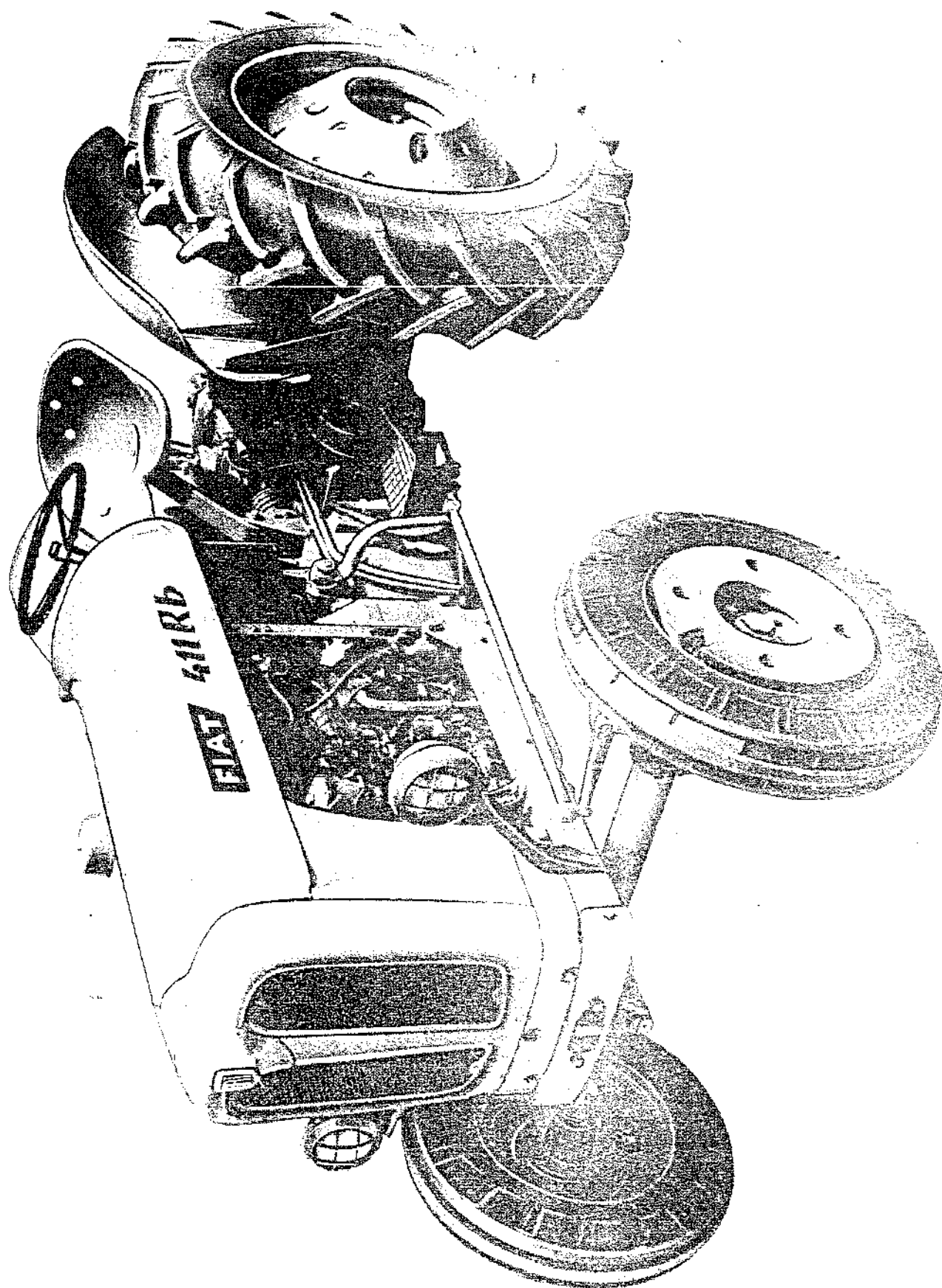




GASOLINE ENGINE

TRACTOR MODEL 411 Rb

OVERHAUL AND REPAIR INSTRUCTIONS



FOREWORD

This publication is destined to Repair Shops and presents the technical data, instructions and illustrations related to the gasoline engine 105.615 fitted on Tractor 411 Rb.

For the repair of the other tractor components, not discussed herein, please refer to Overhaul and Repair Instructions of 400 R series tractors (Print 354.869).

This publication is divided as follows:

- I. Overhaul and adjustment of engine and its components;
- II. The characteristics, performances and implements of Tractor 411 Rb.

NOTE:

Conversions of measures (from mm to in.) of the quoted figures are listed on page 66.

ENGINE

DESCRIPTION

A four-stroke, Otto cycle, four-cylinder-in-line engine type 105.615, fitted on Tractor series 400 Rb.

Special-casting cylinder liners fitted in the crankcase and water cooled.

Aluminum cylinder heads with cast iron inserted valve seats.

Steel counterweighted crankshaft, having integral webs, bearing on three supports.

Thin-shell-type journal bearings at crankshaft and connecting-rod big ends, lined with anti-friction metal.

Inlet and discharge valves controlled by rocker arms, push rods and tappets by camshaft, located in the crankcase, and chain-driven by the crankshaft.

A gear-type pump driven by the camshaft supplies pressure lubrication; circulation controlled by adjustment valve in the main system fitted outside the left crankcase side. The lubrication system includes, in addition, a suction filter, directly connected to the pump suction and a shunt cartridge-type filter.

Water circulation engine-cooling by centrifugal pump and controlled, as engine is cooled, by a thermostat fitted in the water passage between cylinders and radiator.

Carburetor air through oil-bath filter, and gasoline feeding by diaphragm-pump.

Solex non-frost horizontal intake type, provided of starting primer.

Storage-battery-actuated ignition, the distributor being controlled by the distribution shaft, and ignition coil.

Centrifugal-weight governor controlling engine speed, fitted at generator armature spindle rear-end.

Electrical-motor starting, provided of electromagnetic clutch.

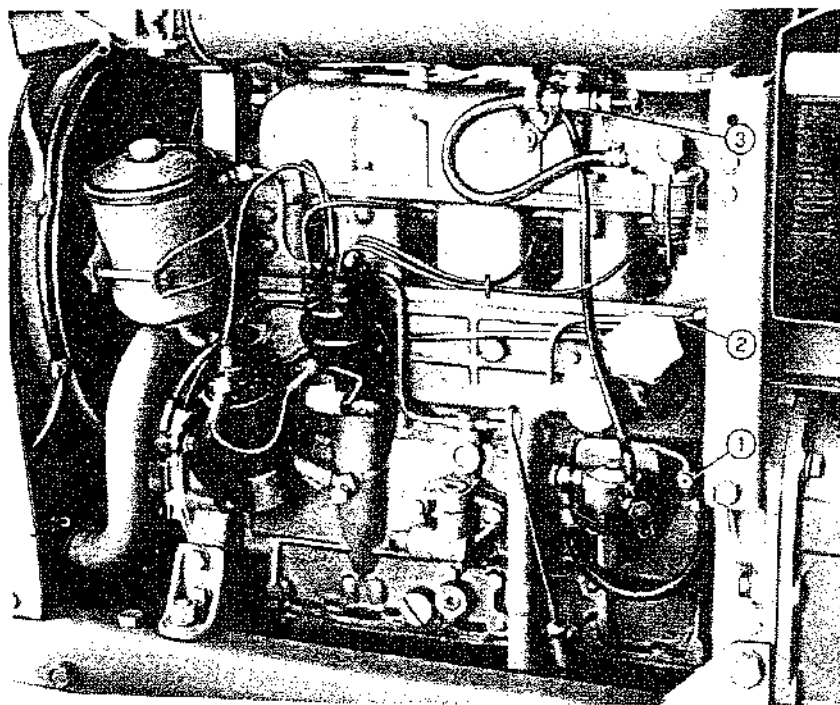


Fig. 1 - Engine mounted on tractor, as viewed from its left side.

1. Crankcase water drain-cock. - 2. Pressure-gauge pipe. - 3. Fuel cock.

Removal of engine and clutch from tractor.

We suggest the following procedure to remove the engine-clutch group from tractor:

Removal of components.

Radiator.

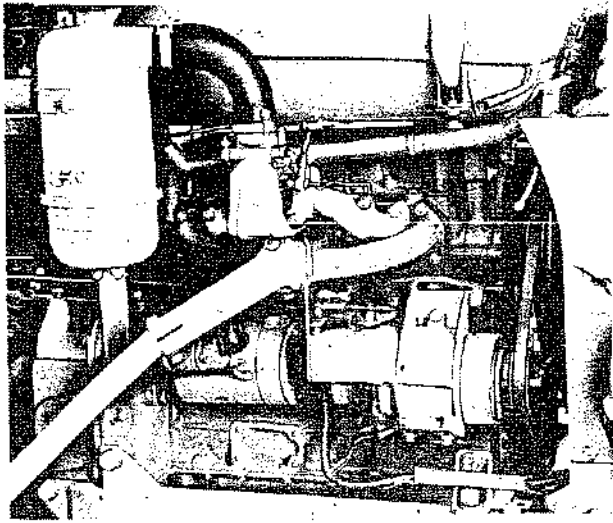


Fig. 2 - Engine mounted on tractor, viewed from its right side.

The fuel tank.

Air cleaner, silencer and exhaust pipe (fig. 2).

Batteries and joints (fig. 3).

Procedure and cautions.

Drain water from the cock found at radiator support bottom and from the crankcase cock (1, fig. 1);

disconnect the headlamp cables and remove the radiator grill;

disconnect the hose clamps and remove the radiator.

NOTE. - If tractor is fitted with hydraulic lift do not remove the pump to take away the radiator, being sufficient:

- to remove the pump control-shaft sections union bolt;
- to slide parallel to shaft axis, towards the pump, the shaft section connected to the driving pulley;
- incline radiator towards engine, to take away the end of shaft connected to pump.

Shut fuel cock (3, fig. 1);

disconnect the bowl filter feed pipe and remove both tank and its front support.

Remove the two batteries from their support, after firstly disconnecting the grounding cable, after remove the feeding cable from generator and starting motor terminals.

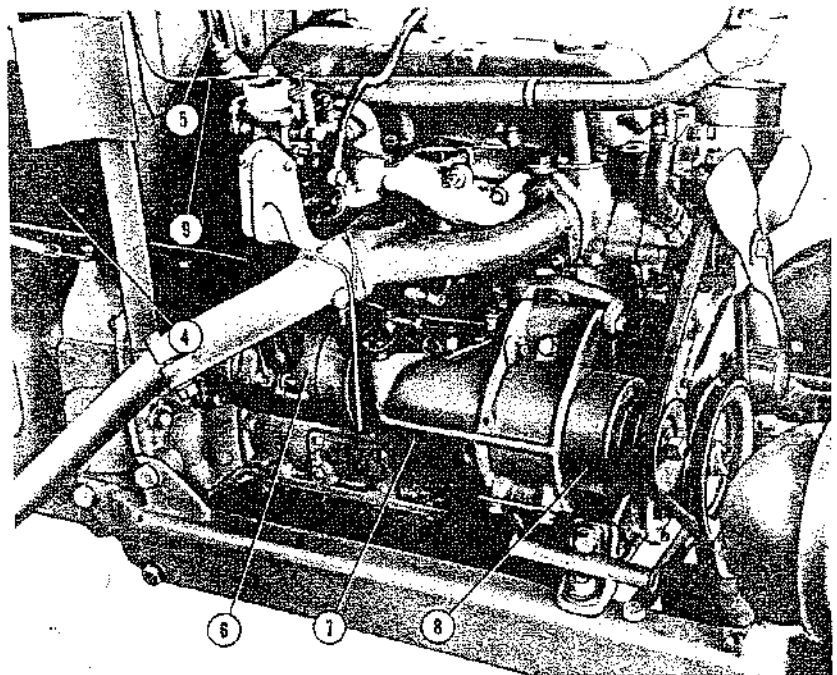


Fig. 3 - Engine removal from tractor.
4. Batteries. - 5. Thermometer bulb.
- 6. Starting motor. - 7. Governor.
- 8. Generator. - 9. Starter control tie-rod.

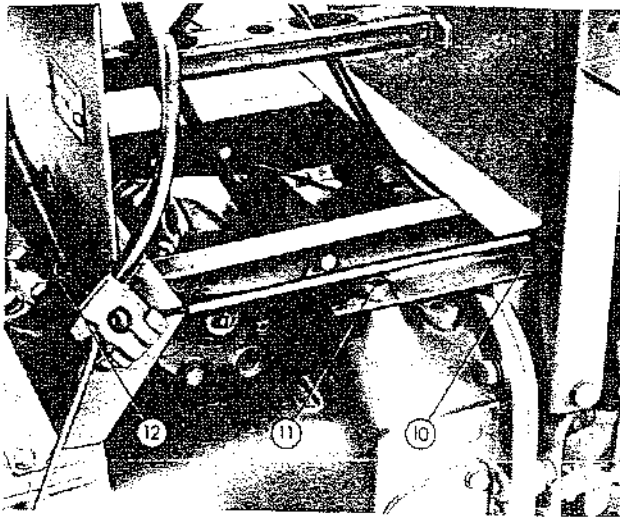


Fig. 4 - Batteries support.
10. Screws fastening support to engine. - 11. Screws fastening support to gearbox casing. - 12. Screws fastening support to frame.

Dashboard instruments connections.

Batteries support frame assembled to dashboard and cowling (fig. 4).

Engine.

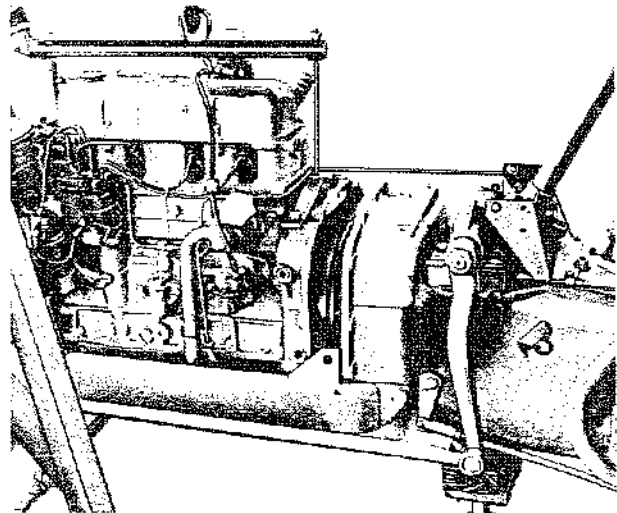


Fig. 5 - Removal of engine-clutch group, using the lifting hook ARR 117005/bis.

Remove thermometer bulb end (5, fig. 3) from cylinder block water exhaust pipe using wrench A 217073; disconnect ignition coil cable terminals and resistance terminals, the fitting between pressure gauge tubing from pipe (2, fig. 1);

from carburetor (9, fig. 3) disconnect the starter control cable end.

Remove the battery support frame fastening screws from engine, gearbox casing and front support and take away the assembly and the cowling.

Use lifting hook ARR 117005/bis as suggested in fig. 5, remove the screws connecting the engine to the gearbox casing and to the frame; finally pull the engine forward and slide out the clutch shaft from the flywheel recess bearing.

NOTE. - *Support the gearbox casing by a hydraulic jack, before removing the screws fastening the frame to the gearbox casing.*

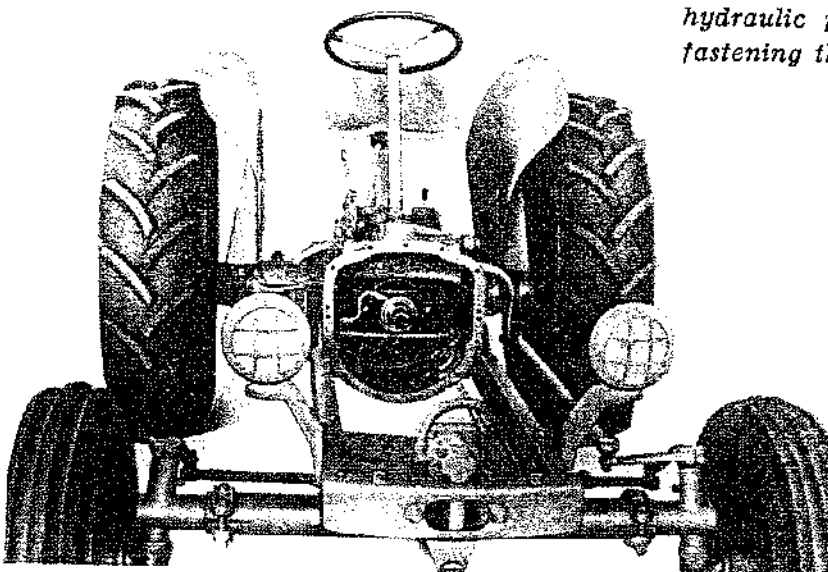


Fig. 6 - The tractor as viewed after engine removal.

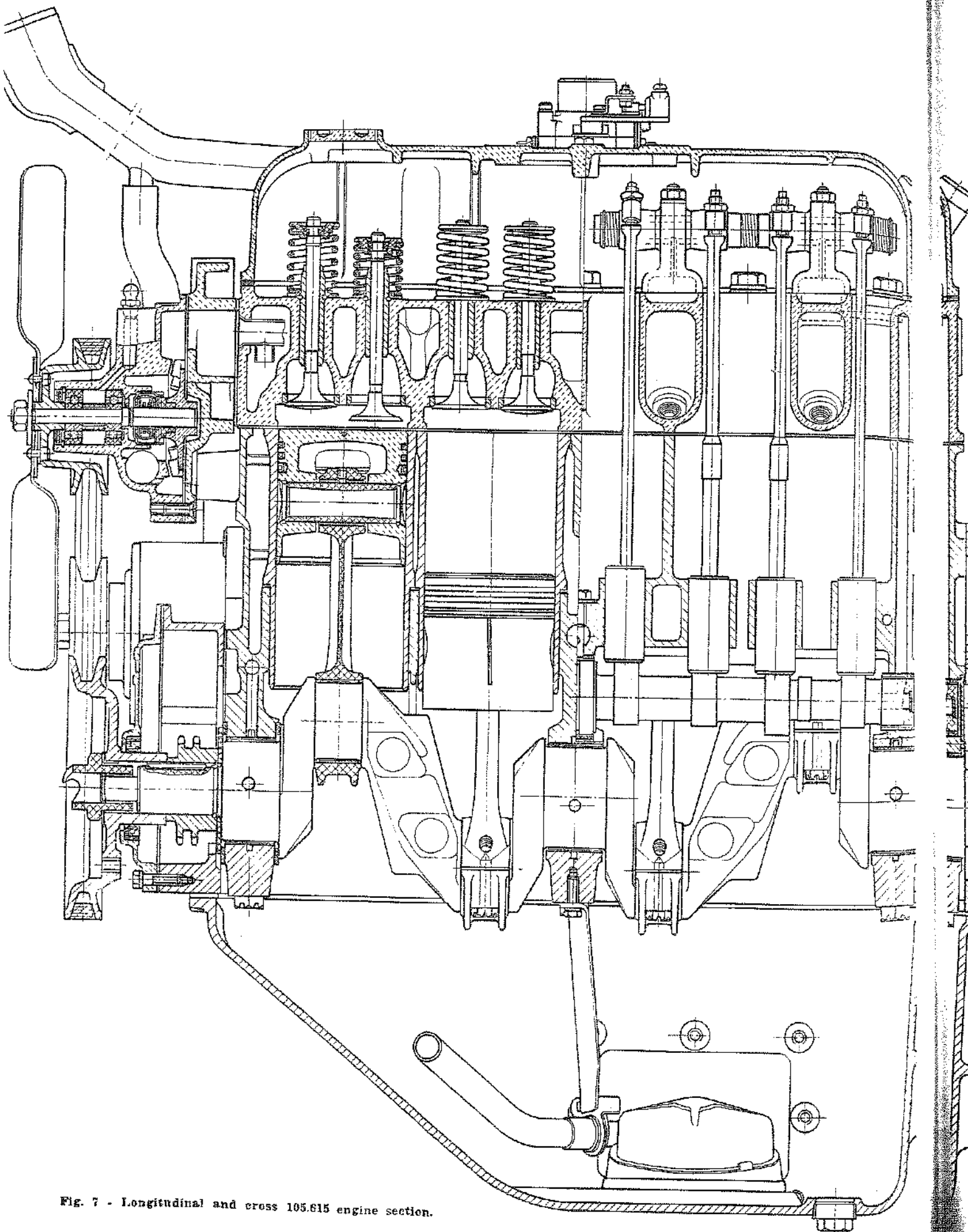
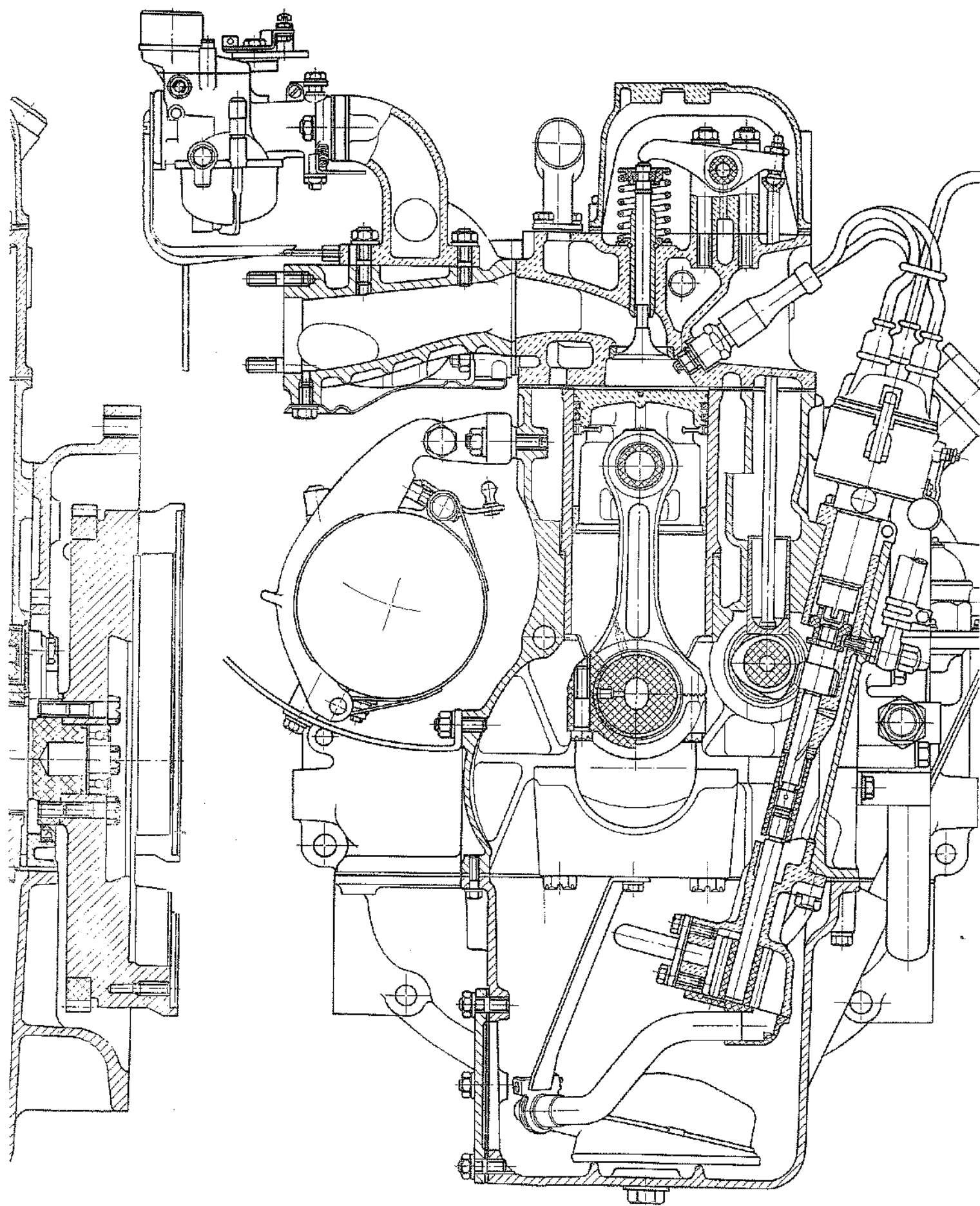


Fig. 7 - Longitudinal and cross 105.615 engine section.

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Engine stripping-out.

The engine stripping-out is facilitated by placing it on rotary stand ARR 2216, fastened by clamps A 117004 bis as shown in figs. 8 and 9; the procedure should be as follows:

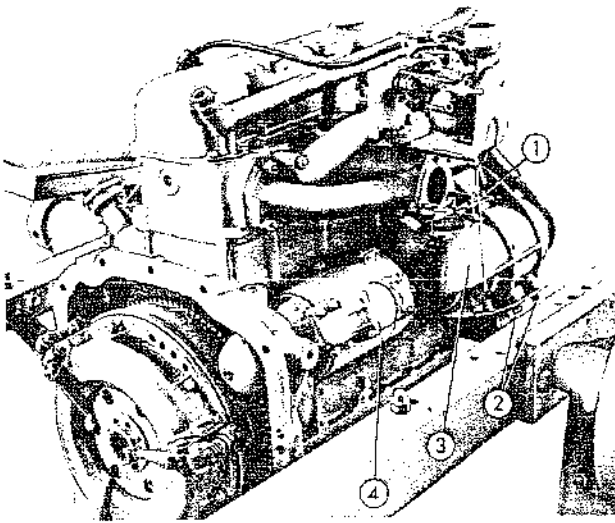


Fig. 8 - Engine installed on rotary stand, rear and right side views.

1. Screw fastening stirrup to support. - 2. Screws fastening support to belt stretcher - 3. Generator support and governor. - 4. Starting motor.

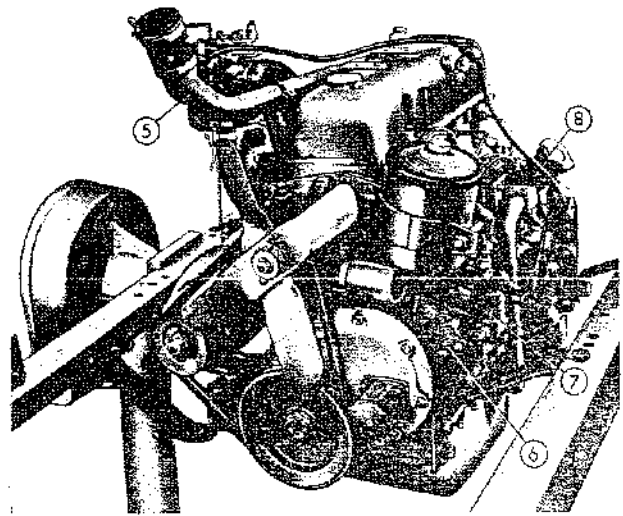


Fig. 9 - Viewing front and left side of engine, mounted on ARR 2216 rotary stand by clamps A 117004/bis.

5. Cylinder block water outlet pipe. - 6. Resistance. - 7. Ignition coil - 8. Oil filler cap.

Removal of components.

Generator and control belting.

Starting motor.

Cylinder head.

Feeding pump.

The firing distributor, the coil and the resistance.

The oil filler and its vent.

The pipe connecting oil filter to pressure gauge and the complete casing containing the oil pressure adjustment valve seat.

Procedure and cautions.

Slacken the screw fastening the clamp to support (1, fig. 8) and the belt-stretching clamp screws (2) and remove the generator complete of pulley and governor.

To separately take away this assembly, first displace forward the generator.

Remove cylinder head and gasket, the rocker arms with axle and supports, the intake and exhaust valve push rods;

remove the cylinder block cooling water exhaust manifold and remove the union clip of the flexible pipe conveying return oil from filter to crankcase;

disconnect the cables running from firing distributor to spark plugs and remove the screws fastening the cylinder head to the engine block.

Remove it with the insulating plate.

We suggest to remove it to inspect and clean the engine vent system gauze.

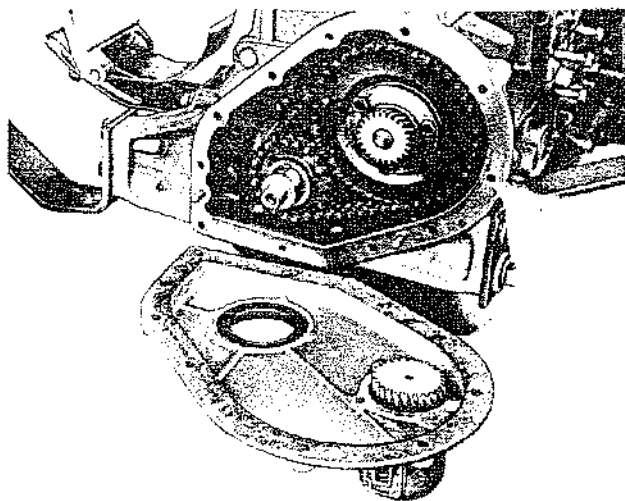


Fig. 10 - Removal of timing gear housing complete cover.

Timing gears (fig. 10).

