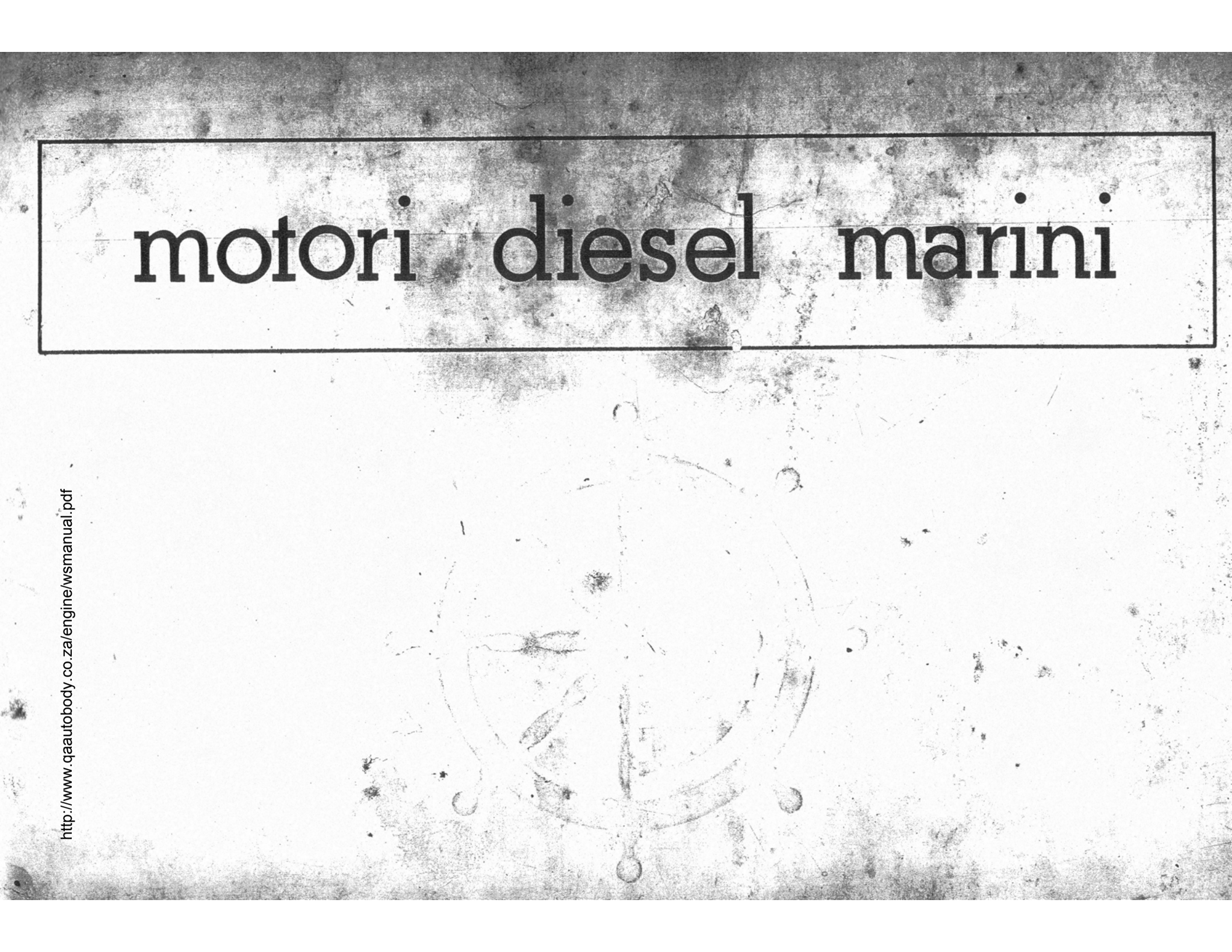
motori diesel marini



I N D E X

UFFICIO TECNICO

workshop manual

CONSTRUCTIONAL AND OPERATIONAL CHARACTERISTICS

AD 295 TYPE ENGINE

Cycle	: 4 stroke, direct injection, diesel
Cylinders	: N° 2
Bore	: 95 mm.
Stroke	: 95 mm.
Unit swept volume	: 673 cu.cm.
Total swept volume	: 1346 cu.cm.
Revs./1'	: 3000
Foreseen Weight	: 195 Kg.

Revs./1'	NA Power Hp.	mpe Corresponding to NA Kg./cm^2	NB Power Hp.	mpe Corresponding to NB Kg/cm^2
3000	24	5,35	26	5,8

Torque	For NA = 24 at 3000 revs./1' : T = 5,7 Kg.m. For NB = 26 at 3000 revs./1' : T = 6,2 Kg.m.

DRIVES

1 Crankshaft flywheel side

2 Crankshaft distribution side

a) direct coupling: derivable power 100% of NB

b) coupling with belts: derivable power 75% of NB

3 Oleodynamic pump control

Revs. : 2445/1' max.: derivable torque 5 Kg.m.

corresponding to the power of 17 Hp.

4 Revs. counter control on the camshaft

5 Bildge pump by use of a belt

STRUCTURAL CHARACTERISTICS

Cooling : with a sea-water by means of a positive displac.pump

Lubrication: Forced

Start-up : electric, with a battery charger

CONSTRUCTIONAL AND OPERATIONAL CHARACTERISTICS

AD 395 TYPE ENGINE

Cycle	: 4 stroke, direct injection, diesel
Cylinders	: N° 3
Bore	: 95 mm.
Stroke	: 95 mm.
Unit swept volume	: 673 cu.cm.
Total swept volume	: 2019 cu.cm.
Revs./1'	: 3000
Foreseen Weight	: 245 Kg.

Revs./1'	NA Power Hp.	mpe Corresponding to NA Kg./cm^2	NB Power Hp.	mpe Corresponding to NB Kg./cm^2
3000	36	5,35	39	5,8

Torque	For NA = 36 at 3000 revs./1' : T = 8,6 Kg.m. For NB = 39 at 3000 revs./1' : T = 9,3 Kg.m.

DRIVES

1 Crankshaft flywheel side

2 Crankshaft distribution side

a) direct coupling: derivable power 100% of NB

b) coupling with belts: derivable power 75% of NB

3 Oleodynamic pump control

Revs.: 2445/1' max.; derivable torque 5 Kg.m. corresponding to the power of 17 Hp.

4 Revs. counter control on the camshaft

5 Bildge pump by use of a belt

STRUCTURAL CHARACTERISTICS

Cooling : with sea-water by means of a positive displac.pump

Lubrication : forced

Start-up : electric, with a battery charger

CONSTRUCTIONAL AND OPERATIONAL CHARACTERISTICS

AD 495 TYPE ENGINE

Cycle	: 4 stroke, direct injection, diesel
Cylinders	: Nº 4
Bore	: 95 mm.
Stroke	: 95 mm.
Unit swept volume	: 673 cu.cm.
Total swept volume	: 2692 cu.cm.
Revs./1'	: 3000
Foreseen Weight	: 300 Kg.

Revs./1'	NA Power Hp.	mpe Corresponding to NA Kg./cm^2	NB Power Hp.	mpe Corresponding to NB Kg./cm^2
3000	48	5,35	52	5,8

Torque	For NA = 48 at 3000 revs./1' : T = 11,4 Kg.m. For NB = 52 at 3000 revs./1' : T = 12,4 Kg.m.

DRIVES

1 Crankshaft flywheel side

2 Crankshaft distribution side

a) direct coupling: derivable power 100% of NB

b) coupling with belts: derivable power 75% of NB

3 Oleodynamic pump control

Revs.: 2445/1' max.; derivable torque 5 Kg.m.

corresponding to the power of 17 Hp.

4 Revs. counter control on the camshaft

5 Bildge pump by use of a belt

STRUCTURAL CHARACTERISTICS

Cooling : with a sea-water by means of a positive displac.pump

Lubrication : forced

Start-up : electric, with a battery charger

PRELIMINARY PREPARATION OF THE FOLLOWING COMPONENTS

H E A D

The following recommendations must be observed in the preparation of the head:

- The openings of the suction and discharge tubings must be centred with respect to the anchoring stud bolts of the manifolds; the check must be performed using special jigs.
- Remove the possible burrs in the water passages inside the head
- For every 1000 heads assembled, check the turbolence on a sample

Values to be found:

- Turbolence
  - Lombard. system $\geqslant$ 2550 rpm.
  - Ricardo system $\geqslant$ 2600 rpm.
- Filling
  - Lombard. system $\geqslant$ 45 cm.H_2O
  - Ricardo system $\geqslant$ 35,5 cm.H_2O

To check the turbolence and the filling follow the indications specified in STANDARD N. 39002.

- The injector must project from the surface of the head by 3,5 ÷ 4 mm. (Figure 1).
- After grinding, the valves must be recessed with respect to the surface of the head by 0,8 ÷ 1,2 mm. (Figure 1b).

