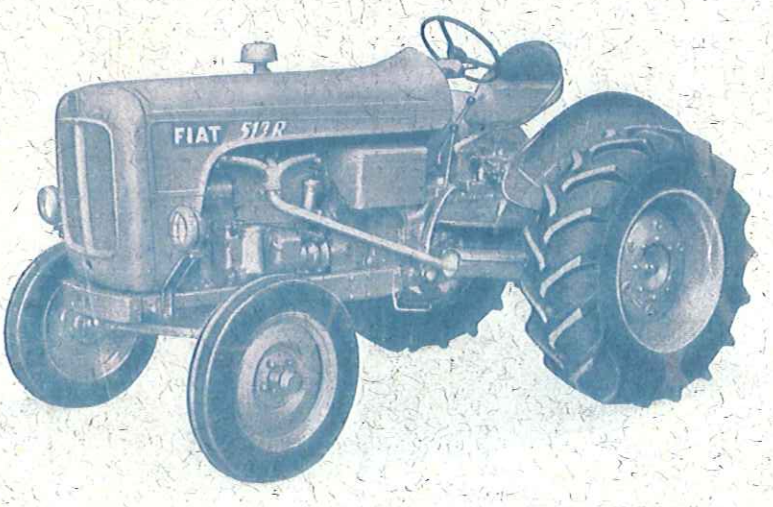
FIAT
tractors

Model 513 R
tractor



Specifications, adjustments and main technical data

FIAT

tractors

513 R MODEL TRACTOR

1. Description specifications.
2. Adjustments and overhaul data.
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SERVICE DEPARTMENT

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DESCRIPTION AND SPECIFICATIONS

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DESCRIPTION AND SPECIFICATIONS

ENGINE

Model	CO1D/55	
4-cycle Diesel, direct-injection and double turbulence action		
Number of cylinders, vertical, in-line	4	
Bore, inches	4.13	(105 mm)
Stroke, inches	4.72	(120 mm)
Number of main bearings	5	
Displacement, cubic inches	253.6	(4156 cm^3)
Compression ratio, approx.	15:1	
Maximum horse-power (without fan, air cleaner and exhaust pipe)	55	
Speed at maximum horse-power, r.p.m.	1750	
Maximum torque (with fan, air cleaner and exhaust pipe), ft.lb.	177.2	(24,5 Kgm)
Speed at maximum torque, r.p.m.	1200	
Weight, lbs.	1000	(454 Kg)

Main components.

— Cast-iron crankcase and cylinder head. Replaceable wet cylinder sleeves made of special cast-iron alloy.
— Aluminum-alloy pistons with combustion chamber located at top. Three compression, one oil-scraper and two oil-control piston rings.
— I-section, steel connecting rods.
— Steel crankshaft with 5 main bearings, induction hardened main and connecting-rod journals. Main and connecting-rod bearings of the thin shell Vandervell type.

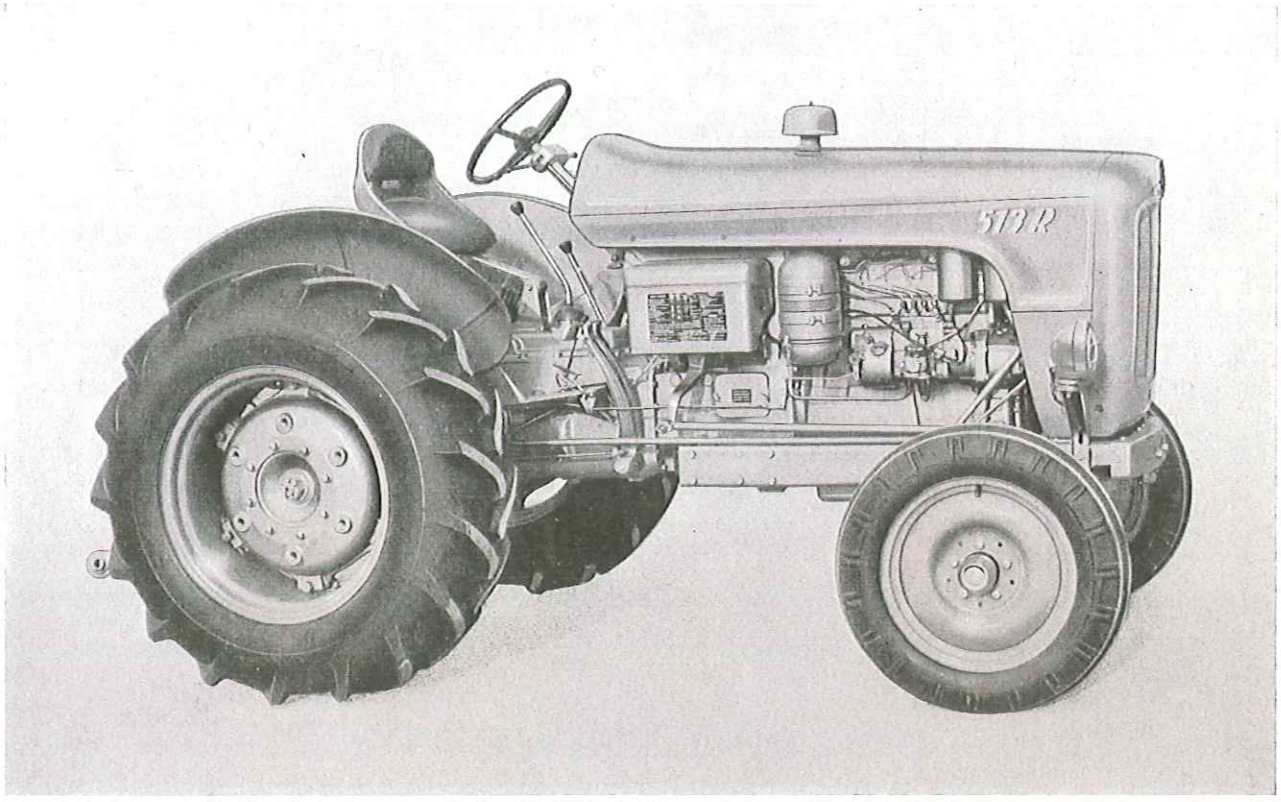


Fig. 1. - Side view of tractor.

Valve system.

Camshaft located in crankcase and driven from helical-teeth gears. Overhead valves (one intake and one exhaust valve for each cylinder) operated by push-rods and rocker arms.

Intake valves { opening: 3° before T.D.C.
closing: 49° after B.D.C.

Exhaust valves { opening: 49° before B.D.C.
closing: 3° after T.D.C.

Valve tappet clearance (as measured on cool engine), inches . . . . . 0.008 (0,2 mm)

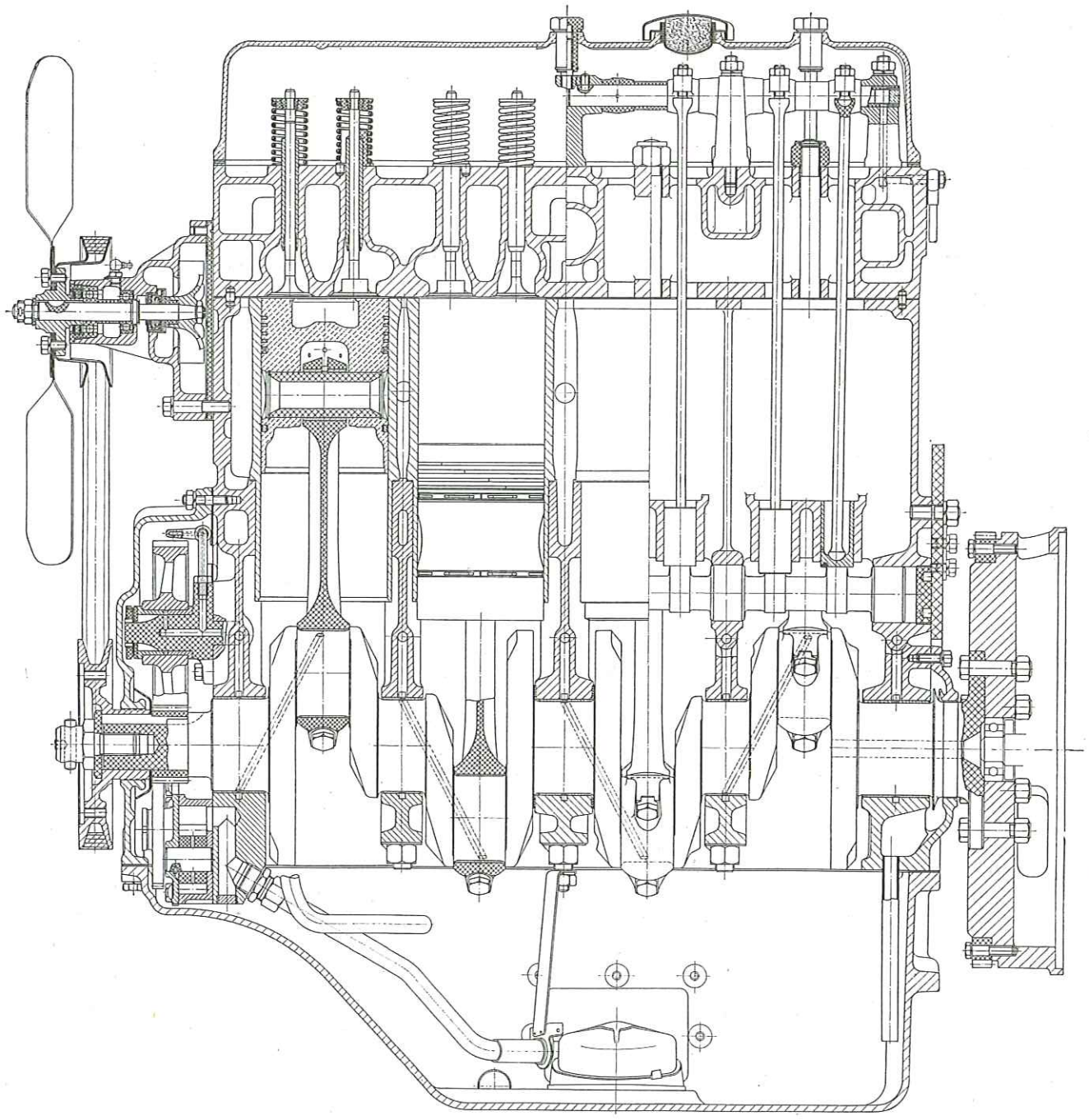


Fig. 2. - Longitudinal section of engine.

Fuel feeding system.

Model PES 4A 85 B 410 : L4/27 (Bosch licence) injection pump flanged to the crankcase.

Model FP/KS 22A : L4/4 plunger-type fuel pump driven from the injection pump camshaft. Two-stage fuel filter with replaceable filtering cartridges (one paper and one cloth cartridges).

Dual throttle control by hand lever underneath the steering wheel and accelerator pedal, both located on the right-hand side of operator.

Direct-injection with 4-hole fuel nozzles.

Injector pressure setting, lbs./sq.in.	2489 ± 71	(175 ± 5 Kg/cm²)
Fuel feeding pressure, lbs./sq. in.	17 to 21	(1,2 ÷ 1,5 Kg/cm²)

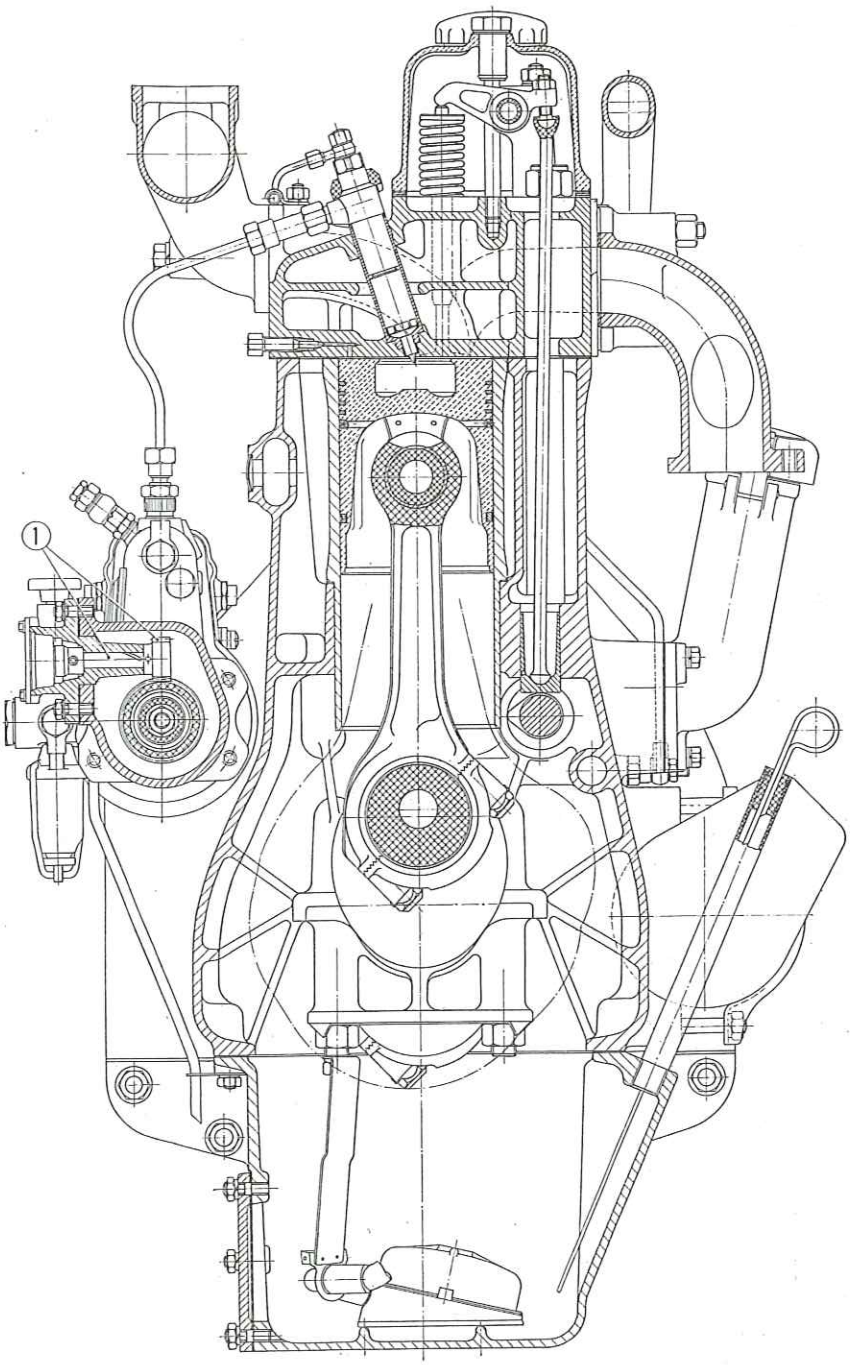


Fig. 3. - Cross section of engine.
1. Tachometer drive.

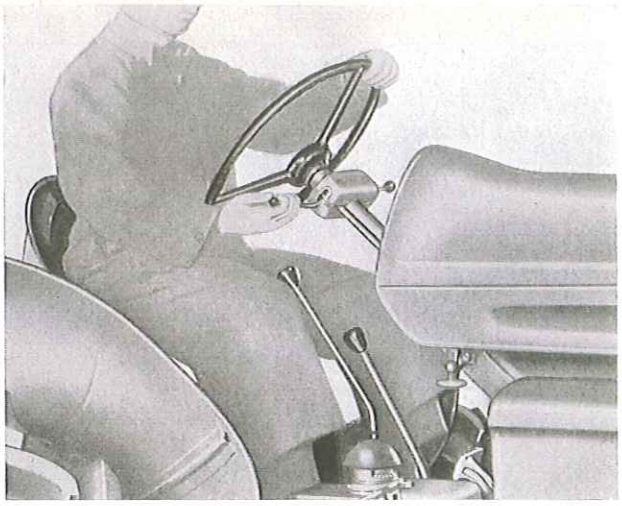


Fig. 4. - Accelerator hand control (to accelerate the engine the control lever must be shifted upwards).

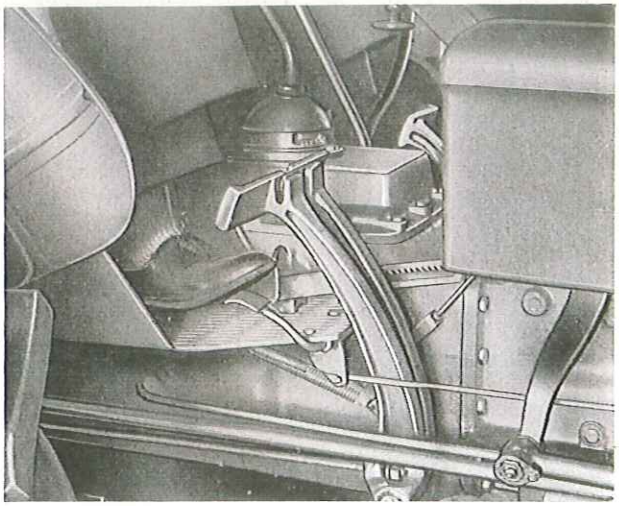


Fig. 5. - Accelerator foot-pedal control (to stop the engine, after shifting the accelerator control lever downwards, or after releasing the pedal, lift the latter up using the foot).

Speed governor.

RPVA 250-875 F2 flyweight-type speed governor attached to the injection pump.

Governor speed setting:	R.P.M.
— Pulling, rated load	1750
— High idle, no-load	1870
— Low idle	580 to 620

Air intake.

Air is drawn in through a centrifugal-type pre-cleaner, then through an oil bath air cleaner with matting elements. The bottom element is removable from the cleaner body being secured to the central tube with a spring-lock ring.

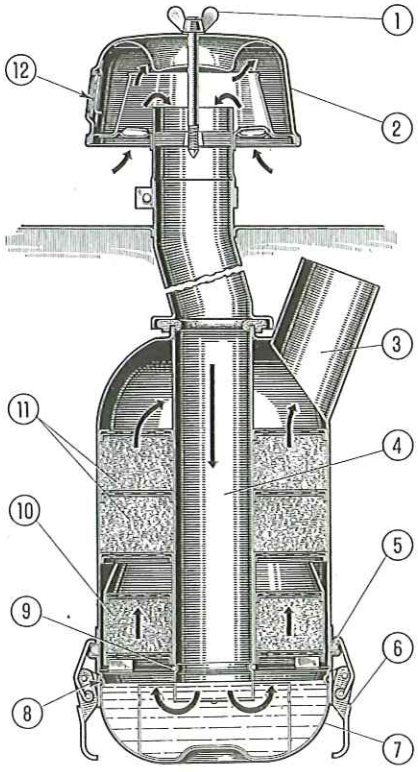


Fig. 6. - Air cleaner section.

1. Pre-filter cap thumb screw - **2.** Pre-filter cap - **3.** Filtered air duct to engine - **4.** Air cleaner inlet duct (centre tube) - **5.** Gasket between filter and bowl - **6.** Bowl-to-body catches - **7.** Oil bowl. - **8.** Oil level fill mark - **9.** Lower filtering pad retaining snap ring - **10.** Lower filtering pad, removable - **11.** Upper filtering pads, non-removable - **12.** Pre-filter inspection window.

Lubrication.

Force-feed type lubrication with oil circulated in the system by a gear pump driven from the crankshaft. Screen filter on the oil pump inlet. Full flow filtering through a self-cleaning disc-type filter and by-pass filtering through a shunted cartridge-type filter.

Oil pressure regulating valve setting, lbs./sq.in. . . . . 49.8 (3,5 Kg/cm²)

Cooling.

Pressurized system with centrifugal pump driven from the crankshaft through a V-belt transmission.
A thermostat regulates the water circulation.
The water is cooled in the radiator by a 4-blade fan.
Adjustable radiator shutter (optional).

Thermostat opening temperature, °F . . . . . 158 to 167 (70 ÷ 75°C)
Thermostat max. opening (at 180° to 189°F), inches . . . . . 0.39 to 0.43 (10 ÷ 11 mm)

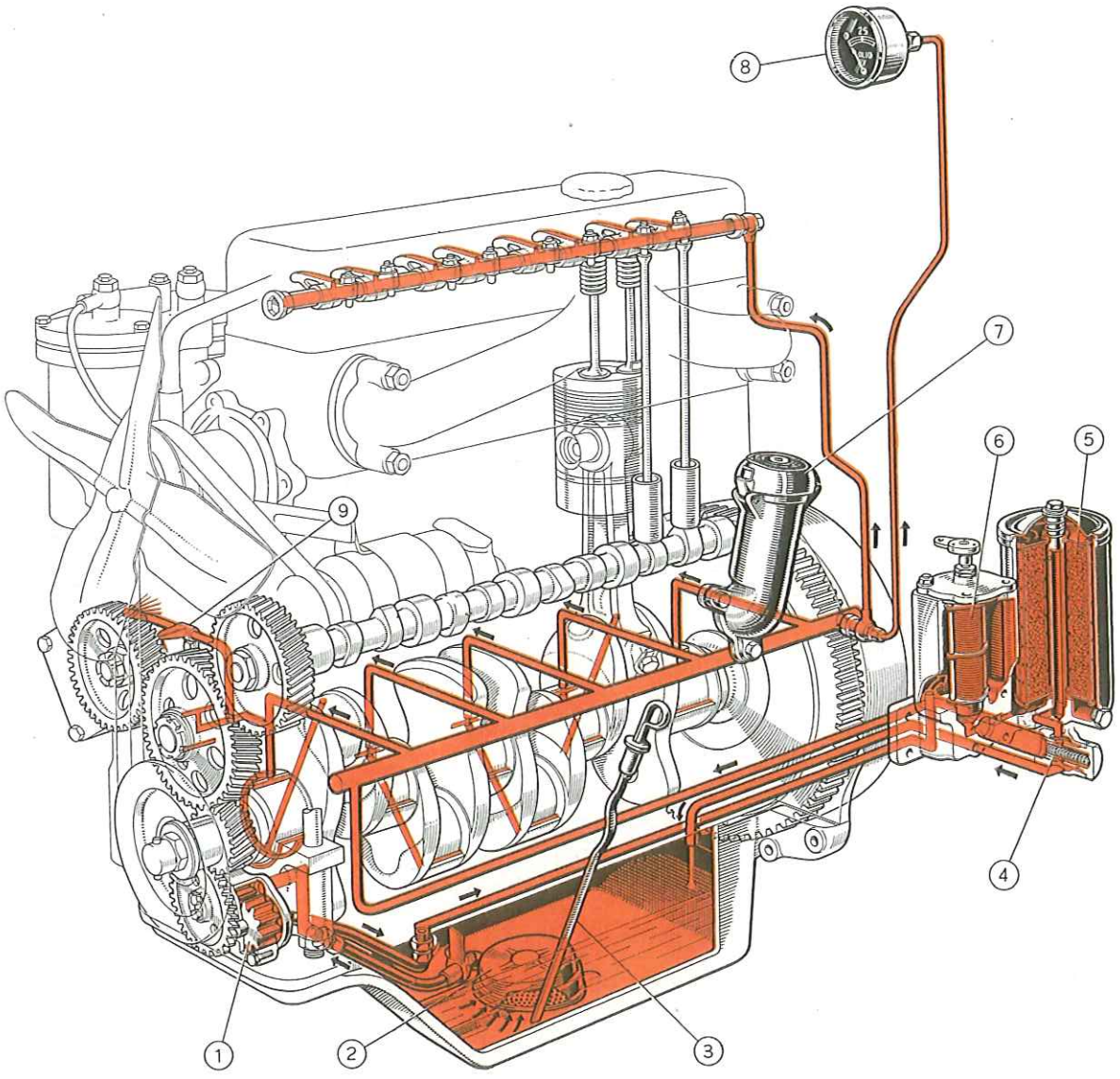


Fig. 7. - Layout of engine lubrication.

1. Oil gear pump - **2.** Gauze filter on oil pump suction intake - **3.** Oil level dipstick - **4.** Oil pressure limiting valve - **5.** Shunted oil filter with replaceable cartridge - **6.** Blade filter (self-cleaning) - **7.** Oil filler cap - **8.** Oil pressure gauge - **9.** Pipe for oil distribution to the gears.

POWER TRANSMISSION UNITS

The tractor chassis includes two iron castings, one of which serves as clutch, P.T.-O. and belt pulley drive gear housing, and the other one as gearbox and differential housing. The engine is flanged to the clutch housing and fastened to the tractor frame members with two angle irons.

The clutch unit.

A FERODO-make, two-stage clutch unit comprising two single plate dry clutches, one of which is coupled to the main drive and the other one drives the P.T.-O. or belt-pulley units indipendently of the tractor forward motion (fig. 36).

A single pedal controls the two stages. First movement of the clutch pedal disengages the main drive leaving the P.T.-O. still engaged; full pedal movement disengages both.

The throw-out collar of the clutch unit is fitted with a pressure lubricator and can be reached through an opening in the clutch housing sidewall (fig. 17) by removing the cover fastened to it. The same opening allows checking the clearance between throw-out collar and release levers, when the wear on the disc lining requires adjusting the free movement.

The gearbox unit.

A selective, sliding spur-gear gearbox, with seven speeds forward and two reverse (fig. 41).

The drive shaft is split into two length units which can be connected to establish direct drive between the engine clutch and the bevel gears by means of a sliding gear.

The first length of shaft carries the speed reduction gears, equipped with operating lever, and the second length carries the 1st-2nd and 3rd speed gear clusters. The tubular countershaft houses internally the P.T.-O. and belt-pulley drive shaft.

Speeds and gear ratios are given in the table which follows.

Speed	Gearbox reduction	Reduction at drive wheels	Maximum speed (°)		Pulling force	
			m.p.h.	km/h	lb.	kg
1st	11,071	211,851	1.24	2	5070 (*)	2300 (*)
2nd	7,251	138,761	1.86	3	5070 (*)	2300 (*)
3rd	4,684	89,632	2.86	4.6	5070 (*)	2300 (*)
4th	3,648	69,819	3.67	5.9	5070 (*)	2300 (*)
5th	2,389	45,730	5.65	9.1	3800	1750
6th	1,544	29,541	8.70	14	2645	1200
7th	1	19,136	13.42	21.6	1760	800
1st reverse	6,975	133,472	1.93	3,1	—	—
2nd reverse	2,298	43,986	5.78	9,3	—	—

Bevel gear reduction ratio: 4.700
Final drive reduction ratio: 4.071

(°) Engine running at maximum power r.p.m.

(*) Depending on ground conditions; values taken on concrete track tests with 14.9/13-28 tyres at maximum power r.p.m. and fully-ballasted tractor.

Bevel pinion and ring gear and rear transmission.

It includes the drive bevel pinion and ring gear unit (10/47 ratio), the differential with 4 planetary gears, two final drive gear reductions (14/57 ratio), and the foot-controlled differential lock.

Brakes.

The foot-controlled, disc-type brakes act upon the rear axle shafts and are operated from two indipendent pedals both located at the right-hand side of tractor.

On road operation the two pedals can be latched together for simultaneous operation. A hand-lever secures the locking of the brake pedals in place when tractor is stationary (fig. 56).

Drive wheels.

Steel plate discs and W 13-28 rims fitted with 14.9/13-28 tyres. The wheel spacing can be adjusted to one of the following 8 available positions: 50.4″ - 55.5″ - 60.6″ - 65.7″ - 66.5″ - 71.7″ - 76.8″ - 81.9″ (1,28 - 1,41 - 1,54 - 1,67 - 1,69 - 1,82 - 1,95 - 2,08 m) by interchanging the rim-to-disc and disc-to-drive shaft mounting combinations.

Three weights of 104 lb. (47 Kg) each can be fitted to the disc of every wheel.

Front axle and wheels.

Tubular section, telescoping and oscillating type front axle adjustable to one of 5 available positions: 53.4″ - 58.3″ - 63″ - 67.7″ - 72.4″ (1,36 - 1,48 - 1,60 - 1,72 - 1,84 m).

Tyres: 6.00 - 19.

A 126 lb. (57 Kg) (approx.) weight can be fitted to each wheel.

Tyre inflating pressures.

Front wheels, lbs./sq.in.		35.5	(2,5 Kg/cm²)
Rear wheels	field work, lbs./sq.in.	11.5 to 14	(0,8÷1 Kg/cm²).
	road operation, lbs./sq.in.	21.5	(1,5 Kg/cm²)

Steering box.

Worm-gear type steering mechanism, located on the tractor center-line.

Seat.

Foam-rubber cushioned steel seat with rubber-lined coil-spring suspension. The height of the backrest is adjustable.

Drawbar.

Swinging drawbar with vertical adjustment and sector-type supporting plate.

Hitch point ground clearance:	minimum	13 - 1/4 in	(350 mm)
	intermediate	16 - 15/16 in.	(430 mm)
	maximum (horizontal towing)	21 - 1/16 in.	(535 mm)

THE ELECTRICAL SYSTEM

The electrical system includes current generating equipment and starting and lighting units, all functioning at 24 V.

The different component units are shown in fig. 8 and described below:

1 DC 115/24/7/3 - two-pole, shunt-wound generator.
Max. continuous power output . . . . . 196 W
Max. continuous current output (cool generator) . . . . . 8,5 Amp

1 GP 1/24/7 regulation group comprising 3 different units and separate from the generator.

2 batteries connected in series, 12 V, 70 Amp.-hr.

1 Marelli MT 43 A, four-pole, 4 h.p., starting motor with solenoid drive.

1 push-button switch for starter control.

1 key-operated switch, two positions for lighting and starting circuit respectively (after introduction turn the key clockwise to the stop release).

1 lighting switch, located below the steering wheel, for switching on the parking lights and low and high-beam headlights. Progressively rotate the hand-knob (fig. 10), pushing on it towards the steering wheel for operating the electric horn.

2 5-1/8 in. (130 mm) headlamps with spring suspension, each incorporating a parking light bulb (7 W), a dimmed-light and a high-beam light bulb (45 W and 50 W respectively).

1 electric horn (optional).

1 battery charging tell-tale lamp (3 W bulb).

2 3 W bulbs for instrument panel lighting.

1 fuel level indicator control located on the fuel tank; it includes a float and a variable ohmic resistance.

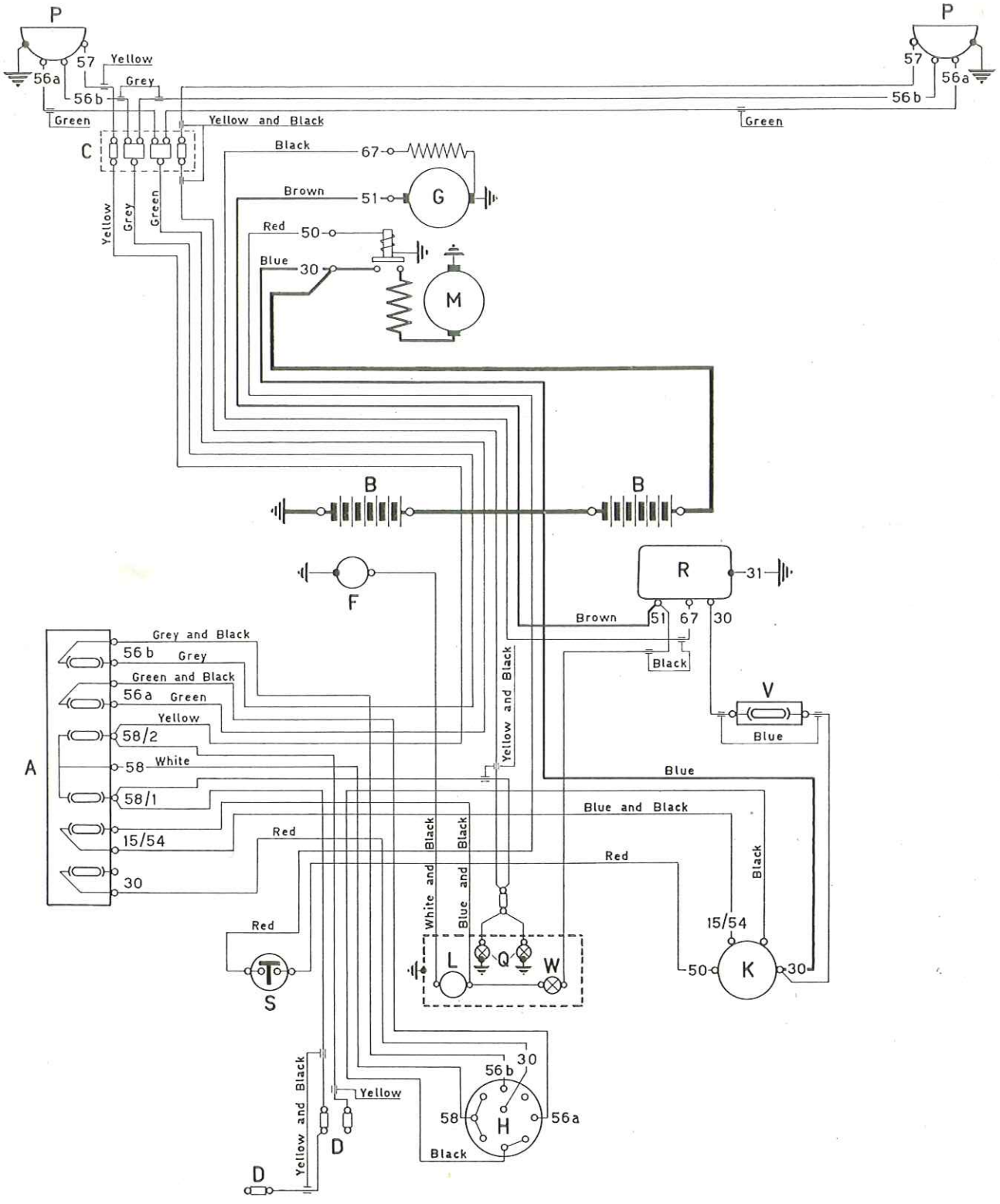


Fig. 8. - Wiring diagram.

