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INFORMATION REPORT

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The Jumo-012 was designed with an air flow of 60 kg/sec. In order to eliminate extensive preliminary tests, the intake diffuser, the axial compressor, the combustion chambers, the axial flow turbine, and the thrust nozzle were to be arranged in a way which had proved successful with the Jumo-004. Jumo-012 was to be equipped with an 11-stage axial flow compressor, a two-stage axial flow turbine, and eight enlarged combustion chambers which were required for the increased output. Various tests were performed with experimental models of the engine. During these tests the power control devices were hand operated. Automatic control equipment was still being developed and was to be tested with the final version of the engine.

I. Arrangement of Engine.

1. Air intake: The air intake is installed in the front side of the engine. It incorporates aerodynamic features and has an intake area of 4,227 cm^2. The exhaust area measures 3,375 cm^2.

2. Compressor: The 11-stage axial flow compressor is driven by the impeller unit. The compression ratio is 1.15 to 6.7 atmospheres (absolute pressure), and the temperature is 33°C in front of the compressor and 263°C behind the compressor. The air speed behind the compressor is 138 m/sec.

3. Turbine: The two-stage turbine is installed behind the combustion chambers. The pressure is 4.35 atmospheres in front of and 1.5 atmospheres (absolute pressure) behind the turbine. The temperature is 850°C forward and 628°C aft of the turbine. The gases leave the turbine with a speed of 250 m/sec.

4. Combustion chambers: The eight chambers are installed between the compressor and turbine. Fuel is injected into the chambers where it burns in the compressed air flowing through.

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5. Tail pipe: The exhaust nozzle is fitted with a movable exhaust cone to vary the outlet area from 2,800 to 4,200 cm^2. The exhaust gases have a pressure of 1.0 atmospheres, a speed of 529 m/sec, and a temperature of 410°C. This refers to a full power performance at sea level and at a flying speed of 250 m/sec.

6. Cooling system: The air required for the cooling of the engine is branched off from the main air flow.

7. Power control equipment: The engine is to be controlled by a single lever device automatically regulating the number of revolutions. The position of the exhaust cone and, therefore, the temperature of the exhaust gases are varied by a control device, which in turn regulates the number of revolutions. Preliminary test models, however, were controlled by hand-operated devices.

8. Performance data: see photograph 1

Altitude Flying Speed	h - 0 m v - 0 m/sec	h - 0 m v - 250 m/sec	h - 8,000 m v - 250 m/sec
Thrust (in kg)	3,000	2,300	1,240
Rotations per minute	6,000	6,000	6,000
Specific fuel consumption (in kg/kgh)	1.30	1.48	1.51
Net dry weight	2,150 kg		

9. For scheme of gears and wheels see photograph 2.

II. Description of Single Units of the Engine:

1. Air intake system: The air intake is installed in the front housing of the engine. Its shape was designed with regard to an advantageous air intake during the take-off and during the flight performance. The ring-shaped lubricant tank encircles the front intake opening. The air flows along the inner side of the lubricant tank cooling it.

2. Intake casing: The front cover is connected in the rear with the casing of the combustion section. The front flange and the lubricant tank are installed within the front section of the cowling; the lubrication pump, oil pump, and filter are installed in the lower part of the casing, and the accessory gears in its upper section. The bearing case supported by four struts houses the front bearing of the compressor and a gear which drives one extension shaft leading up to the accessory gears and another which leads down to the oil pumps. This bearing case is protected by a conical shaped housing which is fitted to the lid of the bearing case by an annular socket and is secured by means of bolts.

3. Compressor system: An 11-stage axial flow compressor was designed to achieve the required air pressure within the compact-constructed power unit. The steel casing is welded along the side. The ten guide vane rings are inserted into the casing and fastened from the outside. Air required for the cooling of the tail pipe is tapped off from the sixth compressor stage through a slot in the casing and is directed through the double-wall compressor and turbine casing. The drum type rotor consists of 11 individual compressor wheels, the shaft running into a bearing at both ends of the compressor.