Tappets (fig. 11) and timing control shaft.

The crankshaft.

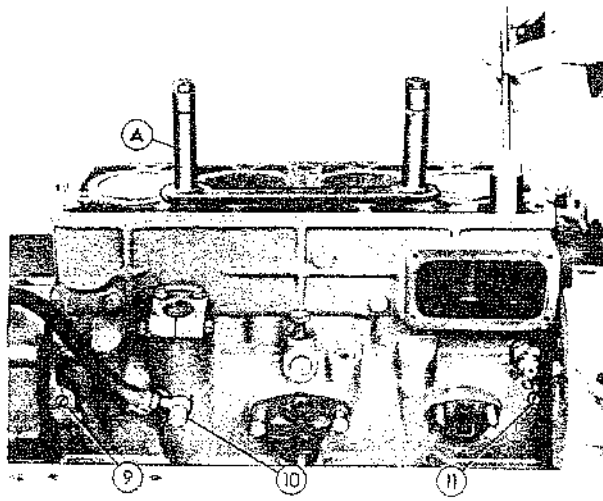
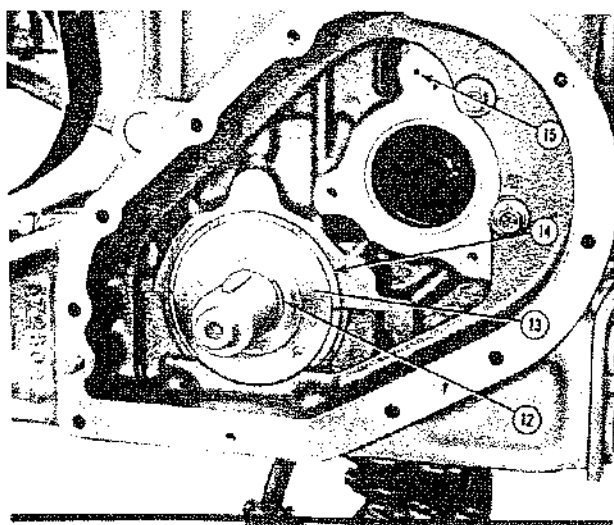


Fig. 11 - Pulling out valve tappets from block seats, with tool A 413055.

A. Tool A 313013 securing sleeves to engine block. - 9. Screw fastening timing shaft front bush. - 10. Stop screw of firing distributor support and oil drain pipe from filter. 11. Screw fastening timing shaft rear bush.

Remove generator control pulley and the water pump, remove the timing gear housing cover and the hourmeter control gear; take away timing gears with driving chain.

Tappets are removed by tool A 413055. Timing shaft is fastened at its front end by screws and safety plates.

To remove bushes, slacken the screws securing them to their seat, minding that the screws fastening front and rear bushes are located externally to crankcase (9, 11, fig. 11), while the screw fastening the central bush is found between the tappet seats (18, fig. 14).

Mount tool to stop sleeves A 313013 (A, fig. 11) and overturn the engine;

remove from one crankshaft end the clutch assembly, the flywheel, and from the other end the stop ring (12, fig. 12), the driving gear thrust ring and the thrust half-rings.

To remove the clutch shaft bearing, housed in the engine flywheel, use puller A 619027 (fig. 37);

remove engine sump and oil pump complete of suction pipe;

remove the connecting rod big end and crankshaft journal caps.

Fig. 12 - Crankshaft removal.
12. Stop ring. - 13. Driving gear thrust ring. - 14. Thrust half-rings. - 15. Timing control chain lubrication hole.

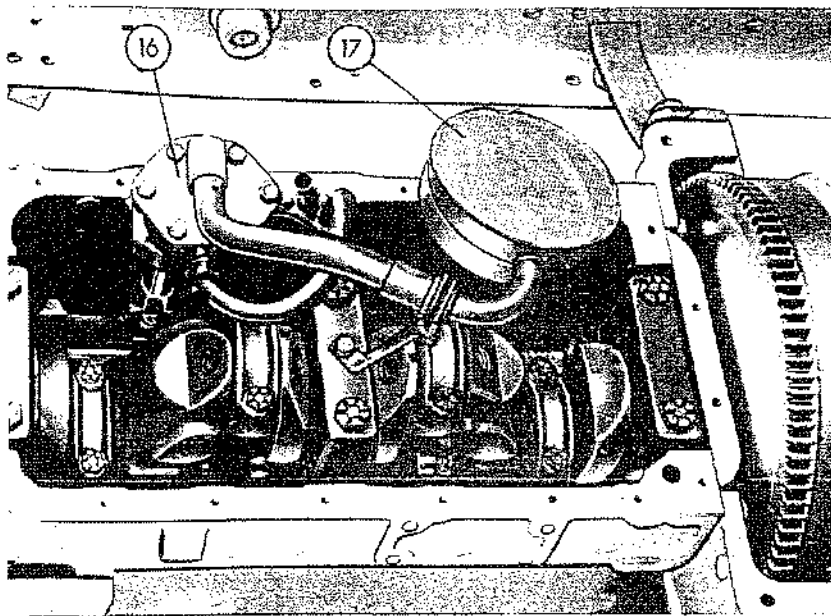


Fig. 13 - Engine viewed from bottom.
16. Oil pump. - 17. Pump suction
gauze filter.

The pistons and the connecting rods (fig. 14).

These assemblies should be removed together with their sleeves from the engine block upper side, or separately sliding out the pistons from the bottom, after having removed the crankshaft.

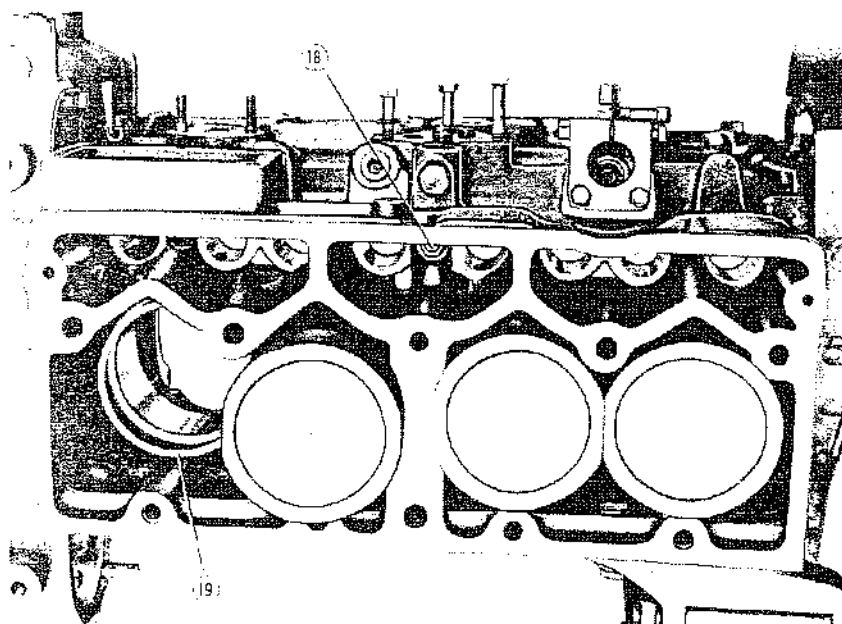


Fig. 14 - Removing cylinder sleeves
with pistons.
18. Timing shaft central bush fa-
stening screw. - 19. Cylinder sleeve
gasket.

ENGINE COMPONENTS OVERHAUL

CRANKCASE AND CYLINDER SLEEVES

Cast iron crankcase engine, with cast iron inserted sleeves. We suggest the following checks for the crankcase overhaul.

1. - Ascertain that, owing to occasional shocks no cracks have developed which might start leakages.
2. - Check for tightness of the screws and nuts fastening the timing gear casing and the rear support.
3. - Check tappets and their seats for right clearance and, if necessary, replace the tappets with oversize ones; check seats for correct diameter to find out if replacements are to be of only 0.05 mm (0.0020 in.) or 0.10 mm (0.0039 in.) oversizing. Seat reaming by reamer U 0337/A or U 0337/B, according to the required oversize.
4. - Clean with gasoline the crankcase lubrication passages and very accurately (15, fig. 12) the timing control chain lubrication hole.

The cylinder sleeves, in conformity to their inner diameter, are classified according to four classes A, B, C, D, of which the corresponding sizes are as follows:

Class A: 82.000 - 82.010 (3.2283 - 3.2287 in.)

Class B: 82.010 - 82.020 (3.2287 - 3.2291 in.)

Class C: 82.020 - 82.030 (3.2291 - 3.2295 in.)

Class D: 82.030 - 82.040 (3.2295 - 3.2299 in.)

The class distinction mark is applied with special ink upon the sleeve upper rim (A, fig. 15).

The sleeve inner diameter size should be checked according to the two directions a-b in planes of different heights; the checked measures should be within the tolerance range of the concerned sleeve class.

The dial gauge for the sleeve inner diameter check-up should be adjusted for its hand facing 0 mark at the beginning of the measure, with the ring gage C313012 (3, fig. 16).

Sleeve reaming may be performed either with a shop machine tool or with a portable reamer M110 installed on proper stand; the following lapping is made with the lapping machine A517021.

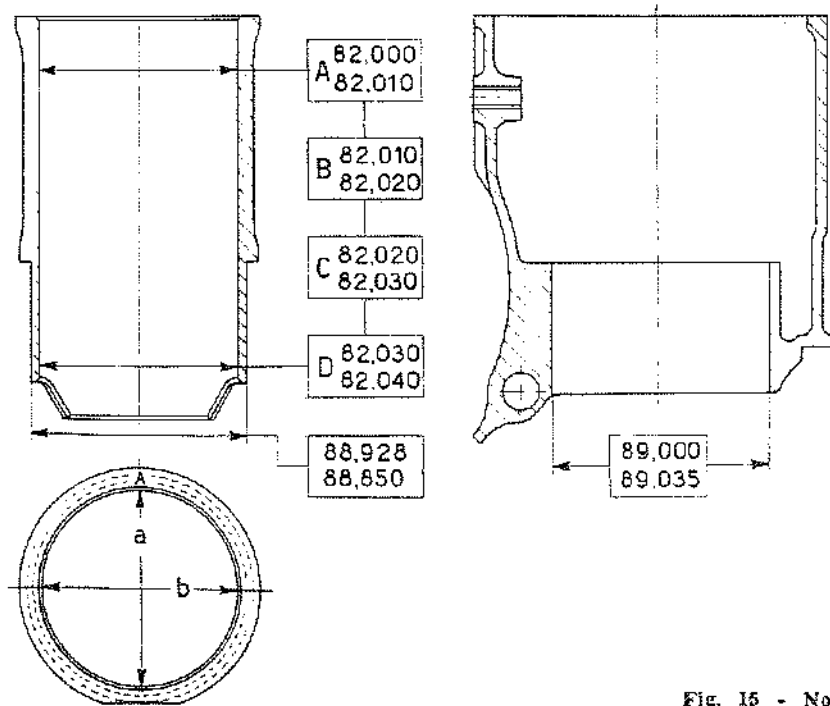


Fig. 15 - Normal dimensions of sleeves and seats on crankcase.

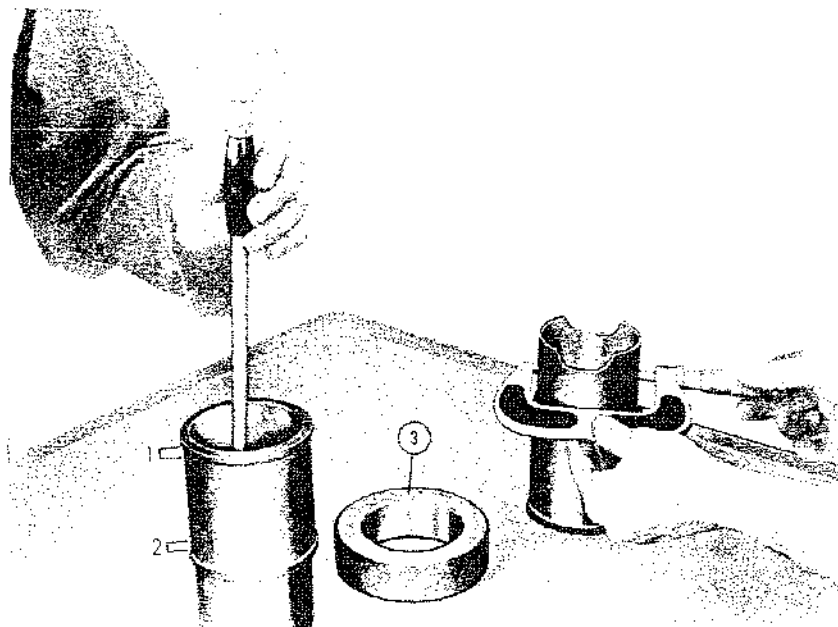
A, B, C, D. Class divisions of sleeves and corresponding diameters. - a, b. Positions where the sleeve inner diameter should be measured.

The assembling of cylinder sleeve-piston should always take place according to class uniformity: for instance, a class B piston should be assembled to a class B sleeve, this being recommended not only for standard pistons, but also for the oversized ones.

Sleeve reaming should be related to piston oversizing (see table on page 42), and the working tolerance should be according the class A, B, C, D which is of 0.01 mm (0.0004 in.).

Between the cylinder sleeve and the maximum piston diameter, measured at piston skirt bottom, and normally to the pin axis (F, fig. 41), a clearance of 0.05 - 0.07 mm (0.0020 - 0.0028 in.) should be ascertained.

Fig. 18 - Cylinder sleeve diameter check.
1-2. Inner diameter check planes. -
3. Ring gauge C313012 for dial gauge setting.



SPECIFICATIONS, ASSEMBLY CLEARANCES AND PERMISSIBLE WEAR OF THE CYLINDER SLEEVES AND CRANKCASE

	Data mm. (in.)	Assembly clearances	mm. (in.)	Wear limits mm. (in.)
Diameter of cylinder sleeve seat in the engine crankcase	89.000 - 89.035 (3.5039 - 3.5053)	Between cylinder sleeve outer diameter and its seat in the crankcase	0.072 - 0.185 (0.0028 - 0.0073)	—
Cylinder liner outer diameter	88.850 - 88.928 (3.4980 - 3.5011)			
Cylinder liner inner diameters (Size of 82.000 - 82.040 is divided into four classes)	A 82.000 - 82.010 (3.2283 - 3.2287) B 82.010 - 82.020 (3.2287 - 3.2291) C 82.020 - 82.030 (3.2291 - 3.2295) D 82.030 - 82.040 (3.2295 - 3.2299)	Between cylinder sleeve and piston belonging to an individual class	0.05 - 0.07 (0.0020 - 0.0028)	0.250 (0.0098)
Projection of cylinder sleeve from engine block	0.100 - 0.200 (0.0039 - 0.0079)	—	—	—
Cylinder sleeve gasket thickness (19, fig. 14)	0.490 - 0.510 (0.0193 - 0.0201)	—	—	—

NOTE - The sleeves are supplied only with the standard dimensions corresponding to the foregoing classes; to assemble them with oversized pistons, they should be reamed according to the oversize increments of the pistons.

CYLINDER HEAD

Aluminium cylinder head, provided of cast iron inserted valve seats.

Cylinder head removal as engine is hot should be avoided, to prevent deformation.

The valve removal is described on page 16.

Check the cylinder head mating surface by moving it upon a surface-plate, being smeared with a very thin layer of lampblack. Spots that are to be worked are thus evidently pointed out.

Use a surface-grinder to grind the cylinder head. Care should be taken to remove as small an amount of matter as possible; the cylinder head height from its assembly upon engine block to rocker-arm cover assembly plane is of 93.15 mm (3.667 in.) the thickness to be removed during such grinding should be of 0.05 - 0.07 mm (0.0020 - 0.0028 in.).

The cylinder head fastening to block calls for repeated screw tightening according to diagram of fig. 68, until a fastening torque of 9 kgm (65 ft-lb.) is attained.

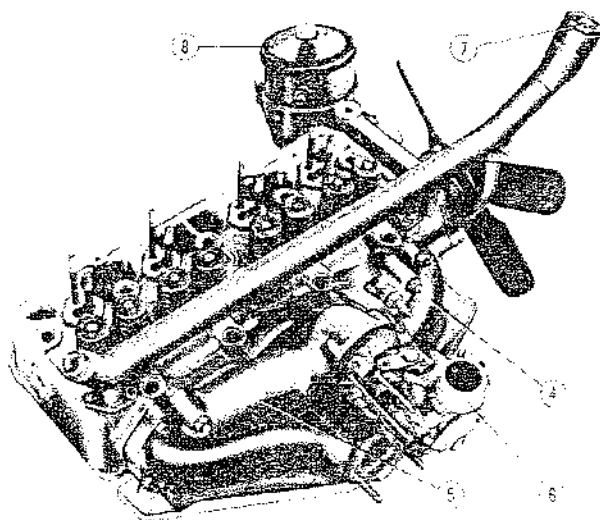


Fig. 17 - Cylinder head assembly removed from engine.
4. Exhaust manifold. - 5. Intake manifold. - 6. Carburetor.
7. Thermostat. - 8. Oil filter.

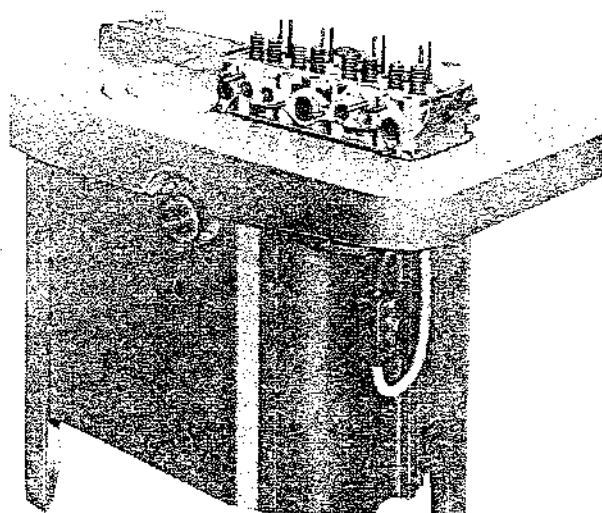


Fig. 18 - Grinding cylinder head upper plane on surface grinder.

VALVE SEAT CHECKING AND OVERHAUL

Valve seats are fitted at a temperature of about 300°C (572°F) and finally expanded to grant good seizure by the cylinder head walls. Valve seat inclination is of $45^\circ \pm 5'$, and those of both intake and exhaust valves are of $45^\circ 30' \pm 5'$.

If necessary, the valve seats refacing should be as follows:

- clean valve-guides using the metallic brush A 313031, fitted to a hand drill chuck and remove the thin but hard layer of the valve seat surfaces, using the grinding wheel A 313039/C used for valve refacing and fixed to normal chuck A 313039/A or on oversize chuck A 313039/B, according to valve-guide wear;
- rework using miller A 313039/F inclined of 45° and one of the foregoing chucks;
- if seats width should be reduced, use the proper millers A 117039/H, having inclination of 20° and A 117039/G inclined of 75° , as represented in diagrams of figs. 19, 20, 21 and 22.

NOTE. - The foregoing milling cutters and chucks, used to reface valve seats, are applied for both intake and exhaust valves working.

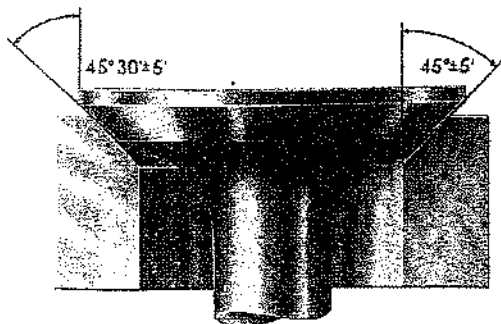


Fig. 19 - Inclination angles of cylinder head seats and on valves.

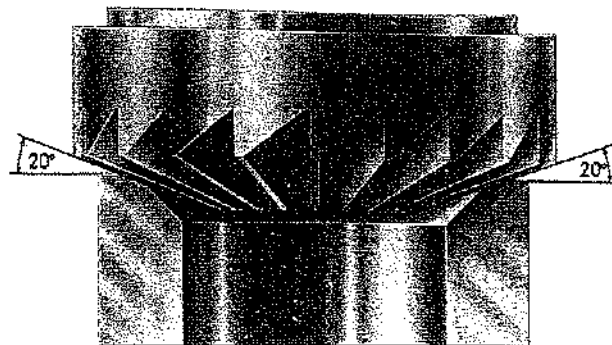


Fig. 20 - Reducing the valve seat width, on top, working with a 20° mill.

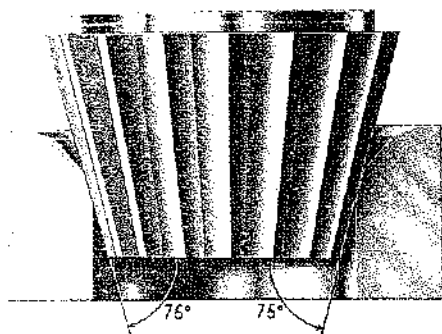


Fig. 21 - Reducing valve seat width at bottom, using a 75° mill.

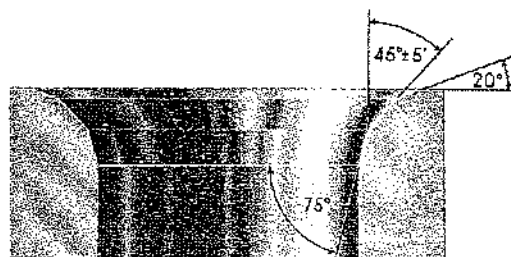


Fig. 22 - Diagram of a valve seat worked with a 20° mill and a 75° mill.

TIMING GEAR

CAMSHAFT

The camshaft is controlled through a roller chain by a gear keyed on the crankshaft and revolves on steel bushes lined with thin antifriction metal pressure-lubricated through passages within the shaft itself. Bushes should be lightly press-fitted to their crankcase seat, to which they are fastened with screws (9, 11, fig. 11 and 18, fig. 14).

We suggest the following inspection check:

- 1) the camshaft journal outrun (outrun should be within 0.10 mm (0.0039 in.), if in excess true-up the shaft by a press or replace it);
- 2) journal and bush wear;
- 3) the cam surfaces (they should be smooth and perfectly fit);
- 4) the beginning and ending of individual strokes for each cylinder (check according indication for « Engine Timing » on page 20, securing a clearance of 0.45 mm (0.0177 in.), in rocker arms and valves and in addition consulting the diagram of fig. 31).

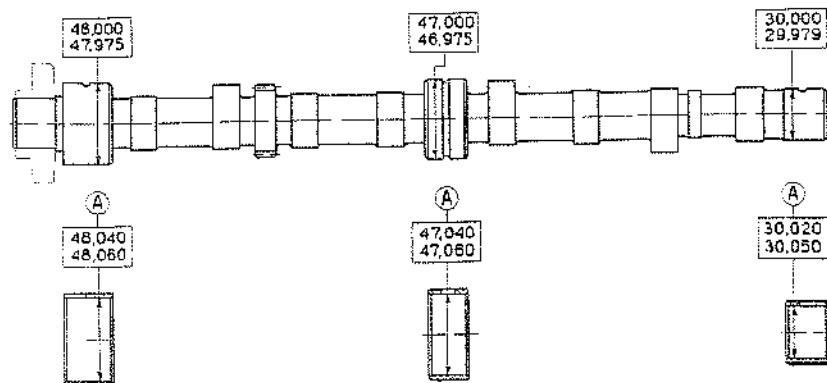


Fig. 23 - Normal sizes of camshaft journals and bushes.

A. Dimension concerning the assembled bush.

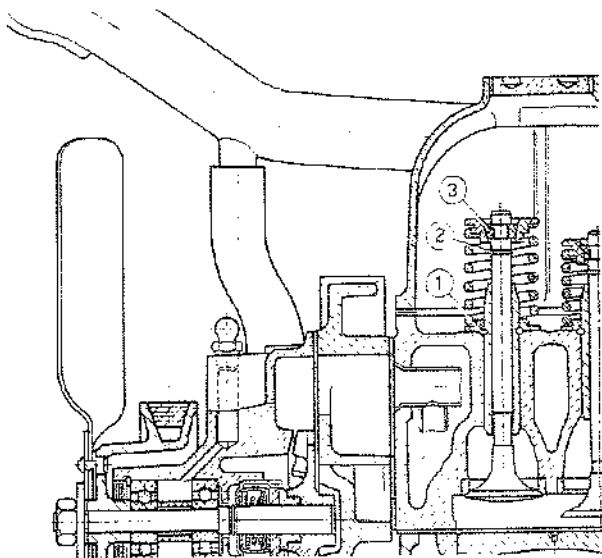


Fig. 24 - Longitudinal section of valves.
1. Valve guide stop ring. - 2. Spring ring. - 3. Half-cone retainers.

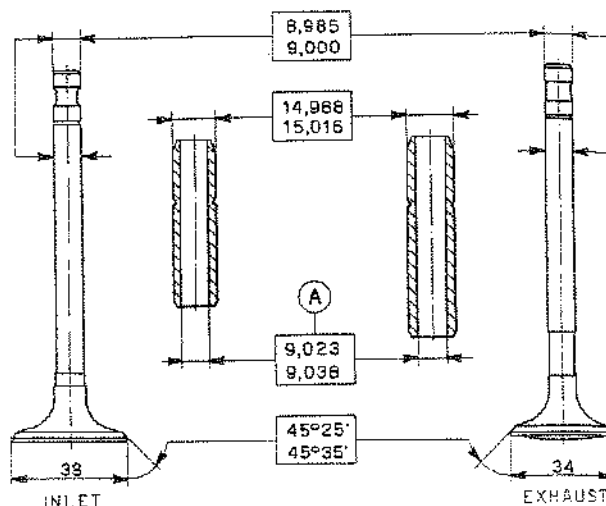


Fig. 25 - Normal dimensions of valves and their guides.
A. Dimension to be obtained after reaming, the valve-guide having press-fit in the cylinder head.

VALVES, VALVE GUIDES AND SPRINGS

Valves are controlled through push rods and rocker arms (fig. 7), by the camshaft, fitted to the engine crankcase.

The removal from cylinder head should be after the removal of the head itself from the cylinder block; in addition free the stems from springs and the spring-rings (2, fig. 24) using tool A 217028.

To remove the valve springs alone it is not necessary to take away the cylinder head. If the removal of valve-guides is necessary, use press and punch A 313009; the following reassembling requires the cylinder head heating (to 390°C, 572°F) before press fitting the valve-guide using said punch. Valve-guides are also supplied oversized of 0.2 mm (0.0079 in.), on the outside diameter contacting the cylinder head.

To clean and ream valve-guide to the necessary diameter use respectively the brush A 313031 and the reamer U 313030.

During the overhaul we advise to perform the following checks:

- 1) Inspect valves and valve seats on the cylinder head. It is necessary that such surfaces be perfectly uniform to ascertain complete mating, this being an indispensable condition to high engine efficiency.
Should the valve provide but imperfect seal within its seat or its sealing surface being scored or notched, regrind it using the universal grinder A 11401 (fig. 27). Deep scoring requires immediate valve replacement.
- 2) Check clearance between valve stem and valve-guide; after having checked the valve stem for bent, ascertain that its clearance be not exceeding the figure of table on page 19.
Before checking the clearance the guides should be cleaned and the surfaces inspected to ascertain that they are smooth, without scoring and seizing evidence.
- 3) Check spring elasticity against data of the exceeding the figure of table on page 19.

TAPPETS, PUSH RODS AND ROCKER ARMS

Valve tappets surface based upon the camshaft eccentric, should be very smooth and free from notches or scoring which, if very light, may be eliminated by a very fine carborundum block.

If wear clearance between tappets and their guide holes exceeds the permissible wear indicated in the table on page 18, the tappets should be replaced with other ones oversized 0.05 or 0.10 mm (0.0020 or 0.0039 in.). The guide hole should be checked for ovalization, and if necessary it should be trued up with a reamer.

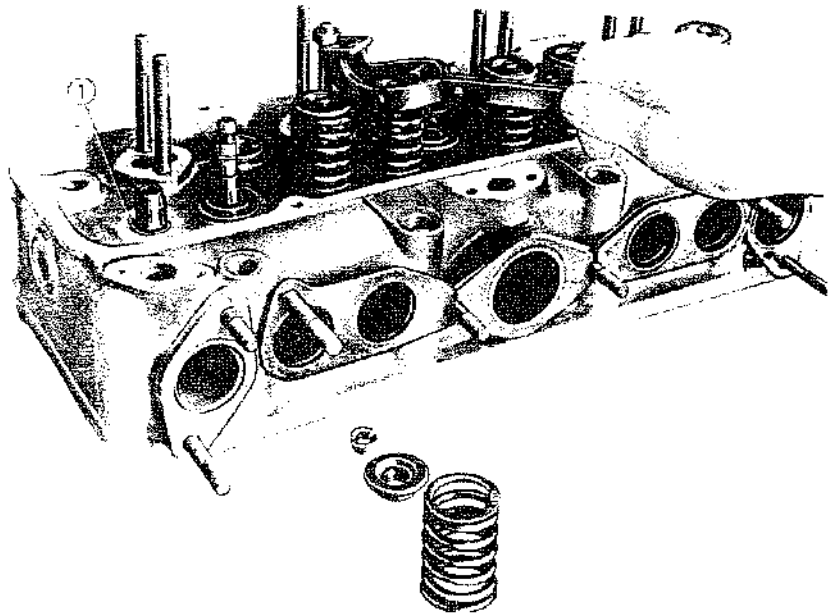


Fig. 26 - Removal of valves from cylinder head using tool A 217028.
1. Valve-guide stop ring.

