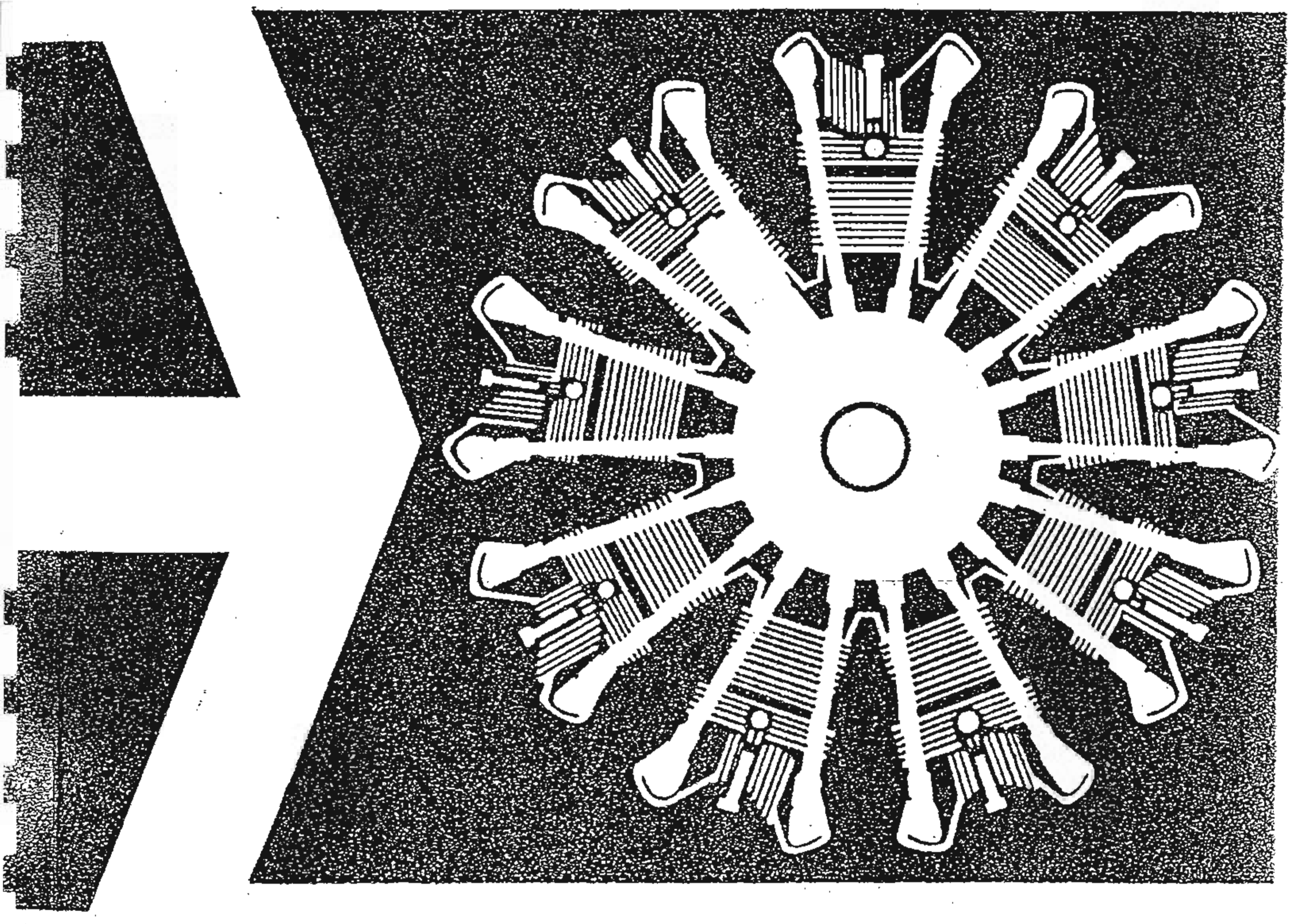
AIRCRAFT ENGINE

M 462-RF



TECHNICAL DESCRIPTION
SERVICING
AND MAINTENANCE

M 462 - RF AIRCRAFT ENGINE

TECHNICAL DESCRIPTION, SERVICING AND MAINTENANCE

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OMNIPOL

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1. INTRODUCTION

The M 462-RF engine is based on the Soviet type AI 14-RF engine and is supplemented by component parts of Czechoslovak production. The latter include the reduction gear unit, the drive of the speed transmitter, the threaded unions for the airframe installation, the device for oil dilution, the instruments, the adaptation of the engine cooling, the injection system and the complete generator drive.
The M 462-RF engine in this arrangement complies with the requirements of the technical conditions as to the output. This handbook should serve primarily to facilitate the servicing and maintenance of the engine.
First, the abbreviations used in the text will be given and their precise meaning explained.

The forward engine side is the engine side carrying the propeller.
The term **forward** applies to the part from the cylinders to the propeller.
The term **rear** applies to the side from the cylinders to the drive of the agricultural equipment.

Right and **left** gives the position on the engine or from the side of the individual component parts when viewing the engine from the rear.

Above applies to the place on the engine where the cylinder No. 1 is mounted. In the cylinder the upper side is the one more distant from the axis of the crankshaft.

Below applies to the place on the engine, where the oil sump is situated.

The direction of engine rotation is determined when viewing the engine from the rear. The direction of rotation to the right is identical with clockwise motion, that of rotation to the left with the anti-clockwise motion.

The direction of rotation of the drives is determined when viewed in the direction from the driving to the driven part.

The gear ratio is the ratio of speed of the driven part to that of the driving part, the resulting gear ratio is the ratio of the drive or propeller shaft speed to that of the crankshaft.

TDC — the top dead centre is a piston position, in which it is most distant from the crank case.

BDC — the bottom dead centre is a piston position, in which it is nearest to the crank case.

2. FUNDAMENTAL DATA OF ENGINE

2.1 Technical description of the engine

The M 462-RF is a nine-cylinder, radial, air-cooled, carburetter-fed, four-stroke aircraft engine. The engine is fitted with a single-speed compressor. The reduction gear unit is of the epicyclic type and is used for reduction of speed of the propeller shaft. The engine case is formed by the reduction gear box, the partition, the crank case, the compressor case and the case of the ancillaries drive. In the reduction gear box, the reduction gear mechanism is situated and up on the external surface is the flange for the drive of the speed regulator. The crank case consists of the forward and the rear half bolted together. Inside the crank mechanism is mounted. On the outside circumference are situated nine flanged surfaces for the bolting of the cylinders and two flanges for the oil sump. Between the reduction gear box and the crank case there is a partition, which carries the drive of the cam disc and the third bearing of the crankshaft. To the rear half of the crank case is fastened the compressor case with the mixture distributor. On the circumference there are 9 lugs for fitting the inlet tubes, eight of which are provided with surfaces with holes for fastening of the engine ring. On the lower part of the compressor case is a flange for fastening the carburetter. The case of the ancillaries drive is bolted to the compressor case and carries the drives of the ancillaries and the ancillaries themselves, two magnetos, a generator, a small compressor, an oil gear pump, a fuel pump and an air distributor. Further on the left-hand side is led out the drive of the speedometer transmitter. In the axis of the crank case is situated the drive for agricultural equipment.