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4. Turbine casing: The welded steel casing of the turbine is screwed to the compressor casing. Eight individual slots, holding the combustion chambers, branch off from the ring section air intake, in the front part of the turbine casing and next to the compressor. Ring gaps taking in cooling air for the turbine are installed between the labyrinth packing at the last compressor stage and the ring section air intake at the turbine housing. The cooling air is further directed through eight bulkheads ending at the outer casing of the engine. These bulkheads also hold the combustion chambers. The outer casing of the engine is provided with holdfasts facilitating the suspension of the engine in an aircraft or at a test stand. These holdfasts are connected with special bulkheads carrying the interior of the engine. The eight combustion chambers are screwed to the exhaust gas collector and pushed into the turbine casing. The exhaust gas collector receives the gases from the individual combustion chambers and directs them through a ring gap into the turbine.

5. Combustion chambers (see picture 3). The air leaving the compressor enters the combustion chambers through the neck of the outer casing, where the air flow is conducted in two different directions through the flame tube and along the flame tube walls for cooling. The air flow directed into the flame tube is given a rotating movement by a swirl vane (Drallrose). The fuel is injected in a very fine spray upstream into the air flow. Applied ignition starts the combustion process. With the engine running under conditions of continuous combustion, partial combustion is achieved within the flame tube with a small access air amount, and the combustion is completed behind the flame tube with additional air being conducted into the flame through slot mixers. If there is a great surplus of air, the combustion is completed in the exhaust gas collector. The air required for the final combustion is guided at a high speed along the flame tube walls which primarily serve as a cooling agent. At the end of the flame tube, this air is separated into three different streams: into the webs of the slot mixers, into the space between slot mixers and combustion chamber inner liner, and into the double wall of the combustion chamber, the latter being used for the cooling of the twin-coat collector. Ignition is started by one spark plug in four of the eight combustion chambers. Connecting pipes carry the flame to the next chamber, preventing the flames in one of the individual combustion chambers from being extinguished. The injection nozzles extend into the interior of the flame tubes.

6. Turbine: The two-stage turbine driving the compressor is composed of two rigidly coupled turbine wheels, each being fitted with a vaned diffuser in front. Turbine and diffuser blades are hollow and air-cooled from within.

7. Tail pipe: The exhaust unit has a welded steel casing flanged to the turbine housing. The double-wall outer casing provides space for the cooling air to pass between the two walls. The exhaust cone, mounted on the longitudinal axle of the tail pipe, moves axially in order to vary the area of exit and thus the performance, temperature, and fuel consumption in different flight conditions. The exhaust cone is controlled by a hydraulic piston which is directly connected. During previous experiments the engine was tested with a fixed exhaust cone. It was to be provided with a control device operating in connection with the rotation controls.

8. Accessory gears: Accessory gears driving engine auxiliaries, i.e., fuel injection pumps, air oil separator, and revolution counter, are flanged into the upper section of the front casing. During the tests an electric engine started the engine via a flexible shaft which was attached to an angular drive at the rear section of the accessory gears. Two additional drives are installed for other accessories.

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III. <u>Circulation Systems:</u> The engine is provided with several separated circulations serving various purposes: fuel, lubrication, air cooling, and electric systems.

1. <u>Fuel System (see picture 4)</u>. The fuel system is subdivided into the starter and operational fuel system.

   a. <u>Starter fuel system:</u> The power plant is started with an outboard engine. Starter fuel is injected into the combustion chambers and ignited when the engine revolves at about 400 rpm. An electric pump at the engine pumps starter fuel from a tank outside the engine through a check valve into the fuel ring and further into the combustion chambers. After ignition has started, the engine gradually gains speed, simultaneously increasing the operation of the prime pumps which are pumping kerosene into the fuel system. As soon as the operational fuel has more pressure than the starter fuel, the check valves close and cut off the flow of starter fuel. The engine is fed with kerosene only when it runs at about 2,000 rpm.

   b. <u>Operational fuel system:</u> The first test models of the Jumo-012 were equipped with fuel filters and prime pumps of the Jumo-004 engine. With regard to the higher fuel consumption of the Jumo-012, two units were to be installed for each one of the Jumo-004. The fuel supply and consequently the number of revolutions are regulated by a fuel control device.

