FIAT
tractors

tractor model 513 R

SERVICE MANUAL

SERVICE DEPARTMENT

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(2nd edition)

TRACTOR SERVICE DEPARTMENT

Via Canaprili, 3 - Stupinigi - Torino

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TABLE OF CONTENTS

DESCRIPTION AND SPECIFICATIONS

NOTE - *The data appearing throughout this manual as British equivalents have been introduced for the reader's convenience, but the metric units only are to be considered as the original design and manufacturing data.*

ENGINE

Model	CO1D/55	CO2D/60 var. 10
4-cycle Diesel, direct-injection and double turbulence action		
Number of cylinders, vertical, in-line	4	4
Bore, inches	4.13 (105 mm)	4.25 (108 mm)
Stroke, inches	4.72 (120 mm)	4.72 (120 mm)
Number of main bearings	5	5
Displacement, cubic inches	253.6 (4156 cm³)	268.3 (4397 cm³)
Compression ratio, approx.	15 : 1	15.5 : 1
Maximum horse-power (without fan, air cleaner and exhaust pipe)	55	60
Speed at maximum horse-power, r.p.m.	1750	1750
Maximum torque (with fan, air cleaner and exhaust pipe), ft.lb.	177.2 (24,5 Kgm)	191.7 (26,5 Kgm)
Speed at maximum torque, r.p.m.	1200	1200
Weight, lbs. (dry)	1000 (454 Kg)	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.

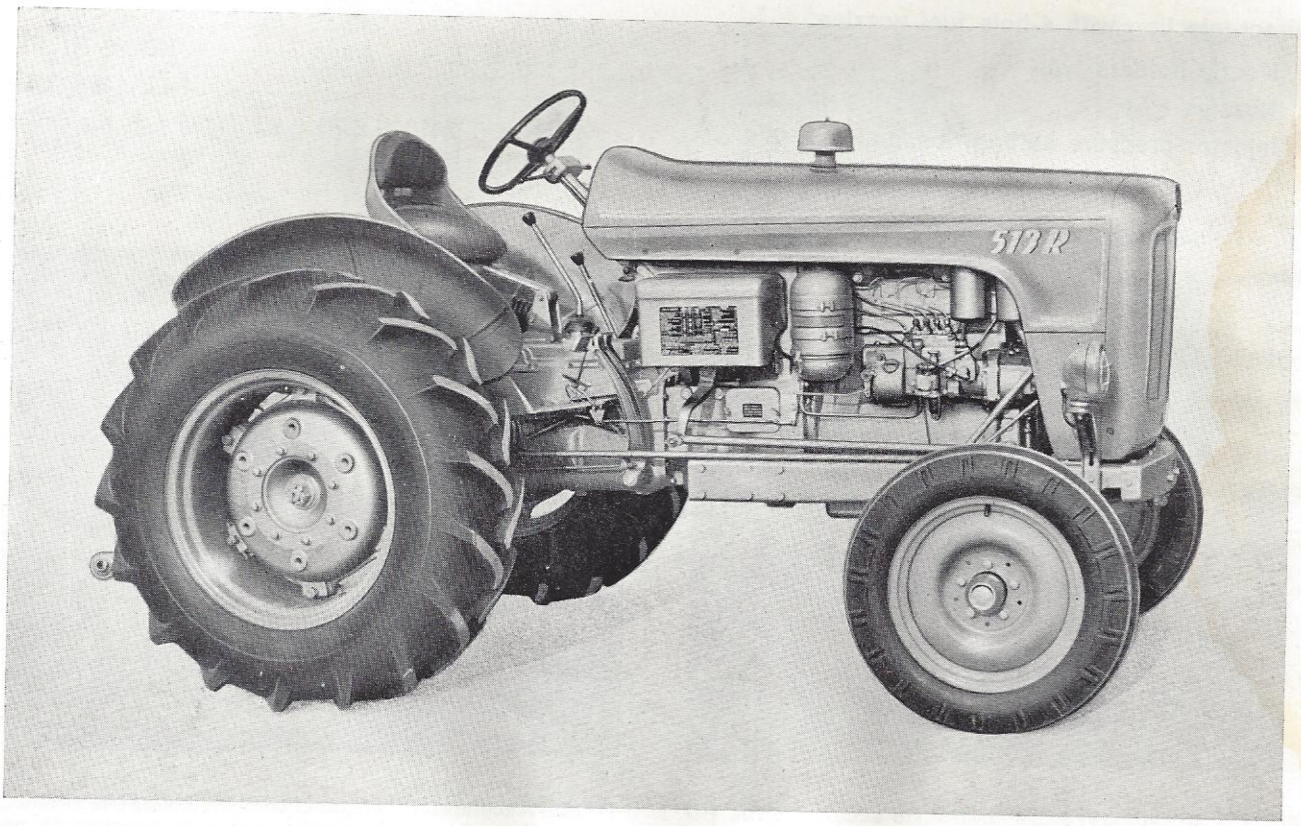


Fig. 1. - Side view of tractor.

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: 10° before T.D.C. (corresponding to 1.260 in., = 32 mm, of linear distance
closing: 54° after B.D.C. measured on flywheel rim).

Exhaust valves { opening: 54° before B.D.C.
closing: 10° after T.D.C.

Valve tappet setting (cold) . . . . 0.010 in. (0,25 mm)

Fuel feeding system.

Fuel feeding: by mechanical lift pump (fitted with a sediment bowl-type filter) driven by the fuel injection pump.

Model . . . . FP/KS 22A : L4/4

Fuel feeding pressure . . . . 17 to 21 p.s.i. (1.2 ÷ 1.5 Kg/cm²)

Dual fuel filter with detachable elements (a cloth and a paper one).
Dual accelerator control: by manual lever mounted underneath the steering wheel and by foot control pedal applied to the tractor, both located on the right-hand side.

Fuel injection pump (Bosch licence), 4 pumping elements, fitted to:

— engine mod. CO1D/55, pump model . . . . PES 4A 85B 410 : L4/27

— engine mod. CO2D/60 Var. 10, pump model . . . . PES 4A 85B 410 : L4/32

Direction of rotation . . . . clockwise

Firing order 1-3-4-2

Phasing to engine: commencement of delivery from pumping element no. 1 takes place when, piston no. 1 being in compression, the crankshaft reaches . . 21° ± 1° before T.D.C.

Direct-injection with 4-hole fuel nozzles.

Nozzle holders type . . . . KB 82 S1 F1

Nozzles type . . . . DLL 145S 35F

Injector pressure setting, lbs./sq.in. . . . . 2418 ± 2580 p.s.i. (175 ± 5 Kg/cm²)

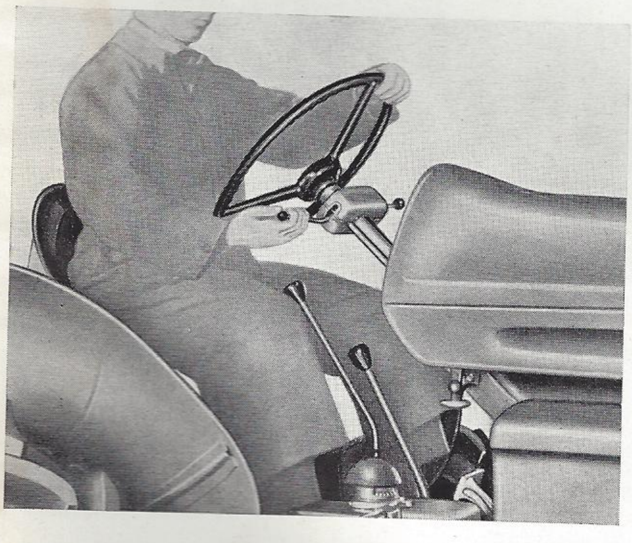


Fig. 2. - Accelerator hand control (to accelerate the engine the control lever must be shifted upwards).

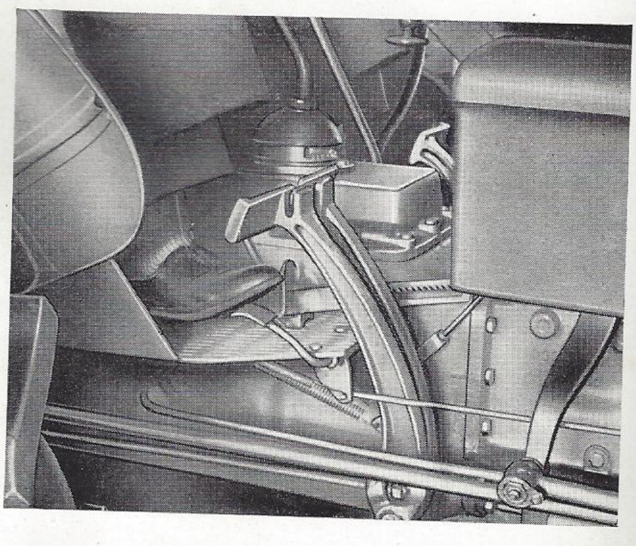


Fig. 3. - Accelerator foot-pedal control (to stop the engine, after shifting the accelerator control lever downwards, or after releasing the pedal, lift the latter up by foot).

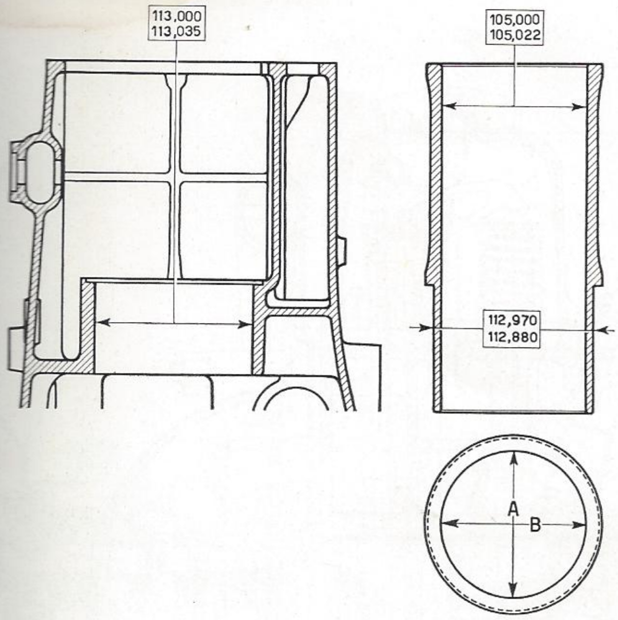


Fig. 5/1. - Dimensions of standard liners and bores in crankcase (engine mod. C01D/55).

a-b. Measuring positions.

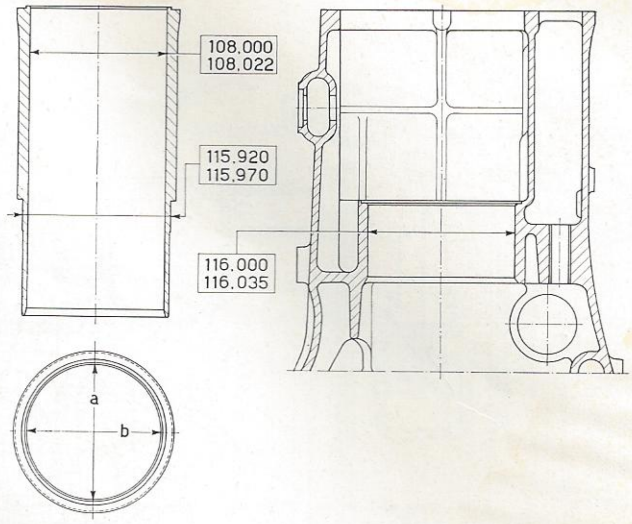


Fig. 5/2. - Dimensions of standard liners and bores in crankcase (engine mod. C02D/60 Var. 10).

a-b. Measuring positions.

(Clearance of liners in bores: 0.030-0.115 mm - 0.0012-0.0045 in).

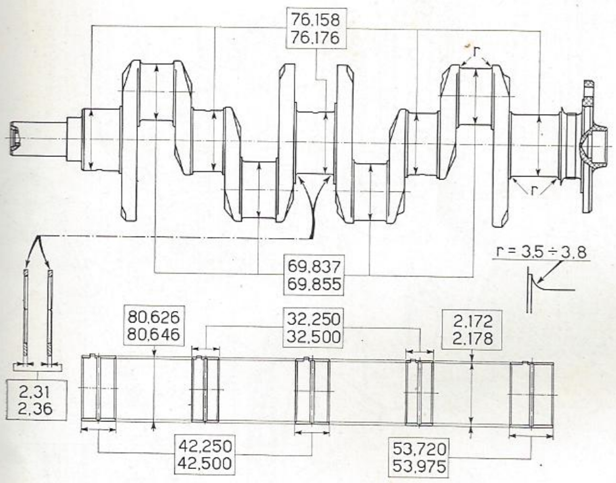


Fig. 5/3. - Major dimensions of crankshaft, main bearings and thrust washers.

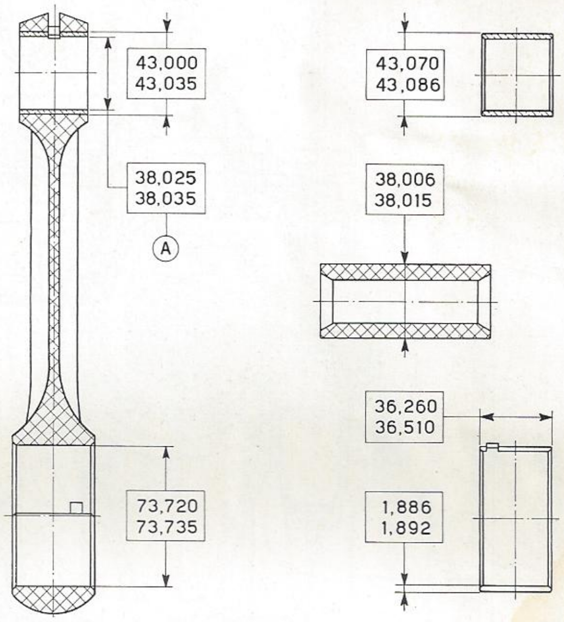


Fig. 5/4. - Dimensions of connecting rods, bearings, bushings and journals.

A. Bushing in position.

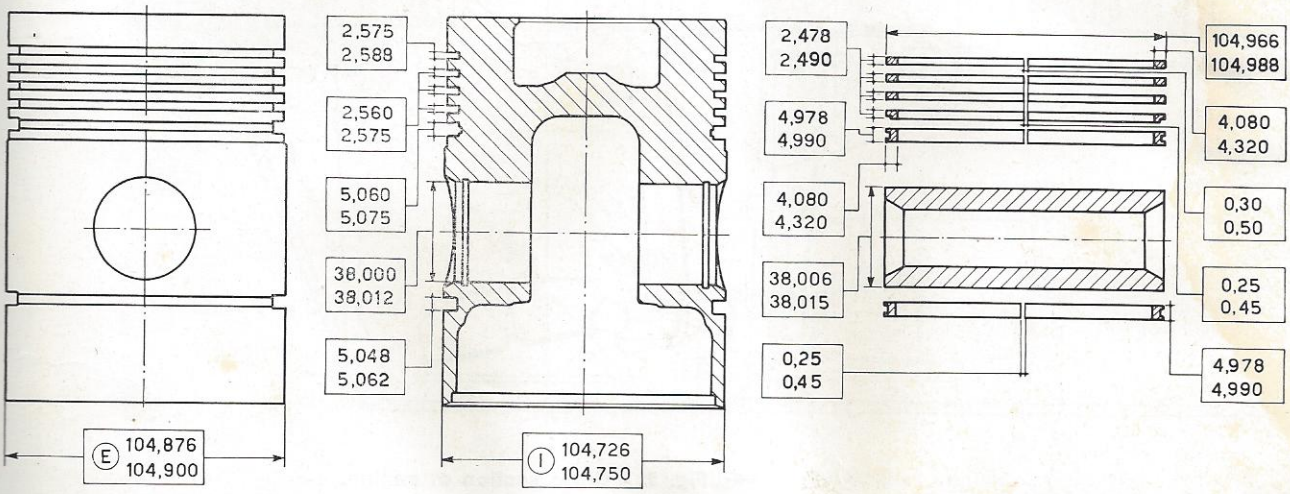


Fig. 5/5. - Dimensions of standard pistons, rings and pins (engine mod. C01D/55).

(**Note.** - End gap with rings in position).

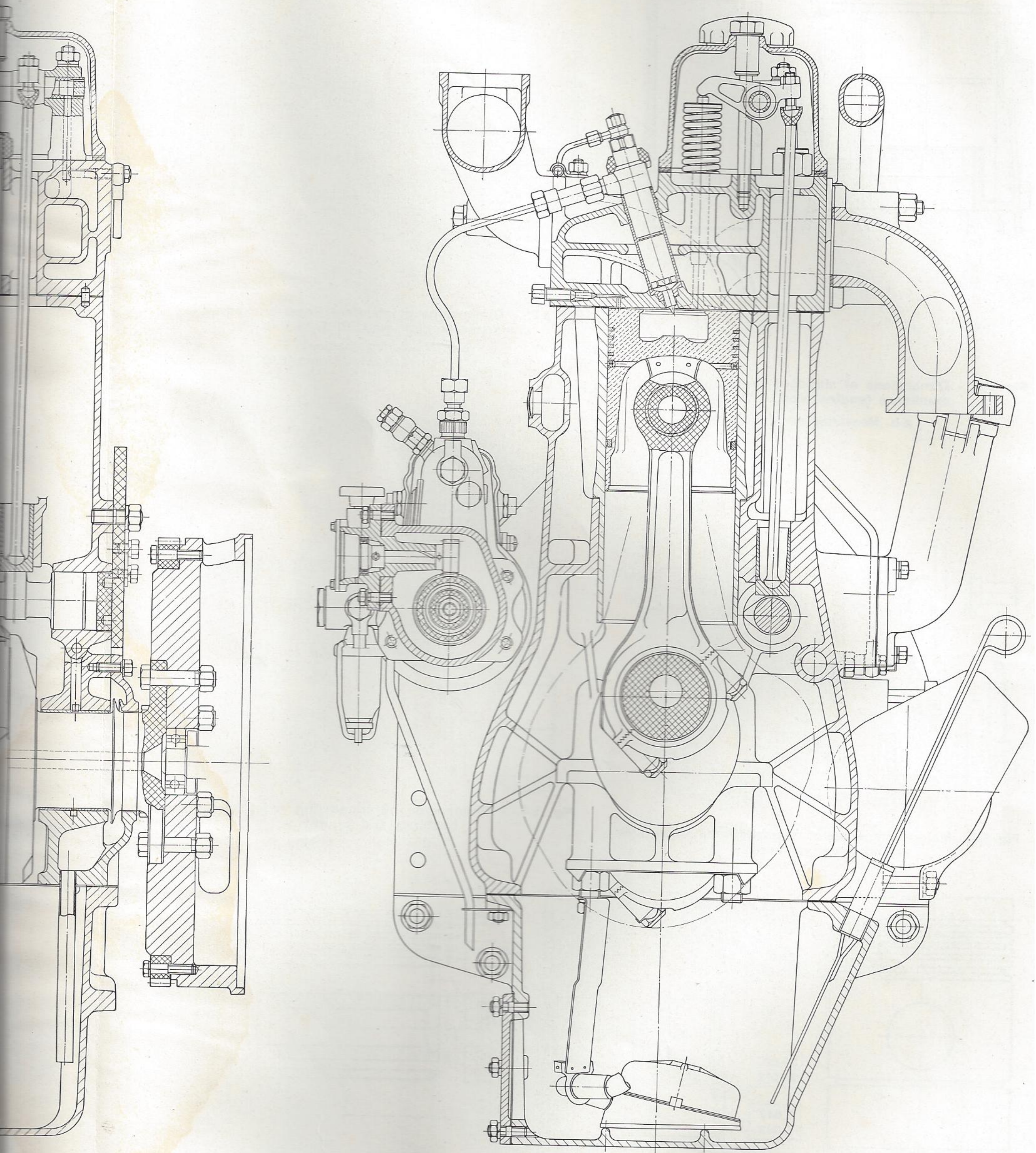


Fig. 5. - Cross section of engine.

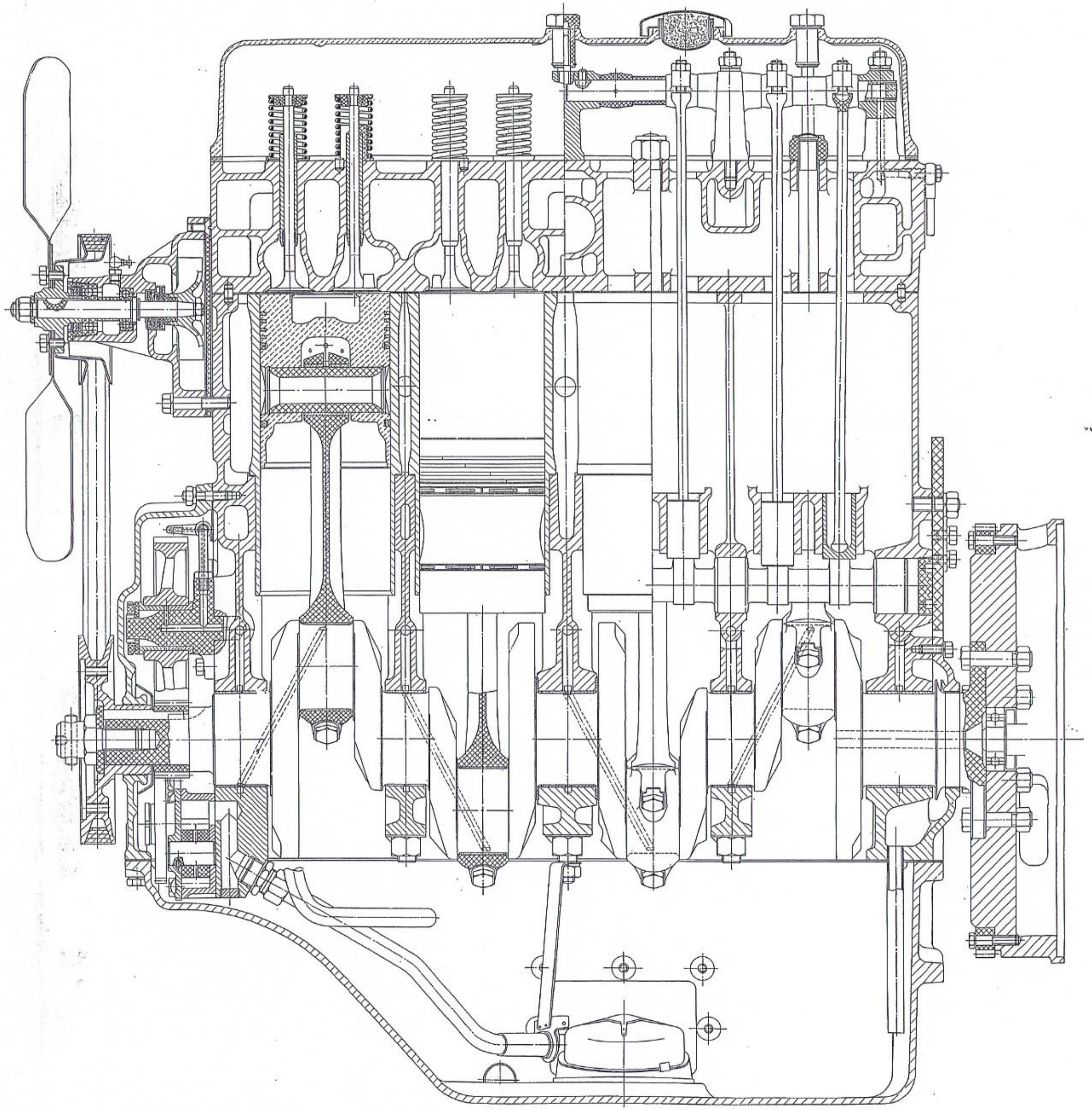


Fig. 4. - Longitudinal section of engine.

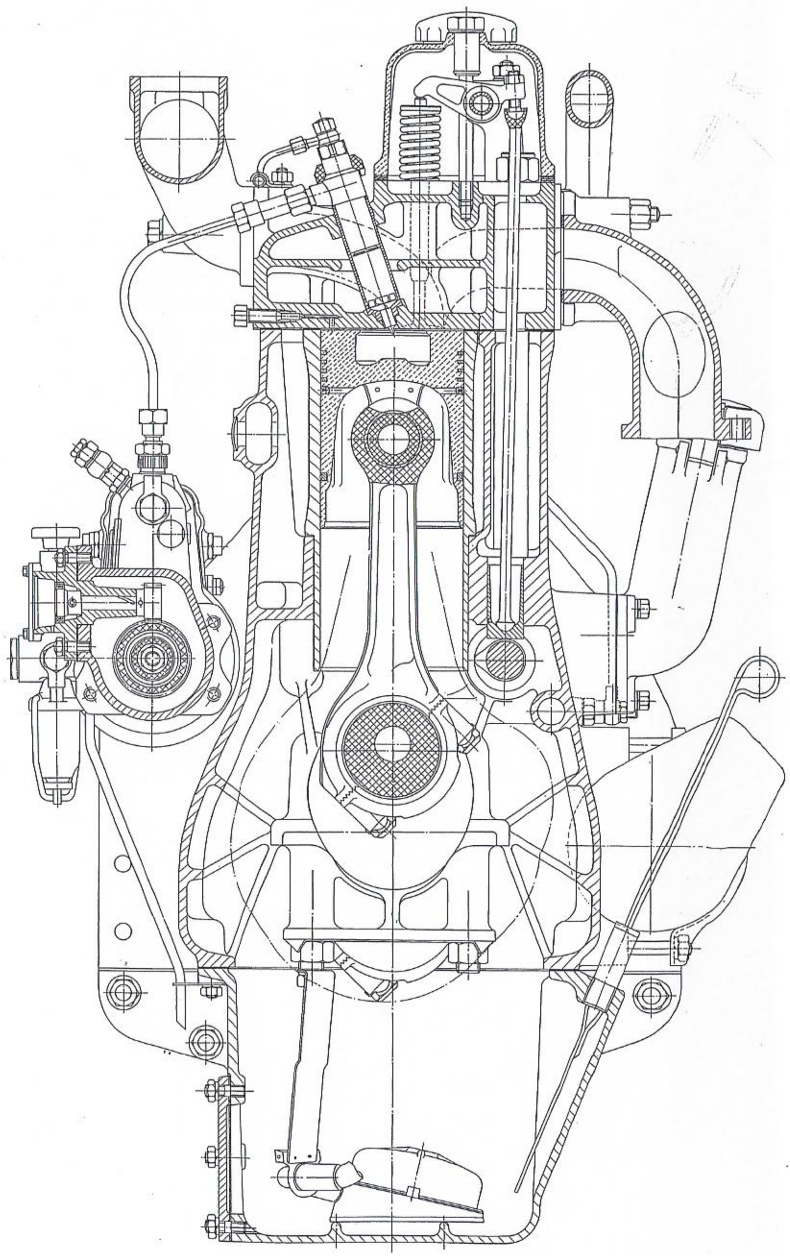


Fig. 5. - Cross section of engine.

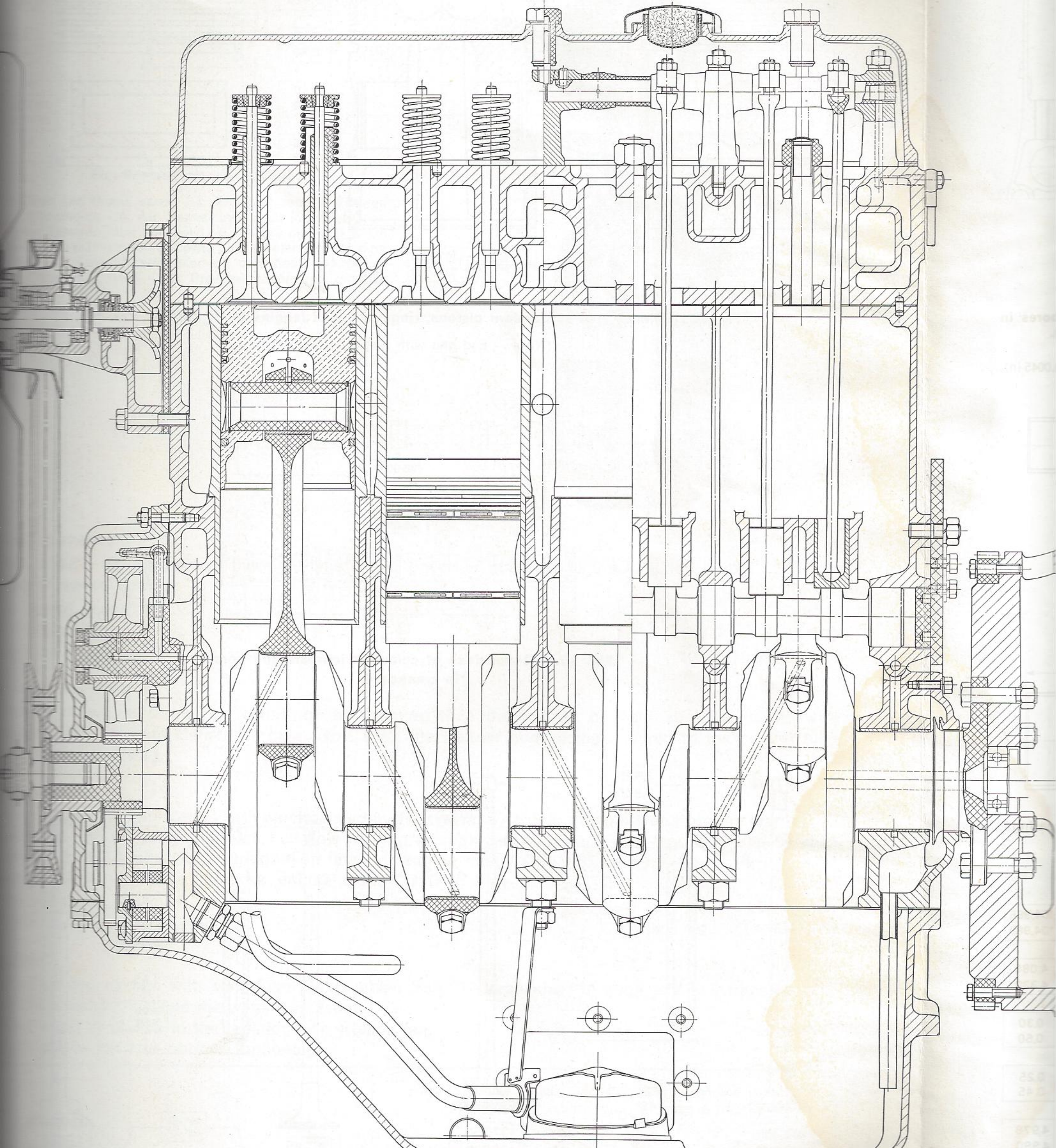


Fig. 4. - Longitudinal section of engine.

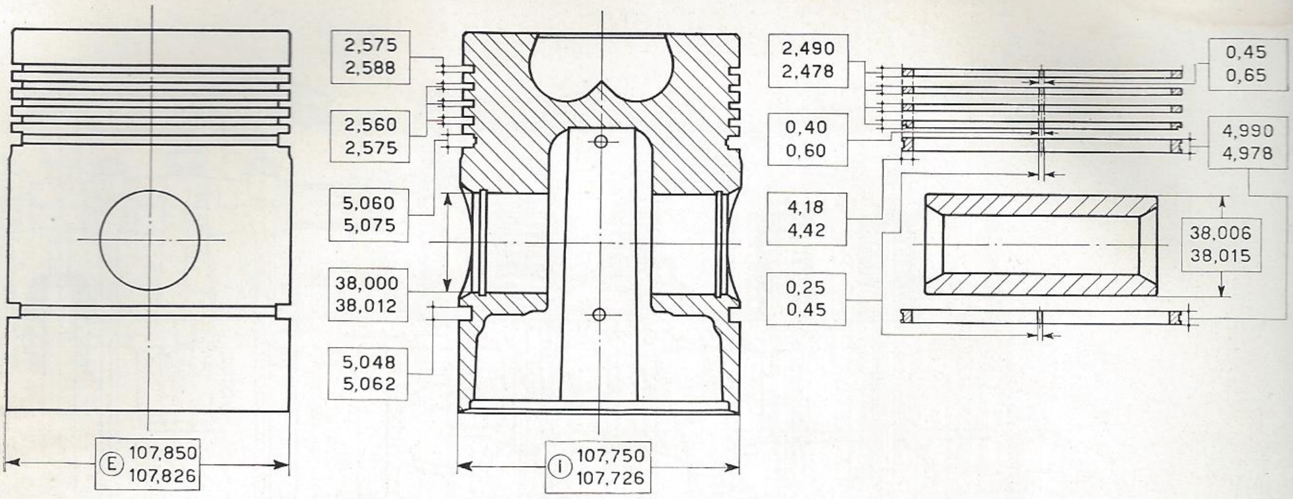


Fig. 5/6. - Dimensions of standard pistons, rings and pins (engine mod. C02D/60 Var. 10).

