

Fig. 1 Longitudinal section

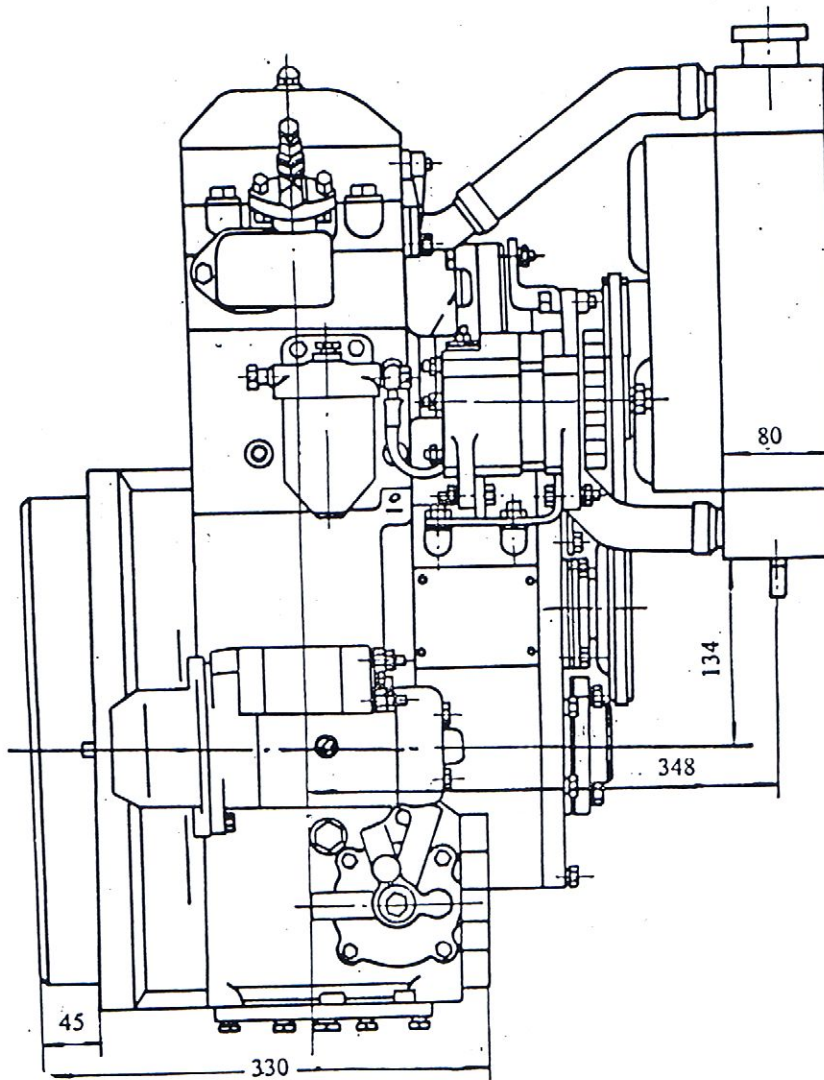


Fig. 3 External view left—hand side

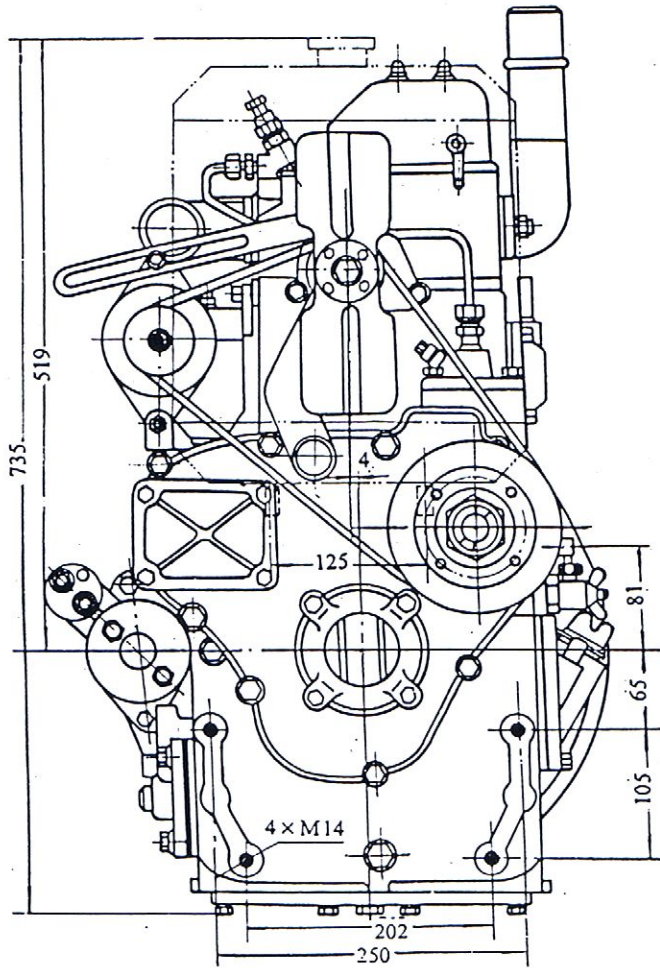
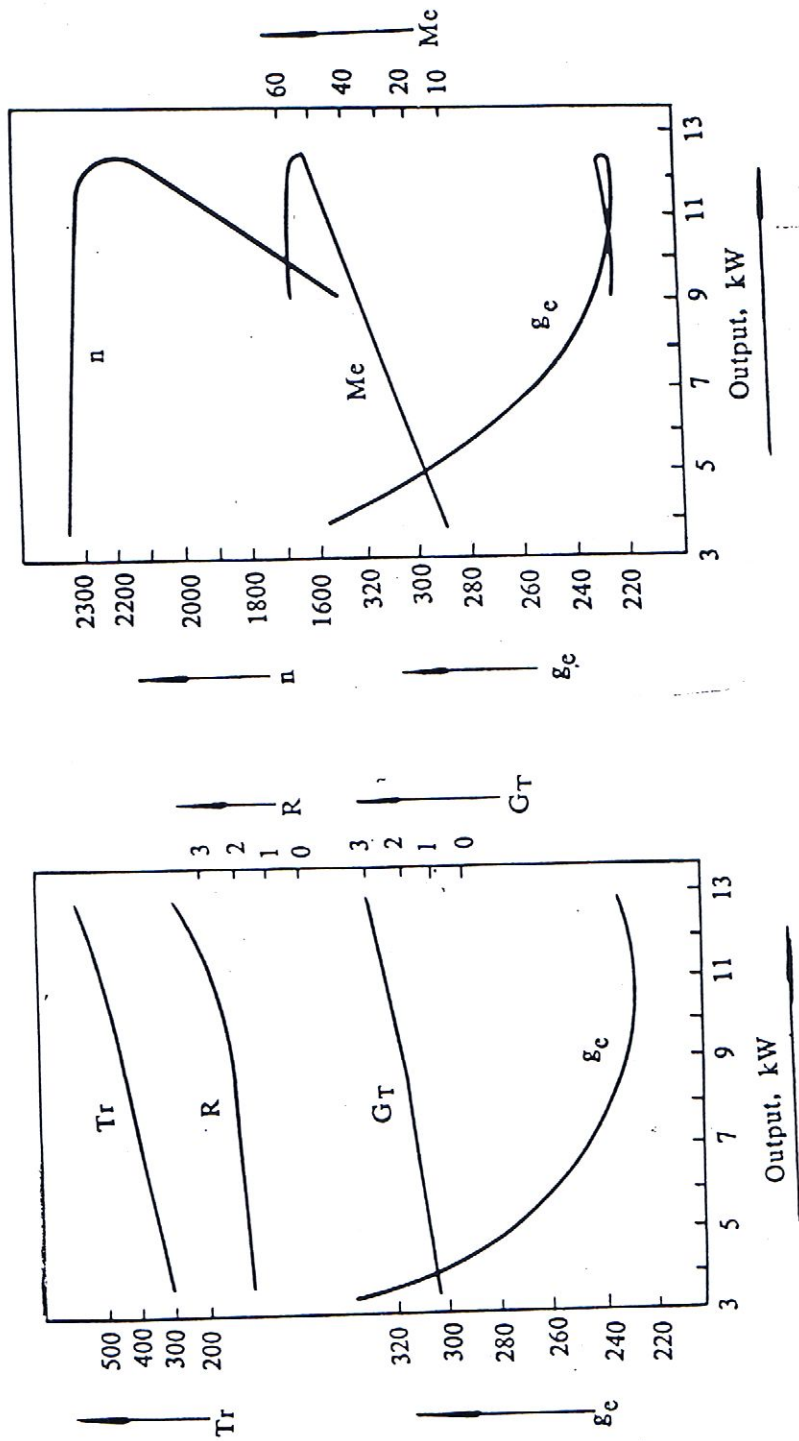


Fig. 5 External view fan end—front  
note: 4×mounting screw holes:M14thread 26deep



(a) Load characteristic curves

(b) Speed characteristic curves

$T_r$ —Exhaust temperature, °C  
 $G_r$ —Fuel consumption, kg/hr  
 $n$ —Speed, r.p.m.  
 $R$ —Bosch smoke number  
 $g_c$ —Specific fuel consumption, gm/(kW.hr)  
 $M_c$ —Torque, N.m

(a) Load characteristic curves

$T_r$ —Exhaust temperature, °C  
 $G_r$ —Fuel consumption, kg/hr  
 $n$ —Speed, r.p.m.  
 $R$ —Bosch smoke number  
 $g_c$ —Specific fuel consumption, gm/(kW.hr)  
 $M_c$ —Torque, N.m



## CONTENTS

Chapter	Title	Page No
1	General .....	(13)
2	Specifications .....	(14)
3	Operation .....	(17)
4	Adjustments .....	(20)
5	Dismantling and Assembly .....	(25)
6	Periodical Preventive Maintenance .....	(36)
7	Curing Faults .....	(38)
8	Dimensions and Clearances of Principal Parts .....	(46)
9	Preparation for Storage .....	(48)
10	Shipping Information .....	(49)
11	Guarantee .....	(51)
12	User comments form .....	(53)

## Chapter 2. Specifications

### Engine

Model	TY1100
Type	Single cylinder, vertical, direct—injection, water—cooled with toroidal piston
Cylinder bore	100mm
Piston stroke	115mm
Displacement	0.903 litre
Compression ratio	18 : 1
12 hour rating	11kW(15HP) at rated speed
Rated speed	2,300 r. p. m
No—load speed	minimum 600r. p. m, maximum 2,480r. p. m
Mean effective pressure	0.64N/mm <sup>2</sup> (6.5kg. f/cm <sup>2</sup> )
Mean piston speed	8.82m/sec
Rated fuel consumption	251g/(kW. hr) [185g/(HP. hr)]
Rated oil consumption	2g/kW. hr [1.5g/(HP. hr)]
Lubrication system	Force—feed and splash
Cooling system	Force—feed water
Starting system	Manual or electric, with decompressor device
Crankshaft rotation	Clockwise viewed from fan
Overall dimensions	485mm×465mm×760mm
Gross weight	165 kg

