Lubricate all serviceable bearing and wrap in grease proof paper.

2. Remove all gasket material from joint face.

3. Inspect bushes for wear or damage, worn chipped or broken teeth check splines for correct fit. Check excessive play.

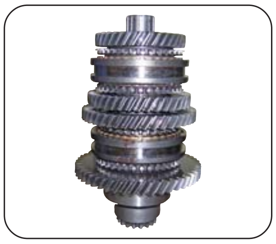
C. Assembly Speed Section

1. Assemble the speed counter shaft in the housing.
2. Fit bearing top shaft.

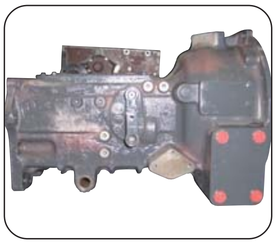
NOTE: **After counter shaft assembly, assemble first, second, third & fourth gears before speed top shaft and idler assembly.**

All bearing installation by heating bearing at 80°C to 90°C.

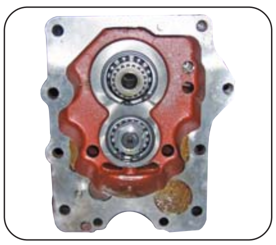
All bearings, bushes, shaft to be lubricated with specified oil for assembling.



3. Assemble the speed top shaft.

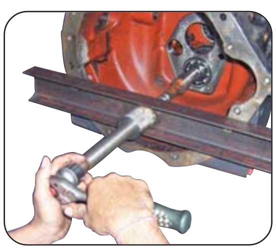


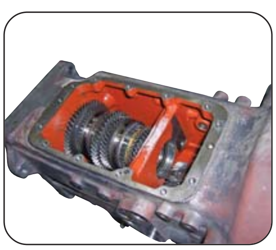
4. Assemble shuttle shift assembly in the housing.

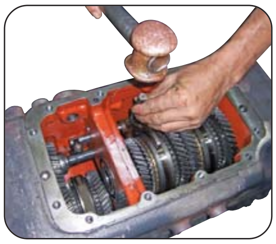


5. Insert Speed Top Shaft from rear end, then put bushes, gears and Synchro.

6. Front bearing to be push on Speed Top Shaft and check float as required. To adjust float use graded 1st gear bush.
7. Install front and rear circlip.
8. Assemble shuttle shift fork after counter shaft assembly.
9. Install forward / reverse and speed levers and then arms.
10. Fit the oil seals by using sleeve.
11. Check float.

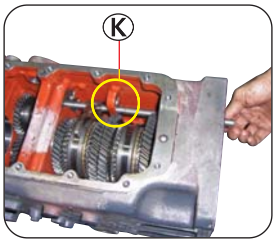




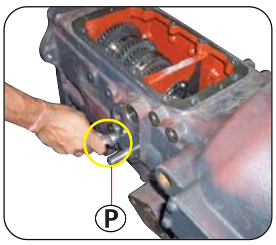


D. Speed Section - RAIL FITTING

1. Slide rail 3^{rd} & 4^{th} from rear side in bottom hole (K).



2. Assemble 3^{rd} & 4^{th} fork in rail, keeping synchronizer in neutral and lock rail and fork with roll pin.
3. Drop inter lock pin from top.
4. Slide rail 1 & 2 from rear side in top hole.
5. Assemble 1 & 2 fork keeping synchronizer in neutral and lock fork and rail with roll pin.
6. Insert detent ball, spring, copper washer and retention bolt and torque with specified value.



E. Forward / Reverse Section - RAIL FITTING

1. Insert special tool in clutch housing from inside.
2. Slide rail from front side.
3. Assemble Forward / Reverse fork without ball & spring and assembly tool outside.
4. Align special tool slot and fork hole, then insert ball and spring.
5. Rotate special tool to ensure locking of ball and spring.
6. Slide rail slowly towards rear keeping fork assembly in position with tool.
7. Lock the rail by special bolt and copper washer.
8. Check centralization of fork by dial gauge shifting in forward and reverse direction. If required adjust the centralization putting remaining shims at countershaft rear end bearing. Keeping dummy piece of front retainer.

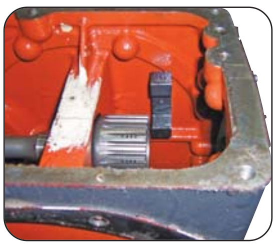
RANGE SECTION

A. Removal

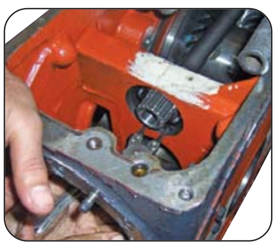
1. Drain oil from Speed and Range section.
2. Split the Tractor between Clutch Housing and Transmission-case as detailed in splitting of tractor.
3. Remove the tires.
4. Remove Hydraulic Lift Housing and Range Section top plate.

NOTE: **Place the Transmission-case with axle on suitable stand and suitable support at front before starting work on Range Section.**

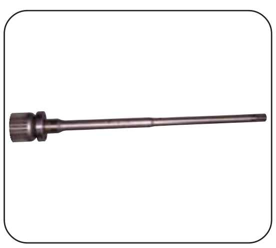
5. Remove the rear PTO cover assembly along with wet clutch assembly and 540 input shaft and gear assembly.

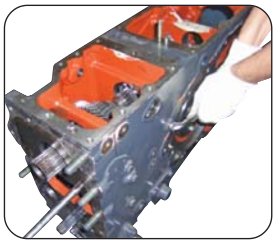
6. Remove external circlip inside hub and remove hub.



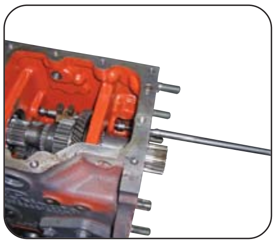
7. Remove PTO middle support bearing rear circlip.

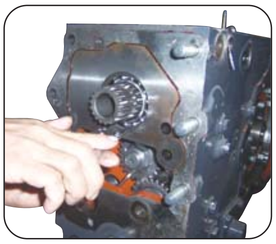


8. Remove PTO intermediate shaft with ball bearing from rear side.



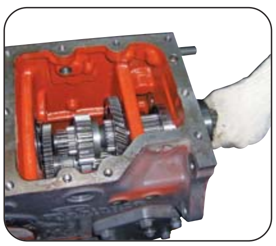

9. Remove spring pin from fork and rail. Remove retainer bolts (2 Nos.), springs & ball and take out the rail & forks.





10. Remove front and rear internal circlip of Range shaft ball bearings.

11. Remove lock nut and lock washer of Range Top Shaft.

12. Slowly tap the Range shaft from rear end. Hold the high and medium gears. After the Range shaft removal, take out the gears.

NOTE: Removal of Spline-shaft refer differential assembly.

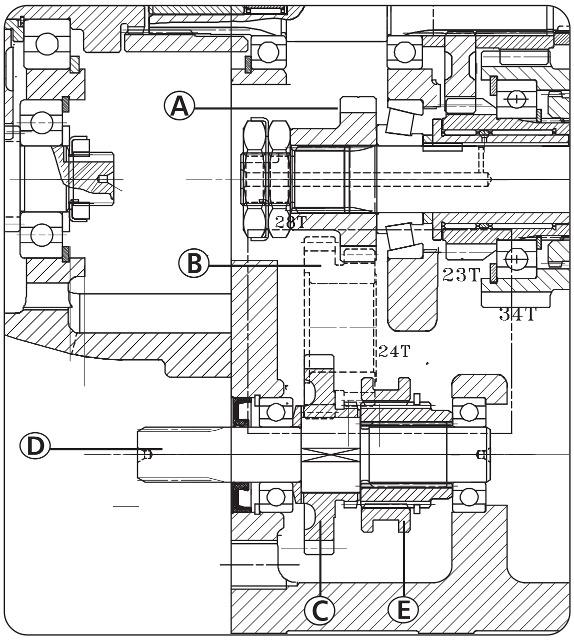
D. Rail Fitting – Range Section

1. Slide rail from rear side.

2. Insert fork in coupling and lock with spring pin with rail.

3. Insert ball, spring at front and rear position of transmission-case and insert retention bolt and torque with specified value.

4. Assemble shifter arm in fork slot. Insert cross shaft and lock the arm with roll pin with cross shaft.



4 WD

A. Theory of Operation

The gear (A) which is mounted on spline shaft constantly mesh with idler gear (B). This gear transmits power to gear 4WD (C) which spins freely on output shaft (D) until engaged by locking collar (E).

When the 4WD lever is pushed down, the locking collar slides so as to engage with gear 4WD (C). Power is then transmitted through the output shaft (D). The propeller shaft is connected to the 4WD axle which give drive to 4WD axle.

B. Dismantling

1. Remove bolt retention for 4WD idler shaft.
2. Take out 4WD idler shaft.
3. Remove 4WD input gear from spline shaft after removing lock nuts.
4. Remove 4WD idler gear, needle bearing and two thrust washers.
5. Remove bolt shaft retention 4WD rail.
6. Tap the rail from rear side and remove from front side of transmission-case.
7. Remove lock plate.
8. Take lever close to wall.
9. Remove fork with ball and spring fitting fork position as per requirement to avoid flying of spring and ball.
10. Remove oil seal and circlip from 4WD output shaft.
11. Tap the output shaft from rear side, take out washer & locking collar.

NOTE: **Take care not to fly out the ball and spring when taking out locking collar.**

C. Cleaning and Inspection

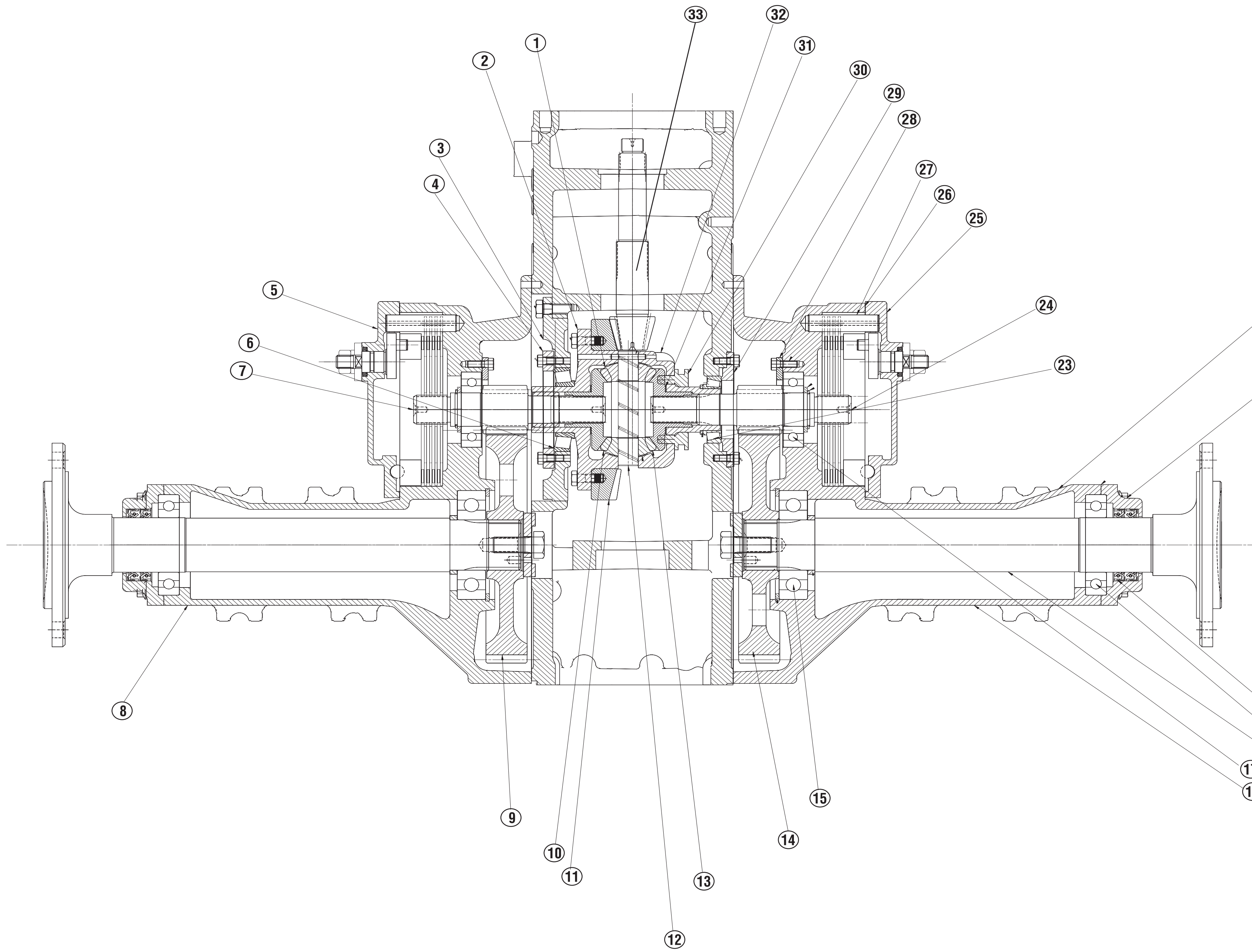
1. Clean all part with suitable solvent.
2. Check all parts for wear, pitting or any crack.
3. Check the spring tension and tilt or damage.
4. Check backlash of gear, locking collar and output shaft. If it is more than limit, replace it.

D. Assembly

Assemble the removed parts in the reverse sequence of dismantling.

CHAPTER - 2

REAR AXLE



1. Pinion Differential Case
2. Differential Case
3. Differential Carrier LH
4. Retainer
5. Brake Assembly LH
6. Taper Roller Bearing
7. Bull Pinion Brake Shaft LH
8. Rear Axle Sub Assembly LH
9. Bull Gear LH
10. Bevel Gear Differential LH
11. Gear Crown Wheel
12. Differential Pinion Shaft
13. Bevel Gear Differential RH
14. Bull Gear RH
15. Ball Bearing
16. Rear Axle Assembly RH
17. Ball Bearing
18. Rear Axle
19. Ball Bearing
20. Oil Seal
21. Retainer Oil Seal
22. Rear Axle Carrier
23. Taper Roller Bearing
24. Bull Pinion Brake Shaft RH
25. Brake Assembly RH
26. Gasket Brake Cover
27. Brake Pin
28. Bearing Retainer Bull Shaft
29. Carrier Differential RH
30. Coupling Differential Lock
31. Thrust Washer Bevel Gear
32. Differential Assembly
33. Spline Shaft

B. REAR AXLE

1. DESCRIPTION

The rear axle shafts are splined at the inner end. Drive is bull gear and bull pinion type. One end of the bull pinion shaft meshes in differential bevel gear and other end is with brake plate. Hence the power is transmitted to axle shaft from differential section through bull gear pair.

2. Removal

1. Front wheel to be wedged.
2. Use proper jack under the clutch housing or transmission-case.
3. Remove tires.
4. Disconnect the wiring harness from couplers.

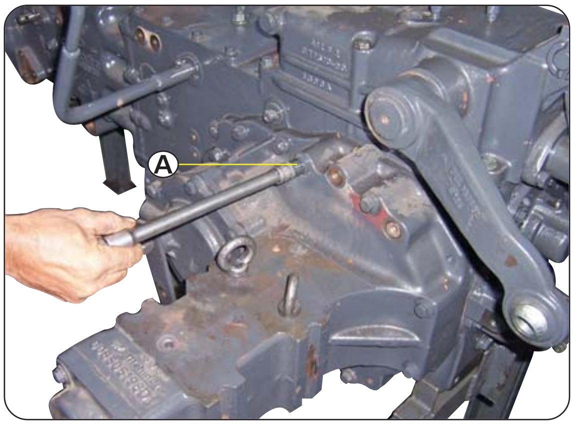

Removal of Tires

5. Remove ROPS, by removing ROPS Mounting Bracket Assembly.


Removal of ROPS

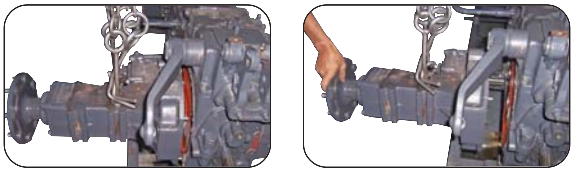
6. Remove fender mounting bolts.


Removal of Fenders



7. Sling the rear axle securely with a suitable hoist, tension the sling.

8. Remove securing bolts (A) of Rear Axle Housing.

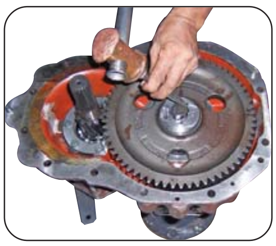


Removal of Rear Axle

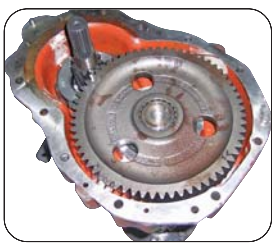
9. Ease the axle away from transmission-case.

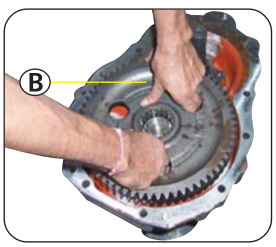
NOTE: Removal / Assembling of LH / RH axle are same.

3. Dismantling

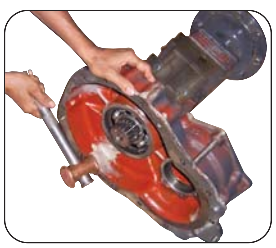


1. Remove the bolt, shims and lock plate and washers (as shown in fig.).

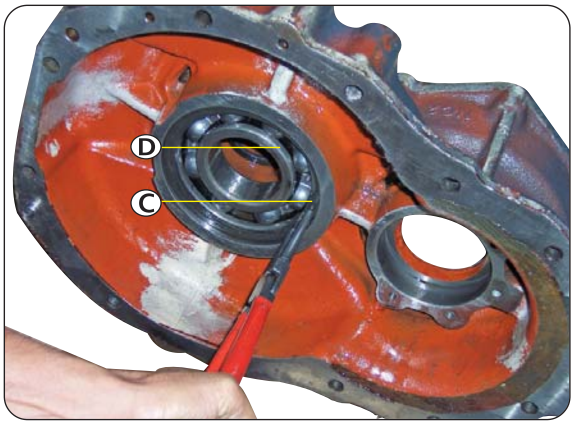




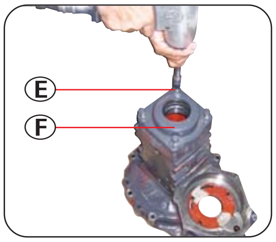
2. Remove bull gear (B).

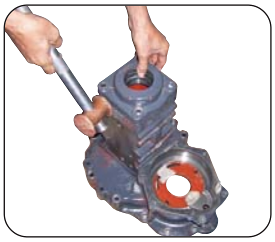


3. Tap the rear axle splined end with copper hammer and pull out the rear axle from other end.

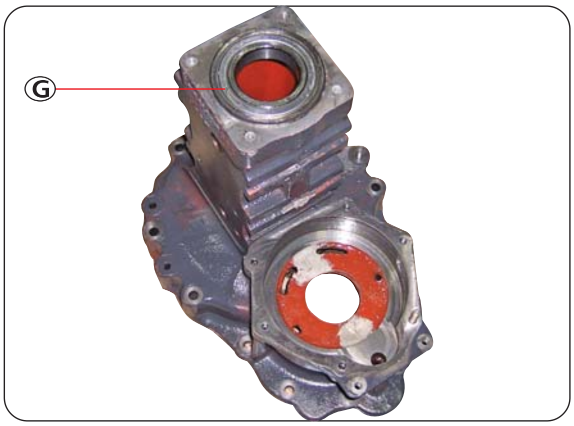


4. Remove inner circlip (C) of inner bearing (D) and take out inner bearing.





5. Loosen bolt (E) of retainer bearing (F) and take out retainer by slight tapping.

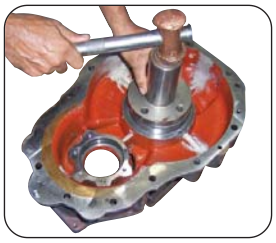
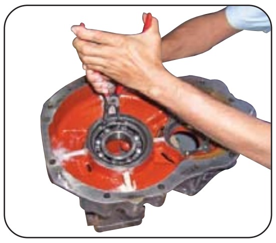


6. Remove outer bearing (G) of Rear Axle.

NOTE: **Check ball bearing and oil seal for damages and pitting, if require replace it.**

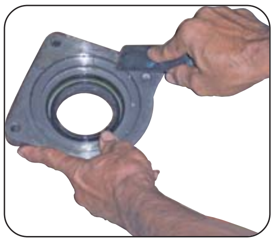
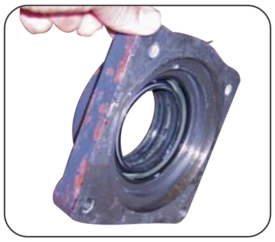
4. Cleaning and Inspection

1. Clean all parts with suitable solvent.
2. Inspect bearing for wear, pitting or damage.
3. Inspect gear for worn, chipped or broken teeth. Check splines for burrs and correct fitting.
4. Check bull pinion shaft for damage, pitting and burrs and backlash.
5. Check Ball Bearings and oil seals for damages and pitting, if require replace it.

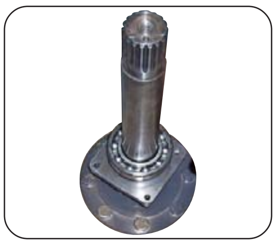
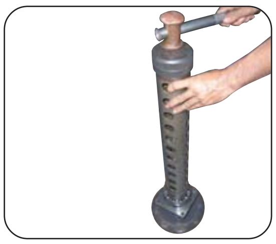
5. Assembly

1. Install big end ball bearing in Real Axle Carrier (RAC) and lock with circlip (H).

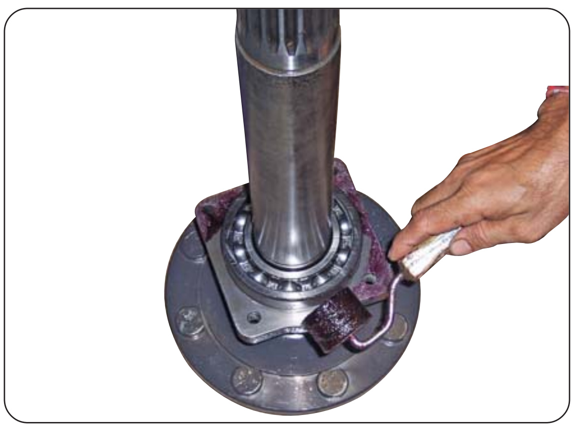



2. Clean retainer surface area and fit new oil seal in retainer Rear Axle (2 nos.).

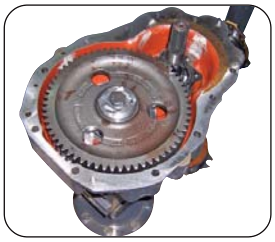
3. Install oil seals with retainer in Rear Axle.

4. Install outer ball bearing with fixture for positioning of bearing.

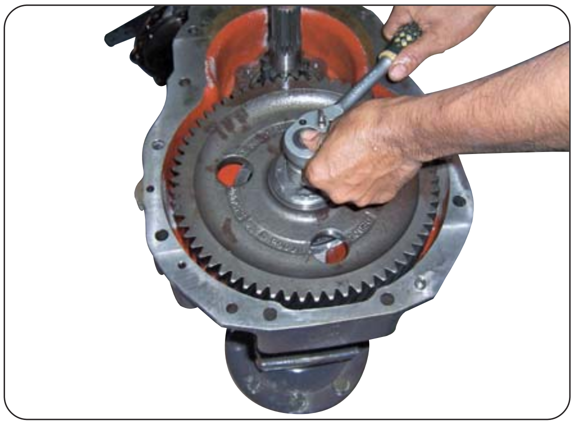


5. Apply liquid gasket on retainer.



6. Keep Rear Axle with above assembly in vertical position with spacer.

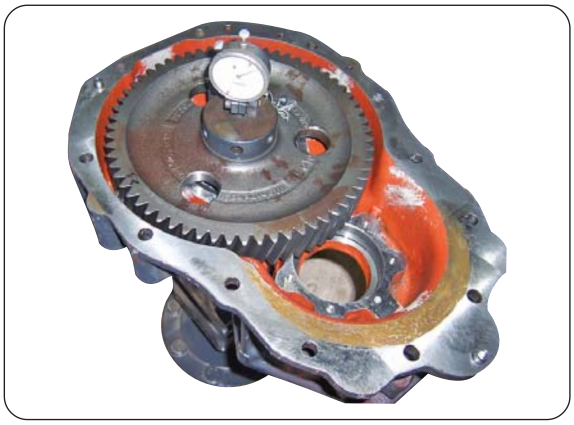
7. Hold RAC with hoist in positioning joint face upward and install in Rear Axle.



8. Always first fit Bull Pinion Shaft and then insert bull gear in the rear axle.

9. Insert Bull gear in end spline and Tap with copper Hammer till big end bearing rest on inside spacer and put shims, spacer and lock plate and bolt. Torque the bolt with the specified values.

NOTE: New oil seal should be used while reassembly.



a. Reverse procedure of removal using liquid gasket and tighten the mounting bolts as specified.

b. Check the gap between rear axle face and bull gear face by dial gauge, add required shims to fill up the gap.

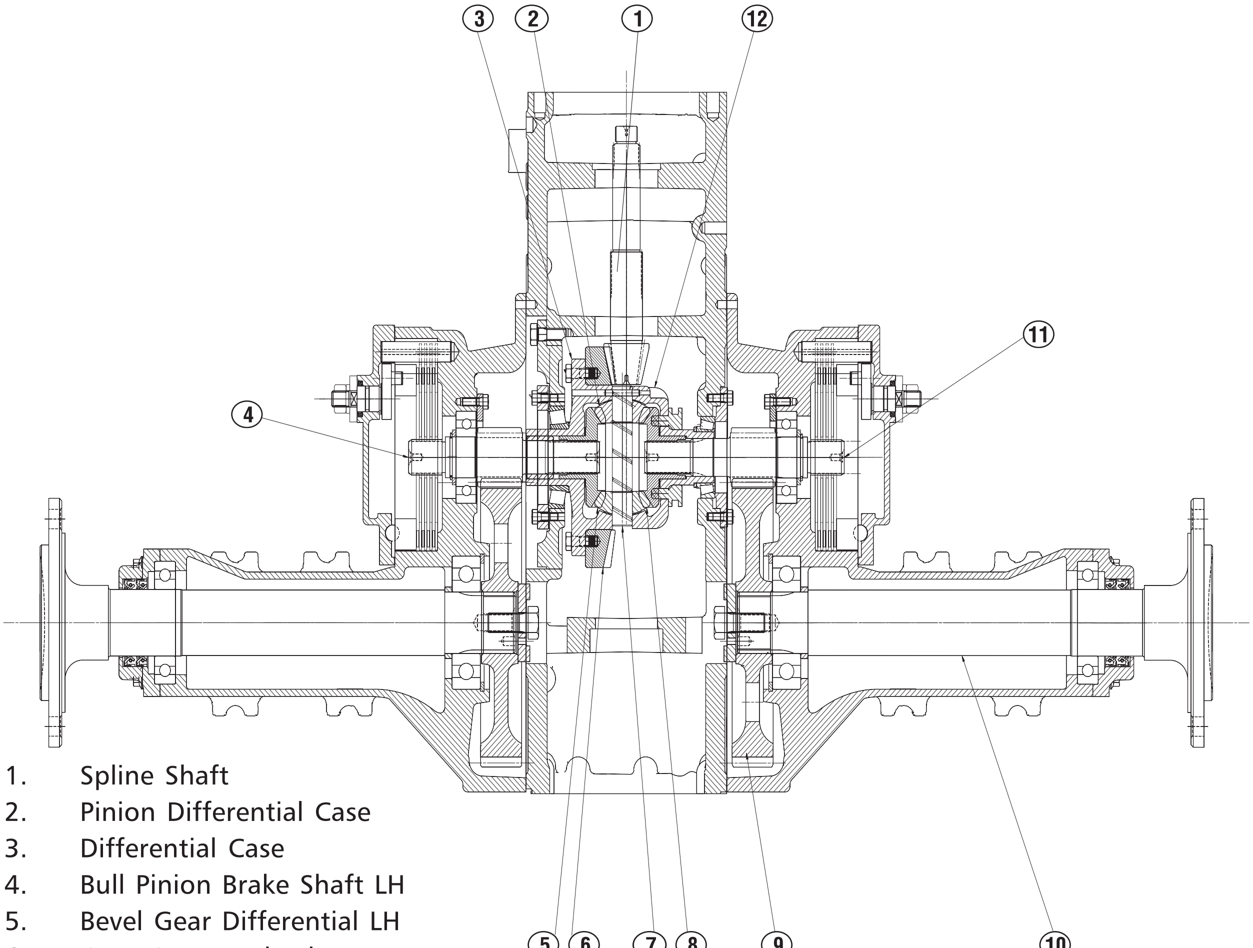
c. Assemble washer, lock plate and bull gear retaining bolt. Torque them to 265 - 290 Nm.

d. Ensure free movement by rotating rear axle carrier.

CHAPTER - 3

DIFFERENTIAL

DIFFERENTIAL LAYOUT



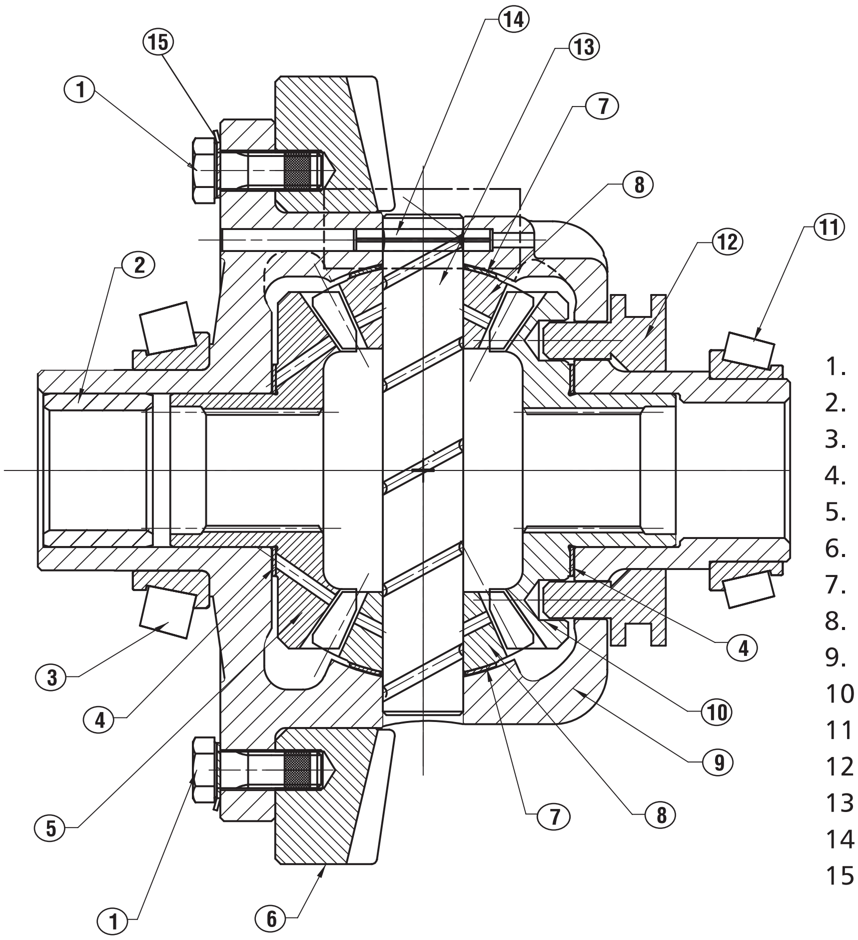
1. Spline Shaft
2. Pinion Differential Case
3. Differential Case
4. Bull Pinion Brake Shaft LH
5. Bevel Gear Differential LH
6. Gear Crown Wheel
7. Differential Pinion Shaft
8. Bevel Gear Differential RH
9. Bull Gear
10. Rear Axle
11. Bull Pinion Brake Shaft RH
12. Differential Housing Assembly

1. Theory of Operation

The power from Spline Shaft (1) drive the Gear Crown Wheel (6). This in turn rotate Differential Housing (12). The power from differential housing flows through differential pinion (2) and then to Bevel Gear Differential (5/8). Bevel Gear drives the Bull Pinion (4/11). The Bull Pinion Shaft end matches with Bull Gear (9). This results in rotation of Axle Shaft (10).

The Differential Housing Assembly consists of two Bevel Gear (LH & RH), two pinion and one shaft.

When tractor takes a turn, one axle moves faster than other. This results in rotation of differential pinion to rotate on it's own axis, and they roll over bevel gear and thus producing differential action.



1. Bolt
2. Bush Bull Pinion Shaft Support
3. Taper Roller Bearing
4. Thrust Washer Bevel Gear
5. Bevel Gear Differential LH
6. Gear Crown Wheel
7. Thrust Washer Bevel Pinion
8. Pinion Differential
9. Differential Case
10. Bevel Gear Differential RH
11. Taper Roller Bearing
12. Coupling
13. Shaft Differential Pinion
14. Pin Spring Differential
15. Lock Plate Bolt Diff. Case

Layout of Differential Assembly

2. Description

The differential is located in the rear housing and is mounted on two taper roller bearings. The drive bevel (ring or crown) gear is bolted to the differential case LH side.

The taper roller bearing is preloaded by shims located between the differential cage and sides of the rear housing, determine the backlash between the bevel gear and the drive pinion and preload on the taper roller bearings support that the differential.

Adjustment of the drive pinion and bevel gear tooth contact is obtain by graded spacer between transmission splined shaft bearing head and machine surface of the housing.

The differential lock unit is incorporated which is controlled by a foot pedal as assembled at the right hand.

The differential gear assembly is a mechanism to provide smooth steering. It automatically provides relative speed to both rear wheels according to road resistance and braking friction at the wheel.

3. Removal of Differential Assembly from Range Section

a. Drain oil from the transmission.

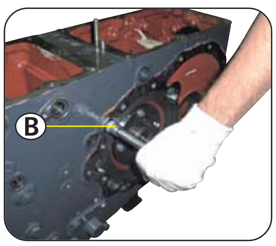
b. Insert wooden wedges / mini jacks between front axle and axle support to prevent the engine pivoting.

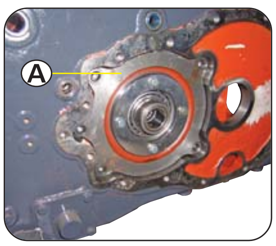
c. Remove the rear axle housing.

d. Remove the brakes as detailed in “Brakes”.

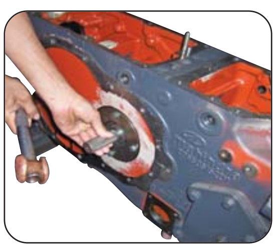
e. Remove hydraulic housing and sheet metal. **(If you are working on spline shaft or differential lock).**

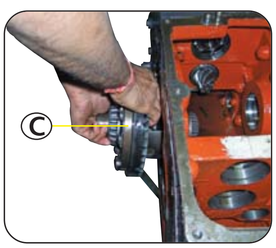
f. Remove LH Rear Axle Carrier.





g. Remove retainer (A) alongwith differential housing assembly by loosening bolt (B).





h. Tap slightly, o take out the differential assembly (C) complete.

NOTE: Remove differential lock shifting arrangement before dismantling differential case assembly.

4. Cleaning & Inspection

a. Thoroughly clean the inside of the rear housing and blow air.

b. Lubricate all serviceable bearing and wrap in grease proof paper.

c. Remove all gasket material from joint face.

d. Inspect bushes for wear or damage, worn gear, chipped or broken teeth, check splines for burrs and correct fit. All gears should slide easily on spline shaft but no excessive side play. Check sliding couplings and gear for burrs and broken teeth and worn out.

e. Check the shifter rails and forks for straightness, wear of poppet recesses and freedom of movements, grooves for damage.

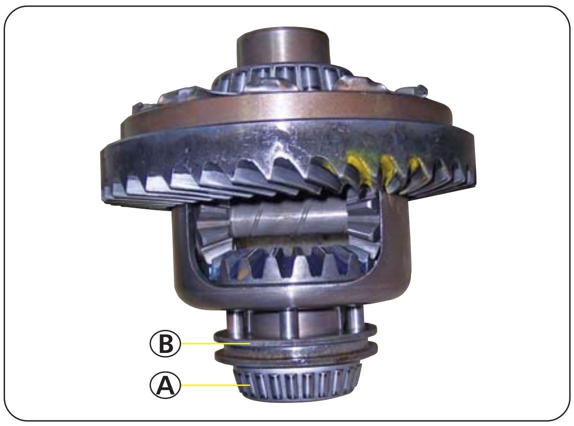
f. Replace all not serviceable parts with new.

NOTE: Use new oil seals, 'O' ring and poppet springs.

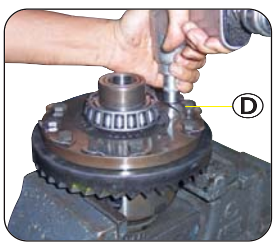
5. Dismantling of Differential Assembly

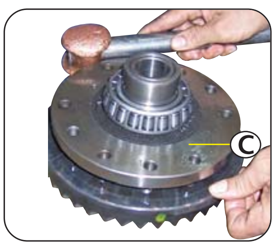
a. Place the Differential in bench-vice.

b. Remove the taper roller bearing (A) and withdraw differential lock coupling (B).

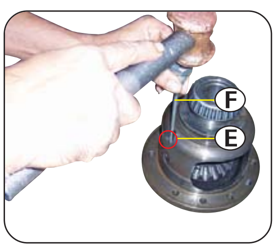


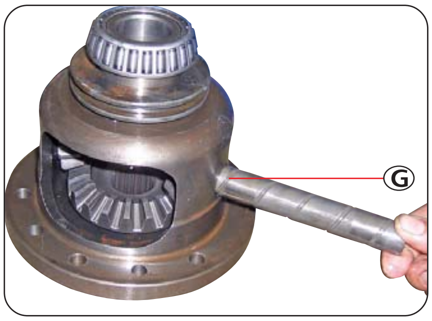
c. Remove Ring Gear (C) by loosening bolts (D).



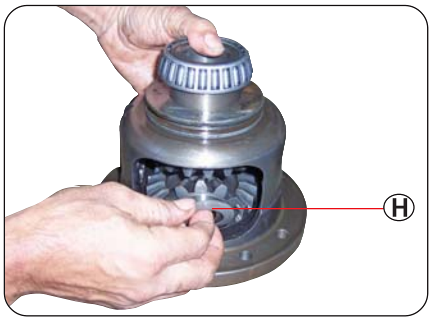


d. Remove spring pin (E) by using Special Tool (F).

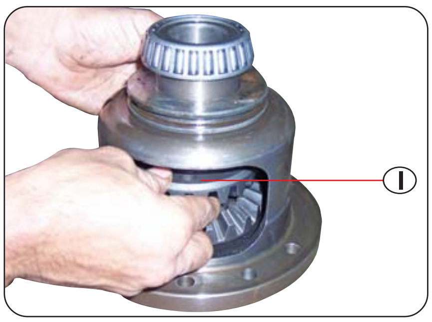




e. Push out Differential Pinion Shaft (G).



f. Remove Pinion Differential (H) and thrust washer.



g. Remove Bevel Gear (I) and thrust washer.

6. Cleaning & Inspection

a. Clean all part with suitable solvent.

NOTE: Mark the parts to know their original position.

b. Check the differential pinion, thrust bearing and pinion shaft; for excessive wear; pitting or teeth damaged. If these parts are damaged or excessively worn replace as a set.

c. Check bevel gear and thrust washer surface of both bevel gears worn or damaged. Replace the parts.

d. Check the ring gear for wear and damage. If no longer serviceable, replace it with spiral pinion shaft as a set.

e. Check Taper Roller Bearings for wear, pitting or crack. If necessary replace it.

7. Assembly of Differential

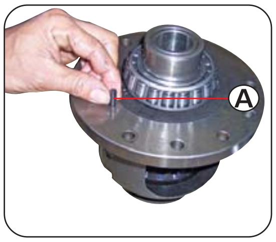
a. Place the differential case on the table.

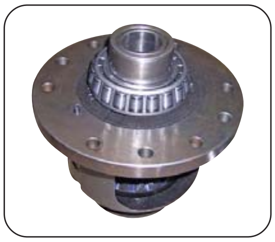
b. Place the thrust washer and bevel pinions inside.

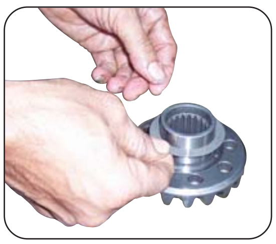
c. Insert the pin (A) in the differential pinions with washer and lock with the pin.

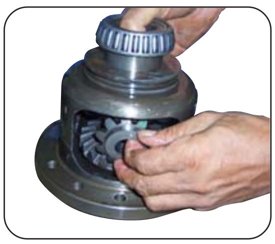
NOTE : Before assembling, all parts should be dipped in transmission oil.

d. Install the pinion gear and thrust washers.









e. Install bevel gears and thrust washers.

f. Install differential pinion shaft and spring pin.

NOTE: Check the gear backlash, if it is not in limit, replace the gears set.

g. Reassemble the ring gear and tighten the bolt as per specified torque and lock the lock washers.

h. Press the taper roller bearing cone on left side.

i. Install differential lock coupling and press taper roller bearing cone of RH side.

8. Installation of Differential Case Assembly to Transmission

a. Install differential assembly in transmission case from LH side cutout and hold.

b. Install RH side bearing cup in Transmission-case.

c. Locate differential assembly in RH side cup. Install LH side carrier with bearing cup.

d. Align and install both side carrier with same shims (as removed).

e. Tighten the both carrier securing bolts with specified torque.

f. Check the preload of bearings as specified.

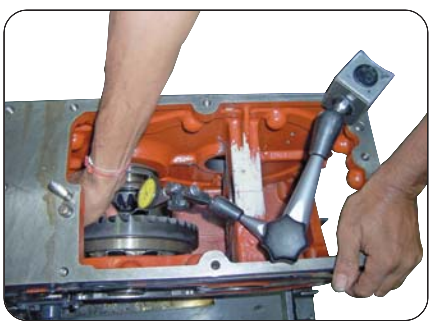
NOTE : Check preload without spiral gear pinion.

g. After preloading check the backlash.

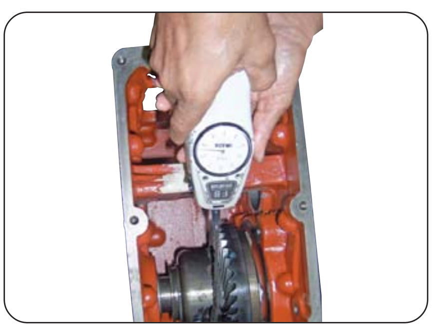
h. Install rear axle as detailed in “Rear Axle”.

i. Install PTO housing assembly.

j. Fill the oil.

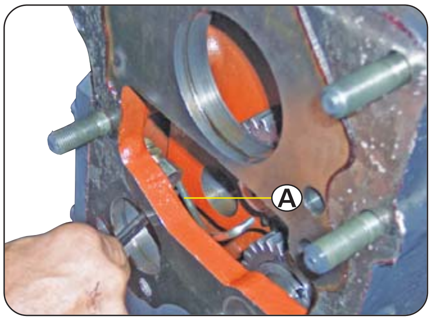


Checking Backlash

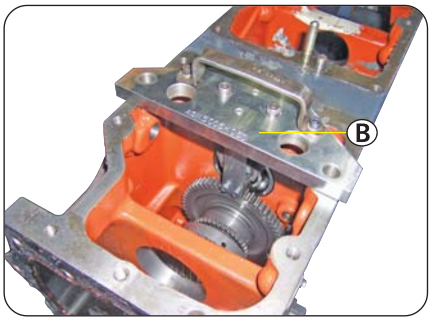


Checking Preload

9. Dismantling of Spline Shaft Assembly



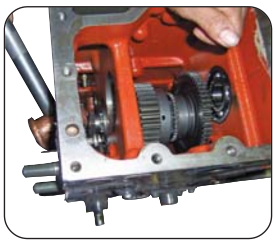
a. Remove idler gear assembly and other parts, lubrication pipe (A).

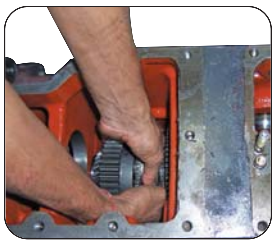


b. Using Special Tool (B), remove Spline Shaft Assembly.

c. Using special tool (B) for locking rotation of spline shaft remove two lock nuts of spline shaft end.

d. Remove gear 4WD input.





e. Slowly tap spline shaft from lock nut end and remove from rear side.

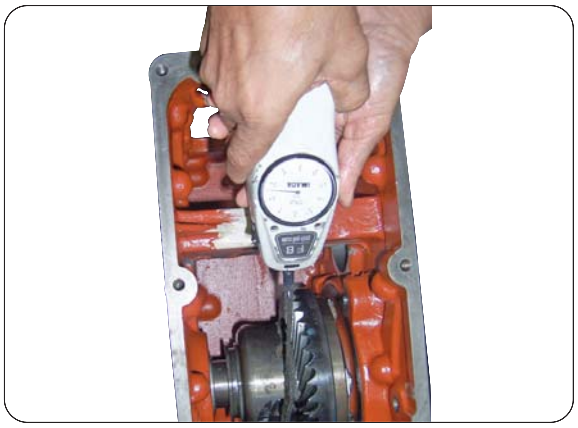
f. Remove all gears of spline shaft assembly.

g. Remove 4WD shifting assembly and 4WD output shaft assembly.

10. Assembly of Spline Shaft

NOTE : Spline-shaft preloading to be done after installing all Range Driven Gears.

1. Install taper roller bearing cone with spline shaft.
2. Insert spline shaft from transmission-case rear side.
3. Insert all gear, bearing, spacers, Spline collar as shown in section. (For correct preloading use graded spacer between front taper roller bearing and bush).
4. Install front taper roller bearing and tighten the spline shaft assembly with lock nut to specified tightening torque. Check the preload with string and spring balance.
5. Adjust graded spacer if required to achieve specified bearing preload.



Preloading of Differential Case Assembly

11. ADJUSTMENTS

a. PRELOADING OF DIFFERENTIAL CASE BEARING

The Ring Gear (Crown Gear) and spline shaft are serviced in matched set and should only be fitted after preloading.

In order to ensure quiet operation and long life of ring gear and spline shaft set the following assembly and adjustment procedure should be rightly followed.

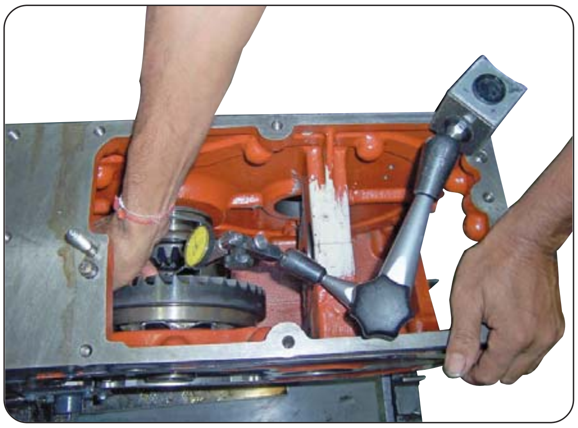
- Check the spline shaft and ring gear are a matched set. (Number)
- Preload the differential case bearings.

1) Assemble the differential case and carrier bearings with left and right shims same as before dismantling. Tighten with specified torque and check the preload as follows.

2) Loop both ends of a piece of string and slip on loop round the differential case opening. Then Wind the string around the differential housing. Secure a spring balance into the free end (as shown in figure) and pull.

NOTE:

1. Pull to keep the assembly revolving at constant speed which should be between 4.4 - 6.6 lbs.
2. Preloading the differential case and spline shaft should be done before assembling of spline shaft.
3. Add or remove shims between the right hand bearing carrier and Transmission Case until the above figure is obtained.
4. Once the correct preload has been obtained, it will only be necessary to transfer shims from one bearing carrier to another to obtain correct backlash between ring gear and spline shaft teeth.
5. After Preloading, remove differential case assembly with shims and fit after preloading the spline shaft.



Checking Backlash

b. BACKLASH AND TOOTH CONTACT BETWEEN RING GEAR AND SPLINE SHAFT.

1) Set the dial indicator between ring gear and Spline Shaft. Move the ring gear by hand.

2) When backlash is more, decrease the number of shims from the ring gear opposite side and insert the removed shims in ring gear side. When the backlash is too less decrease the number of shims from the ring gear side and insert the removed shims in the opposite side.

3) Adjust the backlash properly by repeating the above procedure.

4) Apply red lead / blue light over several teeth at three positions equally spaced on the ring gear.

5) Turn the ring gear, and spline shaft while pressing a wooden piece against the periphery of the ring gear.

6) Check the contact if not proper according to the instructions below.

Backlash between Ring Gear and Spline Shaft	Factory specifications	0.007 to 0.009 in
	Allowable Limit	0.015 in

More than 35% red lead contact are on the gear tooth surface.

The center of both contact a 1/3 of the entire width from the small end.

Adjusting with thicker shims to move spline shaft backward and place the RH shim to left to move ring gear left ward.

Repeat above until proper tooth contact and backlash are achieved.

Fig. A & B gives view of correct markings.

Fig. C & D gives view of setting too far in. This gives incorrect tooth contact resulting noisy operation and premature wear of gears.

Fig. E & F shows the markings of a pinion which has been set too far out. This tends to cause premature wear of the bevel gear.

If it is necessary to reset the pinion, the backlash will need to be adjusted.