(**Note.** - End gap with rings in position).

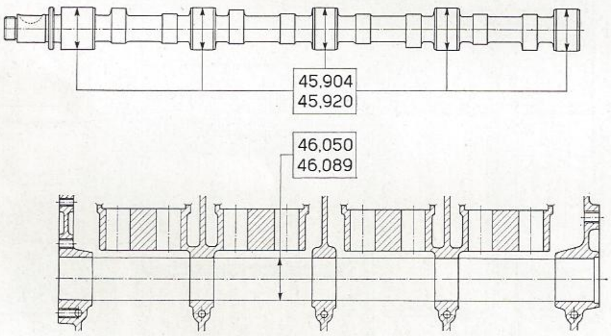
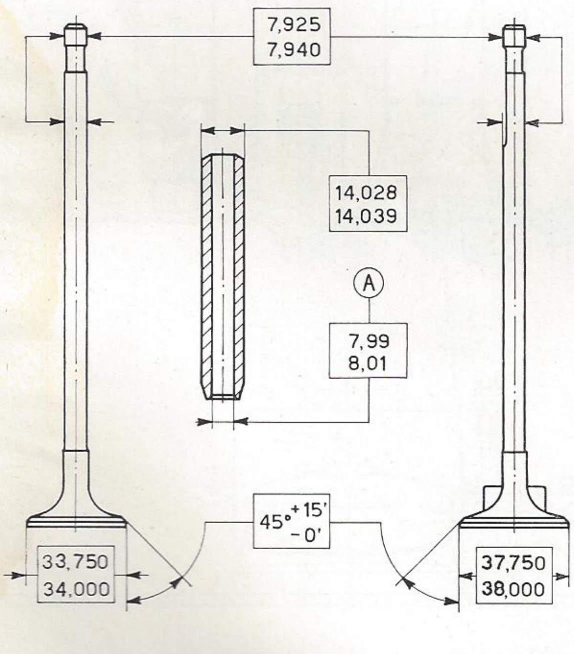


Fig. 5/7. - Dimensions of camshaft journals and bores in crankcase.



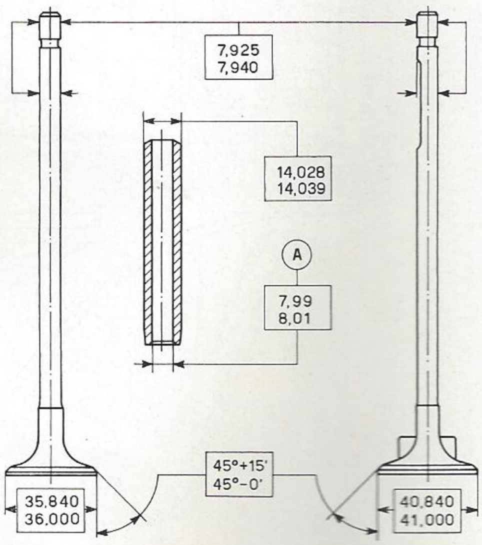


Fig. 5/8. - Standard dimensions of valves and guides (engine mod. C01D/55).

Fig. 5/9. - Standard dimensions of valves and guides (engine mod. C02D/60 Var. 10).

A. After reaming, with valve guides in position.

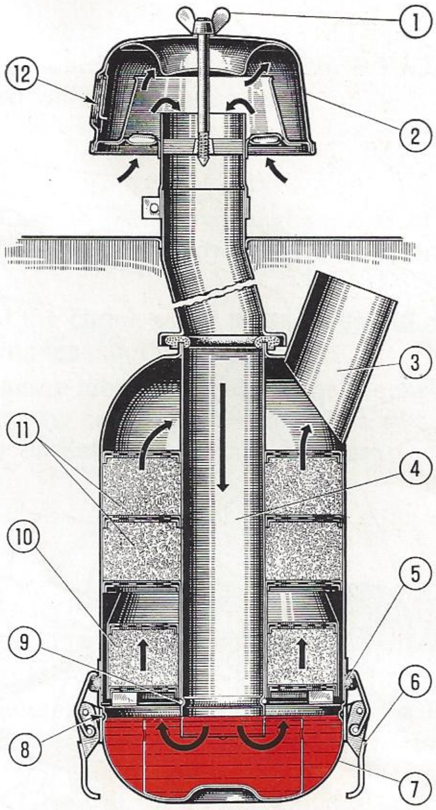


Fig. 6. - Air cleaner section.

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.** Toggle clamps - **7.** Oil bowl - **8.** Oil level fill mark - **9.** Lower filtering element retaining snap ring - **10.** Lower filtering element, detachable - **11.** Upper filtering elements, fixed - **12.** Pre-filter inspection window.

Speed governor.

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

Governor speed setting: R.P.M.

— Rated speed 1750
— High idle 1870
— Low idle . . . . 580 to 620

Air intake.

Air is drawn in through a centrifuge pre-cleaner, then through an oil bath air cleaner with wire elements. The bottom element is detachable from the cleaner body being secured to the central tube with a snap wire ring.

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 for engine model CO1D/55, and full flow cartridge filter equipped with a by-pass valve for engine mod. CO2D/60 Var. 10.

— Oil pressure relief valve setting . . . . 49.8 p.s.i. (3,5 Kg/cm^2)
— Filter by-pass valve setting . . . . 14.2 p.s.i. (1 Kg/cm^2)

Cooling.

Pressurized system with centrifuge 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).

	Up to engine serial No. 807910	From engine serial No. 807911 up
Thermostat;		
Opening temperature	158°-167° F (70°-75° C)	176°-185° F (80°-85° C)
Fully open temperature	180°-188° F (82°-87° C)	198°-206° F (92°-97° C)
Thermostat max. opening	0.394-0.433 in (10-11 mm)	0.394-0.433 in (10-11 mm)

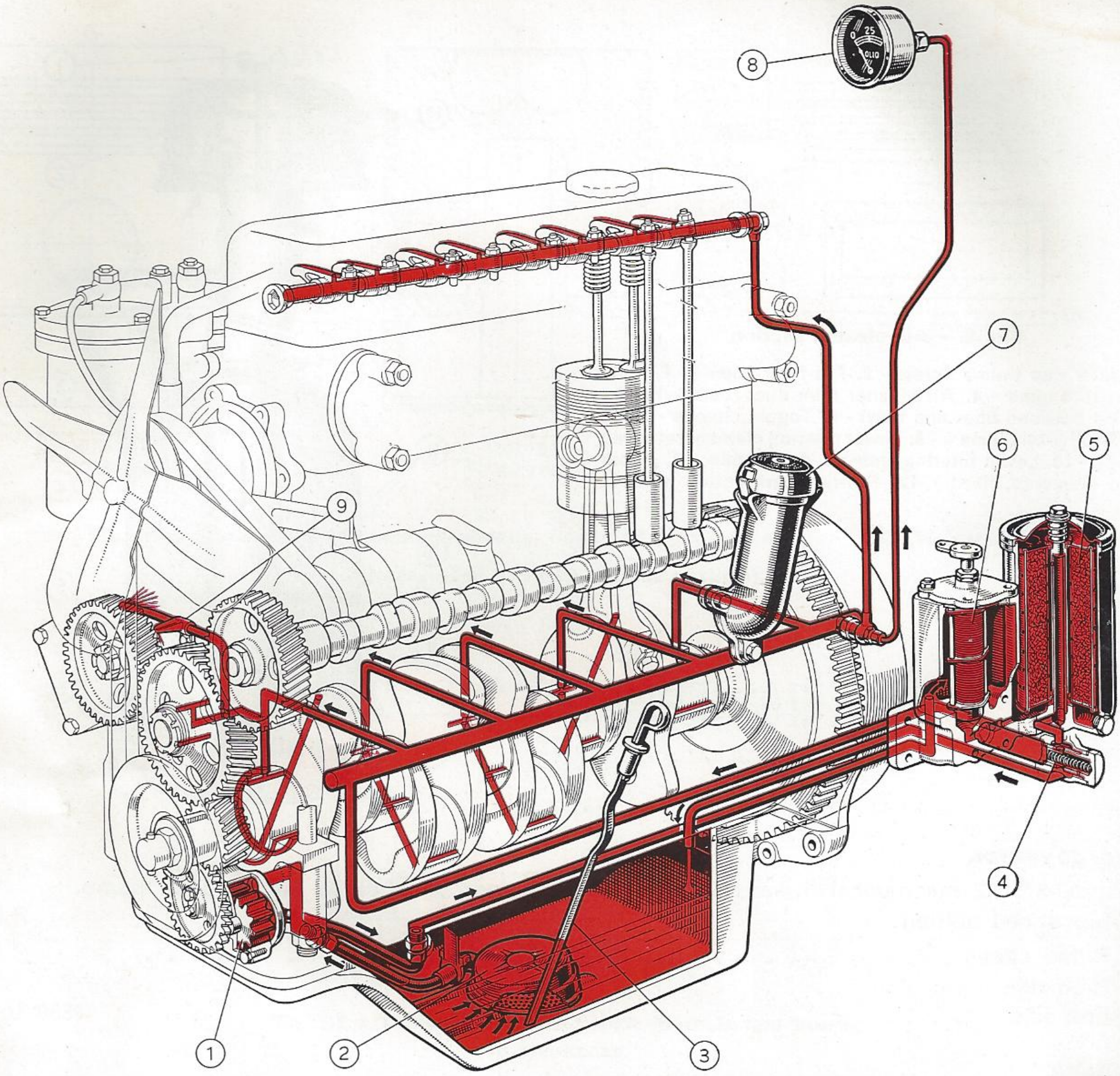


Fig. 7. - Layout of engine lubrication (engine mod. C01D/55).

1. Oil gear pump - **2.** Gauze filter on oil pump suction intake - **3.** Oil level dipstick - **4.** Oil pressure relief valve - **5.** By-pass oil filter with detachable cartridge - **6.** Full flow blade filter (self-cleaning) - **7.** Oil filter cap - **8.** Oil pressure gauge - **9.** Gears lub line.

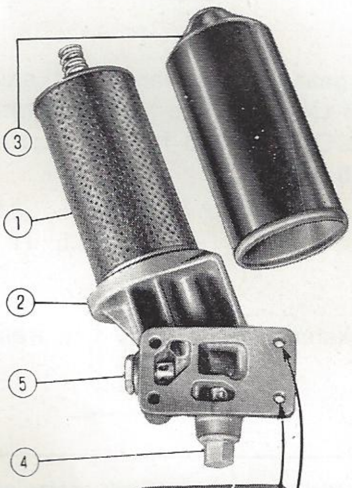


Fig. 7a. - Exploded view of full flow oil filter with detachable cartridge and by-pass valve (engine mod. C02D/60 Var. 10).

1. Detachable cartridge filter - **2.** Header - **3.** Cap - **4.** Oil pressure relief valve - **5.** By-pass valve - **6.** Gasket.

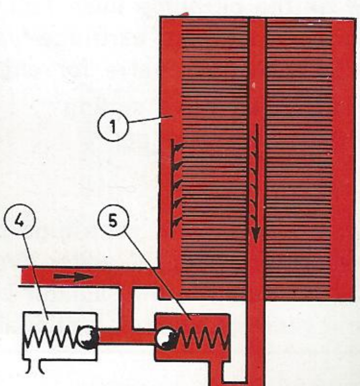


Fig. 7b. - Oil flow diagram in filter (engine mod. C02D/60 Var. 10).

1. Full flow oil filter with detachable cartridge - **4.** Oil pressure relief valve - **5.** By-pass valve.

TRANSMISSION UNITS

The tractor chassis includes two cast iron casings 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 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 which are given in the table that follows refer to tractors equipped with engine model CO1D/55; to obtain the corresponding speeds for the tractors equipped with model CO2D/60 engines, add 0.2 %.

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 parking hand-lever secures the locking of the brake pedals when tractor is stationary (Fig. 45).

Drive wheels.

Steel plate discs and W 13-28 rims fitted with 14.9/13-28 tyres (up to chassis serial no. 114389) and rims W 13-30 for mounting 14.9/13-30 tyres (starting from chassis serial no. 114390 up). 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, two outside and one inside.

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 on 3.62 rims (up to tractor serial no. 114389) and 6.50-20 tyres on rims 5.00F (starting from serial no. 114390 up).

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 control box comprising 3 different units and separate from the generator.

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

1 Marelli MT 43 D, 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 (10 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.

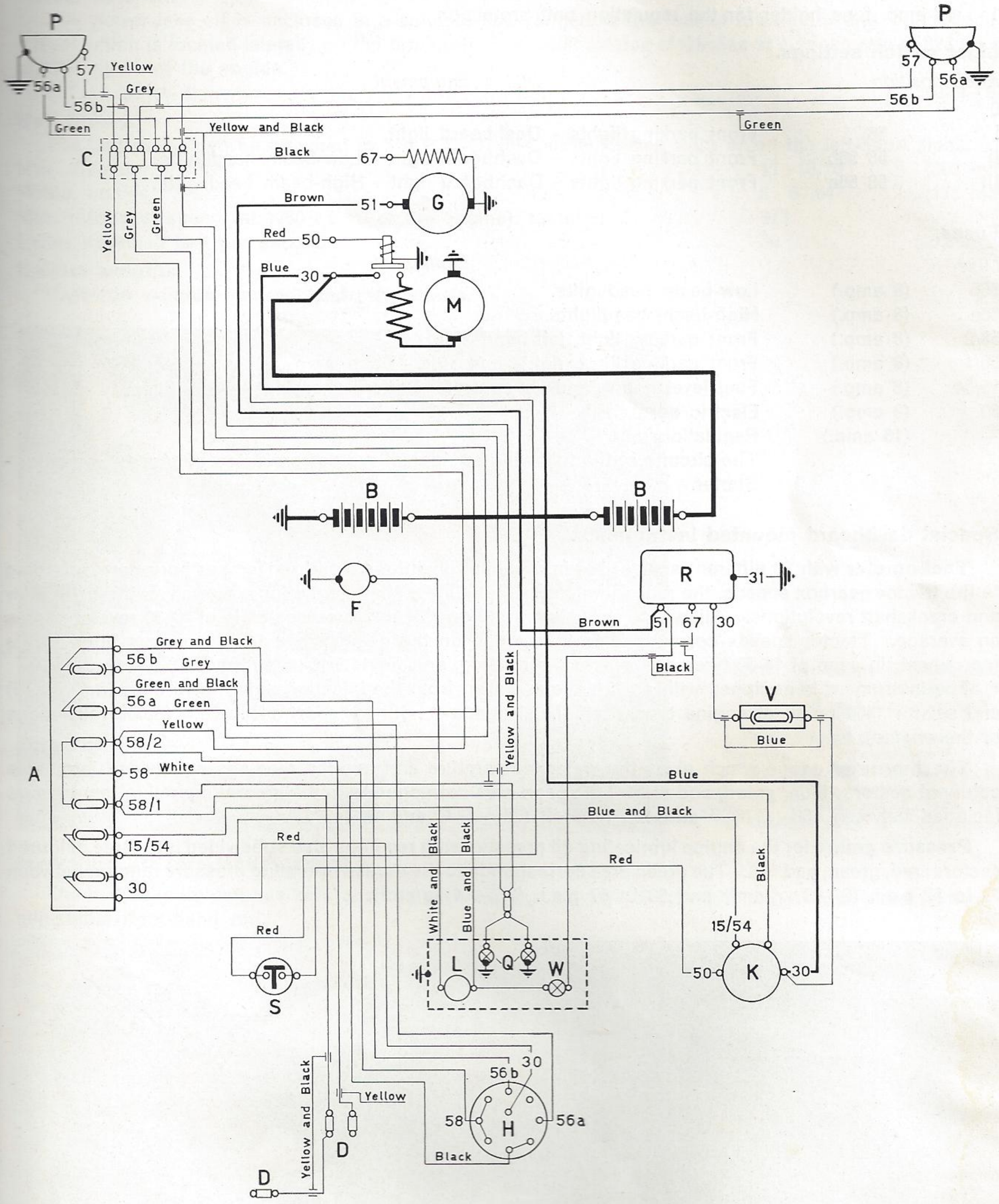


Fig. 8. - Wiring diagram.

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 - Dash lamp.
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 $\pm$ 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 (Fig. 5) 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 158 $\pm$ 176° F and 198 $\pm$ 208° F (75 $\pm$ 5° C and 95 $\pm$ 3° C).

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 p.s.i. (2 $\div$ 3 kg/cm²) and 53 to 57 p.s.i. (3,7 $\div$ 4 kg/cm²).

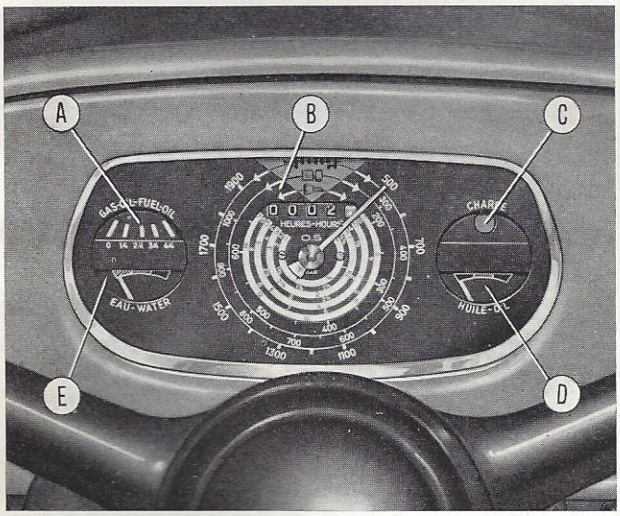


Fig. 9. - Dashboard instruments view.

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

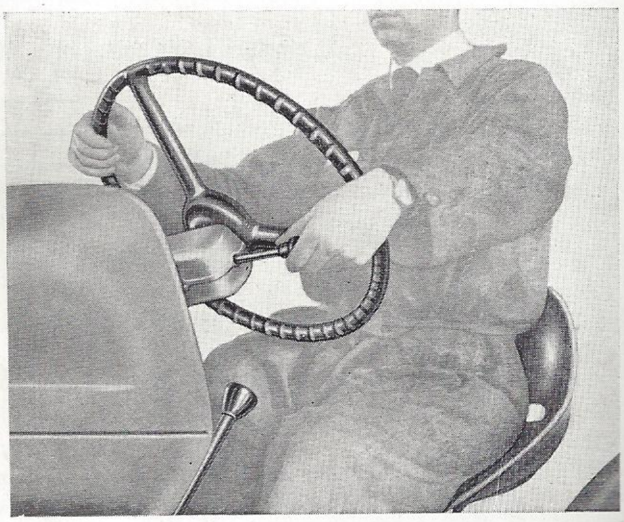


Fig. 10. - Operating the light-switch and electric horn.

ATTACHMENTS

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.)

Ballast weights.

Cast-iron weights for front and rear wheels.

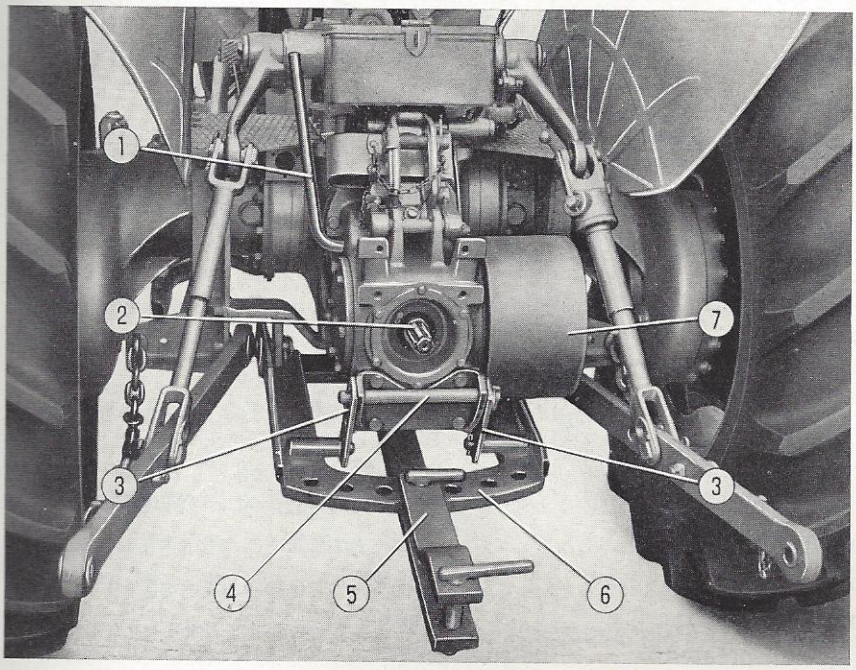


Fig. 11. - Attachments (power take-off, belt pulley, and hydraulic lift equipped with 3-point hitch).

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.

Hydraulic lift (pre-modification).

The hydraulic lift unit has both position and draft control and is equipped with a three-point hitch with adjustable right-hand rod.

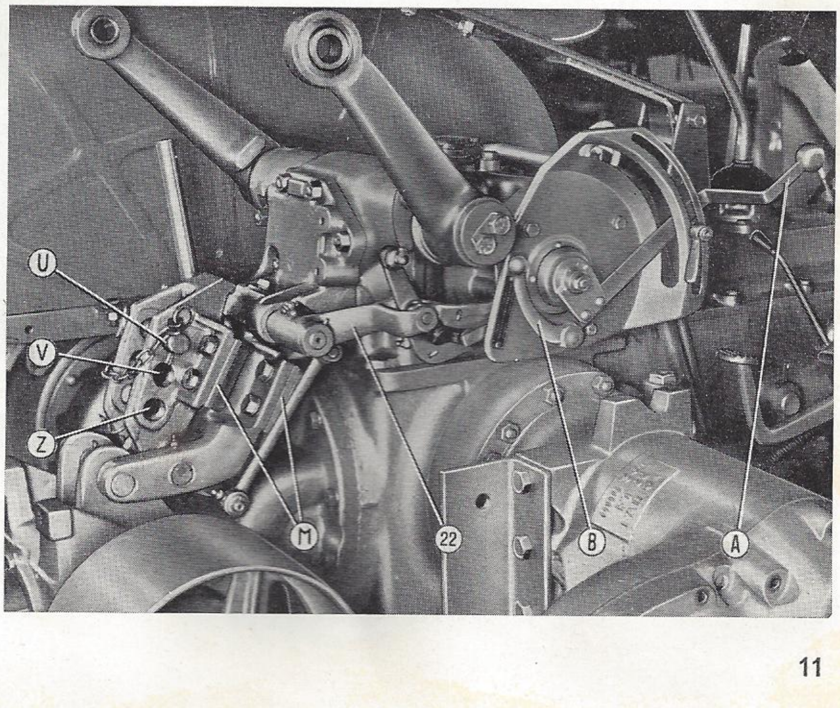


Fig. 12. - Hydraulic lift mounted on tractor (pre-modification).

A. Control lever - **B.** Selector lever - **M.** Reaction spring - **U.V.Z.** Top link mounting holes - **22.** Fork lever.

Hydraulic gear pump (Plessey licence), FIAT model		A 25X	
Ratio between pump and engine r.p.m.		1.235	
Pump speed (at 1750 r.p.m. of the engine), r.p.m.		2.160	
Pump output (Imp.gal/1′)	at no-pressure	5.28	(24 liters/1′)
	at 1849 p.s.i. pressure (130 Kg/cm²)	4.40	(20 liters/1′)
Pressure relief valve setting	up to lift serial n. 04613, p.s.i.	1778-1920	(130 ± 5 Kg/cm²)
	from lift serial n. 04614 up, p.s.i.	2062-2205	(150 ± 5 Kg/cm²)
Cylinder bore, inches		3.74	(95 mm)
Displacement, cu.in.		46.68	(765 cm³)
Lift range, inches	in normal position	28.35	(720 mm)
	in rear position	25.20	(640 mm)
Min. ground clearance in normal position, inches		7,87	(200 mm)
Maximum load lifted, lbs	up to lift serial no. 04613	2535-2866 (1)	(1150-1300 Kg)
	starting from lift serial no. 04614 up	2866-3527 (1)	(1300-1600 Kg)
Lifting effective capacity, ft.lb	up to lift serial no. 04613	6003	(830 Kgm)
	starting from serial no. 04614 up	6799-7378	(940-1020 Kgm)
Lifting time with engine running at rated speed, sec.		3	
Weight of hydraulic lift with pump and oil lines (dry), lbs		220	(100 Kg)

(1) The two data refer, respectively, to the lift rods pivoted to lower links either at front (normal position) or rear holes (a and b, fig. 12/2).

Hydraulic lift (reinforced model).

Starting from serial no.		09001 up	
Hydraulic circuit capacity, Imp.gal.		1.98	(9 lit.)
Oil grade	amb. temp. above 32° F (0° C)	SAE 20 hydr. oil	(FIAT AP 50)
	amb. temp. below 32° F	SAE 10 hydr. oil	(FIAT AP 30/I)
Gear-type pump (Plessey licence) model		FIAT A 25X	
Ratio between engine and pump r.p.m.		1 : 1.235	
Pump r.p.m. (with engine running at 1750 r.p.m.)		2160	
Pump output (oil viscos. SAE 20 and 158° F = 70° C) Imp. gal/1′	at no-pressure	5.28	(24 l/1′)
	at 2134 p.s.i. (150 Kg/cm²)	4.40	(20 l/1′)

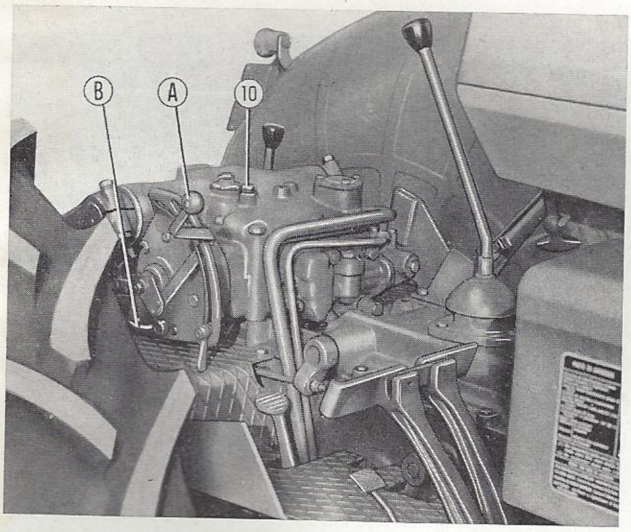


Fig. 12/1. - Front view of reinforced lift installed on tractor.

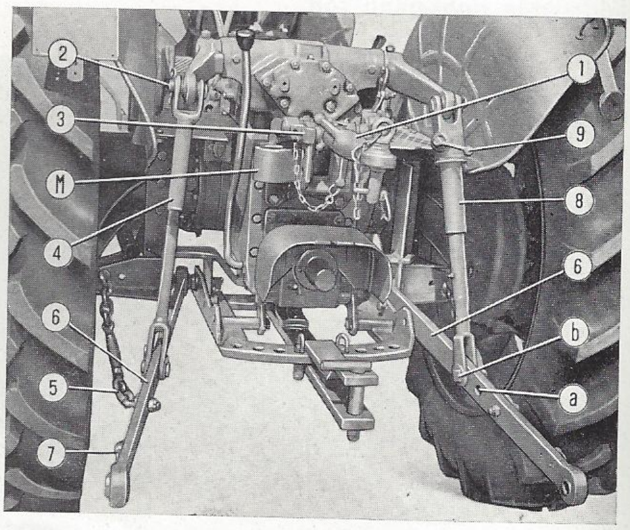


Fig. 12/2. - Rear view of reinforced lift and three point hitch.

A. Lift control lever - B. Selector lever (« down » position for depth control) - a. Rods rear mounting holes - b. Rods front mounting holes - M. Control spring - 1. Adjustable top link - 2. Pivot pin - 3. Top link mounting pin - 4. Left-hand rod - 5. Check chain - 6. Lower links - 7. Linch pin - 8. Right-hand rod - 9. Levelling lever - 10. Link lift range adjuster.

Pressure relief valve setting, p.s.i. (1, Fig. 54/1)	2134	(150 Kg/cm²)
Cylinder pressure relief valve setting, p.s.i. (3, Fig. 54/1)	2845	(200 Kg/cm²)
Lift cylinder bore, in.	3.74	(95 mm)
Displacement, cu.in. — up to serial no. 10615	58	(950 cm³)
Displacement, cu.in. — from serial no. 10616 up	59.2	(970 cm³)
Lift range (in.) with rods pivoted to links at — holes a), Fig. 12/2	25.20	(640 mm)
Lift range (in.) with rods pivoted to links at — holes b), Fig. 12/2	28.35	(720 mm)
Max. load lifted (lb.) with rods pivoted to links at — holes a), Fig. 12/2	4409	(2000 Kg)
Max. load lifted (lb.) with rods pivoted to links at — holes b), Fig. 12/2	3968	(1800 Kg)
Nominal lifting capacity (ft-lb) — up to serial no. 10615	10,307	(1425 Kgm)
Nominal lifting capacity (ft-lb) — starting from serial no. 10616 up	10,524	(1455 Kgm)
Effective lifting capacity (ft-lb) with rods pivoted to links at — holes a), Fig. 12/2	9259	(1280 Kgm)
Effective lifting capacity (ft-lb) with rods pivoted to links at — holes b), Fig. 12/2	9403	(1300 Kgm)
Lifting time (with engine running at 1750 r.p.m.), sec.	2.5 approx.	

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 — without brakes	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 and fuel consumption.

Engine model	CO1D/55	CO2D/60 Var. 10
Belt-pulley horse-power	52	55
Drawbar horse-power:		
— on concrete	44	46.5
— on farmland with low wheelslip	38	40

Hourly fuel consumption in operation, lb. . . . 9.9 (4.5 kg)

LUBRICATION AND CAPACITIES CHART

ITEM	Inspect. interval (hrs.)	Change interval (hrs.)	LUBRICANTS — GRADE: FIAT	LUBRICANTS — GRADE: International	LUBRICANTS — QUANTITY: Metric units (kg)	LUBRICANTS — QUANTITY: Imperial units
Engine: sump (only)	10	150-300	AGER HD or AGERTER 10W-20W 30-40 (1)	SAE HD or HD/3 10W-20W-30-40 (1)	8	7-3/4 Qts.
Engine: sump, filters and oil lines	—	—			11	10 1/2 Qts.
Injection pump, governor	150	—			0.15	1/4 Pt.
Air cleaner	10	150			1	1 Qt.
P.T.-O. drive gear box (intermediate casing)	150	1200	A 90	SAE 90 gear oil	5	4-3/4 Qts.
Gearbox	150	1200			17	4 Gal.
Steering gear box	150	—			0.3	3/5 Pt.
Final drives (each)	150	1200	A 140 (2)	SAE 140 gear oil	2	3-3/4 Pts.
P.T.-O box and drive pulley	150	1200			3.5	6-3/4 Pts.
Front wheel hubs	30	—	G 9 grease	Chassis grease	—	—
Grease fittings	20	—			—	—
Hydraulic lift: pre-modific.	150	1200	AP 50 (3)	SAE 20 hydraulic oil	5.2	5 Qts.
Hydraulic lift: reinforced	150	1200			9	81/2 Qts.
Generator: bearing	1200	—	MR3 grease	High - melting - point grease	—	—
Generator: commutator end bushing wick	300	—	Engine oil drops	—	—	—
Starter (pinion end bushing)	1200	—			—	—

Capacities:

Cooling water . . . . 17.5 liters (15 Qts.)

Fuel tank . . . . 90 liters (20 Gal.)

(1) Ambient temperature and oil viscosity equivalents: **10 W**: —25° to —15° C (—13° to 5° F); **20 W**: —15° to 0° C (5° to 32° F); **30**: 0° to 35° C (32 to 95° F); **40**: above 35° C (95° F).

Note. - The interval of oil change can be increased to 300 hrs. by using FIAT AGERTER (SAE HD/3) class oils. Change filter cartridge after every 300 hrs. in both cases.

(2) Use FIAT A 90 (SAE 90) gear oil for prevailing temperature below —10° C (14° F).

(3) Use FIAT AP 30/I (SAE 10) hydraulic oil for prevailing temperature below 0° C (32° F).

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 10° from T.D.C. (Fig. 14), respectively, equal to a linear distance of 1.260 in. (32 mm) measured on the flywheel rim surface;
— check tappet gap (0.010 in. - 0,25 mm) at cylinder No. 1 and then at cylinders No. 3-4-2 by rotating the crankshaft 180° each time.