P. Headlights - **C.** Headlight junction box - **G.** Generator - **M.** Starter - **B.** 12 V batteries in series - **F.** Fuel level indicator control - **R.** Voltage regulation unit - **V.** Voltage regulation fuse - **A.** Lighting fuse box - **S.** Starter button - **L.** Fuel level gauge - **Q.** Dashboard instrument lights - **W.** Battery charging signal light - **H.** Lighting switch; electric horn, if any (located right below the steering wheel) - **K.** Key-type switch - **D.** Connections available for usage.

1 fuel level gauge with scale marking quarters of full tank capacity.
1 fuse-box containing six fuses of 8 amp. each for equipment protection, as detailed further on.
1 16 amp. fuse holder for the regulation unit protection.

Light switch settings.

Knob position		*Equipment*
0	+	
I	+ 58	Front parking lights - Dashboard light.
II	+ 58 56b	Front parking lights - Dashboard light - Low-beam headlights.
III	+ 58 56a	Front parking lights - Dashboard light - High-beam headlights.

Fuses.

Fuse		*Equipment*
56b	(8 amp.)	Low-beam headlights.
56a	(8 amp.)	High-beam headlights.
58/2	(8 amp.)	Front parking light, left-hand side.
58/1	(8 amp.)	Front parking light, right-hand side.
15/54	(8 amp.)	Fuel level gauge and its control - Battery charging tell-tale lamp.
30	(8 amp.)	Electric horn.
—	(16 amp.)	Regulation unit.
		The circuits of the following equipment are not protected by fuses: Generator - Starter.

Special dashboard mounted instruments.

Tachometer with 10 different scales; seven of which give the speed in miles per hour corresponding to the tractor gearbox speeds, the remaining 3 give the P.T.-O. shaft revolutions, as well as the belt pulley and crankshaft revolutions. Allowance for values read on the last three scales is of ± 30 revolutions as an average. Tractor speeds correspond to those read on the gauge when 14-28 tyres are fitted to the rear wheel; in case of 14-30 tyres add 4 % to the reading, and for 14.9/13-28 subtract 3 %.

The instrument is equipped with an hourmeter driven from the injection pump drive coupling (1, fig. 3) and set for 1450 r.p.m. of engine crankshaft (i.e., it reads 1 hour for every 1450 x 60 = 87.000 revolutions of the engine).

Thermometer gauge which gives the water temperature and has the readings subdivided into three coloured sectors: blue, green, and red. The green area corresponds to the normal operating temperature included between 167 ± 41° F and 203 ± 37° F.

Pressure gauge for the engine lubricating oil pressure with readings also subdivided into three coloured sectors: red, green, and red. The green area corresponds to the normal operating pressure ranging between 28 to 32 lb/sq.in. (2 ÷ 3 kg/cm²) and 53 to 57 lb./sq.in. (3,7 ÷ 4 kg/cm²).

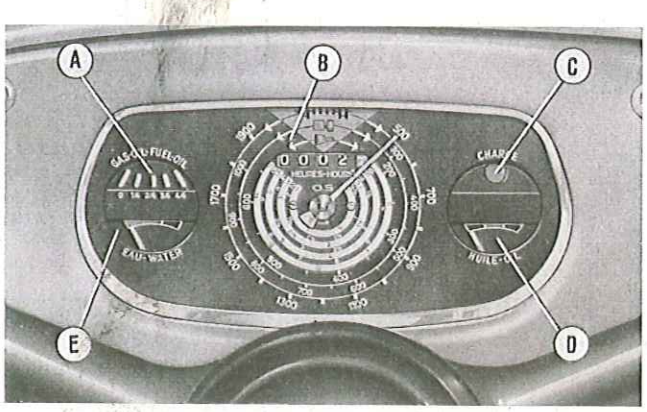


Fig. 9. - Dashboard instruments view.

A. Fuel level gauge - **B.** Multi-meter - **C.** Generator charge indicator - **D.** Engine oil pressure gauge - **E.** Engine cooling water temperature gauge.

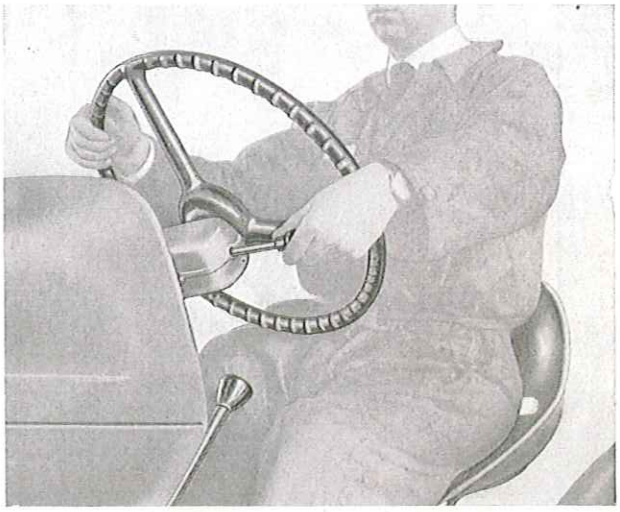


Fig. 10. - Operating the light-switch and electric horn.

Power take-off.

The power-take off is enclosed in a suitable box flanged to the rear of the tractor and controlled by a lever which is located laterally on the box itself. The shaft rotates clockwise at a speed rate of 623 r.p.m. at 1750 r.p.m. of the engine.

P.T.-O. outer diameter	1 - 3/8

Belt pulley.

The belt-pulley can be attached to the P.T.-O. unit either on the right or on the left-hand side.

Max. diameter, inches	11 - 13/16	(300 mm)
Width, inches	6 - 57/64	(175 mm)
Max. rotational speed (at 1750 r.p.m. of the engine), r.p.m.	973	
Pulley speed in feet per second	50	(15,3 m/s.)

Hydraulic lift.

The hydraulic lift unit has position and draft controls in alternative, and is equipped with a three-point hitching device with adjustable right arm.

Hydraulic gear pump (Plessey licence) model	A 25 X	
Ratio between pump r.p.m. and engine r.p.m.	1.233:1	
Pump rotational speed rate (at 1750 r.p.m. of the engine), r.p.m.	2150	
Oil circulating capacity of pump (Imp.gal./min.) at no-pressure	5.2	(23,5 l/1')
Oil circulating capacity of pump (Imp.gal./min.) at 1849 p.s.i. pressure	4.6	(21 l/1')
Overload pressure relief valve setting, lbs.sq.in.	1849 ± 71	(130 ± 5 kg/cm²)
Cylinder diameter, inches	3 - 3/4	(95 mm)
Displacement, cu.in.	46.68	(765 cm³)
Maximum hitch links travel at link ends, inches	25 - 9/16	(650 mm)
Maximum load raised at hitch link ends, lbs.	2205	(1000 kg)
Lifting effective capacity, ft.lb.	4702	(650 kgm)
Lifting time with engine running at max. power speed, sec.	3	
Weight of hydraulic lift unit with pump and oil lines (without oil), lbs.	220	(100 kg)

Ballast weights.

Cast-iron weights for front and rear wheels.

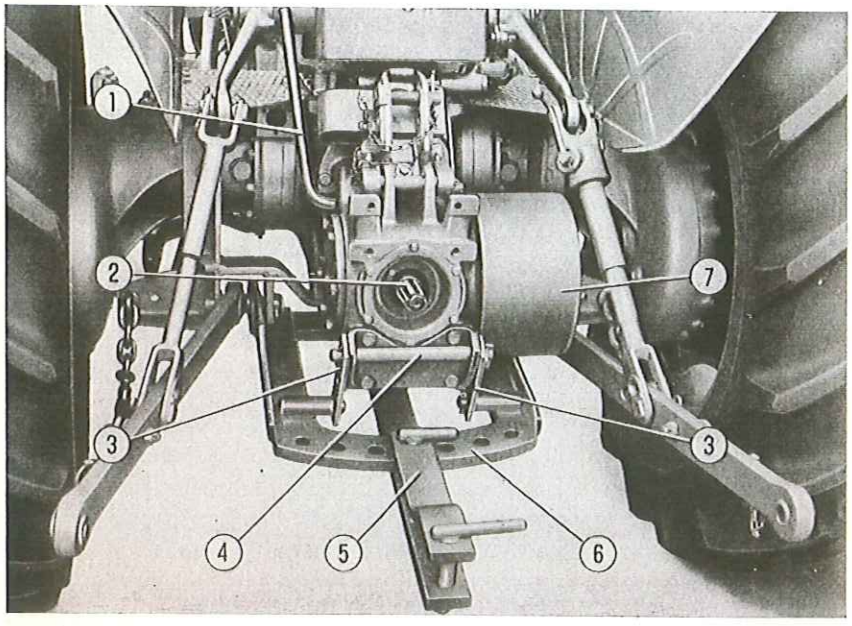
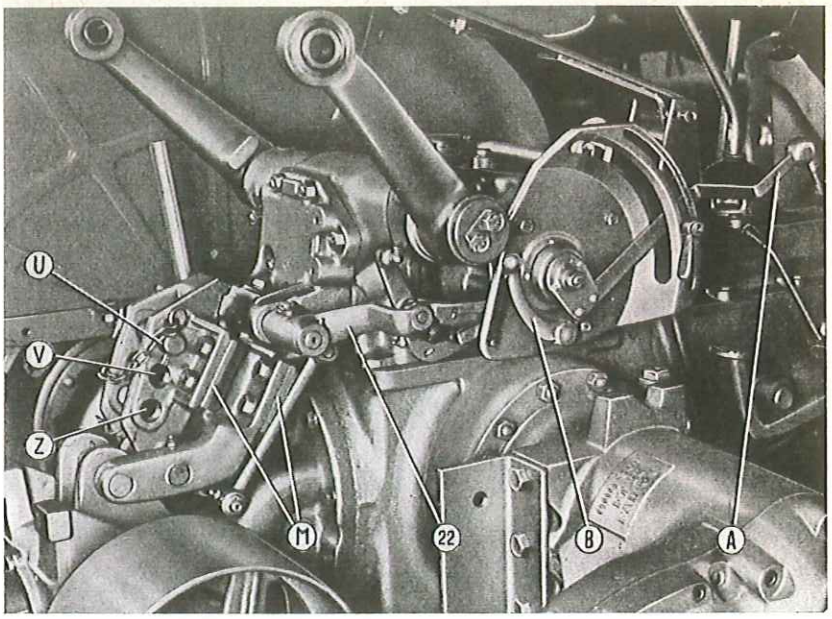


Fig. 11. - Attachments (power take-off, belt pulley, and hydraulic lift equipped with 3-point hitch).

1. Power take-off and belt pulley control lever - **2.** Power take-off shaft - **3.** Drawbar height adjustment tie-rods - **4.** Pin connecting the tie-rods to P.T.-O. casing - **5.** Drawbar - **6.** Drawbar plate - **7.** Belt pulley.

Fig. 12. - Hydraulic lift mounted on tractor.

A. Control lever - **B.** Selector lever - **M.** Reaction spring - **U.** Upper link attachment hole for light work with draft control - **V.** Upper link attachment hole for medium or heavy type work with draft control - **Z.** Upper link attachment hole for position control operation - **22.** Yoke.



MAIN DIMENSIONS

Wheelbase	80.7″	(2,05 m)
Front track width, adjustable to 5 wheel spacings	53.4″ - 58.3″ - 63″ - 67.7″ - 72.4″	(1,36 - 1,48 - 1,60 - 1,72 - 1,84 m)
Rear track width, adjustable to 8 wheel spacings	50.4″ - 55.5″ - 60.6″ - 65.7″ - 66.5″ - 71.7″ - 76.8″ - 81.9″	(1,28 - 1,41 - 1,54 - 1,67 - 1,69 - 1,82 - 1,95 - 2,08 m)
Overall length, at drawbar	11′ 2 - 1/4″	(3,41 m)
Overall width (3rd wheel spacing)	6′ 3 - 3/16″	(1,91 m)
Overall height to steering wheel	5′ 11 - 1/4″	(1,81 m)
Minimum ground clearance, measured under the front axle	16 - 7/8″	(0,43 m)
Minimum turning radius, with brakes off	13′ 4 - 1/4″	(4,07 m)
Minimum turning radius, with brakes on	11′ 7 - 3/4″	(3,55 m)

Weights.

Tractor total weight in operational conditions (including full fuel tank, oil and water - no ballast weights), lbs.	5578	(2530 kg)
Tractor, conditions as above, plus ballast weights fitted to front and rear wheels, lbs.	6228	(2825 kg)
Tractor, as above, plus water-filled tyres, lbs.	7055	(3200 kg)

Performance.

Belt-pulley horse-power	52
Drawbar horse-power:	
— on concrete	44
— on farmland with low wheelslip	38

ADJUSTMENTS

Checking the valve timing.

Fig. 13 illustrates how timing and injection pump gears must be arranged for proper engine timing. To check valve timing with the engine mounted on tractor, proceed as follows:

— remove the cover located on the right-hand side of the clutch housing. Rotate the crankshaft by using wrench **A 413062** on the crankshaft front end until the timing pointer registers with the « P.M.S. 1-4 » mark on the flywheel (corresponding to T.D.C. 1-4);

— rotate the crankshaft back and forth a few degrees to make sure that cylinder no. 1 is ending compression, at which point the intake and exhaust valves of cylinder No. 4 will start opening and closing symmetrically at 3° from T.D.C. (fig. 14), respectively, equal to a linear distance of 0.371 in. (9,42 mm) measured on the flywheel rim surface;

— check tappet gap (0.008 in. - 0,2 mm) at cylinder No. 1 and then at cylinders No. 3-4-2 by rotating the crankshaft 180° each time.

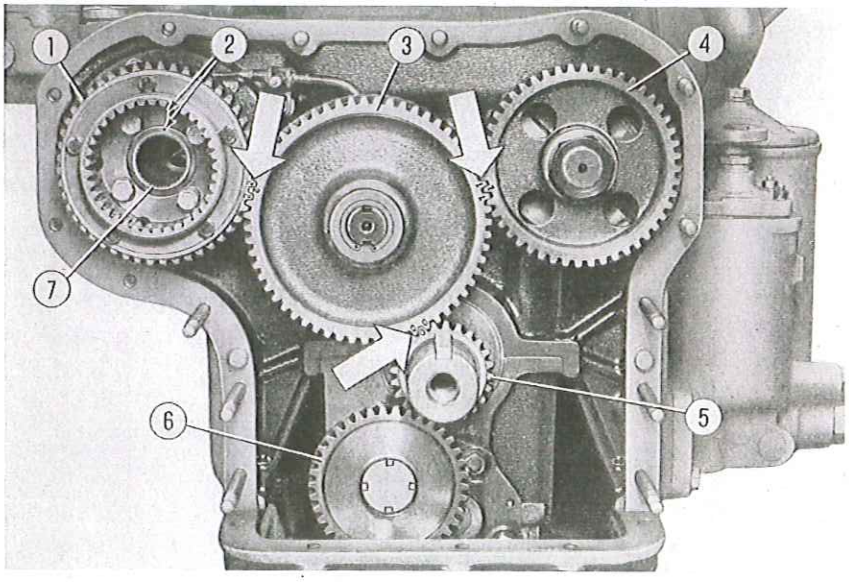


Fig. 13. - Reference marks on the gears for valve gear timing.

Arrows indicate the positions that numbers « 0-1-2 » must have for a correct timing (cylinder no. 1 at T.D.C. at the end of compression stroke).

1. Injection pump drive gear - **2.** Reference marks for gear (1) location on shaft (7) - **3.** Idle gear - **4.** Camshaft gear - **5.** Crankshaft gear - **6.** Oil pump drive gear - **7.** Injection pump drive hollow shaft.

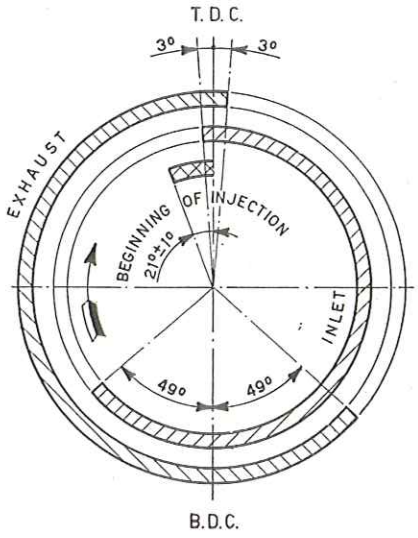


Fig. 14. - Engine timing diagram.

INJECTION PUMP

Refitting the injection pump to the engine.

To refit a previously removed pump to the engine, follow these instructions thoroughly:

— make sure there is the coupling sleeve retaining ring on the toothed bushing which is mounted on the camshaft end (6, fig. 15).

— start the toothed bushing onto the coupling sleeve (4) by matching the double tooth thickness of the former with the corresponding groove in the latter.
To facilitate the operation, the pump camshaft may be rotated, and if necessary, the coupling sleeve may be easily slid off the drive;

— push the pump to contact the crankcase flange and bring the marks on the outside face to register (D, fig. 16);

— lock the pump in position by tightening the nuts.

Checking the injection timing.

The pump refitted to the engine as described above should already be correctly timed, it is good practice, however, to check once more the timing by the overflow method.

Keep in mind that the beginning of delivery to cylinder No. 1 with its piston being on the compression

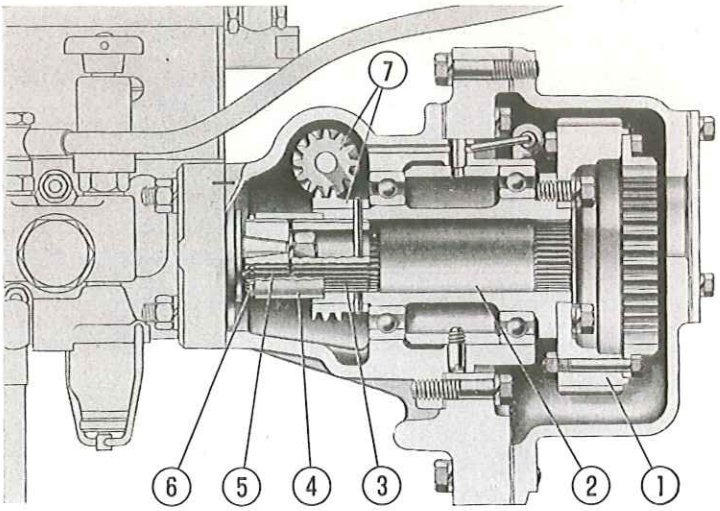


Fig. 15. - Section through the injection pump drive.

1. Front gear, injection pump drive - **2.** Hollow shaft, injection pump drive - **3.** Inner sleeve, pump-to-shaft joint - **4.** Outer sleeve - **5.** Pinion on injection pump shaft - **6.** Circlip, outer sleeve stop - **7.** Multi-meter drive gears.

stroke starts 21° ± 1° before T.D.C. This position of the piston corresponds to a line marked on the flywheel rim next to the « INIEZ » reading.

If the inspection reveals that injection is timed too late, slacken the nuts fastening the pump to the crankcase and pull the pump away from the engine until the register line marked on the pump flange is lower in position than the matching mark on the crankcase.

Previous removal of the fuel lines facilitates the operation.

To correct a too advanced timing do the opposite, that is, move the pump toward the engine.

At engine overhaul or when the change in position of the pump towards or away from engine is not sufficient to correct a faulty timing, move the sleeve (7, fig. 13) clockwise or counterclockwise with respect to the pump driving gear if the beginning of delivery is too late or too advanced, respectively.

This operation has an opposite result for the same direction of displacement as compared to moving the pump body.

It is possible to perform the above operations without removing the timing gear cover by removing instead the hydraulic lift pump and working through the slots existing on the cover itself (fig. 18).

Before checking again tighten the screws which fasten the pump to the crankcase or those which fasten the sleeve to the driving gear (C, D, fig. 16) if they have been slackened before to permit adjusting.

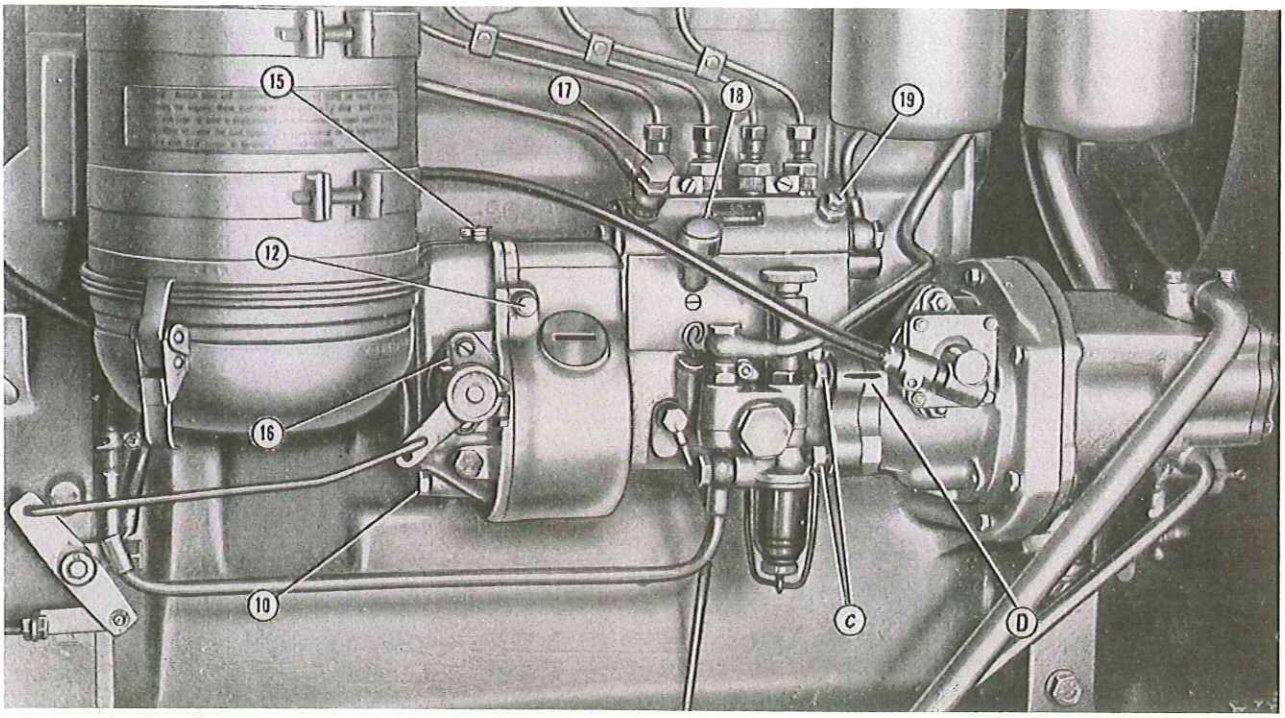


Fig. 16. - View of the injection pump installed on tractor.

C. Screws for fastening injector pump to crankcase - **D.** Reference marks for fitting pump to crankcase - **10.** Oil level plug - **12.** Cold-starting push-button - **15.** Oiler - **16.** Maximum speed adjusting screw - **17.** Fuel pressure relief valve - **18.** Valve cover air cleaner - **19.** Bleed plug.

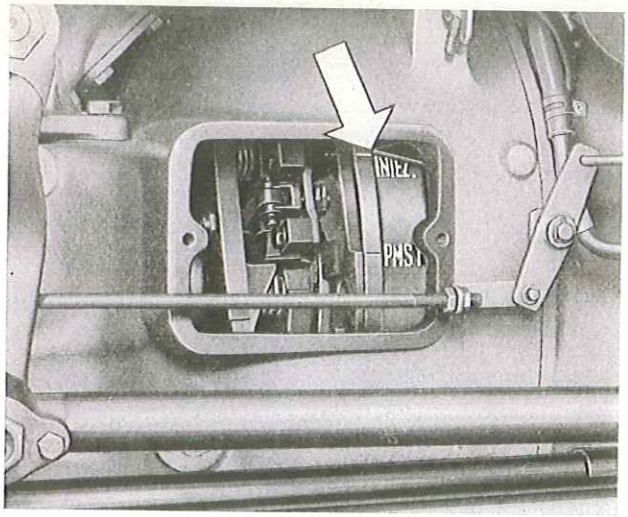


Fig. 17. - Reference mark on flywheel indicating injection advance (21° before T.D.C.).

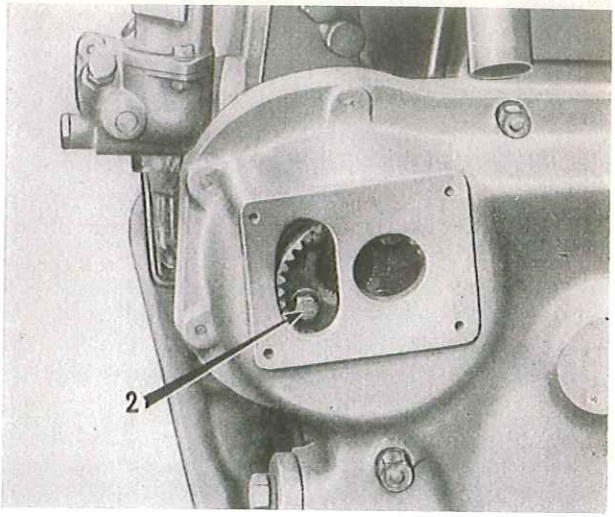


Fig. 18. - Timing the injection pump to the engine through the openings in the timing gear cover.
2. Screws for fastening the gear to the injection pump drive coupling sleeve.

Testing and setting the injection pump.

Tests to be made on the injection pump are the following:

— sealing of fuel fittings under pressure;
— sealing of plungers;
— sealing of pressure valves;
— uniformity of injection deliveries.

a) Fuel fitting pressure test.

Connect the pump fuel intake fitting to the fuel line coming from a hand-primed feeding pump and screw onto the fittings the caps contained in the box **A 527015.**

A good seal should not show any leakage under a pressure ranging from 1060 p.s.i. to 1420 p.s.i. (75 to 100 kg/cm²), otherwise replace the seal or the fitting.

b) Testing injector plunger sealing.

Connect the above testing apparatus to the pump and fit on the pressure fitting of the pumping element a suitable high-pressure gauge.

Move the control rack either to its maximum fuel delivery stop or to an intermediate fuel delivery position, then actuate the plunger a full stroke with a lever and read the pressure on the gauge. The following pressure values indicate satisfactory plunger seal conditions:

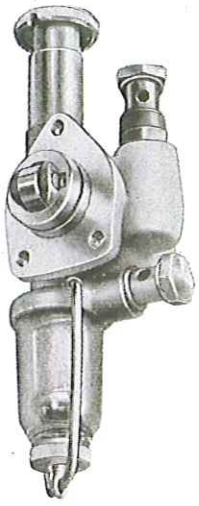


Fig. 19. - The fuel pump.

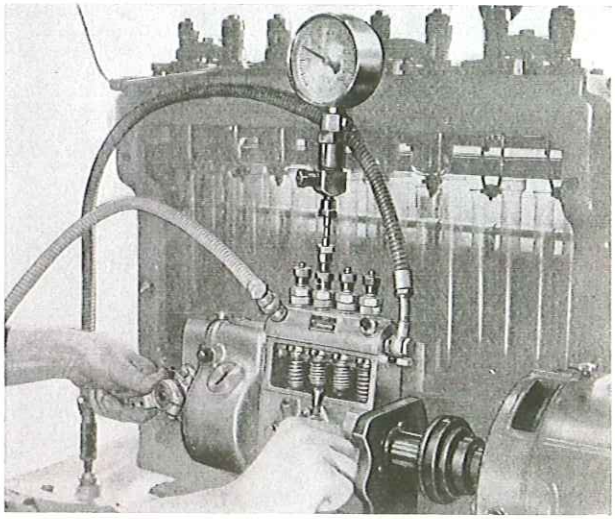


Fig. 20. - Checking the plungers sealing when the control rod is in the position of maximum fuel delivery.

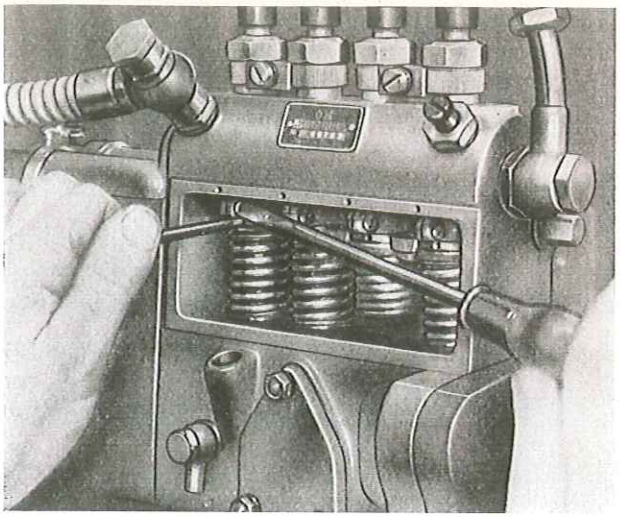


Fig. 21. - Regulating the position of the plunger by acting on the toothed sleeve coupling.

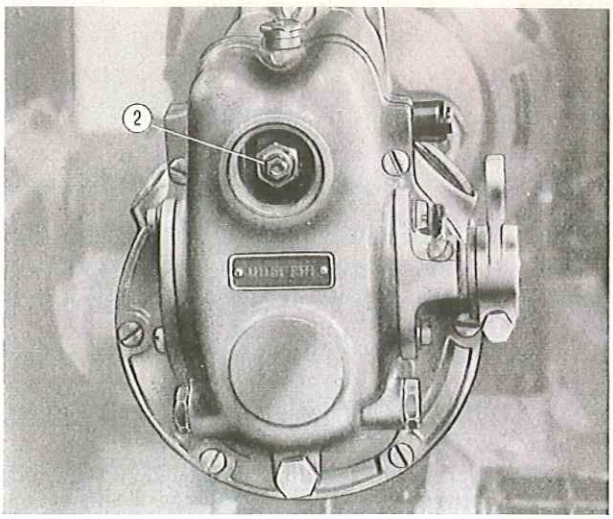


Fig. 22. - Control rod travel adjusting screw (2).

— 2850 to 3550 p.s.i. (250 to 200 kg/cm²), with control rack at its maximum fuel delivery setting;
— 2130 to 2560 p.s.i. (180 to 150 kg/cm²), with control rack at an intermediate setting.

Values differing from those given above are a clear indication of a worn plunger, in which case proceed to replace the plunger and barrel unit.

When the pump has been in operation for long periods of time, we suggest testing plunger seal conditions with the control rack set to its idle position, too.

Pressure should reach 1560 p.s.i. (110 kg/cm²), at least.

c) **Pressure valves seal test.**

Test to be performed jointly with the preceding one; its aim is to check the existance of a constant pressure increment during the pumping stroke, followed by a sharp pressure drop at delivery end.

The pressure drop values are:
— 425 to 570 p.s.i. (30 to 40 kg/cm²), with new parts;
— 850 to 1140 p.s.i. (60 to 80 kg/cm²), with used parts.

d) **Testing and setting the uniformity of deliveries.**

Injection pump testing and setting may be performed by setting the test bench under conditions **A** and **B** as specified in the table at page 18 and by following these instructions:
— disconnect the speed governor using tool **A 427112** which also serves when the speed governor is already removed. Mount a connector **A 423112** with dial gauge **A 19177** in place of the protecting cover plug to measure the length of stroke of the control rod;
— discharge the air from the fuel feeding chamber by slackening the proper screw;
— test fuel deliveries.

The adjustment of the maximum length of the control rod run is carried out using wrenches **A 427042** on the end of the screw (2, fig. 22) through a suitable opening, when the governor has not been previously removed from the injection pump.

IMPORTANT

Before the test begins rotate the pump in order to fill the fuel lines and discharge the air.

If fuel deliveries are different from those specified, correct them by rotating the toothed collars of the plungers (fig. 21). The corrective rotational movement is adequate only when the wear between plunger and cylinder walls is not excessive, if not, it will be necessary to replace them; besides, it is allowed for a limited range only (about 0.08 in. = 2 mm from reference marks) as it would otherwise annull the advantage of the excess fuel needed for engine starting.

Tests will prove that values differ from each other though conditions remain the same (delivery, rotation, control rod run). Differences may be due to excessive clearance between the teeth of control rack and plunger collars and between the lower diameter of plungers and their sleeves which may cause slight angular shifting of the plungers.

We therefore recommend repeating the test three or four times and using the average values found. Fuel feeding pressure during testing must range between 17 and 21 lb./sq.in. (1,2 to 1,5 kg/cm²).

CALIBRATION OF THE INJECTION UNIT TYPE PES 4 A 85 B 410 : L4/27

The regulation of the injection unit may be performed under either one of the following test conditions:

— **Test « A »:** Bosch test-bench provided of nozzle holders with valve spring WSF 2044/4X and nozzles DN 12 SD 12.
Rabotti test-bench « ATMO 700 F » with graduated ring-nut injectors as standard equipment, FIAT 656829 valve spring and DN 12 SD 12 nozzles.
Injector pressure setting: 2500 p.s.i. (175 kg/sq.cm.). Pressure lines: .079″ I.D. x .236″ O.D. x 15.750″ length (2 x 6 x 400 mm).

— **Test « B »:** Test-bench equipped with same injectors as those fitted to the engine (nozzle holders KB 82 S1 F1 and nozzles DLL 145S 35F), and pressure lines 2 x 6 x 400 of same diameter as those installed on the engine.
Injector pressure setting: 2418 to 2580 p.s.i. (175 ± 5 kg/sq.cm).

Stroke of injection pump plunger, from B.D.C. to beginning of injection: .085″ to .088″ (2.15 to 2,25 mm).
Specific gravity of Diesel fuel: .082 to .084 (830 ± 10 gram/liter) at a temperature of 62.6 to 73. °F (20 ± 3 °C).
Feeding pressure: 17 to 21.3 p.s.i. (1.2 to 1.5 kg/sq.cm.).
Pump timing: beginning of delivery to engine cylinder no. 1 at 21 ± 1° before T.D.C.