FIGURE N. 1a

Injector projection

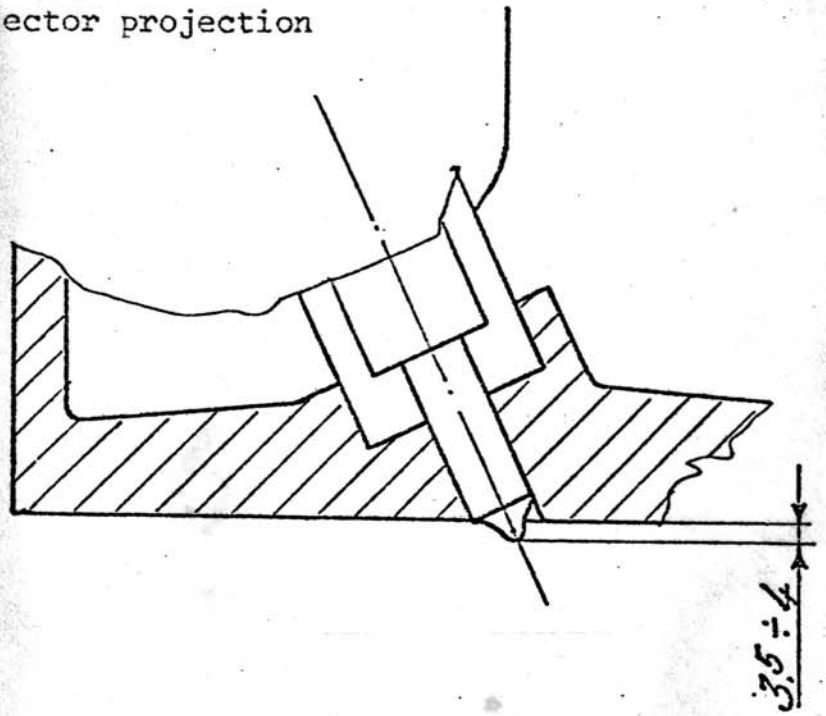
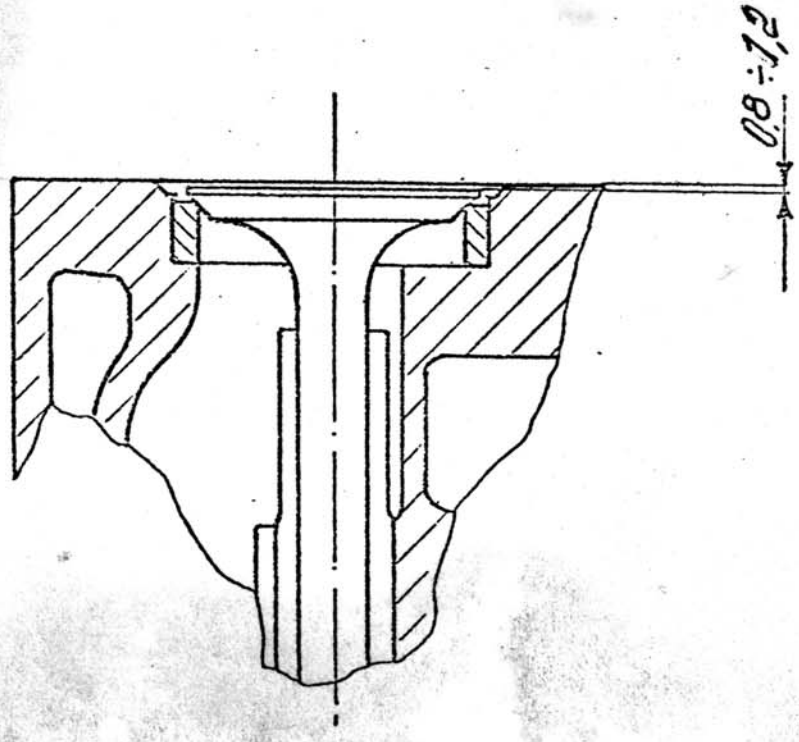


FIGURE N. 1b

Valve position after grinding



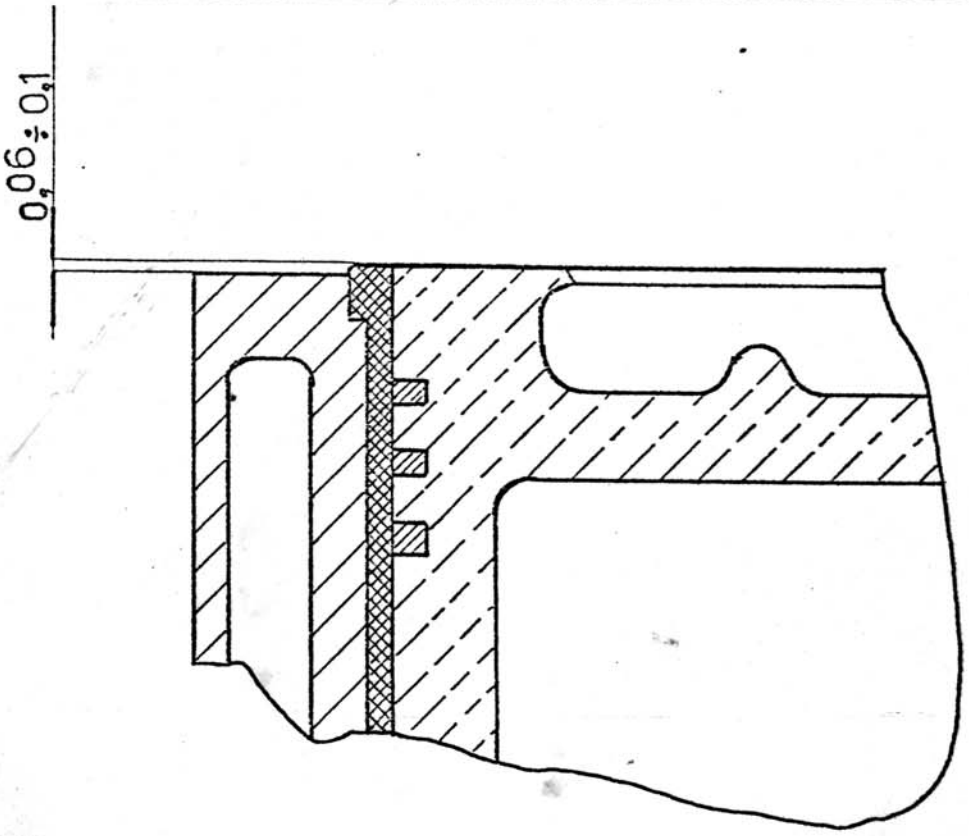
C Y L I N D E R

- The bases resulting from forming must be removed by grinding.
- The internal surfaces must be smooth, that is, free from clots and grains of sand.
- Blowholes, or decreases, even of reduced dimensions on the inside of the cylinder barrel are not permitted.
- The surface of the cylinders must be honed so as to obtain the following characteristics :

  a) Roughness : $R_a = 0,8 \div 1,2 \mu$ $R_t = 2,5 \div 4 \mu$

  b) Inclination of the 90° ÷ 120° crossed grooves (refer to the drawings)

  c) The grooves must not have curved sections at the cylinder extremities; the crossings of the latter must be sharp and uniform.



PISTON - CONNECTING ROD

The pistons and the connecting rods must be selected on a weight basis, so that the difference between the cylinders do not give rise to serious imbalances.

The differences in weight between the pistons must be within 6 g.

The differences in weight between the connecting rods must be within 10 g.

After mounting, the piston must be flush with the cylinder to a tollerance of $^{+\ 0,05}_{-\ 0,05}$

CHARACTERISTICS OF THE INJECTION UNIT

AD 295 TYPE ENGINE — TABLE N° 1

1) BOSCH PFR 2K 70 TYPE INJECTION PUMP

	Characteristics
Pumping element	ø 70 p = 12 - 'R' BOSCH tag EPPK 221 S 6 Z
Seal valve	double seal volume displaced = 25 $mm.^3$ BOSCH tag 2 418 502 003 - D411 710 045
Delivery fitting	BOSCH tag 3 413 372 013
Valve spring	free length = 20 mm. BOSCH tag 1 414 613 002 - WSF 10P 342X
Filler	BOSCH tag 1413 121 116 - EPMF 52 P10X
Filler thickness	BOSCH tag 1410 100 618 - WMS 25P 115X

2) NOZZLE

	Characteristics
Holes	4 x 0,28
Angle of the jets	160°
Length of the holes	0,6
Lift of the needle	0,20 ÷ 0,22
Well dimensions	1,2 x 1,97
Pin diameters	6 x 3,20
Setting pressure	210 ÷ 220 $Kg./cm.^2$

3) DIESEL OIL PIN PIPES

ø int. = 1,5 mm.
length = 650 mm.

4) FUEL FILTER

Type : FIAAM FNA 78/01
Cartridge FA 4043/2

5) FUEL FEED PUMP

Type : FISPA 4008.12

CHARACTERISTICS OF THE INJECTION UNIT

AD 395 TYPE ENGINE TABLE N° 2

1) BOSCH PFR 3K 70 TYPE INJECTION PUMP

	Characteristics
Pumping element	Ø 70 p = 12 - 'R' BOSCH tag EPPK 221 S 6 Z
Seat valve	double seal volume displaced = 25 mm.^{3} BOSCH tag 2 418 502 003 - D411 710 045
Delivery fitting	BOSCH tag 3 413 372 013
Valve spring	free length = 20 mm. BOSCH tag 1 414 613 002 - WSF 10P 342X
Filler	BOSCH tag 1413 121 116 - EPMF 52 P10X
Filler thickness	BOSCH tag 1410 100 618 - WMS 25P 115X

2) NOZZLE

	Characteristics
Holes	4 x 0,28
Angle of the jets	160°
Length of the holes	0,6
Lift of the needle	0,20 ÷ 0,22
Well dimensions	1,2 x 1,97
Pin diameters	6 x 3,20
Setting pressure	210 ÷ 220 Kg./cm.^{2}

3) DIESEL OIL PIN PIPES

Ø int. = 1,5 mm.
length = 650 mm.

4) FUEL FILTER

Type : FIAAM FNA 78/01
Cartridge : FA 4043/2

5) FUEL FEED PUMP

Type : FISPA 4008.12

CHARACTERISTICS OF THE INJECTION UNIT

AD 495 TYPE ENGINE — TABLE N° 3

1) BOSCH PES4 M70 C420 LS48 TYPE INJECTION PUMP

	Characteristics
Pumping element	ø 70 p = 17 - 'S' BOSCH tag 14.183.055.17
Seal valve	BOSCH tag 14.185.020.15
Delivery fitting	BOSCH tag 1.413.372.061
Valve spring	BOSCH tag 1.414.611.024

2) NOZZLE

	Characteristics
Holes	4 x0,28
Angle of the jets	160°
Length of the holes	0,6
Lift of the needle	0,20 ÷ 0,22
Well dimensions	1,2 x 1,97
Pin diameters	6 x 3,20
Setting pressure	210 ÷ 220 Kg./cm.^{2}

3) DIESEL OIL PIN PIPES

ø int. = 1,5 mm.
length = 650 mm.

