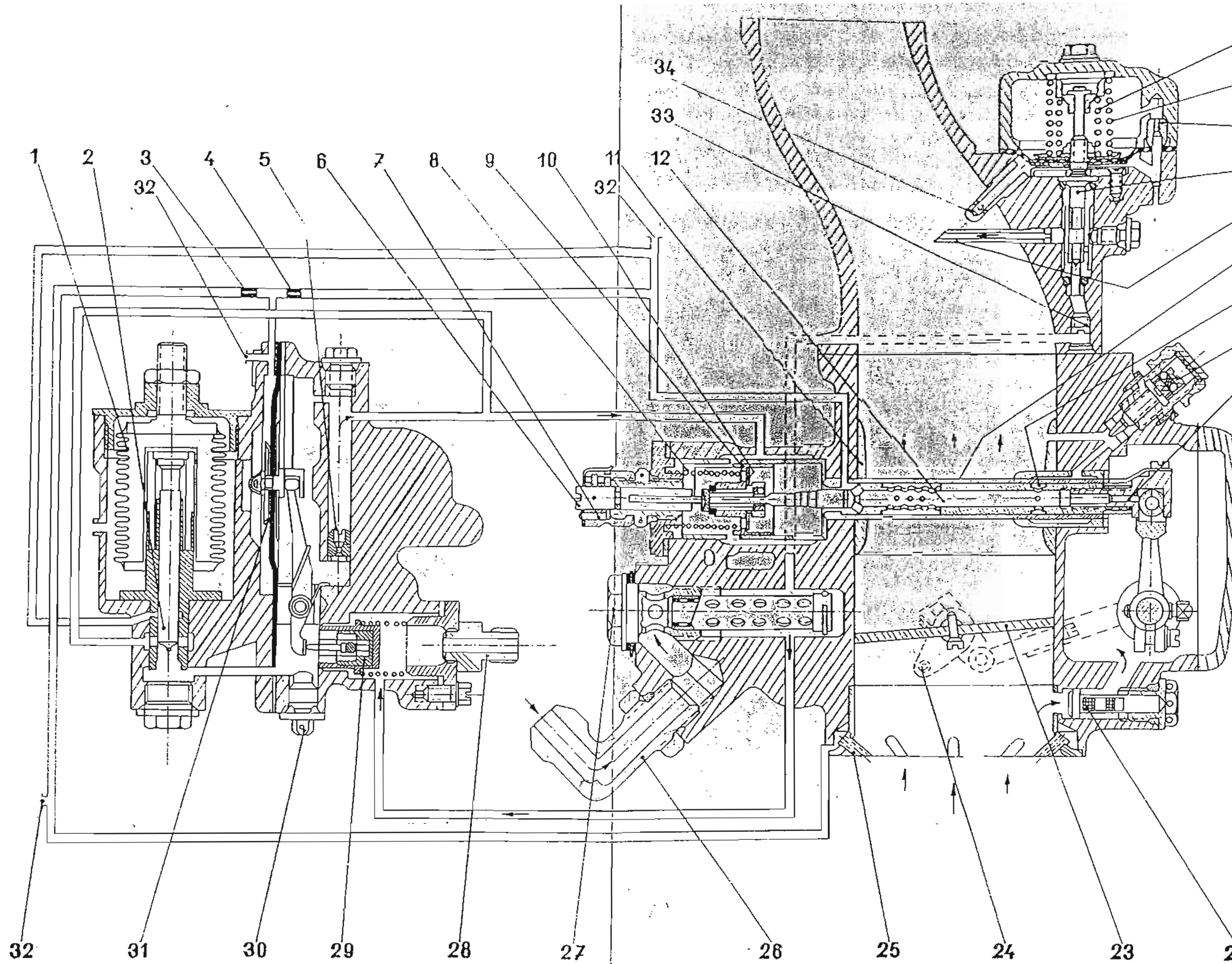

Fig. 8 — Diagram of the AK — 14 RF Carburetter

1 — aneroid (pressure equalizing box) of the automatic height pressure compensator (equalizer)
2 — height-pressure compensator (equalizer) needle
3 — intake air nozzle
4 — suction nozzle
5 — fuel nozzle
6 — adjusting screw of control needle
7 — adjusting screw travel limiter
8 — spring
9 — valve
10 — valve
11 — diffusor
12 — control needle
13 — air nozzle
14 — inner spring
15 — outer spring
16 — pneumatic acceleration pump needle valve c/w membrane
17 — pipe of pneumatic acceleration pump
18 — jet
19 — hole into idling channel
20 — idler adjusting screw
21 — idling air jet
22 — air filter
23 — throttle
24 — throttle (choke) operating lever
25 — dynamic pressure pipes
26 — fuel supply fitting
27 — fuel filter
28 — connection fitting for fuel pressure metering gauge
29 — fuel valve
30 — drain plug
31 — membrane machanism
32 — connection fitting for air pressure metering gauge
33 — fuel nozzle
34 — pipe for air pressure gauge

h) Put on, tighten and secure the plugs previously removed;

i) To remove preserving grease from the carburetter air system pump clean gasoline through the holes of plug **10** (Fig. 9) of the aneroid cavity at 0.1 kg per sq. cm. pressure. Keep the throttle fully open during this process;

j) Pour out the rests of fuel through the holes of plug **10** (Fig. 9) of the membrane chamber and blow them out with dry compressed air at 0.2 kg per sq. cm. pressure. Then reattach and secure the plug.

k) Check the holes of the aneroid cavity venting plug **11** (Fig. 9) for cleanliness. If any grease in the holes is found, remove the plug, clean it and the holes with gasoline, reassemble and secure the plug.

l) Check the cleanliness of the air vent hole **K** (Fig. 10). If any grease has been found in the hole, clean it with a wire of 0.2 mm dia., disconnect fuel pipe from the fitting **5** and attach transport blinding plugs to this fitting and to fitting **1** (Fig. 10).

m) Wipe off outside surfaces of carburetter with a clean cloth.

4. Check the initial position of the height air pressure and fuel mixture compensator needle by the procedure described herein in the paragraph "Height air pressure and fuel mixture compensator adjustment", and if the found position differs from that required by the barometric diagram, adjust duly the needle position.
5. Check the carburettor flanges and fuel mixture collectors for dents and fit a new gasket onto the carburettor flange.
6. Fit the carburettor to the fuel mixture collector, tighten equally the nuts and lock them.
7. Attach to the carburetter:
   — throttle control rod,
   — fuel piping to the fuel supply fitting **5** (Fig. 9),
   — fuel pressure gauge pipe (Fig. 10) to the fitting **1**,
   — the air scoop c/w air filter and pre-heater.
8. Check all fuel pipe joints for air-tightness. Tighten perfectly all leaking joints. No untightness is permissible.
9. Oil all articulated joints, check and remove eventual plays, check free travel of throttle control lever from idling to full throttle positions.
10. Start the engine, check air-tightness and correct functioning of the carburetter at all engine operating regimes; if any leak is detected adjust properly the carburetter.

8.1.9 Carburetter Adjustment

The carburetter is adjusted with engine prewarmed-up and with fuel inlet pressure set to 0.2 to 0.5 kg per s.q cm.

A. Idling Speed Adjustment

1. Check the ignition system, adjust the idling speed to 500 to 600 r.p.m. and warm up the engine.
2. The quality of combustion mixture for engine idling is adjusted by the idling adjusting needle **4** (Fig. 10). When turning the adjusting screw clockwise, the mixture is starved and when turning the screw counterclockwise, the mixture is enriched.