Governor control lever setting	Rotation rate R.P.M.	Control rack excursion mm	Test « A »				Test « B »			
			Delivery of every pump element per cycle cu. mm.	Delivery of every pump element per 500 strokes cu. cm.	Total pump delivery per cycle cu. mm.	Total pump delivery per 500 strokes cu. cm.	Delivery of every pump element per cycle cu. mm.	Delivery of every pump element per 500 strokes cu. cm.	Total pump delivery per cycle cu. mm.	Total pump delivery per 500 strokes cu. cm.
Minimum	250 $^{+\ 0}_{-\ 10}$	8 ± 0.5	10 ± 1	5 ± 0.5	—	—	10 ± 1	5 ± 0.5	—	—
Maximum	875 $^{-\ 10(*)}_{+\ 0}$	12 ± 0.1	69 ± 2	34.5 ± 1	276 ± 3 (**)	138 ± 1.5(**)	62 ± 2	31 ± 1	248 ± 3 (**)	124 ± 1.5(**)
Maximum (without rack stop)	200	—	> 140	> 70	—	—	> 140	> 70	—	—

(*) Rate at which governor begins to operate: 875 $^{-\ 0}_{+\ 10}$ R.P.M. - (**) To adjust the control rack travel stop.

ENGINE PERFORMANCE ON TEST BENCH

The following data refer to engine without fan, air cleaner and exhaust muffler.
Ambient temperature: 62.6 to 73.4 °F (20° ± 3° C).
Pressure: 740 ± 5 mm of mercury.

	Engine speed R.P.M	Engine output, after 2 hours of run-in H.P.	Engine output, after 50 hours of run-in H.P.	Time for fuel consumption of 250 cu. cm. seconds
Maximum (under load)	1750 - 1770	⩾ 53	⩾ 55	⩾ 74
Maximum torque	1200	⩾ 40	⩾ 41	⩾ 102,5
Maximum (idle)	⩽ 1870			
Minimum (idle)	580 - 620			

TRACTOR BELT PULLEY PERFORMANCE

	Speed		Engine output, after 2 hours of run-in	Engine output, after 50 hours of run-in	Time for fuel consumption of 250 cu. cm.
	Engine R.P.M.	Belt pulley R.P.M.	H.P.	H.P.	seconds
Maximum (under load)	1750 - 1770	973 - 977	⩾ 48	⩾ 52	⩾ 74
Maximum torque	1200	670	⩾ 35.5	⩾ 39	⩾ 102,5
Maximum (idle)	1870	1040			
Minimum (idle)	580 - 620	320 - 345			

THE SPEED GOVERNOR

The speed governor is keyed on one end of the injection pump camshaft and possesses the following characteristics:

— centrifugally operated, spring-opposed, fly-weight type governor;
— flexible joint with vibration damper;
— operates at all engine speeds;
— excess fuel device which functions when the injection pump control lever is in the maximum fuel position.

The control rod stop (3, fig. 23) is located inside the governor cover and can be displaced from its setting by depressing a push-button control, which allows the control rod to move beyond the maximum fuel position in order to obtain excess fuel for starting the engine. Once the engine is started the stop and control rod return to their original respective positions.

The governor is lubricated through an oiler (15, fig. 16) mounted on the cover and a plug (10, fig. 23) is provided for checking the oil level.

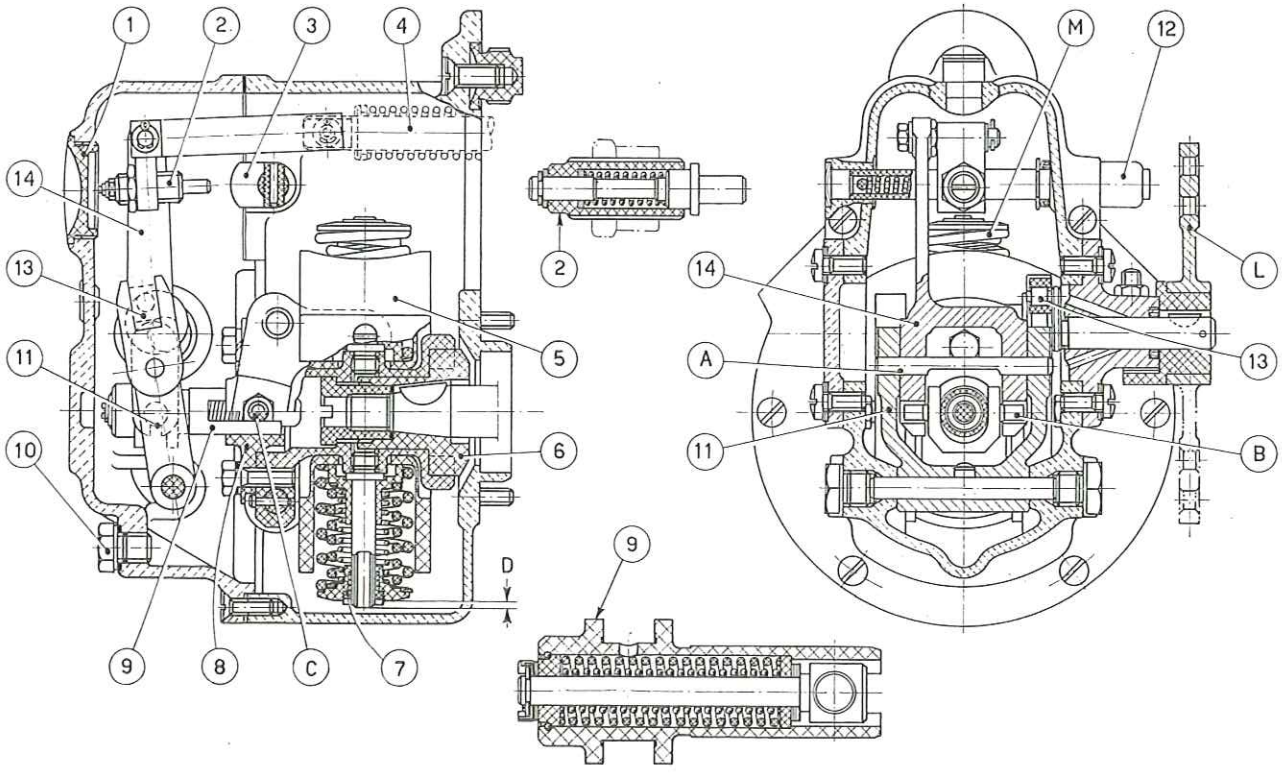


Fig. 23. - Sectional view of the fly-weight type speed governor.

1. Plug hole through which the control rod stroke adjusting screw can be regulated - **2.** Adjusting screw and excess fuel device - **3.** Control rod stop - **4.** Fuel delivery control rod - **5.** Flyweights - **6.** Vibration damper - **7.** Spring loading regulation nut - **8.** Override device support - **9.** Override device - **10.** Oil level inspection plug - **11.** Articulated fork - **12.** Excess fuel control button to be actuated at engine cold-starting and installed on the control rod stop - **13.** Link between outside control lever (L) and articulated fork (11) - **14.** Inside floating lever for fuel rod control floating on two pivots - **A.** and **B.** Pivots of lever (14) - **C.** Link point of fly-weights with the override device pin - **L.** Outside control lever - **M.** Fly-weight springs.

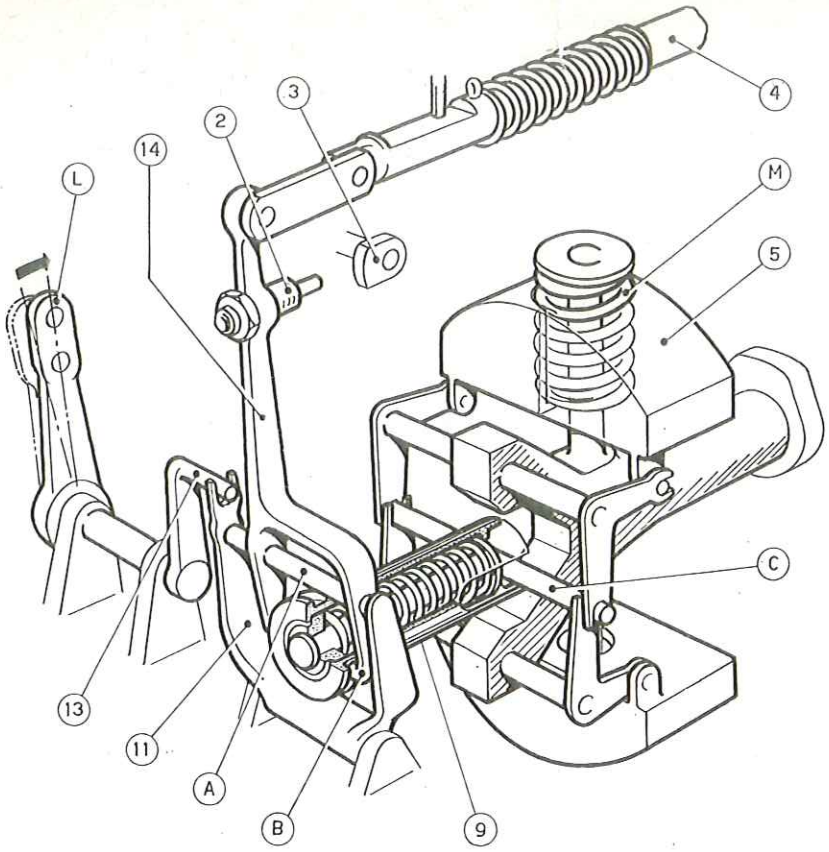


Fig. 24. - Schematic drawing showing operation of speed governor with control lever (L) in 1/4 run position (see fig. 23).

Operation.

The chief components of the speed governor are the following:

— the fly-weights (5, fig. 23) mounted on spindles at right angles to the camshaft and connected through two bell crank levers to the override device (9) by pivot (C);
— the inside floating lever (14) connected to the top end of the control rod (4), to the bottom end of the link fork (11) and to the override device (9) through pivot pin (A) and joint (B);
— the outside control lever (L) connected to the link fork (11) which is pivoted on the governor cover. The important feature which must be clearly grasped if the governor operation is to be understood

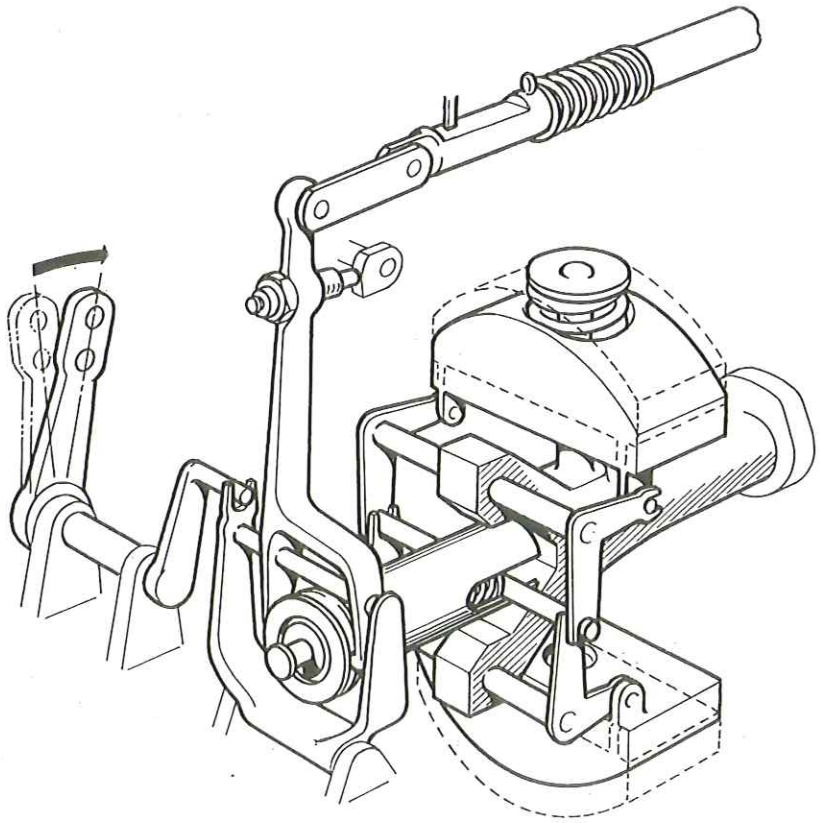


Fig. 25. - Schematic drawing showing operation of speed governor with control lever (L) in 3/4 run position (see fig. 23).

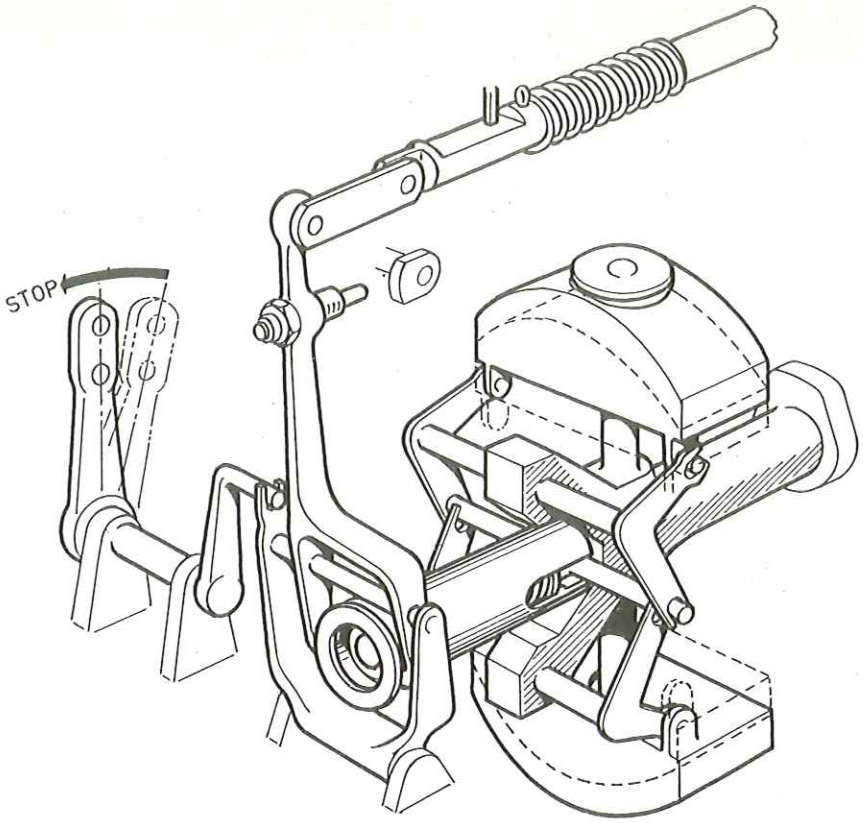


Fig. 26. - Schematic drawing showing operation of speed governor during shifting of control lever (L) from maximum speed to fuel cut-off position (see fig. 23).

is that the inside lever (14) has two pivot points (A and B) and floats on one because of the thrust on the other. In fact, the inside floating lever (14) is actuated through both the outside control lever (L), which is linked to the accelerator, and the fly-weights when the engine undergoes a load variation; thus in the former case the lever floats on pivot B, in the latter on pivot A.

In fig. 24 the sketch illustrates the operation of the speed governor in the case of an engine functioning at practically constant speed and with the outside control lever (L) positioned at about 1/4 of its maximum run. Any variation of speed will thus result in a change of position of the fly-weights (5) which will shift the pivot point (C) to the left if speed decreases and to the right if speed increases. This movement will make the override device (9) move rigidly causing lever (14) to float on pivot (A) thus shifting control rod (4) to increase or reduce fuel supply.

Let us now consider the case where speed is to be increased by shifting control lever (L) from the previous position to about 3/4 of its full run. The mechanism shown in fig. 25 will function as follows.

The link fork (11) is rotated to the right causing floating lever (14) to swing on pivot (B) and push control rod (3) to the right, thus increasing the fuel supply.

A particular feature of the mechanism is that when the control lever is moved to an increased speed position, the relative large movement of the top end of lever (14) may force the screw (2) against the stop (3) before the desired amount of movement of the control lever (L) has been effected. Further movement of the control lever could then only be obtained by forcing the fly-weights apart against their spring-pressure. This would apply heavy loading on the linkage and is obviously undesirable.

With the override device the danger is avoided by making the coil spring of the device itself (9) absorb the extra movement of lever (L).

When the accelerated engine tends to reach the desired condition of equilibrium and the fly-weights moving outwards shift the pivot (C) to the right, the load initially applied on the coil spring of the override device (9) lessens and the plunger returns to rest position bearing against the spring sleeve as at the starting position (fig. 24).

From then on, any variation of speed will cause shifting of the control rod to the left or to the right depending upon the load.

The override device (9) works also in the opposite direction when the control lever (L) is shifted rapidly from the maximum fuel position towards the fuel cut-off position (fig. 26), or when the engine is dragged at a speed rate which is beyond the setting of the control lever. In such cases, without forcing on the pivot (C) of the fly-weights, the control rod is brought against the stop and the extra-movement is absorbed by the override device (9).

When the control lever (L) is in the maximum fuel position and the load increases, the engine slows down, the fly-weights move inwards, and the lever (14) already bears with screw (2) against stop (3), yet the excess-fuel device housed inside screw (2) allows said lever to advance further a short distance and the control rod can also make an extra-movement increasing the fuel supply.

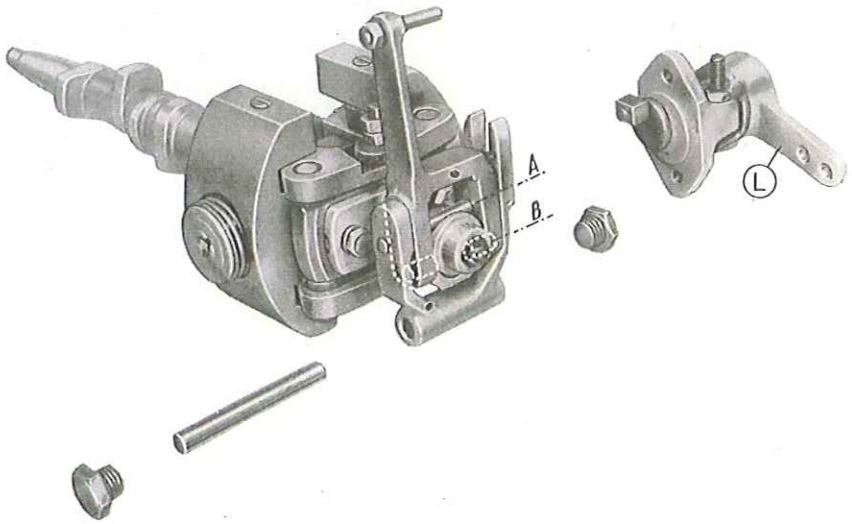


Fig. 27. - View of speed governor installed on the pump camshaft and control lever (L).

Speed governor overhaul.

Disassembly.

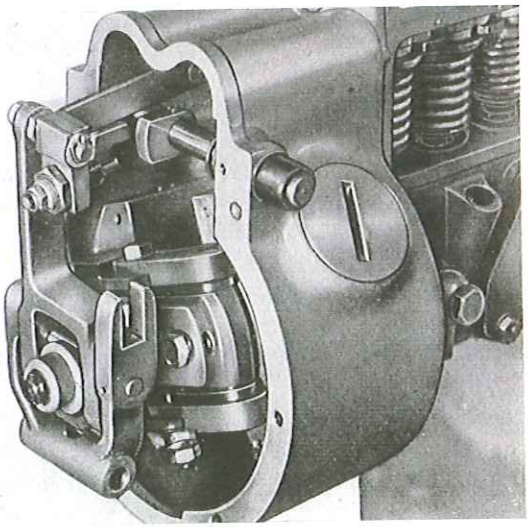


Fig. 28. - Removing the governor housing cover.

Before taking down the cover from the governor housing (fig. 28) unscrew the two fastening screws and remove the pivot pin of the link fork (11).

Detach the inside lever (14) from the control rod and remove it after pivot pin (A) which is held in place by a cotter pin.

Remove the override device (9) after driving out the fly-weight pivot. The latter can be extracted only after removing, or at least displacing the excess fuel device (12) for cold starting of the engine.

Remove the ring locking the fly-weights to the pump camshaft using fixture **A 527055** (fig. 29) and pull out the fly-weights using a screw-driver to shift them.

Also pull out the vibration damping device coupling using puller **A 427011** (fig. 30).

Inspection of governor components.

Check fly-weights for the presence of the same reference mark stamped at the factory after trial test, reference mark which should be the same also at overhaul or replacement.

Inspection the springs, which should carry a mark made in green, yellow or red paint. Equal springs must be painted with same colour.

Should one be replaced, choose a new one painted with the same colour of the one being substituted.

Check control rod for free sliding (an applied force of approximately 5 to 7 oz. - 150 to 200 grams, should be sufficient to slide it back and forth).

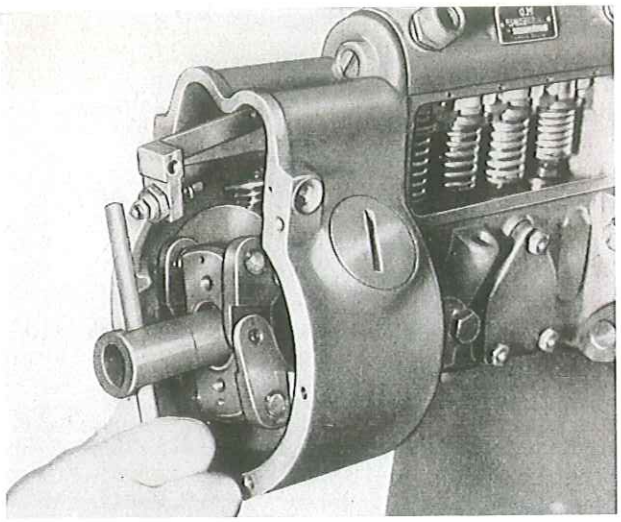


Fig. 29. - Removing the fly-weight retaining collar using screwdriver A 427055.

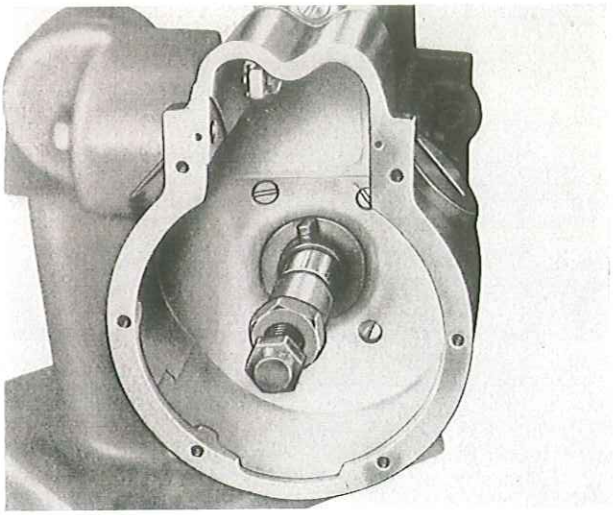


Fig. 30. - Removing the coupling of the vibration damper from the pump camshaft using puller A 427011.

Reassembly.

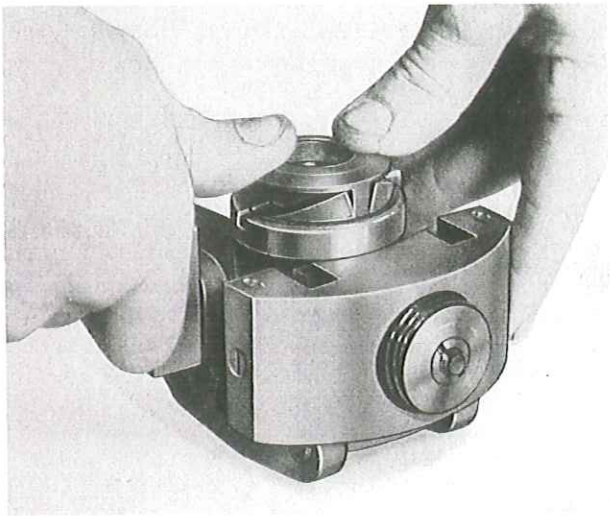


Fig. 31. - Fitting the vibration damper to the flyweights. (Note relative positions of rubber blocks).

Follow the opposite procedure used for disassembly, keeping in mind that the vibration damper must be reinstalled together with the fly-weights and according to the method shown in fig. 31.

To be perfectly balanced the fly-weights need equally loaded springs. The equilibrium is achieved by turning an equal number of threads the retaining collars on both sides.

To check the load on the springs measure the distance between the spindle ends and the collar surfaces, distance which must be equal on both sides (0.080″ to 0.100″ - 2 to 2,5 mm).

The retaining collars have a projection on the lower side which fits inside a slot machined in the spring discs. Thus, to actuate the springs their load must be overcome. There are two releases each turn, and by counting them on each side separately it is possible to check whether or not the spring loads balance.

Adjusting the vibration damper.

Before mounting the rubber blocks on the vibration damper, verify that the end play between ring nut and flyweight spider is 0.002 to 0.004 in. (0,5 to 0,10 mm).

Adjustment is made using shims of suitable thicknesses, it is therefore absolutely necessary to be very careful not to damage them during disassembly.

Governor setting for maximum speed.

Governor setting requires the application of a load during the test (i.e. injection pump operating on test bench with fuel lines connected to it) in order to approach as closely as possible the practical working conditions, and also to avoid possible damages to injector plungers working dry.

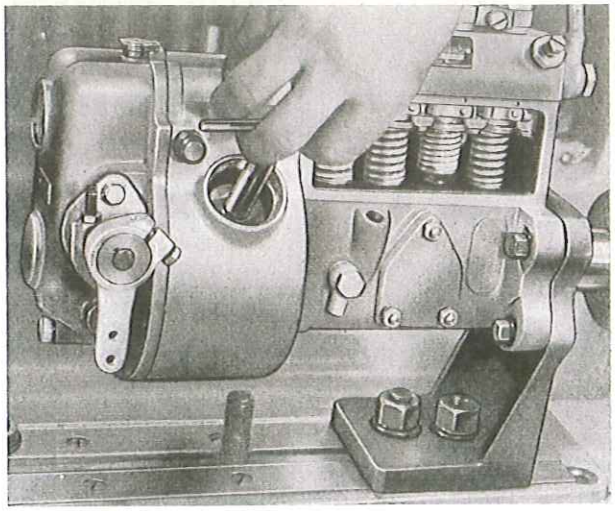


Fig. 32. - Adjusting the fly-weight opposing springs using wrench A 527008.

Temporarily replace the plug in the front cover protecting the end of the control rod with fitting **A 423112** and dial gage fitted to it, loosen locknut and adjusting screw (16) and the stop locknut (2).

Rotate the pump camshaft at 875 r.p.m. and slowly shift the outside control lever (L) to increase fuel supply until the full stroke corresponding to maximum fuel supply has been completed (0.472 ± 0.004 in. - 12 ± 0,1 mm, from the stop).

Holding lever (L) in this position, tighten the maximum fuel supply set screw (16) against the lever stop and lock it in place with the jam nut.

NOTE - In the position corresponding to maximum fuel supply the lever makes an angle of 36 ± 4° with the vertical.

Using the set of wrenches **A 427042** act on mechanism (2) until the screw lightly contacts the stop (3) and lock it in position with the jam nut; check if fuel deliveries correspond to those found in regulating the pump capacity.

Gradually increase speed and check if at a speed rate of 875 ÷ 885 r.p.m. the toothed collars begin to bring the control rod back, thus reducing the fuel supply.

Should the control lever (L) reach the end of its run and the control rod not complete its 0.472″ (12 mm) stroke with a sufficient margin of safety, remove, using special screwdriver **A 12114** the plug of the cover opening which allows reaching the fly-weights and adjust using wrench **A 527008** (fig. 32) the load on governor springs (M) by turning the retaining collars down. The same operation must be carried out when the control rod is not brought back towards the stop in spite of speed rate increasing.

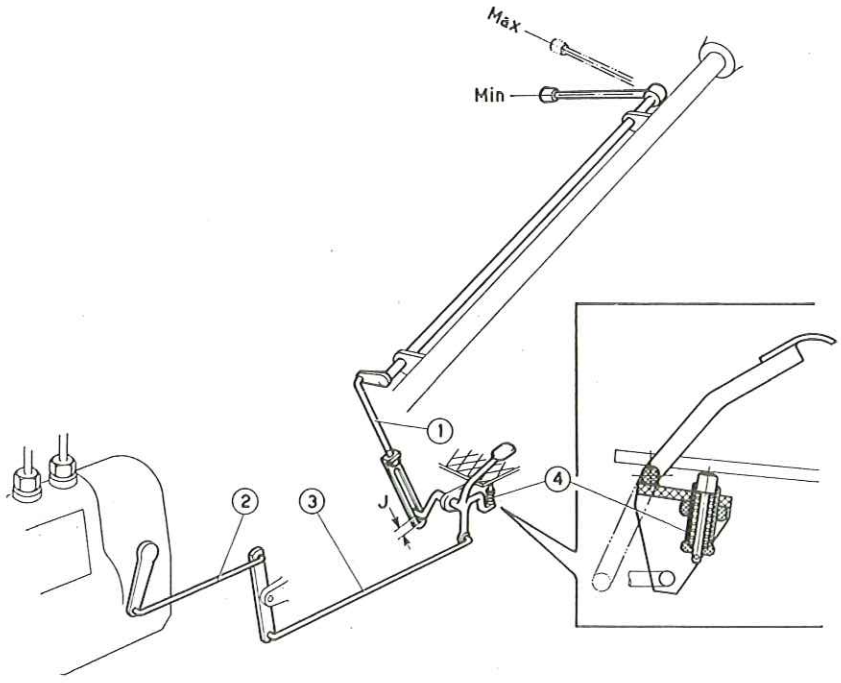


Fig. 33. - Schematic diagram showing the adjustment of the throttle control linkage (idle position).

1. Intermediate rod - **2** and **3.** Throttle control rods - **4.** Idle adjustable stop - **J.** Clearance with accelerator control lever in idle speed position, sufficient to allow the pedal upward movement to cut-off position.

Checking and adjusting the accelerator controls.

To adjust the maximum fuel setting (fig. 33):

— shift the hand lever of the accelerator control to the maximum position (bearing against the upper stop) and lower the accelerator pedal completely down against the footboard.
Should the latter not remain in this position help it to it with a hand and set it in by adjusting the tie-rod nuts (1);

— check the tie-rod (2) which after the above operations have been effected should be slightly flected, if not adjust the length with the nuts.

To adjust the idle setting (fig. 33):

— shift the accelerator control lever downwards to bear against the stop and check the engine speed which should be 580 to 620 r.p.m.
If engine speed is different, adjust the spring stop (4) by turning it clockwise when the engine speed is lower than above;

— make sure it exists a play (J) sufficient to allow stopping the engine by lifting the accelerator pedal using the foot.