4) FUEL FILTER

Type : FIAAM FNA 78/01
Cartridge FA 4043/2

5) FUEL FEED PUMP

Type : BOSCH FP/K22 M6

A S S E M B L Y

TORQUE WRENCH SETTINGS

FOR NEWTON/METER x10.

Item	Ø Thread and pitch	Male Thread Setting Kg./mm.^{2}	Torque wrench setting Kg.m.
Rocker arm pivot lock	6 x 1	80 ÷ 100	1,3
Regulator drive box cover	6 x 1	80 ÷ 100	1,3
Regulator drive box	6 x 1	60 ÷ 70	0,7
Rocker arm box cap	8 x1,25	100 ÷ 120	2
Suction and exhaust manifold	8 x1,25	80 ÷ 100	3
Water pump	8 x1,25	80 ÷ 100	3
Distribution gearbox cover	8 x1,25	100 ÷ 120	2
Oil filter (external)	8 x1,25	80 ÷ 100	3
Oil pump body clamping	8 x1,25	120 ÷ 140	3,5 ÷ 4
Oleodynamic pump pivot	8 x1,25	60 ÷ 70	2
Camshaft seal plate	8 x1,25	60 ÷ 70	2
Supply pump	8 x1,25	90 ÷ 100	2
Injection pump	8 x1,25	100 ÷ 120	3
Nozzle support	8 x1,25	90 ÷ 100	2
Base cover	8 x1,25	80 ÷ 100	3
Distribution gearbox	8 x1,25	60 ÷ 70	2
Regulator shaft bearing	8 x1,25	60 ÷ 70	2

TORQUE WRENCH SETTINGS (Cont.)

Item	Ø Thread and pitch	Male Thread Setting Kg./mm.^{2}	Torque wrench setting Kg.m.
Flywheel side bench bearing	8 x 1,25	100 ÷ 120	4
Connecting rod cover	10 x 1,5	115 ÷ 125	5
Collar for central bearing of bench bushing	10 x 1,5	100 ÷ 120	5
Cranking handle coupling flange	10 x 1,5	60 ÷ 70	3,5
Belt stretcher	8 x 1,25	80 ÷ 100	3
Pump alternator bearing	10 x 1,5	80 ÷ 100	4
Central bearing of bench bushing	10 x 1,5	90 ÷ 100	5
Head and cylinder locking nut	12 x 1,25	90 ÷ 100	8,5
Starter motor	12 x 1,25	80 ÷ 100	10
Engine end	12 x 1,25	80 ÷ 100	10
Intermediary gear lock	14 x 1,5	80 ÷ 100	14
Oil pump lock drilled bolt	14 x 1,5	90 ÷ 100	3,5÷4
Union for small valve (injection pump)	18 x 1,5		4,5÷5
Flywheel	20 x 1,5	90 ÷ 100	35
Camshaft gear	22 x 1,5	65 ÷ 75	20
Water pump drive pulley	27 x 2		32
Distribution drive gear	40 x 1,5		50

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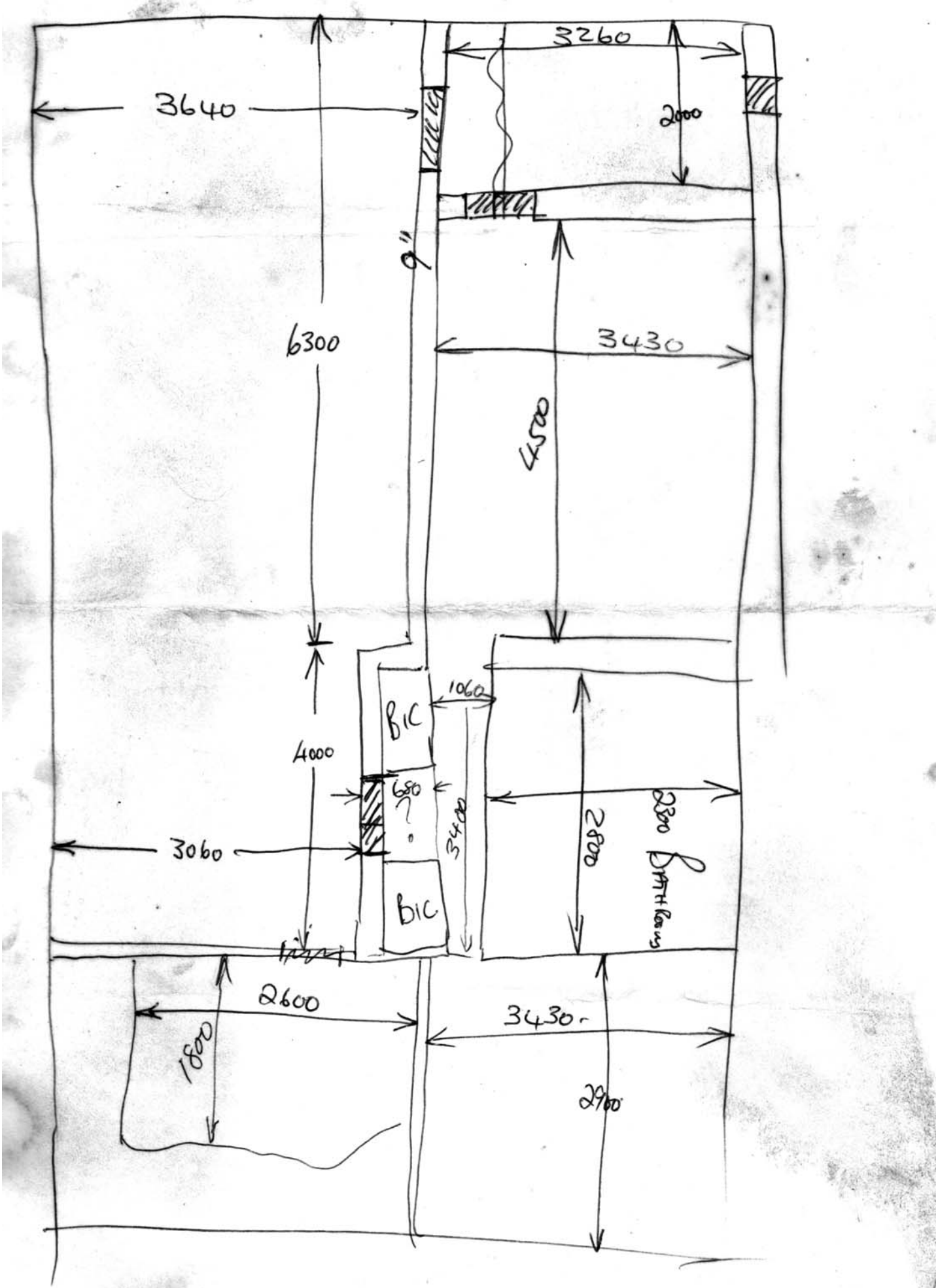
AD295m

TORQUE WRENCH SETTINGS (Cont.)

Item	Ø Thread and pitch	Male Thread Setting Kg./mm.^{2}	Torque wrench setting Kg.m.
Flywheel side bench bearing	8 x 1,25	100 ÷ 120	4
Connecting rod cover	10 x 1,5	115 ÷ 125	5
Collar for central bearing of bench bushing	10 x 1,5	100 ÷ 120	5
Cranking handle coupling flange	10 x 1,5	60 ÷ 70	3,5
Belt stretcher	8 x 1,25	80 ÷ 100	3
Pump alternator bearing	10 x 1,5	80 ÷ 100	4
Central bearing of bench bushing	10 x 1,5	90 ÷ 100	5
Head and cylinder locking nut	12 x 1,25	90 ÷ 100	8,5
Starter motor	12 x 1,25	80 ÷ 100	10
Engine end	12 x 1,25	80 ÷ 100	10
Intermediary gear lock	14 x 1,5	80 ÷ 100	14
Oil pump lock drilled bolt	14 x 1,5	90 ÷ 100	3,5÷4
Union for small valve (injection pump)	18 x 1,5		4,5÷5
Flywheel	20 x 1,5	90 ÷ 100	35
Camshaft gear	22 x 1,5	65 ÷ 75	20
Water pump drive pulley	27 x 2		32
Distribution drive gear	40 x 1,5		50


3260
3640
2000
9"
6300
3430
4500
1060
BIC
4000
680
3400
2800
2300
BATHROOM
3060
BIC
2600
3430
1800
2900

AD295 M1

P L A Y

- AXIAL PLAY OF CRANKSHAFT { 0,33 max. / 0,13 min.

- AXIAL PLAY OF CAMSHAFT { 0,70 max. / 0,40 min.

- PLAY BETWEEN THE SEGMENT POINTS :

1st chromium-plated sealed ring	0,35 ÷ 0,55
2nd and 3rd seal ring	0,30 ÷ 0,45
4th oil scraper ring	0,25 ÷ 0,40

- CLEARANCE VOLUME : 0,8 ÷ 1

- PLAY BETWEEN THE VALVES AND THE ROCKER ARMS :

when cold : 0,30 mm.
when hot : 0,20 mm.

P L A Y

- AXIAL PLAY OF CRANKSHAFT { 0,33 max. / 0,13 min.

- AXIAL PLAY OF CAMSHAFT { 0,70 max. / 0,40 min.

- PLAY BETWEEN THE SEGMENT POINTS :

1st chromium-plated sealed ring	0,35 ÷ 0,55
2nd and 3rd seal ring	0,30 ÷ 0,45
4th oil scraper ring	0,25 ÷ 0,40

- CLEARANCE VOLUME : 0,8 ÷ 1

- PLAY BETWEEN THE VALVES AND THE ROCKER ARMS :

when cold : 0,30 mm.
when hot : 0,20 mm.

DISTRIBUTION OF THE VALVES

(Taken on the crankshaft)

SUCTION
- OPENS 10° BEFORE THE T.D.C. (Corresponding to 27 mm.)
- CLOSES 42° AFTER THE B.D.C. (Corresponding to 115 mm.)