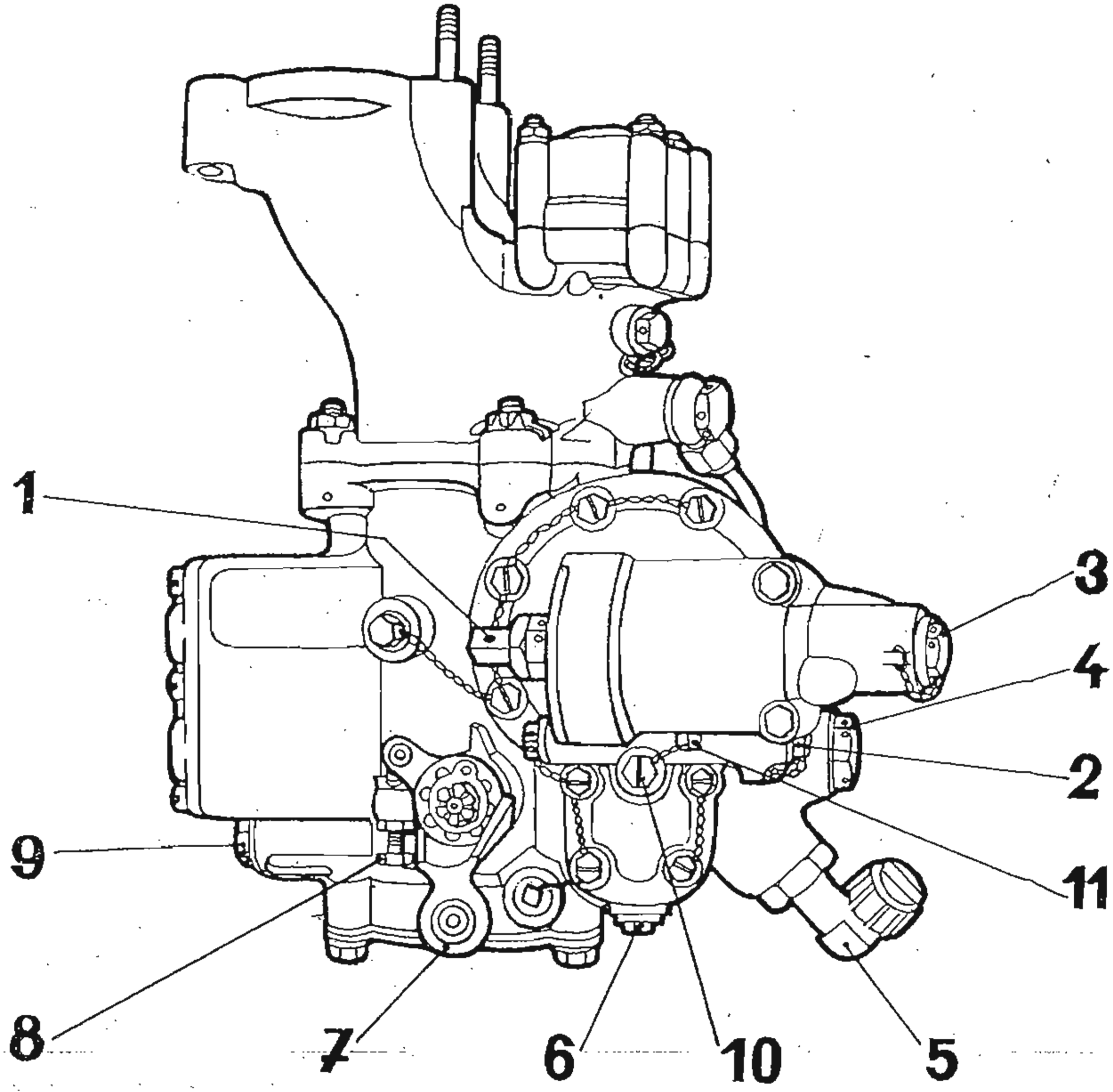

Fig. 9 — General Appearance of the Carburetter
(View from the side of the pressure governor lid)

1 — Screw for adjustment of automatic height-pressure compensator (equalizer) needle position
2 — Plug of suction nozzle
3 — Plug of automatic height-pressure compensator needle initial position metering gauge
4 — Fuel filter
5 — Fitting for fuel supply pipe
6 — Bottom drain plug
7 — Choke throttle control lever
8 — Stop screw of choke (throttle) control lever at idle run
9 — Air filter
10 — Plug of air pressure metering gauge in pressure governor air chamber
11 — Air-bleeding plug of aneroid cavity

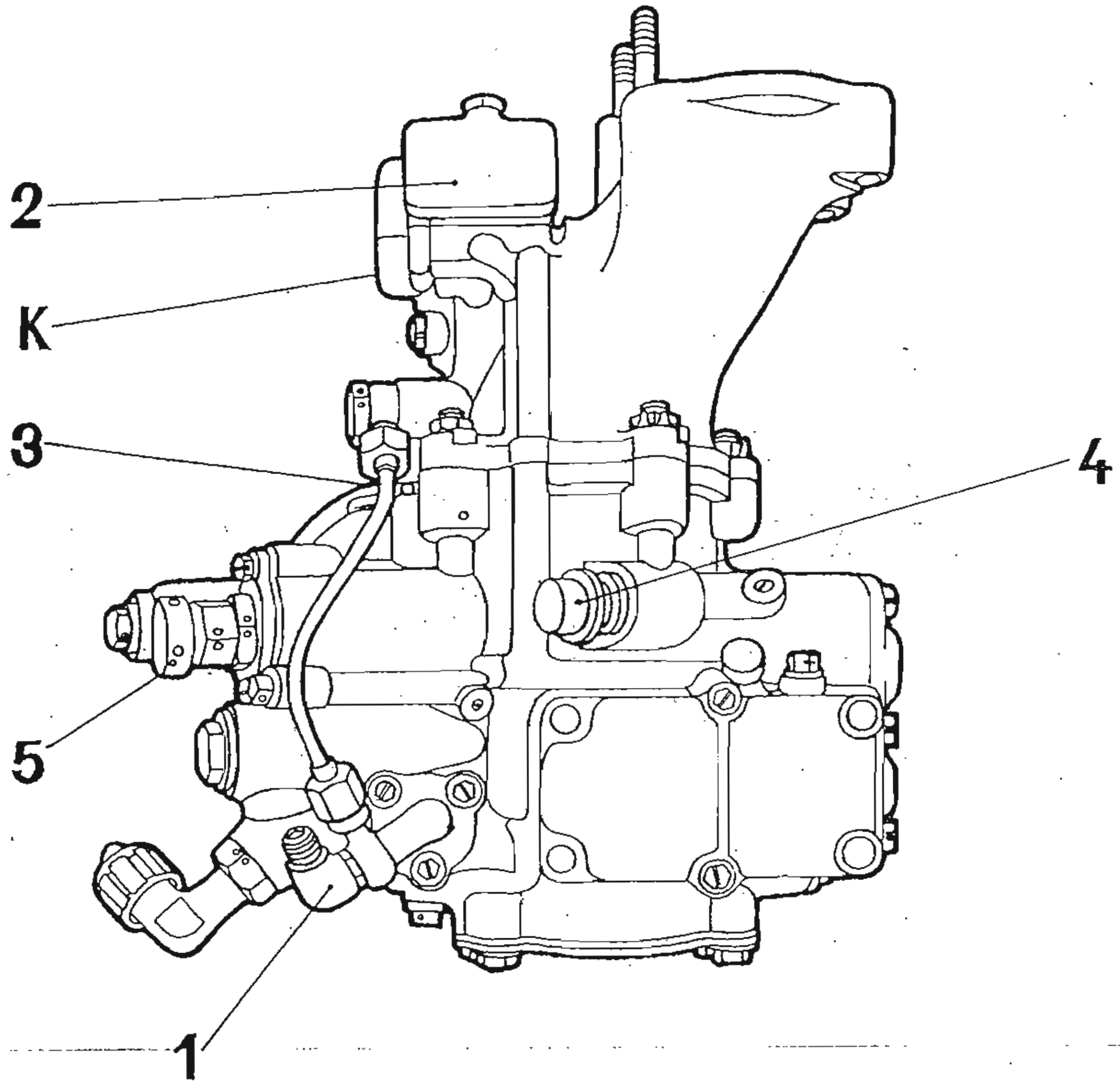

Fig. 10 — General Appearance of the Carburetter
(View from the side of the gate chamber)

1 — Fitting for fuel pressure gauge metering at carburetter intake
2 — Acceleration pump lid
3 — Upper drain plug
4 — Idler needle
5 — Shaft for cruising regime adjustment
K — Air bleeding hole

3. The engine idling speed is adjusted by turning the throttle control stop screw **8** (Fig. 9). When turning this screw clockwise, the engine speed increases and when turning the screw counterclockwise, the engine speed decreases.
4. Final idling speed adjustment is carried out after engine operating regimes have been adjusted.

B. Adjustment of Basic Operating Regimes

Compare the fuel consumption at all engine operating regimes with that at "take-off" operating regime. If the actual fuel consumption differs from values rated in technical specifications, readjust the carburettor by the following procedure:

1. Adjust the engine regime in "take-off" and "max. continuous output" of the engine (full throttle, choke valve fully open) by selecting a suitable ID size of the suction nozzle **4** (Fig. 8). It is permissible to use nozzles of 1.1 to 1.4 mm. As the nozzle diameter is increased, the mixture grows poorer and as it is decreased, the mixture is enriched. An 0.1 mm change in jet inside diameter corresponds to 10 to 15 g/hp/hr. specific fuel consumption at "take-off" regime of engine operation. At cruising regime of the engine speed has the ID of nozzle no influence.
2. The adjustment for cruising is carried out by changing the initial position of the control needle with the help of the control shaft **5** (Fig. 10).
   Carburettors are adjusted with engine being shut off. When turning the spindle clockwise, the mixture grows enriched and when turning the spindle counterclockwise, the mixture is being starved.
   The spindle can be turned at most one half a turn from its initial position to any side. One click of the needle control spindle changes specific fuel consumption by 7 to 10 g/hp/hr.
   After adjustment of the regime "cruising output" is to be checked the control point at the regime "max. continuous output".

