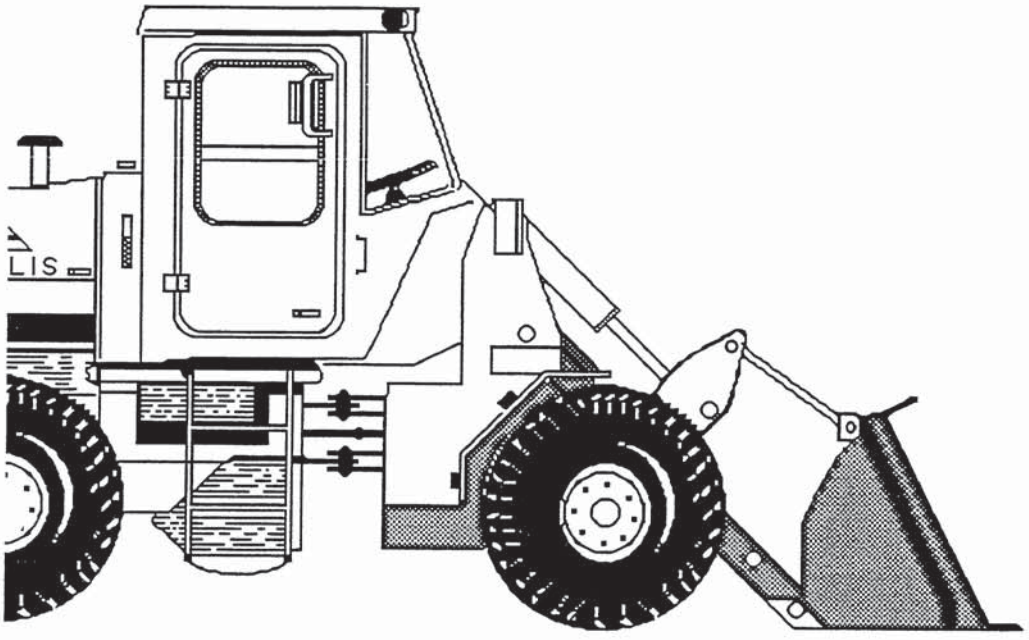
FIATALLIS®

FR7, FR9, FR10
FR12, FR15

WHEEL LOADER

AXLES

SERVICE MANUAL



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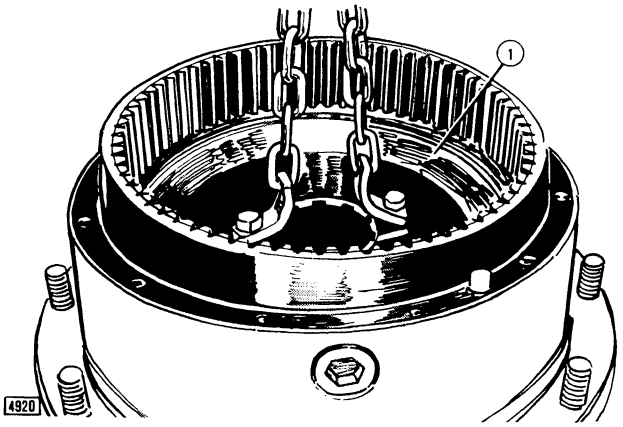


Fig. 8.8 - Lifting out internally toothed drum (1)

– Using a sling chain and screws (two off, size 12 x 1.25 mm) as shown in Fig. 8.8, lift out drum (1).

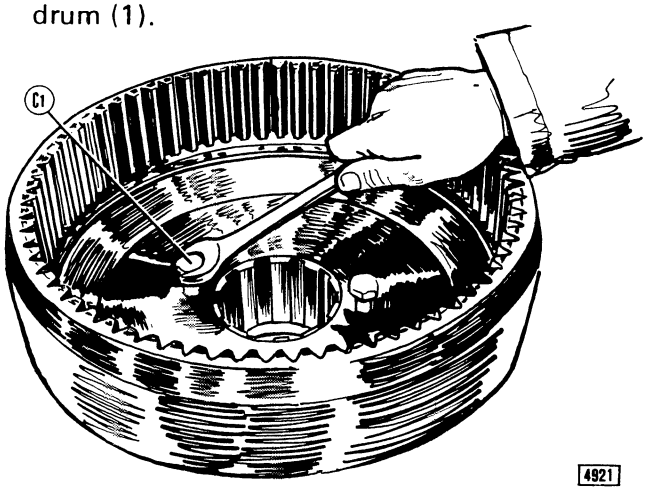


Fig. 8,9 - Wheel hub bearing inner ring removal

C_1. Puller screws.

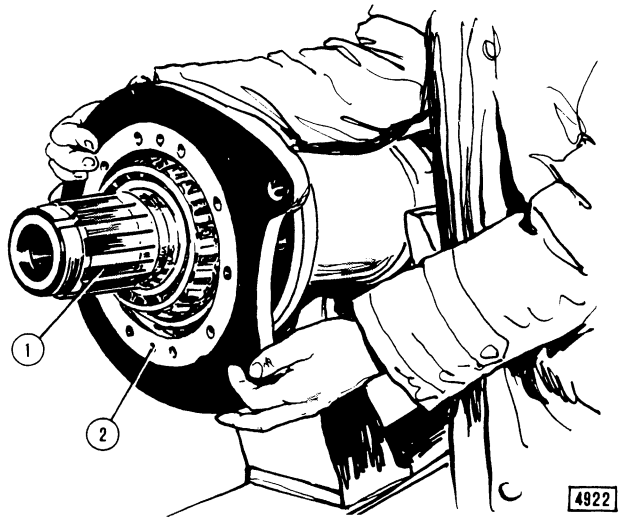


Fig. 8.10 - Removal of brake caliper holder plate (2) from wheel hub (1)

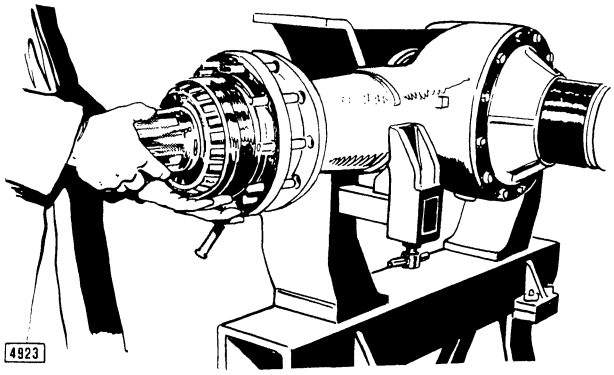


Fig. 8.11 - Removal of wheel hub from axle housing

– Undo the chain and using the same two screws pull out the inner ring of bearing (7) Fig. 8.2 as shown in Fig. 8.9.

– Unscrew the brake caliper holder plate nuts.

– Unscrew hub to axle housing nuts and remove hub.

Check axle shaft bushings for good condition. Bushings need replacement when found to be ovalized or excessively worn (New bushing specified I.D.: 50.20 to 50.25 mm).

When new bushings must be fitted, proceed as follows:

– Bushing press-fitted in axle housing: take off lip seal first then the bushing with the aid of a universal puller.

– Bushing press-fitted on wheel hub: remove bushing with a universal puller (1) Fig. 8.13.

To remove the seal case (1) Fig. 8.14 proceed as follows:

NOTE – This item is not present on FR7 Loader axles.

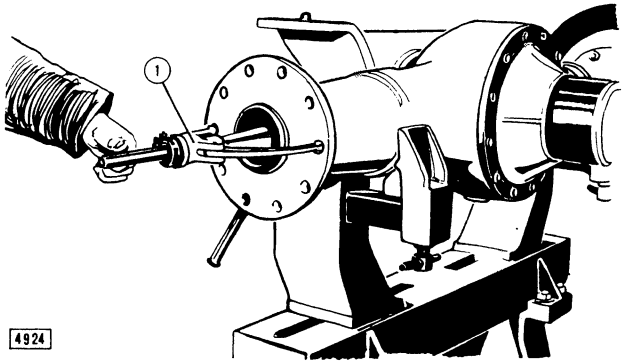


Fig. 8.12 - Removal of axle shaft bushing from axle housing

1. Universal puller.

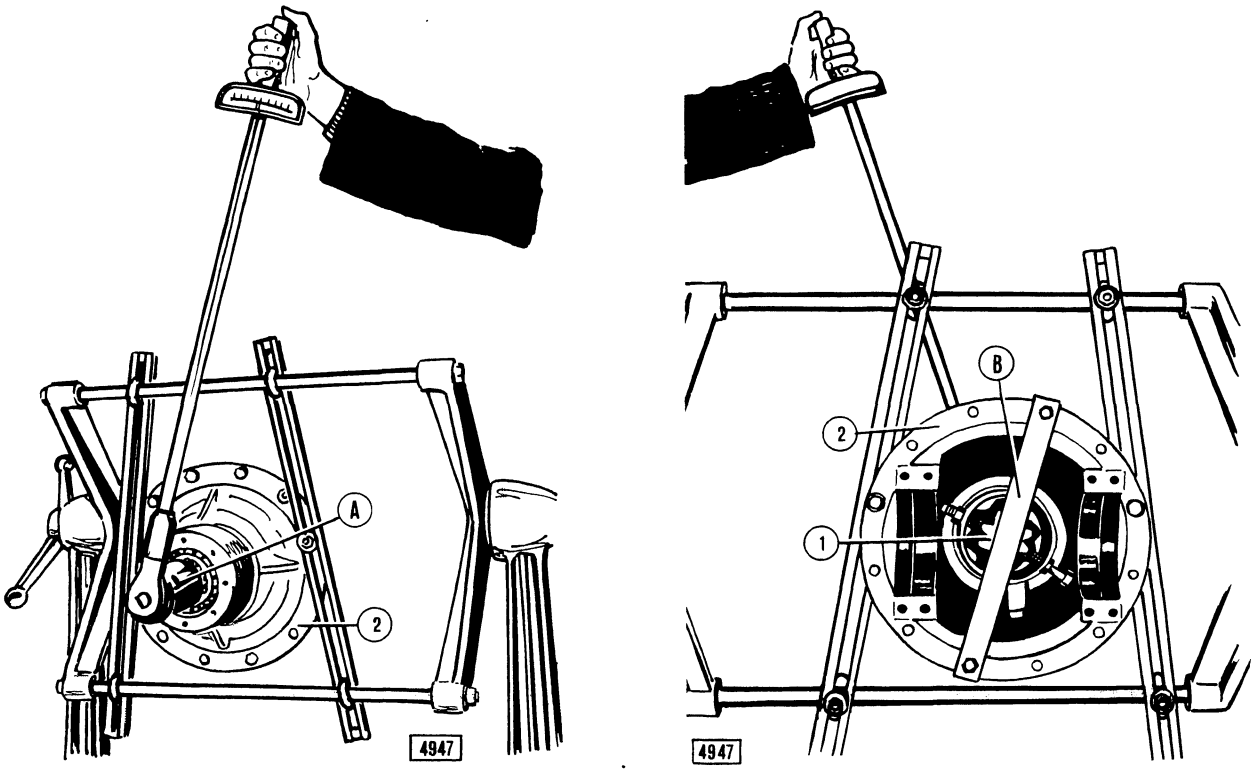


Fig. 8.36 - Bevel drive pinion disassembly

A. Special wrench 75297501 for ring nut removal - B. Drive pinion lock bar 75297520 - 1. Bevel drive pinion - 2. Bearing cage.

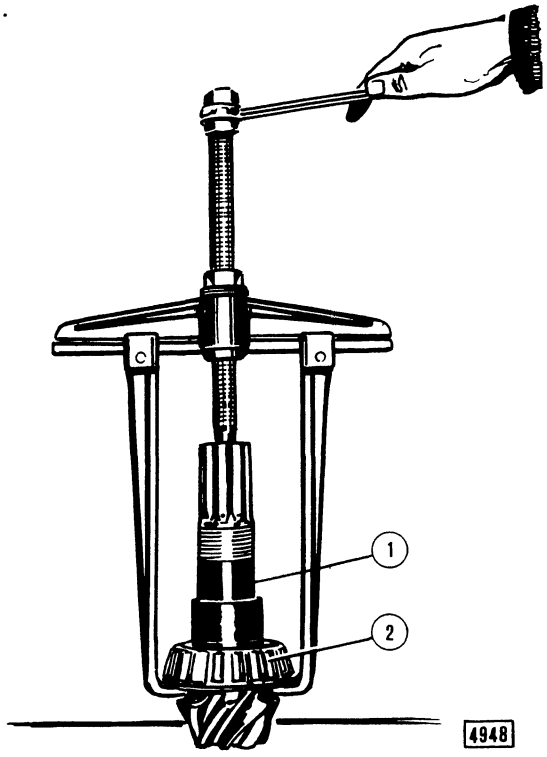


Fig. 8.37 - Removal of drive pinion bearing inner ring

1. Bevel drive pinion - 2. Bearing inner ring.

– Remove lock bar (B) Fig. 8.36 and pull out the drive pinion.

– Using a puller, remove the bearing inner ring (Fig. 8.37).

– From differential case, extract the bearing outer ring (1) Fig. 8.38 using a proper universal puller.

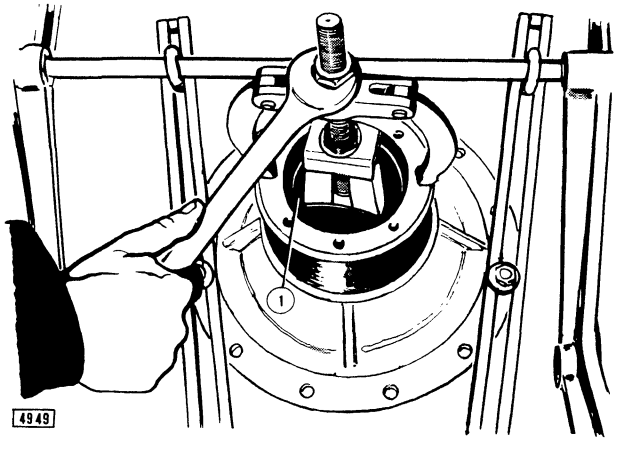


Fig. 8.38 - Removal of drive pinion bearing outer ring

1. Bearing outer ring.

12. DISASSEMBLY, SERVICING AND ASSEMBLY
FR10 - FR12 - FR12 B - FR15 - FR15 B

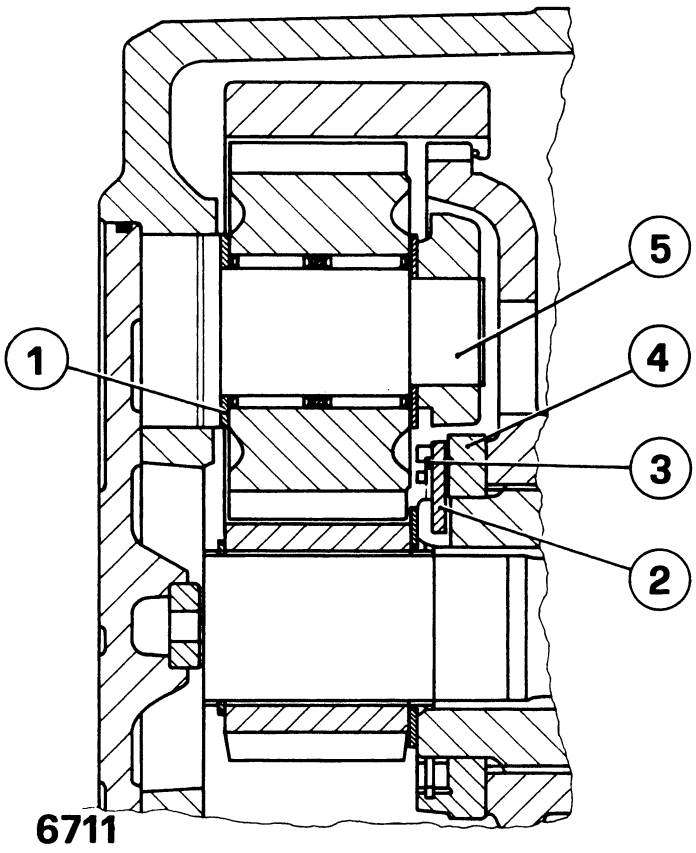


Fig. 12.1bis - Section through the new type side final drive

NOTE - Items shown were modified or added to the early type version.

1. Thrust washer - 2. Lock nut stop plate - 3. Retaining ring - 4. Lock nut - 5. Step pin.

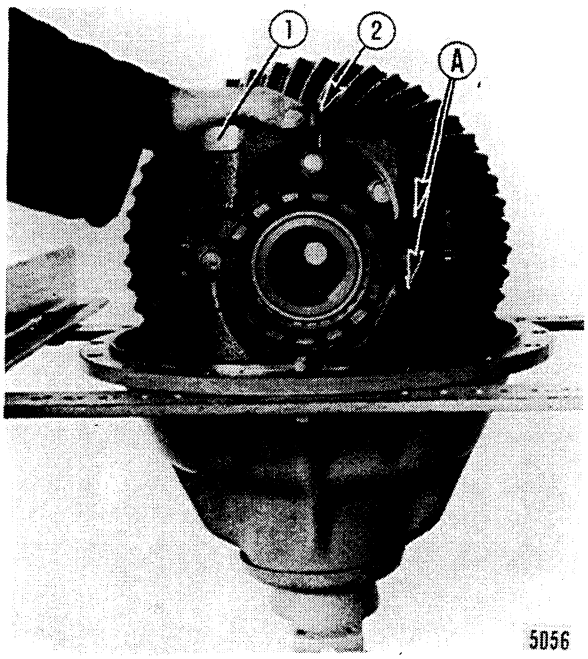


Fig. 12.22 - Differential bearing cap removal

A. Mating marks (provided at assembly in production) 1. Cap - 2. Adjuster lockpins.

12.5 DRIVE PINION DISASSEMBLY

After taking down the differential (Fig. 12.25) and drive pinion bearing cage, proceed as follows:

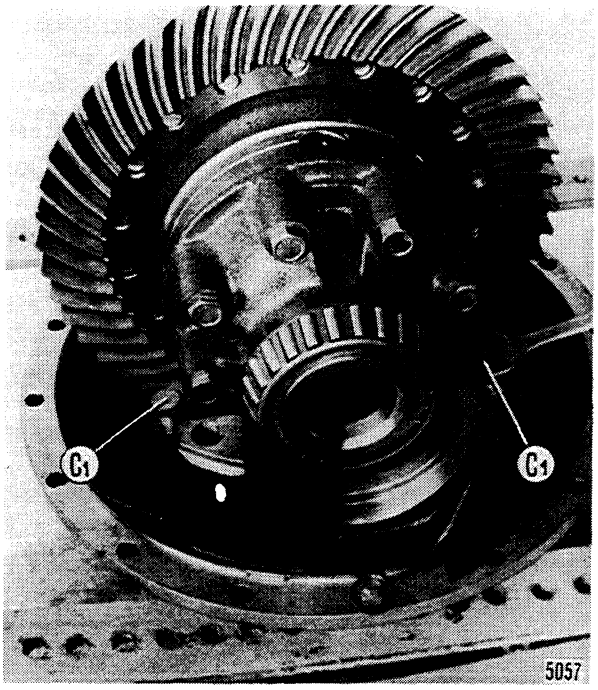


Fig. 12.23 - Drive pinion bearing cage removal

C_1. Puller screws.

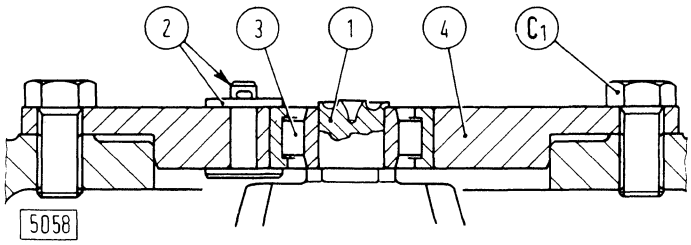


Fig. 12.24 - Section through drive pinion bearing cage

C_1. Mounting screws - 1. Pinion - 2. Bearing outer ring retaining pin and washer - 3. Bearing - 4. Cage.

- Back out ring gear drift screw (C_2) Fig. 12.19 and replace with screw 75297565, making sure that its rounded end fits correctly in the space between two drive pinion teeth.
- Remove the stakings around nut (C_1) Fig. 12.19 and unscrew (Fig. 12.26).
- Remove the companion flange complete with sheet metal shield.
- Pull out the pinion complete with bearing inner ring (2) Fig. 12.27 and spacer (3).
- Using a puller, remove the bearing inner ring (1) Fig. 12.28.

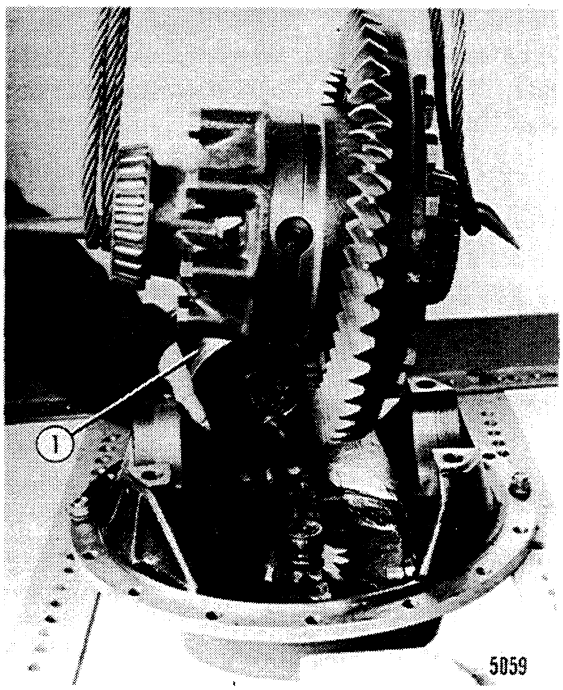


Fig. 12.25 - Lifting out the differential

1. Pinion bearing cage.

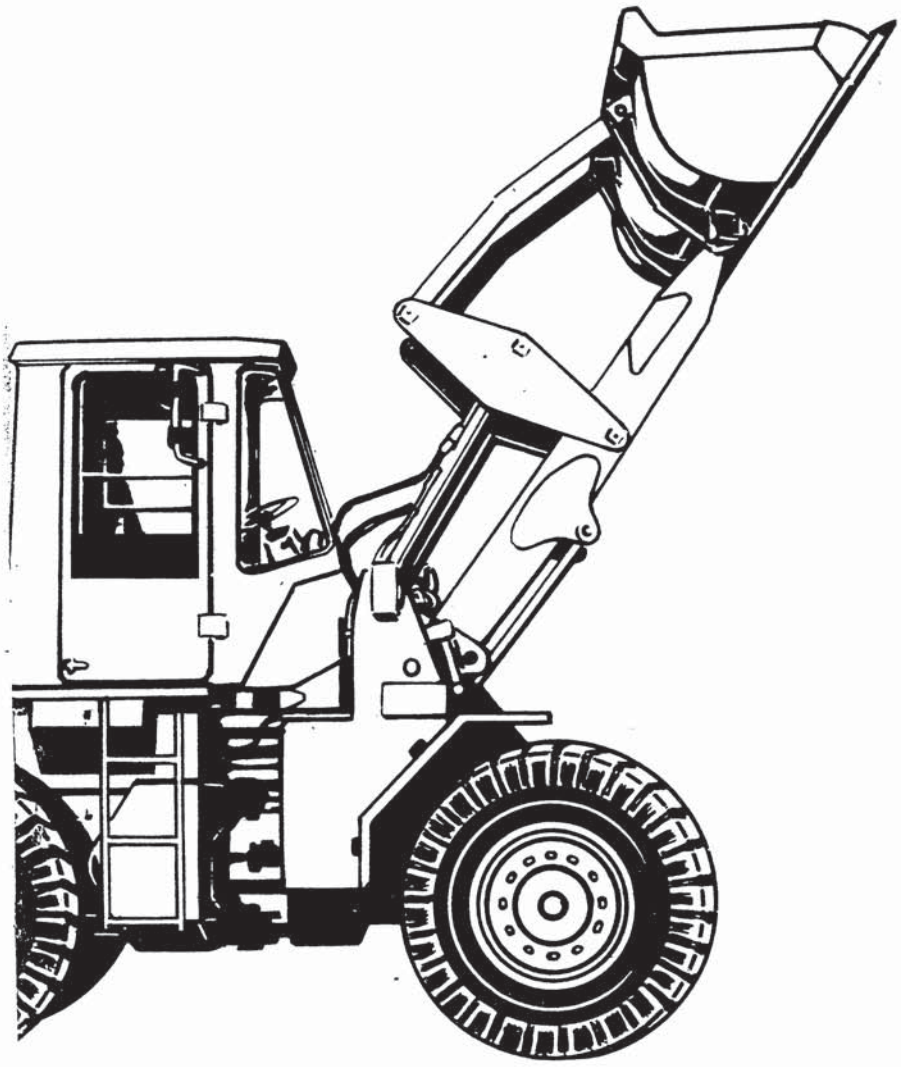
14. TORQUE SPECIFICATIONS

Item	Thread size	Torque	
		daNm (*)	Ft lbs (*)
Side final drives			
Hub lock nut (C_2, Fig. 12.1) FR10/12	80x1.5	142	1047
FR15	95x1.5	150	1106
(4, Fig. 12.1 bis) FR11, FR12B & FR15B		70-100	516 -737
Brake disc mounting screw	20x 1.5	50	370
Brake disc centering nut	20x1.5	51	378
Wheel mounting nut	20x1.5	see op manual	
Differential			
Pinion lock nut	30x1.5	60	442
Ring gear mounting screw	16x1.5	25	184
Ring gear bearing cap bolts	16x1.5	33	243
Differential case halves mounting screws (C4, Fig. 12.19)	16x1.5	12	88.5
Pinion bearing cage mounting screws (C1, Fig. 12.24)	16x1.5	25	184
(*) Lubricate with engine oil			

FIATALLIS®

FR 10
FR 12
FR 12B

Transmission



Service manual

Print no. 604.06.410

Fig. 1A - Transmission diagram.