EXHAUST
- OPENS 42° BEFORE THE B.D.C. (Corresponding to 115 mm.)
- CLOSES 10° AFTER THE T.D.C. (Corresponding to 27 mm.)

The values expressed in mm. are taken on the circumference of the flywheel Ø 314

= 1° corresponding to 2,74 mm. =

SUCTION
- OPENS 10° BEFORE THE T.D.C. (Corresponding to 26,5 mm.)
- CLOSES 42° AFTER THE B.D.C. (Corresponding to 113 mm.)

EXHAUST
- OPENS 42° BEFORE THE B.D.C. (Corresponding to 113 mm.)
- CLOSES 10° AFTER THE T.D.C. (Corresponding to 26,5 mm.

The values expresses in mm. are taken on the circumference of the flywheel Ø 308

= 1° corresponding to 2,68 mm. =

TEST METHOD

- Arrange the striker of a centesimal dial-gauge on the tappet of the suction cam of cylinder N.1
- Zero the dial-gauge on the base radius of the suction cam.
- Rotate the crankshaft in the direction of rotation until the suction tappet lifts by 0,20 mm.

- Check at the perifery of the flywheel, with reference to the T.D.C., the distance in mm. of the beginning opening inlet valve.
- To check the lag of the exhaust valve, proceed in the same manner.

This check may be performed once the engine is finished, after having taken the play between the valves and rocher arms to 0,30 mm.; follow the following:

a) Zero the dial gauge on the cap of the valve

b) On rotating the crankshaft, in the direction of rotation it is possible to identify the beginning of the valve opening by the displacement from zero of the dial gauge pointer; check the value in mm. with respect to the T.D.C., at the perifery of the flywheel in accordance with that detailed on page 14.

CONTROL UNIT

AD 295 - AD 395 ENGINES

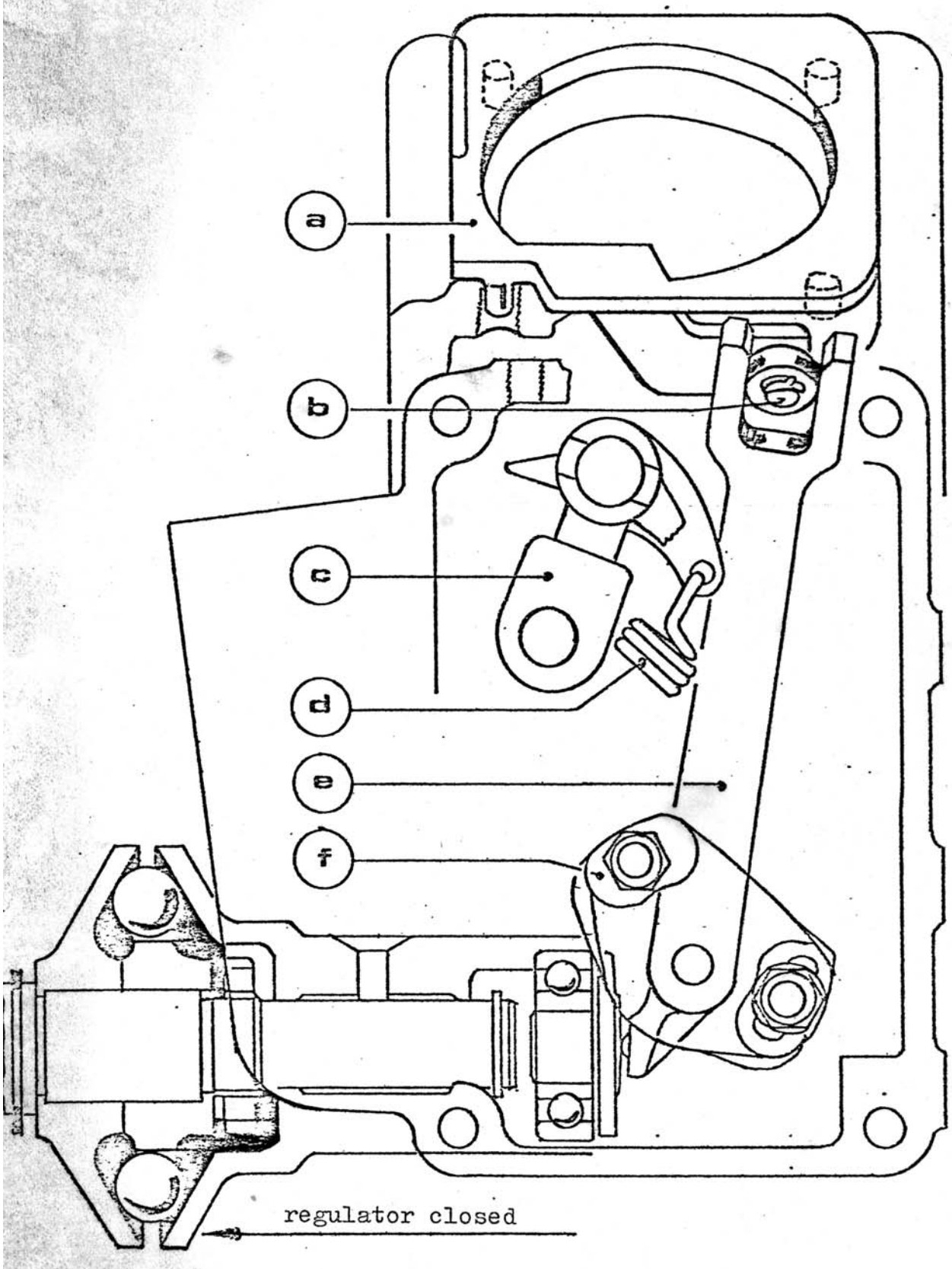
With reference to figure n. 2, the flow control lever (E) must be positioned as follows :

a) Charge the controller spring (D) by operating the lever (C), so that the flow control lever (E) closes the controller.

b) Opportunately rotate the bearing (F), so that the pawl (B) of the control cylinder (A) (for AD 295 dwg. R276-2003-04 and for AD 395 dwg. R277-2003-05) enters freely into the slit of the flow control lever (E).

c) Lock the bearing (F).

Figure N° 2



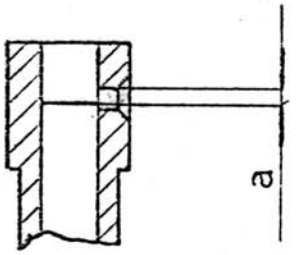


FIGURE Nº 4

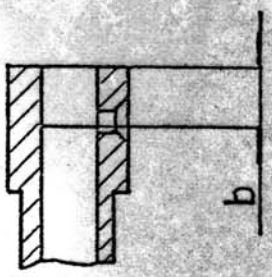


FIGURE Nº 5

ADVANCE AND PRE-STROKE

General and definitions

The injection advance in these engines is fixed and determined by the phasing of the cams, machined on the distribution drive shaft (camshaft).

Given that the reciprocal phasing of the injection cams is that assigned by the drawing, it is possible to vary the static advance within a small range (The static advance is also termed the closing advance of the pumping element supply hole).

To vary the static advance it is necessary to vary the position of the end of the small piston, with respect to the supply hole.

The distance (a) fig. 4 between the upper rim of the hole and the crown of the small piston placed at the bottom dead centre is termed "PRE-STROKE".

It may be altered by adding, or removing gaskets below the pump flange.

NOTE : In our FACTORY, it is usual not to consider the pre-stroke but rather the distance between the small cylinder level and the small piston crown : the dimension (b) fig. 5 is termed SMALL CALIPER.

Since the supply hole is not made with reference to the upper surface of the small cylinder, the diameter (b) is not constant from one pumping element to another, whereas pump manufacturers assure the dimension (a) as constant, obviously with a certain tollerance.

This is the reason which councils the adoption of the concept of pre-stroke and to abandon that of the small caliper.

TEST METHOD

AD 295 - AD 395 ENGINES

To evaluate the pre-stroke, operate the pump as follows (refer to figure N.3) :

1) - Remove the delivery fitting and the small valve from its seat.

2) - Screw on the fitting (r) (dwg.7330-37) so that it locks the small cylinder. Connect the pump to a tank containing diesel oil.

3) - Mount the dial gauge so that the sucker rod strikes the small piston. Zero the dial gauge with the small piston at the bottom dead centre.

4) - Open the tank valve so that the diesel oil can flow from the small tube (t). Slowly rotate the drive shaft in the compression phase until the diesel oil stops flowing.

5) - Read the lift obtained on the instrument, that is the PRE-STROKE.

The values of pre-stroke for the various types of engine are given in TABLE N. 4.

6) - Check the value of the static spark advance at the perifery of the flywheel, with respect to the reference of the T.D.C.

7) - As already stated, by adding, or removing gaskets beneath the pump flange, the spark advance is altered :

a) By increasing the thickness of the gaskets the injection is DELAID.

b) By reducing the thickness, the injection is ADVANCED.