ENGINE FITS AND TOLERANCES

	Data		Wear limits	
	in.	mm	in.	mm
Valve system.				
Diameter inside of valve guides (after driving into cylinder head)	0.314 - 0.315	7,99 - 8,01		
Clearance - stem and guide	0.0020 - 0.0033	0,050 - 0,085		
Diameter - outside of standard tappet	1.0606 - 1.0615	26,939 - 26,960		
Clearance - tappets and crankcase seats	0.0016 - 0.0037	0,04 - 0,094	0.008	0,2
Diameter - intake valves	1.486 - 1.496	37,75 - 38,00		
Diameter - exhaust valves	1.329 - 1.339	33,75 - 34,00		
Angle - intake valves	45°			
Angle - exhaust valves	45° 15′			
Angle - valve seats on cylinder head	44° 40′ - 44° 50′			
Specifications - valve springs:				
— Free length	2 - 27/64″	61,5 mm		
— Length under load	2″	51 mm		
— Test load	44 - 48 lb	20 - 22 kg		
Cylinder sleeves.				
Diameter - inside	4.1339 - 4.1348	105,000 - 105,022		
Diameter - outside, at top of crankcase bore height	4.4436 - 4.4476	112,870 - 112,970		
Clearance - sleeve outside diameter and crankcase bore	0.0012 - 0.0061	0,030 - 0,155		
Height - cylinder sleeves above crankcase	0.0059 - 0.0071	0,15 - 0,18		
Clearance - cylinder sleeves and pistons	0.0039 - 0.0057	0,100 - 0,146	0.0157	0,4
Pistons, pins and rings.				
Diameter - max. of piston (measured at bottom of skirt across pin axis)	4.1289 - 4.1299	104,876 - 104,900		
Diameter - piston pin	1.4961 - 1.4963	38,006 - 38,015		
Allowance - piston pin and its seat	- 0.0006 - 0.0002	- 0,015 - 0,006	0.0020	0,05
Width - 1st piston ring groove	0.1013 - 0.1018	2,575 - 2,588		
Width - 2°, 3°, 4° ring grooves	0.1008 - 0.1013	2,560 - 2,575		
Width - 5° ring groove	0.1993 - 0.1998	5,060 - 5,075		
Width - 6° ring groove	0.1988 - 0.1994	5,048 - 5,062		
Width - 1°, 2°, 3°, 4° piston rings	0.0975 - 0.0980	2,478 - 2,490		
Width - 5°, 6° piston rings	0.1959 - 0.1964	4,978 - 4,990		
Side clearance - 1° piston ring and groove	0.0034 - 0.0043	0,085 - 0,110	0.0138	0,350

(cont'd)

(cont'd: Engine fits and tolerances)

	Data		Wear limits	
	in.	mm	in.	mm
Side clearance - 2°, 3°, 4° and 5° piston rings and grooves	0.0027 - 0.0038	0,070 - 0,097	0.0098	0,25
Side clearance - 6° piston ring and groove	0.0023 - 0.0033	0,058 - 0,084	0.0098	0,25
Wall thickness - piston rings	0.161 - 0.170	4,08 - 4,32		
End gap - piston rings, fitted inside cylinder sleeves:				
— 1° rings	0.0118 - 0.0197	0,3 - 0,5		
— 2°, 3°, 4°, 5° rings	0.0098 - 0.0177	0,25 - 0,45		
Connecting rods and bushings.				
Diameter - inside of bushings (bore after assembly)	1.4971 - 1.4975	38,025 - 38,035		
Clearance-piston pin and bushing	0.0004 - 0.0011	0,010 - 0,029	0.0059	0,150
Difference in weight allowed for connecting rods	0.53 oz.	15 g		
Crankshaft.				
Diameter-main bearing journals	2.9984 - 2.9990	76,158 - 76,176		
Thickness-main bearing shells	0.0855 - 0.0857	2,172 - 2,178		
Clearance-main bearings and journals	0.0036 - 0.0056	0,094 - 0,144	0.011	0,28
Diameter - crank pins	2.7495 - 2.7502	69,837 - 69,855		
Thickness - crank pin bearing shells	0.0742 - 0.0745	1,886 - 1,892		
Clearance - crank pin bearings and journals	0.0037 - 0.0045	0,096 - 0,116	0.009	0,22
Thickness - thrust washers	0.091 - 0.093	2,31 - 2,36		
End play	0.0027 - 0.0105	0,070 - 0,270	0.016	0,4
Torque wrench specifications.				
Crank pin caps	72 ft.lb.	10 kgm		
Main bearing caps	100 ft.lb.	14 kgm		
Cylinder head nuts	160 ft.lb.	22 kgm		
Flywheel bolts	72 ft.lb.	10 kgm		
Fan fastening to pulley	57 ft.lb.	8 kgm		

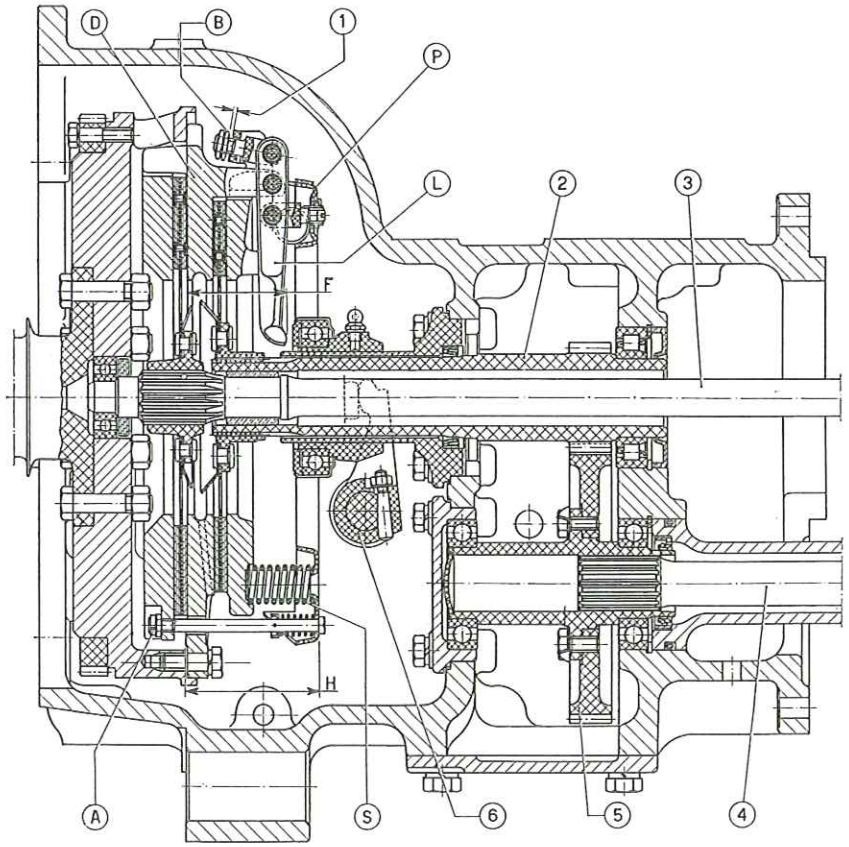


Fig. 34. - Cross-section of engine clutch and P.T.-O. drive gears.

1. Engaged clutch clearance of 0.051″ to 0.067″ (1.3-1.7 mm) to be checked when adjusting the pedal free travel - **2.** Hollow shaft housing the P.T.-O. drive shaft - **3.** Transmission shaft from clutch to gearbox - **4.** P.T.-O. or belt-pulley drive shaft - **5.** P.T.-O. drive shaft driving gear - **6.** Clutch throw-out collar control yoke - **F.** Distance between clutch disc and release lever ends: 2.638″ to 2.665″ (67 to 67.7 mm) - **H.** Distance between clutch fixed plate and lever supporting plate: 3.366″ to 3.405″ (85.5 to 86.5 mm) (to be considered for clutch reassembly). By using fixture **A 417163** as shown in fig. 37, said dimension is automatically assured - **S.** Clutch springs - **L.** Clutch release levers - **A.B.D.P.** See fig. 35.

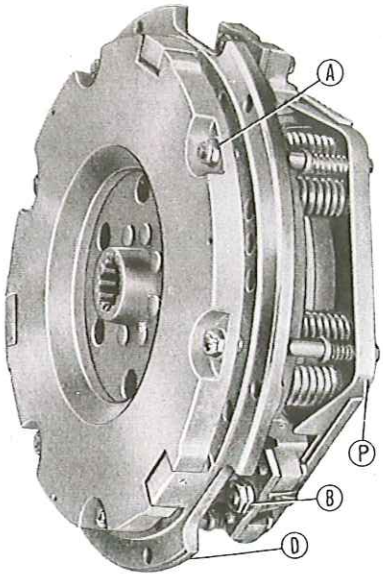


Fig. 35. - Engine clutch assembly.

A. Nuts for screws fastening the engine clutch disc to the lever support plate - **B.** Engaged clutch clearance adjusting nuts - **D.** Disc fixed to the flywheel - **P.** Release levers supporting disc.

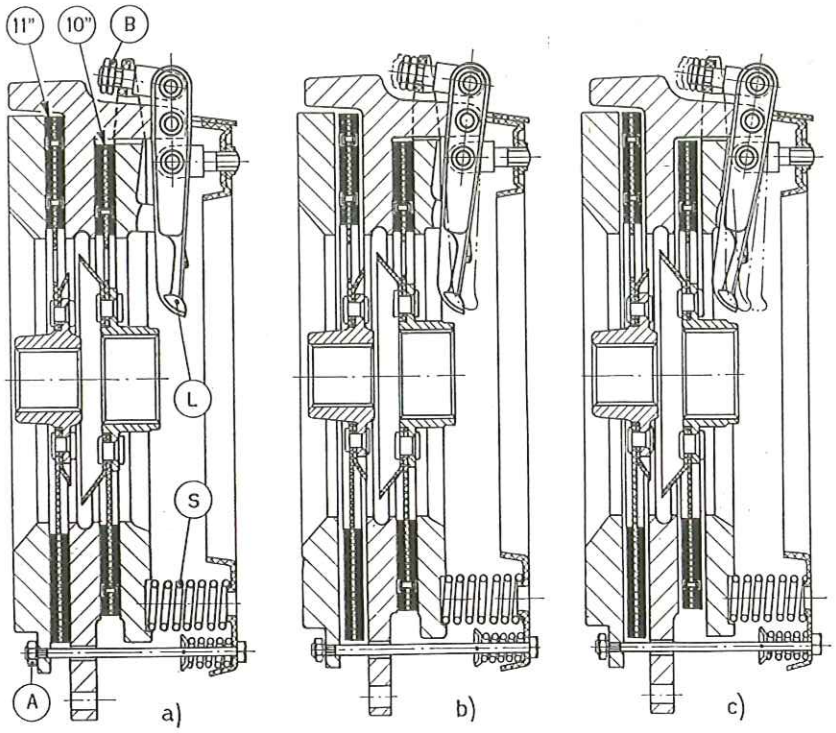


Fig. 36. - Schematic drawings showing clutch operation.

a) Clutch with engaged discs. The 11″ assures the transmission of motion from engine to driving wheels. The 10″ disc assures the transmission of motion from the engine to the P.T.-O. or belt-pulley shaft.

b) The 11″ disc is disengaged by the first stroke of the pedal run following the action of the lever support plate, fixed to the engine clutch disc with screws and nuts (A), and nuts B come in contact with the stop, thus eliminating the initial clerance specified for the clutch in the engaged position.

c) Pushing the pedal down further causes the disengagement of the 10″ disc. Springs (S) are further compressed and nuts (B), previously contacting their stop, can thus push away the pressure disc through the action of release levers (L).

A. Nuts for fixing the engine clutch disc to the release lever support plate - **B.** Nuts at 0.051″ to 0.067″ (1,3 to 7,7 mm) distance from the stop - **L.** Release levers.

Clutch adjustment.

Fig. 36 illustrates the operation of the clutch. The disassembly, adjustments, and reassembly of this unit are best performed using fixture **A 417163** which allows the mechanic to do all the work without memorizing various data and figures.

Figures 37-38-39 illustrate the correct usage of the fixture.

The clutch adjusting procedure requires taking the following steps:

1. Set the right load on springs S, through screws and nuts A (fig. 38).
2. Set release levers L at the correct distance from the surface of the clutch plate fixed to the flywheel, and check that the lever contact points are on the same plane perpendicular to the clutch shaft axis (fig. 39) (co-planarity of the release levers - allowance: 0.004 in.; 0,1 mm).
3. Adjust the clearance between nuts B and their stops, the clutch being engaged.
   This clearance, which must always be maintained to allow the clutch to function properly, is included between 0.051 in. and 0.067 in. (1,3 to 1,7 mm) (see 1, fig. 34).

Important.

The clutch springs (S, fig. 34) do not all possess exactly the same characteristics, therefore each has been given a different colour to make sure that the original fitting order will be maintained at reassembly i.e., install the green-painted springs laterally to the release lever pivot supports.

Clutch disc thickness (new): 0.335 to 0.350 in. (8,5 to 8,9 mm).

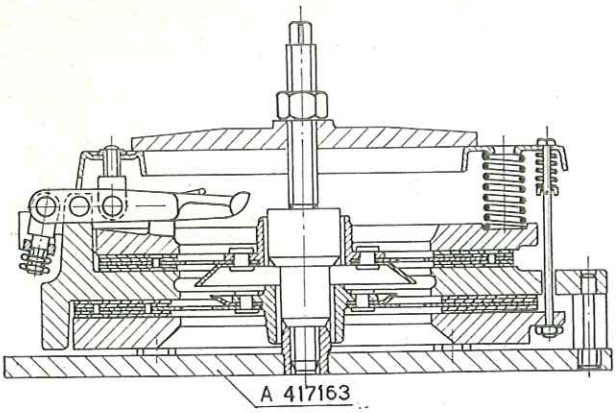


Fig. 37. - Disassembly and reassembly of the clutch on fixture A 417163.

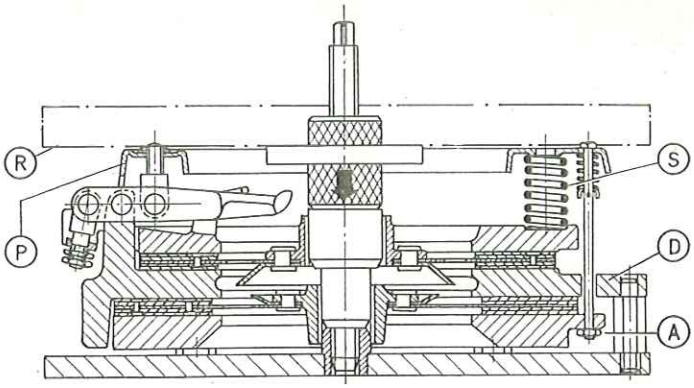


Fig. 38. - Adjusting the spring load with screws and nuts A and checking the co-planarity of disc P with respect to clutch disc D fixed to the flywheel, using steel rule R. (The arrow engraved on the fixture must be pointing downwards).

Adjustment of clutch control linkage.

During operation the wear on the clutch disc linings causes the release levers (L) to reduce progressively their distance from the throwout collar contacting surface and consequently the length of the clutch pedal free travel is also reduced. The pedal free travel must therefore be periodically checked in order to bring it back if necessary to its proper setting of 7/16″ to 9/16″ (1 to 1,5 cm) (horizontal distance measured from the foot-board, fig. 40) by adjusting the pedal tie-rod length.

To check or adjust the linkage to compensate for main disc lining (11″) wear, remove the pedal spring, then move the pedal forward by hand until a resistance is felt opposing further movement, which means that the release levers have contacted the throwout collar.

Measure the horizontal distance (M) from the running board which should be included between 7/16″ and 9/16″ (1 to 1,5 cm), then slacken the locknut (N), remove the yoke (K) from the pedal and screw it to restore the required length of travel.

To check or adjust the P.T.O. or belt pulley clutch (10″) control linkage proceed as follows:

— remove the clutch inspection side cover (fig. 17). Engage the control lever to actuate the P.T.O. or belt-pulley, if mounted, then disengage the two clutches completely with the pedal, start the engine and run it at idle speed;

— slowly release the clutch pedal until the P.T.O. and belt-pulley shaft starts rotating, then measure the distance (O) between the stop welded to the batteries support plate and the pedal. If the clutch is properly adjusted, the above distance should be included between 1″ and 2″ (2,5 to 5 cm).
This check requires two men, one on the tractor and the other one behind it; the latter must signal to hold the pedal when the P.T.O. or pulley start rotating, then measure the pedal travel distance.

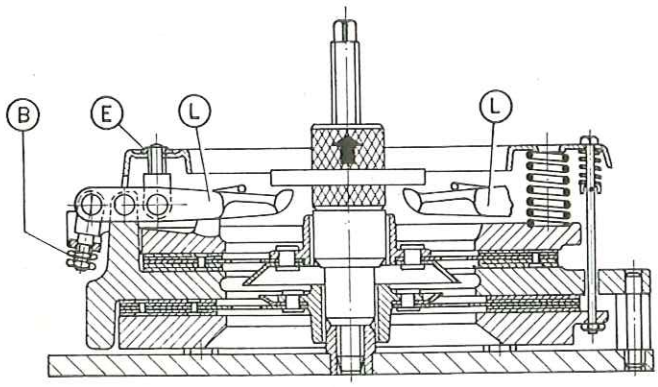


Fig. 39. - Setting the distance and checking co-planarity between the three release levers and disc D.

E. Adjusting nuts for levers L.
(The central part of the fixture must be moved to show the arrow pointing upwards).

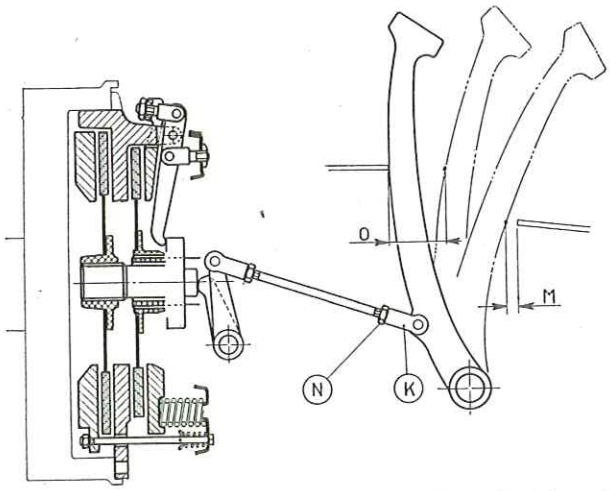


Fig. 40. - Distances O and M of pedal from foot-board and battery support, to be considered for clutch adjusting.

N. Jam nut - **K.** Yoke.

Should the measurement taken be off the limits given, check once more the 11″ disc control linkage setting, or bring back the clearance under the three nuts (1, fig. 34) inside the limits of 0.051 to 0.067 in. (1,3 to 1,7 mm) after engagement of the clutch (pedal relaxed). The latter operation is seldom required.

— refit the recoil spring to the pedal, run the engine at idle speed and inspect the whole group. After engaging the P.T.O. and belt pulley clutch, continue slowly to push on the pedal until the main engine-clutch works, then measure the distance between pedal and stop welded on the battery support plate. If the clutch is set correctly the distance will be included between $3^{3}/_{8}$″ and $3^{15}/_{16}$″ (8,5 to 10 cm). If not, the cause is excessive wear on the disc linings or faulty regulation of the unit.

GEARBOX AND REAR TRANSMISSION

Sectional views of the gearbox and rear transmission are shown in fig. 41 and fig. 43.

We particularly recommend paying attention to the fitting of the split hollow pins which must be turned with the cut facing the direction of their load or torque plane.

The reverse shaft set screw and the screws located on the horizontal diameter of the bearing housings of the differential axles must be spread with jointing compound. Fill with graphite grease the space between the differential axles outside diameter surface and the seal packings on the bearing housings.

Adjustment of the differential bevel pinion and ring gear.

The differential bevel pinion and ring gear undergo a run-in cycle at the factory, then the distance between the pinion face and the ring gear center is measured using a special fixture. This is the reason why the pinion and ring gear are furnished together as a single unit in spareparts service.

After running-in and inspection a factory serial number is marked both on the pinion face and on the ring gear back surface. Another marking is made, in addition to the first one, on the pinion face only. It consists of the prefix P followed by a code number from which it can be found the exact position of the pinion relative to the ring gear by consulting the dimension in the column A, next to the code number, in the table that follows.

P Code number	A Factory original dimension		P Code number	A Factory original dimension	
	mm	in.		mm	in.
1	106,22	4.182	16	107,72	4.241
2	106,32	4.186	17	107,82	4.245
3	106,42	4.190	18	107,92	4.249
4	106,52	4.194	19	108,02	4.253
5	106,62	4.198	20	108,12	4.257
6	106,72	4.202	21	108,22	4.261
7	106,82	4.206	22	108,32	4.265
8	106,92	4.209	23	108,42	4.268
9	107,02	4.213	24	108,52	4.272
10	107,12	4.217	25	108,62	4.276
11	107,22	4.221	26	108,72	4.280
12	107,32	4.225	27	108,82	4.284
13	107,42	4.229	28	108,92	4.288
14	107,52	4.233	29	109,02	4.292
15	107,62	4.237 nominal dimension	30	109,12	4.296

Example:

— 303 P 27 (read on the bevel pinion face);

— 303 - factory serial number of unit;

— P 27 - code number giving the distance from pinion face to gear center by reading the dimension on the same line of column A of the table (in this case 4.284 inches).

The dimension found in column A of the table serves to determine the correct working position of the pinion by following the instructions given hereafter:

— measure the largest diameter of the differential gear housing on the lock side half (let it be in this case = 7.960 in.)

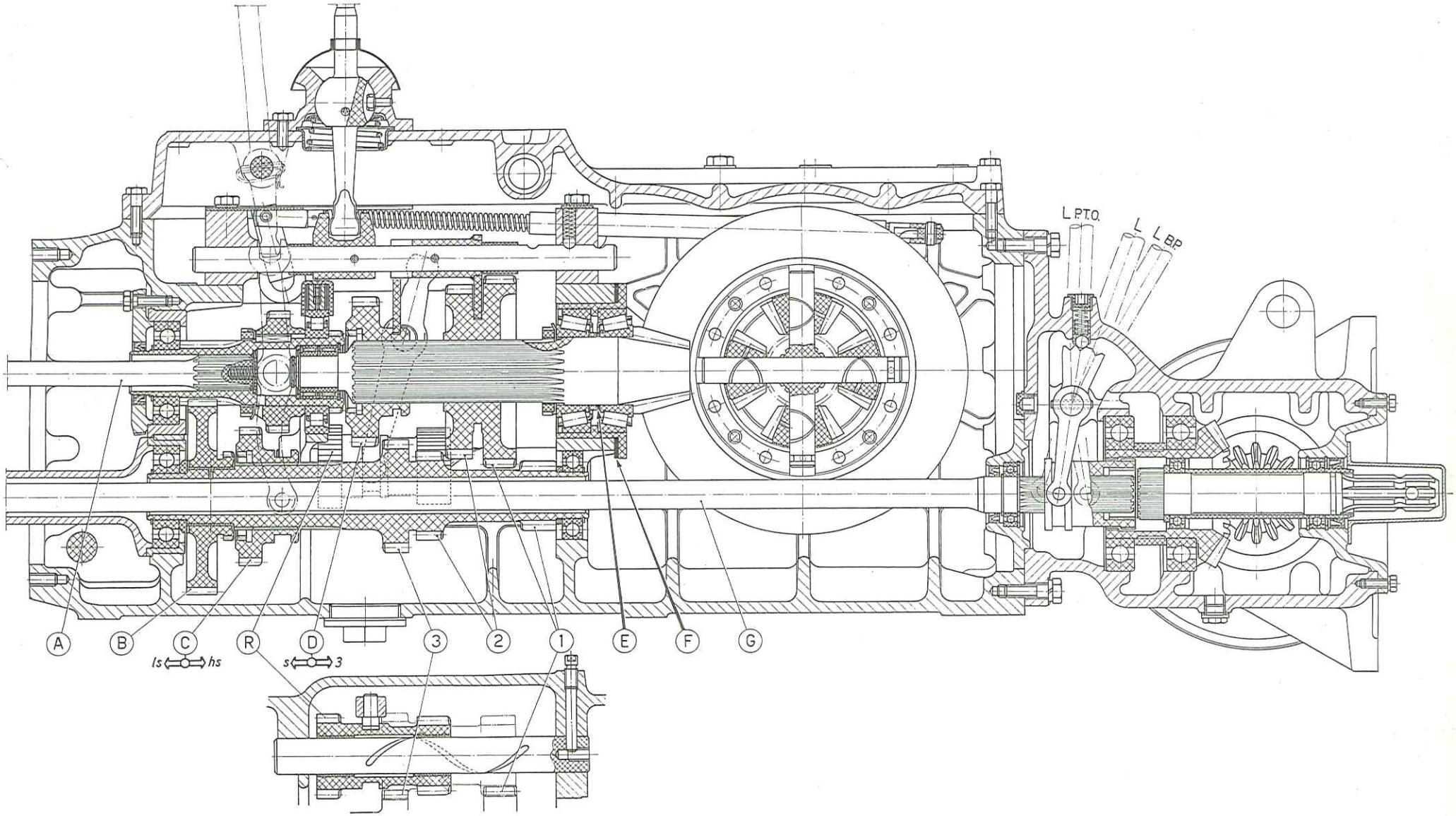


Fig. 41. - Longitudinal section of gearbox, bevel pinion and P.T.-O. unit.

1. 1st and 4th forward speeds and 1st and 2nd reverse gears - **2.** 2nd and 5th speed gears - **3.** 3rd and 6th forward speeds and 1st and 2nd reverse driving gears - **A.** Transmission shaft from clutch to gearbox - **B.** Constant-mesh driven gear of speed-reduction unit (for 1st - 2nd - 3rd forward and 1st reverse), idle on shaft - **C.** Constant-mesh driven gear (for 4th, 5th, 6th forward speeds and 2nd reverse); when in position (ls) it engages the low-range gears, in the position (hs) the high range gears - **D.** Direct drive gear (in the direction of arrow (s) it engages the 7th speed) and 3rd and 6th driven gear (in the direction of arrow 3) - **E.** Bevel gear roller bearing adjusting shims - **F.** Adjusting shims for regulating the correct tooth bearing of bevel pinion and ring gear - **G.** P.T.-O. drive shaft - **L.** P.T.-O. and belt pulley control lever in idle position - **L.B.P.** Belt pulley control lever in position of engagement - **L.P.T.O.** P.T.-O. control lever in position of engagement - **R.** Reverse gears.

— place a suitable number of adjusting shims (F, fig. 41) in between the bevel pinion bearing sleeve and housing in order to establish between the pinion front end and the differential housing a clearance equal to:

$$\text{dimension A} - \frac{\text{differential housing major dia. (lock side half)}}{2}$$

In this particular case which we have been using as an example to illustrate the procedure, the clearance for a 303 P 27 pinion would be:

$$4.296'' - \frac{7.960''}{2} = 4.296'' - 3.980'' = 0.316''$$

The bevel pinion and ring gear unit adjustments concern the cone roller bearings, and the gear teeth mesh and backlash.

a) *Bevel pinion bearing adjusting.*

Mount on the bevel pinion shaft the inner race with rollers of the bearing resting against the pinion shoulder, then the spacer, a pack of adjusting shims for a total nominal thickness of 0.110 in. (E, fig. 41), the bearing housing with the outer races and finally the inner race of the second roller bearing.

Place the assembly under a press so that the thrust of the load exerted on the pinion face will be supported on end by a hollow cylinder slid over the bevel pinion shaft and against the inner race of the second roller bearing.

Apply the load, then rotate the bearing sleeve by hand to check that free rotation exists, but without play. If rotation is not free add shims to the pack and check once more, if on the other end it is too free subtract from the shim pack thickness.

When the adjusting operation is over screw on the nut with its lock washer which will be bent after the nut is in place.

b) *Adjusting the bevel pinion and ring gear relative position.*

Mount the bevel pinion shaft with its gear clusters in the gearbox and after finding the shim pack thickness (F, fig. 41) through the method already described in the section concerning pinion face marking, lock the bearing housing using the proper screws.

c) *Adjusting the differential housing cone bearings.*

Mount the differential unit complete with bearing inner races in the transmission housing and start the bearing housing located on the bevel ring gear side into place until the bevel pinion teeth rest in tight mesh with the bevel ring gear teeth.

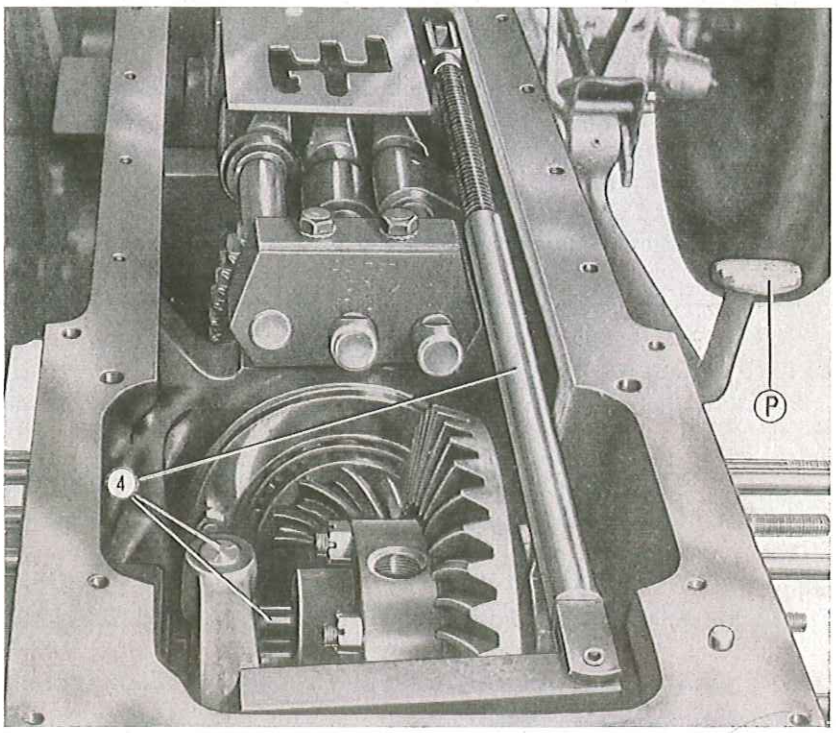


Fig. 42. - Top view of gearbox, gear-shift and differential lock.

P. Differential lock control pedal - **4.** Differential lock.

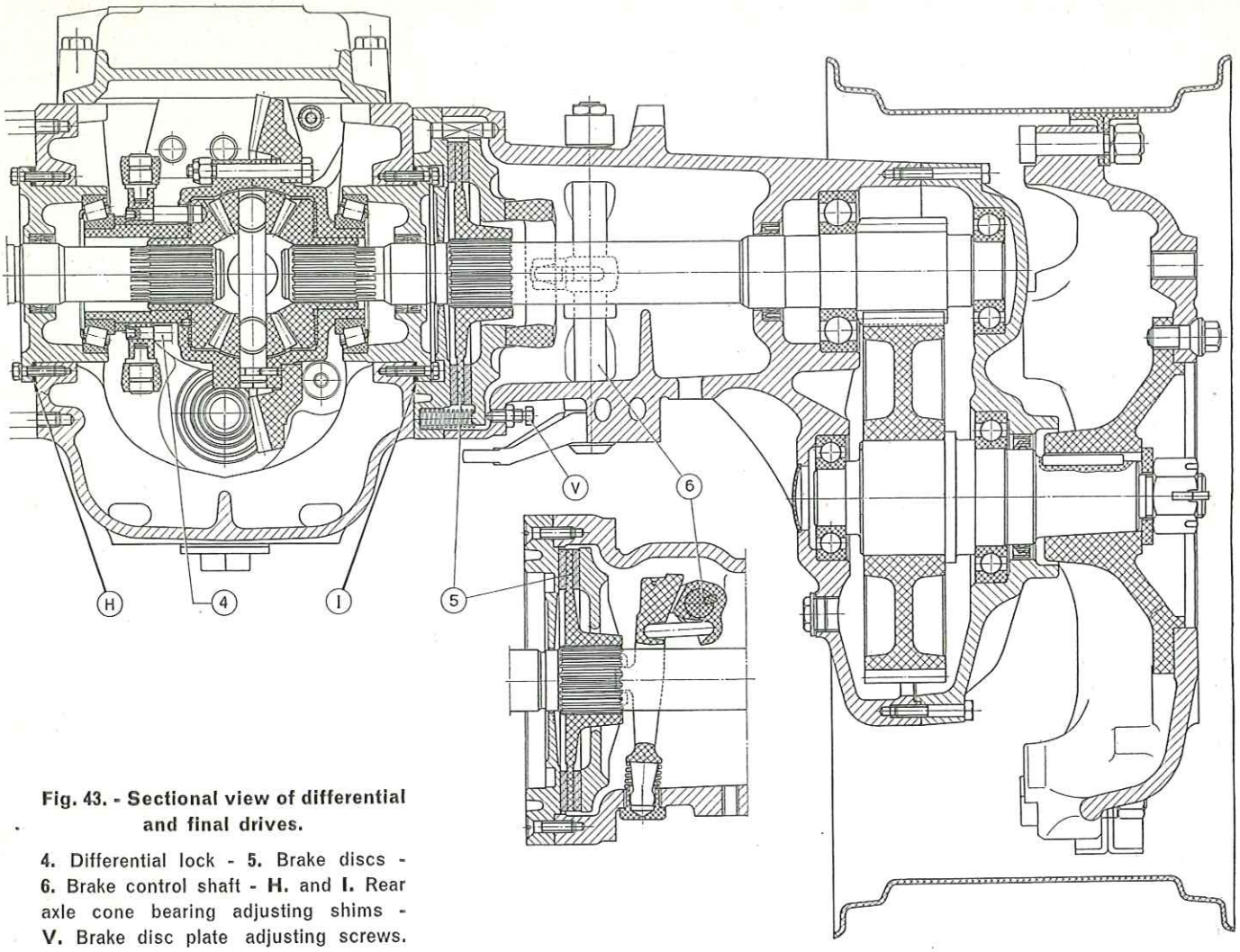


Fig. 43. - Sectional view of differential and final drives.

4. Differential lock - **5.** Brake discs - **6.** Brake control shaft - **H.** and **I.** Rear axle cone bearing adjusting shims - **V.** Brake disc plate adjusting screws.

Measure the clearance existing between the bearing housing side and the transmission housing face and add 0.008 in. to 0.012 in. (0,2 to 0,3 mm) to it in order to obtain the required thickness of adjusting shims (I, fig. 43) and a backlash of 0.006 to 0.010 in. (0,15 to 0,25 mm) between the bevel pinion and ring gear teeth. Fit the adjusting shims and lock the housing in place with two screws at 180° from each other. Repeat the same operation with the bearing housing on the differential lock side and build the pack of adjusting shims (H, fig. 43) according to the previously measured clearance. Fit the adjusting shims and lock the housing in place as above.

Exert a side thrust on the bevel gear in both directions to check the adjustment of the conical roller bearings. If end play exists, diminish the pack thickness of adjusting shims H, fig. 43. Increase it, instead, if there is no end play or possibility to rotate the bevel ring gear.

NOTE - End play is allowed on the differential housing bearings only in the amount necessary to permit rotation.

---

d) *Checking the backlash between the bevel gear and bevel pinion teeth.*

Apply a dial gauge on one face of any bevel ring gear tooth and slowly move the gear back and forth holding the bevel pinion still. Check the backlash between the bevel gear and bevel pinion teeth. The specified backlash is .006″ to .010″ (0,15 to 0,25 mm). If the gear backlash is not between the above limits, adjust it by changing the bevel gear bearing adjusting shims (H and I, fig. 43) in a suitable manner from one bearing cage to the other.

Finally, check the tooth bearing by painting the bevel gear teeth with a marking compound, then rotate the gear and the tooth bearing will show plainly. If necessary adjust it according to the instructions of fig. 44.