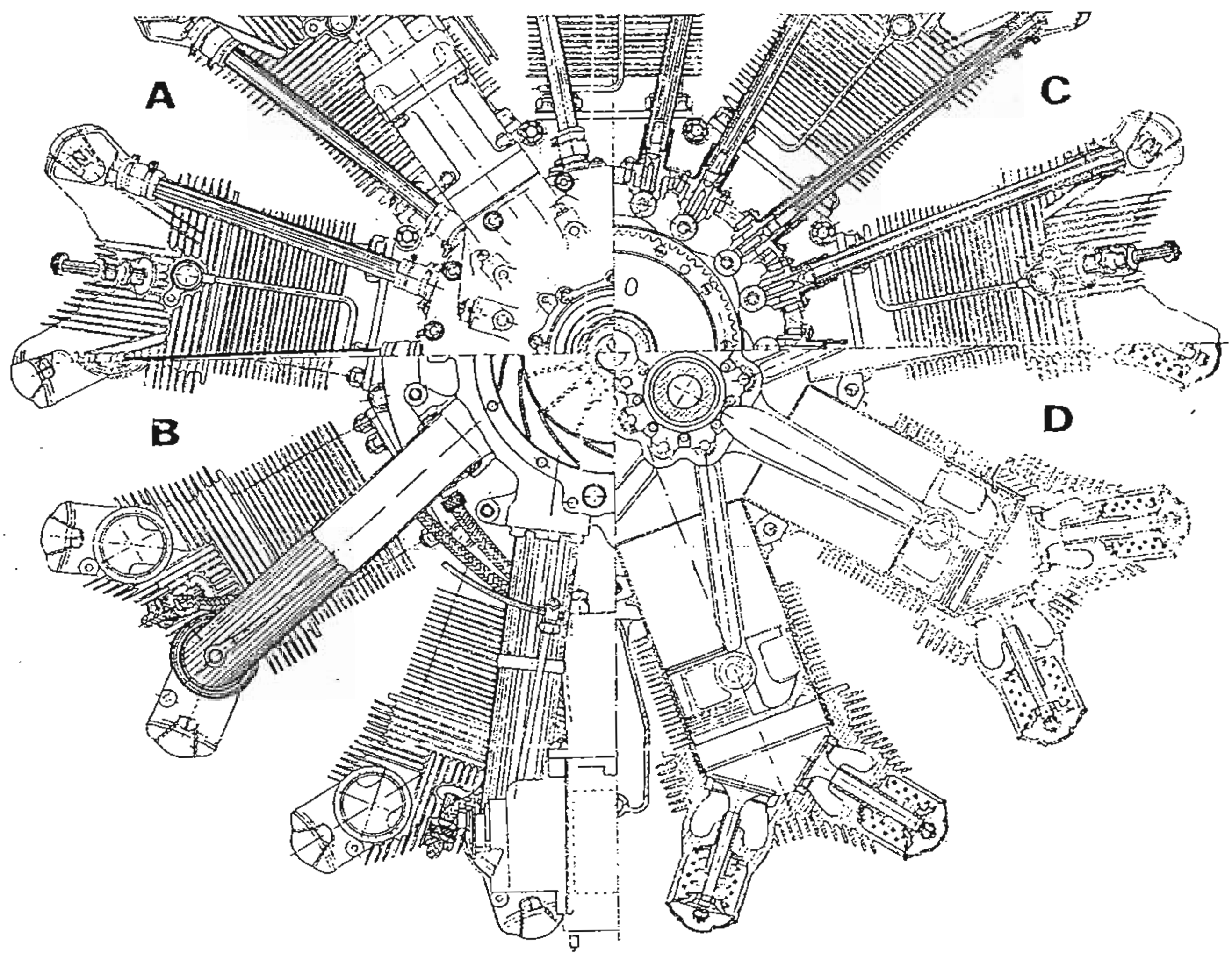

Fig. 1 — Transversal section of the M 462-RF engine

A — Front view, B — Rear view, C — Section through the cam disc, D — Section through main connected rod and valves

The internal engine spaces are connected to ambient atmosphere by means of two breathers, one of which is mounted on the reduction gear box and the other on the compressor case.
The engine is fitted with a pressure-air starting system. Fuel is injected during starting to the inlet tubes by means of jets, a fuel pump and a starting injection pump.

Fig. 2 — Longitudinal section of the M 462-RF aircraft engine is attached to the end of this manual

2.2 Basic technical data

2.2.1 General data:

1. Typ of engine	M 462-RF
2. Cooling	by air
3. Number of cylinders	9
4. Arrangement of cylinders	single radial arrangement
5. Order of cylinder numbers	the top cylinder is designated as the first one, the others are numbered clockwise when viewing the engine from the propeller side
6. Cylinder bore	105 mm
7. Piston stroke	
a) for cylinder No. 4 (with main connecting rod)	130 mm
b) for cylinder No. 3 and 5	130.15 mm
c) for cylinder No. 2 and 6	130.23 mm
d) for cylinder No. 1 and 7	131.25 mm
e) for cylinder No. 8 and 9	130.39 mm
8. Swept volume of all cylinders	10.161 lit.
9. Compression ratio	6.2 ± 0.1
10. Direction of rotation (when viewed from the rear)	
a) of crankshaft	lfet-hand
b) of propeller shaft	letf-hand
11. System of reduction gear unit	epicyclic with three satelites
12. Gear ratio of reduction gear unit	0.787
13. Type of compressor	single-stage, centrifugal
14. Compression ratio	8.82
15. Altitude capacity of engine	non-altitude
16. Specific volume efficiency at take off performance	31 HP per lit.
17. a) Out-of-true of reduction shaft	max. 0.14 mm measured 23 mm from the bearing surface of the reducer nut
b) Axial clearance of reduction shaft	max. 0.35 mm

2.2.2 Systems of engine operation

Operating regime of aeroengine	Rated power HP	Engine speed r.p.m.	Specific fuel consumption gr./HP/hr.	Boost pressure ATA units
Take-off power of engine	315—2%	2450±1%	265—290	1.195±0.02
Maximum continuous engine power	280—2%	2200±1%	255—285	1.165±0.02
Cruising power of engine	195—2%	1900—1950	205—225	0.998±0.013
Idle run	—	min. 550	—	—
Engine power required at agricultural air operations	95÷245 —2%	2000±1%	210—310	(0.580÷1.140)±0.013

2.2.3. Range of engine speed

1. Max. permitted speed during diving and other aircraft manoeuvres. . . . . 2700 r.p.m.
2. Minimum speed (minimum throttle) . . . . 550 r.p.m.
3. The speed (acceleration) change transition time period of the engine
   a) from idling speed up to take-off speed, event. to cruising speed . . . . 4 to 5 sec.
   b) from cruising idling speed (n = 1,100 r.p.m.) up to take-off or event. to rated speed. . . . . . . min. 3 sec.
   c) from standard operation speed (n = 2,000 r.p.m.) and curising speed (n = 1,900 r.p.m.) up to take-off speed . . . . min 1.5 sec.
4. Permitted period of engine run
   a) take off performance. . . . . 5 min.
   b) rated performance. . . . . unlimited
   c) maximum permitted speed . . . . 3 min.

2.2.4 Temperature of cylinder heads:

Measured by means of a thermo-couple under the rear spark plug of the hottest cylinder.