Engine push rods are two types (fig. 7); those for exhaust valves have equal diameter stem and those for intake valves have stems of two diameters and of different materials. The contact surfaces between rocker arm and valve and the surface of the ball seat contacting the rocker arm with the push rod, should be perfectly smooth.

The operational check clearance as engine is cold, between rocker arms and valves, should be of 0.15 mm (0.0059 in.) both for intake and exhaust component. The setting should be performed according to suggestions of fig. 69 and using wrench A 313046 and the feeler gauge.

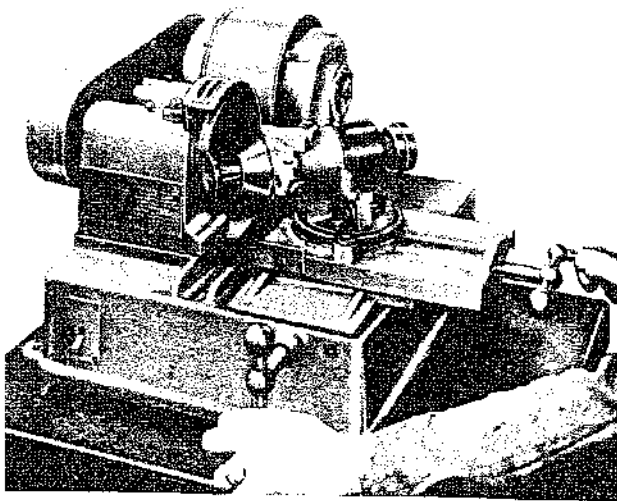


Fig. 27 - Refacing of valve seats using universal grinder A 11401.

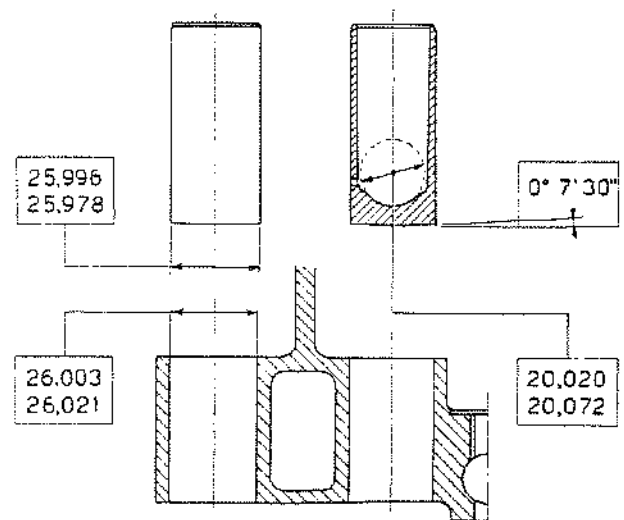


Fig. 28 - Dimensions of normal tappets and their crankcase seats.

CHARACTERISTICS, ASSEMBLY CLEARANCES AND PERMISSIBLE WEAR OF THE TIMING SYSTEM

	Data mm (in.)	Assembly clearances	mm (in.)	Wear limits mm (in.)
Camshaft front bush inner diameter (*)	48.040 - 48.060 (1.8913 - 1.8921)	Between bush and camshaft front journal	0.040 - 0.085 (0.0016 - 0.0033)	0.15 (0.0059)
Camshaft front journal diameter	47.975 - 48.000 (1.8887 - 1.8898)			
Camshaft central bush inner diameter (*)	47.040 - 47.060 (1.8520 - 1.8528)	Between bush and camshaft central journal	0.040 - 0.085 (0.0016 - 0.0033)	0.15 (0.0059)
Camshaft central journal diameter	46.975 - 47.000 (1.8494 - 1.8504)			
Camshaft rear bush inner diameter (*)	30.020 - 30.050 (1.1811 - 1.1931)	Between bush and camshaft rear journal	0.020 - 0.071 (0.0008 - 0.0028)	0.10 (0.0039)
Camshaft rear journal diameter	29.979 - 30.000 (1.1803 - 1.1811)			
Camshaft front support plate thickness	3.925 - 4.000 (0.1545 - 0.1575)	Camshaft end play	0.070 - 0.220 (0.0028 - 0.0087)	0.35 (0.0138)
Crankshaft support front plate seat width	4.070 - 4.145 (0.1602 - 0.1632)			
Crankcase tappet seats diameter	26.003 - 26.021 (1.0237 - 1.0244)	Between tappets and their seats	0.007 - 0.043 (0.0003 - 0.0017)	0.15 (0.0059)
Normal tappet seat diameter	25.978 - 25.996 (1.0228 - 1.0235)			
Tappet oversize mm 0.05 (0.0020 in.)	26.028 - 26.046 (1.0247 - 1.0254)	—	—	—
Tappet oversize mm 0.10 (0.0039 in.)	26.078 - 26.096 (1.0267 - 1.0274)	—	—	—
Rocker arm hole diameter	18.006 - 18.024 (0.7089 - 0.7096)	Between rocker arm holes and their pivots	0.006 - 0.042 (0.0002 - 0.0017)	0.20 (0.0079)
Rocker arm pivot diameter	17.982 - 18.000 (0.7080 - 0.7087)			
Diameter of valve-guide seat on cylinder head	14.950 - 14.977 (0.5886 - 0.5896)	Interference between valve- guide and its seat on cylin- der head	- 0.011 - - 0.066 (0.0004 - 0.0026)	—
Outer diameter valve-guide intake-exhaust	14.988 - 15.016 (0.5901 - 0.5912)			
Valve-guide outer diameter oversize mm 0.2 (0.0079 in.)	15.188 - 15.216 (0.5980 - 0.5991)	—	—	—

(*) Between bush outer diameter and crankcase seat an interference of -0.02 - 0.00 mm (-0.0008 - 0.00 in.) should take place.

(Follows : Characteristics, Assembly Clearances and Permissible wear of the Timing system)

	Data mm (in.)	Assembly clearances mm (in.)		Wear limits mm (in.)
Valve-guide inner diameter	9.023 - 9.038 (0.3552 - 0.3558)	Between valve stem and valve-guide	0.023 - 0.053 (0.0009 - 0.0021)	0.15 (0.0059)
Valve stem diameter	8.985 - 9.000 (0.3537 - 0.3543)			
Inclination angle between seal plane and valve plane	45°30' ± 5'	—	—	—
Exhaust valve head diameter	34 (1.339)	—	—	—
Intake valve head diameter	38 (1.496)	—	—	—
Engine valve springs				
	Rocker arms distance		Engine valves	
Free length of spring	mm 19.5 (in. 0.77)		mm 51.1 (in. 2.01)	
Length of spring under load	mm 11 (in. 0.43)		mm 33.3 (in. 1.31)	
Checking load	kg 4.5 - 4.9 (lb. 9.9 - 10.8)		kg 72.7 - 79.7 (lb. 160 - 176)	

ENGINE TIMING

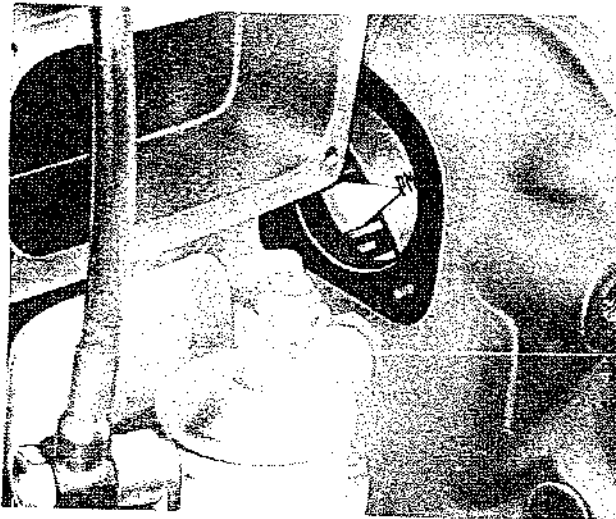


Fig. 29 - Reference of T.D.C. of cylinders 1-4 on engine flywheel.

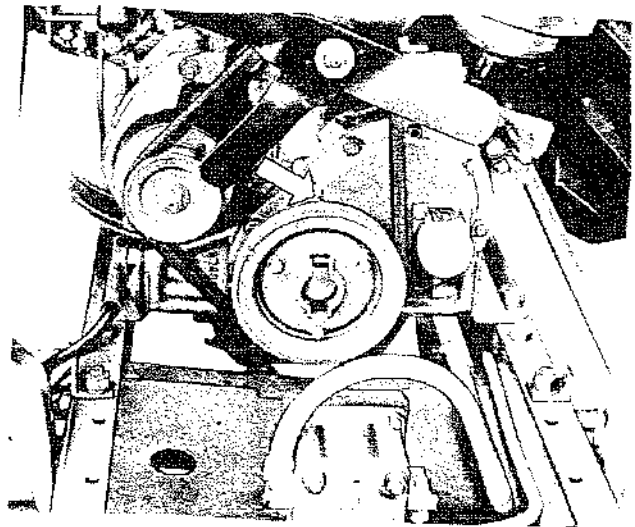


Fig. 30 - Reference of T.D.C. of cylinders 1-4 on timing cover and fan and generator driving pulley.

Reference marks (fig. 10) are found on the gears keyed on the crankshaft and on the camshaft. As engine timing is normal, such reference marks are coinciding.

Should the engine be removed from tractor, its timing procedure is as follows:

- rotate the engine flywheel until the line mark under the mark PMS (T.D.C.) 1-4 is being set at 10° of advance, with reference to the timing index, which corresponds to the cylinder No. 1 intake beginning. Such advance expressed in degrees, corresponds to 26 mm (1.02 in.) of displacement of such line;
- the clearance between valves and rocker arms should be provisionally set at 0.45 mm (0.0177 in.);
- rotate the camshaft until cylinder No. 1 intake valve begins its opening displacement and ascertain that the marks ground on the timing gears are coinciding;
- fit the chain on gears and ascertain, by rotating the flywheel that the exhaust valve closes 11° after the PMS 1-4 (T.D.C.). Such lag in degrees corresponds to about 29 mm (1.14 in.) displacement of the line with reference to the timing index;
- proceed, after check up, to final setting of clearance between valves and rocker arms, as engine is cold, and the clearance amount for all valves, being equal, should be of 0.15 mm (0.0059 in.).

As engine is fitted on tractor the PMS 1-4 (T.D.C.) mark on the flywheel band may be seen through a relevant cover (fig. 29) located on the crankcase left side, as the crankshaft is being rotated using extension A 542350, D (if the tractor is not fitted with the hydraulic lift pump).

The P.M.S. (T.D.C.) of cylinders 1-4 may also be observed from engine front side when the marks protruding from the cover are coinciding with the mark upon the generator and fan driving pulley face (fig. 30).

The timing data, referred to the checking clearance between valves and rocker arms of 0.45 mm (0.0177 in.) and illustrated in diagram of fig. 31 are as follows:

Intake:

beginning, 10° before P.M.S. (T.D.C.) - corresponding to 26 mm (1.02 in.) of the flywheel face and to 14.5 mm (0.57 in.) of the generator and fan driving pulley maximum diameter;

end, 51° after the P.M.I. (B.D.C.).

Exhaust:

beginning, 48° before the P.M.I. (B.D.C.);

end, 11° after the P.M.S. (T.D.C.) - they correspond to 29 mm (1.14 in.) of the flywheel band and to 16 mm (0.63 in.) on the generator and fan driving pulley maximum diameter circle.

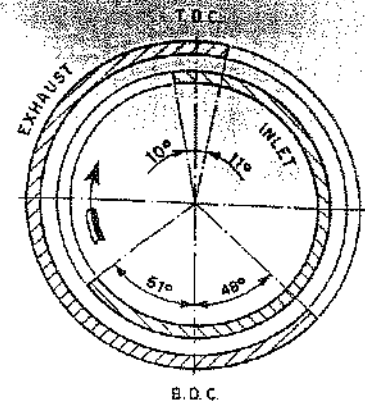


Fig. 31 - Timing diagram.

CRANK GEAR COMPONENTS

CRANKSHAFT AND BEARINGS

A steel crankshaft, provided of three supports with thin shell type bearings and thrust rings, fitted to front support.

An accurate overhaul of the crankshaft must be secured for which we suggest the following procedure:

- alignment of crankshaft journals and crank pin journals (fig. 32). Check on parallel support C 731 on a surface plate, using a centesimal dial gauge for journal measurements. The allowed tolerance on the crankshaft journals is of 0.05 mm (0.0020 in.) and for each couple of crank pins, in both directions, is of 0.25 mm (0.0098 in.). If checked values are in excess, the crankshaft should be trued up;
- perpendicularity of the crankshaft-to-flywheel union plane. Check with centesimal dial gauge which shall be neared to such a union plane as the crankshaft is being rotated; the outrun should not exceed 0.025 mm (0.0010 in.);
- traces of seizing deep scoring or ovalization of crankshaft and crank pin journals. If scoring and ovalization cannot be eliminated by the use of abrasive stones, such journals should be ground and oversize bearings fitted. Regrinding should follow journal check by micrometer

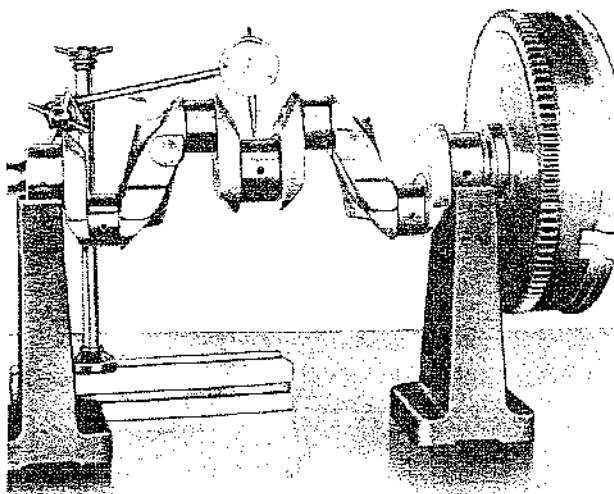


Fig. 32 - Checking crankshaft journal alignment using the parallel support C 731.

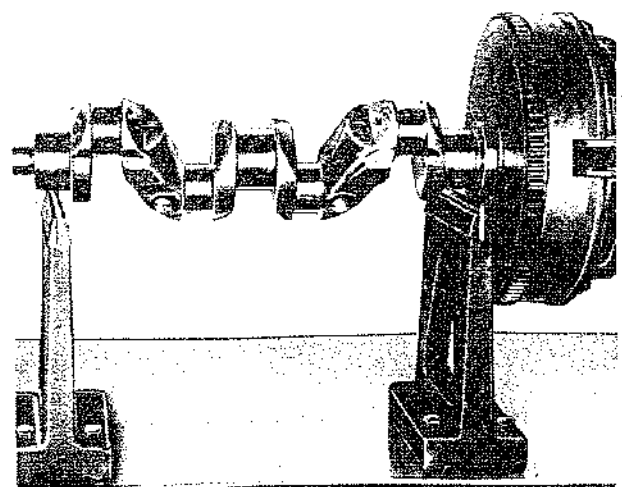


Fig. 33 - Crankshaft static balancing check on parallels C 732.

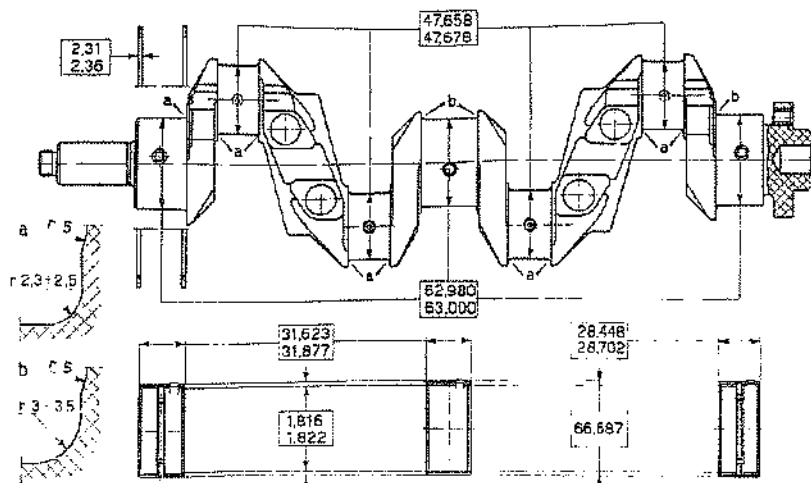


Fig. 34 - Normal sizes of crankshaft journal and crank pin journals, of half-bearings and of thrust half-rings. a. Front crankshaft journal and crank pin fillet radii. - b. Crankshaft central and rear journal fillet radii.

NOTE - Bevel 0.5 mm the lubrication hole edges after journal grinding.

and follow the undersizing of journals which is shown in the table on page 23. Such values are being related to the fact that fitting bearings provided of the same thickness oversizing, a clearance of 0.031-0.075 mm (0.0012-0.0030 in.) is thus being ascertained with the crankshaft journals and of 0.011-0.061 mm (0.0004-0.0024 in.) with the connecting rod journals. Fig. 34 shows the central and rear crankshaft journal fillet radii, of the front crankshaft journal and of crank pin journals, to be applied during regrinding;

- crankshaft statical balancing (fig. 33). Lay the crankshaft fitted with flywheel and clutch upon the two parallel supports C 732 on a plane of which horizontality has been ascertained by a level. A balanced crankshaft will remain motionless; if it revolves towards the heavier section, some putty should be applied on the opposite side to restore statical balance. The putty weight measures the amount of excess material, that shall be removed by a grinding wheel from the webs or, preferably, from holes already drilled through such webs or the flywheel;
- lubricating oil passages cleaning. If accurate cleaning suggests the removal of plugs, they should be caked and the seal checked by 15 atmosphere pressure.

Clearance check between crankshaft and bearings.

Such a clearance check should be made on each bearing separately but after setting all bearings tightening the caps to the torque of 11 kgm (80 ft-lb.). During this preliminary check up, the thrust rings should be fitted to the front support and end play ascertained not to be over 0.40 mm (0.0157 in.) fig. 35.

The crankshaft should be rotated by hand and removed; upon the first support apply one cigarette paper (thickness 0.025 mm; 0.0010 in.) lightly wet with oil (fig. 36); tighten the crankshaft journal caps and check for free rotation through a few degrees angle; if rotation is sufficiently free, the clearance should be considered as normal; if a tightening takes place, the bearing thickness or crankshaft diameter should be measured to ascertain its origin. Should rotation be too free, the check may be repeated and another leaf added; a tight rotation shows that the clearance is yet within tolerance limits; and therefore other supports may be tested likewise.

The maximum number of cigarette paper is three, when clearance reaches 0.075 mm (0.0030 in.) i.e. the maximum admitted clearance.

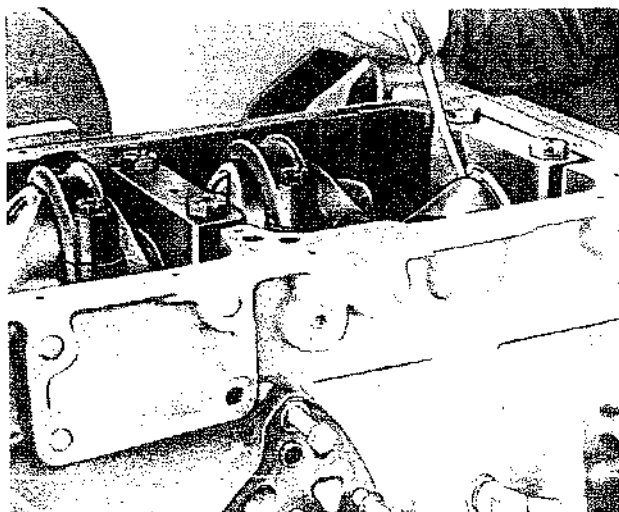


Fig. 35 - Check of crankshaft end play.

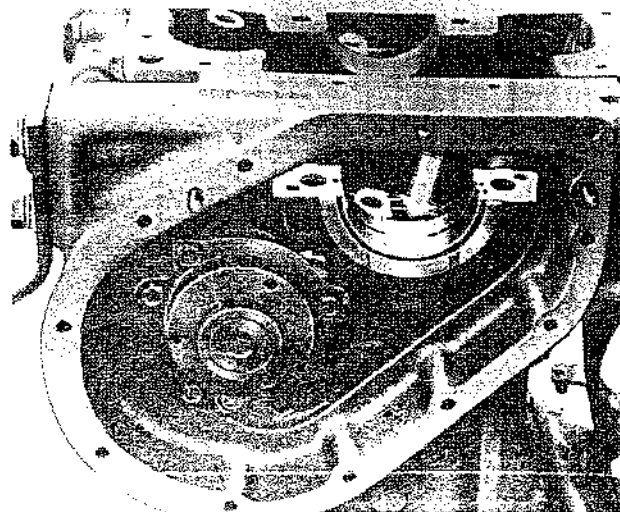


Fig. 36 - Cigarette paper for crankshaft-journal-to-bearing clearance check.

Crankshaft sealing gaskets.

Crankcase oil sealing is granted with two rubber gaskets internally fitted of a small coil spring (fig. 7).

The front gasket is recessed into its timing casing cover seat, and oil seal follows the adhesion which the gasket edge, pressed by the spring, applies to the hub.

Rear gasket is also recessed into the crankshaft rear support cover seat, and oil seal is ascertained with such a gasket contacting circularly the flywheel attachment flange.

Therefore we suggest to ascertain good sealing by a check of said gaskets and of the surfaces contacting them; if necessary, perform replacement and lapping.

DATA, ASSEMBLY CLEARANCES AND MAXIMUM PERMISSIBLE WEAR CLEARANCE OF CRANKSHAFT AND ITS JOURNAL AND CRANK PIN BEARINGS

	Data mm (in.)	Assembly clearances	mm (in.)	Wear limits mm (in.)
Crankshaft journal bearing seat diameter	66.675 - 66.687 (2.6250 - 2.6255)	Between crankshaft journal and bearing	0.031 - 0.075 (0.0012 - 0.0030)	0.15 (0.0059)
Crankshaft journal bearing thickness	1.816 - 1.822 (0.0715 - 0.0717)			
Crankshaft journal diameter	62.980 - 63.000 (2.4795 - 2.4803)			
Connecting rod big end bearing seat diameter	51.333 - 51.346 (2.0210 - 2.0215)	Between crank pin and connecting rod big end bearing	0.010 - 0.061 (0.0004 - 0.0024)	0.15 (0.0059)
Connecting rod big end normal bearing thickness	1.8135 - 1.8224 (0.0714 - 0.0717)			
Crank pin diameter	47.658 - 47.678 (1.8763 - 1.8771)			
Crankshaft journal front length	36.080 - 36.120 (1.4205 - 1.4220)	Crankshaft end play	0.07 - 0.26 (0.0028 - 0.0102)	0.40 (0.0157)
Crankshaft front support thrust half ring thickness	2.31 - 2.36 (0.091 - 0.093)			
Crankshaft crankcase front support length	31.24 - 31.29 (1.230 - 1.232)			

(Follows: Data, assembly clearances and maximum permissible wear clearance of crankshaft and its journal and crank pin bearings).

Crankshaft journal undersizing and relative bearing oversizing

	mm 0.254 (in. 0.010)	mm 0.508 (in. 0.020)	mm 0.762 (in. 0.030)	mm 1.016 (in. 0.040)	
Crankshaft journal diameter	62.735 - 62.755 (2.4699 - 2.4707)	62.481 - 62.501 (2.4599 - 2.4607)	62.227 - 62.247 (2.4499 - 2.4507)	61.973 - 61.993 (2.4399 - 2.4407)	
Crankshaft journal bearing thickness	1.943 - 1.949 (0.0765 - 0.0767)	2.070 - 2.076 (0.0815 - 0.0817)	2.197 - 2.203 (0.0865 - 0.0867)	2.324 - 2.330 (0.0915 - 0.0917)	
Crank pin diameter	47.404 - 47.424 (1.8663 - 1.8671)	47.150 - 47.170 (1.8563 - 1.8571)	46.896 - 46.916 (1.8463 - 1.8471)	46.642 - 46.662 (1.8363 - 1.8371)	
Connecting rod big end bearing thickness	1.9405 - 1.9494 (0.0764 - 0.0767)	2.0675 - 2.0764 (0.0814 - 0.0817)	2.1945 - 2.2034 (0.0864 - 0.0867)	2.3215 - 2.3304 (0.0914 - 0.0917)	
Thrust half-ring thickness					
Oversize mm 0.1 (0.0039 in.)					
mm 2.41 - 2.46 (0.095 - 0.097 in.)					
Tightening torque					
	kgm	ft. lb.		kgm	ft. lb.
Crankshaft journal cap assembly self-locking screws	11	80	Cylinder head fastening screws	9	65
Connecting rod cap assembly self-locking screws	5.5	40	Crankshaft to flywheel assembly self-locking screws	7	51

FLYWHEEL

The flywheel is assembled to crankshaft by self-locking screws, with a torque of 7 kgm (51 ft-lb.). Outside, with 0.175-0.325 mm (0.0069-0.0128 in.) interference, the engine starting ring gear is assembled.

The clutch shaft bearing is removed using screw puller A 619027 (fig. 37).

The flywheel balancing check should embody all the crankshaft-flywheel-clutch assembly as shown in fig. 33.

Starting ring gear replacement requires the new part heating in oil about 100°C temperature (212°F) and press fitting.

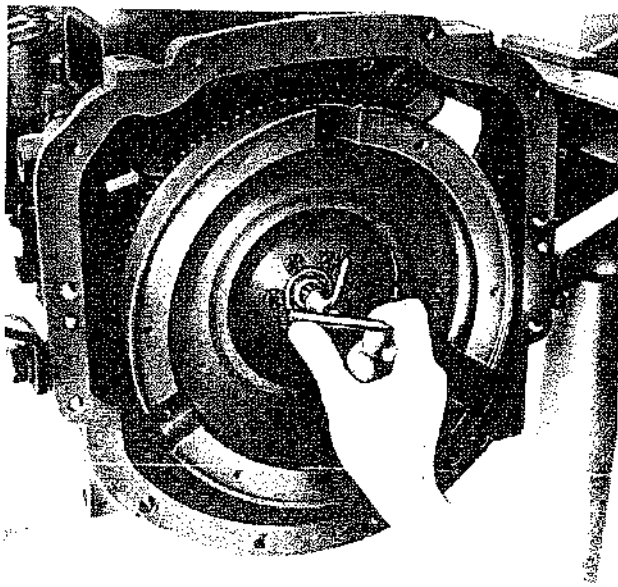


Fig. 37 - Removal of bearing from engine crankshaft using tool A 619027.
I. Timing index.

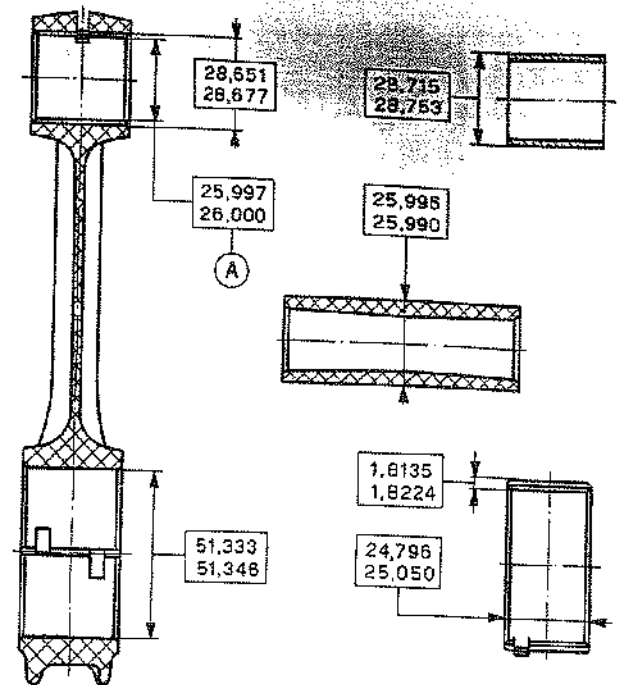


Fig. 38 - Normal dimensions of connecting rods, bushes, piston pins and half-bearings.
A. Dimensions referred to assembled bushing.

CONNECTING RODS

Connecting rods are related to crankshaft pin through the Vanderwell type thin shell half-bearings.