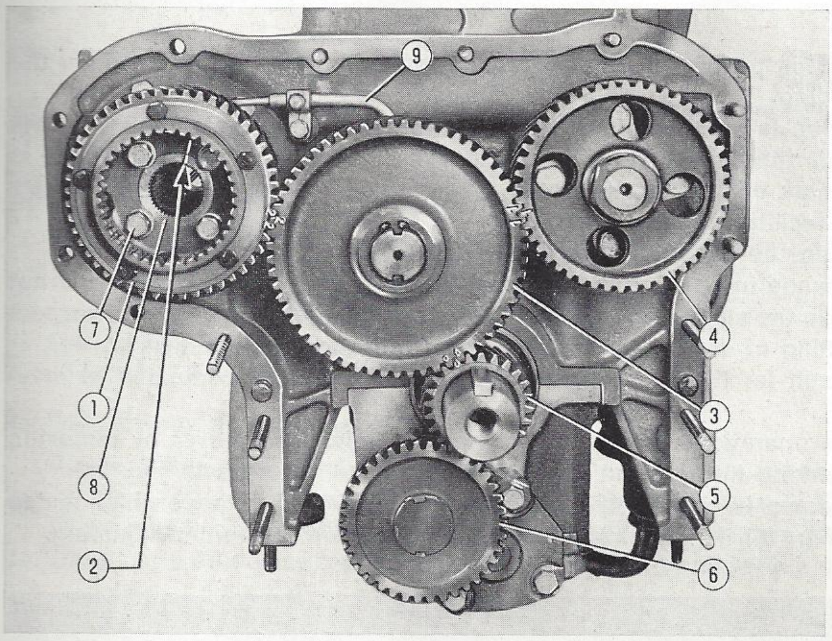


Fig. 13. - Wheelcase gears and timing marks.

1. Injection pump drive gear - **2.** Reference marks for gear (1) location on shaft (8) - **3.** Idler - **4.** Camshaft gear - **5.** Crankshaft gear - **6.** Oil pump drive gear - **7.** Pump drive gear mounting capscrews - **8.** Pump drive hollow shaft - **9.** Gear lub line.

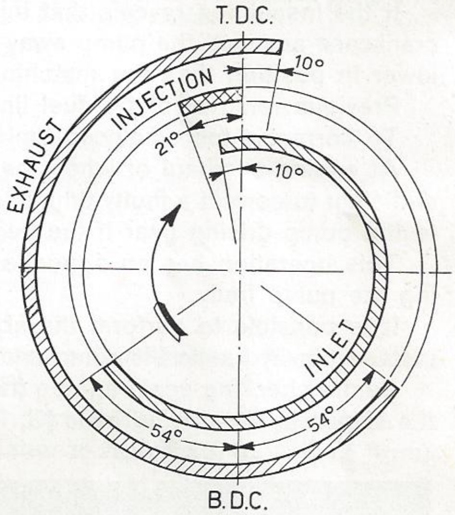


Fig. 14. - Engine timing diagram.

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;
— start the toothed bushing onto the coupling sleeve 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;
— fit the fuel lines, then prime the lift pump manually and bleed the system through the vent (19, Fig. 16) screwed on the pump and the two located on the fuel filters.

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

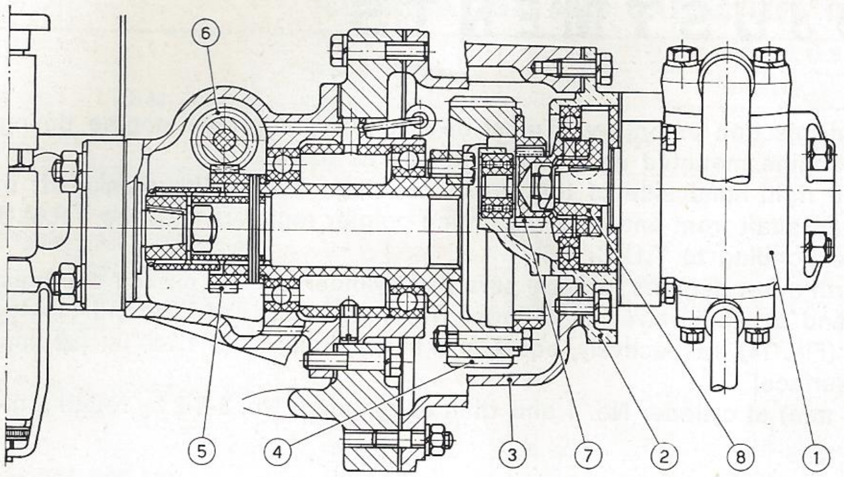


Fig. 15. - Section through the injection pump drive (new version starting from engine CO2D/60 Var. 10 serial no. 815013 up).

1. Pump - **2.** Support - **3.** Timing front cover - **4.** Injection and lift pump drive gear - **5.** and **6.** Chronotachometer drive gears - **7** and **8.** Lift pump drive pinion and coupling.

stroke starts $21^\circ \pm 1^\circ$ 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 (8, 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.

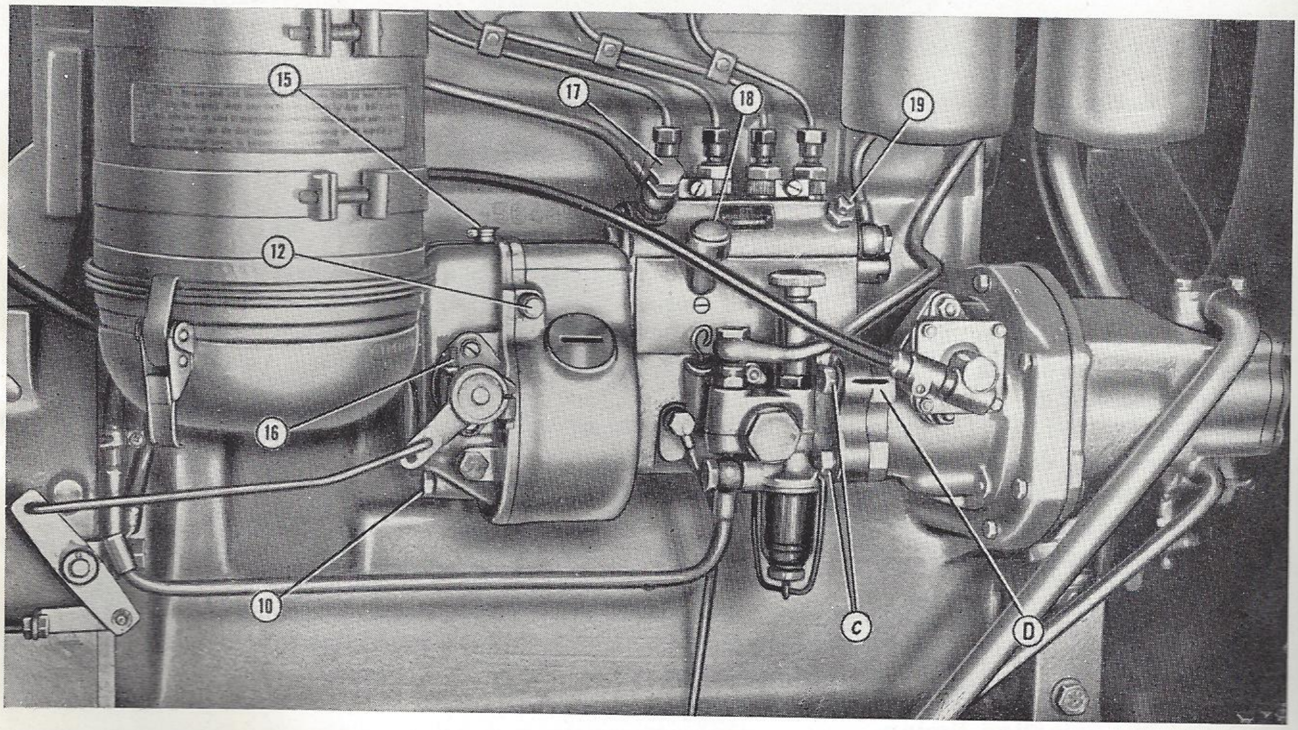


Fig. 16. - View of the injection pump installed on tractor.

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.

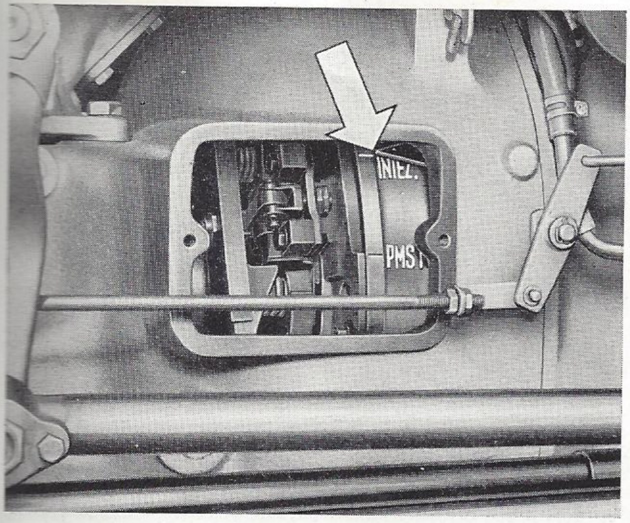


Fig. 17. - Reference mark on flywheel indicating injection advance (21° before T.D.C.).

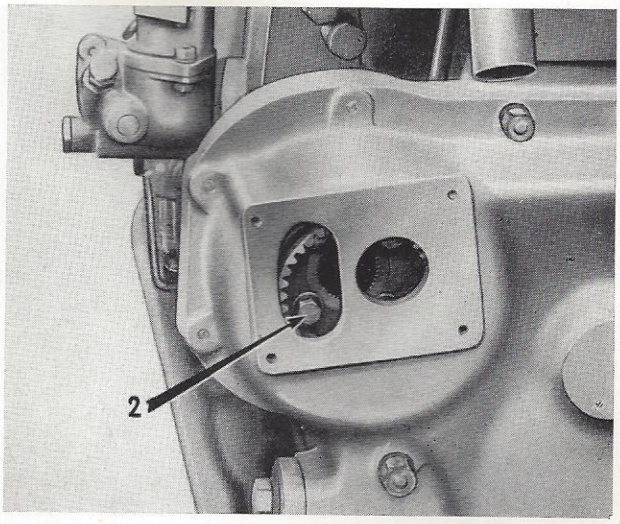


Fig. 18. - Timing the injection pump to the engine through the openings in the timing gear cover.

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 and torque the latter to 25.3-32.5 ft-lb. (3.5-4.5 Kgm).

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 (0-600 atm., approx.).

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:

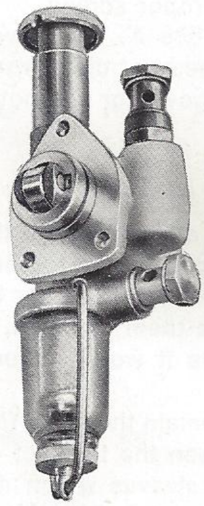


Fig. 19. - The fuel pump.

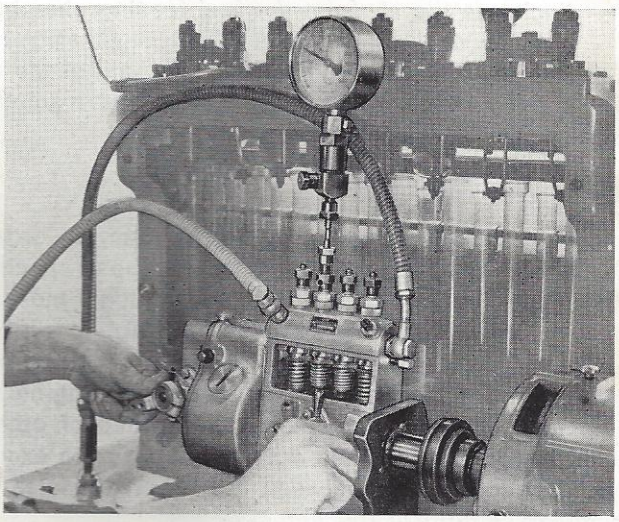


Fig. 20. - Checking the plungers sealing when the control rod is in the position of maximum fuel delivery.

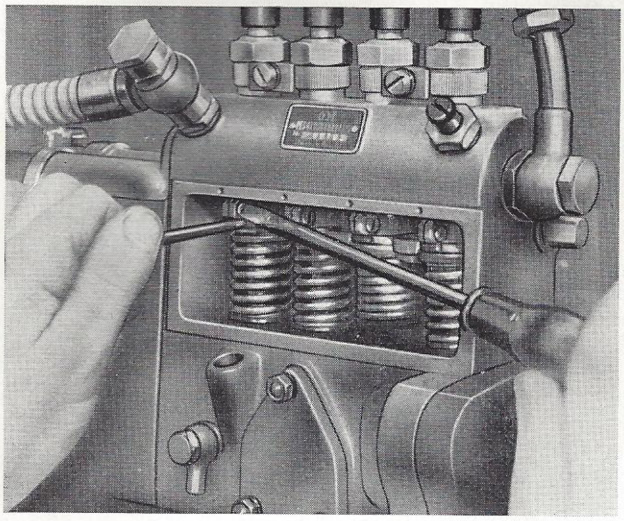


Fig. 21. - Regulating the position of the plunger by acting on the toothed sleeve coupling.

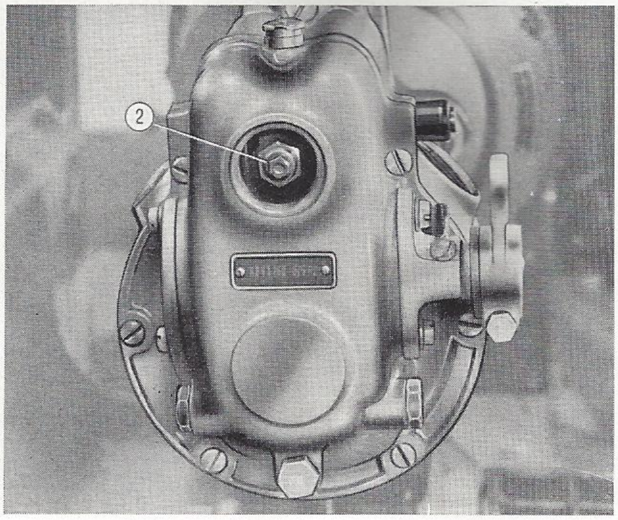


Fig. 22. - Control rod travel adjusting screw (2).

— 4978-5689 p.s.i. (350-400 Kg/cm²), with control rack at its maximum fuel delivery setting;
— 3911-4623 p.s.i. (275-325 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 3129 p.s.i. (220 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 19 for engine models CO1D/55 and CO2D/60 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).

INJECTION PUMP CALIBRATION DATA

The regulation of either 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).

Direction of pump rotation: clockwise - Firing order: 1-3-4-2.
Stroke of injection pump plungers, from B.D.C. to beginning of injection: .085″ to .088″ (2,15 to 2,25 mm).
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. (corresponding to 2.638 in = 67 mm linear distance measured on the flywheel).
Specific gravity of Diesel fuel: .082 to .084 (830 ± 10 gram/liter) at a temperature of 62.6 to 73° F (20 ± 3° C).

Injection unit type PES 4A 85B 410 : L4/27 (fitted to engine mod. CO1D/55).

Governor control lever setting	Pump r.p.m.	Rack opening mm	TEST A		TEST B	
			Delivery per element	Total pump delivery	Delivery per element	Total pump delivery
			c.c. per 1000 strokes		c.c. per 1000 strokes	
Minimum	250 + 0 / − 10	8 ± 0.5	10 ± 1	—	10 ± 1	—
Maximum	875 — 10 (1) / + 0	12 ± 0.1	69 ± 2	276 ± 3 (2)	62 ± 2	248 ± 3 (2)
Max (excluding control rod stop)	200	—	greater than 140	—	greater than 140	—

(1) Governor commencing to cut fuel at 875 $^{-00}_{+10}$ r.p.m.
(2) Set rack stop.

Injection unit type PES 4A 85B 410 : L4/32 (fitted to engine mod. CO2D/60 Var. 10).

Governor control lever setting	Pump r.p.m.	Rack opening mm	TEST A		TEST B	
			Delivery per element	Total pump delivery	Delivery per element	Total pump delivery
			c.c. per 1000 strokes		c.c. per 1000 strokes	
Minimum	250 + 0 / − 10	8 ± 0.5	10 ± 1	—	10 ± 1	—
Maximum	875 — 10 (1) / + 0	12 ± 0.1	73 ± 2	292 ± 3 (2)	63 ± 2	252 ± 3 (2)
Max (excluding control rod stop)	200	—	greater than 140	—	greater than 140	—

(1) Governor commencing to cut fuel at 875 $^{-0}_{+10}$ r.p.m.
(2) Set rack stop.

Table of injection system data.

DESCRIPTION		Data
Lift pump output (delivery pressure 17 to 21.3 p.s.i. = 1.2 to 1.5 kg/cm²)	at 300 r.p.m.	greater than 0.7 Pts./1′ (0.4 l/1′)
	at 1000 r.p.m.	greater than 2.6 Pts./1′ (1.5 l/1′)
Lift pump max. delivery pressure (at 500-600 r.p.m.)		21.3 p.s.i. (1.5 kg/cm²)
Pumping element valve holders, wrench torque		25.3-32.5 ft. lb (3.5-4.5 kgm)
Excess fuel device travel (E, fig. 23)		0.020-0.024 in (0.5-0.6 mm)
Protrusion of flywheight spring spindle (D, fig. 23)		0.098-0.118 in (2.5-3 mm)
Color marking of excess fuel device spindle (F, fig. 23)	C01D/55	red
	C02D60/Var. 10	white
Injector spring	Free length	1.063-1.083 in (27-27.5 mm)
	Give-in from 31.3 to 96.3 lb load (16.1 to 41.8 ± 1.9 kg)	0.032 in (0.8 mm)
Injector clamping nut, wrench torque		14.5 ft. lb (2 kgm)

ENGINE TEST DATA

The following conditions apply to all engine tests for both models CO1D/55 and CO2D/60 Var. 10:
— engine installed in test bed without fan, air cleaner, and muffler;
— ambient temperature 62.6 to 73.4° F (20° ± 3° C);
— pressure 740 ± 5 mm of mercury.

NOTE - The belt performance test requires belt slip values not exceeding 3%. Use an adhesive to increase belt adherence.

Test bed data (CO1D/55).

	Engine r.p.m.	Power output of engine with a total run-in of:		Fuel consumption time for 250 c.c. seconds
		2 hrs. HP.	50 hrs. HP.	
Rated load	1750-1770	≥ 53	≥ 55	≥ 74
Max. torque	1200	≥ 40	≥ 41	≥ 102.5
High idle	≤ 1870	—	—	—
Low idle	580-620	—	—	—

≤ equal or less than.
≥ equal or greather than.

Test bed data (CO1D/60 Var. 10).

	Engine r.p.m.	Power output of engine with a total run-in of:		Fuel consumption time for 250 c.c. seconds
		2 hrs. HP.	50 hrs. HP.	
Rated load	1750-1770	≥ 56	≥ 58	≥ 73
Max. torque	1200	≥ 42,3	≥ 43,5	≥ 98.5
High idle	≤ 1880	—	—	—
Low idle	580-620	—	—	—

Belt performance data (CO1D/55).

	Engine r.p.m.	Belt r.p.m.	Power output of engine with a total run-in of: 2 hrs. HP.	50 hrs. HP.	Fuel consumption time for 250 c.c. seconds
Rated load	1750-1770	973-984	⩾ 48	⩾ 52	⩾ 74
Max torque	1200	670	⩾ 35.5	⩾ 39	⩾ 102.5
High idle	⩽ 1870	⩽ 1040	—	—	—
Low idle	580-620	320-345	—	—	—

Belt performance data (CO2D/60 Var. 10).

	Engine r.p.m.	Belt r.p.m.	Power output of engine with a total run-in of: 2 hrs. HP.	50 hrs. HP.	Fuel consumption time for 250 c.c. seconds
Rated load	1750-1770	973-984	⩾ 51	⩾ 55	⩾ 73
Max torque	1200	670	⩾ 38	⩾ 41.5	⩾ 98.5
High idle	⩽ 1880	⩽ 1040	—	—	—
Low idle	580-620	320-345	—	—	—

THE SPEED GOVERNOR

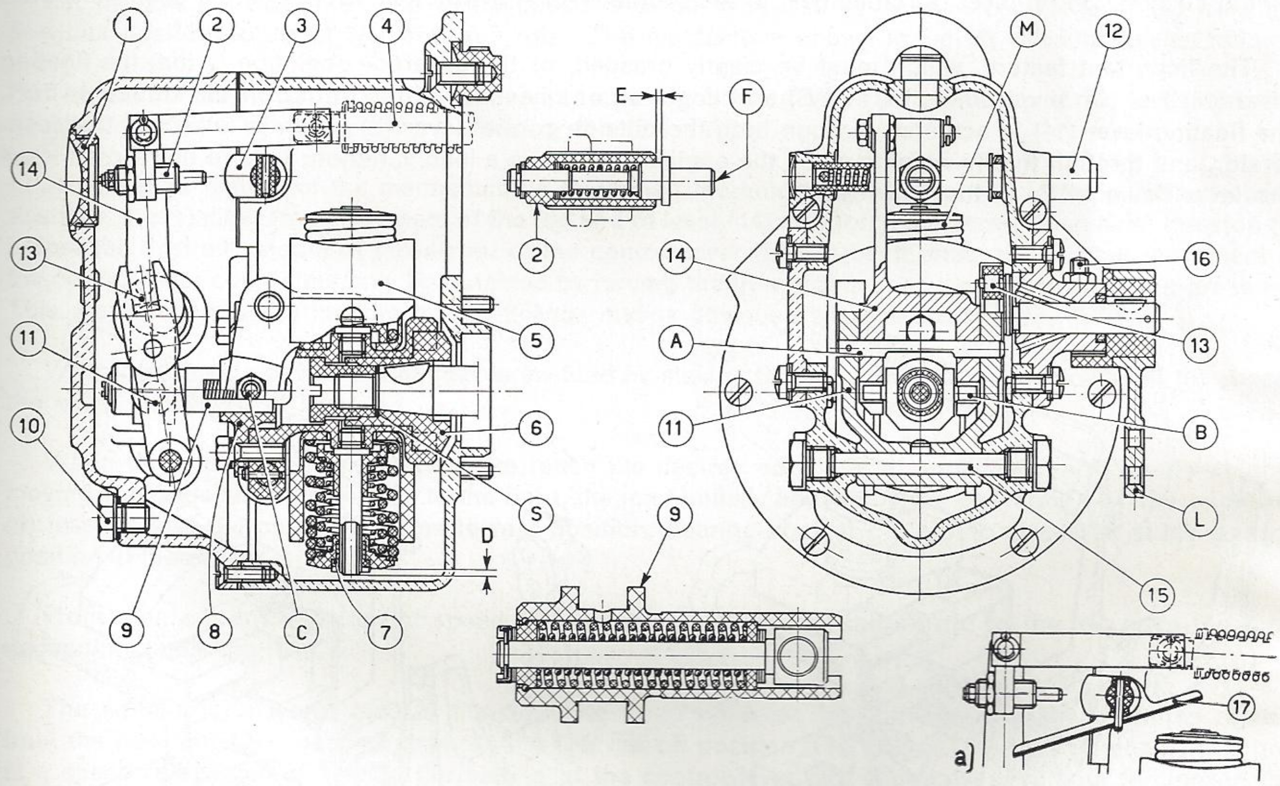


Fig. 23. - Sectional view of speed governor.

A. Cross-pin - **B.** Pivot pin for floating lever (14) - **C.** Flyweight link - **D.** Flyweight spring spindle protrusion (0.098 to 0.118 in = 2.5 to 3 mm) - **E.** Excess fuel device travel (0.024 to 0.028 in = 0.6 to 0.7 mm) - **F.** Paint mark - **L.** Control lever - **M.** Flyweight springs - **S.** Shim - **1.** Control rack travel adjustment access cap - **2.** Max. fuel adjustment screw and excess fuel device - **3.** Control rod stop - **4.** Control rod - **5.** Flyweights - **6.** Vibration damper - **7.** Spring load adjuster - **8.** Equalizer device support - **9.** Equalizer device - **10.** Oil level inspection plug - **11.** Saddle lever - **12.** Cold starting excess fuel control - **13.** Control (L) and saddle (11) lever link - **14.** Floating lever - **15.** Saddle lever (11) cross-shaft - **16.** Max. fuel stop screw.

a) Detail of lubrication oil conveyor (17) fitted starting from pump serial no. 4602 up.

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 drive coupling 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 its position can be regulated 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.

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 and the link pin (C) to the equalizer (9);

— the floating lever (14), linked at one end to the control rod (4), engages at the other end (B) with the equalizer crosshead (9) and pivots on the cross-pin (A);

— the outside control lever (L) connected to the saddle lever (11) which is pivoted on the governor cover.

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

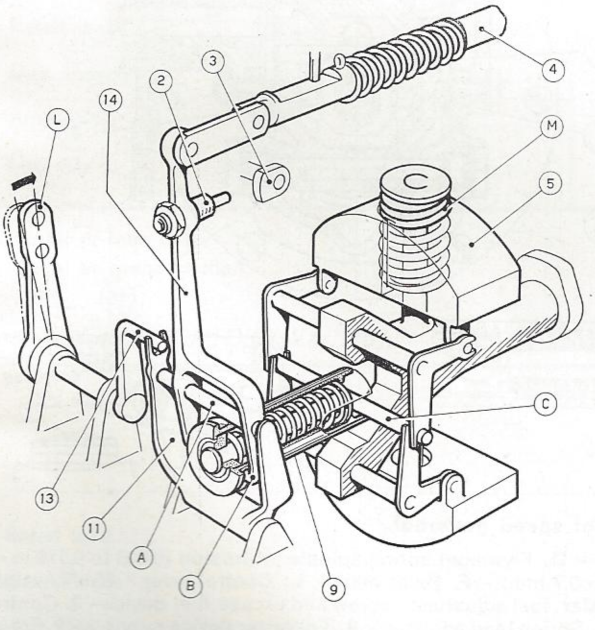


Fig. 24. - Schematic drawing showing operation of speed governor with control lever (L) in 1/4 run position (see fig. 23).

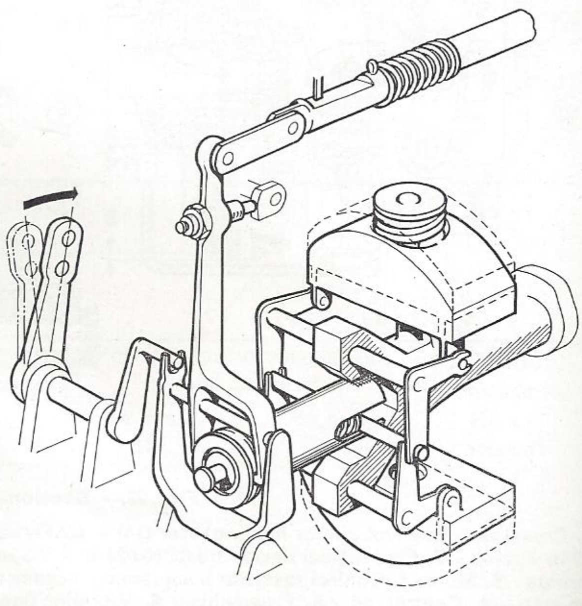


Fig. 25. - Schematic drawing showing operation of speed governor with control lever (L) in 3/4 run position (see fig. 23).

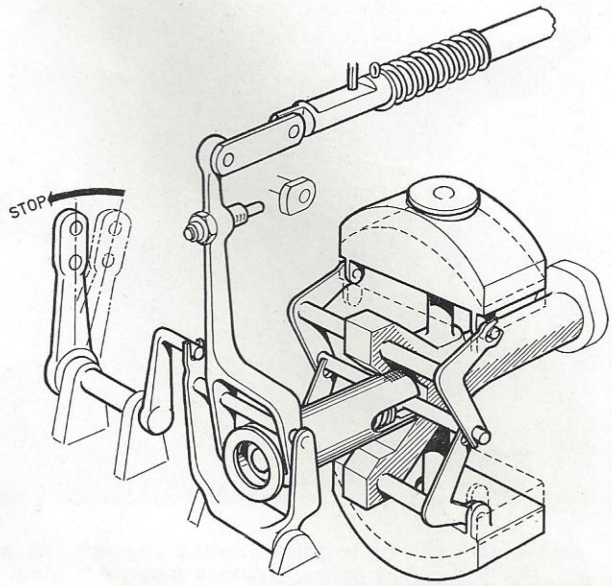


Fig. 26. - Schematic drawing showing operation of speed governor during shifting of control lever (L) from maximum speed to fuel cut-off position (see fig. 23).

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 link (C) to the left if speed decreases and to the right if speed increases. This movement will make the equalizer crosshead (9) move rigidly causing lever (14) to pivot on (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 saddle lever (11) is rotated to the right causing floating lever (14) to swing at (B) and push the 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 link (C) to the right, the load initially applied on the coil spring of the equalizer (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 equalizer (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 link (C) of the fly-weights, the control rod is brought against the stop and the extra-movement is absorbed by the equalizer (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.

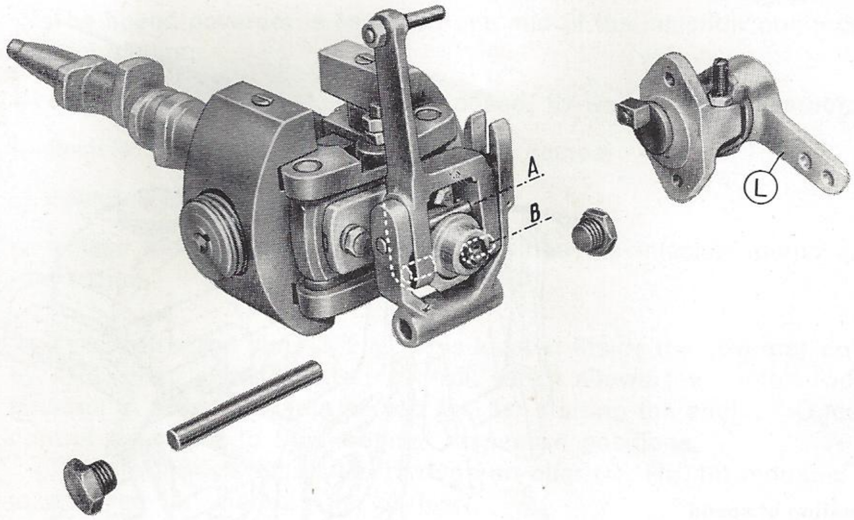


Fig. 27. - View of speed governor installed on the pump camshaft.

A and **B.** Floating lever (14) pivot points - **L.** Governor control lever.

Speed governor overhaul.

Disassembly.

Before taking down the cover from the governor housing (Fig. 28), unscrew the two fastening screws and remove the pivot pin of the saddle lever (11).

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

Remove the equalizer (9) after driving out the fly-weight link. 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 nut locking the fly-weights to the pump camshaft using the tool **A 427055** (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).

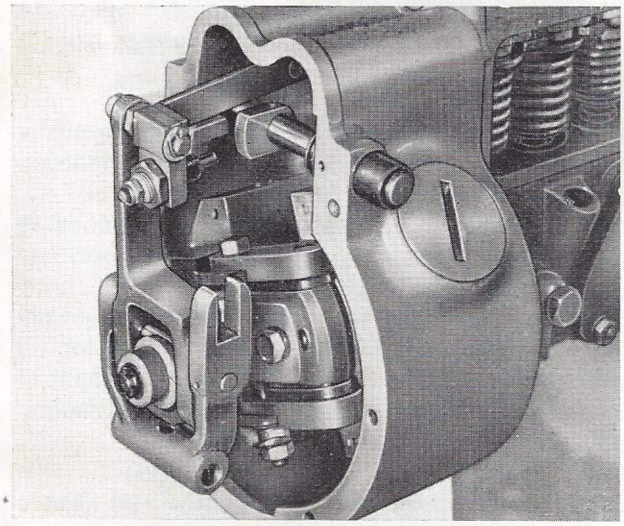


Fig. 28. - Removing the governor housing cover.

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).

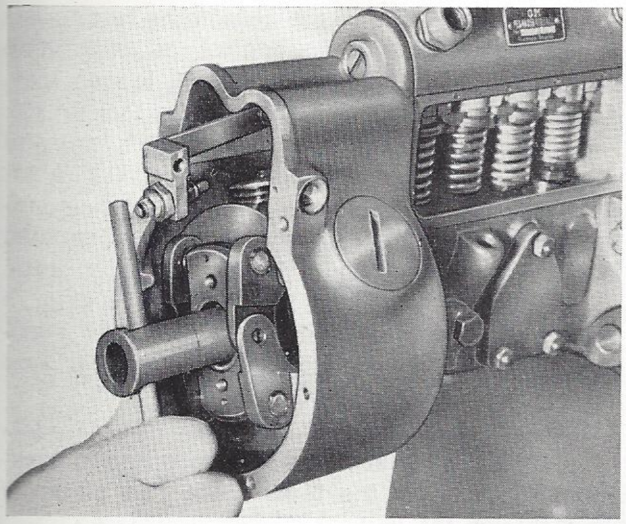


Fig. 29. - Removing the fly-weight retaining collar using wrench A 427055.