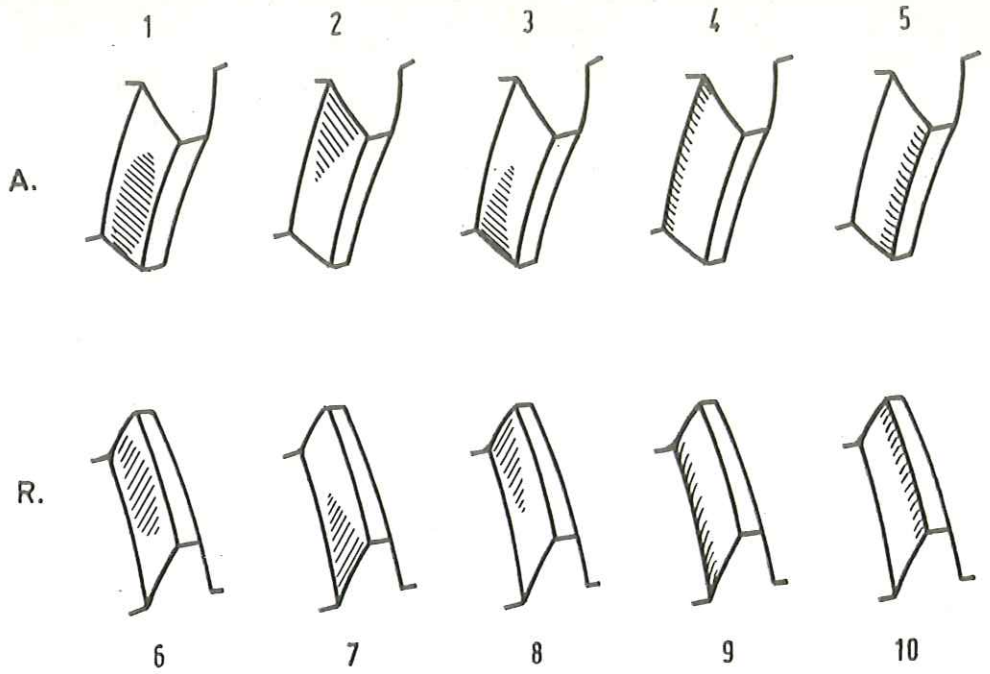


Fig. 44. - Transmission bevel pinion and ring gear tooth bearing.

A. Tooth bearing in forward speeds - **R.** Tooth bearing in reverse gear.

1-6. Correct tooth bearing - **2.** Bearing too far out on bevel ring gear, draw pinion closer and regulate the clearance by shifting the ring gear - **3.** Bearing on ring gear too close to cone center, move pinion away from cone center and regulate the clearance by shifting the ring gear - **4-9.** Tooth bearing on lower part of tooth face, move the pinion away and regulate the clearance by shifting the ring gear - **5-10.** Bearing on upper part of tooth face, move pinion in and regulate tooth clearance by shifting the ring gear - **7.** Bearing too far out on ring gear, move pinion away and regulate tooth clearance by shifting the ring gear - **8.** Bearing on ring gear too close to cone center, draw pinion in and regulate the clearance by shifting the ring gear.

OVERHAUL DATA

DATA	inches	mm
Inside diameter of reverse gear shaft bushing (after assembly and boring)	1.3829 - 1.3839	35,125 - 35,150
Reverse gear shaft diameter	1.3760 - 1.3770	34,950 - 34,975
Inside diameter of constant mesh driven gear bushing (after assembly and boring)	2.0728 - 2.0738	52,650 - 52,675
Outside diameter of intermediate shaft driven gear seat	2.0693 - 2.0701	52,560 - 52,580
Tooth backlash at transmission bevel pinion end ring gear	0.006 - 0.010	0,15 - 0,25
Thickness of adjusting shims for bearing and play on bevel pinion shaft (E, fig. 41)	0.039-0.020-0.008-0.004-0.002	1-0,5-0,2-0,1-0,05
Thichness of bevel pinion adjusting shims (F, fig. 41)	0.059-0.055-0.051-0.047-0.043-0.039	1,5-1,4-1,3-1,2-1,1-1
Thickness of adjusting shims for differential rear axle shaft bearing housings (H, I fig. 43)	0.059-0.055-0.039-0.020-0.008	1,5-1,4-1-0,5-0,2
Thickness of differential gear side washer	0.0312 - 0.0317	0,796 - 0,804
Thickness of differential pinion thrust washer	0.0588 - 0.0607	1,496 - 1,54
Gear shifter springs:		
— Free length	1.50 inches	38 mm
— Compressed length	1.12 - 1.24 inches	28,5 - 31,5 mm
— Test load	54 lb.	24,5 kg

Adjustments.

Adjustments to be made on brakes because of lining wear are the following:

1) setting the distance of the disc pressure ring (c, fig. 45);

2) setting the pedal free travel (d, fig. 45).

Adjustment 1) requires loosening locknut A and turning down screws B (three on each side), until they come in contact with the disc pressure ring. Loosen the screw to get a distance (c) of about 1/16″ (1,5 mm) and lock it in position using jam nut A.

When screw B contacts nut A the linings are worn out, the thickness is 1/32″ to 3/64″ (1 to 1,4 mm) and therefore the disc must be replaced.

Adjustment 2) is to be made by turning nuts F until the pedals free travel (d) measured from the running board is 1″ to 1 1/2″ (2,5 to 4 cm).

To get simultaneous braking action with the two pedals latched together the free travel distance must be the same for both of them.

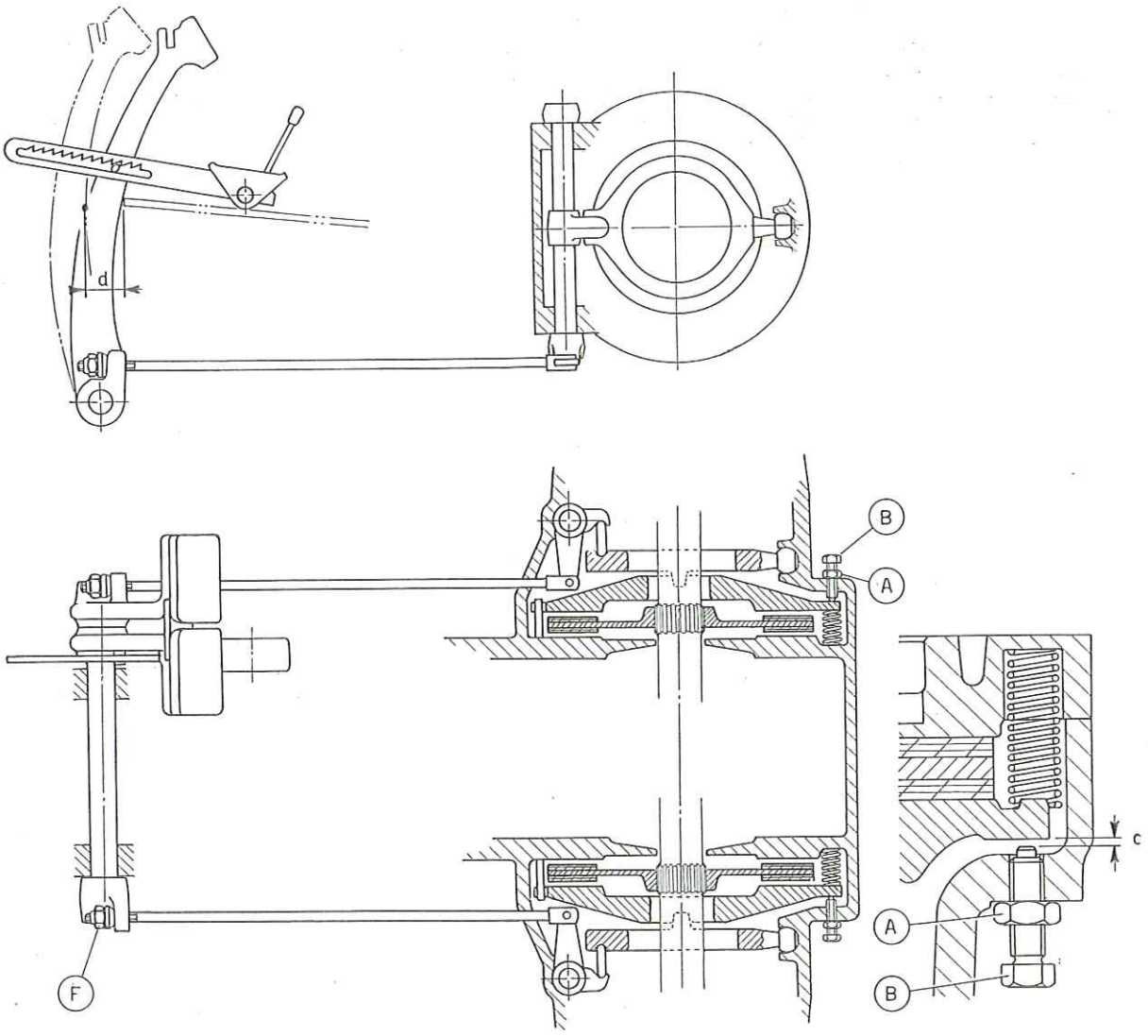


Fig. 45. - Schematic view showing brake adjustment.

A. Jam nuts - **B.** Brake disc adjusting screws - **c.** Distance between screw ends and brake pressure plates - **d.** Brake pedal free travel measured from footboard surface - **F.** Rod adjusting nuts.

Front axle overhaul.

The front axle sectional view is shown in fig. 46. During overhaul check spindle end play which should range between 0.020″ and 0.040″ (0,5 to 1 mm). If not, replace thrust washers A and B.

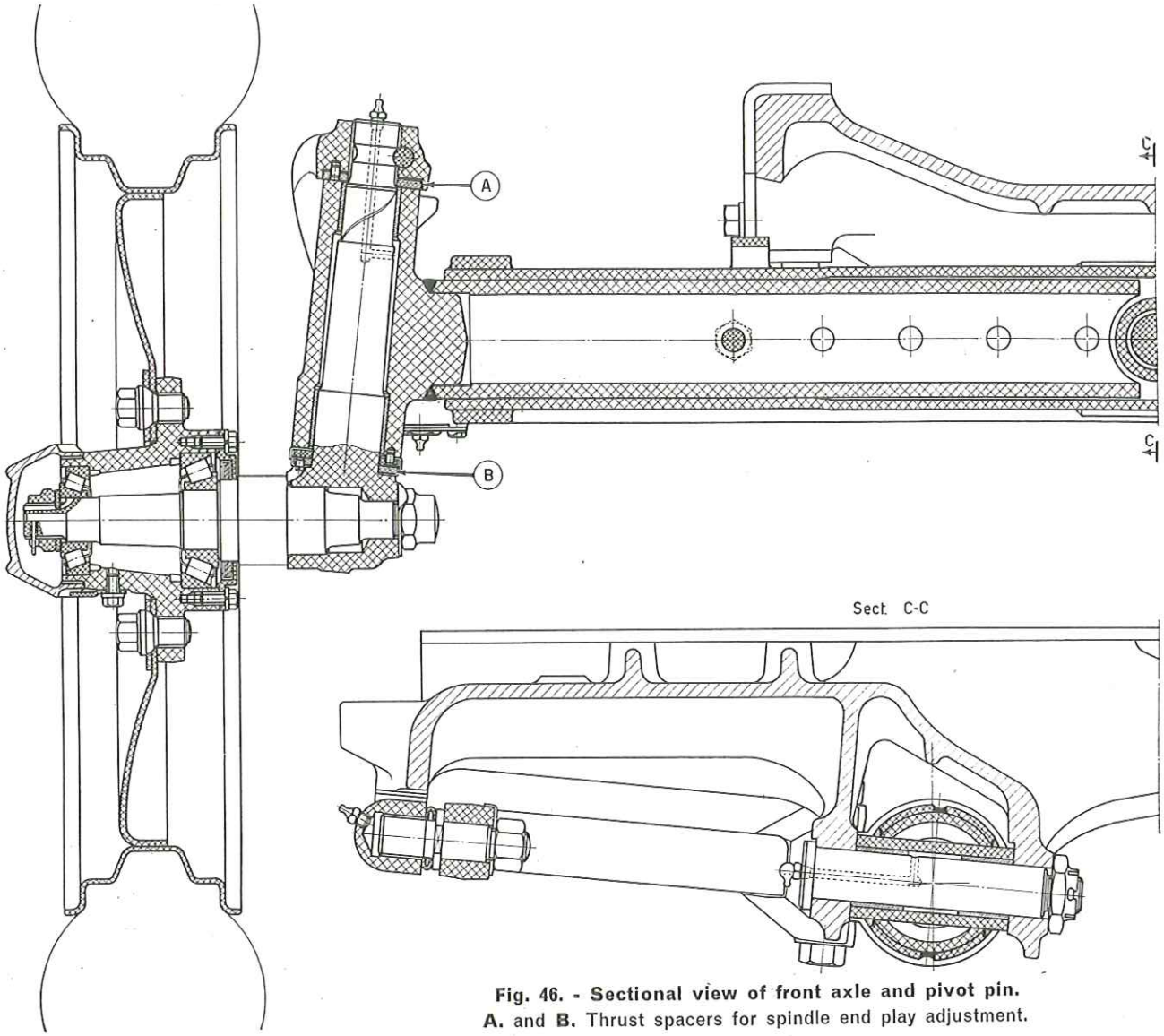


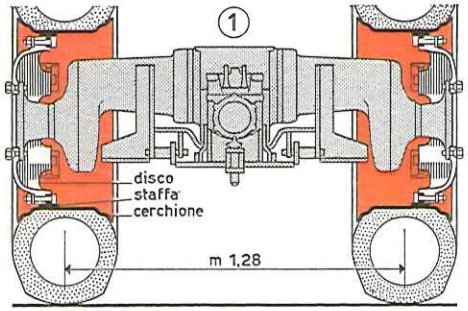
Fig. 46. - Sectional view of front axle and pivot pin.
A. and **B.** Thrust spacers for spindle end play adjustment.

FRONT AXLE COMPONENT FITS AND TOLERANCES

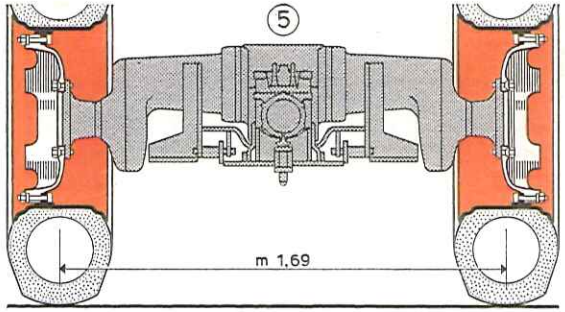
Part description	Fits		Permissible wear	
	in.	mm	in.	mm
Inside diameter of king pin bushings (press-fitted):				
— upper bushing	1.3780 - 1.3790	35,000 - 35,025		
— lower bushing	1.7717 - 1.7727	45,000 - 45,025		
Diameter of king pins:				
— upper bushing pivot	1.3780 - 1.3770	35,000 - 34,975		
— lower bushing pivot	1.7716 - 1.7707	45,000 - 44,975		
Clearance of king pins and bushings	0.000 - 0.002	0,000 - 0,050	0.008	0,20
Thickness of spindle thrust washers:				
— A (fig. 46)	0.2165-0.2362-0.2559	5,5-6-6,5		
— B (fig. 46)	0.1969 - 0.1939	5,000 - 4,925		
Inside diameter of pivot pin bushings (press-fitted)	1.3780 - 1.3790	35,000 - 35,025		
Clearance of pivot pin and bushing	0.000 - 0.002	0,000 - 0,050	0.020	0,50

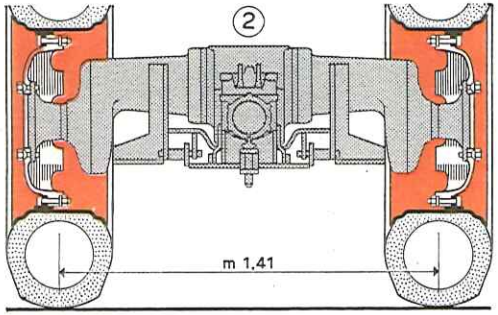
Fig.47.- REAR TRACK SETTINGS

Disco = **Disc**
Staffa = **Clamp**
Cerchione = **Rim**

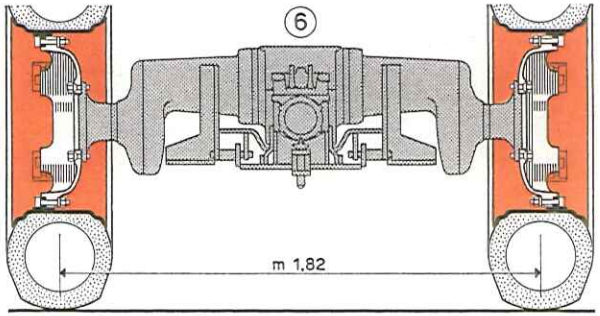


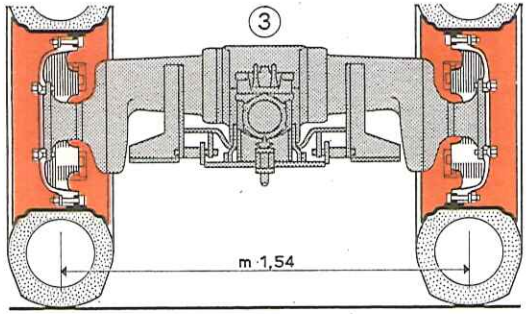
Track settings No. 1 and 5
(m 1,28 = 50.4″ — m 1,69 = 66.5″)
Rims are secured with clamps inside the discs.



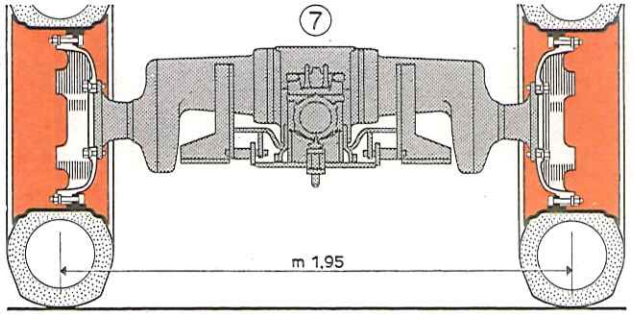


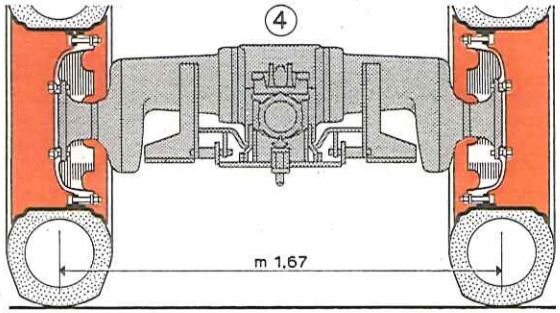
Track settings No. 2 and 6
(m 1,41 = 55.5″ — m 1,82 = 71.7″)
Rims are secured with clamps outside the discs.



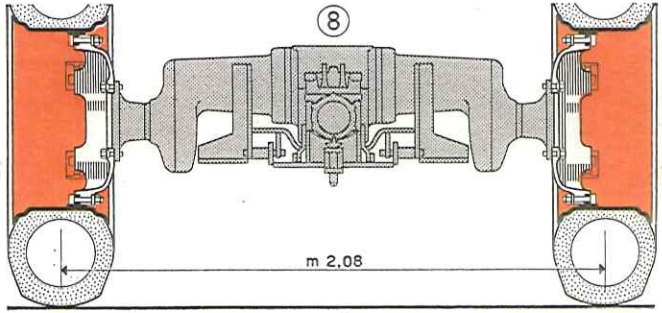


Track settings No. 3 and 7
(m 1,54 = 60.6″ — m 1,95 = 76.8″)
Wheel rims have been interchanged, without turning wheel inside out to avoid tyre tread lugs inversion. Rims are secured to discs as in track settings No. 1 and 5.





Track settings No. 4 and 8
(m 1,67 = 65.7″ — m 2,08 = 81.9″)
Rims are arranged as in track settings No. 3 and 7, but are secured to discs as in track settings No. 2 and 6.



Steering box adjustment.

The torque necessary to actuate the worm is 0.35 to 0.70 ft.lb. (0,05 to 0,10 kgm) and is obtained by adjusting the bearing by shims (S) installed under the lower bearing.

When the steering box is assembled and ready for operation the steering shaft must not have any play through a radial angle of 30° each side and the torque necessary to rotate it must be of 1 to 1.8 ft.lb. (0,15 to 0,25 kgm).

For the remaining 300° of rotation the torque must be of about half the above value.

The play is regulated by setscrew V (fig. 48).

Important: to avoid oil leaking smear the fastening screws with an appropriate compound before installing the steering box on the tractor.

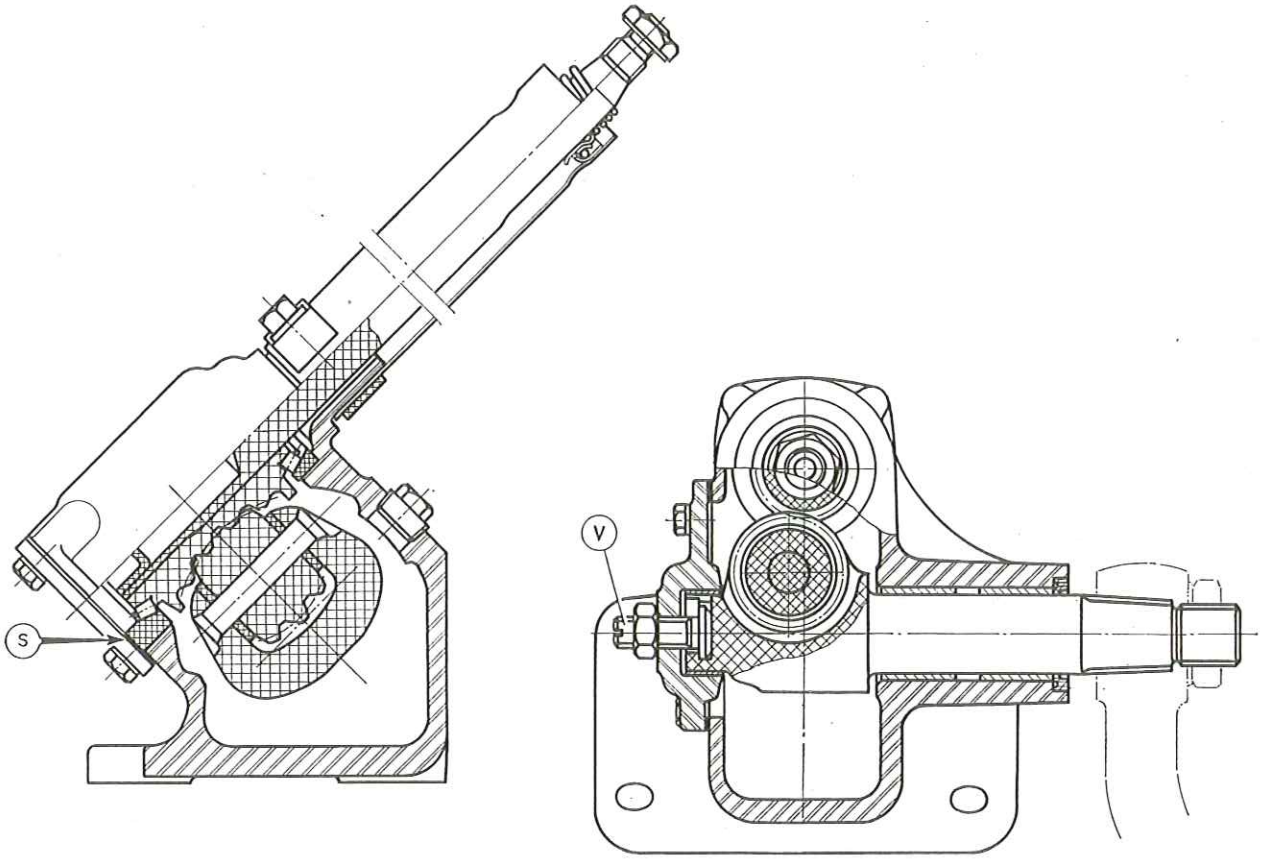


Fig. 48. - Steering box sectional views.

V. Worm gear end play adjusting screw - **S.** Worm gear cone roller bearing adjusting shims.

ELECTRICAL SYSTEM

For repair instructions concerning the DC 115/24/7/3 generator, the GP 1/24/7 voltage regulator unit and the batteries see the servicing manual of the 400 series tractor (Print No. 354.069 and 354.074). For instructions concerning the MT 43 A starting motor see Print No. 354.068.

ATTACHMENTS

Belt-pulley assembly.

The belt pulley of the 513 R tractor is made up of two separate sub-assemblies:

1. The pulley rim with its 16-teeth pinion (factory set to dimension Q, fig. 49).
2. The drive pinion (2), with 25 teeth, bearings and adjusting shims (E) of various thicknesses.

Before installing the groups above on the P.T.-O. box determine the thickness of adjusting shims (E).

To assemble the unit drain the lubricating oil first, then remove the side cover where the pulley is fitted to, remove the rear cover and the P.T.-O. shaft with its front support.

Install the drive pinion (1, fig. 49) in its seat, complete with bearings, only after having established, as explained further on, the total pack thickness of shims (E), which will be mounted first.

Before installing the pinion, shift the engagement lever (L) to dead center position; then slide the splined pinion shaft over the splined engagement sleeve.

Push on the assembly and, if necessary, strike it with the hammer handle until the bearing reaches its proper position in its seat, taking care not to damage it by excessive thrusts or blows.

Recover the P.T.-O. shaft from the previously dismantled assembly and fasten on the rear cover with its screws.

Mount the driven pinion with pulley support, fix it in place with its screws, install the pulley also and check the tooth mesh clearance which must be of 0.016″ to 0.079″ (0,4 to 2 mm) as measured on the pulley rim face. Lock the drive pinion before measuring.

Important.

Where the pulley is not required it will be sufficient to remove the rim. When removing the pinion (2) remove the drive pinion (1) assembly also, to avoid displacements in case of accidental blows.

To install the pulley rim set it first with two dowels and two screws, then remove the dowels and apply the remaining two screws.

Finding the total thickness of shims (E).

The thickness of shims (E, fig. 49) is found by adding up in hundredths of millimeter the numbers stamped on the following parts:

1. On the top surface of the drive unit casing.
2. On the spacer of the drive bevel pinion bearings.

Ex.: 8 + 115 = 123 (hundredths of millimeter).

Find the total thickness rounding up the preceding value to 0.05 mm and measure the pack of shims with a micrometer.

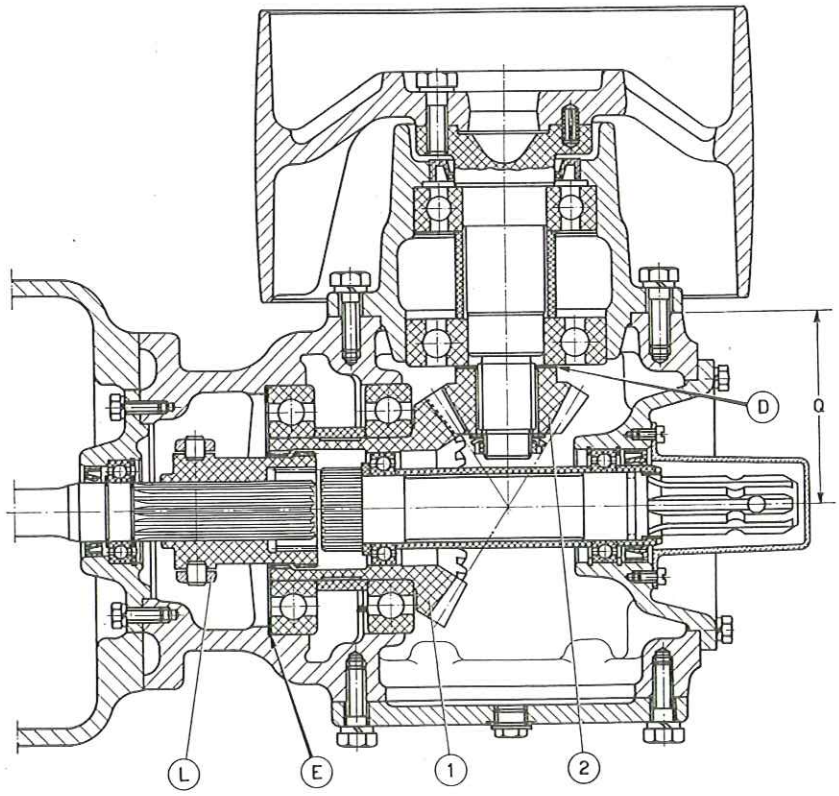


Fig. 49. - Belt pulley unit sectional view.

1. 25-teeth drive pinion - **2.** 16-teeth driven pinion - **D.** Shims installed between driven pinion and bearing to make up dimension Q - **E.** Drive pinion adjusting shims - **L.** End of sleeve control lever - **Q.** dimension = 4.528″ ± 0.002″ (115 ± 0.05 mm)

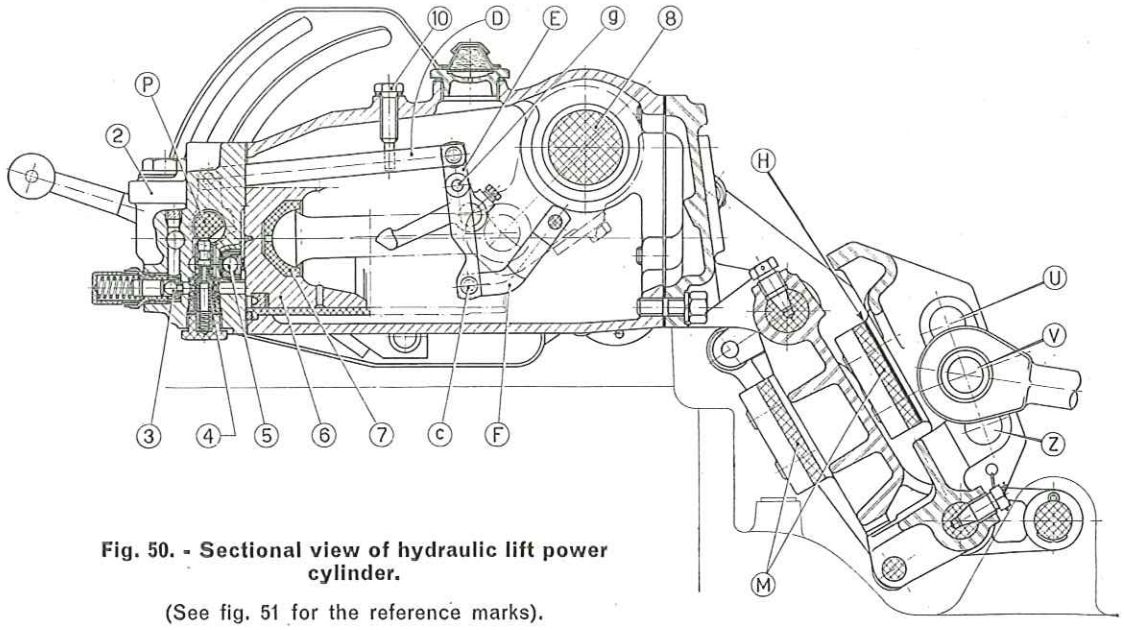


Fig. 50. - Sectional view of hydraulic lift power cylinder.

(See fig. 51 for the reference marks).

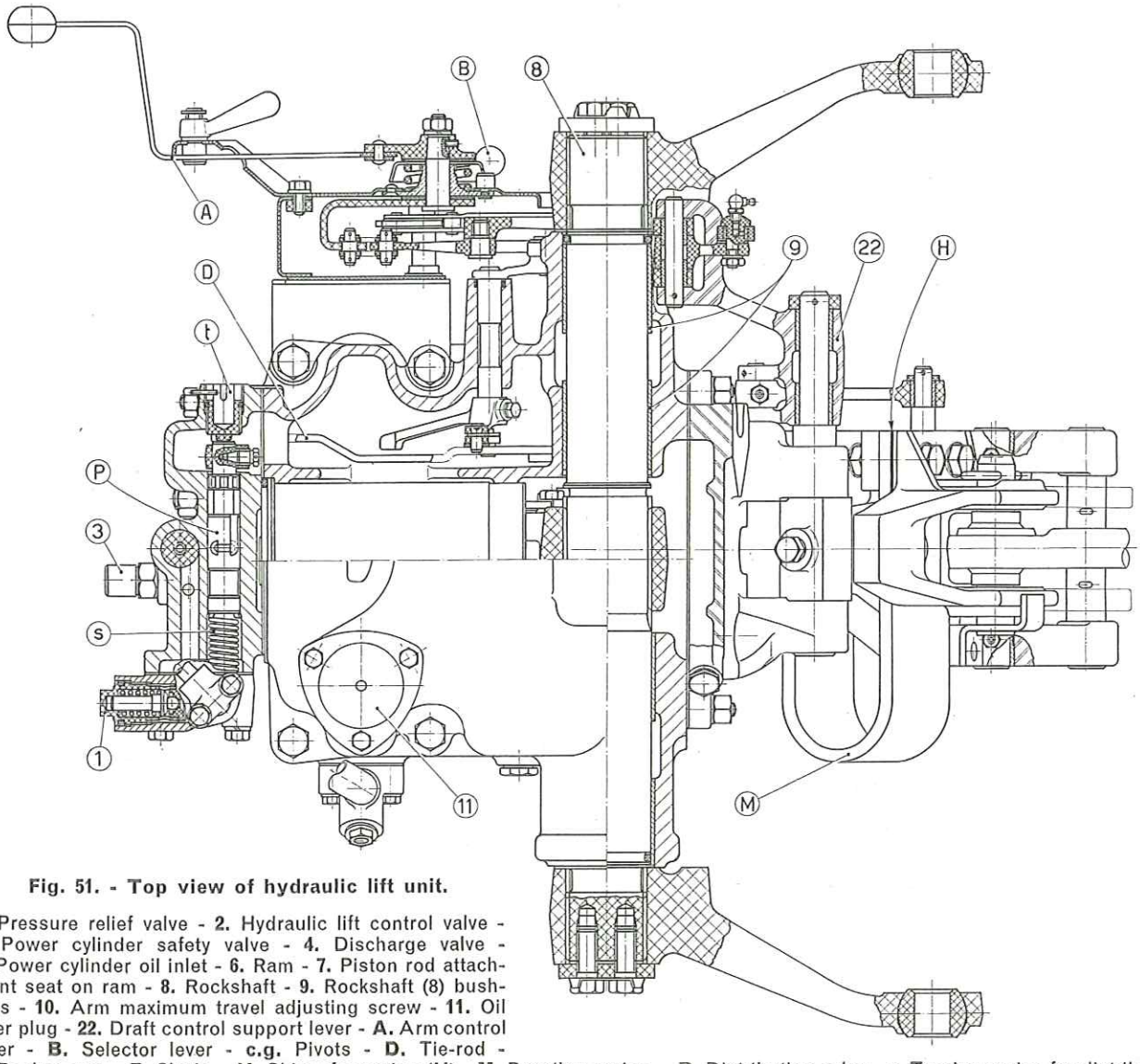


Fig. 51. - Top view of hydraulic lift unit.