C. Adjustment of Height Air Pressure and Fuel Mixture Compensator (Governor)

1. It is permitted to readjust the height air pressure and fuel mixture compensator only if the initial position of the compensator needle does not correspond to the barometric chart, before any installation of a new carburettor onto the engine and after every 100 hour service period.
2. The position of the height air pressure and fuel mixture compensator needle is checked by the following procedure:
   a) Remove the plug **3** (Fig. 9) from carburettor and measure the true initial position of the needle with a special gauge or a depth meter (value "A" in Fig. 11).
   b) Find the correct initial position of the needle according to the barometric diagram (value "A", Fig. 11).
3. If the value "A" established by measuring does not correspond to that required according to the barometric diagram, adjust the height air pressure and fuel mixture compensator by means of the adjusting screw **1** (Fig. 9) of the aneroid after having first unscrewed the lock nut. To decrease the value "A", turn the aneroid

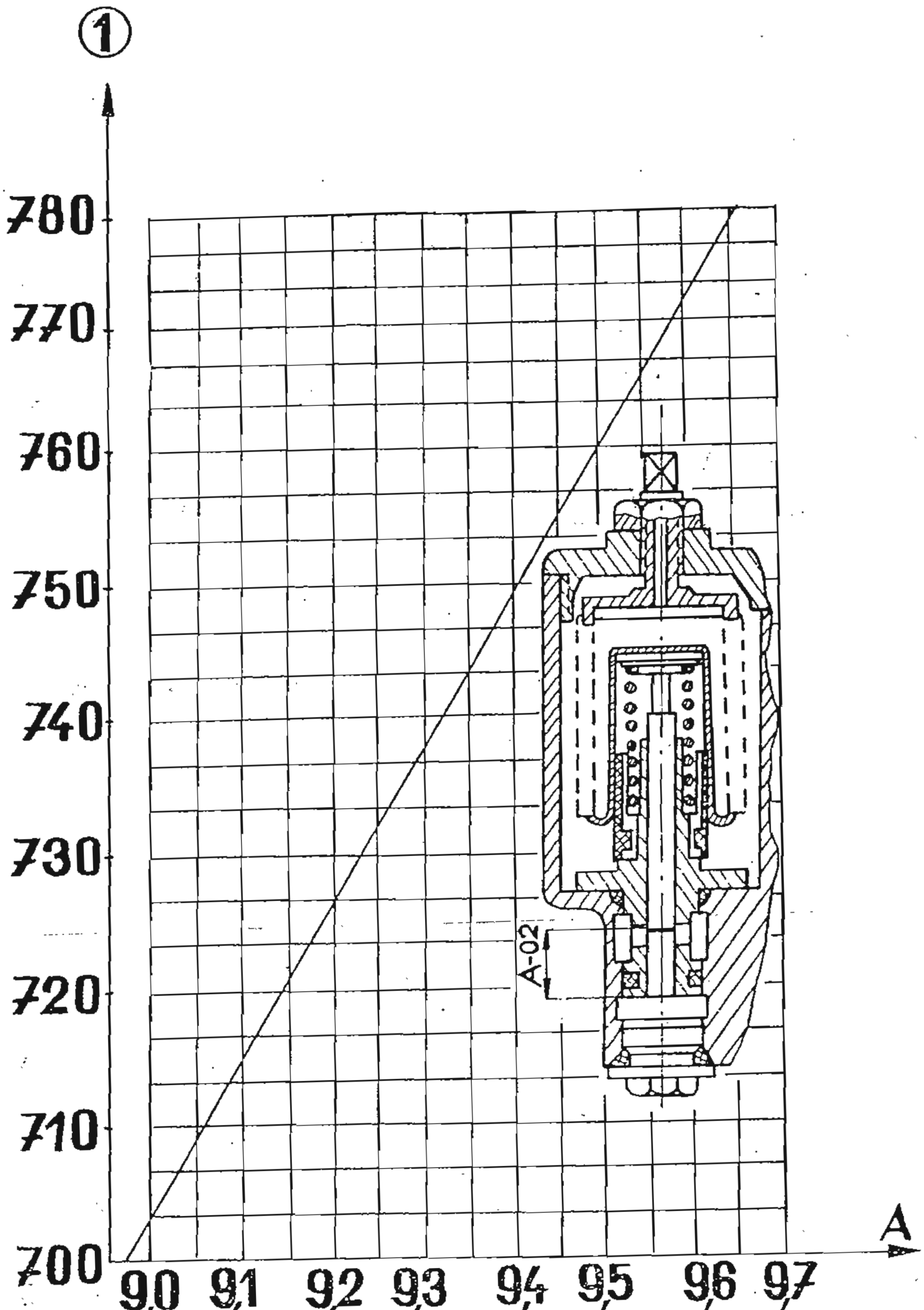

Fig. 11 — Diagram of Adjustment of the Height Air Pressure and Fuel Mixture Compensator Needle Position in Reference to Barometric Pressure (Barometric Diagram)
1 — mm of mercury column A — Ajdusting range

adjusting screw clockwise and to increase the value "A", turn the screw counter-clockwise. Each turn of the adjusting screw corresponds to a change of the value "A" of **1** mm.

4. Then take another check of the correct needle position and height air pressure fuel mixture compensator adjustment, prelace and lock the plug **3** (Fig. 9), secure the aneroid adjusting screw **1** (Fig. 9) with a lock nut and wire. Make en entry about the adjustment into the carburettor log book.

Note: If the air system of the carburettor is soiled (this changes the fuel consumption), the carburettor is to be washed with LBZ-72 gasoline and cleaned through by a stream of compressed air regardless of maintenance and overhaul periods. Thus should be cleaned both the height air pressure fuel mixture compensator needle and the air nozzles.

8.2 The M-9-35° magneto

A four-spark, screened magneto with automatic changing of ingition advance and a single-electrode distributor arm.

8.2.1 Basic technical data

1. Direction of rotation of magneto rotor . . . . to the left
2. Magneto operates regularly under load within the range of . . 600 to 3200 r.p.m.
3. Characteristics of automatic advanced ignition:
   a) Angle of change of the instant of ignition by the automatic device (on magneto rotor) . . . . 35°±2°
   b) Range of automatic device operation within the rotor speed . . . . 800 to 1800 r.p.m.
4. Data for adjustment:
   a) Clearance between the contacts of the contact breaker . . 0.25 to 0.35 mm
   b) Pressure on the contacts of the contact breaker. . . . . . . 650±100 g
   c) Angle of adjustment from the middle position to the instant of breaking of the contact of the contact breaker . . . . . 13 to 16°
5. Maximum weight of magneto . . . . 5.4 kg

8.2.2 Fitting magneto on engine

The magneto is fitted on the engine adjusted to retarded ignition in order to improve starting and idling operation of the engine. At higher speeds the advanced ignition is secured by means of the automatic ignition adjustment.

The automatic ignition adjustment ensures the change of advanced ignition within a range of 35°±2° on the mangeto rotor. The actual angle of adjustment of each of the magnetos is given in its certificate and is stamped on the rear lid. The total ignition advance for both magnetos is $\alpha_c = 30° \pm 2°$ before TDC in the compression stroke. The adjustment of the magneto on the engine must be carried out according to the cylinder No. 4 (the cylinder with the main connecting rod). The adjustment angle α_n of the advanced ignition is determined for the magneto by calculation from the formula:

$$\alpha_n = \alpha_c - \alpha_z \quad \text{where } \alpha_z = \frac{\alpha_a}{p}$$

α_a = angle of automatic adjustment of advanced ignition stamped on the mangeto lid.

$$p = \frac{n_r}{n_z}$$

n_r........speed of magneto rotor
n_z........speed of crankshaft

If the angle $\alpha_z > \alpha_c$ then the angle of the magneto adjustment is in the expansion stroke, if $\alpha_z < \alpha_c$ then it is in the compression stroke.

Example: The engine is to be provided with a magneto, which has the angle of 36° stamped on the lid. By conversion to the angle of displacement of the crankshaft the following values are obtained:

$$\alpha_z = \frac{36°}{1.125} = 32°$$

The adjustment angle thus will be $\alpha_z = 30° - 32° = -2°$, i.e. 2° in the expansion stroke.

The Table below contains the calculated adjustment angles of the magnetos according to the value of the maximum angle of the automatic adjustment of advanced ignition stamped on the magneto lid.

Tab. 1

Maximum angle of automatic adjustment of advanced ignition stamped on the magneto lid	Adjustment angle of magneto	
	Angle of displacement of crankshaft	Angle of displacement of propeller shaft
32°	1.5±1 before TDC	1.2±0.5 before TDC
33°	0.5±1 before TDC	0.4±0.5 before TDC
34°	0.0±1 TDC	0.0±0.5 TDC
35°	1.0±1 after TDC	0.8±0.5 after TDC
36°	2.0±1 after TDC	1.5±0.5 after TDC
37°	3.0±1 after TDC	2.3±0.5 after TDC

The following is the procedure for the magneto mounting on the engine:

1. Set the adjustment disc with the scale on the propeller shaft.
2. Adjust TDC at the 4th cylinder by means of a fixture and determine the position of the propeller shaft by means of the adjustment disc and an indicator mounted on the reduction gear box.

3. Dismount the distributor off the magneto and according to the angle stamped on the flange of the magneto housing determine the value of angle of adjustment applicable to the propeller shaft with the aid of Table I.
4. Adjust the determined angle with the aid of the adjustment disc by turning the propeller shaft.
5. Prior to mounting the magneto on the engine adjust the magneto cam in such a manner that the contacts of the contact breaker start to breake during turning of the follower in the direction of the arrow. The cam edge marked "1" starts to break the contacts, when the electrode of the follower is exactly against the figure "1" marked on the flange of the magneto housing. This position corresponds to the spark production in the cylinder No. 4. In this position the magneto must be mounted on the engine. Do not fully tighten the nuts for the fastening of the magneto.

   Note: If the operating electrode of the follower is adjusted against the mark on the flange of the housing and the lugs of the shaft carrier are not in line with the grooves of the rubber coupling of the drive, the carrier bolts must be loosened and the carrier must be turned to engage the grooves of the rubber coupling, while the follower is held against rotation. Then the magneto can be mounted.

