CAMSHAFT

CAMSHAFT

- Camshaft performs vital role of opening and closing Inlet and Exhaust valves and timely injection of fuel in Cylinder.

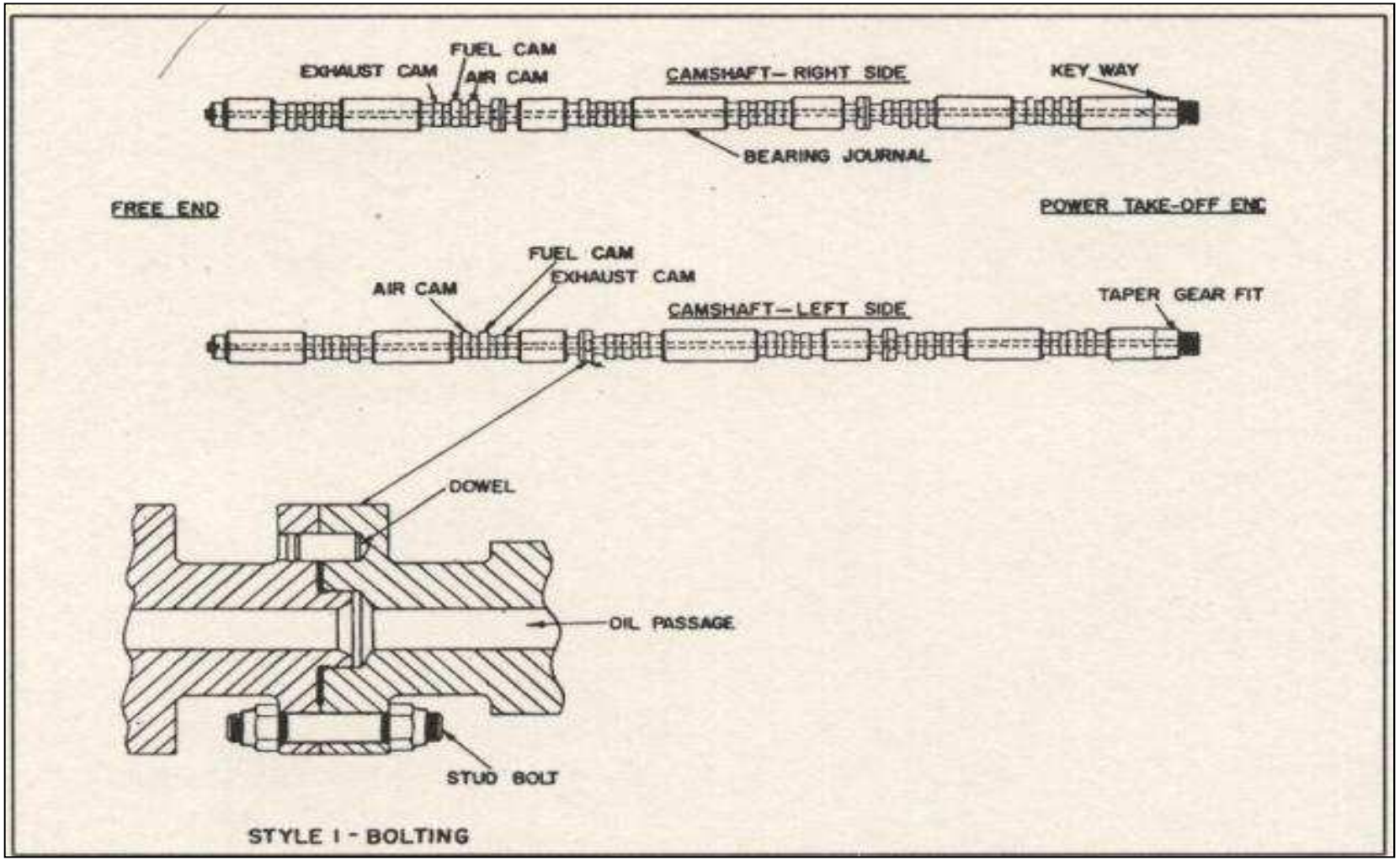
- 3 Cams are provided for each Cylinder. 2 Outer Cams for Exhaust and Air inlet valves and central Cam for fuel injection.

- Camshaft on ‘V’ model 251 Engine is located on either side of Cylinder Block and extend entire length of Engine.

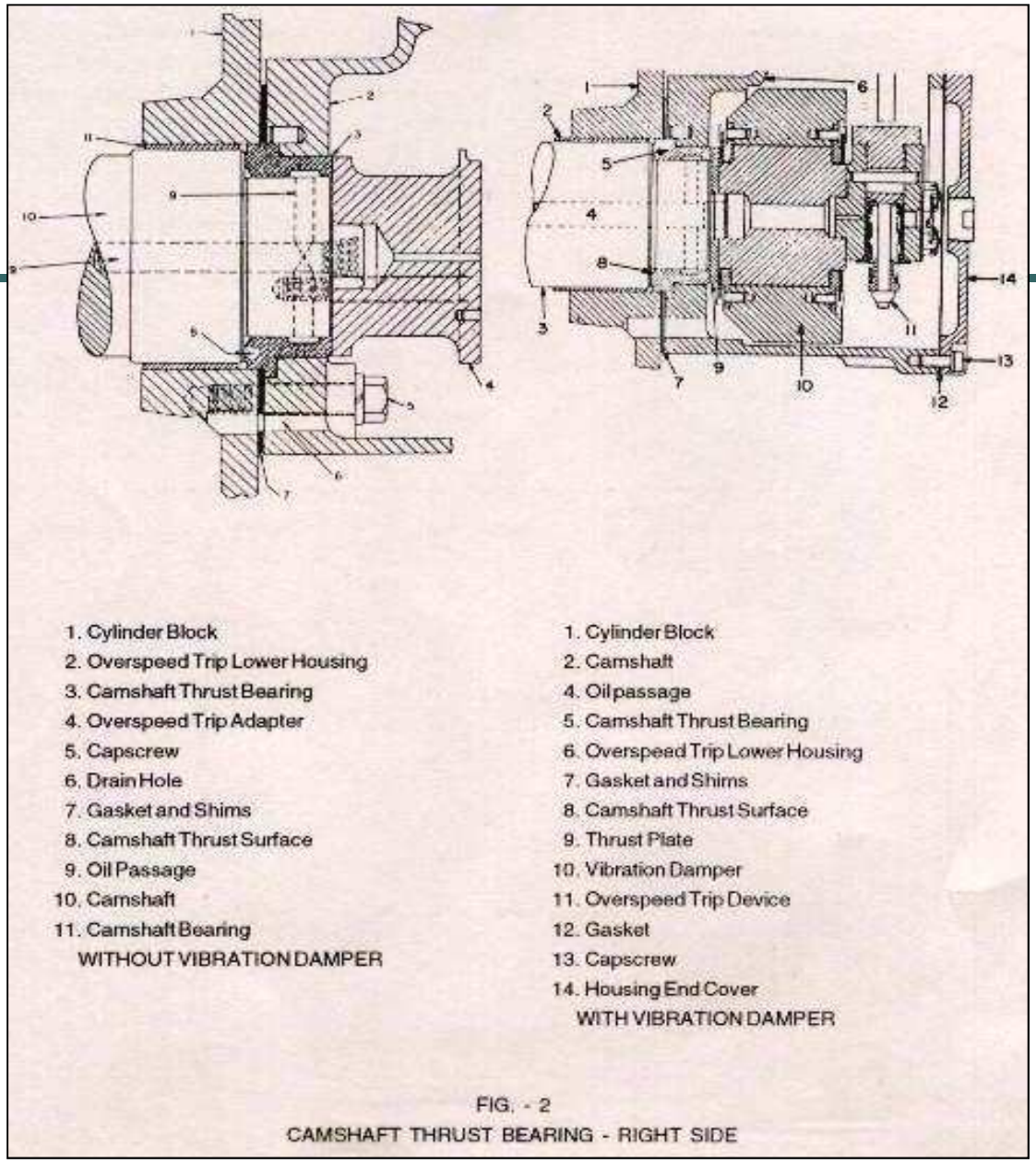
- Camshaft is divided into sections – one for every 2 Cylinders and is joined at section flanges by studs or stud bolts and nuts.