Fig. A

Fig. B

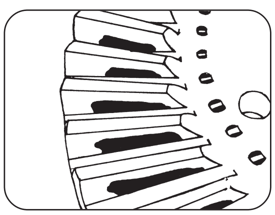


Fig. C

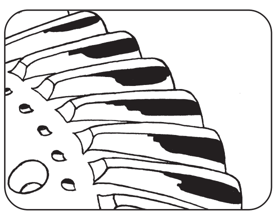


Fig. D

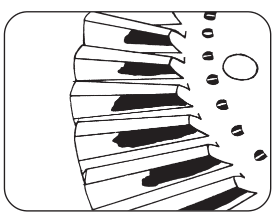


Fig. E

Fig. F

12. ADJUSTMENTS

a. ADJUSTING THE SPLINE SHAFT BEARING PRE-LOAD

1. Using a standard spacer measuring 0.2" on the machined flat surfaces, assemble the spline shaft into transmission case with low gear, bush, collar and sleeve, medium gear assembly, high gear and high gear bush.
2. Install tail bearing using either hydraulic press or by induction heating.
3. Install gear 4WD input and secure assembly with two lock nut and lock washers.

NOTE: **If the differential is in position, sufficient shim thickness must be installed to ensure that the end float of the spline shaft is not restricted by the bevel gear. If the differential is not in position, no shim should be used.**

4. Install a dial indicator on the transmissions case with the stylus bearing against the machined face of the pinion.
5. Determine the end float of the spline shaft by pushing the spline shaft firmly to the rear and noting the reading, then pulling the shaft forward and noting the reading.

NOTE **(1) : Several measurements should be taken, rotating the shaft at each reading.**

(2) : Ensure that the extreme length of travel is reached in each direction.

6. As the pre-load on the spline shaft rear bearings is the equivalent of 0.005" tight, the thickness of spacer and shims is determined as in the following example.

   End float measured.................... 0.003"

   Fixed pre-load............................ 0.005"

   Therefore :-
   Amount of end float to be removed is 0.007" + 0.005" = 0.008"

   Standard spacer measures 0.2"

   Therefore :
   Thickness of spacer and shims to be installed is 0.2" - 0.008" = 0.1992".

NOTE: **The average thickness of the spacer is 0.203" and graded spacers are available in thickness range of 0.192" to 0.214" in increment of 0.001".**

7. Remove the lock nut and press the shaft to take out bearing and spacer out.
8. Remove the standard spacer from the shaft and install the correct thickness spacer.
9. Assemble gear 4WD, lock nut and lock washer, then secure assembly by tightening the lock nut to the specified torque.
10. Major preload of spline shaft bearing by rotating string wrapping around coupling high-low-medium using spring balance.
11. Change the graded spacer if specified preload is not achieved.

b. THE PINION CONE CENTRE DISTANCE

1. The correct cone centre distance is etched on the machined face of the pinion. Also etched on this face is the set number of the pinion and bevel gear. Ensure that the pinion and bevel gear are matched.

NOTE: Spline shaft mounting distance is directly etched on the bevel gear machined face as 0.636" or any.

2. Install the spline shaft using a shim pack of 0.090" between the bearing cone and the Transmission case.

3. Using parallel gauge block (Special Tool) measure the distance between carrier LH mounting axis on transmission case to bevel pinion machined surface.

EXAMPLE: If spline shaft mounting distance is directly etched as 0.636" and thickness of parallel gauge block is 0.628" then feeler gauge of 0.008" should go. If it is going very easily then measure the looseness, if the feeler gauge of 0.012" is going instead of 0.008", it means distance between spline shaft and transmission case is more by 0.004". Therefore 0.004" of shims must be added. Similarly if the feeler gauge of 0.004" is going instead of 0.008" then remove the shims 0.004" to increase the distance.

NOTE: Measurements should be made every 90º and the average of these readings should be taken.

4. With the correct shim pack assemble the bevel pinion with the gears and shaft. Shims to be assembled between head bearing of spline shaft and bearing mounting counter bore on transmission case.

5. Recheck the mounting distance.

CAUTION : During the cone center adjustment it is imperative that backlash be present.

Preload	Ring Gear Differential Case	4.4 - 6.6 lbs.
	Spline Shaft	5.7 - 8.15 lbs.

c. BACKLASH ADJUSTMENT

The backlash for a given pair of spline shaft (pinion gear) and bevel (ring or crown) gear is determined at the factory and is etched on the outer surface of the bevel gear. Adjust backlash to the etched number ± 0.05 mm (0.002"), preferable toward the lower limit.

NOTE: The backlash is adjusted by removing shims from one carrier on transmission case and fitting them to other side. The same quantity of shims must be maintained at all time as otherwise the "PRE-LOAD" of the tapered roller bearing will be upset.

1. Rigidly mount a dial indicator against a gear tooth, being sure that indicator system is perpendicular to the tooth surface at the extreme heels.

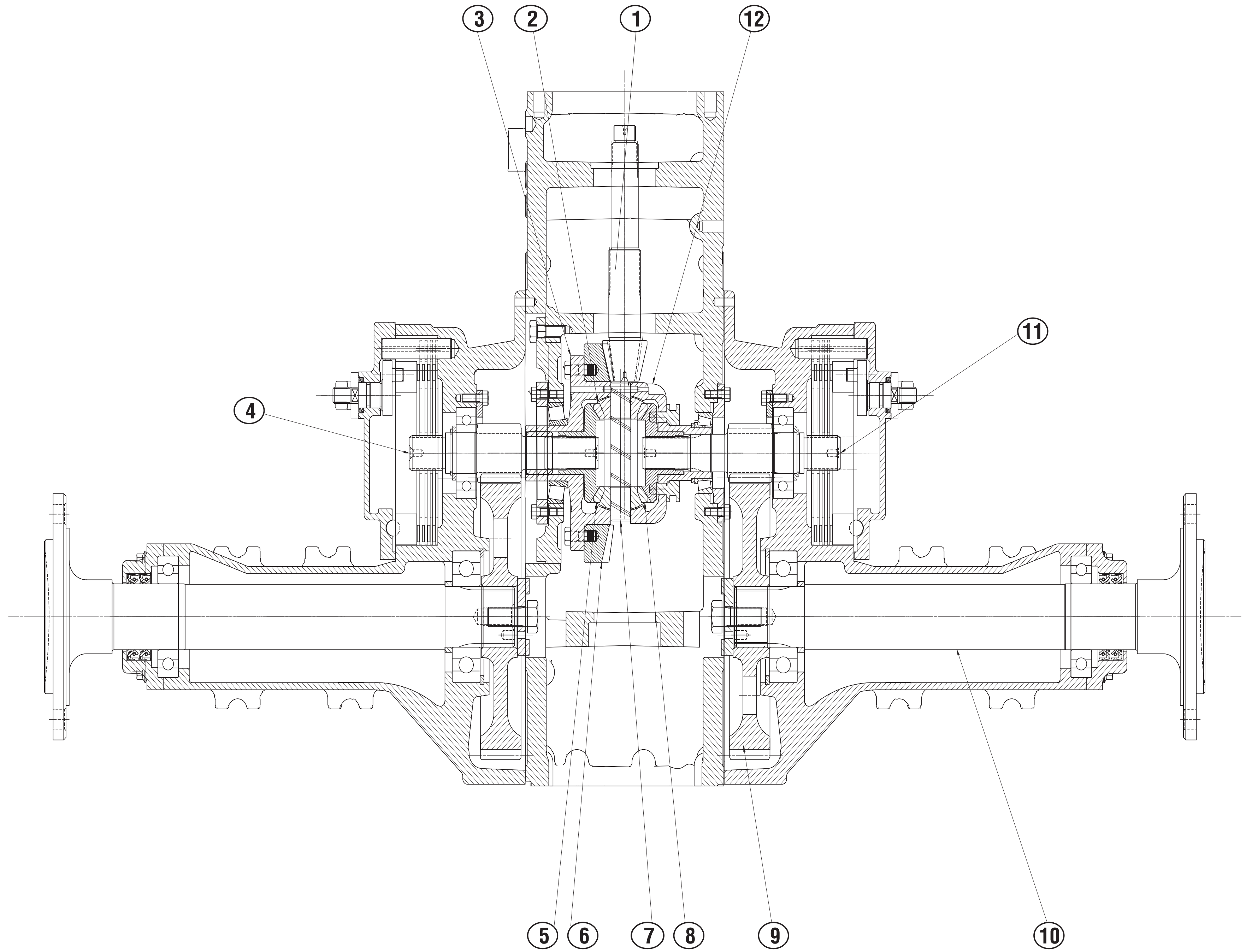
2. Engage two sliding gears in mesh this will held the position quite but a pinch bar used as a lever against one of the teeth of the gear will ensure complete rigidity.

3. Rock the bevel gear noting total indicator reading.

4. Repeat measurement every 90º of the bevel gear.

5. Excessive backlash is reduced by removing shims from the right hand bull pinion bearing cage and assembling them to the left hand bull pinion bearing cage and vice-versa.

   A 0.005" shim transfer approximates to a reduction or increase of 0.003" backlash.

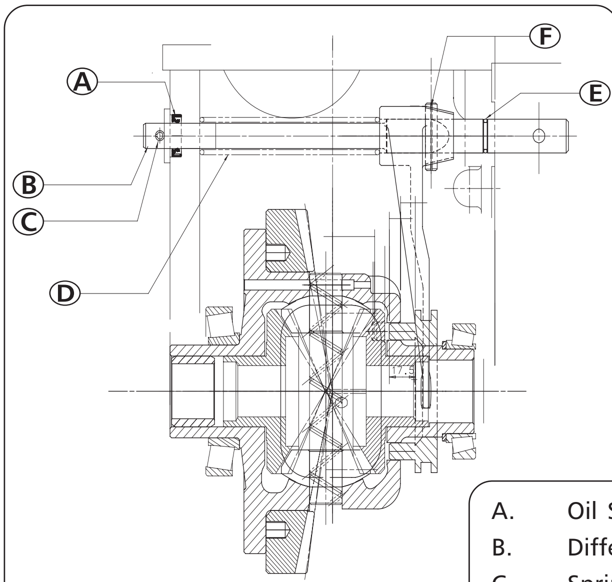


1.	Spline Shaft	7.	Differential Pinion Shaft
2.	Pinion Differential Case	8.	Bevel Gear Differential RH
3.	Differential Case	9.	Bull Gear
4.	Bull Pinion Brake Shaft LH	10.	Bull Pinion Brake Shaft RH
5.	Bevel Gear Differential LH	11.	Rear Axle
6.	Gear Crown Wheel	12.	Differential Housing Assembly

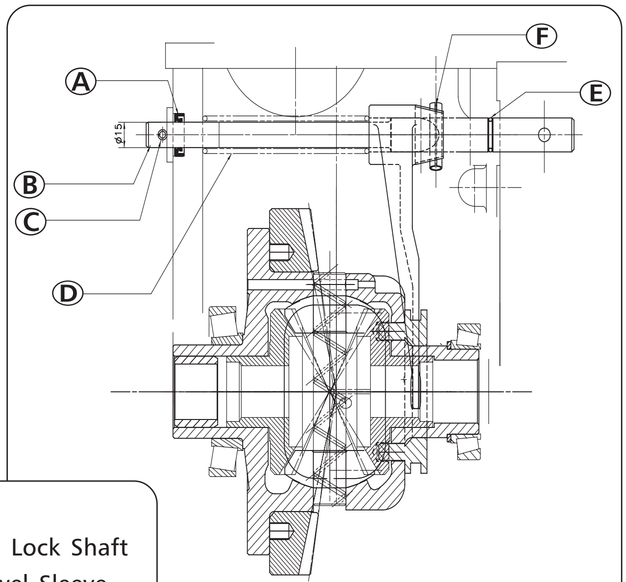
CHAPTER - 4

DIFFERENTIAL LOCK SYSTEM

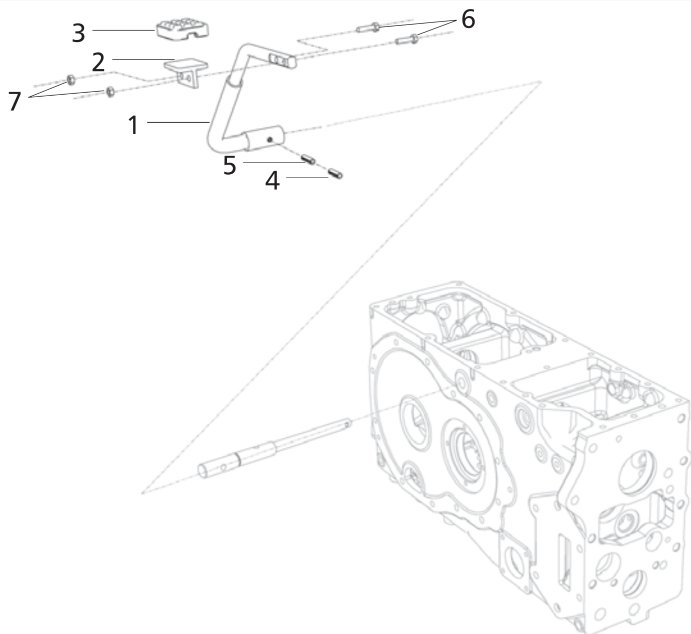
DIFFERENTIAL LOCK DISENGAGED POSITION



DIFFERENTIAL LOCK ENGAGED POSITION



A.	Oil Seal
B.	Differential Lock Shaft
C.	Spring Dowel Sleeve
D.	Spring
E.	O' Ring
F.	Spring Dowel



1. Diff Lock Pedal
2. Foot Plate Differential Lock
3. Rubber Boot Differential Lock Pedal
4. Spring Dowel Pin Outer - RSL
5. Spring Dowel Pin Inner - RSL
6. Bolt Flanged M6 X 1.0 X 30
7. Nut M6 X 1

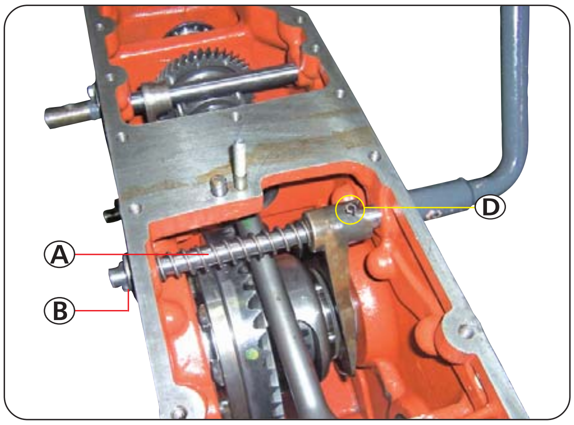
EXPLODED VIEW OF DIFFERENTIAL LOCK PEDAL LINKAGES

1. Theory of operation :

When differential lock pedal is pressed down, the differential lock shaft is rotated. The wedge action of fork differential lock due to rotation of shaft along with spring dowel, moves fork axial against spring. This motion presses the spring. Thus differential fork moves towards differential case.

Differential lock coupling moves towards the differential case. When the differential lock coupling pins, aligned with the holes on the bevel gear, get inserted into the bevel gear.

Since the bull pinion shaft is coupled with spline bevel gear, no differential action takes place and both bull pinion shaft rotate with equal RPM.



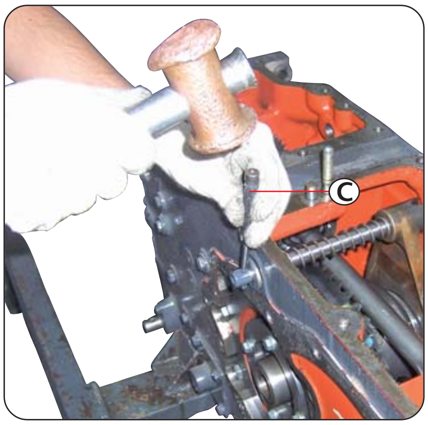
Removal of Differential Lock Shaft

2. Removal

a. Remove Differential lock arrangement as per the procedure given in differential section.

b. Remove differential lock pedal shaft (A) by removing spring pin (B).

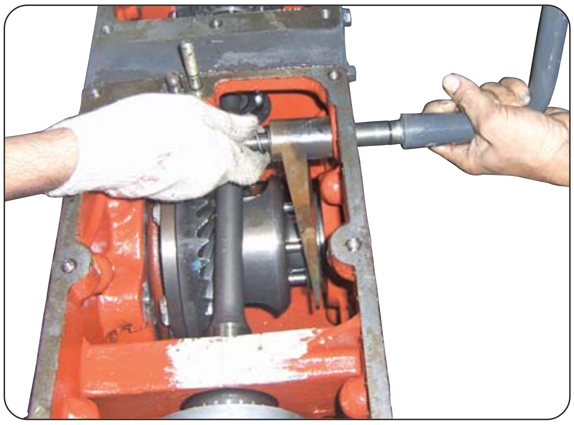
Special Tool



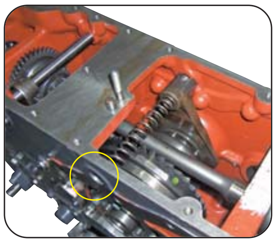
Removal of Differential Lock Shaft Pin

c. Use Special Tool (C) to remove spring pin.

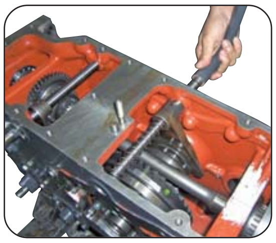
d. Remove fork spring lock pin (D).



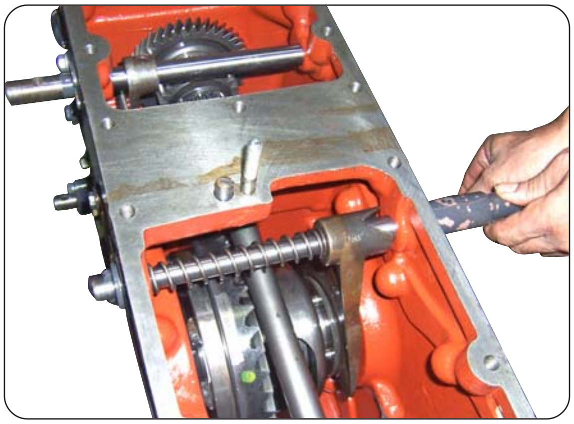
e. Hold spring and differential lock fork and pull differential cross shaft from RH side.



Oil Seal Fitment



Assemble Diff. Lock Shaft



Assembling Differential Lock Shaft Assembly with Fork

3. Assembly

NOTE: Clean all parts and check the spring tension or cracks. If necessary replace it. Replace O' rings and oil seals.

a. Fit oil seal at LH side.

b. Insert differential lock shaft, assemble spring.

c. Assemble fork, locating in differential lock coupling.

d. Insert spring dowel near fork.

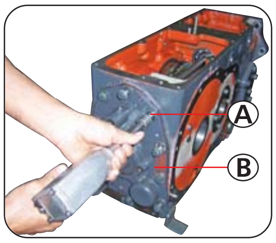
e. Insert washer and spring dowel at LH side.

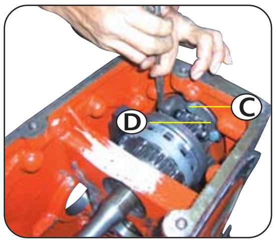
4. Installation

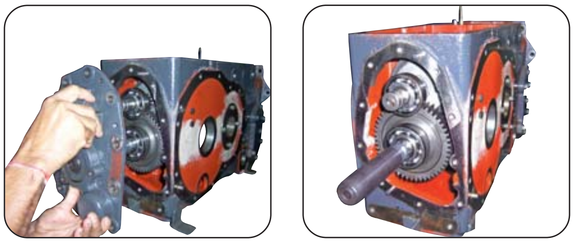
a. Installation is reverse procedure of Removal.

CHAPTER - 5

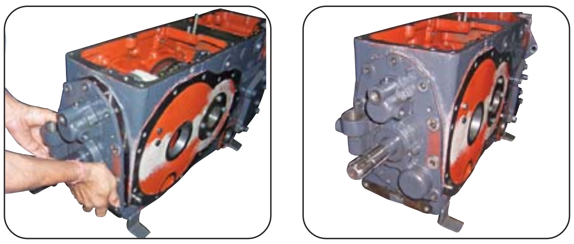
REAR PTO COVER







Removal of Rear PTO Cover



Assembling Rear PTO Cover

A. REAR PTO COVER

1. DISMANTLING

a. Loosen bolt (A) of rear PTO cover (B).

b. Loosen bolt (C) of plate retainer (D).

NOTE: Hydraulic Housing on top of transmission case to be removed for dismantling of Rear PTO Cover.

c. Now take out rear PTO cover from locating pins by slight tapping.

2. ASSEMBLY

a. Put two stud locator in Transmission-case.

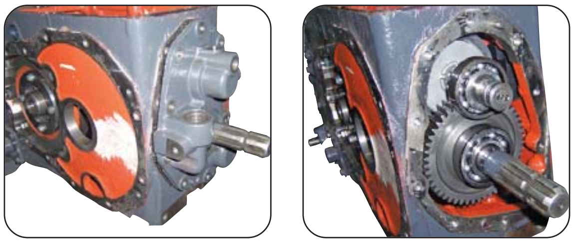
b. Locate PTO cover assembly in stud locator. Slowly push the assembly and precaution to be taken for wet clutch assembly matches with the hub properly to avoid damage of liners.

c. After assembly, check smooth rotation of wet clutch.

d. Then clamp the mounting bolts to the specified torque values.

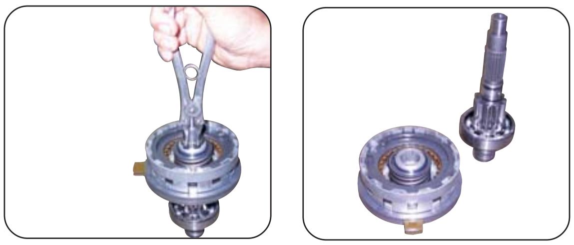
CHAPTER - 6

WET CLUTCH PTO



Removal of Rear PTO Housing Assembly

Removal of PTO Input and Output Shaft



Removal of Input Shaft from Wet Clutch

Output Shaft

A. WET CLUTCH PTO

1. DISMANTLING

a. Remove PTO cover assembly as explained in Rear PTO Cover section.

b. Remove rear PTO shaft assembly, top and bottom simultaneously).

c. Remove external circlip of PTO input shaft and pull out the wet clutch assembly.

2. CLEANING AND INSPECTION

a. Clean all gears and spline for damage and burrs.

b. Check bearing for pitting and crack if any.

c. Replace all seals.

d. Check wet clutch liners for wear.

e. Clean all parts with suitable solvent.

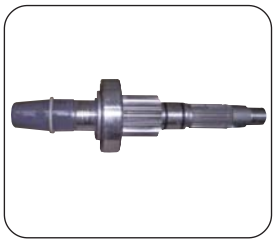
3. ASSEMBLY – PTO COVER

a. Assemble output shaft bearing and oil seal in cover assembly output shaft.

b. Hold the Output gear in position with input gear.

c. Push output shaft in out put gear with spacer in position and insert in bearing and oil seal.

Input Shaft



Fitment of Oil Seal

4. ASSEMBLY - WET CLUTCH PTO – INPUT SHAFT

a. Press input shaft ball bearings, put washer and circlip.

b. Assemble wet clutch assembly and retain with external circlip.

NOTE: Align lubrication hole of wet clutch body and input shaft hole.

c. Assemble the seal ring carefully by using special tool i.e. Sleeve.

d. Assemble the above sub assembly in PTO cover and retain with the bearing retainer.

e. Assemble the complete rear cover assembly along with clutch and gear into transmission case with the help of longer stud.

NOTE: Ensure that the brake lug of wet clutch is properly seated into the stopper provided on transmission case.

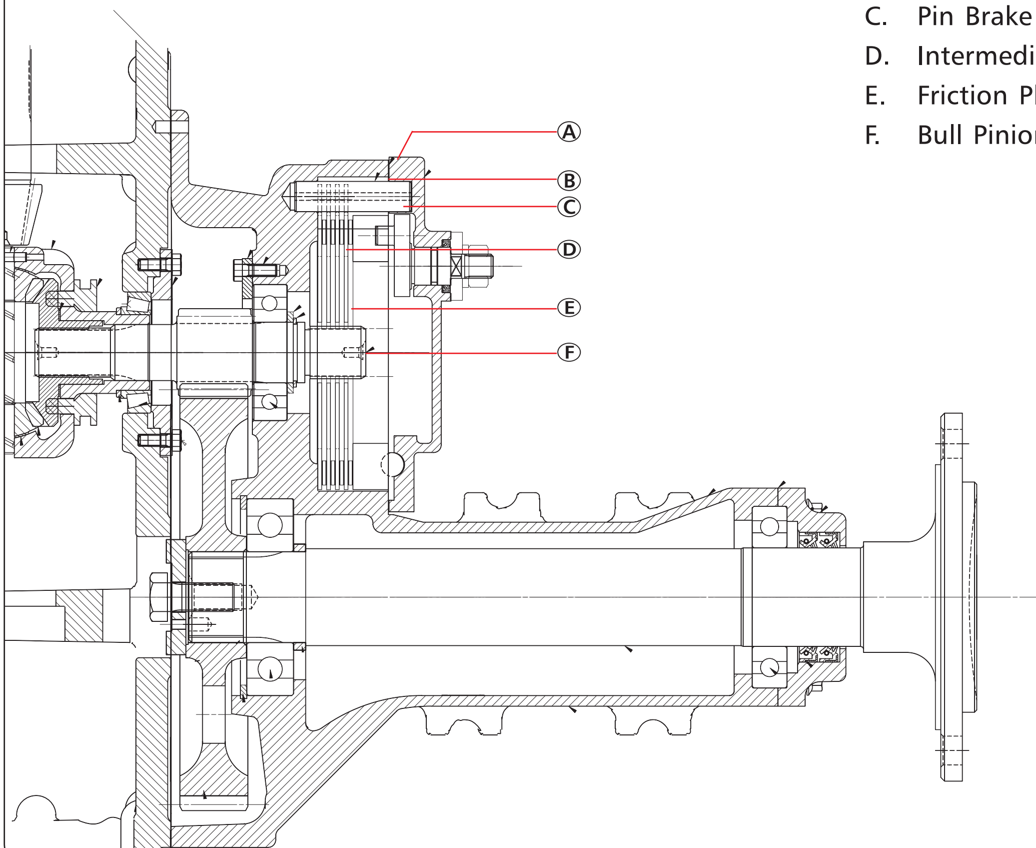
CHAPTER - 7

BRAKES

A. TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
1. Uneven Braking	• Brake pedal free play unevenly adjusted • Brake disc worn • Actuating plate warped	• Adjust • Replace • Replace	
2. Brake drags	• Brake pedal free play too small • Ball holes of actuating plate uneven wear • Brake pedal return spring weaken or broken • Brake pedal shaft sticky on bushes	• Adjust • Replace • Replace • Clean & Lubricate	
3. Poor Braking	• Brake pedal free play excessive • Brake disc worn • Actuating plate warped • Brake lever and shaft damaged • Transmission oil improper	• Adjust • Replace • Replace • Replace • Change	
4. Brake Noisy	• Wrong grad oil • Contaminated oil with water	• Change • Change	

LAYOUT OF BRAKE



A. Brake Assembly
B. Gasket Brake Cover
C. Pin Brake
D. Intermediate Plate (Steel)
E. Friction Plate
F. Bull Pinion Brake Shaft

B. BRAKE SYSTEM

1. Theory of Operations

There are two sets of Brakes in the Tractor. Each set is sandwiched between Cover Plate and Rear Axle Carrier.

Each side contains a set of 4 friction plates and 4 intermediate plates. Friction Plates are mounted on Bull Shaft. Intermediate Plates are supported in Rear Axle Carrier Housing and Brake Bolt.

When Pedal is pressed, Actuating Lever gets activated, which in turn activates Actuating Disc. The actuating disc expands with the guide of Rear Axle Carrier Housing and Brake Pin and Brake liners get compressed between Cover Plate and Rear Axle Carrier Housing. Friction Plate get compressed between adjacent mating surface, so frictional force is generated and this force stops the rotation of Bull Shaft. Thus Brakes are applied.

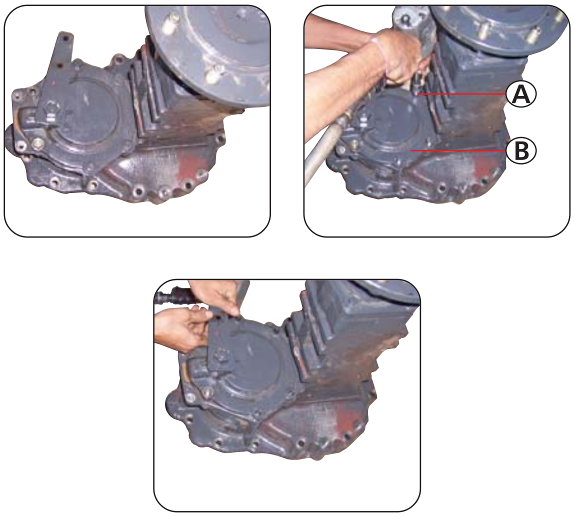
1. Description

These tractors have hanging/suspended type brakes pedals to have wider space of the platform. Independent mechanical wet disc brakes are used the right & left travelling brakes. They are operated by the brake pedals through the mechanical linkages.

The parking brake is a mechanical type. Pulling the parking brake lever results in the same state as that obtained when the brake pedal are pressed.

Although wet disc get worn out by approx. Several tens of micron depending on the accuracy of parts during the initial contact in the initial period of 50 hrs. or 80 hrs., Almost no wear occurs afterwards. This means that very little wear adjustments are required.

Since the brake disc are immersed in transmission oil 'Fade' is rarely caused.

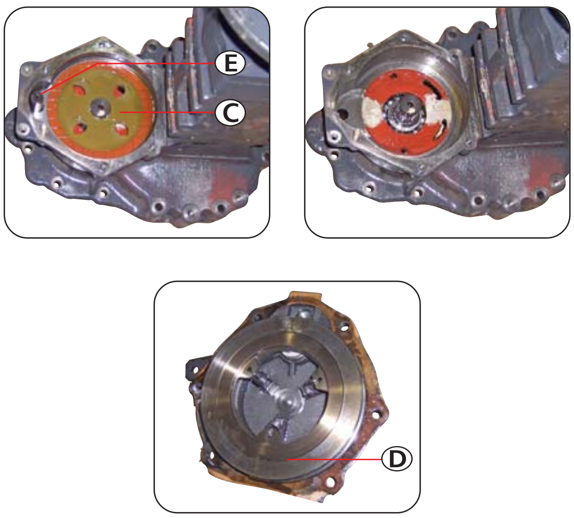


Removal of Cover Plate Brake

2. Removal

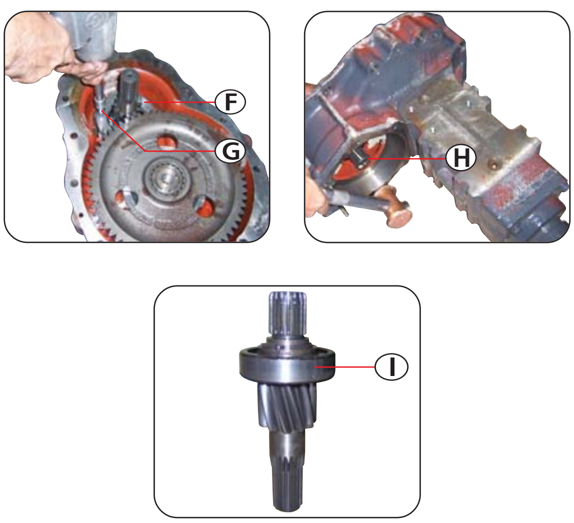
a. Separate Rear Axle Carrier Housing from Transmission Case and place on suitable work bench for further dismantling.

b. Loosen bolt (A) and take out cover plate (B).



Removal of Brake Plates

c. Remove friction disc (C), actuating disc assembly (D) and intermediate pin (E).



Removal of Bull Pinion Brake Shaft

d. Remove retainer (F) from other side by loosening the bolts (G).

e. Take out bull shaft (H) with bearing (I) by slight tapping.

3. **Cleaning & Inspection**

a. Clean all parts with suitable solvent.

b. Check friction plate for wear, crack and splines of plate with bull shaft. If excessive play or damaged, dents found replace the friction plate.

c. Inspect the linkage for wear.

NOTE: Discard the actuating disc spring if found weak or end are deformed.

d. Replace the worn or faulty parts.

NOTE: Removal, dismantling and installation procedure are same with other side brakes.

5. **Installation**

a. Reverse procedure of removal and dismantling.

b. Tighten the bolts at specified torque and check all friction plates and disc intermediates are free.

Group-F

Front Axle

1. **FRONT AXLE**

A. **General Description**

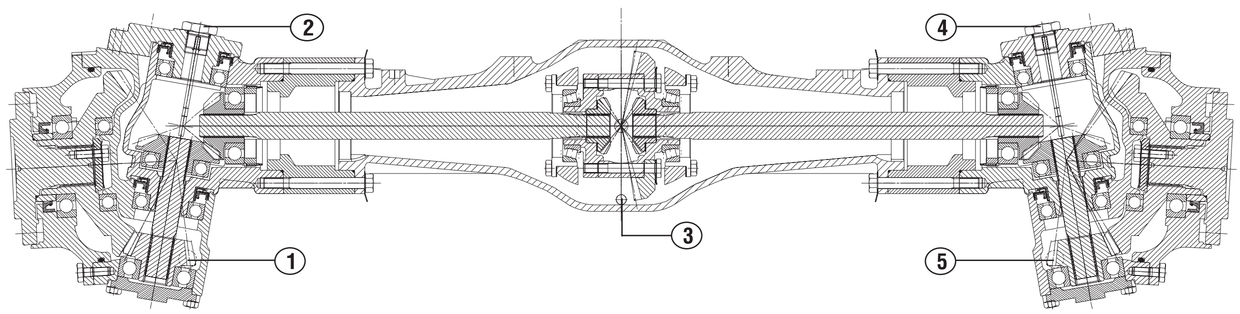
The 4WD Front Axle is a center pivot type. The front wheel drive mechanism is incorporated as a part of the axle.

The front wheel drive power is taken from transmission and transmitted to the differential in the front axle where the power is divided into right and left and to the respective final drives.

In the final drive the transmitted revolution is reduced by the bevel gear to drive the front wheel.

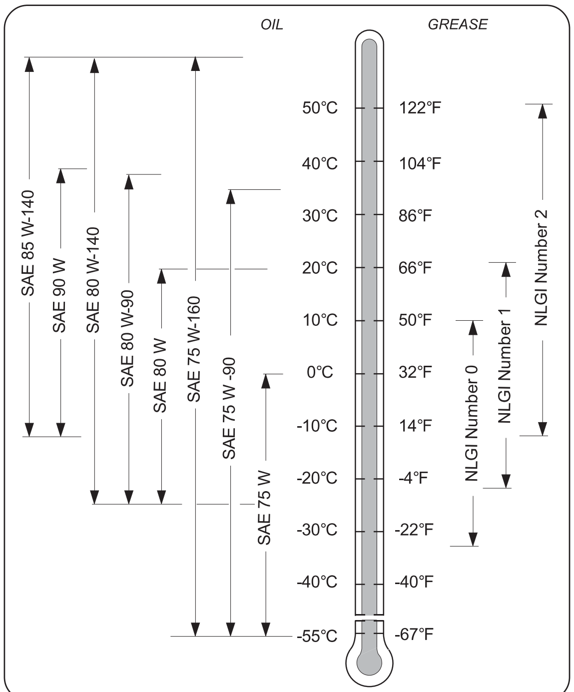
The 4WD mechanism with bevel gears provides wider steering angle and greater durability.

B. **Maintenance Points**



1. Oil Drain Plug Swivel Housing LH
2. Oil Filling and Level Check Point LH
3. Oil Drain Plug Differential Housing
4. Oil Filling and Level Check Point RH
5. Oil Drain Plug Swivel Housing RH

C. **Lubrication / Greasing : Grades & Application Range**



2. TROUBLESHOOTING

PROBLEMS	POSSIBLE CAUSES										
	1	2	3	4	5	6	7	8	9	10	11
- *Wheel vibration; front tire resistance; halfshaft breakage.*	●	●	●		●						●
- *Steering is difficult; vehicle goes straight while its turning.*	●	●	●	●							●
- *No differential action; jamming while steering.*	●			●	●						●
- *No differential action; jamming while steering.*	●	●	●	●	●		●		●		●
- *Uneven wear of tire.*	●	●	●	●	●	●	●				●
- *Friction noise.*	●			●	●			●	●	●	●
- *Vibration during forward drive, intermittent noise.*	●	●	●		●						●

1. **Incorrect installation/defective axle**
Correct installation or repair or replace the differential in case it does not survive any one of the test phases.

2. **Overloading / incorrect weight distribution**
Remove excessive weight and redistribute load, following instructions related to the vehicle.

3. **Different rotation radius of the tires**
If one tire has a smaller radius, it will cause partial wheel slipping when force is applied. The other tire with bigger radius will have to support all the work. Replace the tire or adjust pressure to have same radius on both tire.

4. **Broken halfshaft**
It is not advisable to operate the vehicle with a broken halfshaft. It is acceptable to move the vehicle (engine off unloaded) a few meters away only.

5. **Bent halfshaft**
Replace halfshaft.

6. **Blocked differential**
Abnormal functioning of the differential Verify assembly and all components.
Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns. Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.

7. **Incorrect wheel adjustment**
Verify group integrity and wheel side bearings. Adjusting according.

8. **Spoiled or worn out axle parts**
Check the condition of ring gear, pinion gear, bearings etc. Replace when ever necessary.

9. **Contamination in the axle box or incorrect assembly of parts**
Look for foreign particles. Check assembly of the various parts of the axle.

10. **Incorrect adjustment of bevel gear set: Parts of the transmission worn out.**
(Transmission gears, U joints, etc.)
Replace or adjust as required.

2. TROUBLESHOOTING (Contd.)

This chapter is a descriptive and explanatory guide to common axle problems. This guide suggests the repair correct procedures to be followed.

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
Ring gear tooth broken at the outer side	1. Excessive gear load compared to the one foreseen 2. Incorrect gear adjustment (excessive back-lash) 3. Pinion nut loosened	Replace bevel gear set Follow carefully the recommended operations for the adjustment of bevel gear set back-lash.	
Ring gear tooth broken side	1. Load bump 2. Incorrect gear adjustment (insufficient back-lash) 3. Pinion nut loosened	Replace bevel gear set Follow carefully the recommended operations for the adjustment of bevel gear set back-lash.	
Pinion or ring gear teeth or worn	1. Insufficient lubrication 2. Contaminated oil 3. Incorrect lubrication or depleted additives 4. Worn out pinion bearings that cause an incorrect pinion axle back-lash and wrong contact between pinion and ring.	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of bevel gear set back-lash. Use correct lubricants, fill up to the right levels and replace according to the recommended program.	
Overheated ring and pinion teeth. See if gear teeth have faded	1. Prolonged functioning at high temperatures 2. Incorrect lubrication 3. Low oil level 4. Contaminated oil	Replace bevel gear set. Use proper lubrication, fill up to right level and replace at recommended program.	
Pinion teeth pitting	1. Excessive use 2. Insufficient lubrication	Replace bevel gear set. Use correct lubrication, fill up to the right level and substitute at recommended intervals	
Axle beam body bent	1. Vehicle over loaded 2. Vehicle's accident 3. Load bump	Replace axle beam body	
Worn out or pitted bearings	1. Insufficient lubrication 2. Contaminated oil 3. Excessive use 4. Normal wear out 5. Pinion nut loosened	Replace bearings. Use correct lubrication fill up, to the right level and replace at recommended intervals	

2. TROUBLESHOOTING (Contd.)

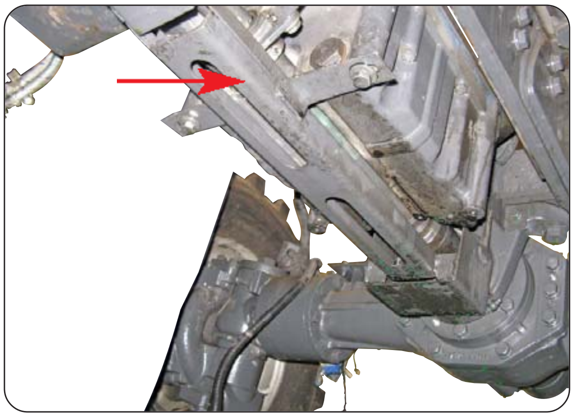
TROUBLE	PROBABLE CAUSE	REMEDY	REF.
Oil leakage form gaskets and seals	1. Prolonged functioning at high temperature of the oil 2. Oil gasket assembled incorrectly 3. Seal lip damaged 4. Contaminated oil	Replace the gasket or seal and matching surface if damaged. Use correct lubrication and replace at recommended intervals.	
Excessive wearing out of input flange spline	1. Exhaustive use 2. Pinion nut loosened 3. Pinion axle back-lash	Replace the flange. Check that the pinion spline is not excessively worn out. Replace bevel gear set if required.	
Fatigue failure of pinion teeth See if the fracture line is well defined (wave lines, beach lines)	1. Exhaustive use 2. Continuous overload	Replace bevel gear set	
Pinion and ring teeth breakage	1. Crash load of differential components	Check and/or replace other differential components.	
Side gear spline worn out. Replace all scratched washers (Excessive back-lash)	1. Excessive use	Replace differential gear group. Replace halfshaft if required.	
Thrust washer surface worn out or scratched.	1. Insufficient lubrication 2. Incorrect lubrication 3. Contaminated oil	Use correct lubrication and fill up to right level. Replace at intervals recommended. Replace all scratched washers and those with 0.1mm thickness lower than the new ones.	
Inner diameter of tapered roller bearing worn out	1. Excessive use 2. Excessive pinion axial back-lash 3. Insufficient lubrication 4. Contaminated oil	Replace bearing. Check pinion axial back-lash. Use proper lubrication, fill up to right level and replace at recommended intervals.	
Bent or broken halfshaft	1. Vehicle intensively operated or overloaded	Replace	
Halfshaft broken at wheel side	1. Wheel support loosened 2. Beam body bent	Replace Check that wheel support is not worn out or wrongly adjusted.	

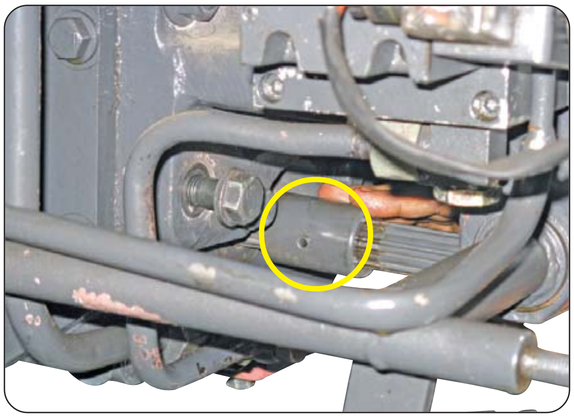
2. TROUBLESHOOTING (Contd.)

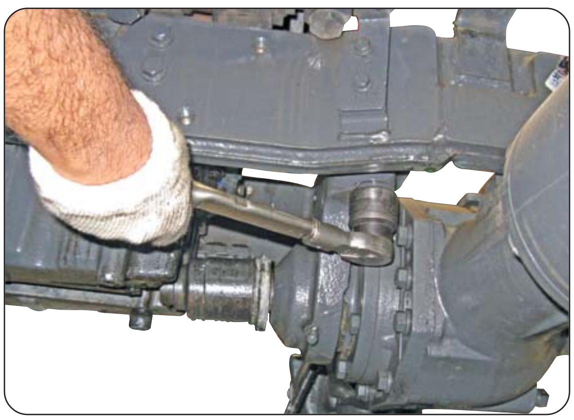
TROUBLE	PROBABLE CAUSE	REMEDY	REF.
Noise while driving	1. Excessive back-lash between pinion and ring gear	1. Adjust	
	2. Worn out pinion and gear ring	2. Replace	
	3. Worn out pinion bearings	3. Replace	
	4. Pinion bearings loosened	4. Adjust	
	5. Excessive axial pinion back-lash	5. Adjust	
	6. Worn out differential bearings	6. Replace	
	7. Differential bearings loosened	7. Adjust	
	8. Ring gear out of roundness	8. Replace	
	9. Low lubricant level	9. Oil level	
	10. Poor or wrong lubricant	10. Replace	
	11. Bent halfshaft	11. Replace	
Noise while driving in neutral	1. Noise coming from axle are usually heard when vehicle moves in neutral gear but are not loud.	1. Replace or adjust (see above)	
	2. Incorrect back-lash between pinion and ring (sound heard while decelerating disappears while increasing the speed)	2. Replace	
	3. Pinion or input flange worn out.	3. Adjust	
Intermittent noise	1. Ring gear damaged	1. Replace bevel gear set	
	2. Differential box bolts loosened	2. Tighten to torque	
Constant noise	1. Ring gear teeth or pinion damaged	1. Replace bevel gear set	
	2. Worn out bearings	2. Replace	
	3. Pinion spline worn out	3. Replace	
	4. Bent halfshaft	4. Replace	
Noise while steering	1. Worn out differential gears	1. Replace	
	2. Worn out differential box or spider	2. Replace	
	3. Differential thrust washers worn out	3. Replace	
	4. Half shaft spline worn out	4. Replace	

3. TORQUE CHART

Sr. No.	Location	Size / Description	Min. Torque (N-m)	Max. Torque (N-m)
1	A. Top Cover LH B. Top Cover RH C. Turning Arrest Rear Side	Nut M12	100	110
2	Swivel Housing LH & RH	Stud M12	55	62
3	A. Swivel Housing LH & RH B. Beam Housing	Drain Plug ½" NPSF	30	40
4	Pillow Block Front & Rear	Grease Nipple 1/8" NPSF	20	25
5	Housing Input Shaft To Housing Differential Carrier	Bolt M12 x 1.5 x 30	115	125
6	Housing Differential Carrier To Beam Housing	BOLT M12 x 1.75 x 35	110	120
7	Bearing Carrier To Housing Differential Carrier	BOLT M10 x 30	40	50
8	Differential case To Ring Gear	BOLT 7/16-20 UNF, 85	90	100
9	Differential case To Ring Gear	BOLT 7/16-20 UNF, 23	90	100
10	Pillow Block Front To Beam Housing	NUT M16	60	70
11	Swivel Housing	Allen Bolt M8 x 1.25 x 16	25	35
12	Beam Housing To Front Axle Spacer To Side Housing For 33 To 43 PTO	Hex Bolt 1/2' - 20 UNF x 120	100	110
13	Beam Housing To Front Axle Spacer To Side Housing For 29 PTO	Hex Bolt 1/2' - 20 UNF x 35	100	110
14	Cover Swivel Housing Bottom To Swivel Housing	Bolt M10 x 20	62	72
15	Retainer Spindle Axle To Spindle Axle	Bolt M10 x 1.25 x 28	62	72
16	Hub Housing To Swivel Housing	Bolt M10 x 30	40	50
17	Top Cover To Swivel Housing	Bolt M12 x 50	70	80
18	Retainer Bearing Hub Housing To Hub Housing	Bolt M8 x 20	20	25
19	Power Cylinder To Beam Housing	Bolt M14 x 1.5 x 33	130	150
20	Tie Rod Ball Joint Assembly To Top Cover	Bolt M18 x 1 Nylock nut	140	160







4. DISMANTLING OF FRONT AXLE

A. Dismantling of Complete Front Axle

1. Dismount the front wheel drive shaft and propeller shaft guards.
2. Remove the right and left tie rods.
3. Suspend the front axle with the chain.
4. Remove the front and rear pillow block bolts and front axle can be separated.
5. Remove front and rear pillow blocks.

INSPECTION

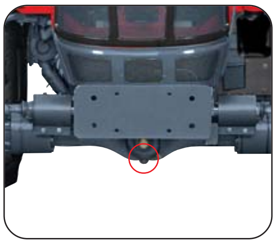
Front & Rear Pillow Block Mounting Diameter:

1. Measure the diameter at a bush contact point with Micro-meter or Vernier-caliper. If the measured value is less than usable limit, replace the pillow block.

	Front	Rear
Standard Values as assembled (mm)	ø 70	ø 74
Usable limit (mm)	ø 70.2	ø 74.2

2. Worn or damaged oil seals, O'rings, bearings, etc. should be replaced.

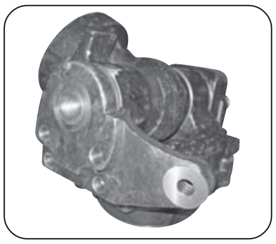
Swivel Housing
Oil Drain Plug



Beam Housing
Oil Drain Plug

B. DISMANTLING MAJOR SUB-ASSEMBLY

1. Remove both wheels.
2. Remove drain plug from both swivel housing and beam housing and then drain oil.
3. Remove side housing RH and LH along with swivel and hub housing from beam housing & remove spacer.



4. Remove top cover and side housing from swivel housing assembly.
5. Remove hub housing.

NOTE: Number of shims and thickness should be noted down from both side.

NOTE: Check the bearing surface and oil seal mating surface for damage, if damaged then replace the same.

Check gear for pitting and teeth breakage. If required, replace it.

C. HUB HOUSING AND FINAL GEAR REDUCTION DISMANTLING

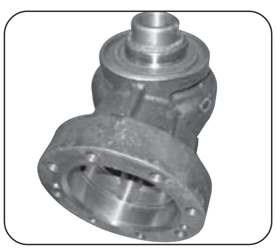
1. For separating final reduction gear from hub housing, remove bolt from spindle front axle. Remove washer and take out the spindle.
2. Support hub housing on flange and then press final reduction bevel gear to separate.
3. Separate hub housing bearing by removing retainer and spacer and pressing from spindle end, remove bearing.

NOTE: Inspect bearing and oil seal, 'O' ring for damage, if required, replace with new.

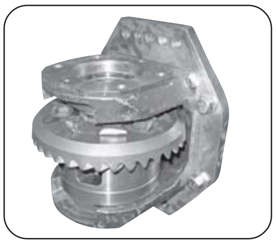
Inspect gear and spline for burrs and damage.Number of shims and thickness to be noted down for both side and preserve it for assembly.

D. SIDE HOUSING DISMANTLING

For removing bearing, first remove crimping of locknut and then remove intermediate pinion with ball bearing from side housing. Remove intermediate bevel gear with bearing through slot provided.



NOTE: Inspect the gear and spline for damage.



E. DIFFERENTIAL GROUP DISMANTLING

Retrieve the differential and hold in a vise.