6. Insert a 0.03 mm clearance gauge between the contacts of the contact breaker and turn the propeller shaft against the direction of rotation by 10 to 15°. Then turn the shaft in the direction of rotation and check the beginning of contact breaking on the adjusting disc. It must occur when the propeller shaft is turned to a value corresponding to that given in Tab. 1. The clearance between the contacts must be 0.25 to 0.35 mm.
7. The adjusted and checked magneto can be bolted definitely on the engine.
8. Cover the magneto with the lid, check its setting and verify its screening and do not omit the following:
   a) Check if the high-voltage lead passes to its bed in the distributor cover.
   b) Check if the distributor cover is correctly set on the key.
   c) Check if the distributor cover contains the damping rubber blocks and the carbon brush.
   d) Test the securing of fastening of the screened leads in the ramp.

8.3 The SD-49 SDM Spark plug

The SD-49 SDM spark plugs are used on the engine. They are dismountable, screened and provided with a ceramic insulation of the middle electrode.

8.3.1 Basic technical data

1. Max. pressure in the space of sparking gap of the plug for regular sparking . . . . 15 kg/sq.cm.
2. The spark plug must not show air leakage up to a pressure of. . . . . 40 kg per sq. cm.

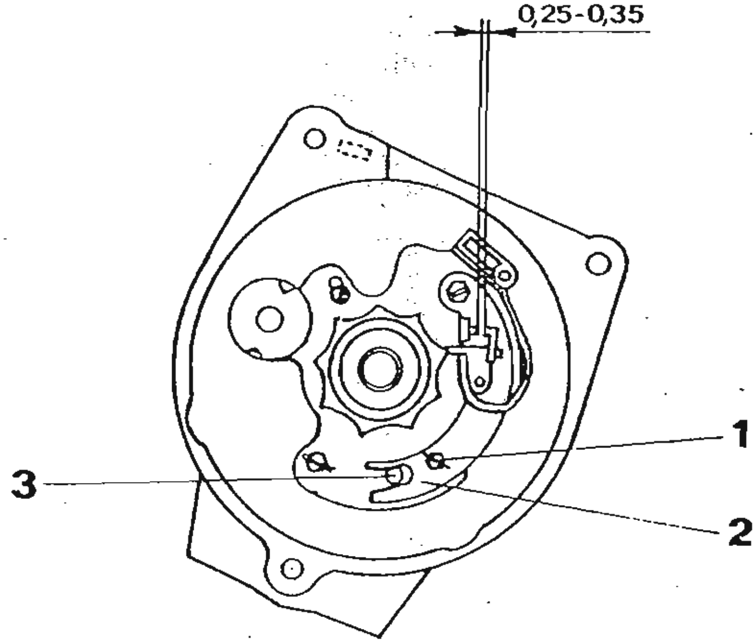

Fig. 12 — Adjustment of contact clearance of contact breaker

1 — Screw holding the adjustment plate
2 — Adjustment plate
3 — Eccentric

3. Test voltage for testing the spark plug insulators . . . . . . max. 16 kV
4. Thread of spark plug end for screwing down into cylinder head . . . . M 14×1.25

8.4 The X 52 — 9086.17 Generator

A four-pole shunt-wound generator without commutation coils. It operates reliably with the LUN 2168 regulating relay, which maintains a constant voltage at various speeds and various generator loads. The generator is of an enclosed design with forced cooling by atmospheric air, which flows through the inner space of the dynamo.

8.4.1 Basic technical data:

1. Rated voltage . . . . 28 V
2. Operating voltage . . . . 27.5±1 V
3. Rated output . . . . 1500 W
4. Rated current . . . . 54 A
5. Excitation current at 27.5 V, 1500 W and 4700 r.p.m. . . . . max. 1.55 A
6. Five-minute output at 6500 r.p.m. . . . . 2250 W
7. Minimum speed . . . . 4700 r.p.m.
8. Medium operating speed . . . . 7300 r.p.m.
9. Maximum speed . . . . 8200 r.p.m.
10. Direction of rotation . . . . to the left

11. Volume of cooling air at output of 1500 W . . . . 30 lit. per sec.
12. Temperature rise of cummutator . . . . 75 °C
13. Temperature rise of excitation winding . . . . 55 °C
14. Efficiency . . . . approx. 72 %
15. Operation mode . . . . long-term
16. Weight of generator . . . . max. 9400 g
17. Minimum engine speed for generator function (milking) . . 1880 r.p.m.

8.5. Type AK-50 M air compressor

The two-stage compressor is intended for the generation of pressure air for starting of the engine and control of other aircraft equipment.

8.5.1 Basic technical data

1. Diameter of 1st stage cylinder . . . . 46 mm
2. Diameter of 2nd stage cylinder . . . . 40 mm
3. Piston stroke . . . . 20 mm
4. Stroke of the suction overflow valve and discharge valve . . . 0.7 to 1.1 mm
5. Operating pressure of compressor . . . . 50 kg per sq. cm.
6. Velocity of air cooling the compressor . . . . min. 20 m per sec.
7. Cylinder temperature . . . . max. 110 °C
8. Time of charging a 12 lit. steel cylinder to pressure of 50 kg per sq. cm at compressor speed 1800 r.p.m.. . . . . max. 26 min.
9. Weight of compressor . . . . 3 kg

8.5.2 Functional description of compressor

The piston is connected to the eccentric shaft of the compressor by means of a connecting rod. During the downward piston motion the volume of the chamber of the 1st stage cylinder is increased, an underpressure is formed in same and at the same time the volume in the chamber of the 2nd stage cylinder is reduced.
Air compressed in the chamber of the 2nd stage cylinder opens the discharge valve and flows into the pressure vessel. The underpressure in the chamber of the 1st stage cylinder actuates the opening of the suction valve and admission of atmospheric air. During the upward piston motion the volume of the chamber of the 1st stage cylinder is reduced and underpressure is formed in the chamber of the 2nd stage cylinder. Owing to differential pressures in both cylinders the overflow valve is opened and pressure from the 1st stage cylinder flows through the ports in the piston to the 2nd stage cylinder.
During the subsequent downward motion of the piston the overflow valve is closed, air in the 2nd stage cylinder is compressed and then the discharge through the air-duct to the pressure vessel follows.

8.6 The 702 ML Fuel Delivery Pump

Fuel is fed to the engine via the fuel delivery pump and the carburetter, which are both mounted on the engine. While the engine is operating, the fuel delivery pump delivers fuel from fuel tanks through filters into the carburetter, where it is subjected

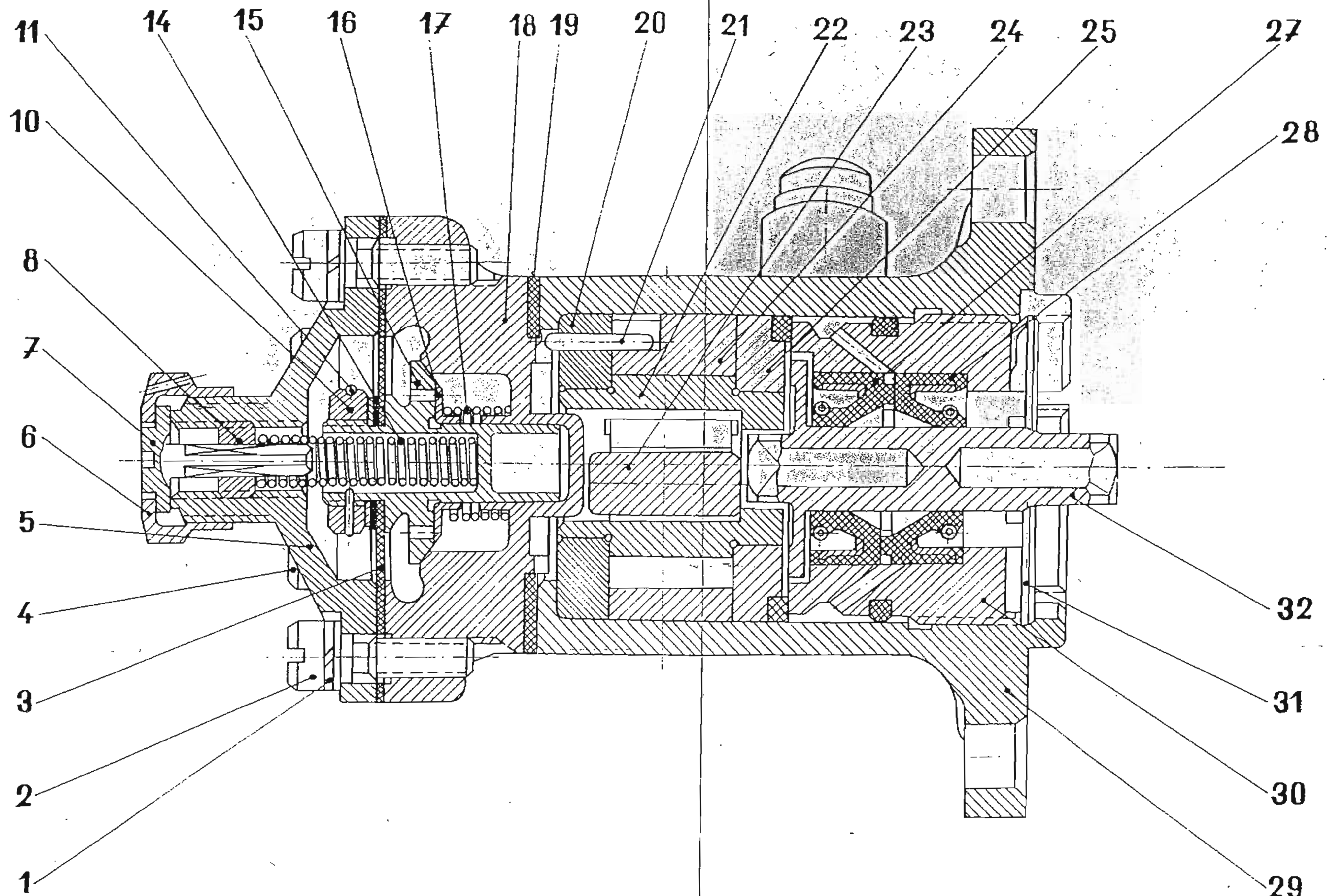

Fig. 13 — The 702 ML Fuel Delivery Pump

to carburation and in form of a prepared combustion mixture is fed into the engine supercharger. The combustion mixture passes through the supercharger, feed pipes, intake valves and enters the combustion space of the engine proper.
The fuel delivery pump is fixed to the bottom flange of the oil pump housing by four studs. The fuel delivery pump impeller is driven by a square extension (stem), which fits into a square recess in the oil pump spindle.