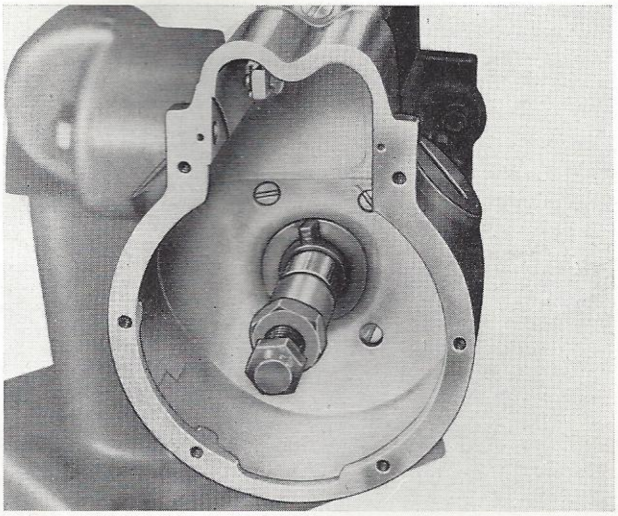


Fig. 30. - Removing the coupling of the vibration damper from the pump camshaft using puller A 427011.

Reassembly.

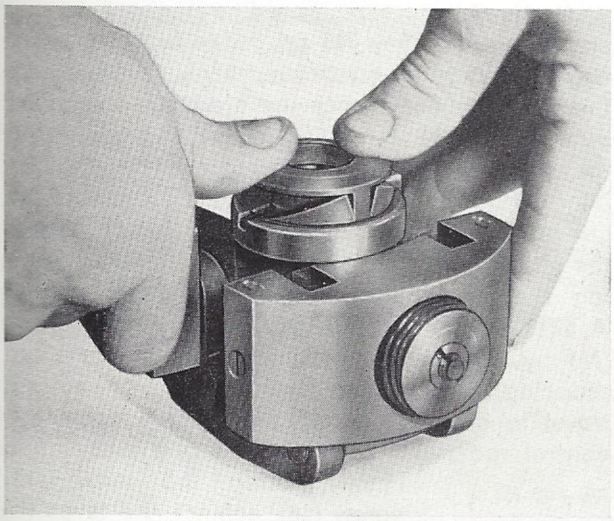


Fig. 31. - Fitting the vibration damper to the flyweights. (Note relative positions of rubber blocks).

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 spring plate, distance which must be equal on both sides (0.098″ to 0.118″ - 2.5 to 3 mm).

The retaining collars have a projection on the lower side which fits inside a slot machined in the spring plates. 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 are balanced.

Adjusting the vibration damper.

Before mounting the rubber blocks on the vibration damper, verify (by provisionally mounting the weights and coupling on the camshaft) that the end play between ring nut and flyweight spider is 0.002 to 0.004 in. (0.05 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.

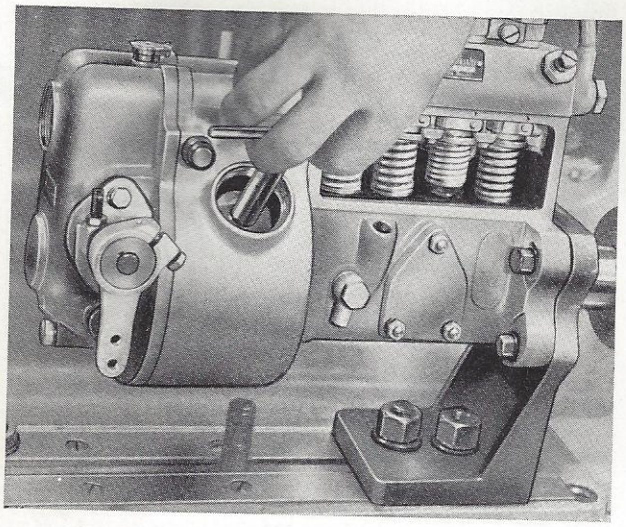


Fig. 32. - Adjusting the fly-weight opposing springs using wrench A 527008.

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 max. fuel stop screw (16, Fig. 23) and the 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 $\pm$ 0.004 in. - 12 $\pm$ 0,1 mm, from the stop).

Holding lever (L) in this position (using, if necessary, the tool **A 427112**) tighten the maximum fuel stop 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 $\pm$ 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. Check, by gradually increasing pump speed while holding lever (L) in position of max. against the max. stop screw (16), that the control rod reaches the position of complete fuel cut off at the speed of 950 r.p.m. If not, remove 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 and reducing, through the lever (L), the control rod travel in order to obtain the commencement of control rod travel at the speed of 875-885 r.p.m.

Finally, bring the max. stop screw (16) against the lever (L), and seal it.

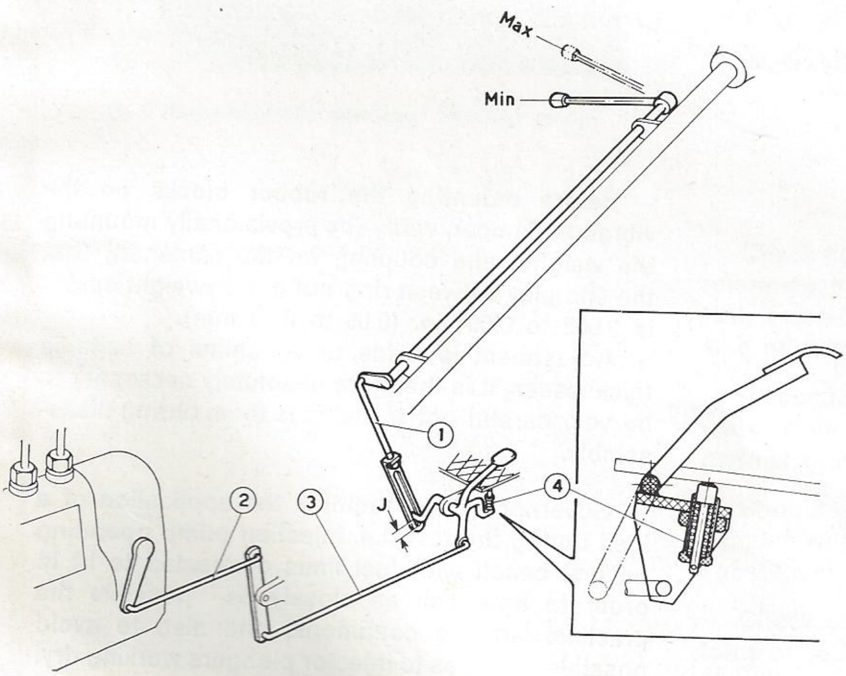


Fig. 33. - Schematic diagram showing the adjustment of the throttle control linkage (idle position).

1. Intermediate link - **2** and **3.** Governor control links - **4.** Idle adjustable stop - **J.** Clearance with governor control lever in idle speed position, sufficient to bring it to STOP by lifting the pedal with the tip of the foot.

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 press the accelerator pedal completely down against the footboard.
Should the latter not remain in this position help it to it manually and set it by adjusting the link nuts (1);

— check the link (2) which, after the above operations have been effected, should be slightly flected; if not, adjust the length of the link 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, if 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 with the tip of the foot.

TABLES OF DATA

Engine model CO1D/55.

DESCRIPTION	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		
Projection of valve guides above the cylinder head top surface — part no. 8807807	0.512	13		
Projection of valve guides above the cylinder head top surface — part no. 8809447	0.905	23		
Specifications - valve springs: (1)				
— Free length	2 - 27/64″	61,5 mm		
— Test length	2″	51 mm		
— Test load	44 - 48 lb	20 - 22 kg		
Cylinder sleeves (Fig. 5/1).				
Diameter - inside (standard)	4.1339 - 4.1348	105,000 - 105,022		
Diameter - inside (oversized, to be obtained by boring) — 0,4 mm (0.016 in)	4.1447 - 4.1457	105,400 - 105,422		
Diameter - inside (oversized, to be obtained by boring) — 0,6 mm (0.024 in)	4.1526 - 4.1535	105,600 - 105,622		
Diameter - inside (oversized, to be obtained by boring) — 0,8 mm (0.032 in)	4.1605 - 4.1614	105,800 - 105,822		
Diameter - inside (oversized, to be obtained by boring) — 1 mm (0.039 in)	4.1683 - 4.1693	106,000 - 106,022		
Diameter - outside, in crankcase bore	4.4440 - 4.4476	112,880 - 112,970		
Clearance - sleeve in crankcase bore	0.0012 - 0.0061	0,030 - 0,155		
Height - cylinder sleeves above crankcase joint surface	0.0059 - 0.0078	0,15 - 0,20		
Max. permissible protrusion difference among liners	0.001	0,03		
Clearance - cylinder sleeves and pistons	0.0039 - 0.0057	0,100 - 0,146	0.0157	0,4
Pistons, pins and rings (Fig. 5/5).				
Diameter - max. of piston (measured at bottom of skirt across pin axis)	4.1289 - 4.1299	104,876 - 104,900		
Diameter - max. of oversized pistons (dimension E) — 0,4 mm (0,016 in)	4.1447 - 3.9488	105,276 - 105,300		
Diameter - max. of oversized pistons (dimension E) — 0,6 mm (0.024 in)	4.1526 - 3.9567	105,476 - 105,500		
Diameter - max. of oversized pistons (dimension E) — 0,8 mm (0.032 in)	4.1605 - 3.9645	105,676 - 105,700		
Diameter - max. of oversized pistons (dimension E) — 1 mm (0.039 in)	4.1683 - 3.9724	105,876 - 105,900		
Diameter - piston pin (2)	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
Side clearance - 1° piston ring and groove	0.0034 - 0.0043	0,085 - 0,110	0.0138	0,350
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

(cont'd)

(1) To replace these springs use spares for engine CO2D/60 Var. 10.
(2) To fit the pin, heat the piston to 212° F (100° C); interference of 0.0004 in (0,01 mm).

(cont'd: Engine data)

DESCRIPTION	Data in.	Data mm	Wear limits in.	Wear limits mm
Wall thickness - piston rings	0.161 - 0.170	4,08 - 4,32		
End gap - piston rings, fitted inside cylinder sleeves:				
— 1^{o} ring	0.0118 - 0.0197	0,3 - 0,5		
— 2^{o}, 3^{o}, 4^{o}, 5^{o} rings	0.0098 - 0.0177	0,25 - 0,45		
Connecting rods and bushings (Fig. 5/4).				
Diameter - inside of bushings (bored 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
Permissible difference in weight between any two connecting rods	0.53 oz.	15 g		
Crankshaft (Fig. 5/3).				
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 to crankshaft	50.5 ft.lb.	7 kgm		
Fan to pulley	61.5 ft.lb.	8.5 kgm		

Engine model CO2D/60 Var. 10.

NOTE - Those data which are common to both engine models have not been repeated in the table below.

DESCRIPTION		Data in.	Data mm	Wear limits in.	Wear limits mm
Valve system (Fig. 5/9).					
Diameter - intake valves		1.5779 - 1.6142	40.080 - 41.000		
Diameter - exhaust valves		1.4110 - 1.4173	35.840 - 36.000		
Angle - intake and exhaust valves		45° - 45° 15′			
Angle - valve seats on cylinder head		44° 40′ - 44° 50′			
Specifications - valve springs:					
— Free length		2.42	61.5		
— Test length		1.59	40.5		
— Test load		85.3 - 96.8 lb	38,7 - 43,9 kg		
Cylinder sleeves (Fig. 5/2).					
Diameter - inside (standard)		4.2520 - 4.2528	108,000 - 108,022		
Diameter - inside (oversized, to be obtained by boring)	0.4 mm (0.016 in)	4.2677 - 4.2685	108,400 - 108,422		
	0.6 mm (0.024 in)	4.2756 - 4.2764	108,600 - 108,622		
	0.8 mm (0.032 in)	4.2835 - 4.2843	108,800 - 108,822		
	1 mm (0.039 in)	4.2913 - 4.2921	109,000 - 109,022		
Diameter - outside in crankcase bore		4.5638 - 4.5657	115,920 - 115,970		
Clearance - sleeve in crankcase bore		0.0012 - 0.0045	0,030 - 0,115		
Clearance - pistons in sleeves		0.0059 - 0.0077	0,150 - 0,196	0.016	0.4
Pistons, pins and rings (Fig. 5/6).					
Diameter - max. of standard piston (dimension E)		4.2451 - 4.2461	107,826 - 107,850		
Diameter - max. of oversized pistons (dimension E)	0.4 mm (0.016 in)	4.2608 - 4.2618	108,226 - 108,250		
	0.6 mm (0.024 in)	4.2687 - 4.2697	108,426 - 108,450		
	0.8 mm (0.032 in)	4.2766 - 4.2776	108,626 - 108,650		
	1 mm (0.039 in)	4.2845 - 4.2855	108,826 - 108,850		
Width - piston rings		0.165 - 0.174	4,18 - 4,42		
End gap - piston rings (installed)	1st	0.018 - 0.026	0,45 - 0,65	0.060	1,5
	2nd, 3rd, 4th	0.016 - 0.024	0,40 - 0,60	0.060	1,5
	5th and 6th	0.010 - 0.018	0,25 - 0,45	0.060	1,5

THE CLUTCH

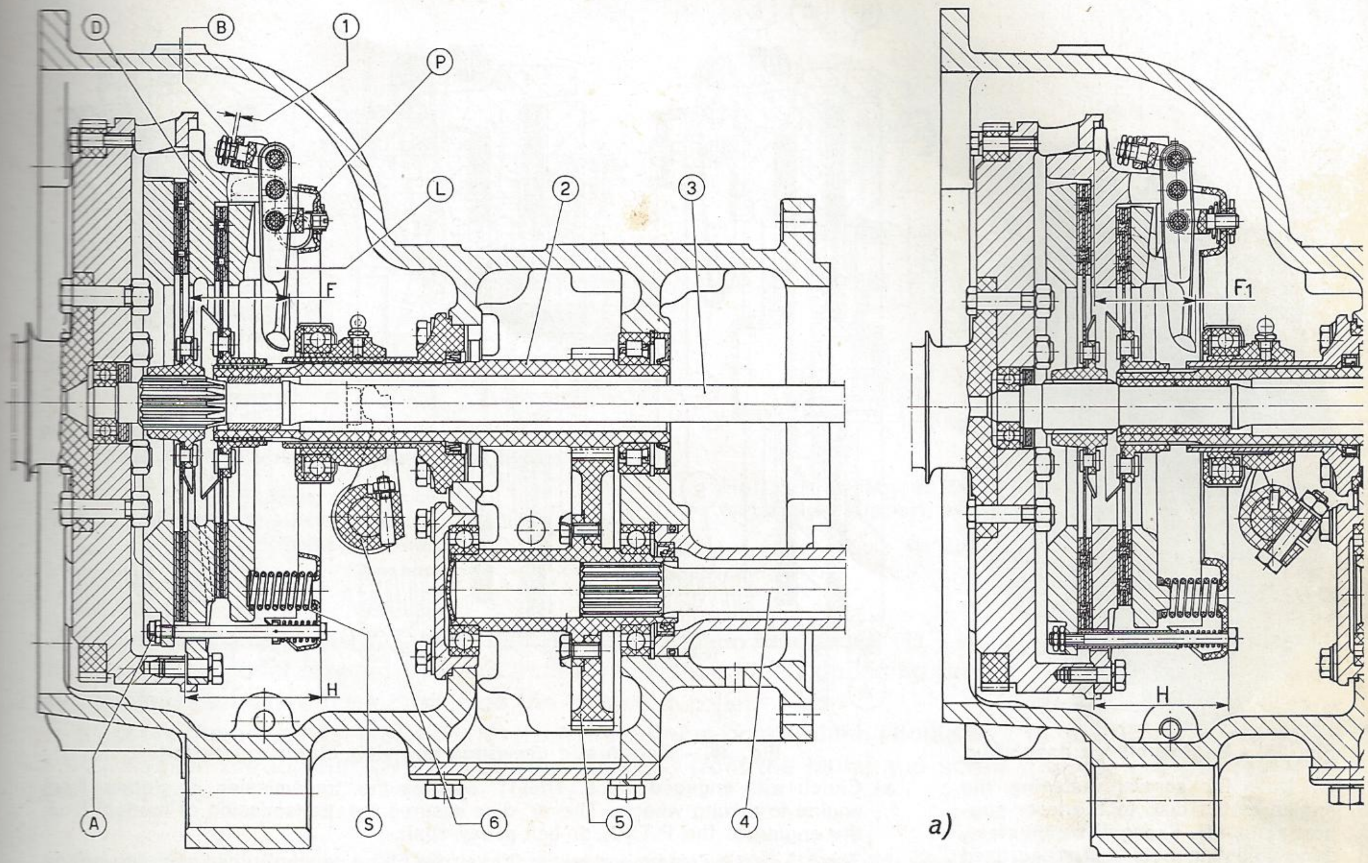


Fig. 34. - Cross-section of engine clutch and P.T.-O. drive gears.

1. Engaged clutch clearance of 0.067″ to 0.083″ (1,7 ÷ 2,1 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. shaft drive gear - **6.** Clutch throw-out collar control yoke - **F.** Distance between clutch disc and release lever ends: 2.64″ ÷ 2.67″ (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.

a) Sectional view of post-modification unit. $F_1 = 2.60''$ to $2.63''$ (66 to 66.7 mm).

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 37-38-38/1 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. 38/1) (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 0.067 in. and 0.083 in. (1,7 ÷ 2,1 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).

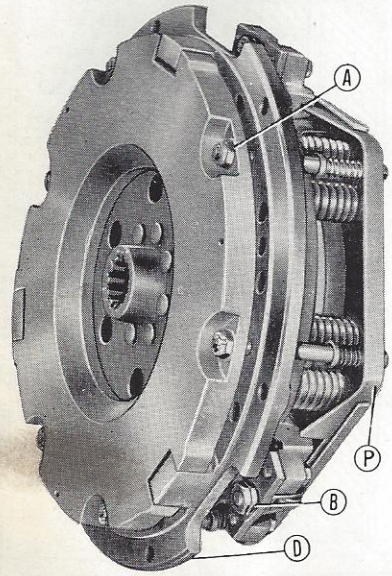


Fig. 35. - Engine clutch assembly.

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.

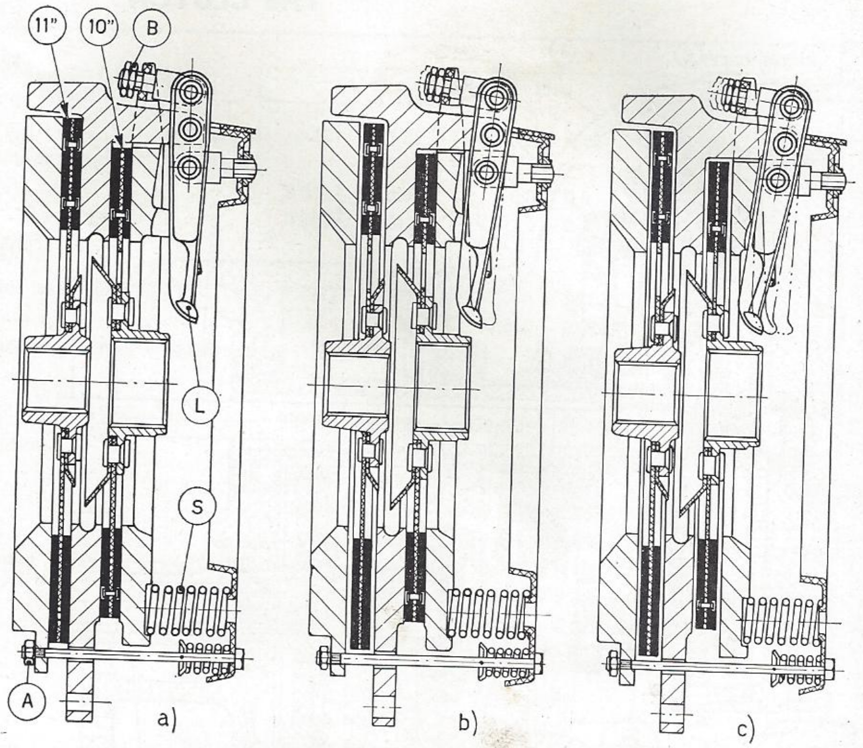


Fig. 36. - Schematic drawings showing clutch operation.

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 clearance 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.

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 M, Fig. 39) by adjusting the pedal tie-rod length.

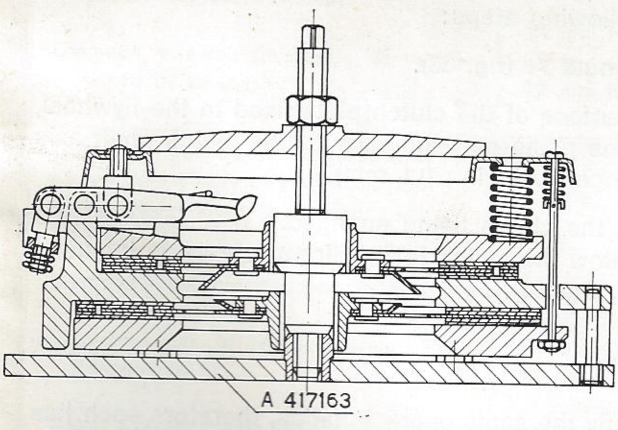


Fig. 37. - Disassembly and reassembly of the clutch on fixture A 417163.

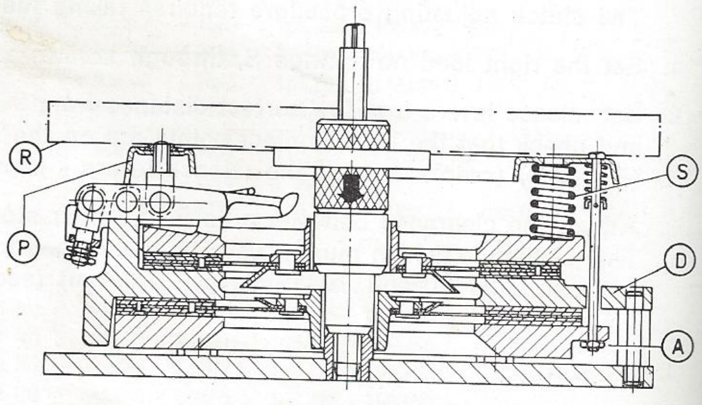


Fig. 38. - Adjusting the spring load with screws and nuts A and checking the co-planarity of disc P with respect to clutch disc D fixed to the flywheel, using steel rule R. (The arrow engraved on the fixture must be pointing downwards).

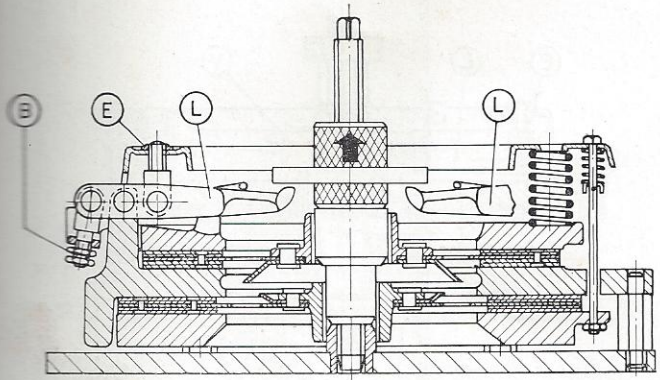


Fig. 38/1 - Setting the distance and checking co-planarity between the three release levers and disc D.

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

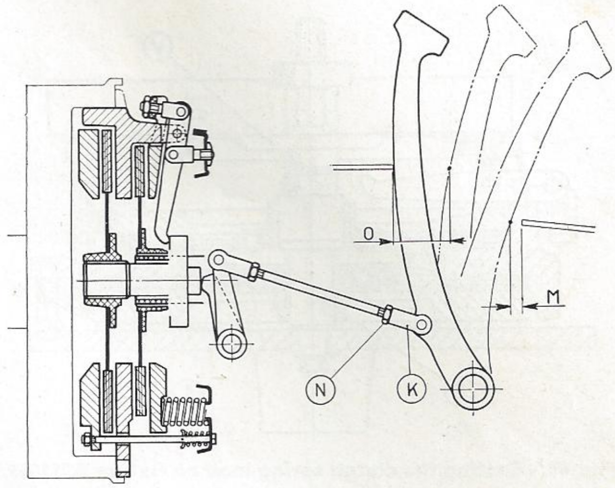


Fig. 39. - Distances O and M of pedal from foot-board and battery support, to be considered for clutch adjusting.

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

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 7/16″ to 9/16″ (1 to 1,5 cm); if not, 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.
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 0.067 to 0.083 in. (1,7 to 2,1 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.

How to use the fixture A 711063.

Dismantling, setting and assembling of the clutch can be performed on fixture **A 417163** or on fixture **A 711063**, the latter being suitable for all FIAT spring-loaded clutches.

To load the springs correctly (Fig. 40), select the central locator marked 512 R - 513 R and install it in the fixture, then fit the three outer locators, marked with a capital C, in their respective holes in the faceplate, holes lying on the circle marked 512 R - 513 R; finally, fit the gauge (V) on centre with ends turned upwards in order to enable positioning the straightedge at the highest permissible level of the clutch release lever supporting plate.

To check the release lever setting, turn the gauge (V) over (Fig. 40/1) so that it rests on the central locator and its three ends correspond to or are positioned within 0.004 in. (0.1 mm) from the three clutch release levers. For dismantling and assembly proceed as with the fixture **A 417163**.

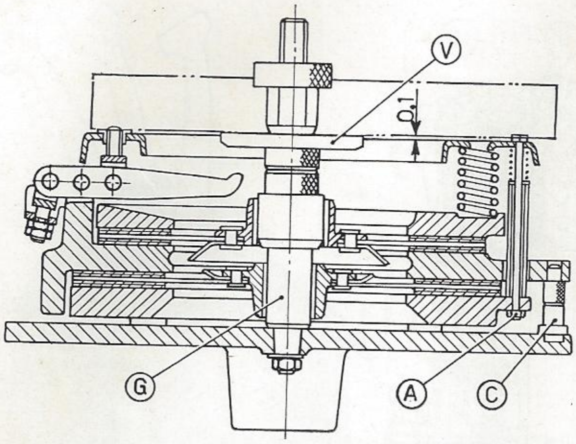


Fig. 40. - Setting the clutch spring load on fixture A711063.
A. Nut - **C.** Outer locators - **G.** Central locator - **V.** Gauge piece.

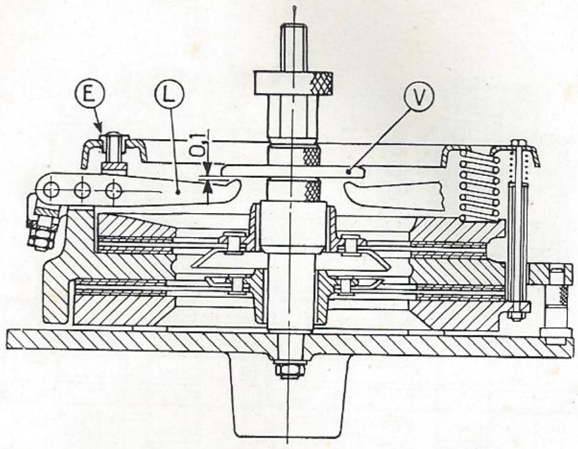


Fig. 40/1. - Setting the clutch release levers.
E. Jam nut - **L.** Release lever - **V.** Gauge piece. (0,1 mm = 0,004 in).

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

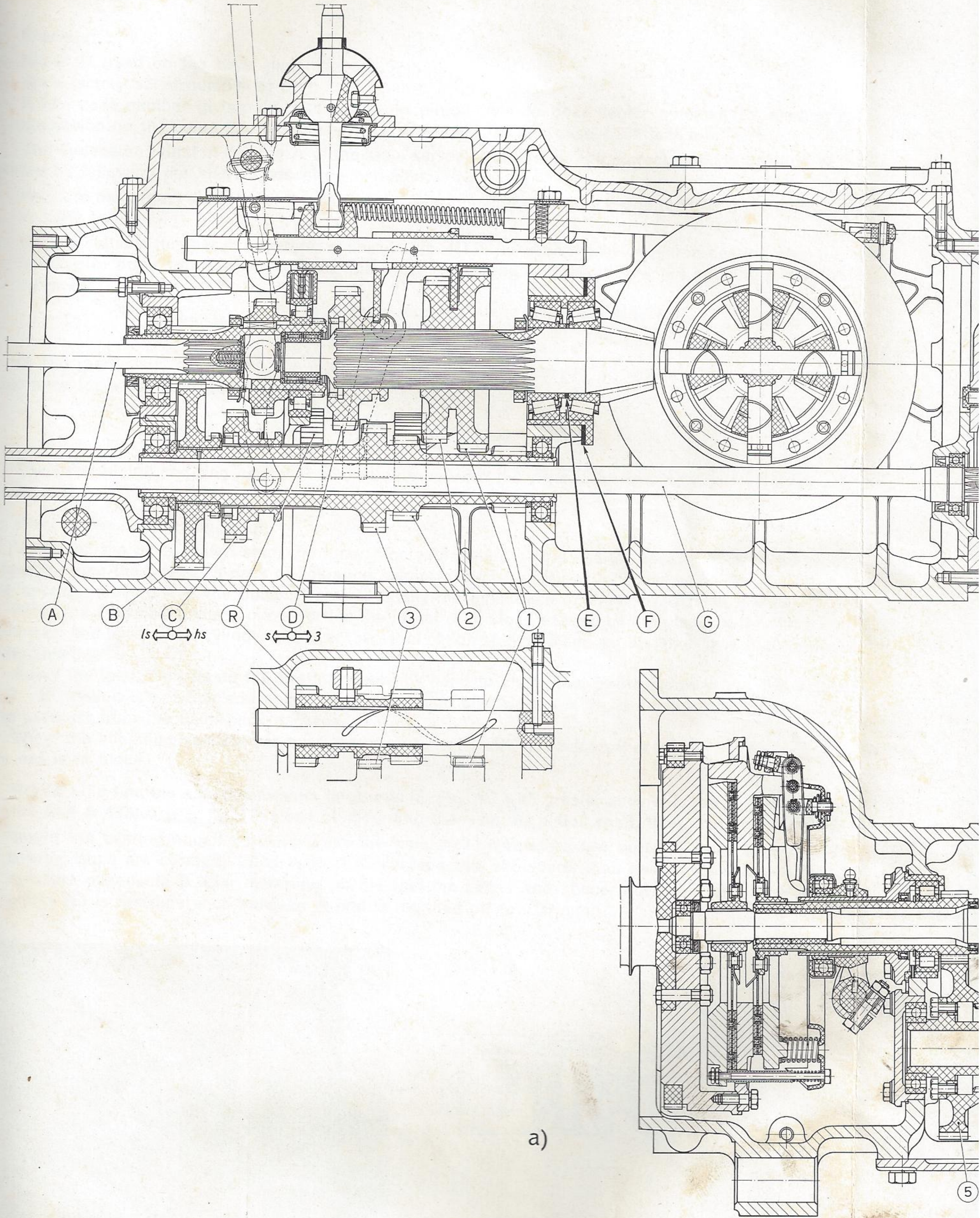


Fig. 41. - Longitudinal section of gearbox, bevel pinion and P.T.-O. unit.

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 2
from clutch to gearbox - **B.** Constant-mesh driven gear of speed-reduction unit (for 1st - 2nd - 3rd forward and 1st reverse), idle on sh
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.** Dire
the 7th speed) and 3rd and 6th driven gear (in the direction of arrow 3) - **E.** Bevel gear roller bearing adjusting shims - **F.** Adjusting
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
control lever in position of engagement - **R.** Reverse gears.

a) Sectional view through PT-O gears (post-modification).