Unscrew all the fastening screws and lock washers of the bevel gear crown.

NOTE: This will make both differential half boxes free, so take care not to drop the internal components. Remove bevel gear crown.

Disassemble the differential box in two half boxes complete with relative components.

NOTE: Mark the two half boxes before disjoining them, in order to reassemble them, in the same position as the one before disassembling.

Disassemble all the components. Check the operating and wear conditions of the components.

Number of shims and thickness to be noted down for both side and preserve it for assembly.

Take the bearing out of the differential half box, using two levers or three hold extractor.

F. PINION GROUP DISMANTLING

Place the housing input shaft on fixture and lock the pinion.

Unscrew the locknut with special spanner provided.

NOTE: This is the destructive operation for the lock nut.

Remove the locknut, oil seal. Remove preloading spacer and O' ring.

For reassembly use new locknut and oil seal, O' ring.

Tap the pinion shaft with soft material hammer from spline end and remove the pinion shaft.

Take care not to drop pinion.

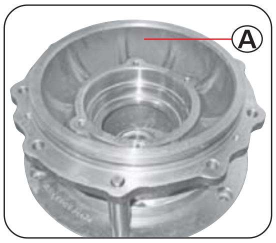
Remove the inner cone of taper roller bearing of the pinion, use a standard extractor.

Check all pinion components for wear and damage.

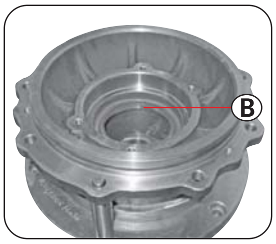
Number of shims and thickness to be noted down for both side and preserve it for assembly.

5. ASSEMBLY OF FRONT AXLE

A. HUB HOUSING ASSEMBLY

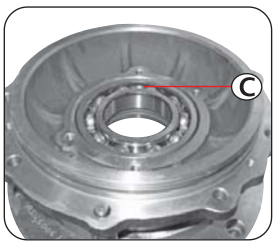


1. Put hub housing (A) on a fixture.

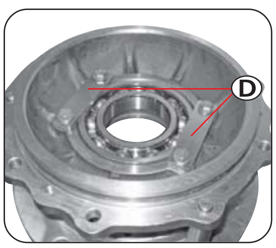


2. Press Oil Seal (B) in Hub Housing.

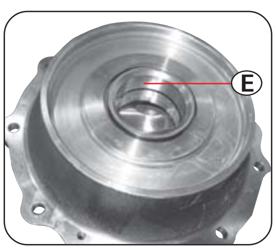
NOTE: Apply Grease on oil seal before fitment in housing.



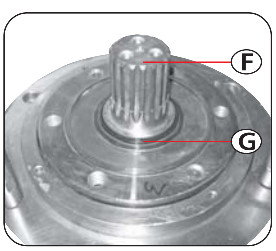
3. Press bearing (C).



4. Put bearing retainer (D) and torque the mounting bolt to 25 Nm.

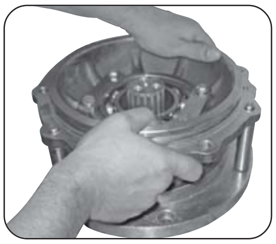


5. Put spacer (E) in another side of hub housing.

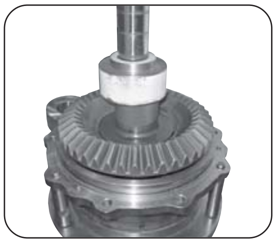


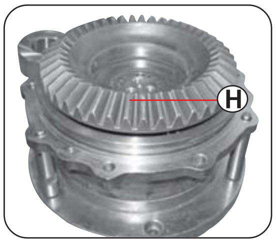
6. Place a spindle axle (F) on fixture and put O'ring (G) on the flange.

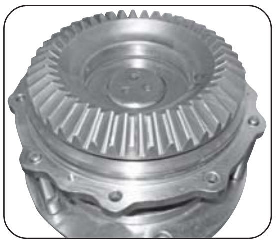
A. HUB HOUSING ASSEMBLY



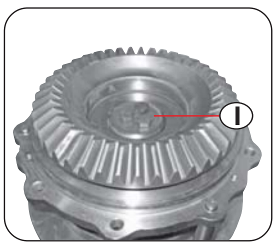
7. Put hub housing assembly on spindle axle carefully.

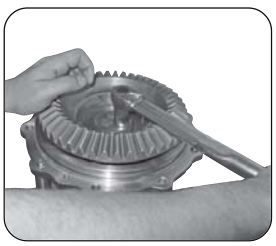




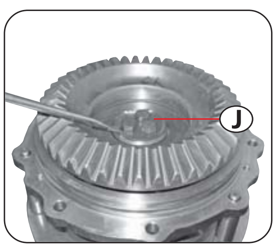


8. Insert final bevel gear (H) and retainer spindle axle & washer.





9. Lock the spindle axle by tightening bolt (I) to the specified torque (65 Nm).

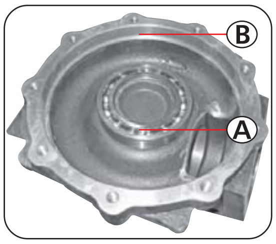


10. Lock the bolt by bending washer (J) at three places near bolt head.

11. Fit O'ring (K) in place.

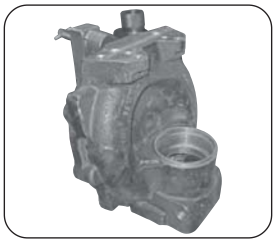
NOTE: Apply oil to O'ring before fitment.

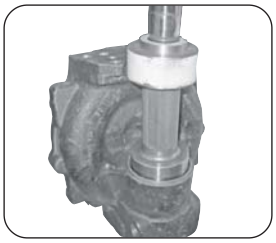
B. SWIVEL HOUSING ASSEMBLY



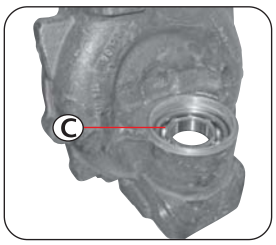
1. Fit the bearing (A) inside swivel housing (B).

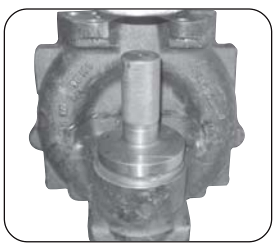
NOTE: Bearing temperature 120ºC.

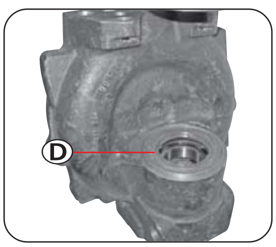




2. Fit the side housing pivot bearing (C).

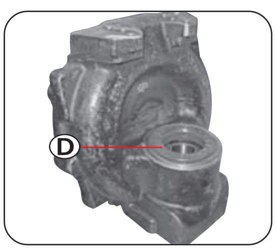


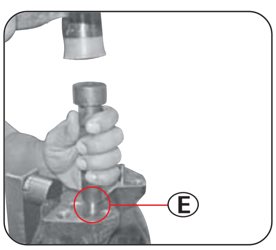




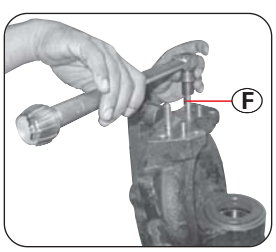
3. Press the oil seal (D).

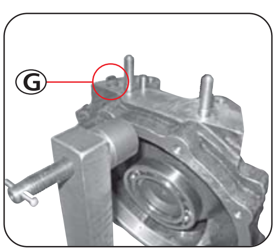
NOTE: Apply grease to oil seal before fitment.





4. Fit locating Dowels (E) and Studs (F) and torque the studs to 55-65 Nm.

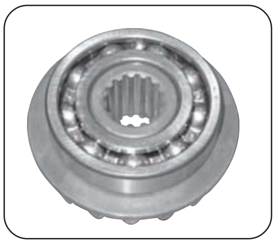




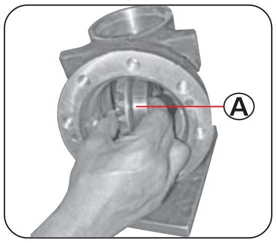
5. Fit the allen bolt (G) with copper washer.

NOTE: During oil filling in swivel housing, remove the allen bolt and fit after oil filling.

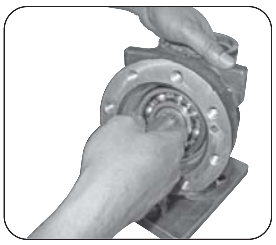
C. SIDE HOUSING ASSEMBLY

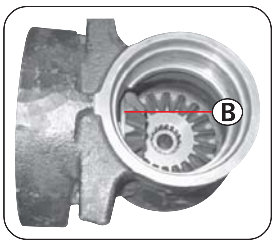


1. Press ball bearing on intermediate gear and press ball bearing on intermediate pinion.

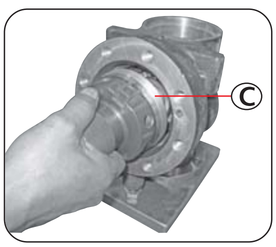


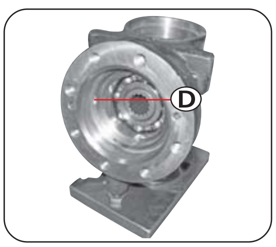
2. Insert the intermediate reduction gear (A) with bearing through slots provided in side housing and assemble in position.

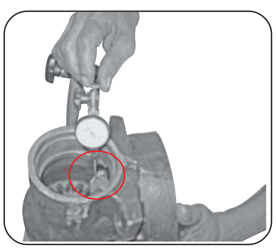




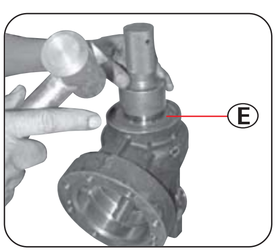
3. Assemble intermediate pinion (B) with bearing and special nut (C). Adjust nut till desired backlash and crimp (D) the special nut.

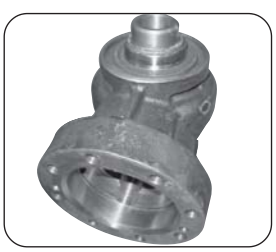






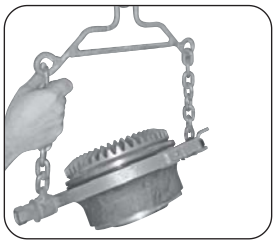
4. Check the backlash, it should be between 0.13 to 0.20 mm.

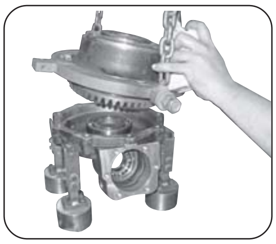


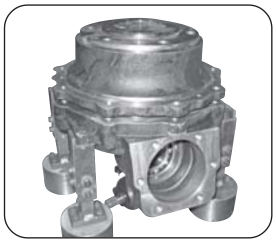


5. Fit the oil seal (E).

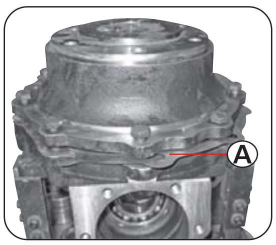
D. ASSEMBLY OF HUB/SWIVEL/SIDE HOUSING

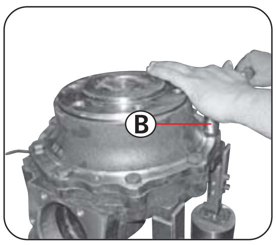




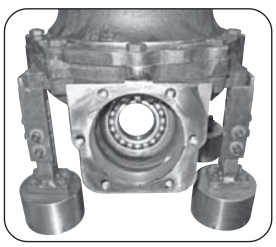


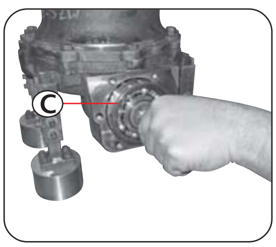
1. With suitable bracketaries, lift hub housing assembly and place on swivel housing assembly.



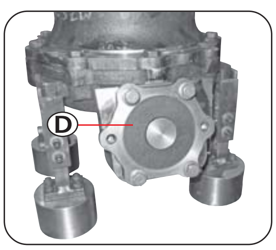


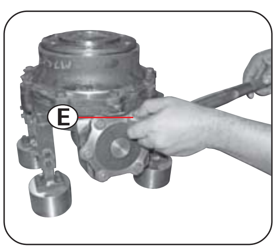
2. Put shims (A) between swivel housing & hub housing and tighten both assemblies mounting bolt (B) to torque 41-50 Nm.





3. Apply thread sealant on swivel housing and fit final reduction pinion with bearing (C) inside swivel housing.

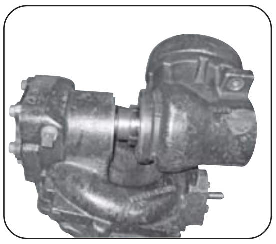




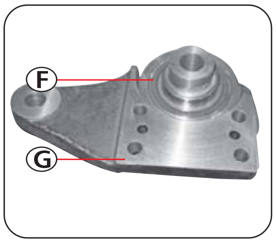
4. Fit the cover (D) on swivel housing and tighten bolts (E) to torque 65-72 Nm.

5. Check backlash for final reduction gear pair, it should be between 0.13 to 0.30 mm., if necessary adjust the shims.

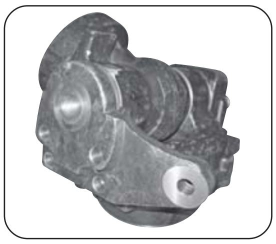
D. ASSEMBLY OF HUB/SWIVEL/SIDE HOUSING

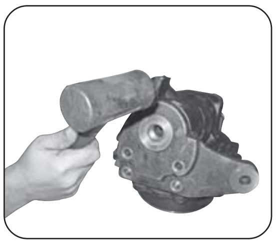


6. Lift the side housing and fit to swivel housing by slight tapping.

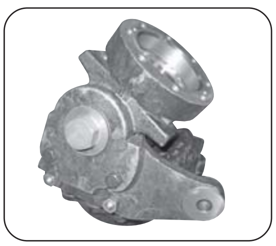


7. Press oil seal (F) inside top cover (G).

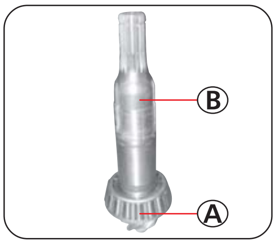




8. Fit top cover to side housing by slight tapping and tighten the mounting bolt to specified torque (70-80 Nm) and tighten the nut to torque 110 Nm.

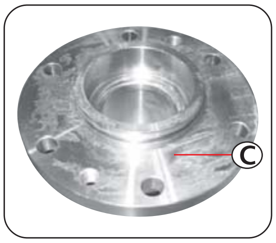


E. PINION GROUP ASSEMBLY

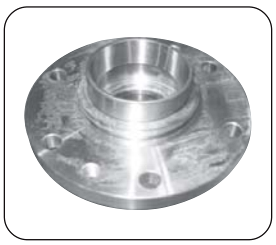


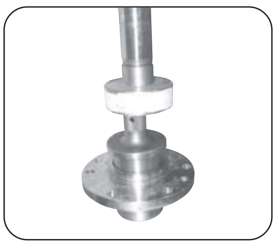
1. Insert bearing (A) on spiral bevel pinion (B).

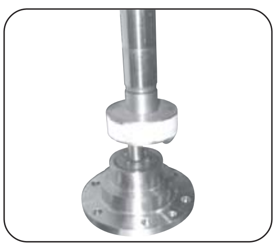
NOTE: Temperature of bearing 120°C



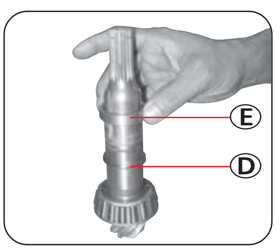
2. Place the housing input shaft (C) on a flat surface.



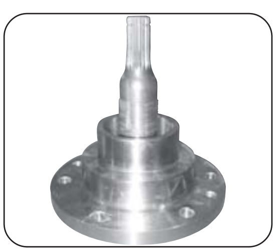




3. Press the outer cone of bearing to both side of housing input shaft.

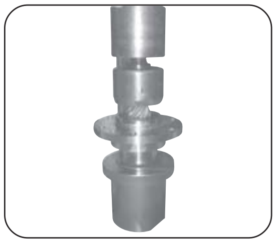


4. Put shims (D) and spacer (E) on pinion.

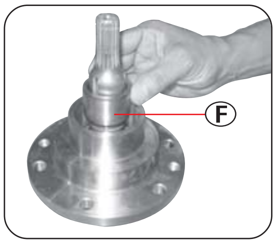


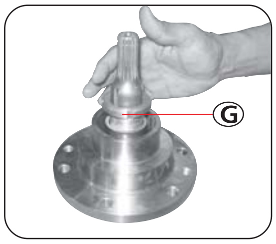
5. Insert housing input shaft to the pinion.

E. PINION GROUP ASSEMBLY

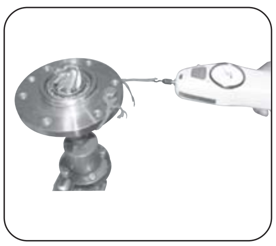


6. Press the front taper roller bearing to the pinion.

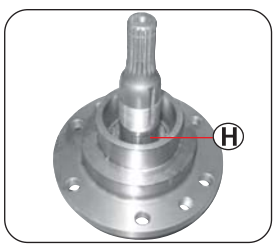




7. Put spacer (F) and tighten the lock nut (G) to 65 Nm torque.



8. Check the preload. It should be between 3.0 to 3.75 Kg. If the preload is within limit or more, accordingly add or remove the shims.



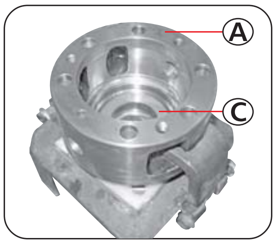
9. Once the preload set and shim value decided, remove lock nut. Put O'ring (H) on pinion by using plastic sleeve to avoid damage to O'ring.

   Press oil seal. Then tighten lock nut to 65 Nm and measure preload. Finally crimp the lock washer in pinion slot provided.

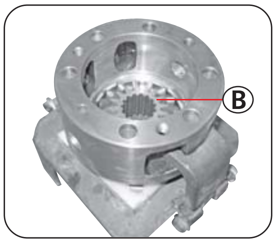
   Preload after oil seal fitment to be 4 to 5 Kg.

NOTE: Preload to be measured before oil seal fitment.

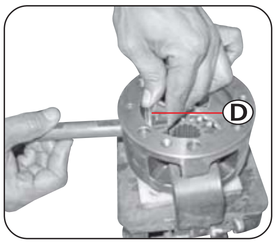
F. DIFFERENTIAL GROUP RING GEAR ASSEMBLY



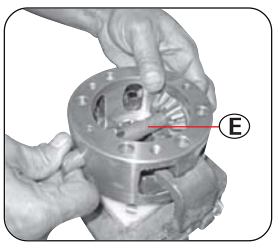
1. Hold the Differential RH Housing (A) with suitable fixture / holding device.

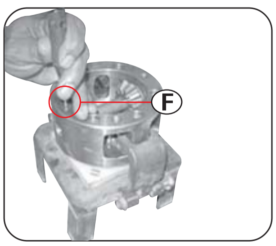


2. Assemble differential bevel gear (B) with thrust washer (C) in RH Differential case.

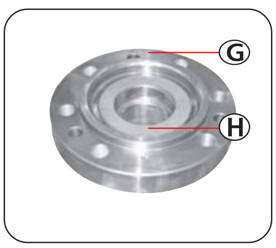


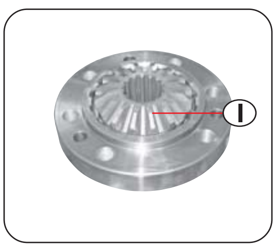
3. Assemble differential bevel pinion (D) with thrust washer (2 Numbers).





4. Insert shaft differential (E) and position with spring pin (F) with proper dolly.

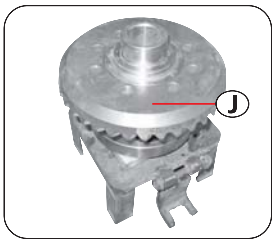




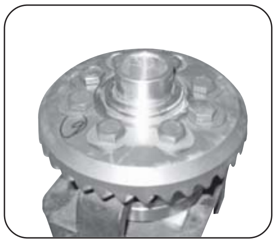
5. Assemble differential case LH (G) along with thrust washer (H) and differential gear (I).

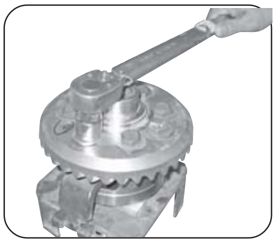
6. Assemble differential case LH and RH with position mark as supplied.

F. DIFFERENTIAL GROUP RING GEAR ASSEMBLY

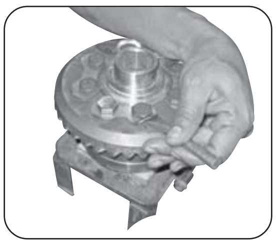


7. Locate ring gear (J) on RH Differential case.

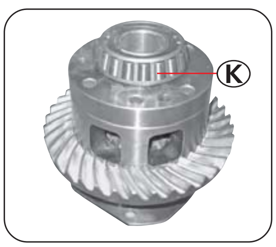




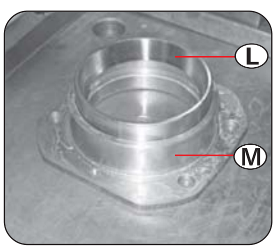
8. Put bolt along with lock washer and torque the bolt to 100 Nm.

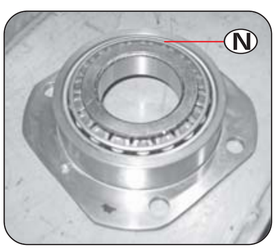


9. Lock the bolts with washer by bending it on bolt head.



10. Fit the taper roller bearing (K) (temp 120ºC) on LH differential case.

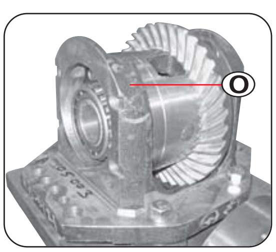




11. Fit the cone (L) into bearing carrier (M) with taper roller bearing (N).

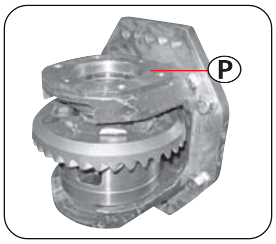
NOTE: The taper roller bearings and cups / cones are not serviceable separately.

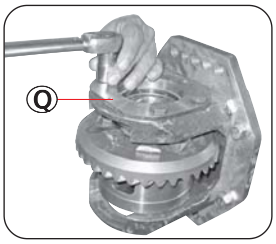
Ensure to assemble new match pair while repairing.



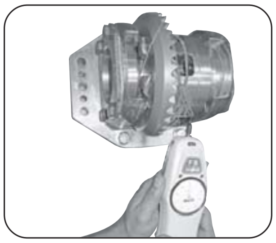
12. Hold the housing differential carrier (O) on suitable fixture and place differential assembly.

F. DIFFERENTIAL GROUP RING GEAR ASSEMBLY



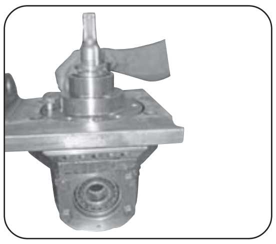


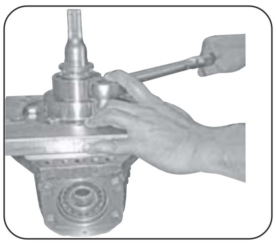
13. Insert the bearing carriers (P) from both side, along with known value of shims (Q) and tighten the bolts to 45 Nm torque.



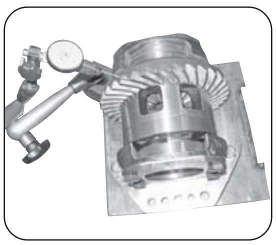
14. Check preload and add or remove shims till you get desired preload.

    Preload Differential case - 1.25 to 2 Kg.





15. Fit Pinion assembly to Differential case assembly and tighten the bolts to 120 Nm torque.



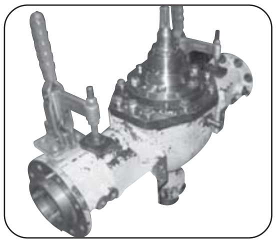
16. Check the differential gear backlash as specified.

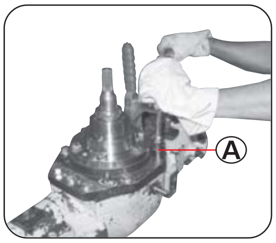
    Backlash Differential gear - 0.1 to 0.25 mm.

    Adjust the backlash by shifting shims (Q) from one side to other.

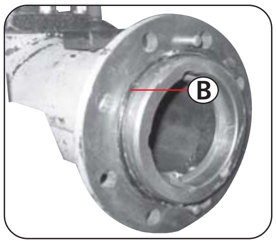
G. ASSEMBLY OF SIDE HOUSING TO BEAM HOUSING AND DIFFERENTIAL CARRIER

1. Clean beam housing and apply loctite on differential carrier resting surface.



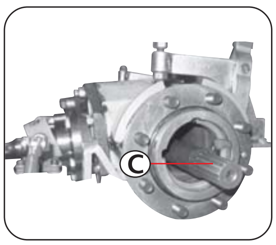


2. Mount differential carrier assembly to the beam housing and tighten bolts (A) to 120 Nm torque.

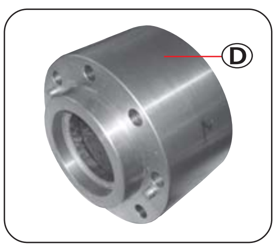


3. Put o'ring (B) on beam housing both ends.

NOTE: Apply grease to o'ring before fitment.

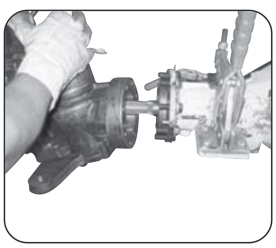


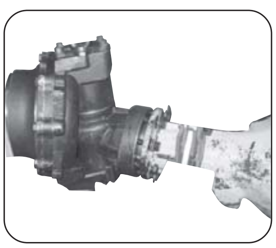
4. Insert shaft beam housing (C) in differential.



5. Put spacer (D) to beam housing both end side. (Not Applicable for 29 PTO).

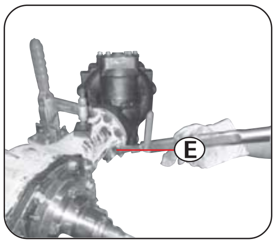
NOTE: This spacer is not applicable for 29 PTO tractors.

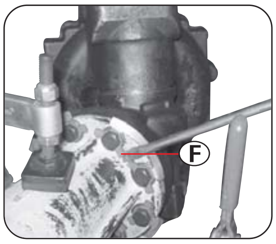




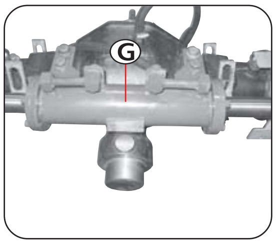
6. Fit side housing to beam housing with the help of suitable hoist.

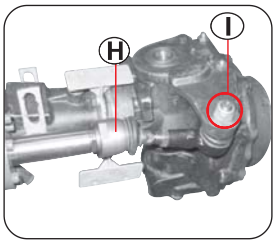
G. ASSEMBLY OF SIDE HOUSING TO BEAM HOUSING AND DIFFERENTIAL CARRIER



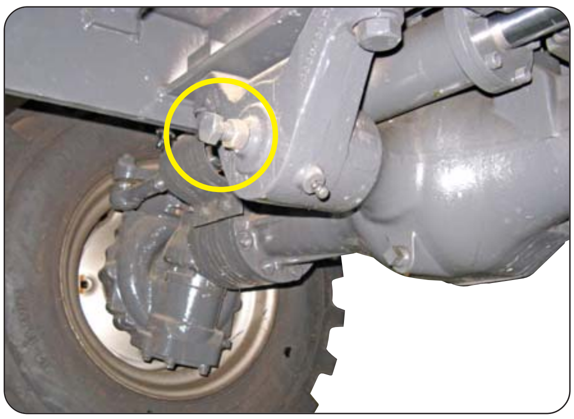


7. Fit the bracketaries.
8. Tighten the bolts (E) to 100 Nm torque and crimp the lock washer (F) at the bolt head.
9. Fit both sides oil level dipstick.



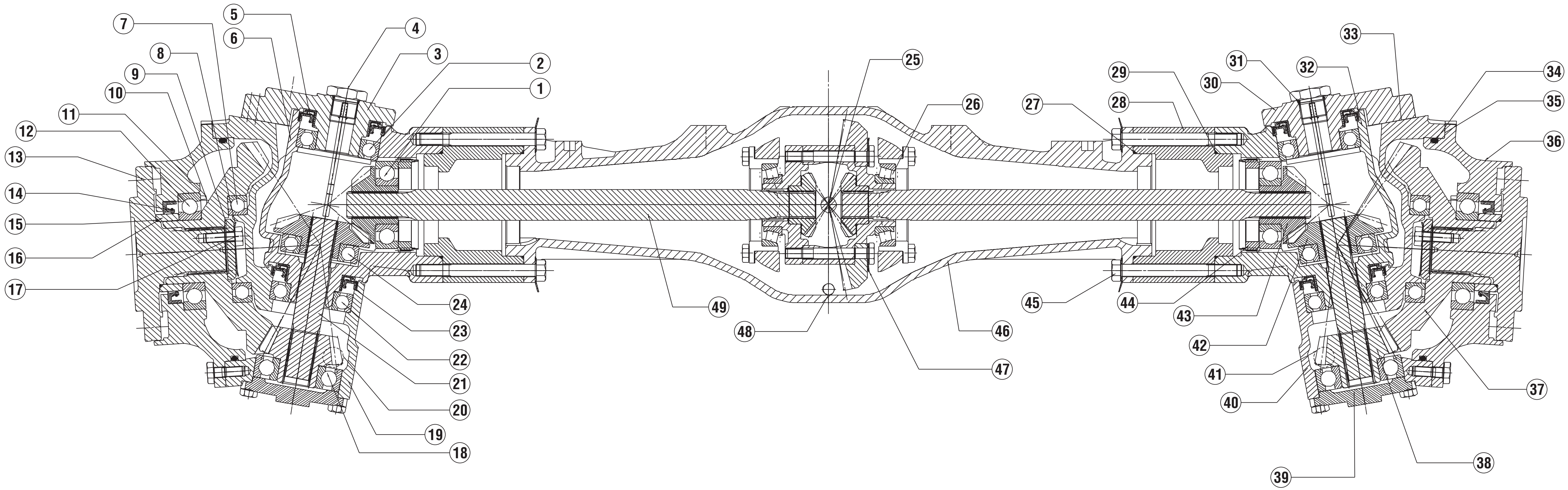


10. Fit the steering cylinder (G) and tie rod ends (H) and fit guard for steering cylinder.
11. Assembly power cylinder (G) on beam housing and tighten it to torque 140 Nm.
12. Fit tie rod ball joint assembly (H) to power cylinder and top cover. Tighten these joints (I) to torque 160 Nm.



Pillow Block Bolt Adjustment

1. Assemble the Pillow Blcok front and rear with semichassis with the help of bolts.
2. Fix the semichassis and try to swing the axle.
3. Then tighten pillow block bolt to stop the swinging action of axle.
4. Loose the same bolt for only half rotation and tighten the nut to get float.



1. Ball Bearing
2. Ball Bearing
3. Top Cover LH
4. Dipstick
5. Oil Seal
6. Side Housing LH
7. Ball Bearing
8. Washer Retaining Axle Shaft
9. Retainer Spindle Axle
10. Hex. Bolt
11. Retainer Bearing Hub Housing
12. Ball Bearing
13. Spindle Front Axle
14. Oil Seal
15. O'Ring
16. Collar Oil Seal
17. Hex. Bolt
18. Ball Bearing
19. Swivel Housing LH
20. Drain Plug
21. Shaft Side Housing
22. Ball Bearing
23. Oil Seal
24. Ball Bearing
25. Ring Gear
26. Taper Roller Bearing
27. O'Ring
28. Front Axle Spacer
29. O'Ring
30. Top Cover RH
31. O'Ring
32. Side Housing RH
33. Dowel
34. O'Ring
35. Shim
36. Hub Housing
37. Bevel Gear Final
38. Straight Bevel Gear
39. Cover Swivel Housing Bottom
40. Swivel Housing RH
41. Drain Plug
42. Bevel Gear
43. Bevel Pinion
44. Lock Nut
45. Hex. Bolt
46. Beam Housing
47. Lock Plate
48. Drain Plug
49. Shaft Beam Housing

Group-G

Electrical

1. CHECKING ELECTRICAL TROUBLES

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
BATTERY			
1. Battery Discharging	1. Short circuits.	1. Locate shorts and correct cause.	
	2. Defective regulator.	2. Replace.	
	3. Alternator not charging.	3. Check as below.	
2. Battery Overheating	1. Improper battery solution level.	1. Keep proper water level/solution.	
	2. Regulator defective.	2. Replace if necessary.	
	3. Internal short.	3. Replace.	
3. All electrical load don't operate	1. Battery discharge	1. Check as above	
	2. Battery positive cable disconnected or improperly connected	2. Replace or repair	
	3. Battery negative cable disconnected or improperly connected	3. Replace or repair	
4. Battery discharged too quickly	1. Battery defective	1. Recharge or replace	
	2. Alternator defective	2. Repair or replace	
	3. Wiring harness loose connected. (between battery positive terminal and alternator terminal)	3. Repair or replace	
	4. Cooling fan belt slipping	4. Adjust tension	
ALTERNATOR			
1. No Alternator output	1. Defective Regulator.	1. Replace Regulator.	
	2. Worn brushes.	2. Replace brushes.	
	3. Dirty or oxidized slip rings.	3. Clean slip rings.	
	4. Sticking brushes.	4. Clean assembly and ease brushes with fine cut file.	
	5. Low brush tension.	5. Adjust or replace brush spring.	
	6. Alternator windings burnt out.	6. Replace alternator.	
	7. Broken or defective wiring.	7. Check wiring and make connections.	
2. Alternator output excessive	1. Internal short.	1. Inspect and repair alternator.	
	2. Voltage regulator defective.	2. Replace regulator.	

1. CHECKING ELECTRICAL TROUBLES (Contd.)

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
3. Charge indicator continuous glows with engine operating at governed speed	1. Alternator inoperative.	1. Service alternator as at (c) above.	
	2. Faulty regulator.	2. Replace control box.	
	3. Short circuits.	3. Test cables for shorts.	
	4. Drive belt loose or broken.	4. Tighten or replace belt.	
	5. Alternator fuse diffused.	5. Check and replace.	
4. Alternator noisy	1. Loose mountings.	1. Tighten mounting bolts.	
	2. Loose pulley.	2. Tighten pulley.	
	3. Worn bearings.	3. Install new bearings.	
	4. Internal damage.	4. Repair or replace.	
5. Flickering of charger system rapidly with the engine operating at governed speed	1. Intermittent shorts or loose connections.	1. Test for short circuits, and tighten connections.	
	2. Alternator defective.	2. Service alternator as at (c) above.	
	3. Defective regulator.	3. Replace regulator.	
	4. Alternator drive belt loose.	4. Adjust belt if necessary, replace.	
	5. Surging of engine speed.	5. Adjust engine speed setting.	
	6. Slip ring dirty	5. Clean.	
6. Charge indicator does not appear when starter switch is on	Test lamp connect to 'F' and -ve of Alternator. 1. If the bulb now lights the cause is faulty regulator. If the bulb does not lights ground 'A' terminal of the Alternator.	1. Replace Regulator.	
	2. If the bulb lights, now brush lead the causes are. a) Jammed brushes or brush lead adrift. b) Dirty slipring c) Rotor open circuit	Free brushes replace if necessary. Clean the slip ring. Check that the ends of the rotor winding are soldered properly to slipring terminals. Re solder the windings if open or replace the rotor.	

1. CHECKING ELECTRICAL TROUBLES (Contd.)

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
	3. If the bulb does not light even grounding 'A' terminal the cause are. a) Blown fuse. b) Short circuited warning lamp holder	Check the short circuit if any in the wiring harness replace fuse after rectifying the short fault. Replace Holder.	
7. Charge indicator glow dim	1. Regulator defective	1. Replace regulator.	
	2. Rotor defective	2. Replace rotor	
STARTER			
1. Starter will not operate	1. Faulty batteries / discharged.	1. Recharge or install new battery.	
	2. Cables and terminals defective.	2. Check earth cable, battery to starter cable, and batteries connecting cable for secure mounting to terminals. Replace cables if necessary.	
	3. Starter relay defective.	3. Replace	
	4. Safety switch defective / Safety interlock not working. a) P.T.O. Relay / PTO flahser b) Neutral switch	4. Replace a) Check if it is not ok, replace b) Check and replace if not OK.	
	5. Internal damage to starter motor (solenoid switch should be heard to click).	5. Repair or replace	
	6. P.T.O. Relay faulty	6. Replace	
	7. Wiring harness disconnected or improperly connected.	7. Repair or replace	
	8. Start motor defective.	8. Repair or replace	
	9. Main switch defective.	9. Replace	
	10. Starter motor pilot switch out of adjustment or defective.	10. Replace or readjust switch.	
	11. Starter motor solenoid switch defective.	11. Replace switch.	

1. CHECKING ELECTRICAL TROUBLES (Contd.)

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
2. Start Motor insufficient torque	1. Starter motor burned out.	1. Install new starter motor.	
	2. Commutator worn or dirty.	2. Remove band, inspect brushes and commutator for grooves, pitting, burned spots.	
	3. Brushes not making proper. contact.	3. Inspect brushes for proper seating. Replace if necessary.	
INSTRUMENT CLUSTER			
1. Charging lamp does not light when main switch is turned ON	1. Fuse blown	Replace	
	2. Wiring harness disconnected or improperly connected	Repair or replace	
2. Charging lamp light ON when engine is running.	1. Short circuit between alternator L. terminal lead and chassis.	Repair or replace	
	2. Alternator defective	Repair or replace	
3. Gauge in Red zone, when engine is running	1. Engine oil pressure too low	Repair Engine	
	2. Engine oil insufficient	Replenish	
	3. Engine oil pressure switch defective	Replace	
	4. Short circuit between engine oil pressure switch lead and chassis.	Repair	
4. Engine oil pressure needle flickers when main switch is turned ON and Engine is not running	1. Engine oil pressure switch defective	Replace	
	2. Warning harness disconnected or improperly connected (between panel board and engine oil pressure switch)	Repair or Replace	
5. Engine does not stop when main switch is turn OFF	1. Key switch defective	• Replace	
	2. Wiring harness short	• Repair or Replace	
6. Engine does not start	1. Fuel solenoid defective	• Replace	
	2. Key switch defective	• Replace	
	3. Starter relay defective. PTO relay / PTO flasher & Neutral switch defective	• Replace	
	4. Wiring disconnected / loose connected	Tighten properly	

1. CHECKING ELECTRICAL TROUBLES (Contd.)

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
7. RPM meter not working	1. Alternator not working	• Rectify or Replace	
	2. RPM Gauge faulty	Replace	
	3. Open circuit between 'W' Terminal of Alternator and Hour meter.	Rectify	
8. Fuel Gauges Does not function	1. Fuel gauge defective	• Replace	
	2. Fuel level sensor defective.	• Replace	
	3. Wiring harness disconnected or improperly connected. (between panel board and fuel level sensor)	• Replace	
9. Coolant Temperature gauge does not Function	1.Coolant temperature gauge defective	• Replace	
	2.Coolant temperature sensor defective	• Replace	
	3. Wiring harness disconnected or improperly connected. (between panel board and fuel level sensor)	• Repair or Replace	
	4. Cluster defective	• Replace	
10. Turn signal indicator does not function	1. Turn signal switch defective	• Replace	
	2. Flasher unit defective	• Replace	
	3. Bulb blown	• Replace	
	4. Fuse blown	• Replace	
	5. Hazard switch defective	Replace	
	6. Switch Instrumental cluster defective	Replace	
11. 4WD Indicator does not function	1. Fuse blown	Replace	
	2. 4 WD Sensor switch defective	Replace	
	3. Wiring harness disconnected	Repair or Replace	
	4. Cluster defective	Investigate & Repair or Replace	
12. Parking brake indicator does not function	1. Fuse blown	Replace	
	2. Brake switch defective (Pork)	Replace	
	3. Wiring harness disconnected from switch and panel.	Repair or Replace	
	4. Instrumental cluster defective	Replace	

1. CHECKING ELECTRICAL TROUBLES (Contd.)

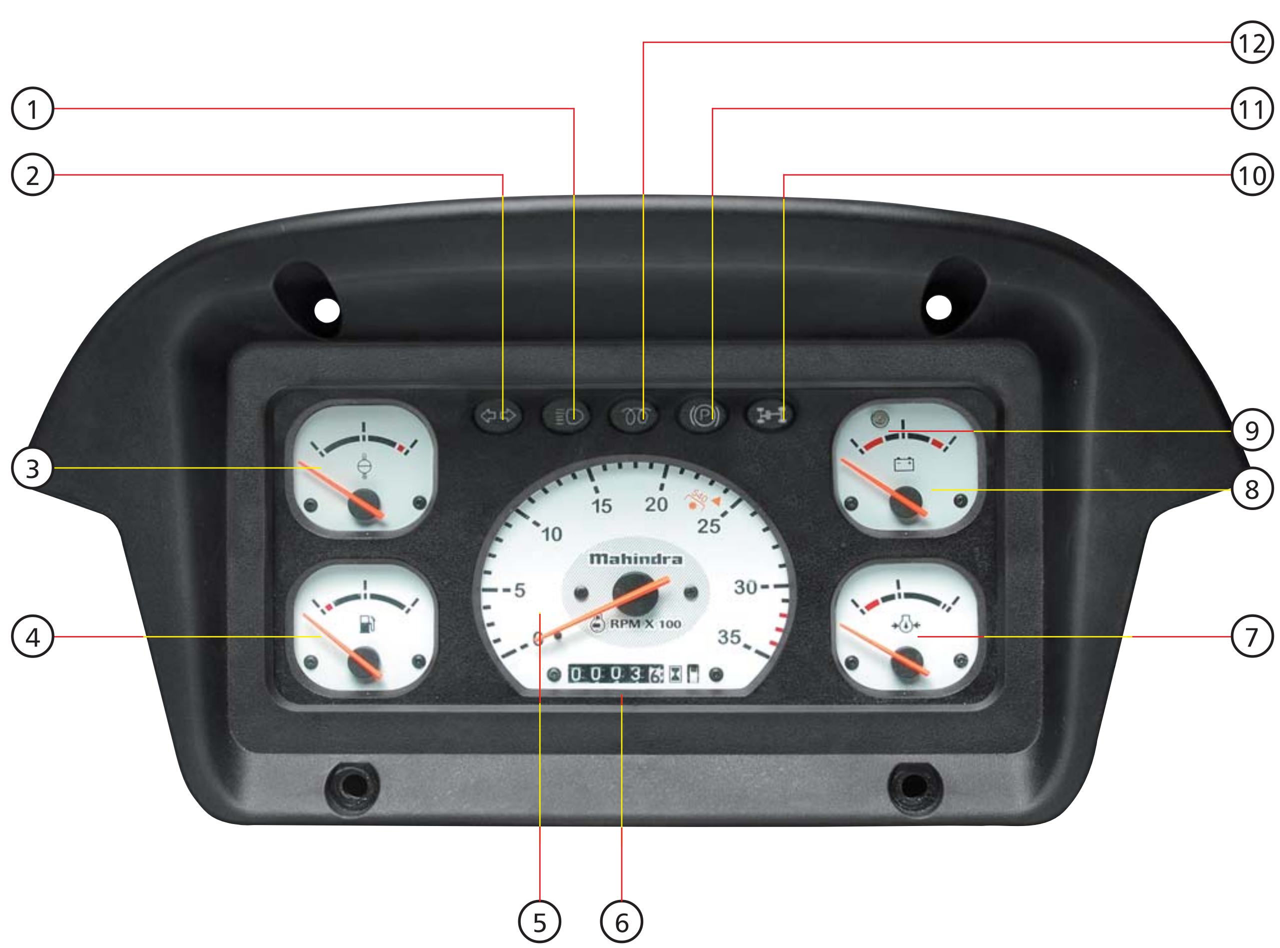
TROUBLE	PROBABLE CAUSE	REMEDY	REF.
1. **Head lamp does not light**	1. Fuse blown, switch faulty.	Replace	
	2. Bulb blown	Replace	
	3. Wiring harness disconnected or improperly connected (between main switch terminal and head light switch terminal)	Repair or replace	
2. **Illumination light does not light**	1. Fuse blown	Replace	
	2. Bulb blown, switch faulty	Replace	
	3. Wiring harness disconnected or improper.	Repair or replace	
3. **Position lights do not light**	1. Fuse blown	Replace	
	2. Wiring harness disconnected or improperly connected (Between head light switch terminal and tail light)	Replace	
4. **Hazard light does not light**	1. Fuse blown	Replace	
	2. Bulb blown	Replace	
	3. Wiring harness disconnected (Between main switch terminal and hazard unit, Between hazard unit and hazard switch terminal and hazard light.	Repair or Replace	
	4. Hazard switch defective.	Replace	
	5. Flasher defective.	Replace	
5. **Direction indicator lamps not working**	1. Bulb blown	Replace	
	2. Turn signal switch faulty	Replace	
	3. Hazard switch faulty	Replace	
	4. Flasher faulty	Replace	
	5. Wiring Harness loose or wrongly connection or faulty.	Repair or Replace	
6. **Brake lamps not working**	1. Blown bulb	Replace	
	2. Main brake switch faulty	Replace	
	3. Parking brake switch faulty	Replace	
	4. Wiring Harness loosen or wrongly connection.	Rectify the problem	

1. CHECKING ELECTRICAL TROUBLES (Contd.)

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
7. Plow lamp	1. Blown bulb	Replace	
	2. Fuse blown	Replace	
	3. Switch faulty	Replace	
	4. Wiring Harness	Rectify or replace	
8. Fuse blown frequently	1. Short circuited / heavy over load	Repair or replace.	
9. Heater Indicator continuously "ON"	1. Timer relay faulty	Replace the timer	
	2. Wiring faulty	Repair or replace	
KSB			
	1. KSB/FIP circuit faulty	Replace	
	2. KSB Relay faulty	Replace	
	3. Wiring faulty	Rectify or Replace	

NOTE: **If heater indicator is "ON" for more than 2 minutes, switch "OFF" the tractor and remove the battery connection.**

2. Instrument Cluster



A.General

The various Instruments gauges and switches are mounted on the instrument panel and scuttle assembly.

The panel is secured by four screws on the scuttle assembly under the steering wheel. The operator can easily pay attention on the gauges and indicators and can reach to the switches and control while driving.

WARNING :

The operator must be thoroughly acquainted with the location and use of all instruments and controls regardless of experience, must read operators manual carefully before attempting to operate the tractor.

The Instrument Cluster is a descriptive unit that gives the user various indications about the working of the tractor and its various features. It consists of the following:

1. High Beam Indicator
2. LH / RH Turn Signal Indicator
3. Coolant Temperature Gauge
4. Fuel Level Gauge
5. Engine RPM Meter
6. Hour Counter
7. Engine Low Oil Pressure Gauge
8. Voltmeter
9. Battery Charge Indicator
10. 4WD Indicator
11. Parking Brake Indicator
12. Heater Indicator

⚠ WARNING

Do not drive the vehicle when Engine RPM is in Red Zone for longer duration.

Engine RPM Meter

This meter gives the number of Revolution Per Minute of the engine. To arrive at the RPM value at any given point of time, multiply the pointer reading by 100.

Example : If the reading shows 15, the actual engine RPM value = 15 x 100 = 1500.

PTO 540 RPM Mark

This mark is located in the Engine RPM Meter. It indicates Engine RPM at which the PTO shaft will rotate at 540 RPM.

Hour Counter

This is a Digital Hour Counter located in the RPM meter. It is operated by pulses coming from Alternator when the engine is running. Hour counter displays the cumulative engine running hours.

Fuel Gauge

The Fuel Gauge indicates quantity of fuel available in the fuel tank. Refill the fuel tank when the pointer lies in Red Band.

Coolant Temperature Gauge

This gauge indicates coolant temperature of the engine. When the pointer lies in RED band :

1. Indicates excessive engine coolant temperature.
2. Get the cause identified.
3. Further engine operation should be done only after elimination of the problem.

Turn Indicators (LH/RH)

LH and RH turn indicator is provided to indicate the direction of turning.

A blinking turn indicator implies that either LH Turn Signal or RH Turn Signal indicator of tractor is ON.

High Beam Indicator

It glows when Head Lamps are operated in High Beam.

Heater Indicator

When the key is turned to 2nd position, the Heater Indicator glows to indicate the activation of heater element provided in engine's intake manifold. The indicator continues to glow for approx. 42 seconds. A timer controls this time.

1. Turn the key to "ON" position and hold it till the heater indicator is put-off.
2. Crank the engine when the heater indicator light is put off after approx. 42 seconds.

Parking Brake Indicator

It glows when either brakes or Parking Brake is applied.

4WD Indicator

It glows when 4WD is engaged.