1. Pressure relief valve - **2.** Hydraulic lift control valve - **3.** Power cylinder safety valve - **4.** Discharge valve - **5.** Power cylinder oil inlet - **6.** Ram - **7.** Piston rod attachment seat on ram - **8.** Rockshaft - **9.** Rockshaft (8) bushings - **10.** Arm maximum travel adjusting screw - **11.** Oil filter plug - **22.** Draft control support lever - **A.** Arm control lever - **B.** Selector lever - **c.g.** Pivots - **D.** Tie-rod - **E.** Rocker arm - **F.** Clevis - **H.** Shims for spring (M) - **M.** Reaction spring - **P.** Distributing valve - **s.** Torsion spring for distributing valve - **t.** Distributing valve sensitivity adjusting plug - **U.** Top link attachment hole for light work requiring draft control - **V.** Top link attachment hole for medium or heavy work requiring draft control - **Z.** Top link attachment for position control work.

Fig. 50 and 51 show a sectional view of the power cylinder and the top view of the draft and position control hydraulic lift. To illustrate as clearly as possible the operation of the mechanism which links the upper link support to the distributing valve we have drawn the schematic view of the leverage, fig. 52.

Basically, the hydraulic lift operation is identical with the one described in the repair instructions for 400 Series tractors (print No. 354.069). The principal differences concern the position of spring (M) and therefore the levers connected to its support, and the regulation of the hydraulic circuit safety valve which is set at 1920 lb/sq.in. (135 kg/sq.cm).

See the above publication for what dismantling and reassembly are concerned, as we have herewith reported modified adjustment data only. Numbers and letters used to identify single parts are the same for all illustrations concerning this particular subject.

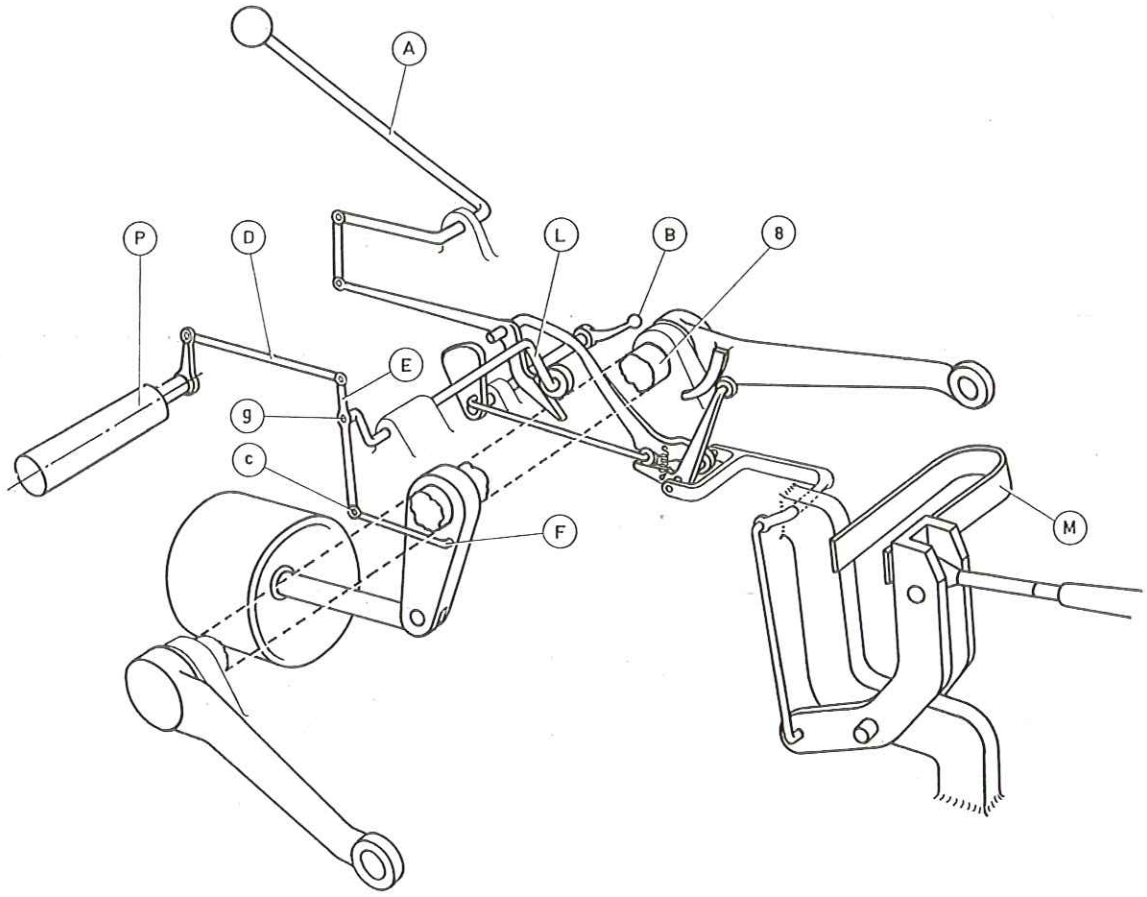


Fig. 52. - Schematic view of the hydraulic lift unit.

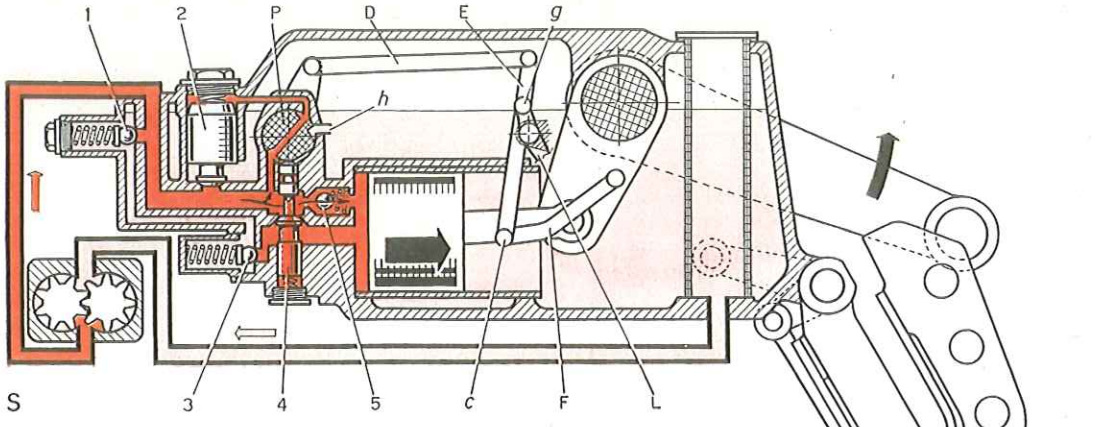
Important.

The hydraulic pump of the lift unit has not been considered as it does not need any maintenance or adjustment during its service life and is quite similar in principles and design to the unit described for the 400 series. The pump capacity data are reported in the specification section.

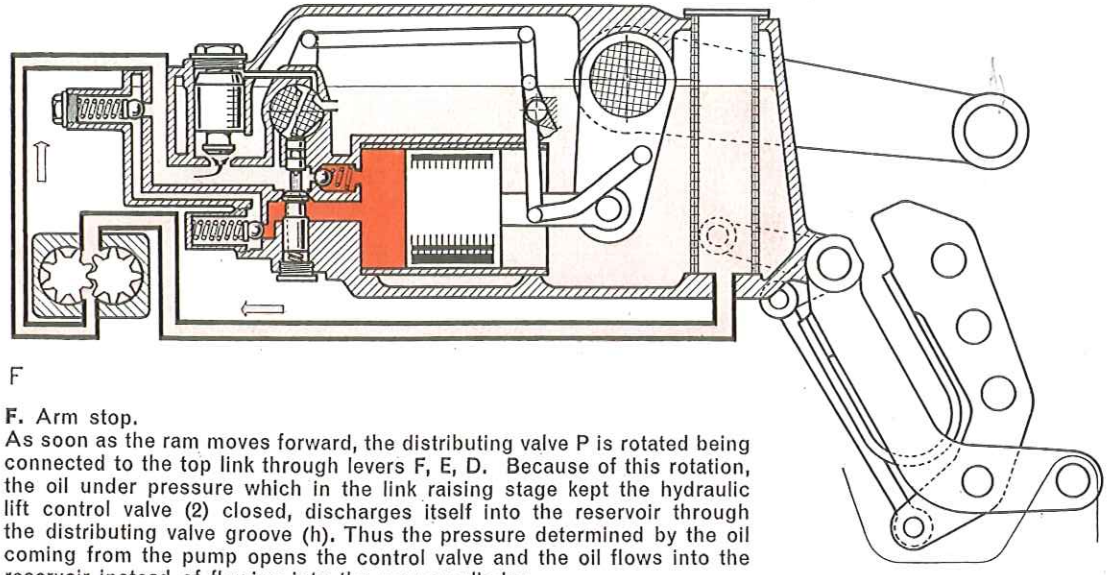
Hydraulic lift adjustment.

The regulation and setting of the hydraulic lift are carried out with the assembled unit mounted either on tractor or on bench **I 495005** equipped with suitable ballast weights.

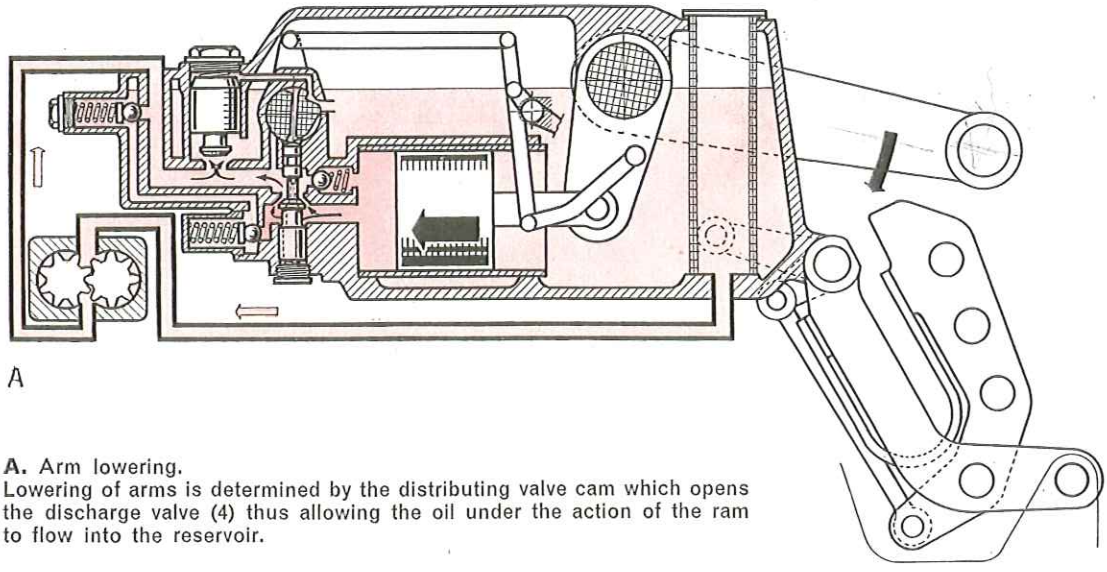
a) *Distributing valve setting*: bring the engine to maximum acceleration, lift the arms and consequently the loads they carry and shift the selector lever to position control setting (downwards).
Remove the cotter pin and slowly screw the adjusting plug in (t, fig. 51) until the applied load starts oscillating vertically, then loosen the plug half a turn and set the cotter pin back in place.



S. Arm raising.
Distributing valve P is rotated to a position which allows oil passage from the pump. The oil under pressure acts on the hydraulic lift control valve (2) closing it, then flows into the power cylinder through valve (5), thus actuating the ram which in turn raises the arms.



F. Arm stop.
As soon as the ram moves forward, the distributing valve P is rotated being connected to the top link through levers F, E, D. Because of this rotation, the oil under pressure which in the link raising stage kept the hydraulic lift control valve (2) closed, discharges itself into the reservoir through the distributing valve groove (h). Thus the pressure determined by the oil coming from the pump opens the control valve and the oil flows into the reservoir instead of flowing into the power cylinder.



A. Arm lowering.
Lowering of arms is determined by the distributing valve cam which opens the discharge valve (4) thus allowing the oil under the action of the ram to flow into the reservoir.

Fig. 53. - Schematic drawings showing the circuit of the hydraulic lift unit in operation.
(Note: the distribution pattern is identical both for position and draft control operation).

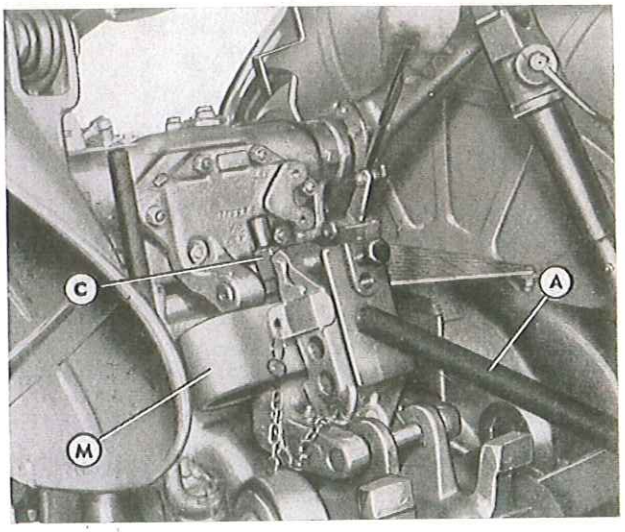


Fig. 54. - Checking the play between roller and quadrant using lever A 197016 (A) and the « GO-NOGO » gage C 497015 (C) which locks the upper link support in position thus keeping spring M under load.

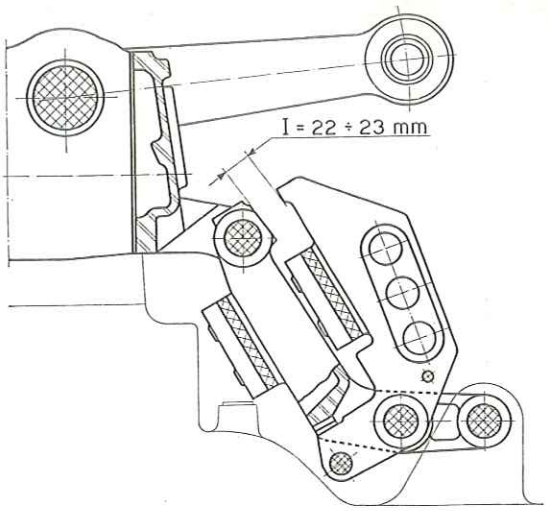


Fig. 55. - Checking play I between upper link support and lift cover.

b) *Arm travel setting*: with the engine running check that the lift range of the lower hitch points connected through the lift linkage to the innermost holes of the lower links as shown by fig. 11, is included between 25 $^{9}/_{16}$″ and 26 $^{3}/_{8}$″ (650 to 670 mm). If not, modify the shim pack located under the screw head (10). Keep in mind that when the lower links are in the position of maximum height there must be a tolerance on the lift range which is checked by raising the links by hand.

c) *Adjustment of roller and sector play*: shift control lever (A) to the highest position allowed by the sector slot in order to obtain full arm lift and set selector lever (B) in draft control position (upwards). Apply lever **A 197016** into a hole of the upper link support (fig. 54), force it downwards in order to eliminate completely the play existing between top link support and hydraulic lift cover, then check the play of roller and sector which should be 0.079″ to 0.098″ (2 to 2,5 mm). If not, rotate the eccentric carrying the roller.

d) *Setting the top link support spring* (M): should reconditioning or replacement of parts be required check the clearance (I, fig. 55) between top link support and lift cover to be 0.866″ to 0.905″ (22 to 23 mm), if not vary the number of adjusting shims (H) installed between the spring and its support. To check the play use the end of smallest block of the « go-no go » gauge **C 497015**; the other end of the gauge may be used in the preceding check to keep the support in the position reached when the play is taken up to check the distance between roller and sector applied to the right arm.

SPECIFICATIONS, FITS AND TOLERANCES OF THE HYDRAULIC LIFT MAIN COMPONENTS

Description of part	Dimensional data		Permissible wear	
	in.	mm	in.	mm
Cylinder liner inside diameter	3.7416 - 3.7429	95,036 - 95,071		
Piston diameter	3.7402 - 3.7388	95,000 - 94,965		
Clearance - cylinder liner and piston	0.0014 - 0.0042	0,036 - 0,106	0.0098	0,25
Distributing valve diameter	0.8661 - 0.8656	22,000 - 21,987		
Clearance - distributing valve and its seat	0.0010 - 0.0014	0,025 - 0,035	0.0039	0,10
Inside diameter of rockshaft bushings (after reaming):				
— right side	2.1693 - 2.1720	55,100 - 55,170		
— left side	2.3661 - 2.3688	60,100 - 60,170		
Clearance - rockshaft and bushings	0.0039 - 0.0078	0,100 - 0,200	0.0197	0,50
Inside diameter of bushings press-fitted into the draft control support lever	0.7902 - 0.7882	20,072 - 20,020		
Clearance - draft control support lever and bushings	0.0008 - 0.0048	0,020 - 0,124	0.0118	0,30
Thickness of lift control hand-lever friction discs	0.0787	2	0.0591	1,50

(cont'd)

(cont'd specifications fits and tolerances of the hydraulic lift main components)

Tightening torques:

— cylinder pressure discharge valve (4)	65 - 72 ft.lb.	(9 - 10 kgm)
— cylinder safety valve (3)	29 - 36 ft.lb.	(4 - 5 kgm)
Opening pressure of cylinder valve	2134 ± 70 p.s.i.	(150 ± 5 kg/sq.cm)
Opening pressure of safety valve	1850 ± 70 p.s.i.	(130 ± 5 kg/sq.cm)

Spring specifications	Hand lever (A)	Lift control valve (2)	Discharge valve (4)
Free length	1.221 in. (31 mm)	1.811 in. (46 mm)	0.866 in. (22 mm)
Test load	132 ± 13 lbs. (60 ± 6 kg)	4.4 ± 0.4 lbs. (2 ± 0,2 kg)	5.4 ± 0.3 lbs. (2,45 ± 0,15 kg)
Test loaded spring length	0.710 in. (18 mm)	0.787 in. (20 mm)	0.394 in. (10 mm)

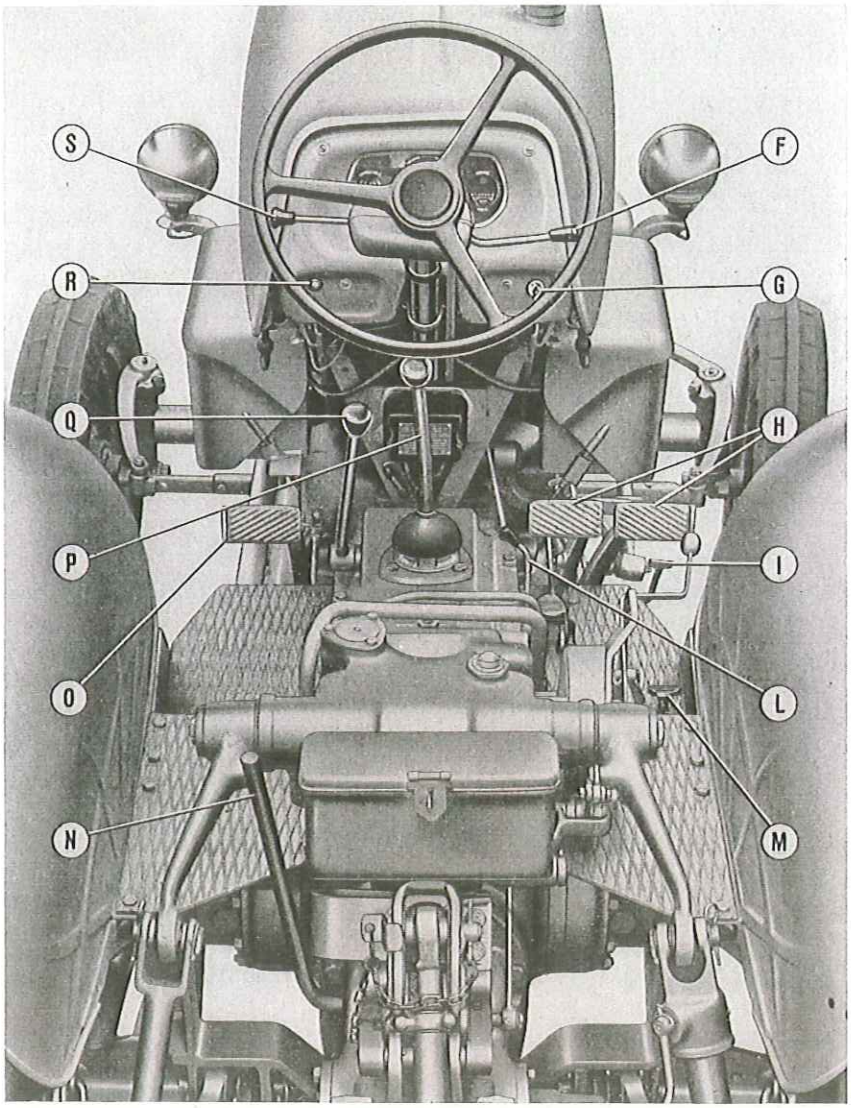


Fig. 56. - Tractor controls.

F. Engine accelerator lever - **G.** Lock switch - **H.** Brake pedals - **I.** Accelerator pedal - **L.** Brake locking hand lever - **M.** Differential lock pedal - **N.** P.T.O. (and belt pulley) control lever - **O.** Clutches release pedal - **P-Q.** Gearbox and transfer shift lever - **R.** Engine starting button - **S.** Outer lighting change-over switch knob.

Every 10 service hours:

Check:

— crankcase oil level;
— water level in radiator;
— air cleaner oil level and dust deposits.

Every 20 service hours.

Lubricate:

— water pump shaft bearings (1 grease fitting);
— clutch throw-out bearing (1 grease fitting);
— brake and clutch pedal shafts (2 grease fittings);
— front wheel spindles (2 grease fittings);
— front axle pivot pins (2 grease fittings);
— tie-rod pivots (4 grease fittings);
— hydraulic lift pivots (7 grease fittings).

Check:

— oil level in P.T.-O. housing.

Every 150 service hours.

Change:

— crankcase oil and clean the oil sump filter.

Wash with kerosene:

— crankcase oil disc-type filter;
— engine breather;
— air cleaner lower element;
— fuel bowl-type filter.

Check:

— oil level in injection pump and speed governor;
— fan and generator V-belt correct tension;
— steering box oil level;
— gearbox oil level;
— final drive oil level;
— P.T.-O. transfer gear housing oil level;
— hydraulic lift oil level;
— battery electrolyte level.

Lubricate:

— starting motor. (Loosen the plug located on the casing next to the driving pinion and lubricate the bushing).

Every 300 service hours.

Replace:

— crankcase oil filter cartridge.

Check:

— clutch pedal free travel;
— brake pedal free travel.

Lubricate front wheel bearings.

Wet the generator wick with some SAE 50 oil.

Wash with kerosene the cloth cartridge of the fuel filter.

Replace the paper cartridge of the fuel filter.

Have valve tappet gap checked (0.008"- 0,2 mm).

Every 600 service hours.

Disassemble:

— air cleaner and clean all component parts;
— fuel injectors, and have them checked by a specialized shop.

Change the hydraulic lift oil.

Every 1200 service hours.

Wash:

— engine cooling system.

Change the oil:

— P.T.-O. transfer gear housing;
— gearbox;
— final drives;
— P.T.-O.

Have the following items inspectioned:

— generator commutator and brushes. Lubricate the armature shaft bearings;
— starting motor commutator and brushes.

FIAT tractors

INSTRUCTIONS FOR DISASSEMBLY AND REASSEMBLY

IMPORTANT - This publication completes the " Specifications, adjustments and main technical data - Model 513 R tractor " book, Form. No. 354,083, by adding the instructions concerning the dismantling and reassembly operations. Therefore, page and figure numbers continue the preceding numerical order.

ENGINE

REMOVAL OF ENGINE FROM TRACTOR

It is recommended that the equipment and accessories installed on the engine be removed or disconnected according to the order specified hereafter. Instructions have been kept to a minimum considering that the present publication will be used by qualified mechanics.

— The recommended order is the following:
hood, batteries, fuel tank; air cleaner; radiator; dashboard connections; link rods from accelerator pedal to speed governor and from clutch pedal to the self-cleaning oil filter; headlamps and electrical equipment wiring harness; oil lines serving the hydraulic lift and the pump; intake and exhaust manifolds; exhaust pipe; fuel filters; water outlet from cylinder block, with thermostat; radiator water inlet tube; water pump tubes; fuel lines from injection pump to injectors.

— The engine is now ready for removal from the tractor. Using the special engine lifting bar **ARR 413005** and proper lifting equipment (Fig. 57) slowly move the engine forward to free it from guide dowels (1, Fig. 57), and lift it as necessary.

— Place the engine on rotary stand **ARR 2216** (Fig. 58 and 59) fastening it rigidly with brackets **ARR 413004/A/B/C.**

— Remove the accessories still remaining on the tractor, and precisely: oil filter; starting motor; hourmeter; hydraulic lift pump; injection pump with speed governor and fuel pump; injectors and fuel drain line; engine oil filler plug.

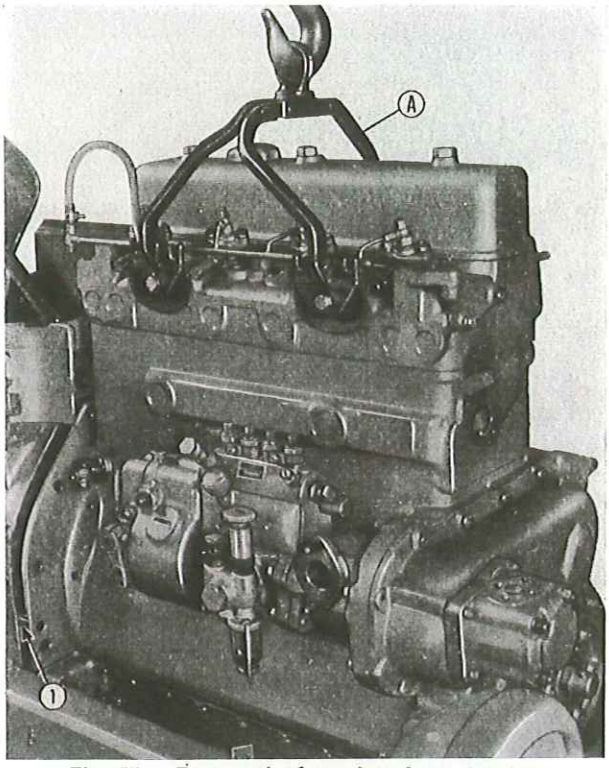


Fig. 57. - Removal of engine from tractor.
A. Lifting bar **ARR 413005 - 1.** Guide dowels.

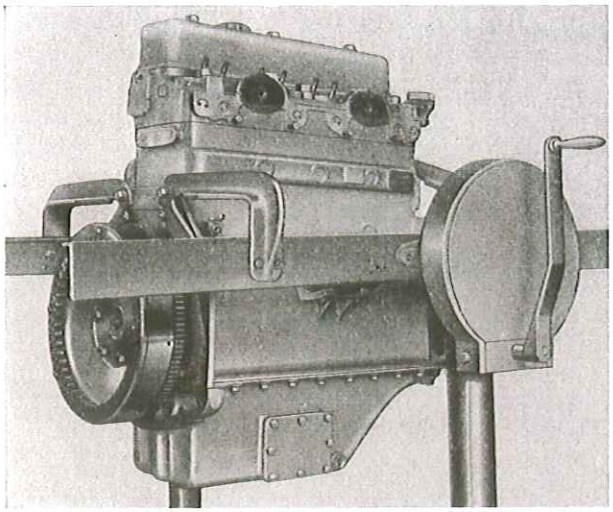


Fig. 58. - Right-side view of engine on rotary stand ARR 2216 (Note the rear brackets position).

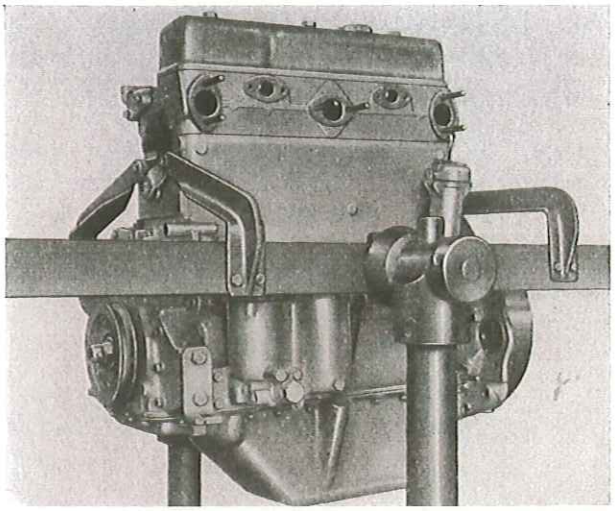


Fig. 59. - Left-side view of engine on rotary stand ARR 2216 (Note the front brackets position).

DISASSEMBLY OF ENGINE

The engine is assumed as being installed on rotary stand **ARR 2216** with suitable brackets. All external equipment and accessories have already been removed or disconnected (see topic « ENGINE REMOVAL FROM TRACTOR », page 45).

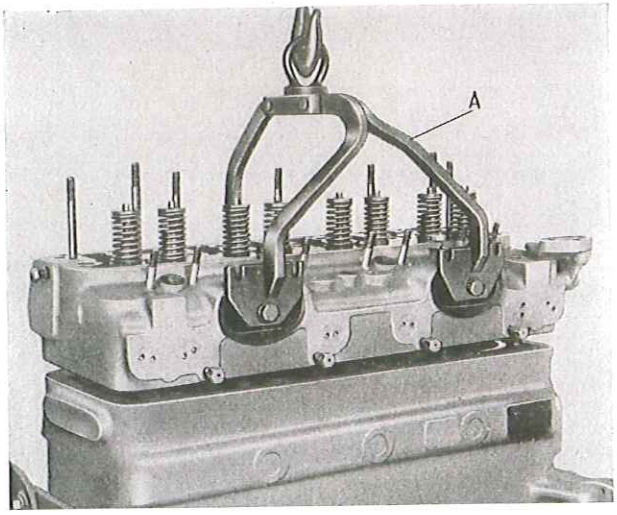


Fig. 60. - Removal of cylinder head from the crankcase.
A. Lifting bar **ARR 413005.**

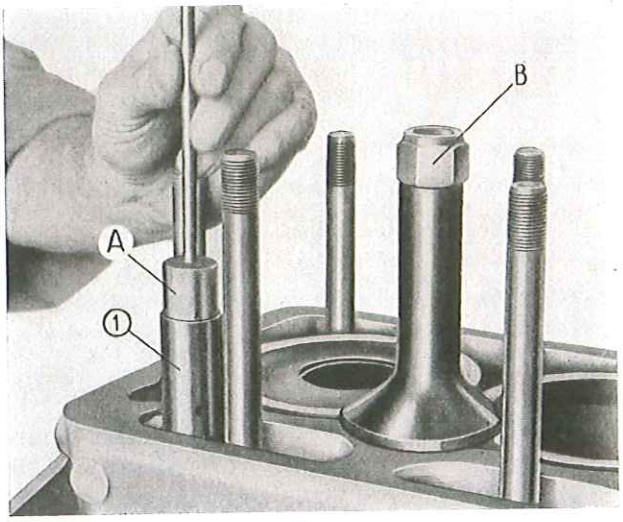


Fig. 61. - Withdrawal of tappets from their seats.
1. Valve tappet - **A.** Extractor **A 413055** - **B.** Sleeve retainer **A 413113.**

Parts to be removed.

Valve tappet cover and rocker arm assemblies.

Valve pushrods.

Cylinder head.

Fan pulley.

Timing gear cover.

Operations and instructions.

Drain crankcase oil.

Use wrench **A 483024** to loosen the nuts which fasten the cylinder head to the crankcase.

Attach the hook **ARR 413005** for lifting the cylinder head (Fig. 60).

Pull tappets out with the aid of tool **A 413055** (A, Fig. 61) and lock on special retainer **A 413113** (B, Fig. 61) to hold cylinder sleeves in place.

Turn the engine upside down.

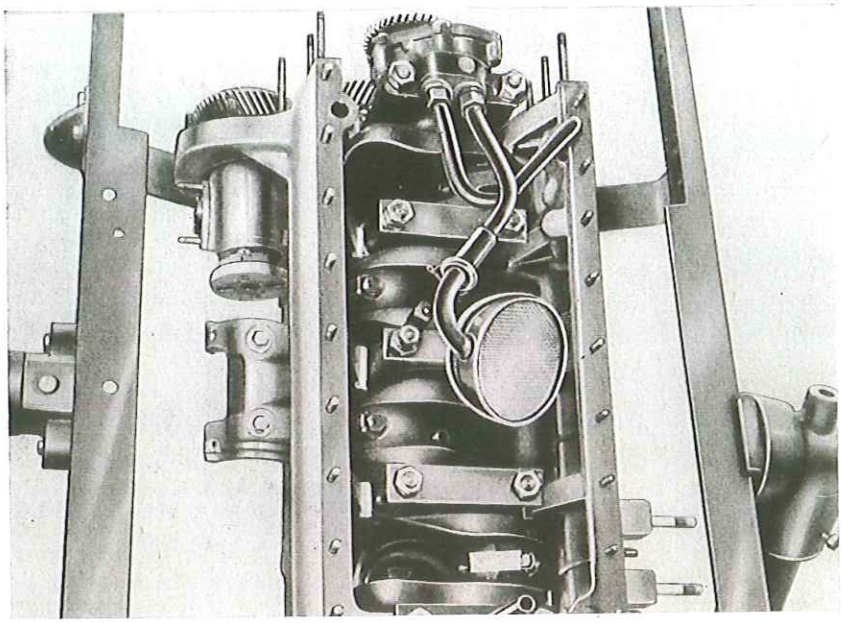


Fig. 62. - Bottom view of engine.