1. Minimum temperature for good acceleration . . . . 120 °C
2. Recommended temperature for horizontal flight. . . 160 to 210 °C
3. Max. temperature at long run of engine . . . . 230 °C
4. Max. permitted temperature during take off and climbing (for max. 5 min.) . . . . 240 °C

2.2.5 Fuel and fuel supply system:

1. Kind of fuel and mark . . . . LBZ 78 according to Strd. PND 33-241-67
2. Octane rating of fuel . . . . min. 78
3. Carburetter
   a) type . . . . AK-14 RF floatless
   b) number . . . . one
4. Fuel pressure ahead of carburetter
   a) at operating performance . . . . 0.2 to 0.5 kg per sq. cm.
   b) at minimum speed . . . . min. 0.2 kg per sq. cm
5. Fuel pump
   a) type . . . . 702 ML, rotary pump
   b) number 1
   c) gear ratio of drive 1.125
   d) direction of drive rotation . . . . to the right

2.2.6 Oil and lubrication system:

1. Kind of oil for winter and summer operation . . . . MS 20, according to GOST 1013-49
2. Oil consumption at cruising performance . . . . . max. 12 g/HP/hr., i.e. 2.5 lit.
3. Oil pump
   a) type . . . . MN 14 B, gear pump with a delivery and a suction stage
   b) number 1
   c) gear ratio of adrive 1.125
   d) direction of drive rotation . . . . to the left
4. Oil pressure in main piping
   a) at operating performance . . . . 4 to 6 kg per sq. cm.
   b) at minimum engine speed . . . . min. 1.0 kg per sq. cm.
5. Oil temperature at inlet to engine
   a) recommended . . . . 50 to 65 °C
   b) minimum permitted (during warming up of engine) 40 °C

c) maximum during continuous operation of engine . max. 75 °C
d) maximum permitted for max. 5 min. . . . . . . max. 85 °C

6. Max. permitted oil temperature at engine outlet . . max. 125 °C
7. Max. difference in oil temperature between engine inlet and outlet . . . . 50 °C
8. Oil flow at rated performance and inlet temperature of 50 to 60 °C . . . . min. 360 kg per hr.

2.2.7 Timing:

1. Adjustment of timing in degrees of crankshaft rotation (according to cylinder No. 4)
   a) beginning of inlet . . . . 20°±4 before TDC
   b) end of inlet . . . . 54°±4 after BDC
   c) beginning of exhaust . . . . 65°±4 before BDC
   d) end of exhaust . . . . 25°±4 after TDC

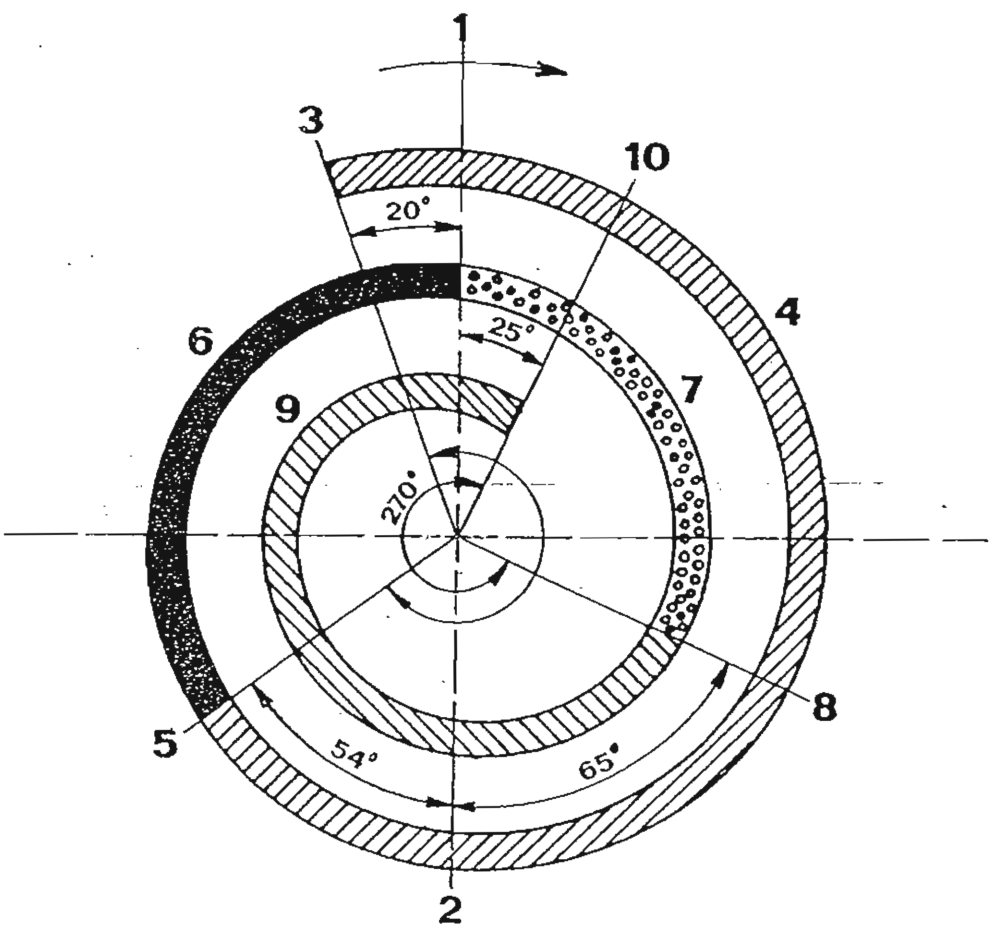

Fig. 3 — Diagram of timing adjustment

1 — T.D.C.; 2 — B.D.C.; 3 — Intake opens; 4 — Intake course; 5 — Intake closes; 6 — Compression; 7 — Expansion; 8 — Exhaust opens; 9 — Exhaust course; 10 — Exhaust closes.

e) inlet course	254°
f) exhaust course	270°
2. Clearance between the rocker arm roller and valve shank as adjusted for checking the timing gear	
a) Inlet valve	1.1 mm
b) Exhaust valve	1.1 mm
3. Clearance between the rocker arm roller and valve shank for engine run (adjustment at cold state)	
a) Inlet valve	0.3 to 0.4 mm
b) Exhaust valve	0.3 to 0.4 mm

2.2.8 Ignition system:

1. Magneto	
a) Type	M-9-35°, four-spark, screened with single electrode distributor arm
b) Number	2
c) Direction of rotation	to the left
d) Gear ratio of drive	1.125
2. Spark plugs	
a) Type	SD-49 SMM
b) Number of pieces per cylinder	2
3. Firing order	1-3-5-7-9-2-4-6-8
4. Max. permitted drop of speed of crankshaft with one magneto off at n = 1900 r.p.m. (fixed propeller)	60 r.p.m.
5. Full advanced ignition in degrees of crankshaft for both left- and right-hand magneto	30°±2 before TDC compression stroke

2.2.9 Starting system:

1. Engine starting	by pressure air
2. Type of air compressor	AK-50 M, piston-type
3. Number of pieces per engine	one
4. Direction of rotation of compressor drive	to the right
5. Gear ratio of compressor drive	0.9
6. Pressure air distributor	slide valve type
7. Direction of rotation of distributor drive	to the left
8. Gear ratio of distributor drive	0.5
9. Adjustment of distributor	at piston position of cylinder No. 4—12° after TDC (measured at crankshaft); during expansion stroke the port for supply of pressure air to cylinder No. 4 must be opened to 1 mm.