8.6.1 General Technical Specifications of the Fuel Delivery Pump

1. Sense of drive rotation . . . . counterclockwise
2. Fuel pump impeller rotation speed:
   — peak speed, maximum for 30 seconds only . . . . 3040 r.p.m.
   — rated speed . . . . 2470 r.p.m.
   — minimum speed . . . . 200 r.p.m.
3. Working liquid to be used . . . . aviation gasoline
4. Peak permissible pressure at compression border line . . . . 1.0 kg/sq. cm.
5. Dry weight of fuel delivery pump . . . . 600 grammes maximum

8.6.2 Design of the Fuel Delivery Pump

The fuel pump (Fig. 13) of the rotary type has four, mutually perpendicular impeller blades. These blades rest with one side against a floating pivot and with their other side against the inner surface of the pumping mechanism jacket. The jacket chamber is cylindrical.
The fuel delivery pump can be easily adjusted for operation in an opposite sense of rotation by turning the disattachable pressure reduction chamber through 180 degrees. There is no need to adjust the position of the pumping mechanism.
The design of the pressure reduction mechanism provides necessary fuel pressure at the compression border line and permits fuel to pass through the pump when flooding the main fuel piping of the engine before starting up the engine.
A pressure reducing valve with a flat rubber membrane compensates pressure automatically in dependence on the aeroplane climbing and on changes of fuel level in fuel tanks.
The pump housing consists of three separate parts: the pumping gear housing, reduction valve housing and the reduction valve lid.
The pumping gear housing **29** is made of an aluminium alloy. Two lugs in the central part of the housing are drilled and threaded. The thread is metric, its size is M 14× 1.5 mm. The fuel inlet and outlet pipe fittings are attached to these lugs.
A flange with threaded lugs fastens the pressure reduction chamber housing to the pump housing and another flange with four holes fastens the pump to the engine.
At the flange side, whereby the fuel pump housing is attached to the engine, is a turned recess wherein is fitted the pumping gear.

The pumping mechanism (gear) consists of the following parts:

A case-hardened steel jacket **24**, a case-hardened steel impeller wheel **22**, journals of which are carried in foot step bearings — the bottom bearing **29** and the upper one **25**, further a hardened steel floating pin **23** and four blades, moving in the impeller wheel grooves (see Fig. 13).

The pumping mechanism is fastened by the gland nut **30.** The position of the pumping mechanism in the pump housing is secured by a pin **21.**
A square of the removable case-hardened stem-type coupling **32** is powered by the engine and drives the fuel pump impeller wheel. Th coupling shoulders resting by its one ground face against the upper foot step bearing **25** of the pumping gear and with its other face against the gland nut, limits the range of the stem-type coupling axial displacement. To prevent fuel leakage around the coupling, it is sealed by a strengthened rubber cuff **27,** which is pressed into the gland nut **30.**
To prevent engine oil leakage from the pump drive gear around the coupling, there is another strengthened rubber cuff **28** pressed into the gland nut **30.**
Channels drilled in the gland nut **26,** connecting the inner space of the gland with the oil leakage inspection pipe union, serve for oil outlet and oil leakage inspection.
A steel wire retaining ring **31** locks the nut **30** against loosening during operation of the engine. One end of the retaining ring fits into gland nut grooves and its other end into the grooves of the pump housing fastening flange (shoulder).
The pressure reduction chamber housing **18** made of an aluminium alloy, is attached to the flat flange of the pumping gear housing, which is provided with a turned recess for the reduction valve housing shoulder. Joint surfaces of the pumping gear housing flange and of the pressure reduction chamber housing flange are sealed by a paranite gasket **19.**
The pressure reducing valve assembly consists of the steel valve proper **15,** a flat rubber membrane **3,** a pad, a fixing nut **10** and of the lock **11.**
A supply valve, consisting of the duralumin supply valve proper **16** and of a spring **17,** is attached to the cylindrical guide of the pressure reducing valve.
The cylindrical section of the pressure reducing valve fits into a hole in the chamber housing lug guide, and its tapered section rests against the sharp edge of the pressure reduction chamber housing seat.
The membrane is attached to the face of the flange by the pressure reduction chamber housing lid **5** (made of an alluminium alloy) — which is fastened by six screws **2** and **4** provided with lock washers **1.**
The hollow section of the pressure reducing valve holds a spring **14,** one face of which rests against the valve bottom surface and its other face rests against the adjusting screw **8** located in the chamber lid.
The spring tension is adjusted by turning the adjusting screw head **7.** The head of this adjusting screw is fixed by a cap nut **6.**
A vent in the pressure reduction chamber lid connects the space above the membrane directly with outdoor environment.
The pump is provided with a profile flange with four holes, which permit the pump to be attached to the engine in four different positions, spaced 90° degrees apart. This system permits to select the optimum pump position in regard to the fuel delivery piping installation.

8.6.3 System of Fuel Pump Operation

The pump impeller wheel with its four vanes (blades) and the floating pivot forms a rotary system, which subdivides the inner space of the pump housing into four sections: A, B, C and D (see Fig. 14). As the pump impeller is positioned eccentrically in respect to the inner space of the pump housing, the volumes of sections A, B, C and D change continuously in dependence upon the pump impeller rotation.

An underpressure is generated in volume-expanding sections A und B and fuel is sucked in through the fitting E while the pump impeller is rotating, whereby the volume of sections C and D is just decreasing and fuel is pushed out through the fitting F. Pressurized fuel is supplied into the carburettor.
When utilizing full fuel pump output, the pressure reducing valve, actuated by the spring, seals the chamber of the pumping gear housing and all fuel is delivered into the fuel pressure piping F.
If fuel flow decreases, the air pressure in the pressure chamber is getting increased and acts upon the pressure reducing valve, lifts and simultaneously compresses its spring. As a result of this, part of the delivered fuel passes through the pressure reducing valve hole to the intake side, and the volume of supplied fuel is automatically

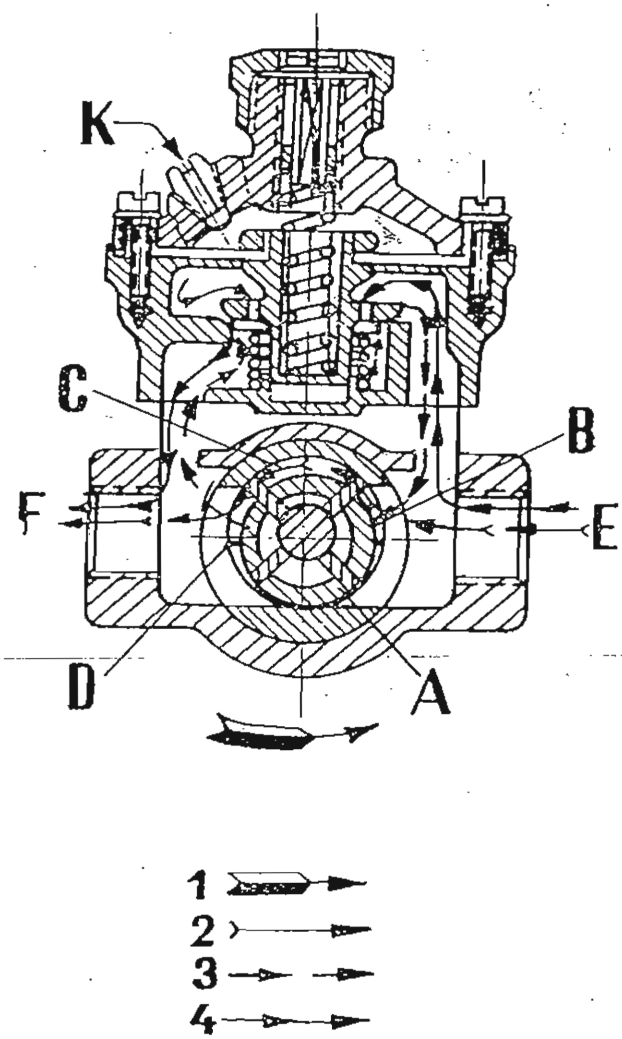

Fig. 14 — Diagram of Fuel Pump Operation

1 — sense of fuel pump impeller rotation
2 — fuel supply from tank to carburettor
3 — excessive fuel
4 — fuel during flooding the fuel supply system