Oil sump.

Main and crankpin bearings caps; their shells and thrust washers.

The No. 1 main bearing cap comes off with the oil pump, screen filter and intake tube attached to it.

Main bearing caps may be removed using spanner **A 413042.**

Arrange bearing shells and caps so as to avoid mixing them.

The crankshaft is removed together with the flywheel and the drive gear (7, Fig. 63).

Rotate the engine 90°.

Piston and connecting rods.

Cylinder sleeves.

Remove special retainer tool **A 413113** and pull out the cylinder sleeves and their gaskets.

Timing gears (Fig. 63).

Rotate the engine 90°.

Use puller **A 413057** to extract the idler gear bushing.

Camshaft.

Injection pump drive assembly.

Remove the injection pump drive gear screws (2, Fig. 63).

INSPECTION AND RECONDITIONING OF ENGINE PARTS

Cylinder head.

— Scrape the carbon from the surface in contact with cylinder block and clean the inside ducts using brush **A 517031** fitted to a portable electric drill.

— If necessary grind the mating surfaces, and inspection the single component parts of the assembly.

— Make a seal test using hot water at 142 p.s.i. and flaring tool **A 721121** to avoid possible leakages.

Valve system.

— For valve removal and installation on the cylinder head use tool **A 413028** (A, Fig. 64).

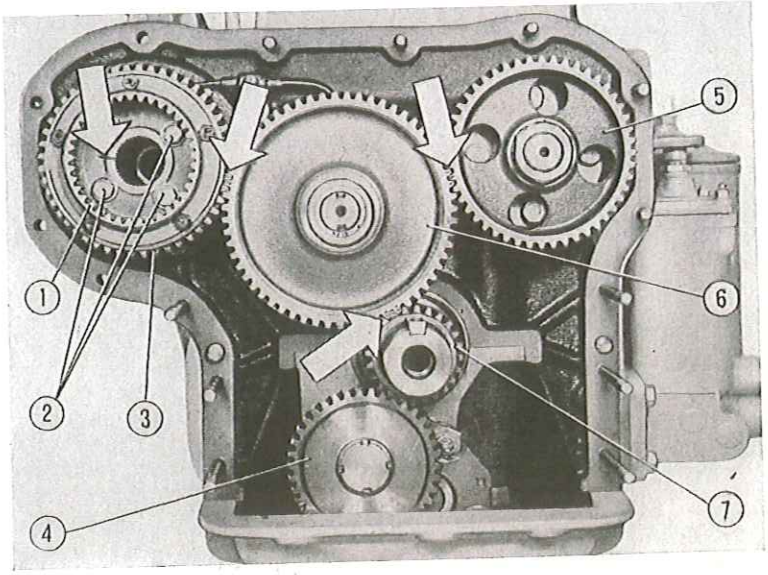


Fig. 63. - Timing gears (arrows show register marks for engine timing).

1. Hydraulic pump driving gear - **2.** Injection pump driving gear screws - **3.** Injection pump driving gear - **4.** Crankcase oil pump driving gear - **5.** Timing drive gear - **6.** Idler gear - **7.** Crankshaft gear.

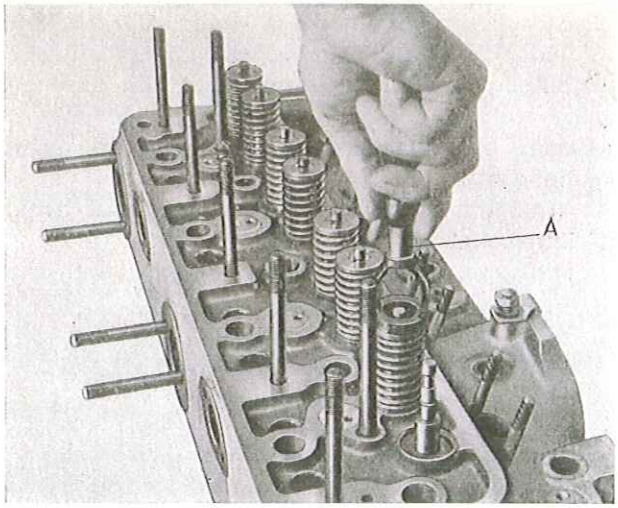


Fig. 64. - Valve removal.
A. Tool **A 413028** for valve springs removal and re-fitting.

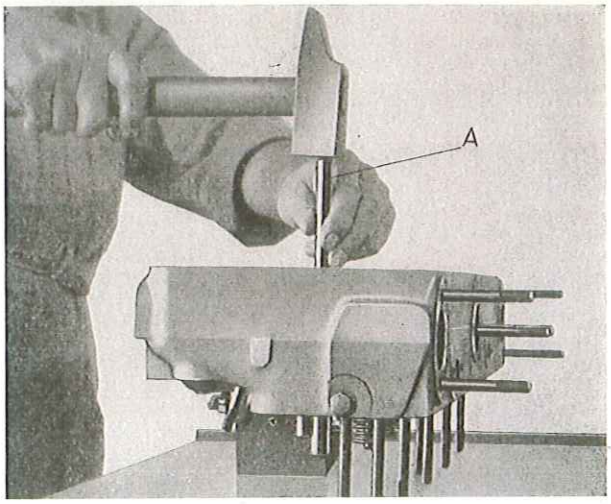


Fig. 65. - Valve guide extractor.
A. Punch **A 413009.**

— Remove and install the valve guides operating with punch **A 413009** from the bottom (A, Fig. 65). At reassembly, introduce the valve guides from the top and press-fit them into place using special punch **A 413054.**

— Ream the valve-guide bores with reamer **U 413030.** Before checking the clearance between valve-guide holes and valve stems, be sure to clean the holes carefully using steel brush **A 413031.**

— Refacing operations of valve seats on the cylinder head are best performed according to the following order:

— the first operation calls for grinding cutter **A 413139/E** fitted to spindle **A 413039/A**;

— the second operation is carried out using milling cutter **A 413139/C** or **A 413039/B** (the latter oversized of 0.028 in. = 0.7 mm);

— finally, reface top surface of valve seats with milling cutter **A 413039/D** (using the spindle recommended for the first operation).

— Provided that proper equipment be used, valve surface grinding will not require any special instructions.

— Check tappets and their seats, if out of tolerance ream holes and replace tappets with oversized ones of either 0.008 in. (0.2 mm) or 0.016 in. (0,4 mm).

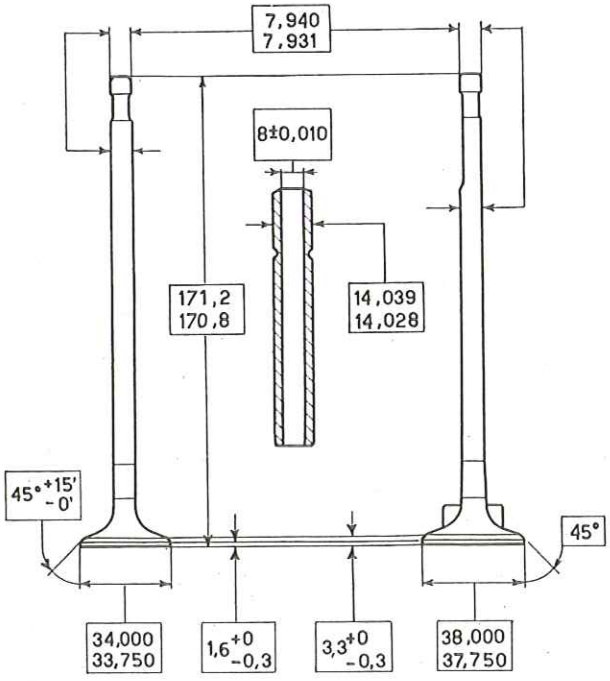


Fig. 66. - Valve and valve-guide standard dimensions.

Note: the timing data for CO1D/55 engines appearing on page 4 and page 14 of the publication « Model 513 R Tractor-Specifications, adjustments and main technical data » (Form. No 354.083), which the present publication completes, must be corrected as follows:

Intake valves:

— opening 10° before TDC (corresponding to 1.237 in = 31,4 mm measured on the flywheel);

— closing 54° after BDC.

Exhaust valves:

— opening: 54° before BDC;

— closing: after TDC.

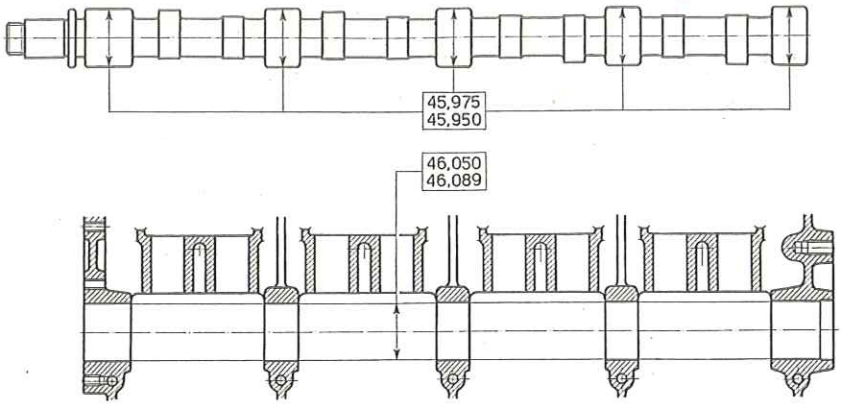


Fig. 67. - Camshaft journal and bearing fits.

Crankgear components.

— Check cylinder liners inside diameter with dial test indicator **C 687** after setting it inside the ring gauge **C 413112.**
Cylinder liners can be re-bored using boring fixture **M 110** attached to the bench **ARR 711019**; the finish is given by honing tool **A 517021.**

— Checking piston wear requires inspecting the following parts: piston skirt, piston boss bore (if necessary ream the hole with adjustable reamer **U 413017**), piston ring grooves. Should piston replacement be necessary, check the weight on a reliable scale.

— For correct mounting position of connecting rods on pistons, refer to Fig. 2.

— Use special pliers **A 619022** to remove and install the piston rings. To check piston rings diameter, which should always be done before installing new parts, use ring gauge **C 413112**, or insert the rings into the lower end of a cylinder liner.

— Connecting rod alignment can be checked using test fixture **C 517023**; should the inspection reveal slight deformation or misalignment correct them with a hydraulic press or a fork lever.
To replace the connecting rod small end bushings use punch **A 9433815**, then ream the hole with tool **U 413017** to achieve the dimensions and tolerances given on the drawing.
Check alignment of piston-connecting rod units after assembly.

— Check crankshaft journals alignment using parallel blocks **C 731** or mounting the crankshaft on lathe centers. Tolerance is 0.002 in. = 0.05 mm.
Crankshaft balance can be checked with parallel block **C 732**, with the engine clutch mounted. (This check is necessary only when a new part is installed, such as a new flywheel, or clutch pressure plate, or the clutch assembly).

IMPORTANT: should main and crankpin journals require grinding it will be necessary to provide fillets of 0.14 to 0.15 in. (3.5 to 3.8 mm) radius and lubrication hole rounded corners with 5/64″ in. (2 mm) radius.
Mating surfaces of main and connecting rod bearing caps must never and for no reason be filed or otherwise adjusted by removing material.

Oil pump.

Fig. 68 shows pump components and their dimensions.

Water pump.

The impeller (Fig. 69) can be driven off its shaft by means of puller **A 413060**. Keep in mind that the critical element for correct pump performance is the seal gasket.

Scale inside the water pump must be scraped off, then cleaned out by immersing the pump in a 20% solution of water and soda or water and hydrochloric acid.

Drift pin **A 922341** ensures the correct mounting of the water seal gasket.

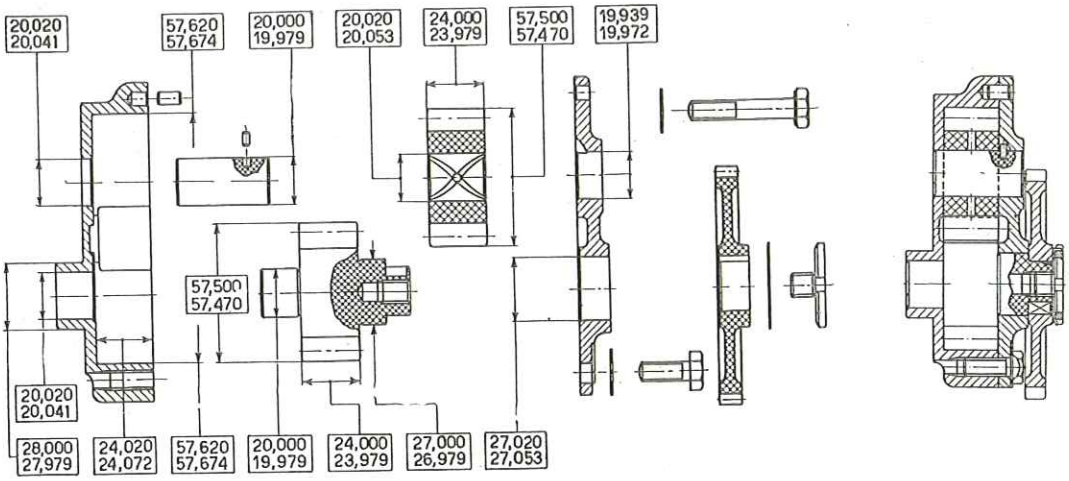


Fig. 68. - Oil pump.

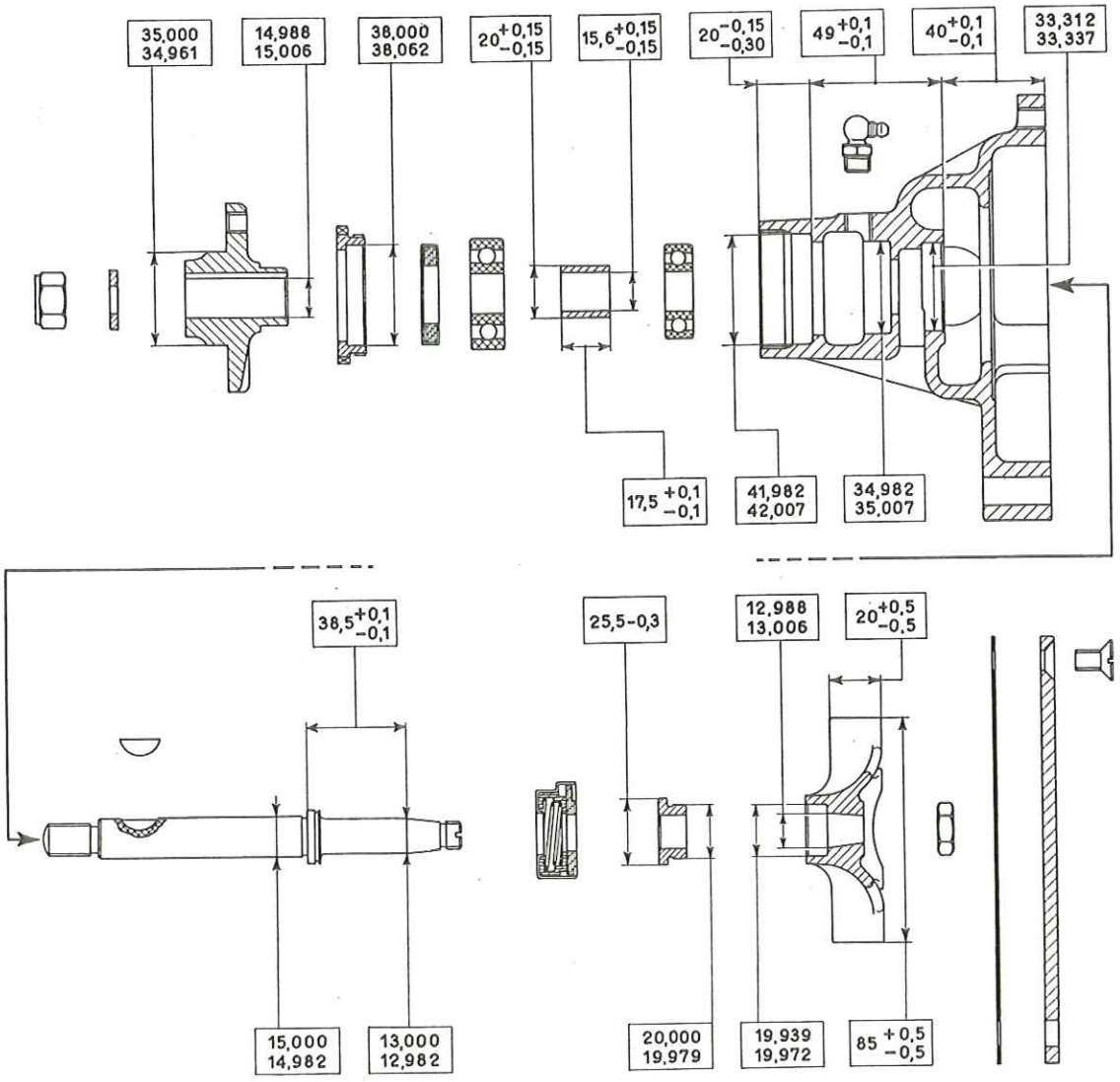


Fig. 69. - Water pump.

ENGINE REASSEMBLY

The engine can be reassembled easily keeping in mind the data and instructions given in the topics « Removal of engine from tractor » and « Disassembly of engine » and the following supplementary information:

— The protrusion of the top surface of cylinder liners above the top flat surface of the cylinder block can be checked using sleeve retainers **A 413113**, rule **C 517011** and feeler gauge **C 315** (Fig. 70).

— Install side seals on rear main bearing cap using adhesive and tool **A 711050**.

— The introduction of pistons with piston rings on into the cylinder sleeves is facilitated by guide band **A 413118**.

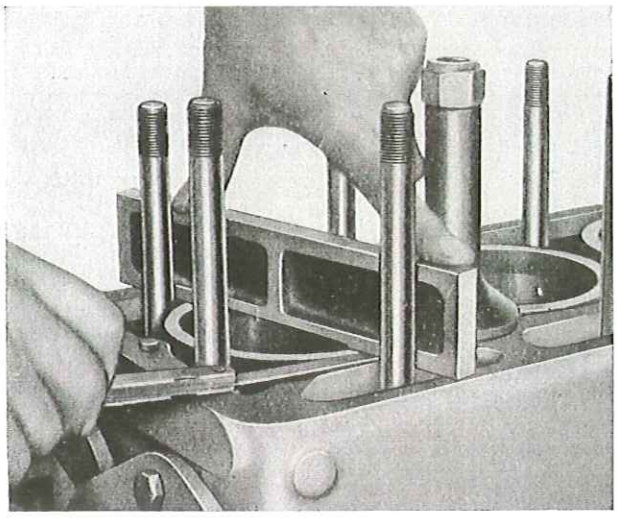


Fig. 70. - Measuring cylinder liner projection.

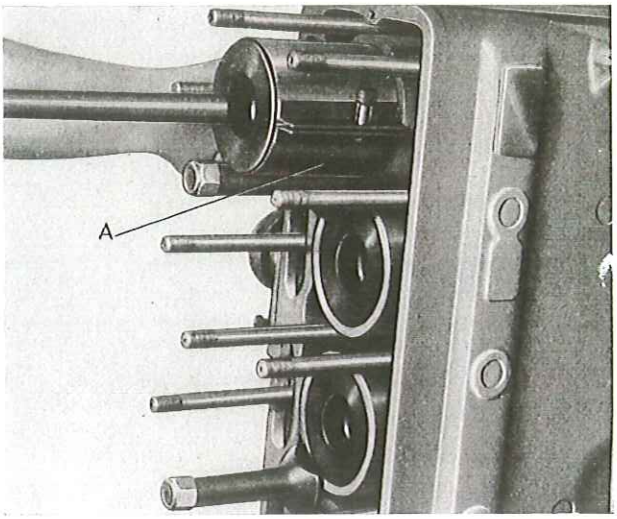


Fig. 71. - Fitting pistons into cylinder liners.
A. Band clamp **A 413118**.

— Use punch **U 611907** to bend connecting rod-to-crankpin lock washers.

— Guide rod **A 413055** is used to install tappets into their seats.

— For wrench-torques, fits, and tolerances see data table on page 25.

— Follow the tightening order of cylinder head nuts according to Fig. 72.

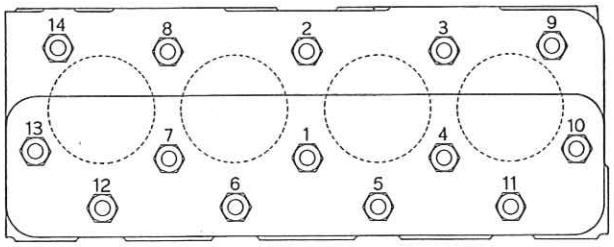


Fig. 72. - Cylinder head stud nut tightening sequence.

NOTE - Check carefully the cylinder head gasket and make sure while refitting it that it is correctly positioned.

Before mounting a new gasket spread a thin layer of grease on it.

TRANSMISSION

THE CLUTCH

Removing and refitting the clutch.

The clutch assembly is rigidly fastened to the engine flywheel by means of screws, it remains therefore attached to the engine when the latter is removed from the tractor.

The refitting of the clutch assembly to the engine flywheel requires the use of disc-centering tool **A417063**, as shown on Fig. 73. This tool allows holding friction discs concentric with respect to the engine centerline and consequently the introduction of the transmission shaft into its seat when refitting the engine on tractor.

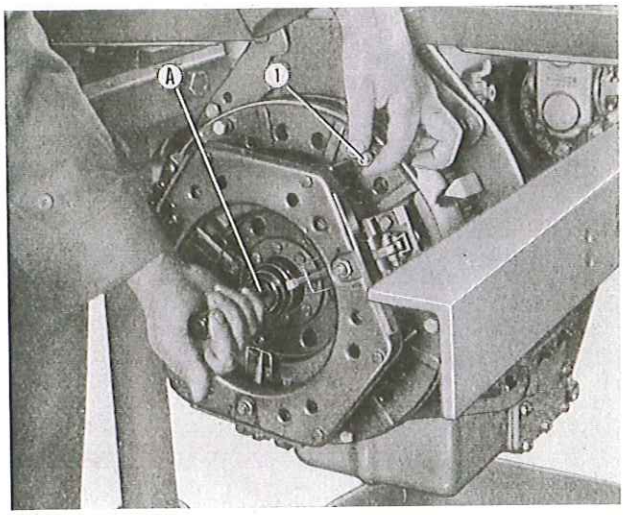


Fig. 73. - Refitting the clutch assembly to the engine flywheel.
A. Disc-centering tool **A 417063** - **1.** Clutch-to-flywheel fastening screws.

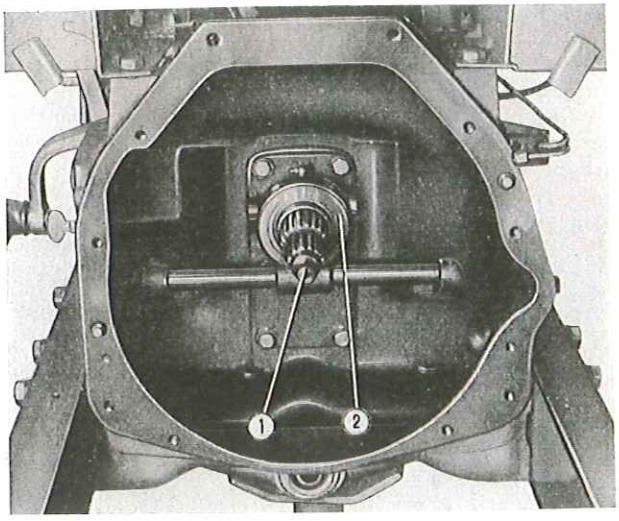


Fig. 74. - View of clutch assembly housing compartment after engine removal.
1. Transmission shaft - **2.** Clutch release sleeve.

Disassembly and reassembly of clutch release control.

These operations are facilitated by referring to Fig. 74 and Fig. 75 which illustrate respectively the clutch release control group located in the front compartment of the clutch housing shown after engine removal, and the exploded view of the group dismantled into its components.

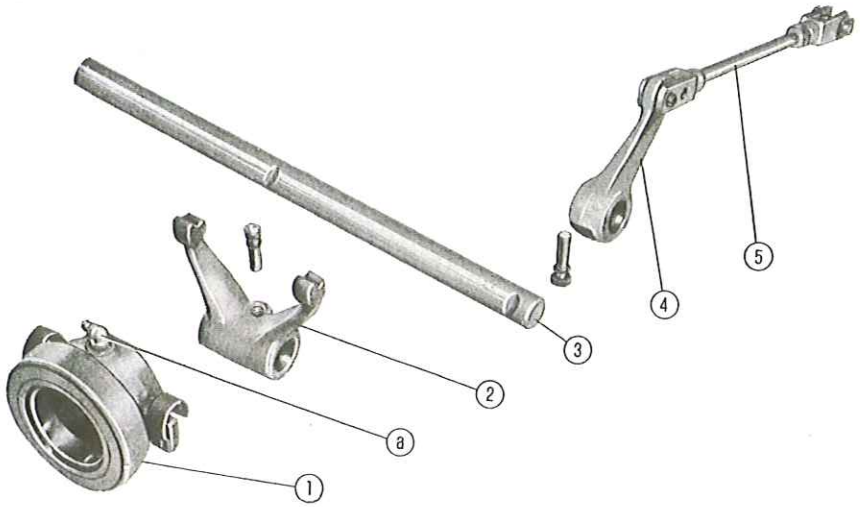


Fig. 75. - Clutch release parts.
1. Clutch release sleeve - **2.** Yoke - **3.** Shaft - **4.** Lever - **5.** Rod - **a.** Grease fitting.

GEARBOX, BEVEL GEARS, AND DIFFERENTIAL

The rear half of the tractor is composed by a ribbed reinforced casting (Fig. 76), which houses the gearbox, bevel gears and differential. The casting is closed on the rear end by a cover through which the P.T.-O. shaft protrudes.

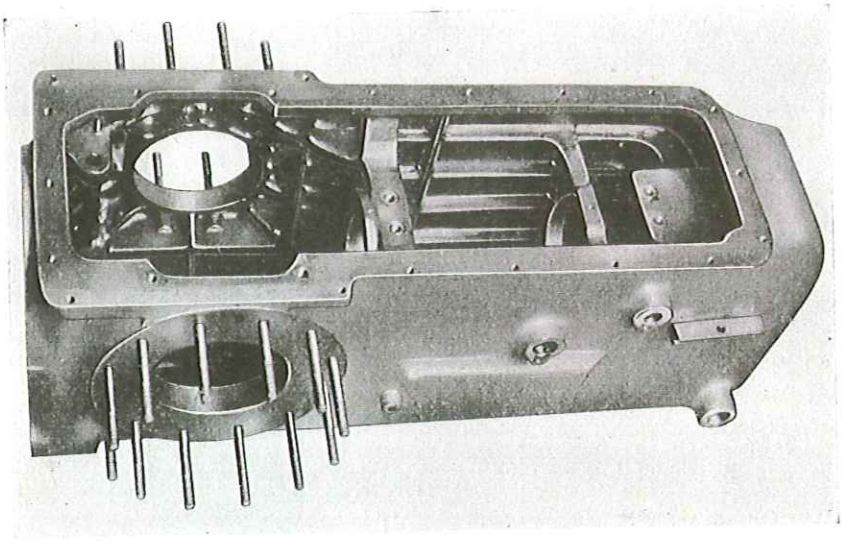


Fig. 76. - Transmission case.

DISASSEMBLY

To remove the complete box from the tractor for disassembly, proceed as follows:

Parts to be removed.

Final drive casings.

Control pedals, their shafts and return springs.

Hydraulic lift.

Operations and instructions.

Follow the instructions concerning the removal of the units from the tractor, as reported on page 59.

Remove the brake, clutch and accelerator pedals after detaching their respective link rods.

Drain the oil from the lift (loosen the breather cap to facilitate the outflow of the oil) and detach the oil lines serving the hydraulic lift and its pump; pull the cotter pin and slide the lower shaft (5) out of the reaction strut (3, Fig. 77).

Remove the complete hydraulic lift from the transmission housing cover, using a hoist, after removing the fastening nuts.

NOTE - The hydraulic lift can also be removed and more easily in two separate pieces by pulling out the shaft (1, Fig. 77), and so making it possible to free the whole reaction support with its spring from the lift casing.

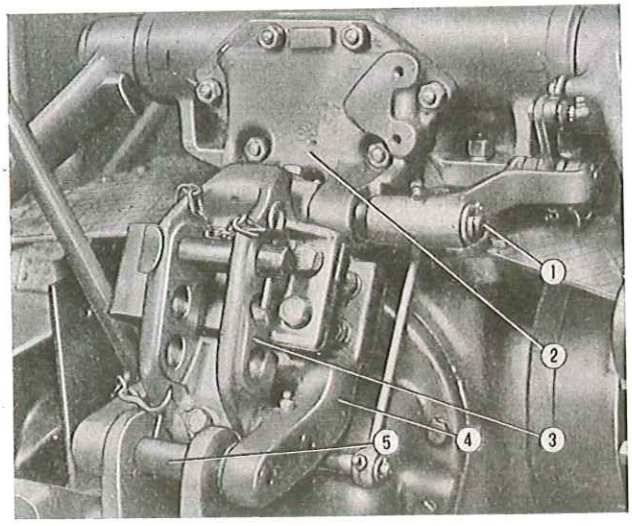


Fig. 77. - Hydraulic lift rear view.

1. Upper shaft - **2.** Cover - **3.** Reaction strut - **4.** Reaction-strut support - **5.** Lower shaft.

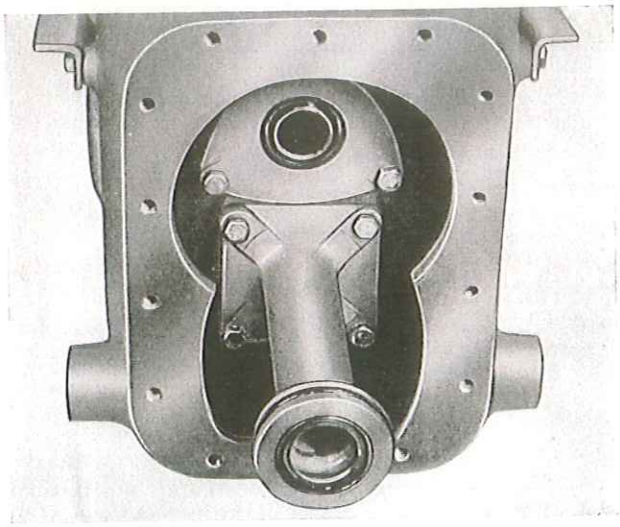


Fig. 78. - Transmission case with the P.T.-O. drive shaft sleeve.

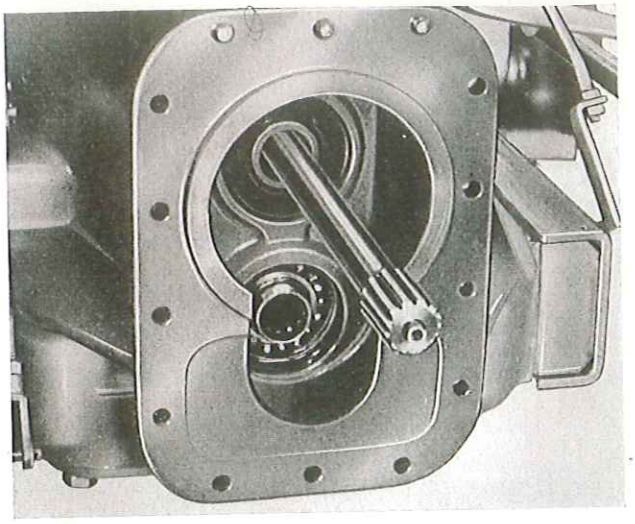


Fig. 79. - Clutch case with the transmission shaft.

Seat.

Remove the seat with its support from the transmission housing cover.

Tractor front end, with engine and clutch housing.

Drain the oil from the P.T.-O. drive box; insert wooden wedges between front axle and axle support to prevent side displacement of engine; hook up the middle section of the tractor (after removing the steering wheel which is in the way), withdraw the bolts fastening the gearbox flange to the clutch housing flange, then proceed to separate the two sections by making the tractor front end advance slowly.

NOTE - Pay attention not to allow any appreciable deviation away from the tractor longitudinal axis as this could result in bending the transmission shaft (Fig. 79).

Rear P.T.-O. and pulley box, with power take-off shaft.

Hook the box up to a hoist, withdraw the flange fastening screws; remove the complete box away from the transmission box sliding the P.T.-O. drive shaft off the gearbox hollow shaft (Fig. 80).

Transmission housing cover.

Remove the cover with the gearbox speed control levers (Fig. 81).

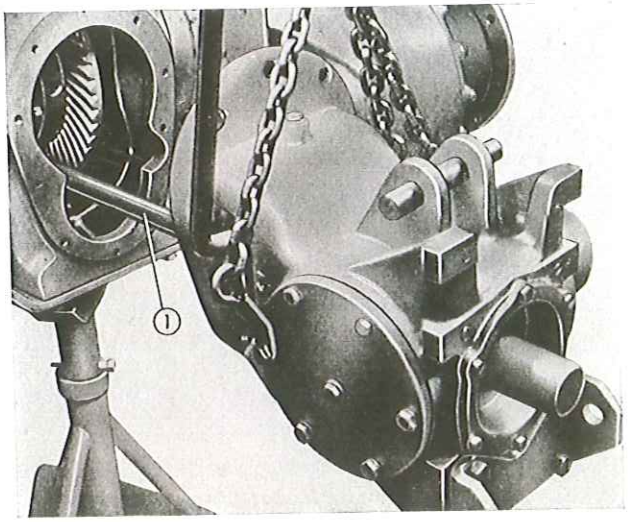


Fig. 80. - Removal of the P.T.-O. and belt-pulley drive rear housing.