Note :

1. Locating Dowel is used to position each Section.
2. Location of Dowel hole is important as it determines the relative angular position of one Camshaft section with respect to adjacent one.



ENGINE SEGMENT



1. Cylinder Block
2. Overspeed Trip Lower Housing
3. Camshaft Thrust Bearing
4. Overspeed Trip Adapter
5. Capscrew
6. Drain Hole
7. Gasket and Shims
8. Camshaft Thrust Surface
9. Oil Passage
10. Camshaft
11. Camshaft Bearing

WITHOUT VIBRATION DAMPER

1. Cylinder Block
2. Camshaft
4. Oil passage
5. Camshaft Thrust Bearing
6. Overspeed Trip Lower Housing
7. Gasket and Shims
8. Camshaft Thrust Surface
9. Thrust Plate
10. Vibration Damper
11. Overspeed Trip Device
12. Gasket
13. Capscrew
14. Housing End Cover

WITH VIBRATION DAMPER

FIG. - 2

CAMSHAFT THRUST BEARING - RIGHT SIDE

- Camshaft rotates on bearings pressed into supports of Cylinder Block. Lubrication delivered to bearings through an oil hole which runs the length of Camshaft. This hole feeds oil into smaller holes, located at each bearing journal.
- Each section of camshaft has 3 integral cams for each cylinder. As the rollers for Fuel pump cross head and Valve push rod lifters ride on cams, rotation of Camshaft actuates Engine’s Inlet and Exhaust valves and Fuel pumps.

- Lateral movement of Camshaft restricted by Thrust bearing, located at free end of Engine. On the right side, the bearing is contained in OST Housing and on left side in a Thrust bearing housing.
- At the power take-off end of engine, camshaft gear located on each side, is mounted on tapered end of Camshaft by means of heavy locked Key and Split Camshaft gear nut.

Manufacture

- Camshaft is manufactured in replaceable steel sections of heat treated precision machined alloy steel with Chromium.
- Material AISI 1050 (with Chromium)
  - Chemical composition (%) is :
    - Carbon : 0.48 - 0.53
    - Manganese : 0.60 - 0.90
    - Phosphorus : 0.025 max.
    - Chromium : 0.15-0.30

  Note : Total Carbon + Chromium should not exceed 0.78%

Process of Manufacture:

- Mill and Centre
- Plunge grooving operation (For location of cam position)
- Cam Milling
- Turning and Drilling operation
- Induction Hardening
- Rifle hole drilling
- Cam Grinding
- Bearing Grinding
- Magnaflux Testing

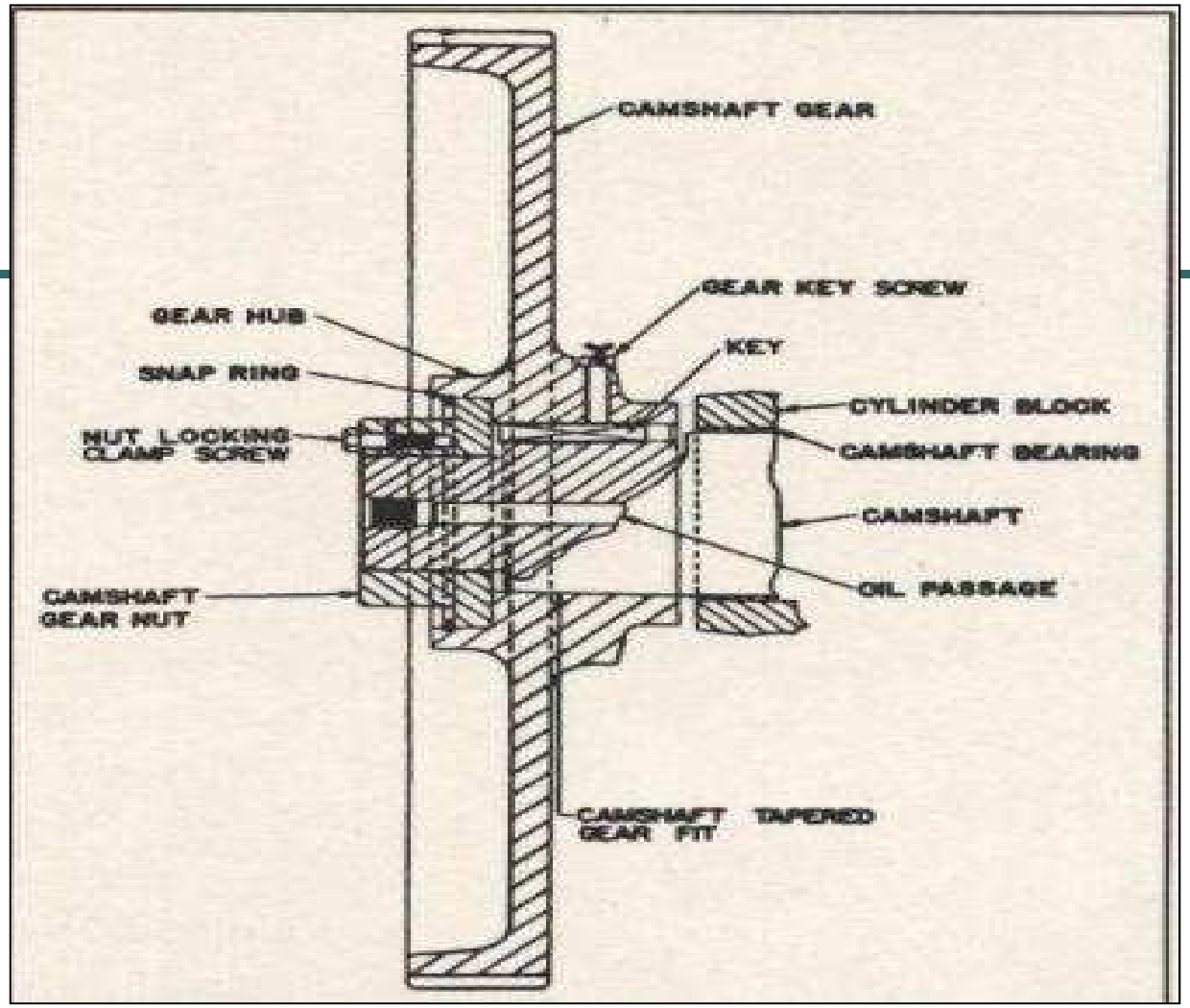
Note : ALCO is machined from 125 mm diameter bar.

Depth of Hardness area : 0.100 – 0.150”

Surface Hardness : Rc 58-62

Removal and Disassembly

- Disconnect necessary lube oil inlet and drain piping.
- Remove Cylinder head covers, Valve lever and Push rods.
- Remove Fuel pump cover, Fuel pumps and Fuel pump supports.
- Remove left and right Camshaft gear covers, Tachometer generator and drive mounted on right Cover.
- Remove WW Governor and Gov. Drive Cylinder Block
- Check camshaft thrust to determine whether replacement of Thrust bearing is required.