getting decreased. If the gasoline flow in the fuel pressure piping is interrupted, all fuel is returned to the intake side and the pump begins to operate in a closed circuit (i.e. on idling run).
The pressure of fuel in the main fuel pressure piping is regulated by alteration of the compression power of the pressure reducing valve sping, i.e. by tightening or setting back its adjusting screw.
To increase the pressure of fuel, remove the cap protecting the head of the adjusting screw and turn the screw head clockwise. The adjusting screw will thus compress the valve spring and this will press the valve down into its seat with a greater force.
On the other hand, to decrease fuel pressure, turn the adjusting screw countre-clockwise. This will loosen the spring and decrease its pressure onto the valve. Having the fuel pressure adjusted to the required value, protect the head of the adjusting screw by putting-on and tightening-up its cap nut by means of a wrench and securing it with wire.
Every climbing of the air-craft and dropping of fuel level in fuel tanks is accompanied by increasing of the underpressure on the pump intake side. However, as pressure above the pressure reduction chamber membrane, as well as in the fuel pump feed piping and in the air chamber of the carburettor membrane mechanism drops simultaneously, the feed pressure remains within a correct operating range up to a certain height.
A spring will force the feed valve to the plate of the pressure reducing valve and thus seal its hole.
If the hand-operated fuel pump of the fuel feed system is installed ahead of the fuel delivery pump and is operated before starting the engine, the fuel floods the space above the pressure reducing valve, it develops a force upon the feed valve through the holes in the pressure reducing valve plate, forces the spring down thus gain entrance into the pressurized section of the fuel feed system.

8.6.4 Replacement of Fuel Pump

When replacing the 702 ML fuel delivery pump, follow this procedure:

1. Check whether the new pump rotates counterclockwise. The marking "Inlet" stamped on the reduction chamber of the fuel pump housing must be always turned towards the intake hole. If the pump has been assembled for counterclockwise rotation, the stamped marking "Inlet" ("VSTUP") and the fuel inlet hole must be positioned on the left side, when facing the fuel pump drive and the pump housing is held with the data plate upwards. If the pump is assembled for clockwise rotation, change this setting to counterclockwise rotating by replacing the reduction chamber housing through 180 degrees.
2. Disconnect the fuel system pipe. Screw off the four nuts fixing the fuel pump and take off the fuel pump from the engine.
3. Inspect and clean carefully the bearing surface of the flange and the fuel drive shaft shank. If any dents have been detected, file them flat carefully.
4. Before attaching the new fuel pump to the engine, remove all preservants by the following procedure:
   a) Remove the packings and wrappings, remove blinding plugs from holes and wash off all the grease from the outer surfaces of the pump housing with gasoline.

b) Immerse the fuel pump into a vessel containing clean gasoline (LB-72) and wash out the inner space of pump housing and by turning the fuel pump drive shaft clockwise as a counterclockwise rotation would force grease into the reduction chamber).

5. Wipe off and inspect carefully the pump flange, the centering surface and the shaft extension (shank). Check them for eventual dents and remove them if found any ones.
6. Insert the gasket between the pump flange and its seat on the engine.
7. Fit the pump so that the shank of the drive shaft seats freely in its recess (bedding).
8. Then slip washers over studs and tighten equally the four nuts fastening the fuel pump housing.
9. Connect fuel system pipes and secure air-tightness of the system.
10. Start the engine and adjust correctly the fuel pressure.

Pay special attention to airtightness and reliability of joints when mounting the fuel pump.
The air chamber of the fuel pump must have connection with the environment. The pipe of the outlet fitting must be lead out of the engine nacelle to simplify thus observation of eventual fuel or oil leaks through the sealing.

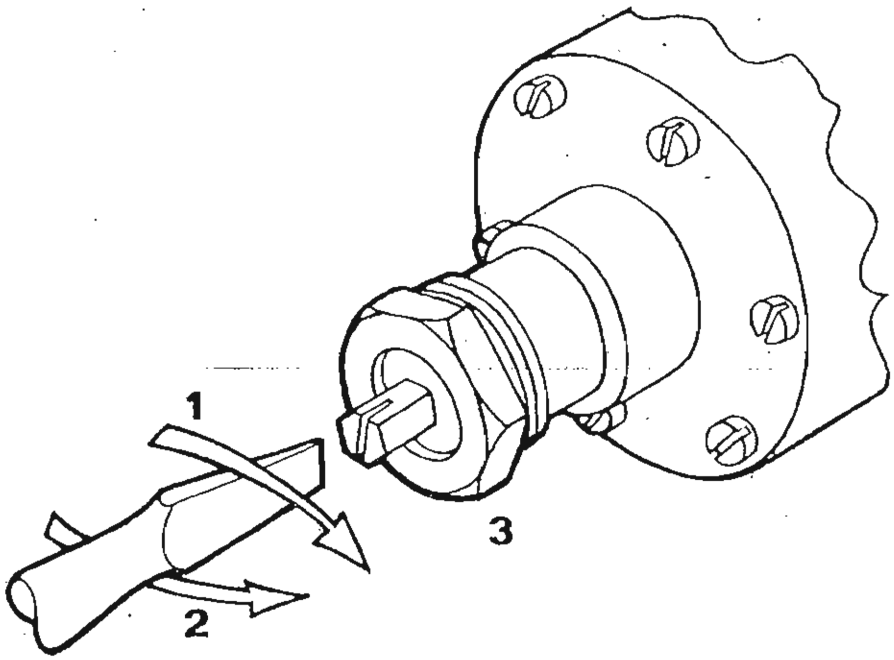

Fig. 15 — Adjustment of fuel pressure (by means of the pressure reducing valve of the fuel delivery pump)

1 — Pressure increasing
2 — Pressure decreasing
3 — Before pressure adjustment is the cap nut to be loosened and it is to be retightened after having finished the adjustment

8.6.5 Adjustment and Check of Fuel Pressure

The adjustment of fuel pressure is carried out by means of a screw in the pump lid according to Fig. 15. When turning the screw to the right the pressure is increased, by turning to the left it is reduced.
If the actual fuel pressure differs from the rated value and its permissible tolerances, readjust fuel pressure by the following procedure:

1. Turn back the fuel pressure adjusting screw cap nut by quarter a turn, holding thereby the head of the adjustment screw in its original position with a screwdriver inserted into the screw head slot.
2. Adjust the fuel pressure to a range of 0.2 to 0.5 kg per sq. cm. at rated engine regime. Thereby — to increase fuel pressure, turn the fuel pressure adjusting screw clockwise and, on the other hand, to decrease fuel pressure, turn it counter-clockwise (see Fig. 15).
3. Hold the fuel adjustment by a screwdriver to prevent thus its angular displacement and thereby duly tighten and secure the adjusting screw cap nut.
4. Check proper fuel pressure with engine operating.

8.7. The MN-14 B Oil-pump

The pump is intended for delivery of oil from the oil tank into the oil circuit of the engine and for drawing off oil from the oil sump. The pump is formed by two stages: the pressure and the suction one. Each stage is fitted with two spur gears of identical diameter. The pump is fitted with a pressure reduction valve to regulate pressure of the oil delivered to the engine.

8.7.1 Basic technical data

1. The efficiency of pump at n = 2310 r.p.m.
   a) The pressure stage with pressure reduction valve adjusted to 5±0.2 kg per sq. cm. at temperature of inlet oil of 50 to 55 °C. . . . . min. 450 kg/hr.
   b) Drawing off stage at an oil temperature of 75 to 125 °C and counterpressure at discharge of 0.5±0.1 kg per sq. cm. . . . . min. 1000 kg/hr.
2. Speed of driving gear of pump:
   a) Minimum . . . . 450 r.p.m.
   b) Rated . . . . 2400 r.p.m.
   c) Maximum . . . . 2760 r.p.m.
3. Direction of rotation of the driving gear of pump . . . . . . to the left
4. Gear ratio 1.125

8.7.2 Functional description of pump

Oil flows from the oil tank through the oil piping, via the gauze filter it gets from the space of the lug on the rear cover to the hollow shaft of the driven gear of the pump. From there it flows through the radial holes to the circular recess and through a system of bores it flows to a pair of gears of the pump pressure stage. From the pressure stage the oil flows to the hollow shaft of the driving gear of the pump and then to the lubrication circuit of the engine. In order to ensure the required oil pressure at the delivery branch a pressure reduction valve is incorporated between the inlet and delivery branches of the pressure section of the pump.

8.7.3 Adjustment of oil pressure

The regulation of the oil pressure is carried out by means of the screw of the pressure reduction valve on the oil pump housing within a range from 4 to 6 kg per sq. cm. The screw of the pressure reduction valve is turned to the right in order to increase the oil pressure, and to the left in order to reduce same.

8.8 Dismounting and mounting the V 520 propeller

8.8.1 Dismounting the propeller off the engine

Release the retainer in the forward part of the propeller hub, loosen the lock bolt to the left by means of spanner No. 3 and a mounting tube and unscrew it. Pull down the flange of the de-icer by means of flexible dismounting spanner No. 4 from the propeller supporting tube. Insert spanner No. 1 on the splined end of the supporting tube and, by means of mounting tubes, loosen the lock nut of the propeller from the engine shaft by turning it to the left and unscrew it.