### Auxiliaries

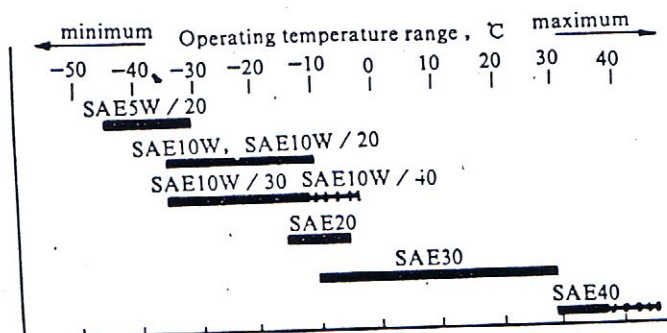
Fuel injector	
type	Dalian ZCK 150. S. 430, long stem or kiki DLLA 154. 5. 32. 4 N413 long stem
holes	4N°× 0.030mm diameter
pressure	18.6 ± 1N/mm <sup>2</sup> (190±10kgf/cm <sup>2</sup> )
Fuel pump	
type	'A' single element
plunger	8.5mm diameter
Engine oil pump	
type	J2×1014, four lobe rotor
delivery	≥10 l/min, at 0.39N/mm <sup>2</sup> (4kgf/cm <sup>2</sup> ) and 2,300 r. p. m
Water pump	
type	Centrifugal

Connecting rod screws	88—108N • m (9—11kgf. m)
Flywheel bolts	88—108N • m (9—11kg f. m)
Hand starting stub shaft	441—490N • m (45—50kgf. m)

The engine serial number is shown on the data plate fixed below the alternator. Always quote it if you need to communicate with us.

Selecting suitable lubricant and fuel.

1. The lubricant used in this engine should be a good quality, detergent mineral oil with a viscosity range suitable for the air temperatures in which the engine is operated. Please consult the chart below.



2. This engine is designed to burn fuel of the following specifications:

	Minimum temperature °C		
	0	-10	-20
Kinematic viscosity at 37.8°C—centi Stokes	3.0—8.0	3.0—8.0	2.5—8.0
Cetane number—minimum	50	50	45
Carbon residue, % by mass	0.4	0.3	0.3
Distillation 90% at, °C	355	350	350
Water	Trace	Trace	Trace
Sediment	Nil	Nil	Nil
Ash, % by mass	0.025	0.025	0.025
Sulphur, % by mass	0.2	0.2	0.2
Cold filter plugging point	Summer use	0°C	—
	Winter use	—	-10°C

Owing to differences in the various national standards, it is not possible to quote exactly equivalent figures for the fuel. Consult your fuel supplier and use the available fuel that is nearest to these specifications. If winter temperatures are very low, it may be necessary to use a fuel with a cold filter plugging point below -20°C.



(2) Turn the de-compressor lever clockwise to 'S' position. See Fig 12.

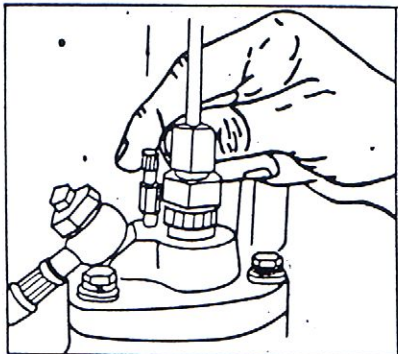


Fig. 11 Lifting the starting plunger

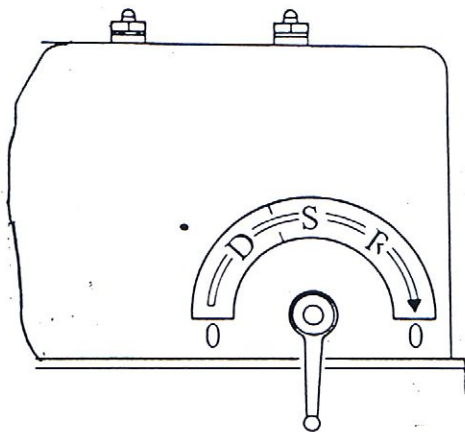


Fig. 12 Settings on automatic de-compressor device

- D—Decompression—to permit easy turning of engine
- S— Starting
- R —Running—normal position from here to vertically—down position shown

(3) Insert the starting handle and, keeping the thumb on the same side as the fingers, turn at an increasing rate. After 5 turns the de-compressor will have advanced to 'R' position. The engine should fire and the handle be ejected. Do not try to stop the handle if, because the engine does not fire, it is reversed.

#### Electric starting:

(1) Set the speed-control lever, de-compressor and starting plunger as if for hand-starting.

(2) Close the battery switch and control switch; the engine should start within 5 seconds.

(3) If the engine fails to start, open the control switch and wait 2 minutes before attempting another start.

(4) If the engine still does not start, refer to chapter 7—Curing Faults—for possible causes and remedies. On no account run the electric starter for more than 15 seconds at one time or its rating will be exceeded and it may burn out.

(5) In temperatures below 5°C, the coolant system may be filled with hot water to assist starting.

#### 3. Starting an engine fitted with the manually-operated de-compressor

The procedure is similar to that for an engine with the automatic device except that the user, having first set the lever to the de-compression position, releases it when the engine has been brought up to speed either manually or electrically. In manual starting, that is

a matter of experience but it is important to be ready for the increased resistance to rotation that will occur momentarily when the lever is released



## Chapter 4. Adjustments

### 1. Adjusting valve clearances

(1) With the engine cold, ensure that the automatic de-compressor (if fitted) is in the running position. R in fig. 12.

(2) Turn the engine until the piston is at T.D.C. on the compression stroke, (refer to Chapter 3. 6. 3.). Both valves should be closed.

(3) Insert a feeler gauge between each valve stem and its rocker-arm pad, in turn, Fig. 14.

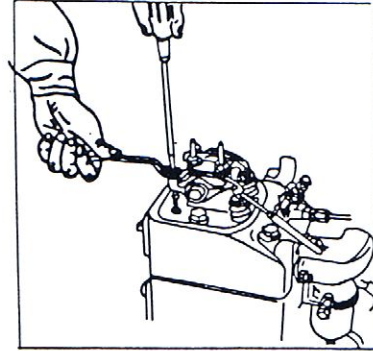


Fig. 14 Adjusting the valve clearance

(4) Adjust, if necessary, to obtain inlet valve clearance of 0.25mm, and exhaust valve clearance of 0.30mm. The feeler gauges should slide easily in the clearance.

(5) To adjust, use a ring spanner of the correct size to release the rocker-arm lock-nut and then adjust the clearance with a screwdriver in the slot. Fig. 14.

(6) Turn the engine two full turns and re-check the clearances; when they are correct, re-tighten the lock-nuts.

### 2. Adjusting injection pump timing

The start of injection is carefully set before the engine leaves our factory. If, however, after long service or when the pump is removed for any reason, it requires re-setting, proceed as follows:

(1) Slacken off the high-pressure fuel line nut at the injector and remove the pipe retaining clip.

(2) Release the high-pressure fuel line nut on the injection pump; lift the pipe slightly to free the nipple and swing the pipe carefully aside.

(3) Set the speed-control lever to its mid-position; apply the manually operated de-compressor or, on the automatic device, set the lever to 'D', Fig. 12.

(4) Use the starting handle to turn the engine until fuel starts to flow from the top of the injection pump. Then carefully turn the engine a further  $7/4$  turns ( $7/8$  turn of the starting handle) and continue to turn slowly. Stop as soon as the fuel level, on top of the pump, rises and look at the flywheel marks through the viewing hole. Fig. 15, 16.

(5) If adjustment appears to be necessary, first repeat the procedure above to confirm the observation. Then:

① Note if the timing shows early- 'E' mark in Fig. 15(a) or late- 'L' mark in Fig. 15(a).

② Remove the high-pressure fuel pipe and cover the ends with plastic caps or fluffless

(6) To replace the fuel injection pump, first turn the engine to B. D. C. and check that the speed — control lever is still in mid — position so that its top end can be seen below the square cut — out of the injection pump mounting.

(7) Centralize the fuel rack in the pump body and carefully land the pump on its flange; the top end of the control lever and the fuel rack pin should engage easily. Check that they have done so by moving the speed — control lever and note that the injection pump rocks slightly — see Fig. 17 for proper engagement.

(8) Fasten the injection pump — 3 screws — and re — check the timing (paras 3 to 5 above). Re — adjust if necessary until it is correct.

(9) Re — fit the high — pressure fuel line and bleed the system; replace the mid — point pipe clip.

### 3. Adjusting the automatic de — compressor (Fig. 18)

(1) Turn the de — compression lever to "D".

(2) Remove the valve rocker cover.

(3) Turn the engine to T. D. C. on the exhaust stroke; the inlet valve starts to open.

(4) Release the adjusting screw lock — nut and use a screwdriver to bring the end of the adjusting screw to bear lightly on the de — compressor spindle.

(5) Turn the de — compressor spindle half a turn and screw the adjusting — screw down 3/4 of a turn towards the flat; tighten the lock — nut.

(6) Turn the spindle another half turn and replace the cover while holding the lever in 'D' position.

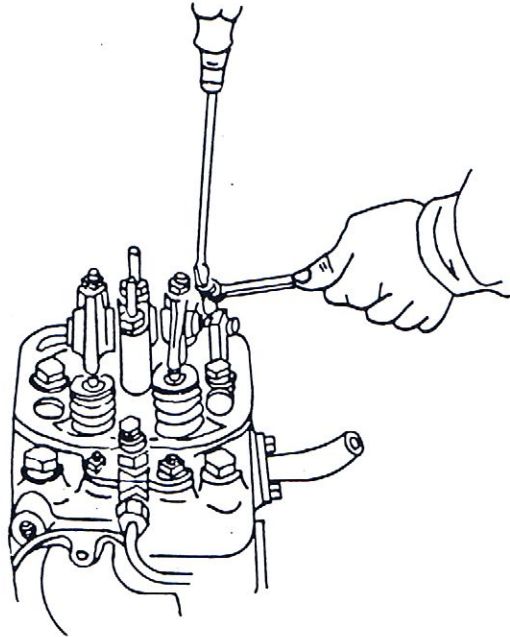


Fig. 18 Adjusting the automatic decompressor

### 4. Adjusting the injection pressure

**WARNING;** The spray from an injector nozzle can cause fuel to penetrate the skin and enter the body. Never direct the spray towards the body and use suitable screens when testing injectors to ensure that accidental contact is prevented.

This operation requires special equipment in the form of a hand — operated test pump and a robust, high — pressure gauge. If they are not available and incorrect injection is indicated a new or serviced injector should be fitted. However, if they are available.

(1) Release the high — pressure fuel line from the injector and cover both ends with plastic caps or fluffless cloth.