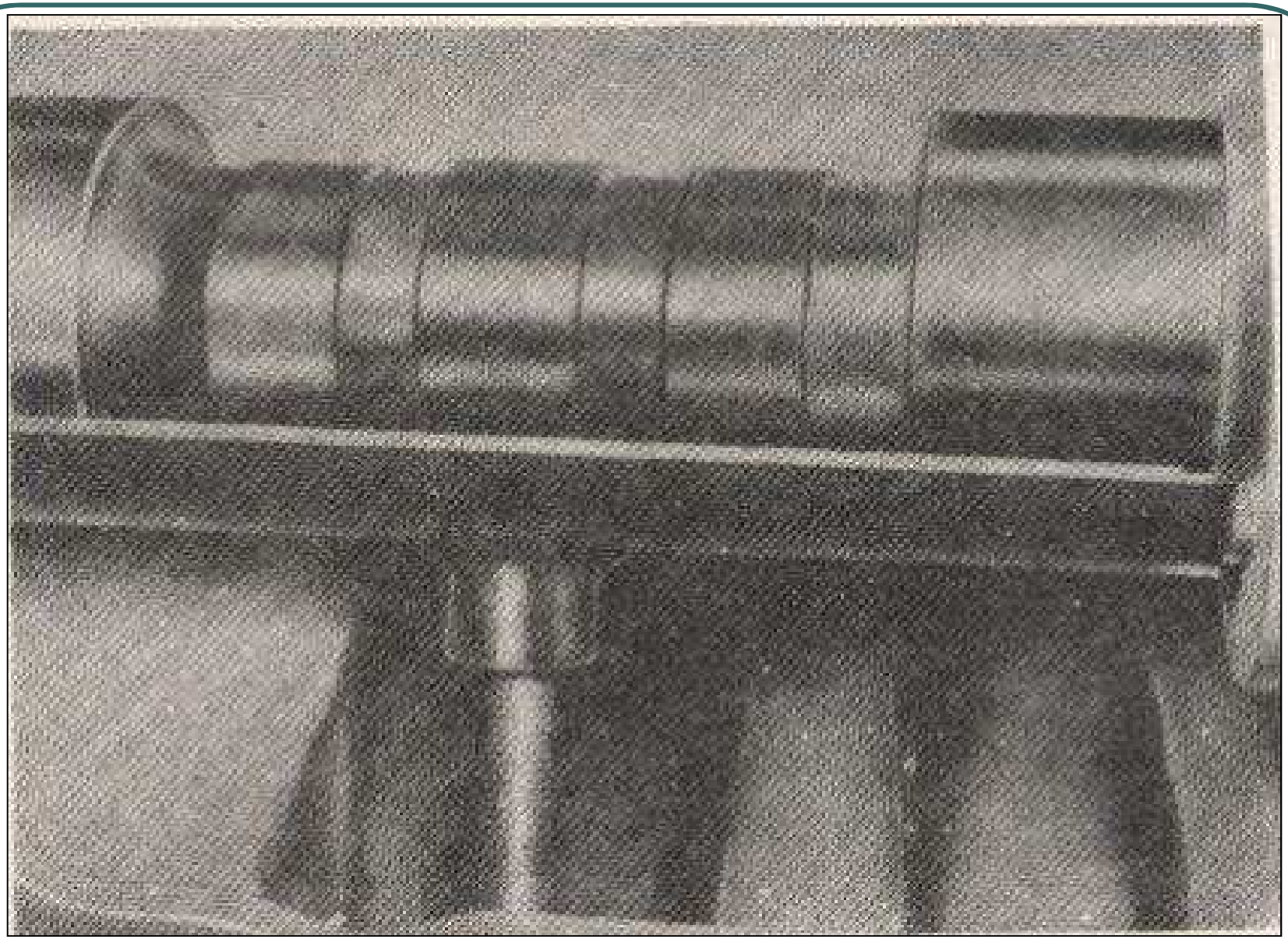
CAMSHAFT GEAR MOUNTING
(POWER TAKE-OFF END)

- Remove OST assembly on right side free end of Engine.

Note : Ensure Over speed mechanism has been tripped.

- Remove locking clam screw on Camshaft gear. Support Cam gear using slings and back off gear nut.
- Apply Camshaft ‘Installation Saddle’ to underside of Camshaft bearing extension.

Note : Point of saddle support should be against Engine base rail, inside Camshaft compartment.



INSTALLATION SADDLE

Inspection and Maintenance

- Examine Thrust bearing for wear particularly Camshaft thrust area

  Camshaft Thrust : 0.006 - 0.012”(New)

  : 0.022” (Limit)

- Examine Camshaft gear for wear, pits or groove and score marks. Shallow score marks may be stoned. Otherwise Camshaft gear must be reground.
- **Camshaft Bearings :**
- Lined with antifriction metal. Examine for pitting, shelling and wear.
- Check inside diameter and running clearance between camshaft journal on bearing against condemning limits.

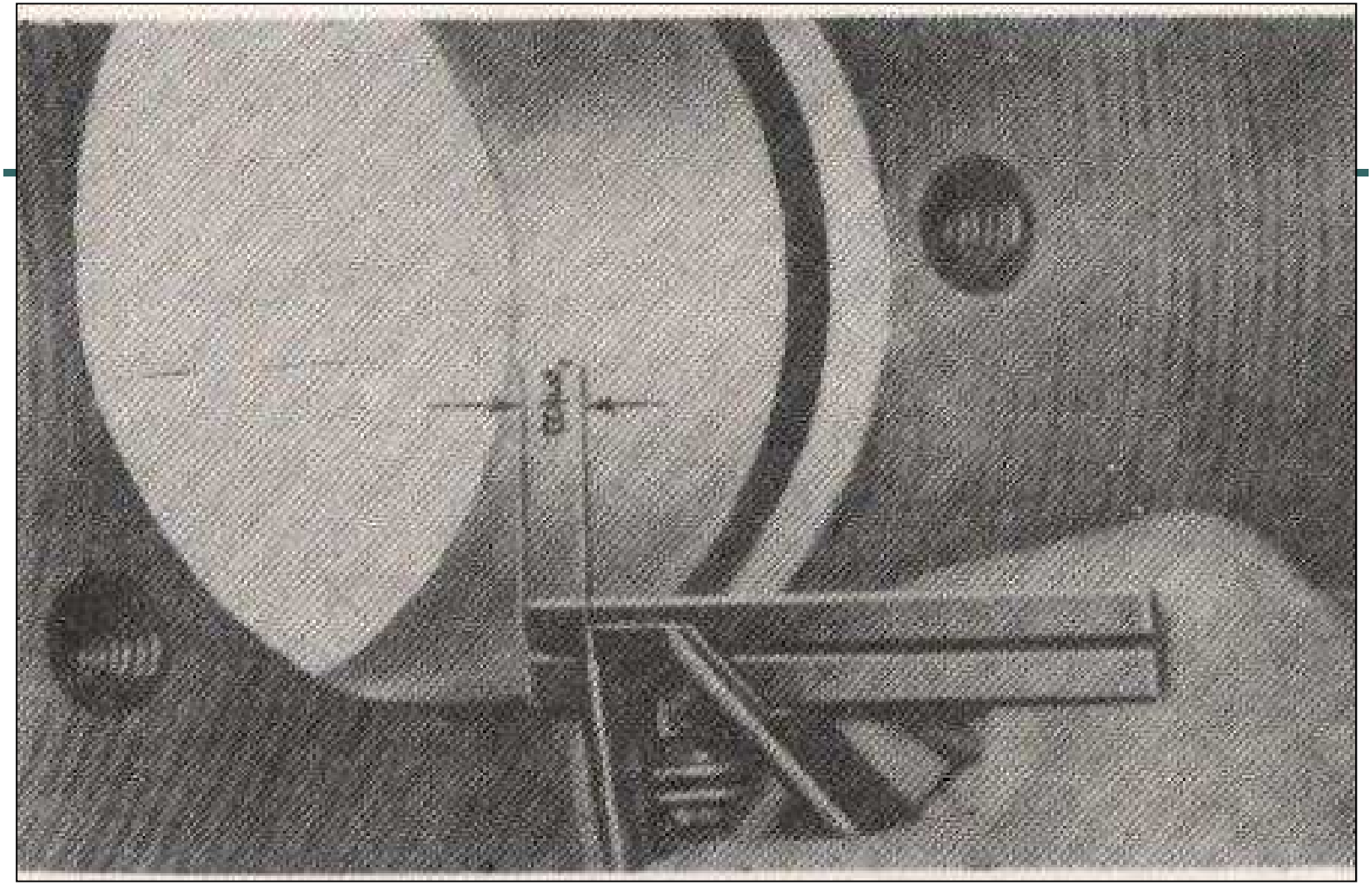
- Camshaft Bearing ID : 4.511”(limit)

Running Clearance : 0.0045- 0.011”(New)

between Bearing & Camshaft : 0.015(Limit)

- Special Arbor Tool to be used for pressing in new bearing.