5. PT-O shaft drive gear.

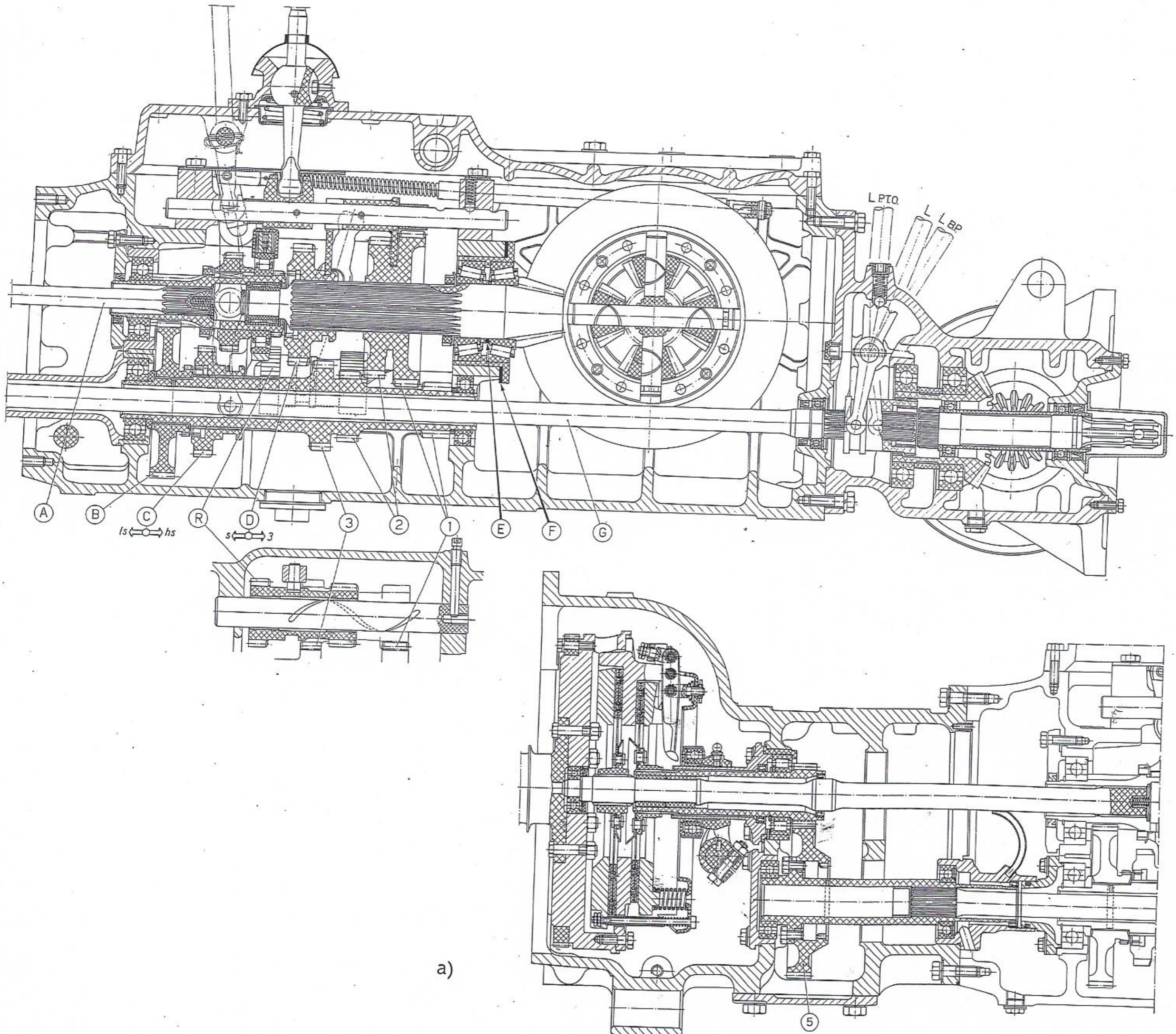


Fig. 41. - Longitudinal section of gearbox, bevel pinion and P.T.-O. unit.

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.

a) Sectional view through PT-O gears (post-modification).

5. PT-O shaft drive gear.

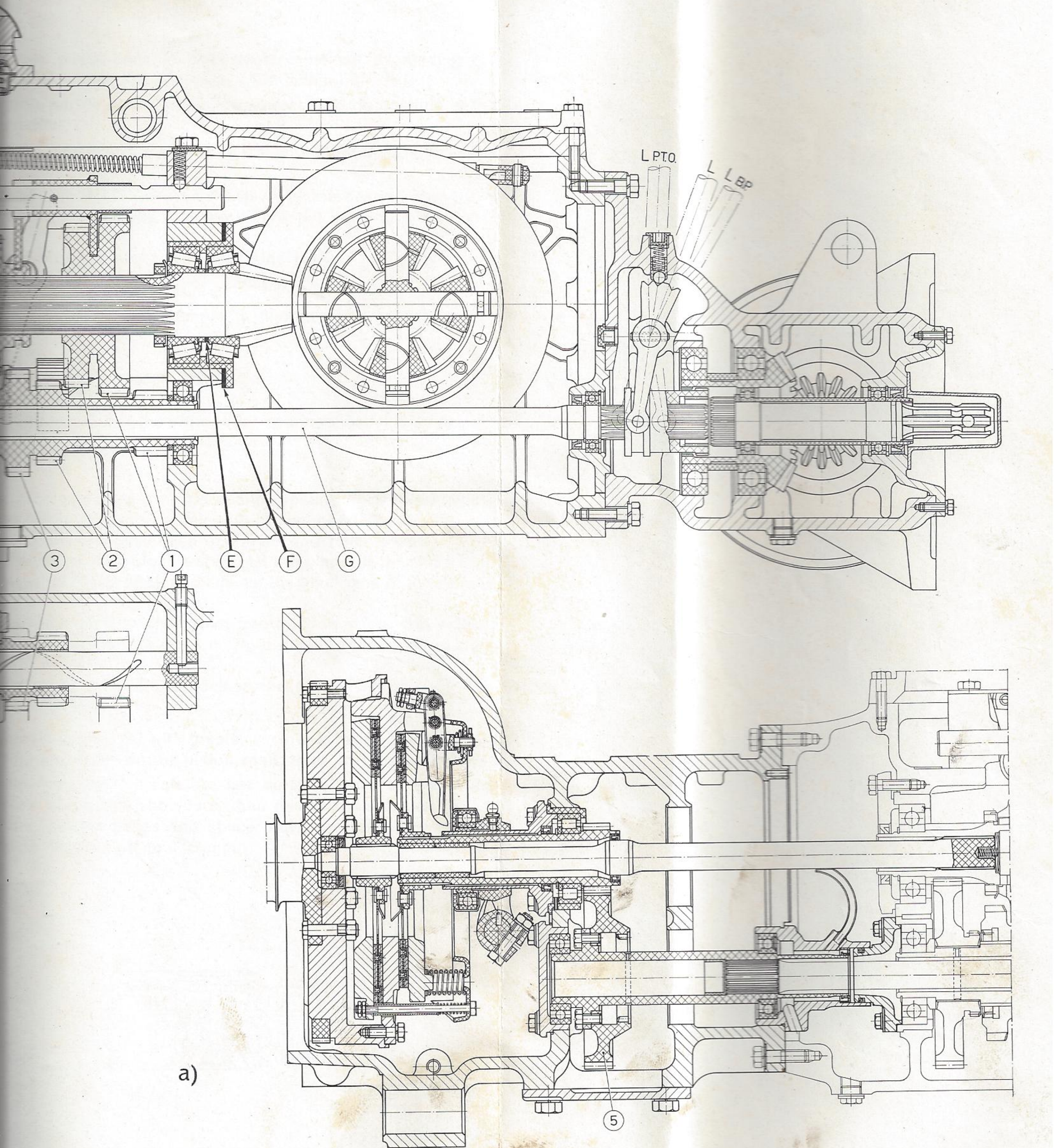


Fig. 41. - Longitudinal section of gearbox, bevel pinion and P.T.-O. unit.

nd reverse gears - **2.** 2nd and 5th speed gears - **3.** 3rd and 6th forward speeds and 1st and 2nd reverse driving gears - **A.** Transmission shaft 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, 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 (in the direction of arrow 3) - **E.** Bevel gear roller bearing adjusting shims - **F.** Adjusting shims for regulating the correct tooth bearing of re 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.

a) Sectional view through PT-O gears (post-modification).

5. PT-O shaft drive gear.

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 obtained 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.)
— 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.

NOTE - To find the adjustment shim thickness (E, Fig. 41) with greater accuracy, install the bearings on the tool **A 437009** (Fig. 42/1) instead of mounting them on the pinion shaft, then proceed as follows:

— mount the bearing housing complete on the tool, make it rotate a few turns to make sure that the bearing cups are correctly fitted against their respective shoulders, then measure dimension A;
— measure dimension B after mounting on the tool the cones and spacer only; the total thickness of shims (E) is the difference between A and B rounded off to 0.05 mm.

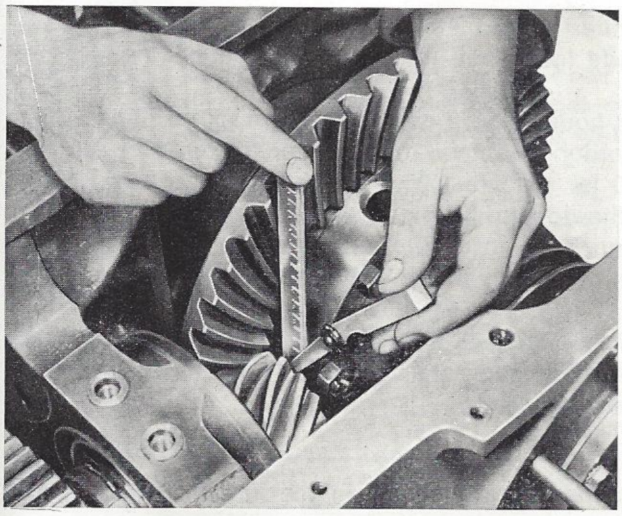


Fig. 42. - Measuring pinion cone centre distance.

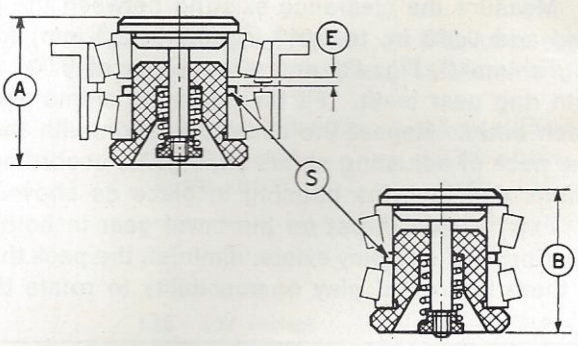


Fig. 42/1. - Finding the pinion shaft cone bearing adjustment shim pack thickness (E) with the tool A 437009.

E. Shims pack - **S.** Spacers.

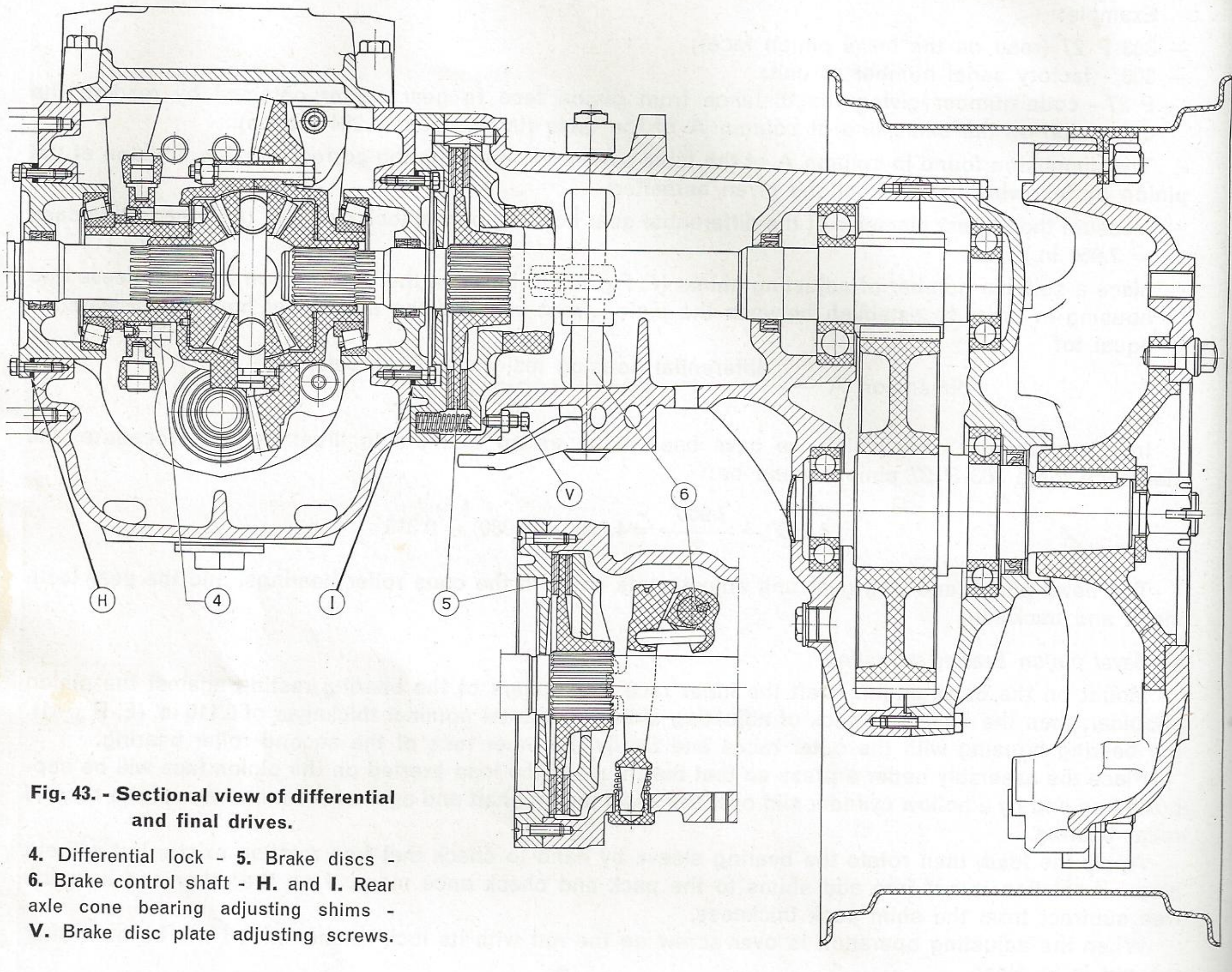


Fig. 43. - Sectional view of differential and final drives.

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.

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.

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.

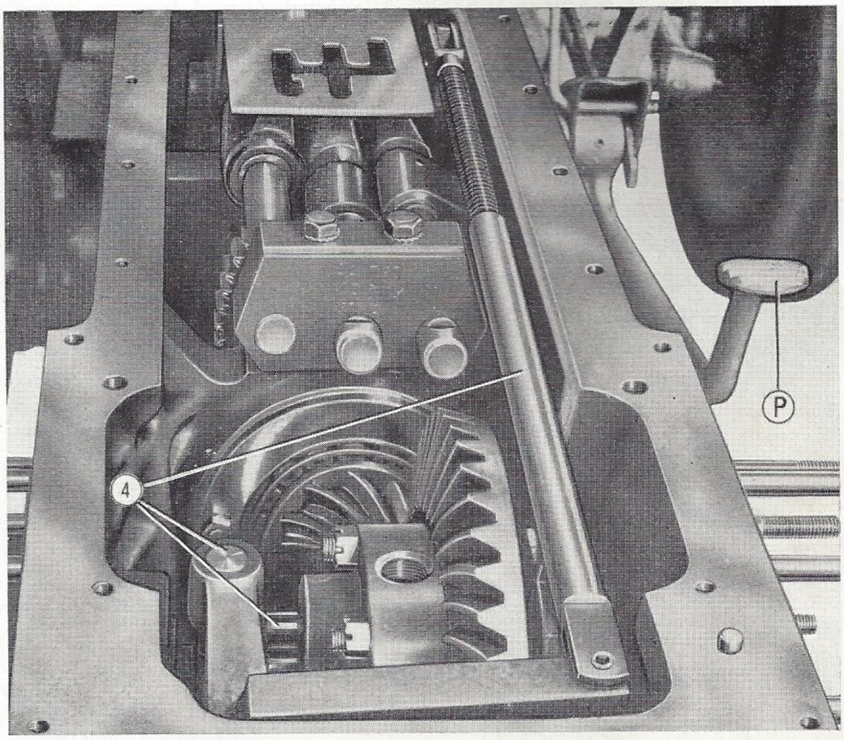


Fig. 44. - Top view of gearbox, gear-shift and differential lock.

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

TABLE OF TRANSMISSION DATA

DESCRIPTION	Data in	Data mm
Inside diameter of reverse gear shaft bushing (after assembly and boring) [1]	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

(1) Interference fit of 0.0021 ÷ 0,0046 in (0,054 ÷ 0,117 mm).

THE BRAKES

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.

The thickness of new brake bands complete with linings is 0.70 to 0.72 in. (17.7 to 18,3 mm).

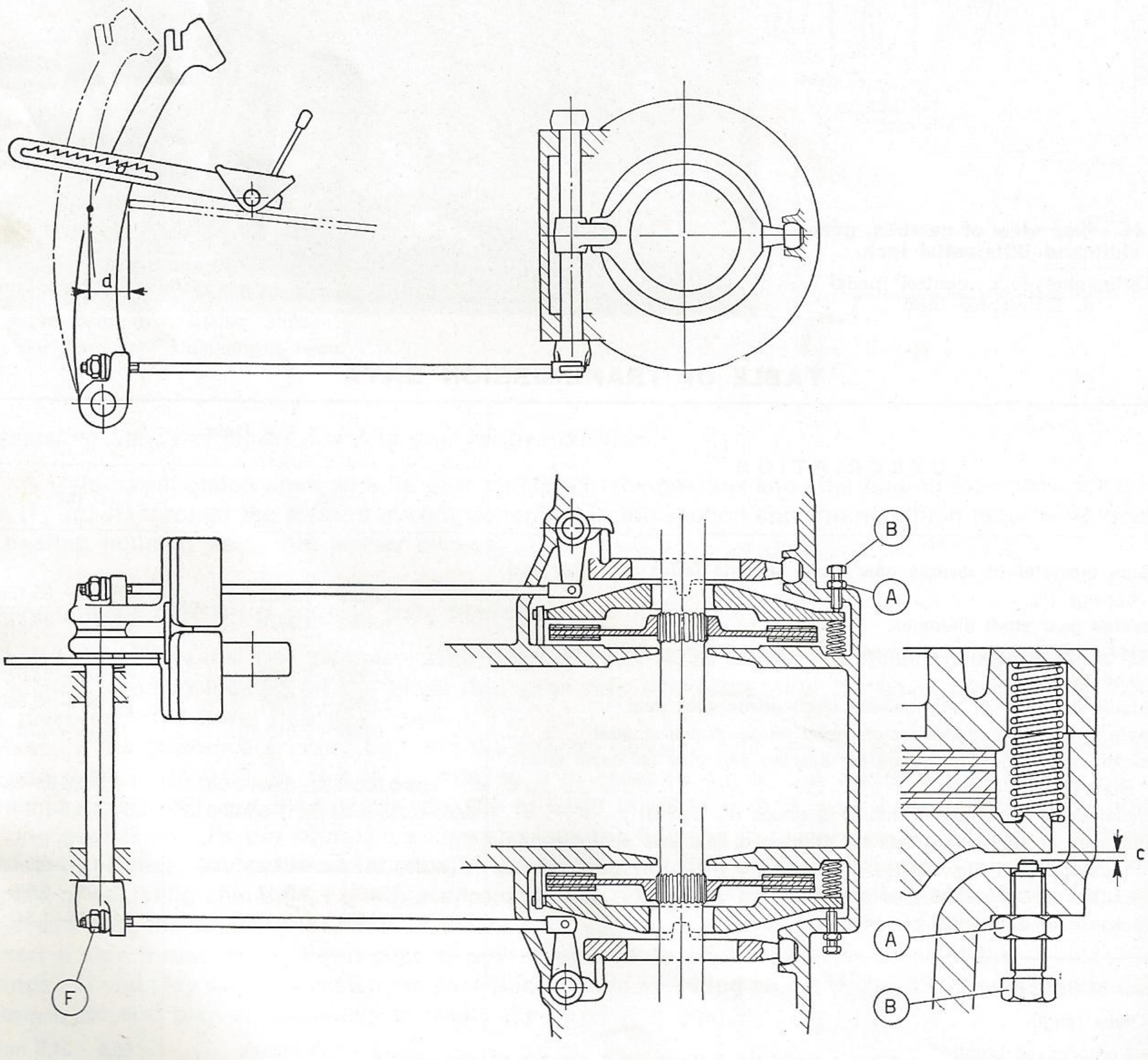


Fig. 45. - Schematic view showing brake adjustment.

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

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.

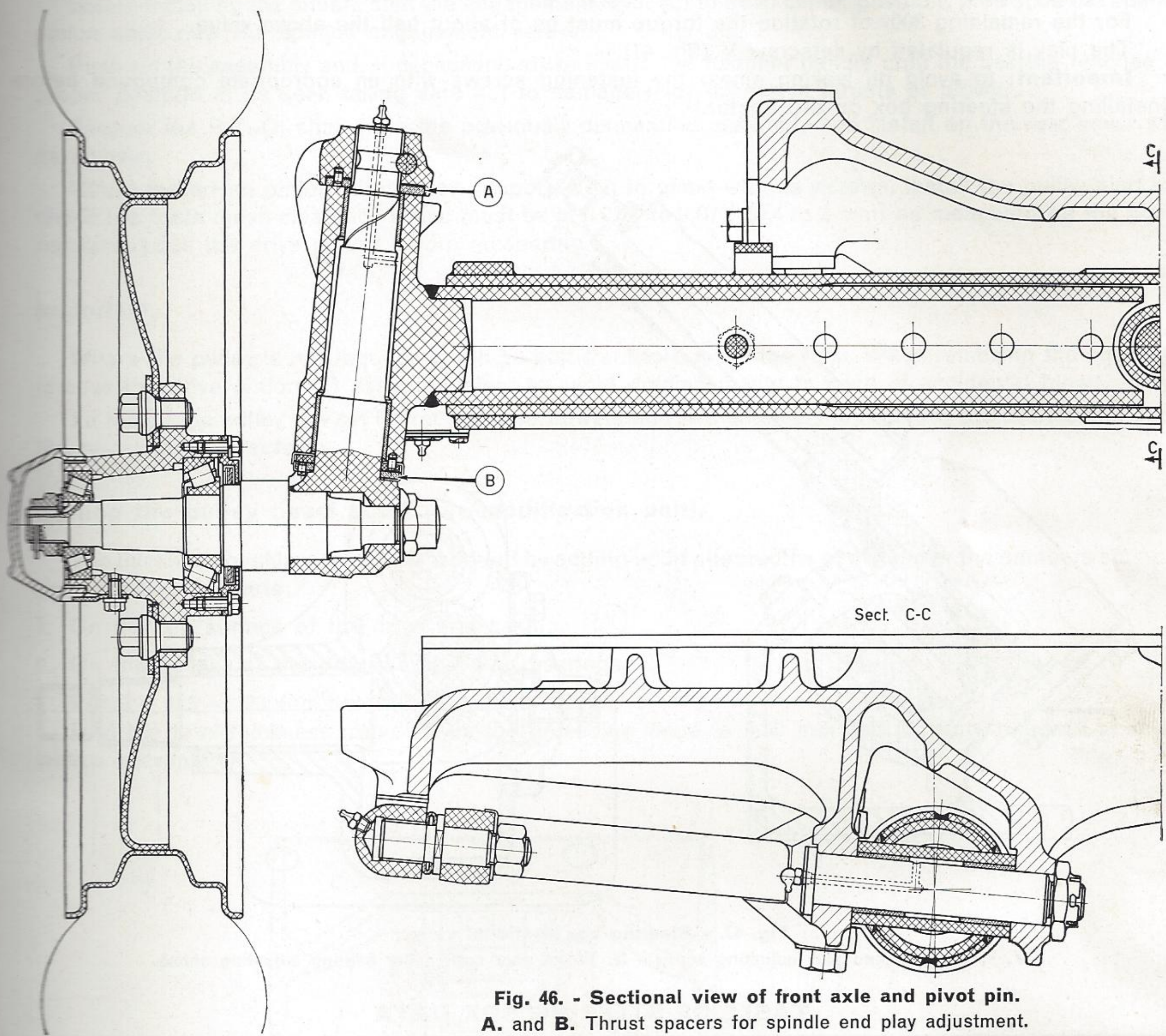


Fig. 46. - Sectional view of front axle and pivot pin.
A. and **B.** Thrust spacers for spindle end play adjustment.

TABLE OF FRONT AXLE DATA

Description	Data		Wear limits	
	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

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. 47).

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

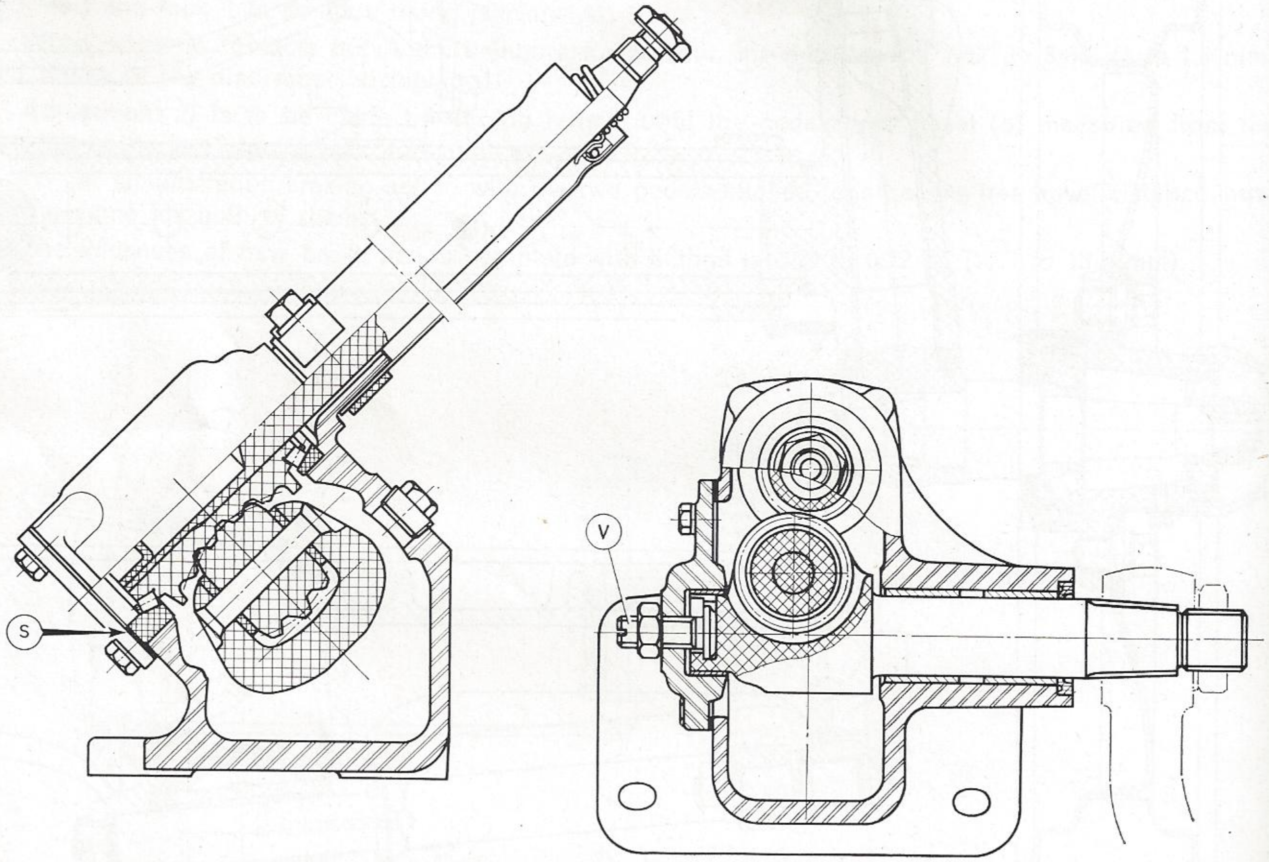


Fig. 47. - Steering box sectional views.
V. Worm gear end play adjusting screw - **S.** Worm gear cone roller bearing adjusting shims.

TABLE OF STEERING BOX DATA

DESCRIPTION	Data in	Data mm
Inside diameter of force fitted bushings in steering box	1.2497 - 1.2507	31,743 - 31,768
Diameter of worm shaft	1.2479 - 1.2489	31,698 - 31,723
Clearance of worm shaft in bushings	0.0008 - 0.0027	0,020 - 0,070
Inside diameter of force fitted bushings in worm shaft cover	1.2492 - 1.2504	31,730 - 31,760
Clearance of worm shaft spigot in bushing	0.0003 - 0.0024	0,007 - 0,062
Wrench torque data:		
Steering box attachment capscrews: up to chassis serial No. 104752		58 ft. lb (8 kgm)
Steering box attachment capscrews: from chassis serial No. 104753		123 ft. lb (17 kgm)

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. 48).
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. 48) 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.

Setting the pulley bevel gears (pre-modification unit).

The thickness of shims (E, fig. 48) 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.

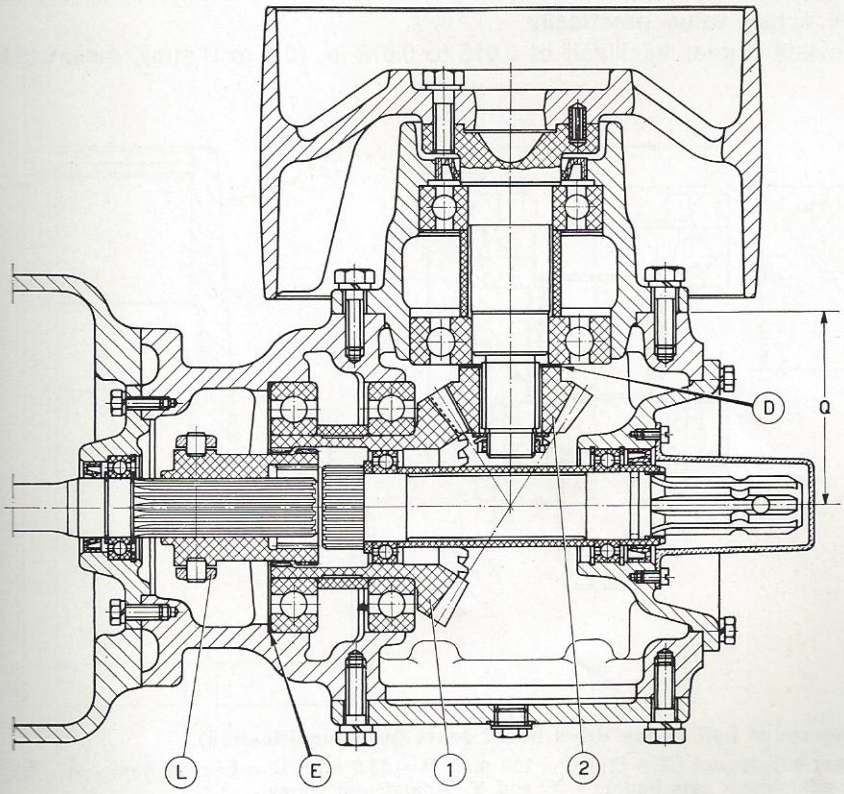


Fig. 48. - Belt pulley unit sectional view.

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)

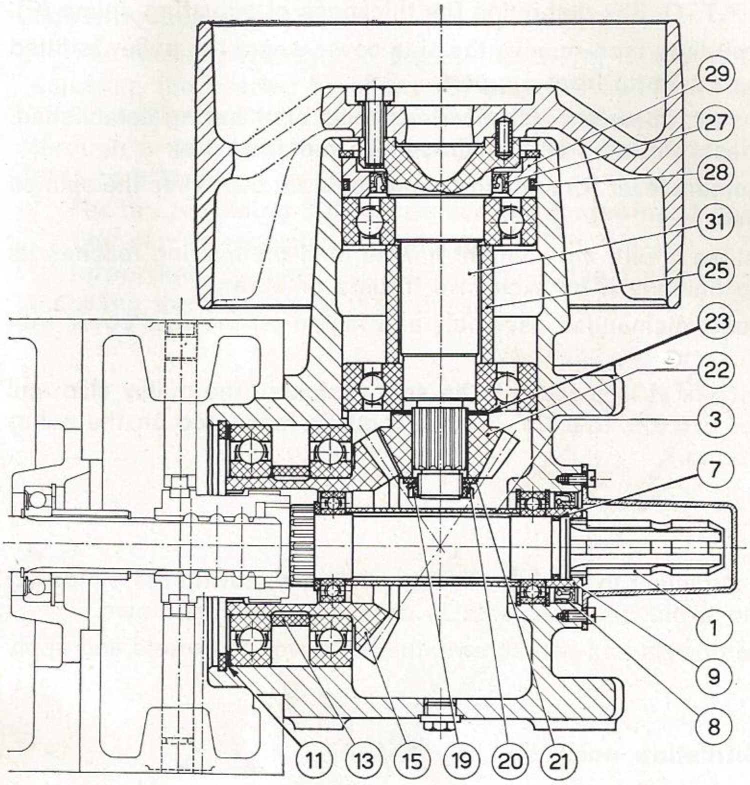


Fig. 49. - Sectional view of belt pulley and power take off (post-modification).