Battery Charging Indicator

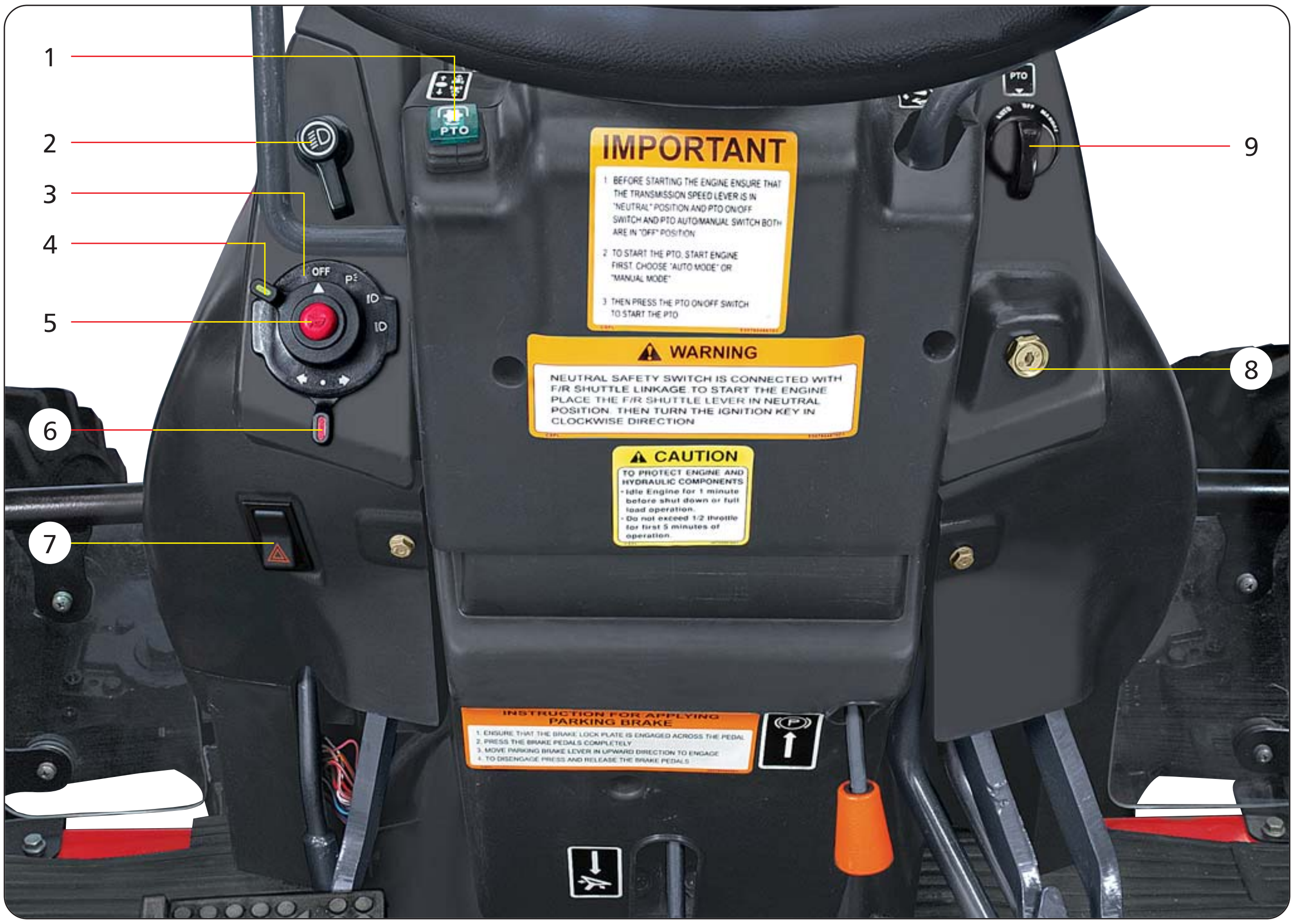
This indicator will glow if battery is not getting charged. Once the engine is running, this indicator should go OFF, if the Battery is getting charged. If the indicator glows continuously even when the engine is running above low idle rpm of the engine. The cause should be investigated to prevent complete discharge of battery and possible damage of alternator.

Voltmeter

This gauge indicates the battery voltage at all times.

Engine Low Oil Pressure Gauge

This gauge will be in RED Zone if Engine lubricating oil pressure is less while engine is operating. The pointer will be in GREEN Zone when pressure is Okay. After putting ignition switch in "ON" position, the oil pressure gauge pointer should be in RED Zone. When the Engine is running and healthy it should be in GREEN Zone. If the pointer is in RED Zone, the problem should be eliminated before starting the engine.



3. Switches

Following switches are provided for various operations.

1. PTO ON / OFF Switch
2. Plow Lamp Switch
3. Combination Switch
4. Light Switch
5. Horn Push Button
6. Turn Signal Switch
7. Hazard Switch
8. Starter Key Switch
9. PTO AUTO / MANUAL / OFF Switch

Hazard Switch

The piano type switch is located below the combination switch in LH side of steering column on dashboard.

ON position operates LH, RH turn signal lamps simultaneously. This operation can be performed even if the key switch is in OFF position.

SWITCHES

Combination Switch:

It is located in LH side of steering column on dashboard. It consists of:

1. Horn (in centre)
2. Light Switch
3. Turn Signal Switch

Horn

Pressing the horn switch will blow the horn.

Light Switch

It is a 4 positions rotary switch. It operates in clockwise direction and positions are as follows:

1. Off
2. Illuminate Parking Lamp
3. Illuminate low beam of head lamp & Parking Lamp
4. Illuminate high beam of head lamp & Parking Lamp

Turn Signal Switch

This is 3 positions rotary switch. The vertical position of knob operates in both directions and the positions are as follows:

1. Vertical - OFF
2. Left - Operates LH Turn signal Lamp
3. Right - Operates RH Turn Signal Lamp

Starter Key Switch

It is a key operated 3 positions rotary switch. It is located in RH side of steering column on dashboard. It operates in clockwise direction and positions are as follows:

1. Off
2. It gives readiness to electrical circuit for operation of plow lamp switch, combination switch, instrument cluster.
3. Activates the starting circuit for engine.

NOTE: The Starting circuit is interconnected with the Forward / Reverse system. Thus the Engine will not start unless the Forward / Reverse is in neutral.

Plow Lamp Switch

It is a 2 positions rotary switch located in LH side of steering column on dashboard. It operates in clockwise direction and positions are as follows:

1. Off
2. Illuminates the plow lamp

PTO Operation Switches

PTO can be operated by using a combination of "PTO Engage - Disengage Switch" and "PTO Mode Switch".

After switching ON the "PTO Engage - Disengage Switch" the operator has a CHOICE to select AUTO or MANUAL MODE through "PTO Mode Switch".

The PTO will turn-Off if the "PTO Engage - Disengage Switch" or "PTO Mode Switch" is in OFF position.

PTO Engage - Disengage Switch

This is a 2 in 1 switch, located on LH side of steering column on the dashboard.

1. Press the PTO switch to engage the PTO.
2. To disengage the PTO, press the PTO switch again.

PTO MODE switch (PTO Auto / Manual / Off Switch)

This rotary switch enables the operator to choose the AUTO or Manual mode of PTO and even turn-off the PTO when desired.

The Operating positions of knob are as follows:

1. Alignment of OFF - Mark with Pointer - PTO Turn-OFF

The Auto and Manual Mode switch will be activated when the "PTO Engage - Disengage Switch" is in ON position.

2. Alignment of Auto-mark with pointer - Operates AUTO mode

This switch can be used when the "PTO Engage - Disengage Switch" is in ON position.

When this switch is in AUTO-POSITION, the PTO shaft rotation will be stopped as soon as the implement is raised.

This will happen irrespective of clutch being engaged or disengaged. Such a situation is indicated by **A BLINKING** "PTO Engage - Disengage Switch"

While this switch is in AUTO-POSITION, IF the PC lever is lowered and clutch pedal released, the PTO shaft will become operative and will be indicated by **A CONTINUOUSLY-GLOWING** "PTO Engage - Disengage Switch"

While this switch is in AUTO-POSITION and the clutch pedal is pressed, the PTO shaft rotation will be stopped and indicated by **A BLINKING** "PTO Engage - Disengage Switch"

⚠ WARNING

Tampered electrical wiring or connections will render this feature INEFFECTIVE. In such a case, some Inadvertent movement of personnel near the PTO shaft can prove fatal.

WARNING

While the PTO is in MANUAL-MODE, some inadvertent movement of personnel near the PTO shaft can prove fatal.

3. Alignment of Manual-mark with pointer - Operates Manual mode

This switch can be used when the "PTO Engage - Disengage Switch" is in ON position.

Keeping this switch in MANUAL-POSITION, will FORCE the PTO shaft rotation in RAISED as well as LOWERED position of implement. Even disengagement of clutch will not stop the PTO-SHAFT rotation. The "PTO Engage - Disengage Switch" will be **CONTINUOUSLY-GLOWING** when this switch is in MANUAL mode.

POWER TAKE OFF

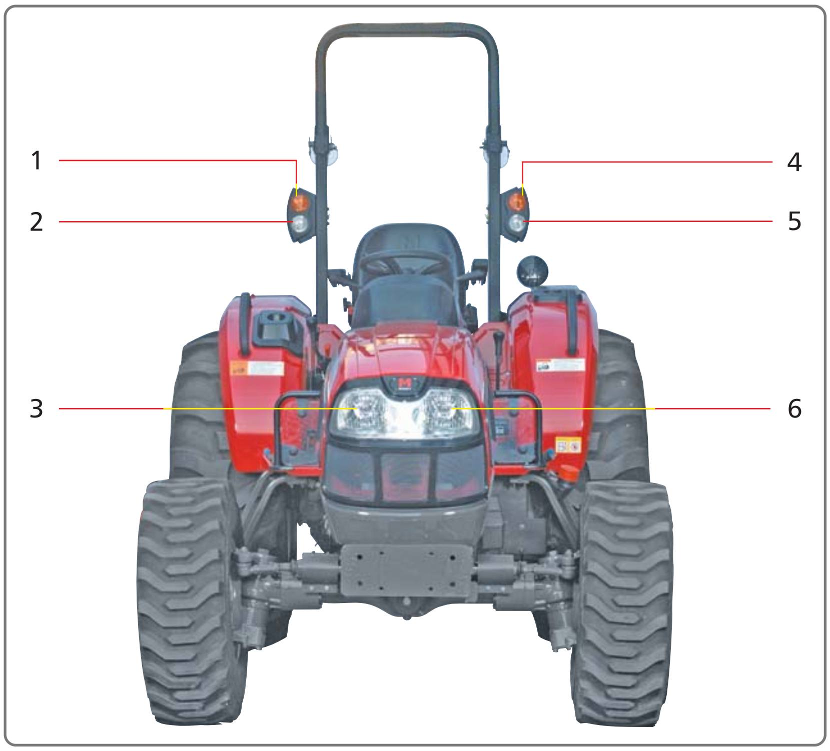
PTO is operated by electrically. PTO can be operated by using a combination of "PTO Engage - Disengage Switch" and "PTO Mode Switch".

After switching ON the "PTO Engage - Disengage Switch" the operator has a CHOICE to select AUTO or MANUAL MODE through "PTO Mode Switch".

The PTO will turn-Off if the "PTO Engage - Disengage Switch" or "PTO Mode Switch" is in OFF position.

Refer table shown for combinations of PTO Operations.

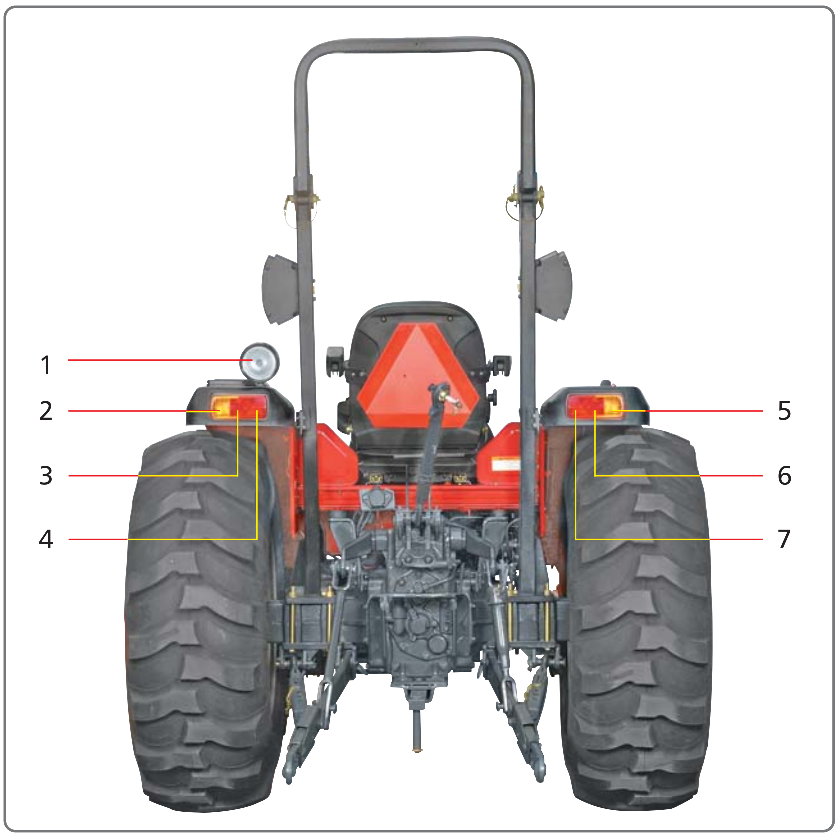
PTO ON / OFF Switch	PTO Control Switch	Clutch Pedal	PC Lever	PTO Switch	PTO Shaft
ON	Manual Mode	Either pressed or released	Either raised or lowered	Glows	Rotates
ON	Auto Mode	Pressed	Either raised or lowered	Blinks	Stationary
ON	Auto Mode	Either pressed or released	Raised	Blinks	Stationary
ON	Auto Mode	Released	Lowered	Glows	Rotates



4. Lamps

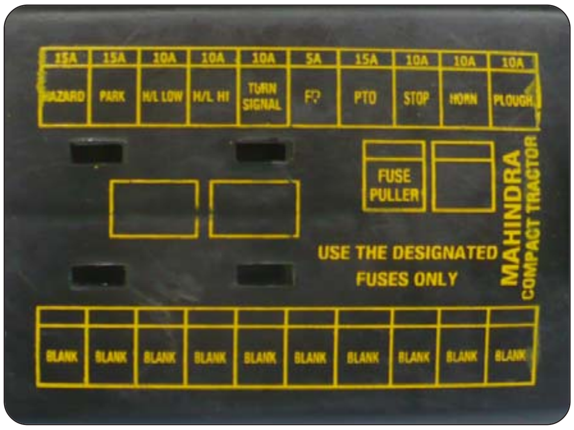
Front View :

1. Turn Signal Lamp RH
2. Parking Lamp RH
3. Head Lamp RH
4. Turn Signal Lamp LH
5. Parking Lamp LH
6. Head Lamp LH



Rear View :

1. Plow Lamp
2. Turn Signal Lamp LH
3. Reflector & Rear Position Lamp LH
4. Rear Brake Lamp LH
5. Turn Signal Lamp RH
6. Reflector & Rear Position Lamp RH
7. Rear Brake Lamp RH



5. FUSE BOX

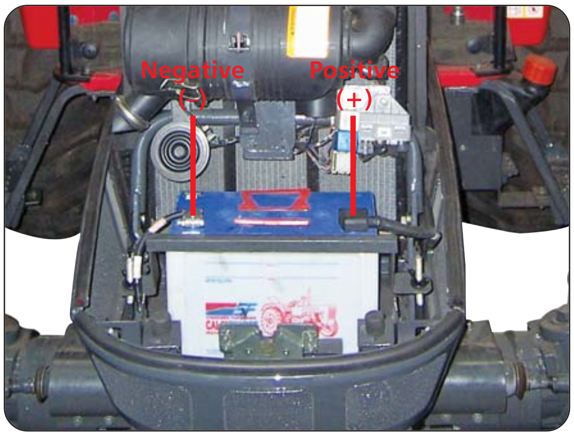
The fuses protecting various circuits are mounted on the fuse box. The blown fuse will be indicated by failure of the particular system and can be confirmed by a continuity test. Before replacing blown fuse, inspect the wiring of the circuit for evidence of short circuit or any other fault which may have caused the fuse to blow.

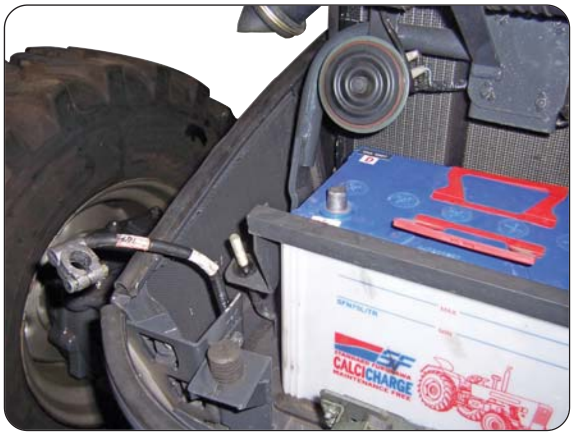
a. Use correct type of fuse as shown on the fuse box cover.

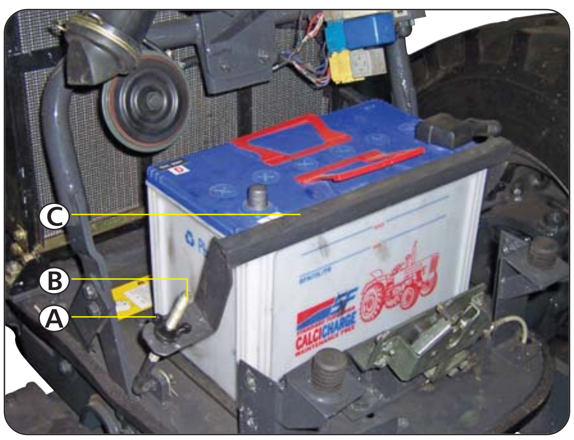
b. 4 extra fuse links (one each) have been provided in the side fuse box cover. To remove this extra fuse from cover, press the link from contact point and push up in the direction of arrow marked on the cover.

c. The fuse is located at LH side behind clutch pedal. Press plastic cover of the fuse box from top and bottom. The fuse cover will come out. If no fault can be detected and another fuse blows, have the equipment examined.

d. While refitting the fuse box cover care should be taken that clicking sound after fitting is heard. This ensures proper fitting of fuse box cover.







6. Electrical System

The electrical system on the modern tractor is to all practical purposes indispensable. By medium of electrical energy stored in the battery and replenished by the alternator, essential services are provided for starting the engine, lighting and operating accessories.

A. THE BATTERY

In general the lead acid cell is a device which stores electrical energy as chemical energy. The process of conversion of this energy is ready reversible and commonly referred to as a battery.

1. Construction

Each cell has one set of positive plates and one set of negative plates placed alternately and insulated by separators which not only prevent plates from touching but also holds the active material in the plate grids. This assembly is immersed in a solution of dilute sulphuric acid known the electrolyte.

2. Principle of Operation

As the battery is charged by passing a current through it the material on the positive plates is converted to lead peroxide and the negative plates to lead sponge. In this process the acid becomes more highly concentrated and so its specific gravity rises.

As the battery is discharged the active material on both plates is converted into lead sulphate robbing the acid of its sulphur.

3. BATTERY REMOVAL

a. Open the hood.

b. Remove the battery cable from its negative terminal and then positive terminal.

c. Remove the wing nut (A) of the Battery holding bracket stay rods (B), and take away the bracket (C).

d. Take away the Battery

4. INSTALLATION

Installation is reverse procedure of removal.

NOTE: **When you are using sealed battery there is no need of top up the electrolyte.**

NEVER allow a battery to stand discharged.

NEVER operate for any length of time with the battery in a low state of charge — recharge.

ALWAYS keep terminal posts and cable clamps clean and tight — NEVER scrape posts but clean with wire wool or emery paper, a light coating of petroleum jelly gives good protection against corrosion.

CHECK battery case retaining bolts and mountings regularly — poor mounting can cause extensive damage. NEVER overcharge for any length of time.

Sealed battery cannot test for specific gravity.

Fig. 1

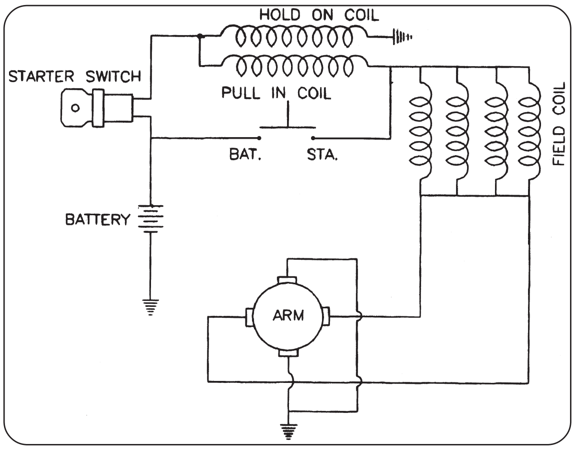


Fig. 2
Electrical Circuit Diagram

B. STARTER MOTOR

1. Introduction

Self Starter is used for cranking the engine.

The starter described here is pre-engaged type. This starter is designated as 'Pre-engaged' since the drive goes into complete mesh with the Ring gear before the full power torque of the starter motor is developed. The main feature being prevention of premature ejection of the pinion by the flywheel during intermittent firing pulses of the engine.

2. Description and Principle of Operation

The starter is 4-pole, 4 brush, earth return machine with parallel connected field. Main parts are i) DE bracket assy, ii) Drive assy, iii) Intermediate bracket assy, iv) Armature assy, v) Solenoid switch assy, vi) yoke & field coil assy, vii) commutator end bracket assy, viii) brush gear assy. When the ignition switch is operated (refer Fig. 2). The solenoid switch mounted on starter motor gets energised and the plunger gets pulled. An actuating lever whose top end is linked with the plunger, bottom end is linked with the drive and centre is supported on the eccentric pin, pushes the drive into mesh with the flywheel ring gear when the solenoid is energised. At the end of the travel of the plunger a pair of contacts close connecting the starter to the battery directly, this bye-passes the series winding (also called as operating winding) of the solenoid Shunt winding (also called hold-on winding) which is energised as long as ignition switch is on holds the plunger in position. As soon as the engine fires and the ignition switch is released, the solenoid is released and supply to starter is cut off. This also disengages the drive from the ring gear.

a. Drive Assembly

The drive assembly transmits the torque developed by the armature to ring gear. The roller clutch arrangement of the drive prevents armature from being rotated at an excessively high speed in the event of pinion remaining in mesh with the ring gear when the starter is on. The clutch operates on the principle of wedging of cylindrical rollers between two converging surfaces. The convergent form is obtained by matching cam tracks on a cylindrical surface. The clutch consists of 5 rollers which run on cam track cut in inner member which is driven by the armature. The pinion is an integral part of the outer member.

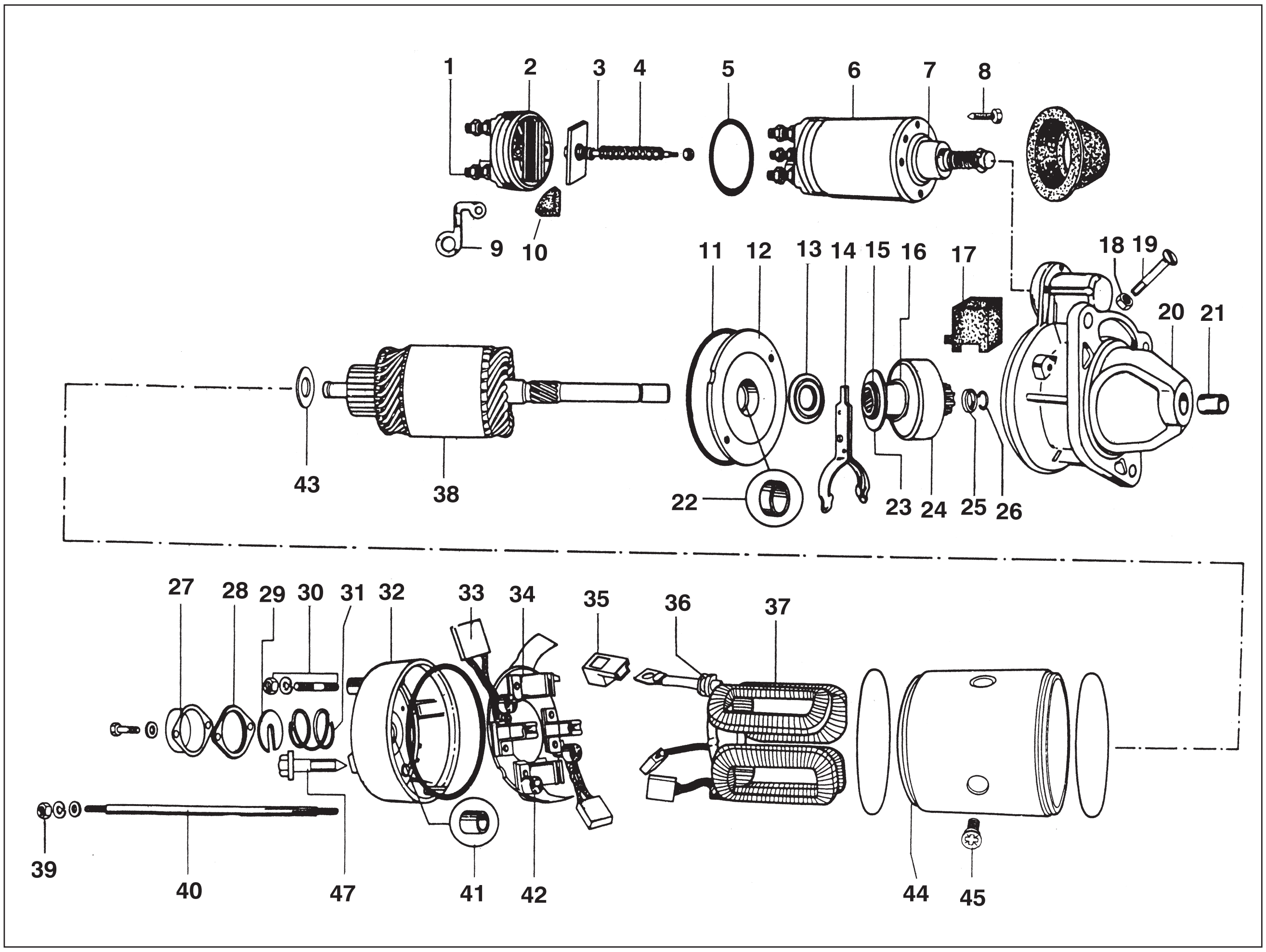


Fig. 3
Exploded view of Starter Motor

1 Main Terminal (Sol.)
2 Terminal Base Assy.
3 Spindle Assembly
4 Plunger Return Spring
5 Sealing Ring (Sol.)
6 Solenoid Switch
7 Plunger Assembly
7A Shroud
8 Screw (Sol. Fixing)
9 Connector
10 Seal
11 Sealing Ring (C.E. & D.E.)
12 Intermediate Brkt. Assy.
13 Oil Seal
14 Engaging Lever Assembly
15 Jump Ring (Pinion)
16 Spring (Pinion)
17 Grommet
18 Nut (Pivot)
19 Pivot Pin
20 Fixing Bracket Assembly
21 Bearing Bush (Fag. Bakt.)
22 Bearing Bush (Inter Bakt.)
23 Operating Plate (Pinion)
24 Drive Assembly
25 Thrust Collar
26 Jump Ring
27 End Cover
28 Seal (End Cover)
29 "C" Washer
30 Earth Terminal
31 Spring (End Cover)
32 C.E.Bracket Assembly
33 Brush Set
34 Brush Carrier Assembly
35 Lead Assembly
36 Grommet
37 Field Coil Assembly
38 Armature Assembly
39 Nut (Fixing Stud)
40 Fixing Stud
41 Bearing Bush (C.E. Brkt.)
42 Brush Spring
43 Stop Washer
44 Insulator Yoke
45 Pole Screw
46 Rear Bracket Assy.
47 Screw (B.G. Fixing)

b. Solenoid Relay

The solenoid relay is mounted on the DE bracket with its axis parallel to that of armature. This contains a soft iron plunger, a pair of heavy duty copper studs forming fixed contacts, a moving contact made up of copper is carried on a non-magnetic spindle which is insulated to the contact plate. This also moves the drive assembly with the help of a lever and peg assembly which is pivoted on an eccentric pin screwed on the DE bracket. The electrical circuit diagram given below explains the connections of solenoid winding. The coil consists of two windings, a heavy gauge which is called pull-in or series winding and a thinner gauge winding called hold-on or shunt winding. The pull in winding is connected through the field coil and armature to the ground. Whereas shunt is connected between smaller terminal on the solenoid phenolic moulded terminal base and ground. When the switch is closed both pull in and hold on windings get energised resulting in pulling in of plunger. At the end of the travel the main contacts get closed, connecting starter to battery. Simultaneously series winding gets short circuited between main contacts.

c. Tooth to Tooth Abutment

When the tooth to tooth abutment takes place the plunger movement is restricted because the drive movement is restricted. But the plunger is so designed that it can move in further closing the contacts connecting the starter to battery. When starter rotates, the pinion gets slipped into mesh by the force of the compressed engaging spring.

d. The Lost Motion Device

A feature of 'Lost Motion' is designed into engagement mechanism to allow the solenoid contacts to open before pinion retraction begins. This action depends upon the yielding of a weaker spring which forms the lost motion device, to the stronger system return spring of the plunger. The lost motion spring is carried in the plunger. The initial yielding results in the switch contacts being fully opened within the first 3.20 mm of plunger return travel- this action being followed by normal drive retraction.

3) Routine Maintenance

1) Ensure that the mounting bolts are securely fastened and all electrical connections are clean and tight.
2) Cables should be examined for fractures.

4) STARTER MOTOR DO'S AND DONT'S

DO's	DONT's
Ensure that all electrical connections in the circuit including the battery are clean and secure.	Do not operate the starter motor when the engine is running as this could result in damaging the starter motor and flywheel ring gear.
Observe correct polarity, i.e. connect negative to negative and positive to positive.	Do not crank continuously. If the engine does not fire immediately, allow sometime to cool the starter motor before cranking again.
For earth return system, a twin wiring system between battery and starter motor should be used.	If still the engine does not start, ascertain the cause and do not drain the battery by cranking the starter motor.
The total resistance of the starter circuit including that of return path and junctions should not exceed 0.002 Ohm 20^0 C.	Do not inch (move) the vehicle using starter motor.
The main feed cable should be supported to prevent the cable weight and vibrations from coming on to the electrical terminals.	Do not disconnect battery cables while the engine is running.
While washing the vehicle with high pressure gun starter motor should be suitably protected.	Do not subject the starter motor to continuous oil / water drip.

ROUTINE MAINTENANCE

- Ensure that the starter motor mounting bolts are securely fastened.
- Check and ensure that all electrical connections are firmly tightened.
- Examine cables for fractures / cracks particularly at the terminal lugs.

5) TROUBLE SHOOTING FOR STARTER MOTOR

SERVICE RECOMMENDATIONS :

The failure of the engine to start may be attributed not only to starter but also to other system. Before dismantling Starter Motor from engine, make sure that Starter Motor is faulty.

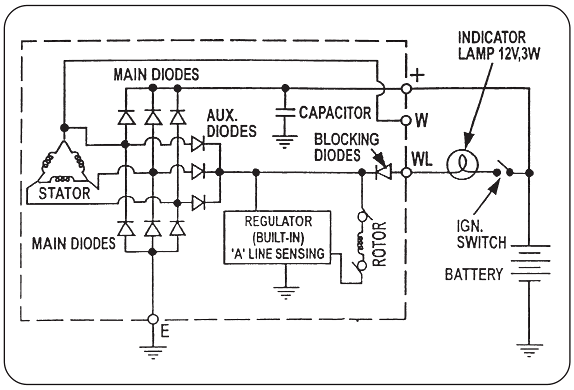
Below trouble shooting chart will help on diagnosing the fault.

It is recommended to replace complete Starter Motor for any internal failure of Starter Motor. Not to disassemble the Starter Motor for repairing inside components.

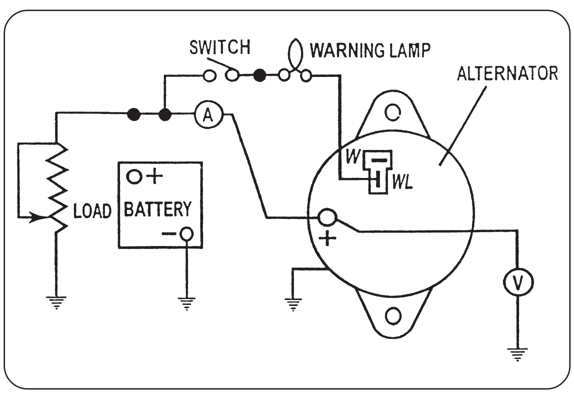
TROUBLE	PROBABLE CAUSE	REMEDY
(A) Starter does not starts the engine.	1. Check the Ignition key switch. 2. Check the battery condition. 3. Check the proper connection of battery terminal. 4. Defective Starter Motor.	1. Replace Ignition key switch. 2. Substitute a fully charged battery. 3. Clean the battery terminal and apply petroleum jelly on terminal & tight all connection 4. Replace the Starter Motor.
(B) Starter crank but engine does not fire.	1. Check the battery condition. 2. Check the fuel flow. 3. Remove the Starter Motor & check.	1. Substitute a fully charged battery. 2. Ensure fuel flow. 3. Check the starter if found defective replace the starter motor.
(C) Starter works but pinion fails to engage.	1. Pinion sticky on shaft. 2. Burr on pinion / ring gear. 3. Lever defective. 4. Bushes worn out.	1. Replace starter motor.
(D) Starter continuous to run after switch is released	1. Sticky starting switch. 2. Sticky solenoid switch contact. 3. Pinion/Ring Gear folded or damaged. 4. Sticky Drive Assembly	1. Disconnect Starter cable immediately with battery & replace starter switch 2. Replace Starter motor. 3. Replace Starter motor. 4. Replace Starter motor.
(E) Pinion engages with Ring Gear but the engine is not cranked	1. Clutch (Drive Assembly) Slip. 2. Starter switch defective. 3. Check the battery condition.	1. Replace the Starter motor 2. Repair or replace starter switch. 3. Replace with charged battery.

Table No. 1

Alternator



Wiring Diagram for Alternator



C. ALTERNATOR

1. GENERAL DESCRIPTION

This Alternator is built-in with Electronic Regulator is designed and matched to form part of an Battery Charging & Electrical Power System for Tractor applications. This alternator is suitable for negative earth systems.

2. SALIENT FEATURES

- Delta connected 3-phase output winding wound on a laminated stator.
- 12-pole wound field rotor, carried on ball-race bearings in aluminium end brackets and belt driven from engine.
- Self-excited field (via three field diodes) at normal running speeds.
- Built-in rectifier provides rectification of generated A.C.
- Voltage control is provided via a built-in electronic regulator.
- An RFI suppression capacitor is provided across the positive and negative terminals.
- A phase terminal can be made available if required.

3. SPECIFICATIONS FOR ALTERNATOR

1. Type	3GA15
2. Rating	Continuous
3. Normal Output	12 V
4. Weight	7 Kg Approx. (Incl. Pump & Pulley)
5. Rated Max. Output Speed	6000 R.p.m.
6. Max. Permissible Speed	11,500 R.P.M.
7. Polarity	Negative Earth
8. Regulator System	Built-in Regulator
9. Reg. Set Voltage	14.1 – 14.6 V
10. Direction of Rotation	Clockwise (Viewed From Pulley Side)
11. Operating Temperature	–30ºC To 100ºC

4. CHECKING AFTER RE-ASSEMBLY ALTERNATOR

1. Clamp the Alternator in a test rig.
2. Connect as shown in figure.
3. Observe correct polarity of battery.
4. Connect oil inlet, outlet and vacuum connection.
5. Close the switch, warning lamp should glow.
6. The oil pump and the main drive should be switched 'ON' simultaneously.

7. Increase the speed to 3000 rpm. The warning lamp should not glow and ammeter should shown charging current. Oil pressure should be 1.0 to 3 kgs/cm^2.
8. Run the Alternator at 5000 rpm. Adjust the load so that Terminal voltage is between 13.0 to 13.5 Volts. The Ammeter should read the rated output.
9. Run the Alternator at 6003 rpm, and adjust the loads to 18 Amps. The volt meter should read 14.1 – 14.6 Volts.
10. Disconnect the Air pipe at the Vacuum pump, install Vacuum gauge. Run Alternator at 5,000 RPM speed. After 35 seconds the Vacuum reading should read 500 mm/Hg.
11. Close the solenoid valve, the Vacuum pump gauge should read the rated Vacuum in 3 minutes at 5,000 RPM.
12. Check for Vacuum leak : Stop the drive (both main drive and oil pump). There should not be any drop in vacuum for 15 seconds.

5. ROUTINE MAINTENANCE

- Keep the alternator clean.
- Ensure that the ventilation slots are clear.
- Check and ensure that mounting bolts are tightened properly.
- Ensure that the belt on the alternator is in good condition.
- Check the belt tension and ensure that it is neither too slack nor too tight.
- Adjust the belt deflection to be 10-15 mm at the longest point when pressed at midway between pulleys.
- Check the brush length after every 60,000 km.
- Ensure correct level of electrolyte in the battery.
- Check the general condition of the battery.
- Grease battery terminals with petroleum jelly.

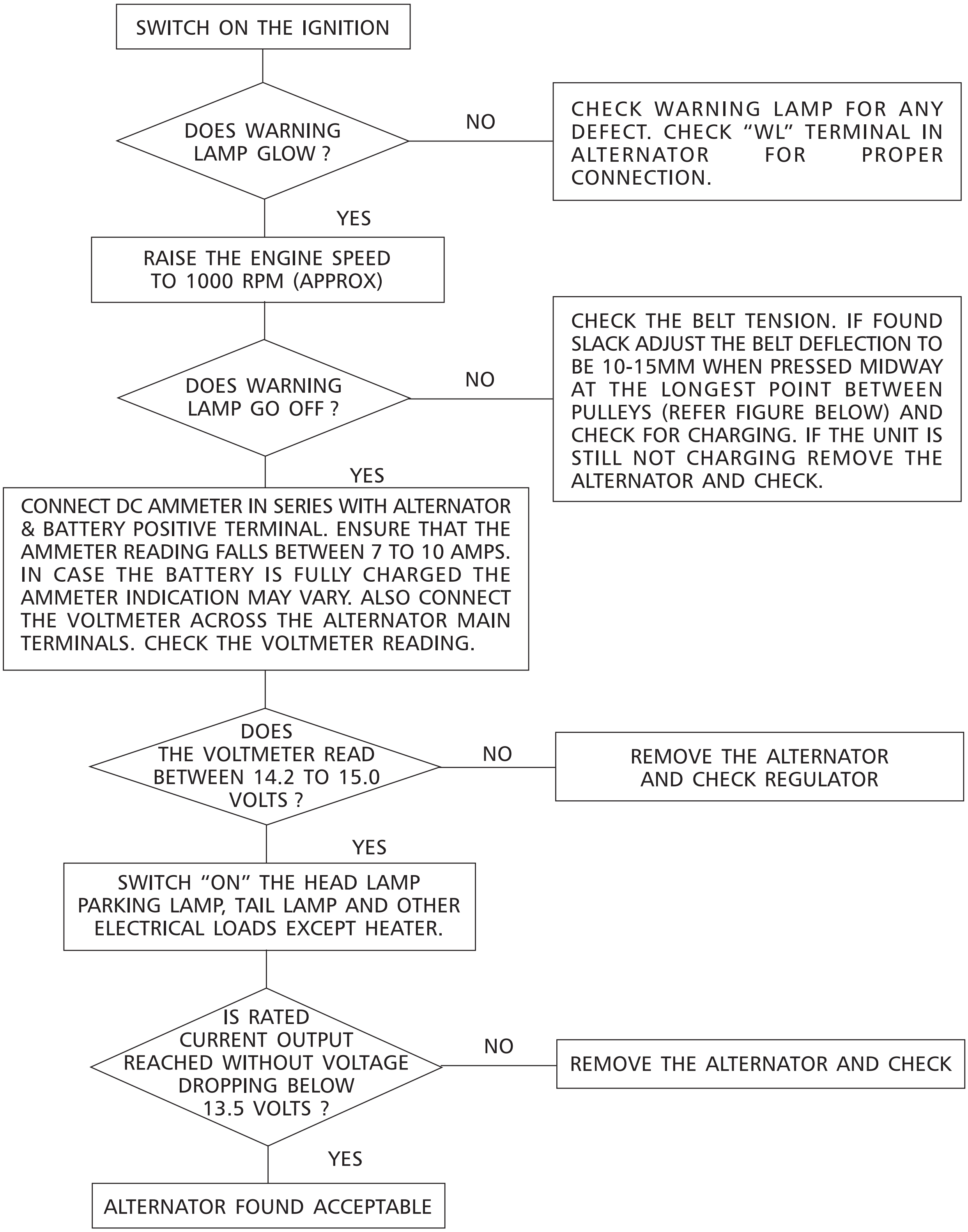
6. ALTERNATOR DO'S AND DONT'S

DO's	DONT's
Do ensure that all electrical connections are clean and secure.	Do not dis-assemble the Alternator without removing the brush box assembly.
Do ensure that no electrical connection in the circuit including the battery is open.	Do not run the Alternator with the battery disconnected.
Do observe correct polarity, i.e. connect negative to negative and positive to positive. Otherwise, Alternator will be damaged.	Do not disconnect any lead of Alternator / Regulator with the engine in running condition.
Disconnect all Alternator terminals, while carrying out welding jobs on the vehicle.	Do not disconnect battery cables while the engine is running.
Disconnect the battery earth cable before removing the Alternator.	

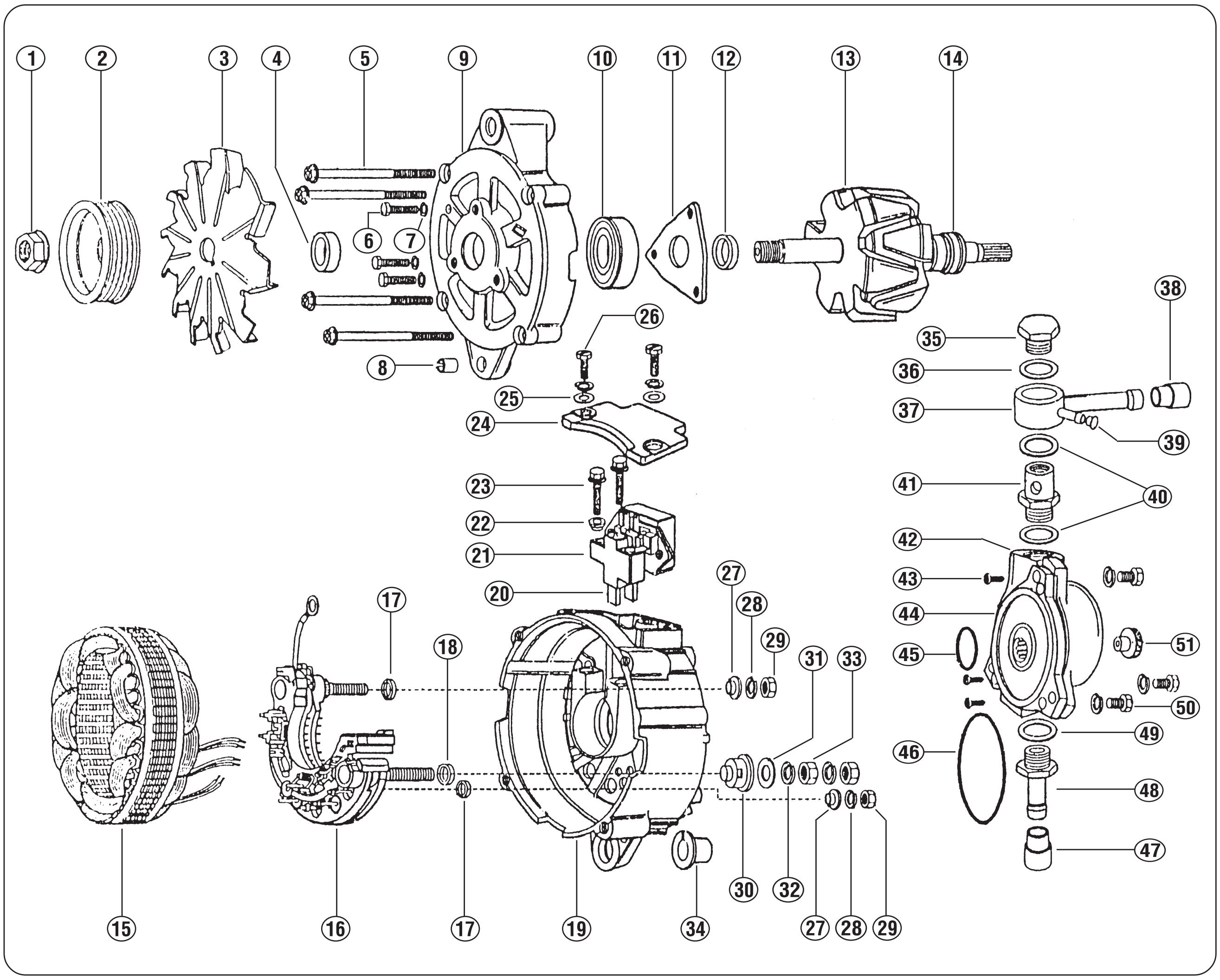
7. TROUBLE SHOOTING FLOW CHART FOR ALTERNATORS

SERVICE RECOMMENDATIONS :

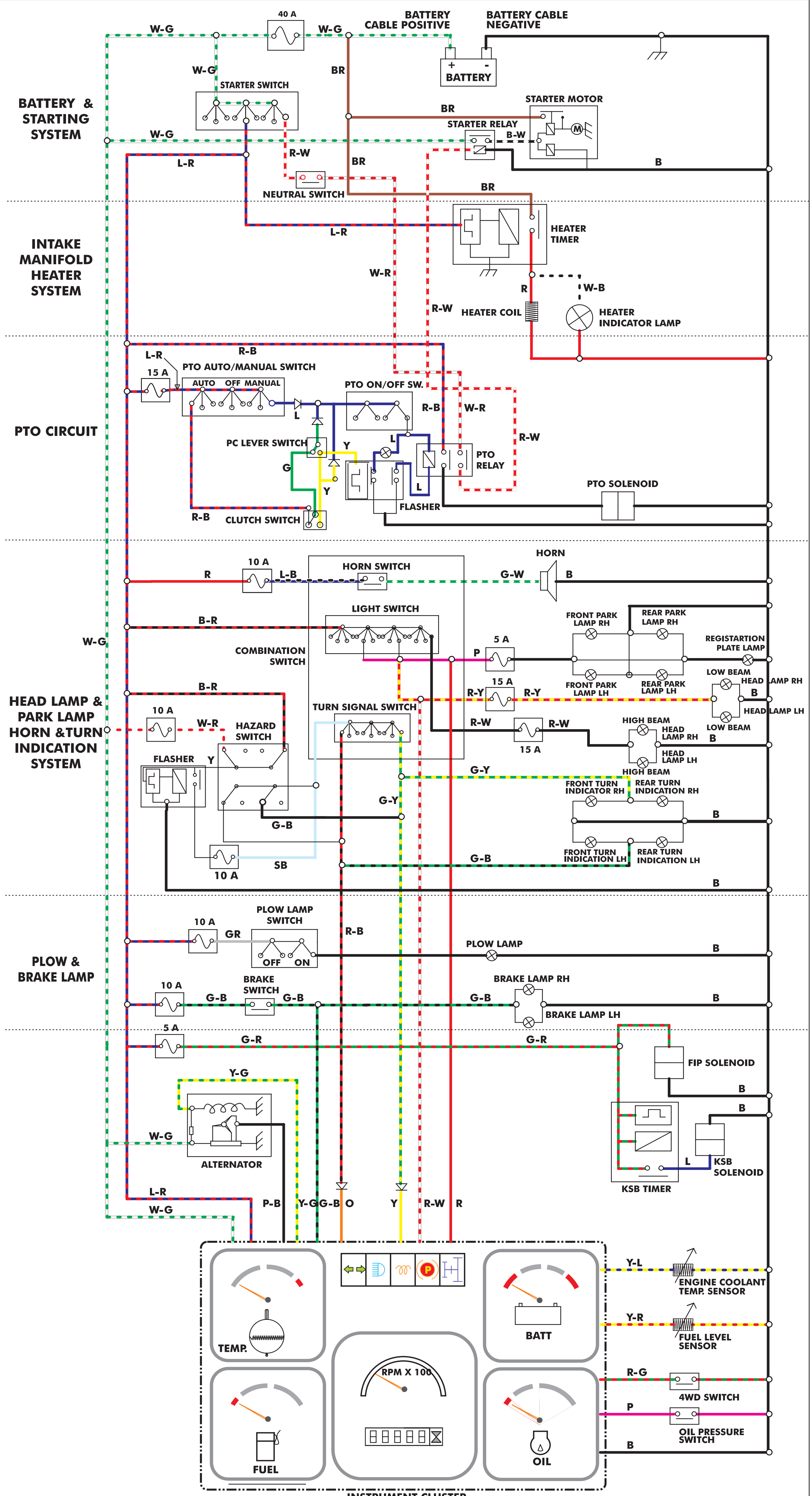
Before dismantling Alternator from engine, make sure that Alternator is faulty. Below flow chart will help on diagnosing the fault. It is recommended to replace complete Alternator for any internal failure of Alternator. Not to disassemble the Alternator for repairing inside components.