Note : Edge of Bearing at No.1 cylinder should be 3/8” (approx.) from end of Engine Block.



INSTALLING NO. 1 CAMSHAFT BEARING

Reassembly

- Insert stud in Camshaft sections.

Note : Studs on right side camshaft should extend 1-11/32” (approx) from face of camshaft section and on left side camshaft 1-25/32” from face of camshaft section.

- Align proper sections of Camshaft. Apply Lock nuts and tighten.
- Apply Gear nut and Snap ring to Camshaft gear.

Installation

- Rotate Engine to Top Dead Centre (TDC) for No. 1 Right (R1) Cylinder. Both right and left side Camshafts and Gears are installed with same Crankshaft position.

Note : TDC for any cylinder is located by aligning Timing marks on Camshaft gear or Generator fan gear (whichever is used), with TDC Pointer mounted on right side (power take off end of Engine)

- Apply Camshaft Installation Saddles.
- Slide Camshaft (threaded end first) through free end of Engine.

- Apply Camshaft gear (both side) so that scribe lines near ring of Gear are aligned with face of Cylinder Block when gear is mished with Crankshaft Split gear.
- Align key-way and Camshaft with key-way in Cam gear. Push shaft in so that threads on shaft and Gear nut contact each other.
- Tighten Camshaft gear nut until tapered fit of camshaft is completely flush with bore of gear.
- Remove Camshaft Installation Saddles.
- Check Camshaft Gear backlash using Dial Indicator.

  Camshaft Gear Backlash : 0.009”- 0.016” (New)

  0.028”(Limit)

Camshaft Timing :

- Verify Camshaft timing with relationship to Crankshaft position as follows:

(a) Mount Fuel Injection Pump Support at No.1 right and left cylinder.

(b) Set Dial Indicator at mid range and mount on Cylinder block near either pump with Indicator pointer resting against Pump cross head.

© Rotate crankshaft in opposite normal direction until Fuel cam roller is on Base circle (off cam lobe) of Fuel cam.

Note : Movement of dial indicator hand will stop when it happened.

(d) Push Fuel pump cross head down to make sure all play is taken out.

(e) Set Dial Indicator at zero.

(f) Rotate Crankshaft in normal direction until it is at TDC (on compression stroke) for Cylinder being checked.

(g) Cross head lifts should be followed :

Camshaft using 4 pitch Spur Gear (140º overlap camshaft)

RS Camshaft (CCW)	:	0.405-0.470”
LS Camshaft (CCW)	:	0.415-0.480”

Note :

(i) It lift is not within limits , check Timing using Dial Indicator method for locating TDC

(ii) Make sure Camshaft gear was installed following specified instructions.

(h) Repeat steps at (a) to (h) to verify camshaft timing for other side of Engine.

- Apply Over speed Trip on right side of Engine.

Note : Use 1/8”shim and gasket for applying OST Housing with Thrust bearing to Cylinder Block.

- Check lateral location of camshaft using ‘Camshaft location gauge’. Sides of Gauge must not project beyond Fuel cam edges

Note : (i) To adjust camshaft location, adjust shim thickness.

(ii) If more than 1 Shim is used, sealing compound between Shim is preferred.

- Apply Overspeed Trip adapter (or Vibration Damper) to Camshaft.

Note : Check free movement of Vibration Damper by oscillating Inner Spider before application and Outer ring after application.

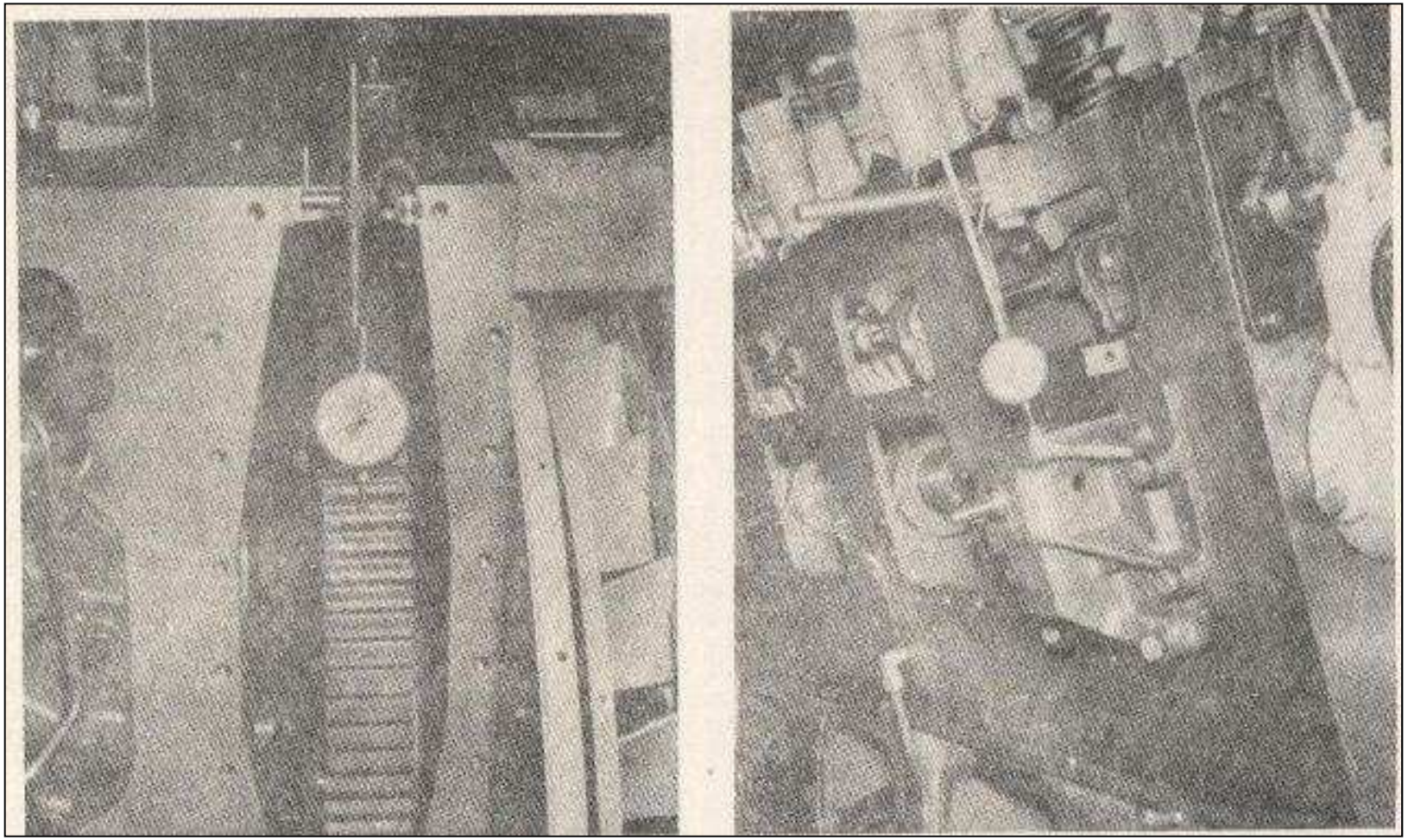
- Check ‘Camshaft Thrust’.
- Reapply Camshaft gear covers
- Reapply WW Governor, Tachometer generator and hydraulic drives.
- Reapply Fuel pump supports, Pumps, Valve levers, Push rods, Pump covers and Cylinder head covers.
- Reconnect all necessary lubrication oil inlet piping.
- Check Fuel pump timing, Fuel pump rack setting and Valve Clearance.