2.2.10 Other ancillaries and drives:

1. Dynamo
   a) Type. . . . . 52-9086.179 — TAH F-II
   b) Gear ratio 2.5
   c) Direction of rotation . . . . to the left
2. Speed regulator
   a) Type . . . . LUN 7811.1, centrifugal
   b) Gear ratio 1.045
   c) Direction of rotation . . . . to the right

Drives:

1. Drive of speedometer transmitter . . . . for LUN 1316 transmitter
   a) Gera ratio 0.5
   b) Direction of rotation . . . . to the right

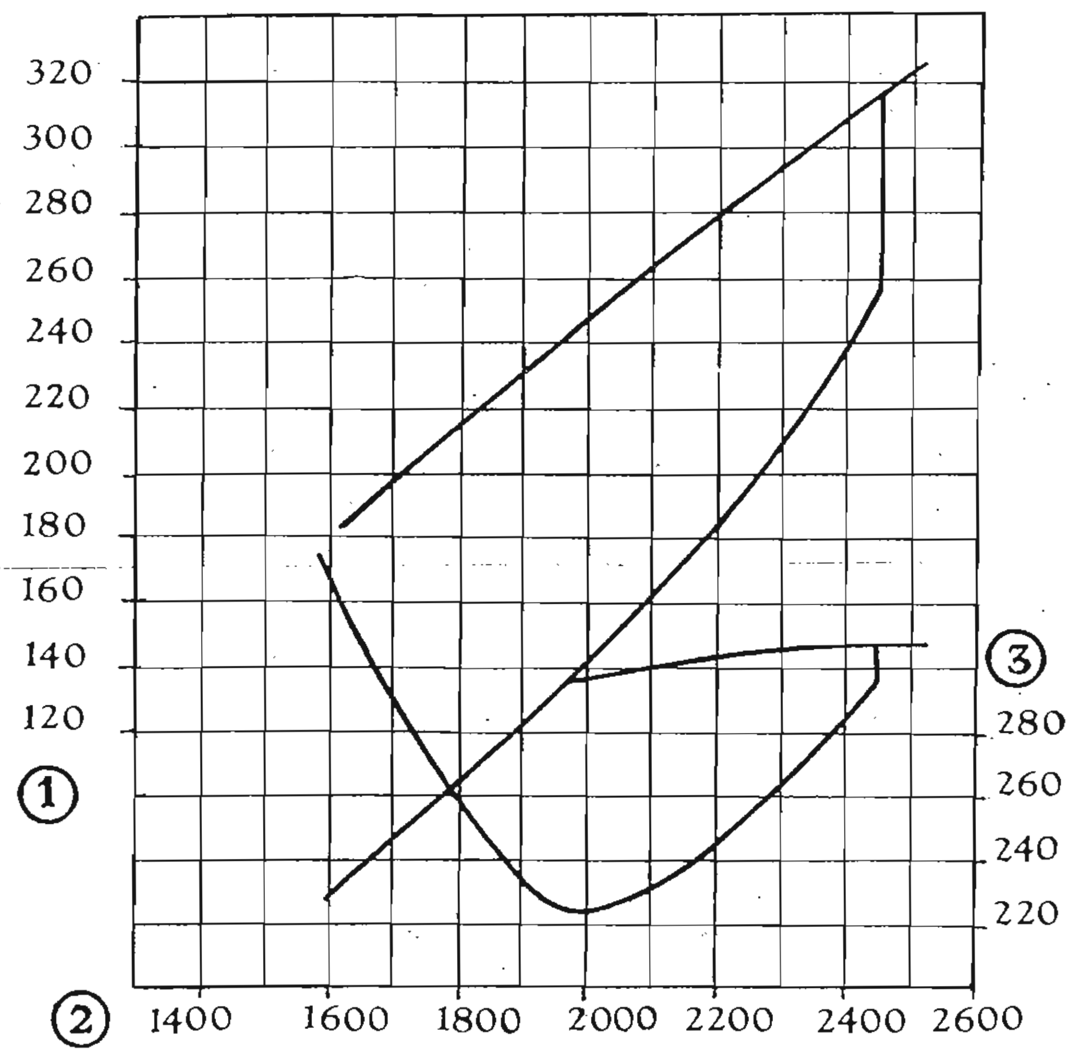

Fig. 4 — Output characteristics of the M 462-RF engine with the V 520 propeller
4 — No./HP, 2 — r.p.m., 3 — Ce./g./HP/hr.

2. Drive of agricultural equipment
   a) Gear ratio 1.0
   b) Direction of rotation .. . . to the left

2.2.11 Weight values and dimensions of engine:

1. Weight of dry engine according to technical conditions . . . . 218 kg +2%
   The weight of dry engine includes the weight of the following ancillaries: Dynamo, compressor and the ring of the engine bed with fastening component parts.
2. Weight of oil in engine after checking test . . . . . . 2 kg

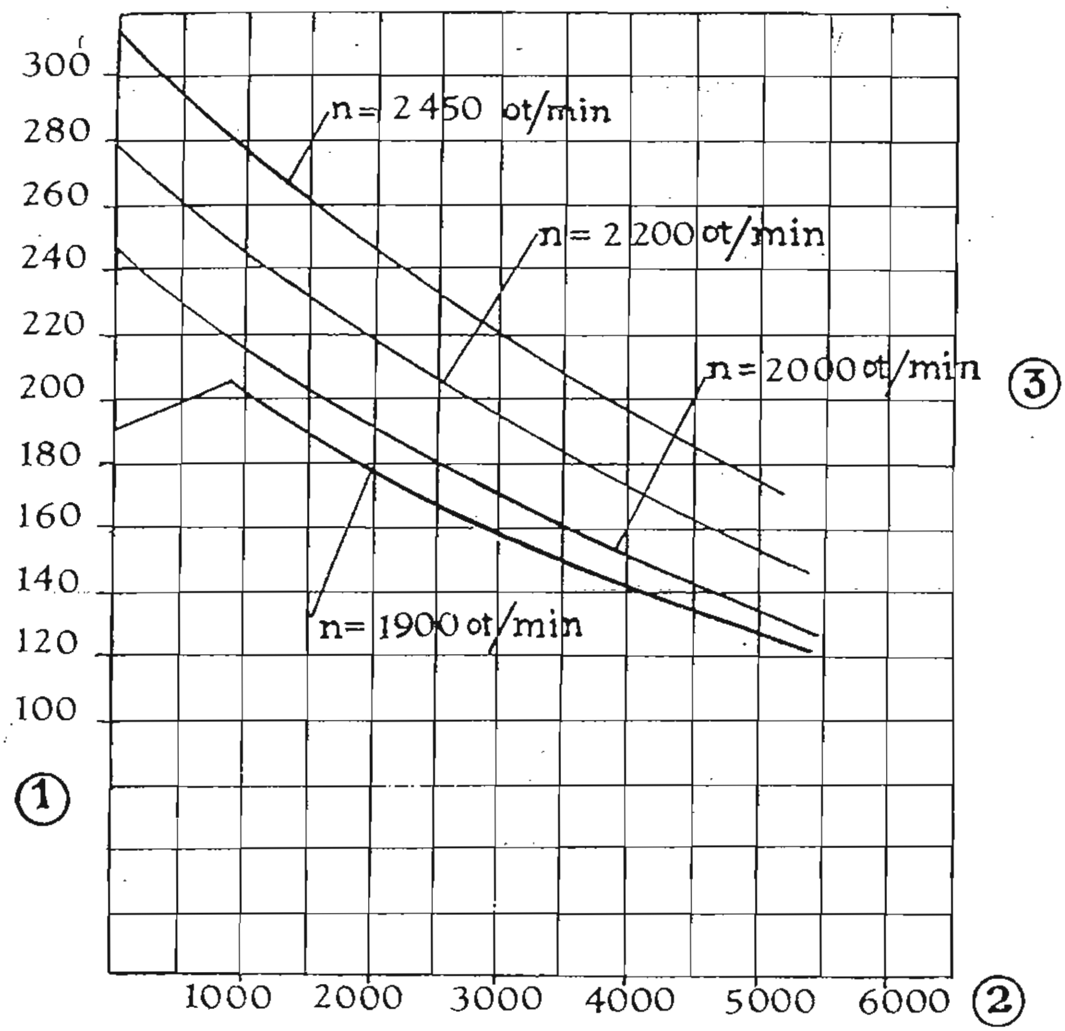

Fig. 5 — Altitude characteristics of the M 462-RF engine

1 — No/HP, 2 — altitude, 3 — r.p.m.

3. Engine dimensions

a) Max. diameter . . . . 985±3 mm

b) Max. length. . . . . 1020±3 mm

c) Engine diameter with deflectors. . . . . 1000±3 mm

4. Position of centre of gravity. . . . . On the horizontal axis of engine 145 mm forward from the plane of engine fastening to the ring of the engine mount.