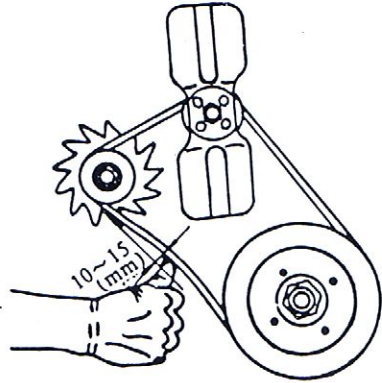


Fig. 19 Checking the fan (vce) belt tension

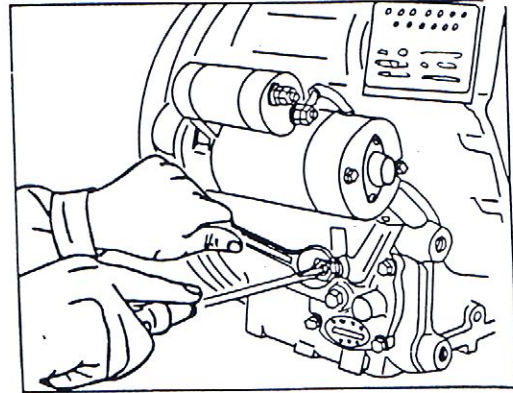


Fig. 20 Adjusting lubricating oil pressure



the piston rings may require to be changed.

## 2. Dismantling the gear — case cover

- (1) Remove the fan belt.
- (2) Remove the starting handle stub shaft and pulley.
- (3) Take out the nine securing bolts and carefully lift off the cover and gasket. Note that the thickness of the gasket should not be altered or the camshaft end—float will be affected. So if it is necessary to fit a new gasket, it is essential it is of the same thickness as the one removed. No jointing compound is used.
- (4) When re—assembling, be sure to tighten the bolts evenly.

## 3. Dismantling the speed—control mechanism

- (1) Remove the injection pump and gear—case cover in the manner already described.
- (2) Release the small spring from the cylinder body.
- (3) Take off the butterfly nut on the speed—control lever and remove the pin, bushing, small crank, shaft and speed—control spring.
- (4) Release the clamping screw from the crankshaft end (left—hand thread ) and remove the locking—plates, governor end plate, steel balls, separator and the sliding assembly. When re—assembling, ensure that the end plate is fitted with the same, hardened, face against the steel balls.
- (5) Remove the securing screws from the speed—control lever yoke to remove the yoke and lever together.
- (6) When re—assembling, lightly oil all parts and make sure moving parts move freely.

## 4. Removing the camshaft

- (1) Follow the instructions already given to remove the gear—case cover.
- (2) Remove the crankcase breather plate and oil filler plate.
- (3) Push the valve tappets to their highest position and hold them there.
- (4) Gently ease the camshaft forward until it is free, taking care not to bend it or sway it about in its bearings.
- (5) Before re—placing the camshaft, ensure that the timing marks on the crankshaft gear, small idler, balance shaft and large idler coincide and that the marks on the camshaft gear are brought to the marks on the small idler. See Fig. 21.
- (6) When the camshaft and gearcase cover have been replaced, but before fitting the pulley and stub shaft, check the camshaft end—float. If it exceeds the maximum permissible, 0.25mm. remove thickness from the camshaft bearing end—cover to obtain end—float between 0.1mm and 0.25mm. A selection of gaskets is included in the spare parts kit.
- (7) If the tappets are removed for any reason, they should be replaced in the guide from which they were removed.



## 6. Removing piston rings and piston pin

(1) It is good practice to fit new piston rings whenever the piston is withdrawn but, if re-use is unavoidable, take great care not to break them during removal. Clean the grooves with a stiff, non-metallic brush and do not scratch the piston.

(2) Remove the circlips at either end of the piston pin and drive the pin out with a copper or hardwood punch. When re-fitting the piston pin, make sure that the piston and connecting rod are correctly positioned—see 5.2 above. For easy assembly, first heat the piston in boiling water.

(3) When re-fitting piston rings, start with the bottom, oil-control, ring and ensure that the harness is equally engaged in the two ends of the spring and that the joint is on the opposite side from the ring gap.

(4) Next fit the second gas, compression, ring. It has a tapered cross-section and MUST be fitted with the “上” identification mark uppermost.

(5) Finally, fit the top ring, which is chromium plated. When all the rings are fitted, stagger their gaps around the circumference but making sure that none of the gaps is opposite the piston pin holes.

## 7. Removing the flywheel

(1) First, measure the crankshaft end-float and note that it is adjusted by altering the thickness of gasket under the main bearing housing. See 8 below.

(2) Take out the five securing screws and ease the flywheel forward until it is free.

(3) When replacing the flywheel, note that the five holes are not evenly spaced and coincide only when the 6 mm holes, in the end of the crankshaft and in the flywheel, are aligned.

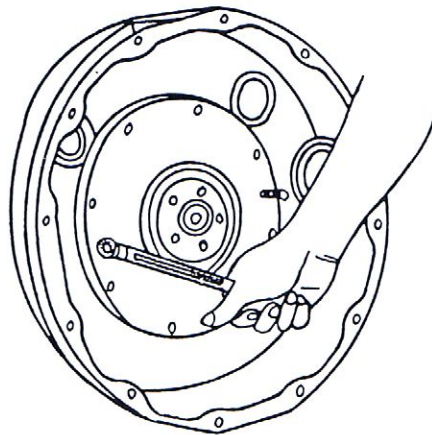


Fig. 22 Jacking out main bearing housing

## 8. Dismantling the crankcase (Fig. 22)

(1) Take out the ring of screws securing the back main bearing housing and insert M8 screws into the tapped holes to jack out the housing evenly. Put the housing and gasket(s) aside.

(2) Carefully lift the crankshaft forward and remove it.

(3) Turn the engine, by hand, three or four turns to prove that assembly has been accurate.

### 11. Dismantling the valve mechanism (Fig. 24)

With the cylinder head removed :

(1) Place the valve tool on one of the rocker arm pedestal studs and lightly secure it with a nut so that the central hole is over the spring plate of a valve.

(2) Press down sharply on the tool to compress the valve spring and free the collets.

(3) Release the tool; remove the spring plate and springs before tapping the valve stem through the guide with a block of wood.

(4) Carefully examine the valve seating. It should extend all the way around the circumference in the form of a dull, grey ring about 2mm wide. If the valve requires re-grinding, first clean it, the combustion face of the cylinder head and the valve guides to remove carbon and other deposits.

(5) Apply a little grinding paste to the valve seat, and, using the grinding tool supplied, rapidly twist the valve stem to and fro while pressing it lightly against the seating in the head. See Fig. 25. From time to time turn the valve to a new position and resume the to and fro motion.

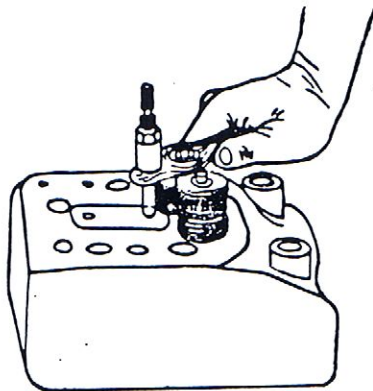


Fig. 24 Valve tool in use

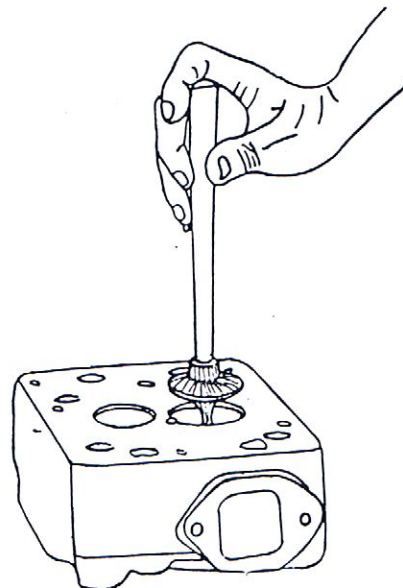


Fig. 25 Valve grinding tool in use

(6) Examine the seating occasionally until it is seen to be satisfactory but avoid over-grinding which may produce undesirable scoring.

(7) To confirm that the seating is satisfactory, clean off all traces of abrasive and re-assemble the valve.



marks on the control rack and gear first, then the marks on the plunger and barrel. The assembly is correct when the two pairs of marks are aligned.

⑦ Before re-fitting the pump, make sure that the rack moves smoothly and easily and that the push-rod parts are free. After fitting, check the injection timing as already described in 4.2.

(2) Fuel injector (Fig. 28)

① Remove the injector as described in 4.4 and support it in a dummy mounting or, grip it by the flange only, in a vice.

② Remove the injector cap, pressure adjusting screw, spring and spindle.

③ From the other end, remove the nozzle cap nut and the nozzle body; if they do not part, lightly tap the end of the nozzle with a soft punch. Do NOT strike the body sides and avoid damage to the holes.

④ Scrub the nozzle and needle with a brass-wire or a non-metallic brush and clean all other parts before re-assembly.

⑤ After re-assembly, check atomisation and adjust the injection pressure in the manner already described; remember to take precautions against injury from the spray.

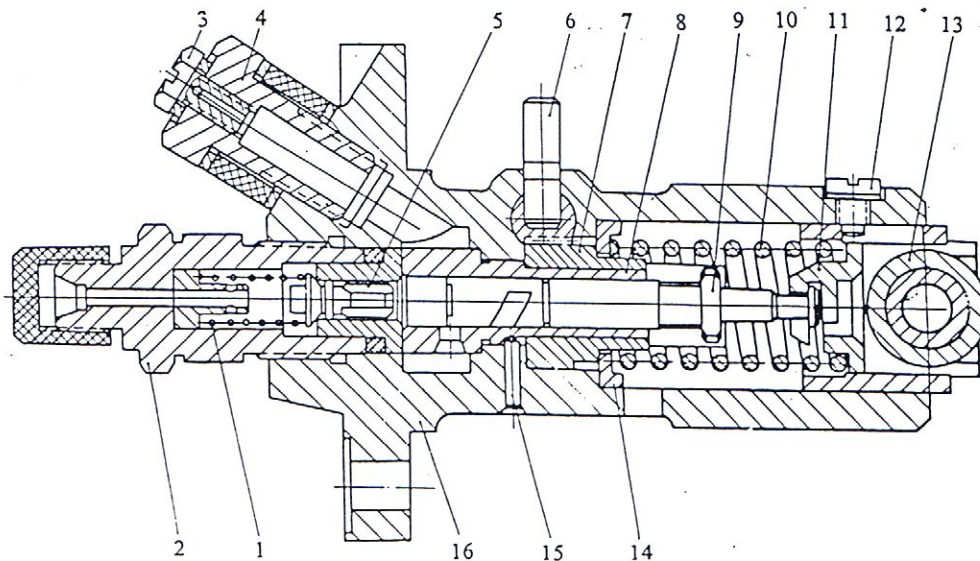


Fig. 26 Section through fuel injection pump

- |                              |                        |   |
|------------------------------|------------------------|---|
| 1. Delivery valve spring     | 2. Delivery valve seat | 3. Bleed screw                          |
| 4. Fuel inlet banjo union    | 5. Delivery valve      | 6. Control rack                         |
| 7. Rack gear                 | 8. Barrel              | 9. Plunger (8,9 keep as a matched pair) |
| 10. Plunger spring           | 11. Lower spring seat  | 12. Pilot screw or pin                  |
| 13. Top of push rod assembly | 14. Upper spring seat  |   |
| 15. Timing bush              | 16. Pump body          |   |