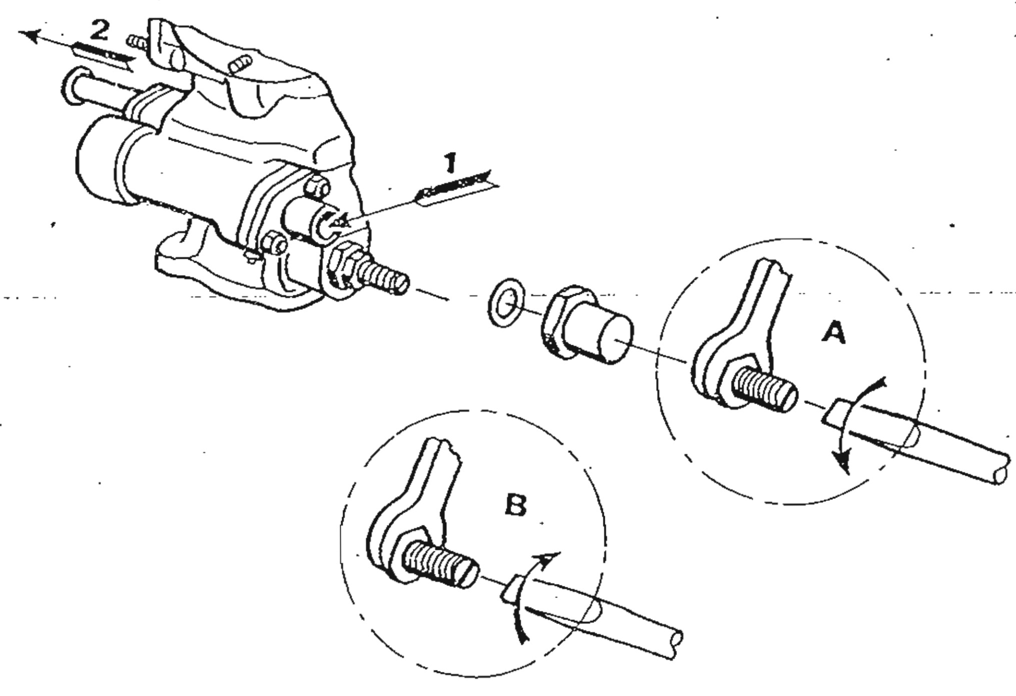

Fig. 16 — Regulation of oil pressure

1 — Inlet of oil to engine, 2 — Outlet of oil from engine, A — Pressure reduction, B — Pressure increase.

The propeller is fastened on the engine shaft by the forward and rear centering cone with a nut designed in such a manner, as to function as a puller when being unscrewed. If the lock nut is fully unscrewed from the engine shaft thread, the propeller can be easily pulled off the shaft. When loosening the propeller prevent the propeller shaft from turning by holding the propeller blades. After dismounting the propeller remove the rubber packing ring, the washer and the rear centering cone from the shaft. Screw down a polyamide blind into the rear of the propeller hub and set the propeller on a clean pad.

8.8.2 Mounting the propeller on the engine

Clean the engine shaft, insert the rear cone to bear against the nut of the shaft bearing, as well as the washer and the rubber packing ring. Unscrew the polyamide blind from the propeller hub and insert the propeller on the shaft, until the lock nut strikes against the threaded part of the shaft. Insert the spanner No. 1 on the splined end of the supporting tube of the propeller and screw down the lock nut to the right. Tighten the propeller with a torque Mk = 35 to 40 kgm. Insert the mounting tubes into the spanner and prevent the propeller shaft from turning by holding the propeller blades.
An auxiliary assembly mark is engraved on the spanner No. 1, which after tightening of the propeller must be in line with the axis of one of the 6 position holes in the de-icer and in the cylinder. Then insert the flange of the de-icer on the splined end of the supporting tube in such manner that one of the position pegs of the flange engages the hole, the axis of which was in line with the mark on the spanner. Insert the retainer into the forward part of the flange and secure the latter by means of a lock nut with a torque Mk = 4.5 to 5 kgm. Use spanner No. 3 together with a mounting tube for tightening. After tightening secure the bolt by bending the finger of the retainer.

8.9 The LUN 7811.01 propeller speed regulator

The LUN 7811.01 apparatus is a centrifugal, single-acting regulator of a preset, constant speed of the propeller.
The speed regulator maintains the continuous propeller speed by means of a servomechanism which either supplies pressure oil to the branch of high pitch, or opens the same port for oulet of oil from the servo-mechanism to the engine during change of speed caused by external influences. Thus it changes the propeller pitch corresponding to the preset speed of the power unit (single-acting operation).
The presetting of the regulated speed is carried out by loading or releasing the regulator spring by means of a control wheel of the regulator.

8.9.1 Basic technical data of the speed regulator

Direction of rotation of the drive when viewing the flange from the drive side . . . . clockwise
Guaranted range of engine speed, at which proper function of propeller is guarantee . . . . 1700 to 2500 r.p.m.

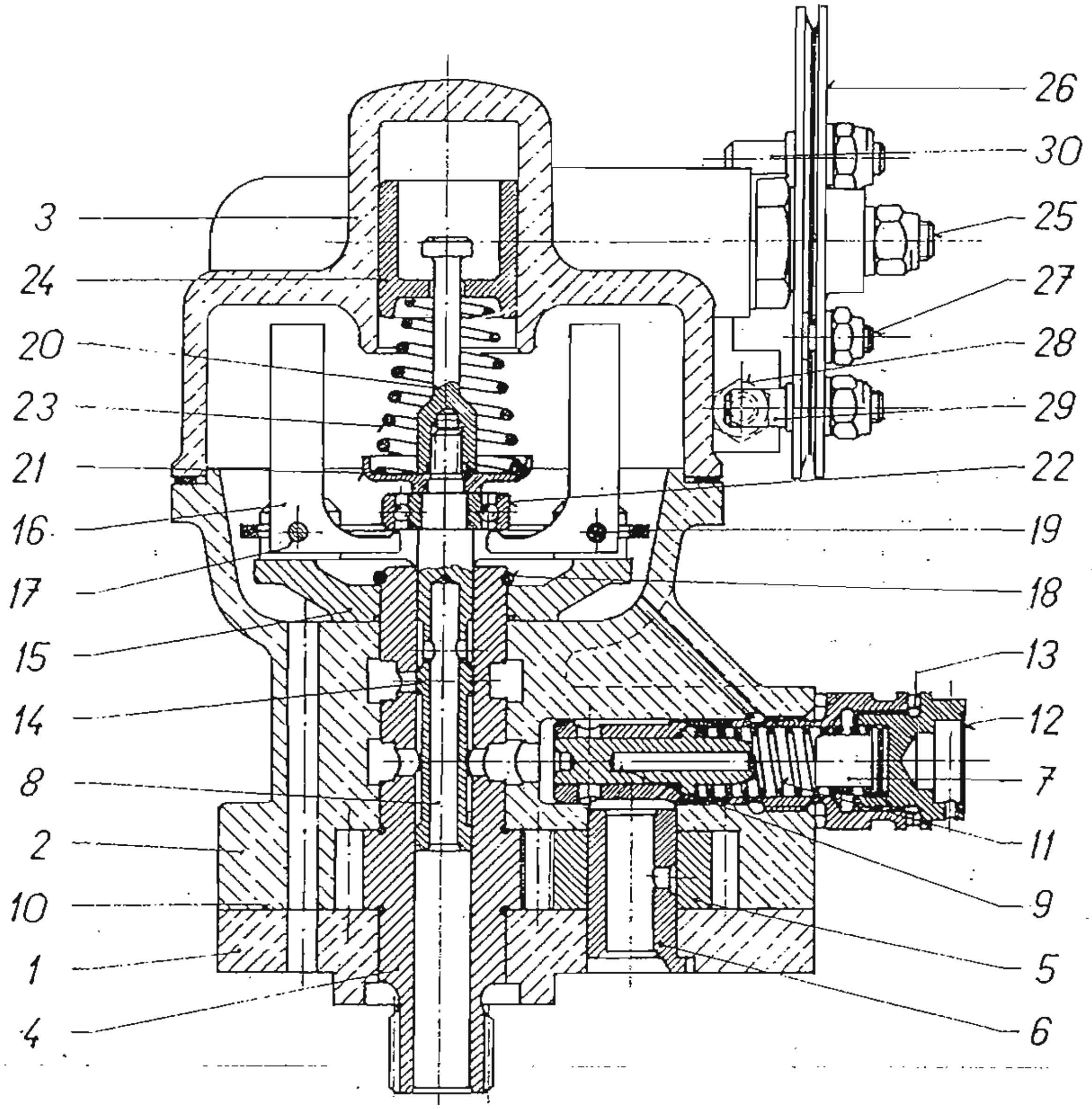

Fig. 17 — Section of the speed regulator

1 — Flange, 2 — Regulator pump housing, 3 — Regulator cover, 4 — Driving shaft, 5 — Driven gear of pump, 6 — Pivot of driven gear, 7 — Pressure reduction valve, 8 — Plunger, 9 — Pressure reduction valve plunger, 10 — Packing, 11 — Spring of pressure reduction valve, 12 — Valve lid, 13 —Packing ring, 14 — Shoulder of plunger 8, 15 — Bracket for fastening of centrifugal weights, 16 — Centrifugal weights, 17 — Weight pin (bearing needle), 18 — Retaining ring of the regulator shaft, 19 — Retaining ring of bracket with weights, 20 — Spring pin, 21 — Spring thrust, 22 — Ball bearing, 23 — Tapered spring, 24 — Selector sleeve, 25 — Selector shaft, 26 — Control wheel of regulator (for speed selection), 27 — Securing bolt for fastening the control cable, 28 — Adjusting bolt of take off stop, 29 — Take off stop, 30 — Stop of lowest regulating speed (beginning of regulation)