8. EXPLODED VIEW - ALTERNATOR



1. Flange Nut
2. Pulley
3. Asymmetric Fan
4. Bearing Collar
5. Through Bolt
6. Screw (Bearing Retainer Fixing)
7. Spring Washer
8. "DE" Insert
9. "DE" Bracket Assembly
10. "DE" Ball Bearing
11. Bearing Retainer
12. Spacing Collar
13. Rotor Assembly
14. "SRE" Ball Bearing
15. Stator Winding Assembly
16. Rectifier Assembly
17. Aluminium Spacer
18. Insulating Washer
19. SRE Bracket Assembly
20. Brush Set
21. Regulator & Brush Box Assy.
22. Insulating Bush
23. Captive Screw Assembly
24. Cover Moulding
25. Plain Washer
26. Screw
27. Bush
28. Spring Washer
29. Nut
30. Insulating Cup Washer
31. Plain Washer
32. Spring Washer
33. Nut
34. Sliding Bush
35. Suction Connector Screw
36. Sealing Washer
37. Suction Connector Assy.
38. Dust Cap
39. Dust Cap
40. Sealing Washer
41. Check Valve Assy.
42. Housing M/C
43. Screw
44. Centre Plate M/C
45. 'O' Ring
46. 'O' Ring
47. Dust Cap
48. Delivery Connector Assy.
49. Sealing Washer
50. Screw
51. Oil Inlet Plug



COLOR CODE	DESCRIPTION
R	RED
B	BLACK
W-G	WHITE - GREEN
L-R	BLUE - RED
R-W	RED - WHITE
B-W	BLACK - WHITE
R-L	RED - BLUE
L-B	BLUE - BLACK
L-Y	BLUE - YELLOW
L-W	BLUE - WHITE
G-W	GREEN - WHITE
R-W	RED - WHITE
BR-W	BROWN - WHITE
R-G	RED - GREEN
R-Y	RED - YELLOW
W-R	WHITE - RED
Y	YELLOW
SB	SKY BLUE
G-L	GREEN-BLUE
G-R	GREEN-RED
GR	GRAY
R-B	RED-BLACK
BR	BROWN
W-B	WHITE-BLACK
G-B	GREEN-BLACK
Y-G	YELLOW-GREEN
O	ORANGE
L	BLUE
W	WHITE
P	PINK
G	GREEN
G-R	GREEN-RED
GR-B	GRAY-BLACK
W-R	WHITE-RED
BR	BROWN
Y-L	YELLOW-BLUE
Y-R	YELLOW-RED

INSTRUMENT CLUSTER CONNECTION DETAILS

L-R	POWER SUPPLY (IGN.SW)
W-G	POWER SUPPLY (BAT.+VE)
B	GROUND
P	CHARGE INDICATOR
Y-L	TEMPERATURE INDICATOR
P	OIL PRESSURE INDICATOR
R-G	CLOG INDICATOR
Y-R	FUEL LEVEL INDICATOR
R-W	HIGH BEAM
G-L	LEFT TURN INDICATOR
G-B	PARK BRAKE INDICATOR
G-R	RIGHT TURN INDICATOR
R	ILLUMINATION
BR-W	HEATER INDICATOR
R-B	PLOW LAMP INDICATOR
P	ENGINE SYS. INDICATOR

Group-H

Steering

1. SPECIFICATION

a) Steering Control Unit

1. Make -- EATON
2. Type --- Open center non load reaction
3. Displacement -- 6.10 inch^3 / rev (100 cc/rev)
4. Relief valve setting ------------------------------------- 100 Bar
5. Rated flow --- 19 lpm

b) Pump

1. Make -- EATON
2. Type --- Gear
3. Displacement -- 8 cc / rev

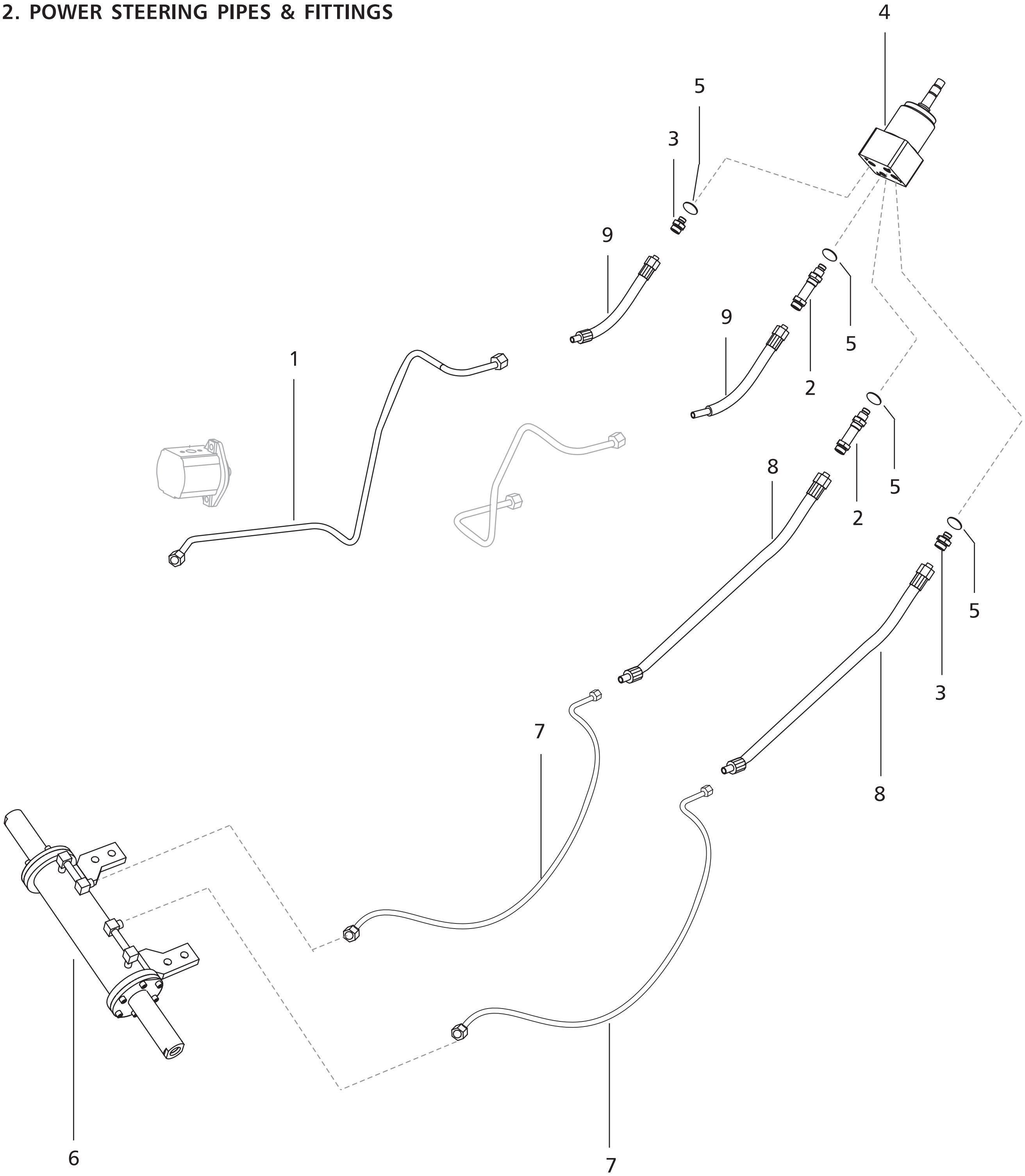
c) Cylinder

1. Type --- Double acting balanced
2. Bore -- ø 63 mm (2.48 in.)
3. Rod --- ø 38 mm (1.50 in.)
4. Stroke -- 220 mm (8.66 in.)

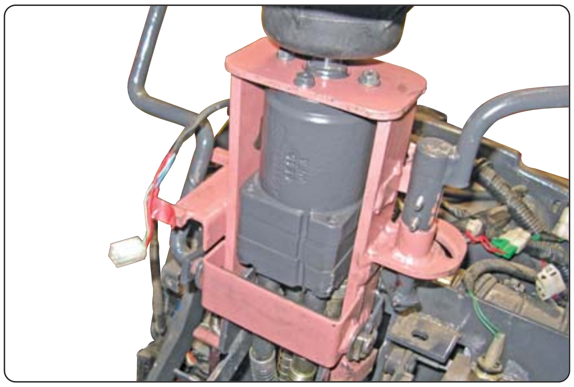
d) Filteration -- Strainer 100 mesh and suction line filter 10 micron common with hitch circuit

e) Maximum Operating Temperature ----------------------- 90°C

2. POWER STEERING PIPES & FITTINGS



1	Pipe Steering Pressure From Pump To Hose	6	Cylinder Power Steering
2	Adaptor - T & L Port Of HSU (Series 5)	7	Hose HSU To Cylinder
3	Adaptor (P & R Port On HSU)	8	Hose Pressure, HSU Integral Column
4	Steering Control Unit	9	Hose
5	O'Ring for P, L, R & T Ports of HSU		



3. REMOVAL & REFITMENT OF HSU UNIT

A. Removal

1. Remove the battery cables. Remove the Battery by removing the two stay bolts and the battery holding plate. Take away the Battery.

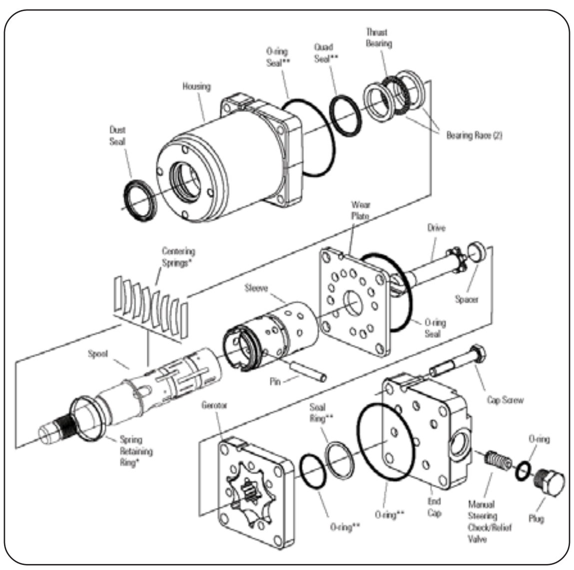
NOTE: Always disconnect the negative terminal first.

2. Disconnect the following hydraulic oil connections & Plug the pipes to prevent oil spillage.
   a) Hose pipe of L & R ports.
   b) Hose from Hydraulic pump to HSU.
   c) Hose from HSU to PTO solenoid valve.
3. First remove the steering wheel cap and steering wheel nut. Remove the steering wheel by loosening nut and use steering wheel puller to remove the steering wheel.
4. Dismantle the steering column cover, Disconnect the wiring harness to PTO engaging switch.
5. Dismantle the scuttle cover.
6. Remove linkages of hand accelerator and forward/reverse.
7. Loosen bolts of HSU Bracket.
8. Loosen hose connector of HSU to separate HSU.

In case any internal leakages observed, remove HSU unit to replace O'Rings (seal kit) as follows:

Hydraulics Steering Unit Removal (Ref Fig.)

1. Loosen the cap screws of unit.
2. Gently take out the end cap.
3. Check the O'Rings for wear or damage.
4. Install the new O'Rings (seal kit) and fit the adaptor and tighten as per the specified torque of 25 Nm / 18 lb.ft.
5. Refit the removal parts of unit in reverse sequence of removal.



B. Refitment

1. Assemble HSU unit
2. Fit the HSU hose pipe, connections and bracketaries.
3. Connect the linkages of hand accelerator and forward/reverse.
4. Assemble scuttle cover.
5. Fit the steering wheel and cap.

Recommended Practices for Handling and Storage of Hydraulic Components

The life of every hydraulic system is directly related to system cleanliness. Typically, the cleaner a system is, the longer it will last. Particle or chemical contamination, therefore, is the enemy of any hydraulic system and extra effort should be taken to avoid contamination whenever and wherever possible. The following is a list of good practices to reduce or eliminate potential contamination while storing, handling, assembling and using hydraulic system components.

Ports & Fittings

- Port plugs should remain in components and hoses until ready to use.
- Use care in removing port plugs so that plastic does not shear off in threads.
- Use caution to ensure excess paint near the port face does not chip off or fall into the unit.
- The area around the port face is a sealing surface and should be protected from dents or contamination.
- Fittings being screwed into the port should be kept clean and lubricated.

Assembly & Storage

- Hose and tube assemblies should be flushed and capped until used.
- Never use shop air to blow out a tube, hose or reservoir as the air supply may not be "clean" air.
- Filler caps should be kept clean.
- Hydraulic assembly areas should be free of airborne contaminants.
- If components are stored in a cold environment, be sure to remove any condensation that may occur as the components warm up.
- If storage is prolonged, components may need to be rust proofed.

Fluids

- Hydraulic fluid should be filtered to ISO 18/13 or better for initial fill.
- Water and hydraulic fluid do not mix; water is considered a foreign chemical contaminant.
- Any surface in contact with hydraulic fluid must be clean and dry.
- Random sampling should be taken from hydraulic systems on vehicles ready to ship to ensure cleanliness level meets ISO 18/13 or better.

Exposed Surfaces

- Exposed cylinder rods should be handled with care to avoid scratches and dents.
- Motor and pump shafts should be kept clean and free of physical damage. Splines should be coated with anti-seize compound or grease before assembly.

  Tapered shafts should also be protected from physical damage to the shaft and coupling ID.

Returns

If there is a suspected problem with a new start-up component, remove the component and protect it for later analysis. In the event a component must be returned to Eaton or Mahindra dealer do NOT disassemble the unit and use only lint-free rags to wipe components.

NOTE: Units returned to Eaton require a returned goods authorization assigned BEFORE shipping.

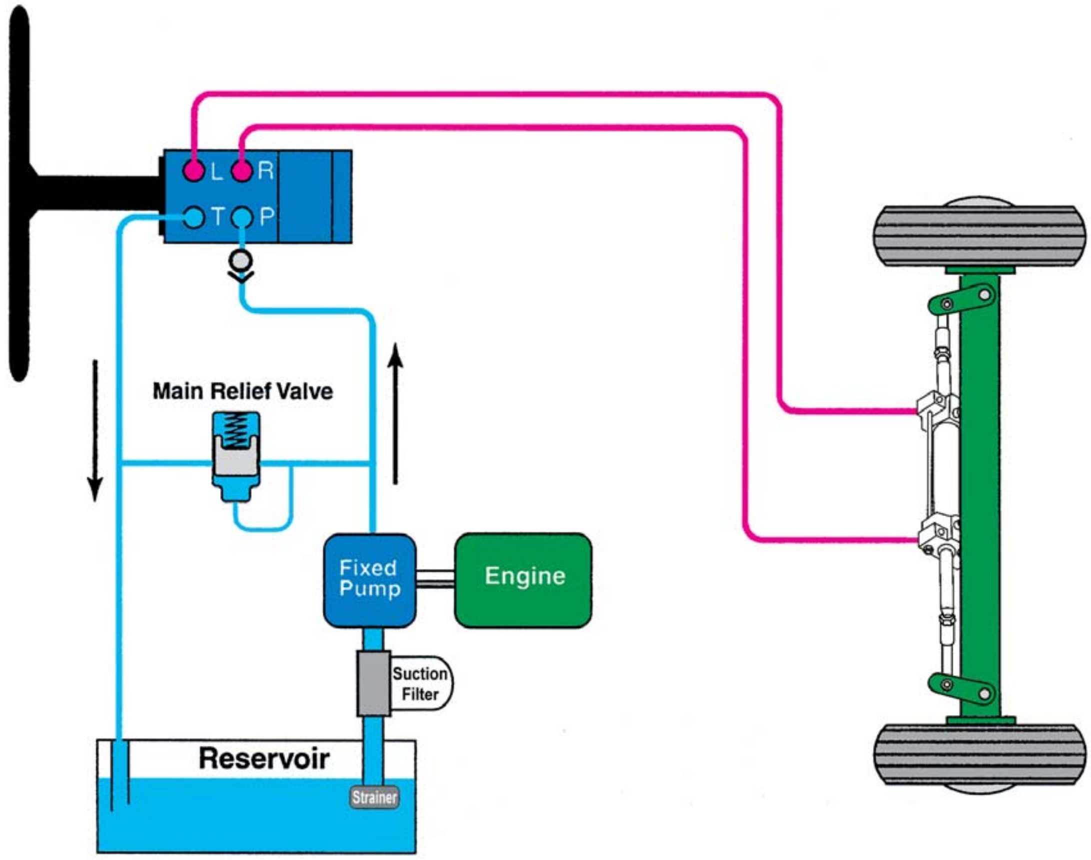
WARNING : SINCE SOLVENTS ARE FLAMMABLE BE EXTREMELY CAREFUL WHEN USING THEM EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE OR INJURY.

WARNING : Eye protection should be worn.

ADDITIONAL NOTES :

1) Fluid too thick to flow in cold weather start-up will cause pump cavitation and possible damage motor cavitation is not a problem during cold start-ups. Thick oil can cause high case pressure which in turn can blow pump shaft seals.
2) If the natural colour of the fluid has become black it is possible that an overheating problem exists.
3) If the fluid become milky, water contamination may be a problem.
4) Take fluid level reading when system is cold.
5) Contact your dealer-representative if you have specific questions.

STEERING SYSTEM CIRCUIT



4. DESCRIPTION

The power steering is of the hydrostatic type, linked by fluid, there being no mechanical connection between the steering wheel and front axle. The system consist of an engine driven pump, control valve, a hydraulic cylinder and suction line filter. Manual pump and control valve are integrated to form a compact steering unit. Figure show a schematic drawing of the system. This is open centre, non load reaction type system.

Turning the steering wheel delivers fluid to move the spool valve against its centering spring. This then directs the delivery of fluid to the inlet side of the manual pump, passing through the pump and the control valve to the steering cylinder. This in turn supplies the required steering effort according to the rate of steering wheel turn. The only manual effort required is that necessary to over come the control valve centering spring. The stiffness of the spring has been selected to give the desired feel and self-straightening effect.

Manual steering is accomplished in the same manner when the engine is running, except that there is no power assistance. By rotating the steering wheel, the manual pump delivers fluid through the control valve to the steering cylinder. A check valve in the control valve provides for the return of fluid from the cylinder to the manual pump instead of to the reservoir, to complete the circuit.

a. Manual Steering Effort

This circuit consists of the manual pump, control valve and steering cylinder. Hydraulic fluid circulates in the closed circuit from manual pump, through the control valve to the steering cylinder, and returns from the steering cylinder through the control valve back to the manual pump.

Initial movement of the steering wheel in either direction develops pressure (15 to 20 lb/in^2) which actuates the control valve spool. The movement of the control valve spool opens the ports from the manual pump to the steering cylinder and return ports from the steering cylinder to the manual pump.

The resistance of the wheels determines the steering effort required by the operator to develop the necessary hydraulic pressure at the steering cylinder piston to turn the wheels. The manual pump attached to and driven by the steering wheel develops the necessary pressure.

The initial effort to turn the steering wheel in either direction instantly increases hydraulic pressure in the manual pressure line, while the pressure in the suction line remains static or in lowered. Since the manual pump and the control valve are part of the closed hydraulic circuit, this same difference in pressure exists between the ends of the control valve spool. Were it not for the centering spring, the spool would instantly move toward the lower pressure end. Very little force is required at the steering wheel rim to create a pressure difference of 15 to 20 lb/in^2, the pressure necessary to over come spring resistance. The spool then moves, diverting fluid to the steering cylinder.

Continued turning of the steering wheel moves the fluid to and through the control valve to the steering cylinder and against the cylinder piston.

Therefore, as pressure against the cylinder causes it to move. Turning the wheels an equal amount of displaced fluid moves, under pressure from steering cylinder to the control valve, it unseats a re-circulating check ball connecting the engine driven pump pressure inlet chamber and the cylinder return chamber. This allows the fluid to move through the passage in control valve spool and back to the manual pump to complete the cycle.

The displaced fluid does not return to the reservoir even though the reservoir return line is open because of the suction created in the manual pump.

The engine driven pump being stopped, the fluid in the power circuit and the reservoir is under no pressure and is therefore static.

The re-circulating check ball is seated under pressure when engine driven pump is operating.

b. Power Steering

This circuit consists of reservoir, engine driven pump, control valve, manual pump and steering cylinder. The initial turn of the steering wheel develops the 15 to 20 lb/in^2 pressure differential in the manual pump lines at the control valve spool to direct the incoming high pressure fluid from the engine driven pump to the manual pump inlet.

A small amount of steering effort must always be supplied throughout a turn to add the extra 15 to 20 lb/in^2 pressure to whatever the pump is supplied to the manual pump.

This gives "steering feel" while providing sufficient force to over come the resistance of the control valve spool centering spring.

As soon as the manual steering effort ceases, the 15 to 20 lb/in^2 pressure differential in the manual pump to control valve spool centres and the fluid in steering circuit becomes static. The fluid moving from the engine drive pump into the centered control valve is directed back onto the reservoir.

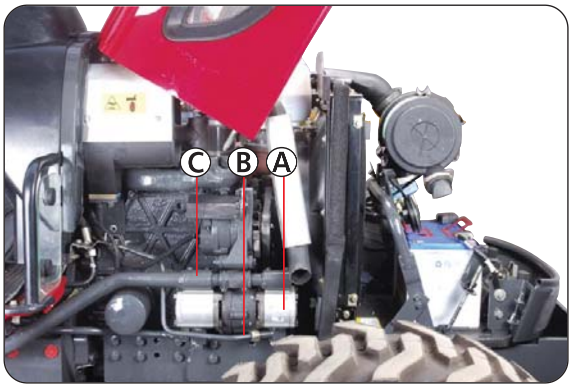
Fluid from the engine driven pump is directed by control valve to manual pump inlet or returned to the reservoir when not needed. Fluid supplied by the engine driven pump never goes directly to the steering cylinder.

i. Turning :

The initial turn of the steering wheel driving the attached manual pump, moves the control valve spool and opens the port to the manual pump and the steering cylinder. The fluid from the engine driven pump enters the control valve and this fluid passes through the control valve spool passage into the manual pump. The fluid the passes through and out of the manual pump under high pressure to and through the control valve to the steering cylinder and against the cylinder piston. An equal amount of fluid displaced by the moving piston flows to the control valve under low pressure and return to the reservoir to supply the engine driven pump.

ii. Neutral

With no steering at the manual pump, the control valve spool is in the centered or neutral position. Fluid in the closed manual steering circuit is static. With the spool centered fluid flow from the engine driven pump is directed through the open control valve channels back to the reservoir. When the steering wheel is turned to move the valve spool off its centered position this fluid is instantly available.

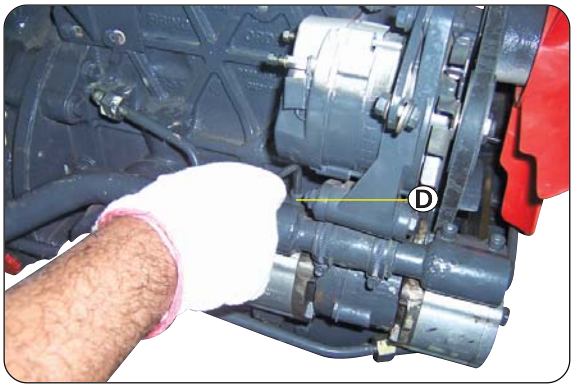


5. REMOVAL & REFITMENT OF STEERING PUMP

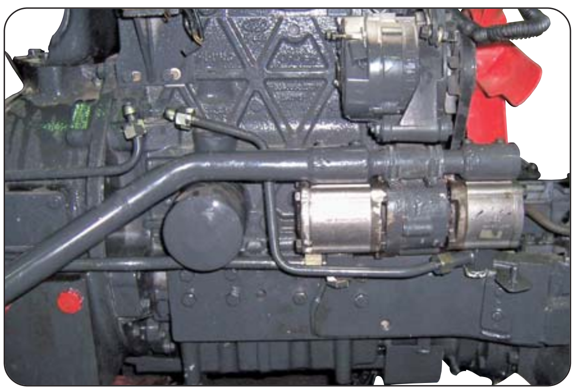
A. Dismantling the Steering Pump

1. Unlock the Hood lock and lift the hood.
2. Remove RH side panel.
3. First remove the battery cable from its negative terminal. Then remove the same from its positive terminal.
4. Disconnect the Steering Pressure Line (B) of steering pump (A) by loosening the pipe nut.
5. Disconnect the Suction Line (C) by loosening the cap screws (D).

NOTE: Close all openings with caps and plugs.



6. Remove both Pumps for further repairs or replacement.



B. ASSEMBLING THE STEERING PUMP

IMPORTANT: Always use new O'Rings. Damaged or used O'Rings will leak.

1. Place new O'Rings on pump flange. Install pump on engine.
2. Install cap screws for connecting the Hydraulic Suction Lines.
3. Connect the Steering Lines and Hydraulics Pressure lines.

NOTE: Hold adapters when tightening Hydraulics / Steering lines to eliminate overtightening of adapters on pump.

4. Connect the Battery connections.
5. Fit the RH side panel and close the hood.
6. Start engine and operate hydraulics. Check all connections for leaks.
7. Check oil level, add if necessary with the recommended grade of oil.

Service Recommendation:

It is not recommended to repair pump. Pump should be completely replaced, if internal problem suspected.

6. AIR BLEEDING THE SYSTEM

1. Maintain the oil level in transmission housing by means of dipstick. Be ready to add oil when the engine is started.

NOTE: This oil will be circulated only from the power pump to and through part of the HSU control valve and to the power steering pump. When more oil can be added and oil is clear proceed as follows:

3. Turn the steering wheel alternately left and right, approx. 10 times avoiding, however that wheel contact their front axle stops. Turn steering wheel twice to each side.

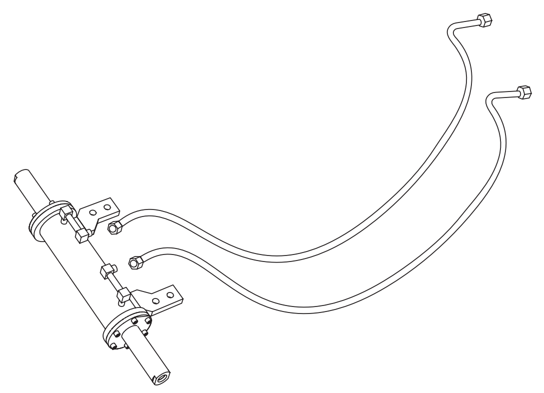
4. After venting it is recommended to jack up the front axle, especially if steering cylinder is removed.

CAUTION : Do not operate vehicle until air is bleed out.

5. Maintain recommended oil level in reservoir and assemble reservoir cap.

7. TIPS FOR MAINTAINING THE HYDROSTATIC STEERING SYSTEM

- Top up fluid level in reservoir (transmission housing) if necessary.
- Maintain correct inflation pressure in front tire.
- Always use a puller to remove the steering wheel. Do not use a hammer, torch, or crow bar.
- Investigate and correct immediately any play, raffle, shimmy, or other unusual occurrence in the steering system.
- Do not attempt to weld any broken steering component. Replace the component with original equipment only.
- Do not cold straighten, hot straighten, or bend any steering part.
- Prevent dirt or other foreign matter from entering the hydraulic system. Clean off around filler caps before checking oil level. Investigate and correct any external leak in the steering system, no matter how minor the leak.
- Clean or replace the filter as per the routine service schedule.



8. Removal of Steering Cylinder from Tractor

a. Jack up the tractor.

b. Open the hood.

c. Disconnect both hoses from HSU to Steering cylinder.

d. Plug both ends of the hoses to prevent entry of dust.

e. Remove plastic ties binding the axle breather hose and push the hose below battery mounting plate towards the axle.

f. Close the hood.

g. Hold the front axle with ropes.

h. Remove both front wheels.

i. Remove front & rear propeller shaft guards.

j. Remove propeller shaft sleeve at transmission case end.

k. Disconnect Propeller shaft bearing from bearing bracket.

l. Slide the propeller shaft towards axle first and then slide away from the axle.

m. Remove mounting bolts holding axle to semi-chassis.

n. Move the axle away from the tractor.

o. Remove both connecting links connected to axle & steering cylinder.

p. Remove Steering cylinder mounting bolts from axle.

q. Move away the steering cylinder.

9. Inspection

Visually inspect all parts and replace those parts which are not in good condition. Inspect cylinder bore finished surface and piston surface. Piston rod surface. Inspect for abnormal wear scoring or damage.

a) Thoroughly wash all components in clean solvent and blow dry with compressed air.

b) Check the cylinder bore for scratches or grooves.

c) Inspect the cylinder bore that is out of round must be replaced.

d) Inspect the piston and piston rod for scratches and wear, then check the piston rod or straightness.

e) Inspect the piston rod bearing for excessive wear or damage.

10. Assembly

a) Coat all internal parts with clean hydraulic fluid.

b) Renew the O'rings and wiper seal then assemble in the reverse order to dismantling.

NOTE: **Discard and replace all seals, gaskets, O'rings etc. Whenever a unit was taken down for repair.**

Do not attempt to lap or rework mated parts with a high precision fit as this will cause internal leakage.

11. Adjustment

On these tractors full piston stroke of the steering cylinder is not utilized, but front wheels are stopped by regular steering knuckle stopper. Stoppers are factory adjusted and welded to give a definite front wheel angle in lock position.

1. Place front wheel in central position and check toe-in if necessary. Adjust tie rod length to obtain a toe-in of 0.07" to 0.23".

2. Mount steering cylinder pre-assembled to specified length, to axle and steering lever.

3. Jackup tractor front axle. Turn wheels to both directions, full lock, and make sure inside wheels are stopped by lock stopper and not by the end of piston stroke.

4. With inside wheels in full lock position. Make sure there is a clearance of 0.004" between front stopper of the outer wheels and front axle stop.

5. Connect up pressure lines to their correct cylinder port.

6. Tighten lock nuts of ball joints.

12. Testing

a. Unit may be tested after installation on the machine.

b. Remove the air as per procedure given in point no.6.

c. With the tractor standing on dry concrete and the engine running at govern speed, operate the steering for approximately five minutes.

d. With the engine stopped it should be possible to rotate the steering from straight ahead to full lock in approximately six seconds.

e. With the engine running at rated speed and tractor standing on dry concrete, input torque should not exceed 3.8 Nm.

f. Stop the engine, and using the special spanner and a spring balance in the hole further from the end check input torque does not exceed 11.4 Nm Response must be insantaneous.

Check the both directions.

g. With the engine running at maximum rev/min. and steering wheel turned appropriate lock the pressure of 100 Bar must be recorded on a gauge fitted to one of the cylinder hose.

h. With the engine running at rated speed hydraulic oil temperature at 55^{0}C ± 5^{0}C. Turn the wheels to the extreme left and right lock and with a torque of 11.3 Nm.at steering shaft, check steering slippage does not exceed 3 rev/min.

NOTE: **If no suitable torque wrench is available, the above slippage test can be made with a spring scale. A pull of approx. 8.8 lbs. at the steering wheel rim equals the necessary test torque 6 lbs/ft.**

i. Testing the power steering internal leakage before and after repair.

   a) Fill the cylinder with hydraulic fluid (testing oil)

   b) Connect a nozzle test pump to the inlet port of the filled cylinder side.

   c) Apply test pressure to determine leak oil volume. See "Specifications".

NOTE: **A small amount of external leakage (an oil moistered piston rod) is acceptable.**

13. Trouble Shooting General

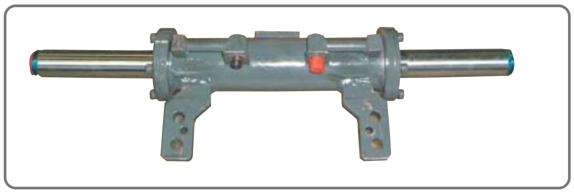
When steering problems are encountered, the following points should be checked first before proceeding with fault spotting.

- Oil level in reservoir.
- Suction pipe and return oil filter condition.
- External oil leakage.

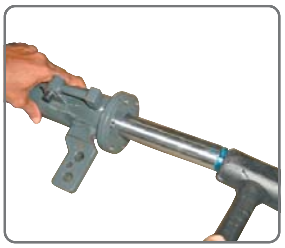
- Air lock in system.
- Cavitation, air lock in oil lines (leak on suction side or pump shaft oil worn.)
- Hydraulic fluid temperature and conditions
- Oil change intervals observed.
- Specified oil grading.
- Discolouration or flaking of paint coating on tandem pump due to over heating of oil.
- Mechanical damage (wheel bearings, steering knuckles, ball joints, etc.)

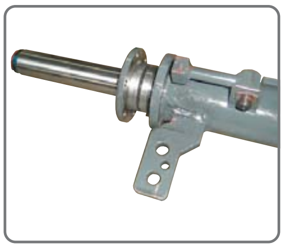
Should these investigations bring no result, proceed to inspect the tandem pump, manual steering control unit (manual pump) and/or steering cylinder, refer to general information in respective section and follows trouble shooting chart.

Steering Cylinder dismantling

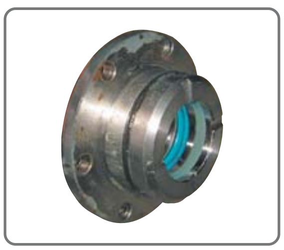


1. Loosen the allen screws from both sides of the cylinder head.

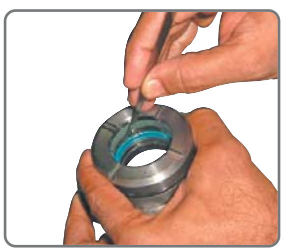


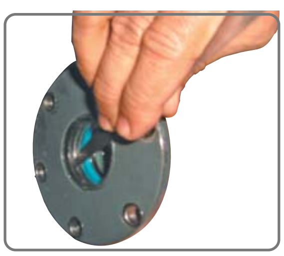


2. Gently tap by plastic hammer the rod till the cylinder head will come out.



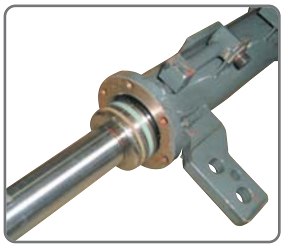
3. Remove cylinder head.





4. Inspect cylinder head rod wiper, rod seal, bearing ring and o'ring for wear or cracks.

5. Remove wear or damaged seals or o'rings and install with new one. If these seals or O'Rings damaged, this will result into external leakages.



6. Further tap the rod till the piston comes out.

7. Inspect the piston seal and bearing ring for wear or cracks.

8. Remove wear or damaged seal or ring and install with new one. If these seals or O'Rings damaged, this will result into external leakages / free wheeling problem.

Steering Cylinder Refitment

1. After installing new seals and o'ring on piston and cylinder head, tap gently by plastic hammer the rod to align it to cylinder housing face mounting bolt.

2. Tighten the allen screw of cylinder head to cylinder housing as per the specified torque. (i.e.25Nm / 18 lb.ft.)

NOTE: Whenever dismantling of steering cylinder for inspection/checking always replace piston seal, head cover seals, rod seals, wiper ring and O'Ring (Seal Kit).

9. TROUBLE SHOOTING

Most steering problems can be corrected if the problem is properly defined. The entire steering system should be evaluated before removing any components. The steering control unit is generally not the cause of most steering problems. The following is a list of steering problems along with possible causes and suggested corrections.

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
A. Slow steering, hard steering, or loss of power assist.	Worn or malfunctioning pump.	Replace pump.	
	Malfunctioning relief valve allowing the system pressure to be less than specified.	Replace the relief valve.	
	Overloaded steer axle.	Reduce load.	
B. Wander - Vehicle will not stay in a straight line.	Air in the system due to low level of oil, cavitating pump, leaky fitting, pinched hose, etc.	Correct.	
	Worn mechanical linkage.	Repair or replace.	
	Bending of linkage or cylinder rod.	Repair or replace.	
	Wear in steering control unit.	Replace the steering control unit.	
C. Drift - Vehicle veers slowly in one direction.	Worn or damaged steering linkage.	Replace linkage and align front end.	
D. Slip - A slow movement of steering wheel fails to cause any movement of steered wheels.	Leakage of cylinder piston seals or accessory valve between cylinder lines or ports.	Replace seals or accessory valve.	
	Worn steering control unit meter.	Replace steering control unit.	
E. Temporary hard steering or hang-up	Thermal Shock *	Check unit for proper operation and cause of thermal shock.	

9. **TROUBLE SHOOTING (Contd.)**

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
F. Erratic steering	Air in system due to low level of oil, cavitating pump, leaky fitting, pinched hose, etc.	Correct condition and add fluid.	
	Loose cylinder piston.	Replace cylinder.	
	Thermal shock damage. *	Replace steering control unit.	
	Sticking flow control spool.	Replace flow control valve.	
G. "Spongy" or soft steering	Air in hydraulic system. Most likely air trapped in cylinders or lines.	Bleed air out of system. Placing ports on top of the cylinder will help prevent air trapping.	
	Low fluid level.	Add fluid and check for leaks.	
H. Free Wheeling - Steering wheel turns freely with no feeling of pressure and no action on steered wheels.	Steering control unit meter has a lack of oil. This can happen on start-up, after repair, or long periods of non use.	Usually starting engine will cure problem.	
	No flow to steering unit can be caused by:		
	1. Low fluid level.	Add fluid and check for leaks.	
	2. Ruptured hose.	Replace hose.	
	3. Internal steering control unit damage due to thermal shock*.	Replace the unit.	
I. Free Wheeling - Steering wheel turns with slight resistance but results in little or no steered wheel action.	Leaking relief valve in cylinder lines.	Repair or replace the accessory valve.	
	Piston seal blown out.	Determine cause. Correct and replace seal.	
J. Excessive free play at steering wheel.	Loose steering wheel nut.	Tighten the nut.	
	Steering column shaft worn or damaged. There should be very little free play in the unit itself.	Repair or replace steering wheel connection or column.	

9. TROUBLE SHOOTING (Contd.)

TROUBLE	PROBABLE CAUSE	REMEDY	REF.
K. Excessive free play at steered wheels.	Broken or worn linkage between cylinder and steered wheels.	Check for loose fitting bearings and anchor points in steering linkage between cylinder and steered wheels.	
	Leaky cylinder seals.	Replace cylinder seals.	
L. Binding or poor centering of steering wheel.	High back pressure in tank line can cause slow return to center. Should not exceed 300 psi.	Revise circuit return line.	
	Large particles can cause binding between the spool and sleeve.	Clean the unit and filter the oil. If another component has failed generating contaminants, flush the system while bypassing the steering control unit.	
M. Steering unit locks up.	Large particles in meter section.	Clean the unit.	
	Insufficient hydraulic power (units over 15 in^3).	Check hydraulic power supply.	
	Severe wear and/or broken pin.	Replace the unit.	
	*Thermal shock.	Replace the unit.	
N. Steering wheel oscillates or turns by itself.	Parts assembled wrong.	Correct it.	
	Steering unit improperly timed.	Correct timing.	
	Lines connected to wrong ports.	Reconnect lines correctly.	
O. Steered wheels turn in wrong direction when operator activates steering wheel.	Lines connected to wrong cylinder ports.	Reconnect lines correctly.	
P. Steering wheel kicks at start of steering.	No inlet check valve on steering control unit.	Install a check valve.	

*Thermal shock - A condition caused when the hydraulic system is operated for some time without turning the steering wheel so that fluid in the reservoir and system is hot and the steering control unit is relatively cool (more than 50^0C temperature differential). When the steering wheel is turned quickly the result is temporary seizure and possible damage to internal parts of the steering control unit. The temporary seizure may be followed by total free wheeling.

Group-I

Hydraulics

1. SPECIFICATION

a) Pump

1. Make -- EATON
2. Type -- Gear
3. Output @ 2800 RPM ------------------------------------ 41 lpm (11 gpm)

b) Hydraulic Lift Unit

1. Make -- MITA
2. Lift Cylinder ID -- 85 mm
3. System Relief Valve Pressure @ 40 lpm ---------- 200 (+5/-0) bar
4. Shock Load Relief Valve Setting --------------------- 225 - 230 bar
5. Bell Crank Pin Hole ------------------------------------- 19.5 mm
6. Suction Strainer Size ------------------------------------ 100 mesh
7. Suction Filter Size -- 10 micron

Features

i) Position and Draft Control

ii) Lowering speed adjustment of Lifting Arm

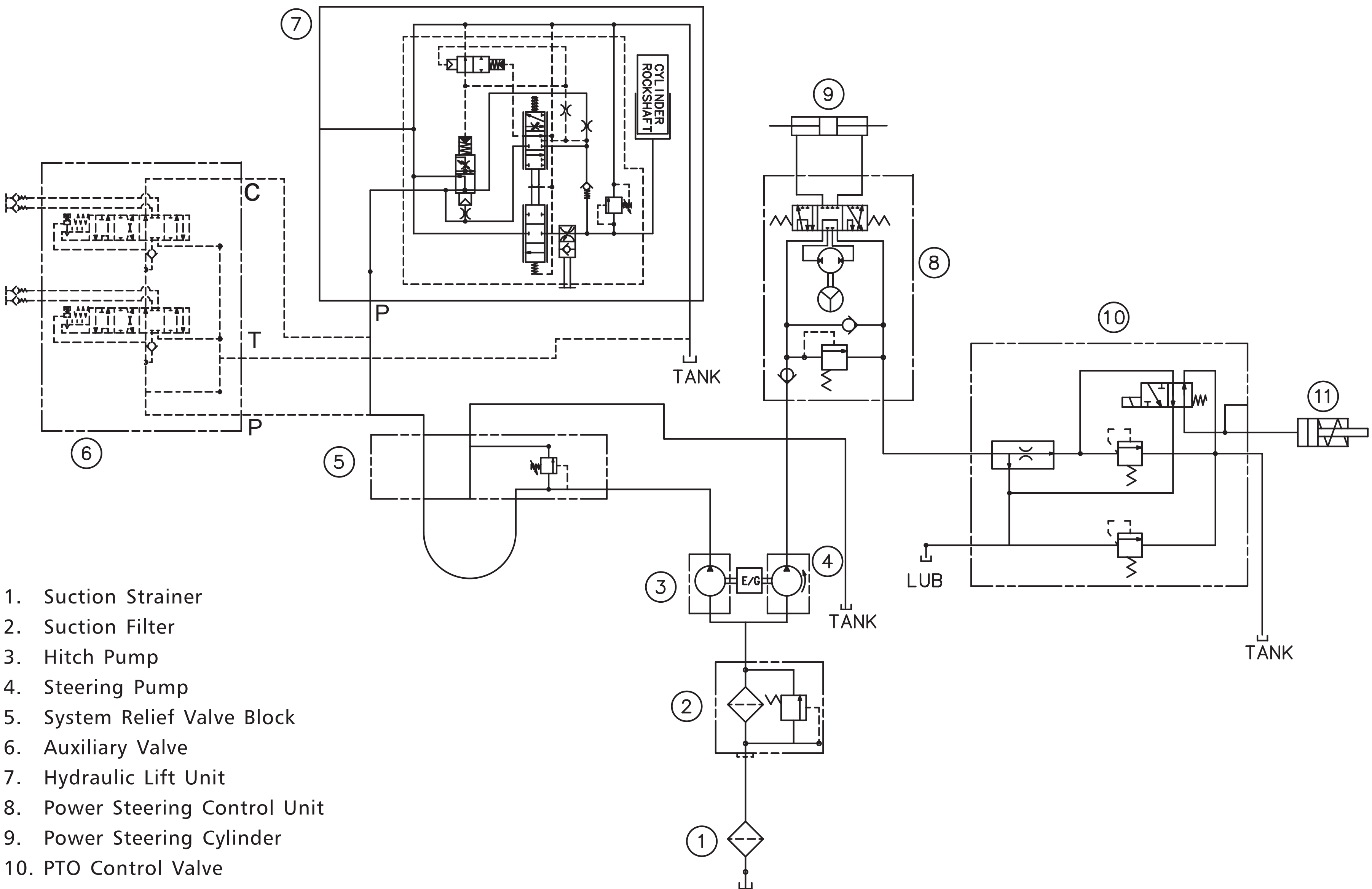
iii) Common oil for Transmission, Hydraulic and Power Steering

iv) Common Relief Valve for Hitch Valve, Auxiliary Valve and Loader Valve

TECHNICAL FEATURES

- Operation with draft and position control.
- Reading of traction force on top link.
- Adjustment of operating sensibility during draft control work.
- Lowering speed adjustment of lifting arms.
- Safety transport lock on control valve.
- Automatic hydraulic limit stop of angular excursion of lifting arms.
- Sector control with two levers: One lever for the position and one for the draft control.

2. HYDRAULIC CIRCUIT



1. Suction Strainer
2. Suction Filter
3. Hitch Pump
4. Steering Pump
5. System Relief Valve Block
6. Auxiliary Valve
7. Hydraulic Lift Unit
8. Power Steering Control Unit
9. Power Steering Cylinder
10. PTO Control Valve
11. PTO Wet Clutch

3. HYDRAULIC OPERATION

1. GENERAL DESCRIPTION

These tractors are equipped with hydraulic system consist of an engine driven gear pump, lift housing, connecting pipes and the filter.

The reservoir is transmission housing. The oil used is common for transmission, hydraulics and Brakes. A strainer is fitted on transmission. Addition paper filter is incorporated on suction line which ensure 100% filteration. Lift housing houses lift cylinder, control valve, shockload relief valve, control valve linkages, and Rock shaft. A pivot bracket in the rear has two holes for different draft sensitivity, carries a toplink. Heavy duty top link, collapsible type lower links, telescopic stabilizer jug & collar lift rods are provided as part of 3 point linkage.

2. PRINCIPLE OF OPERATION

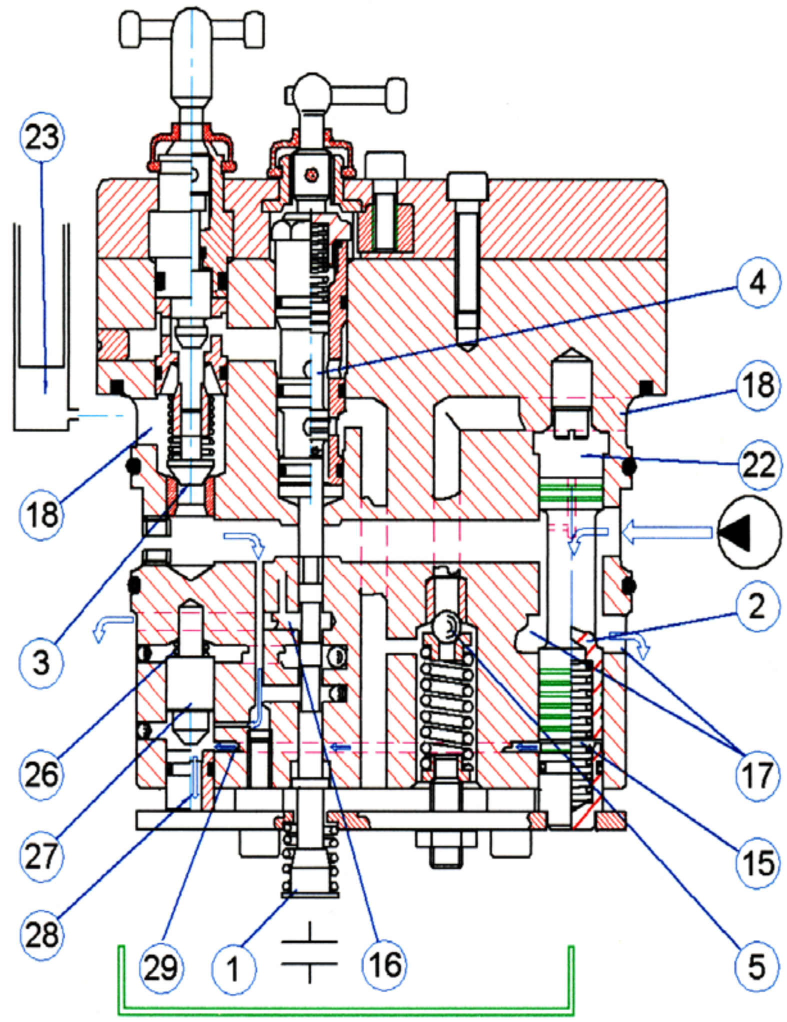
The direction of oil flow is from strainer, filter, pump, Auxiliary valves, control valve to lift cylinder. The lifting of the system is protected by a relief valve between the pump & control valve. The cylinder of the system is protected by shock load relief valve. The control valve is operated by two levers.

Thus the only flow
delivered to the cylinder is that controlled by the lever in use. The inner lever controls the implement draft and outer lever controls the implement position. When the spool is in neutral or hold position the fluid passes through unloading valve to go to tank. Unloading

When spool is in lift position the part of fluid passes to the opposite side of unloading valve. Making unloading valve pressure more than working pressure. Then the fluid passes through non return valve to the lift cylinder and rest of fluid passes through flow control valve to tank.

When spool is in lower position the fluid passes through unloading valve to tank. The oil trapped in the cylinder passes through lowering valve to tank.

4. FUNCTIONING OF FLOW CONTROL VALVE



The Control Valve has three distinct functioning phases:

A) NEUTRAL PHASE

B) DELIVERY PHASE

C) DISCHARGE PHASE

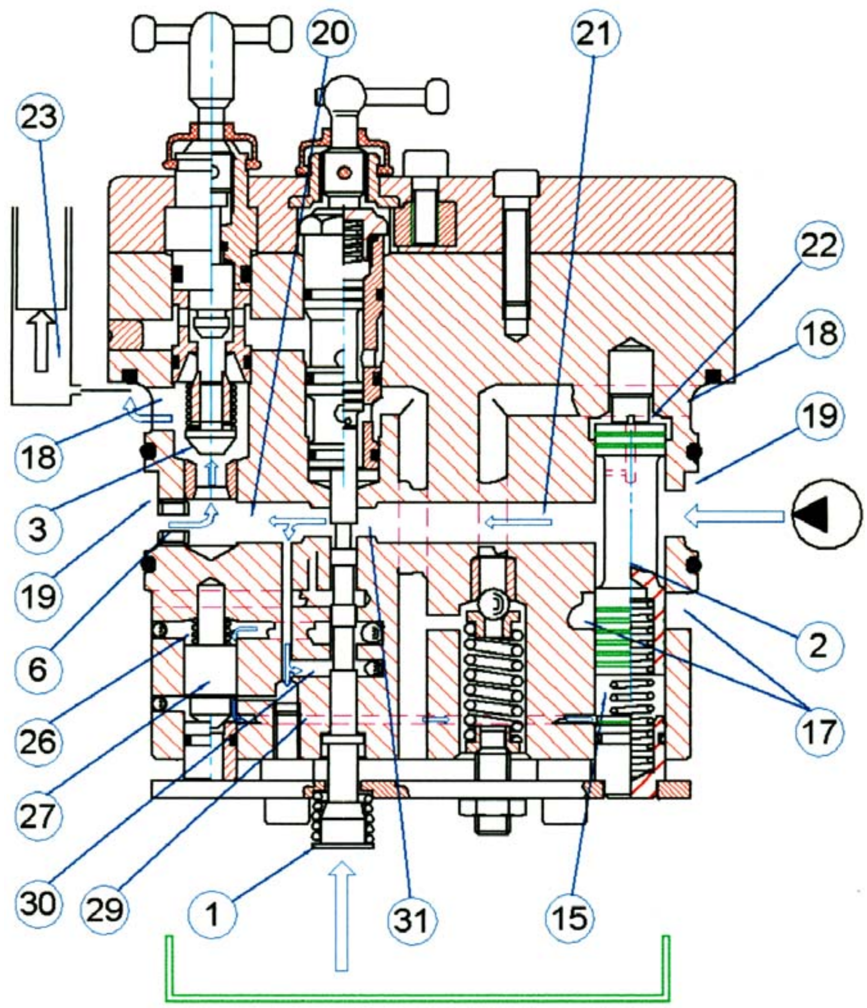
A. NEUTRAL PHASE

In this phase the control valve keeps under pressure the oil in the cylinder bearing the load while the oil coming from the pump flows freely into the tank.