We suggest the following sequence for an accurate check up and repair of the connecting rod components:

- 1) half-bearing check up and, if necessary their replacement with oversized ones after previously grinding the crankshaft journal;
- 2) check up of bushes and if necessary reaming or replacement. After replacement press fitting, the bush should be milled to produce the lubrication of journal, and reamed with expansible blade reamer U 313017;
- 3) equal weight of the four connecting rods check up, and if necessary trueing-up of weight ± 3 grams (± 0.1 oz.);
- 4) check parallelism of the two connecting rod axes, and eventual correction.

At a distance of 125 mm (4.92 in.) the outrun from parallelism should not exceed 0.05 mm (0.0020 in.); if outrun excess is discovered, the connecting rod should be trued-up using a fork or a press.

Such a check may apply device C 517023 (fig. 39) which may also check connecting rod alignment (piston and piston pin).

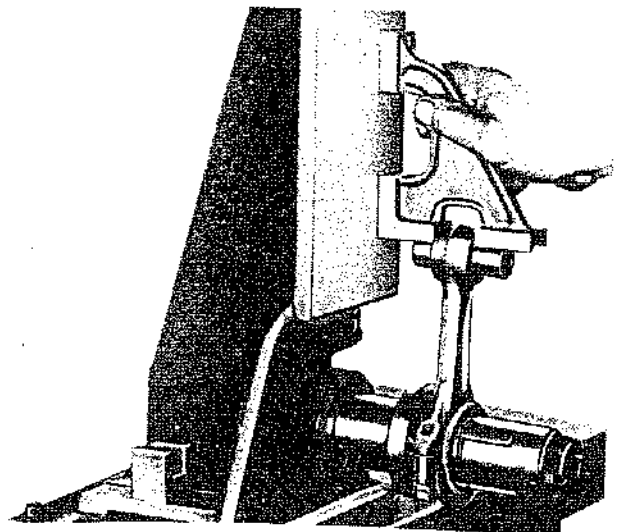


Fig. 39 - Checking connecting rod alignment: piston assembled with C 517023.

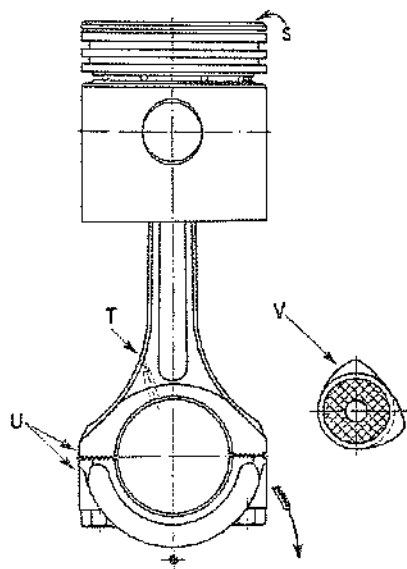


Fig. 40 - Connecting rod and piston assembled diagram.
S. Marks of class and weight of piston. - T. Lubrication hole. - U. Cylinder number mark. - V. Time shaft.
(Arrows indicate the direction of rotation of the crankshaft).

Assembling connecting rods with pistons.

Use the piston pins to connect pistons to connecting rods, minding that the lubrication hole and the marks on connecting rods and caps result on the side opposite to the marks on the piston tops (fig. 40).

Assemble piston-connecting-rod groups in the liners observing that connecting rod and cylinder numbers are corresponding, and being located to the opposite side of the camshaft.

The assembling fits of the various parts and the assembly torque may be observed at the describing paragraphs on pages 28 and 29 table, and following ones on page 24 table.

PISTONS

As already for liners on the top of the various pistons in addition to the weight indication, a letter distinguishing the class to which they belong, is stamped, according to a selection made with reference to the maximum diameter (F, fig. 41).

The class division is as follows:

Class A: 81.94-81.95 (3.2260-3.2264 in.)	Class B: 81.95-81.96 (3.2264-3.2268 in.)
Class C: 81.96-81.97 (3.2268-3.2272 in.)	Class D: 81.97-81.98 (3.2272-3.2276 in.).

The same sub-division is being made for the oversizing shown in the table on page 29 and it may be observed that such classes are differing between themselves of 0.01 mm (0.0004 in.).

Assembling of various pistons should mate the same class liners, and thus the assembling clearance, measured at the skirt base, along the diameter perpendicular to the pin axis, is being maintained within the described tolerances 0.050-0.070 mm (0.0020-0.0028 in.).

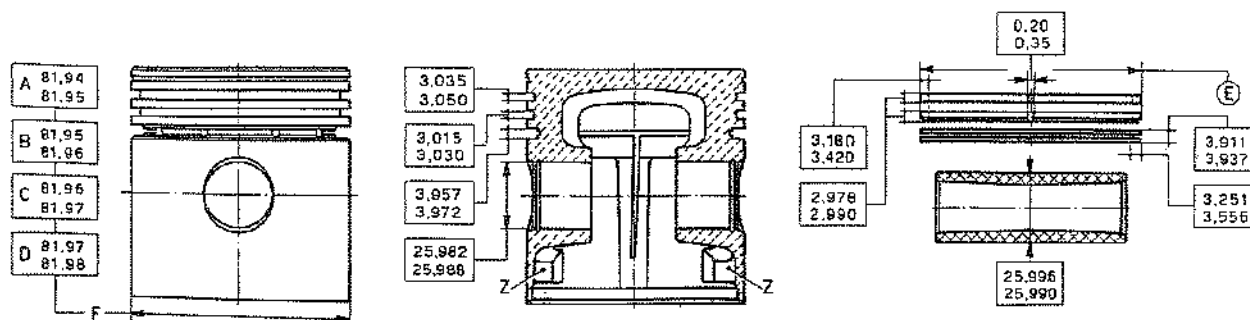


Fig. 41 - Normal dimensions of pistons, piston rings and pins.
Z. Metal removal area.

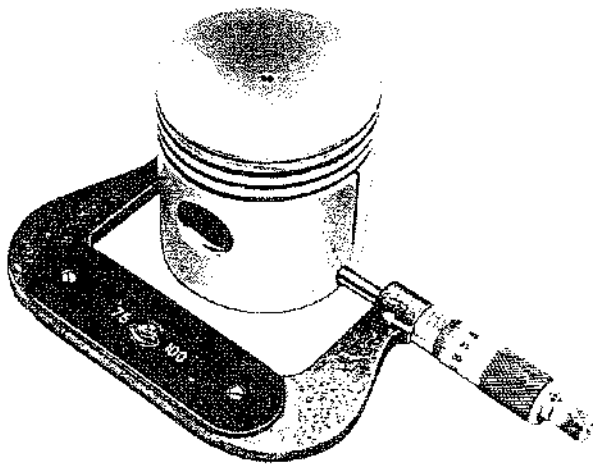


Fig. 42 - Max. piston diameter check.

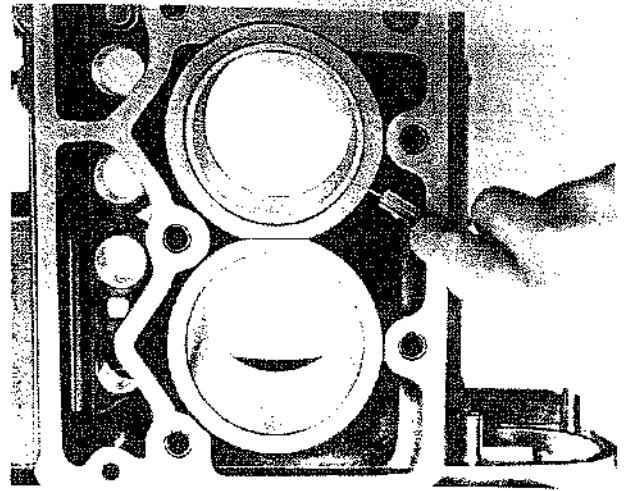


Fig. 43 - Checking gap between ring ends as introduced in the cylinder liners.

As a piston series is assembled, their balancing should be considered and the weight tolerance between piston and piston of ± 2 grams (± 0.07 oz.) may be allowed, and metal from zone Z has to be removed, if necessary (fig. 41).

The same figure indicates the main dimensions of pistons, pins and piston rings.

PISTON PINS

When reassembling pistons having work-wear their pin hole should be checked for ovalization and clearance; if necessary such hole should be reamed using expansible blade tool U313017 until dimension indicated in the table on page 29 is reached, and which corresponds to the pin oversizing.

Pins should be assembled to pistons with an interference of 0.002 - 0.014 mm (0.0001 - 0.0006 in.) and with reference to connecting rod bushes with a clearance of 0.001 - 0.010 mm (0.00004 - 0.0004 in.). Assembly will be facilitated by piston heating in oil or water bath, at a temperature of 80°C (176°F).

Care the fitting of pins to connecting-rod bushes and to the piston bosses, to avoid difficulties during the first engine operation period or knocks that could rapidly augment.

PISTON RINGS

Three types of rings are fitted to pistons; one pressure and two oil scrapers of bevel and U-Flex types.

Ring inspection should point out:

1. - adhesion to liners along all circumference;
2. - distance between gap ends of first and second ring (fig. 43);
3. - clearance referring to piston grooves;
4. - ring thickness (measured corresponding to the surfaces contacting the piston grooves).

Checks No. 1 and 2 may utilize the liner in which they work, using the least worn out section or, if normal new rings are being checked, using the ring gauge C 313012.

Removal and assembly of the first two rings into the piston grooves implies the plier A 619022 (fig. 44), the last U-Flex oil scraper ring is assembled and disassembled by hand and its two ends should overlap of 8.534 - 10.109 mm (0.3360 - 0.3980 in.) when such a ring is free on its piston, but they should contact as it is fitted into the liner.

To introduce pistons fitted with their rings into the liners, use band A 313018/bis as shown in fig. 44.

If the piston ring clearances concerning the grooves exceed the wear limit shown in the table, it is necessary to replace both pistons and rings. Oversize piston assemblings should require also oversize rings, which have to be checked for their appropriate diameter when introduced into the lower liner section. If such a check points out that in the gap exceeds 0.20 - 0.35 mm (0.0079 - 0.0138 in.), the ring must be replaced; a lower gap calls for ring working with device A 10650 (fig. 45).

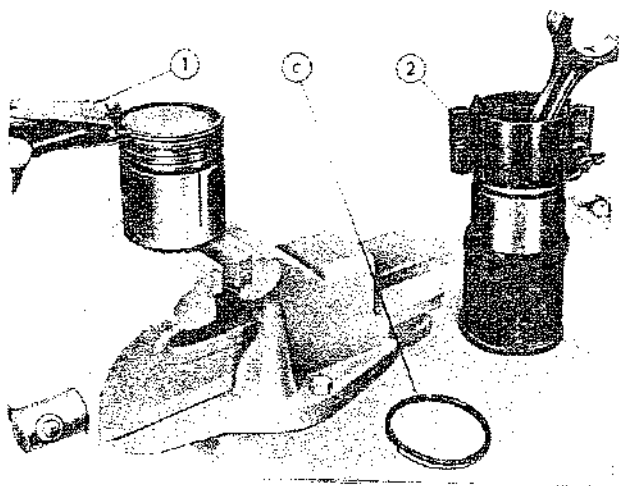


Fig. 44 - Assembling of rings in piston grooves and assembling of pistons in cylinder liners.
1. Plier A 619022. - 2. Band A 313018/bis. - C. U-Flex ring.

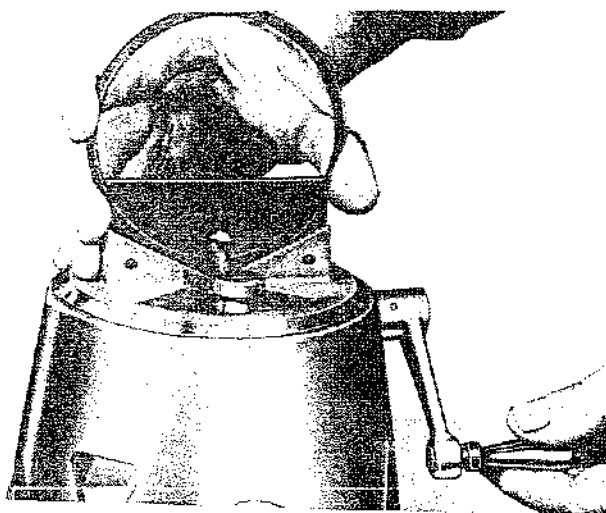


Fig. 45 - Piston ring ends grinding using A 10650.

SPECIFICATIONS, ASSEMBLY CLEARANCES AND PERMISSIBLE WEAR OF CONNECTING RODS, PISTONS AND PISTON RINGS

	Specifications mm (in.)	Assembly clearances mm (in.)		Wear limits mm (in.)
Connecting rod bush outer diameter	28.715 - 28.753 (1.1305 - 1.1320)	Interference between bush and its connecting rod seat	- 0.102 - - 0.038 (0.0040 - 0.0015)	—
Connecting rod bush inner diameter (bush press fitted)	25.997 - 26.000 (1.0235 - 1.0236)	Between connecting rod bush and piston pin	0.001 - 0.010 (0.00004 - 0.0004)	0.15 (0.0059)
Piston pin diameter	25.996 - 25.990 (1.0235 - 1.0232)			
Normal pistons maximum diameter (F, fig. 41)	A 81.94 - 81.95 (3.2260 - 3.2264) B 81.95 - 81.96 (3.2264 - 3.2268) C 81.96 - 81.97 (3.2268 - 3.2272) D 81.97 - 81.98 (3.2272 - 3.2276)	Between cylinder liner and piston of the same class	0.05 - 0.07 (0.002 - 0.0028)	0.25 (0.0098)
Piston pin seat diameter	25.982 - 25.988 (1.0229 - 1.0231)	Interference between pin and its seat on piston	- 0.002 - - 0.014 (- 0.0001 - - 0.0006)	—
Piston first ring groove height	3.035 - 3.050 (0.1195 - 0.1201)	Between groove and first ring thickness	0.045 - 0.072 (0.0018 - 0.0028)	0.15 (0.0059)
First ring thickness	2.978 - 2.990 (0.1172 - 0.1177)			
Piston second ring groove height	3.015 - 3.030 (0.1187 - 0.1193)	Between groove and second ring thickness	0.025 - 0.052 (0.0010 - 0.0020)	0.15 (0.0059)
Second ring thickness	2.978 - 2.990 (0.1172 - 0.1177)			
Gap between first and second ring ends as fitted into the sleeve	0.20 - 0.35 (0.0079 - 0.0138)	—	—	0.8 (0.0315)
First and second ring outer diameter (E, fig. 41)	81.97 - 82.000 (3.2272 - 3.2276)	First and second ring thickness	3.28 - 3.42 (0.1291 - 0.1346)	—

(Follows: Specifications, Assembly Clearances and Permissible wear of connecting rods, pistons and piston rings)

	Specifications mm (in.)	Assembly clearances	mm (in.)	Wear limits mm (in.)
Piston third ring (U-Flex) groove height	3.957-3.972 (0.1558-0.1564)	Between groove and third ring (U-Flex) thickness	0.020-0.061 (0.0008-0.0024)	0.15 (0.0059)
Third ring thickness	3.911-3.937 (0.1540-0.1550)			
Gap between third ring ends, as fitted ends should contact into liner	—	—	—	—
Third ring (U-Flex) outer diameter	81.915-82.219 (3.2250-3.2370)	—	—	—
Oversized U-Flex ring outer diameter of 0.4-0.8 mm (0.0157-0.0315 in.)	mm 82.880-82.296 (3.2630-3.2400 in.)			
Piston pin and connecting rod bush oversizing scale				
Oversizing	mm (in.)	0.2 (0.0079)	0.5 (0.0197)	
Pin diameter	mm (in.)	26.196-26.190 (1.0313-1.0311)	26.496-26.490 (1.0431-1.0429)	
Connecting rods bush diameter (after pressfitting, the ma- chined dimension)	mm (in.)	26.197-26.200 (1.0314-1.0315)	26.497-26.500 (1.0432-1.0433)	
Liner, pistons and piston rings oversizing scale				
Oversizing mm (in.)	Liner inner diameter (*) mm (in.)	Piston maximum diameter (*) mm (in.)	1st, 2nd ring outer diameter mm (in.)	
0.1 (0.0039)	82.10-82.14 (3.2323-3.2340)	82.04-82.08 (3.2299-3.2315)	82.07-82.10 (3.2311-3.2323)	
0.2 (0.0079)	82.20-82.24 (3.2362-3.2378)	82.14-82.18 (3.2339-3.2354)	82.17-82.20 (3.2350-3.2362)	
0.4 (0.0157)	82.40-82.44 (3.2441-3.2457)	82.34-82.38 (3.2417-3.2433)	82.37-82.40 (3.2429-3.2441)	
0.6 (0.0236)	82.60-82.64 (3.2520-3.2535)	82.54-82.58 (3.2496-3.2512)	82.57-82.60 (3.2508-3.2520)	
0.8 (0.0315)	82.80-82.84 (3.2598-3.2614)	82.74-82.78 (3.2575-3.2590)	82.77-82.80 (3.2587-3.2598)	
1 (0.0394)	83.00-83.04 (3.2677-3.2693)	82.94-82.98 (3.2653-3.2669)	82.97-83.00 (3.2665-3.2677)	
1.2 (0.0472)	83.20-83.24 (3.2756-3.2772)	83.14-83.18 (3.2732-3.2748)	83.17-83.20 (3.2744-3.2756)	
1.4 (0.0551)	83.40-83.44 (3.2835-3.2850)	83.34-83.38 (3.2811-3.2827)	83.37-83.40 (3.2823-3.2835)	
1.6 (0.0630)	83.60-83.64 (3.2913-3.2929)	83.54-83.58 (3.2890-3.2905)	83.57-83.60 (3.2902-3.2913)	
1.8 (0.0709)	83.80-83.84 (3.2992-3.3008)	83.74-83.78 (3.2968-3.2984)	83.77-83.80 (3.2980-3.2992)	
2 (0.0787)	84.00-84.04 (3.3071-3.3087)	83.94-83.98 (3.3047-3.3063)	83.97-84.00 (3.3059-3.3071)	

(*) Each oversizing embodies 4 classes A, B, C, D, differing between themselves of 0.01 mm (0.00039 in.); lack of space prevents development of such subdivision and the lower limit of class A and upper limit of class D have been simply stated.

LUBRICATION

Force feed lubrication of engine, by gear pump fastened to crankcase lower section and driven by timing-shaft-integral helical gear.

Oil normal pressure is of 30-35 water meters (43-50 p.s.i.); engine sump and system oil supply is of 5,5 kg (12 lb.) and oil grade is shown in the replenishment table.

The lubrication system is illustrated in fig. 46 and in addition to the foregoing gear pump it embodies also:

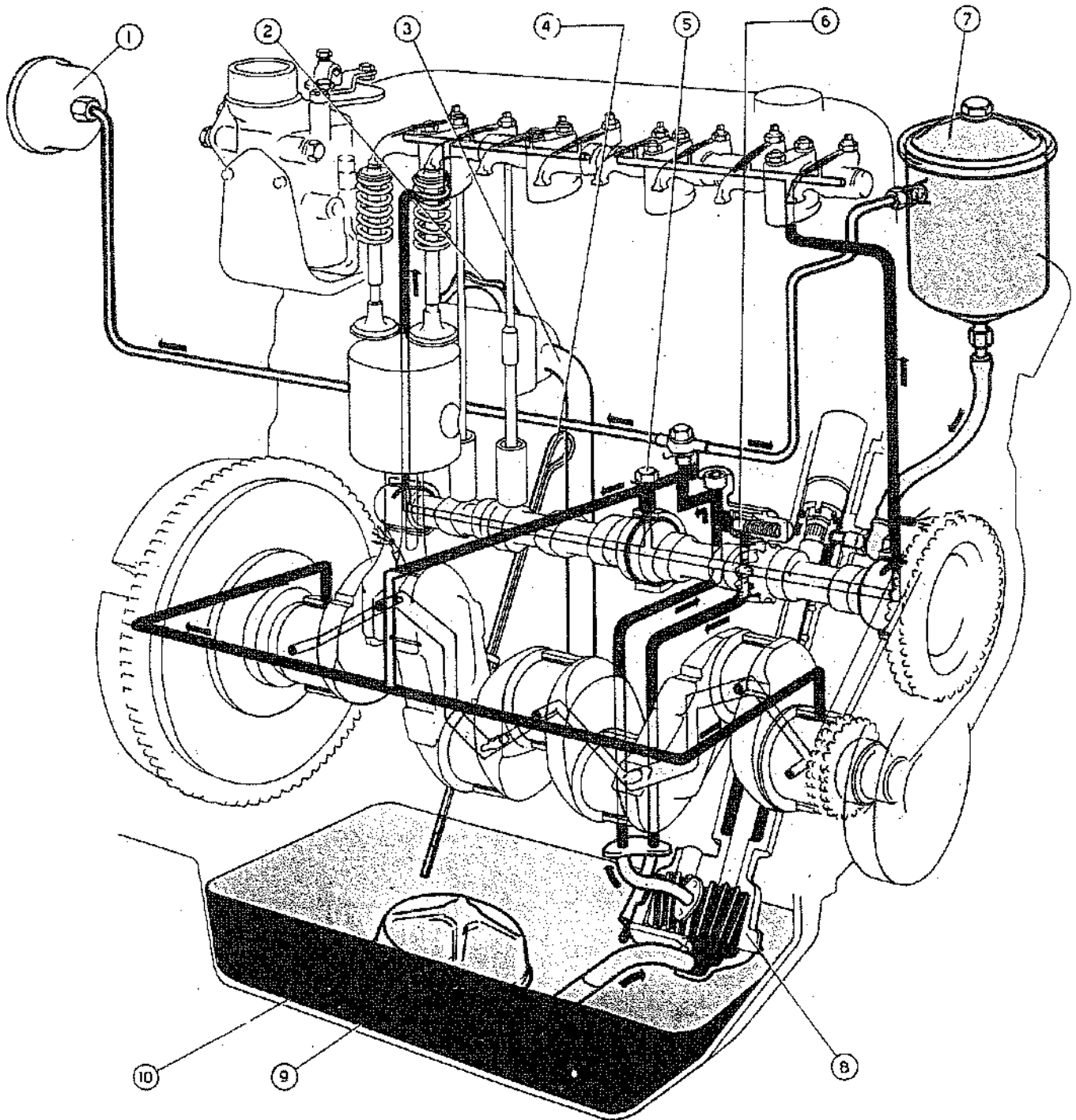


Fig. 46 - Engine lubrication diagram.

1. Oil pressure gauge. - 2. Oil filler. - 3. Vent pipe. - 4. Sump oil dipstick. - 5. Timing shaft central bush fastening screw. - 6. Oil pressure setting valve. - 7. Cartridge type oil filter. - 8. Oil pump. - 9. Pump intake pipe strainer with filter. - 10. Sump oil drain plug.

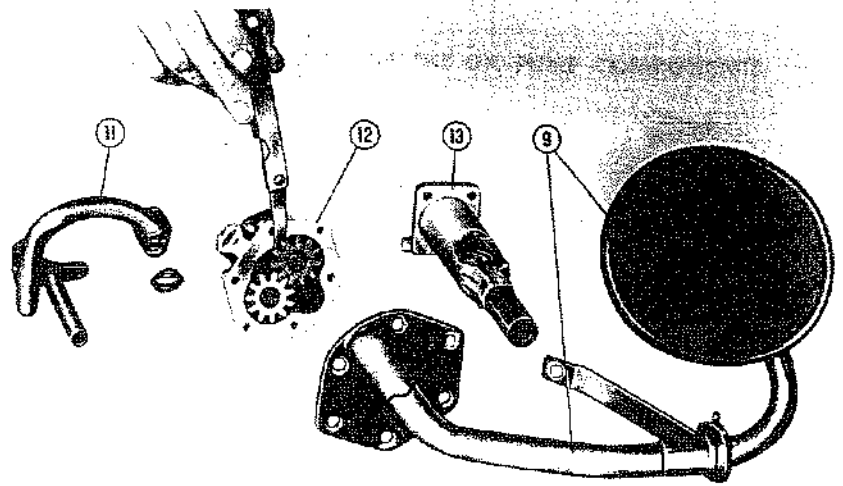


Fig. 47 - Pump-body versus gears clearance check.

9. Strainer and suction pipe. - 11. Pressure pipe. - 12. Pump body and gears. - 13. Pump and firing distributor control.

- gauze filter on pump suction pipe (9);
- a shunted cartridge filter (7) located on the left side of engine crankcase;
- a pressure setting valve (6), outside the crankcase;
- a coloured scale pressure gauge, for checking pressures (1).

CAUTION. - Timing system gears and chain lubrication by oil jet flowing from crankcase hole (15, fig. 12), and communicating with the oil duct lubricating the timing shaft front support. Therefore mind that such a hole be not clogged.

OIL PUMP

During overhaul check the driving and driven gear teeth. If deteriorated, or worn the gears should be replaced.

Ascertain that between gear periphery and pump body the wear limit be not exceeding 0,2 mm (0.0098 in.): use a feeler gauge for such a check, as shown in fig. 47.

The pump driving shaft should not exceed a wear limit of 0.20 mm (0.0079 in.) with reference to its guide.

Pump strainer gauze filter should not be clogged or torn.

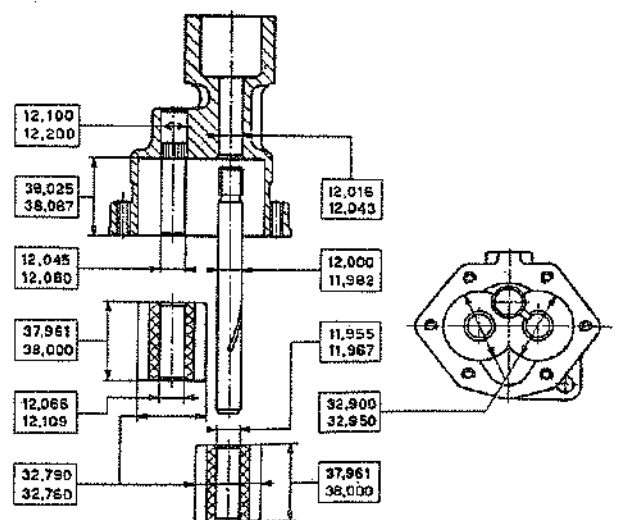


Fig. 48 - Main dimensions of the oil pump components.

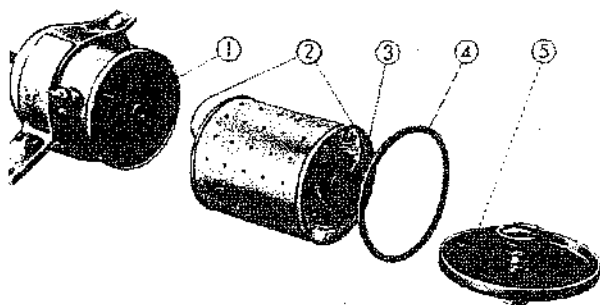


Fig. 49 - Oil filter components.

1. Container. - 2. Seal gaskets. - 3. Filtering cartridge. -
4. Cover gasket. - 5. Cover.

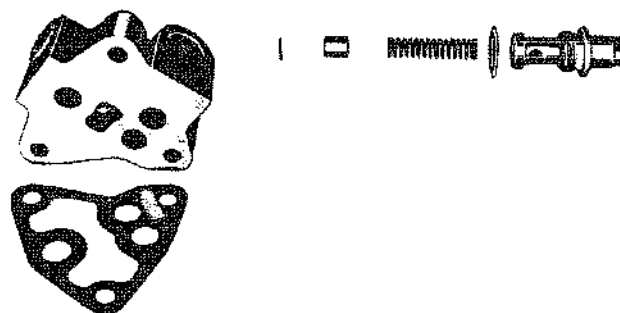


Fig. 50 - Oil pressure setting valve components.

Oil filter maintenance.

The shunt oil filter maintenance should be particularly cared for, as this filter has much importance for a good engine lubrication.

This oil filter is composed by a plate container of a filtering element (fig. 49).

Oil colour should be observed during the engine sump oil level check by the dipstick. If dark, the filter should be checked, during engine operation for a few minutes, in order to heat the oil to the operational temperature.

Should the filter body remain cold, its inefficiency is ascertained. Nevertheless check the passages, or the filtering cartridge for dirt to trace the trouble. Therefore oil passages should be cleaned or the filtering oil cartridge replaced, to restore normal conditions.

The two gaskets (2, fig. 49) should also be checked for conditions; find them at the upper and lower ends of the filtering cartridge, and if necessary replace them. In addition ascertain their regular assembling, to prevent oil passages through the filter body, without flowing through the filtering plug.

About every 300 hours substitute in any case the cartridge independently from the periodic checks.

Take care to avoid engine operation as filter is deprived of the filtering cartridge, because in addition to trouble due to unfiltered oil, a too high loss of pressure could follow. New engine calls for filtering element substitution after 60 working hours.

Suction pipe filter need no particular maintenance; we suggest at each oil drain to remove the sump side cover, and to clean the gauze using a brush and kerosene.

CAUTION. - Engine lubrication should be attentively cared for. Adequate grade oil should be used, and oil drains and cartridge replacement should take place at the required periods.

Oil pressure setting valve.