INSTRUMENTS TO EVALUATE THE PRE-STROKE

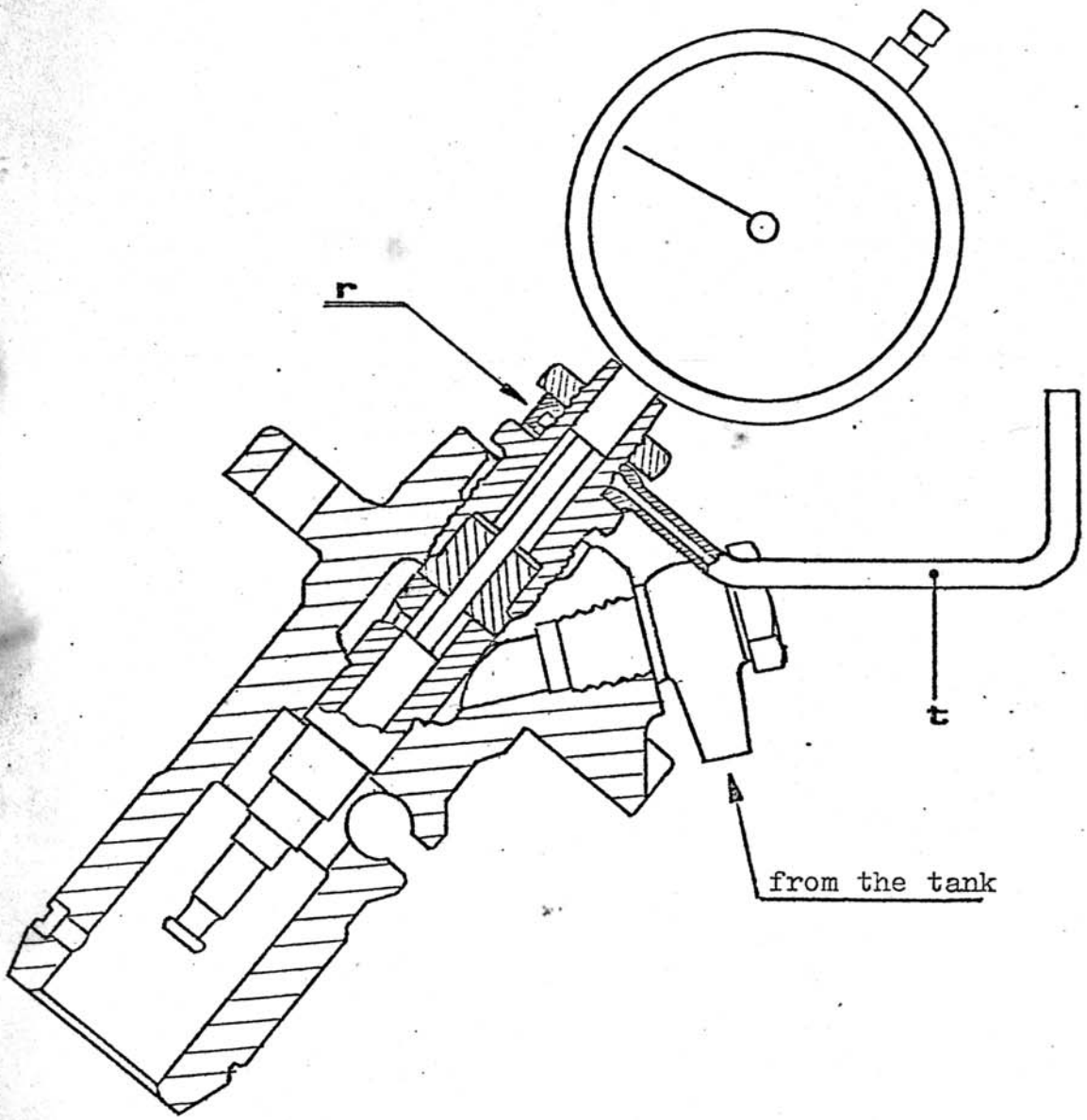


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TABLE N° 4

SPARK ADVANCE AND PRE-STROKE

Prescribed values

Engine	Pre-stroke mm.	Injection spark advance		
		degrees	Ø 314 mm.* flywheel	Ø 308 mm.* flywheel
AD 295	2 ÷ 2,2	27°45' ÷29°31'	76 ÷ 81	74,5 ÷ 79
AD 395	2 ÷ 2,2	27°45' ÷29°30'	76 ÷ 81	74,5 ÷ 79
AD 495		32°45' ÷33°40'	90 ÷ 93	88 ÷ 90,5

* The values expressed in mm. are taken at the perifery of the flywheel.

Ø flywheel mm.	Corresponding to 1° in mm.
314	2,74
308	2,68

TESTING THE BRAKED ENGINE

After having placed the engine at the brake, perform the following operations :

1st - Check the oil level
2nd - Unscrew the torque corrector
3rd - Start the engine at the idling speed and adjust to 1100 rpm.
4th - Check the oil pressure on the pressure gauge
5th - Ensure that there are no oil, or water losses
6th - Running-in as per table

After having terminated the test at 2700 rpm. at 7 Kg. weight, proceed in the following way to correctly set the engine :

1) - Take the engine to 2800 rpm. and the balance to 9,5 Kg.
2) - Re-mount the torque corrector
3) - Read and note the following data on the report :
   a) Oil pressure Kg./cm^2
   b) Oil temperature in the sump
   c) Exhaust gas temperature
   d) Smoke
4) - Decrease the engine revs. by discharging the brake and at the same time adjust the idling speed to 900 + 950 rpm.
5) With the brake discharged accelerate to max. and adjust the max. revs. to 3150.

RUNNING-IN TABLE FOR THE AD 295 ENGINE WITH HURTH HBW.15 REVERSE GEARBOX reduction 1,96:1

PHASE	MINUTES	R.P.M.	WEIGHT IN KG. FOR A BRAKE HAVING AN ARM OF 0,716 m.	POWER HP
1	10'	1000	NO-LOAD	A)
2	15'	1500	2,5	3,75
3	20'	1800	3,5	6,30
4	20'	2000	4,5	9,00
5	30'	2200	5,5	12,10
6	30'	2400	6,2	14,88
7	30'	2500	6,5	16,25
8	30'	2600	6,8	17,68
9	20'	2700	7,0	18,90
10	10'	2800	9,5	26,6 B) C)
11	SETTING TIME		RAPID CHECK OF THE MAXIMUM POWER AN SETTING OF THE INJECTION PUMP CAPAC	

A) Minimum oil pressure with the engine hot

B) Note the smoke

C) Note the fuel consumption

RUNNING-IN TABLE FOR THE AD 395 ENGINE WITH HURTH HBW.15 REVERSE GEARBOX reduction 1,96:1

PHASE	MINUTES	R.P.M.	WEIGHT IN KG. FOR A BRAKE HAVING AN ARM OF 0,716 m.	POWER HP
1	10'	1000	NO-LOAD	A)
2	15'	1500	6,86	5,25
3	20'	1800	9,60	8,82
4	20'	2000	12,34	12,60
5	30'	2200	15,10	16,94
6	30'	2400	17,00	20,83
7	30'	2500	17,83	22,75
8	30'	2600	18,65	24,75
9	20'	2700	19,20	26,46
10	10'	2800	26,00	37,13 B) C)
11	SETTING TIME		RAPID CHECK OF THE MAXIMUM POWER AND SETTING OF THE INJECTION PUMP CAPACITY	

A) Minimum oil pressure with the engine hot

B) Note the smoke

C) Note the fuel consumption

RUNNING-IN TABLE FOR THE AD 495 ENGINE WITH HURTH HBW.15 REVERSE GEARBOX reduction 1,96:1

PHASE	MINUTES	R.P.M.	WEIGHT IN KG. FOR A BRAKE HAVING AN ARM OF 0,716 m.	POWER HP
1	10'	1000	NO-LOAD	A)
2	15'	1500/770	13	10,5
3	20'	1800/912	15	12,5
4	20'	2000/1020	20	20,5
5	30'	2200/1122	25	28,5
6	30'	2400/1224	27,5	33,5
7	30'	2500/1275	29	37
8	30'	2600/1326	32	42,5
9	20'	2700/1377	33,6	47
10	10'	2800/1428	35	50 B) C)
11	SETTING TIME		RAPID CHECK OF THE MAXIMUM POWER AND SETTING OF THE INJECTION PUMP CAPACIT	

A) Minimum oil pressure with the engine hot

B) Note the smoke

C) Note the fuel consumption

SETTING OF THE INJECTION PUMP

AD 295 - AD 395 ENGINES

Method (mechanical type control drive)

The setting of the injection pump delivery and control of the maximum power must be performed as follows (figure N. 6) :

a) Take the engine to the off-load idling speed. Set the off-load idling speed (*).

b) Unscrew the torque corrector.

c) Load the engine up to the power and the number of revs./1' required.

TABLE N. 5 details the setting values.

d) Check that the consumption lies within the values indicated in table N.5.

If the consumption does not lie within the values given, it is necessary to vary the balance conditions detected at the brake, by altering the load and the controller. With the engine stabilised, re-check the consumption.

(*) Prescribed setting values of the idling speed :

AD 295	revolutions 900 ÷ 950
AD 395	revolutions 900 ÷ 950

e) Tighten the calibrator until its striker touches the delivery limiting lever, taking care to place a piece of paper between the two strikers.

f) Lock the setting screw in contact with the controller drive lever.

g) Release the brake completely and check the steady state condition at which the engine stabilises itself.
The change of the revs. must not exceed some 150 revs./1'.
Check that in the range between the maximum and the minimum there is no hunting.

h) Stop the engine and set the play of the valves, when hot (0,30 mm.)