The control spool (1) is in the position to connect chamber (26) of the pilot valve (27) directly to the discharge through hole (16). Thus allowing the same valve to open hole (28) which discharges chamber (15) by means of the duct (29) of the regulator piston (2). Thus the oil coming from the pump feeds chamber (22) and allows the regulator piston (2) to open the holes (17) and the oil flows to the tank.

The oil contained in the cylinder (23) remains under pressure by means of the check valve (3), by the discharge valve (4) and by the safety valve (5) which are connected to the cylinder by the annular duct (18) and thus sustains the load applied to the lifting arms.

The safety valve (5) protects the cylinder from the possibility of eventual over-pressure due to the oscillation of the load during road transport.



B. DELIVERY PHASE

During this phase the Control Valve supplies oil under pressure to the cylinder (23) and this consequently lifts the arms.

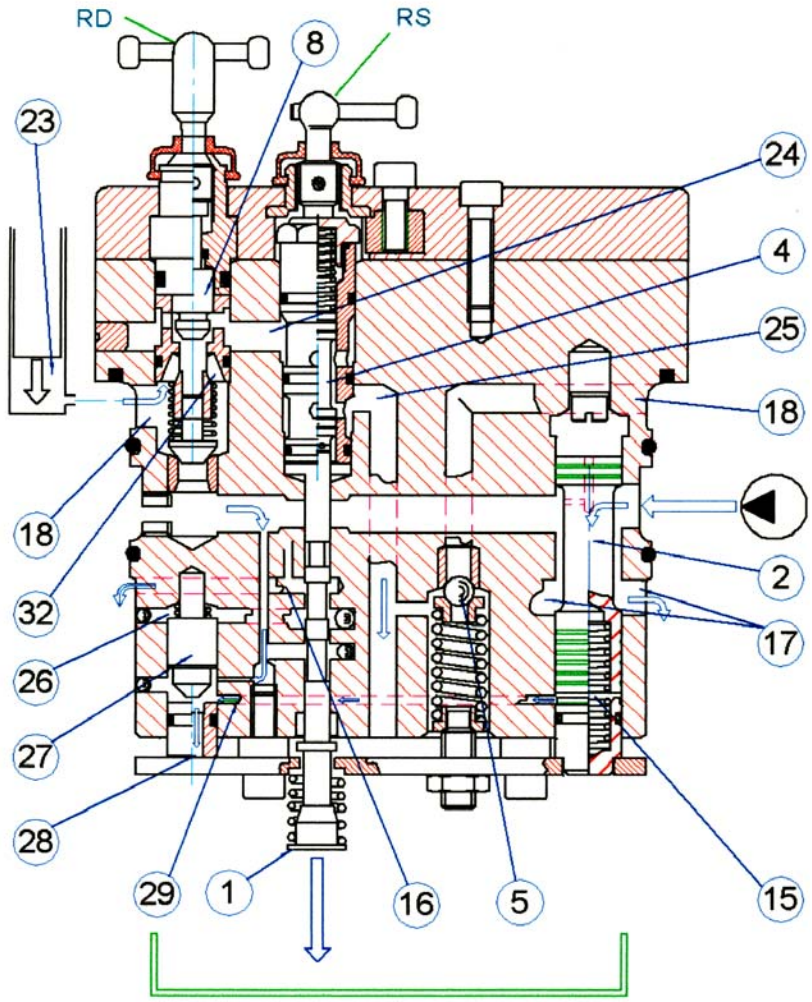
The control spool (1) is in the position to connect chamber (26) of the pilot valve (27) with the oil coming from the pump through the annular duct (19) and the holes (20), (21) and (30) thus allowing the pilot valve to close itself. The oil coming from the pump feeds at the same pressure chamber (22) and chamber (15) (through duct - 29) of the regulator piston (2) that closes the discharge holes (17) due to the upward push of the return spring.

The oil under pressure flows to the cylinder through the annular duct (19, enters in hole (20) through the fixed throat (6) and the variable throat made by the control spool (1) with the hole (21), opens the check valve (3), enters in the annular duct (18) and feeds chamber (23) of the cylinder.

The regulator piston (2) regulates the oil flow of the cylinder because chambers (15) and (22) are subject to the difference in pressure created by the oil in the passage through the variable throat (31) which is opened or closed by the control spool (1).

The excessive flow Is deviated on the rising pressure from holes (17), thus regulating the maximum lifting speed and allowing a slow and smooth starting and arrival of the lifting arms.

The maximum lifting pressure is controlled by a relief valve placed on the body of rock shaft connected to the inlet port of oil coming from the pump.



C. DISCHARGE PHASE

During this phase the Control Valve supplies to the discharge both the oil coming from the pump as well as the oil coming from chamber (23) of the cylinder, with the consequential lowering of the lifting arms.

The control spool (1) is in the position to connect chamber (26) of the pilot valve (27) directly to the discharge through hole (16), thus allowing the same valve to open hole (28) that flows to the discharge through duct (29) chamber (15) of the regulator piston (2). The oil coming from the pump, as in the neutral phase, is able to move the regulator piston towards chamber (15) that opens the discharge holes (17) causing oil to flow to the tank.

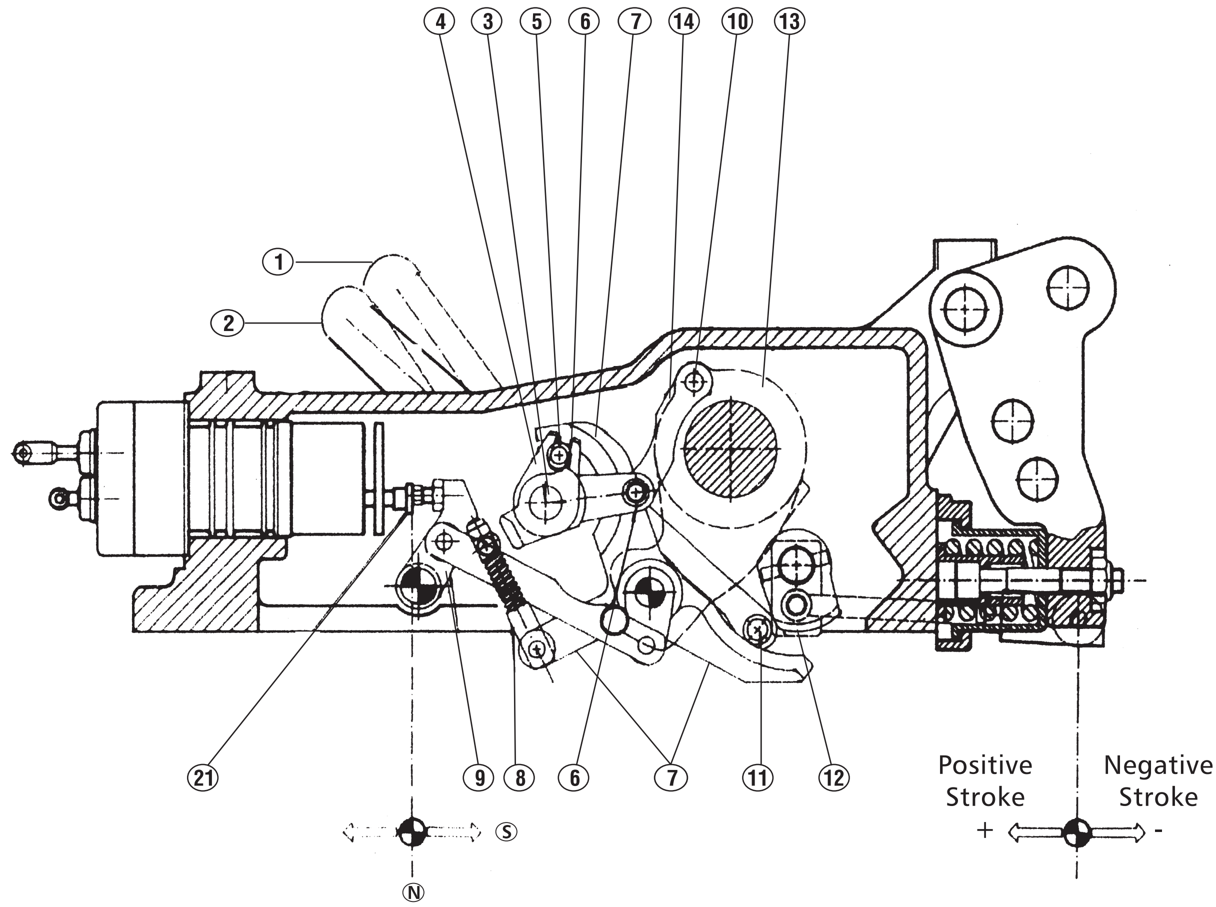
At the same time the oil from the cylinder under pressure (chamber - 23) enters in the annular duct (18) passes through the holes (32), the valve (8) and hole (24) enters in the discharge valve (4) flowing to the tank from hole (25), causing the lowering of the arms.

In this phase the lowering speed of the arms can be regulated by the manual lever "RD" (by screwing the lever clockwise the lowering speed decreases).

For road transport, in order to avoid the accidental lowering of the rockshaft arms due to the movement of the levers, screw shut the lever "RD", this completely closes the valve (8) in its seat in order to close the passage between the chamber (23) of the cylinder and the discharge valve (4).

The cylinder is always protected by accidental over-pressure by the safety valve (5).

5. HOW THE INTERNAL LEVERAGE SYSTEM FUNCTIONS



a. FUNCTIONING OF POSITION CONTROL

b. FUNCTIONING OF DRAFT CONTROL

c. COMBINED FUNCTIONING OF POSITION AND DRAFT CONTROL

A. FUNCTIONING WITH POSITION CONTROL

By positioning the draft control lever (2) against the backstop (E) the roller (11), which slides on the flywheel (7) of draft cam (12), will be moved away completely.

In this way the draft levers will not in any way interfere with the operation of the position control. The arms are raised by moving the position control lever (1) upward, and the leverage system will act in the following way:

Crank (4) being an integral part of shaft (3) turns in a clockwise direction and causes roller (5) to slide on the position cam (6), in turn causing the clockwise rotation of flywheel (7). The flywheel will transmit an anticlockwise rotation, by means of friction shock absorber (8), to the transmission lever (9) that will bring distributor shaft (21) into delivery position (C), thus causing the arms to be lifted.

During the lifting movement of the arms, crank (13) with pin (10) will rotate in an anti-clockwise direction, and by means of the link (14) will cause position cam (6) to rotate clockwise.

When the roller (5) meets the inclined plane of the cam (6), it allows the anti-clockwise rotation of the flywheel (7) that by means of a friction shock absorber (8) rotates the lever (9) in a clockwise direction, which is pushed by the spring of the control valve shaft (21) which moves to position (N) (neutral phase) and thus blocking the movement of the lifting arms.

During the lowering phase of the arms the movements of the levers indicated above will occur in the opposite sense.

The position of the arms, during lifting and lowering, correspond to a specific position of the position control lever (1).

B) FUNCTIONING OF DRAFT CONTROL

By positioning the control lever (1) for position control against the backstop (E), the crank (4) reaches its maximum position of anti-clockwise rotation. In said position the roller (5) is totally lowered from the inclined plane of position cam (6) allowing the anti- clockwise rotation of flywheel (7) as well as the clockwise rotation of the transmission lever (9) that is pushed by the spring of shaft (21) which in turn will position itself for the discharge position (S). In this way the position levers will not interfere with the functioning of the draft control levers.

By positioning the draft control lever (2) against backstop (F), draft control shaft (16) is caused to rotate clockwise.

The crank (15) being an integral part of shaft (16), will reach its extreme position of clockwise rotation, and by means of tension rod (17) will move roller (11), the latter acting on the draft cam (12). This causes flywheel (7) to rotate clockwise which by means of function shock absorber (8) produces the anti-clockwise rotation of transmission lever (9) thus setting the distributor shaft (21) in delivery position (C) and consequently lifting the arms.

The arms will come to a stop only as soon as the piston comes into contact with the pin of the limit stop (22).

This limit stop, by means of tension rod (23) causes lever (9) to rotate clockwise, thereby compressing the spring of friction shock absorber (8) and thus releasing shaft (21) which now can move to the neutral position (N) where it is pushed outward by its spring.

Moving the draft control lever (2) toward backstop (E), the leverage system will function in the following manner:

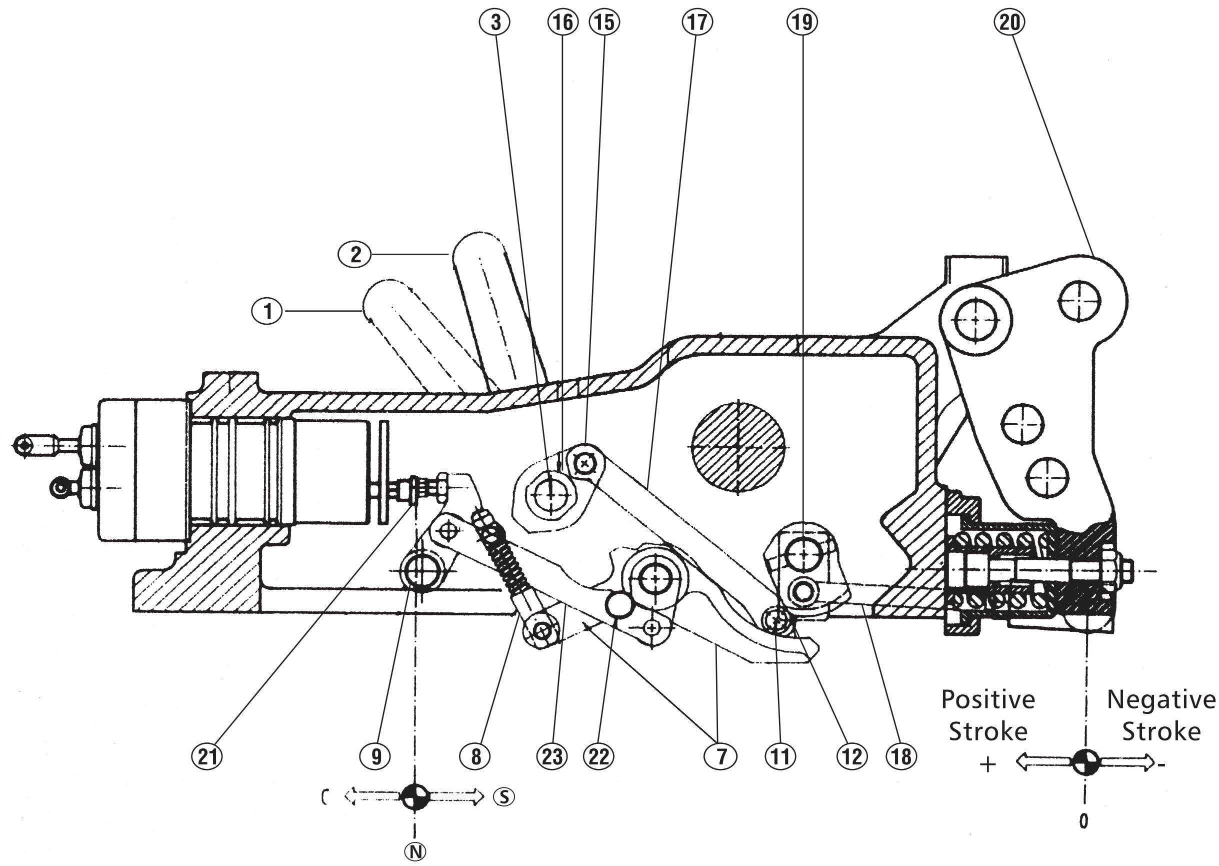
The crank (15), being an integral part of the draft shaft (16), rotates counter-clockwise and by means of tension rod (17) causes roller (11) to slide on flywheel (7).

The roller (11), when it meets the inclined plane of the draft cam (12), permits the counterclockwise rotation of flywheel (7) which by means of shock absorber (8) will rotate transmission lever (9) in a clockwise manner thus leaving distributor shaft (21) free to move into neutral position (N) and continuing the movement of lever (2), in the discharge position (S), causing the arms to lower.

In fact, during the initial part of the movement toward backstop (E), of draft control lever (2) the corresponding lowering of the arms does not happen yet.

The traction force on the top link point (20) acts on tension rod (18) in the direction indicated by the arrow "positive" causing flywheel (19) to rotate clockwise together with draft cam (12) which is fastened to the same pin.

When the inclined plane of draft cam (12) meets roller (11), a clockwise rotation of flywheel (7) is achieved this by means of shock absorber (8) will cause transmission lever (9) to rotate counter-clockwise thereby moving the distributor shaft (21) into neutral position (N) and stopping the movement of the arms.



As the traction force is increased, draft cam (12) will further move roller (11) thus incrementing the movement as described above.

The distributor shaft (21) will move from neutral position (N) to delivery position (C) causing the arms to be lifted. When the traction force diminishes, shaft (21) will return to the neutral position or to the lowering position which will mean an inverse movement of the leverage systems to what is described above.

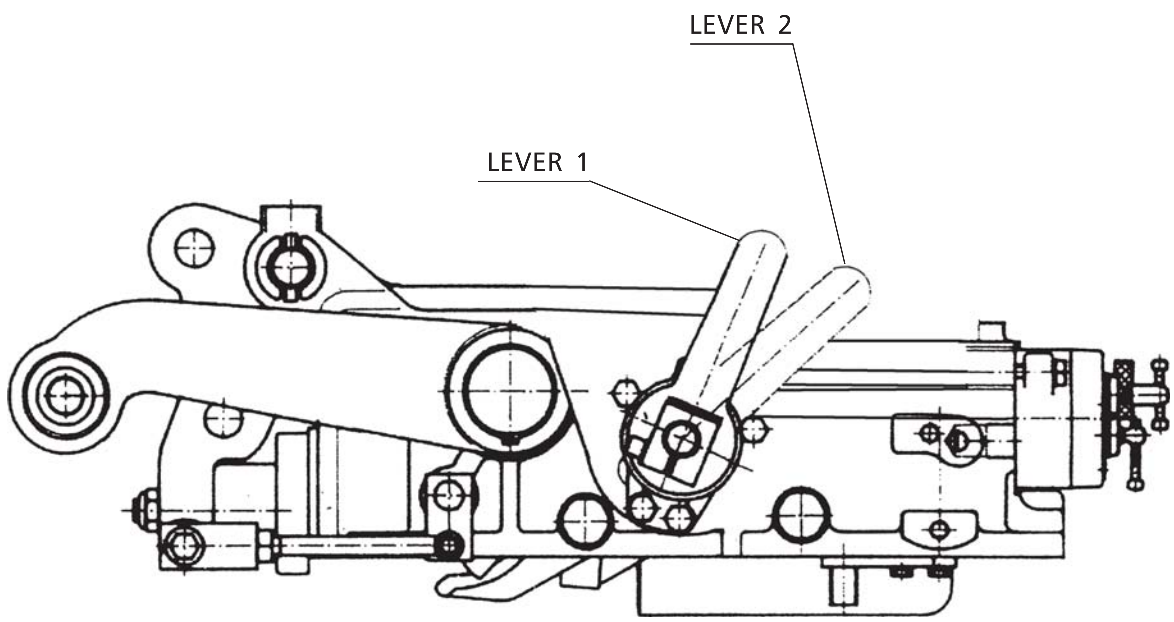
C. COMBINED FUNCTIONING OF POSITION AND DRAFT CONTROL

To utilize the lifting device in this condition it is necessary to observe the following instructions:

1. Move the position control lever (1) upwards with respect to the backstop "E" until the maximum working depth has been attained.
2. Determine the desired minimum working depth by operating the draft control lever and raising it from its zero position so that roller (11), acting on the draft cam (12), will move the distributor shaft (21) into the lifting position (C) and causing a further upward movement of the lifting arms.

2. Due to the position previously established by position control lever (1), flywheel (7), roller (4) and position cam (6), the distributor shaft (21) is prevented from entering the lowering position (S) and therefore the arms cannot sink even though the traction force acting on the top link point (20) will tend to diminish and putting stress on the tension rod (18) in the direction of arrow "negative".
3. This condition will not prevent the rockshaft from operating with the draft control when, in the presence of more consistent soil, the traction force on the top link (20) will tend to increase, exerting pressure on the tension rod (18) in the direction arrow "positive".
4. Consequently the combined operation of position and draft control will limit variations in height toward the ground, as happens during the use of the draft control, and at the same time ensuring the maximum possible depth desirable.

6. USE OF CONTROL LEVERS



The two control levers carry out following operations:

A. Position Control

B. Draft Control

C. Combined operation for Position and Draft Control

The above operations may be chosen in consideration of the work to be carried out, the implement type and the soil superficial hardness.

A. POSITION CONTROL (LEVER 1)

Move the draft control lever 2 fully down. Fix the implement position, inside or outside the soil, by moving the lever 1 up for raising and down for lowering.

The implement movement is proportional to the movement range fixed by means of lever 1.

B. DRAFT CONTROL (LEVER 2)

Move the position control lever 1 fully down, have the implement penetrated into the ground till reaching the desired depth by gradually moving the lever 2 down.

The implement depth reached is proportional to the draft determined by soil hardness. In this condition the rockshaft keeps the draft required automatically constant.

Once the draft is regulated at the end of the rope is possible to lift the implement with position lever 2 in order to keep in memory the draft.

During last movement stroke of lever 2 a floating function is obtained and the rockshaft does not control the draft.

C. COMBINED OPERATION FOR POSITION AND DRAFT CONTROL

In case of workings carried out under draft control on not-homogeneous soils, during which excessive implement penetration may occur, it is convenient to use the combined position and draft control.

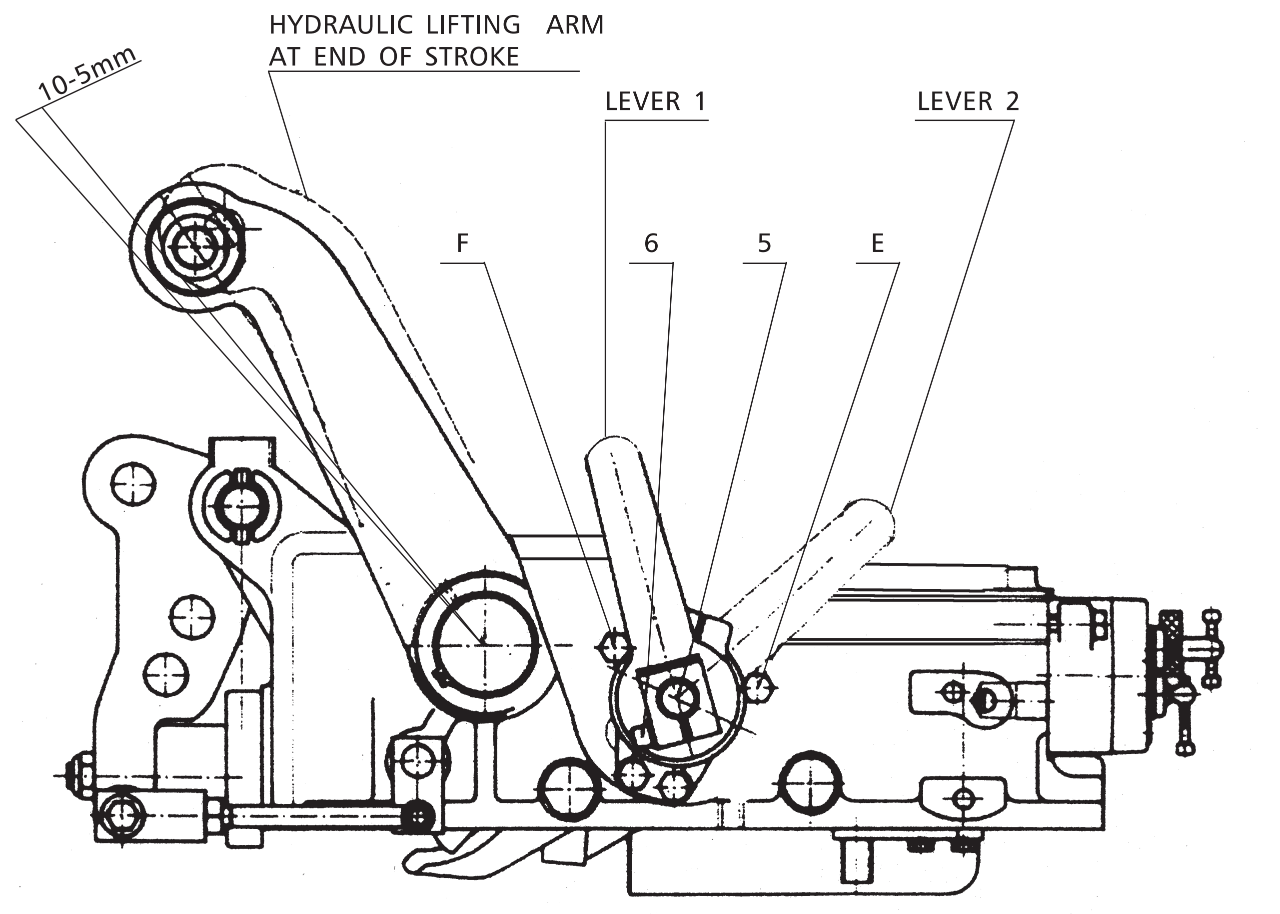
Have the implement penetrated into the ground and search for the desired working depth in the way described for the draft control.

When the desired depth is reached, gradually move up the lever 1 till the lower links slightly start raising. The rockshaft operates under controlled draft, but at the same time it prevents the implement from excessively penetrating into the ground causing a not very uniform work, when coming up against a less hard ground.

For raising and having the implement penetrated at the end and beginning of each pass, acting on position lever 1 only.

IMPORTANT: It is not correct to find the position with the draft lever 2 because the lifting and lowering of arms with this lever changes with the top link position.

This can be on neutral -positive -negative - position depending on the draft force, or to the changement of force on the top link bracket depending on the implement weight.



7. ADJUSTMENTS

In case of complete disassembly of the rockshaft it is necessary to make the following adjustments:

a. ADJUSTMENT OF POSITION CONTROL LEVER

b. ADJUSTMENT OF DRAFT CONTROL LEVER

c. CONTROL OF ASSEMBLY OF REACTION SPRING

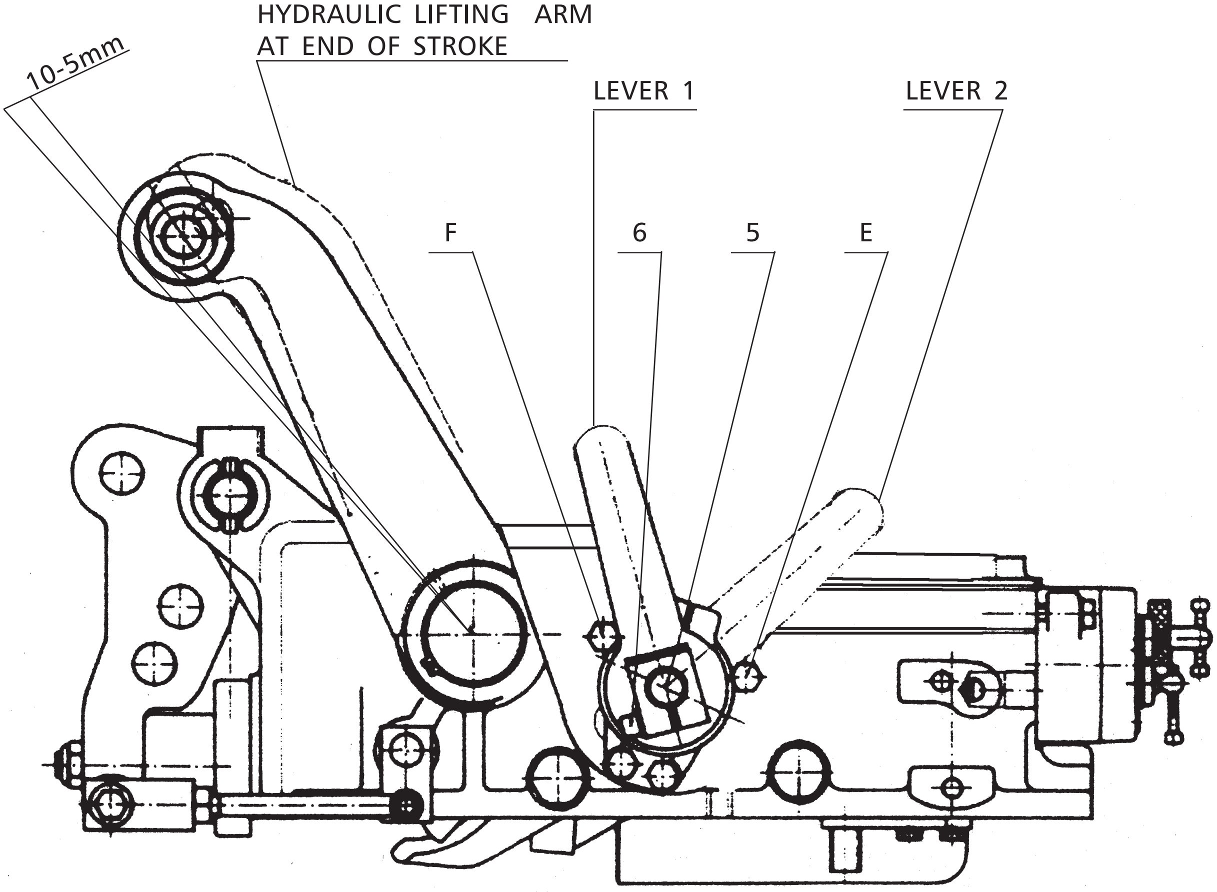
d. MEASUREMENT OF INTERNAL PUSH ROD

a) ADJUSTMENT OF POSITION CONTROL LEVER

The adjustment is carried out in order to establish the maximum raised position of the rockshaft's lifting arms.

Completely lower the arms and apply a light weight which creates a pressure in the cylinder of 50- 60 bar.

Loosen the fastening screw (6) so as to free the position control lever (1) from the shaft (5). With the draft control lever (2) at its lowest position against the backstop (E) raise the position control lever (1) against the backstop (F).

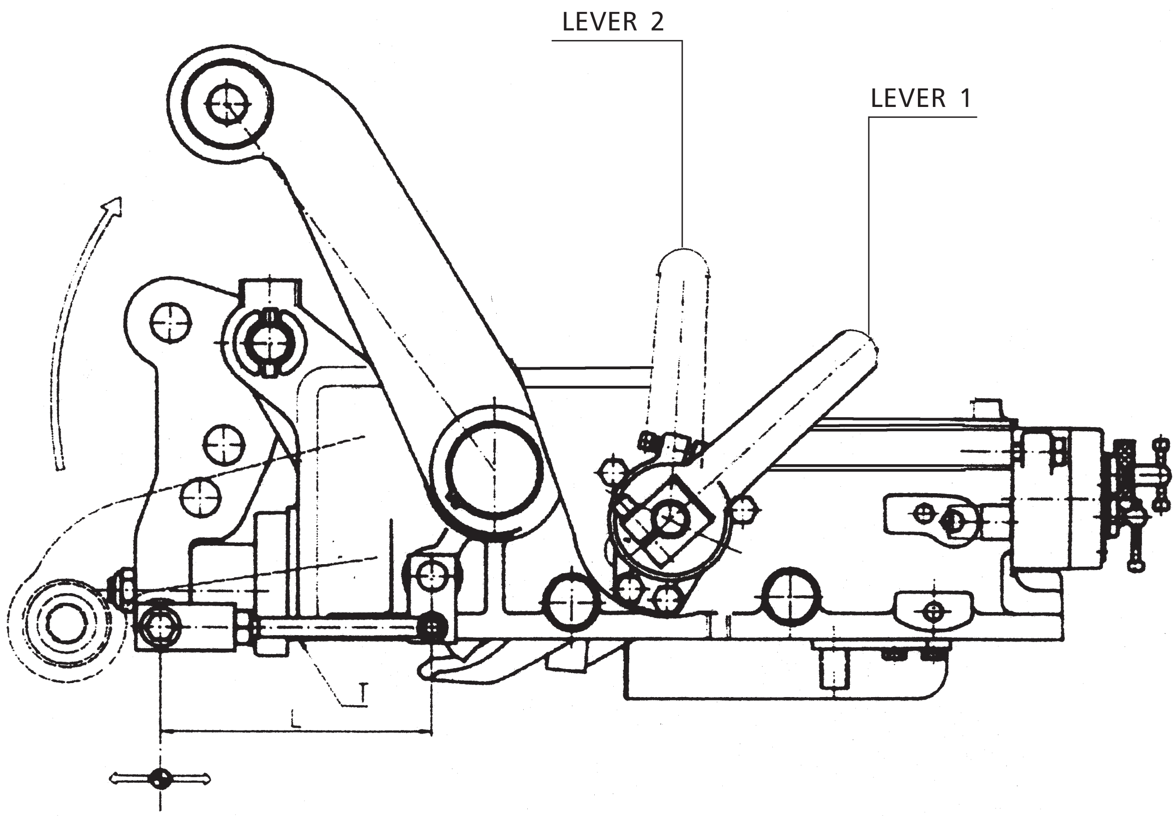


Maintaining fixed the levers (1) and (2) and with a 13 mm open end wrench rotate slowly in an anticlockwise direction the position control shaft (5) so as to raise the arms to their maximum raised position which is determined by the internal hydraulic limit stop. Since during the functioning of the position control the hydraulic limit stop must not be triggered it is necessary to have a safety margin of 10-15 mm.

In order to do this, rotate slowly in a clockwise direction the shaft (5) until the arms are lowered by the required safety margin.

At this point keep the shaft (5) fixed and with lever (1) against the backstop (F) keep the lever fixed with the shaft by tightening fully the fastening screw (6).

To control, raise completely the arms by moving the position control lever (1) (against the backstop F), raising completely the draft control lever (2) there is a further movement upwards of the rockshaft arms. This movement should be contained within 10-15 mm.



b) ADJUSTMENT OF DRAFT CONTROL LEVER

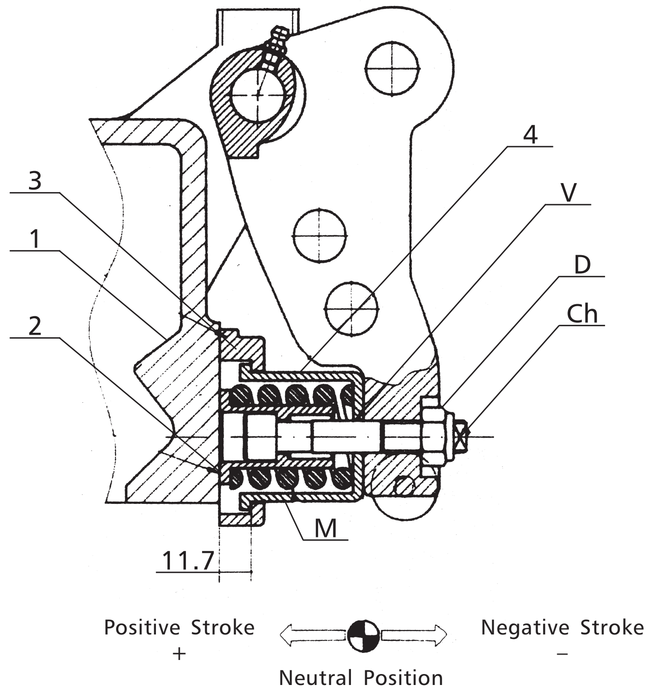
The adjustment of the draft control lever must be carried out to have a correct synchronization between this lever and the stroke (positive and negative) of the top link bracket in order to make full use of the reaction spring.

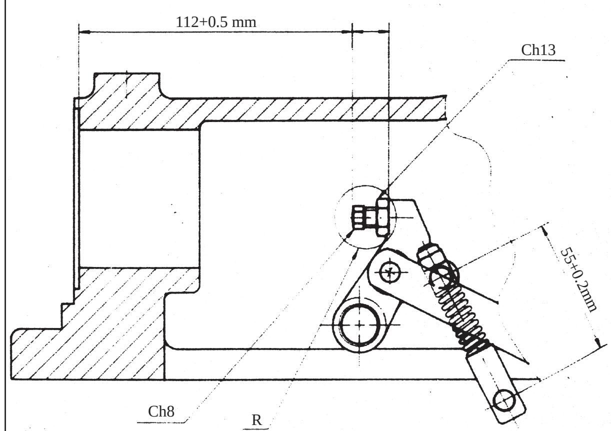
The adjustment must be carried out without implements or loads applied to the three point linkage (20) (i.e. in a neutral position).

Position the two control levers (1) and (2) in the lowest position.

With the motor running at minimum RPM slowly raise the draft control lever (2). The adjustment of the draft lever (2) is correct when it is moved upward and this allows the arms to be completely raised.

NOTE: The position of the lever establishes only the position of the arms but does not influence the adjustment of the draft control lever (2).





c) CONTROL OF ASSEMBLY OF REACTION SPRING

For a correct functioning of the rockshaft the top link bracket, when it is not working, must not have an axial play in the positive and negative.

After having carried out a correct assembly, the spring holder (2) must rest against the rockshaft housing (1), while the spring holder cover (4) must rest against the flange (3).

In this condition the spring (M) is preloaded by about 1 mm. Before assembling the complete reaction assembly to the rockshaft housing a pre-assembly of the spring (M) is needed in order to obtain a measurement of about 11.7 mm.

After carrying out the reaction assembly a definitive adjustment is made. Keep the screw (V) fixed with an 8 mm wrench and adjust the self-locking nut (D) by tightening or loosening it gradually in order to eliminate the axial play completely.

d) MEASUREMENT CONTROL OF INTERNAL PUSH ROD

If the rockshaft is disassembled and if the regulator (R) must be changed it is advisable to control the measurement (X) (15) in order to re-assemble the push rod in the same position. Ensure also that the measurement of the spring is 55 0/-0.2 mm.

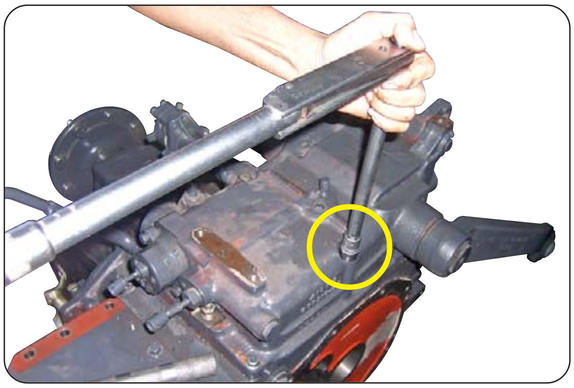
The control of the measurement of the push rod with respect to the control valve face is carried out after making all the adjustments (sensitivity of control valve - position control lever - draft control lever).

With the rockshaft's arms completely lowered and without loads or implements on the three point linkage (neutral position), position the two control levers (1) and (2) at their lowest position against the backstop (F).

In this position push the push rod and verify with the appropriate gauge that the distance of 112 0/+0.5 mm is correct.

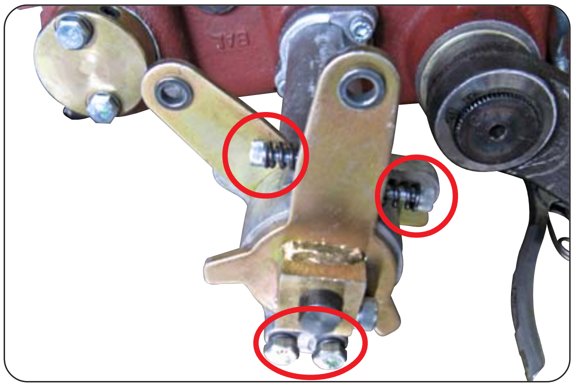
NOTE: If the measurement (X) is changed it is obligatory to carry out again the adjustment of the position and draft control levers.

9. TORQUE DETAILS



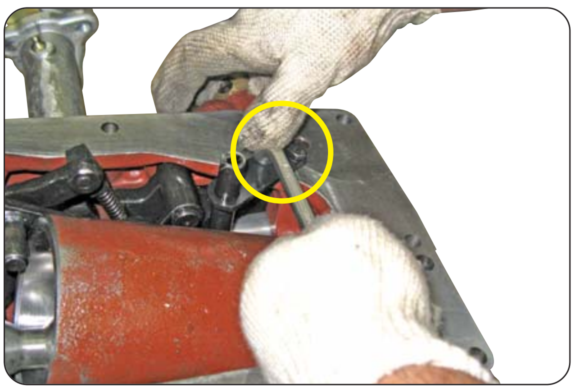
Cap Screw Hydraulic Housing to Transmission Case

41-50 Nm (30-37 Lb-ft.)



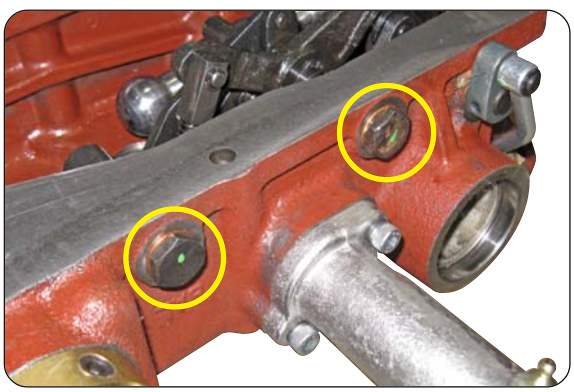
Control Support Quadrant Linkage Screw

19-29 Nm (14-21 Lb-ft.)



Bracket Synchro Lubrication Mounting Bolt

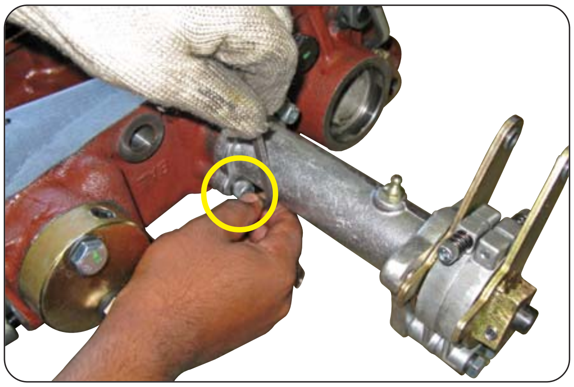
8-10 Nm (6-7 Lb-ft.)



Compensator Linkages Cap Screw

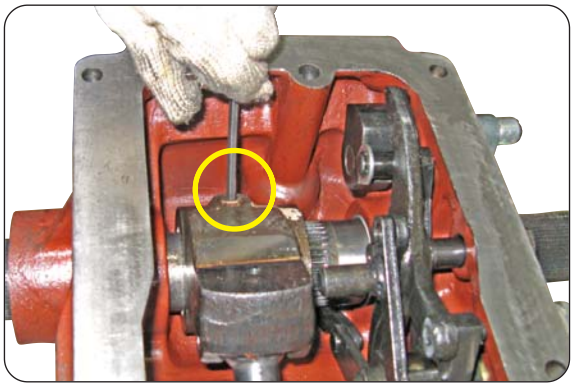
88-98 Nm (65-72 Lb-ft.)

9. TORQUE DETAILS (Contd.)



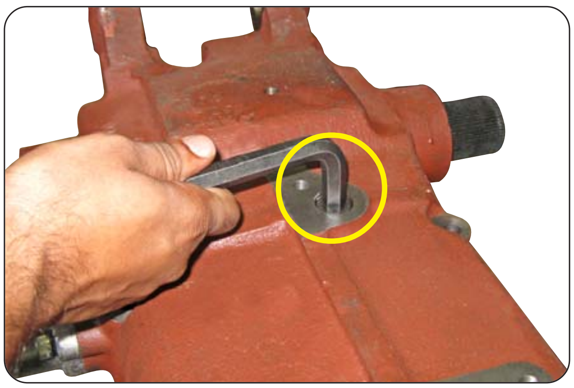
Control Support Assembly Mounting Screw

19-29 Nm (14-21 Lb-ft.)



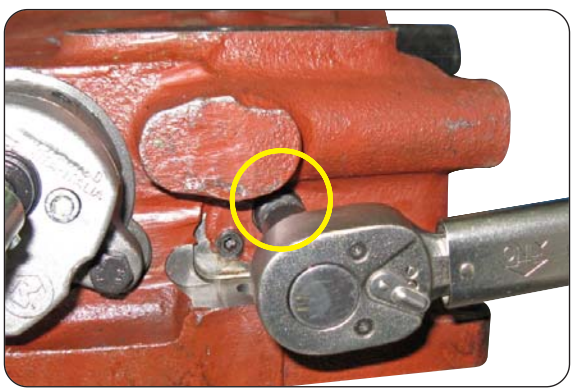
Crank Locking Screw

19-29 Nm (14-21 Lb-ft.)



Cylinder Mounting Set Screw

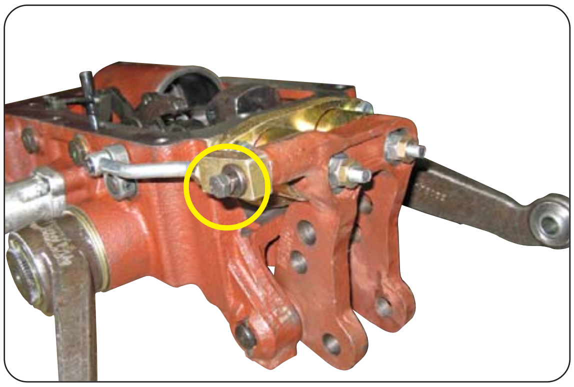
98-127 Nm (72-94 Lb-ft.)



Cylinder Mounting Set Screw

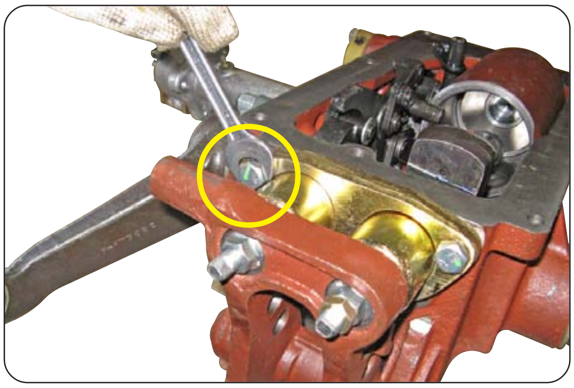
68-88 Nm (50-65 Lb-ft.)

9. TORQUE DETAILS (Contd.)



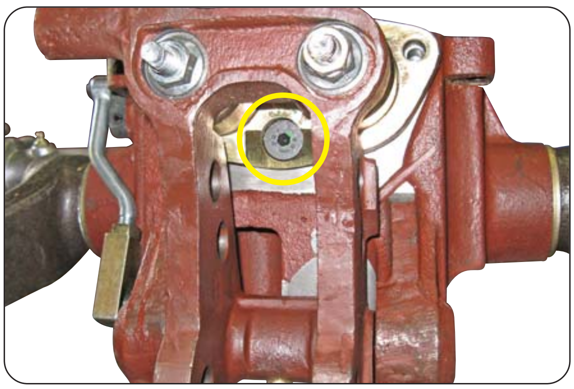
Tie Rod Mounting Screw

19-29 Nm (14-21 Lb-ft.)



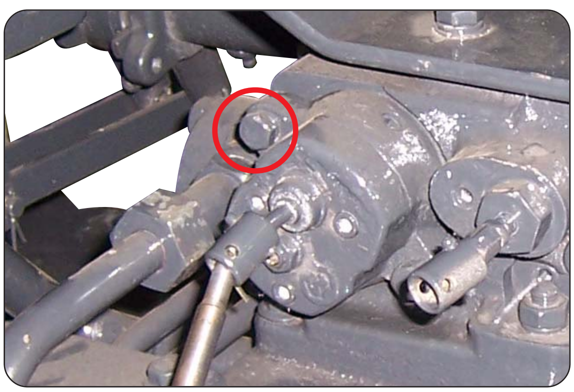
Top Link Bracket Mounting Screw

39-49 Nm (29-36 Lb-ft.)



Top Link Bracket Mounting Screw

39-49 Nm (29-36 Lb-ft.)



Control Valve Mounting Screw

19-29 Nm (14-21 Lb-ft.)