A. Forward - C. Torque converter - S. Reverse - U. Output shaft.

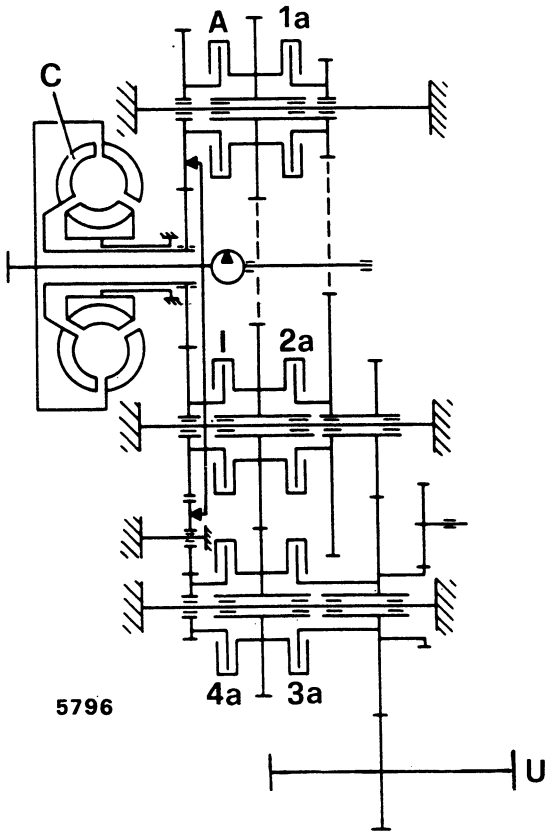


Fig. 1 - Torque converter - transmission schematic.

1. Sump - 2. Suction screen - 3. Pump - 4. Filter - 5. Filter cold oil relief valve - 6. Main pressure regulating valve - 7. Torque converter relief valve - 8. Torque converter - 9. Torque converter regulating valve - 10. Heat exchanger - 11. Modulating piston - 12. Boost piston - 13. First range delay piston - 14. First range delay signal piston - 15. Quick dump valve - 16. Shifter spools - 17. Solenoid valves - 18, 19, 20. Orifices - 21. Check valves.

a. Transmission in neutral with 3rd speed clutch on.
b. Intermediate phase of 1st forward shift.
c. Intermediate phase of 1st reverse shift.

	V				R				N			
	1	2	3	4	1	2	3=4		1	2	3	4
M 1				●	○	○	●	●				
M 2	●				●				●			
M 3	○	○	●		○	○	●	●				
M 4	●	●			●	●			●	●		
AS									●	●	●	
RF					●	●	●	●				

5797

Fig. 10-Tester warning lights check.

NOTE white circles refer to warning light switching out with brake left pedal or parking brake control lever on.

AS. Starting lock - RF. Reverse utilizers (back-up alarm, rear flood lights etc.) - M_1, M_2, M_3, M_4 - Solenoid warning lights - V. Forward direction - R. Reverse direction - N. Neutral - 1, 2, 3, 4. 1st, 2nd, 3rd, 4th speed.

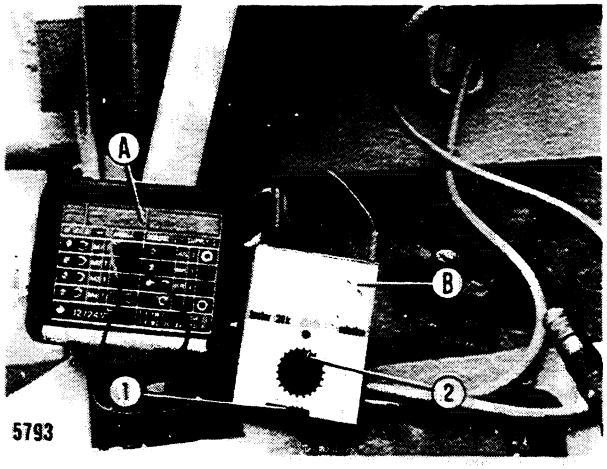


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Fig. 11-Connection of tester 75297590 for solenoid consumption check (B).

A. Tester 75297575.

1. Gage selector - 2. Scale selector potentiometer.

Solenoid consumption check

Execute this check after completion of the transmission control check.

WARNING! The solenoid check has to be executed with engine off.

Place gage selector (1, fig. 11) on mark A and potentiometer (2, fig. 11) on scale 1A. Connect by cables tester 75297590 with tester 75297575 and the latter with the transmission as shown in fig. 11.

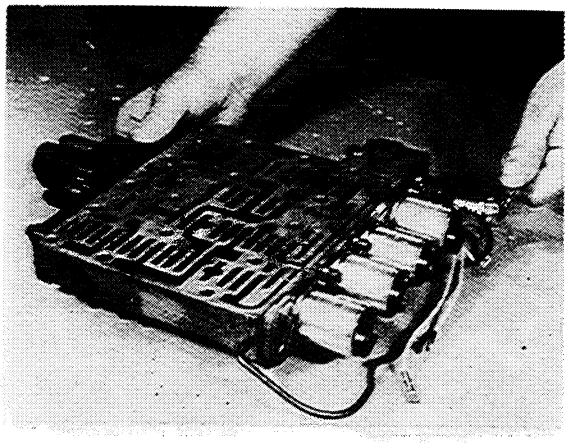
Actuate the various combinations for speed selection as shown in fig. 10, insert the two tester plugs into jockets (15 and 16, fig. 9) of solenoids to be cecked. Move to the left the relevant switch (4, fig. 9) and read the corresponding consumption value. Rated consumption is 0.3 to 0.5 A.

If gage arrow does not move, this means an interruption in the connections.

In case of max. displacement up to travel end, a short circuit has to be diagnosed.

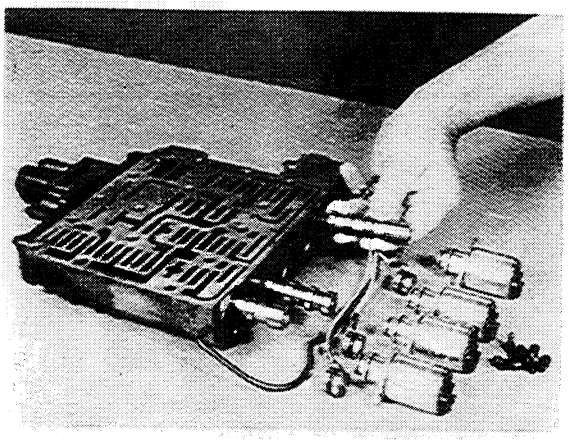
Transmission oil pressure check

Connect pressure gage kit 75297591 as shown in fig. 12 start the engine and let oil worm up to 70°-90°C. Engage the various speeds to be checked and with parking brake on run the engine at max. speed. Execute the checks and compare with those of fig. 13.



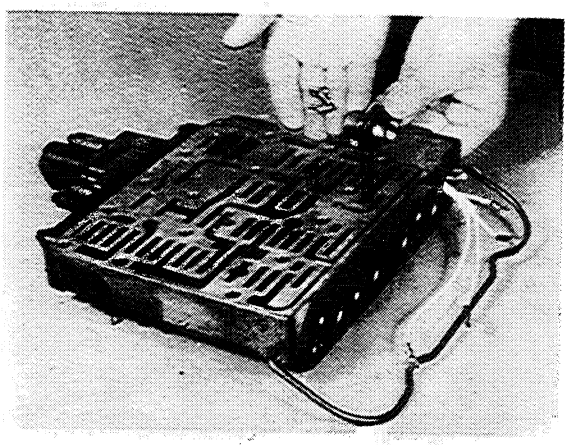
Pull off cable.

Loosen socket head screws and pull solenoid valves out of the housing.

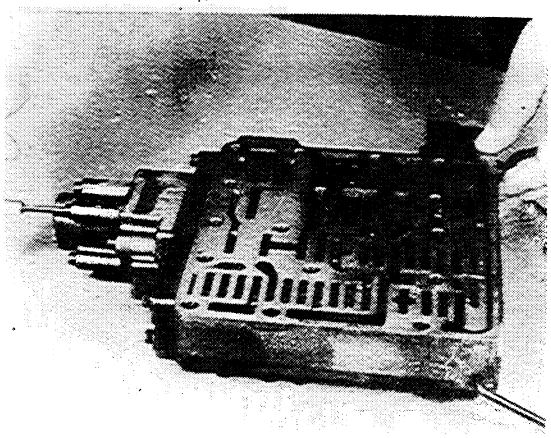


Remove detent blocks and take pistons and springs, laying behind them out of the housing.

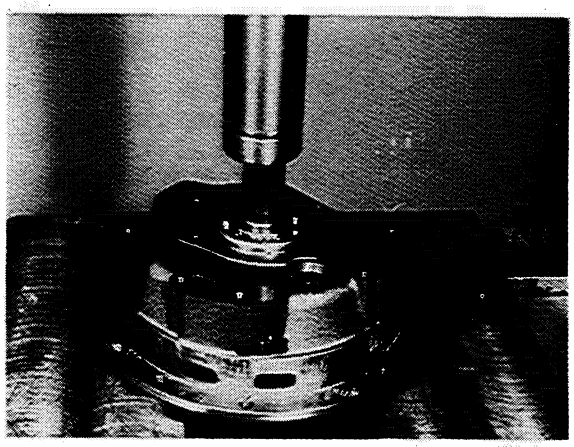
Note: pay attention to the different pistons and their mating with the corresponding bores!



Loosen socket head screws and remove cable harness.



Loosen socket head screws and remove two-stage valve.



Press drive shaft out until the spur gear has been released.

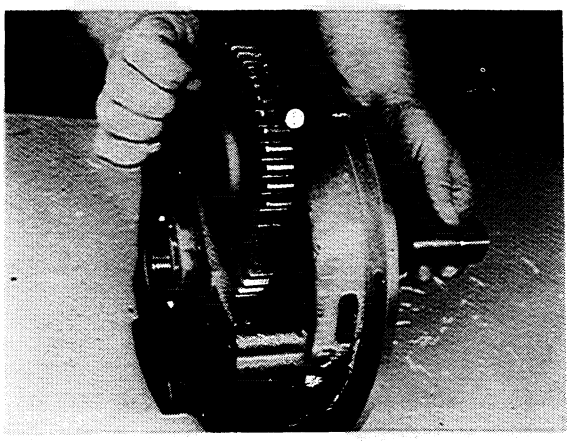
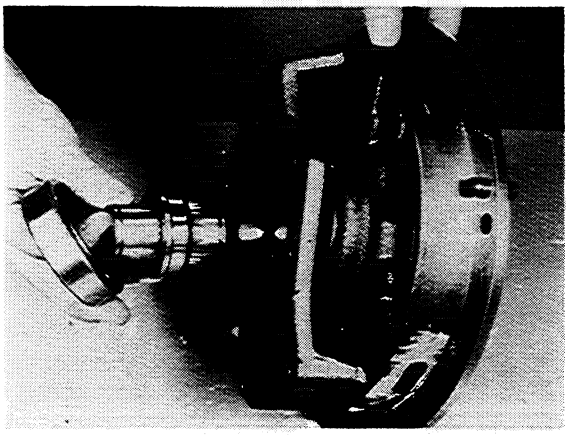
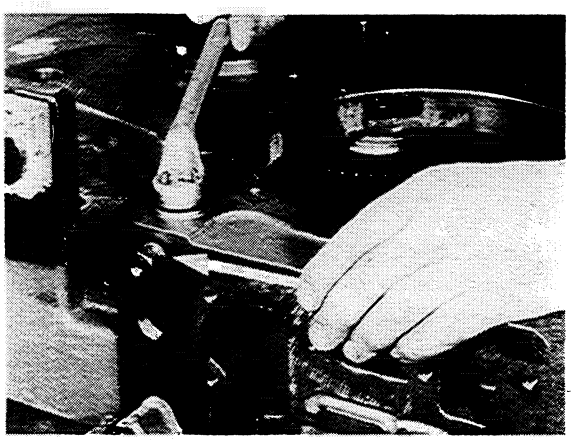


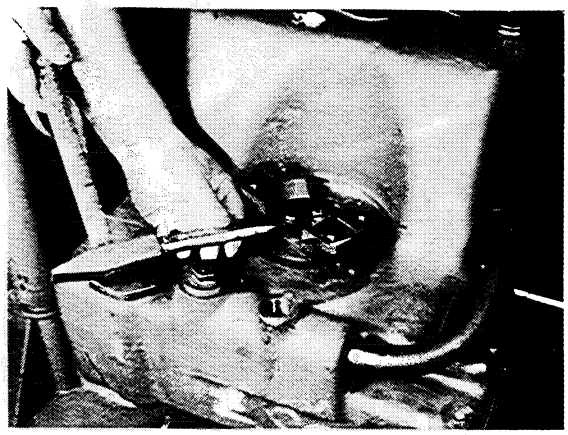
Illustration shows the removal of the spur gear.



Remove ball bearing, drive shaft and roller bearing out of the housing.

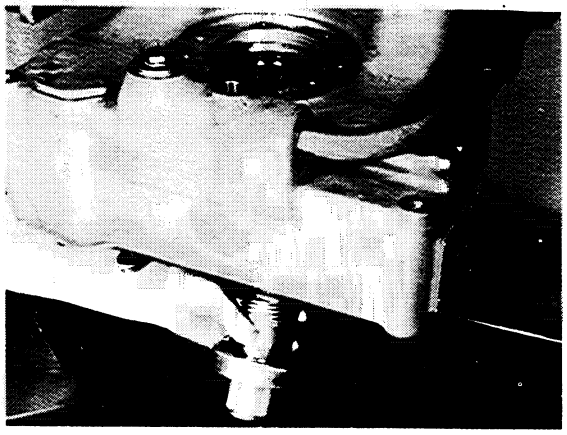


Remove screw plug and temperature connecting piece.



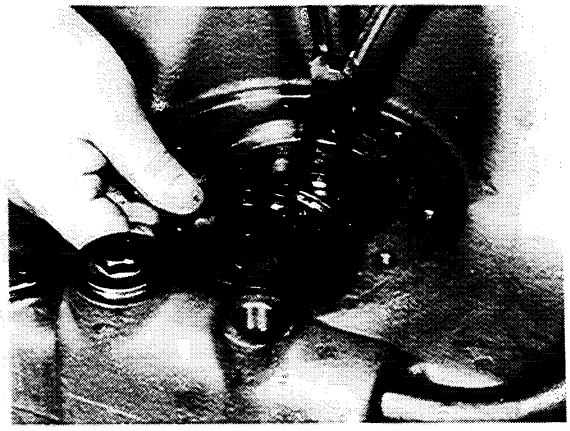
Rotate gearbox housing for 180°.

Loosen lock plate and pull off flange.



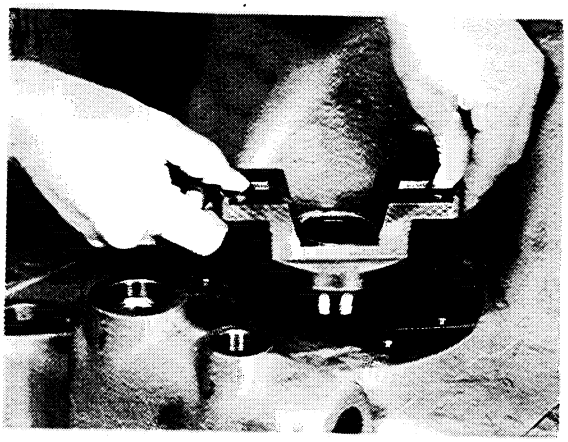
Tap output shaft loose and drive it out of the gearbox housing.

Take 2nd half of the shield and spur gear out of the housing.

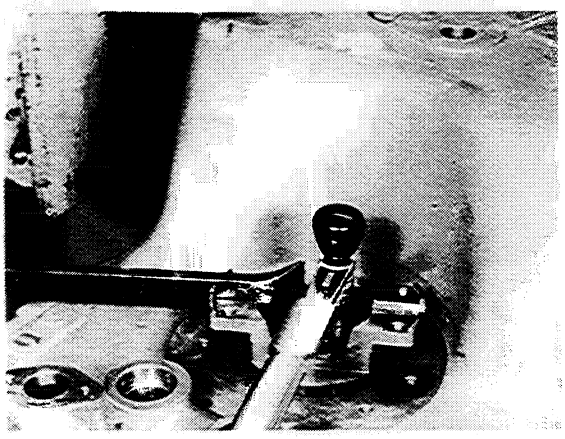


Remove shaft seal and circlip.

Drive roller bearing out of the housing.

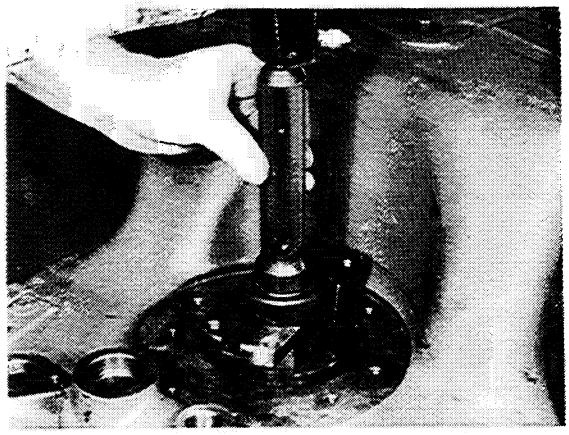


Guide output flange upon the splines of the output shaft and place it firmly against shoulder.



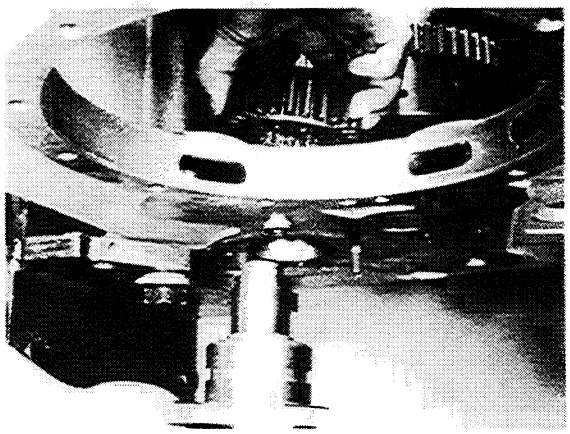
Cover washer with sealing compound and fasten by means of hex. head screws.

Torque limit (M8/10.9) 35 Nm



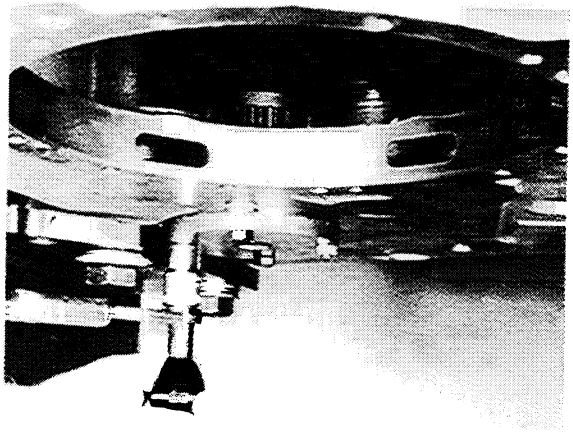
Install lock plate firmly against shoulder.

(S) driver 75297594



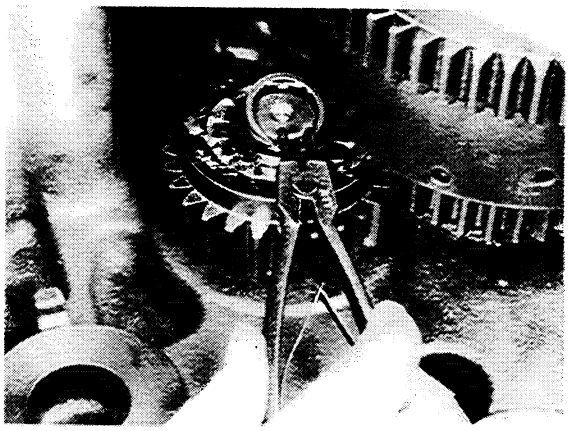
Insert axle into the housing bore, starting from below and assemble reverse gear -collar showing towards above - together with thrust washer.

Note: pay attention to the installation position of the thrust washers!



Fasten axle by mens of hex. head screws and one hex. nut.

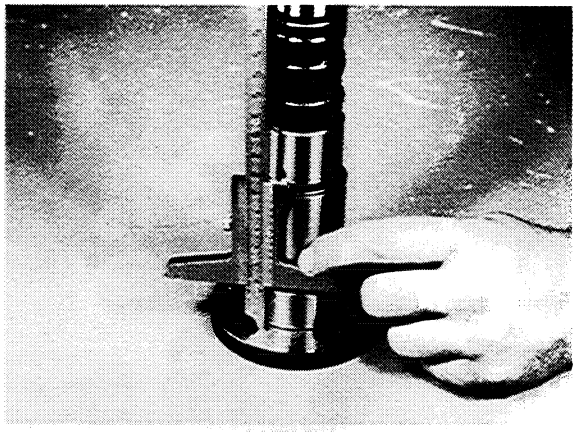
Torque limit (M8/8.8) 25 Nm



Engage circlip.

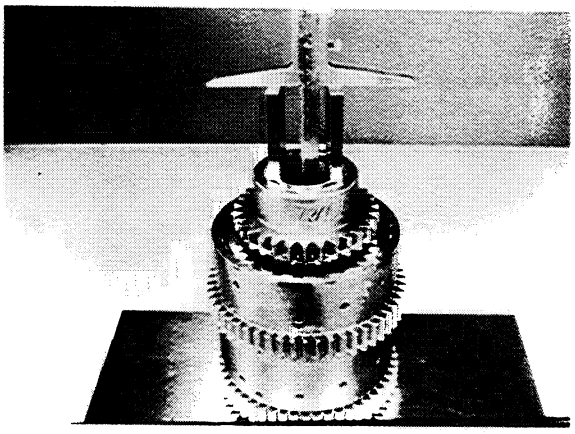
KR/K2:

Complete piston carrier as with K3/K4 - see pages 33-34.



Determine dimension B from contact area of the bearing rollers to the flange facing.

e.g. 27,00 mm



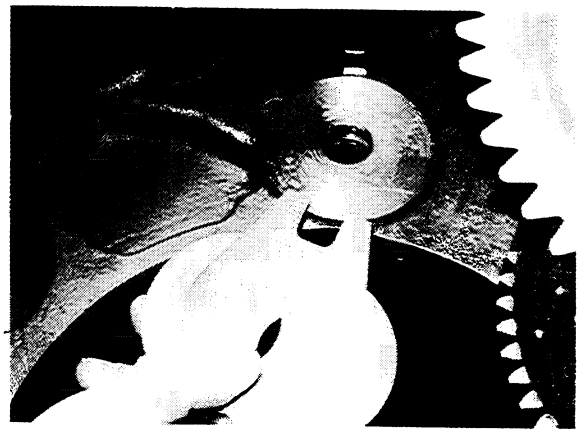
Measure dimension C from plane surface ball bearing to the contact area of the spur gear KV.

e.g. 209,70 mm

Example:

Dimension A	237,80 mm
- Dimension B	27,00 mm
gives	210,80 mm
- Dimension C	209,70 mm
gives	1,10 mm

In order to obtain the required end play of 0,10 - 0,30 mm select in this case a shim of e.g. s = 1,00 mm.



Install centring sleeve.

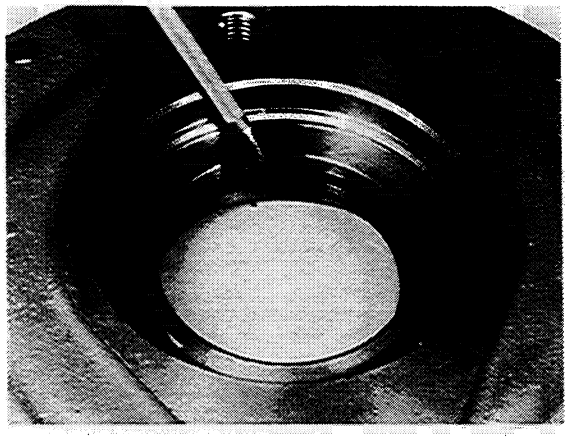
Lay determined shim, e.g. s = 1,00 mm, forked washer and thrust washer (plastic)

Note: cover washers with grease!

Pay attention to the installation position of the forked washer!

Fasten bearing cover by means of hex. head screws.