Oil pressure at the inlet to the regulator	5 to 7 kg per sq. cm.
Maximum pressure generated by the regulator at the inlet pressure of 5 kg per sq. cm	27 kg per sq. cm
Output of the regulator oil pump at pressure of 15 kg per sq. cm at the discharge, inlet pressure of the regulator of 5 kg per sq. cm and speed of 2300 r.p.m. at oil temperature of 85 to 90°	min. 5 lit. per min.
Dead band (laboratory value) of the regulator proper.	max. ±10 r.p.m.
Weight of dry regulator	max. 1900 g

8.9.2 Functional description of the speed regulator

In the equilibrium state there is an equilibrium between the centrifugal force of the pendulum governor weights and the force stressing the spring (by the r.p.m. control): The regulated system is working correctly at the preset speed, the port of the high pitch is closed by the shoulder of the plunger, the propeller is not supplied with pressure oil and the blades are not actuated.
At increased speed of the engine the equilibrium state is disturbed. The centrifugal force of the weights is increased. Since it is greater then the force stressing the spring, the plunger is moved in the direction of the acting force. The port of the high pitch is opened and pressure oil readjusts the pitch the propeller blades to a higher value, until the speed settles at the preset one and the equilibrium is reestablished.
At reduced speed the centrifugal force of the weights is also reduced. The force stressing the spring is higher and it moves the plunger in the direction opposite to that mentioned before. Thus the high pitch port is opened by the other side of the shoulder for draining off the returning oil (single-acting function of the propeller) from the propeller to the engine. The propeller blades are adjusted to lower pitch owing to the torque produced by centrifugal forces, the speed drops, until it settles at the original preset value. The equilibrium is readjusted.

8.9.3 Depreserving

When depreserving the speed regulator the inner spaces must be flushed with clean oil heated to 70—90 °C, while the driving shaft is slowly rotated. The outside surfaces must be cleaned by a clean rag dipped in technical petrol and dried by dry air.

Note: For washing pure non-ethylized technical petrol is used. The regulator flange must be protected during depreserving of external surfaces by a protective lid in order to prevent petrol from penetrating into the inside spaces.

The clean speed regulator is to be slightly coated with spindle oil after depreserving. The depreserving of the regulator must be entered into its log sheet. The regulator may be stored in depreserved state for max. 24 hrs.

8.9.4 Mounting speed regulator on engine

Remove the cover lid from the flange on the reduction gear box intended for mounting of the speed regulator. Inspect the flange for surface defects and clean same with a rag dipped in pure petrol.
Remove the protective cover lid from the regulator flange, check the bearing surface and the centering shoulder for surface defects (such as dents etc.). Then insert the required packing (from separate component parts of the speed regulator) on the flange, inspect the packing for eventual cracks. Mount the speed regulator, fasten it with nuts and washers and lock them by means of split pins (from separate component parts of the speed regulator).

Warning: When mounting the speed regulator take care that the splining of the driving shaft is freely in mesh with that one of the counterpiece in the engine. The mounting of the speed regulator must be entered in its "Log sheet".

For connecting the control cable and checking the function — see the handbook "The V 520 Propeller — Technical Description and Operation Instructions".

8.9.5 Dismounting regulator from engine

The dismounting of the speed regulator from the engine is carried out as follows: Disconnect the control cable, dismount the split pins of the stud bolts and loosen the nuts with washers. Loosen the speed regulator by a slight tap from either side and dismount it off the reduction gear box. Protect the bearing surface by a protective cover lid. Insert the separate component parts of the regulator, i.e. the packings, the nuts, the washers and split pins, in a paper bag.
Enter the dismounting of the speed regulator from the engine into the "Log sheet" of the device.

9 FUEL AND OILS

In order to ensure faultless operation of the engine, use is permitted solely of fuel and lubricants complying with the specifications for the aircraft fuel and lubricants.

9.1 Fuel

Non-ethylized aircraft petrol of a minimum octane rating 78, i.e. petrol LBZ 78 according to Strd. PND 33-241-67 is to be used.
Fuel with a lower octane rating cannot be used, since there is a danger of detonations and faults in the engine operation. The used fuel must comply with all conditions of the official regulations and standards concerning fuel for aircraft engines in force.
Fuel must be filled into the tank by means of funnel with a fine sieve and care must be taken that dust, water and other impurities do not get into the tank. Safety precautions must be strictly observed during refueling.

9.2 Oil

For both summer and winter operation the mineral oil for aircraft engines MS 20 according to GOST 1013-49 is used. Oil must comply with all conditions of the applicable official specifications of aircraft engine oils. Fresh oil is filled into the tank through a funnel with a fine sieve. The filling vessels, funnels and the filling branch of the tank must be clean.

9.2.1 Oil quantity

The total oil quantity in the entire system should amount to 15.5 lit., of which 13 lit. is in the oil tank.
It is not permitted to operate the engine with less than 4 lit. of oil in the tank.

10 MOUNTING THE ENGINE ON AIRCRAFT

10.1 Unpacking and preserving new engine

The following procedure must be observed for unpacking of the engine:

1. Remove the seals from the cover of the packing case.
2. Unscrew the nuts from bolts fastening the cover to the body of the case.
3. Remove the paraffin paper wrapping from the engine and check the details and tools packed with the engine in the case according to packing list.
4. Inspect the engine and draw up a record on the external inspection. Inform the supplier of all defects and damage found.
5. Depreserve the engine in accordance with this handbook (chapter 17).
6. The propeller and the speed regulator are unpacked and depreserved according to the handbook "The V 520 Propeller — Technical Description and Operation Instructions".

10.2 Mounting the engine on aircraft

1. Carry out the required preparatory work contained in the instructions for the aircraft operation.
2. Fasten the engine mount to the engine and set the latter in the aircraft by means of a crane.
3. Connect the short circuit cables from the change-over switch to both magnetos. Check the conductivity of the connections.
4. Set the change-over switch of the magnetos to its "OFF" position.
5. Connect the starting buzzer to the magneto M 1.
6. Connect the respective conduits to the generator terminals and check the connection. The entire electric installation must be carefully carried out, the cables must not come into contact with sharp edges of the airframe constructions and the connections on the engine must withstand continuous shocks and jolts of the engine.

7. The propeller must be mounted on the engine, the speed regulator control connected and adjusted according to the handbook "The V 520 Propeller — Technical Description and Operation Instructions".
8. Turn the crankshaft 10 to 12 times in order to remove oil from the inlet pipes and combustion spaces of the lower cylinders. The rest could cause hydraulic hammers during starting of the engine.

11 STARTING, WARMING UP AND ENGINE TEST

11.1 Engine starting

1. Make sure the ignition is off. Then rotate the propeller shaft 6 to 8 times in the direction of rotation with closed throttle in order to admit the mixture into the cylinders and to fill the oil circuit in the engine.
   If the turning of the engine is difficult, unscrew one spark plug from each of the cylinders No. 5 and No. 6 and the drain plugs on the inlet pipes of these cylinders. Turn again the propeller 3 to 4 times, in order to drain the accumulated oil and fuel. Then screw back the spark plugs and the plugs.

   Note: When the propeller shaft is slowly rotated, knocking can occur in the engine by fouling of the damper against the stop bar. This is a normal effect!

2. In the course of the last 2 to 3 revolutions of the propeller, approximately 100 to 150 c.c. of fuel (i.e. 2 to 5 doses of the pump plunger) must be injected into the inlet manifold by means of a hand injection pump. The quantity depends upon the temperature of ambient air and the degree of cooling of the engine. **Do not inject more fuel than permitted,** since oil in the cylinder could be washed down and the pistons could get seized.
3. Open the throttle slightly to the position corresponding to 800 — 900 r.p.m.
4. Set the propeller control lever to position "Take off" (i.e. forward up to the stop).
5. Switch on all instruments checking the engine run.
6. Switch on the drowned fuel pump and check the fuel pressure.
7. Open the starting air cock, which simultaneously connects the buzzer.
8. Switch on the magnetos.

   Note: In order to improve the engine starting inject simultaneously 1 to 3 doses of fuel by the hand injection pump. Thus fuel gets into cylinders and facilitates the transition to the regular fuel supply by the carburetter.

9. After starting the engine stop the starting air cock, switch off the drowned fuel pump and the solenoid valve.
10. As soon as the engine runs smoothly set the lever to the position corresponding to 700 — 800 r.p.m. Observe oil pressure on the pressure gauge. If after 20 sec. of engine run the oil pressure fails to reach 1.5 kg per sq. cm, the engine must be stopped at once and the cause of the insufficient oil pressure must be determined.