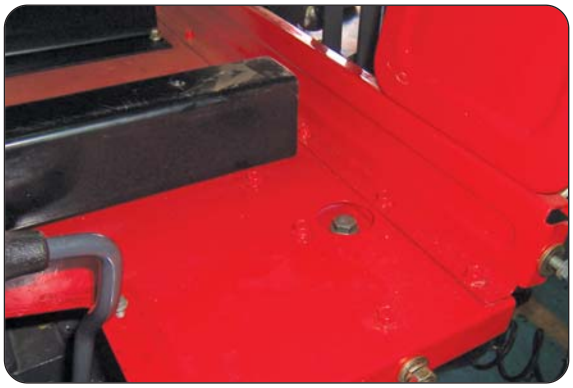
10. TROUBLESHOOTING

DRAWBACKS	CAUSES	REMEDIES
The Rockshaft lifts jerkily	Insufficient oil level in the tank. Pump inlet filter clogged. Infiltration of air into the pump inlet pipe.	Top up the level. Clean or replace the filter. Check the inlet pipe and any coupling and gasket.
Rockshaft does not operate	Differential Valve blocked or dirty.	Remove the control valve and unblock the regulator piston.
The rockshaft starts to lift, but it stops as soon as it feels the load, without the functioning of the over-pressure valve	Tension rod measurement "L" is not correct	Adjust the draft control lever
The rockshaft does not descend over its entire travel.	Faulty adjustment of the position control lever "1" Sensibility adjusted badly	Adjust position control lever Adjust sensitivity of Control Valve
The rockshaft does not descend. valve	Discharge Valve blocked	Remove Control Valve and unblock or clean discharge
Lifting capacity does not match that prescribed.	Deterioration of the Control Valve seal rings. Relief and Safety valves out of calibration. Poor pump efficiency. Excessive loss of oil from Control Valve.	Remove control valve and replace the external seal rings. Control calibration of the valves. replace the pump Overhaul the Control Valve

10. TROUBLESHOOTING (Contd.)

DRAWBACKS	CAUSES	REMEDIES
The Rockshaft supports loads with difficulty; there is a rhythmic oscillation when the engine is on; the load descends when the engine is off.	Piston gasket worn. Discharge Valve not adjusted Oil leakage from Safety Valve Oil leakage from Check Valve	Replace the gasket. Adjust the sensitivity of Control Valve or substitute the valve Remove Control Valve and adjust valve Remove the Control Valve and adjust valve
With the arms raised at back stop and with the engine on, we have verified a rhythmic oscillation; with the engine off the load does not lower	Incorrectly adjusted of position control lever which, at maximum raised height, causes the internal automatic back-stop to function	Adjust the position control lever
Working with the draft Control, the implement drops too much or doesn't stay in the groove	Sensitivity of the Control Valve is badly adjusted	Adjust the sensitivity of the Control Valve
The draft control does not function; the rockshaft raises and lowers only with the position lever	Draft control lever is adjusted badly	Adjust the draft control lever
The position control does not function; the rockshaft raises and lowers only with the draft lever	Position control lever is adjusted badly Internal levers damaged	Adjust the position control lever Overhaul the rockshaft
Rockshaft does not lift and the relief valve acts with the possibility to damage the pump	Preselector is fully closed	Unscrew fully the preselector "P"

11. REMOVAL AND REFITMENT OF HYDRAULIC LIFT UNIT



1. Remove rear isolator mounting bolt.
2. Then remove rear platform to front platform bolts.

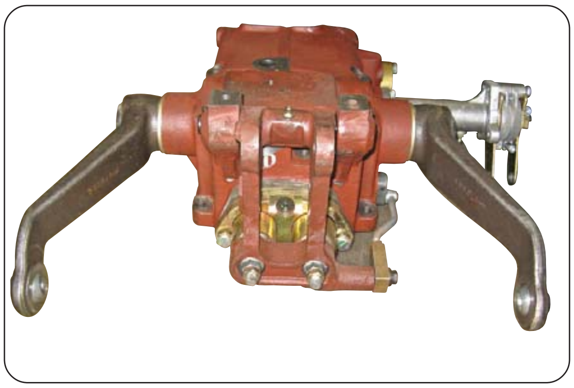
Removing of Control Levers Knob

3. Remove the PC, DC, Range, Speed Lever Knobs and slow fast valve knob.
4. Remove diff. lock pedal.
5. Remove four wheel lever plate.
6. Remove fender to front platform bolts.
7. Remove ROPS connecting plate bolt.
8. Remove wiring connections and dismantle wiring from front platform.
9. Remove gear lever rubber boot and knob.
10. Lift the fender rear platform, sheet assembly.

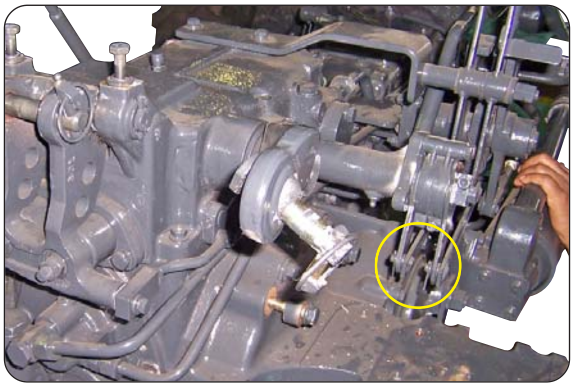
11. Disconnect necessary connections while lifting the assembly.
12. Then first dismantle all hydraulics pipes.
13. Remove hydraulic mounting bolts.

14. Lift the hydraulic unit assembly.
15. Make repairs as necessary.
16. Clean mating surfaces of housing assembly and differential housing using primer.
17. Install hydraulic lift unit using cap screws. Torque the bolt to 41-50 Nm (30-37 lbs.ft)
18. Connect lift unit supply line. Tighten to torque to 60 Nm (45 lbs.ft).
19. Install top link and connect lift links.
20. Follow the reverse sequence of dismantling for assembly.

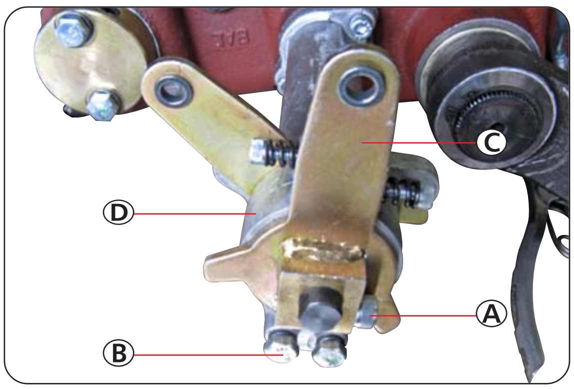
12. REMOVE, INSPECT AND INSTALL HYDRAULIC CONTROL LEVER SUPPORT ASSEMBLY



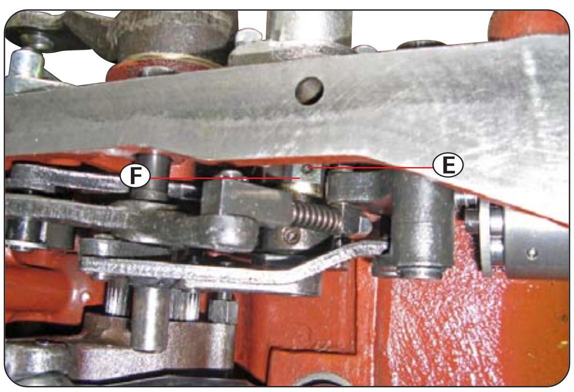
1. Remove Hydraulic Lift Unit as per the guided procedure.



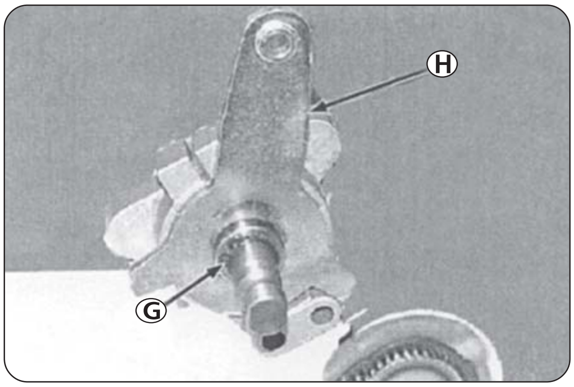
2. Remove position and draft control linkages levers by loosening lock clips and washers.



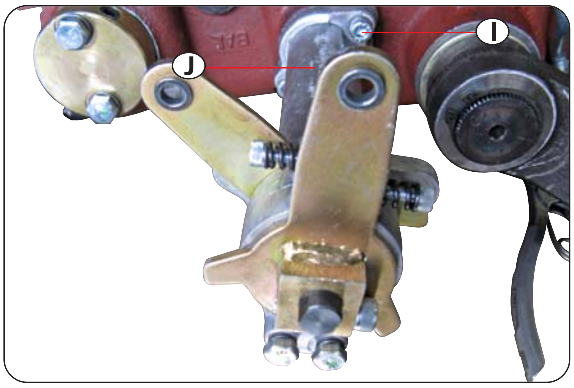
3. Remove socket head screw (A), two cap screw (B), lever position control (C) and hub (D).



4. Loosen set screw (E) in link (F).



5. Remove snap ring (G) and lever draft control (H).



6. Remove support (J) by loosening set screw (I).
7. Loosen socket head screws on clutch hubs and remove clutch hubs and nylon bushings (2 nos).
8. Inspect nylon busing for excessive wear or cracks. Replace as necessary.
9. Clean and inspect all parts for wear or damage. Replace as necessary.

IMPORTANT: Always use new O'rings. Used or damaged O'rings will leak.

Protruding side of clutch hub fits between tabs on control lever.

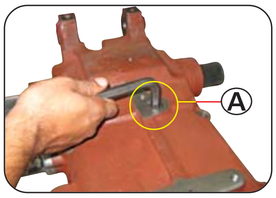
10. Install nylon bushings into clutch hubs and install hubs to control lever and pitman arm. Hand tighten adjusting screw.
11. Install new O'ring onto shaft and apply multipurpose grease on shaft.
12. Install support over shaft and tighten two screw.
13. Install new O'ring on lever draft control.
14. Install lever draft control into support.
15. Install snap ring in groove of shaft.
16. Install hub to lever draft assembly using cap screw.
17. Install lever position control using socket head screw.
18. Install linkages levers to control levers and secure with lock clips.
19. Install lift unit.
20. Adjust hydraulic control lever friction.

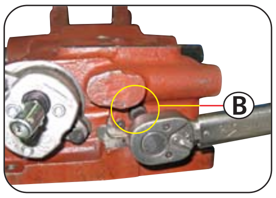
13. REMOVE, INSPECT AND INSTALL HYDRAULIC CONTROL LINKAGES

1. Remove Hydraulic Lift Unit as per the guided procedure.

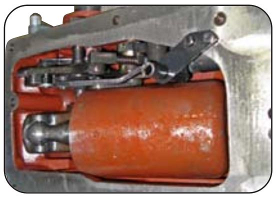
NOTE: To access links inside hydraulic lift assembly, housing lift assembly must be placed upside down.

2. Remove cylinder by loosening two allen set screws (A) & (B).

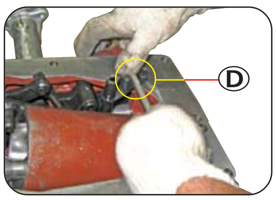


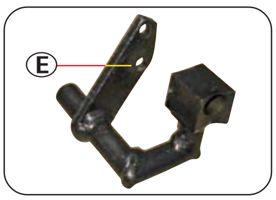


3. Remove cylinder from lift unit.

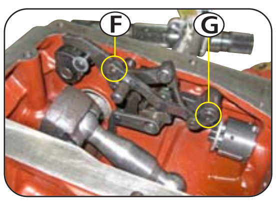


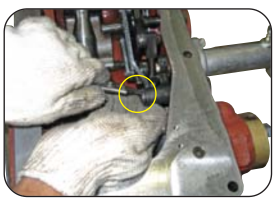
4. Loosen bolts (D) of bracket lubrication (E) and take it out.



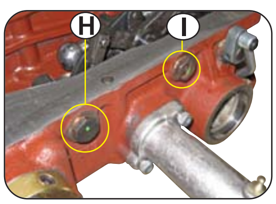


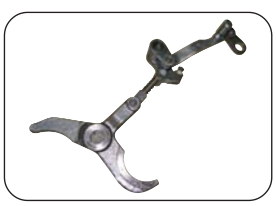
5. Remove snap ring (F) & (G).

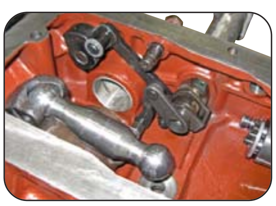


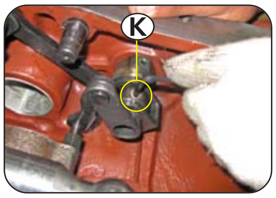


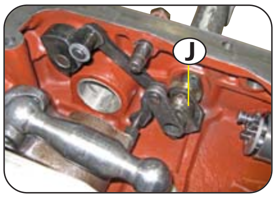
6. Loosen pin (H) & (I) and take out cam, compensator assembly and linkages.



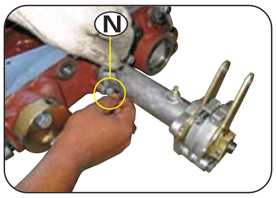


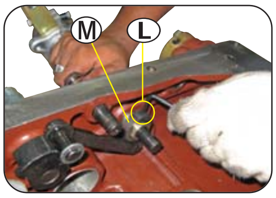




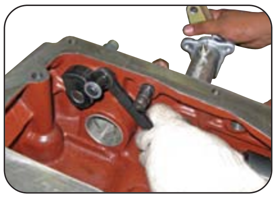


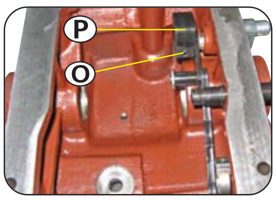
7. Remove cam (J) and allen set screws (k).



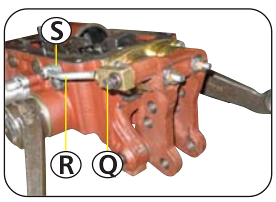


8. Loosen the allen set screw (L) of crank (M) and remove control lever support assembly by loosening bolts (N) and take out control lever support assembly.





9. Remove roll pin (O) of cam (P) and snap ring.



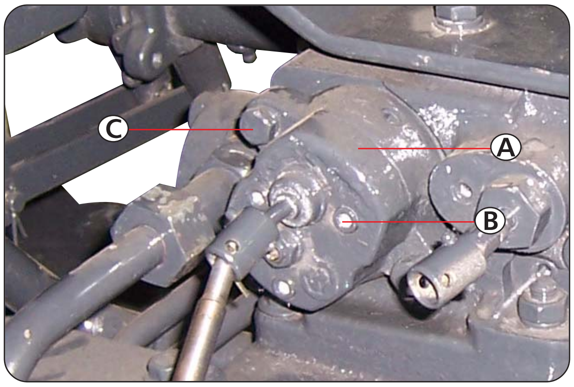
10. Remove capscrew (Q) of tie rod (R) and pin assembly (S).

NOTE: Inspect bushings for wear or damage. Replace as necessary.

11. Reverse the dismantling procedure for assembly and installation.

NOTE: Apply thread sealant to allen set screws during assembly.

12. Adjust hydraulic lift unit position and draft sensing feedback linkages.



14. REMOVE, INSPECT AND INSTALL HYDRAULIC RATE-OF-DROP VALVE

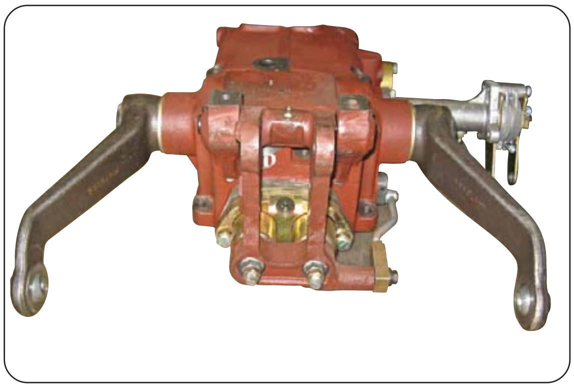
1. Open rate-of-drop valve and lower lift arms completely.
2. Remove seat.
3. Remove cap screws (C) and remove rockshaft control valve (A).
4. Remove three socket head screws (B). Firmly grab tee handle and pull straight out, removing rate-of-drop valve assembly from rockshaft control valve.
5. Install new rate of drop valve and tighten bolts to specified torque 19-29 Nm (14-21 Lb-ft.).
6. Install seat.
7. Operate hydraulic.
8. Fill transmission / hydraulic oil as per the recommended grade and quantity.
9. Adjust hydraulic control valve.

Service Recommendation:

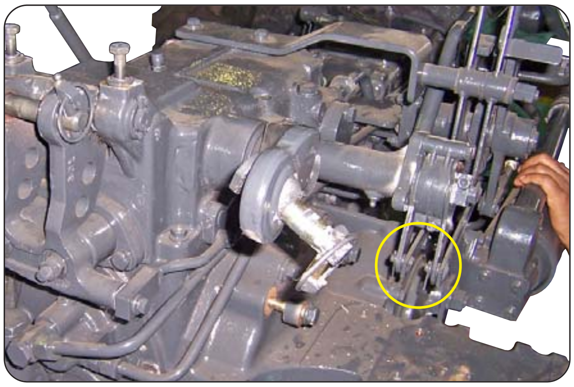
It is not recommended to repair Flow Control Valve. Flow Control Valve should be completely replaced, if internal problem suspected.

NOTE: **Use O'Ring set (Seal kit - contains outer O'Rings of flow control valve) of flow control valve for replacement. Use protective sleeve to install O'Rings on flow control valve.**

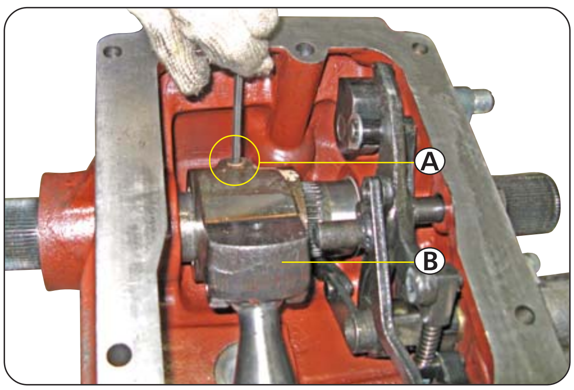
15. REMOVE, INSPECT AND INSTALL HYDRAULIC LIFT ARMS, ROCKSHAFT, ROCKER ARM, SEAL



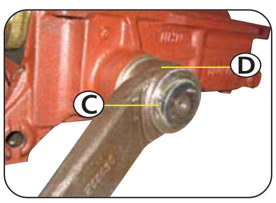
1. Remove Hydraulic Lift Unit as per the guided procedure as given in point no.11.

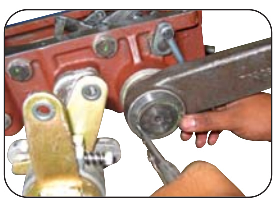


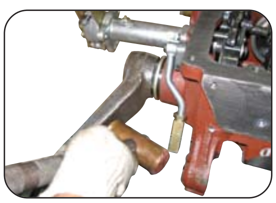
2. Remove position and draft control linkages levers by loosening lock clips and washers.



3. Rotate lift arms to access and remove setscrew (A) in crank (B).



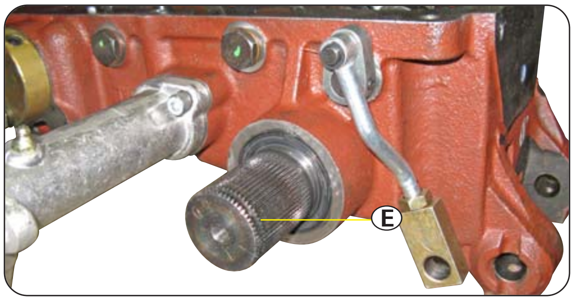




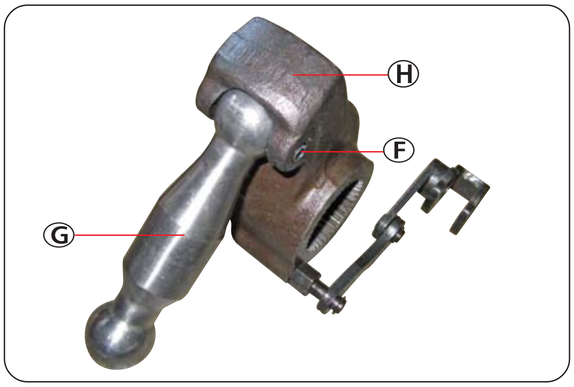
4. Remove snap ring (C) and arm (D) from opposite side of control levers on hydraulic.

NOTE: **Index parts to hydraulic with a punch mark before disassembly, to aid in correct alignment of these parts during assembly.**

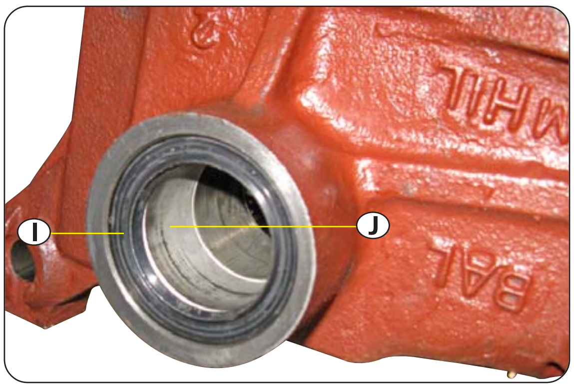
Slightly tap lift arms to take out.



5. Remove shaft (E) from crank and housing.
6. Remove cylinder from lift unit by loosening setscrews.



7. Remove crank and link assembly from control levers linkages. Remove spring pin (F) and link (G) from crank (H).



8. Remove seal (I) and bushing (J) from both side of the housing.

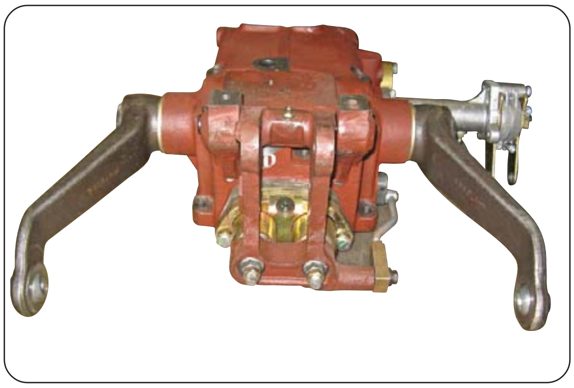
NOTE: **Bushings are a press fit into housing. Remove using a bearing, bushing and seal driver set.**

9. Clean and inspect all parts for wear or damage. Replace as necessary.
10. Install bushing without bushing flush with outer edge of inner bore, using a bearing, bushing and seal driver set.
11. Apply clean transmission / hydraulic oil to all internal parts.
12. Install link to crank with spring pin.
13. Install crank assembly into housing and connect to feedback linkages with lock washer.
14. Install shaft through housing and crank, aligning indexing marks from disassembly.
15. Clean threads of setscrew with cure primer.
16. Apply thread sealant to setscrews, install into crank and tighten.

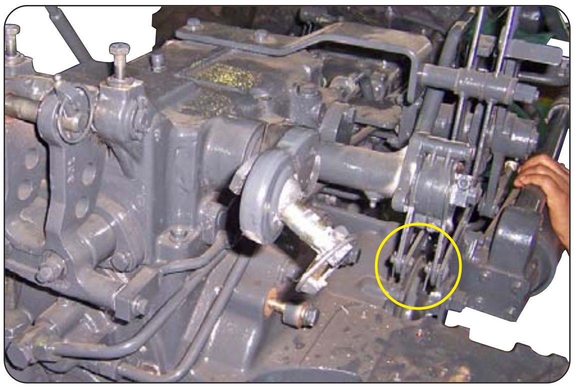
IMPORTANT: **Always use new seals. Old or damaged seals will leak.**

17. Install new seals around shaft.
18. Install washers and arms on shaft, aligning indexing marks from disassembly.
19. Install snap rings.
20. Install hydraulic lift unit.

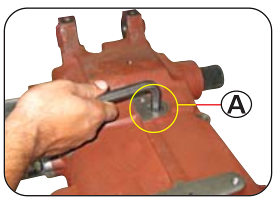
16. REMOVE, INSPECT AND INSTALL HYDRAULIC PISTON AND CYLINDER

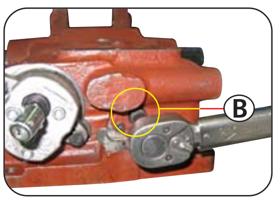


1. Remove Hydraulic Lift Unit as per the guided procedure as given in point no.11.

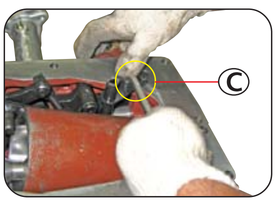


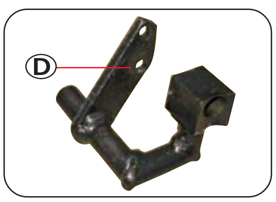
2. Remove position and draft control linkages levers by loosening lock clips and washers.



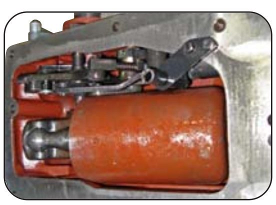


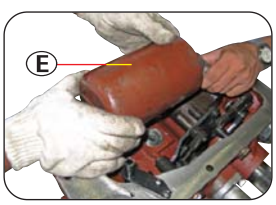
3. Remove two allen screws (A) & (B) to loosen the cylinder.





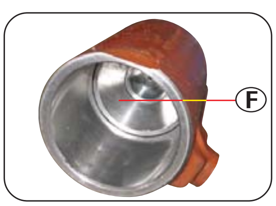
4. Remove bolt (C) of bracket lubrication (D) and take it out.

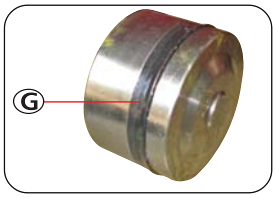




5. Remove cylinder assembly (E).
6. Insert a long wood dowel or brass drift through cylinder opening to remove piston (F).
7. Inspect all part for wear or damage. Check piston and cylinder for cracks or scoring. Replace as necessary.

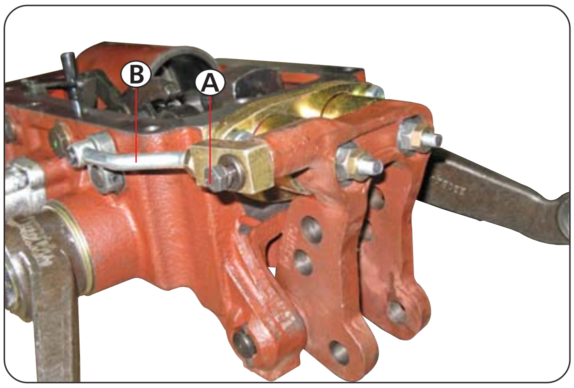
IMPORTANT: Always use new seals. Old or damaged seals will leak.



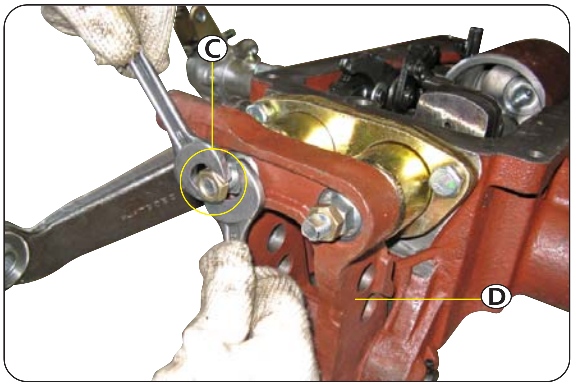


8. Replace seal ring (G) of piston.
9. Apply clean transmission / hydraulic oil to piston and inner walls of cylinder.
10. Install piston with concave end facing opening of cylinder.
11. Apply thread sealant to threads of allen set screws.
12. Install hydraulic lift unit.

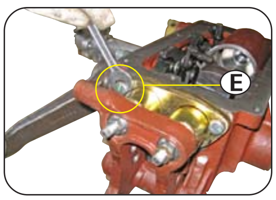
17. REMOVE, INSPECT AND INSTALL TOP LINK BRACKET ASSEMBLY

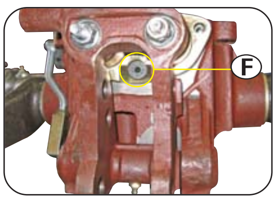


1. Loosen screw (A) of tie rod (B).

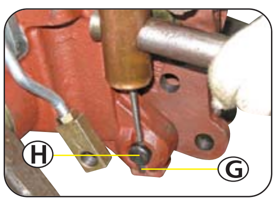


2. Remove nut (C) of top link bracket (D) to separate it.
3. Check top link bracket for any wear or damage. Replace as necessary

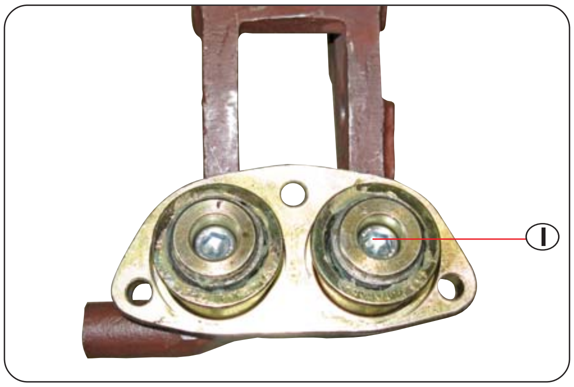




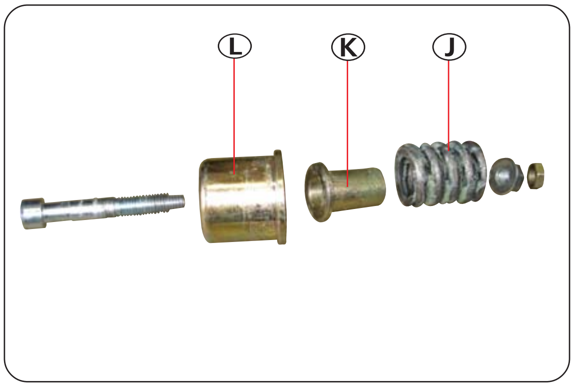
4. To remove top link bracket assembly completely with spring and cover assembly, loosen two screws (E) and one set screw (F).



5. Remove lock roll pin (G) of pin (H) , to take out top link bracket.



6. Remove special allen screw (I) to check spring wear.



7. Check any wear or damage to the spring (J), bush spring guide (K) and cover (L).
8. Install top link bracket assembly to hydraulic lift unit.
9. Apply grease on spring before fitment.
10. After complete assembly, grease through grease nipple provided on control support sleeve and top link bracket.

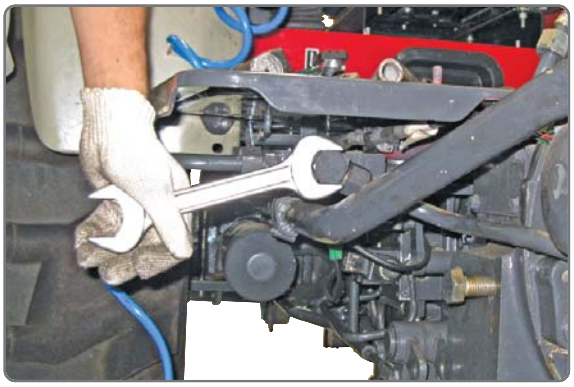
18. REMOVAL & REFITMENT OF RELIEF VALVE ASSEMBLY

Removal

1. Loosen the connections to relief valve as shown in fig. for further replacement.

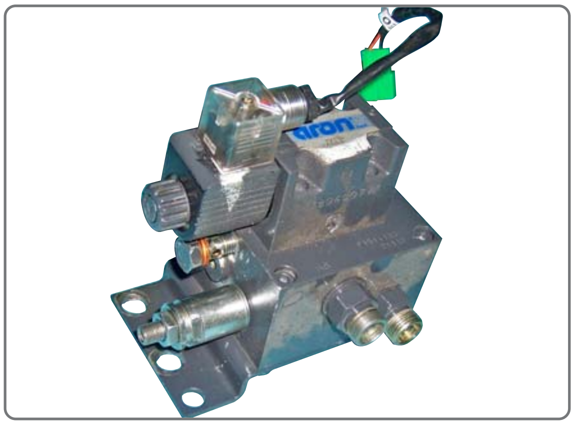
Refitment

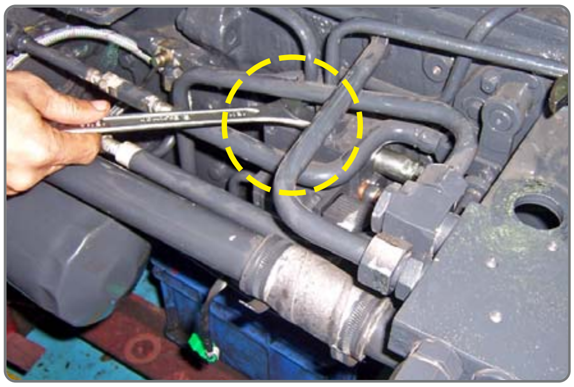
1. Assemble the connections to relief valve.

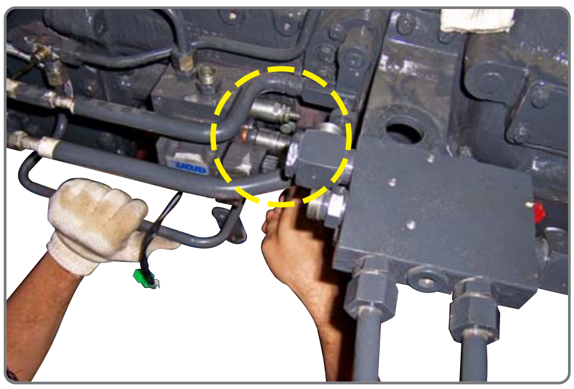


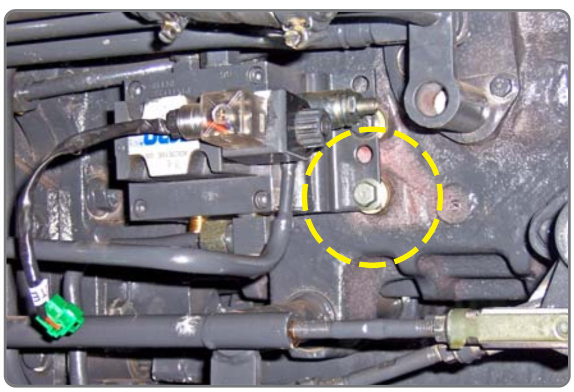
Service Recommendation:

It is not recommended to repair Relief Valve assembly. Relief Valve assembly should be completely replaced, if internal problem suspected.









19. PTO CONTROL VALVE

a. Specification of PTO Control Valve

MAKE	–	ARON
Fluid Temperature	–	- 40°C to 100°C
Pressure	–	16 - 18 bar

b. General Description

This series of tractors is equipped with Hydraulically operated wet PTO clutch which is controlled by PTO control valve mounted on RH side of tractor below platform. Hydraulic power is taken from the return line of steering unit. The PTO control valve provides actuation pressure of 16-18 Bar in 'ON' condition, also it provides lubrication flow to 'WET PTO Clutch', synchroniser and spline shaft.

c. Theory of Operation (Refer Circuit I-4)

When the PTO ON/OFF button is in 'OFF' position all the oil enters through 'P' port and leaves through 'L' port for the lubrication of 'Wet PTO Clutch', synchroniser and spline shaft. Now, when it is put to 'ON' position solenoid gets energised and shifts the spool. This diverts part of oil to the PTO clutch cylinder and hence PTO gets engaged.

d. Removal & Refitment of PTO Control Valve

1. Drain transmission oil completely from the transmission housing by loosening drain plug.
2. Remove PTO pipes connectors and bolts to separate valve.
3. Remove PTO control valve.

Service Recommendation:

It is not recommended to repair PTO Control Valve. PTO Control Valve should be completely replaced, if internal problem is suspected.

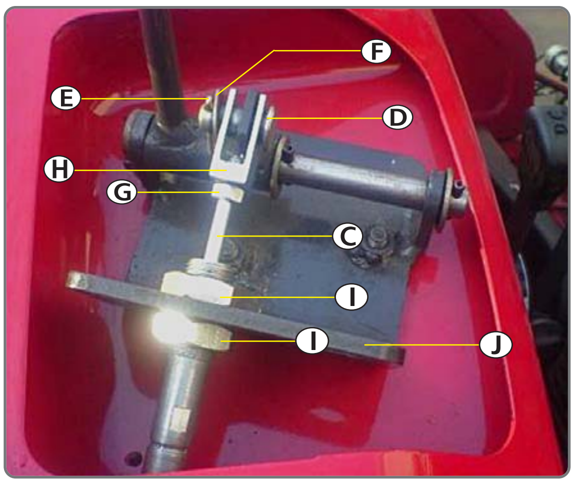
20. AUXILIARY VALVE - SINGLE SPOOL

Auxiliary valve is standard fitment on 5035 and optional fitment on 4535, 4035 & 3535 Tractors.

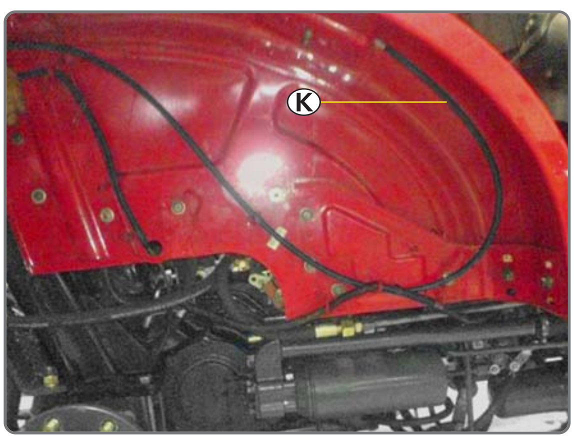
Removal of Single Spool Auxiliary Valve and Pipings

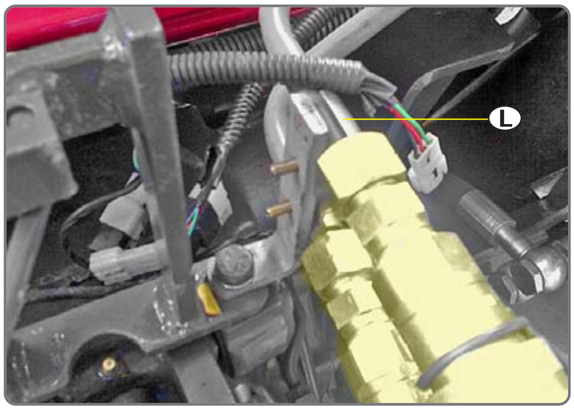
1. Remove right hand side rear wheel assembly.
2. Position rail and jack beneath RH side of the rear axle and jack up the tractor.
3. Remove auxiliary valve knob (A) and then remove auxiliary valve cover (B).

4. Disconnect aux valve inner cable (C) from lever assembly by removing pin (D), cotter pin (E) and washer (F).
5. Loosen the small nut (G) behind the clevis (H) and take out clevis from inner cable. Preserve the clevis safely.
6. Loosen nuts (I) on cable outer and remove cable assembly from bracket auxiliary valve lever mounting (J) and remove cable out of fender assembly.



7. Free the cable assembly (K) from fender guide clip.

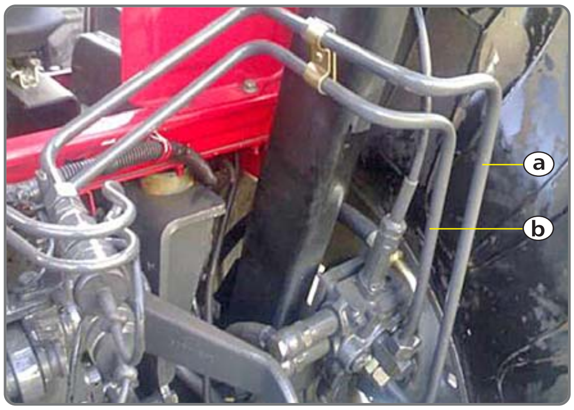




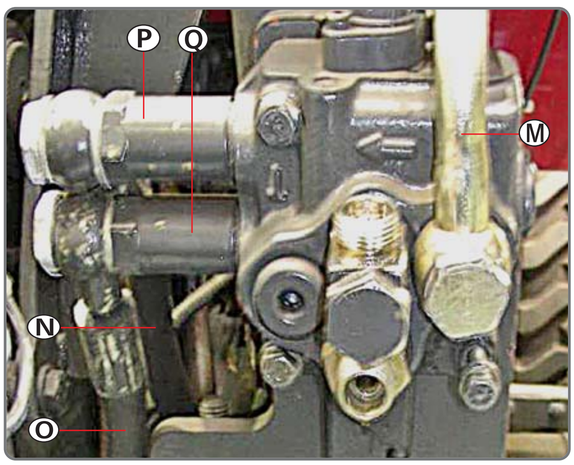
8. Dis-assemble pipe clamps (L) by removing hardware and free the pipes off the bracket.

NOTE: Before removing the pipes and connector, keep an oil collection tray below the auxiliary valve.

After removal of connectors from auxiliary valve, take care to see that open ports of the auxiliary valve are properly plugged.



9. Take out the two pipes (a & b) connected to auxiliary valve ports A1 & B1 by loosening the respective connectors.



10. Remove Hose Auxiliary-valve P Port to Adapter P Port (M) by removing banjo bolt.

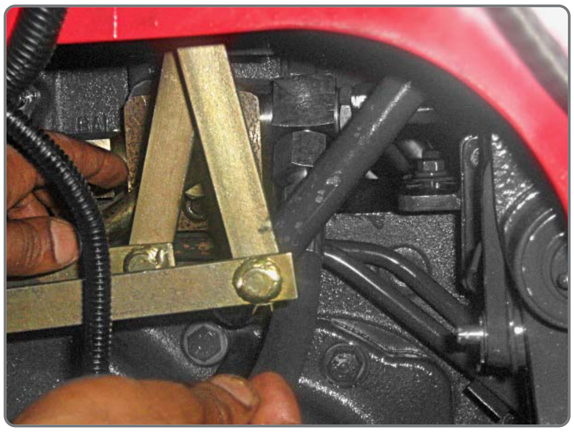
NOTE: After removal of Banjo bolt from auxiliary valve, take care to see the open ports of the auxiliary valve are properly plugged.

11. Disconnect Hose Auxiliary-valve C Port to Adapter V Port (O) & Hose Auxiliary-valve T Port to Adapter T Port (N) by removing banjo bolt from adapter fitted on C & T ports.

12. Loosen adapter (P&Q) from C & T ports and immediately plug the ports. Preserve the adapters and washers.

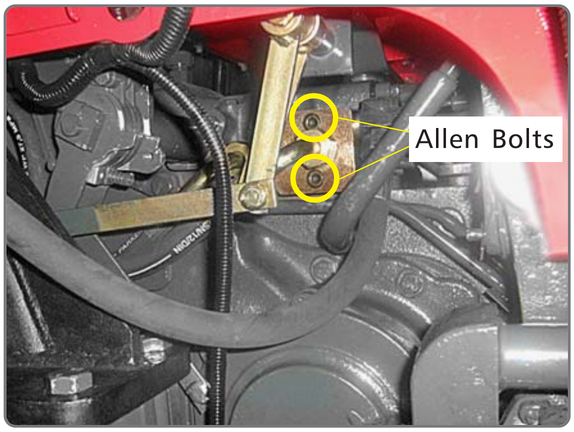
13. At this stage Auxiliary valve can be removed from the mounting bracket for replacement by removing mounting bolts.

NOTE: Do not fit repaired auxiliary valve on the tractor. It is recommended to replace the complete auxiliary valve with cable assembly as a single unit.



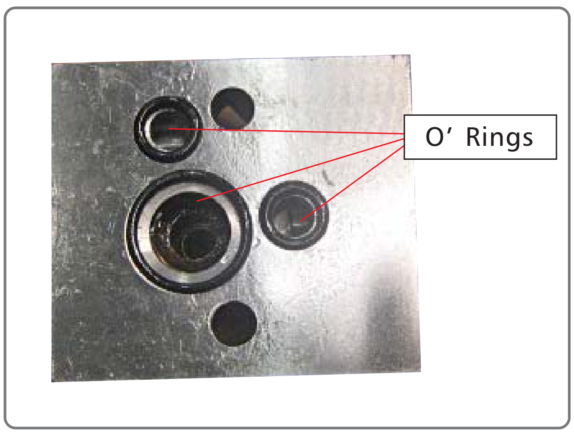
For removal of hoses connecting auxiliary valve to adapter plate & adapter plate from Hydraulic unit follow the procedure mentioned below:

14. Disassemble PC-DC operating links, by removing the cotter pins from PC-DC linkage assembly.



15. Loosen allen bolts and take out adapter plate assembly from the hydraulic lift housing.
16. Loosen banjo bolt & banjo body of the respective hose to remove the hose for checking and further replacement if required.

NOTE: During re-assembly orient the hoses as required such that both the end fitting are assembled and tightened properly.



17. Check the condition of the O'Rings on the adapter plate for damages and replace with new ones if required.

NOTE: O'Rings from closing flange assembly mounted on hydraulic lift housing has been used for adapter plate. For ordering new O'Rings refer parts catalogue page of hydraulic lift housing

Refitment of Single Spool Auxiliary Valve and Pipings

For refitment of Auxiliary Valve and piping follow disassembly procedure in reverse sequence.