1. P.t.-O. shaft - **3.** Spacer - **7** and **8.** Oil seals - **9.** Threaded bushing - **11.** Shim - **13.** Spacer - **15.** Drive pinion - **19.** Locknut - **20.** Safety washer - **21.** Plain washer - **22.** Drive pinion - **23.** Shim - **25.** Spacer - **27.** Spacer inner seal - **28.** Spacer outer seal - **29.** Spacer - **31.** Pulley drive shaft.

Setting the pulley bevel gears (post-modification unit, Fig. 49).

Before carrying on the correct assembly of the bevel gears, let us find the nominal thickness for shims X and Y (Fig. 50), based upon markings at A* and D* on the pulley outer casing and on bearing washers E* and B* (Fig. 50).

The above markings represent the variation of actual dimensions with respect to theoretical ones (A, D, E, B), preceded by a + or — sign and expressed in hundredths of a millimeter; it will suffice, therefore, to add them algebrically, so that:

$$X = (A) + (B) \text{ and } Y = (D) + (E).$$

To find the desired value in millimeters, divide the result obtained by 100, and temporarily install shims up to that thickness; finally, find the actual value practically.

After assembly, check that there exists a gear backlash of 0.016 to 0.078 in. (0.4 to 2 mm), measured on the pulley.

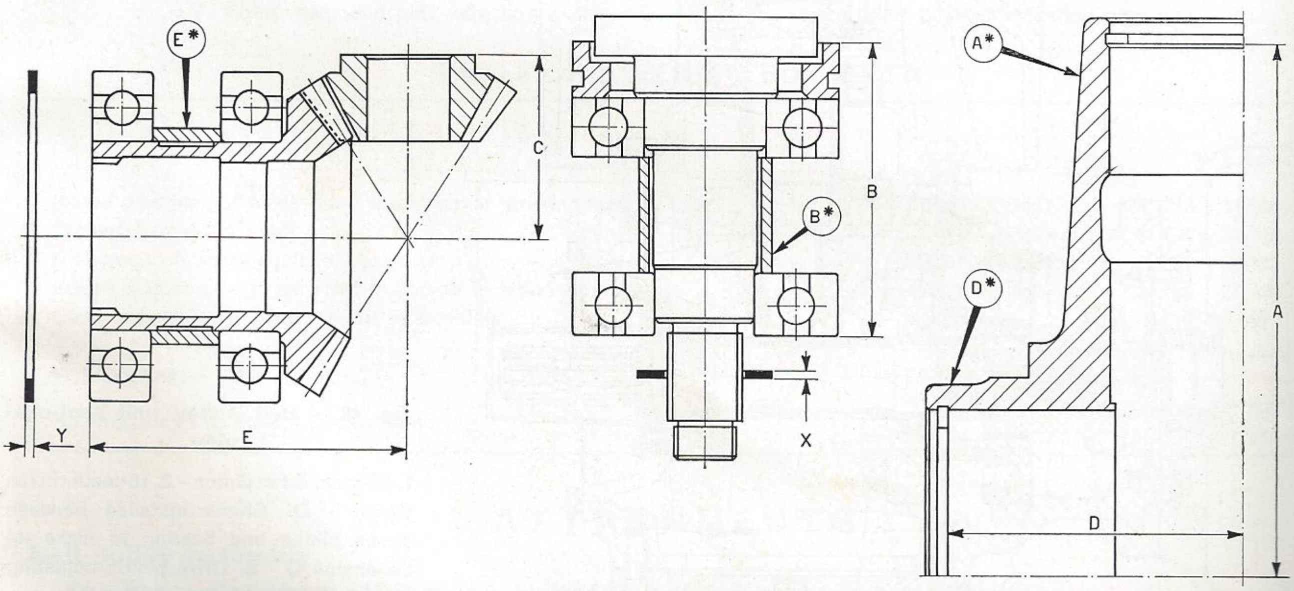


Fig. 50. - Adjustment diagram of belt pulley drive bevel gears (post-modification).
A, B, D, E. Nominal dimensions for bevel gear adjustment (A = B + C = 239 mm; B = 83.5 mm; D = E = 133 mm) - **A*, B*, D*, E*.** Location of adjustment data figures - **X.** and **Y.** Adjustment shims.

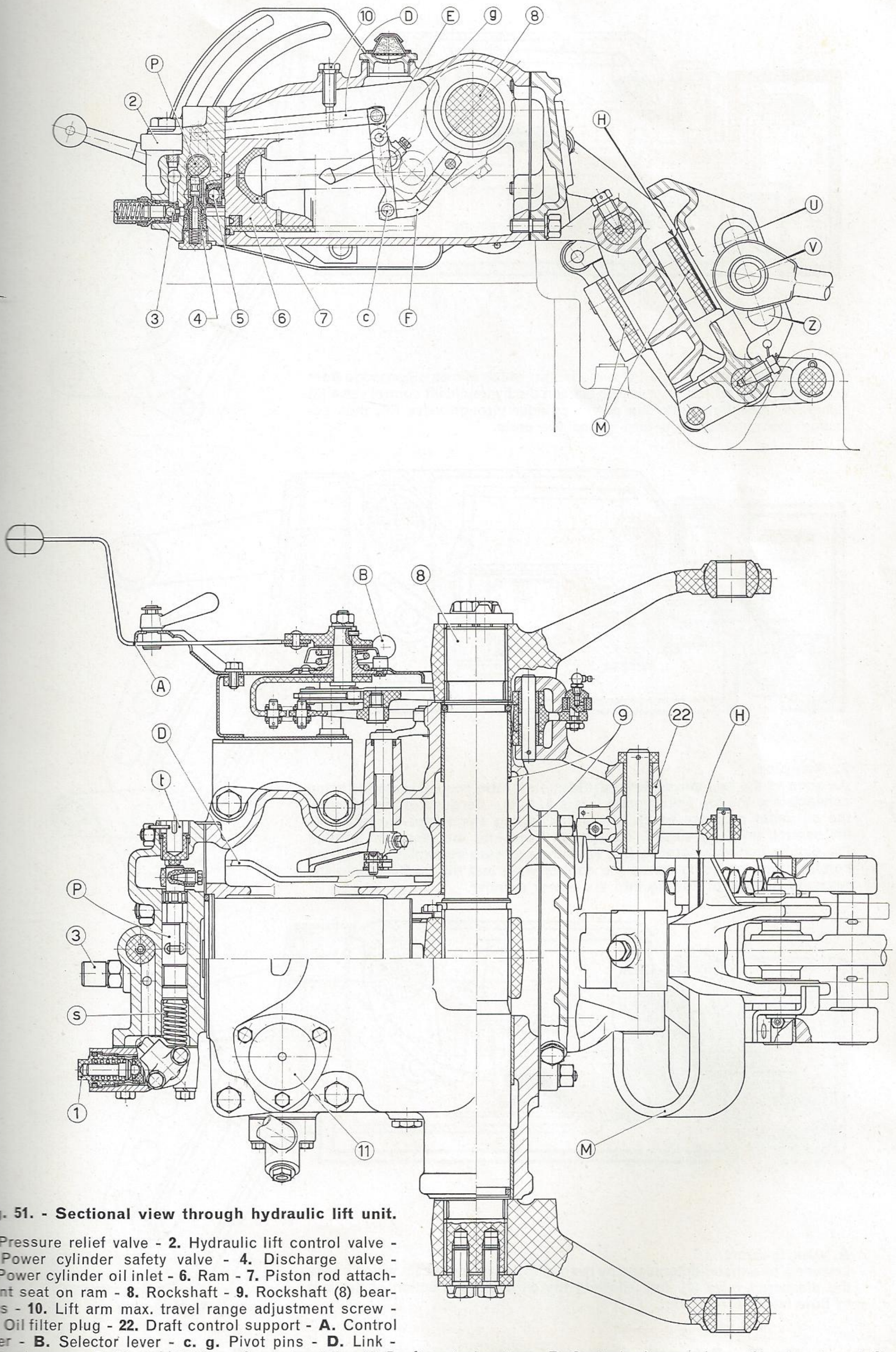


Fig. 51. - Sectional view through hydraulic lift unit.

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) bearings - **10.** Lift arm max. travel range adjustment screw - **11.** Oil filter plug - **22.** Draft control support - **A.** Control lever - **B.** Selector lever - **c. g.** Pivot pins - **D.** Link - **E.** Rocker arm - **F.** Clevis - **H.** Shims for spring (M) - **M.** Draft control spring - **P.** Control valve spool - **s.** Spool spring - **t.** Spool sensitivity adjustment plug - **U.V.Z.** Top link mounting holes.

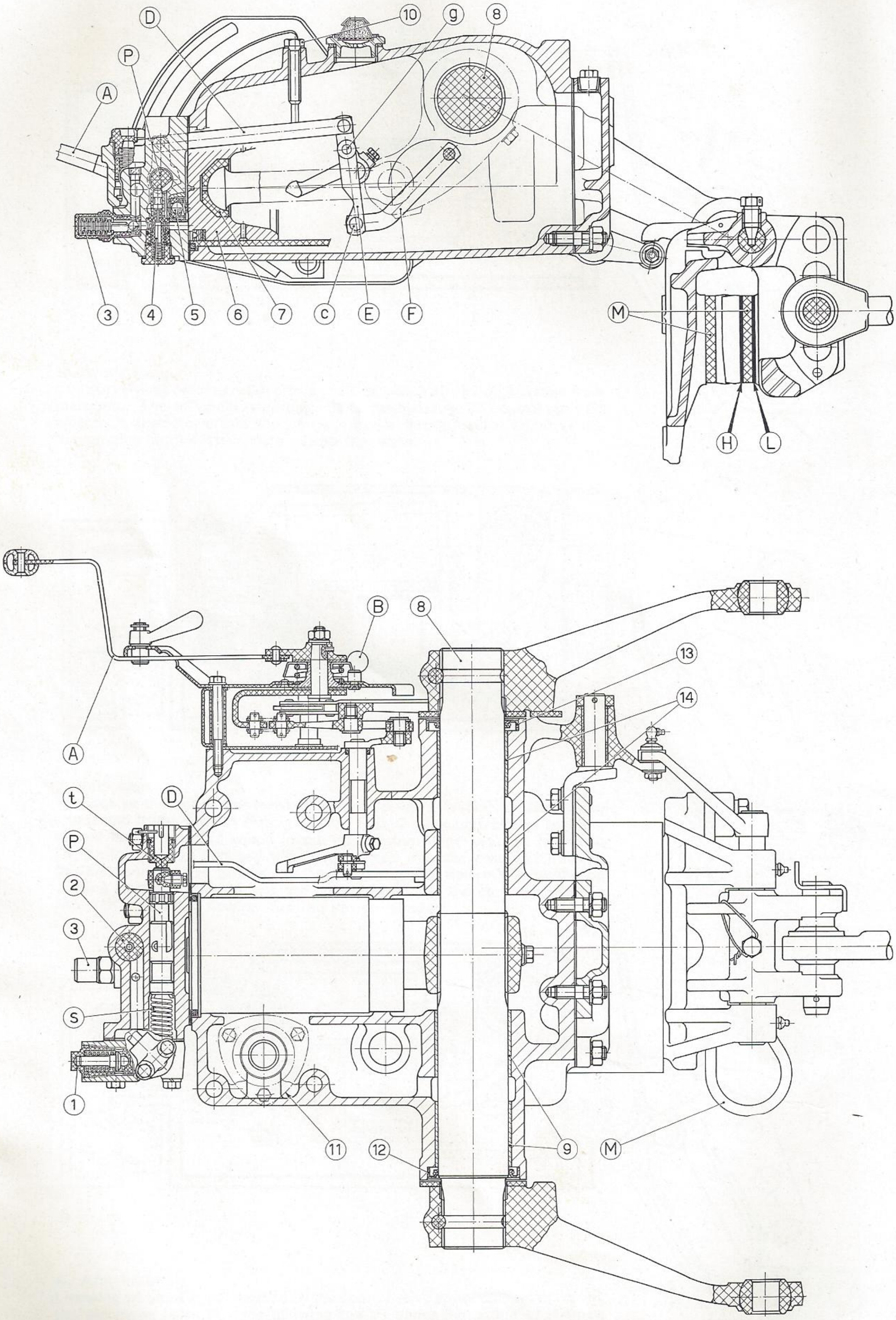
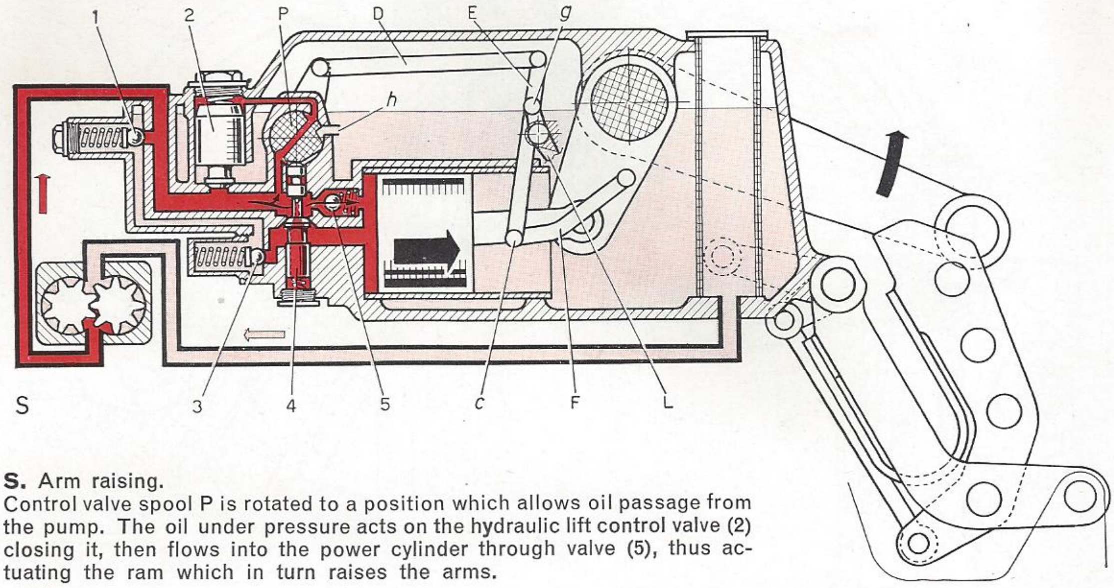


Fig. 52. - Sectional view through the reinforced model.

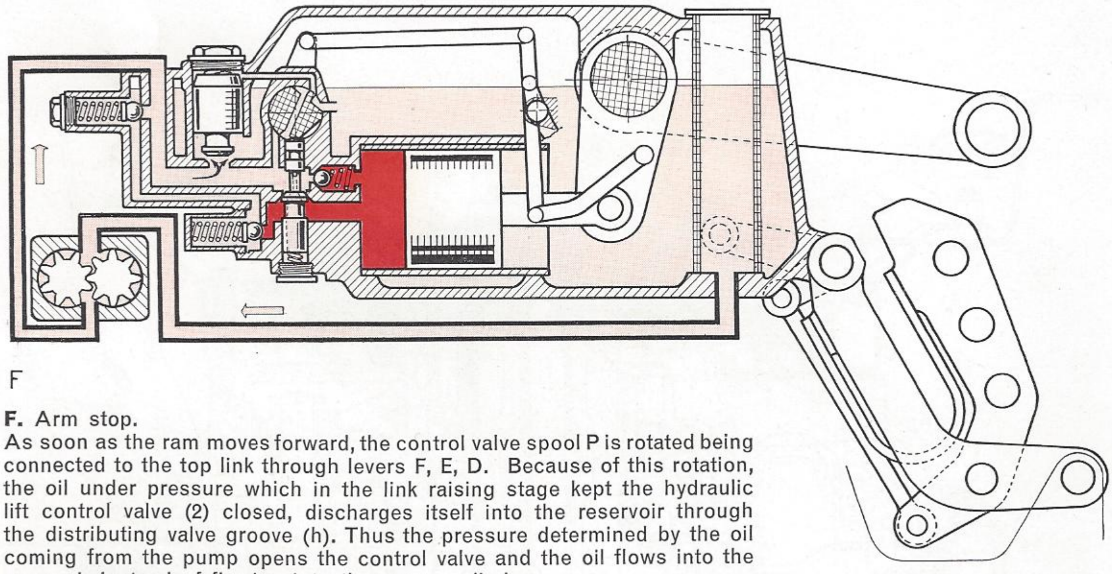
12 and **13.** Oil seals - **14.** Rocker shaft (8) bearings - **L.** Control spring (M) shims - **s.** Control valve spool spring - **t.** Spool sensitivity adjustment plug.

(Refer to Fig. 51 for missing letters and numbers).



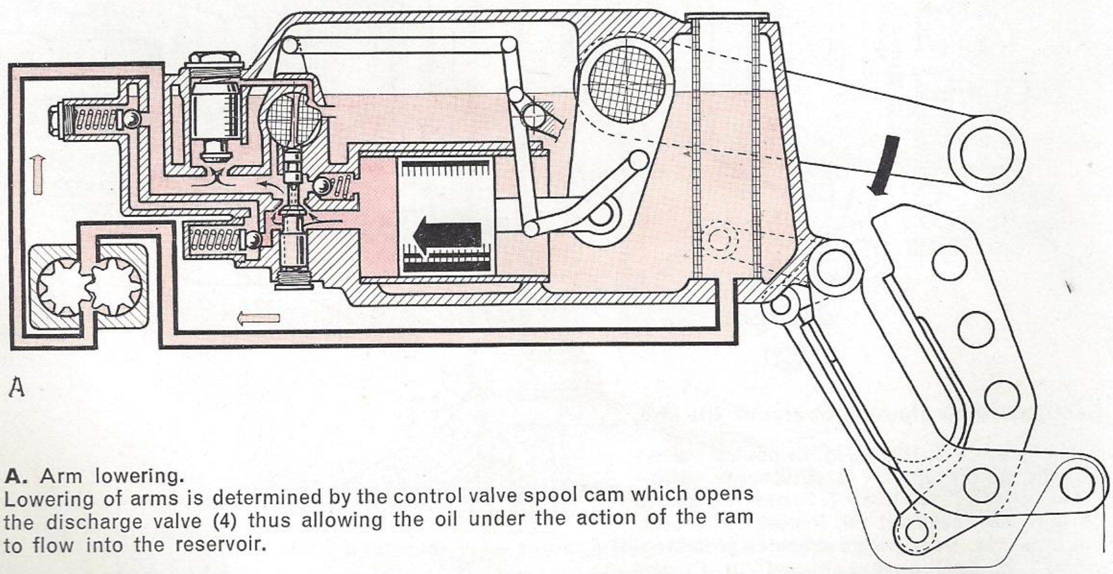
S

S. Arm raising.
Control valve spool 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

F. Arm stop.
As soon as the ram moves forward, the control valve spool 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

A. Arm lowering.
Lowering of arms is determined by the control valve spool 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 oil flow pattern is identical both for position and draft control operation).

HYDRAULIC LIFT

Operation.

The hydraulic lift offers both types of operation: position and draft control. For either type of operation, shift the selector lever B (Fig. 12/1) downwards for position control, and upwards for draft control; the selector lever should be operated only when the implement is fully raised in order to avoid deformations of the control linkage.

Lift arms are operated through the control lever (A), which, in position control operation, sets height of the implement in function of the position of the lever in its sector.

In draft control operation, a limited range only in the sector is available for arm manoeuvering, whilst the remaining part serves to set the draft desired for the advancement of the implement at work.

Any time the lever A is shifted it actuates the control valve spool which rotates and, depending on the direction of rotation, it determines a different flow of oil through the valves, resulting in the raising and lowering of the lift arms.

In position control operation, the position of the lift arms can be controlled through lever (A) only, whilst in draft control there is also the thrust imparted by the implement onto the control spring (M, Fig. 12/2). This control spring, strained by the thrust imparted by the implement, actuates, through the outside leverage linked to its support, the control valve spool; the rotation of the latter, in turn, actuates the lift arms so as to bring the implement draft back within the range set by the position of lever (A) in the sector.

In position control operation, the selector lever (B), by varying the relative position of levers and rockers, frees the control valve spool from the action of the control spring (M).

The oil flow diagram is illustrated in Fig. 53; specifications and data are reported on page 49.

ADJUSTMENT OF THE HYDRAULIC LIFT SETTING

The directions given below apply to the type of hydraulic lift illustrated in Fig. 52, i.e., with the top link attachment hinged at the top; the other type, i.e. with the top link attachment hinged at the bottom (Fig. 51), has been dealt with only when specifications differ.

A - **Control spring adjustment.**

The correct setting of the double-acting, U-shaped control spring ensures that the control valve spool (P, Fig. 51) rotates within the predetermined range, and that the subdivision of the total travel (in tension and compression) is the desired one. Data for this check differ for each of the types illustrated in Fig. 51 or in Fig. 52.

Operations.

Hold the engine stationary.

Remove the top link, then check that distance G (diagram 1, Fig. 53/1) is 0.47-0.49 in. (12 to 12,5 mm); in the case of the other type of support (Fig. 53/2) dimension I should be 0.87-0.91 in. (22-23 mm).

If this distance is less, remove one or two of the shims H inserted between the control valve and mounting plate; if this is not enough, remove enough material from the back of the mounting plate, taking care not to alter the 5° angle of the contact plane (for the type of support shown in Fig. 53/2 only).

If this distance is greater than specified, add one ore two shims H, inserting them between spring and mounting plate.

Introduce the end of a lever or tool **A 197016** in the top link mounting holes, then take up the

Cautions.

Do not use a large numbers of adjustment shims to either reduce or increase the play G, as this would vary the assembly conditions and the load upon the spring.

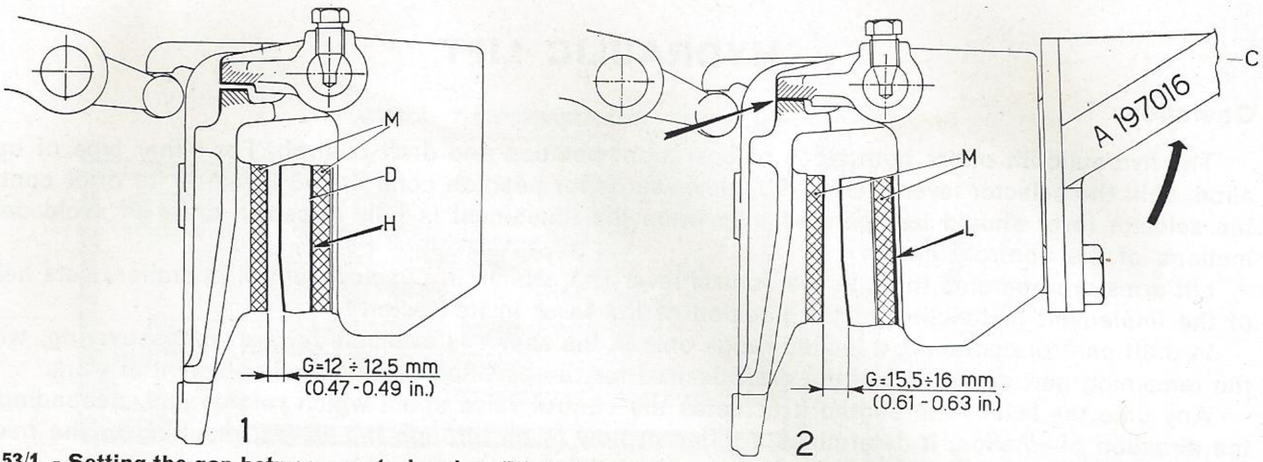
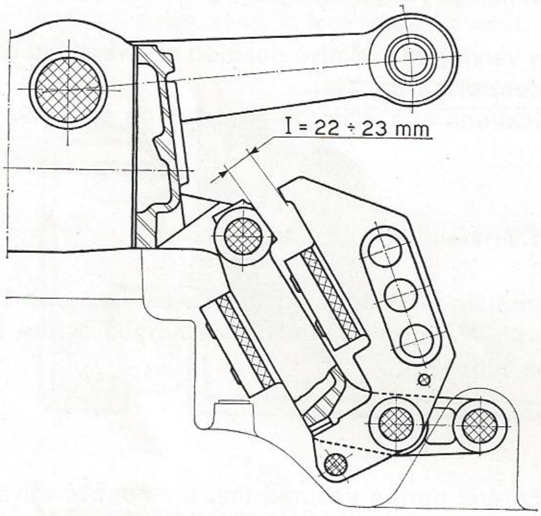


Fig. 53/1. - Setting the gap between control spring (M) and mounting plate (D) in lift units equipped with top link support hinged at top.

C. Control spring setting tool - **D.** Mounting plate - **H.** and **L.** Adjustment shims - **M.** Control spring.
1) Setting the gap G (0.47-0.49 in = 12-12,5 mm) between mounting plate and unloaded control spring (M).
2) Setting the gap G (0.61-0.63 in = 15,5-16 mm) between mounting plate and loaded spring (M).



clearance existing between the top link support and its upper stop (as shown by the arrow in the diagram 2, Fig. 53/1).

Now the distance G should be 0.61-0.63 in. (15,5-16 mm); if greater, add one or two shims (L) inserted between spring and top link support.

If still insufficient, report a suitable thickness material over the upper stop surfaces to cover up nicks and surface defects.

As for the support hinged at the lower end, the distance is 1.220-1.260 in. (31-32 mm) for the test conditions illustrated in Fig. 53/2; if greater, thicken the stop by a suitable report of material over its surface.

Fig. 53/2. - Setting the gap I between top link support and cover, on lift units equipped with the former hinged at lower end.

I = 0.87-0.91 in (22-23 mm).

B - Lift arms adjustment.

When lift arms reach their max. height, the control valve spool (P, Fig. 51) should automatically return to neutral in order to prevent the inside link, actuated by the piston, from pushing against the lift back cover, keeping the circuit under pressure and causing overheating, which might damage the safety valve and the oil pump.

Operations.

— Apply a load of at least 110 lb (50 kg) to the three-point hitch lower links.

— Start the engine and make it run to medium speed.

— Shift the control lever to the position of max. height (highest point in the sector).

— Make two alignment marks on lift casing and right-hand arm sector (Fig. 53/3).

— Turn the lift adjustment screw (10, Fig. 53/3) a few turns back until the safety valve cuts in.

— Check that the residual upwards travel of the lift arms, as shown by the alignment mark previously made, is 0.20-0.24 in. (5-6 mm).

Cautions.

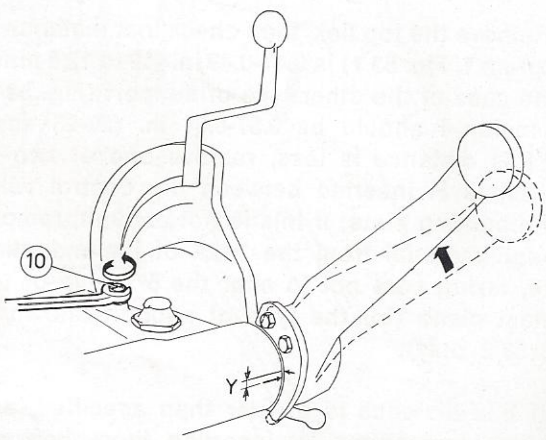


Fig. 53/3. - Lining up marks on lift casing and lift arm sector.

Y = 0.20-0.24 in. (5-6 mm), corresponding to the residual travel - **10.** Lift arm travel range adjustment screw.

If the travel is less or null, remove the shims from under the adjustment screw head (10, Fig. 53/3) until the desired dimension is obtained by proceeding as outlined above.

If the travel is greater, add shims under head.

If, after varying the shims under the adjustment screw head no variation of arm travel is noted, look for a faulty assembly or bent linkage, which requires a thorough check of the lift unit.

To reset the adjustment screw after varying the shim pack thickness, shift the control lever back downward in its sector in order to remove from it the link (D, Fig. 51) which, if deformed, might hamper the adjusting operation.

C - Sensitivity adjustment.

In order to make the lifting effort useful, it will be necessary to obtain an adequate sensitivity at the control valve spool (P, Fig. 51). This sensitivity is a function of the distance separating, in neutral position, the spool cam from the discharge valve follower rod (4).

Operations.

Apply a load of 154 lb (70 kg) approx., to the three-point hitch lower arms.

Shift the control lever all the way up in its sector and the selector lever in « position control » operation (downwards).

Start the engine and make it run at medium speed.

Shift the control lever from highest position to a medium one in its sector, then mark the position of the lever on the sector (A_1, Fig. 53/4); wait for the arms to stop.

Gradually shift the control lever upwards, a short stroke each time, until the lift arms start moving up; mark the corresponding position of the lever on the sector (A_2, Fig. 53/4). The distance travelled by the control lever from position A_1 to position A_2 should be 0.20-0.40 in. (5-10 mm);

Cautions.

If adequate ballast weights are unavailable, a man's weight will do.

This check should not be carried on in the max. lift range as results might be made unreliable by the action of the adjustment screw (10), recalling the valve spool to neutral.

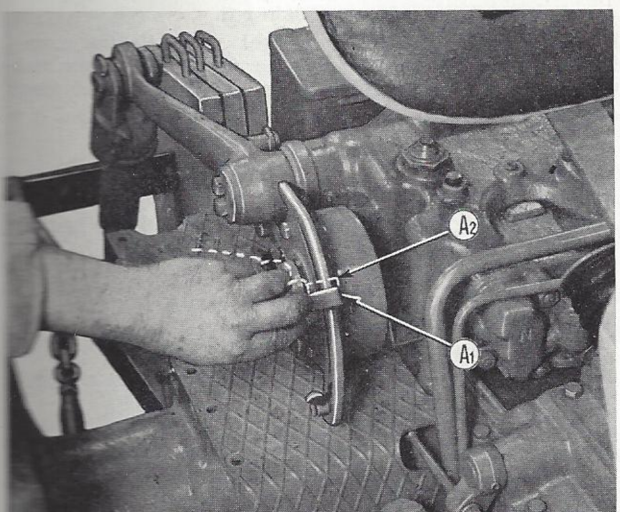


Fig. 53/4. - Adjusting the sensitivity of the lift unit.
A_1. Initial position of control lever - **A_2.** Sensitivity limit of control lever.

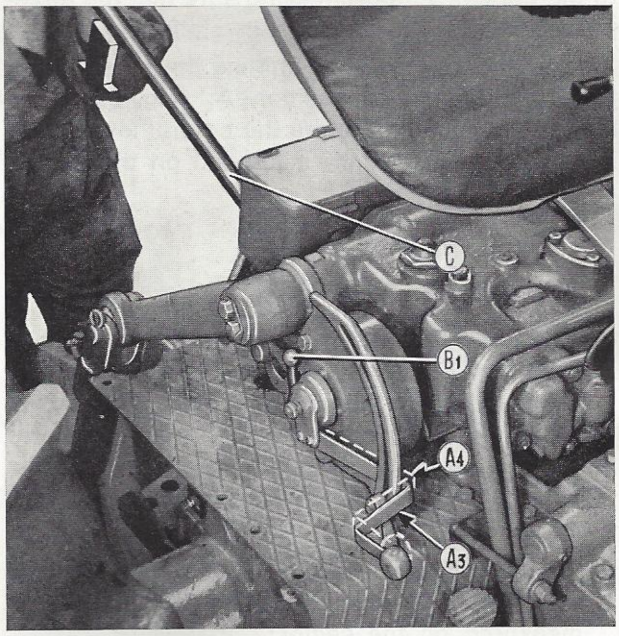


Fig. 53/5. - Adjusting the draft control range.
A_3. Initial position of control lever - **A_4.** Travel limit of control lever - **B_1.** Selector lever in « draft control » - **C.** Lever A 197016. (Travel of control lever from A_3 to A_4 measured on the sector to be less than 0.20 in. - 5 mm).

Should it be greater then 0.40 in. (10 mm), remove the cotter pin from the adjustment plug (t, Fig. 51) located at the end of spool (P), then screw it up slightly a quarter of a turn at a time until the desired dimension is obtained. Should the lever travel be less than 0.20 in. (5 mm), loosen the adjustment plug (t).

The control valve spool is actuated by a cylindrical helical return spring; it is therefore necessary to operate the lift a few times until the spring is properly set.

D - **Draft control adjustment.**

The distance between the follower (R, Fig. 53/7) and actuating cam applied to the left right hand arm determines the range of draft control operation on the control lever sector.

If this range is misplaced, either of the following may occur:

— too high: there is a neutral range, low in the sector, in which no reaction to thrusts imparted by the support will occur;

— too low: it will be impossible controlling heavy loads, and consequently working with some implements in certain conditions.

Operations.

Apply a weight of no less than 154 lb (70 kg) to the three-point hitch lower links.