3. FUEL SUPPLY SYSTEM

Fuel is supplied to the engine by means of the 702 ML fuel pump via the AK-14 RF carburetter. With the engine in operation, the fuel pump supplies fuel from the fuel tanks to the fuel chamber of the diaphragm mechanism of the carburetter. Through the proportioning system of the carburetter fuel already partly mixed with air is delivered behind the throttle. Air is admitted through the inlet branch, flows through the carburetter diffuser, produces underpressure over the outlet emulsion holes of the atomizer, so that the emulsion from the holes is atomized and mixed with the main stream of air. Thus the combustion mixture is formed. The mixture is then compressed by the compressor and by means of the mixture header and the inlet tubes distributed to the individual cylinders of the engine.

4. SYSTEM OF LUBRICATION AND AIR-VENTING OF ENGINE

4.1 Lubrication of the engine

The engine lubrication serves to reduce friction and to dissipate heat from the surface of component parts that are in mutual contact and motion. Force feed and splash oil is used for lubrication purposes. Force feed oil is used for lubrication of all principal component parts of the engine. By splash oil are lubricated e.g. the cylinder walls, piston skirts, anti-friction contact roller bearings, toothings, rocker arms and valve springs.

The pull-rods and levers are lubricated with grease. Oil flowing from the engine parts is collected in an oil sump. From the oil sump oil is exhausted by an oil pump and delivered to the external oil circuit of the engine, comprising the oil cooler, the filter and the oil tank.

The following instruments are used for checking the oil system:

a) The thermometer for measuring the temperature of oil entering the engine.

b) The thermometer for measuring the temperature of oil leaving the engine.

c) The pressure gauge for measuring the pressure of oil entering the engine behind the oil pump.

4.2 Circulation of oil through engine

Oil is delivered to all component parts of the engine lubricated by pressure oil by an oil pump with a pressure and exhaust stage. Oil flows from the tank through the oil piping via a gauze filter to the pressure stage of the oil pump. Behind the pressure stage of the pump, the oil pressure amounts to 4—6 kg per sq. cm. The pressure oil

discharged from the pump flows through the cavity of the driving shaft of the pressure stage gear and further on through the hollow vertical shaft, the radial ports of its wall to the circular recess of the vertical lug of the rear cover of the engine case, while lubricating the upper and lower bearing of the vertical shaft.
From the circular recess, oil flows through ports to the flanges of the engine speed transmitter and the compressor drives. It lubricates the above metioned ancillaries. From the drives of the engine speed transmitter and the compressor, oil flows to the two grooves of the magneto drive housing.
The oil supply to the bearings of the compressor and magneto drives is effected by a recess, a chamfer and radial holes in the drive housings.
The main oil circuit continues from the circular recess of the lug of the drive box of the ancillaries through a port in the central lug of the drive box of the sets and from there it branches out in two directions as follows:

a) Through the inner port to the centering under the generator drive housing and through a port drilled in the generator drive housing oil flows to the inner circular recess and is used to lubricate the bearings of the generator drive gear and slip coupling. Through the bores in the drive box of the ancillaries there are lubricated the AK-50 M compressor, the drive of the engine speed transmitter' the counter-shaft of the compressor and the air distributor drives.
b) Through the radial holes in the driving gear and shaft of the ancillaries drives, oil flows in the bore of the shaft through small holes, it lubricates the compressor wheel shaft and flows then to the cavity in the crankshaft.

From the cavity in the main body of the crankshaft rear part oil flows through front holes to the space of the crank pin of the forward part of the crankshaft and from there it branches out into three directions as follows:

1. By means of two oil pipes to the crank pin chamfer for the lubrication of the connecting rod mechanism.
2. By means of the oil thrower countersunk in the throw of the forward part of the crankshaft for the lubrication of the cylinder and piston assembly group.
3. Through the port in the throw of the forward part of the crankshaft, the oil flows from the crank pin to the space of the forward part of the crankshaft.

Clean oil (centrifuged) is supplied to the details of the connecting rod mechanism by way to the two separate oil pipes mounted in the space of the crankshaft. During rotation of the crankshaft, the heavier particles of oil impurities are slung by the centrifugal force to the roots of expanded protruding tubes and clean oil flows through the tubes to the main connecting rod lining. From the gap between the main connecting rod lining and the crank pin, the oil flows through radial holes in the lining and bores in the big end bearing of the main connecting rod to the spaces of the connecting-rod pins of the auxiliary connecting rods. From there the oil flows through two radial holes to lubricate the surface of the auxiliary connecting rod linings. The cylinders, the pistons and the small end bearings of the connecting rods are lubricated by splash oil flowing from the gaps of the connecting rod and crankshaft mechanism and from the crankshaft nozzle. The forward and rear bearings of the crankshaft journals are lubricated also by splashed oil.
From the inner space of the crank pin, the oil flows through the bore in the throw of the crankshaft forward part to the space of the latter and from there on through a radial hole via the distance sleeve to the cam disc bush.

The gears and the bearings of the valve gear mechanism, the cam disc, the tappets and the drive of the speedometer are lubricated by splashed oil.
From the space of the forward part of the crankshaft, the oil flows to the propeller shaft, while lubricating the bushes force-fitted in the crankshaft and forming the rear bearings of the propeller shaft. Next, the oil flows through bores in the wall of the case disc of the propeller shaft and through radial holes in the rear thrust arm to the satelite gear pivots.
From the space of the forward part of the crankshaft, the oil flows to the propeller shaft through small ports, while through the main port it flows via the oil distributor and the gauze filter to the speed regulator and lubricates the tappets through the extended port. By means of the push-rods of the valve gear of the cylinders No. 1, 2, 3, 8 and 9 it lubricates their rocker arms and valves.

4.3 Drawing off oil from the engine

Oil flowing from the clearances in fitting of the reduction gear component parts as well as from the speed regulator is conducted from the reduction gear box direct to the oil sump. Splash oil from the crankshaft flows through the holes in the lower part of the crank case to the oil sump, where oil from the compressor case and the case of the set drive is also collected. The oil sump is situated under the crank case between the cylinders No. 5 and 6. Oil flows through a filter mounted in the lowest forward part of the oil sump, through ports in the oil sump, the compressor case and through a port in the case of the ancillaries drive it is exhausted by the admission stage of the oil pump and flows further on via an oil filter and a cooler to the oil tank.

4.4 Air-venting of the engine

During the engine operation a certain volume of gases penetrates from the combustion space round the compression rings of the piston to the engine case. In addition the splashed oil is partly evaporated in the engine at high temperature. Thus the pressure in the engine case is increased and the overpressure would force oil to the packing surfaces of the engine case. In order to equalize the pressures inside the case the case spaces are interconnected by holes and in order to equalize the inside pressure with the ambient atmospheric pressure the engine is fitted with two breathers for air-venting purposes. One is mounted on the forward part of the reduction gear box and the other on the compressor case.

5. COOLING SYSTEM

The engine is cooled by air flowing through the circular hole in the front part of the cowling. In order to improve the efficiency and distribution of air to the individual cylinders, deflectors are mounted on same, which direct the air stream along the cylinder outlines to the inter-fin spaces. The deflectors are made of aluminium sheet.