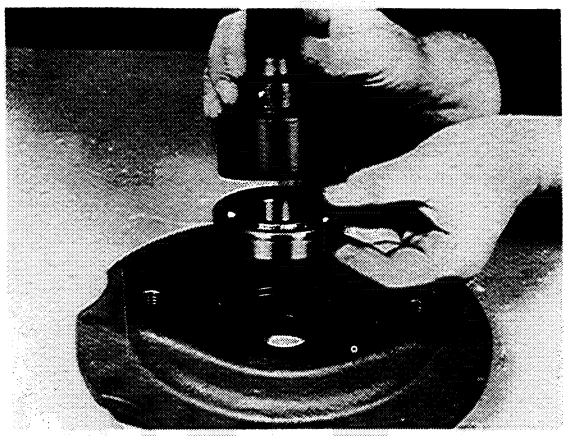
Torque limit 25 Nm



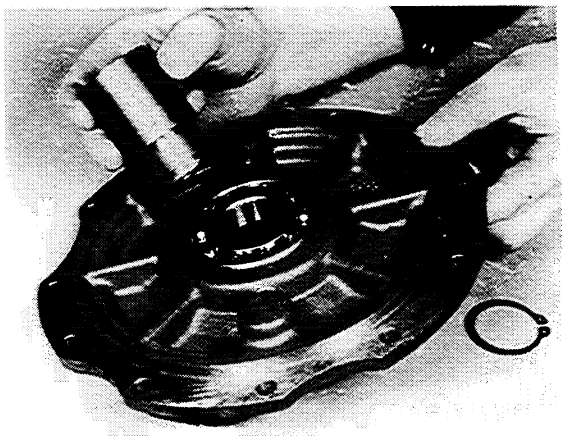
Rotate gearbox housing for 180°.

Engage both snap rings into the groove of the pump flange.

Note: pay attention to the installation position!



Insert expanding ring and drive bearing into position, using driver, until the upper snap ring is engaged in the bearing groove.



Heat bearing inner race and install drive ring firmly against shoulder.

Fix drive ring by engaging the circlip.

(S) hot-air blower 75297587

E. Piston returning spring: free length 48.6 mm - L. Adjusting shims for clutch-gear end play on the shaft: from 1 mm up to 5.2 mm with oversize steps 0.2 mm - 1-5mm - 1. Gears with inside toothed hub - 2. Backing plate - 3. Piston - 4. Inside toothed bell -6. Shaft.

Clutch	Toothed plate	Plate number 1st Type	Plate number 2nd Type	Plate thickness 1st Type	Plate thickness 2nd Type	Plate total thickness 1st Type	Plate total thickness 2nd Type	Code 1st Type	Code 2nd Type
KV	External	11	11	2.4	2.0	26.4	22.0	A	G
	Internal	1	1	2.5	2.5	2.5	2.5	D	D
	Internal	7		1.5		10.5		C	
	Internal	1	8	2.0	2.0	2.0	16.0	F	F
	Internal for adjustment	1	1	1.5/2.0/2.5		1.5/2.0/2.5		B	B
KR	External	10	11	2.4	2.0	24.0	22.0	A	G
	Internal	1	1	2.5	2.5	2.5	2.5	D	D
	Internal	7	8	2.0	2.0	14.0	16.0	F	F
	Internal for adjustment	1	1	2.0/2.5		2.0/2.5		H	H
K1 K2	External	8	8	2.0	2.0	16.0	16.0	G	G
	Internal	1	1	2.5	2.5	2.5	2.5	D	D
	Internal	5	5	2.0	2.0	10.0	10.0	F	F
	Internal for adjustment	1	1	1.5/2.0/2.5		1.5/2.0/2.5		B	B
K3	External	8	8	2.0	2.0	16.0	16.0	G	G
	Internal	1	1	2.5	2.5	2.5	2.5	D	D
	Internal	5	5	2.0	2.0	10.0	10.0	F	F
	Internal for adjustment	1	1	1.5/2.0/2.5		1.5/2.0/2.5		B	B
K4	External	8	8	2.0	2.0	16.0	16.0	G	G
	Internal	1	1	2.5	2.5	2.5	2.5	D	D
	Internal	3	3	2.0	2.0	6.0	6.0	F	F
	Internal	2	2	1.5	1.5	3.0	3.0	C	C
	Internal for adjustment	1	1	1.5/2.0/2.5		1.5/2.0/2.5		B	B

Directions for assembling clutch plates.

For all clutches, the thickness of the first internal toothed plate (D) installed after the piston (3) should be 2.5mm.

Alternate external and internal toothed plates as shown in the chart. On early model transmissions, the thickness of external plates used in the forward (KV) and reverse (KR) clutches was 2.4mm. This plate was later superseded by an external plate that was 2.0mm thick, thus resulting in a different arrangement of the internal toothed plates in order to achieve the same stack height.

Keep in mind when ordering external toothed plates that you will receive the 2.0mm plate so also order internal toothed plates accordingly.

The total end play, when the clutch is installed, has to be between 2.0 and 2.9mm for all clutches (refer to assembly instructions for measurement). Adjustments can be made by substituting one internal toothed plate with a different thickness "compensation" plate (B).

Using the view at top right, the projection (A) of the first internal toothed plate (D) inside the drum has to be not less than 2.3mm for all clutches (refer to assembly instructions for measurement). If the projection is less than 2.3mm, it is necessary to add on the piston (3) side one supplementary external toothed plate. In order to compensate the addition of this plate, one or more thinner internal toothed plates should be used on the backing plate (2) side in order to maintain proper end play.

HYDRAULIC SYSTEM

Equipment pressure relief valve	190 ± 5 bar
Bucket dump circuit overload valve	97 ± 5 bar
Bucket retract circuit overload valve	207 ± 5 bar
Steering system pressure setting	145 ± 3,5 bar

SAFETY RULES

Face the access system when climbing up and down.

Apply the parking device and place the transmission in neutral before starting the machine.

Do not bypass the starter safety switch. Repair the starter safety controls if they malfunction.

Fasten seat belt before operating.

Steering should be checked to both right and left. Brakes should be tested against engine power. Clutch and transmission controls should be moved through or to neutral positions to assure disengagement. Operate all controls to insure proper operation. If any malfunctions are found, park machine, shut off engine, report and repair before using machine.

If the power steering or the engine ceases operating, stop the machine motion as quickly as possible. Lower equipment, set parking device and keep machine securely parked until the malfunction is corrected or the machine can be safety towed. Never lift loads in excess of capacity.

Should the machine become stuck or frozen to the ground, back out to avoid roll over.

Know and understand the job site traffic flow patterns.

Keep the machine in the same gear going down hill as used for going up hill.

When roading a machine, know and use the signaling devices required on the machine. Provide an escort for roading where required.

Always use the recommended transport devices when roading the machine.

Do not attempt repairs unless proper training has been provided.

Use extreme caution when removing radiator caps, drain plugs, grease fittings or pressure taps. Park the machine and let it cool down before opening a pressurized compartment.

Release all pressure before working on systems which have an accumulator.

When necessary to tow the machine, do not exceed the recommended towing speed, be sure the towing machine has sufficient braking capacity to stop the towed load. If the towed machine cannot be braked, a tow bar must be used or two towing machines must be used - one in front pulling and one in the rear to retard. Avoid towing over long distances.

Observe proper maintenance and repair of all pivot pins, hydraulic cylinders, hoses, snap rings and main attaching bolts.

Always keep the brakes and steering systems in good operating condition.

Replace all missing, illegible or damaged safety signs. Keep all safety signs clean.

Do not fill the fuel tank to capacity. Allow room for expansion.

Wipe up spilled fuel immediately.

Always tighten the fuel tank cap securely. Should the fuel cap be lost, replace it only with the original manufacturers approved cap. Use of a non-approved cap may result in overpressurization of the tank.

Never drive the machine near open fires.

Use the correct fuel grade for the operating season.

SYMPTOM	PROBABLE CAUSE	TOOLS REQUIRED	TEST	SOLUTION
Engine shows loss of power(continued)	Fuel injection pump improperly timed	Timing light	Flow time the pump to the engine	Time the fuel injection pump
	Inoperative fuel injection pump or fuel injection nozzles	Engine diagnostic kit	Run engine diagnostic test	Repair or replace defective parts
	Cylinder *"cutting"* out		Locate *"missing"* cylinder as follows: Run engine at low idle speed and cut out each injection nozzle in turn by loosening the fuel injection line nut attaching the line to the fuel pump	A decrease in engine speed indicates the nozzle for that cylinder is functioning properly. If engine speed does not decrease, nozzle is malfunctioning and must be replaced
	Loss of compression	Compression tester	Compression test	May be due to leaking valve or worn piston rings or cylinder sleeves. Repair or replace defective parts
Engine runs unevenly and vibrates excessively	Governor not operating properly		Check pump and throttle linkage	If tight or loose, adjust governor and linkage
	Fuel supply erratic or insufficient	Engine diagnostic kit	Run diagnostic test	If fuel system fault, check fuel system
	Engine operating temperature too low	Engine diagnostic kit	Run diagnostic test	If cooling system fault, check thermostat
	Fuel injection pump malfunctions	Engine diagnostic kit	Run diagnostic test	Check fuel injection pump
	Valves in bad condition			Recondition or replace valve
	Cylinder *"cutting"* out		Locate *"missing"* cylinder as follows: Run engine at low idle speed and cut out each injection nozzle in turn by loosening the fuel injection line nut attaching the line to the fuel pump	A decrease in engine speed indicates the nozzle for that cylinder is functioning properly. If engine speed does not decrease, nozzle is malfunctioning and must be replaced
	Fuel injection nozzle malfunction	Nozzle tester	Check nozzle popping pressure, pattern and sound	Repair or replace nozzle

3.3 TACHOMETER TIMING LIGHT

⚠ WARNING

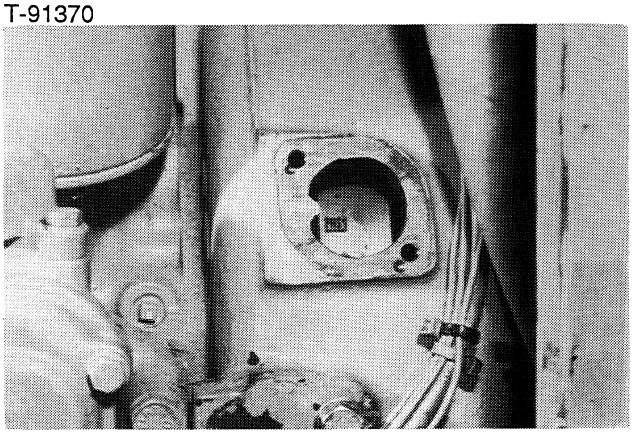
Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.

*Observe all start up and shut down procedures and **"WARNING"** listed in the Operation and Maintenance Instruction Manual.*

This machine and its attachments are to be operated only by qualified operator seated in the operator's seat.

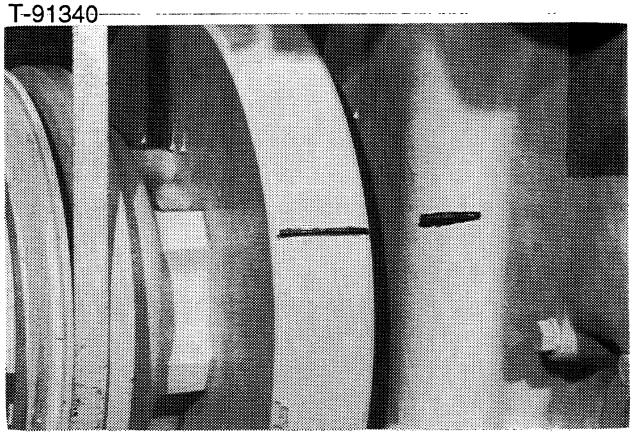
Before starting machine, check, adjust and lock the operator's seat for maximum comfort and control of the machine.

T-91370

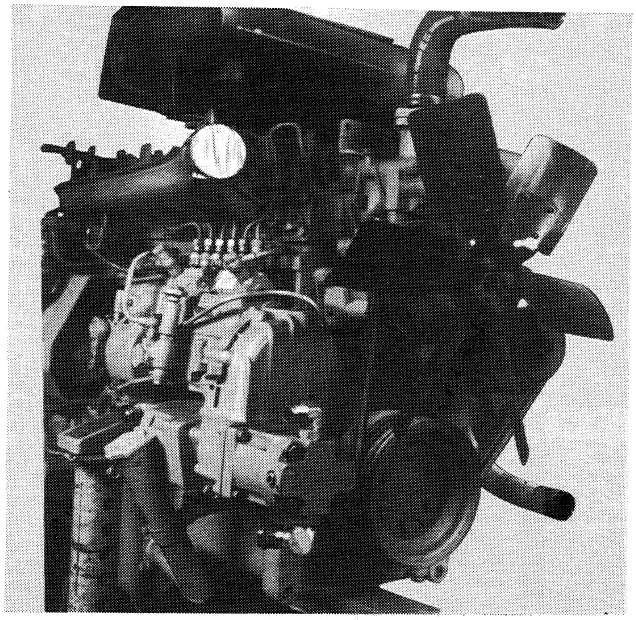


3.3.1
Position the engine at the specified timing mark with number one cylinder on its compression stroke.

T-91340

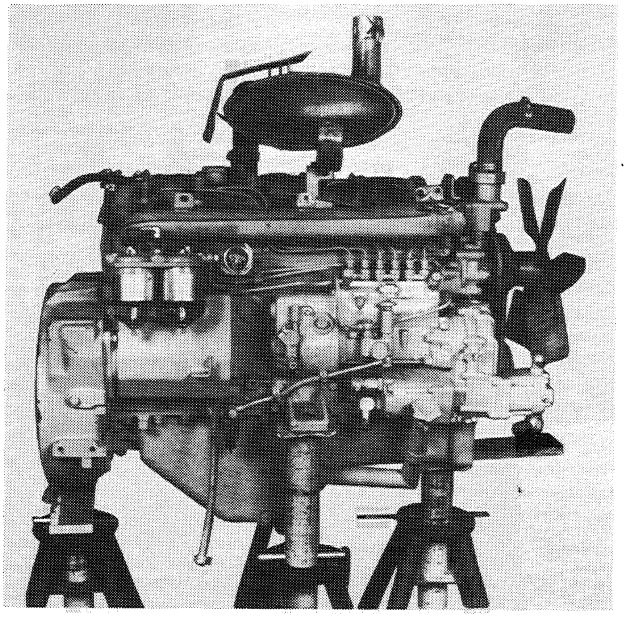


3.3.2
Establish an index mark by means of a marking pen, wire or tape which contrasts the color of the engine on a rotating member of the engine as well as a stationary member.



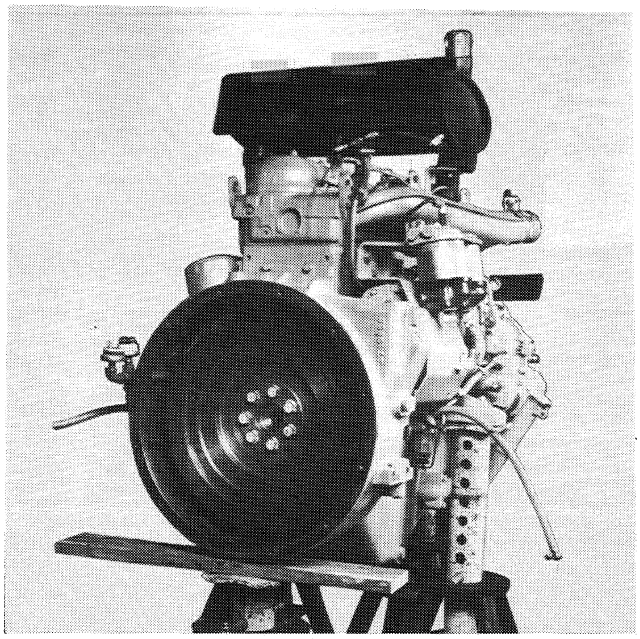
T-81812

FIG. 3 ENGINE (FRONT- RIGHT)



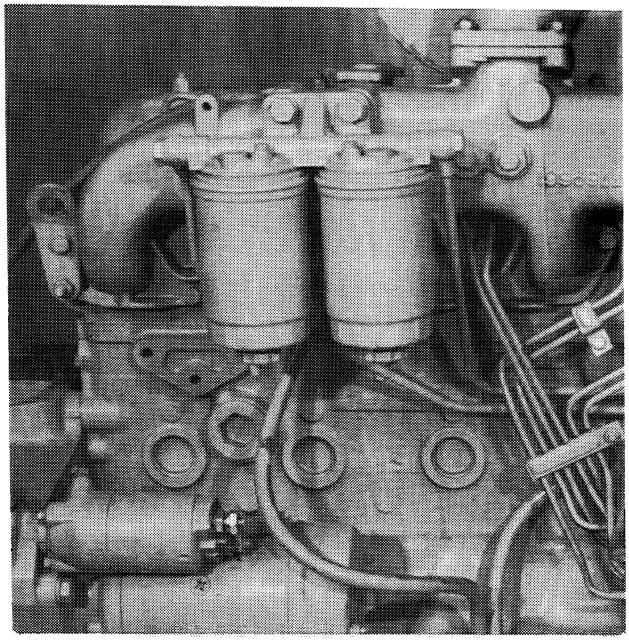
T-81813

FIG. 4 ENGINE (RIGHT SIDE)



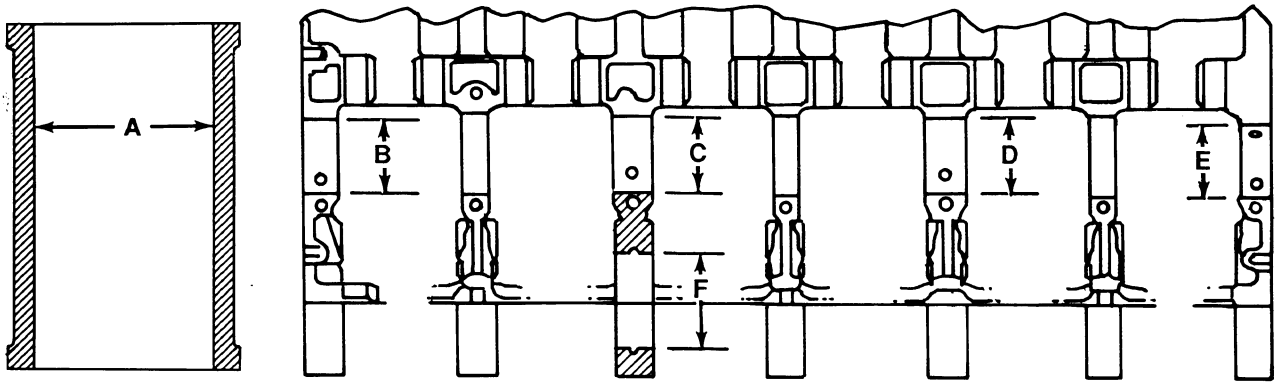
T-81814

FIG. 5 ENGINE (REAR - RIGHT)



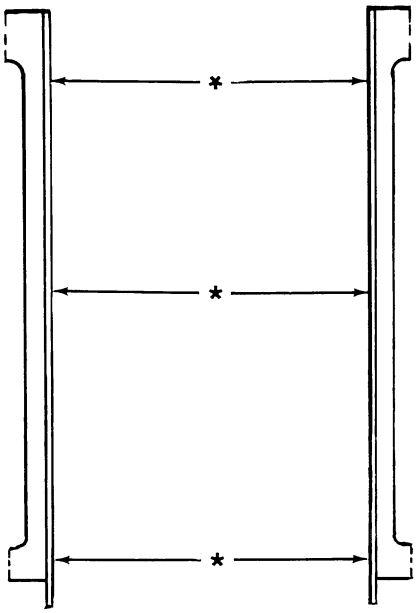
T-89072

FIG. 6 FUEL FILTERS



T-85656

FIG. 23 CYLINDER BLOCK

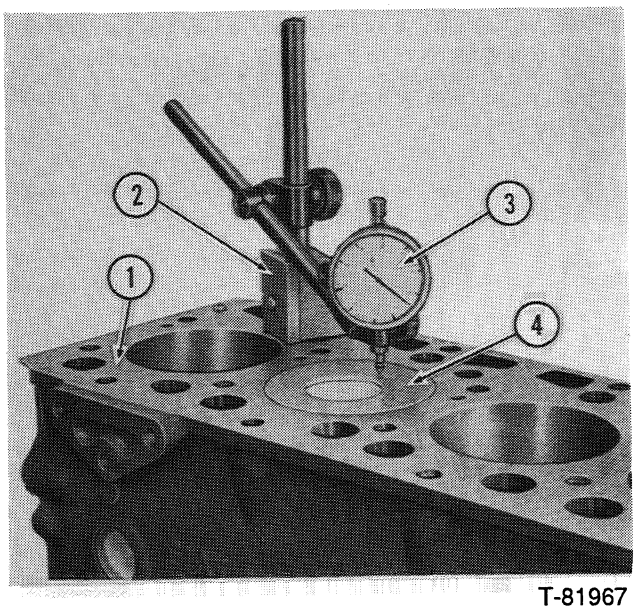


T-85451

FIG. 24 CYLINDER SLEEVE

PISTONS, PISTON RINGS, CONNECTING RODS & PINS

	8065.04.___	8065.24.___	8065.05.___	8065.25.___
D. Width of ring grooves				
Top	2.58-2.60 (.1016-.1024)	tapered	2.58-2.60 (.1016-.1024)	tapered
Intermediate	2.55-2.57 (.1004-.1012)	2.55-2.57 (.1004-.1012)	2.55-2.57 (.1004-.1012)	2.55-2.57 (.1004-.1012)
Bottom	4.03-4.05 (.1587-.1595)	4.03-4.05 (.1587-.1595)	4.03-4.05 (.1587-.1595)	4.03-4.05 (.1587-.1595)
Thickness of rings				
Top	2.478-2.490 (.0975-.0980)	3.0 Nominal (.118 Nominal)	2.478-2.490 (.0975-.0980)	3.0 Nominal (.118 Nominal)
Intermediate	2.478-2.490 (.0975-.0980)	2.478-2.490 (.0975-.0980)	2.478-2.490 (.0975-.0980)	2.478-2.490 (.0975-.0980)
Bottom	3.978-3.990 (.1566-.1571)	3.978-3.990 (.1566-.1571)	3.975-3.990 (.1564-.1571)	3.978-3.990 (.1566-.1571)
Ring side clearance				
Top	.090-.122 (.0035-.0048)	tapered	.090-.122 (.0035-.0048)	tapered
Intermediate	.060-.092 (.0027-.0036)	.060-.092 (.0027-.0036)	.060-.092 (.0027-.0036)	.060-.092 (.0027-.0036)
Bottom	.040-.072 (.0016-.0028)	.040-.072 (.0016-.0028)	.040-.075 (.0016-.0029)	.040-.072 (.0016-.0028)
Ring end gap				
Top	.35-.55 (.0138-.0217)	.40-.65 (.0157-.0256)	.40-.65 (.0157-.0256)	.40-.65 (.0157-.0256)
Intermediate	.30-.50 (.0118-.0197)	.30-.50 (.0118-.0197)	.30-.55 (.0118-.0217)	.30-.55 (.0188-.0217)
Bottom	.30-.45 (.0118-.0177)	.30-.45 (.0118-.0177)	.30-.60 (.0118-.0236)	.30-.45 (.0118-.0177)
Oversize rings available	0.1,0.2,0.4,0.6,0.8 (.004, .008, .016, .024, .031)	0.1,0.2,0.4,0.6,0.8 (.004, .008, .016 .024, .031)	0.4 - 0.8 (.016 - .031)	0.4 - 0.8 (.016 - .031)
E. Piston standout	.460 - .790mm (.018 - .031 in)	.460 - .790mm (.018 - .031 in)	.460 - .790mm (.018 - .031 in)	.460 - .790mm (.018 - .031 in)



T-81967

FIG. 43 CHECKING STANDOUT OF PISTONS

1. Block deck
2. Magnetic mount
3. Dial indicator
4. Piston crown

7.2 FLYWHEEL & RING GEAR

7.2.1
The flywheel is bolted to the flange on the rear end of crankshaft and is normally removed and replaced in conjunction with crankshaft and/or seal repairs. One bolt hole in the flywheel is offset so the flywheel will install on crankshaft in only one position. The circumference of flange that flywheel bolts to is the running surface that rear seal seats against. Whenever the position of seal or flange is disturbed, the seal must be replaced.

NOTE: The concentricity of flange seal surface is critical. See Specifications.

7.2.2
To remove seal, remove flywheel and then pull seal (seal must be replaced if the position of the flywheel housing is disturbed).

7.2.3
Removal and replacement of flywheel is a matter of unbolting retaining capscrews. Note that flywheel retaining capscrews should be secured thread lock FA P/N 75000776 (Loctite 262) or similar compound. Torque flywheel capscrews to specifications.

IMPORTANT: When removing flywheel, secure it with hoist before removing capscrews.