The setting valve, of which the components are illustrated in fig. 50, has fixed calibration and therefore needs no setting. When erratic, the spring should be checked against specifications on page 33.

**SPECIFICATIONS, ASSEMBLY CLEARANCES AND PERMISSIBLE WEAR OF THE OIL PUMP COMPONENTS
AND OF THE PRESSURE SETTING VALVE**

	Specifications mm (in.)	Assembly clearance	mm (in.)	Wear limits mm (in.)
Pump body gear seat inner diameter	32.900 - 32.950 (1.2953 - 1.2972)	Between seat and gear di- ameters	0.110 - 0.190 (0.0043 - 0.0075)	0.25 (0.0098)
Driving and driven gears outer diameter	32.760 - 32.790 (1.2898 - 1.2909)			
Pump body gear seat depth	38.025 - 38.087 (1.4970 - 1.4995)	Between seat depth and gear width	0.025 - 0.126 (0.0010 - 0.0050)	0.20 (0.0079)
Gear width	37.961 - 38.000 (1.4945 - 1.4961)			
—	—	Between gear teeth flanks	0.15 (0.0059)	0.25 (0.0098)
Pump body driving gear shaft seat diameter	12.016 - 12.043 (0.4731 - 0.4741)	Between pump body seat and driving gear shaft	0.016 - 0.061 (0.0006 - 0.0024)	0.20 (0.0079)
Driving gear shaft diameter	11.982 - 12.000 (0.4717 - 0.4724)			
Driven gear shaft diameter	12.045 - 12.060 (0.4742 - 0.4748)	Between shaft diameter and driven gear hole diameter	0.006 - 0.064 (0.0002 - 0.0025)	0.15 (0.0059)
Driven gear inner diameter	12.066 - 12.109 (0.4750 - 0.4767)			
Control support shaft seat inner diameter	12.050 - 12.077 (0.4744 - 0.4755)	Between shaft seat and pump control shaft diameters	0.050 - 0.095 (0.0020 - 0.0037)	0.20 (0.0079)
Oil pump and firing distributor control shaft diameter	11.982 - 12.000 (0.4717 - 0.4724)			
Setting valve seat inner diameter, on valve body	11.016 - 11.043 (0.4337 - 0.4348)	Between setting valve and its seat	0.016 - 0.061 (0.0006 - 0.0024)	0.20 (0.0079)
Oil pressure setting valve diameter	10.982 - 11.000 (0.4324 - 0.4331)			
Oil pressure setting valve spring characteristics				
Free spring length	mm 43.5	(in. 1.71)		
Spring length under load	mm 29.5	(in. 1.16)		
Check load	kg 37.8 - 38.2	(lb. 83.3 - 84.2)		

FEEDING

AIR CLEANER

An accurate servicing of the air cleaner is suggested to grant engine long life, especially where operation takes place in very dusty air.

To this end, remove the oil cup (7, fig. 52), remove ring (9) and also the lower filtering mass (10) and pre-cleaner (2). The filtering mass surfaces will be cleaned with a dry brush, and the dust removed from the filter inner surfaces, and from pipes, especially the central one (12) and from precleaner. The removed filtering mass and the one still fastened to the filter body, shall be dipped into a container with kerosene.

Before filter replacement wait until the masses are well dried and drain the oil from the cup, which shall be refilled till the level shown in fig. 52.

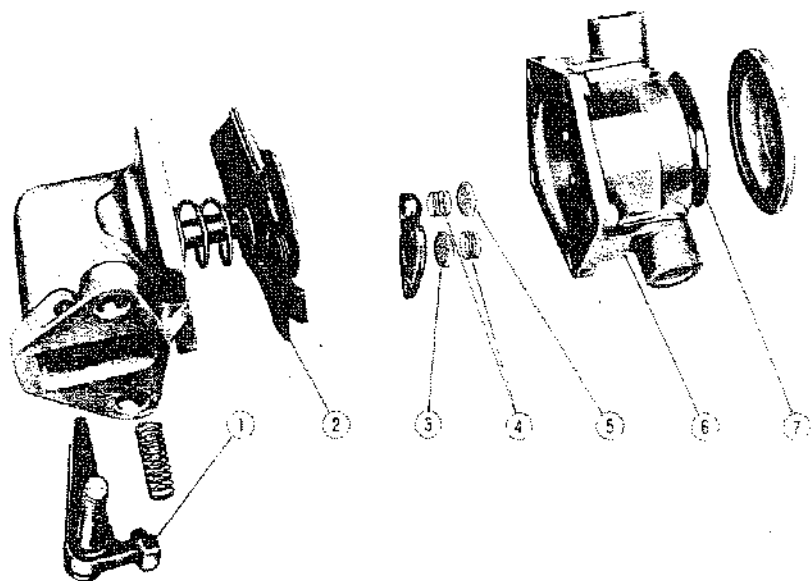


Fig. 51 - Feed pump components.

1. Diaphragm control. - 2. Diaphragm. - 3. Suction valve. - 4. Suction and pressure valves spring. - 5. Pressure valve. - 6. Fuel container. - 7. Gauze filter.

GASOLINE FEEDING

- Gasoline feeding system includes:

- the tank;
- the filter and cup;
- the feed pump;
- the carburetor.

FUEL TANK

Tractor overhaul should include an accurate cleaning of the tanks and lines. Any crack must be welded, after draining the tank, refilling with water without refitting the gasoline filler cap.

BOWL FILTER

The bowl filter, between the tank and the feed pump, prevents the foreign matters floated by the gasoline to damage the feed pump components and clog the carburetor passages.

This filter features a decantation bowl and a cylindrical gauze filter.

The filter overhaul consists simply in the cleaning of the bowl and of the filter, using an air jet or the substitution of this last element if impaired.

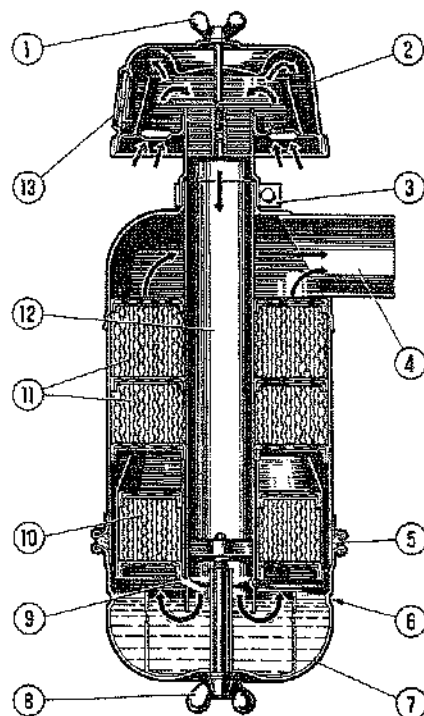


Fig. 52 - Air cleaner section.

1. Pre-cleaner fastening screw. - 2. Pre-cleaner, centrifugal. - 3. Pre-cleaner fastening clamp. - 4. Air-duct to engine. - 5. Gasket between cleaner body and oil cup. - 6. Oil level. - 7. Oil cup. - 8. Oil-cup fastening screw. - 9. Bottom filter-element retaining snap ring. - 10. Replaceable bottom filter element. - 11. Fixed filter element. - 12. Central air duct. - 13. Pre-cleaner inspection port.

FEEDING PUMP

A mechanically operated fuel feed pump, provided of a diaphragm (fig. 51); fastened to engine crankcase, it is actuated by a timing shaft cam, through a lever which actuates the diaphragm control tie-rod.

The pump upper section features: a fuel container (6) used to prime the pump, the gauze filter (7), the suction (3) and pressure (5) valves with their springs (4).

The lower section is fitted with the pump diaphragm (2) and its control (1).

No particular attention is due to the feed pump; nevertheless we suggest to periodically inspection it, and remove foreign matters collected into the container or on the gauze filter. In addition wash both suction and pressure valves and replace them if worn-out; check the springs efficiency and if deformed, replace them.

Springs should never be changed with each other during the reassembling: the pressure valve spring contains greater number of turns.

Before replacing new diaphragms immerse new parts in kerosene for at least 15 minutes.

CAUTIONS

Failure of gasoline to reach the carburetor may be traced to:

- empty gasoline tank;
- bowl filter clogged;
- impaired feed pump diaphragm;
- slackened upper covers screws or assembling the two pump sections;
- feed pump gauze filter (7, fig. 51) clogged;
- impaired valves (3, 5);
- unelastic or broken springs (4);
- feed pump control lever (1) showing excessive wear on surface contacting the cam.

CARBURETOR

Specifications and adjustment of the SOLEX C 26 NH carburetor.

Body diameter	26 mm (1.02 in.)
Choke diameter	21 mm (0.83 in.)
Main jet diameter	1.25 mm (0.049 in.)
Idle jet diameter	0.60 mm (0.0236 in.)
Emulsion air jet diameter	1.25 mm (0.049 in.)
Needle valve seat diameter	1.30 mm (0.051 in.)
Well (without mark, integral to emulsion air jet)	
Float weight	10,5 gr (0.37 oz.)
Float level (see page 37 «Instructions for carburetor overhaul»)	26 mm (1.02 in.)

This carburetor, horizontal type, has the following characteristics:

- anti-icing, allows good carburation also with notably humid and cold air;
- gives a good carburation also when the tractor operates on grounds of notable crosswise and longitudinal slope;
- starting is fitted of synchronizing control between the starting butterfly and the main one;
- the starting butterfly opening as engine is running, is automatically caused due to suction prevailing downstream of butterfly;
- float chamber and starting functional air and the air for idling and maximum output, is intaken from the main carburetor inlet, located downstream of filter. This advantages the prevention of dust entering the float chamber and keeps constant the pressure difference between intaken air and the air existing within the Venturi, independently from air cleaner operational conditions, in order to maintain an evenly rich mixture.

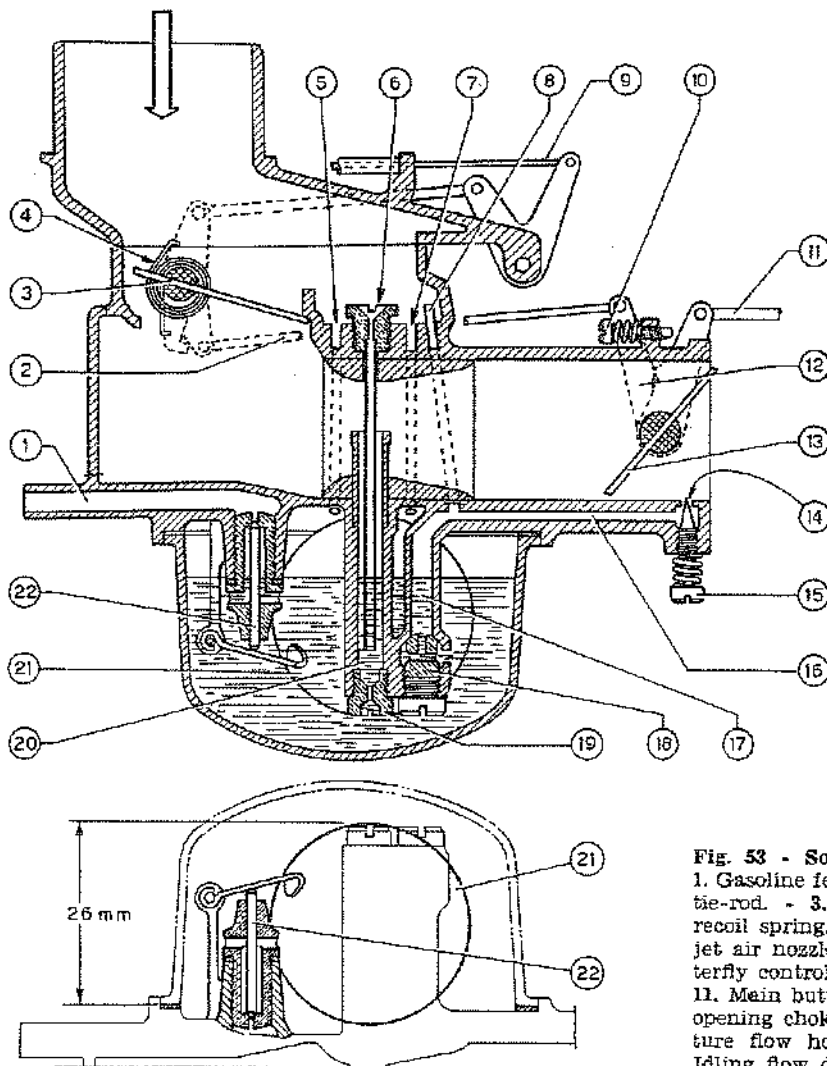


Fig. 53 - Solex C26 NH carburetor functional diagram. 1. Gasoline feed line. - 2. Starting butterflies synchronizing tie-rod. - 3. Starting butterfly. - 4. Starting butterfly recoil spring. - 5. 7. Float chamber air intake. - 6. Main jet air nozzle. - 8. Idle jet air intake. - 9. Starting butterfly control tie-rod. - 10. Butterfly adjustment screw. - 11. Main butterfly control tie-rod. - 12. Starting butterfly opening choke lever. - 13. Main butterfly. - 14. Idle mixture flow hole. - 15. Mixture adjustment screw. - 16. Idling flow duct. - 17. Idling well. - 18. Idling jet. - 19. Main jet. - 20. Full load and starting well. - 21. Float. - 22. Needle valve.

Progressive starter.

The progressive starter device allows of prompt engine cold starting, actuated by a relevant control and it should progressively be excluded according to the engine increasing heating, until complete exclusion, as soon as the engine might have reached a regular functional temperature.

As starting control knob is fully pulled, the butterfly (3, fig. 53) through tie-rod (9) becomes completely shut. On such a position tie-rod (9) and through tie-rod (2), articulated to the same lever, lightly opens the main butterfly (13) in order to set up conditions favourable to carburation. Under such circumstances, i.e. the starting butterfly being closed and the main butterfly lightly open, a very rich mixture is being produced, which serves to the starting.

After engine starting and its speeding up to a given speed rate, the suction effects downstream butterfly (3), prevails against spring (4) elasticity, and the opening of such a butterfly will follow (independently from the operator, and the starting device control knob being still completely pulled out). This prevents excessive mixture enrichment after starting. Such a device allows, therefore, a succession of positions, available for regular starting under all conditions.

The observation of the carburetor diagram shows that the suction brought about by the nearly total shutting of the main butterfly, sucks into the choke minimum section the mixture produced into well (20), together with the air flowing through metering nozzle (6), which is being additionally mixed to air intaken through the starting butterfly main duct (3).

CAUTION. - After starting, the knob should be pushed back.

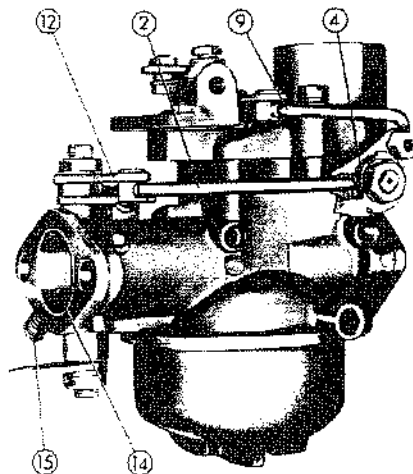


Fig. 54 - Overall view of carburetor.
2. Starting butterfly synchronizing tie-rod. - 4. Starting butterfly recoil spring. - 9. Starting butterfly control tie-rod. - 12. Starting butterfly part-opening lever. - 14. Idling mixture flow hole. - 15. Mixture adjustment screw.

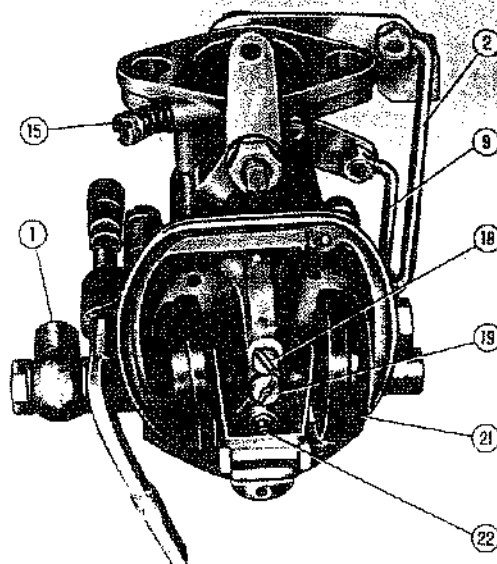


Fig. 55 - Carburetor and float chamber.
1. Gasoline inlet line. - 2. Starting butterfly synchronizing tie-rod. - 9. Starting butterfly control tie-rod. - 15. Mixture adjustment screw. - 18. Idling jet. - 19. Main jet. - 21. Float. - 22. Needle valve.

Idling.

As main butterfly (13) is closed the engine suction sucks gasoline from well (17) through the hole (14).

The mixture takes place as gasoline meets the air entering from intake (8), and is delivered from duct (16) down stream of the butterfly and through ring-orifice of the hole (14), and from the screw (15) taper end.

Screw (15) adjusts and corrects the amount of mixture delivered from the idling nozzle, in order to meet the engine requirements for a best idling.

Full load functioning.

The main butterfly (13) being opened, the suction intakes the gasoline from well (20).

The gasoline is mixed with air entering from metering nozzle (6), and such a mixture escapes from the pipe positioned at the choke minimum section (the max. suction zone).

Constant level float chamber.

Float chamber is fitted with a float (21, fig. 55), which actuates the needle (22) protruding from its seat. As the fuel reaches the proper level, the float actuates the shutting of the flow aperture and stops fuel delivery.

Carburetor trouble shooting.

As engine inspection detects impaired carburation, the causes may be traced as follows:

Carburetor flooding: check the needle valve for seat leakages.

Impossible cold starting of engine: it follows clogged-starting-jet, or as control displacement is partly prevented.

Starting impossible when engine is hot: check for clogged jets or clogged inner passages or for irregular idling system setting.

Acceleration difficulties: check the main jet for clogging, or for main air metering nozzle obstruction.

Excessive consumption: it is related to the main air-calibration nozzle.

CARBURETOR OVERHAUL INSTRUCTIONS

Level.

After removal of the carburetor float chamber, the needle valve seat and float are easily inspected.

Before checking the float-chamber fuel-level, verify that:

— the needle-valve seat be well screwed and tightened with inserted gasket;

- the calibrated hole of the needle-valve seat, should be free from foreign matters and not bent or worn;
- the needle should be free in its guide. If leaking occurs, both valve and needle should be replaced;
- float be not deformed or broken and prevented to oscillate due to excess of friction.

Overturn the carburetor to check the fuel-level, measuring the distance between the float-chamber plain, bearing upon the gasket, and uppermost profile of float: the measured distance should be of 26 mm (1.02 in.) (fig. 53).

Fuel level adjustment requires adjustment of the gasket-thickness located on the needle-seat as follows: to augment the level, the gasket-thickness should be decreased correspondingly to the required variation, whereas it should be increased for the reverse adjustment.

Butterfly components.

The butterfly shafts should freely rotate into their guides even if engine is very hot.

Ascertain that no excess of play and butterfly deformation are present, because they would cause engine irregular functioning, especially when idling and starting. If necessary, replace the butterfly and shaftlets assembly.

Cleaning of inner passages and gauged components.

We suggest the following procedure for the carburetor general cleaning:

Inner passages. - All gasoline passages have the diameter as required for best functioning; it is therefore necessary to remove deposits and incrustations originated by fuel, which would impair functional conditions. Use gasoline and a compressed air-jet for cleaning purposes; avoid using metallic points which could enlarge passage size.

Gauged components. - Full-load and idling jet-holders, and the jets, are removable using a normal wrench and screwdriver.

The gauged components cleaning requires a washing in gasoline, followed by a compressed air-jet blowing, metallic point use being absolutely prohibited.

To avoid functional trouble ascertain, when reassembling the carburetor, that all parts be screwed to their seats providing sufficient seal.

Idling adjustment.

Idling adjustment device features a butterfly closing adjustment-screw (10, fig. 56) and a mixture adjustment screw (15, fig. 56).

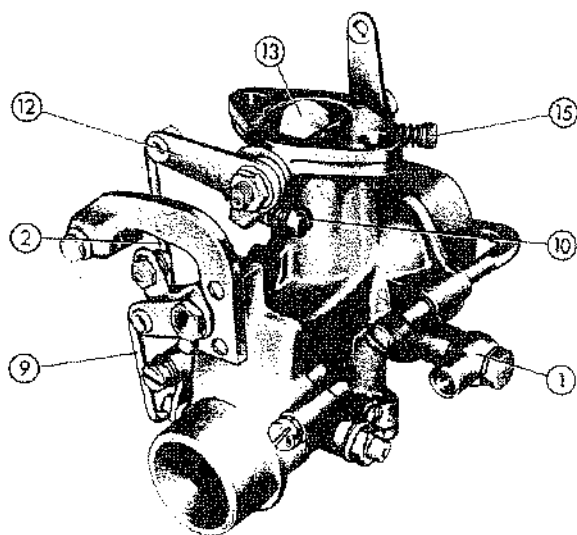


Fig. 56 - Overall view of the carburetor.
1. Gasoline inlet line. - 2. Starting butterfly synchronizing tie-rod. - 9. Starting butterfly control tie-rod. - 10. Butterfly adjustment screw. - 12. Starting butterfly opening control lever. - 13. Main butterfly. - 15. Mixture adjustment screw.

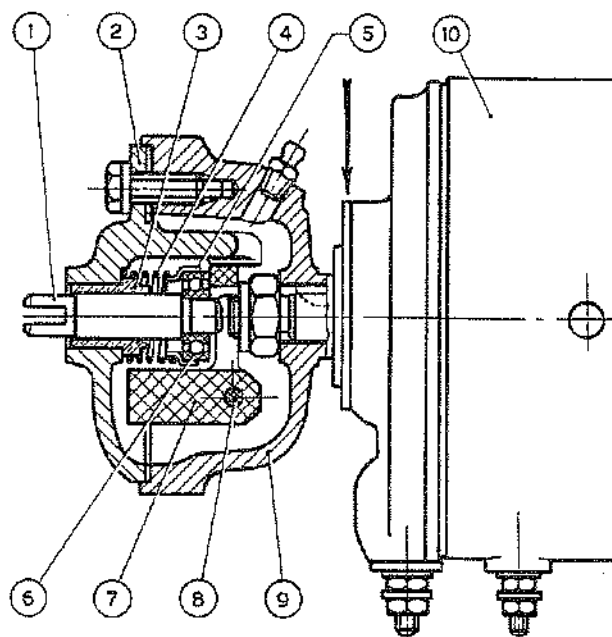


Fig. 57 - Governor sectioned.
1. Shaft. - 2. Centrifugal-weights cover-support. - 3. Bush. - 4. Spring. - 5. Spring centering-ring. - 6. Bearing. - 7. Centrifugal weight. - 8. Centrifugal weight pivot. - 9. Body. - 10. Generator.
(Arrow shows the thickness adjustment shims between governor and generator).

The butterfly adjustment screw allows its opening setting, whereas the mixture adjustment screw aims to set the mixture amount flowing from the idling passage. The mixture is dispersed into the engine sucked air, through the gap offered by the butterfly idling position: thus a better mixture-grade is being produced as fit for regular engine operation.

Idling adjustment should be when engine is both hot and running, and the suggested procedure is as follows:

- the butterfly stop screw should be lightly screwed down (10, fig. 56), thus increasing the engine speed rate;
- after, slack the mixture richness adjustment screw (15, fig. 56) until the engine begins « hunting », and progressively tighten it until engine runs regularly;
- lastly, slowly unscrew the throttle adjustment screw, until the engine speed-rate runs at its lowest idling. Should the engine show a residual light « hunting », the idling air setting-screw should be lightly tightened.

In any case avoid the mixture adjustment screw to be completely tightened.

NOTE. - This servicing should be particularly cared for to avoid excessive gasoline consumption when engine runs at normal speed rate.

GOVERNOR

Centrifugal weight type governor (fig. 57), operating at all engine speed rates, being keyed to the generator armature spindle extension, at the generator rear end.

This assembly needs no functioning adjustment; the overhaul is limited to check the spring (4) efficiency, and the clearance between spindle (1) and bush (3), if not exceeding 0.02 mm (0.0079 in.).

Bush (3) replacement by punch A 313009. Before reassembling the weight carrying cover (2), refill the governor body using Fiat grease G 9.

The only servicing adjustments concern the control tie-rods, as illustrated in fig. 70.

INTAKE AND EXHAUST MANIFOLDS

All manifolds (fig. 58) should be carefully cleaned and the intake passages freed from dust deposits and the exhaust one from carbon incrustation.

Check the cylinder head bearing surfaces for bent. If necessary grind them on the surface grinder, or using a file.

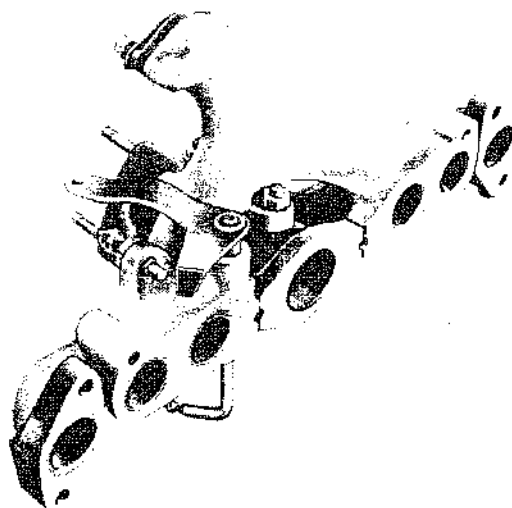


Fig. 58 - Intake and exhaust manifolds.

COOLING SYSTEM

Engine cooling by water circulation, controlled by a thermostat, fitted into the cylinder-block water outlet-pipe (7, fig. 17).

The system components are:

- water pump;
- thermostat;
- radiator;
- fan.

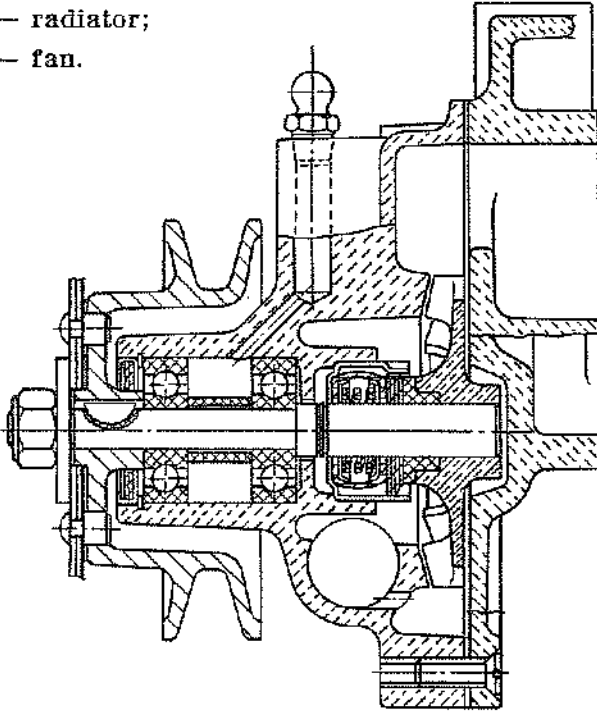


Fig. 59 - Water pump section.

WATER PUMP

The water pump is a blade impeller centrifugal type, its spindle rotating on ball bearings, fitted with a plate-cased rubber-gasket sealing (fig. 59).

Stripping out, overhaul and reassembling.

The impeller.

Fan, driving pulley, cover and assembling-key, should be removed; and the impeller slid out, complete of spindle.

Bearings.

Remove front sealing-gasket, the stop-ring, bearings and the spacer.

NOTE. - If possible, avoid removal of the sealing-gasket as, if not much careful, it may be damaged.

Inspections.

Check for efficiency front and rear sealing gaskets; ascertain that bearings are smoothly running; remove the lime deposits from water-contacting surfaces.

Reassembling.

Check that the impeller plane be slightly beneath the cover assembling plane (fig. 61), and check that between the impeller blades and the pump body there is sufficient clearance to allow free running.

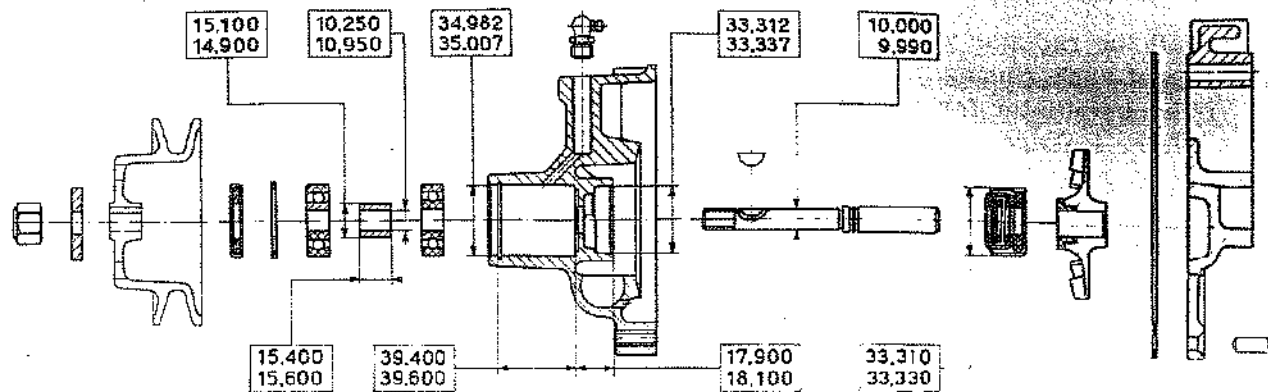


Fig. 60 - Water pump main dimensions.
(Impeller is supplied with spindle).