### 13. Removing the cylinder liner

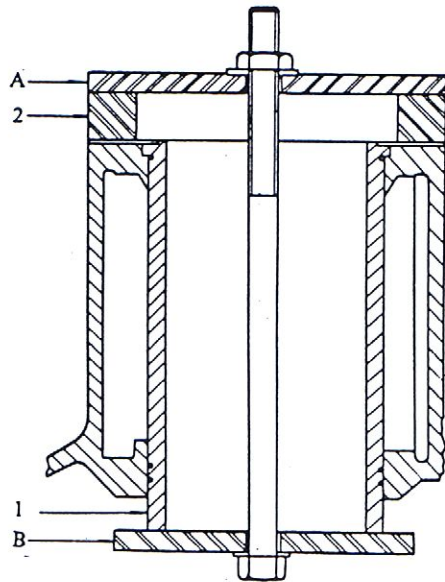


Fig. 29 Assembly for withdrawing cylinder liner

(see also Figs. 30, 31, 32 and 33)

'A' — Top plate 'A'

'B' — Bottom plate 'B'

1. Cylinder liner 2. Packing Piece

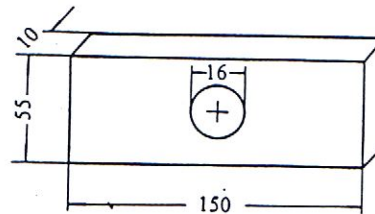


Fig. 30 Bottom plate 'B'  
(Material: mild steel)

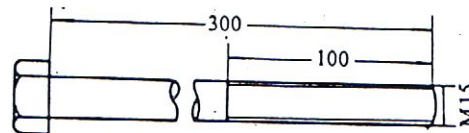


Fig. 31 Steel bolt for withdrawing cylinder liner

Note: fine thread preferred

(1) With the cylinder head and piston/connecting rod assembly removed, tap the liner upwards with a block of wood.

(2) If, after long service, it does not move readily do not use excessive force but draw it out; see Fig. 29.

① Place a plate-B in Fig. 30- laterally across the bottom of the liner and centralise it clear of obstructions.

② Thread a 15mm, fine thread,  $\times 300$  bolt—Fig. 31—up through the plate and centrally up the liner. Put a plate-A in Fig. 32—over the bolt and support it on packing pieces—Fig. 33—that are clear of the liner flange and the locating dowels. Tighten a nut against the top plate to withdraw the liner.

(3) Before replacing the liner, clean the bore at the bottom of the liner housing to remove any deposits but be sure not to scratch the bore.

(4) Clean the sealing ring grooves and smear a little soap or engine oil around them to ease the task of fitting the rings.

(5) Use new sealing rings if possible and fit them into the grooves without twisting them.



## Chapter 6. Periodic Preventive Maintenance

To guard against poor performance, excessive wear and premature failure, maintain the engine in accordance with the following schedule. It is good practice to use the opportunity presented, especially during items No. s 5 and 11, to note the approach of a need for replacement parts so that they can be obtained in good time. Remember always to quote the part number to ensure correct supply.

The schedule recommends certain attention for a new or overhauled engine followed by regular attention at intervals determined by the number of hours in service. In specially arduous conditions, it may be advisable to carry out some items more frequently; for example, cleaning the air cleaner in very dusty conditions.

Permissible clearances are tabulated in Chapter 8 of this manual.

Schedule of Preventive Maintenance

Item	Part(s)	Service hours					Attention required	Refer to:
		50	100	200	500	1000		
1	Air cleaner		*				Paper type; remove element, shake it clean and replace.	
		*					Oil-bath; drain and clean oil—bath. Refill with clean oil.	
2	Oil filter		1	*			Clean element in petrol or fuel. Shake dry and replace.	
3	Fuel filter				*		Clean element in petrol or fuel oil. Blow dry from the inside and replace. If the element is damaged, however slightly, fit a new one as soon as possible.	
4	Lubricating oil		I				Drain crankcase, remove bottom cover and clean the interior. Replace cover and refill crankcase with oil to the correct level. If the oil strainer is removed, make sure when replacing it, that there is a copper washer each side of the hollow bolt where it passes through the crankcase.	
					*		Drain oil. Refill with clean oil to correct level.	

## Chapter 7 . Curing Faults

If the engine has been operated and maintained in accordance with the contents of this manual it should give long, trouble—free service. If, however, faults do arise, work systematically through the appropriate parts of the following schedule. Remember that more than one fault may be responsible.

Permissible clearances are tabulated in Chapter 8 of this manual. Always check sizes that become accessible during maintenance or repairs and use the information to plan future maintenance and obtain necessary spare parts.

**Fault—finding Schedule**

Item	Problem and possible causes	Attention required	Refer to:
1	Difficulty in starting		
	(1) Fuel system trouble .		
	① Air in system.	Bleed the injection pump, injector and fuel filter	3. 1. (6)
	② System blockage.	Trace and clear the blockage starting at the tank and proceeding to the filter, pump and injector pipe work. If the fuel pump has been operating without fuel, during repeated attempts to start, the barrel and plunger may be damaged so examine them if the problem persists after the blockage has been cleared	5. 12. (1)
	③ Injection pump not delivering correct quantity of fuel	Check the pump timing. If that is correct examine the barrel and plunger for scoring	4. 2 5. 12. (1)
	④ Fuel injector defective	Remove the injector and fit a serviced one	5. 12. (2)
	(2) Insufficient compression		
	① Worn piston rings	Change piston ring set.	5. 6
	② Valve leakage.	Ensure valve clearance is correct. If fault persists, remove and grind in the valves	4. 1 5. 11
	③ Cylinder liner worn	Renew cylinder liner and fit new sealing rings	5. 13

Item	Problem and possible causes	Attention required	Refer to:
	(6) Speed—control fault	Check speed — control mechanism ensuring that the lever engages properly with the control rack and moves freely. If fault persists, change injection pump.	4.2
	(7) Exhaust pipe blocked.	Clear blockage. If it is due to severe carbon build —up, clean the valves, piston crown and cylinder head. Ensure air cleaner is properly serviced.	
3	Speed unstable		
	(1) Fuel system problem		
	① Air in system	Bleed fuel pump, injector and filter	3.1. (6)
	② Water in fuel	Drain and flush fuel tank and filter bowl. Bleed pump and injector. Find the source of the contamination and prevent a repetition	
	③ Fuel leakage	Check high —pressure system and cure leak (s)	
	(2) Governor defect	Dismantle and inspect. Replace worn or broken parts. On re —assembly, ensure all parts are clean, lightly oiled and move freely	5.3
4	Exhaust emissions		
	(1) Black smoke		
	① Engine overloaded	Reduce the load	5.12. (2)
	② Injection problem	Service the injector or change it for a new one	6.1, 4.1
	③ Air starvation	Service air cleaner and check valve clearances	4.1
	④ Valve leakage	Ensure clearances are correct. If fault persists, grind —in valves	5.11
	(2) Blue smoke		
	① Oil passing piston rings	Clean or renew piston rings, clean ring grooves	5.6
	② Oil passing down valve guides	Fit new valves and valve guides. Drive guides in and out with a soft tool	
	③ Oil bath air cleaner overfilled	Reduce oil level to mark on bowl	



Item	Problem and possible causes	Attention required	Refer to:
	(1) Incorrect oil level (2) Serious overloading (3) Piston scuffing	Correct sump level Reduce load Strip out piston and fit new piston, piston rings and liner. Change engine oil and filter element	3. 1. (2) 5. 6, 5. 13
7	Coolant outlet temperature too high		
	(1) Coolant level low (2) Radiator problem (3) System blocked by scale etc. (4) Engine overloaded (5) Water pump worn	Top up system. If air locks are suspected, drain the system and refill Clean radiator externally, straighten any bent or flattened fins. Ensure vee-belt tension is correct Flush the system Reduce load Fit new pump	6. 8
8	Engine stops suddenly		
	(1) Fuel starvation ① Fuel tank empty ② Water in fuel ③ Blocked fuel pipe ④ Fuel filter blocked ⑤ Injection pump plunger seized ⑥ Injector needle seized (2) Engine seizure	Refill with clean fuel Drain system, clean fuel filter bowl, bleed pump and injector. Refill with clean fuel Clear blockage Renew filter element and clean bowl Remove and wipe clean with fluffless cloth. DO NOT use abrasive of any sort. If fault persists, renew plunger and barrel as a matched pair Remove and wipe clean with fluffless cloth. DO NOT use abrasive of any sort. If fault persists fit new nozzle and needle as a matched pair Strip to find cause; piston or bearing seizure. Fit new parts as necessary and ensure lubrication system is correct	3. 1. (6) 5. 12. (1) 5. 12. (2)
9	Engine overspeeds Note: Use one of the emergency methods to stop engine		3. 5. (2)
	(1) Governor seized	Examine governor parts and rectify fault. Replace damaged or badly worn parts	5. 3



Item	Problem and possible causes	Attention required	Refer to:
	② Broken valve spring(s)	Renew broken spring(s)	5.11
	③ Displaced push rod	Remove the rocker box cover and take off the rocker arm pedestal nuts. Lift off the pedestal and lift out the push-rods for examination. Replace or renew them. Re-fit the pedestal and set valve clearances	5.1.7 5.1. (10) 4.1
	(4) Valve striking piston	Remove cylinder head to check piston crown for damage. Renew piston if necessary. Replace cylinder head and set valve clearances. Turn the engine, by hand, and if fault persists, check the gear train timing marks. If they are correct, the piston/connecting rod assembly must be removed for examination. Renew bearing shells and/or piston pin as necessary	5.1 4.1 5.10 5.5

#### Connections to automatic voltage regulator

1. The FT111.14 Automatic Voltage Regulator (A. V. R. ) is suitable for use with JF01, JF11, JF21, and JF13 alternators and will control their output at 13.5 to 14.5 volts.

2. To prevent the battery from discharging itself via the A. V. R. and alternator, there must be an isolating switch between the AVR alternator +ve terminal, and the battery as shown above.

3. Clearance between the armature and the contact on the underside of the contact arm is set at 1.4—1.5mm and should not be disturbed.