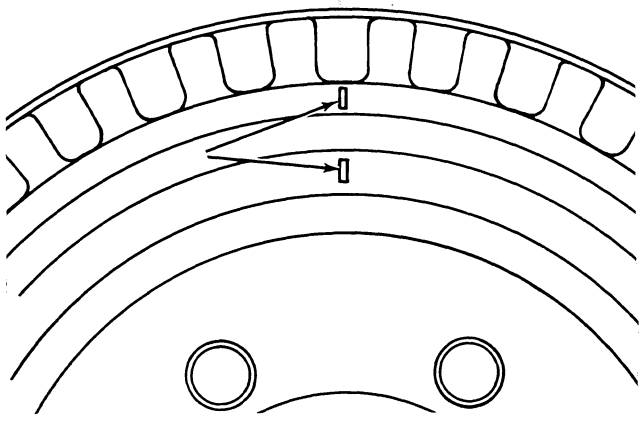
7.2.4
The ring gear on flywheel is replaceable. Always inspect flywheel ring gear for general condition and wear. When ring gear removal is necessary, grind a notch through one of the ring gear teeth (at the root), expand the ring, and drive the ring off of flywheel. To install ring gear on flywheel, uniformly heat the gear to 149°C - 163°C (300°F - 325°F) (a dull red glow is visible only in the dark). Overheating will destroy gear. After gear is properly heated, quickly position gear on flywheel (gear must be installed so the chamfered ends of gear teeth will face the block when flywheel is installed). Allow gear to cool slowly. Do not cool with water.

NOTE: It is suggested that a "Temple Stick" be used to measure flywheel temperature.

7.3 CRANKSHAFT PULLEY, DAMPER & HUB INSTALLATION

7.3.1
The mechanical condition of the pulley and damper, attached to the crankshaft, is critical to the life of the engine.

IMPORTANT: Always install a new crankshaft damper in conjunction with any crankshaft failure.



T-85378

FIG. 44 CRANKSHAFT DAMPER REFERENCE MARKS

7.3.2
Check reference marks on the face of the damper, Fig. 44. If marks are out of line more than 10mm (0.40"), replace damper.

Examine the grooves of pulley for signs of wear or fatigue.

8.4 REASSEMBLY PROCEDURES

8.4.1
Thoroughly clean work bench and assembly area.

8.4.2
Thoroughly clean the head and all related parts before beginning reassembly procedure.

⚠ WARNING

Never use gasoline or solvent or other flammable fluid to clean parts. Use authorized commercial, non-flammable, non-toxic solvents.

Wear safety glasses with side shields or goggles when using compressed air for cleaning to reduce the danger of personal injury from flying particles. Limit the pressure to 2.06 bar (30 psi) according to local or national requirements.

8.4.3
Set head on its side. Carefully slide the stem of each valve (new or renewed) into its proper guide hole.

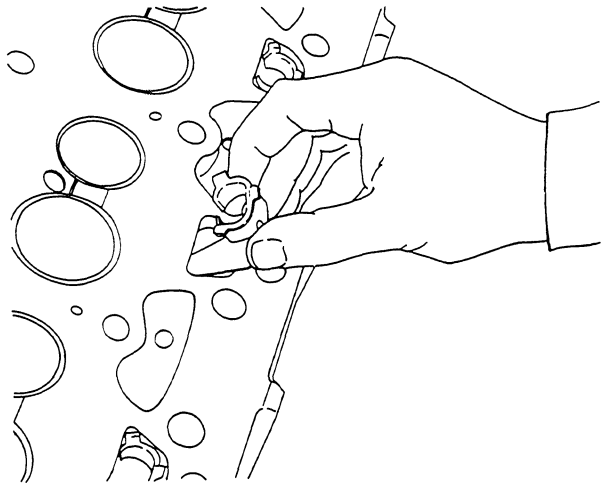
NOTE: Make sure the turbulence wing on each intake valve is properly orientated. The notch in each intake valve stem should be referenced toward front of engine.

Carefully tip the head down so that cups, springs and cones can be installed over valve stems.

8.4.4
Install the specially designed lower valve spring seats on intake valve stems. Install remainder of springs, seats, and cones.

IMPORTANT: Valve springs on some engines are not symmetrical. Install springs with tight spirals seated against lower seats.

8.4.5
Use valve spring compression tool to compress each spring assembly. Carefully reposition the split cones around valve stems and lock springs to valve stems.



T-81981

FIG. 56 INSTALLING WATER BAFFLES

8.4.6
Position cylinder head on its side, and install the water baffles, Fig.56.

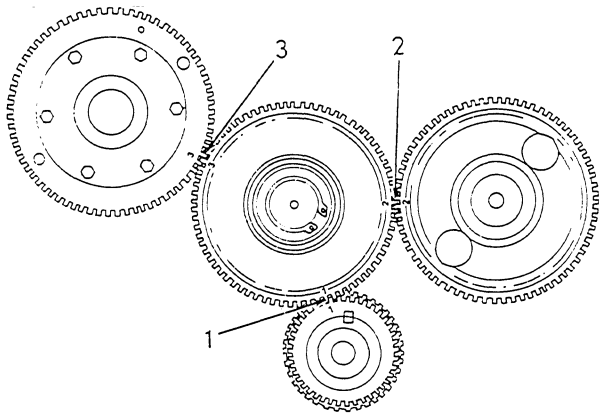
8.4.7
Cylinder head gasket must be replaced whenever cylinder heads are removed. The gasket is designed with an anti leak adhesive rib that fits along side the push rod passages. When installing head be sure that cylinder head gasket is properly positioned on engine block with the word "ALTO" facing upward, Fig. 57. Install gasket dry. Do not use sealant, dope or cement to install gasket.

IMPORTANT: There is a rocker arm oil passage restriction dowel which must be installed between deck of block and lower surface of head, Fig.57.

9.1.2.6
Remove and identify lifters.

9.1.2.7
The journal and cam lobe surfaces should be perfectly smooth. If scratches, score marks, or sign of scuffing are discovered, camshaft must be replaced.

9.1.2.8
Examine the camshaft for straightness. Place the camshaft in V-blocks and use a dial indicator to measure journal concentricity. The maximum acceptable variance from straight is .02mm (.0008"). To restraighten the camshaft, use a press to correct errors of up to .2mm (.008"). If distortion is greater than .2mm (.008") the camshaft must be replaced.



T-81984

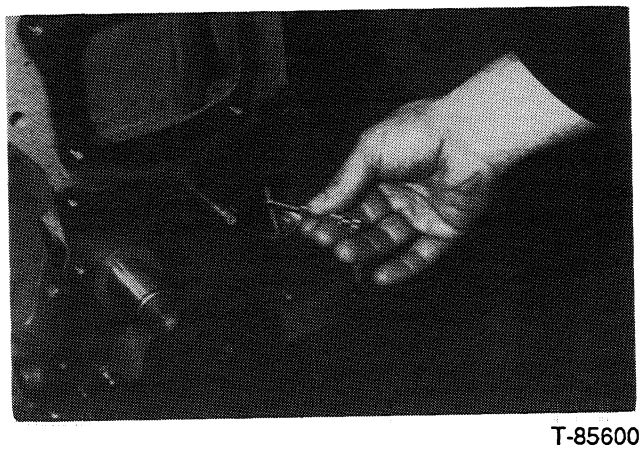
FIG. 66 CORRECT RELATIONSHIP OF REFERENCE MARKS ON GEARS (Right sideup)

1. Numbers 1 aligned
2. Numbers 2 aligned
3. Numbers 3 aligned

9.1.2.9
Examine camshaft bushings. Access to the bushings (and lifters) is gained with engine upside down. Carefully rotate crankshaft to expose bushings, and lifters. The cam bushings are press-fit into their seats in the engine block. If any looseness is discovered, the bushings must be replaced, Fig. 67. Remove cam shaft bushings using tool FA P/N 75294892.

9.1.2.10
Examine the bores of the bushings for traces of scuffing or scoring. The bores must be smooth and bright. Slight scratches on bushings can be corrected by touching them up with a very fine grit oil stone, Fig. 67.

9.1.2.11
The clearance between camshaft bushings and journals must be within tolerances. Use inside reading micrometer to measure I.D. of camshaft bushings. Use outside reading micrometer to measure O.D. of camshaft journals. The clearance between any given camshaft bushing and journal should be .080mm - .160mm (.0031 - .0063"). Replace bushings and/or camshaft when wear exceeds the .160mm (.0063") maximum. To remove bushings, use the special tool illustrated in Fig. 68, item 1.

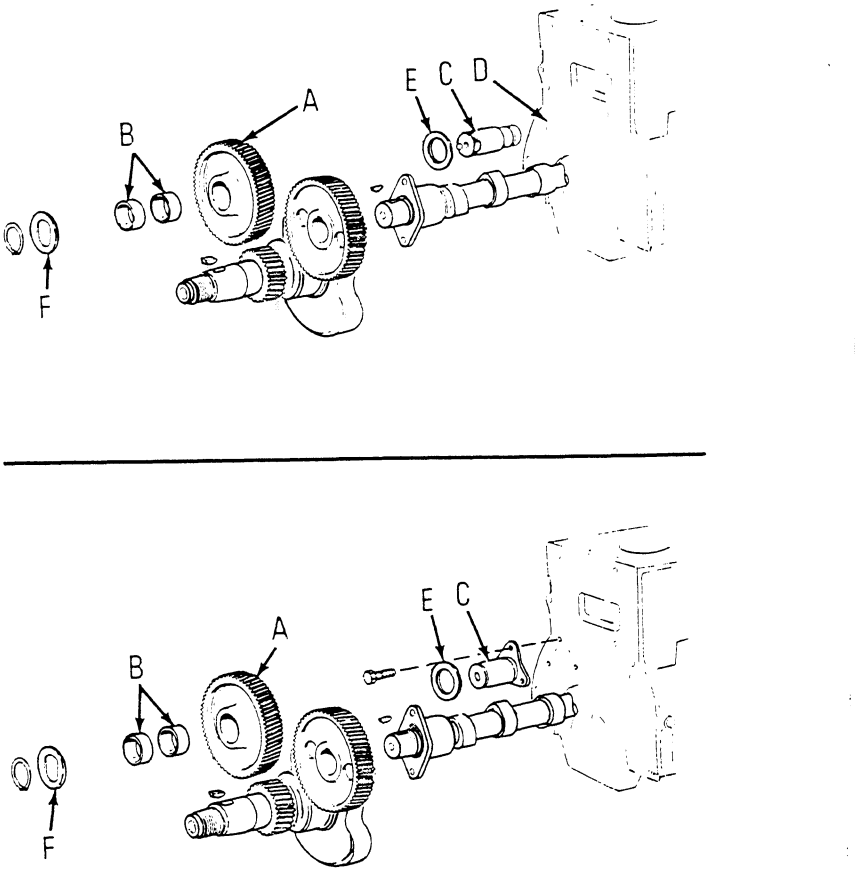


T-85600

FIG. 67 MEASURING CAMSHAFT BUSHING ALIGNMENT

9.1.2.12
Inspect the cam lobes and related tappets. Even though wear of the cam lobes may not be visible, it is advisable to use a micrometer to compare the height of lobes (intake-to-intake)(exhaust-to-exhaust). If any serious wear difference is discovered, the camshaft should be replaced. Lifter wear information is reviewed in paragraph 9.2

9.1.2.13
Examine the drive gear on end of camshaft. If wear is noticeable, the gear should be replaced. Remove gear by using a conventional gear pulling tool. To install gear, slip thrust plate and woodruff key into place on camshaft, and secure camshaft vertically beneath an arbor type press. Heat the gear to 122°C (250°F) and press onto shaft until gear seats against the land that holds gear away from thrust plate.

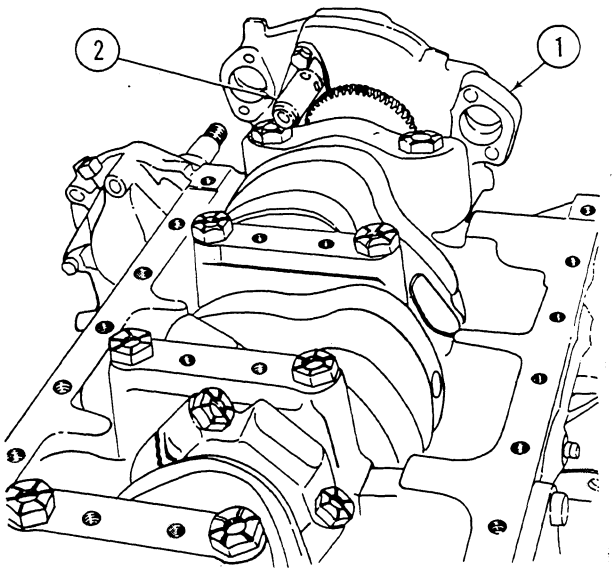


T-100299

FIG. 79 IDLER GEAR ASSEMBLY

The following Idler Gear specifications are divided into two columns determined by the cylinder sleeve bores.

103mm (4.0550 in)		104mm (4.0945 in)	
8065.04.089	65B	8061.I05.017	65B
8065.04.095	FD7,FL7	8065.05.290	FR10B
8065.04.097	FE18	8065.05.295	FD7,FL7
8065.24.091	FR10	8065.05.297	FE18
8065.24.092	FR12	8065.25.080	FH200
8065.24.098	FE18R	8065.25.092	FR12,FR12B
		8065.25.094	FR130
		8065.25.095	FD9
		8065.25.096	FA120
		8065.25.097	FL10E
		8065.25.098	FE18R
		8065.25.099	FD10E
		8065.SI25.003	FR10
		8065.SI25.004	FR11



T-81998

FIG. 85 OIL PUMP & RELIEF VALVE

1. Oil pump 2. Relief valve

10.3.2.2
Remove oil pan (refer to paragraph 10.2)

10.3.2.3
Remove oil inlet and outlet pipes to pump, then remove oil pump.

10.3.2.4
Clean the pump assembly.

⚠ WARNING

Never use gasoline or solvent or other flammable fluid to clean parts. Use authorized commercial, non-flammable, non-toxic solvents.

10.3.2.5
Remove capscrews and washers securing pump cover to pump body, and remove cover, gears, etc.

10.3.2.6
Inspect pump gear teeth, housing, and interior face of pump cover, for wear and scoring. All surfaces must be free of scratches, score marks and rough spots.

10.3.2.7
If the driving gear and shaft requires removal, use a conventional gear extraction tool to pull helical gear off of opposite end of shaft.

With helical gear removed, the driving gear and shaft can be removed to gain access to the back bushing. A conventional bushing/seal tool should be used to remove and replace failed parts.

10.3.2.8
Measure and compare the dimensions of the oil pump components with specifications in paragraph 10.4.

NOTE: Low oil pressure, or a noticeable loss of oil pressure, usually indicates severe wear. Pump should be replaced.

10.3.2.9
While pump is removed, thoroughly clean the pipes and suction screen.

10.3.2.10
Remove, clean and inspect the oil pump pressure relief valve. The spring loaded piston must slide smoothly in bore of valve body. When parts show wear or excessive roughness, the assembly should be replaced.

10.3.3 OIL PUMP ASSEMBLY & INSTALLATION
10.3.3.1
A special procedure is required to reinstall the helical gear on driving gear shaft. The helical gear must be heated and the shaft cooled until there is a temperature difference of 240°C (464°F) between the two parts. It is recommended that dry ice be used to cool shaft.

IMPORTANT: Do not heat gear above 149° - 163°C (300° - 325°F) (a dull red glow visible only in the dark). Heating to cherry red will destroy gear heat-treatment. When gear is properly heated, and shaft is properly cooled, slide shaft into pump housing. Quickly align heated gear on shaft and press gear onto shaft (concave face of gear toward pump housing) until it seats. Allow assembly to cool slowly. Do not cool with water!

NOTE: It is suggested that a *"TEMPLE STICK"* be used to measure gear temperature.

10.3.3.2
Fig. 86 illustrates the location of parts that make up oil pump. Use illustration to guide reassembly.

10.3.3.3
Torque pump capscrews (lubricated) to specifications. Do not use any type of gasket material, compound or cement. Lubricate each component before installation. Use a new O-ring under the relief valve.

IMPORTANT: Replace the water pump seal whenever the pump is opened for examination.

Use a conventional drift punch to drive the old seal out through the impeller gallery of pump.

11.6.4. WATER PUMP ASSEMBLY

⚠ WARNING

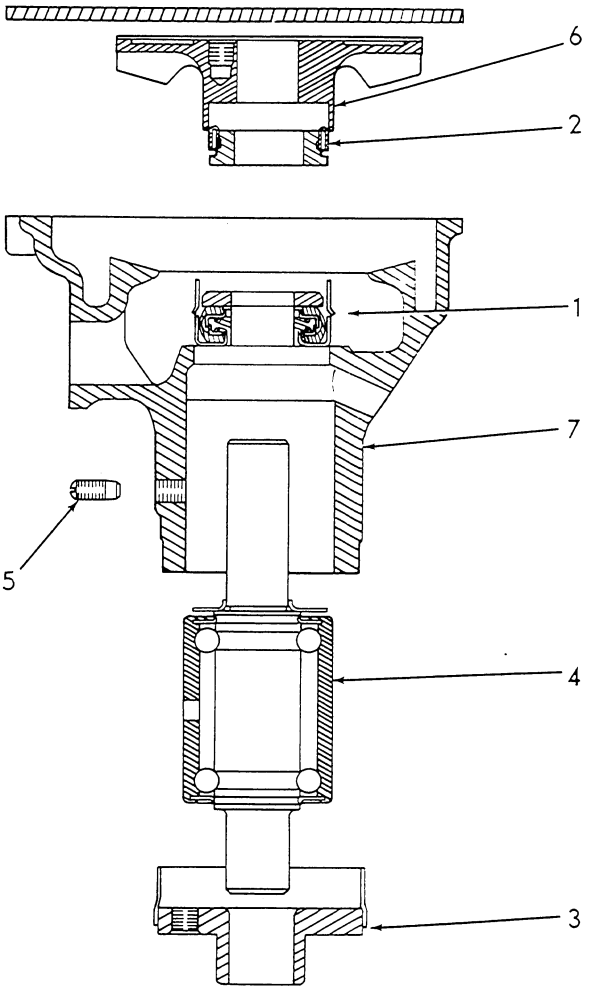
Never use gasoline or solvent or other flammable fluid to clean parts. Use authorized commercial, non-flammable, non-toxic solvents.

11.6.4.1
Thoroughly clean all surfaces of pump body, impeller and cover plate. Make sure the threaded hole that accepts the bearing retaining set screw, Fig. 91, item 5 is clean and open.

11.6.4.2
Replace seal as follows: position the pump body in an arbor press with the impeller gallery up, Fig. 95. Center the seal over hole in pump body (7). Carefully press the bearing (1) into place until seal stop tabs (1) contact pump body.

11.6.4.3
Fig. 95. Press the cushioned metal bushing (2) into the recess in impeller (6) (cushioned side in).

11.6.4.4
Fig. 95, items 3 and 4. Place the shaft/bearing assembly (4) in arbor press, and center the hub (3) over shaft. Press hub onto shaft/bearing assembly (4) until the chamfered end of shaft extends just beyond hub, until edge of chamfer just shows.



T-82069

FIG. 95 WATER PUMP ASSEMBLY SEQUENCE (Typical)

1. Seal (presses into pump body - 7)
2. Cushioned metal bushing (presses into impeller recess - 6)
3. Fan/pulley hub (presses onto shaft/bearing assembly -4)
4. Shaft/bearing assembly (fits into pump body - 7)
5. Set screw (locks the shaft/bearing 4 to pump body - 7)
6. Impeller (presses onto shaft/bearing - 4)
7. Pump body

12.5.2.1.4

Carefully pull the holder assemblies out of engine cylinder head using a slide hammer (FA P/N 75300175) and an adaptor made by welding two nuts together as shown in Section 13, Service Tools.

NOTE: Each holder assembly is fitted into a sleeve in cylinder head. After extended usage, the holder assemblies sometime stick in these sleeves. When holders are seized, use penetrating oil and/or a conventional slide hammer type puller to loosen parts. Each holder hole should be plugged at the time holder is removed. Do not allow foreign material to fall into injector holes.

Holders and their corresponding sleeved holes should be numbered for ease of identification.

12.5.2.2 Inspection & Cleaning

12.5.2.2.1

Visually examine each holder assembly for signs of fouling or deterioration. Such signs are often indications of more serious engine and/or fuel pump problems.

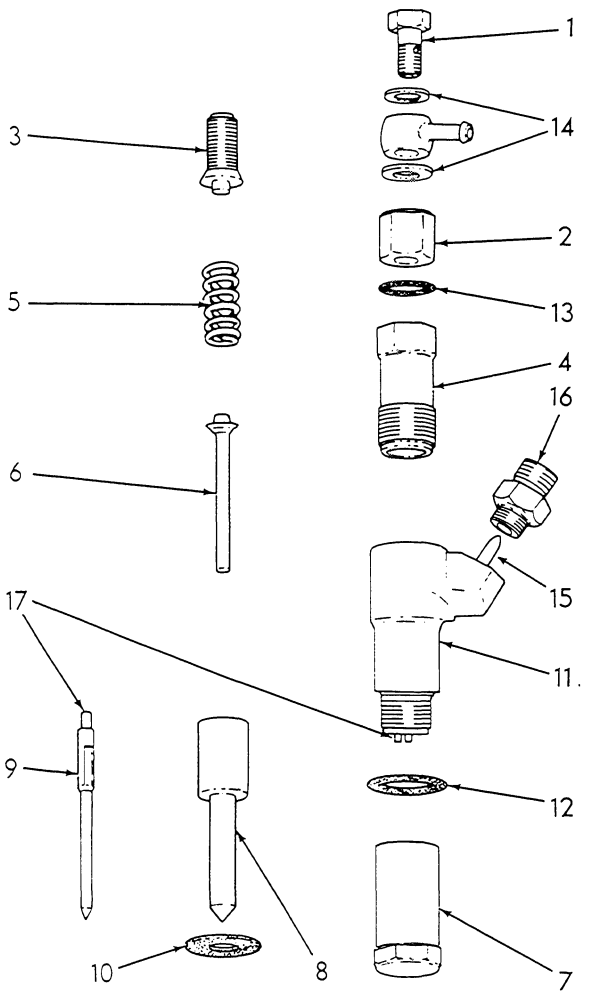
12.5.2.2.2

After the holders are removed, use a wire brush to clean all carbon deposits from nozzles/holders. Make sure that the spray orifices are clean. In conjunction with nozzle cleaning, it is suggested that each injector sleeve in head be examined. Use a flashlight to look for cracks, leaks, burns, and similar failures; after the exterior of holders is thoroughly cleaned, remove the inlet fitting, Fig. 105, item 16. Remove, clean and reinstall the filtering magnet (if applicable). Reinstall the inlet fitting. Torque to 74 Nm (55 lbs.ft).

12.5.3 NOZZLE & HOLDER REPAIR

12.5.3.1

Lock the holder assembly (nozzle up) into a padded vice so that it will not turn when a wrench is applied to nozzle nut, Fig. 107, item 7. Remove the outlet capscrew (1) and banjo fitting. Insert an allen wrench into adjusting screw (3) and turn counter-clockwise until tension on spindle spring (5) is relaxed. Remove nozzle nut (7) nozzle (8) and needle (9). Remove seal ring (12).



T-82079

FIG. 107 TYPICAL NOZZLE/HOLDER

1. Outlet screw & fitting
2. Locking nut
3. Adjusting screw
4. Spring barrel
5. Spindle spring
6. Spindle(with seat)
7. Nozzle nut
8. Nozzle body
9. Needle
10. Seal washer
11. Holder body
12. Seal ring
13. O-ring
14. Washer
15. Magnet (some applications)
16. Inlet fitting
17. Index pins

ELECTRICAL SYSTEMS

service manual

FORM 73146366 English

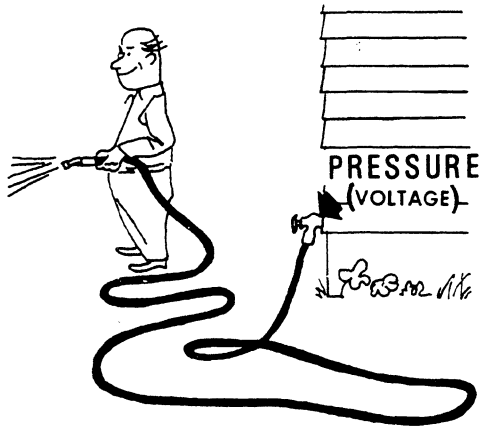
(Replaces 70695436, 73063024, 70696657)

TOPIC 2 TROUBLESHOOTING

2.1 TROUBLESHOOTING INSTRUMENTS

2.1.1
Introduction—Many different tools and instruments have been developed for checking the mechanical or electrical condition of the components of an electrical system. This specialized equipment enables quick and accurate checks in a minimum amount of time. Three basic instruments are used in the testing of electrical equipment. These instruments are the voltmeter, the ammeter, and the ohmmeter.

2.1.2
The Voltmeter—Voltage in an electrical circuit is frequently compared to water pressure in a piping system (Figure 1). The voltmeter is used to measure this electrical pressure to assist in the location of electrical malfunctions. For the applications associated with electrical systems described in this manual, greater accuracy is desired in the voltmeter than in any of the other electrical checking instruments because the most accurate settings have to be made to the voltages in these systems.