Checking Camshaft Thrust

- Remove Camshaft gear cover
- Force Camshaft towards power take-off end of Engine by barring against Camshaft gear.
- Plot Dial Indicator pointer against side of Camshaft gear and set Dial at zero.
- Force Camshaft towards free end of Engine until contact with Thrust bearing
- Reading on Indicator will be Total Camshaft Thrust.

  Camshaft Thrust : 0.006 – 0.012” (New)

  : 0.022” (Limit)



CHECKING CAMSHAFT GEAR BACKLASH

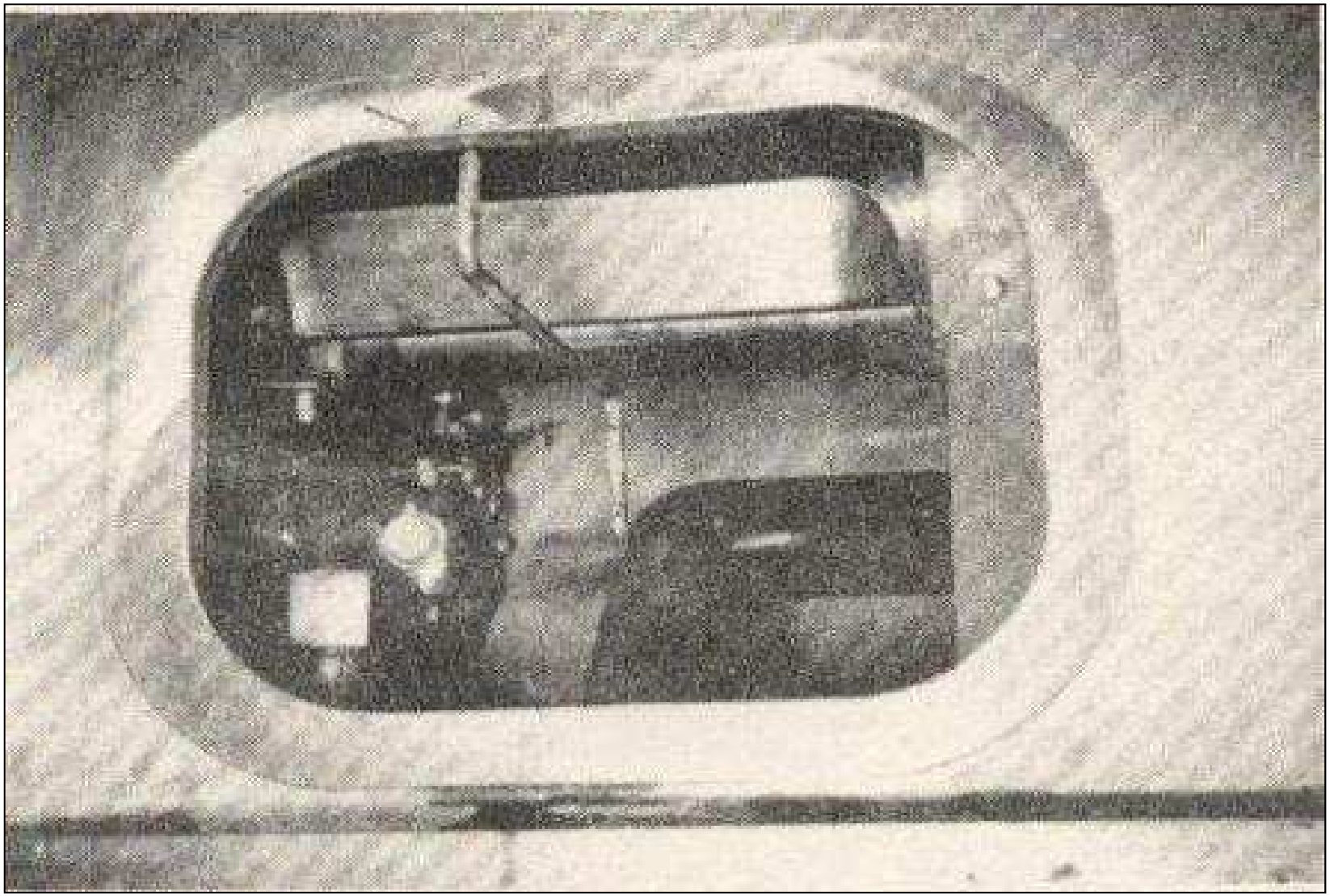
CHECKING FUEL TIMING

Locating TDC for No.1 Right Cylinder

(I) **Method I – Using Trammel :**

1. TDC is located when Crankshaft is rotated until trammel an be fitted between centre punch mark on Engine base Inspection door sill and punch mark on Crankshaft counterweight.
2. Check alignment of TDC Timing pointer Mounted on right side, power take-off end of engine with mark on camshaft on generator fan gear whichever is used.)

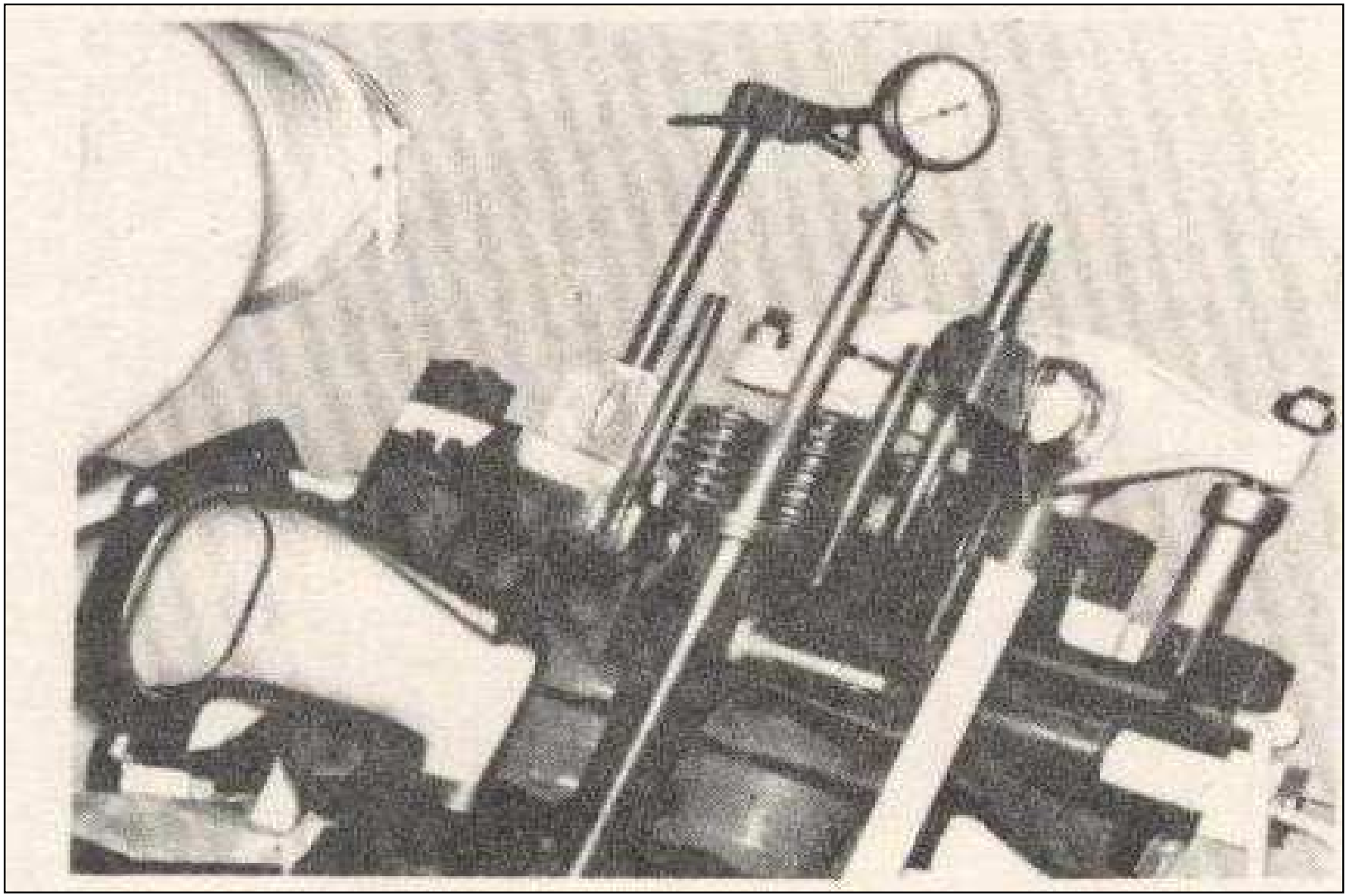
Note : If pointer is not aligned, or there is any doubt regarding trammel accessory, or if new crankshaft is installed, locate TDC in accordance with Method 2 below and relocate Timing Pointer (if necessary).