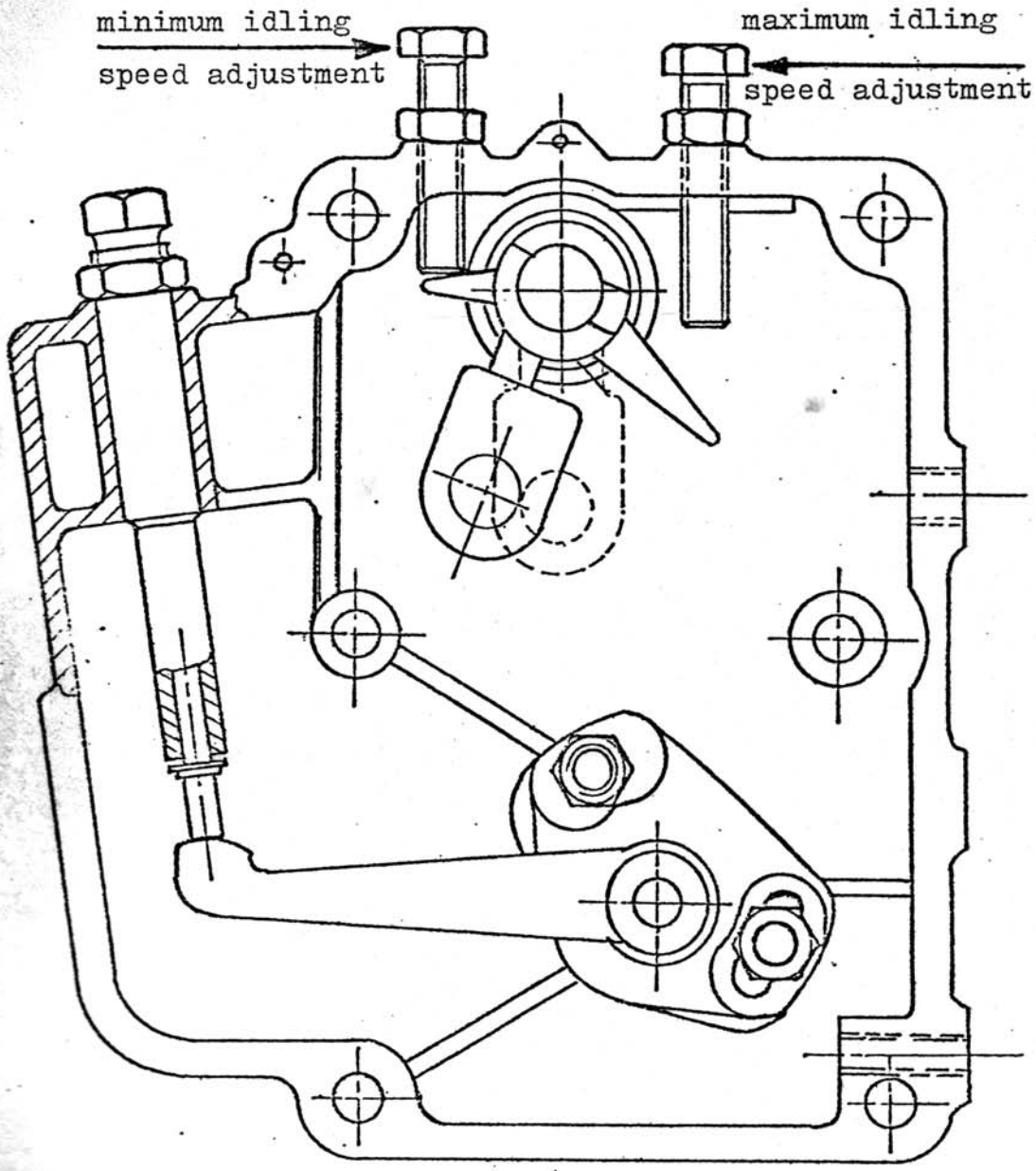
i) Wash and dry the engine.

Set values of the engine

The set values relative to the power and to the number of revs./1', for the different versions, are indicated in TABLE N.5

DIAGRAM OF THE MECHANICAL TYPE REGULATOR CONTROL

FOR THE AD 295 - AD 395 ENGINES



SUMMARY OF THE SETTINGS FORESEEN

Engine	Revs./ min.	Power Hp.	Fuel consumption			
			Time x 100 cm.3	g/HPh	Time x 200 cm.3	g/HPh
295	3000	N 28			106 ÷ 108"	199 ÷ 195
295	3000	N_B 26			114 ÷ 116"	198 ÷ 195
295	3000	24			124 ÷ 126"	198 ÷ 195
295	3000	22			135 ÷ 137"	198 ÷ 195
295	2600	N 26			114 ÷ 116"	198 ÷ 195
295	2600	N_B 24			124 ÷ 126"	198 ÷ 195
295	2200	20			148 ÷ 152"	200 ÷ 194
295	1500	N_B 15	98 ÷ 101"	200 ÷ 195		
395	3000	N 42			70 ÷ 72"	200 ÷ 195
395	3000	N_B 39			76 ÷ 78"	199 ÷ 194
395	2600	N 39			76 ÷ 78"	199 ÷ 194
395	2600	N_B 36			83 ÷ 85"	197 ÷ 195
395	2200	N_B 33			94 ÷ 97"	192 ÷ 185
395	1500	N_B 22,5	70 ÷ 73"	188 ÷ 180		
495	3000	N 56			54 ÷ 56"	195 ÷ 188
495	3000	N_B 52			58 ÷ 60"	195 ÷ 188
495	3000	N 48			64 ÷ 66"	192 ÷ 186
495	2200	N_B 44			71 ÷ 74"	189 ÷ 182
495	1500	N_B 30	52 ÷ 55"	189 ÷ 179		

VARIOUS CHECKS

PRESSURE OF THE LUBRICATING OIL

A check to be made on all the engines.

The lubrication system of these engines is forced circulation. The oil filter is equipped with a pressure control valve which discharges the excess oil directly into the sump and by-pass valve which excludes the filtering mass in the event that the latter becomes blocked.
The two valves are set by the filter manufacturer.

The oil pressure must be checked on the filter head using the special pressure gauge take-off.
A pressure gauge with a range from 0 to 10 Kg./cm^2 is necessary for this check.

The oil pressure, with the engine hot, must be:

at 1000 revs./1' 1,5 Kg./cm^2

EXHAUST BACK-PRESSURE

The exhaust back-pressure must be contained within given values since it creates harmful conditions for the proper running of the engine.

The exhaust back-pressure is measured at the exhaust manifold furnished with a connection for a U-shaped mercury column pressure gauge and placed some 15 mm. from the silencer connection flange. The check must be performed at the maximum power and at the maximum number of revs./min. of the engine.

The exhaust back-pressure, with the engine at 3000 revs./min. must be :

50 mm Hg

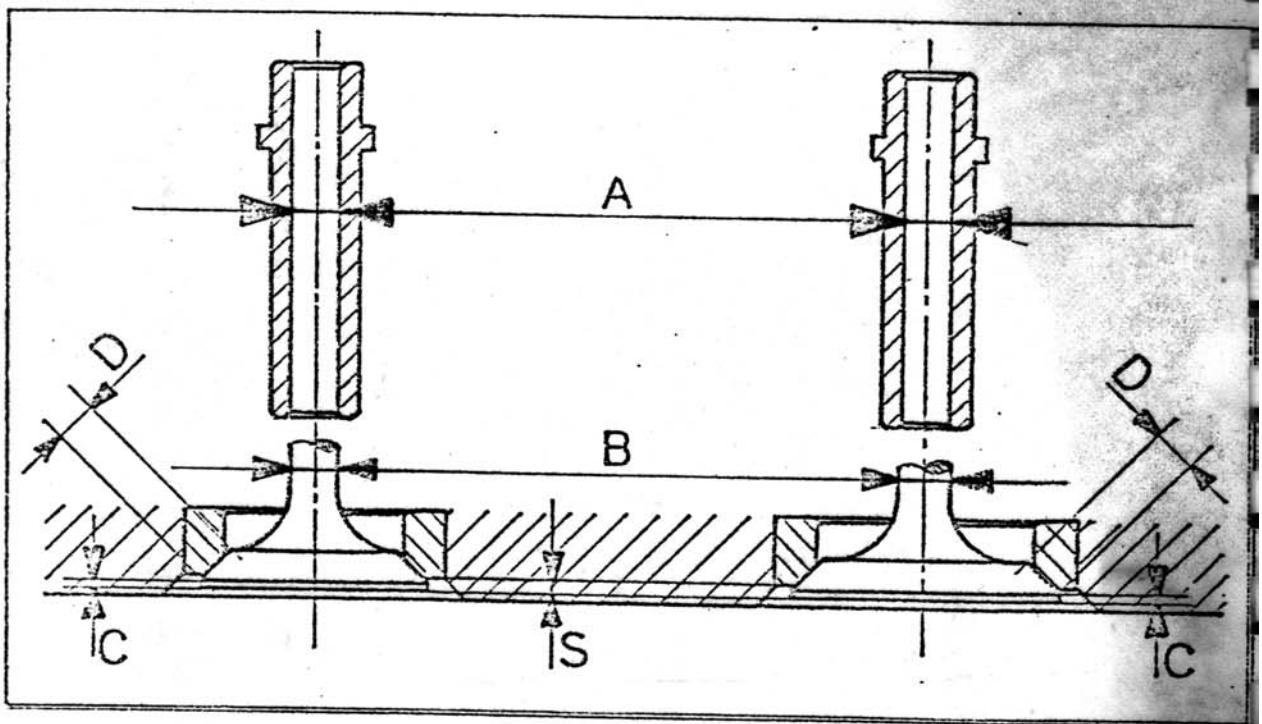


Figure N°7

Dimensions of valve guide and seats after assembling of cyl.head

A	9,03 ÷ 9,05	9,10
B	8,98 ÷ 9,00	8,97
C	0,65 ÷ 0,85	0,40
D	1,40 ÷ 1,60	2,00
S	1,40 ÷ 1,70	0,20

CYLINDER HEADS

Do not remove cylinder head when hot as this would cause deformation.

Descale carbon deposits and check mating face on cylinder. If deformed or pitted, lap removing as much as 0,5 mm. if necessary.

ROCKER ARMS

Check that there is not play between the gudgeon pin of the rocker arms and the slots in the head. The negative allowance at mounting is some 0,04 ÷ 0,06 mm.

The play between the rocker arms and gudgeon pins is some 0,03 ÷ 0,06 mm. Replace the worn piece if the play exceeds 0,1 mm.
To re-mount the gudgeon pin make use of a press after having heated the head in an oven at 160 ÷ 180° C. If the contact surface with the valve shaft is worn, replace the rocker arm.

VALVES - GUIDES - SEATS

After disassembling and discaling with a wire brush, check conditions of valves and replace if valve heads are out of shape, cracked or too worn.
To re-use slightly worn valves, we recommed restoring seat with a 45° valve grinder.
Check that guides bore has no grooves, seizure marks or carbon deposits. Clean with wire brush and gasoline, and check clearance from table. Guides can be replaced with others having a 0,5 mm. oversize O.D., proceeding as follows :

- Remove worn guides with a punch from cylinder head surface.
- Ream housings in cylinder head.
- Turn oversize guides to an O.D. of 0,05 ÷ 0,06 mm. in excess to housing diameter.
- Heat up cylinder head in oven to 160 ÷ 180° C.
- Drive in guide with a press or punch
- Insert valves and check that they slide freely in guides.