4. The A. V. R. is a precision component and its adjustment requires special equipment. In the event of electrical trouble, first check all other parts of the circuit—see 7.1. (4). ①—and

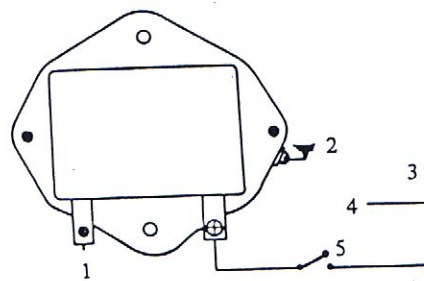


Fig. 35 Connections to automatic voltage regulator

Note: Ensure voltage regulator is mounted vertically with terminals below or on the right-hand side

1. Connection to alternator field  
2. Frame 3. Connection to alternator +ve  
4. To battery +ve 5. Control switch or battery switch

## Chapter 8. Dimensions and Clearances of "Principal" Parts.

All dimensions are in mm

Component	Diameters			Clearances.	
	Parts.	Max.	Min.	When new	Max.
Front main bearing.	Journal.	70.000	69.981	0.080~	0.250
	Bearing shells.	70.100	70.080	0.119	
Connecting rod bearing.	Crankpin.	65.000	64.981	0.046~	0.250
	Bearing shells.	65.095	65.046	0.114	
Piston in cylinder liner.	Piston skirt.	99.840	99.820	0.160~	0.450
	Liner bore.	100.035	100.000	0.215	
Connecting rod /piston pin.	Piston pin.	36.000	35.995	0.020~	0.120
	Rod bush.	36.040	36.020	0.045	
Piston/ piston pin.	Piston pin.	36.000	35.995	0.000~	0.120
	Piston hole.	36.011	36.000	0.016	
Valve stem/ valve guide.	Valve stem.	9.495	9.493	0.005~	0.150
	Valve guide.	9.522	9.500	0.029	
Rocker arm.	Shaft	20.000	19.967	0.020~	0.200
	Arm bore	20.053	20.020	0.086	
Tappet.	Tappet	19.980	19.960	0.020~	0.250
	Guide bore	20.021	20.000	0.061	
Camshaft, centre bearing	Journal	50.000	49.984	0.040~	0.250
	Bush hole	50.070	50.040	0.086	
Camshaft, back bearing.	Journal	28.000	27.987	0.030~	0.250
	Bush hole.	28.060	28.030	0.073	
Top piston ring and groove	Ring width.	2.500	2.480	0.050~	0.200
	Groove width.	2.570	2.550	0.090	
Second piston ring and groove.	Ring width	2.500	2.480	0.040~	0.200
	Groove width	2.560	2.540	0.080	
Oil control ring and groove	Ring width	5.000	4.980	0.030~	0.200
	Groove width.	5.050	5.030	0.070	

Piston ring gaps when rings are tried in liner bore	Top ring	0.300—2.500 0.500
	Second ring	0.250—2.500 0.450
	Oil control ring	0.250—2.500 0.450
Valve heads; dimension below cylinder head face.		0.400—1.800 0.600

## Chapter 9. Preparation for Storage

To prevent deterioration and possible damage, the following precautions should be taken if the engine is to be left out of use for longer than two months. If possible, it should be kept indoors or covered against wet but air must be able to circulate around it to minimise condensation. Keep the engine well away from corrosive chemicals and dust.

- (1) Drain the sump while the oil is still hot after running. Replace the drain plug.
- (2) Completely drain the coolant system. Leave the drain cocks open.
- (3) Empty the fuel tank.
- (4) Clean the oil filter and fuel filter.
- (5) Clean the air cleaner. Replace the paper element or refill the oil bath with clean oil.
- (6) Fill the crankcase with a rust-inhibiting oil, if available, or with clean engine oil and turn the engine, by hand, several times to distribute oil over moving parts.
- (7) Add about half a litre of engine oil to the air inlet manifold and turn the engine several times by hand. Leave the piston at T. D. C.
- (8) Remove the rocker cover and apply oil to the rocker arms, de-compressor, valve springs and push rods.
- (9) Wipe over exterior with a fluffless, oily cloth.
- (10) Ensure silencer and air cleaner are covered against dust and that the fuel tank and radiator caps are in place.

It is advisable to repeat this attention every six months if storage is to be prolonged.



Piston ring—top, gas.	1	TY1100 · 04 · 103	} 1set
Piston ring—second gas.	1	TY1100 · 04 · 104	
Piston ring—oil control.	1	TY1100 · 04 · 012	
Fuel pump element—barrel and plunger. *	1	TY1100 · 16 · 014	
Fuel injector nozzle and needle. *	1	— TS4100 · 19 · 011	
Fuel filter element.	1	TY1100 · 18 · 102	
Lubricating oil filter element.	1	TY1100 · 06 · 011	
Fan belt.		— HG4 · 401 · 74	
Crankshaft rear oil seal.	1	TY1100 · 02 · 002	
Air intake gasket.	1	TY1100 · 01 · 122	
Exhaust pipe gasket.	1	TY1100 · 01 · 120	

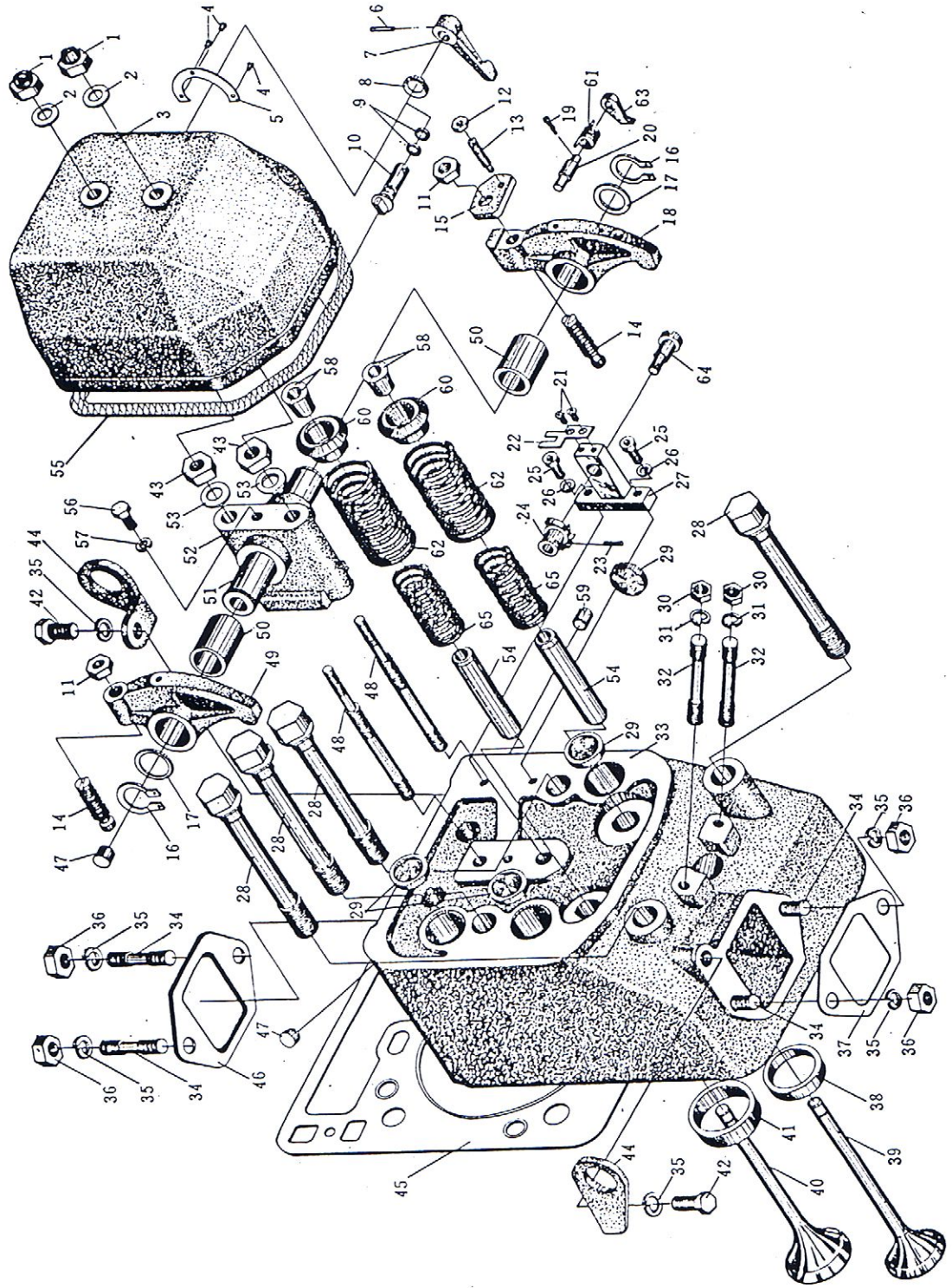
\* — Precisely matched parts; keep together as pairs

#### Parts used for adjusting clearances

(1) Shims for adjusting fuel — pump timing, 0.1, 0.2, 0.3mm. of	1set. 5	TY1100.02.135.
(2) Gasket for main bearing housing, 0.2, 0.3, 0.5mm.	1set of 6.	TY1100.02.114A.
(3) Gasket for camshaft bearing housing, 0.1, 0.2, 0.3mm.	1set of 3	TY1100.02.154A.