TRAMELLING FOR TDC

(II) Method-2-using Dial indicator :

1. Rotate Crankshaft until No. 1 Right Piston is almost at TDC/Use Pointer marked TDC.
2. Remove Cylinder Head Cover and Fuel injection nozzle from Cylinder Head.
3. Mount dial indicator on Cylinder head with indicator extension rod inserted through nozzle hole and resting on Piston crown.
4. Bar Crankshaft over until indicator shows that piston has moved 0.100” beyond TDC. When TDC is reached, indicator hand will stop. It will more in opposite direction, when Piston moves passed TDC. Count 0.100” from point where hand stopped.



LOCATING TDC USING DIAL INDICATOR

(As shown in Engine Cut-a-way)

5. Directly opposite TDC pointert place temporary make on Camshaft gear or Generator Fan gear (whichever is used)
6. Repeat Steps 4 and 5 for reverse rotation of crankshaft.
7. Place third temporary mark which bisects, first and second marks. This third mark is TDC for No. 1 right piston and should coincide with permanent mark already on Camshaft gear or Generator fan ring.
8. If Centre mark does not coincide with permanent TDC mark, move pointer until it is aligned with permanent mark.
9. Repeat Steps 4 through 7 to check
10. While crankshaft is still in TDC position, fit trammel between centre punch marks in Engine base door sill and bottom of crankshaft counter

11. Mark with centre punch if there are no mark or if old marks do not coincide with the location of trammel.

Note :

(i) Be sure to remove old marks if new ones are punched.

(ii) In future, TDC of No. 1 Right Piston may be located by trammeling between punch marks.

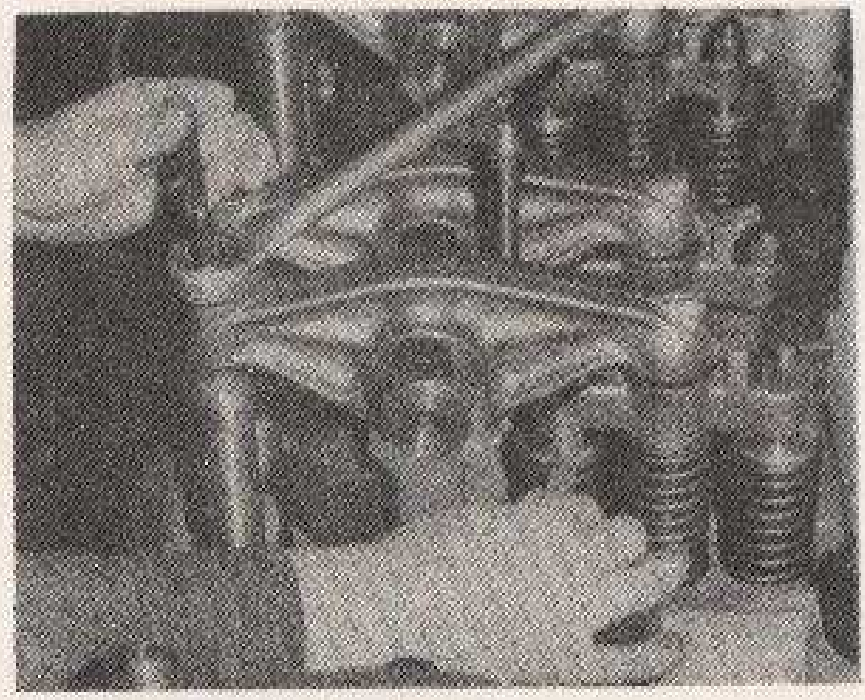
Adjusting Valve Clearance (Valve Timing)

- With the clearance Adjusting screws backed off to their upper limit, bar the engine over until the timing mark on Fuel pump spring guide up lines with the mark on Fuel pump window on the up stops.

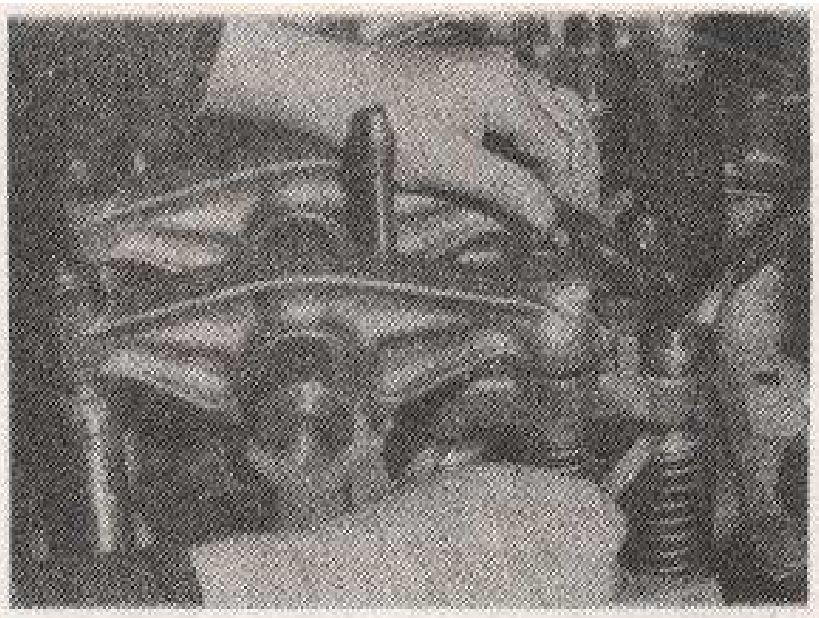
  The Cylinder on which Valves are being set will then have both its Cam rollers on base circle of Camshaft.
- Check timing mark on Fuel pump with the timing pointer and timing hole on Ring or Camshaft gear.
- Turn Adjusting screw at Push rod end of Valve Lever until Feeler of specified clearance (0.034”) can be inserted between non-adjustable end of Equalizing yoke and Valve stem.