THERMOSTAT

The thermostat is assembled into the cylinder block water outlet (7, fig. 17) and ascertains rapid engine-temperature increment until a proper operating temperature is being reached. Effectively, at starting, the thermostat being closed, the water circulates only through the crank-case and the cylinder-head, the radiator being excluded. But, as soon as temperature increases, the thermostat bellows extends, and the valve being opened, the circulation through the radiator takes place.

The thermostat has a fixed calibration and needs no setting. Functional temperature-range is as follows:

— beginning of opening	82° - 87° C (179.6 - 188.6° F)
— end opening	90° - 95° C (194 - 203° F)
— valve maximum displacement	6 - 8 mm (0.24 - 0.32 in.)

Check the thermostat regularity of functioning by placing it into a water-heater and immerse also the bulb-thermometer found on dashboard.

RADIATOR

Excess of water heating, experienced during engine functioning, calls for various checks: after a thermostat check-up, ascertain that the radiating mass be not prevented by outside obstructions and limestone incrustations inside the tubes.

Such incrustations, inside the radiator and the cooling system circuit, may be removed with accurate cleaning, as the radiator is installed on the tractor; the procedure is as follows:

- make a solution of 300 grams (10.6 oz.) of sodium carbonate in about six liters of water (1.3 imp. gal.) and strain the solution through a cloth;
- fill the radiator with the solution, and run the engine, nearly idling speed, for about 10 minutes. Drain the radiator;

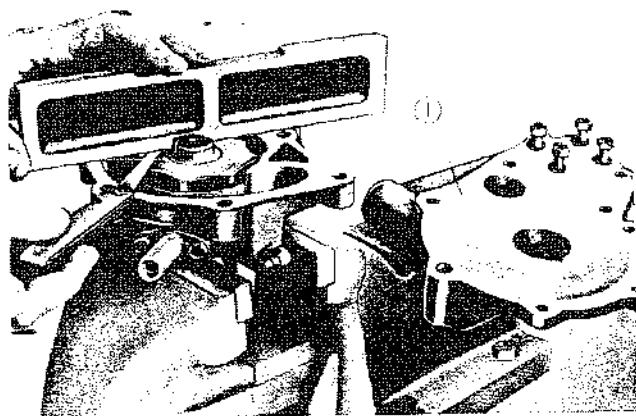


Fig. 61 - Check of distance between the pump assembling plane and the impeller plane.
1. Pump cover.

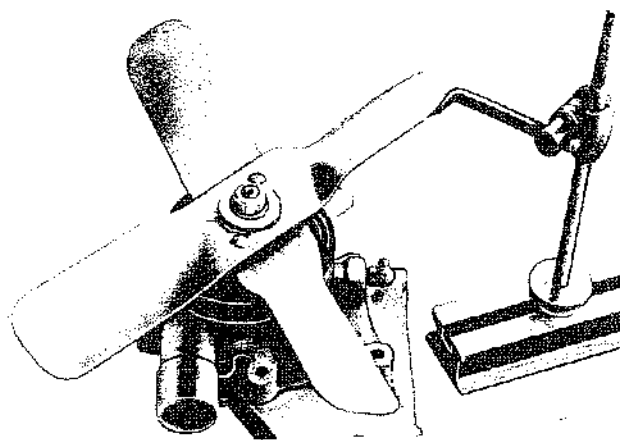


Fig. 62 - Checking fan blades for distortion using a surface gauge.

— refill the radiator with clean water, and run again the engine, and drain it again; if necessary repeat such rinsing.

Check radiator for eventual leakages.

Water leakages may be located by a pressure test.

NOTE. - Free the radiator steam-exhaust-pipe if clogged by calcareous scale or soil to avoid abnormal pressure rise into the cooling system.

FAN

Fan blade unbalancing makes rising noise during engine tests and should be checked and if necessary trued up.

A surface gauge of which the point bears upon the fan blade, may point-out the fan conditions if blades are slowly rotated (62).

Replacement of generator and fan driving-belts.

To replace belting, when tractor is fitted with hydraulic-lift, avoid the control-pump removal, but proceed as follows:

- remove the bolt assembling the hydraulic pump control shaft to sections (63), after removal of the nut fastening split pin; slide lengthwise the shaft section assembled to the pulley, towards the pump;
- slacken screws fastening the generator support to the belt stretcher (2, fig. 8).

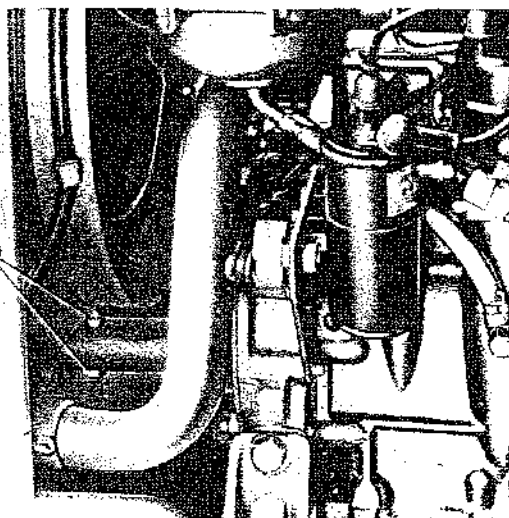


Fig. 63 - Hydraulic pump control shaft.
2. Shaft sections union bolt.

ENGINE REASSEMBLING

To speed up reassembling, fit the timing gear case and the rear support to engine crankcase, which shall be mounted on the rotary stand ARR 2216, using the stirrups A 117004/bis; the procedure is as follows:

Components being assembled:

Lines and pistons.

Camshaft.

Crankshaft.

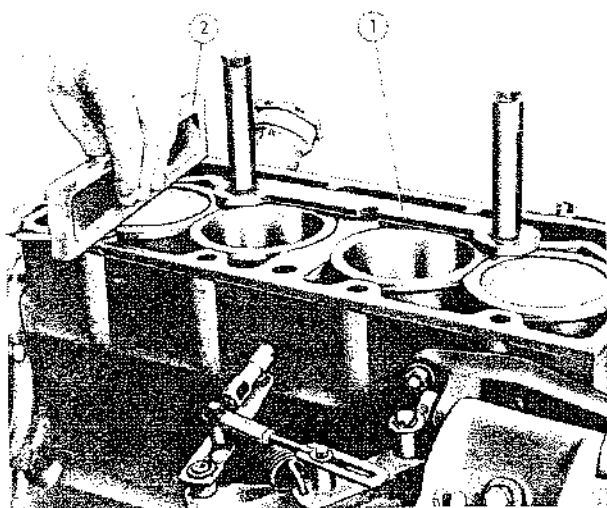


Fig. 64 - Checking projection of cylinder liners on engine block.

1. Tool A 313013, assembling the liners to the engine crankcase. - 2. Straight edge C 517011.

Crankshaft rear cover and seal gasket (3, fig. 66).

Procedure and cautions:

Fit piston connecting-rod-units into respective liners, caring the piston ring introduction using the band A 313018/bis.

Piston pins and connecting rods fitting to pistons, should be according to instructions on page 26.

Liners reassembling is related to correct fitting of the gaskets (19, fig. 14); after reassembling, check liner projection upon engine block, which should be within the range limits shown in the table on page 13; use straight edge C 517011 and feeler gauge (fig. 64).

Mount tool A 313013 to fasten liners, using the same screws and washers normally connecting the cylinder head; overturn (180° rotation) the crankcase; fit the camshaft support bushes and tighten the relevant screws to their seats (9, 11, fig. 11, 10, fig. 14); from the crankcase front end, slide in the camshaft, and after assemble to it the bronze stop-plate, and the three screws provided of the two stop-plates.

Fit the crankshaft journal half-bearings to the three supports, and the thrust half-rings to the front support, after having checked the half-bearings thickness against variations following grinding of the crankshaft journals, if necessary;

check clearance between journals and half-bearings, according to indications on page 23.

NOTE. - When fitting journal bearing caps, ascertain that the number marks be facing the same side as those marked on crankcase (fig. 65).

The cap self-locking screws tightening, should be performed using the torque-wrench applying a torque of 11 kgm (80 ft-lb.).

Check that the crankshaft end play (fig. 35) be within the limits provided in the table on page 23.

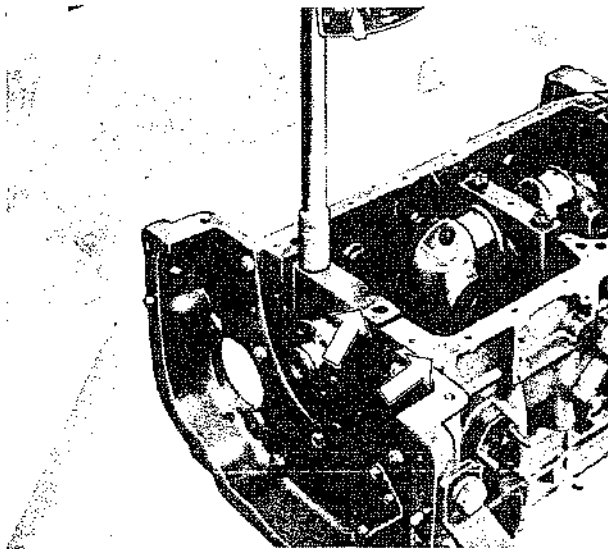


Fig. 65 - Crankshaft journal caps tightening, and positioning of numbers marked on caps and crankcase.

Connecting-rod big-end caps.

Flywheel.

Timing gears.

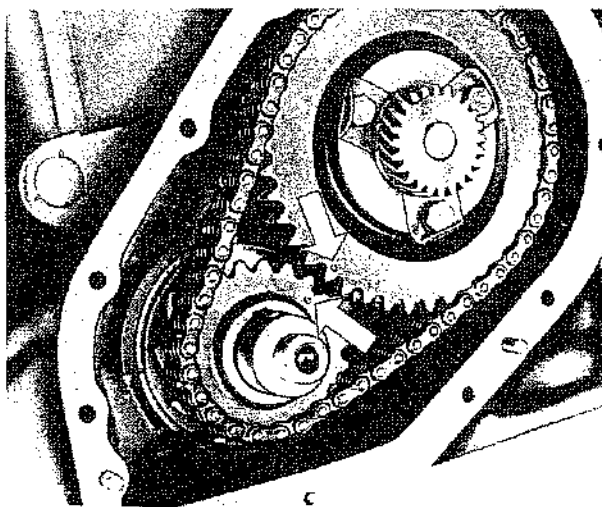


Fig. 67 - Timing gears.

(NOTE. - Reference marks on gears are coinciding before the T.D.C. takes place, when the first cylinder intakes).

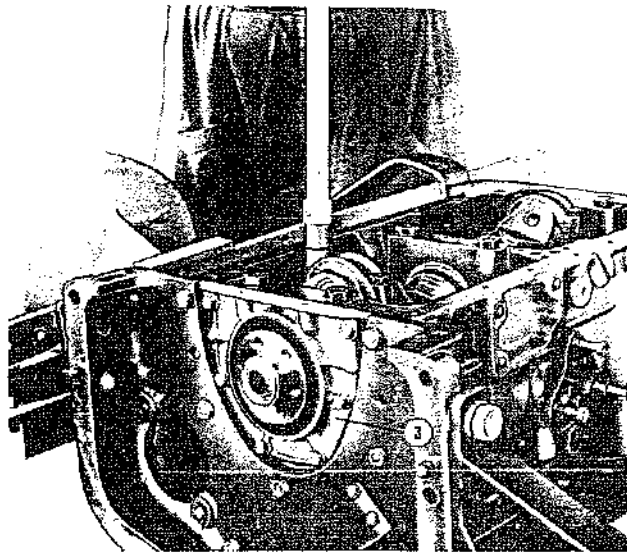


Fig. 66 - Using torque wrench to apply a torque of 5.5 kgm (40 ft-lb.) for the connecting rod big end cap tightening.
3. Cover with rear sealing gasket.

Fit the caps with the half-bearings, after checking if the clearance between journal and half-bearings is within limits, as shown in the table on page 23.

After assembling, the number marks on caps should correspond to the cylinder numbers, found near to the connecting rod assembling plane (U, fig. 40).

The self-locking screws tightening torque is 5.5 kgm (40 ft-lb.).

Set the crankshaft with its no. 1 cylinder at the T.D.C. and position the flywheel so that the mark T.D.C. 1-4, marked on the external face, be corresponding to the timing index. Use the torque wrench to tighten the self-locking screws to a torque of 7 kgm (51 ft-lb.).

Fit to the crankshaft end the gear bearing ring, its elastic stop and the key.

Set the crankshaft no. 1 web its T.D.C., and at the same time fit the end of the shafts with gears and chains. Mind that the gear reference marks be in correspondance and that the chain stretching pins be facing the crankcase (fig. 67).

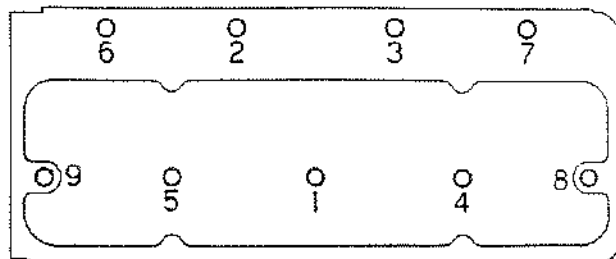


Fig. 68 - Cylinder head screws tightening sequence.

Oil pump, complete.

Engine sump.

Tappets.

Cylinder head (fig. 17)

Push rods, rocker arms and their supports, and housing cover.

Crankshaft pulley.

Cylinder outlet pipe, complete of thermostat (fig. 17).

Oil filler, pressure-setting box and filter inlet-and-outlet pipes.

The resistance, coil, and firing distributor with its support, and the sparking plugs.

Fit to camshaft the hourmeter driving-gear and the complete cover.

Fasten the pump to the crankcase and the strainer to the crankshaft central journal-cap.

Overturn the crankshaft (180° rotation) and using tool A413055 (fig. 11) fit the tappets into their seats.

The cylinder head should be fitted with: the valves, the intake and exhaust manifolds, provided of the generator and starting motor shield, the carburetor, the water pump complete of fan and oil filter.

Lay upon the crankcase, the gasket and fasten the cylinder head with the screws and the steel and copper washers.

The tightening torque is 9 kg (65 ft-lb.) applied gradually to the screws according to the sequence of fig. 68 diagram.

Two series of push rods, easily detectable, one for the exhaust, being of equal diameter and the other, for the intake, having two-diameter-rods of different metals are fitted to control the engine valves through rocker arms.

After fastening both axles and rocker arms the valves should be adjusted according to the instructions shown on page 20 and concerning the timing checks.

Keyed to the crankshaft, it is fastened with nut and stop plate.

Between the flanges attaching the pipe to the cylinder head, fit the gaskets.

The reassembling of valve components should follow the suggestions at fig. 50.

Fasten to crankcase the filter oil outlet pipe, after assembling of the firing distributor support.

Fasten the resistance and the coil to the support opposite side, and fasten the side to the timing housing;

mount the oil-pump control-and-firing distributor support, and fasten its upper and front side to the crankcase using the screw attaching the oil outlet pipe to the filter;

fasten to its support the firing distributor and fit its cap;

Starting motor, the generator, fitted with the governor, and the control belting.

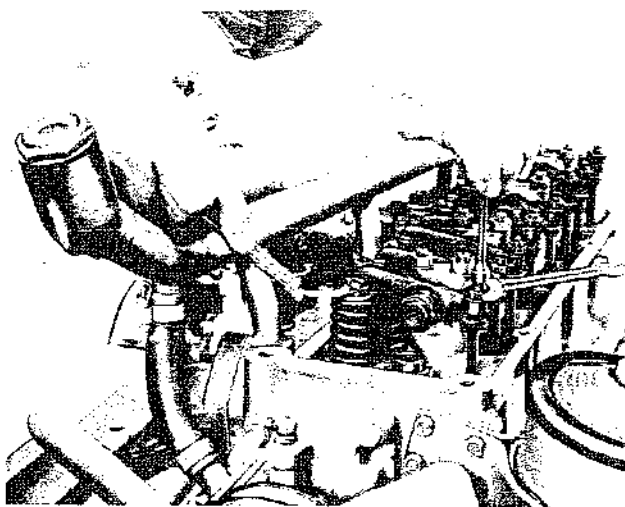


Fig. 69 - Adjustment of clearance between valves and rocker arms.

Feed pump and piping.

connect the firing plugs to the corresponding numbered cables.

Tighten the starting motor inner nut with the wrench A 117069.

To assemble the generator it is necessary the coincidence of the dowel projecting from its frame with the relevant support hole.

After the assembling, the governor control lever-end should be housed into the relevant governor-shaft recess.

NOTE. - The generator control-pulley fastening nut tightening-torque should be of 7 kgm (51 ft-lb.) and the speed-governor case to armature fastening torque of 2 kgm (14 ft-lb.).

After belting assembling, its tension may be adjusted by pulling the generator outside, and tightening the stretcher screws (2, fig. 8) when, applying a slight pressure by hand, the belt settling is of 1-1.5 cm (0.39-0.59 in.).

Excess tension might rise abnormal pressure upon the generator-and-water-pump spindle bearings.

Mount the pump and its insulating plate to the engine crankcase.

ENGINE BRAKE TESTING

Install the engine on the test bench, checking the alignment between crankshaft and brake shaft; connect the cooling water, the gasoline and the exhaust gas pipes.

Energize by a 24 V battery the starting motor.

Refill to normal level the engine oil sump. Start the engine and measure the access of oil, fuel, and water leakages; the oil gauge pressure should be normal, ecc. If necessary, eliminate trouble before testing.

The run-in period is related to the previous overhaul importance of its components. After general overhaul the run-in cycle should be applied by degrees, during about two hours and the speed rate increasing from 1000 to 2500 r.p.m.; a gradually applied braking to the increasing facility of engine rotation, keeps the r.p.m. rate within the required speed level.

As run-in is ended, the engine operation of about 15 minutes at its maximum output, will precede the check-up of the developed power.

To check output, set governor as stated at page 49, caring the main throttle extreme setting and idling setting.

For power testing we suggest to use the tractor belt pulley to operate the test-bench driven-pulley, taking care that the belt sliding be within the 3% limit. If necessary the belt slipping may be reduced by a proper adhesive.

NOTE. - The output of a freshly overhauled engine, after only two hours of run-in, cannot reach the initial specification figure, which will be reached as the engine run-in is completed.

TEST BENCH ENGINE OUTPUT

	Speed rate R.P.M.	Output corresponding to a two hour engine run-in HP	Output corresponding to a 20 hour engine run-in HP	Necessary time to use 100 cm ³ (6.1 cu. in.) of fuel sec.
Maximum speed rate (under load)	2500	not less than 35	not less than 38	approx. 30
Maximum torque	1600	not less than 24	not less than 26.5	approx. 44
Maximum speed (under no load)	not more than 2650 - 2700	—	—	—
Idling (under no load)	480 - 500	—	—	—

BELT PULLEY ENGINE OUTPUT

	Engine speed rate R.P.M.	Belt pulley speed rate R.P.M.	Output corresponding to a 2 hour engine run-in HP	Output corresponding to a 20 hour engine run-in HP	Necessary time to use 100 cm ³ (6.1 cu. in.) of fuel sec.
Maximum speed rate (under load)	2500	1400 - 1415	not less than 32	not less than 34	approx. 30
Maximum torque	1600	930	not less than 22	not less than 24	approx. 44
Maximum speed (under no load)	not more than 2650 - 2700	1400	—	—	—
Idling (under no load)	480 - 500	300 - 325	—	—	—

NOTE - The foregoing power specifications are admitting a tolerance of less 5%; consumption data admit a tolerance in excess of 5%.

GOVERNOR CONTROL TIE-RODS ASSEMBLY ADJUSTMENT

The centrifugal weights type governor functions at all engine operating speed rate and is keyed at the rear of the generator shaft extension.

Good engine operation requires the governor control tie-rods adjustment, as follows and according to the scheme of fig. 70.

As engine is stopped.

- Check for free oscillation levers and articulation (g). The articulation adjustment requires the castellated-nut nearing and its unscrewing, corresponding to one or two nuts-slots. In addition, ascertain that the lever (q) be centered into the governor shaft slot (5); if necessary, adjust by displacing thicknesses (p);
- ascertain, after removal of governor spring (m), that shaftlet-run (5) be of about 7 mm (0.28 in.); for such a displacement, use tool A 217043 (fig. 72);
- ascertain that the accelerator control-lever-clutch be so adjusted that it be necessary to apply to the control knob a weight of about 8 kg (18 lb.), to lower it to the position of « completely accelerated » (i.e., the carburetor main-throttle being completely open). On such conditions the displacement of the lever under action of the recoil spring (m) of governor, is being avoided, when the engine is accelerated.
The clutch adjustment is through the nut (0);

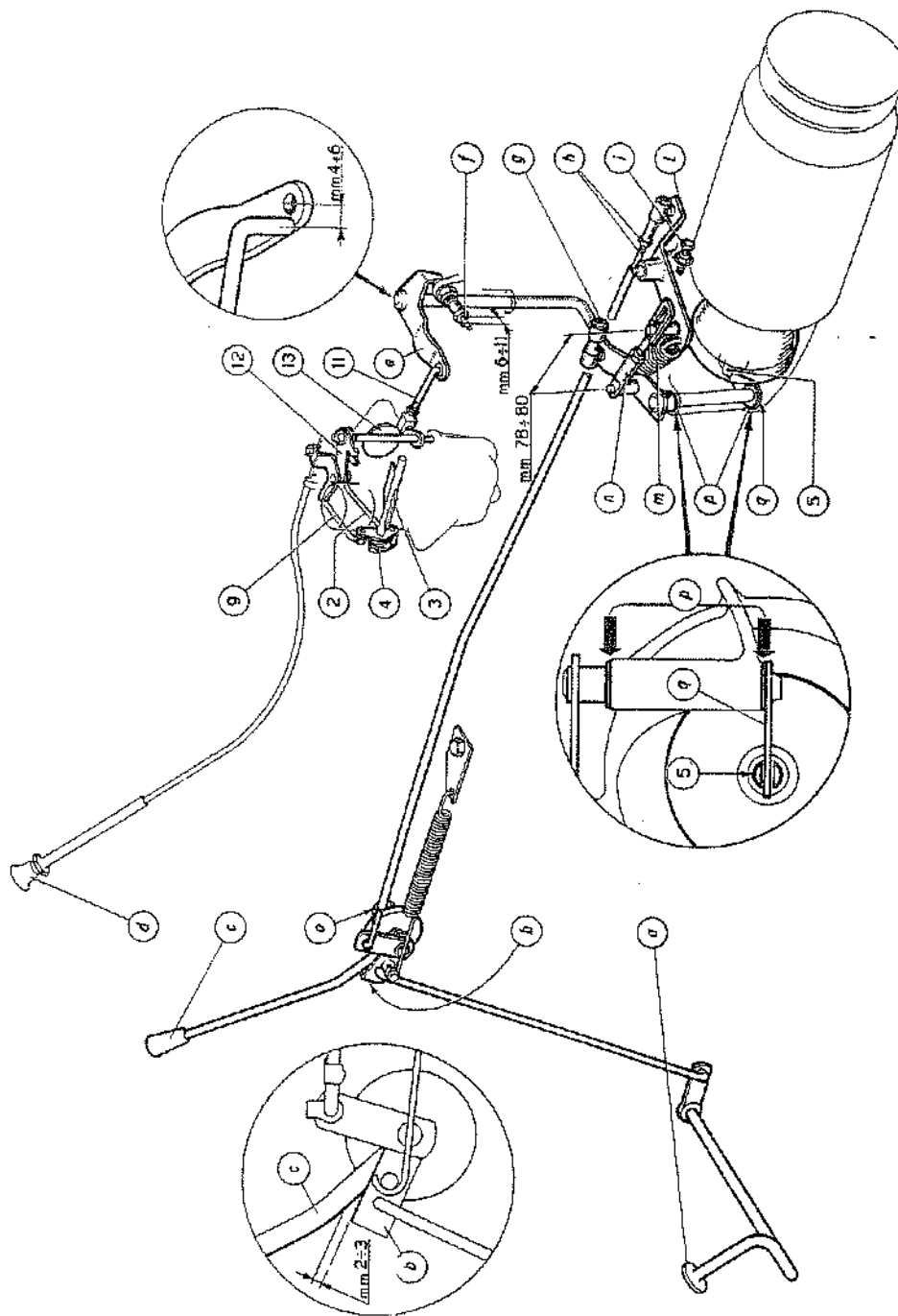


Fig. 70 - Diagram for adjustment of governor and carburetor tie-rods.
 a. Accelerator pedal. - b. Accelerator pedal tie-rod lever. - c. Accelerator hand control lever. - d. Starting control knob.
 e. Carburetor throttle control lever. - f. Elastic point. - g. Ball articulation. - h. Adjustable tie-rod. - i. Maximum
 output adjustment screw. - j. Lever. - m. Spring. - n. Adjustable tie-rod. - o. Accelerator clutch adjusting nut. - p.
 Adjustment shims. - q. Shaft lever (5). - 2. Starting butterfly synchronizing tie-rod. - 3. Starting butterfly. - 4. Starting
 butterfly recoil spring. - 5. Governor shaft. - 9. Starting butterfly control tie-rod. - 11. Main butterfly control adjustment
 tie-rod. - 12. Starting (13) butterfly opening partializer lever. - 13. Main butterfly.

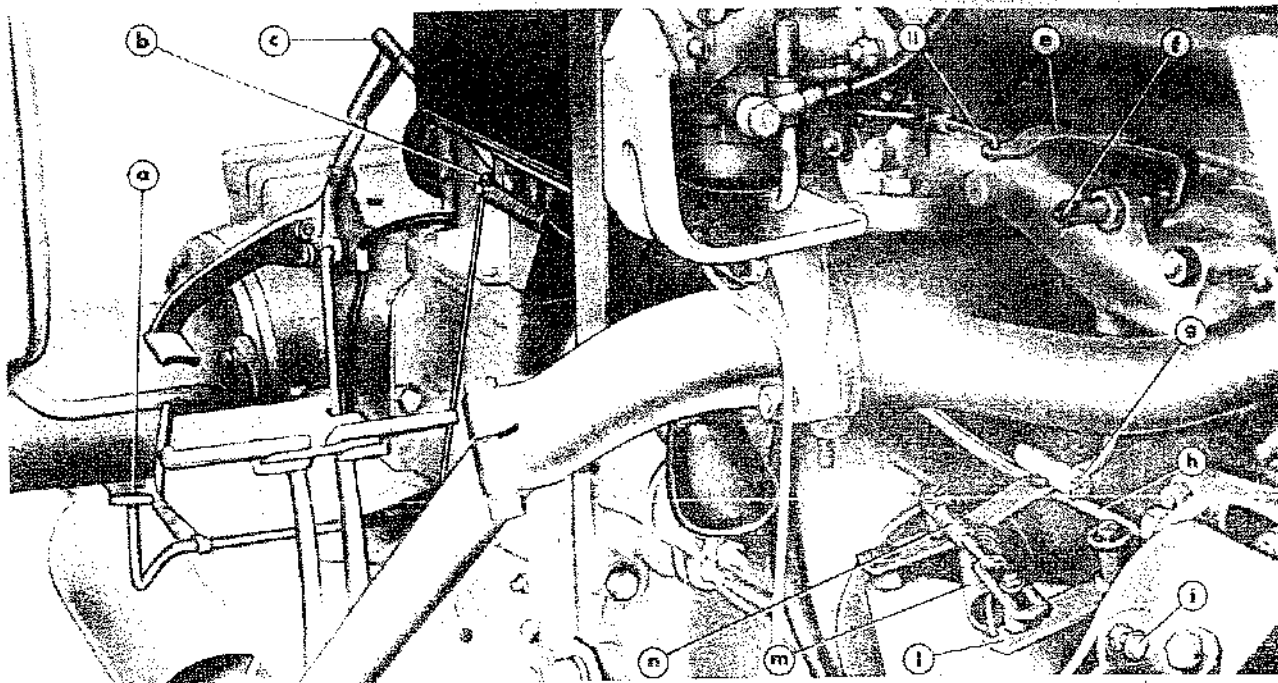


Fig. 71 - The tractor viewed from the carburetor and governor control tie-rods side. (For reference see fig. 70).