Start the engine and make it run at medium speed.

Cautions.

Drive the tractor over a shop pit, or raise it by placing wooden wedge blocks under the drive wheels in order to prevent the ballast or weight from touching ground.

Shift the control lever all the way up in order to shift the selector lever from « position » to « draft control » operation (upwards).

Shift the control lever all the way down in the sector.

Take up the gap (G, Fig. 53/1) with the aid of a crowbar or lever **A 197016**, (Fig. 53/5) applied to the top link support, making sure that the three-point hitch lower links remain stationary.

On the contrary, when shifting the control lever from position A_3 to position A_4 (Fig. 53/5), the links must move up before the control lever travel reaches 0.20 in. (5 mm) measured on the sector.

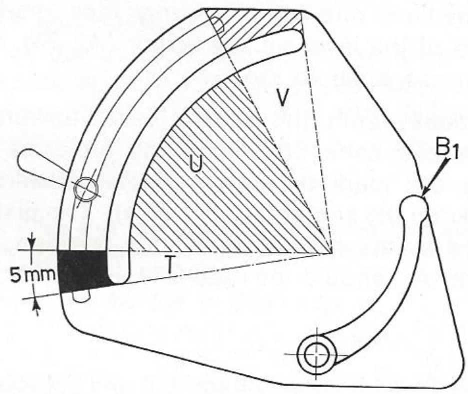


Fig. 53/6. - View of control lever sector for draft control range adjustment.

B_1. Selector lever in « draft control » - **T.** Neutral zone - **U.** Draft control zone - **V.** Lift zone. (The neutral zone measured on the periphery of the sector to be 0.20 in.-5 mm or less).

If, however:

a) the lower links move up lifting the weights or load applied to them and without displacing the control lever, the distance between reaction roller (R) and actuating cam is excessive: progressively reduce it through excentric pins of rollers R and R_1 until the hitch lower links remain stationary.

The draft control range is too low on the sector.

b) the lower links do not move, or require a travel of the control lever exceeding 0.20 in. (5 mm) measured on the sector:
Increase the gap between roller R (Fig. 53/7) and actuate cam through excentric pins R and R_1, until the lower links move up with a control lever travel of less than 0.20 in. (5 mm).

The draft control range is too high on the sector.

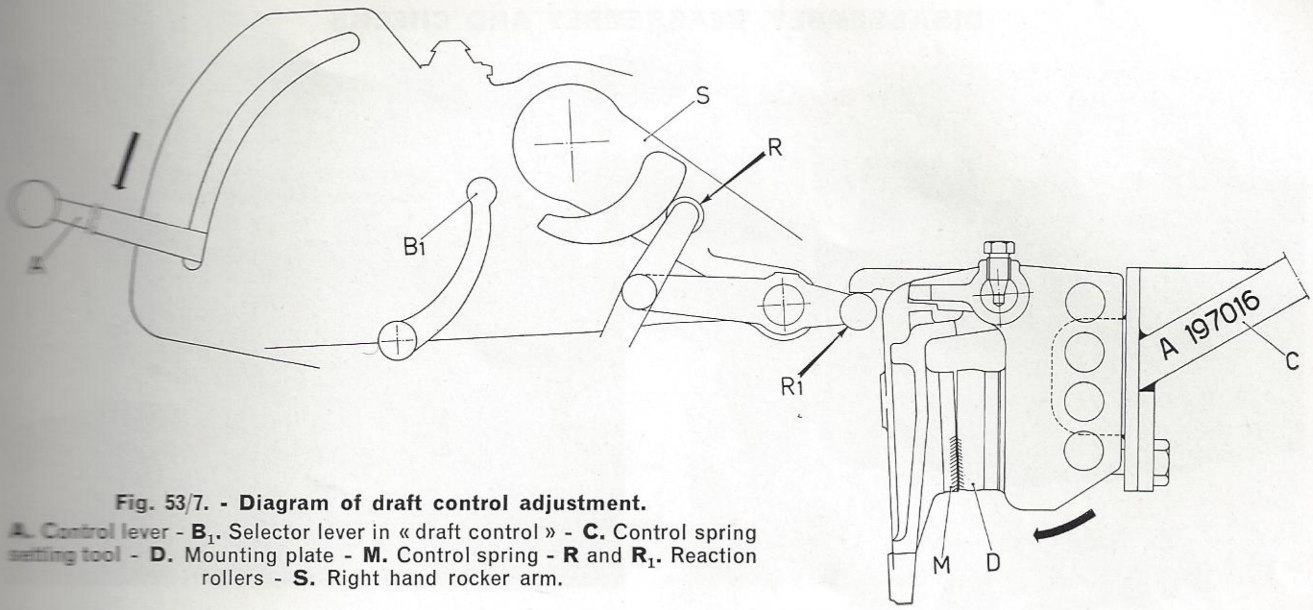


Fig. 53/7. - Diagram of draft control adjustment.
A. Control lever - **B$_1$.** Selector lever in « draft control » - **C.** Control spring setting tool - **D.** Mounting plate - **M.** Control spring - **R** and **R$_1$.** Reaction rollers - **S.** Right hand rocker arm.

TROUBLESHOOTING GUIDE

FAULT	POSSIBLE CAUSE	ATTENTION REQUIRED
Lift inoperative	1) Dry reservoir.	Fill up to level.
	2) Sticking hoisting control valve (2, Fig. 54/1).	Cleat it
	3) Pump operation defective.	Dismantle and inspect it.
Lift will hoist jerkily.	1) Oil level too low.	Fill up to level.
	2) Oil filter plugged.	Clean it.
	3) Air entering the intake.	Inspect seals and gaskets.
Lift will not hold the load raised (up-and-down oscillation with engine running; dropping of load with engine stopped).	1) Faulty control valve spool adjustment (P, Fig. 51).	Adjust it.
	2) Discharge valve (4, Fig. 54/1) leaky or sticking.	Dismantle and check; assemble the valve tightening the plug to a torque of 65-72 ft. lb. (9-10 kgm) to avoid deformations.
	3) Cylinder intake valve (5, fig. 51) leaky	Dismantle and inspect it.
	4) Piston or cylinder seals leaky.	Replace them.
	5) Cylinder safety valve (3, Fig. 54/1) leaky.	Replace it.
	6) Discharge valve seals defective (4, Fig. 54/1).	Replace them.
Weak hoisting action.	1) Pressure relief valve (1, Fig. 54/1) out-of-setting.	Replace it.
	2) Cylinder pressure safety valve (3, Fig. 54/1) out of setting.	Replace it.
	3) Low pump efficiency (*)	Check pump performance and recondition it if necessary.
Pressu rerelief valve (1, Fig. 54/1) blows with lift arms fully raised.	1) Wrong setting of adjustment screw (10, Fig. 54/1).	Reduce number of shims under screw head.
Engine oil in hydraulic fluid.	1) Pump shaft packing defective.	Inspect parts and replace where required.
Outflow of emulsioned oil from vent plug.	1) Oil level either too high or too low.	Bring oil to correct level.
	2) Oil filter plugged.	Clean it.
	3) Air entering intake duct.	Replace defective seals and inspect welds.
	4) Refer to point 1) of preceding fault.	

(*) This cause is often accompanied by a considerable increase in hoisting time.

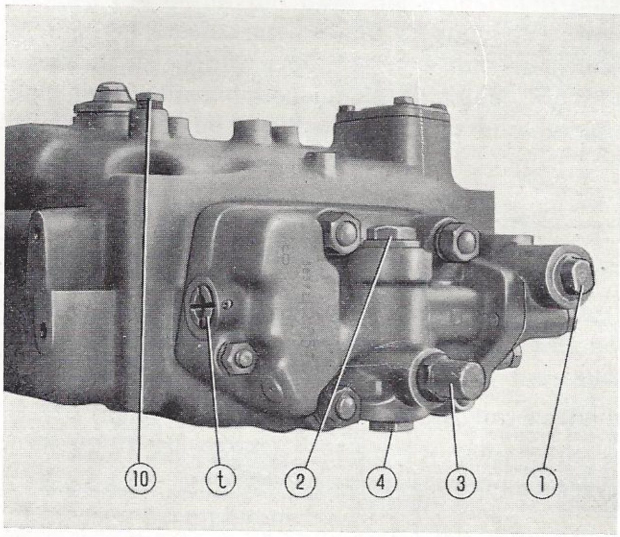


Fig. 54/1. - Arrangement of valves on lift assembly.
t. Control valve spool adjustment plug - **1.** Pressure relief valve - **2.** Lift control valve - **3.** Power cylinder safety valve - **4.** Discharge valve - **10.** Adjustment screw for rocker arms travel range.

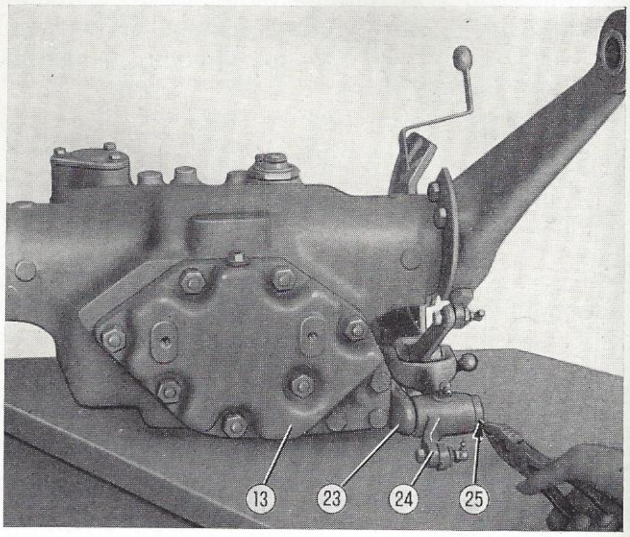


Fig. 54/2. - Removing the fork lever from the lift casing cover hinge pin.
13. Lift casing cover - **23.** Fork lever shaft - **24.** Fork lever - **25.** Cotter pin.

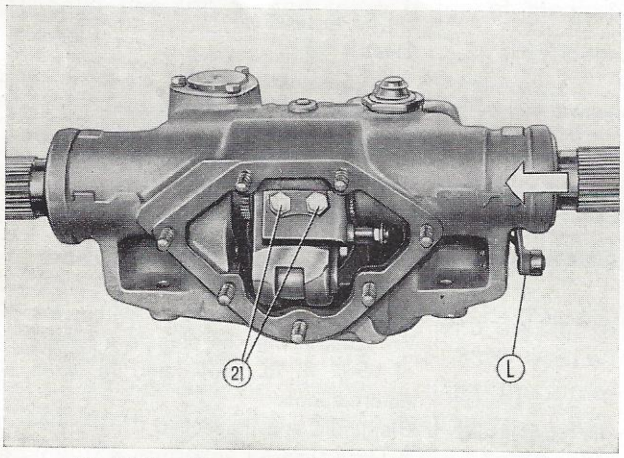


Fig. 54/3. - Removing the rocker arms shaft.
(The arrow shows direction of removal).
L. Linkage control lever - **21.** Capscrews fixing levers to inside rocker arm.

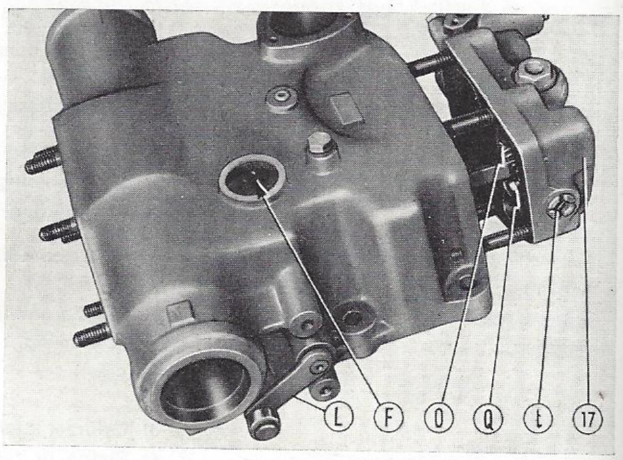


Fig. 54/4. - Removing the control valve block.
L. Linkage control lever - **O.** Cotter pin locking link to valve spool lever - **Q.** Screw securing control lever to valve spool - **F.** Access hole to the screw connecting lever **L** and rocker - **t.** Control valve spool adjustment plug - **17.** Control valve block.

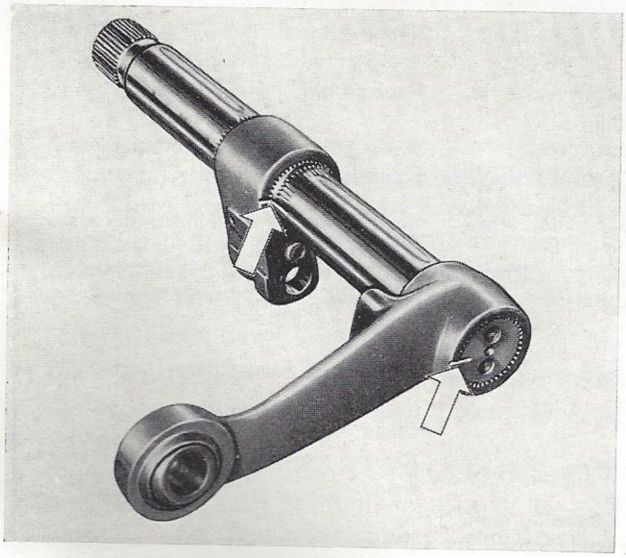


Fig. 54/5. - Assembly marks for outer and inner rocker arms.

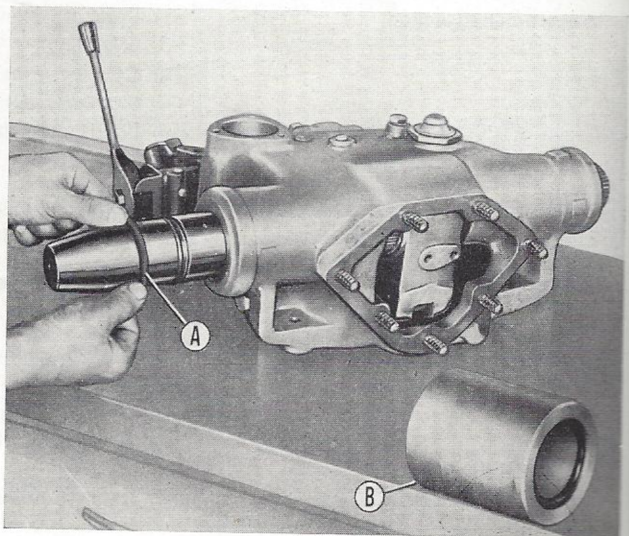


Fig. 54/6. - Fitting the seals onto the rockshaft.
A. Seal guard A 497003/A - **B.** Special punch A 497003/B.

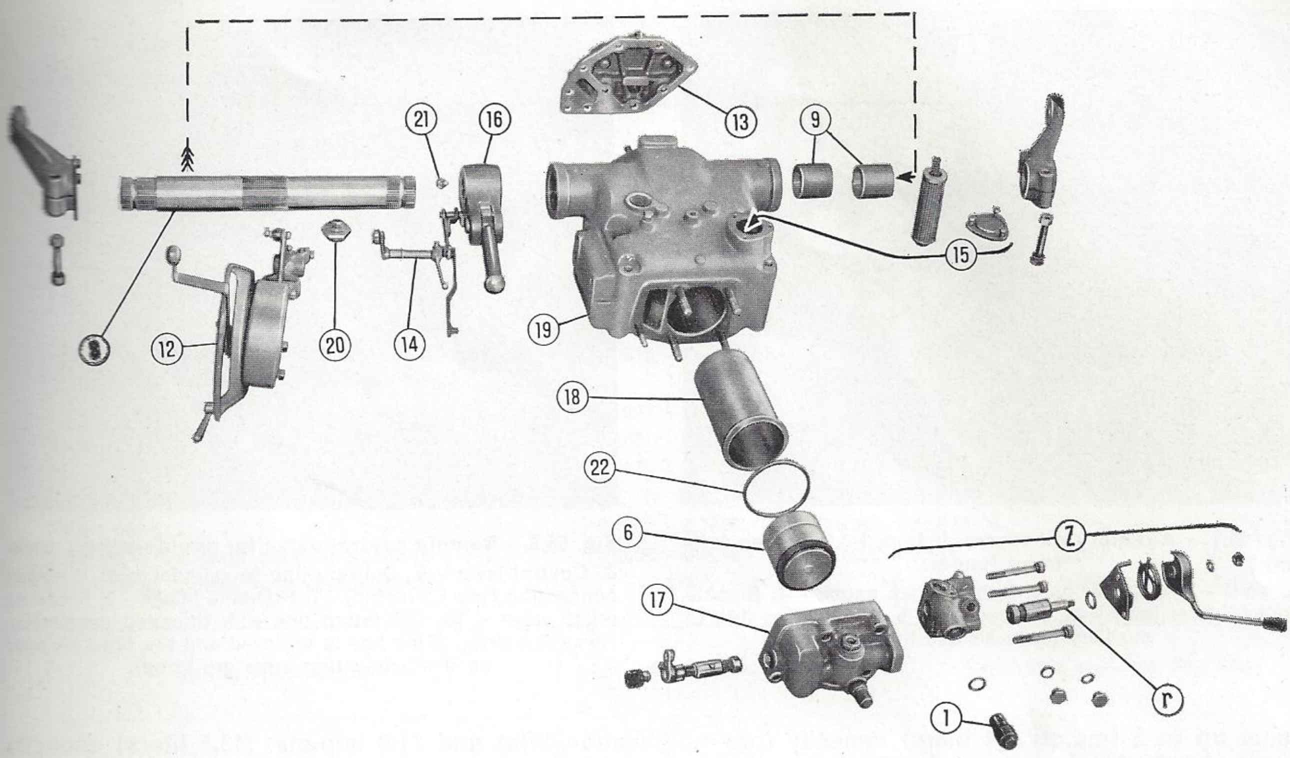


Fig. 54/7. - Exploded view of hydraulic lift unit.

6. Piston - **8.** Rockshaft - **12.** Outside linkage - **13.** Rear cover - **14.** Inside linkage - **15.** Oil filter parts - **16.** Inside arm complete with strut - **17.** Control valve block - **18.** Barrel - **19.** Lift casing - **20.** Vent plug - **21.** Capscrew fixing levers to inside arm - **22.** Barrel seal.

Z. Dismantled parts of auxiliary, remote control valve - **1.** Pressure relief valve - **r.** Valve spool.

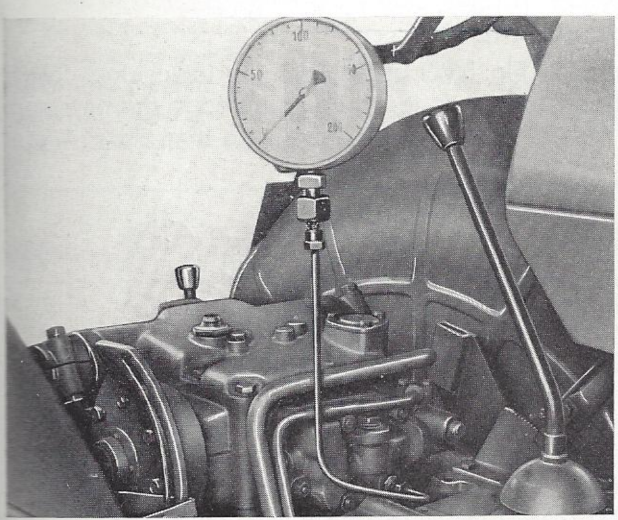


Fig. 54/8. - Checking the hydraulic system working pressure with test pressure gauge fitted with adaptor A 197035 and temporarily replacing the power cylinder safety valve

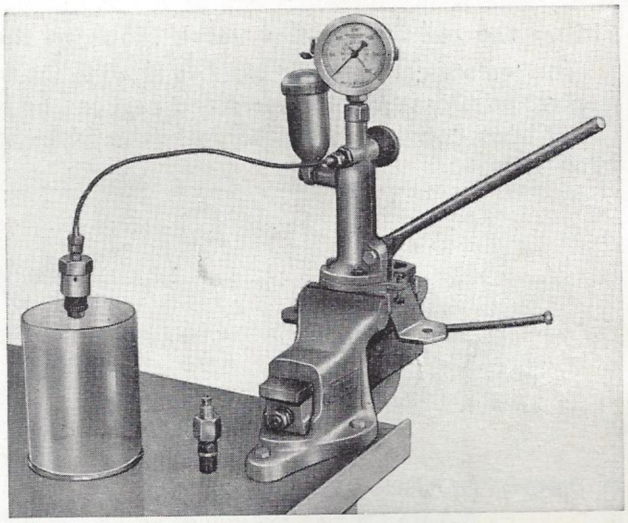


Fig. 54/9. - Test rig for pressure relief and power cylinder safety valves, fitted with valve holder A 197032/A/B.

INSTALLATION OF AUXILIARY OIL RESERVOIR FOR REMOTE CONTROL RAMS

The lift unit can be equipped with a remote control valve block for single and double-acting rams, fitted in place of the lift casing cover.

This equipment is not controlled through the lift arms lever, but rather through a special lever fitted to the valve block; this arrangement makes for indipendent operations of the two systems. They cannot operate together at the same time, but if remote control ram does not require more than 3 Imp.qts. (3.5-4 liters, pre-modification lift) and 5.7 Imp.qts. (6.5 liters, reinforced model) of fluid, the oil contained in the lift casing reservoir will do. If the equipment requires a larger volume of fluid, it will be necessary to fit with suitable brackets to the left hand-fender an auxiliary reservoir (Fig. 55/1) which will permit using

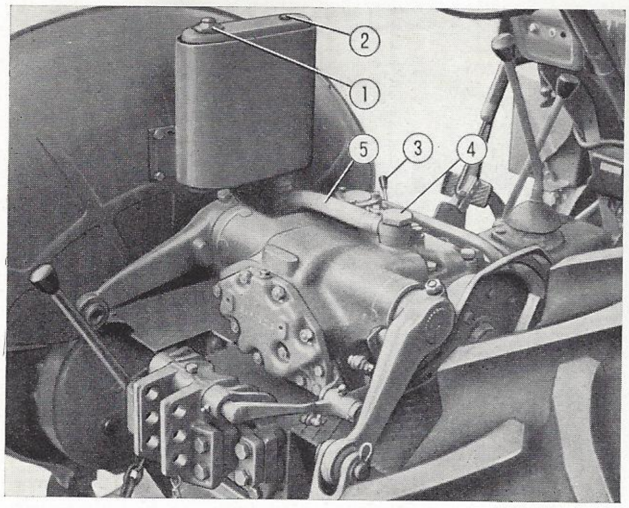


Fig. 55/1. - Auxiliary oil reservoir tank installed on left-hand fender.
1. Vent - **2.** Oil filler plug with dipstick gauge - **3.** Remote control valve lever - **4.** Connection - **5.** Connecting line of auxiliary reservoir and lift unit.

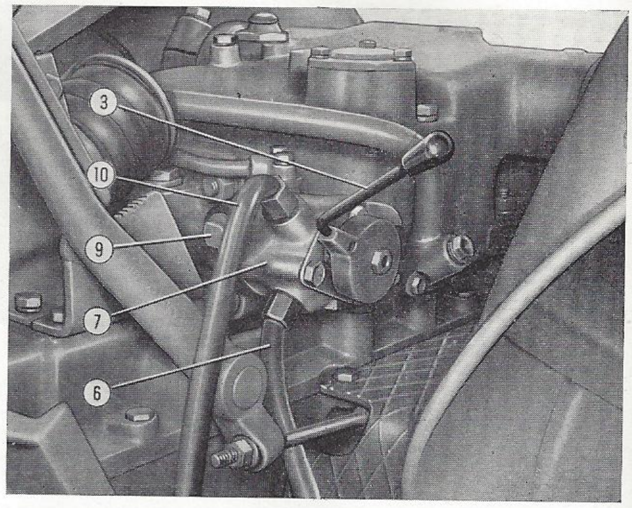


Fig. 55/2. - Remote control valve for double-acting arms.
3. Control lever - **6.** Delivery line to cylinder with threaded connection (16 x 1.5 metric) - **7.** Pressure intake - **9.** Pressure relief valve - **10.** Oil return line with threaded connection (16 x 1.5 metric). (This line is removed and the hole plugged up if single-acting arms are fitted).

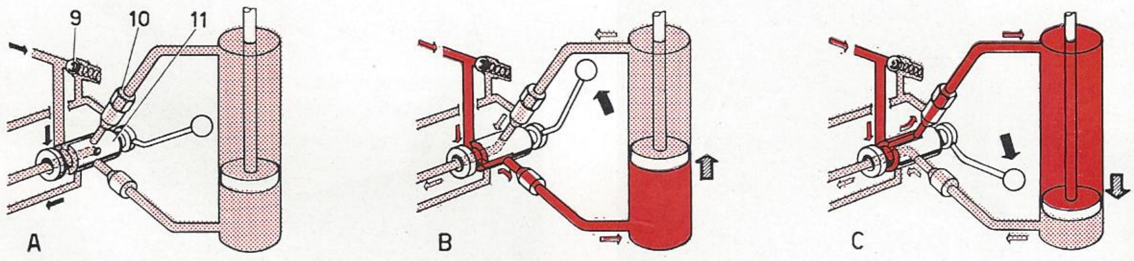
rams up to 8 Imp.qts. (9 liters) capacity (pre-modification lifts) and 11.9 Imp.qts. (13.5 liters) capacity (reinforced model).

The standard and auxiliary reservoirs are connected by an oil line attached through a suitable connection to the vent plug seat which in turn is moved with its seal to the top of the tank (Fig. 55/1). Prior to installing the auxiliary reservoir make sure the lift is properly sealed in order to avoid leaks due to the higher pressure inside the system.

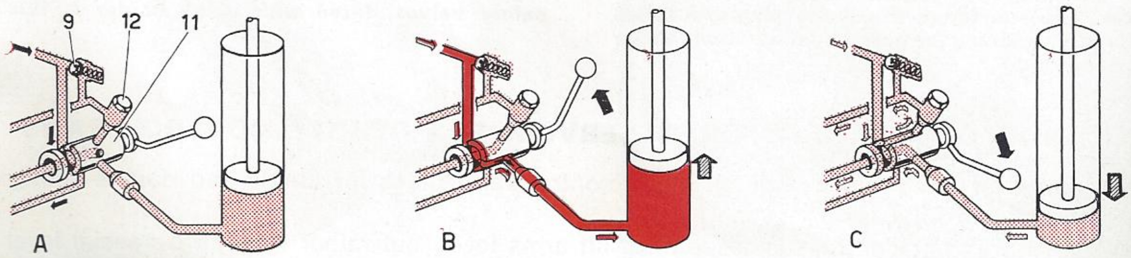
Fitting the remote control valve block to the hydraulic lift.

The remote control valve block is fitted to the hydraulic lift (Fig. 55/2) in place of the lift casing cover; gasket and pressure relief valve and seal can be recovered from the latter to be mounted in the new unit.

Oil lines connecting the control valve block to the remote control rams have a 16 mm dia., 1.5 mm pitch thread.



D. Diagrams for double-acting rams.
Remove the plug (12) and screw the fitting (10) up to connect the oil return line from the ram.



S. Diagrams for single-acting rams.
Apply the plug (12) with its seal in place of the fitting (10).

Fig. 55/3. - Flow diagram for single and double-acting rams.
9. Pressure relief valve - **10.** Connection for double-acting ram line - **11.** Remote control valve spool - **12.** Closure plug, for single-acting ram operation.

TABLES OF HYDRAULIC LIFT DATA

Standard, pre-modification model.

DESCRIPTION	Data		Wear limits	
	in	mm	in	mm
Cylinder barrel inside diameter	3.7416 - 3.7429	95,036 - 95,071		
Piston diameter	3.7388 - 3.7402	94,965 - 95,000		
Clearance - cylinder barrel and piston	0.0014 - 0.0042	0,036 - 0,106	0.010	0,25
Control valve spool diameter	0.8656 - 0.8661	21,987 - 22,000		
Clearance - spool in valve	0.0010 - 0.0014	0,025 - 0,035	0.004	0,10
Inside diameter of rockshaft bushings (press-fitted)				
— right - hand side	2.1693 - 2.1720	55,100 - 55,170		
— left - hand side	2.3661 - 2.3688	60,100 - 60,170		
Clearance - rockshaft in bushings	0.0039 - 0.0078	0,100 - 0,200	0.020	0,50
Inside diameter of bushings (press - fitted) for fork lever shaft	0.7902 - 0.7882	20,020 - 20,072		
Clearance - fork lever shaft in bushings	0.0008 - 0.0048	0,020 - 0,124	0.012	0,30
Thickness of control lever clutch plates	0.079	2	0.060	1,5

Spring specifications	Lift control valve (2, Fig. 54/1)	Discharge valve (4, Fig. 54/1)
Free length	1.81 in (46 mm)	0.87 in (22 mm)
Test length	0.78 in (20 mm)	0.39 in (10 mm)
Test load	4 - 4.8 in (1,8 - 2,2 mm)	5 - 5.7 in (2,3 - 2,6 mm)

Blow-out pressure of pressure relief valve (1, Fig. 54/1):		
— up to lift serial No. 04613	1778 - 1920 p.s.i.	(125 - 135 kg/cm²)
— starting from serial No. 04614	2062 - 2204 p.s.i.	(145 - 155 kg/cm²)
Blow-out pressure of cylinder safety valve (3)	2062 - 2204 p.s.i.	(145 - 155 kg/cm²)
Wrench torque for cylinder safety valve (3)	29 - 36 ft. lb	(4 - 5 kgm)
Wrench torque for discharge valve (4)	65 - 72 ft. lb	(9 - 10 kgm)

Reinforced model.

DESCRIPTION	Data		Wear limits	
	in	mm	in	mm
Cylinder barrel inside diameter	3.7416 - 3.7429	95,036 - 95,071		
Piston diameter	3.7388 - 3.7402	94,965 - 95,000		
Clearance - cylinder barrel and piston	0.0014 - 0.0042	0,036 - 0,106	0.010	0,25
Control valve spool diameter	0.8656 - 0.8661	21,987 - 22,000		
Clearance - spool in valve	0.0010 - 0.0014	0,025 - 0,035	0.004	0,10
Inside diam. of rockshaft bushings (force fitted) (1)				
— right - hand side	2.3661 - 2.3689	60,100 - 60,170		
— left - hand side	2.5630 - 2.5657	65,100 - 65,170		
Diameter of rockshaft:				
— right - hand side	2.3610 - 2.3622	59,970 - 60,000		
— left - hand side	2.5578 - 2.5591	64,970 - 65,000		
Clearance - rockshaft in bushings	0.0039 - 0.0078	0,100 - 0,200	0.016	0,40
Inside diameter of control lever sector hub	0.6312 - 0.6328	16,032 - 16,075		
Diameter of control lever shaft	0.6282 - 0.6299	15,957 - 16,000		
Clearance - lever shaft in sector hub	0.0013 - 0.0046	0,032 - 0,118	0.010	0,25
Inside diameter of bushings (force fitted) for fork lever shaft (2)	0.7882 - 0.7902	20,020 - 20,072		

(1) Interference fit: 0.0008-0.0040 (0.020-0.102 mm).
(2) Interference fit: 0.0020-0.0091 (0.05-0.23 mm).

Cont.: **Reinforced model.**

DESCRIPTION	Data		Wear limits	
	in	mm	in	mm
Diameter of fork lever shaft	0,7854 - 0.7874	19,948 - 20,000		
Clearance - fork lever shaft in bushings	0.0008 - 0.0048	0,020 - 0,124	0.020	0,50
Inside diameter of bushings (force fitted) for fork lever pivot	0.4730 - 0.4747	12,016 - 12,059		
Diameter of fork lever pivot	0.4717 - 0.4724	11,982 - 12,000		
Clearance - fork lever pivot in bushings	0.0006 - 0.0030	0,016 - 0,077	0.006	0,15
Inside diam. of reaction roller bushings (force fitted)	0.4737 - 0.4754	12,032 - 12,075		
Diameter of reaction roller pins	0.4714 - 0.4724	11,973 - 12,000		
Clearance - roller pin in bushing	0.0012 - 0.0040	0,032 - 0,102	0.010	0,25
Inside diameter of outside rocker arm pin bushing (force fitted)	0.4737 - 0.4754	12,032 - 12,075		
Diameter of outer rocker arm pin	0.4714 - 0.4724	11,973 - 12,000		
Clearance - rocker arm pin in bushing	0.0012 - 0.0040	0,032 - 0,102	0.010	0,25
Inside diam. of strut pivot bushings (force fitted) (²)	0.9851 - 0.9871	25,020 - 25,072		
Diameter of strut pivot	0.9822 - 0.9843	24,948 - 25,000		
Clearance - strut pivot in bushings	0.0008 - 0.0048	0,020 - 0,124	0.020	0,50
Thickness of control lever clutch plates	0.079	2	0.060	1,5
Thickness of shim for lift arm range adjustment screw (10, Fig. 54/1)	0.018 - 0.022	0,45 - 0,55		
Thickness of control spring adjustment shims (H and L, Figs. 51 and 52)	0.010 - 0.014	0,25 - 0,35		
Distance between ends of control spring M, removed	1.76 - 1.78	44,8 - 45,2		

Spring specifications	Lift control valve (2, Fig. 54/1)	Discharge valve (4, Fig. 54/1)
Free length	1.81 in (46 mm)	0.87 in (22 mm)
Test length	0.78 in (20 mm)	0.39 in (10 mm)
Test load	4 - 4.8 in (1,8 - 2,2 mm)	5 - 5.7 in (2,3 - 2,6 mm)

Blow - out pressure of pressure relief valve (1, Fig. 54/1)	2062 - 2204 p.s.i.	(145 - 155 kg/cm²)
Blow - out pressure of cylinder safety valve (3) .	2845 - 2987 p.s.i.	(200 - 210 kg/cm²)
Wrench torque for cylinder safety valve (3) . . .	21.7 - 28.9 ft. lb	(3 - 4 kgm)
Wrench torque for discharge valve (4)	43.4 - 50.6 fr. lb	(6 - 7 kgm)

(²) Interference fit: 0.0020-0.0091 (0.05-0.23 mm).