Mill the valve seats with the following dimensions using normal milling cutters at 45° of Ø 40 ÷ 42 mm. and a stem of 9 mm.

Ø Suction seat	36 mm.
Ø Exhaust seat	32 mm.

Cut valve seat and grind valves even for slight scoring on the parts.
Lap valves in seat using a fine grinding compound.
If seat cutting causes excessive recess of the valve or if contact face width exceeds 2 mm., replace seat as follows :

- Drill a few 2 ÷ 3 mm. diameter holes through the seat and cut it through with a chisel avoiding damage to seat housing
- Pull seat out
- Warm head in oven to 160 ÷ 180° C.
- Press seat in using discarded valve or pilot drift.

We recommend having this job done by a skilled machining shop.
Seat and valve grinding or replacement always require lapping.

When assembling valves, insert rubber oil seal on intake valve stem.

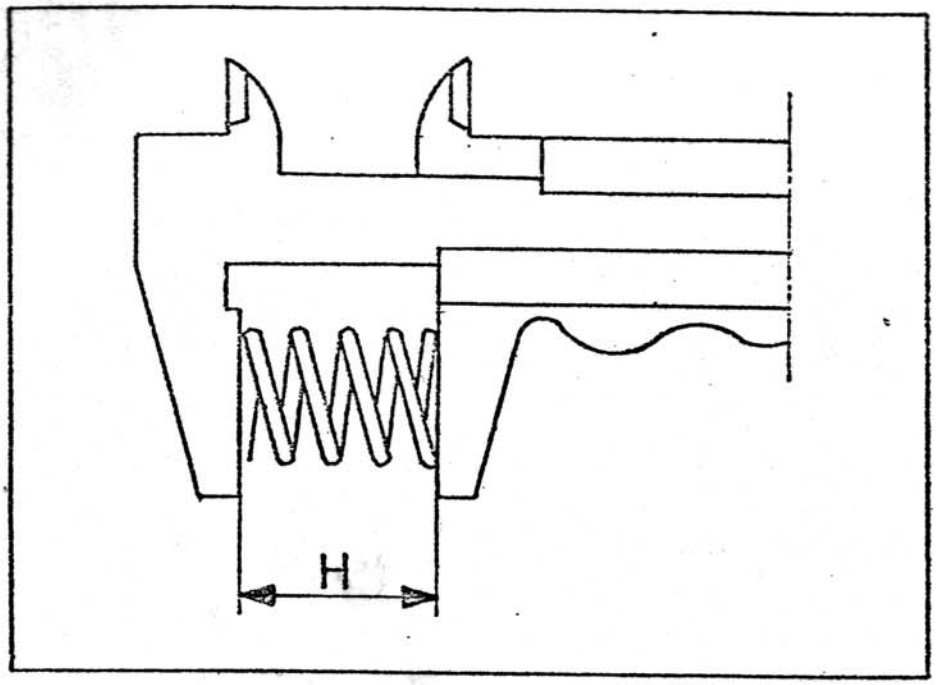


Fig. N° 8

VALVE SPRINGS

Check if springs are damaged or have lost their elasticity. Free length must be 54 ÷ 56 mm., replace springs for lower length values.

Springs compressed under a load of 42,1 ÷ 42,9 Kg. must have a length of 26,3 ÷ 26,5 mm.

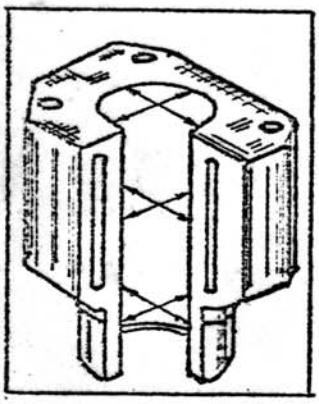


Fig. 9

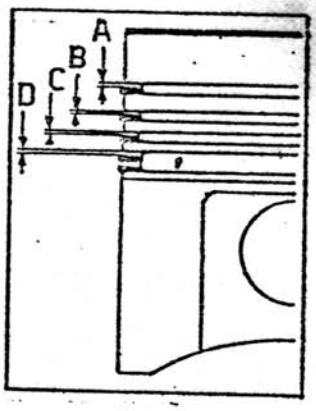


Fig. 10

Fig. 11

Cylinders dimensions mm. :			
Standard	1st O/S + 0,5	2nd O/S + 1,0	Difference a - b
95,00 ÷ 95,02	95,50 ÷ 95,52	96,00 ÷ 96,02	0,02 ÷ 0,12
100,00 ÷100,02	100,50 ÷100,52	101,00 ÷101,02	

Pistons diameters mm. :		
Standard	1st O/S + 0,5	2nd O/S + 1,0
94,843 ÷ 94,853	95,343 ÷ 95,353	95,843 ÷ 95,853
101,800 ÷101,810	102,300 ÷102,310	102,800 ÷102,810

CYLINDERS

Check with dial gauge two diameters perpendicular to each other at three different heights.

Replace piston rings only if wear of cylinder is less than 0,10 mm. or if cylinder surface is very lightly scored.

In this case restore roughness of cylinder by honing with coarse emery cloth (grain size 80-100) soaked in diesel fuel. Work in a helical movement to obtain a crosshatched pattern surface (Degree of roughness to be 0,8 ÷ 1,2 micron).

Lucese - Bogliasco (Ge) - 1000 - 273 - XII

PISTON AND RINGS

Measure piston skirt diameter at 2 mm. from base perpendicularly to gudgeon pin.

Maximum piston skirt wear must not exceed 0,05 mm.

Check that out-of-roundness of piston pin bore is not more than 0,10 mm., otherwise replace piston and piston pin.

Check the perfect mating between rings and cylinder throughout entire cylinder circumference and measure ring end gap. File rings ends if necessary.

1st Compress. ring	2nd and 3rd compress. ring	Oil control ring
0,35 ÷ 0,55	0,30 ÷ 0,45 0,30 ÷ 0,55	0,25 ÷ 0,40

Make sure rings move freely in grooves and measure ring-to-groove clearance with feeler gauge. Replace piston and rings if wear limit exceeds :

1st	compression ring	A 0,30 mm.
2nd	compression ring	B 0,20 mm.
3rd	compression ring	C 0,15 mm.
Oil	control ring	D 0,10 mm.

Check that the weights of the pistons do not differ between each other by more than 10 grams.

PISTON PIN AND CONNECTING ROD

Ensure that piston pin bears no scoring or seizure marks; otherwise replace it. Measure piston pin and small end bushing diameters to make sure that assembly clearance is 0,02 ÷ 0,03 mm.

If clearance exceeds 0,07 mm. replace both parts. Check aligment of connecting rod bore. Permissible bending or twist is 0,03 mm. in any direction at the piston pin ends. If slightly out of aligment straighten it out under a press with gradual exertions. Check that the difference in weight of the connecting rods does not exceed 10 grams.

CRANKSHAFT

Cleaning

Remove expansion plugs and screw. Dip shaft in Kerosene or solvent bath. With a metal point remove sludge from oil channels.

Checks

Make sure crankshaft has no craks, otherwise replace it.
Crankshaft journals and crank pin must be free from seizure marks or grooves.
Light grooves or dents should be removed with a very fine carborundum file and finished with an equally grain emery cloth.
Tapered ends, key seats and threads must not be worn or out of shape. If they are so, replace crankshaft.
Measure with micrometer in two perpendicular direction the diameter of main journals and crank pin. If wear exceeds 0,10 mm. grind shaft and install undersize bearings.
After seizures, overheating and grinding, make a Magnaflux check of the shaft to detect surface cracks. After cleaning or grinding, the hardness of the journal should be 50 ÷ 60 Rockwell C.
If below, grind to next undersize or replace shaft.
Journals surface must be neatly finished without helical grooves and have a roughness of 0,2 ÷ 0,5 micron.
Restore journals fillet radius as indicated in Fig. 12.

When grinding crankshaft do not remove any material from journal flanges facing side thrust rings.

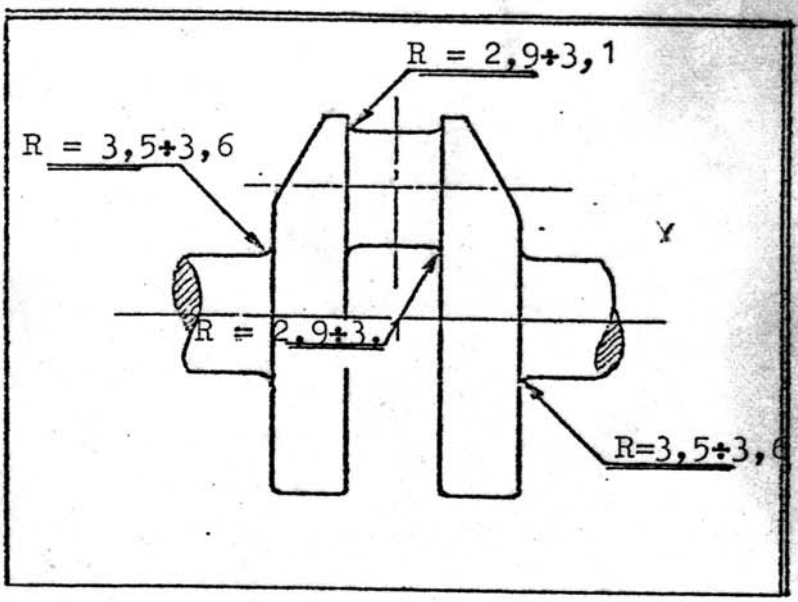


Figure N°12

Main bearing I.D. after assembling, mm. :		
Nominal	1st - undersize -0,25	2nd - undersize -0,50
60,00 ÷ 60,01	59,75 ÷ 59,76	59,50 ÷ 59,51

Dimensions of crank journals, mm. :			
Dimension	Journal-crank pin diameter	Bearing-Journal Clearance	
Nominal	55,34 ÷ 55,35	Assembly	Worn limit
1st u.size -0,25	55,09 ÷ 55,10	0,04 ÷ 0,07	0,10
2nd u.size -0,50	54,84 ÷ 54,85		

Dimensions of crank pins, mm. :			
Dimension	crank pin diameter	Bearing-Journal Clearance	
Nominal	59,94 ÷ 59,95	Assembly	Worn limit
1st u.size-0,25	59,68 ÷ 59,70	0,05 ÷ 0,07	0,10
2nd u.size-0,50	59,44 ÷ 59,45		

To remove the distribution and flywheel side main bearings from the slots make use of the extractor.
When mounting, make the holes coincide with the oil ducts and lubricate the outside with vaseline oil, or lubricating oil to make the keying easier and to avoid the formation of very small air pockets.
After mounting check the internal diameter.