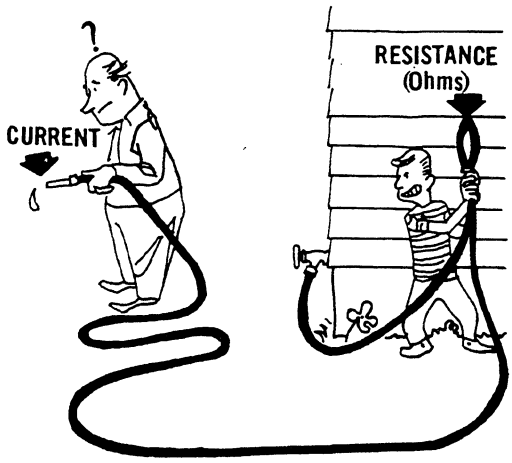


T-74522

FIG. 1 VOLTAGE IS SIMILAR TO PRESSURE IN A WATER HOSE

Voltmeters measure the difference in electrical pressure between the points where the voltmeter leads are attached. For example, a voltmeter connected across the terminal posts of a battery measures the difference in electrical pressure—the battery voltage—between the two terminals. A voltmeter connected across a resistor (in parallel, with one lead connected to each side of the resistor) measures the difference in voltage caused by the resistor. Typically, the voltage at a given point in a circuit is measured with respect to the voltage at some reference point, usually the return side of the circuit at the battery. It is often the case that one side of the battery is connected (grounded) to the conducting metal frame and chassis of the unit. In such cases, the chassis is used instead of many separate wires to the battery terminal. In general, the grounded battery terminal should be used as the reference point for the voltages in a circuit.

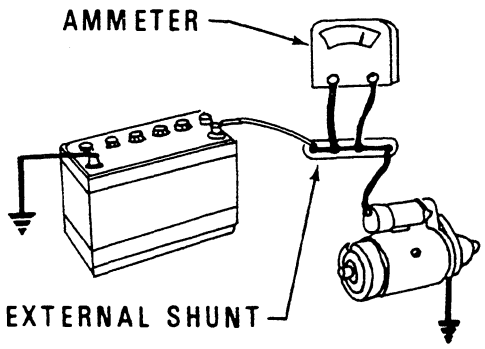
2.1.3
The Ammeter—The current past a point in an electrical circuit can be compared to the quantity of water that can flow through a particular pipe in a water system. The amount of current (measured in amperes) that will flow depends on the voltage (like pressure) available to push the current and on the amount of resistance encountered in the electrical circuit to impede it. (See Figure 2.)



T-74524

FIG. 2 AMPS AND OHMS ARE SIMILAR TO CURRENT AND RESISTANCE IN A WATER HOSE

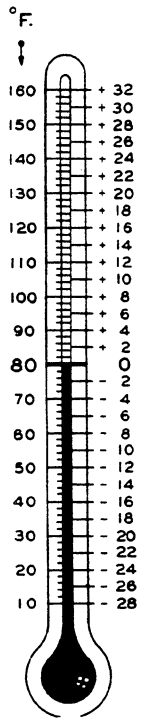
The ammeter is used to measure the flow of current. Since the current flows through the circuit, an ammeter must be connected in series with the circuit being measured. However, most ammeters cannot use all the current in the circuit in indicating a measurement, so a large, accurately measured fraction of the current is often diverted through an external path or shunt (shown in Figure 3) across the



T-74523

FIG. 3 EXTERNAL SHUNT

MEMO



EXAMPLE No. 1 —
Temperature *below* 80°F.
Hydrometer Reading 1.250
Acid Temperature 20°F.
***Subtract* .024 Sp. Gr.**
Corrected Sp. Gr. is 1.226

EXAMPLE No. 2 —
Temperature *above* 80°F.
Hydrometer Reading 1.235
Acid Temperature 100°F.
***Add* .008 Sp. Gr.**
Corrected Sp. Gr. is 1.243

(T-74527)

FIG. 22 CORRECTION FOR HYDROMETER

CAUTION

The battery electrolyte is a corrosive, acid solution. Avoid any contact of the electrolyte with skin, eyes, or clothing. If spills occur, they should be washed immediately with large amounts of water and, if possible, soap.

7.3 MAINTENANCE

7.3.1
Basic Servicing—A battery is a perishable item requiring periodic service. When a battery is properly maintained, the reward will be long and trouble-free operation. Regular maintenance should include the following steps:

1. Check the electrolyte level. Add clean water (distilled, if available) to maintain the prescribed level, but do not overfill the battery cells and cause a loss of electrolyte from spillage. Excessive use of water indicates overcharging or possible leakage.

2. Keep the top of the battery clean. When necessary, wash corrosion off the terminals with a baking soda solution, and rinse them with clear water. Use a steel brush or steel wool, if necessary, to be sure that the terminals are really clean. Coat the connections and the terminals with a very light layer of grease to retard additional corrosion.

3. Inspect the cables, clamps, and hold-down brackets. Clean them, and replace them as necessary.

7.3.2
Temperature Considerations—The electrolyte of a battery, in various states of charge, will start to freeze at the temperatures indicated below. The given temperatures indicate the approximate temperatures at which ice crystals first begin to form in the electrolyte. The electrolyte will not freeze solidly until a slightly lower temperature is reached, but solid freezing of the electrolyte may crack the battery container or damage the plates.

Specific Gravity (Corrected to 80°F (27°C)	Freezing Temperature
1.280	-90°F (-69°C)
1.250	-62°F (-55°C)
1.200	-16°F (-27°C)
1.150	+ 5°F (-15°C)
1.100	+19°F (- 7°C)

A battery charged three-fourths or more is in no danger of freezing, so batteries shoulc be kept at least three-fourths charged in winter weather.

7.3.3
Storage—If the equipment is not going to be used for more than one month, the battery should be removed and stored in a cool, dry place. During extended storage, it should be checked periodically and recharged as necessary. A battery left unused for a long period of time is subject to the crystallization of lead sulfate on the plates; this deterioration will adversely affect future performance.

7.3.4
Testing on the Unit—The electrolyte level should be checked and corrected, and the battery should be visually inspected. Signs of damage or serious abuse, like excessive corrosion, a cracked or bulging case, or cracked cell covers, will mean that the battery has to be replaced. A hydrometer test also can be performed.

The voltage of each cell of the battery may be checked with a voltmeter to be sure that each cell is properly charged. It is possible that a single cell of the battery has gone bad and has become incapable of holding a charge. This will be evident either through a low battery voltage, or a low individual cell voltage. Figure 18 illustrates the use of a special voltmeter to check the battery. Any voltmeter can be used, and the voltmeter should indicate between 1.7 and 1.8 volts per cell for battery temperatures between 70°F and 90°F (21°C and 33°C). If any cell indicates a low voltage and the situation cannot be remedied by charging (as described in Section 7.3.6), the battery will have to be replaced.

It is possible for a faulty battery to indicate sufficiently high cell voltages on a voltmeter, but still not perform satisfactorily on the unit. This is because the voltmeter

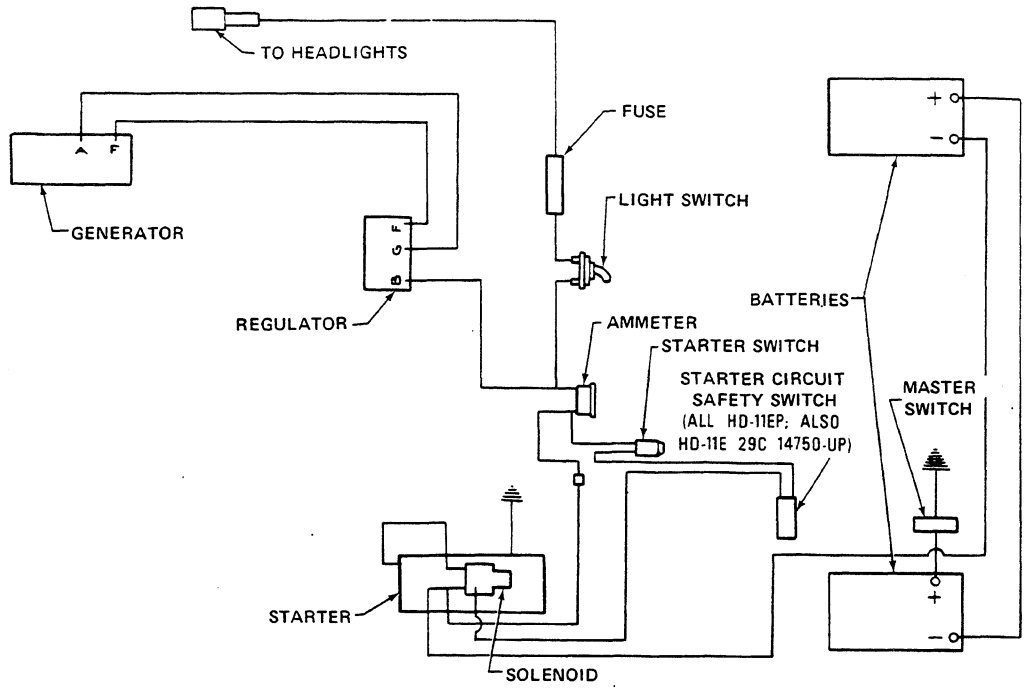


FIG. 27 HD-11 CRAWLER TRACTOR, HD11G CRAWLER LOADER (S/N 6427-up; 17L14651 through 17L16000; 29C14651 through 29C16000; 46Y14651 through 46Y16000)

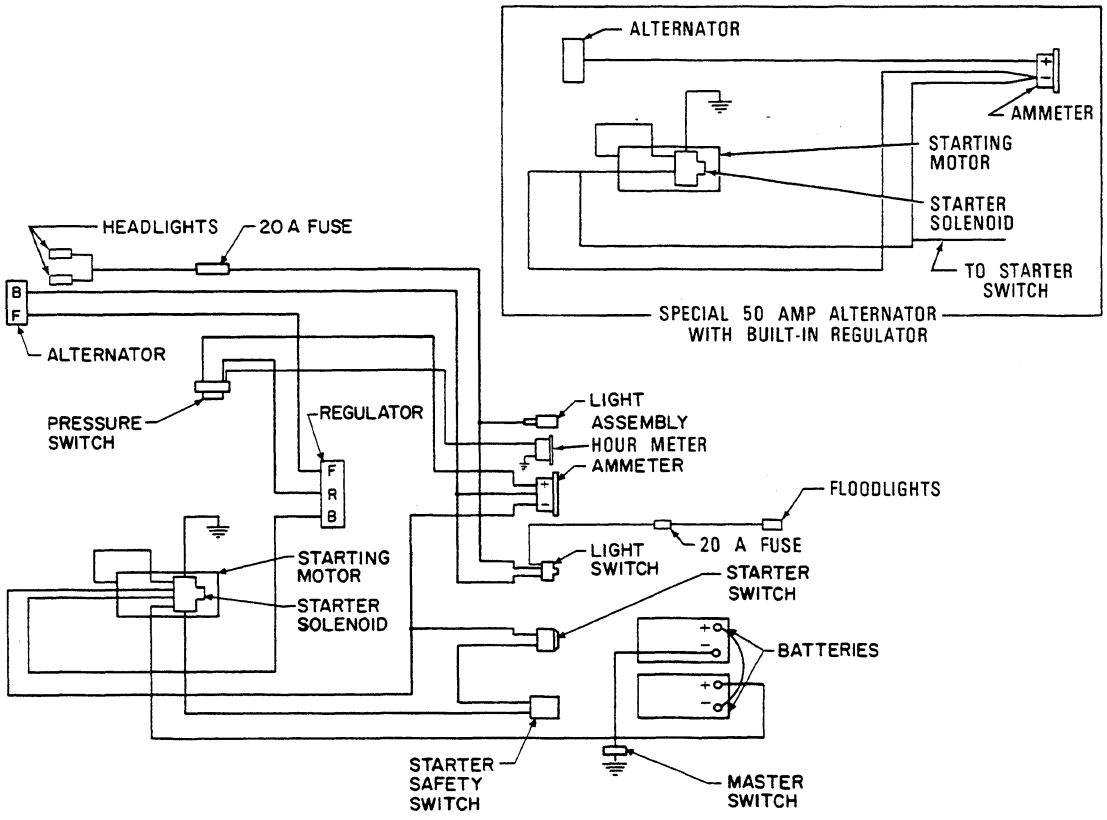
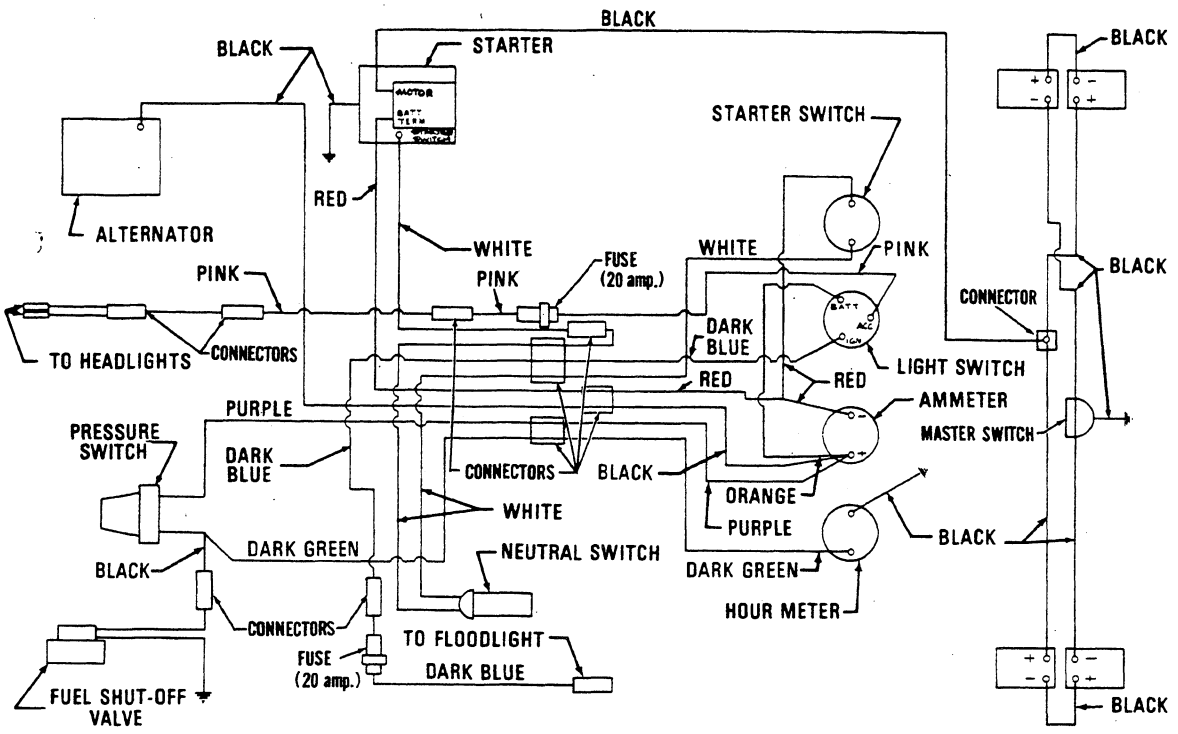


FIG. 28 11-B CRAWLER TRACTOR (S/N 16C16001-up; 25L16001-up)



HD-41

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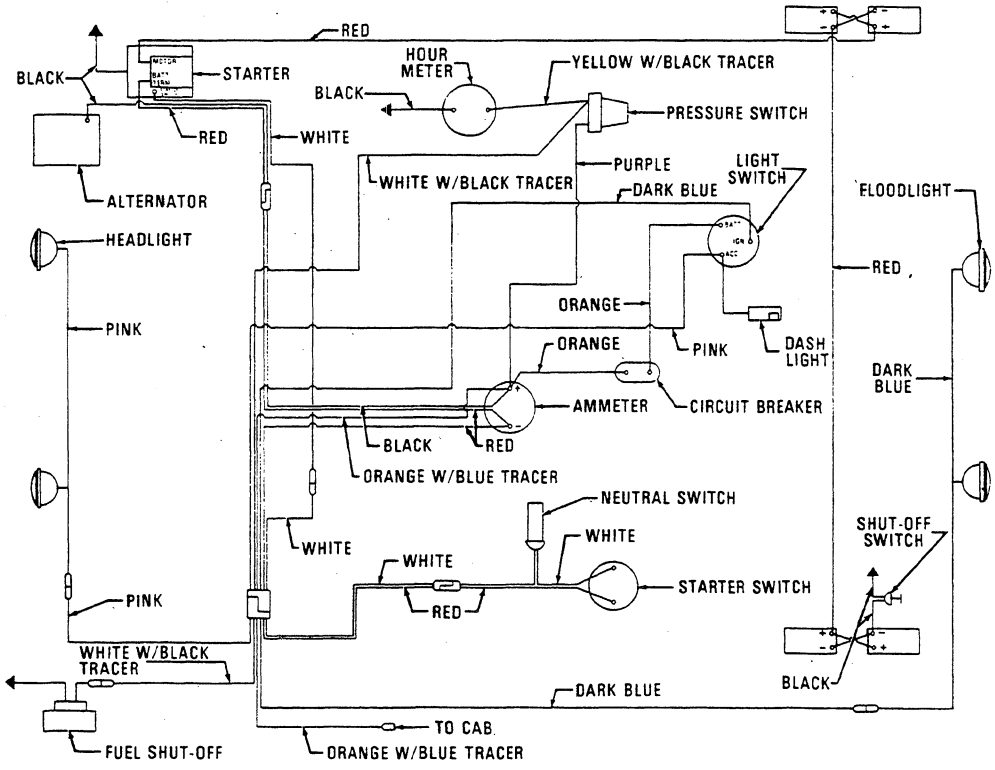

41-B

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FIG. 39 WIRING SCHEMATIC

Study SAFETY RULES in the front of this manual thoroughly for the protection of machine and safety of personnel.

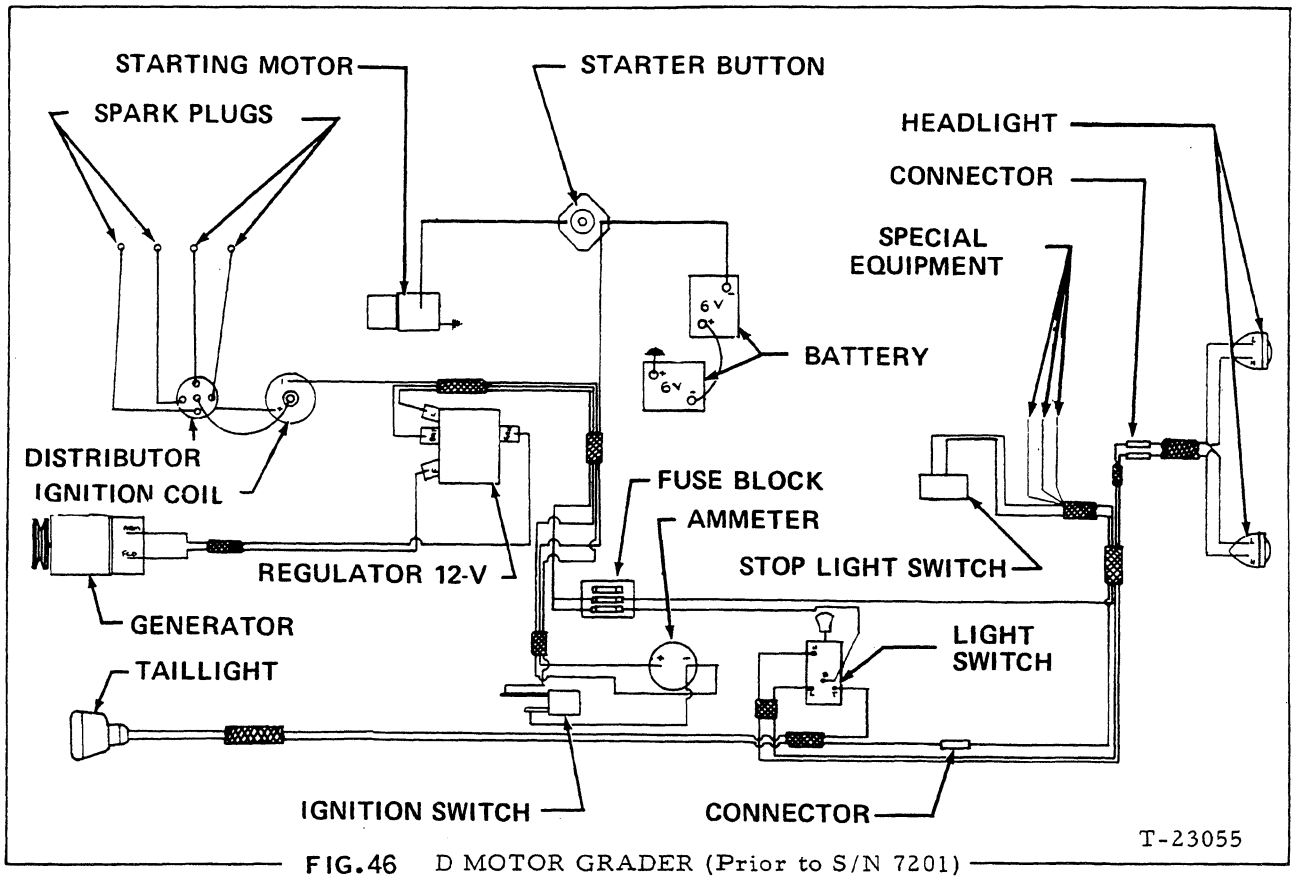


FIG. 46 D MOTOR GRADER (Prior to S/N 7201)

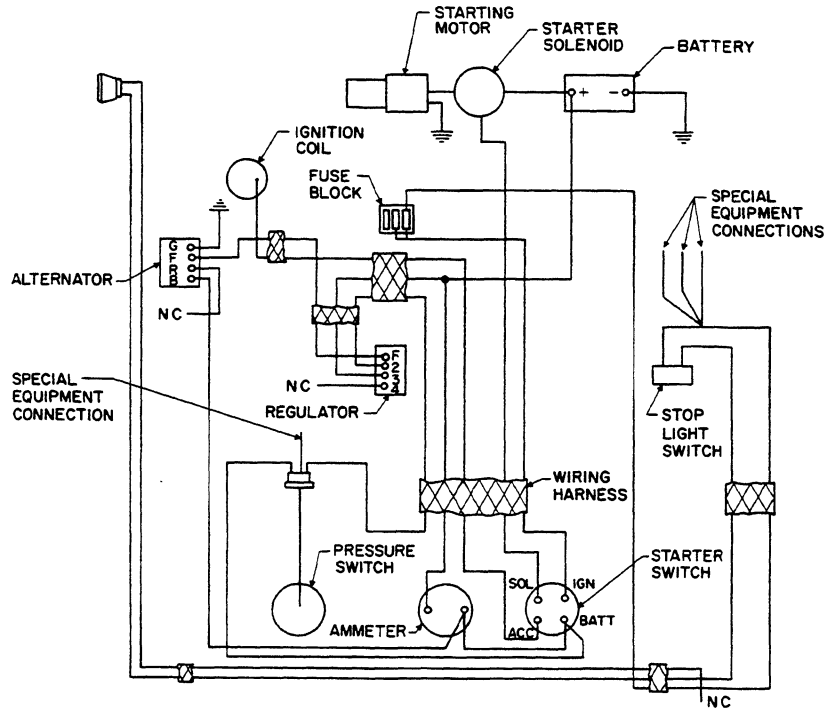


FIG. 47 D MOTOR GRADER (S/N 7201-up)

Electrical System Schematics

Legend for Fig. 59

1. Circuit Breaker
2. Circuit Breaker
3. Circuit Breaker
4. Circuit Breaker
5. Circuit Breaker
6. Circuit Breaker
7. Circuit Breaker
8. Circuit Breaker
9. Key switch
10. Hourmeter
11. Voltmeter
12. Engine start clearing switch(FG85,95 only)
13. Cold start switch
14. Cold start solenoid
15. Coldstart engine temperature switch
16. Engine oil pressure/hourmeter switch
17. Full fuel solenoid
18. Lamp diode(FG85,95 only)
19. Starter

Electrical System Schematics

Legend for Fig. 64

1. Circuit Breaker
2. Circuit Breaker
3. Circuit Breaker
4. Circuit Breaker
5. Circuit Breaker
6. Circuit Breaker
7. Circuit Breaker
8. Circuit Breaker
9. Key switch
10. Reverse alarm
11. Reverse alarm switch
12. Saddle lock pin solenoid
13. Moldboard pin switch
14. Beacon switch
15. Beacon