Group-J

Cut-Section Charts

Engine

Mahindra Tractors
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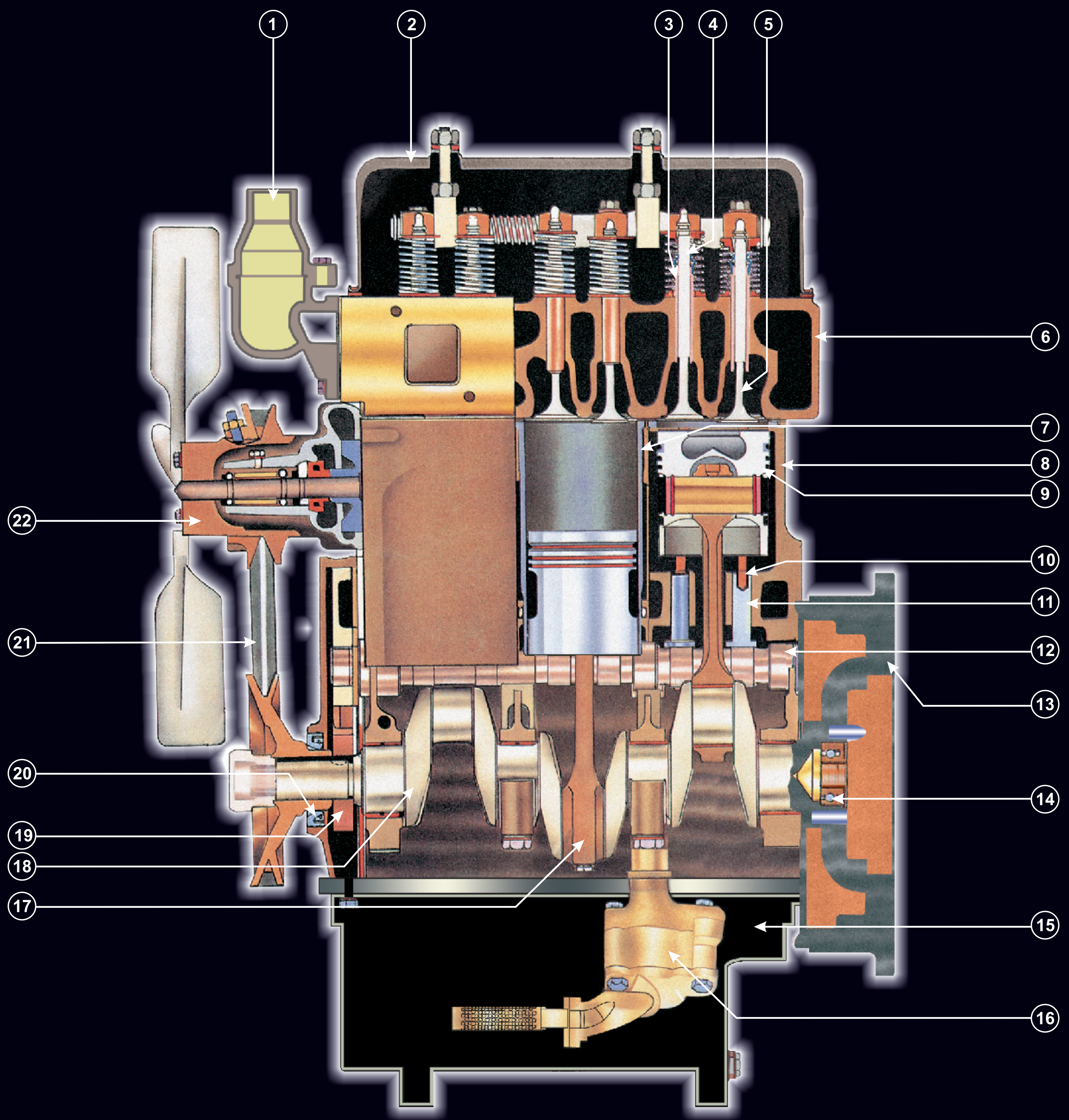
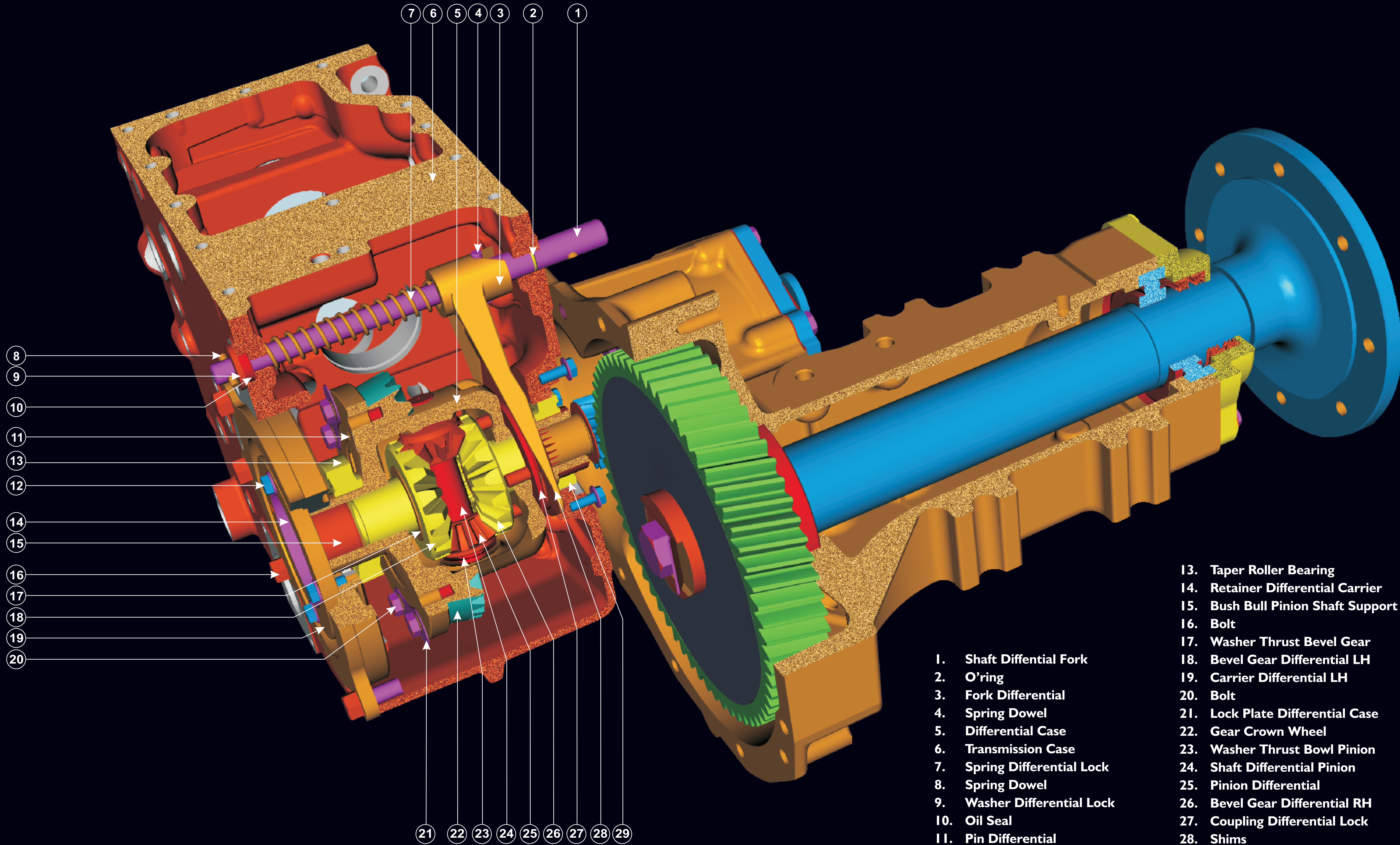


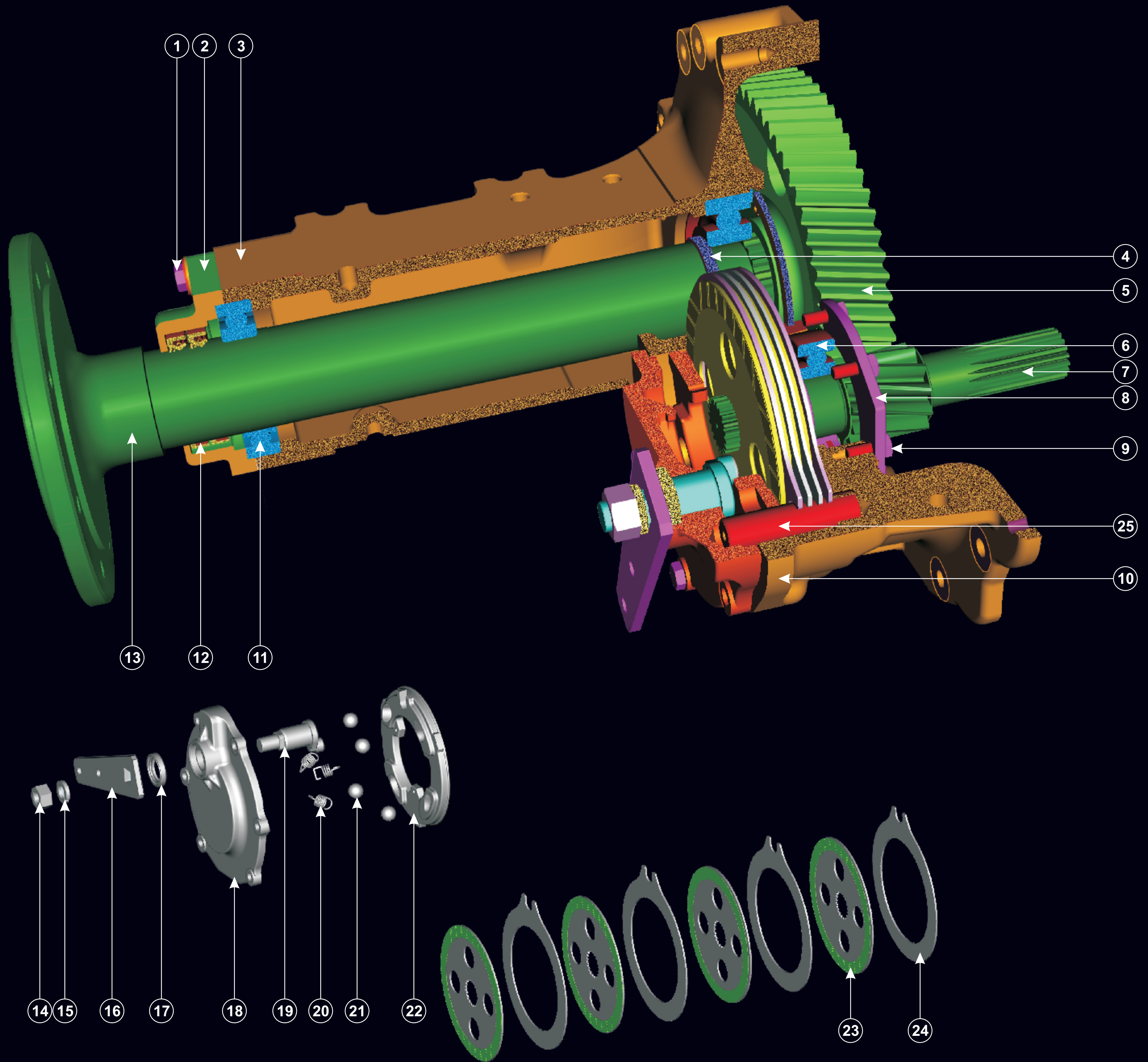
1. Thermostat
2. Valve Housing Cover
3. Valve Seal
4. Exhaust Valve
5. Intake Valve
6. Cylinder Head
7. Cylinder Sleeve
8. Crankcase
9. Piston
10. Push Rod
11. Valve Tappet
12. Camshaft
13. Flywheel
14. Clutch Shaft Pilot Bearing
15. Crankcase Oil Pan
16. Lubrication Oil Pump
17. Connecting Rod
18. Crankshaft
19. Crankshaft Gear
20. Crankshaft Front Oil Seal
21. Fan Belt
22. Water Pump Assembly

Differential Assembly & Rear Axle



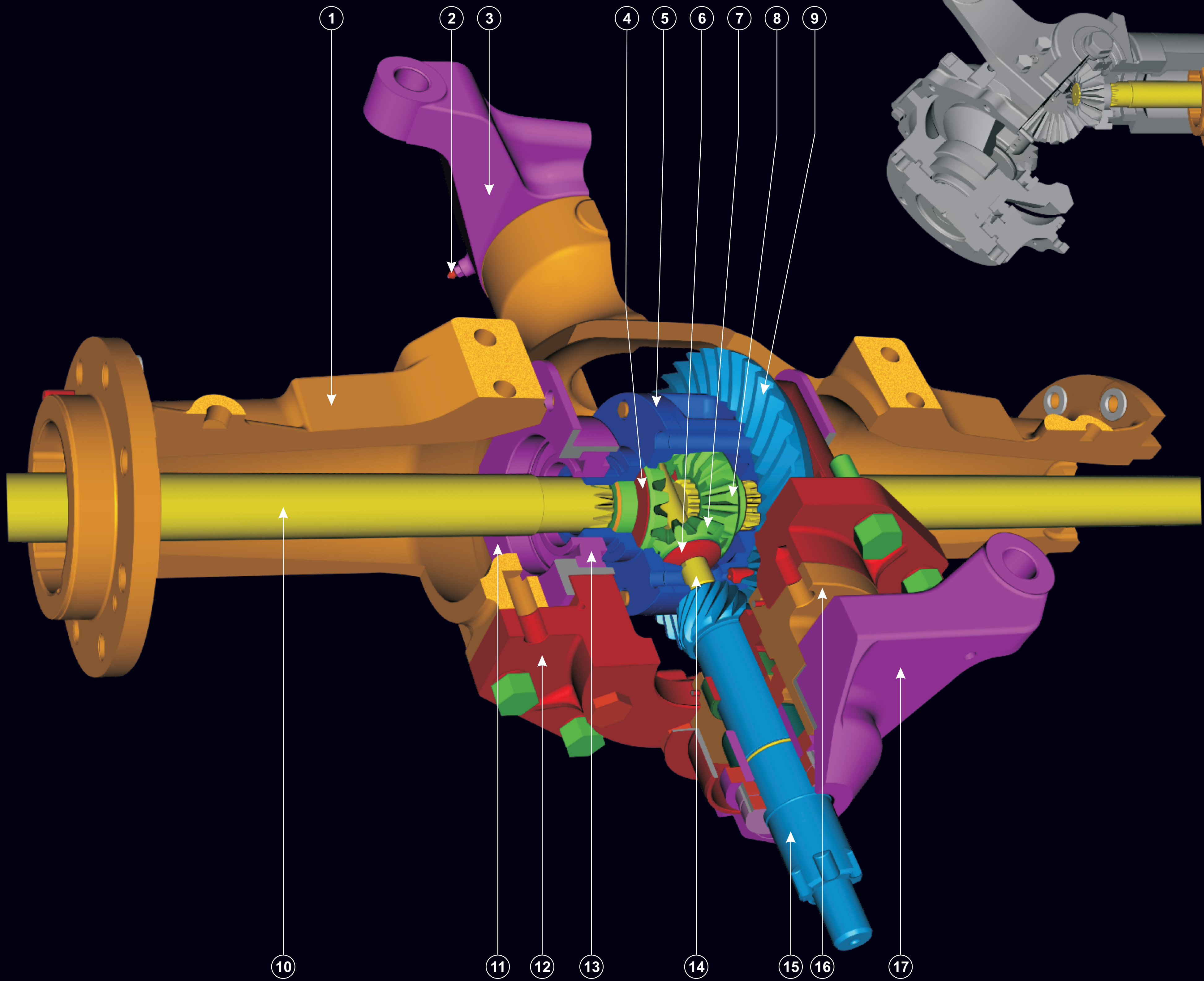
1. Shaft Differential Fork
2. O'ring
3. Fork Differential
4. Spring Dowel
5. Differential Case
6. Transmission Case
7. Spring Differential Lock
8. Spring Dowel
9. Washer Differential Lock
10. Oil Seal
11. Pin Differential
12. Flange Bolt
13. Taper Roller Bearing
14. Retainer Differential Carrier
15. Bush Bull Pinion Shaft Support
16. Bolt
17. Washer Thrust Bevel Gear
18. Bevel Gear Differential LH
19. Carrier Differential LH
20. Bolt
21. Lock Plate Differential Case
22. Gear Crown Wheel
23. Washer Thrust Bowl Pinion
24. Shaft Differential Pinion
25. Pinion Differential
26. Bevel Gear Differential RH
27. Coupling Differential Lock
28. Shims
29. Taper Roller Bearing

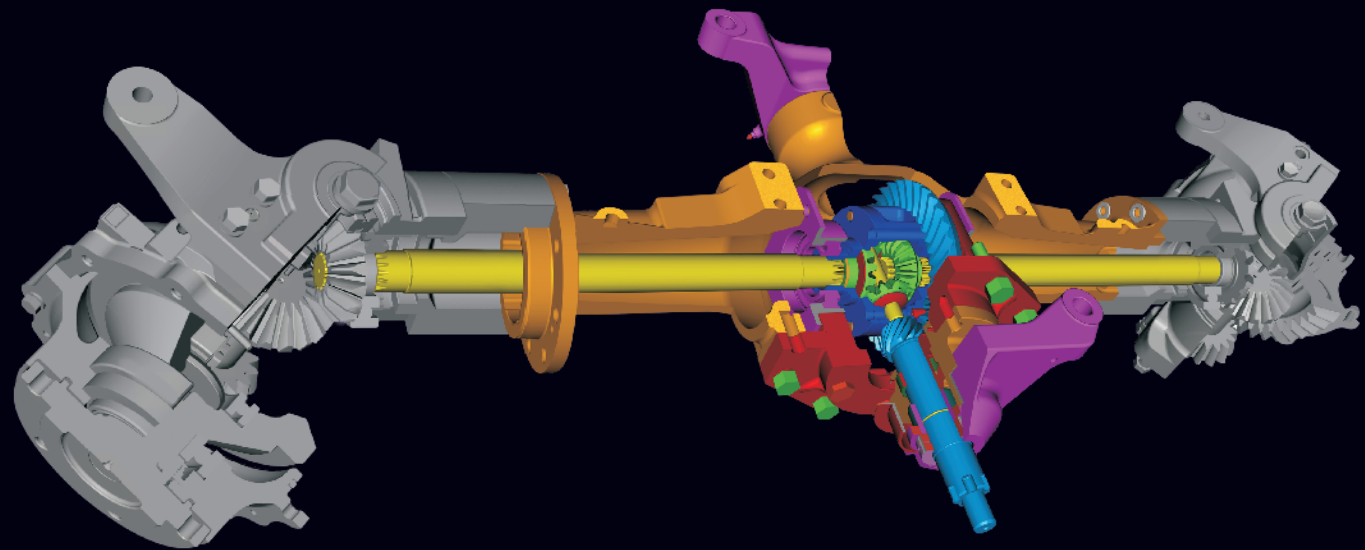
Rear Axle Carrier and Brake Assembly



1. Flange Bolt
2. Case, Oil Seal Retainer
3. Rear Axle Carrier
4. Collar
5. Bull Gear
6. Ball Bearing
7. Bull Pinion Shaft
8. Bearing Retainer
9. Bolt M8 x 20
10. Brake Assembly
11. Bearing
12. Oil Seal
13. Rear Axle
14. Nut
15. Spring Washer
16. Brake Lever
17. Oil Seal
18. Brake Cover
19. Brake Cam
20. Spring
21. Steel Ball
22. Brake Plate
23. Brake Disc
24. Steel Plate
25. Brake Pin

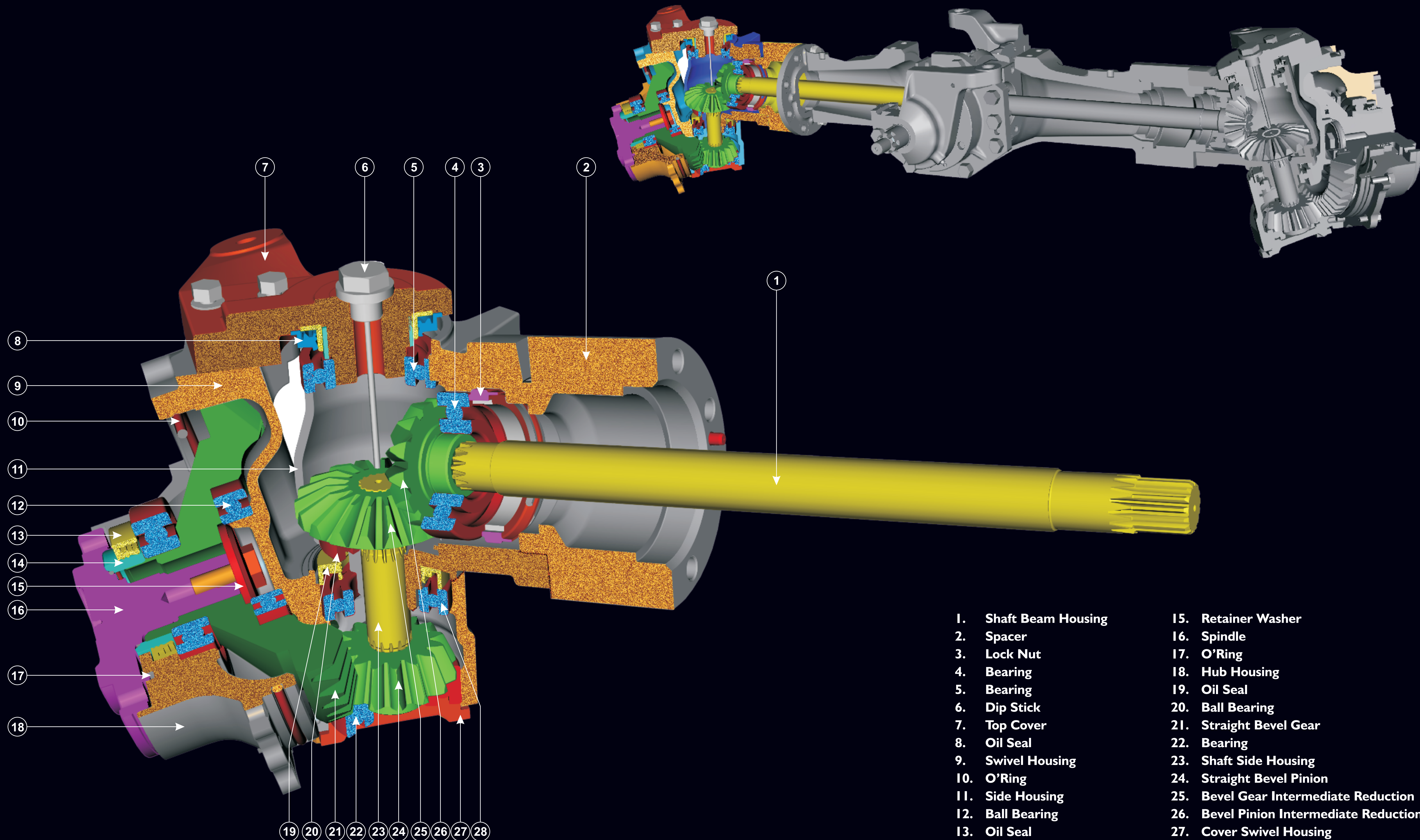
Front Axle - Differential





1. Beam Housing
2. Grease Nipple
3. Pillow Block Front
4. Thrust Washer
5. Differential Case
6. Thrust Washer
7. Bevel Pinion Differential
8. Bevel Gear Differential
9. Ring Gear
10. Shaft Beam Housing
11. Bearing Carrier
12. Housing Differential Carrier
13. Taper Roller Bearing
14. Shaft Differential Pinion
15. Spiral Bevel Pinion
16. Housing Input Shaft
17. Pillow Block Rear

Front Axle - Side Section



1. Shaft Beam Housing
2. Spacer
3. Lock Nut
4. Bearing
5. Bearing
6. Dip Stick
7. Top Cover
8. Oil Seal
9. Swivel Housing
10. O'Ring
11. Side Housing
12. Ball Bearing
13. Oil Seal
14. Collar
15. Retainer Washer
16. Spindle
17. O'Ring
18. Hub Housing
19. Oil Seal
20. Ball Bearing
21. Straight Bevel Gear
22. Bearing
23. Shaft Side Housing
24. Straight Bevel Pinion
25. Bevel Gear Intermediate Reduction
26. Bevel Pinion Intermediate Reduction
27. Cover Swivel Housing
28. Ball Bearing

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Speed Section - Transmission

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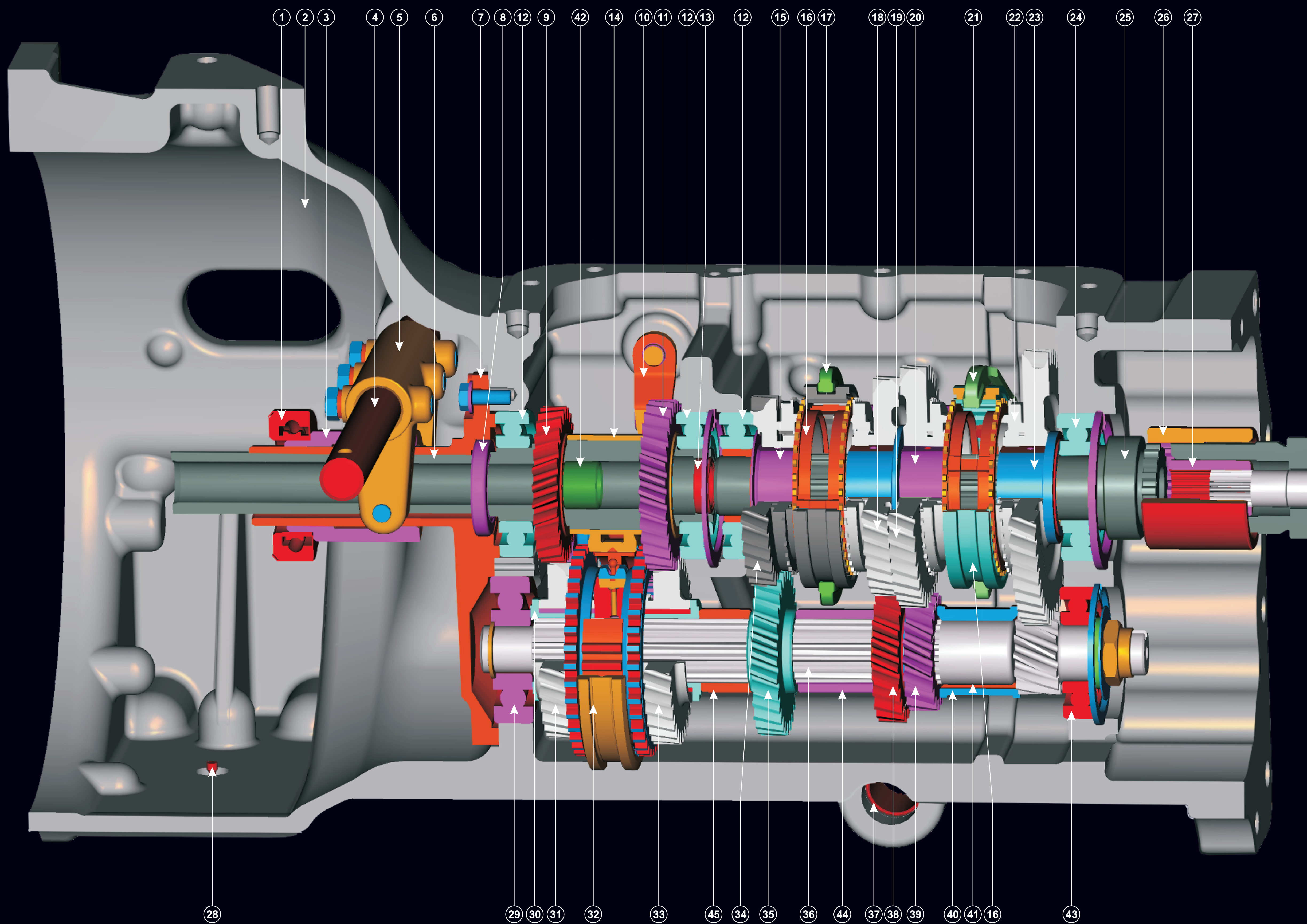
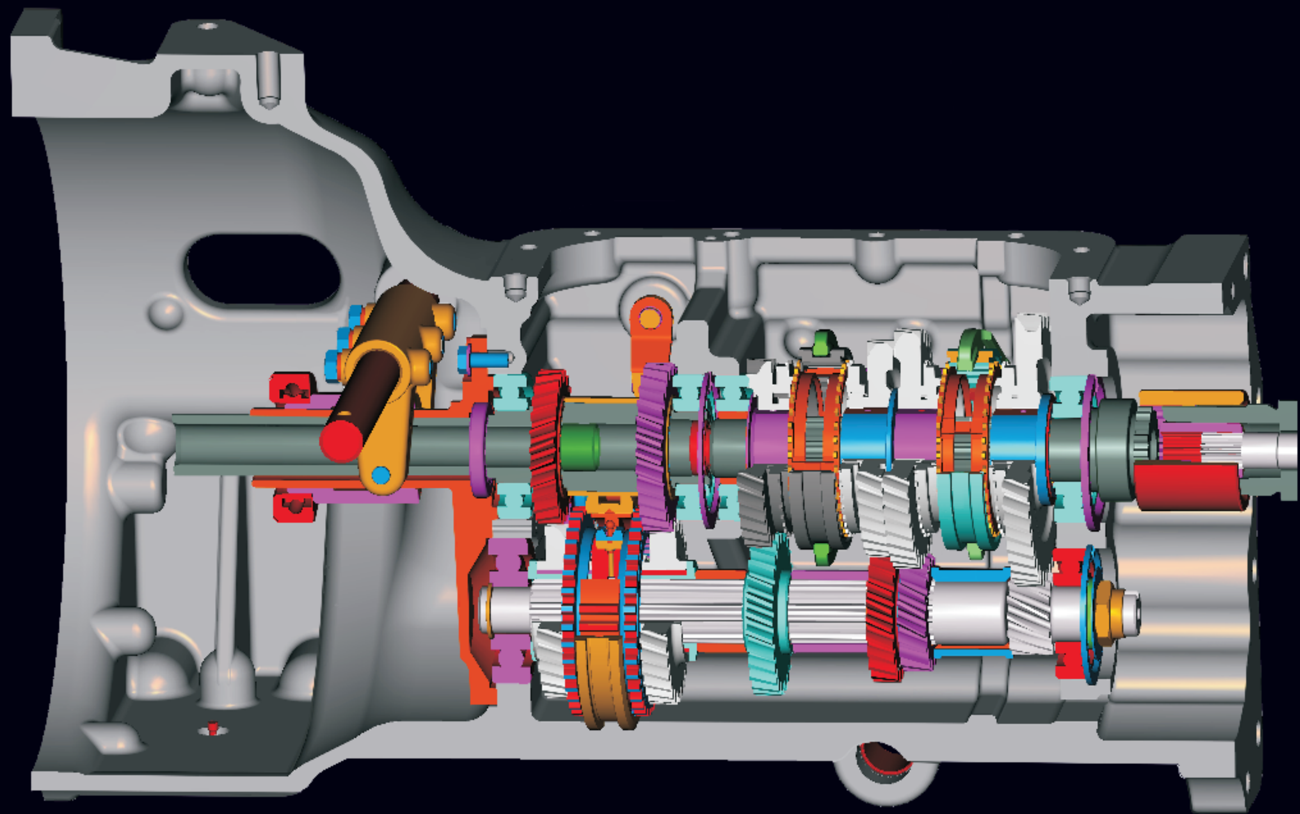
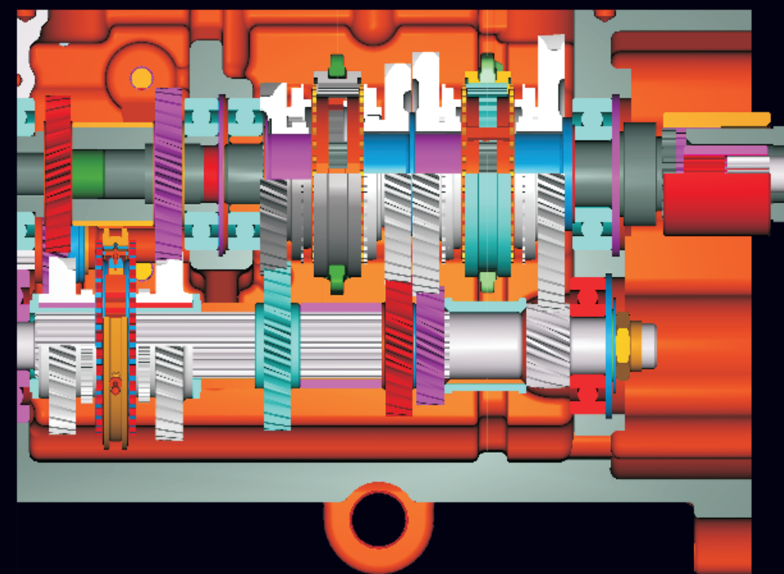


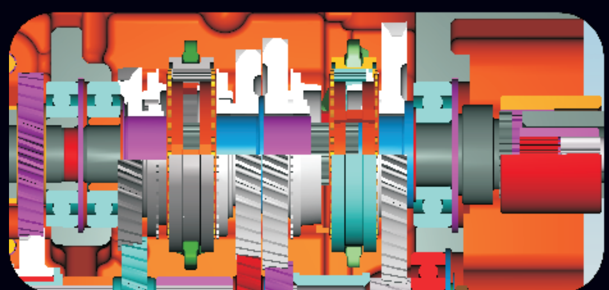
1. Clutch Release Bearing
2. Clutch Housing
3. Sleeve Clutch Release
4. Shaft Clutch Release
5. Fork Clutch Release
6. Main Hollow Drive Shaft Shuttle
7. Retainer Main Drive Shaft
8. Oil Seal
9. Gear Reverse Driving
10. Lever Speed
11. Gear Forward Driving
12. Bearing 6208
13. Oil Seal
14. Spacer
15. Bush 4th Gear
16. Synchro Nizer
17. Fork 3rd-4th Speed
18. Gear 3rd Driven
19. Gear 2nd Driven
20. Bush 2nd-3rd
21. Fork 1st-2nd Speed
22. Gear 1st Driven
23. Bush 1st Gear (Graded)
24. Bearing 6307
25. Main Top Shaft Speed Section
26. Coupling Speed & Range
27. Coupling Speed & PTO
28. Breather
29. Bearing 6405
30. Bush Forward / Reverse
31. Gear Reverse Driven
32. Forward / Reverse Synchronizer
33. Gear Forward Driven
34. Gear 4th Driven
35. Gear 4th Driving
36. Counter Shaft
37. Bush
38. Gear 3rd Driving
39. Gear 2nd Driving
40. Bush
41. Woodruff Key
42. Bush
43. Bearing 6306
44. Spacer Rear
45. Spacer Front

Speed Section - Transmission

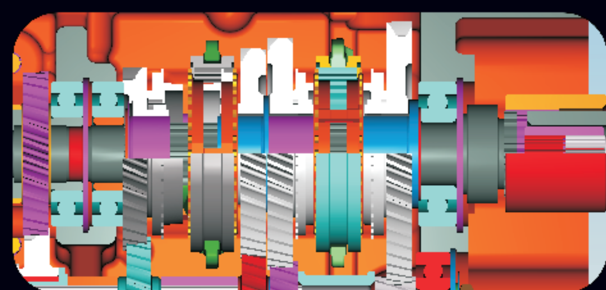




Neutral

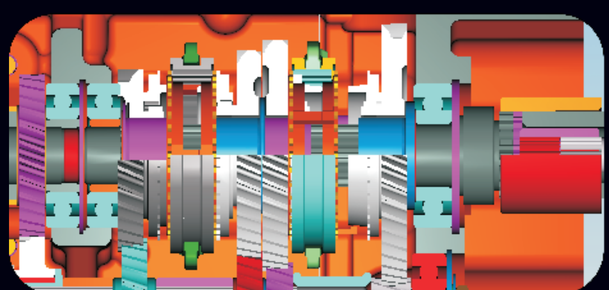


Speed 1

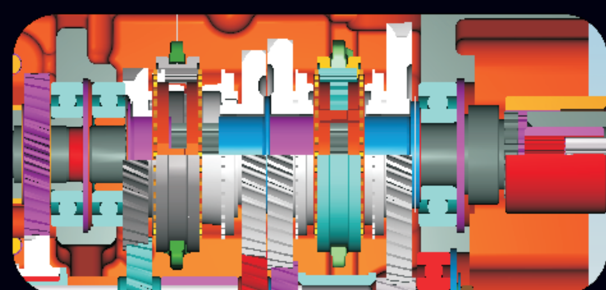


Speed 3

Forward Engaged



Speed 2



Speed 4

Reverse Engaged

Range Section - Transmission

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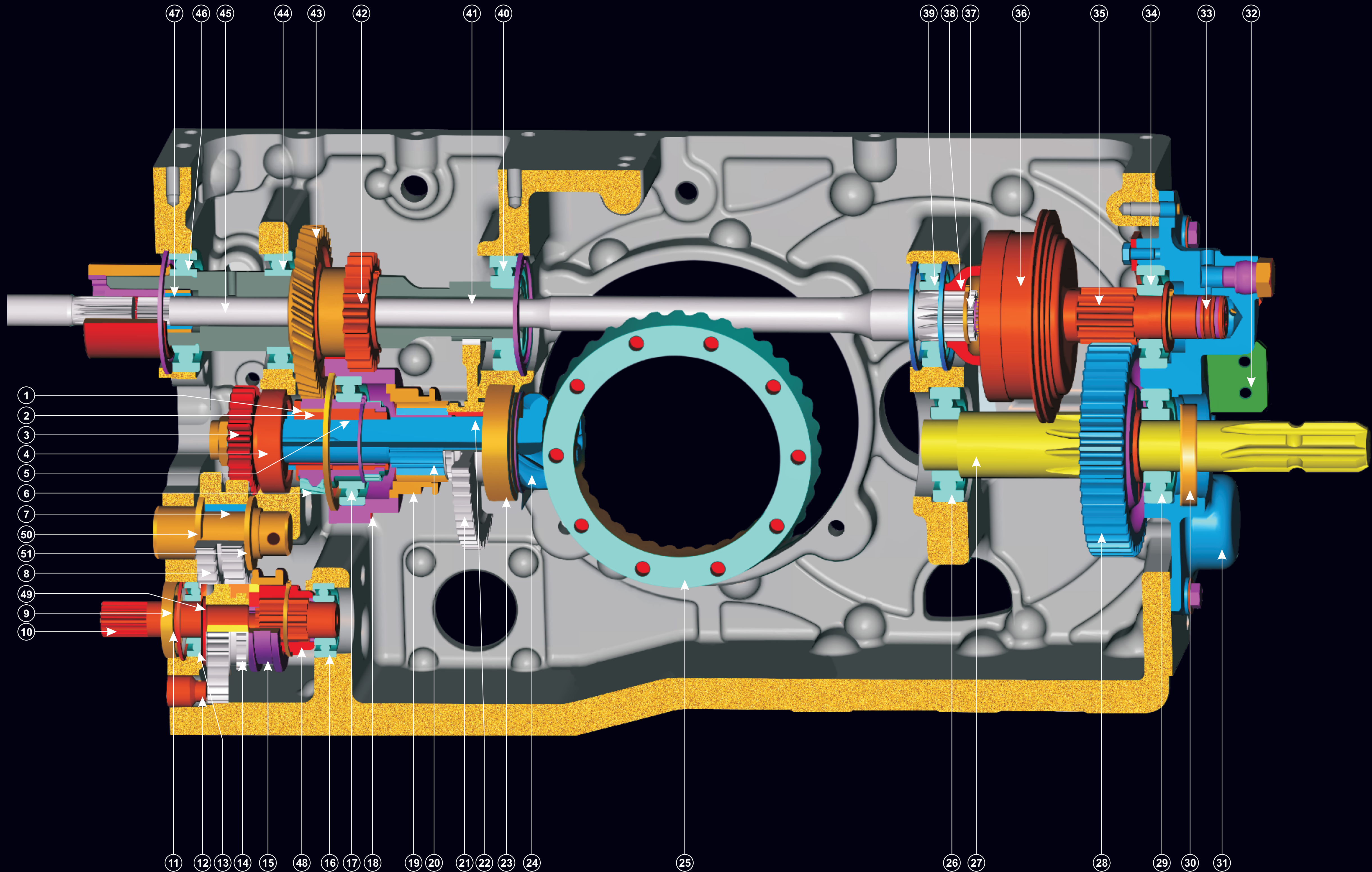
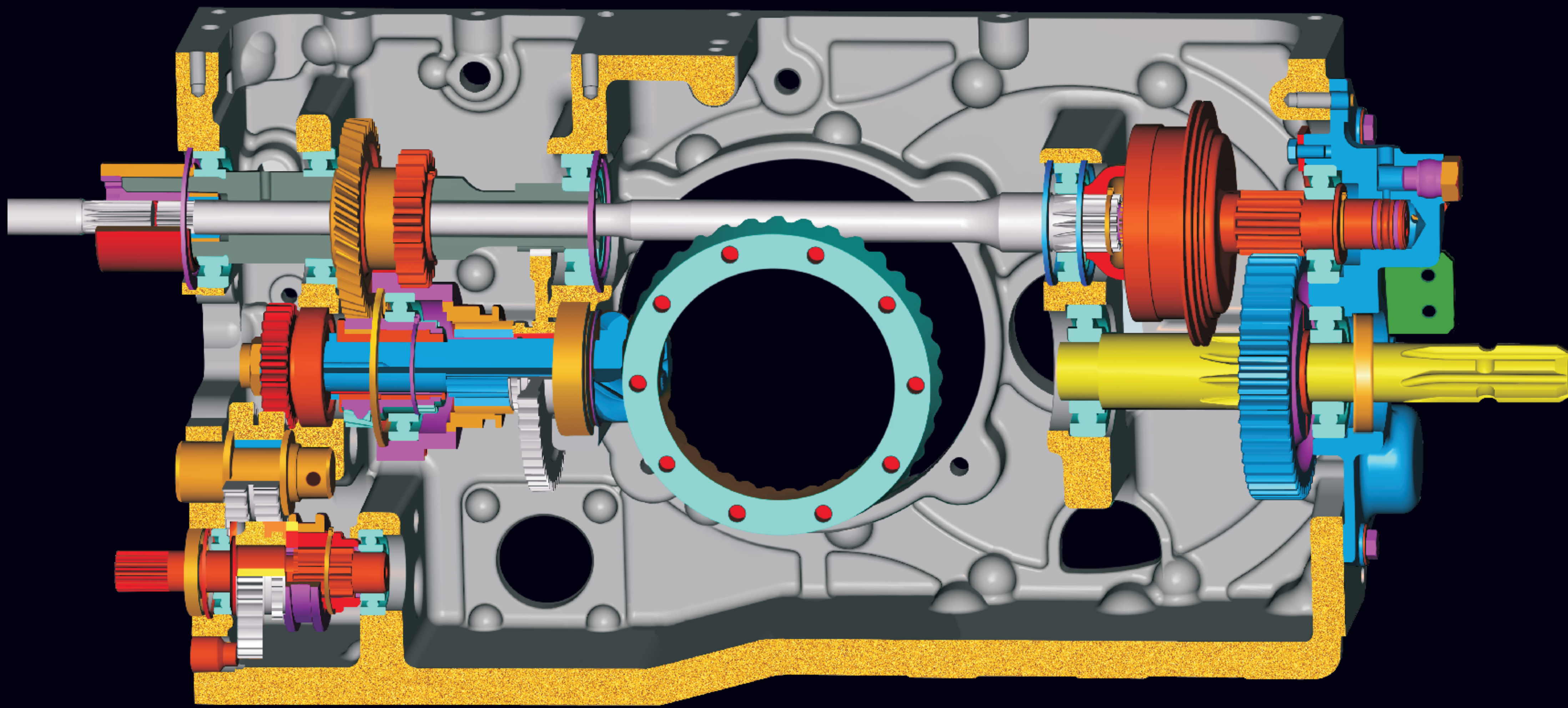
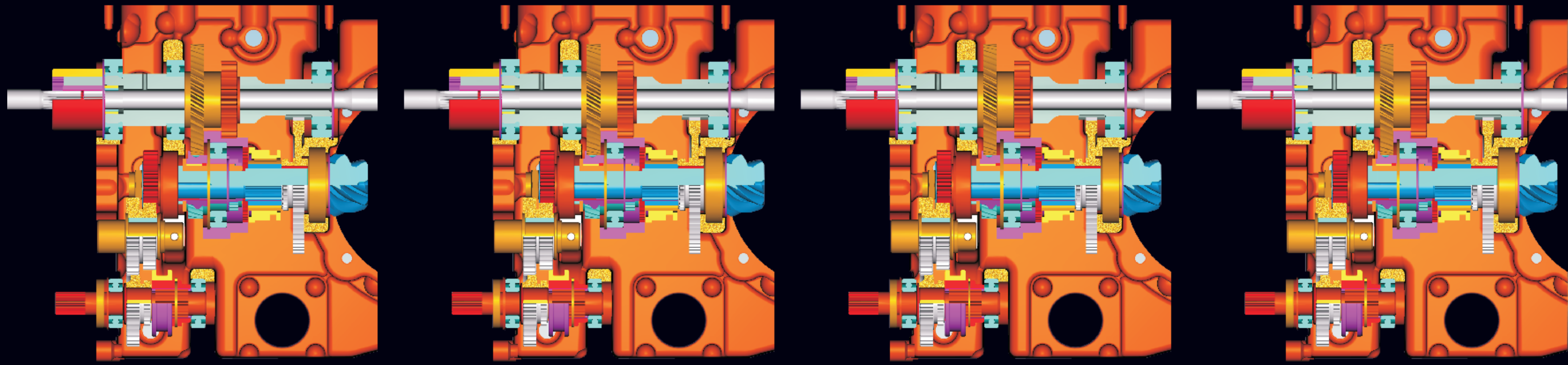


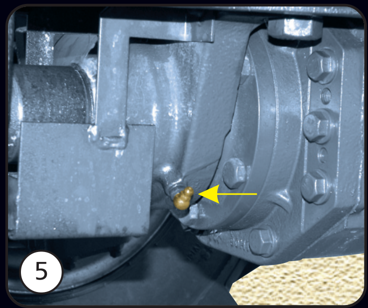
1. Bush High Driven Gear
2. Needle Roller Bearing
3. Gear Spline Shaft
4. Taper Roller Bearing
5. Needle Roller Bearing
6. Gear High Driven
7. Needle Roller Bearing
8. Gear 4WD Idler
9. Oil Seal
10. Shaft 4WD Output
11. Oil Seal
12. Drain Plug
13. Bearing 6205
14. Gear 4WD Output
15. Coupling
16. Bearing 6205
17. Bearing 6011
18. Gear Medium Driven
19. Sleeve
20. Splined Collar
21. Low Driven Gear
22. Bush Low Gear
23. Taper Roller Bearing
24. Spline Shaft
25. Ring Gear
26. Bearing 6307
27. Shaft PTO Output
28. Gear Rear PTO
29. Bearing 6307
30. Oil Seal
31. Rear Cover
32. Bracket PT Shield Mounting
33. PTFE Seal
34. Bearing 6306
35. Shaft PTO Input
36. Wet Clutch
37. O'Ring
38. Hub PTO Clutch
39. Bearing 6207
40. Bearing 6307
41. Range Driving Shaft
42. Gear Medium Driving
43. Gear High Driving
44. Bearing 6010
45. PTO Intermediate Shaft
46. Bearing 6010
47. Needle Roller Bearing
48. Collar
49. Washer
50. Washer Front
51. Washer Rear

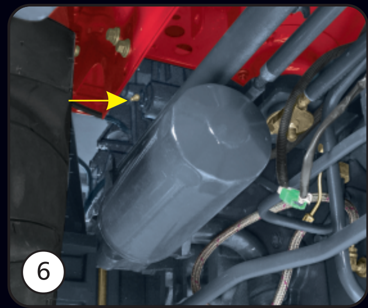
Range Section - Transmission

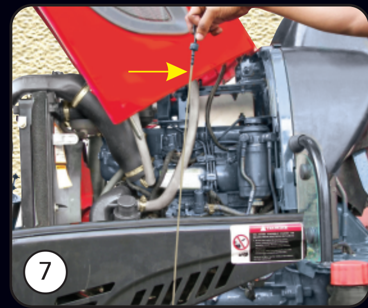


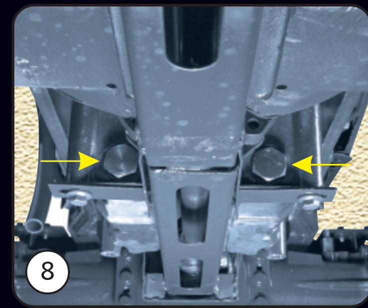


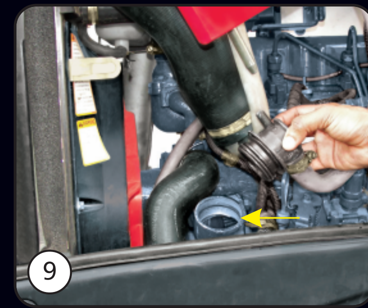
Lubrication & Greasing Chart - 35 Series

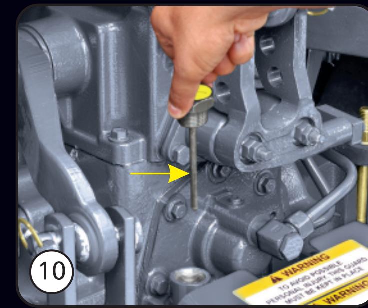


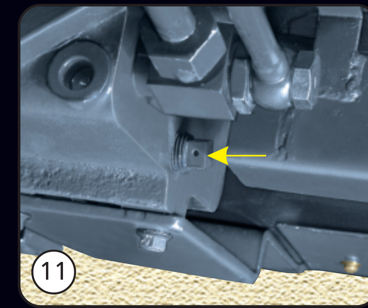


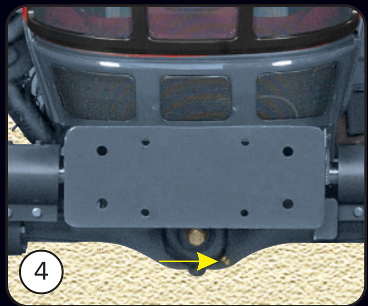


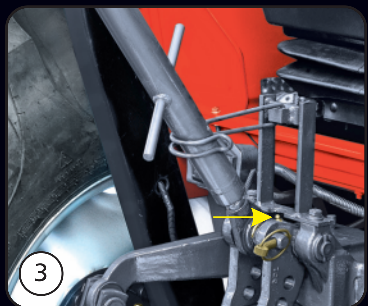


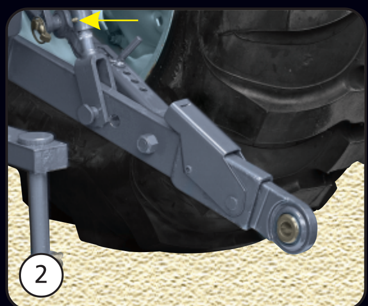


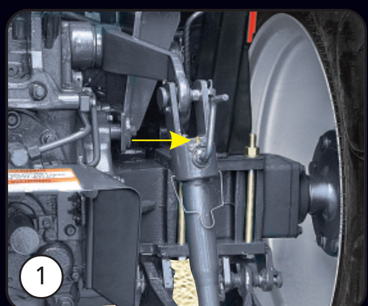


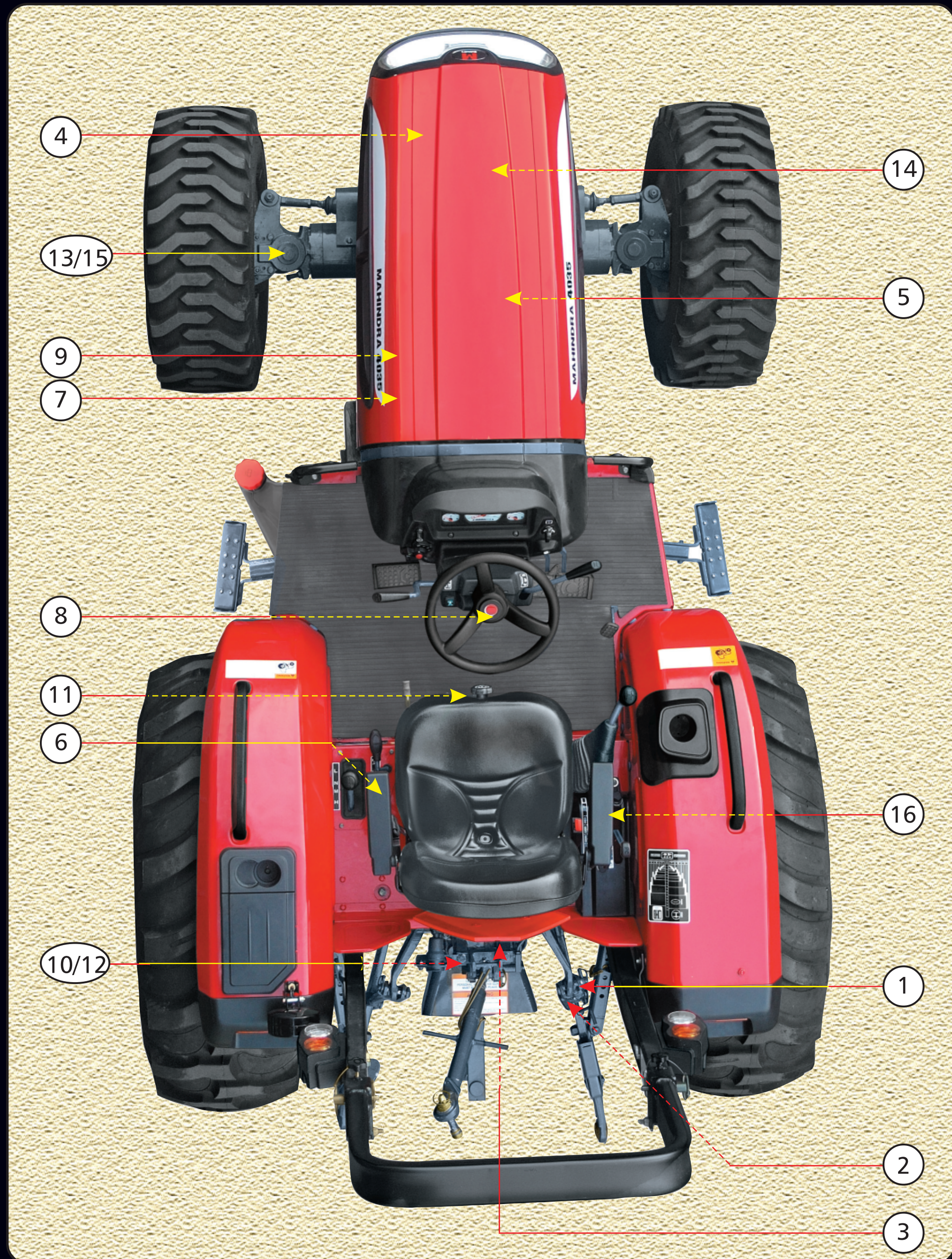












No.	Description	Lubricant
1	Lift Rod RH	CG
2	Levelling Rod RH	CG
3	Pin Pivot Sensing Bracket	CG
4	Front Pillow Block	CG
5	Rear Pillow Block	CG
6	Speed Shift Mounting Bracket	CG
7	Engine Oil Level Check	EO
8	Engine Oil Drain Plug	EO
9	Engine Oil Filling Port	EO
10	Trans/Hydraulic Oil Level Check	GO
11	Trans/Hydraulic Oil Drain Plug	GO
12	Trans/Hydraulic Oil Filling Port	GO
13	Front Axle Oil Level Check	FO
14	Front Axle Oil Drain Plug	FO
15	Front Axle Oil Filling Port	FO
16	Quadrant Linkages Shaft Hyd.	CG