6. IGNITION SYSTEM

The ignition system is intended to secure safe ignition of the fuel mixture in the engine cylinders. The fuel mixture is ignited by a spark of high-voltage electric current across the electrodes of the spark plug. The high-voltage current is generated in a pair of magnetos mounted on the case of the ancillaries drive. The current between the magnetos with distributors and the spark plugs is conducted by means of high-voltage conductors. The conductors are situated in a screening cable ramp. The left-hand magneto is connected to the forward spark plugs and the right-hand one to the rear ones.
To ignite the fuel mixture during the starting of the engine, a buzzer is incorporated in the ignition system. The buzzer is fed from the direct current network and it is connected to the primary winding of the M_1 magneto. The buzzer is connected by

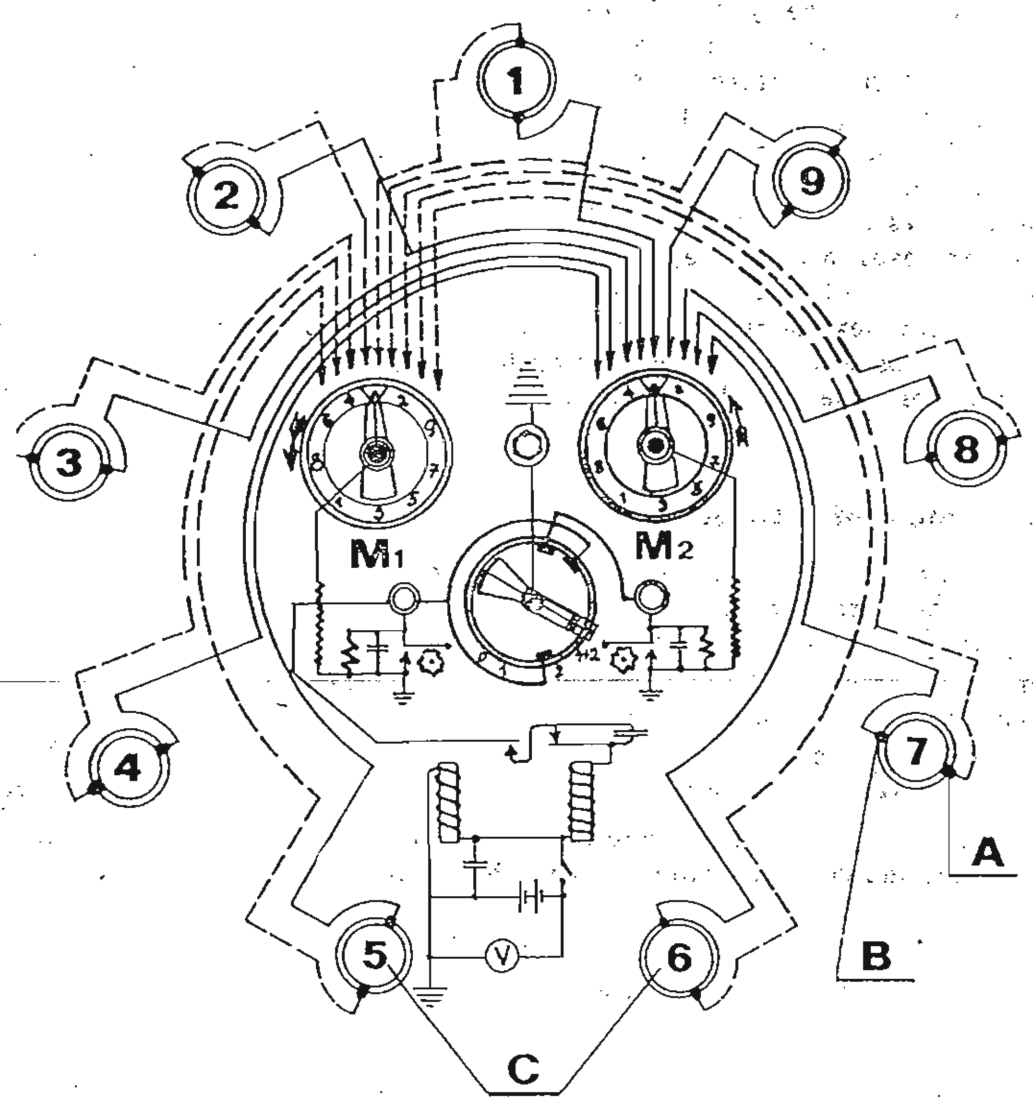

Fig. 6 — Ignition diagram

M — left-hand magneto, M_2 — right-hand magneto, A — Forward spark plug, B — Rear spark plug, C — Cylinder Nos.

a switch, which controls the cock of starting air. The control of the ignition system, i.e. switching on and off of the magnetos, can be carried out both separately and simultaneously by means of a change-over switch on the instrument panel.

7. STARTING SYSTEM

7.1 Starting mechanisms

The engine starting is carried out by pressure air. The starting system consists of the following main assembly groups:
a) Air distributor
b) Pressure air piping
c) Starting valves on the cylinder heads.
The starting air is delivered by the type AK-50 M compressor into a pressure vessel. During starting, the pressure air is distributed by a slide valve distributor to the individual cylinders in the periods of the expansion. Thus the pistons are actuated and the crankshaft rotated. The distributor is driven by a pair of bevel pinions of r.p.m. indicator drive.
Nine steel tubes connect the ports of the distributor cover to the starting valves on the cylinder heads in the same sequence as the firing order. The starting valves are screwed down into bronze bushes in the cylinder heads. The valve is continuously forced into the seat of the housing by a spring and during the engine run it is permanently closed. Only during starting it is partly open by the effect of pressure air and releases same into the cylinder.

7.2 Adjustment of Distributor

The distributor is adjusted according to the cylinder No. 4 by means of an adjusting sleeve and the distributor disc as follows:

a) Set the piston of the cylinder No. 4 into position corresponding to the crankshaft turning by 12° after TDC during the expansion stroke.
b) The distributor disc set on the distributor cover must be adjusted in such a manner that the hole in the disc may uncover the hole of the pressure air pipe to the cylinder No. 4 approximately 1 mm in the direction of rotation of the distributor disc.

Set the cover on the distributor housing in this position. The sequence of pressure air supply to the individual cylinders: 1-3-5-7-9-2-4-6-8.

7.2.1 Replacement of Distributor

To replace the compressed-air distributor follow this procedure:

1. Disconnect all the nine pipes feeding compressed air to cylinders from the compressed-air distributor and disconnect also the pipe supplying air to the distributor.
2. Remove the locks and two nuts fixing the distributor to the engine and take the former down from the engine.

3. Remove packings and wrappings from the new distributor, and wash off the preserving grease from its outer surfaces with gasoline.
4. Remove all the preservants from inner surfaces of the distributor by the following method:
   a) Remove transport blinders from the distributor holes;
   b) Remove the distributor housing lid, holding thereby the lid gasket in its place;
   c) Remove the lid gasket, adjustable coupling, axial bearing and the slide valve c/w spring from the lid. Wash all the removed parts and the lid of the distributor housing in gasoline, dry them with a stream of compressed air and lubricate them with a thin layer of proper aviation oil.
5. Replace the slide valve c/w spring, axial bearing and the adjustable coupling into the distributor housing lid.
6. Attach the housing of the compressed-air distributor to the engine, then place a paranite gasket under the flange. To obtain airtightness, coat the gasket with some sealing preservative. Then tighten and lock the nuts fastening the distributor to the engine. Before reattaching the compressed-air distributor housing lid to the distributor housing, adjust the compressed-air distributor by the following procedure:

7.2.2 Adjustment of the Replaced Compressed Air Distributor

1. Fit the adjusting disk onto the threaded end of the shaft and fasten an indicating pointer to the front part of the engine housing.
2. Remove one spark plug from each cylinder.
3. Screw the adjusting device into the spark plug hole of cylinder No. 4 and with the aid of the device set the piston of this cylinder to a position of 12 degrees after top dead center at the expansion stroke.
4. Adjust the slide valve in the distributor lid so that its hole, which is nearer to the center, opens approximately 1 mm of the hole, through which air is fed to cylinder Nr. 4. The value of 1 mm should not be exceeded. (The other hole of the slide valve opens the compressed-air feed to cylinders No. 4, 5, 6, 7 for the purpose of removing excessive fuel and oil from cylinders by a stream of compressed air.)
5. Adjust the adjustable coupling (shiftable in grooves of the foot step bearing) so that its grooves are in line with splines of the driving shaft without changing the original position of the slide.
6. Attach the distributor lid to the distributor housing and put a paranite gasket, coated with some sealing grease on each side.
7. Slip on the lock washers, screw on, tighten and lock the three nuts fastening the distributor lid to the distributor housing.
8. Reconnect all the 9 pressure pipes feeding compressed air to individual cylinders and the pipe supplying compressed air to the distributor.
9. Remove the auxiliary adjusting disk from the threaded shaft end and the indicating pointer from the front part of the engine crankcase.
10. Screw out the adjusting device from the spark plug hole of cylinder No. 4 and replace all spark plugs.
11. Check correct assembly and compressed-air distributor adjustment by turning the engine crankshaft with the aid of compressed air.