T-78864

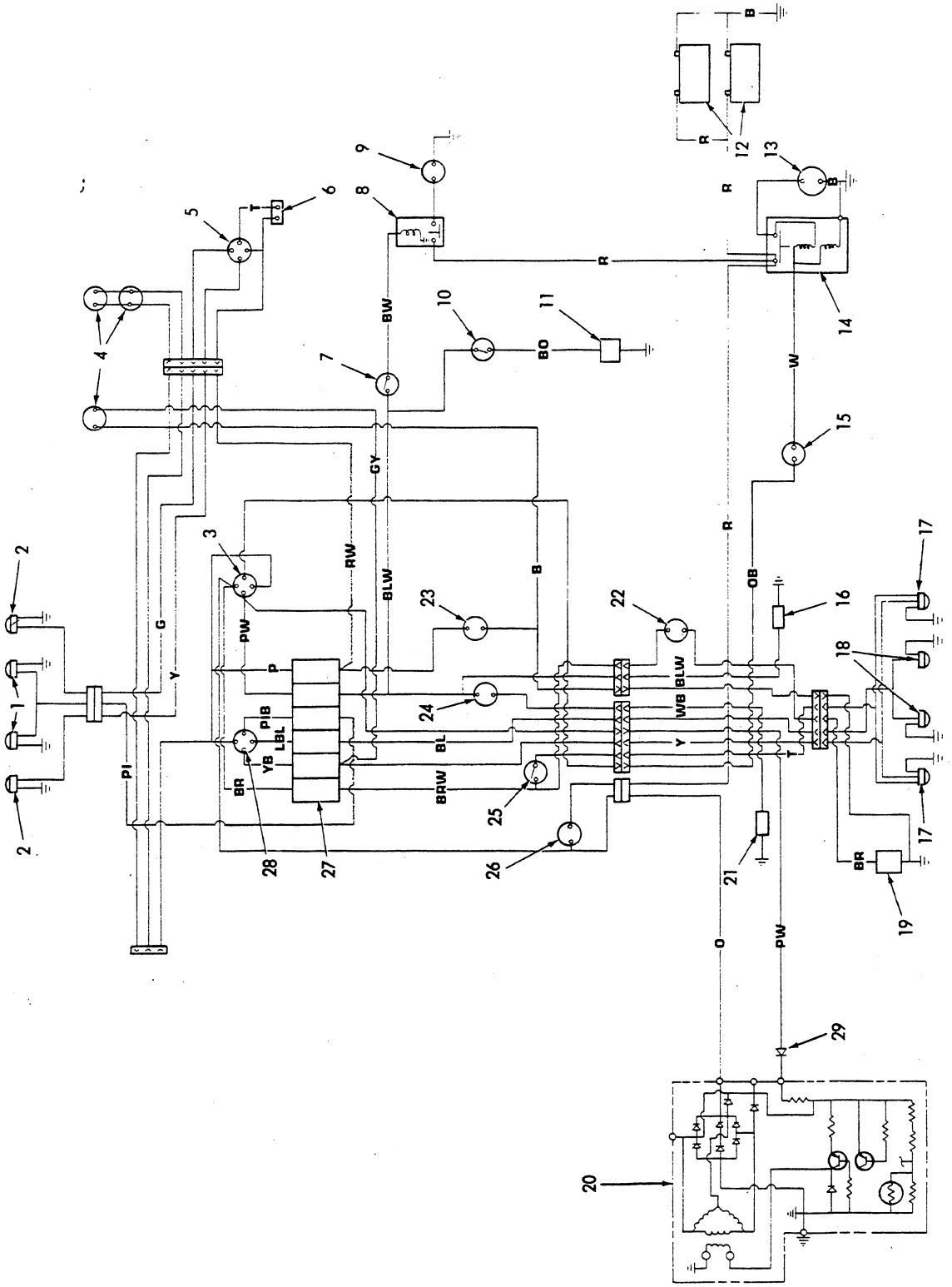
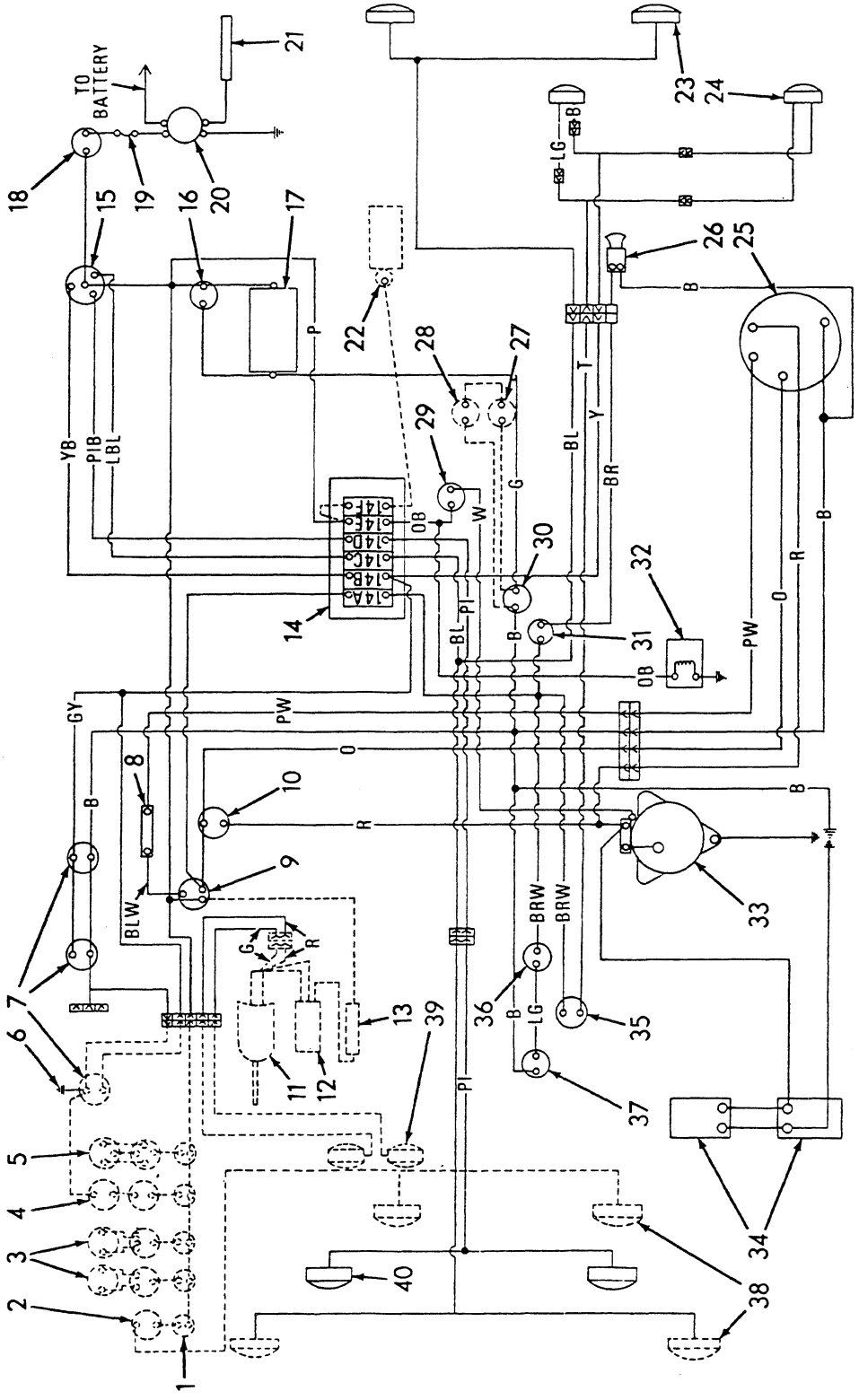


FIG. 73-345-B WHEEL LOADER



T-80419

FIG. 81 ELECTRICAL SYSTEM SCHEMATIC
(Eff. 545-B S/N 21C06870 and 605-B S/N 6863)
(Except 545-B S/N 33A07204-UP)

LEGEND FOR FIG. 49

1. Flood light switch
2. Cab defroster fans
3. Rear window wiper
4. Front window wiper
5. Cab ground
6. Instrument panel lights
7. Key switch
8. Ammeter
9. Circuit breaker junction box

9A. Stop lights - 8 amp
9B. Tail lights - 8 amp
9C. Flood lights - 15 amp
9D. Head lights - 8 amp
9E. Starter switch - 15 amp
9F. Cab heater - 8 amp

10. Low air pressure buzzer
11. Low air pressure warning light
12. Light switch

*13. Engine air heater switch
*14. Fuse
*15. Magnetic switch
*16. Air heater

17. Cab heater switch
18. Rear flood lights
19. Stop lights/tail lights

**20. Back-up alarm
21. Alternator (integral) 40, 45 or 50 amps

***22. Electric F.I.P. shut off

23. Low air pressure switch
24. Starter switch

**25. Back-up alarm pressure switch

26. Starting motor
27. Batteries
28. Stop light switch

**29. Hour meter pressure switch
**30. Hour meter

31. Optional flood lights
32. Optional turn signals
33. Fuse
34. Turn signal flasher
35. Turn signal switch
36. Head lights
37. Fuse and fuse holder
38. Resistor (part of integral alternator circuit)

See Note:
*** Standard circuit after Feb. 1966 (S/N 11Y04904)
** Standard circuit after May 1966 (S/N 11Y05008)
* Standard circuit after Nov. 1977 (S/N 11Y05638)

NOTE: Not applicable to brush-type alternator

COLOR CODE FOR FIG. 49

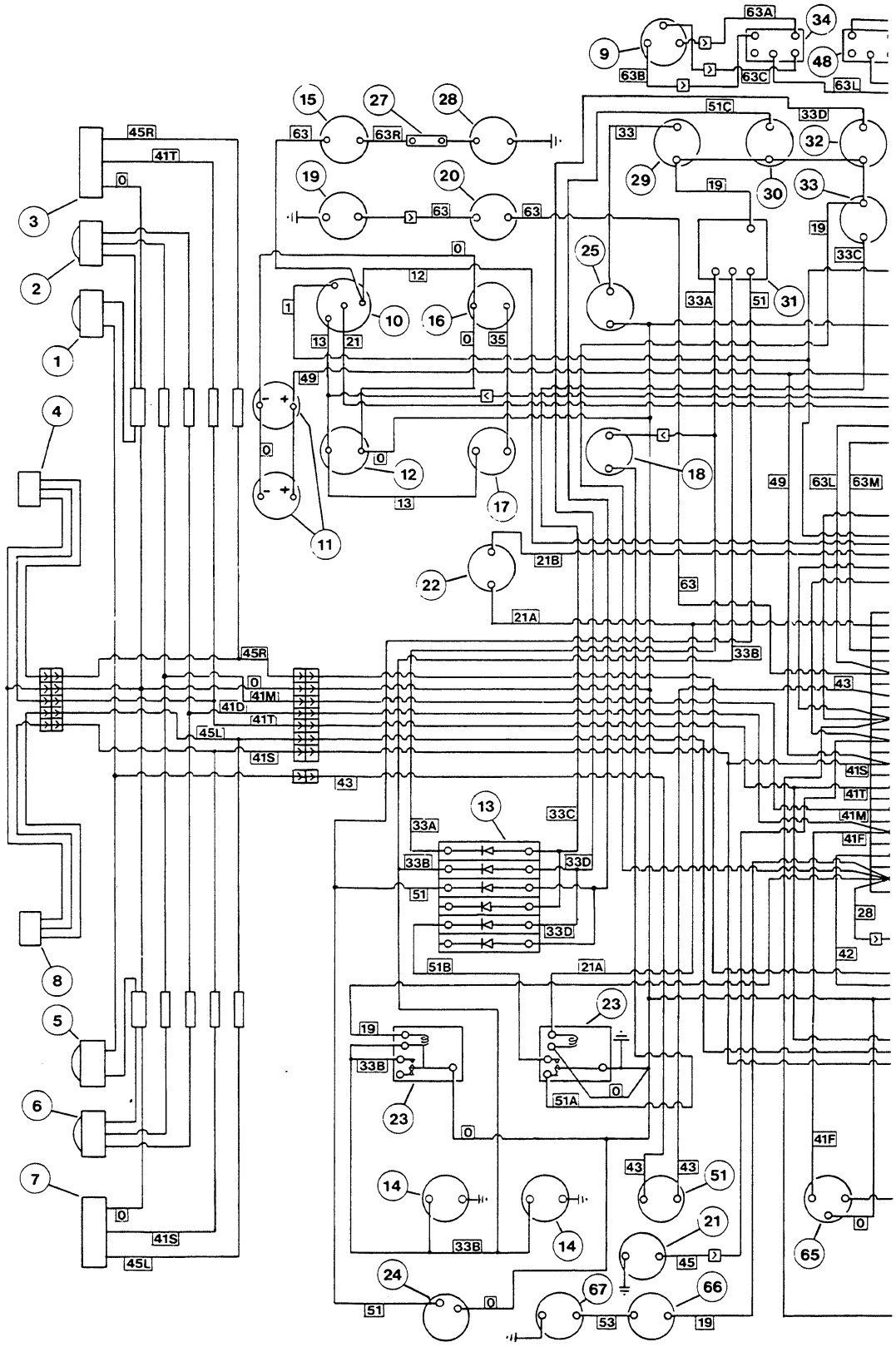
B - Black
LBl - Light Blue
Bl - Blue
Br - Brown
G - Green
LG - Light Green
Gy - Grey
O - Orange
P - Purple
Pi - Pink
R - Red
T - Tan
W - White
Y - Yellow
Br/W* - Brown with white tracer
O/B* - Orange with black tracer
Pi/B* - Pink with black tracer
Y/B* - Yellow with black tracer

LEGEND FOR FIG. 93

1. Panel Lights
2. Key Switch
3. Ammeter
4. Cab Junction Box
5. Brake Fluid Level Warning Light
6. Low Air Pressure Warning Light
7. Light Switch
8. Warning Buzzer
9. Headlight
10. Pressure Convertor Stroke Switch
11. Starter Switch
12. Pressure Switch
13. Pressure Switch
14. Back-Up Horn
15. Stop, Tail, Flasher Light
16. Alternator
17. Hourmeter
18. Starter Motor
19. Pressure Switch
20. Batteries
21. Floodlight
22. Resistor
23. Fuel Shut-Off Solenoid
24. Stoplight Switch
25. Flasher Switch
26. Flasher Unit
27. Flasher Warning Light
28. Hazard Warning Light
29. Side and Flasher Light
30. Main Beam Warning Light
31. Cab Connector
32. Diode
33. Warning Light, Floodlight

WIRING COLOUR CODE

B	—	Black
BL	—	Blue
BR	—	Brown
G	—	Green
LG	—	Light Green
GR	—	Grey
O	—	Orange
P	—	Purple
R	—	Red
T	—	Tan
DG	—	Dark Green
W	—	White
GW	—	Green/White
RB	—	Red/Black
RW	—	Red/White
YB	—	Yellow/Black
BRW	—	Brown/White
GR	—	Green/Red
BRY	—	Brown/Yellow
BRG	—	Brown/Green
BRR	—	Brown/Red
BLR	—	Blue/Red
BLW	—	Blue/White
GY	—	Green/Yellow
GB	—	Green/Black
GBR	—	Green/Brown
PB	—	Purple/Black



(LEGEND : see page 124)

FIG. 98-FR10 **ELECTRICAL**

(Loader serial no.

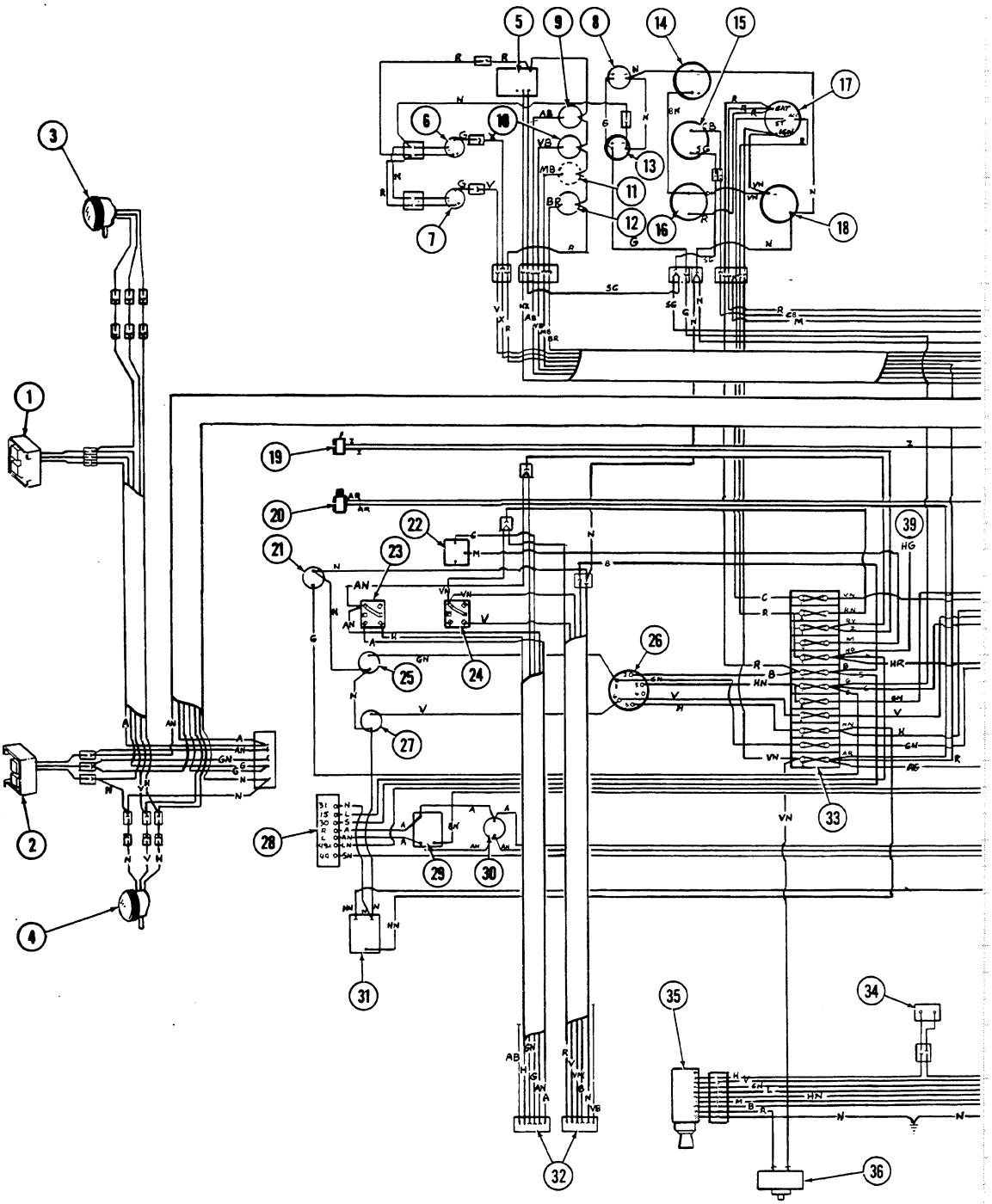
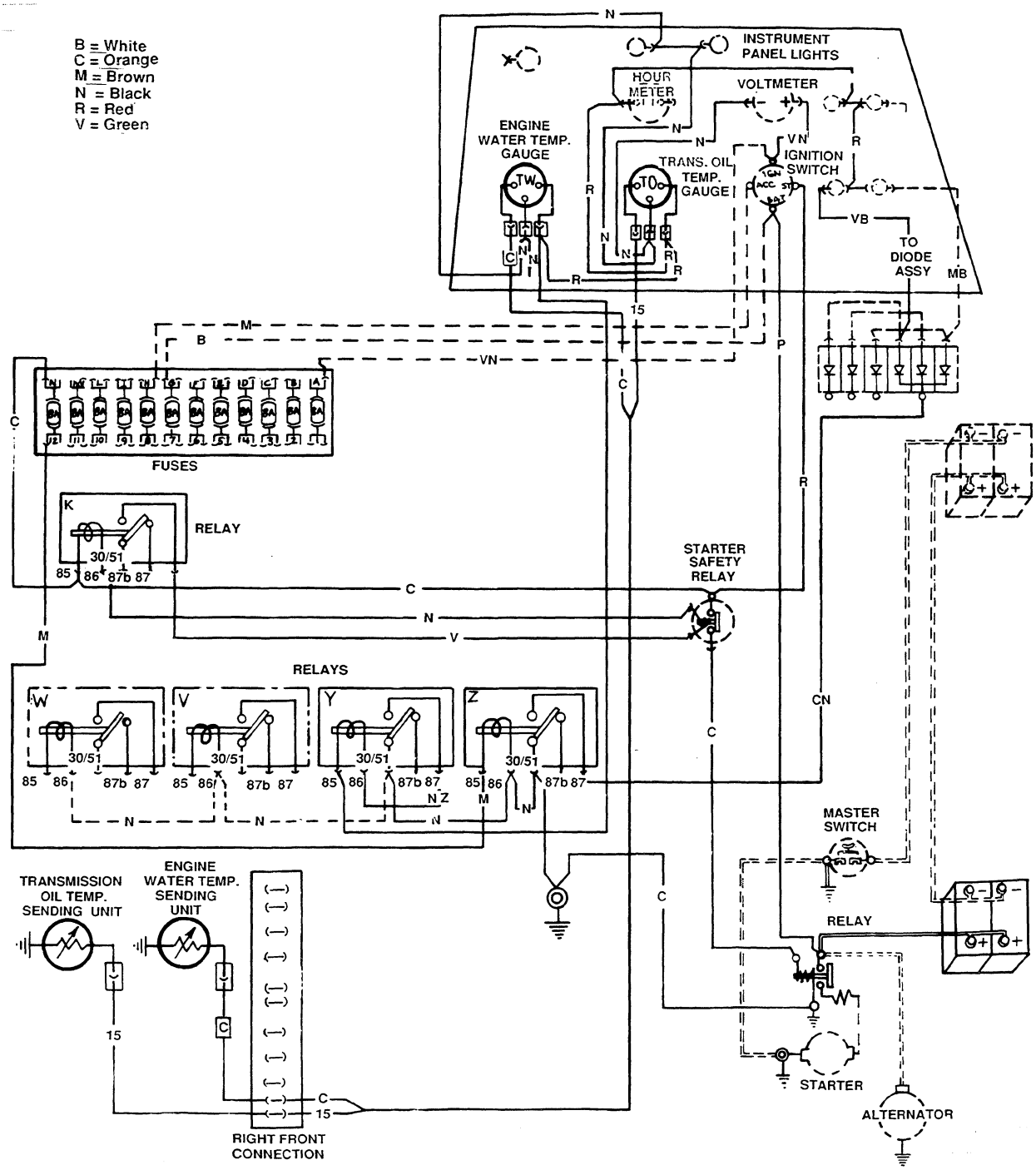


FIG. 101 FR10 (S/N 525395-UP);



T-85280

FIG. 107 FR15 (S/N 575403-UP) ENGINE WATER TEMP. and TRANS. OIL TEMP. GAUGES

NOTE:

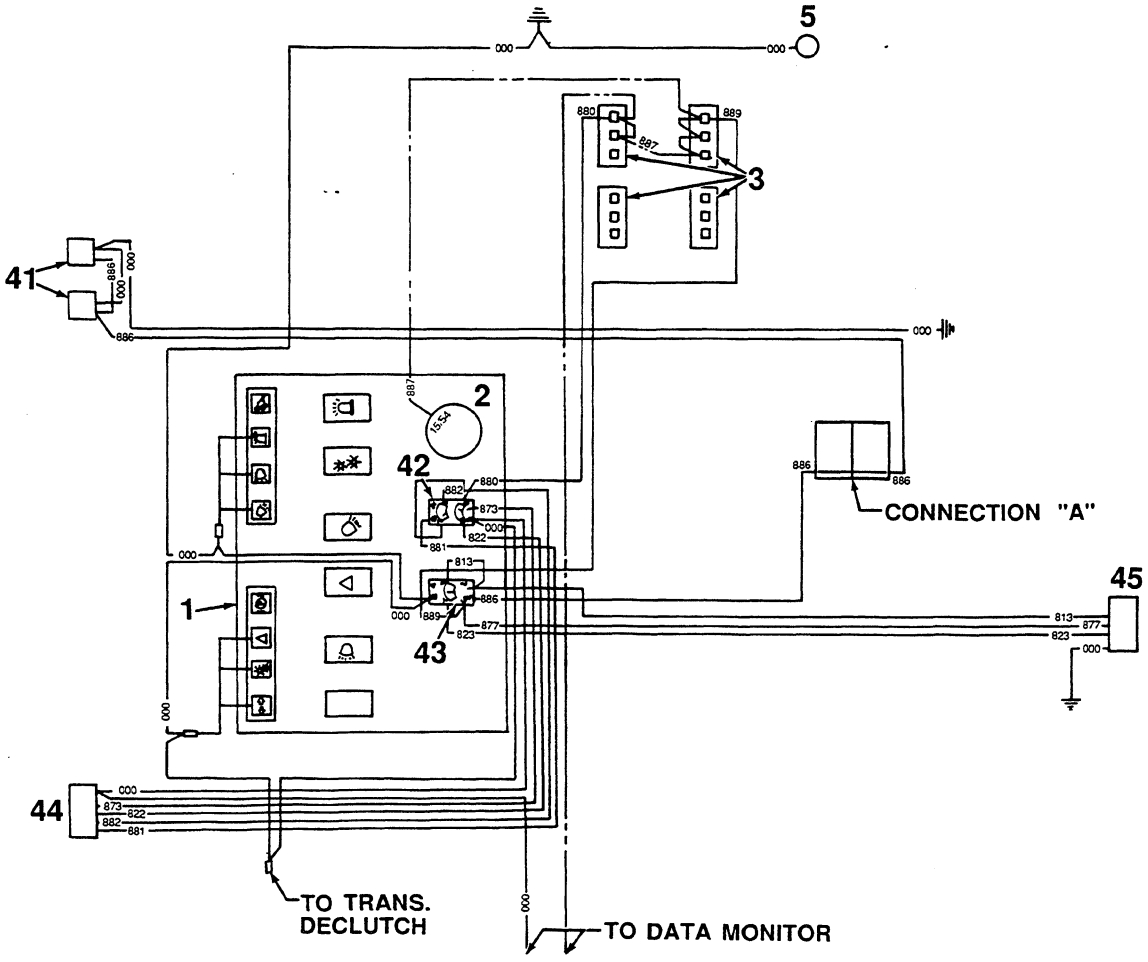
1. Circuits are identified by a number, or by a number and letter, contained in a square box. Metal tags bearing the circuit identification number are attached to each wire at all connectors and / or connection points.