- ascertain that, the accelerator lever being put at the idling position, the main butterfly being close, the distance between the adjusting tie-rod to pivots (n), be of 78-80 mm (3.07-3.15 in.) in order to impart, during the assembling, a light pre-load to the governor spring (m);
- completely lower the governor control lever (c), disconnect tie-rod (11) from lever (e) and *after completely opening the throttle*, ascertain that the tie-rod (11) end be displaced backwards of 4-6 mm (0.16-0.24 in.) with reference to the attachment hole found on lever (e). Different conditions call for resetting through adjustable tie-rod (11);
- displace the accelerator control hand lever (c) to idling position, and ascertain that between this lever and lever (b), there is a distance of 2-3 mm (0.08-0.12 in.) and in addition see that the main butterfly control lever be contacting the idling lever; if otherwise, adjust through tie-rod (h). This adjustment ascertains that, as soon as pedal is being freed, its recoil springs displace the main butterfly (13) to the idling position.

NOTE. - If the required gap between levers (b) and (c) is not being obtained, as no more threads on adjustable tie-rod (h) are available, do reduce (if necessary till zero) the gap of 4-6 mm (0.16-0.24 in.), measured when the butterfly was completely open by acting upon the adjustable tie-rod (11).

- Set the accelerator control hand lever (c) to its idling position and check the point (f) displacement, that should be of 6-8 mm (0.24-0.32 in.). Ascertain that lever (e) be centered, at half run, on point (f) in order to maintain its best contact with the point, in any position.

NOTE. - During tie-rod setting, and when the accelerator control (c) hand lever is brought from the maximum output to the idling position, ascertain that lever (b) be continuously contacting lever (c) during the first part of such a displacement. If otherwise, pull back the accelerator pedal, to obtain such a condition.

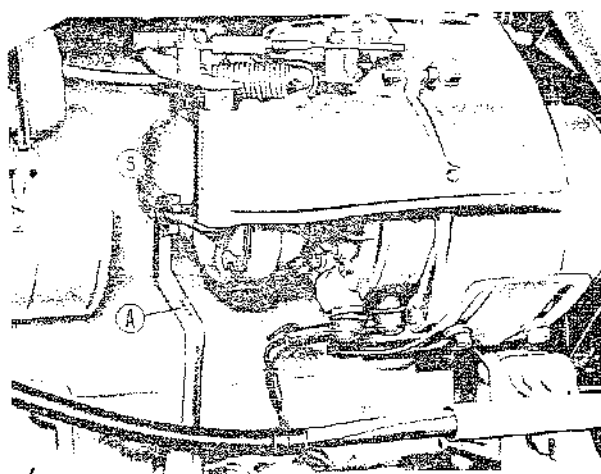


Fig. 72 - Opening of governor weights, as engine is stopped.
A. Tool A 217043. - 5. Governor shaft.

With running engine.

- The engine idling maximum speed rate (2650-2700 r.p.m.) may be adjusted by the adjustment screw (i), which actuates lever (1);
- should the engine idling be irregular (hunting) or too high, follow the instructions of the paragraph «Idling adjustment» on page 37;
- if with engine running at half-load, such a condition may be experienced as tractor runs on second gear, when brakes are moderately actuated, the speed is oscillating the point (f) displacement should be GRADUALLY increased, until a maximum of 11 mm (0.43 in.), if necessary.

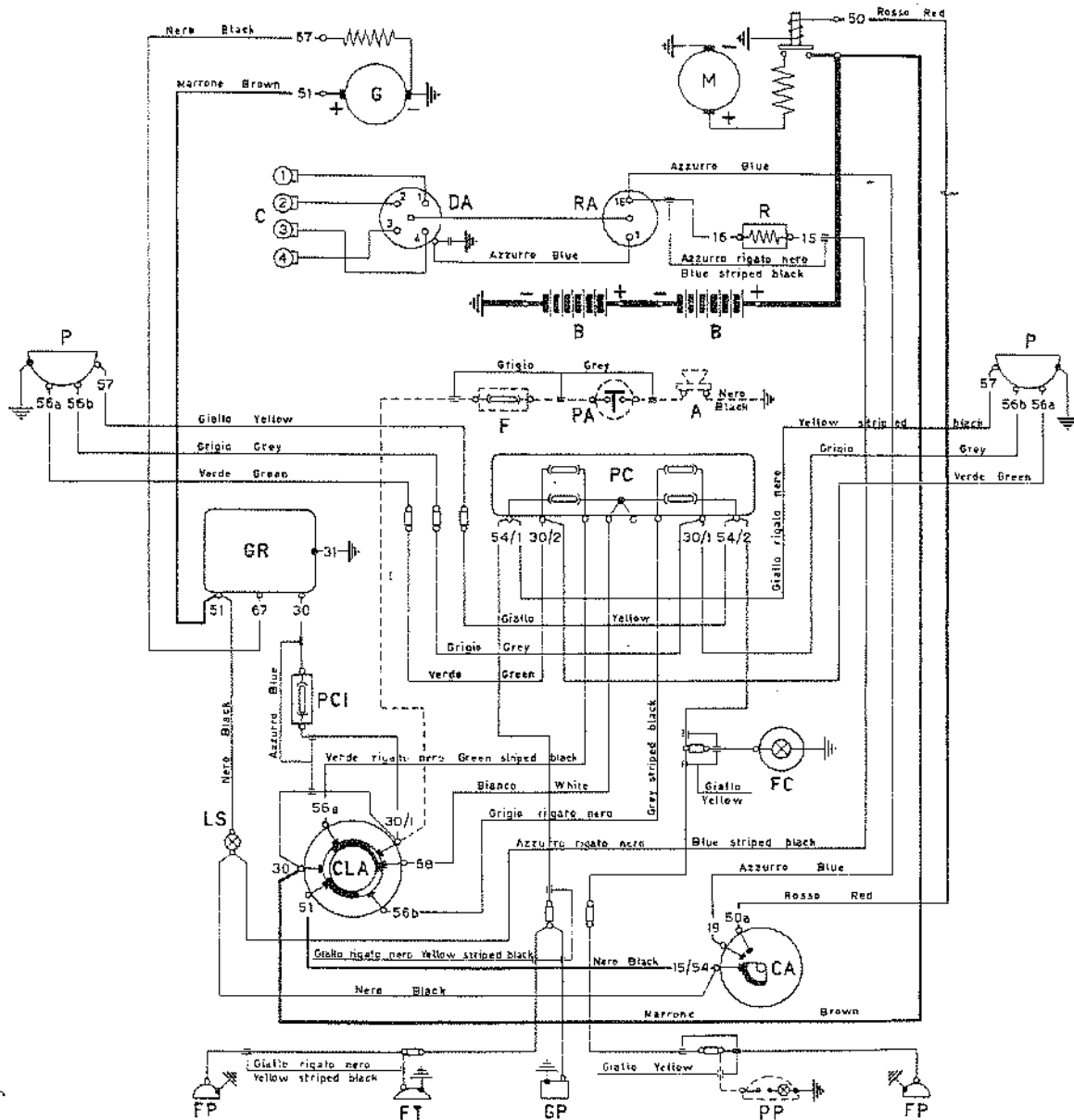


Fig. 73 - Electrical system diagram.

G. Generator. - M. Starting motor. - C. Spark plugs. - DA. Firing distributor. - RA. Firing coil. - R. Additional resistance. - B. Batteries. - P. Head-lamps, 3-light type. - F. Hooter fuse. - PA. Hooter push-button. - A. Hooter (optional). - PC. Fuse box (4). - GR. Regulator group. - PCI. Regulator-group fuse holder. - FC. Dashboard lamp. - LS. Battery charge tell-tale lamp. - CLA. Starting and illumination switch. - CA. Starting switch. - FP. Rear parking light. - FT. Number-plate illumination lamp. - GP. BI-pole jack. - PP. Rear lamp (optional).

(NOTE. - The illustrated electrical plant diagram concerns its complete system).

ELECTRICAL SYSTEM - LIGHTING

Figure 73 illustrates the electric-system diagram. The instructions concerning the instrument overhaul, may be seen in the *Overhaul and Repair Instructions of 400 R series tractors* (Print 354.069).

We give hereafter only such positions concerning the starting-and-light switch, and the indications about fuses, which differ from 400 R Diesel tractor series.

LIGHTING AND STARTING SWITCH

The following circuits are energized in correspondence of each specified key position:

— Position 0	30	30/1	— all circuits out.
— Position 1	30-51	30/1	— energized: firing, starting switch, generator tell-tale lamp.
— Position 2	30-51	30/1-58	— energized: firing, starting switch, generator tell-tale lamp, front parking lights, dashboard lamp, rear parking lights, name-plate lamp, 2-pole jack, 100 mm (3.9 in.) lamp, with integral switch.
— Position 3	30-51	30/1-58-56b	— energized: firing, starting switch, generator tell-tale lamp, front parking lights, dashboard light, rear parking lights, name plate lamp, 2-pole jack, 100 mm (3.9 in.) lamp, with integral switch, passing lights.
— Position 4	30-51-56a	30/1-58	— energized: firing, starting switch, generator tell-tale lamp, front parking lights, dashboard lamp, rear parking lights, name-plate lamp, 2-pole jack, 100 mm (3.9 in.) lamp, with integral switch, driving lights.

To remove the key, be sure to set it at zero position.

STARTING SWITCH

Starting switch functioning, is conditioned to the position of « lighting and starting switch ».

At each switch lever position, the following will take place:

— Position 0 : 15/54	— All circuits excluded.
— Position 1 : 15/54-19	— Additional resistance excluded.
— Position 2 : 15/54-19-50a	— Additional resistance and starting excluded.

FUSES

The electrical system is protected by four 8 A fuses seated into a relevant box, located near the dashboard and by a 16 A fuse for the regulator group, seated into its cylindric fuse-box.

The circuits, as protected by each individual fuse are:

- 54/1 (8 A) protects: right front parking light, left rear parking light, name plate lamp, 2-pole joint.
- 30/2 (8 A) protects: driving light, right and left.
- 30/1 (8 A) protects: passing light, right and left.
- 54/2 (8 A) protects: left front parking light, right rear parking light, dashboard lamp, rear lamp 100 mm (3.9 in.) having embodied switch.
- 16 A fuse protects: regulator group.
- 8 A fuse, optional, protects: hooter.

Without protection being: the firing circuit, the starting circuit, the generator and its tell-tale lamp circuit.

IGNITION SYSTEM

The ignition system (fig. 74) embodies:

- the firing coil;
- a resistance, in series to the primary coil winding of 6 ohm;
- the distributor, with the contact breaker, the automatic advance, and the condenser;
- low and high voltage cable;
- spark plugs;
- an electrical energy source, composed by generator and battery.

The firing circuit features:

- the low voltage circuit, or primary circuit, embodying: energy source, contact breaker, condenser and the firing coil primary winding, and the resistance, in series to the coil primary;
- the high voltage circuit, or secondary circuit, features: the firing coil secondary winding, the rotary brushes of distributor, the distributor cap and its terminals and central carbon contact, the high voltage cables, and spark plugs.

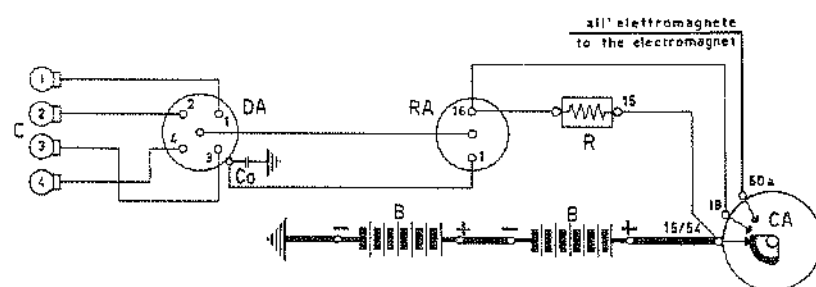


Fig. 74 - Ignition system diagram.
C. Spark plugs. - DA. Firing distributor. - Co. Condenser. - RA. Firing coil. - R. Additional resistance, in series with firing coil primary - B. Battery. - CA. Starting switch.

OPERATION

The contact breaker, from the inside of distributor, interrupts the primary circuit by the contact-opening.

The current, being interrupted as flowing through the primary coil, is prevented to generate an arc through the contact, as is absorbed by the condenser, branched in parallel to those contacts.

Thus rapid extinction of the primary current is being obtained, and, consequently, also rapid diminishing of the magnetic field intensity, which induction-generates, through the firing-coil-secondary-winding, a very high electro-motive force; this is delivered to the spark plugs (according order 1-3-4-2), through the distributor rotary brush.

IGNITION DISTRIBUTOR

This distributor features:

- automatic advance device;
- low voltage circuit contact breaker;
- the condenser and the high voltage distributor.

The centrifugal automatic advance (fig. 75) is composed of a disc (1) keyed to the control shaft, fitted with two symmetrical weights (2), hinged to one end. Each other end of the two weights is articulated to a plate (3) integral to the camshaft.

Two recoil helical springs (4) counteract the weight displacement.

The rotation-speed variations, owing to centrifugal force, bring about weights distance increment; such weights being articulated to the camshaft, an angular rotation of it and consequently the rotation of the cam with reference to the distributor control shaft, is following.

The contact-breaker is composed by the distributor shaft cam and two contacts; one fixed and the other fitted to a small hammer, provided of slide, bearing upon the cam.

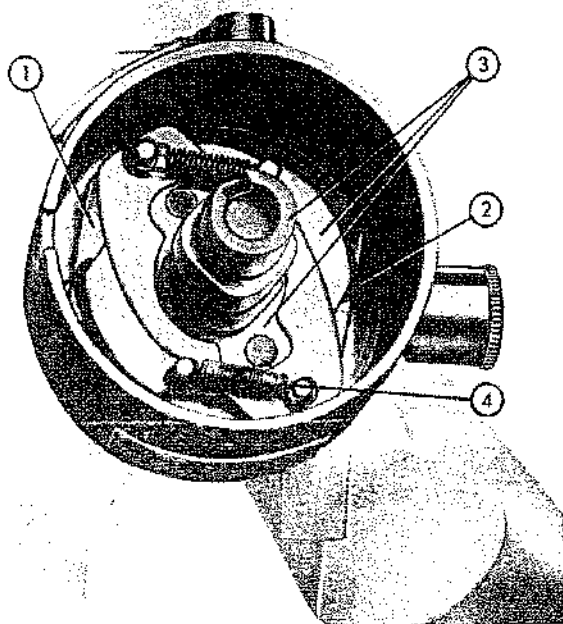
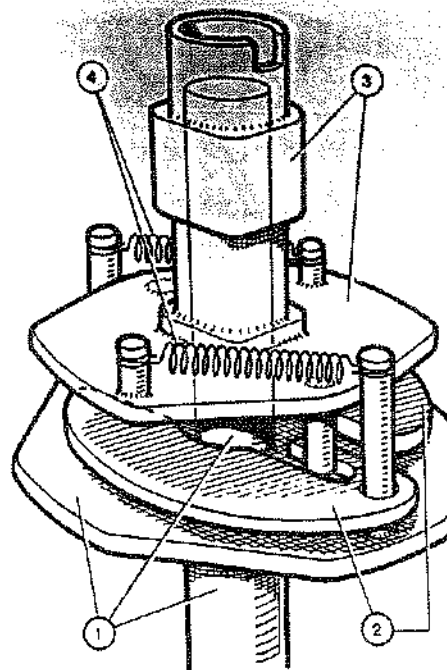


Fig. 75 - Distributor automatic advance.
 1. Weights carrying disc. - 2. Weights. -
 3. Plate integral to the camshaft. -
 4. Weight recoil springs.



The cam has four lobes, which control opening and closing of the two contacts.
 The fixed contact is assembled to an adjustable support (3, fig. 76), in order to set the contact maximum gap by a screw (1).

High voltage is delivered to the distributor-cap central-terminal from the firing coil, and through carbon-and-rotary-brush fitted on relevant seat to the camshaft, is being fed, during the rotation, to each of the four sparking-plugs.

CHECKING THE DISTRIBUTOR ON THE TEST-BENCH

1. Functional test.

Fit the distributor to the electric-system test-bench, and connect it to the variable-speed motor. After, connect a firing-coil and a battery, and connect the four cap peripheral terminals to the spark-gap meter four terminals (adjustable spark-gap type fig. 77).

Rotate the distributor (see the prescribed rotation direction) during a few minutes, at a speed rate of 2000 r.p.m., the spark-gap being about 5 mm (0.20 in.). After, increase such point distance to 10 mm (0.39 in.) and check the distributor for internal noise which would show discharges. Such condition, in addition to the internal noise, is also pointed out by decrement of intensity (or total lack) of one or more sparks, observed at spark-gap meter.

2. Automatic-advance diagram inspection.

The distributor being fitted to the test bench, connect it to the coil, motor and battery, as described hereup.

After, connect one of the peripheral terminals of the cap to the test bench stroboscopic device, through a cable.

Rotate distributor to 300-400 r.p.m., and by the stroboscope, measure the angle degrees corresponding to the spark beginning.

After having increased the distributor speed rotation, perform again such a measure by the stroboscope.

If the speed increment is not very high, with reference to the preceding speed rate, the angular reading will be the same.

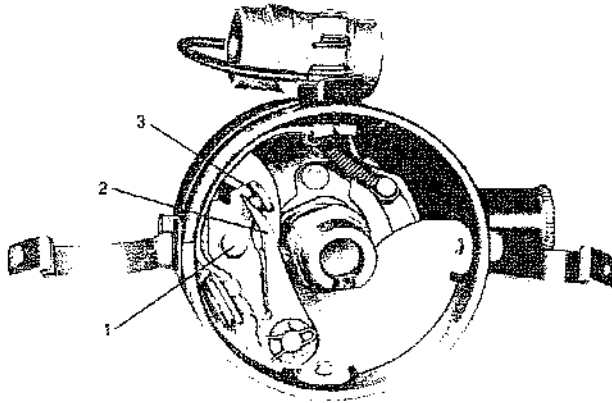


Fig. 76 - The distributor viewed without cap.
1. Fixed contact fastening screw. - 2. Mobile contact. -
3. Fixed contact.

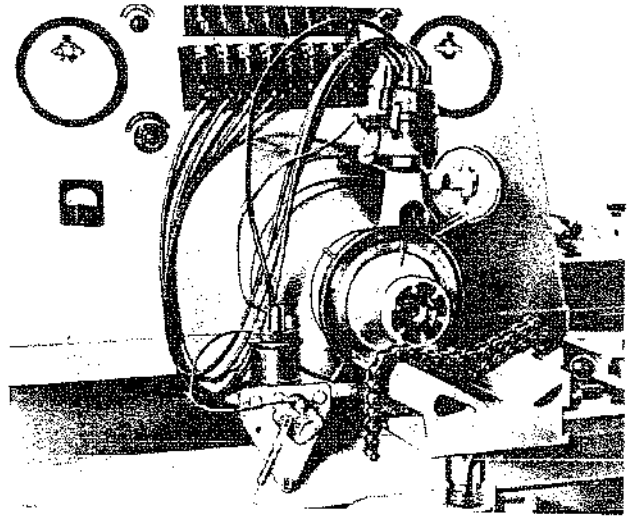


Fig. 77 - Distributor on the test bench.

The rotation speed-rate being continuously increased, and reading taken at each increment of 200-300 r.p.m., it is possible to read new values as stroboscopic indication.

The difference taking place between these last values and those (constant) read before, gives the firing advance degrees with reference to the distributor.

Minding that the distributor runs at half engine's speed, the read values should be doubled (both r.p.m. and advance degrees) in order to check the automatic advance, referred to engine, of which the diagram has been illustrated in fig. 78.

The distributor maximum automatic advance is $24^{\circ} \pm 2^{\circ}$.

3. *Timing check.*

Fit distributor on test bench and remove the cap.

Connect it to firing coil and battery, and insert on the primary circuit an ammeter and a small lamp.

Rotate by hand, in the prescribed direction, the distributor, and read on the stroboscope graduated disc, and corresponding to the reference marks, the degrees corresponding to the contact opening.

Such opening-time is shown as the amperemeter hand returns to zero, or as the lamp is extinguished.

Continue the distributor rotation, always in the same direction, until the amperemeter hand is being displaced towards the instrument indication side (the amperemeter follows the primary-current value) or till the lamp is being again lit, which points out the contacts are being closed.

At this exact time, the degrees value corresponding to the reference mark, should be read.

In addition, the distributor being still rotated, the new value corresponding to a new contact reopening should be measured (pointed out by the lamp extinction or the amperemeter hand returning to the zero mark).

The difference taking place between the second and first values, gives the closing angular value; the difference between third and second value, represents the opening angle value.

The addition of those two values in degrees, should be of $90^{\circ} \pm 1^{\circ}$.

After having checked the angular distance between first and second opening position, check also angular distance between third and fourth positions, according to the foregoing procedure, and checking such amplitude against the admitted tolerance: $90^{\circ} \pm 1^{\circ}$.

4. *Checking of the opening-closing sequence of the contact breaker.*

This check should be according the procedure explained at point 3 for the timing; care should be taken, however, to begin, at the test starting, from a closing position (amperemeter is showing the primary current, or the lamp is lit).

Afterwards, measure the closing amplitude angle and the opening amplitude angle.

The first one should be of $58^{\circ} \pm 3^{\circ}$ and the second one of $32^{\circ} \pm 3^{\circ}$.

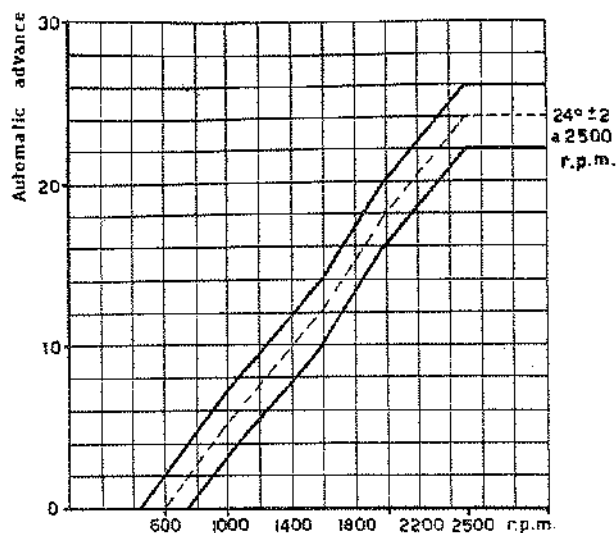


Fig. 78 - Automatic advance diagram.
(Gradi anticipo su motore - Advance degrees referred to engine.
 $24^{\circ} \pm 2$ a 2500 giri min. - $24^{\circ} \pm 2$ at 2500 r.p.m.
giri motore - engine r.p.m.).

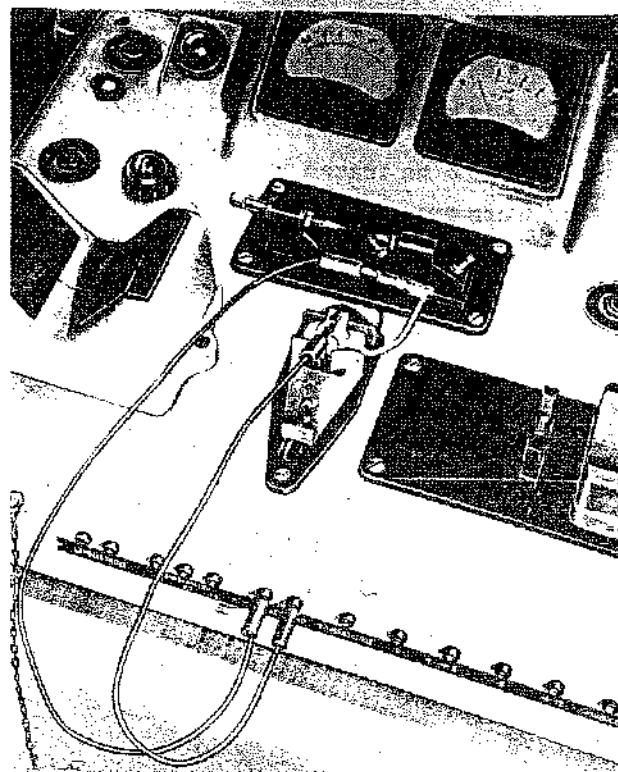


Fig. 79 - Distributor condenser verified on test bench.

5. Distributor noise check.

During tractor operation, the firing distributor should not be noisy for any engine speed.

Noise excess should be generally traced to the following:

- contact pressure differing from gr 550 ± 50 (19.4 ± 1.8 oz.);
- worn-out bushes;
- weight pivots excess wear;
- insufficient elasticity of weight-recoil-springs.

The first trouble brings about also a firing difficulty at high speeds, if the pressure is less than the prescribed value. If, on the contrary, the contact pressure is larger, an accentuated contact wear will be experienced and also of the cam and the mobile contact lever slide.

The last case brings about also a shifting of the automatic advance diagram, and firing would be advanced with reference to the prescribed speed rate.

6. Mechanical components check.

Check for fitness the contacts, mainly for oxidation, burns, and crater like formation, etc.

In addition the wear of the rotary brush, of cap fixed-blocks and high voltage terminal should not be in excess of 0.3 mm (0.0118 in.).

Check the distributor contact lever slide for wear. Wear should never rise a contact-breaker-timing displacement exceeding 2° , referred to the firing distributor. Check contact opening for gap (mm 0.45 ± 0.03 ; 0.0177 ± 0.0012 in.) and that the contact pressure be of gr 550 ± 50 (19.4 ± 1.8 oz.).

7. Checking insulation resistance.

Insulation resistance between the various terminals and grounding should exceed 10 mega-ohm at 500 V.

Such measure between the contact breaker terminal and grounding, should be performed as the breaker contacts are opened.

8. Bench test of the condenser (fig. 79).

Condenser capacity should range between 0.15 and 0.20 micro-farad, when measured at a frequency between 50 and 100 hertz. Insulation resistance, at hot condition and 100 V direct-current, should exceed 1 mega-ohm/micro-farad.

FUNCTIONAL DEFECTS TROUBLE SHOOTING

Impaired firing or completely missing.

It can be traced to the following causes:

- a) worn-out contacts of starting switch;
- b) short circuited condenser, or poor insulation.

Consequently the firing-coil secondary-winding is insufficient to produce either any sparking or an efficient one.

- c) Cracked firing distributor cap or having carbon dust on its inner surfaces, or humidity traces. The regular functioning in this case is due to current leaking through cracks, burns and humidity traces, to grounding.

- d) Rotary brush plastics-component, being cracked, carbon dusted, or humid.

The same dispersions towards grounding as described for the cap.

- e) Wear, breakage of the carbon central-spring-contact or deformation of its pressure spring.

Thus, a sparking-arc will take place between the contact and rotary brush, with consequent voltage drop and reduction of sparking-plug-electrode voltage.

- f) Contacts having point or crater (hollow) formation.

This happens generally when contact opening is less than the prescribed gap amount. Point formation renders the primary winding opening, erratic, and therefore, inefficient the spark delivered to the secondary winding.

- g) Oxidized or blacked contacts.

The trouble may be traced to:

- condenser-circuit high resistance, due to impaired connections, or interrupted wires, which brings about defective firing at starting and at high speeds;
- oil, or various dirt, smearing the contacting surfaces;
- in some cases, less frequent, the regulator calibrating voltage being excessively high (much more than the admitted maximum).

Oxidation or blackening of contacts endangers high resistance between the contacts themselves and therefore interrupts continuously the primary current, thus bringing about firing system interruptions.

- h) Contacts excessive opening.

The spark being weak, especially at high speed, this is due to the impossibility of the primary current to reach a sufficient value, because the contact breaker acts too rapidly.

Abnormal advanced firing.

This generally should be traced to lack of elasticity of the centrifugal governor springs.

REPAIR INSTRUCTIONS

Replace caps when cracked or showing carbon formation.

Cap terminals, rotary brush and breaker contact (when oxidized, corroded or burnt), may be reshaped with a very smooth file. Emery paper should never be used.

Whenever terminal or rotary brush wear exceeds 0.3 mm (0.0118 in.), replace both cap and rotary brush.

In addition replace the contact breaker lever when the slide shows excess of wear, or the gap opening is exceeding 0.48 mm (0.0189 in.) and it is impossible to turn any more the fixed contact support adjustment screw. In all other cases it is sufficient to adjust such a screw.

Should the distributor shaft show excess of play, we suggest to replace the distributor assembling.

If the centrifugal governor springs be without elasticity, the replacement should be made using the distributor Maker original replacement parts.

During repairs or firing distributor checks, always verify the shaft bush lubrication. Lack of lubricant calls for replenishing the relevant greaser using Fiat Jota 3 grease. In addition smear using FIAT VE (SAE 50) engine oil the felt found inside the camshaft.