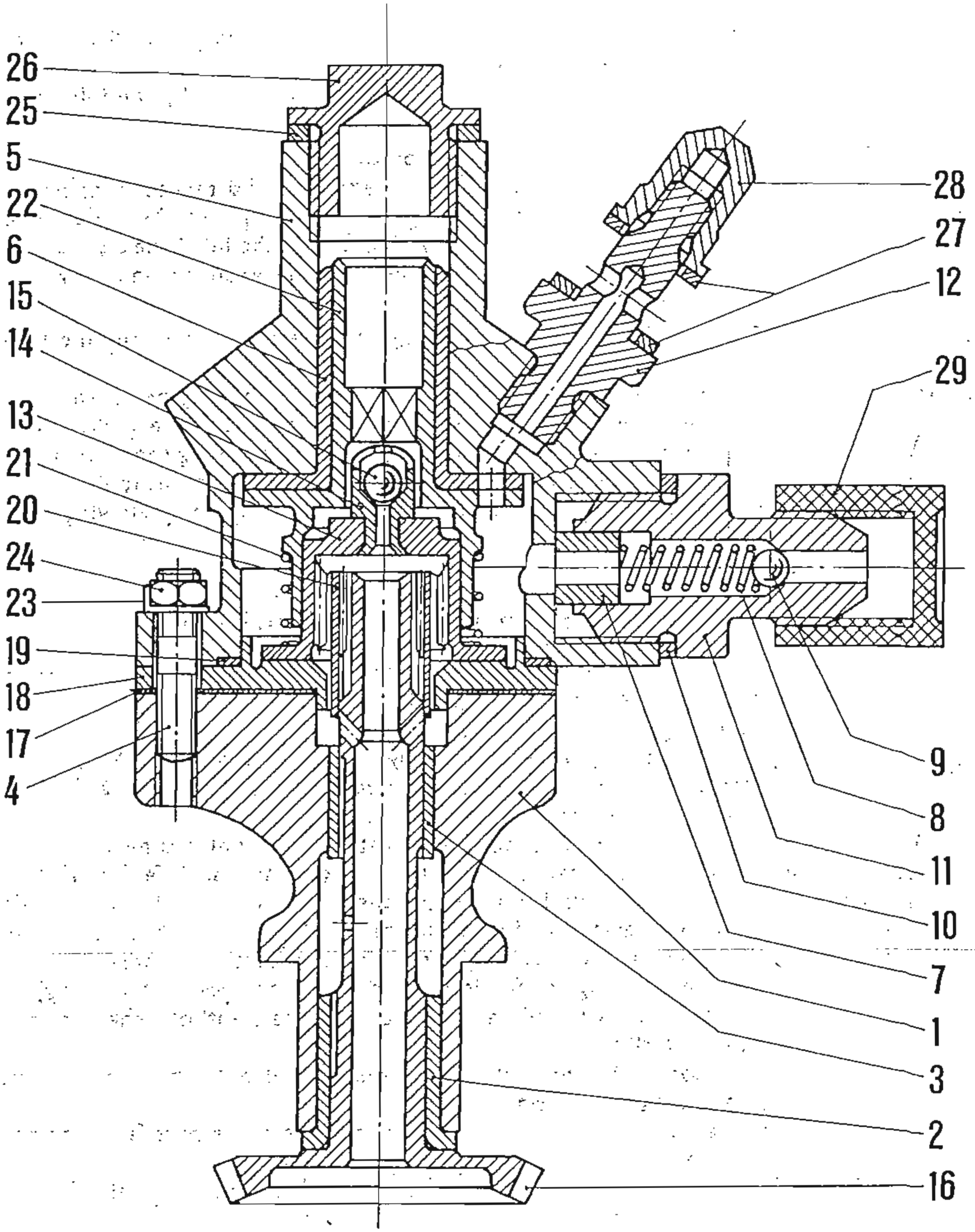

Fig. 7 — Pressure air distributor

7.3 Fuel injection during starting

During starting of the engine the fuel supply via the carburetter would be insufficient and would not safeguard uniform production of the fuel mixture. During starting, therefore, fuel is injected by the starting injection pump and by means of fuel nozzles into the inlet manifold and it is carried into the engine cylinders by the air stream.

8. ANCILLARIES

8.1 The AK-14 RF carburetter

General Data

The AK-14 RF (Figs. 8, 9 and 10) is used with the supercharged, air-cooled, nine-cylinder radial engine of the AI-14 RF model.
The carburetter is of a floatless, single-diffuser type and is equipped with a pneumatic acceleration pump for additional fuel injection and with an automatic mixture governor for governing the proper quality of combustion mixture composition in proportional dependence upon the reached flight height when climbing up.

8.1.1 Basic technical data

1. Diameter of the mixing chamber . . . . 76 mm
2. Diameter of diffuser . . . . 58 mm
3. Fuel pressure after entering the carburetter behind the fuel filter during operating processes . . . . 0.2 to 0.5 kg/sq. cm.
4. Weight of carburetter . . . . 6.0 kg
5. Adjustment of Carburetter:
   a) Suction nozzle . . . . 1.1—1.4 mm ID
   b) Air intake nozzle . . . . 2.5 mm. ID
   c) Air nozzle of idle run . . . . 2.2 mm. ID
   d) Main fuel injection nozzle . . . . 3.2—3.3 mm. ID
   e) Fuel injection nozzle of acceleration pump . . . . . . 1.5—1.8 mm. ID
   f) Air intake nozzle of acceleration pump. . . . . 0.6 mm. ID

◀ 1 — air distributor housing
2 — sleeve
3 — sleeve
4 — stud bolt
5 — air distributor cover
6 — slide valve sleeve
7 — bushing
8 — spring
9 — ball
10 — packing ring
11 — pipe union
12 — pipe union
13 — axial bearing
14 — slide valve bushing
15 — ball
16 — pinion
17 — gasket
18 — axial bearing support plate
19 — packing ring
20 — adjustable connecting branch
21 — spring
22 — air distributor slide valve
23 — tab washer
24 — nut
25 — packing ring
26 — stud bolt
27 — packing ring
28 — cap nut
29 — blinding cap (for transport only)

8.1.2 Diagram of Carburetter Operation (see Fig. 8)

Fuel being fed to the carburetter by the fuel pump passes through the fitting **26** and a fuel filter **27** into a fuel valve **29**. If this valve is open, fuel fills the governor fuel chamber. Fuel passes from the governor fuel chamber through the main fuel nozzle **5** and through the automatic needle **2** of the height governor (corrector) of combustion mixture composition into a cavity located ahead of the piston **9**, and from here through a hole in the piston **9** into a twin control element — the jet **18** and the control needle **12** — and further flows through emulsion passage holes into the carburettor mixing chamber.
The fuel flow is maintained by the fuel pressure drop between the pressure values in the governor fuel chamber and the inner cavity of the jet, further by the play between the control needle and the jet eye, as well as by the passage cross-section (inside dia.) in the needle guide of the height corrector of combustion mixture composition and by the size of the main fuel nozzle.
When the valve **16** is opened, the fuel acceleration pump feeds the fuel through a pipe **17** directly from cavity behind the fuel filter into the carburettor mixing chamber.
A pressure governor maintains constant fuel pressure in the fuel chamber (if the engine operating regime remains constant).