AXIAL PLAY

The axial play of the engine shaft is adjusted to 0,15 ÷ 0,25 mm. by placing the two thrust washers between the central bearing, (distribution side bearing for AD395-AD495) and the skim adjustments of the main journal.
If the play exceeds 0,5 mm. replace the washers possibly with others having an increased thickness 0,35 mm.

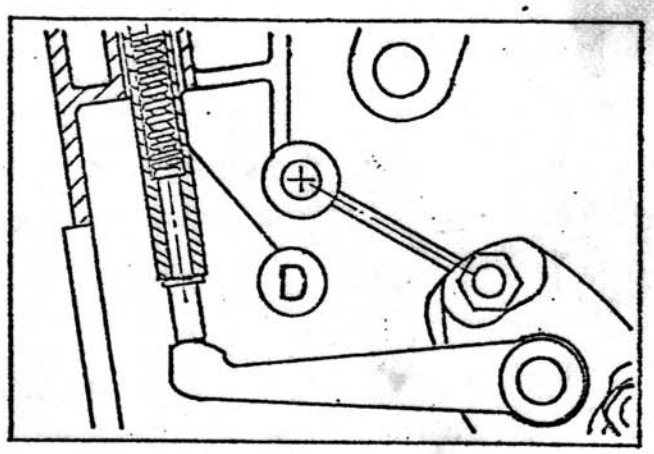


Figure N° 13

Weight gr.	Stroke mm.	Setting revs./mi
625 ÷ 650	0,35 ÷ 0,45	3000
400 ÷ 420	0,35 ÷ 0,45	2600
400 ÷ 420	1,00 ÷ 1,10	2200

TORQUE CORRECTOR AND CAPACITY LIMITER

Under steady state conditions of maximum torque the deflection of the spring (D), contained in the small cylinder, under the thrust of the supplement lever allows the delivery of a greater quantity of fuel necessary under such a condition.
The small cylinders, which are variable depending on the engine setting are not interchangeable.
Remove the device and wash it with petrol.
The end of the mobile element, loaded as per the table, must cover the above stroke in mm.-

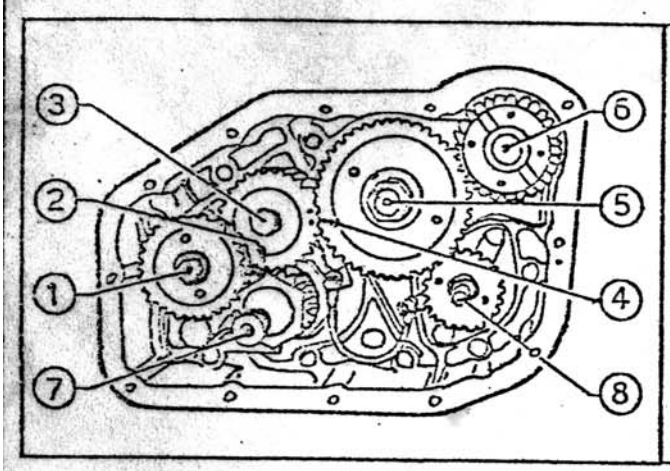


Figure N° 14

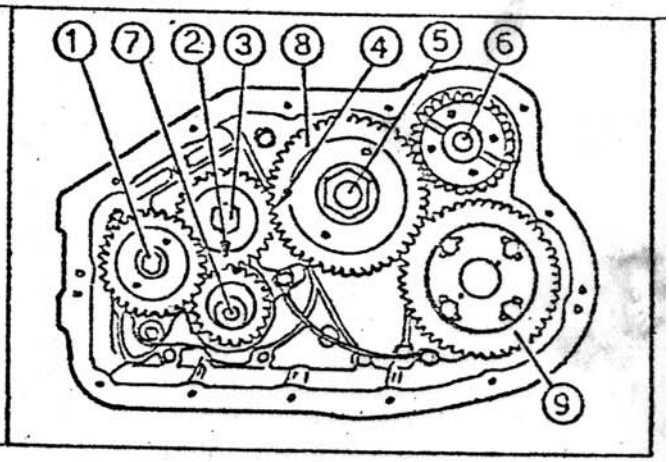


Figure N° 15

DISTRIBUTION

Mount the gear box on the base plate centring it on the two reference bushes. Tighten the bolts to 2 Kgm.

AD 295 - AD 395 engine - Fig. 14 - details :

1 - oil pump; 2 - engine and intermediate shaft gear references; 3 - intermediate gear; 4 - intermediate gear and camshaft references; 5 - camshaft; 6 - oleodynamic pump drive connection; 7 - drive shaft; 8 - revolution regulator.

AD 495 engine - Fig. 15 : Mount the oil feeder tube to the injection pump control gear.

Details :

1 - oil pump; 2 - engine and intermediate shaft gear references; 3 - intermediate gear; 4 - intermediate gear and camshaft references; 5 - camshaft; 6 - oleodynamic pump drive connection; 7 - drive shaft; 8 - camshaft gear; 9 - injection pump control.

Heat up the distribution control gear in an oven at 180°C and mount it on the drive shaft tightening the lock nut to 50 Kgm. To prevent rotation during tightening make use of a collar, or similar device on the flywheel.

In the absence of a suitable dynamometric spanner apply a force of 50 Kg. with an arm of 1 meter.
Rivet the safety lamina.

Successively mount the camshaft and the intermediate gear with a helical movement on the teeth of the contact gear, making the references on the teeth coincide when the piston of the No. 1 cylinder, (flywheel side) is at the T.D.C.
Tighten the camshaft gear lock nut to 20 Kgm. and the intermediate gear bolt to 14 Kgm.
Rivet the safety lamina.
The camshaft gear lock nut has a left-handed thread.

To mount gears which have no reference marks proceed as follows :

- Arrange the N. 1 piston, (flywheel side) to the T.D.C.
- Insert two small cylinders of equal height into the tappet slots
- Rotate the camshaft and place the tappets in a change-over position, (suction opens, exhaust closes) checking that the tappets are at the same height, using a ruler.

Engage the intermediate gear with a helical movement between the distribution control and camshaft.
Mark the teeth in contact using a punch, or mark them with paint.
Check, by following the same procedure, the timing of the cams of each cylinder, as per the table.

Cam timing in degrees and mm. :

SUCTION		EXHAUST	
Opening before T.D.C.	Closing after B.D.C.	Opening before B.D.C.	Closing after T.D.C.
10° 28 mm.	42° 115 mm.	42° 115 mm.	10° 28 mm.

If different values are found, check the correspondance of the references on the gears and the conditions of the cams.

Mount the oil pump and drive gears.

Fix the distribution box cover by centring it on the two pins and tightening the bolts to 2 Kgm.

Mount the oil introduction filler.

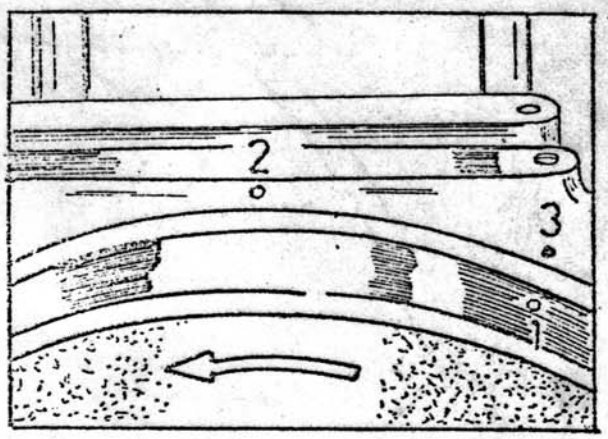


Figure N° 16

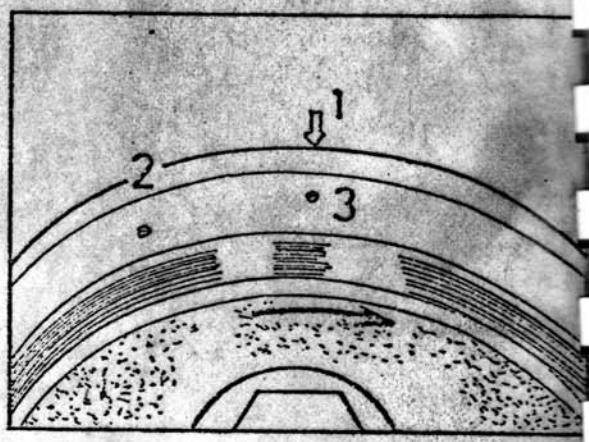


Figure N° 17

Injection advance with respect to the T.D.C., mm. :			
Engine	At the flywheel Ø 308 mm.	At the pulley Ø 95 mm.	Degrees
AD 295	74,5 ÷ 79	22 ÷ 24,5	27°45' ÷ 29°30'
AD 395	74,5 ÷ 79	22 ÷ 24,5	27°45' ÷ 29°30'
AD 495	88 ÷ 90,5	27 ÷ 28	32°45' ÷ 33°45'

If lower values are found, (delaid injection) remove a number of thicknesses between the pump and base.

For higher values (advanced injection) add a number of thicknesses.

In the case of disagreement between the values of advance and pre-stroke check the camshaft, pumping unit and injection pump tappet rollers.

At the end of the advance check, remount the delivery valve with the spring in the small cylinder of the N. 1 pump and connect it to the delivery tubes.