CYLINDER HEAD

1



CYLINDER HEAD

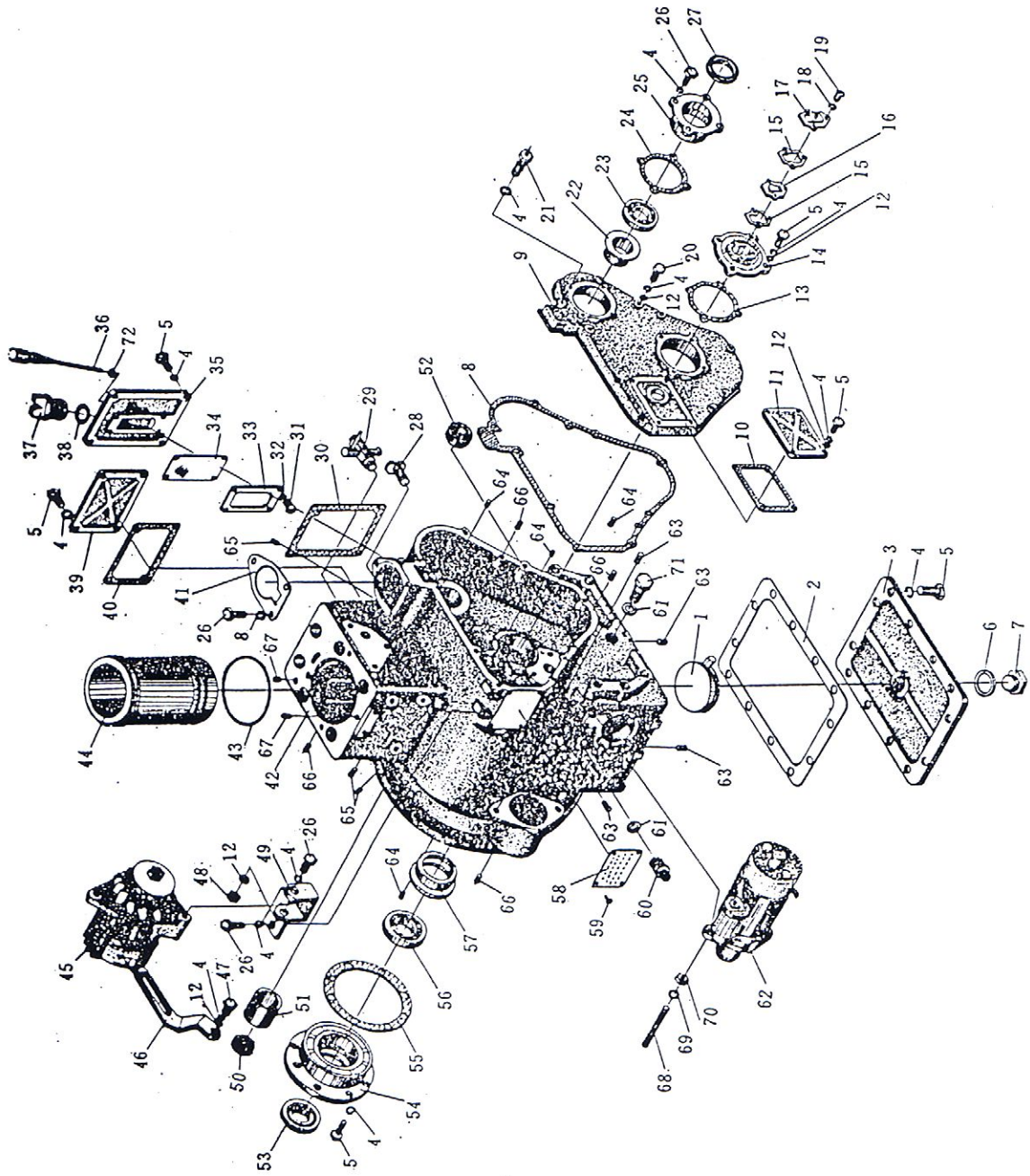
ITEM NO.	PARTS NO.	NAME	QTY
1	GB923-76	ACORN NUT M8	2
2	GB97-76	WASHER 8	2
3	TY1100-01-137	ROCK ARM COVER	1
4	GB827-76	RIVET 2.5X5	3
5	TY1100-01-141A	DECOMPRESS MARK	1
6	GB117-76	TAPER PIN 3X16	1
7	TY1100-01-139B	DECOMPRESS HANDLE	1
8	GB860-76	CURVED SPRING WASHER 10	1
9	GB1235-76	O-RING 9X1.9	2
10	TY1100-01-138	DECOMPRESS HANDLE SHAFT	1
11	TY1100-01-127	VALVE ADJUSTING SCREW	2
12	GB54-76	NUT M6	1
13	TY1100-01-130	DECOMPRESS ADJUSTING SCREW	1
14	TY1100-01-126	VALVE ADJUSTING BOLT	2
15	TY1100-101-134	LOCK, LEAF, DECOMPRESS SCREW	1
16	GB894-76	SPRING CIRCLIP 20	2
17	TY1100-01-118	CIRCLIP, ROCK ARM SHAFT	2
18	TY1100-01-125A	ROCK ARM, EXHAUST VALVE	1
19	GB91-76	SPLIT PIN 2X16	1



ITEM NO.	PARTS. NO.	NAME	QTY
43	GB52-76	NUT M10	2
44	TY1100-01-142	SHACKLE	2
45	TY1100-01-121A	GASKET, CYLINDER HEAD	1
46	TY1100-01-120	GASKET, EXHAUST PIPE	1
47	TY1100-01-107A	PLUG	2
48	TY1100-01-116	BOLT, ROCKSHAFT SUPPORT	2
49	TY1100-01-123A	ROCK ARM, INLET VALVE	1
50	TY1100-01-124	BUSH, ROCK ARM	2
51	TY1100-01-136	ROCKSHAFT	1
52	TY1100-01-117A	ROCKSHAFT SUPPORT	1
53	GB97-76	WASHER 10	2
54	TY1100-01-104	STEM GUIDE, VALVE	2
55	TY1100-01-119	GASKET, HEAD COVER	1
56	GB30-76	BOLT M6X20	1
57	GB93-76	WASHER 6	1
58	TY1100-01-113	VALVE COLLET	4
59	TY1100-01-106	PLUG	1
60	TY1100-01-112	UPPER RETAINER, VALVE SPRING	2
61	TY1100-01-135	SPRING, DECOMPRESS PAWL	1
62	TY1100-01-110	SPRING EXTERNAL, VALVE	2
63	TY1100-01-128	DECOMPRESS PAWL	1
64	TY1100-01-131	DECOMPRESS SHAFT	1
65	TY1100-01-111	SPRING INTERNAL, VALVE	2

CYLINDER BLOCK AND ELECTRICAL EQUIPMENT

2



ITEM NO.	PARTS NO.	NAME	QTY
22	TY1100-02-106A	MID BUSHING, CAMSHAFT	1
23	GB283-64	ROLLER BEARING 42208	1
24	TY1100-02-154B	GASKET	1
25	TY1100-02-153B	FRONT BEARING SEAT	1
26	GB21-76	BOLT M8X22	9
27	HG4-692-67	OIL SEAL SG50X70X12	1
28	TY1100-02-136-1	BOLT, SPEED LIMITATION	1
29	TY1100-02-004A	DRAIN COCK ASSY.	1
30	TY1100-02-128	GASKET, SIDE COVER	1
31	GB67-76	SCREW M4X6	4
32	GB859-76	WASHER 4	4
33	TY1100-02-126	BRACKET, FILTER SCREEN	1
34	TY1100-02-127	FILTER SCREEN	1
35	TY1100-02-121	SIDE COVER	1
36	TY1100-02-013A	DIPSTICK UNIT	1
37	TY1100-02-122	COVER	1
38	TY1100-02-123	SEALING WASHER	1
39	TY1100-02-147	COVER, TAPPET	1
40	TY1100-02-148A	GASKET	1
41	TY1100-02-135	ADJUSTING SHIM, PUMP	1
42	TY1100-02-101-B	CYLINDER BLOCK	1



ITEM NO.	PARTS. NO	NAME	QTY
65	TY1100-02-111A	PLUG (II)	3
66	GB119-76	PIN 10d4x16	4
67	GB119-76	PIN 6jc4x10	2
68	GB898-76	DOUBLE END STUD M10X22	2
69	GB93-76	WASHER 10	2
70	GB52-76	NUT M10	2
71	TY1100-02-138	CONNECTION SCREW	1
72	TY1100-17-109	SEALING WASHER	1

VALVE TIMING MECHANISM

ITEM NO.	PARTS NO.	NAME	QTY
1	TY1100-03-112	PLUG	1
2	TY1100-03-101A	CAMSHAFT	1
3	TY1100-03-102	PUSH ROD	2
4	TY1100-03-103	TAPPET	2
5	GB1096-79	KEY 10X20	1
6	GB1096-79	KEY 10X20	1
7	TY1100-03-110	SHAFT, IDLER GEAR	2
8	TY1100-03-109A	BUSHING	2
9	TY1100-03-108	SMALL IDLER GEAR	1
10	TY1100-03-104	CAMSHAFT GEAR	1
11	TY1100-03-106	BIG IDLER GEAR	1
12	TY1100-03-107	THRUST WASHER, IDLER	2
13	TY1100-03-126	LOCK WASHER	2
14	GB21-76	BOLT M8X50	4
15	TY1100-03-105-1	V-- BELT PULLEY	1
16	TY1100-03-113	ADJUSTING SHIM	1--2
17	TY1100-03-111	STARTING CLAW	1

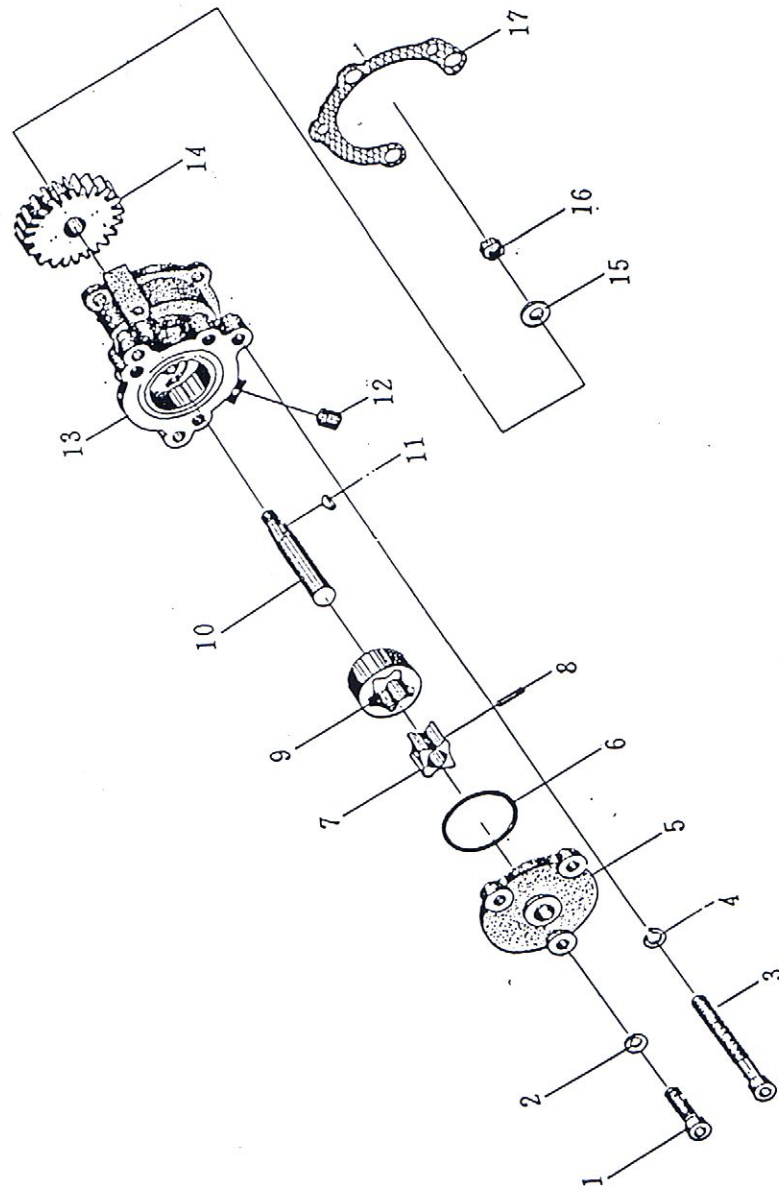
CRANK AND CONNECTING ROD MECHANISM

ITEM NO.	PARTS NO.	NAME	QTY
1	TY1100-04-116	FLYWHEEL BOLT	5
2	TY1100-04-126	LOCK PLATE, FLYWHEEL BOLT	1
3	TY1100-04-115B	FLYWHEEL	1
4	TY1100-04-111A	RING GEAR	1
5	TY1100-04-206	WASHER	1
6	TY1100-04-130	SCREW, CRANKSHAFT	1
7	TY1100-4-101-1	CRANKSHAFT	1
8	TY1100-04-109	BEARING, CONNECTING ROD	2
9	TY1100-04-113A	CONNECTING ROD CAP	1
10	TY1100-04-110A	BOLT, CONNECTING ROD	2
11	GB1096-79	KEY 6X18	1
12	TY1100-04117A	TIMING GEAR, CRANKSHAFT	1
13	TY1100-04-120	OIL SLINGER	1
14	TY1100-04-125	BALANCING BLOCK	2
15	195-04008	SCREW	4
16		WIRE 1.2X200	2
17	TY1100-04-118	CIRCLIP AT THE END OF SHAFT	1
18	TY1100-04-119	STOP WASHER	1
19	GB30-76	BOLT M14X1.5 5X30-L	1
20	TY1100-04-112A	CONNECTING ROD BODY	1