ELECTRICAL SYSTEM

GENERATOR FIAT MOD. DC 115/24/7/3

Wiring diagrams for testing generator on bench.

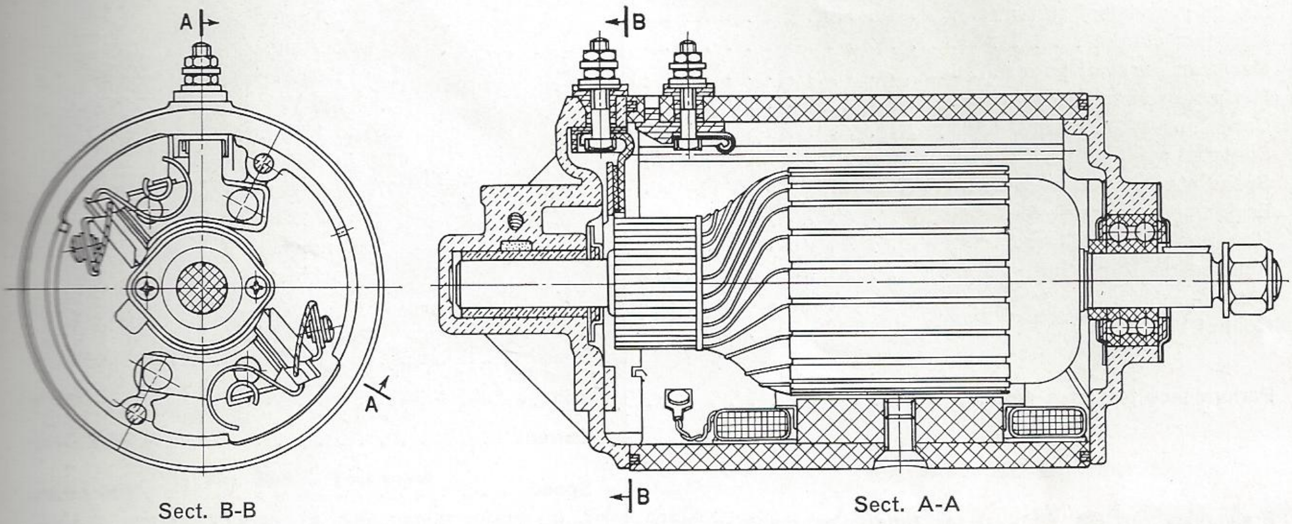


Fig. 56. - Sectional views of generator model DC 115/24/7/3.

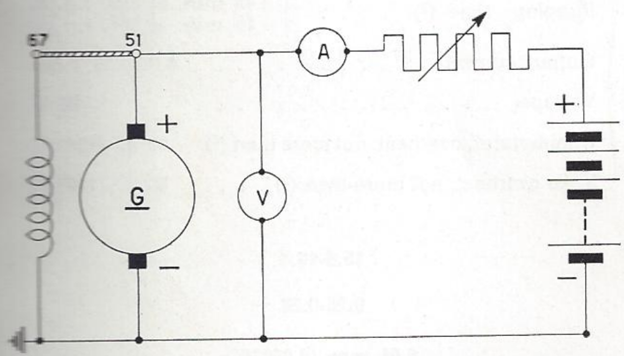


Fig. 56/1. - Motor test.

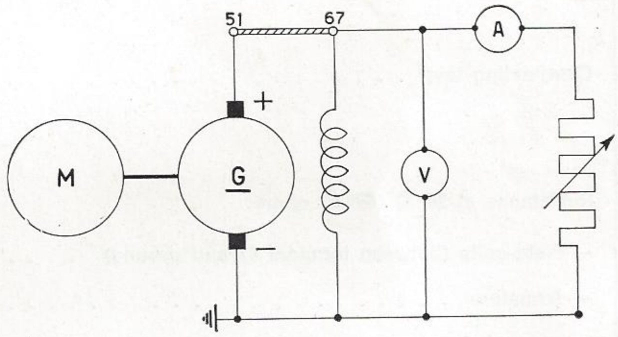


Fig. 56/2. - Output test.

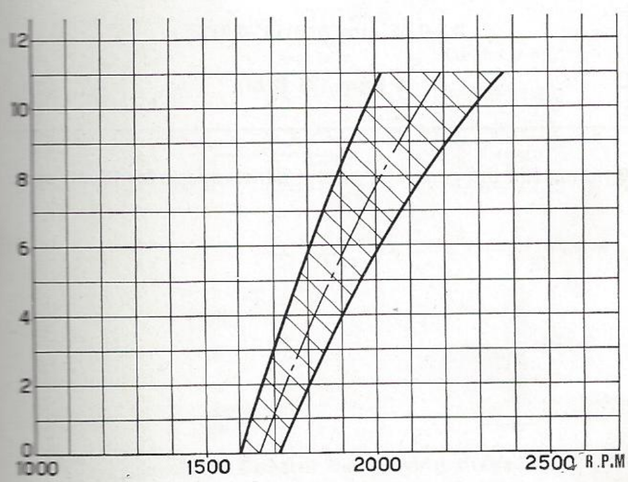


Fig. 56/3. - Output curve (hot).

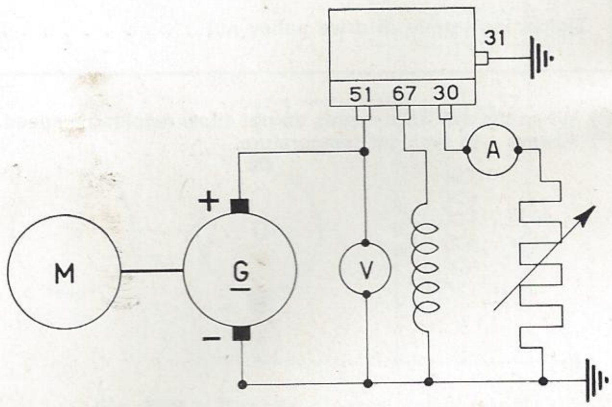


Fig. 56/4. - Overheating test.

A. Ammeter (0-10 Amp) - **G.** Generator - **M.** Generator driving motor - **V.** Voltmeter (0-30 V.).

SPECIFICATIONS

Description	Data
Voltage	24 V
Maximum constant current	7 Amp.
Maximum current	8,5 Amp.
Maximum constant power	196 W
Maximum power (cold)	238 W
Cut-in speed, 24 V, 20° C (68° F)	1550 to 1650 r.p.m.
Speed at max. constant current output, 7 Amp., 20° C (68° F)	1725 to 1875 r.p.m.
Speed at max. current, output 8.5 Amp. at 20° C (68° F)	1770 to 1930 r.p.m.
Engine and generator revs. ratio	1 : 2,062
Maximum constant speed	5800 r.p.m.
Rotation (looking from drive end)	clockwise
Shunt - wound.	
Control box	type GP 1/24/7
Performance test as a motor	Speed: **1170-1330 r.p.m.** Voltage: **24 V** Current: **4.5-6.5 Amp**
Preliminary run (**30** minutes) for Amp/r.p.m. readings for a warmed-up unit	Speed: **2900 r.p.m.** Voltage: **28 V** Current: **6.75-7.25 Amp**
Overheating test	Running time (1): **45 min.** at **2900 r.p.m.**; **15 min.** at **5800 r.p.m.** Output current: **6.75-7.25 Amp** Voltage: **28 V** Commutator, overheat, not more than (2): **90° C (194° F)** Yoke overheat, not more than (2): **60° C (140° F)**
Resistance at **20° C (68° F)** ohms:	
— Field-coils (between terminal 67 and ground)	**15.6-16.4**
— Armature	**0.25-0.28**
Commutator bar maximum out-of-round	**0.01 mm (0.00039″)**
Brush side play	**0.1-0.4 mm (0.0039″-0.0157″)**
Pressure by springs on brushes (new)	**0.69-0.76 kg (1.52-1.67 lb)**
Diameter between pole shoes middle line	**70.6-70.75 mm (2.779″-2.785″)**
Air gap	**0.3-0.45 mm (0.0118″-0.0177″)**
Tightening torque of drive pulley nut	**4 kgm (29 ft/bl)**

(1) When the available means do not allow reaching a speed of 5800 r.p.m., run the generator at test bench speed for 15 minutes.
(2) Always add ambient temperature.

CONTROL BOX FIAT MOD. GP 1/24/7

Wiring diagrams for testing control box on bench.

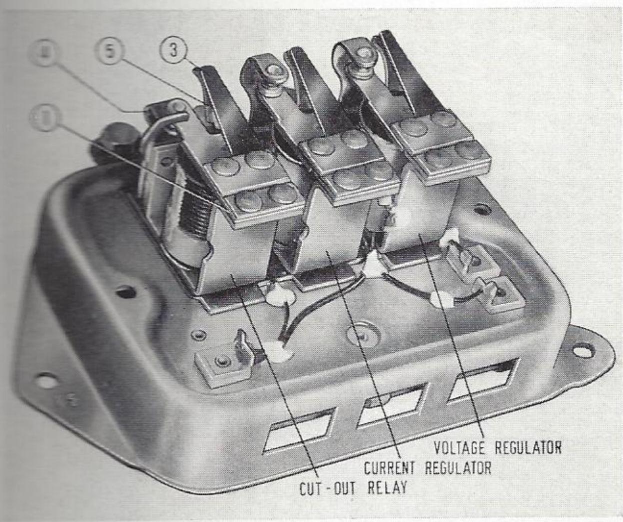


Fig. 56/5. - Top view.

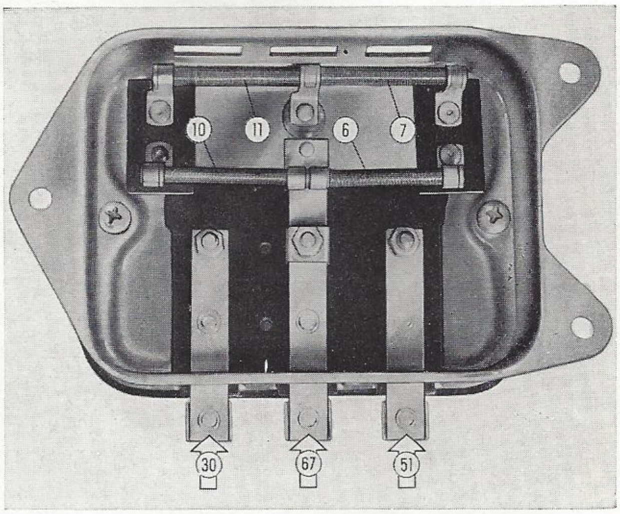


Fig. 56/6. - Bottom view.

1. Cut-out armature hinge - **3.** Adjustment spring - **4.** Fixed contact plate - **5.** Adjustment spring plate - **6.** Regulation resistance - **7.** Additional resistance connected across the voltage regulator - **10.** Damping resistance shunted across the generator between current regulator and ground - **11.** Additional resistance for current regulator and cut-out windings - **30.** Electrical equipment terminal - **51.** Generator positive terminal - **67.** Generator field winding terminal.

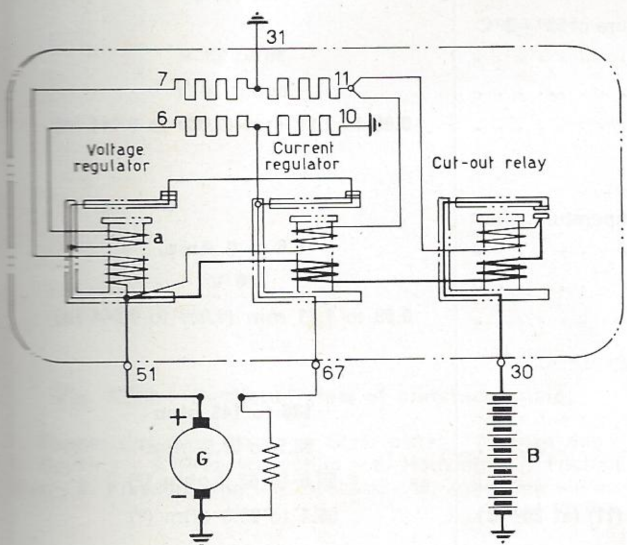


Fig. 56/7. - Control box wiring diagram.

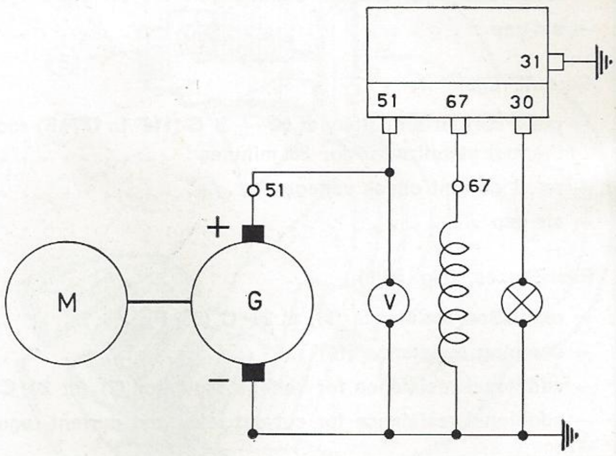


Fig. 56/8. - Cut-out closing voltage test.

a. Accelerator winding in series with the regulation resistance (6) - **B.** 12 V. batteries, in series - **G.** Generator model DC 115/24/7/3 and derived models - **M.** Test bench motor - **V.** Voltmeter (31—30 V).

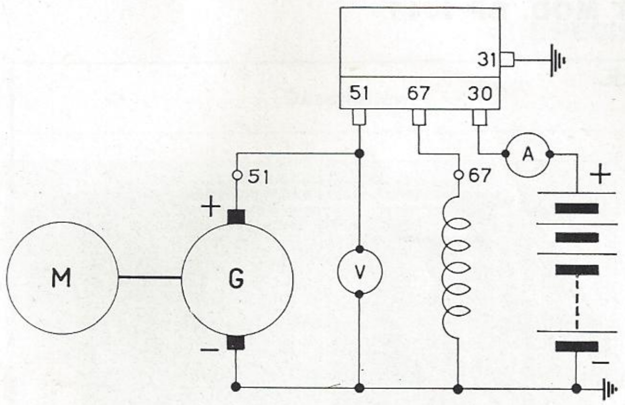


Fig. 56/9. - Cut-out reverse current test.

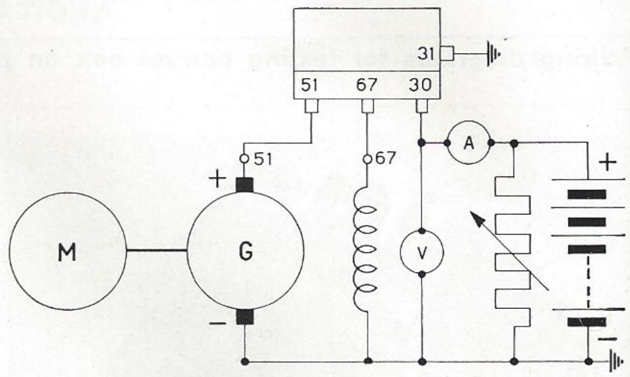


Fig. 56/10. - Current and voltage regulator check.

A. Ammeter (0-10 Amp) - **G.** Generator FIAT DC 115/24/7/3 and derived models - **M.** Test bench motor - **V.** Voltmeter (0-30 V.).

SPECIFICATIONS

Description	Data
Cut-out relay:	
— feed voltage for thermal stabilization at **25°** ± **10° C** (**59°** to **95° F**) for **15** to **18** minutes	about **30 V**
— cut-in voltage	**25.1** to **25.9 V**
— voltage variation for contact closing stroke	**0.2 V** or less
— reverse current	**6** to **14 A**
— air gap, contacts closed	**0.25 mm (0.010 in)**
— gap between contacts	**0.64** to **0.76 mm (0.025** to **0.029 in)**
Voltage regulator:	
— batteries capacity at **28 V**	**100 Ah**
— half load current	**3.5 Amp.**
— rated voltage after thermal stabilization at an ambient temperature of **50°** ± **3° C** (**116°** to **127° F**) for **30** minutes at half load	**28** to **29 V**
— feed voltage for thermal stabilization	about **30 V**
— air gap	**0.99** to **1.11 mm (0.039** to **0.044 in)**
Current regulator:	
— rated current on battery at **50°** ± **3° C** (**116°** to **127° F**) room temperature, after thermal stabilization for **30** minutes	**6.6** to **8 Amp.**
— rated current check voltage	**26 V**
— air gap	**0.99** to **1.11 mm (0.039** to **0.044 in)**
Resistances, (Fig. **56/6**)	
— regulation resistance **(6)**, at **20° C** (**68° F**)	**130** to **145 ohm**
— damping resistance **(10)**	**56.5** to **63.5 ohm**
— additional resistance for voltage regulator **(7)** (at **20° C**)	**56.5** to **63.5 ohm** (°)
— additional resistance for cut-out relay and current regulator **(11)** (at **20° C**)	**56.5** to **63.5 ohm** (°)

Note: The generator check and adjustment speed is 3500 r.p.m.

(°) It was 71 to 79 ohm in pre-modification units, part no. 4055883.

STARTING MOTOR MT 43 D

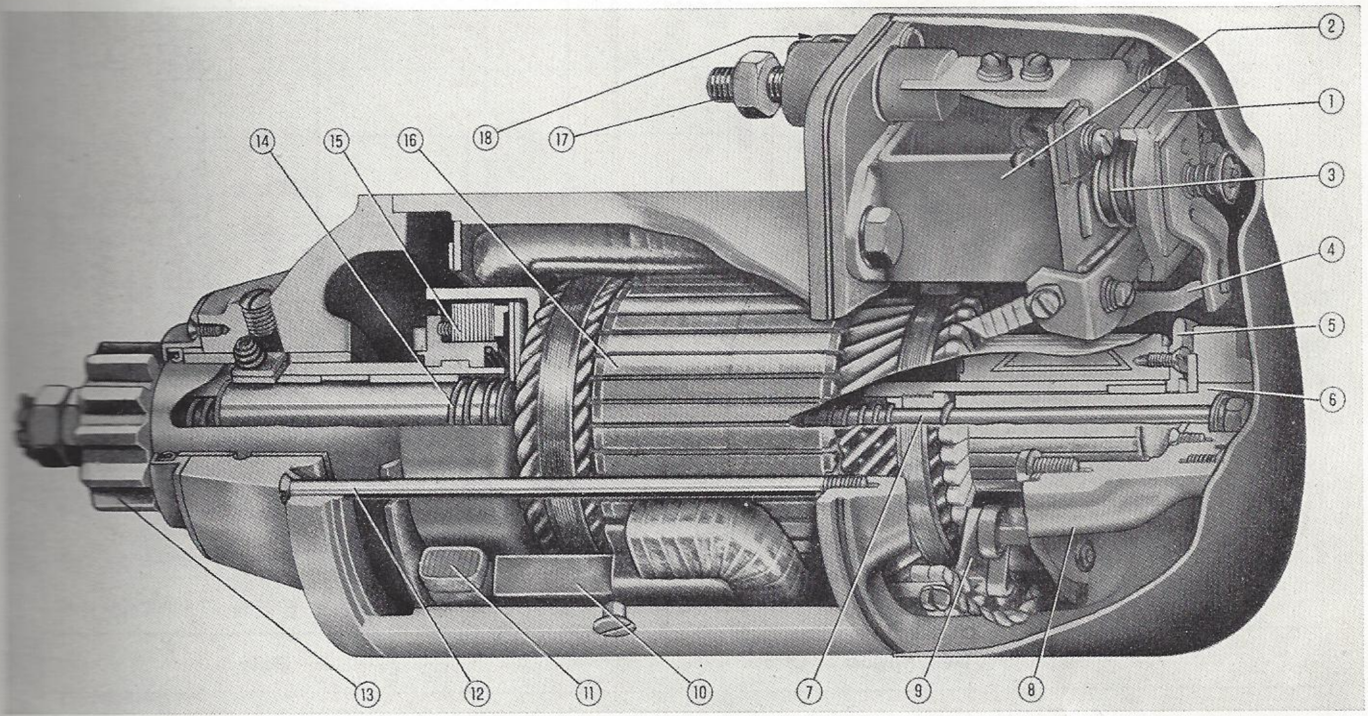


Fig. 56/11. - Sectional view of starting motor mod. MT43D.

1. Closing contact bridge - **2.** Solenoid switch - **3.** Contact bridge recoil spring - **4.** Engagement lever - **5.** Uncoupling disc - **6.** Armature guide bushing - **7.** Armature recoil spring rod - **8.** Brush-holder supporting bracket - **9.** Brush - **10.** Pole shoe - **11.** Field coil - **12.** Through-bolt - **13.** Pinion - **14.** Thrust spring - **15.** Disc-type clutch - **16.** Armature - **17.** Positive terminal - **18.** Solenoid feed terminal.

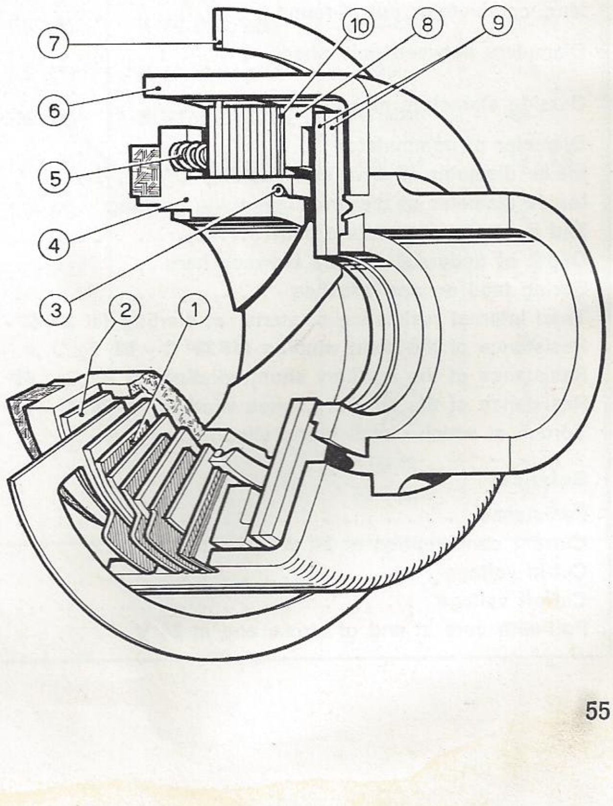


Fig. 56/12. - Sectional view of clutch-coupling.

1. Copper-zinc alloy discs - **2.** Steel plates - **3.** Snap ring - **4.** Bushing - **5.** Pressure spring - **6.** Housing - **7.** Friction disc - **8.** Pressure ring - **9.** Spacers - **10.** Adjusting shims.

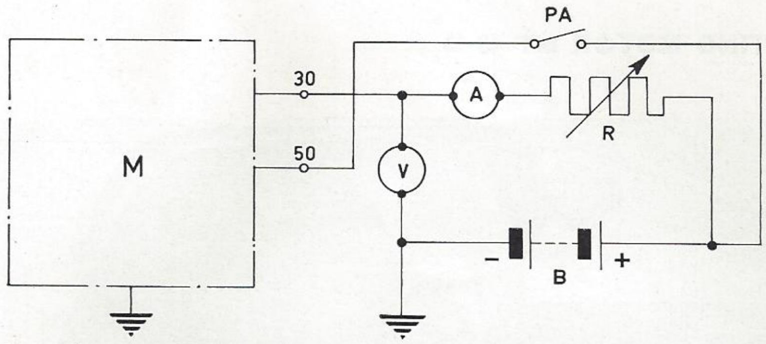


Fig. 56/13. - Wiring diagram of test bench arrangement for starting motor.

M. Starting motor undergoing test - **V.** 0-30 V voltmeter - **A.** 0-1000 Amp. ammeter - **B.** 12 V, 100 Ah, fully charged batteries, connected in series - **R.** Carbon-plate rheostat, 0-1000 Amp. - **PA.** Starting push-botton.

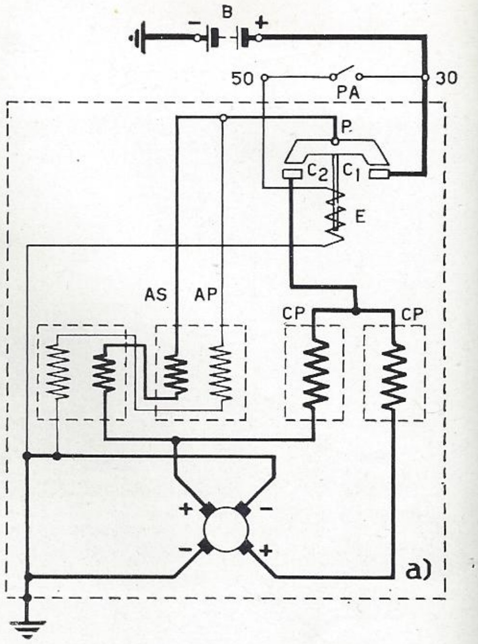


Fig. 56/14. - Wiring diagram of starting motor.

B. Battery - **PA.** Starting push-button - **P.** Contact bridge - **E.** Solenoid - **AS.** Auxiliary series winding - **AP.** Auxiliary shunted winding - **CP.** Main field winding - **C_1.** Feed contact for auxiliary wirding - **C_2.** Feed contact for main field winding.

SPECIFICATIONS

Description		Data
Make and model		Marelli - MT 43 D
Rated voltage		24 V
Rated output		4 HP
Excitation		compound wound
Number of poles		4
Rotation (viewed from driving end)		clockwise
Starter drive (solenoid)		clutch - type
Load test	current	**250 Amp** or less
	torque	**1.2 kgm (8.7 lb/ft)**
	speed	**2300** to **2500 r.p.m.**
	voltage	**21** to **21.5 V**
Lock test	current	**960 Amp** or less
	voltage	**14.3** to **14.5 V**
	torque	**6 kgm** or more **(43.5 lb/ft)**
Idle run test	current	**55 Amp** or less
	voltage	**24.5 V**
	speed	**950** to **1100 r.p.m.**
Max. commutator out-of-round		**0,03 mm (0.0012 in)**
Diameters between pole shoes		**83.25** to **83.35 mm (3.278** to **3.282 in)** **83.65** to **83.85 mm (3.293** to **3.301 in)**
Outside diameters of armature		**82.346** to **82.403mm (3.242** to **3.244 in)** **82.946** to **83.00 mm (3.266** to **3.268 in)**
Diameter of commutator		**48.540** to **48.70 mm (1.911** to **1.917 in)**
Inside diameter of drive end bushing		**34.70** to **34.80 mm (1.366** to **1.370 in)**
Inside diameter of the armature guide bushing		**16.550** to **16.62 mm (0.652** to **0.654 in)**
End float of the armature shaft		**0.5** to **2.5 mm (0.020** to **0,098 in)**
Depth of undercut of mica between bars		**0.8 mm (0.031 in)**
Spring load on new brushes		**0.8** to **1 kg (1.7** to **2.2 lbs)**
Total internal resistance of starter at starting (at **20° C - 68° F**)		**0.0090** to **0.0098 ohms**
Resistance of the main winding (at **20° C - 68° F**)		**0.0030** to **0.0036 ohms**
Resistance of the auxiliary shunt winding (at **20° C - 68° F**)		**1.8** to **2 ohms**
Resistance of the auxiliary series winding (at **20° C - 68° F**)		**1** to **1.1 ohm**
Torque at which clutch starts slipping		**12** to **16 kgm (87** to **115 lb/ft)**
Solenoid		
Resistance		**3.05** to **3.35 ohms**
Current consumption at **24 V**		**7.3** to **7.75 Amps**
Cut-in voltage		**14 V** or less
Cut-off voltage		**3 V** or less
Pull with core at end of stroke and at **24 V**		**4.6** to **5.4 kg (10** to **12 lb)**

WRENCH TORQUE DATA

DESCRIPTION	Thread	R (1)	Torque ft-lb	Torque kgm
Engine.				
Nut, flywheel to crankshaft	M 12 x 1.5	R 50 cad. pltd.	50.5	7
Screw, crankpin bearing caps	M 13 x 1 (*)	R 100	72	10
Nut, main bearing cap studs	M 16 x 1.5	R 50 cad. pltd.	100	14
Nut, cylinder head	M 16 x 1.5	R 80 cad. pltd.	160	22
Screw, generator and fan drive pulley	M 18 x 1.5 (*)	R 80	130	18
Nut, fan pulley hub	M 12 x 1.5	R 50	61.5	8.5
Nut, timing drive gear	M 25 x 1.5	R 60	108.5	15
Screw, injection pump drive gear	M 8 x 1.25 (*)	R 80 cad. pltd.	14.5	2
Nut, generator drive pulley	M 12 x 1.5	R 50 cad. pltd.	50.6	7
Nut, injectors to cylinder head	M 8 x 1.25	R 80 cad. pltd.	14.5	2
Transmission.				
Screw, p.t.-o. gear to support	M 10 x 1.5 (*)	R 100	50.6-54.2	7-7.5
Locknut, straight-drive gear to drive shaft	M 65 x 2 (*)	R 80	145	20
Locknut, taper roller bearings to driven shaft	M 62 x 1.5	R 80	181	25
Screw, bevel gear to differential casing	M 12 x 1.25 (*)	R 100	79	10.9
Nut, studs, final drive to transmission casing	M 12 x 1.75 (*)	R 50 cad. pltd.	56.5	7.8
Nut, final drive shaft to hub	M 39 x 4 (*)	R 50 cad. pltd.	723	100
Screws, steering gear box to clutch casing	M 14 x 1.5 (*)	—	123	17 (2)
Nut, steering arm to steering gear box	M 22 x 1.5 (*)	—	145	20
Screw, steering lever to righthand steering	M 14 x 1.5 (*)	R 80 cad. pltd.	87	12
Screw, steering lever to left-hand steering knuckle	M 14 x 1.5 (*)	R 80 cad. pltd.	87	12
Nut, steering knuckle to spindle	M 24 x 1.5 (*)	R 50 cad. pltd.	398-434	55-60
Nut, steering wheel hub bearings to steering knuckle	M 24 x 1.5 (*)	R 50 cad. pltd.	29	4
Screw, steering wheel disc to hub	M 20 x 1.5 (*)	R 80 phosptd.	311-340	43-47
Screws, strut support to axle support	M 16 x 1.5 (*)	R 80 cad. pltd.	130-141	18-19.5
Nut, strut central pin	M 20 x 1.5 (*)	R 50 cad. pltd.	126.5-137	17.5-19
Attachments.				
Locknut, belt pulley driven bevel pinion	M 28 x 1.5 (*)	R 80	145	20
Valve, cylinder pressure relief (3, Fig. 54/1) — pre-modif	—	—	29-36	4-5
Valve, cylinder pressure relief (3, Fig. 54/1) — reinforced	—	—	21.7-29	3-4
Valve, discharge (4, Fig. 54/1) — pre-modif	—	—	65-72	9-10
Valve, discharge (4, Fig. 54/1) — reinforced	—	—	43.5-50.5	6-7

(*) Dip in oil prior to tightening.

(1) Ultimate strength of material in kg/sq.mm.

(2) It was 58 ft-lb (8 kgm) up to chassis serial No. 104752.

MAINTENANCE AND LUBRICATION SCHEDULE

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.

Wash with kerosene:
- crankcase oil disc-type filter (engine mod. CO1D/55);
- 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 engine oil.
Wash with kerosene the cloth cartridge of the fuel filter.
Replace the paper cartridge of the fuel filter.
Have valve tappet gap checked (0.010"-0,25 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.

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