- Leave this Feeler is place and tighten locknut at the Push rod end holding the Adjusting screw while tightening the Lock nut.
- Without removing Feeler between non-adjustable end of Equalizing yoke and Valve stem, turn Adjusting screw on Equalizing yoke until Feeler of specified clearance can be inserted in between Adjusting screw and Valve stem. With the Feeler in place hold the Adjusting screw with an Allen wrench while tightening the Lock Nut.

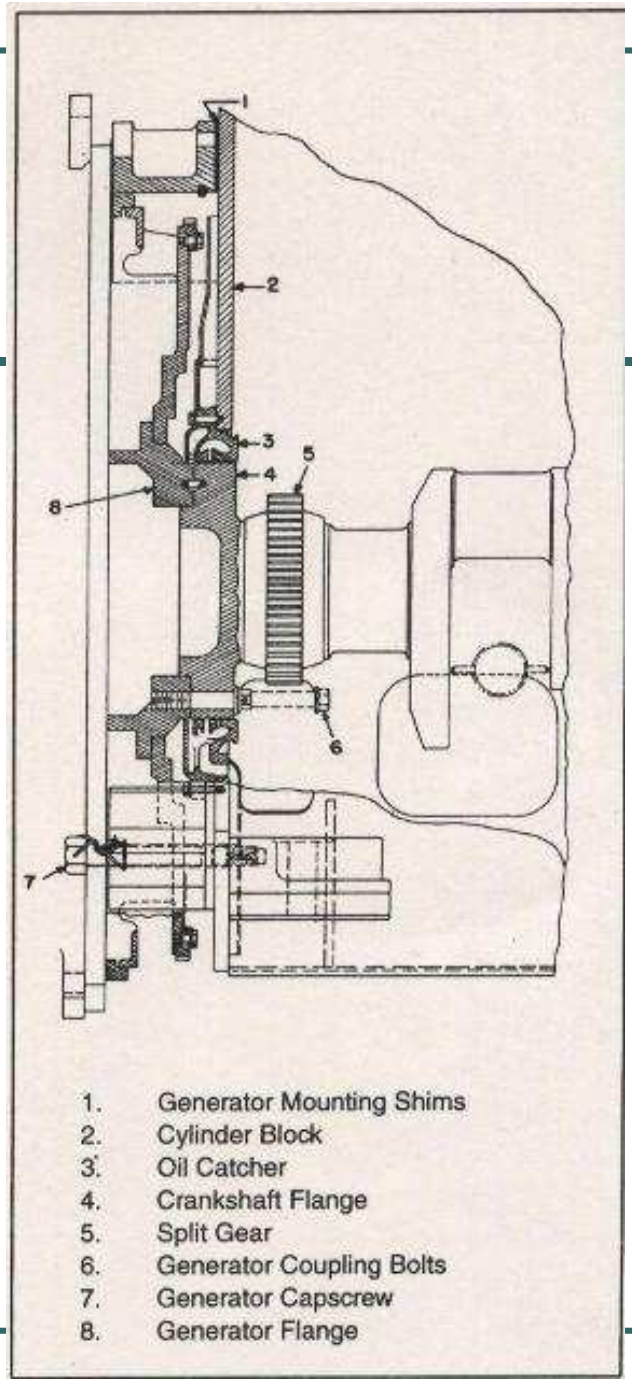
  Note : Recheck both clearances with Feeler to make certain that proper valve clearance exists on both Valves.
- Continue through the Firing order for checking valve clearance on subsequent Cylinders.



ADJUSTING VALVE CLEARANCE

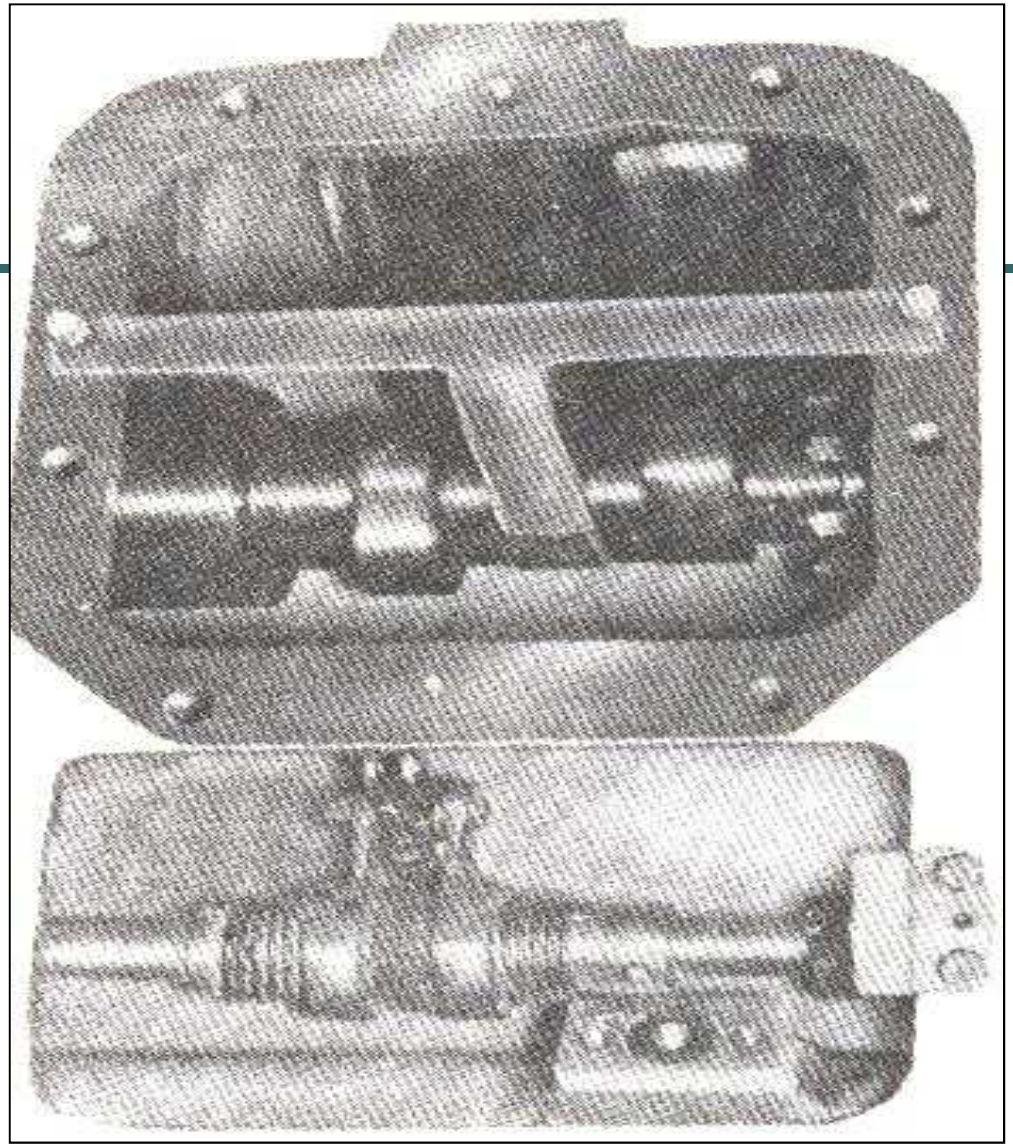


EQUALIZING VALVE CLEATANCE



1. Generator Mounting Shims
2. Cylinder Block
3. Oil Catcher
4. Crankshaft Flange
5. Split Gear
6. Generator Coupling Bolts
7. Generator Capscrew
8. Generator Flange