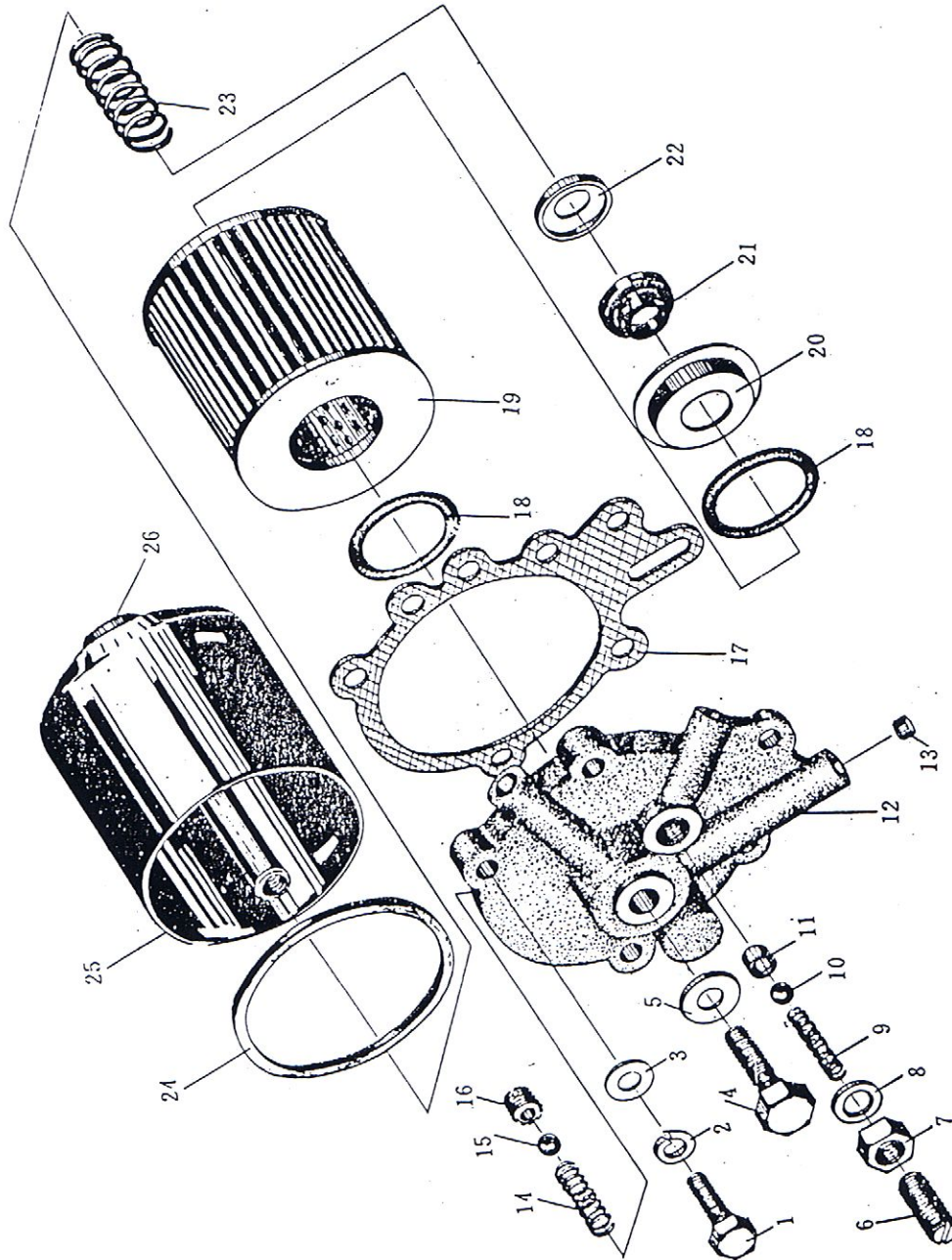
LUBRICATION OIL PUMP

5



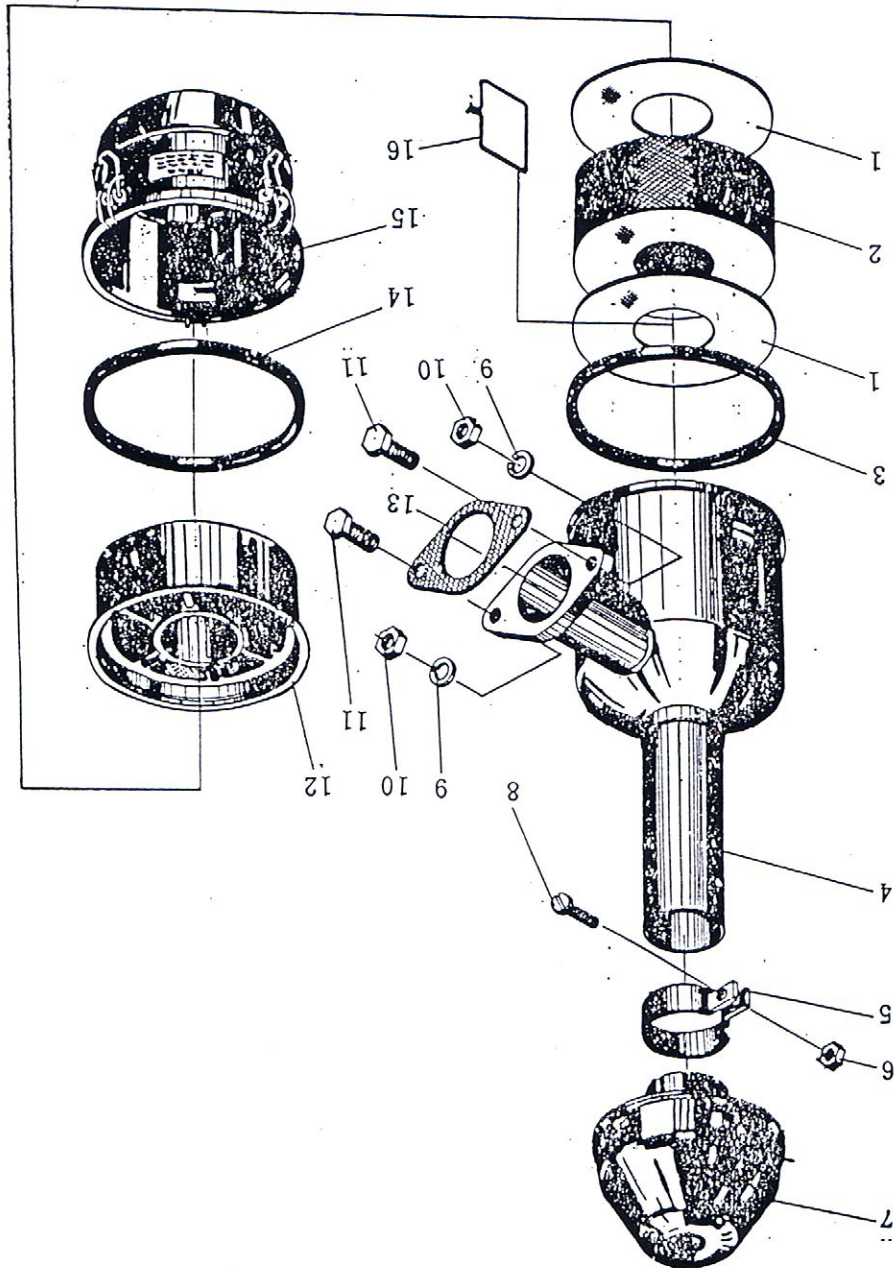
# OIL FILTER

6



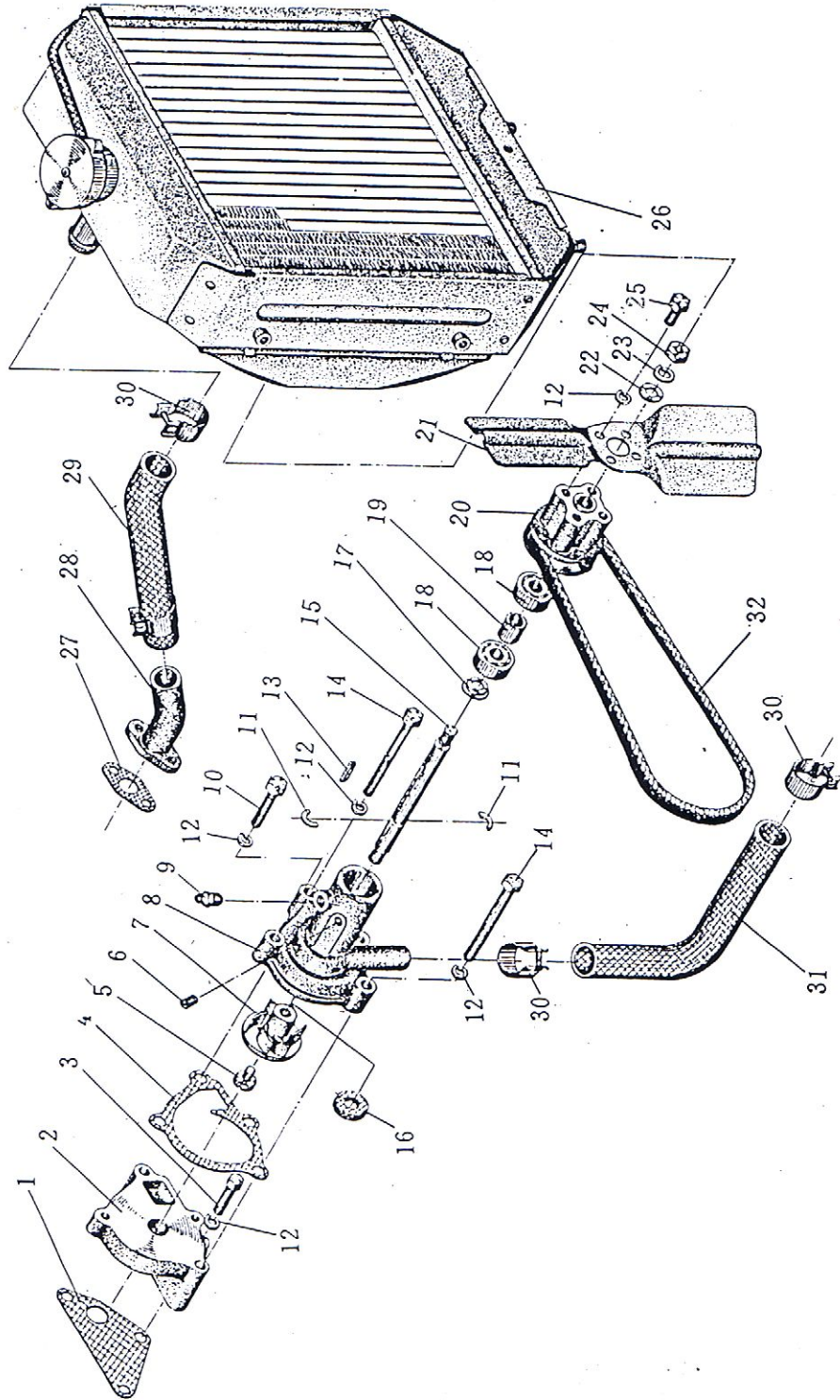
AIR CLEANER FILTER

7





RADIATOR, WATER PUMP AND FAN.