2. Components are designated by a number in a circle. The following list identifies each designated component by its name.

LEGEND FOR FIG. 113

1. Right front cab floodlight
2. Right front head light
3. Right front side and turn signal/hazard flasher light
4. * Right front side and turn signal/hazard flasher light
5. Left front cab floodlight
6. Left front head light
7. Left front side and turn signal/hazard flasher light
8. * Left front side and turn signal/hazard flasher light
9. Front windscreen wiper motor
10. Ignition switch
11. Panel lights
12. Voltmeter
13. Diode assembly
14. Overstroke sensor switch
15. Rear windscreen washer switch
16. Hour meter
17. Engine oil pressure switch
18. Air pressure switch
19. Front windscreen washer pump
20. Front windscreen washer switch
21. Dome light
22. Neutral safety switch
23. Relay
24. Flow switch
25. Parking brake switch
26. Circuit breaker assembly
27. 10 amp. fuse
28. Rear windscreen washer pump
29. Parking brake "on" light
30. Emergency steering activated light
31. Buzzer
32. Brake system fault light
33. Low air pressure light
34. Front windscreen wiper switch
35. Flasher unit
36. Turn signal switch
37. Hazard warning switch
38. Light switch
39. Ether starting aid switch
40. Starter solenoid
41. Battery disconnect switch
42. Starter motor
43. Ether start solenoid
44. Thermo guard
45. Panel light
46. Heater switch
47. Heater unit
48. Rear windscreen wiper switch
49. Rear windscreen wiper motor
50. Turn signal/hazard flasher indicator light
51. Cab floodlight switch
52. Brake light switch
53. Excess fuel solenoid
54. Alternator
55. Batteries (2)
56. Alarm switch
57. Back-up alarm
58. Right rear flood light
59. Right rear turn signal/hazard flasher/tail light
60. Registration number plate light
61. Left rear flood light
62. Left rear turn signal/hazard flasher/tail light
63. Main beam warning light
64. Flood warning light
65. Fog light switch

* Fitted to Bucket Tooth Guard (Special Equipment)



T-85680

FIG. 120 FR10B WINDSHIELD WIPERS & WASHERS

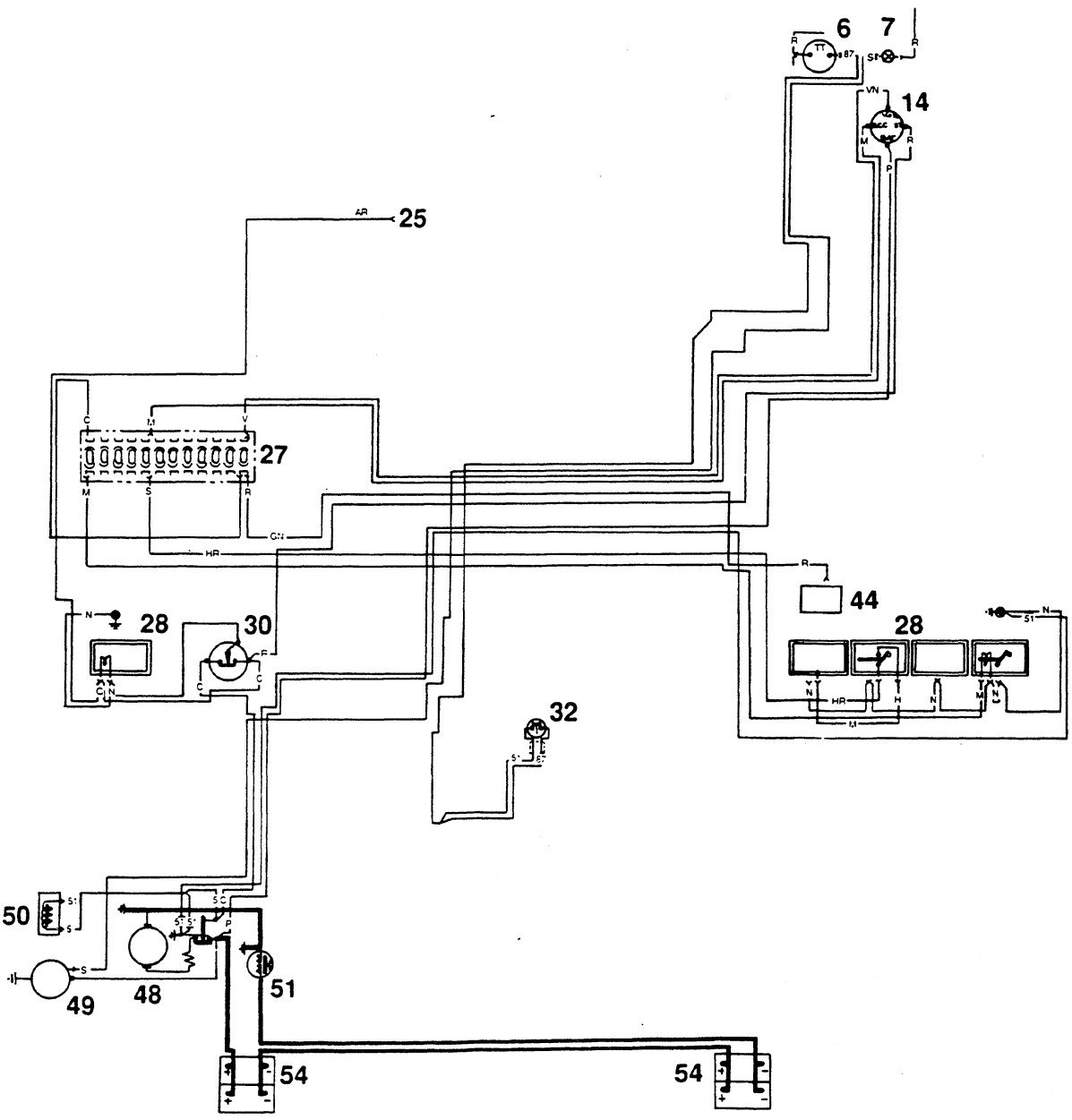


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FIG. 128 FR11, 12B, 15B, 20B BATTERY FEED

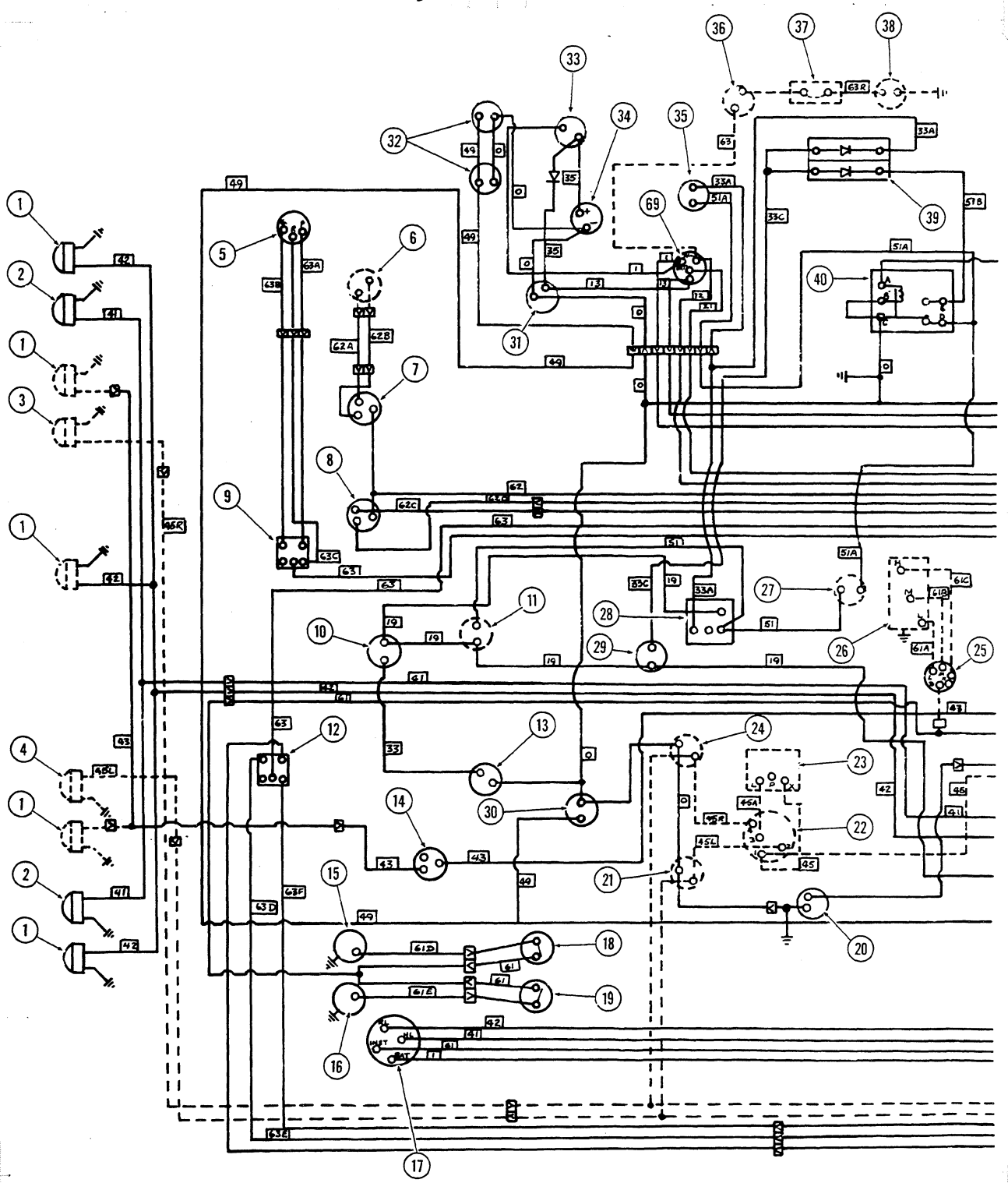

FIG. 133 FR35 ELECTRICAL SCHEMATIC

SAFETY RULES

Face the access system when climbing up and down.

Apply the parking device and place the transmission in neutral before starting the machine.

Do not bypass the starter safety switch. Repair the starter safety controls if they malfunction.

Fasten seat belt before operating.

Steering should be checked to both right and left. Brakes should be tested against engine power. Clutch and transmission controls should be moved through or to neutral positions to assure disengagement. Operate all controls to insure proper operation. If any malfunctions are found, park machine, shut off engine, report and repair before using machine.

If the power steering or the engine ceases operating, stop the machine motion as quickly as possible. Lower equipment, set parking device and keep machine securely parked until the malfunction is corrected or the machine can be safety towed. Never lift loads in excess of capacity.

Should the machine become stuck or frozen to the ground, back out to avoid roll over.

Know and understand the job site traffic flow patterns.

Keep the machine in the same gear going down hill as used for going up hill.

When roading a machine, know and use the signaling devices required on the machine. Provide an escort for roading where required.

Always use the recommended transport devices when roading the machine.

Do not attempt repairs unless proper training has been provided.

Use extreme caution when removing radiator caps, drain plugs, grease fittings or pressure taps. Park the machine and let it cool down before opening a pressurized compartment.

Release all pressure before working on systems which have an accumulator.

When necessary to tow the machine, do not exceed the recommended towing speed, be sure the towing machine has sufficient braking capacity to stop the towed load. If the towed machine cannot be braked, a tow bar must be used or two towing machines must be used - one in front pulling and one in the rear to retard. Avoid towing over long distances.

Observe proper maintenance and repair of all pivot pins, hydraulic cylinders, hoses, snap rings and main attaching bolts.

Always keep the brakes and steering systems in good operating condition.

Replace all missing, illegible or damaged safety signs. Keep all safety signs clean.

Do not fill the fuel tank to capacity. Allow room for expansion.

Wipe up spilled fuel immediately.

Always tighten the fuel tank cap securely. Should the fuel cap be lost, replace it only with the original manufacturers approved cap. Use of a non-approved cap may result in overpressurization of the tank.

Never drive the machine near open fires.

Use the correct fuel grade for the operating season.

1. GENERAL

FUEL SYSTEM
Fuel decontamination by two replaceable filters.

Fuel feed by piston lift pump and in-line, six barrel injection pump incorporating full speed range governor.

Fuel injection pump
Timing, port opening
FR10, FR12 ..... 28° ± 1° B.T.D.C.
FR11, FR12B ..... 25° ± 1° B.T.D.C.
Injection order 1-5-3-6-2-4
Injection release pressure ..... 230 +8 bar (3335 + 116 psi)

SUPERCHARGING
By exhaust gas-driven turbocharger
Type ..... GARRETT TO4B

LUBRICATION SYSTEM
Forced feed by gear pump provided with pressure relief valve.

Oil refrigeration by intercooler located in engine cooling system.

Gauze strainer on oil pump suction intake; full flow oil decontamination on delivery line by two replaceable, paper cartridge filters.

COOLING SYSTEM
Water, recirculated by centrifugal blade pump, thermostat controlled.
Engine to water pump RPM ratio ..... 1 to 1.68
Water cooling through radiator and seven-blade blower fan.

POWER TRAIN
Single-stage, single-phase, 280mm (11.02 in) dia hydraulic torque converter.
Stall ratio ..... 2.63 to 1

Powershift transmission providing 4 speeds forward and 3 reverse; electrically controlled.

Converter/transmission gear pump:
Pump/transmission speed ratio ..... 1:1.
Transmission fluid full-flow filter incorporating a by-pass valve.
Oil cooling by heat exchanger.

AXLES
Front: rigid, full-floating, with central bevel drive set, differential and planetary side final drives in wheel hubs.

Rear: swinging, full-floating, with central bevel drive set, differential and planetary side final drives in wheel hubs.

Total reduction ratio, both axles
FR10, FR11 ..... 1 to 22.3
FR12, FR12B ..... 1 to 26.1

WHEELS
Check manufacturers specifications for tire inflation pressure.

1. GENERAL

NUTS TORQUE CHART - Unit of measure daNm (lbs ft)

Diameter and width of thread mm	Strength class: 10 (RBO)					Strength class 12 (R100)
	standard ZNT	standard CDT	jam type	with polyamide ring		standard FOSF
				standard	jam type	
M6 x 1	1.3 (96)	-	-	-	-	1.4 (10)
M8 x 1.25	3.2 (23)	-	*2.6 (19)	*3.9 (19)	*3.2 (23)	3.5 (26)
M10 x 1.25	-	-	*5.2 (38)	*8.2 (60)	*6.2 (48)	-
M10 x 1.5	6.5 (48)	7.2 (53)	*5 (37)	*7.7 (57)	*6 (44)	7 (52)
M12 X 1.25	-	13 (96)	*8.7 (64)	*14.5 (107)	*10.2 (75)	-
M12 X 1.75	11 (81)	-	*8.1 (60)	*12.9 (95)	*9.6 (71)	12 (88)
M14 X 1.5	-	19.5 (144)	*13 (96)	*21.6 (159)	*15 (110)	-
M14 X 2	18 (133)	-	*12.5 (92)	*20 (147)	*14.6 (107)	19 (140)
M16 X 1.5	30 (221)	23.5 (173)	°13 (96)	°26.8 (198)	°16 (118)	30 (221)
M16 X 2	-	23 (170)	°12.5 (92)	°26.5 (195)	°16 (118)	-
M18 X 1.5	45 (332)	34.5 (254)	°19 (140)	°39 (236)	°23.5 (173)	45 (332)
M18 X 2.5	-	32 (236)	°17.5 (129)	°36.5 (269)	°22 (162)	-
M20 X 1.5	60 (442)	46 (339)	°23.5 (173)	°51.7 (381)	°29 (214)	60 (442)
M20 X 2.5	-	44.5 (328)	°21.5 (158)	°50 (369)	°27 (199)	-
M22 X 1.5	80(590)	62 (457)	°32 (236)	-	-	80 (590)
M22 X 2.5	-	61 (450)	°29.5 (217)	-	-	-
M24 X 2	100 (737)	78 (575)	°37 (273)	°85.8 (633)	°45 (332)	100 (737)
M24 X 3	-	76 (560)	°33 (243)	°84 (619)	°41 (302)	-
M27 X 2	95 (700)	-	-	-	-	95 (700)
M30 X 2	130 (959)	-	-	-	-	130 (959)
M33 X 2	170 (1254)	-	-	-	-	160 (1180
M36 X 3	220 (1622)	-	-	-	-	220 (1622)

*ZNT (Zinc plated) °CDT(Cadmium plated)

SYMPTOM	PROBABLE CAUSE	TOOLS REQUIRED	TEST	SOLUTION
Engine shows loss of power(continued)	Fuel injection pump improperly timed	Timing light	Flow time the pump to the engine	Time the fuel injection pump
	Inoperative fuel injection pump or fuel injection nozzles	Engine diagnostic kit	Run engine diagnostic test	Repair or replace defective parts
	Cylinder *"cutting"* out		Locate *"missing"* cylinder as follows: Run engine at low idle speed and cut out each injection nozzle in turn by loosening the fuel injection line nut attaching the line to the fuel pump	A decrease in engine speed indicates the nozzle for that cylinder is functioning properly. If engine speed does not decrease, nozzle is malfunctioning and must be replaced
	Loss of compression	Compression tester	Compression test	May be due to leaking valve or worn piston rings or cylinder sleeves. Repair or replace defective parts
Engine runs unevenly and vibrates excessively	Governor not operating properly		Check pump and throttle linkage	If tight or loose, adjust governor and linkage
	Fuel supply erratic or insufficient	Engine diagnostic kit	Run diagnostic test	If fuel system fault, check fuel system
	Engine operating temperature too low	Engine diagnostic kit	Run diagnostic test	If cooling system fault, check thermostat
	Fuel injection pump malfunctions	Engine diagnostic kit	Run diagnostic test	Check fuel injection pump
	Valves in bad condition			Recondition or replace valve
	Cylinder *"cutting"* out		Locate *"missing"* cylinder as follows: Run engine at low idle speed and cut out each injection nozzle in turn by loosening the fuel injection line nut attaching the line to the fuel pump	A decrease in engine speed indicates the nozzle for that cylinder is functioning properly. If engine speed does not decrease, nozzle is malfunctioning and must be replaced
	Fuel injection nozzle malfunction	Nozzle tester	Check nozzle popping pressure, pattern and sound	Repair or replace nozzle

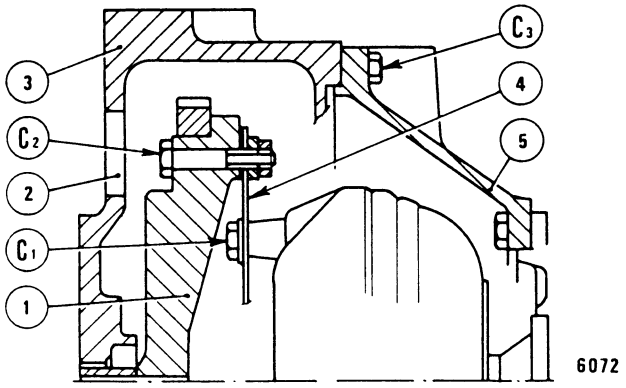

FIG. 3-4 SECTION THROUGH TRANSMISSION TO ENGINE ASSEMBLY ITEMS

C_1. Flex joint (4)/converter capscrew
C_2. Flex joint/flywheel screw
C_3. Transmission case/flywheel housing screw
1. Flywheel
2. Opening in housing to reach screws (C_2)
3. Flywheel housing
4. Flex joint
5. Transmission case

- Remove radiator with the hoist, as shown in Fig. 2-2.

NOTE: On the back side of radiator are connected, by means of screwed clamps, the electrical wires for rear work lights; disconnect them before lifting up the radiator.

- Disconnect transmission to inter-cooler lines.
- Separate engine oil drain line from loader frame.
- Disconnect fuel lines to tank.
- Remove bottom guard.
- Disconnect the two propeller shafts (transmission side).
- Backout the screws (c), Fig. 3-2, securing engine to frame and transmission to frame.

⚠ WARNING

Lift and handle all heavy parts with a lifting device of proper capacity. Be sure parts are supported by proper slings and hooks. Use lifting eyes if provided. Watch out for people in the vicinity.

- Lift out the unit as shown in Fig. 3-3.
- Lay the unit down and, still holding the hoist under tension properly support the unit with blocks or stands.
- Remove flywheel housing covers and turn flywheel to allow backout of screws C_2) through the opening (2).
- Separate engine from transmission.

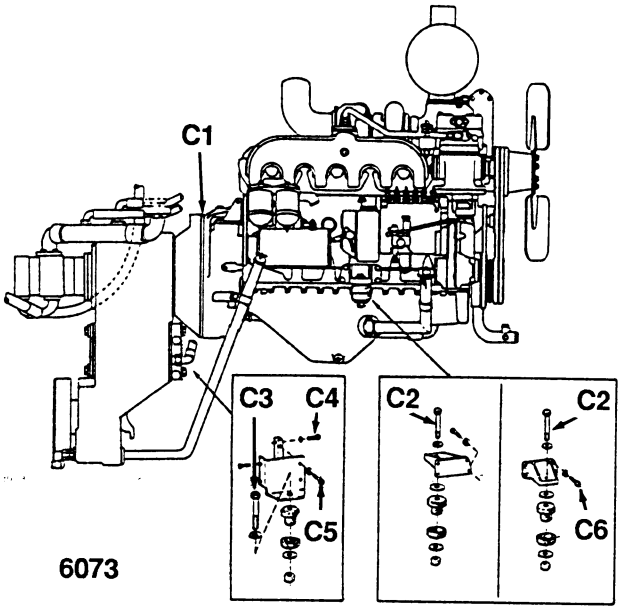

FIG. 3-5 ENGINE/TRANSMISSION UNIT MOUNTING ITEMS TO LOADER FRAME

C_1. Converter/flywheel housing screws
C_2. Transmission/engine to frame screws
C_3. Transmission/engine to frame screws
C_4. Transmission mounting bracket screws
C_5. Transmission mounting bracket screws
C_6. Engine mounting bracket

3.2.4 Installation of engine/transmission unit
To assembly engine with transmission proceed as follows:

- Carefully clean the mating surfaces between transmission and flywheel housing and apply sealing compound.

⚠ DANGER

Adhesives are extremely flammable. Follow the manufacturers instructions when applying.

- Carefully clean the flywheel central opening and mating surfaces of converter flexible drive joint.
- Turn flywheel so that one hole into flywheel for screw (C_2), Fig. 3-4, correspond to opening (2) in housing.
- Turn flex drive joint (4) in order to align the holes of joint and flywheel with opening (2).

NOTE: Put the appropriate shims between converter centering hub and flywheel.

- Mate transmission case (5) with flywheel housing (3), insert the screw and tighten to 5 daNm (36.9 lbs. ft).