GENERATOR MOUNTING ARRANGEMENT



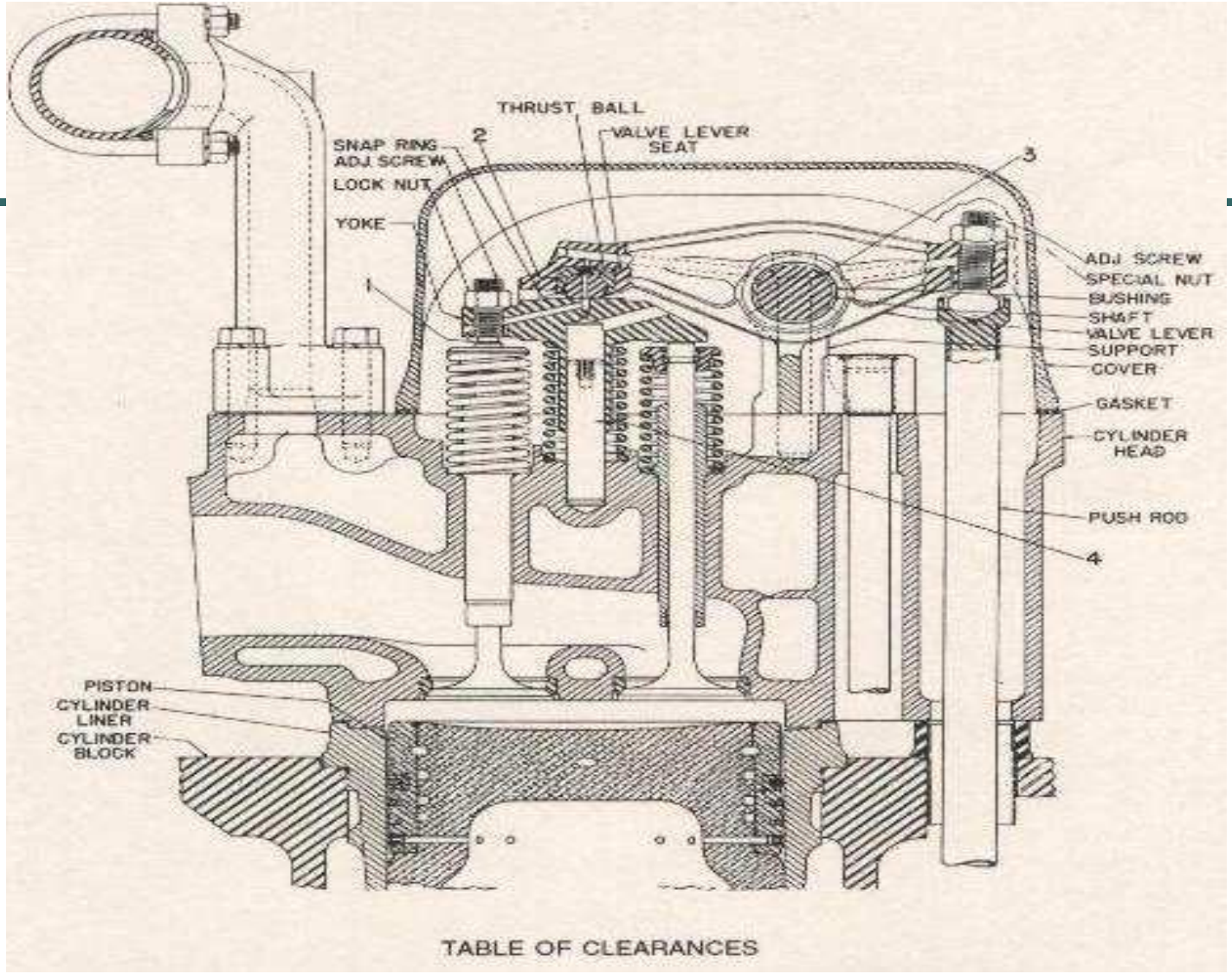
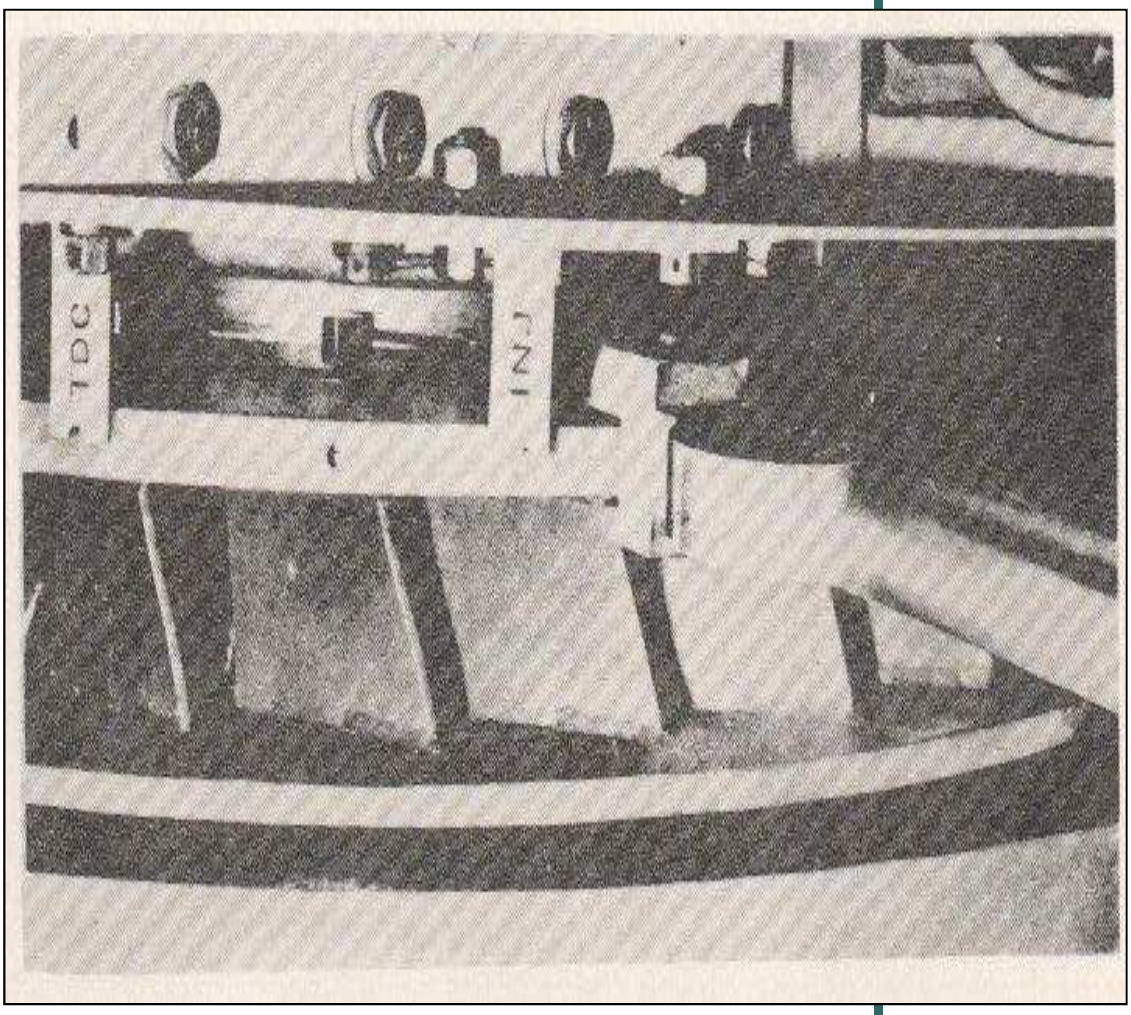


TABLE OF CLEARANCES


TDC
INJ

THANK YOU