ITEM NO.	PARTS	NAME	QTY
22	GB97-76	WASHER 10	1
23	GB859-76	WASHER 10	1
24	GB1007-76	NUT M10	1
25	GB21-76	BOLT M8X18	4
26	TY1100-13-001	RADIATOR ASSY. COOLING WATER	1
27	TY1100-13-105	GASKET	1
28	TY1100-13-104	OUTLET PIPE	1
29	TY1100-13-102	HOSE, WATER OUTLET	1
30	Q680-32	HOSE CLAMP	4
31	TY1100-13-103	HOSE WATER INLET	1
32	HG4-401-74	FAN BELT "A"	1

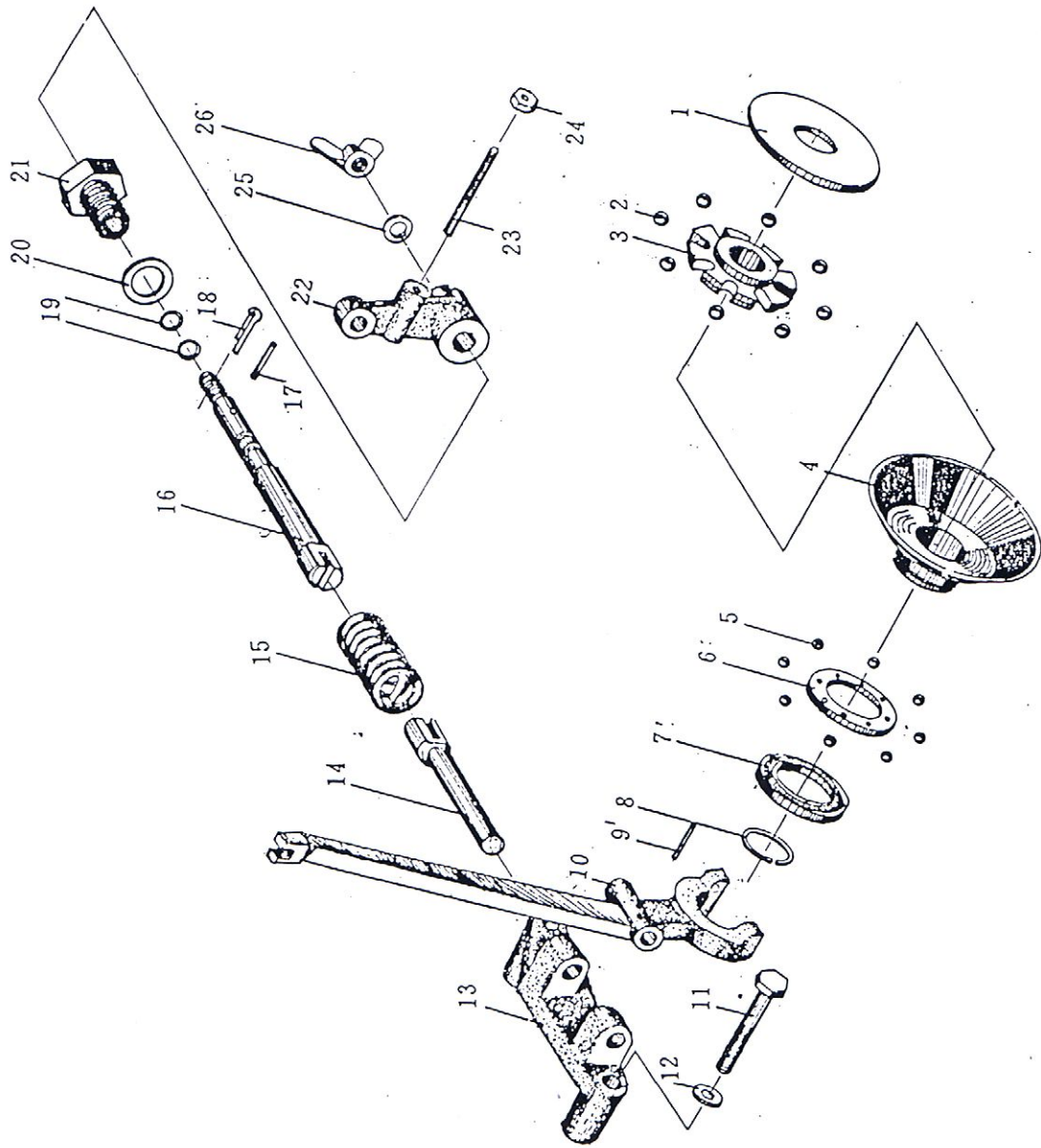
BALANCING SHAFT			QTY
ITEM NO.	PARTS NO.	NAME	
1	GB276-64	BALL BEARING 206	1
2	TY1100-14-104B	BALANCING SHAFT	1
3	GB1096-79	KEY 6X14	1
4	GB276-64	BALL BEARING 207	1
5	TY1100-14-101A	SEAT, BALANCING SHAFT	4
6	GB93-76	SPRING WASHER 8	1
7	GB21-76	BOLT M8X20	1
8	TY1100-14-102A	BUSH	1
9	TY1100-14-103A	GEAR, BALANCING SHAFT	2
10	GB812-76	ROUND NUT M30X 1.5	1
11	GB858-76	TAB WASHER 30	3
12	GB21-76	BOLT M8X25	



FUEL PIPELINE AND FILTER			QTY
ITEM NO.	PARTS NO.	NAME	
1	C0560-200	HOUSING ASSY.	1
2	CS0708-0011	NAME PLATE	1
3	C0506-0006	SCREW, PIPE CONNECTOR	2
4	A-10706	SEAL RING 12	4
5	C0506-0003	SUPPORTING DISC	1
6	C0506-0004	SEALING WASHER	1
7	C0506-0002	SUPPORTING PLATE	1
8	C0810A-0014	SPRING	1
9	GB1235-76	O-RING 30X3.1	2
10	C0506-0100	FILTER ELEMENT ASSY.	1
11	C0506-0005	SEALING WASHER	1
12	C0506-0001	OIL FITLER SEAT	1
13	A-10706	SEAL RING 14	1
14	C0506-0007	NUT	1
15	A-10706	SEAL RING 8	2
16	C0506-0008	PLUG	1
17	TY1100-15-013	FUEL RETURN PIPE ASSY.	1
18	TY1100-15-111	LONG PIPE CLAMP	1
19	TY1100-15-001	FUEL INJECTOR PIPE ASSY.	1
20	TY1100-15-112	SHORT PIPE CLAMP	1
21	GB93-76	SPRING WASHER 6	2
22	GB30-76	BOLT M6X12	2
23	TY1100-15-011	INLET PIPE ASSY.	2
24	TY1100-15-120	INLET PIPE ASSY, FILTER	1

FUEL INJECTION PUMP			
ITEM NO.	PARTS NO.	NAME	QTY
1	QWB 402-66	CAPPED NUT M12X1.5	1
2	TY1100-16-106	PRELOADER, DELIVERY VALVE	1
3	TY1100-16-108	LIMITER, DELIVERY VALVE	1
4	TY1100-16-107	SPRING, DELIVERY VALVE	1
5	TY1100-16-105	WASHER, DELIVERY VALVE	1
6	TY1100-16-124	DELIVERY VALVE	1
7	TY1100-16-125	SEAT, DELIVERY VALVE	1
8	TY1100-16-123	BARREL, PLUNGER	1
9	TY1100-16-113	BLEED SCREW	1
10	TY1100-16-150	COPPER WASHER	1
11	TY1100-16-111	INLET OIL BOLT	2
12	TY1100-16-110	COPPER WASHER	1
13	TY1100-16-112	DUSTPROOF SLEEVE	1
14	TY1100-16-114	PUMP HOUSING	1
15	TY1100-16-109	GUIDE PIN	1
16	TY1100-16-104	ADJUSTING PINION	1
17	TY1100-16-103	SPRING SEAT, UPPER	1
18	TY1100-16-102	PLUNGER SPRING	1
19	TY1100-16-122	PLUNGER	1
20	TY1100-16-101	SPRING SEAT LOWER	1

12 GOVERNOR





1  
1  
1  
1  
1  
1

THREADED BUSHING  
CONTROL HANDLE  
GOVERNOR SCREW  
NUT M6  
WASHER 8  
WING NUT AM8

TY1100-17-108  
TY1100-17-110  
TY1100-17-111  
GB52-76  
GB97-76  
GB62-76

21  
22  
23  
24  
25  
26

INJECTOR		QTY
ITEM NO.	PARTS NO. NAME	
1	TSA4100-19-111 CONNECTION SCREW	1
2	TSA4100-19-112 CAPPED WASHER	1
3	TSA4100-19-113 WASHER	2
4	TSA4100-19-114 INJECTOR NUT	1
5	TSA4100-19-118 NUT	1
6	TSA4100-19-115 WASHER	2
7	TSA4100-19-108 PRESSURE ADJUSTING SCREW	1
8	TSA4100-19-117 SPRING	1
9	TSA4100-19-103 SEAT, SPRING	1
10	TSA4100-19-104 LIFTING ROD	1
11	GB308-77 STEEL BALL 1/8"	1
12	TSA4100-19-107 INJECTOR HOUSING	1
13	GB119-76 PIN 3gax8	2
14	TSA4100-19-102 NOZZLE NEEDLE	1
15	TSA4100-19-101 NOZZLE BODY	1
16	TSA4100-19-109 CAP	1
17	TSA4100-19-110 PROTECTIVE CAP	1
18	TSA4100-19-119 CAPPED NUT	1
19	TSA4100-19-105 PRESSURE LINE CONNECTION	1
20	TSA4100-19-106 FILTER	1
21	TSA4100-19-116 WASHER	1