TIMING IGNITION

If the distributor control shaft sleeve has been removed, the timing should be made as follows:

- bring cylinders No. 1 and 4 pistons to the T.D.C., ascertaining that cylinder No. 1 valves be closed. This check should bring the reference mark found on the engine flywheel P.M.S. 1-4 (T.D.C. 1-4) with the timing index (fig. 29). Another couple of marks may be coincided to this end: one on timing cover and the other on fan generator control pulley (fig. 30);
- mount the distributor, without cap, on its support, after removal from engine. Insert on the distributor lower end the control joint. Rotate by hand, the control shaft, so that the rotary brush be facing the cylinder No. 1 firing contact, and the breaker contacts are just beginning the opening (but before, ascertain that maximum contact gap be the prescribed one, i.e. 0.42 - 0.48 mm (0.0165 - 0.0189 in.);
- without displacing the distributor shaft from this last position, insert the lower joint into the control shaft indented end. Fasten support to engine by its two screws;
- check again if contacts are beginning the opening and tighten the distributor to the support using the fastening screw;
- finally connect the cables to the sparking plugs, according to the firing sequence: 1-3-4-2.

IGNITION COIL

The firing-coil, features a soft iron-core, around which the primary and secondary windings are produced. Such two windings, immersed into solid insulating mastic, are housed into a metallic container fitted to a bakelite insulating cap, presenting the two winding ends.

On the firing coil cap are taking place two peripheral terminals and a central one. The two peripheral ones are the primary winding ends; the central terminal is the secondary winding end.

BENCH TEST INSTRUCTIONS

To check a firing coil efficiency, use the relevant test bench (fig. 80) with the following procedure.

1. Ohmic resistances.

Primary ohmic resistance at $20^{\circ} \pm 5^{\circ} \text{C}$ ($68 \pm 41^{\circ} \text{F}$) should range within 11 - 16 ohm. Secondary resistance should range between 3000 - 11000 ohm.

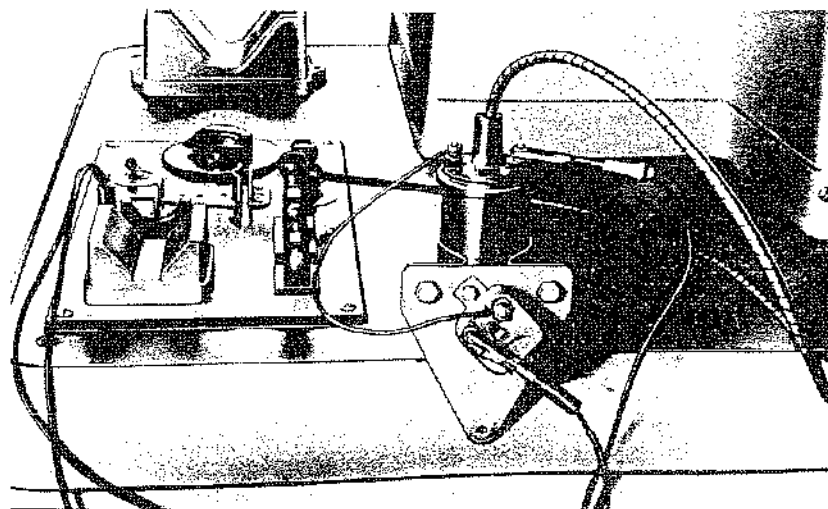


Fig. 80 - Firing coil checked on test bench.

2. *Grounding-to-coil insulation.*

The coil should resist temperatures of 100°C (212°F) to an alternate voltage of 500 V effective at 50 hertz applied during 3 minutes between one primary winding terminal and the metallic shell, without any discharge taking place.

Insulation resistances to grounding, at 100°C (212°F), should exceed or equal 50 mega-ohm at 500 V direct current.

3. *Spark length measurement (added resistance being inserted).*

Operate the coil provided of distributor, without using the high voltage distribution and discharge all sparks with a sparking-gap meter, equipped with a ionizing point to measure maximum spark-length; such a length is defined by the distance between points as spark begins to extinguish.

At high temperature, after about two hour functioning of the coil, delivering 50 sparks per second, the spark length should be at least 12 mm (0.47 in.) at 24 V.

4. *Testing with shunted spark gap (additional resistance inserted).*

Shunt 1 mega-ohm resistance to the spark-gap meter.

Spark length, in this condition, should not be reduced, with reference to the foregoing test, of more than 25%.

5. *Overvoltage test (additional resistance inserted).*

Energize the coil with a 34 V battery with 60 sparks per second, after the high voltage terminal is connected to the spark gap, set at 8 mm (0.32 in.). The coil should resist such a test during 15 minutes.

After two hours functioning at a voltage of 24 V with 60 sparks per second (this being called hot test), additionally energize with 24 V, for 5 minutes, the secondary circuit being open. No damaging should follow.

TROUBLE SHOOTING AND REPAIR INSTRUCTIONS

Firing coil defects may be as follows:

- a) Circuit interruptions, easily traceable with simple tests (bulbs, electric bells, etc.).
- b) Internal short circuits, of groups of turns verifiable through circuits resistance measures, provided that short circuit be of many turns.
- c) Spilling of insulating mastic, which may impair the coil internal insulation.
- d) Water leakaging inside, or lack of sealing. Check such a defect by an insulating measure between winding and ground.
- e) Slackened or dirty connections.

All foregoing cases call for coil substitution; but for case e) which consents the assembly repair.

IGNITION COIL ADDITIONAL RESISTANCE

Such a resistance is inserted in series on the firing coil primary winding.

When starting, set the switch lever to the first clic, and the additional resistance (6, fig. 9) is being automatically short-circuited, whereas the second clic setting allows the starting. When the additional resistance is being excluded, the coil primary winding drains more current and consequently more efficient spark is being delivered to the spark plugs even if battery voltage is relatively low; this facilitates the starting.

As the engine is being started, the resetting of the starting switch lever to its rest position, automatically inserts the additional resistance, thus giving the system normal functioning possibility. To check this resistance simply measure its resistance value, feeding it with a current of maximum 2 A.

CAUTION. - The engine being stopped and the light switch set to position 1, if the generator battery charge tell-tale lamp remains extinguished, ascertain, between other items, that the firing coil additional resistance be not grounded. A similar check is to be performed if, when engine is running, at a speed rate in excess to the one bringing the cut-out relay interruption, such a generator tell-tale lamp is being relit.

If the starting switch lever is being set at position 2 and engine may be started and as such a lever is freed the engine starts, the foregoing resistance should be checked for interruption.

SPARKING PLUGS

Type	M 14-12/240
Threads for connection to engine	mm 14 x 1.25
Electrode gap	mm 0.5 - 0.6 (0.0197 - 0.0236 in.)

We suggest to remove the sparking plugs at 100-150 hours of work, to ascertain their functioning, to clean and adjust the electrode gap.

However, as irregular engine operation is being experienced, owing to various troubles and particularly to erroneous carburation or lubrication, also the spark plugs, may show a lack of efficiency.

In many cases, as the spark plugs have been removed and attentively inspected, it is possible to trace the engine trouble origin, thus bringing about easy repair jobs.

A scrupulous sparking plugs cleaning, and their electrical test, before reinstallation can be performed only by an authorized Service Station.

Incrusted spark plugs, or simply dirt ones, are firstly completely cleaned by a powerful sand jet; follows a cleaning, using gasoline injected under pressure; and finally an air jet, to dry the spark plugs.

Additionally, the check of electrode-gap would then take place and adjustment to 0.5 - 0.6 mm (0.0197 - 0.0236 in.) gap is essential.

In addition a test is performed of the various spark plug components sealing: i.e. the body, the insulator, and the central electrode. The spark plug should be screwed up to the test bench, and pressure air used to check if small bubbles are appearing to the outer surface of the spark plug as it is wet with petroleum.

Lastly the spark plug is tested under pressure on the relevant device.

The spark plug under test is screwed into the hole corresponding to its thread measures and completely tightened. After, the compressed air is actuated in order to rise air pressure up to 7-8 kg/cm² (p.s.i. 100-114). The electrical circuit is then inserted, with the cable terminal of the device connected to the spark plug terminal, and depressing the high-voltage coil control-switch push-button. If the spark plug is efficient, a series of strong sparks between electrodes, should be observed, through the magnifying lens eye-piece.

Should the spark be defective, the discharges would take place between the spark gap, located inside the device. Such a case requires the spark plug replacement.

IGNITION SYSTEM SPECIFICATIONS

IGNITION DISTRIBUTOR

Assembling (keying) initial advance	0°	
Centrifugal automatic advance	24°±2°	
Breaker contacts pressure	gr 550±50	(oz. 19.4±1.8)
Contacts gap	mm 0.45±0.03	(0.0177±0.0012 in.)
Insulating resistance between terminals and grounding at		
500 V direct current	M-ohm >10	
Condenser capacity at 50-1000 Hz	micro-F 0.15-0.20	
Condenser insulating resistance at 100°C (212°F) and at		
100 V direct current	M-ohm/micro-F >1	
Revolving shaft bush-lubricant, using screw-grease	grease FIAT Jota 3	
Camshaft lubricant	oil FIAT VE	

IGNITION COIL

Primary ohmic resistance at 20°±5°C (68±41°F)	ohm 11-16
Secondary ohmic resistance at 20°±5°C (68±41°F)	ohm 3000-11000
Insulating resistance between coil and grounding, at 100°C	
(212°F) and 500 V direct current	M-ohm ≥50
Firing coil additional resistance	ohm 6±0.4

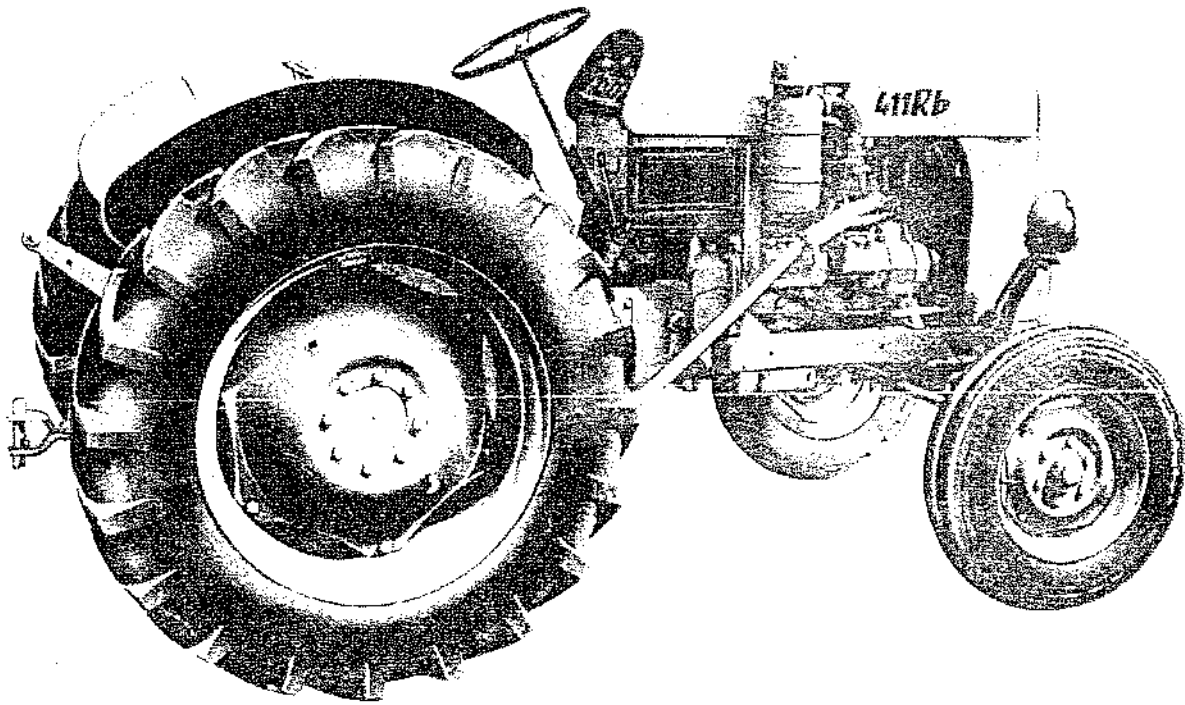


Fig. 51 - Tractor 412 Rb as viewed from the right side.

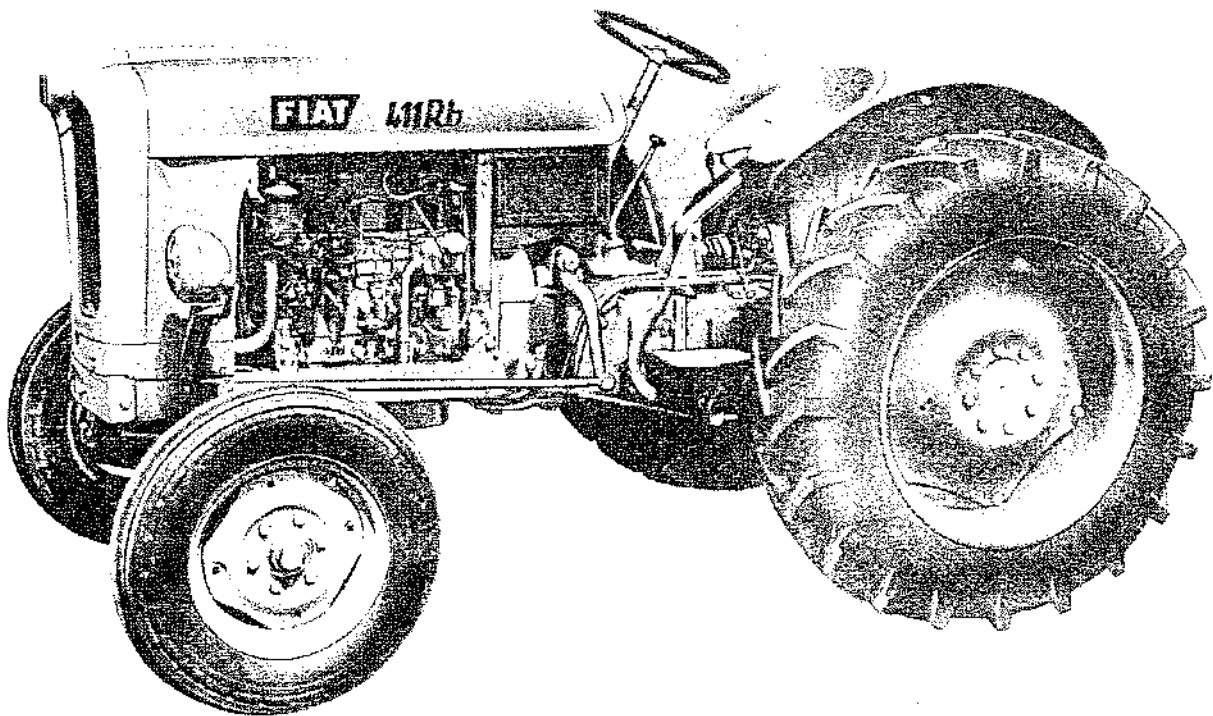


Fig. 52 - Tractor 411 Rb as viewed from the left side.

SPECIFICATIONS AND PERFORMANCE

ENGINE

Type	105.615	
Four stroke Otto cycle	—	
Cylinder number	4	
Crankshaft journal supports	3	
Piston diameter and stroke	mm 82 x 90	(in. 3.23 x 3.54)
Total cylinder capacity	cu. cm. 1901	(cu. in. 116)
Compression ratio	7.5	
Maximum output, with air cleaner, without fan and exhaust muffler	HP 39 ⁽¹⁾	
Maximum output corresponding speed rate	R.P.M. 2500	
Maximum torque	Kgm 11.8	(ft-lb. 85)
Maximum torque speed-rate	R.P.M. 1600	
Engine weight (without lubricant)	Kg 200	(lb. 441)

Timing.

Valve in head, controlled by tappets, push rods and rocker arms, actuated from the camshaft.

Intake	{ beginning	10° before T.D.C.
	{ end	51° after B.D.C.
Exhaust	{ beginning	48° before B.D.C.
	{ end	11° after T.D.C.

Cold engine clearance between rocker arms and both intake and exhaust valves, for timing purposes	mm 0.45	(in. 0.0177)
Cold engine clearance between rocker arms and both intake and exhaust valves for actual engine operation	mm 0.15	(in. 0.0059)

Feeding.

- Of fuel: by diaphragmed feed pump, actuated by timing camshaft; Solex C 26 NH anti-ice horizontal carburetor, with starting priming device; bowl filter between tank and feed pump.
 - Of air: through oil bath air cleaner fitted with centrifugal cleaner.
- Hourly consumption, during operation liter 6.3-7 (p.t.s. G. B. 11-12)

SOLEX C 26 NH carburetor specification

Body diameter	mm 26	(in. 1.02)
Choke diameter	mm 21	(in. 0.83)
Main jet diameter	mm 1.25	(in. 0.049)
Idle jet diameter	mm 0.60	(in. 0.0236)
Emulsion air jet diameter	mm 1.25	(in. 0.049)
Needle valve seat diameter	mm 1.30	(in. 0.051)
Float diameter	mm 26	(in. 1.02)
Float weight	gr 10.5	(oz. 0.37)

Speed governor.

Centrifugal weight, mechanical, operating at all speed rates, and fitted to generator armature shaft rear extension.

Engine idling maximum speed rate	r.p.m. 2650-2700
Engine idling minimum speed rate	r.p.m. 480-500

(1) Less 5% tolerance being admitted on max. output.

Lubrication.

Pressure-feed lubrication, by gear pump, controlled by timing-shaft. Oil cleaning by plug-type shunt replaceable-filter. Oil pressure-gauge, located on the dashboard.

Setting-valve calibration pressure kg/cm² 3-3.5 (p.s.i. 42.7-49.8)

Cooling.

Centrifugal pump water circulation, with vertical tube radiator, four blade fan and thermostat fitted to the cylinder head outlet. Remote-control-thermometer, for water temperature check and radiator partializer, optionally.

Exhaust.

With downward body silencer or optionally, directed upwards.

Starting.

Electrical motor and FIAT E 115—3/24 electromagnet.

Firing.

Marelli distributor with automatic advance S 69 C
Original advance 0° T.D.C.
Automatic advance 24°±2°
Marelli coil V 24
Resistance in series to the coil primary, for starting ohm 6
M 14-12/240 spark plugs Marelli CW 240N
Firing order 1-3-4-2

CLUTCH

The assembly embodies two dry-single-plate clutches; one clutch controls the tractor transmission and the other controls the power take-off.

Both are controlled by single pedal which during the first part of its run, disengages the transmission, and during the residual run disengages the power take-off when actuated by the engine.

TRANSMISSION

Speed	Change speed gear ratio	Speed ratio between engine and wheels	Maximum speed		Maximum traction effort with ballasted tractor (water ballasted into tyres), and driver	
			Km/h	M.P.H.	Kg.	lb.
1st	10.668	235.499	2.3	1.4	Kg. 1500 (1)	lb. 3300
2nd	5.901	130.276	4.2	2.6	1500 (1)	3300
3rd	3.749	82.756	6.7	4.2	1500 (1)	3300
4th	2.938	64.847	8.5	5.3	1200	2640
5th	1.625	35.873	15.4	9.6	650	1430
6th	1.032	22.788	24.2	15	400	880
1st REV	7.263	160.340	3.4	2.1	—	—
2nd REV	2.000	44.151	12.5	7.8	—	—

(1) Limited by adhesion.

ELECTRIC SYSTEM(*)

A 24 V system. The fig. 73 diagram includes:

- 1 FIAT type DC 115/24/7/3 D generator - Output 196 W (armature shaft on bearings);
- 1 FIAT GP 1/24/7 regulator group, with one fuse protection, 16 A;
- 2 batteries, 12 V, 56 Ah capacity, at 20 hour discharge, connected in series;
- 1 3 kw starting motor, with FIAT E 115-3/24 type electromagnet;
- 1 Marelli type firing distributor, with automatic advance, type S 69 G;
- 1 Marelli 24 V ignition coil;
- 1 6 ohm resistance, in series with firing coil primary;
- 4 Marelli M 14-12/240 (CW 240 N) spark plugs;
- 1 key operated light and starting switch featuring 5 positions;
- 1 control lever switch;
- 2 head-lamps, fitted with passing-and driving and-parking-lights, respectively 45/50 W and 7 W;
- 2 rear parking-lights, with 7 W bulb;
- 1 dash-board illuminating lamp, and 1 generator charge tell-tale lamp, having 7 W bulb;
- 1 number-plate illuminating lamp, having 7 W bulb;
- 1 two-pole current socket;
- 1 fuse box, with 8 A fuses, for electric system protection;
- 1 hooter (optional) protected by one 8 A fuse;
- 1 rear lamp, 100 mm (3.94 in.) diameter, provided of spring suspension, and of embodied switch, fitted with 50 W bulb (optional).

(*) The listed components refer to the complete tractor supply.

ATTACHMENTS

Power take-off.

Fitted internally to cover rear transmission, may be directly driven by engine crankshaft, or by gearbox.

independent power	{	with engine running at maximum	
take-off speed	{	speed rate	R.P.M. 625
		with engine running at 2160 R.P.M.	R.P.M. 540

Speed of the power take-off synchronized to the gearbox:

R.P.M./m of tractor displacement, about	3.8
Shaft diameter	1 3/8"

Belt pulley.

It may be rotated either clockwise or counter-clockwise, according to the assembling position; controlled by a lever.

Maximum power	Cv 35 (1)	
Maximum speed rate	R.P.M. 1300	
Peripheral speed	m/sec 17	(ft/sec 56)
Pulley diameter	mm 250	(in. 9.8425)
Face	mm 150	(in. 5.9055)
Weight (without lubricating oil)	kg 26.5	(lb. 58.4)

Draft-control and position-control hydraulic lift.

Actuated by hydraulic pump, having embodied tank, and controlled by a valve.

Hydraulic gear pump	type	A 18 X
Ratio between engine crankshaft and hydraulic pump spindle	1:1	

(1) A tolerance of less 5% is admitted on maximum engine output.

Output, with oil at 60°C (140°F)	at kg/cm ² 0	at p.s.i. 0
	lts/min 20.5	pts./min 36
	at kg/cm ² 150	at p.s.i. 2134
	lts/min 20	pts./min 35
Pressure limiting valve calibration	kg/cm ² 150	(p.s.i. 2134)
Lift-cylinder diameter	mm 85	(in. 3.35)
Capacity	cm ³ 500	(cu. in. 30.5)
Implement lifting-arms end maximum displacement	mm 580 - 600	(in. 22.8 - 23.6)
Implement lifting arm end maximum lifted weight	kg 850	(lb. 1870)
Lifting effective capacity	kgm 500	(ft-lb. 3600 approx.)
Lifting time (engine running at 2500 R.P.M.)	sec 3	
Weight of lifter with pipes and pump (without oil)	kg 85	(lb. 187)

REPLENISHMENT TABLE

Replenishment item		Quantity	Replenishment type
Cooling system	lts.	10 (imp. gall. 2.2)	Water (*)
Fuel tank	lts.	39 (qts. 34)	Gasoline
Engine sump (filter and lines included)	kg	5.450 (qts. 5.3)	FIAT oil { 10 W (SAE 10) under —15°C (5°F) VI (SAE 20) from —15°C to 0°C (5°F to 32°F) VN (SAE 30) from 0°C to 30°C (32°F to 86°F) VE (SAE 50) above 30°C (86°F)
Engine sump (only)	kg	4.500 (qts. 4.4)	
Air cleaner	kg	0.55 (qts. 0.54)	Use engine sump oil { FIAT oil A 90 (SAE 90) FIAT oil A 140 (SAE 140)
Gear box and transmission	kg	12.5 (qts. 12)	
Final drives (each)	kg	1.45 (qts. 1.4)	
Steering box	—	—	FIAT oil A 90 (SAE 90) under —10°C (14°F) FIAT oil A 140 (SAE 140) above —10°C (14°F)
Front wheels (each)	—	—	FIAT grease G 9
Pressure grease fitting	—	—	FIAT grease G 9
Belt pulley	kg	0.33 (qts. 0.3)	{ FIAT oil A 90 (SAE 90) under —10°C (14°F) FIAT oil A 140 (SAE 140) above —10°C (14°F)
Hydraulic lift	kg	3.2 (qts. 3.1)	
Firing distributor	—	—	Hydraulic FIAT oil AP 50
Distributor camshaft	—	—	FIAT grease Jota 3
Generator	—	—	FIAT oil VE (SAE 50)
Governor	—	—	FIAT grease Jota 3
Starting motor (free wheel)	—	—	FIAT grease G 9
			FIAT grease Jota 2/M

(*) For temperature lower than 0°C (32°F) we recommend the use anti-freeze mixture.

ENGLISH EQUIVALENTS OF METRIC DATA REPORTED IN THE FIGURES

Fig. 15					
mm	82.000 to 82.010	82.020 to 82.030	82.030 to 82.040	88.928 to 88.850	89.000 to 89.035
in.	3.2283 to 3.2287	3.2291 to 3.2295	3.2295 to 3.2299	3.5011 to 3.4980	3.5039 to 3.5053
mm	82.010 to 82.020				
in.	3.2287 to 3.2291				
Fig. 23					
mm	48.000 to 47.975	30.000 to 29.979	48.040 to 48.060	47.040 to 47.060	30.020 to 30.050
in.	1.8898 to 1.8888	1.1811 to 1.1803	1.8913 to 1.8921	1.8520 to 1.8528	1.1819 to 1.1831
mm	47.000 to 46.975				
in.	1.8504 to 1.8494				
Fig. 25					
mm.	8.985 to 9.000	14.988 to 15.016	9.023 to 9.038	38	34
in.	0.3537 to 0.3543	0.5901 to 0.5912	0.3552 to 0.3558	1.50	1.34
Fig. 28					
mm.	25.996 to 25.978	26.003 to 26.021	20.020 to 20.072		
in.	1.0235 to 1.0228	1.0237 to 1.0244	0.7882 to 0.7902		
Fig. 34					
mm.	2.31 to 2.36	47.658 to 47.678	62.980 to 63.000	21.623 to 21.877	28.448 to 28.702
in.	0.091 to 0.093	1.8763 to 1.8771	2.4795 to 2.4803	1.2450 to 1.2550	1.1200 to 1.300
mm	1.816 to 1.822	66.687	5	2.3 to 2.5	3 to 3.5
in.	0.0715 to 0.0717	2.6255	0.20	0.09 to 0.10	0.12 to 0.14
mm	0.5				
in.	0.0197				
Fig. 38					
mm	28.651 to 28.677	25.997 to 26.000	51.333 to 51.346	28.715 to 28.753	25.996 to 25.990
in.	1.1280 to 1.1290	1.0235 to 1.0236	2.0210 to 2.0215	1.1305 to 1.1320	1.0235 to 1.0232
mm	1.8135 to 1.8224	24.796 to 25.050			
in.	0.07140 to 0.07175	0.9762 to 0.9862			
Fig. 41					
mm	81.94 to 81.95	81.95 to 81.96	81.96 to 81.97	81.97 to 81.98	3.035 to 3.050
in.	3.2260 to 3.2264	3.2264 to 3.2268	3.2268 to 3.2272	3.2272 to 3.2276	0.1195 to 0.1201
mm	3.015 to 3.030	3.957 to 3.972	25.982 to 25.988	0.20 to 0.35	3.180 to 3.420
in.	0.1187 to 0.1193	0.1558 to 0.1564	1.0229 to 1.0231	0.0079 to 0.0138	0.1252 to 0.1346
mm	2.978 to 2.990	3.911 to 3.937	3.251 to 3.556	25.996 to 25.990	
in.	0.1172 to 0.1177	0.1540 to 0.1550	0.1280 to 0.1400	1.0235 to 1.0232	

(Follows : English equivalents of metric data reported in the figures)

Fig. 46					
mm	12.100 to 12.200	38.025 to 38.087	12.045 to 12.060	37.961 to 38.000	12.066 to 12.109
in.	0.4764 to 0.4803	1.4970 to 1.4995	0.4742 to 0.4748	1.4945 to 1.4961	0.4750 to 0.4767
mm	32.790 to 32.760	12.016 to 12.043	12.000 to 11.982	11.955 to 11.967	32.900 to 32.950
in.	1.2909 to 1.2898	0.4731 to 0.4741	0.4724 to 0.4717	0.4707 to 0.4711	1.2953 to 1.2972
mm	37.961 to 38.000				
in.	1.4945 to 1.4961				
Fig. 70					
mm	2 to 3	4 to 6	6 to 11	78 to 80	
in.	0.08 to 0.12	0.16 to 0.24	0.24 to 0.43	3.07 to 3.15	

TRACTOR 411 Rb REPAIR TOOL LIST

Catalogue No.	Item	Page	Fig.
	ENGINE		
A 217073	Wrench for thermometer bulb end disassembling .	6	—
ARR 117005/bis	Engine lifting sling	6	5
ARR 2216	Rotary stand	9-43	8-9
A 117004/bis	Clamps fastening engine to stand	9-43	8-9
A 413055	Valve tappet puller	10-45	11
A 313013	Sleeve to engine crankcase assembling tool	10-43	11
A 619027	Flywheel bearing puller	10-25	37
U 0337/A/B	Rocker arm control cam seat reamer	12	—
C 313012	Sleeve checking ring gauge	12-13-27	16
M 110	Portable reamer	—	—
A 517021	Engine sleeve lapping machine	—	—
A 117139	Valve seat spindle and mill equipment box	14-15	20-21-22
A 217028	Valve spring removal tool	16-17	26
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