1. P.T.-O. drive shaft.

Gearbox speed selector rods.

Remove the gearbox speed selector rods with slotted guide plate (Fig. 42); be careful to mark spacers correct position for reassembly;
remove pedal P, tie-rod, lever, and fork (4, Fig. 42 and 6, Fig. 82).

Bevel gears and differential.

Withdraw the screws fastening the bearing carriers to the transmission housing (1, Fig. 82); pull out the carriers with their adjusting shims; lift out the complete bevel ring gear and differential assembly (Fig. 42) from the transmission housing; the parts making up the bevel ring gear, differential box and locking device assembly come loose after fastening bolts (6, Fig. 83) have been removed; draw out slotted hollow dowels (9) and bearings (8, Fig. 83), then detach the bevel ring gear from the differential housing.

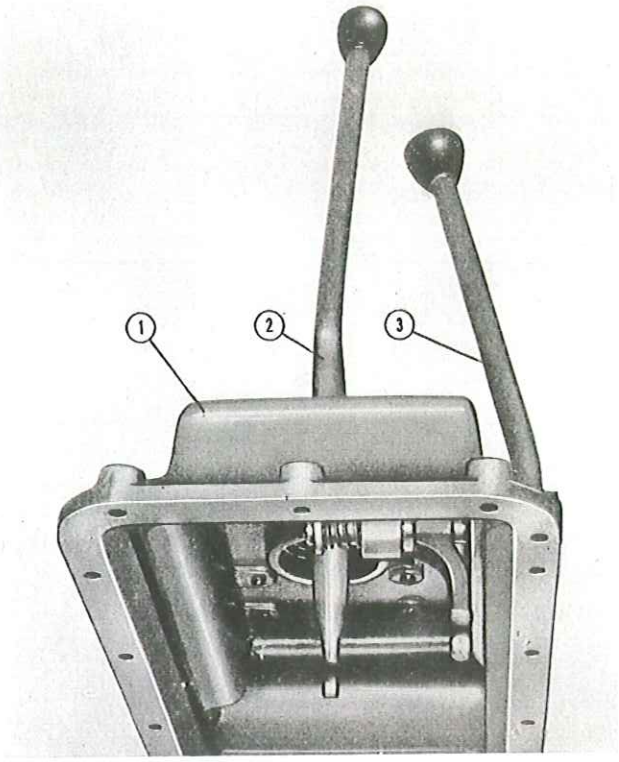


Fig. 81. - Transmission box cover with control levers.

1. Cover - **2.** Gearbox speed selector lever - **3.** Low range speed control lever.

Bevel pinion shaft (Fig. 84).

Remove the screws fastening the pinion shaft bearing cage flange to the transmission housing side wall (36, Fig. 84);
pull out the bearing cage together with the pinion and shaft assembly, including the adjusting shims; slide off the spur gears (10 and 11, Fig. 84), loosen the ring nut (9) which holds the bearings in place after removing lock washer (8); pull out the bearings first then their outer races using puller **A 511110.**

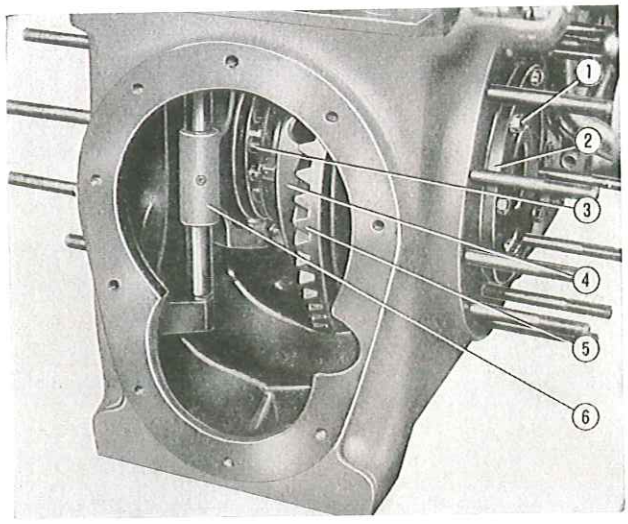


Fig. 82. - Rear view of transmission box.

1. Rear axle bearing holder screws - **2.** Rear axle bearing holder - **3.** Differential lock - **4.** Differential - **5.** Crown wheel - **6.** Differential lock fork.

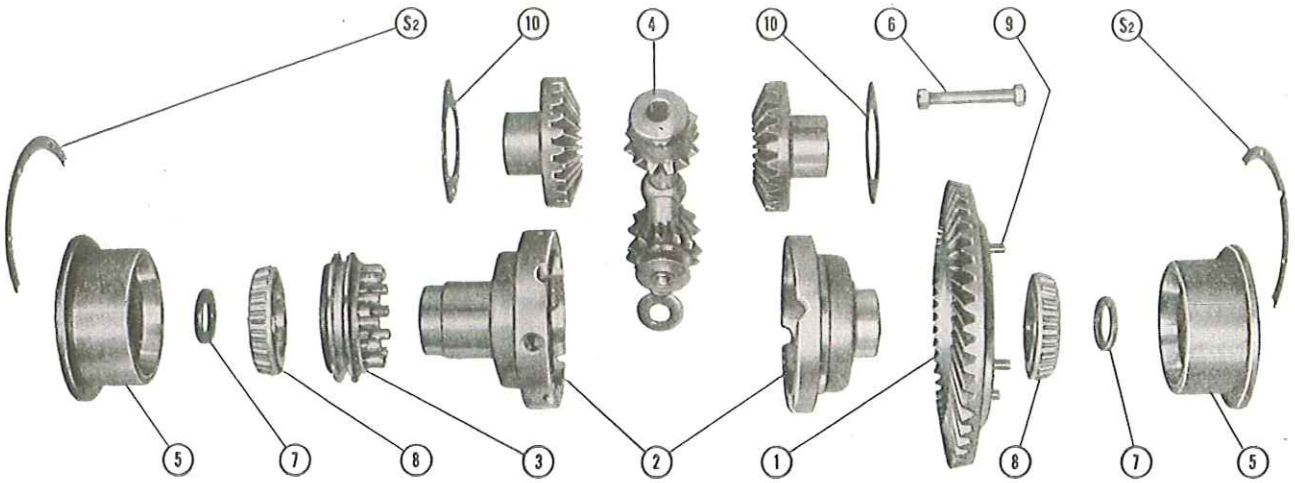


Fig. 83. - Rear transmission.

1. Crown wheel - **2.** Differential half-casings - **3.** Differential lock - **4.** Differential pinions - **5.** Bearing casings - **6.** Differential half-casings fastening screws - **7.** Oil seals - **8.** Cone bearings - **9.** Elastic pin - **10.** Differential shims - **S_2.** Bearing casing shims.

Gearbox primary shaft (15, Fig. 84).

Remove cover (25) screwed on the front face of the transmission housing, circlip (23) holding the bearing on the shaft, and clevis (17); push the shaft assembly inwards, the gear can be slid off the front end of the shaft after screwing off ring nut (20) and lock washer (19).

NOTE - At disassembly the roller bearing (13) remains inside the primary shaft and the hardened bushing (2) working as inner race of the bearing remains on the end of the bevel pinion shaft, being held in place by retaining circlip (3).

Intermediate shaft (33, Fig. 84).

Remove the sleeve (Fig. 30) complete with oil seals; remove circlip (27) and push the shaft towards the inside of the gearbox, slide the gears off the shaft, then pull out the latter pushing it towards the opposite direction.

Reverse gear axle.

To pull off the axle withdraw setscrew (35).

INSPECTION OF THE GEARBOX, BEVEL GEAR, AND DIFFERENTIAL PARTS

— Before inspecting the transmission individual parts see the data of page 33.

— Gears must not be damaged or show excessive tooth wear, and the chamfers must also be undamaged.

— Check single gear trains for good tooth bearing and gear teeth surface for smooth finish and no scoring. The same considerations hold for splined shafts surface finish.

— Make sure splined shafts have surfaces in perfect shape and finish, particularly on sections where the gears slide.

— The reverse gear axle must show smooth surface free from scratches and scoring. If the play between the bushing and the axle is excessive, replace both.

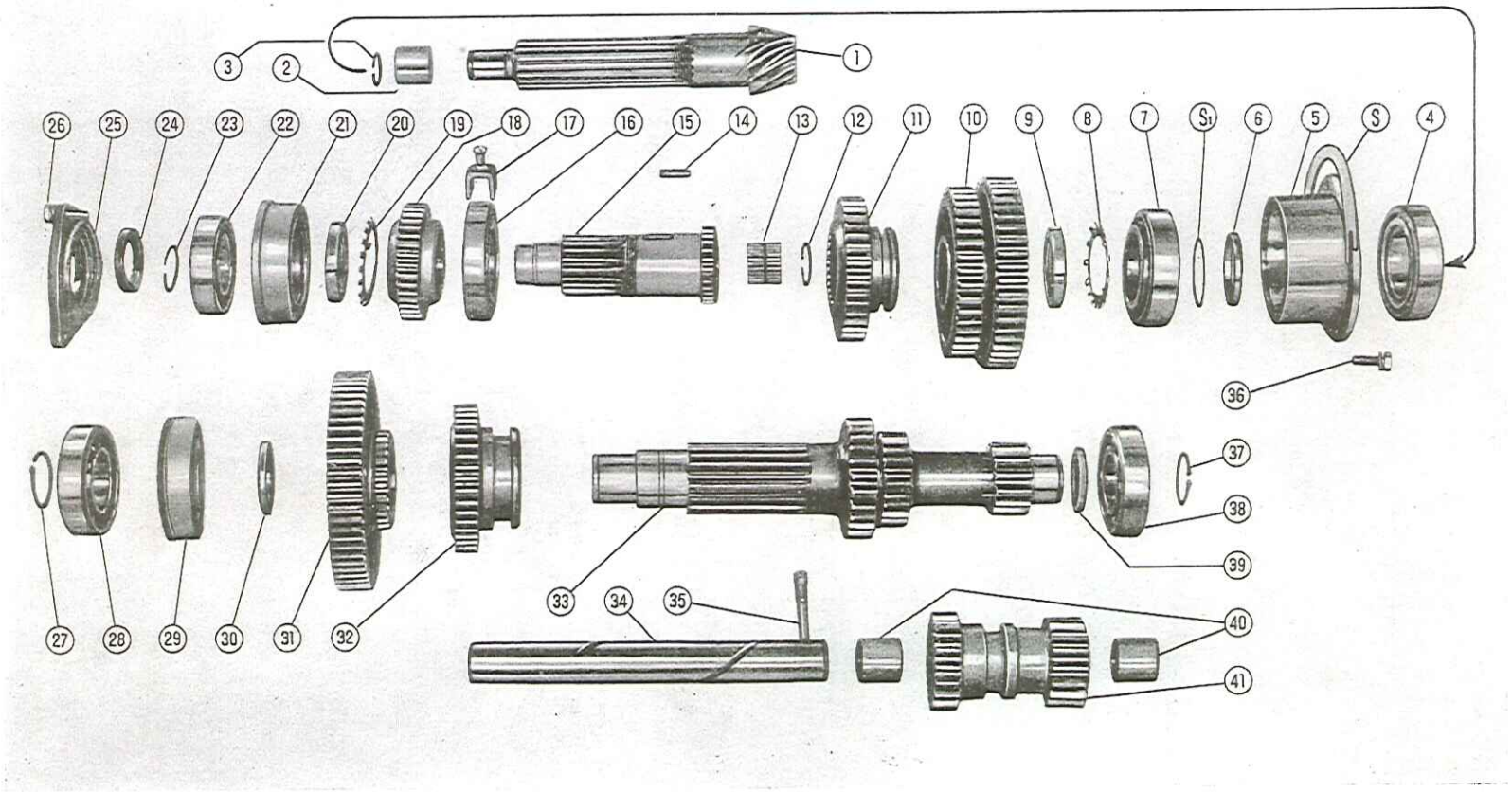


Fig. 84. - Gearbox parts.

1. Bevel gear shaft - **2.** Needle bearing inner ring - **3.** Circlip - **4.** Bearing - **5.** Bearing holder - **6.** Spacer - **7.** Bearing - **8.** Spring washer - **9.** Ring nut - **10.** 1st and 2nd speed gears - **11.** Direct drive and 3rd speed gear - **12.** Circlip - **13.** Needle bearing - **14.** Key - **15.** Gearbox driving shaft (needle bearing outer ring and spacer inside) - **16.** Bearing - **17.** Clevis - **18.** Driving shaft gear - **19.** Spring washer - **20.** Ring nut - **21.** Bearing holder - **22.** Bearing - **23.** Circlip - **24.** Oil seal - **25.** Cover - **26.** Cover fastening screw and washer - **27.** Circlip - **28.** Bearing - **29.** Bearing holder - **30.** Spacer - **31.** Low speed gear - **32.** Intermediate shaft gear - **33.** Intermediate shaft - **34.** Reverse shaft - **35.** Set screw - **36.** Bearing holder fastening screw and washer - **37.** Circlip - **38.** Bearing - **39.** Washer - **40.** Bushings - **41.** Reverse gears - **S.** and **S_1.** Shims.

— Ball bearings must rotate freely without producing any noise.
Roller bearings must be mounted on surfaces having a perfect finish.

— The gearbox shifter forks must hold their characteristics of surface hardening, be unbent and not warped to any extent, and must slide freely with the shifting levers inside their guide slots.

— Inspect and check thickness of differential pinions and gears thrust washers, using dimensional data given in table of page 33.

— Inspect the rear axle supports oils seals and bearings.

— Inspect mating surface of differential locking sleeve seat and check correct split dowels application.

— Check the cast walls of the gearbox housing (Fig. 76) for cracks or other serious defects.

REASSEMBLY OF THE GEARBOX, BEVEL GEARS AND DIFFERENTIAL

Proceed reversing the order of disassembly and be sure to follow thoroughly the instructions given on the adjustment book, Form no. 354.083 from which the following supplementary information has been gathered:

— Install the split dowels with the cut turned facing the direction of stress, or on the plane of the torque set on them (see Fig. 41).

— Spread on adhesive compound over the reverse gear axle setscrew and over the rear axles bearing housing screws.

— Fill with graphitized grease the space located between the rear axles and the outside surface of the bearing housing gaskets.

FINAL DRIVES

At general overhaul of transmission, disc brakes, and final drives we recommend starting from the last units. Removal and disassembly of final drive shafts only does not require removal from the tractor, as in the first case.

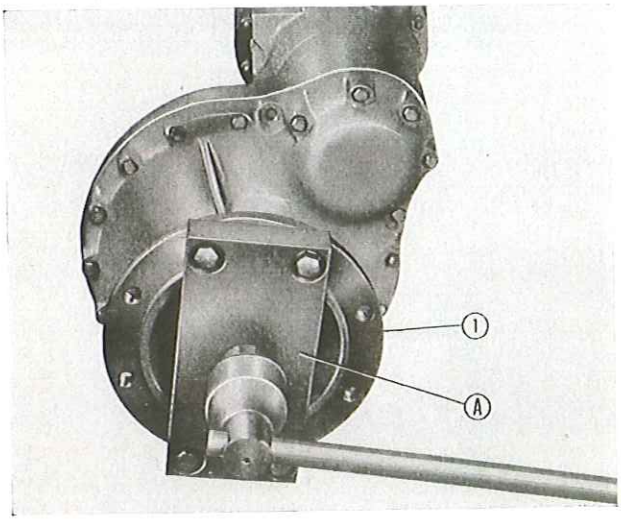


Fig. 85. - Withdrawal of the drive wheel shaft hub.
1. Hub - **A.** Extractor plate **A 487019.**

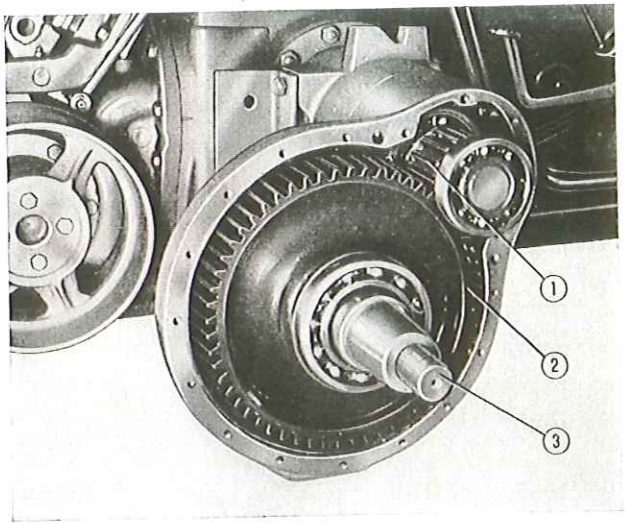


Fig. 86. - View of the final drive gears after removal of the cover.
1. Driving pinion - **2.** Driven gear - **3.** Wheel shaft.

REMOVAL FROM TRACTOR AND DISASSEMBLY

— *Drive wheel shaft hub*: remove weights, if any, then raise the rear section of the tractor placing the transmission housing on suitable floor stands; lock the brakes, hook the wheel to a hoist, withdraw the screws fastening the wheels to the discs, then lift up and remove the wheels;
pull the cotter pin off the drive wheel shaft nut, then loosen and remove the nut itself;
pull off the drive wheel hub using puller **A 487019** (Fig. 85).

— *Final drive housing assemblies*: drain the oil from the final drive and transmission housings;
remove mudguards, footboards, drawbar assembly and its supporting frame, brake tie-rods, and the exhaust;
using a suitable lifting tackle, remove the final drive housing assemblies from the tractor, after loosening and withdrawing the flange fastening screws.

— *Drive wheel shaft*: loosen the fastenings, then remove the final drive box cover; pull out the drive wheel shaft assembly (the shaft bearings can be removed later using a suitable universal puller, as shown in Fig. 87).

— *Rear axle shaft*: it will slide out the final drive housing simply by pulling on it.

INSPECTION OF THE FINAL DRIVE COMPONENT PARTS

— Inspect gear teeth and bearings.

— Inspect splined shafts and check their clearances.

— Check conditions of the oil seals mounted on the rear axle shafts and on the final driven shaft.

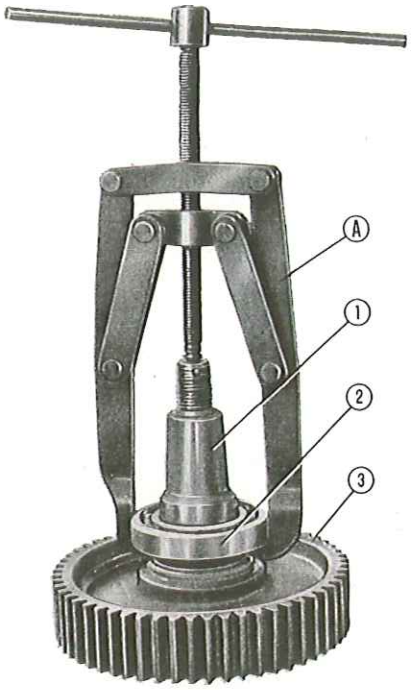


Fig. 87. - Extraction of the drive wheel shaft bearing with a universal type puller.
1. Shaft - **2.** Bearing - **3.** Gear - **A.** Universal puller.

REASSEMBLY

Proceed by reversing the disassembly order of operation: for a correct fitting of the oil seal on the drive wheel shaft use guide pin **A 487012.**

DISC BRAKES

The disc type brakes are mounted inside the final drive housing casings which must be separated from the tractor to allow removal of the brake assemblies (for removing final drive housings from tractor see instructions on page 59).

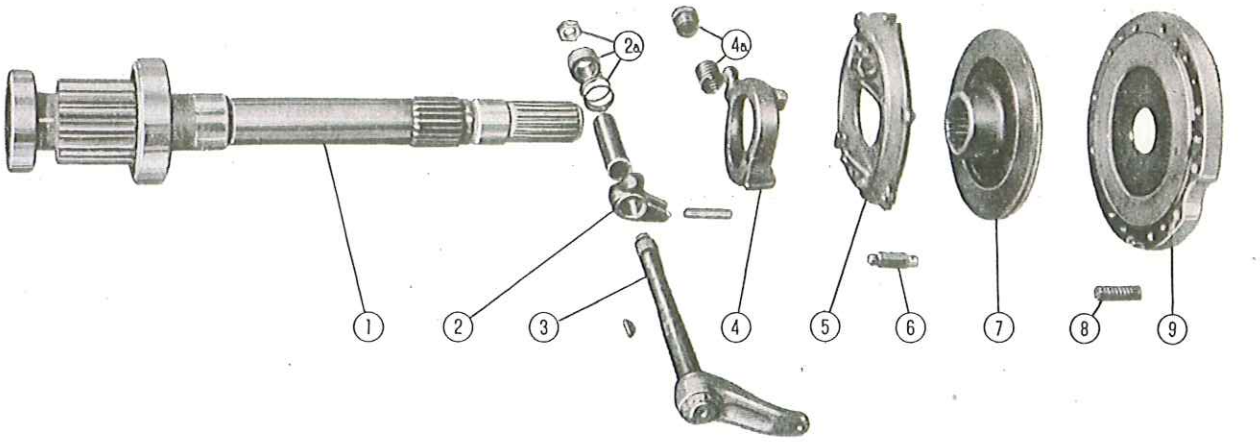


Fig. 88. - Exploded view of the disc brake parts.

1. Rear semi-axle - **2.** Transmission lever - **2/a.** Spring, spacer, and nut - **3.** Lower lever - **4.** Pressure lever - **4/a.** Spring and plug - **5.** Pressure ring - **6.** Pivot - **7.** Disc - **8.** Return spring - **9.** Stationary ring.

DISASSEMBLY

Refer to Fig. 88; withdraw the screws and remove the fixed plate; pull of the friction disc (mounted on the splined section of the rear axle shafts), the pressure plate, and the pressure lever; the brake springs will slide off automatically at disassembly; pull out the transmission lever using puller **A 447060** (Fig. 89), then the remaining parts still in the brake compartment.

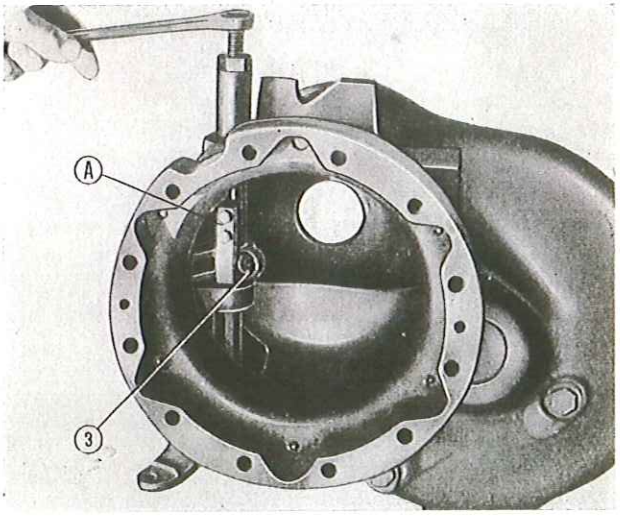


Fig. 89. - Removal of transmission lever.
3. Lever - **A.** Extractor **A 447060.**

INSPECTION OF DISC BRAKE COMPONENT PARTS

— Inspect friction linings and check total disc thickness which must not be less than 5/16" (8 mm).

— Replace the complete friction disc if the lining is deeply impregnated with oil; if only superficially, wash it with gasoline then resurface it with a metallic brush.

REASSEMBLY

It may be easily done by reversing the order of disassembly and referring to the sectional view of the tractor rear transmission as shown on page 32 and the exploded view of Fig. 88. For control rod adjustment instructions see page 34.

POWER TAKE-OFF

FRONT DRIVING GEAR ASSEMBLY

The P.T.-O. front driving gear and its support shaft are located in a compartment of the clutch housing (refer to Fig. 89 and to Fig. 90).

Parts to be removed

Engine and clutch assembly.

Clutch housing box bottom cover.

Bearing housing front cover (1, Fig. 90).

Supporting shaft (4, Fig. 90).

Driving gear (5, Fig. 90).

Operations and instructions.

Follow instructions on page 45.

Drain the lubricating oil in the housing, then remove the bottom cover.

Remove the screws fastening the cover to the inside wall of the clutch housing, then remove the cover itself with gasket and ball bearing.

Reaching through the front opening and using a box wrench withdraw the screws fastening the P.T.-O. driving spur gear to the supporting shaft flange;
withdraw the shaft from the gear, then out of the housing through the front opening.

Withdraw it from the clutch housing compartment through the bottom cover opening.

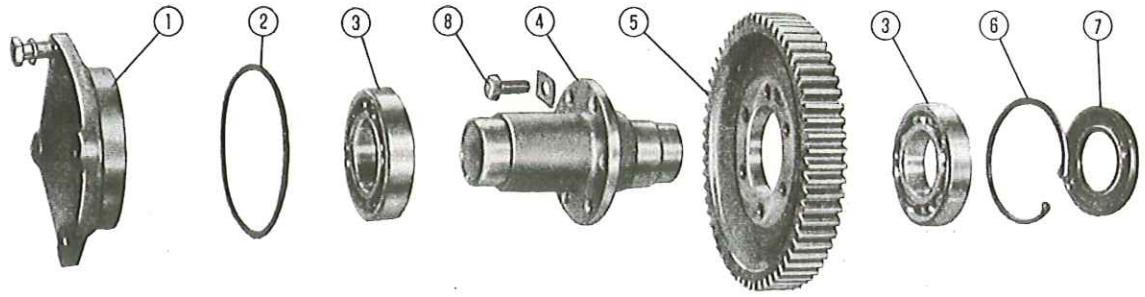


Fig. 90. - Exploded view of P.T.-O. front driving gear assembly (located in the lower compartment of the clutch housing).
1. Cover - **2.** Gasket - **3.** Ball bearing - **4.** Carrier shaft - **5.** Gear - **6.** Circlip - **7.** Oil seal - **8.** Screw, for fixing the gear to the shaft flange, with spring washer.

REAR CASING

Important.

— The left side cover of the rear P.T.-O. housing has a threaded plug hole (A, Fig. 91) which serves for lubricating oil level inspection. Be sure at assembly to fit the side cover to the housing according to the indications stamped on the cover (HAUT = upper, and BAS = lower), which determine the correct position of the plug hole.

— The removal and refitting operations of the spring dowel pin on the P.T.-O. control hand lever and engagement fork are to be performed as shown on Fig. 91.

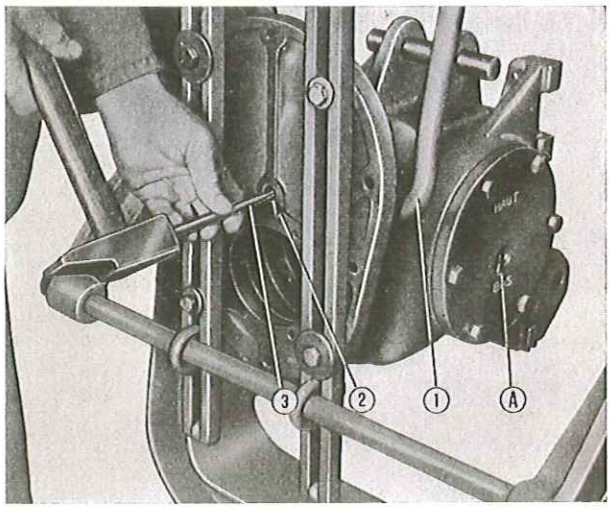


Fig. 91. - Power take-off casing.
1. Control lever - **2.** Access hole to lever-to-fork split dowel - **3.** Driving punch - **A.** Oil level and filler plug threaded hole.

TOOL LIST

Tool No.	Description	Page No.	Fig. No.
A 12114	Screwdriver for weight adjusting plug	24	—
A 19177	Dial gauge for measuring length of travel of control rod	17	—
A 197016	Lever	42	54
A 197032/A	Fitting for lift cylinder valve testing	—	—
A 197032/B	Fitting for lift safety valve testing	—	—
A 197034	Fitting for lift cylinder inlet valve	—	—
A 197036	Fitting for lift discharge valve	—	—
A 393016/B	Plate for lift bushings removal	—	—
A 413009	Punch for valve guides removal	48	65
A 413028	Valve extractor	47	64
A 413031	Steel brush for valve guide holes	48	—
A 413039/A	Spindle for valve seats grinding cutter	48	—
A 413039/B	Milling cutter for valve seats, oversized	48	—
A 413039/D	Milling cutter for valve seats	48	—
A 413042	Wrench for main bearing caps	47	—
A 413054	Punch for valve guide refitting	48	—
A 413055	Guide rod for tappet removal and refitting	46-51	61
A 413057	Extractor for idler gear bushing	47	—
A 413060	Extractor for water pump impeller	49	—
A 413062	Wrench for rotating crankshaft manually	14	—
A 413113	Retainer for cylinder liners	46-47-51	61
A 413118	Band for piston mounting into cylinder liners	51	71
A 413139	Milling cutter for valve seats	48	—
A 413139/E	Grinding cutter for valve seats	48	—
A 417063	Centering rod for clutch disc	52	73
A 417163	Fixture for clutch dismantling and reassembly	27	35
A 423112	Fitting for dial gauge	17	—
A 427011	Extractor for weight retaining sleeve	22	30
A 427042	Wrench for adjusting the length of control rod	17-24	—
A 427055	Wrench for weight retaining ring nut removal	22	29
A 427112	Tool for adjusting length of travel of the control rod	17	—
A 9433815	Punching tool for connecting rod small end bushings extraction	49	—
A 447060	Extractor for disc brake lever	60	89
A 483024	Wrench for cylinder head nuts	46	—
A 487012	Guide tool for fitting final drive oil seals	59	—
A 487019	Extractor for drive wheel hub	59	85
A 497003/A	Guide for gasket mounting on lift shaft	—	—
A 497003/B	Protection for lift shaft gasket	—	—
A 497016	Plate for lift bushings removal	—	—
A 497033	Guide for gasket mounting on lift piston	—	—
A 511110	Puller for bevel pinion shaft bearing	55	—
A 517021	Honing tool for cylinder liners	49	—
A 517031	Brush for cylinder head ducts	47	—
A 527008	Wrench for spring load adjusting ring nut	24	32
A 527015	Fitting set for fuel pressure test	16	20
A 619022	Pliers for piston rings	49	—
A 695112	Wrench for oil intake valve of lift cylinder	—	—
A 711050	Tool for installation of side seals and rear main bearings	51	—
A 721121	Flaring tool for cylinder head	47	—
A 922341	Drift pin for water pump seal	49	—
ARR 2216	Rotary stand	45	58-59
ARR 413004	Brackets for rotary stand (A/B/C)	45	58-59
ARR 413005	Lifting bar for engine	45	57
ARR 413006	Lifting bar for cylinder head	46	60
ARR 711019	Boring bench	49	—
C 315	Feeler gauge	51	70
C 687	Dial gauge for cylinder liners inside diameters	49	—
C 731	Parallel blocks for crankshaft journals alignement	49	—

Tool No.	Description	Page No.	Fig. No.
C 732	Parallel block for checking crankshaft balance	49	—
C 413112	Ring gauge for liners and piston rings diameter	49	—
C 497015	« Go-No-Go » gauge	42	—
C 517011	Steel rule	—	—
C 517023	Fixture for checking connecting rod alignement	49	—
I 495005	Test bench	40	—
M 110	Boring fixture for cylinder liners	49	—
U 413017	Adjustable reamer for piston boss bores	49	—
U 413030	Reamer for valve-guide bores	48	—
U 611907	Punching tool for lock washers installation	51	—

CONVERSION FROM METRIC SYSTEM TO BRITISH SYSTEM

(mm — inches)

Note: Conversions of values from metric to British system are given for the reader's convenience and are necessarily approximated. The original design and manufacturing dimensions appear on the drawings.

Fig. 67.

mm	in.
45,975	1.8100
45,950	1.8090
46,050	1.8130
46,089	1.8145

Fig. 68.

mm	in.	mm	in.	mm	in.	mm	in.
20,020	0,7882	24,000	0.9449	20,020	0.7882	20,000	0.7874
20,041	0.7876	23,979	0.9440	20,041	0.7876	19,979	0.7866
57,620	2.2685	57,500	2.2638	28,000	1.1024	24,000	0.9449
57,674	2.2680	57,470	2.2625	27,979	1.1015	23,979	0.9440
20,000	0.7874	19,939	0.7850	24,020	0.9457	27,000	1.0630
19,979	0.7866	19,972	0.7863	24,072	0.9477	26,979	1.0622
20,020	0.7882	57,500	2.2638	57,620	2.2685	27,020	1.0638
20,053	0.7895	57,470	2.2625	57,674	2.2706	27,053	1.0650

Fig. 69.

35,000	1.3780	20	0.7874	41,982	1.6528	20	0.7874
34,961	1.3740			42,007	1.5751		
14,988	0.5900	49	1.9291	34,982	1.3772	15,000	0.5906
15,006	0,5908			35,007	1.3783	14,982	0,5898
38,000	1.4961	40	1.5748	38,5	1.5157	13,000	0.5118
38,062	1.4985					12,982	0.5114
20	0.7874	33,312	1.3115	25,5	1.0039	20,000	0.7874
		33,337	1.3124			19,979	0.7866
15,6	0.6142	17,5	0.6890	12,988	0.5114	19,939	0.7850
				13,006	0,5120	19,972	0.7863
				85	3.3465		

Tolerances (fig. 69).

mm	in.
0,10	0.004
0,15	0.006
0,30	0.012
0,50	0.020

INDEX

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