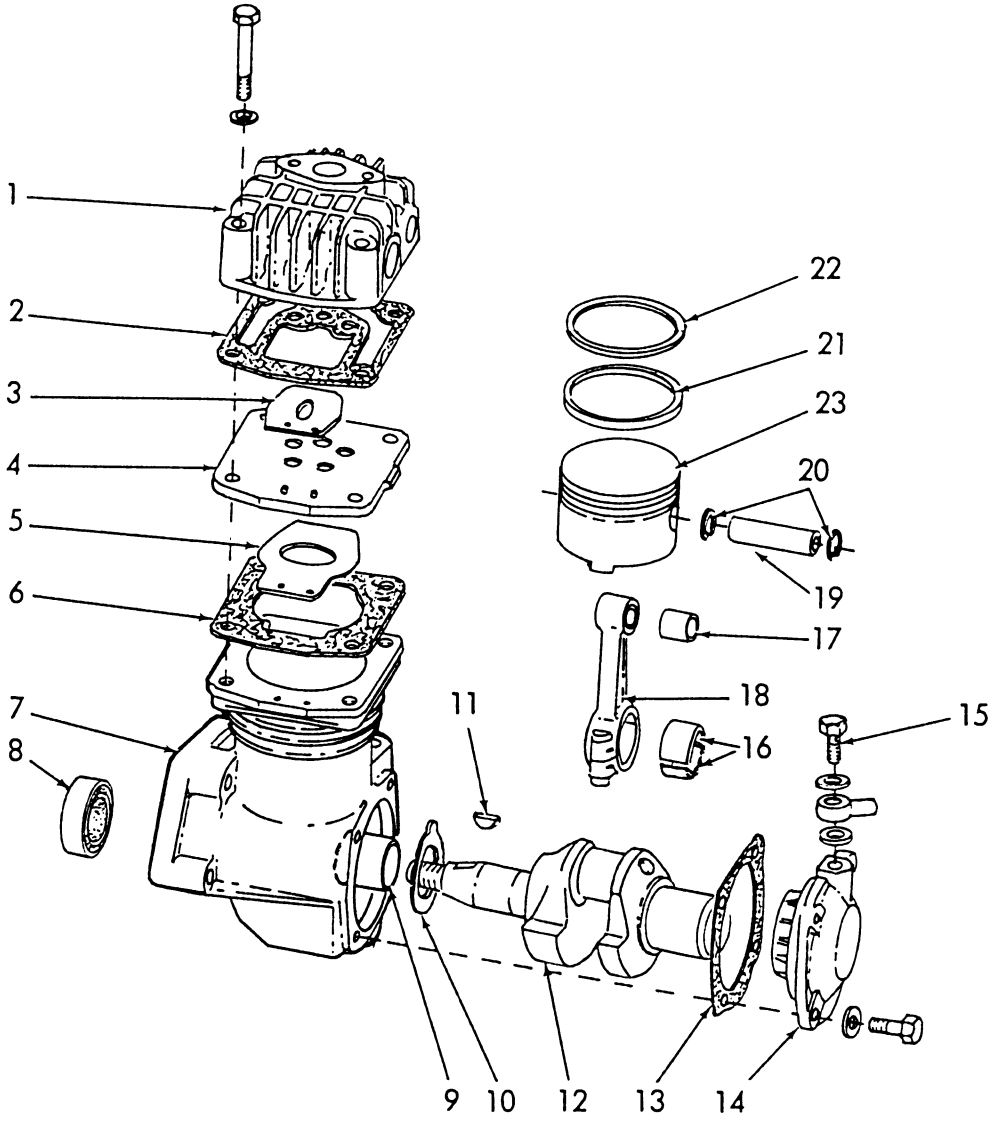

FIG. 5-7 COMPRESSOR ASSEMBLY (Marelli model)

1. Head
2. Gasket
3. Valve, upper
4. Plate
5. Valve, lower
6. Gasket
7. Housing
8. Seal
9. Bushing
10. Thrust ring
11. Key
12. Crankshaft
13. Gasket
14. Cover
15. Plug
16. Bearing
17. Bushing
18. Connecting rod
19. Wrist pin
20. Snap ring
21. Bottom ring
22. Top ring
23. Piston

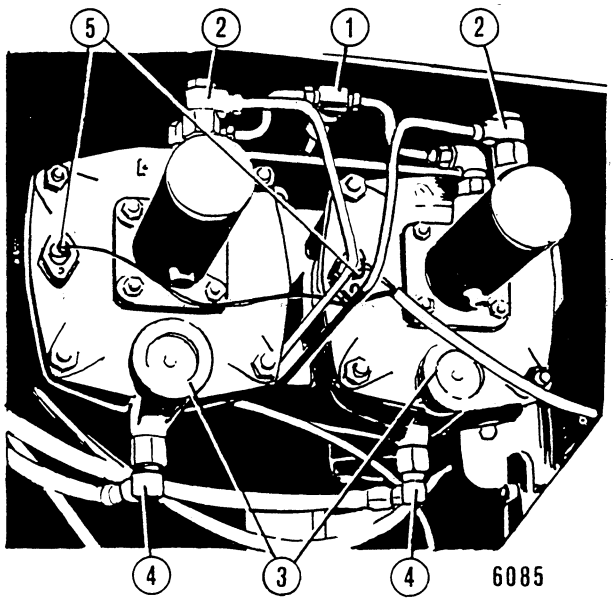

FIG. 5-15 BRAKE BOOSTERS ON MACHINE

1. Inlet connection, fluid from rear reservoir
2. Outlet connection, fluid to rear brake cylinders
3. Filter cover (vent)
4. Compressed air inlet
5. Piston stroke switch

⚠ WARNING

DO NOT USE HANDS to search for pressure leaks. Fluid escaping under pressure can penetrate skin

Inspect accurately rubber components. Check spring efficiency and sliding surface conditions. Change all damaged or worn parts. Metal parts must be perfectly clean.

Lubricate accurately all sliding parts with appropriate grease. Lubricate all rubber parts with the special grease for compressed air equipment.

For reassembly, reverse the disasssembly operation.

After assembly, connect the booster to a compressed air supply source and check that piston (8, Fig. 5-14) cause switch (2) to stroke a distance of 38 ± 0.5mm (1.5 ± 0.02 in).

5.8 BRAKE FLUID RESERVOIR

⚠ WARNING

Brake fluid reservoirs must be filled with fluid to the proper level. Fill with specified fluid.

Brakes are inoperative when manually released for servicing. Provision must be made to maintain control of the machine by blocking or other means.

Observe all start up and shut down procedures and *WARNINGS* listed in the Operation and Maintenance Instruction Manual

Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.

No particular maintenance is required. Simply check that the diaphragm (1, Fig. 5-16) is not cracked, hardened or otherwise faulty. If not, replace.

After any servicing of the brake system hydraulic section restore the fluid level as required (See Operation and Maintenance Instruction Manual).

NOTE: Bleed the brake system hydraulic section as instructed under 5.10.

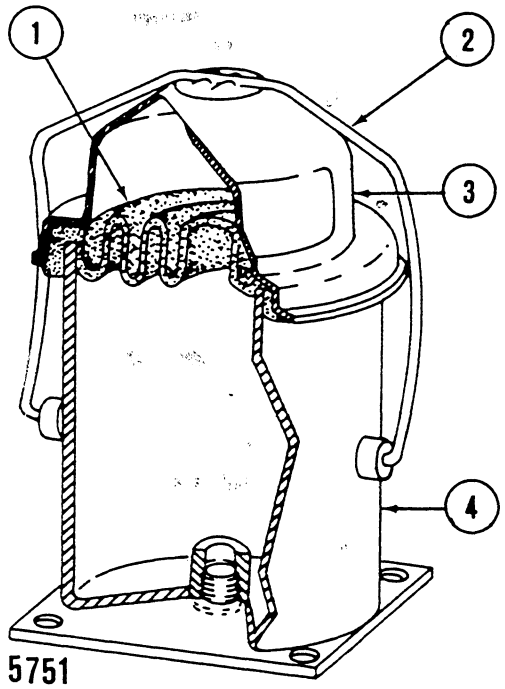

FIG. 16 BRAKE FLUID RESERVOIR

1. Diaphragm
2. Cover retainer
3. Cover
4. Container

6. HYDRAULIC SYSTEM

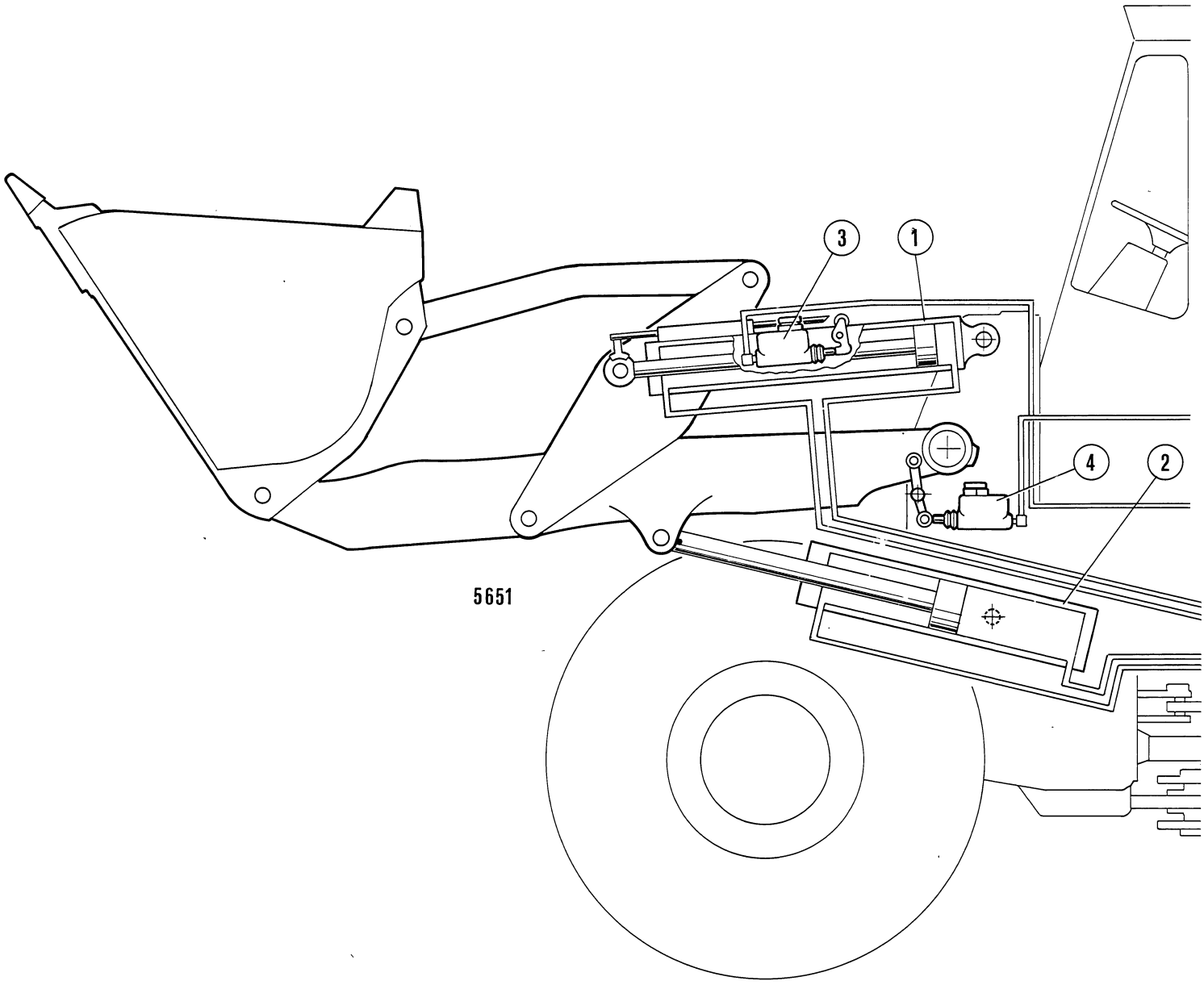

FIG. 6-1 EQUIPMENT HYDRAULIC SYSTEM SCHEMATIC (Typical)
(Note the system is shown in boom lower position with steering operation.)

D. Main control valve
Fa. Suction line filter
Fr. Return line filter
P_1. Steering pump
P_2. Equipment pump
S. Oil reservoir
1. Bucket cylinder
2. Boom cylinder
3. Automatic bucket leveler
4. Automatic boom kickout
5. Bucket control lever
6. Boom control lever
7. Actuator for bucket leveler (3)
8. Actuator for boom kickout (4)
9. To main flow divider valve
10. From main flow divider valve

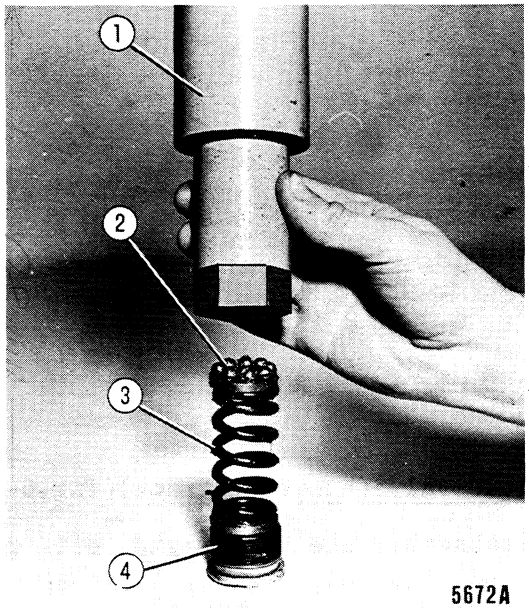

FIG. 6-17 ASSEMBLY (Disassembly) OF SPOOL RETAINER DEVICE

1. Cover/case
2. Balls
3. Spring
4. Plug

6.3.10 MAIN CONTROL VALVE SETTING
Adjust valve settings with oil at 60 - 70°C (140 - 158°F) and engine turning at 2300 rpm.

1 Pressure Relief Valve Setting Adjustment (Fig. 6-20).

- Fit a 200 bar (2900 psi) pressure gauge in the tap located on main control valve (P1). Disconnect the lever retainer actuator control lines (3, Fig. 6-22). With engine at the specified rpm rate actuate lever (1, Fig. 6-22) for boom lift control until lift cylinder is fully extended. Persist for a while in this position at the same time checking the pressure reading on test gauge. Should this pressure be other than the specified 162 bar (2349 (psi) for the FR10 and 172 bar (2494 psi) on the FR12 and 190 bar (2755 psi) for the FR11, FR12B) act on screw (1, Fig. 6-11) until the rated reading is obtained. After adjustment, tighten the jam nut and check, again, that the pressure has not been changed by screwing in the nut. Refit the protection plug.

2 Overload Valve Setting Adjustment
a) Bucket retract circuit (Fig. 6-18)

- Fit a 250 bar (3625 psi) bar pressure gauge in the tap located on bucket cylinder oil inlet line (rod end) (P_2, Fig. 6-21).

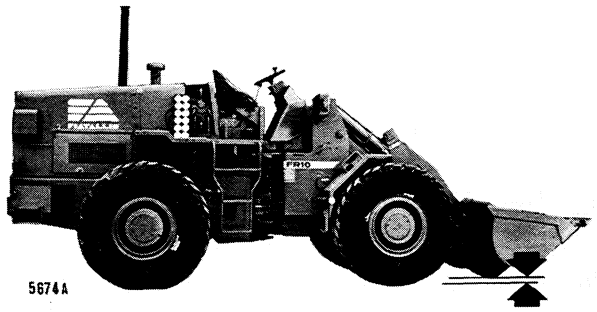

FIG. 6-18 POSITION OF BUCKET FOR ITS RETRACT CONTROL CIRCUIT OVERLOAD VALVE SETTING CHECKS

NOTE: Pressure gauge must be fitted in tap (P2, Fig. 6-21). Specified reading: 207 bar (3000 psi)

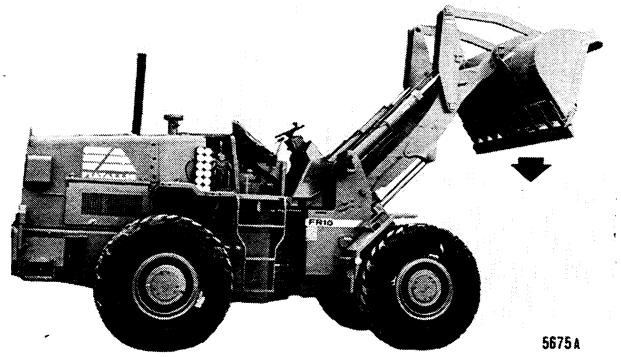

FIG. 6-19 POSITION OF BUCKET FOR ITS DUMP CONTROL CIRCUIT OVERLOAD VALVE SETTING CHECKS

NOTE: Pressure gauge must be fitted in tap (P_1, Fig. 6-21). Specified reading 96.5 bar (1400 psi).

- Connect a flow meter as shown in Fig. 6-6. With engine and oil respectively at their rated speed and temperature, raise the booms and retract the bucket. Lower the booms while taking the pressure reading on pressure gauge and flow meter.

  NOTE: Should valve actuation not be possible because the bucket is in contact with the ground, place two blocks under the front wheels to raise the machine somewhat and thus allow further lowering of the booms until the overload valve actuation is ensured.

  Should the pressure reading not be as specified 207 bar (3000 psi) at 19 L/min (5.02 gpm, operate on screw (1, Fig. 6-13) until the specified value is obtained.

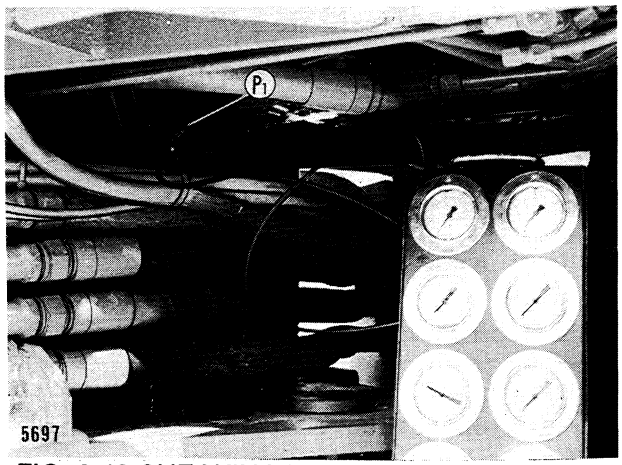

FIG. 6-42 CHECKING THE STEERING SYSTEM RATED PRESSURE SETTING

P_1. Pressure tap

6.5.4 COMPONENTS INSPECTION

Check that spool (4, Fig. 6-41) slides freely in its housing bore without excessive play (slap). If marked scoring or wear of sliding surfaces are evident, mated components will call for replacement.

Make sure the orifices (A, Fig. 6-40) drilled in connections (2, Fig. 6-41) are not obstructed by any impurities. Check that the sealing faces of plunger (3, Fig. 6-39) in pressure relief valve are not scored or otherwise deteriorated. If necessary, replace; remember that only complete valves (already set) are available for spares.

6.5.5 PRESSURE RELIEF VALVE SETTING ADJUSTMENT ON BENCH

Blank off any valve openings and connect the oil delivery line to connection (6, Fig. 6-41). For this adjustment, use hand pump P/N 75290284. Couple a discharge (return) line to the connection located on top of the pressure relief valve. Actuate the pump and take note of the valve opening pressure which should be 145 bar (2103 psi) as specified. If adjustments are needed, operate through retainer (1, Fig. 6-39) as required to obtain the correct pressure.

6.5.6 VALVE ASSEMBLY

Reverse the operation sequence described for disassembly.

6.5.7 PRESSURE RELIEF VALVE SETTING ADJUSTMENT ON MACHINE (Fig. 6-42)

Connect a 200 bar (2900 psi) pressure gauge onto the tap located in oil delivery line from pump to valve.

Start engine and warm up the oil to the service operation temperature. Steer wheels fully either way, alternately right and left. Pressure should read 145 bar (2103 psi) as specified.

6.5.8 POWER STEERING CONTROL VALVE DESCRIPTION

The power steering valve consists basically of:

- A rotary gerotor set located inside an outer element (3, Fig. 6-44).
- A selector sleeve and control spool (8 and 9, Fig. 6-44) for sending oil to the power cylinders.
- A check ball valve (2, Fig. 6-44) which is used when steering is needed with engine inoperative.
- A flange mounted valve block incorporating the shock and safety valve.

6.5.9 POWER STEERING CONTROL VALVE REMOVAL

Proceed as follows:

- Remove lines (Fig. 6-45) and blank suitably to prevent issuance and loss of oil
- Slacken the screws (C1) located in steering post bracket top end.
- Remove the assembly, complete with valve block and place on service bench.

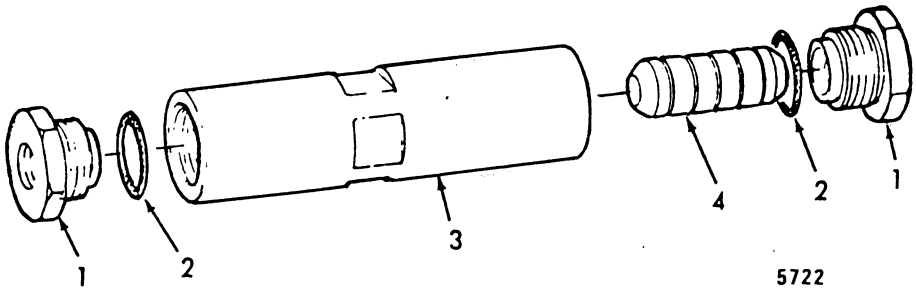

FIG. 6-66 CUSHION VALVE COMPONENTS

1. Plugs
2. Seals
3. Valve case
4. Valve plunger

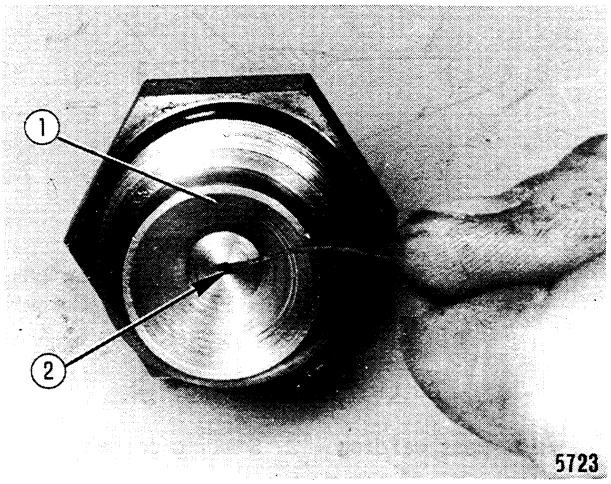

FIG. 6-67 CLEANING ORIFICE (2)

1. Cushion valve plug.

Reassemble the valve by reversing the disassembly operation sequence. Tighten nut (14 Fig. 6-64) and end plate (7, Fig. 6-64) to the specified torque (see Specifications and Data Table).

6.5.7 CUSHION VALVE

The cushion valve (Fig. 6-66) is located on the oil line to the power steering left cylinder.

6.7.6 CUSHION VALVE DISASSEMBLY

For this operation, simply separate the two plugs (1, Fig. 6-66) and pull out valve plunger (4). Check that the inner surfaces of valve case (3) are not distorted and that plunger (4) slides freely. Clean accurately the restriction orifices (2, Fig. 6-67) using a thin wire, as shown.

For valve reassembly, reverse the above operations and replace the two seals (2, Fig. 6-66).

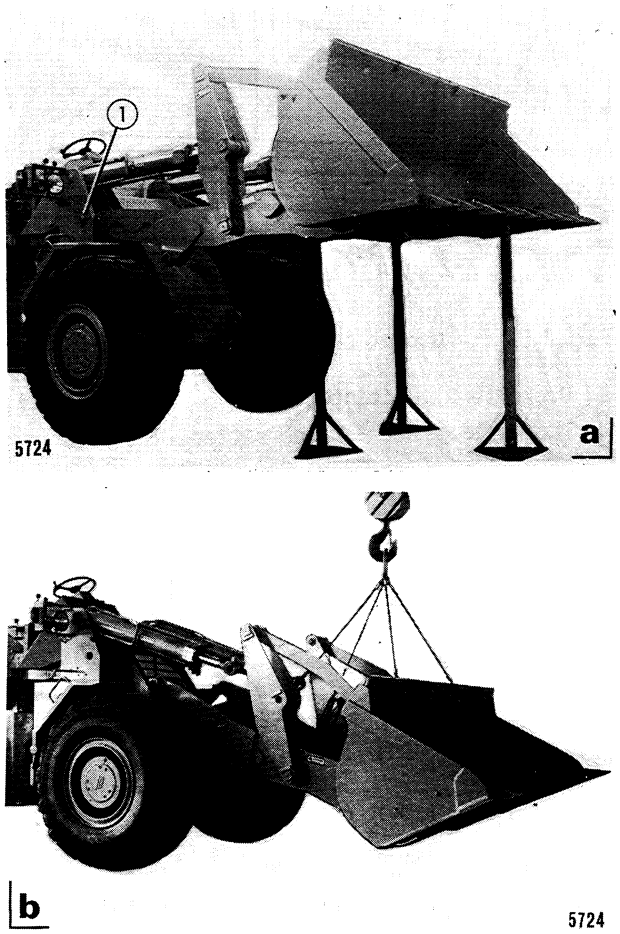

FIG. 6-68 LOADER BOOMS REMOVAL

a. First stage, disconnect lift cylinders
b. Second stage, disconnect bucket dump/retract cylinder and separate booms from loader
1. Boom articulation pivot pin

6. HYDRAULIC SYSTEM

TROUBLE	POSSIBLE CAUSE	REMEDY
With engine off, steering wheel may be turned but wheels do not steer	1. Excessive wear between rotor & housing.	1. Replace worn parts.
	2. Quick drop and overload valve stuck open because of interposed foreign matter or damages.	2. Eliminate foreign matter and clean filter or replace complete valve block.
Steering wheel catches, steering out of control, wheels turning on side opposite to desired turn.	1. Steering control valve mistimed.	1. Set correct timing.
	2. Oil lines to cylinders inverted.	2. Reconnect correctly.
Wheels do not keep to the desired course & continuous corrections are needed on steering wheel	1. Oil supply short in hydraulic system tank.	1. Restore correct oil level.
	2. Hydraulic cylinder piston seal worn.	2. Replace the seals.
	3. Control valve mechanical wear.	3. Replace valve unit.
Steering wheels continues to turn or is stationary and machine continues to turn	1. Failure or weakness of springs returning the sleeve to neutral position.	1. Replace the set of springs.
	2. Valve sleeve/spool in delivery position due to foreign matter.	2. Eliminate any foreign matter and clean the filter.
	3. Crushing of sleeve/spool as result of excessive pressure.	3. Check setting or pressure relief valve in main flow divider valve.
Steering articulation vibrations (shimmy)	1. Wear of steering cylinder pins and bushes.	1. Replace parts as needed.
	2. Overload & anti-cavitation valves stuck open because of interposed impurities or damages.	2. Remove impurities & clean filter or replace complete valve block.
Steering difficulties in general or only in one direction	1. Insufficient pressure.	1. Check hydraulic pump and setting of the pressure relief valve on main flow divider valve.
	2. Excessive oil seepages within the steering control valve.	2. Replace the complete valve.