8.1.3 Pressure Governor Operation

The pressure governor consists of the membrane mechanism **31**. A part of this mechanism is formed by a membrane with a pivot, which is connected to a lever, acting upon the fuel valve rod **29**. Air, entering the carburettor through a nipple of the engine air intake system passes through air piping **25** and through the intake air nozzle **3** into the pressure governor air cavity. This cavity is connected by means of an air suction nozzle **4** with the inner cavity of the nozzle **18**.
With the engine stationary the fuel valve **29** is closed under the force of the lever spring. When the engine is started, negative pressure (underpressure) mounts in the nozzle cavity and in the fuel cavity, the membrane shifts to the right and opens the fuel valve.
Fuel enters the fuel cavity and increases the pressure acting upon the membrane until the force acting upon the membrane from the fuel cavity side will be equal to that one acting upon the membrane from the air chamber side.
With carburettor fixed to the engine and operating, the air pressure in the pressure governor air cavity will be proportional to that one at the carburettor intake, and its absolute value will be nearly the same.
With engine operating on a constant regime, the pressure in the pressure governor fuel cavity will be equal to the pressure in the air cavity, i.e. a constant fuel pressure at the intake of the governor control elements will be maintained.
Regardless of the negative pressure (underpressure) drop behind the throttle **23**, the negative pressure (underpressure) round the emulsion holes will rise proportionally to the setting of the throttle (the engine operating regime setting). This property can be obtained by selection of proper location and cross-section of emulsion holes.
When the pressure gradient (drop) between the air cavity and the fuel cavity changes (during operation of the carburettor), the membrane shifts and thus close or open

the fuel valve and maintain a constant fuel pressure in front of the pressure governor control elements.
By changing the opening angle of the throttle **23** (as the engine operating regime is changed), the air flow passing through the diffuser **11** changes and the number of opened holes in the nozzle also changes simultaneously; this leads to a pressure change in the nozzle **18** and thus to a change of fuel pressure drop (gradient) in the pressure governor control elements.
Simultaneously with any change of angular setting of the throttle **23** changes also the position of the control needle **12** in the nozzle eye **18** and the annular clearance between the profiled needle section and the nozzle eye changes in parallel.
Fuel flow is given by the fuel pressure gradient between the pressure governor fuel chamber and the inner cavity of nozzle by spacing between the control needle and the nozzle eye, by the available passage cross-section for fuel flow through the height-pressure compensator needle guide, and by the size of the main fuel nozzle.
The position of the control needle is precisely indicated by the position of the throttle at the respective carburettor operating regime over a system of levers, connecting kinematically the throttle to the needle.
The shaft 5 (Fig. 10) controls the relative operating positions of the control needle and the nozzle eye and, permits governing of temporary (transitive) or cruising regimes of engine operation by shifting the needle within narrow limits regardless of the throttle control lever position.

8.1.4 System of Engine Idling Run

With engine idling, i.e. with throttle lever resting against idling dog adjustment screw (approximately 9 angular degrees from position "throttle closed") all emulsion holes (except the first one and partially the second one) in jet **18** will be covered by the guide of control needle **12**. Fuel passing through the annular space between the needle and the nozzle eye enters the control needle, where is mixed with air supplied through the main air nozzle **21** and air filter **22**. The fuel-air mixture passes through the idling system hole below the idling needle **20** and through a channel into the carburettor mixing chamber. A small amount of fuel enters the mixing chamber through leaks of the nozzle and needle and through the incompletely closed emulsion holes. The composition of fuel-air mixture for the engine idle run is controlled with the needle **20**.
As the throttle opening angle increases, the idling holes in the nozzle are gradually covered by the control needle and the idling system is by-passed; emulsion holes are thereby simultaneously opened and the main control system becomes operative.

8.1.5 Main Control System

If the emulstion holes in the nozzle **18** are open, fuel having passed through the adjustable control space between the nozzle eye and the profiled section of the control needle enters into the nozzle cavity and then into the needle. Here it is mixed with air passing through the main air nozzle and through the suction nozzle (forming thus the primary emulsion) and this emulsion passes through holes in the needle and in the nozzle into the mixing chamber, where it is mixed with the main air stream.

8.1.6 Operation of the Acceleration Pump

The acceleration pump suppplies additional fuel during starting of the engine.
With engine idling a negative pressure (underpressure) step appears behind the choke valve (throttle) **23**, and this step is transferred through a pipe below the membrane of the needle valve **16** and through jet **13** into the spring cavity of the acceleration pump. When the choke valve **23** is quickly opened, the pressure below the membrane of the acceleration pump rises steeply, the membrane is subjected to a pressure difference, this opens the valve **16** and fuel is injected into the air stream. When air enters the spring cavity of the acceleration pump through the nozzle **13**, pressures in both chambers become equalized and the valve is closed by the force of the spring **15**. Another acceleration pump is arranged in parallel with the pneumatic acceleration pump. This second pump is mechanical and supplies additional fuel when the acceleration (gas) setting is changed. This additional pump can eb used during engine starting.

8.1.7 Operation of the Height Air Pressure and Mixture Compensator (Governor)

The main aim of the height air pressure mixture (governor) compensator is to maintain constant fuel mixture ratios at changing flight altitudes. As the aircraft climbs, air density decreases and this condition requires to decrease the fuel flow to maintain a constant fuel composition. This requirement is met by the height air pressure and mixture compensator.
The automatic height air pressure and fuel mixture compensator consists of height-sensitive elements: an aneroid **1**, a needle **2** and a needle guide. Profiled holes in the needle guide are covered by the needle. As the aircraft climbs, the aneroid tends to spread and this shifts the needle which covers the profiled cross-sections of fuel holes and decreases thus the fuel flow.

8.1.8 Replacement of Carburetter

1. Disconnect fuel piping, control pull-rod, fuel pressure gauge pipe and air nipple with filter and pre-heater from the carburetter fitting **5** (see Fig. 9).
2. Remove the nut locks and unscrew the nuts holding the carburetter.
3. Remove preservants from the new carburetter by the following procedure:
   a) Remove preserving grease from outer surfaces of carburetter with a brush wetted in gasoline;
   b) Remove the upper drain plug **3** (Fig. 10) and the plug **3** (Fig. 9) for measuring the initial position of the automatic height air pressure and fuel mixture compensator needle;
   c) Remove transport blinding plugs from fitting **5** (Fig. 9) of fuel supply to carburettor and from fitting **1** (Fig. 10) of fuel input pressure metering gauge;
   d) Attach the fuel delivery pipe of the hand-operated fuel pump to fitting 5 (Fig. 9);
   e) Set the throttle control lever to full throttle;
   f) Open the fuel valve. Do this by removing plug **10** (Fig. 9) from the hole for the carburetter cavity air pressure metering gauge and feed air compressed to O2 kg per sq.cm. into the cavity;
   g) Pump clean gasoline through the fitting **5** at a pressure of 0.5±0.2 kg per sq.cm., until gasoline starts to leak through the holes from which plugs have been removed, then reput the plugs to place and proceed to pump until gasoline appears in emulsion jet holes. At this operation shift the throttle control lever about 3 to 4 times from stop to stop. Do not collect the outflowing gasoline;