2. <u>Lubrication system (see picture 5)</u>. The lubrication system of the power unit is based on oil circulation. The lubricant serves as a cooling oil for the bearings and as a fluid for the control cylinder of the exhaust cone. The ring-shaped lubricant tank is installed around the air intake. The tapping point is at the right side of the engine. The pressure release of the lubricant tank leads into the open. Two pressure pumps suck lubricant from the tank and press it into a double filter and further into two tubes leading to the engine. One of these tubes leads to the gear driving the two extension shafts, to the front bearing of the compressor, and to the auxiliary drive; and the other one leads to the rear bearing of the compressor and to the turbine bearings. From the accessory gears, a hydraulic tube branches off to the control device operating the exhaust cone. The return oil is collected in the lower part of the bearing box in the turbine casing and is sucked off by the rear return pump. During dives, a connecting pipe permits the return oil to flow from the rear to the front oil sump. Return oil from the front casing and from the control device of the exhaust cone is also collected in the front sump. A return pump, in the front section of the engine, sucks the collected oil and leads it via a centrifugal air oil separator back to the oil tank. This separator is to prevent foam in the oil tank.

3. <u>Air cooling system (see picture 6)</u>: All air is taken in through the intake opening and compressed at a ratio of one to five by the compressor. Leaving the compressor the air flows through the combustion chambers where the fuel is injected and the burning takes place. The exhaust gases from the combustion chambers drive the turbine which in turn impels the compressor. The gases and the cooling air are expelled at an increased speed through the reduced exhaust section of the tail unit. Cooling air for the turbine is tapped off through a ring slot in the turbine housing and directed through guide pipes into a distributor chamber.

From here, cooling air is directed through the hollow blades of the first vaned diffuser, and the remaining amount of air enters the hub of the turbine disc from where it is further distributed into the hollow blades of the first turbine wheel and also into the space between the two turbine wheels. Then the air flows through the blades of the second diffuser, enters the second turbine disc through bores and streams further into the turbine blades. The air leaves the guide vane rings through exit holes in the rear edge of the blades and the turbine blades through holes in the tips. Cooling air for the exhaust unit is taken from the sixth compressor stage and is directed through the double coating of the compressor and turbine housing to the tail pipe. Two air streams are branched off at the struts supporting the exhaust cone. One of them is to cool the strut coating and the other is directed into the exhaust cone and against the rear of the second turbine wheel. The air streams back through guide vanes inside the exhaust cone to an exit between cone body and cone neck.

4. Electric system: Electrical equipment of the engine includes the auxiliary starter unit, the revolution indicator, and the gas temperature indicator. All electric disconnecting points are jointed in one special plug on the left brake switch board.

   a. The auxiliary starter unit is composed of an electric pump for a dual starter, a summer ignition system, and spark plugs. The unit pumps starter fuel and simultaneously gives ignition current through the summer system to the spark plugs.

   b. The revolution counter is flanged to the auxiliary drives. The unit works on alternating current which changes its voltage in accordance with the alternating number of revolutions. The data obtained by this unit are transmitted to the revolution indicator which shows the revolutions per minute.

   c. The tail pipe temperature is measured by a thermoelement which is connected to the main plug at the left disconnecting board by a special cable.

IV. Controls: The design of the Jumo-012 controls is based on the control system of the Jumo-004. Modifications include the different control system for the exhaust cone. On the Jumo-004 the thrust is controlled with a control rod, a bevel gear, and a pinion gear extending and retracting the exhaust cone. The Jumo-012 is to be equipped with a hydraulic control device for the exhaust cone. This hydraulic control is to operate in connection with the revolution control device and will be tested during future experiments. A slightly altered version of the Jumo-004 revolution control device will be used with the Jumo-012. The preliminary dimensions of the sluice valve and the spill piston were derived from an interpolated curve of fuel consumption at full power performance with an assumed fuel injection pressure of the Jumo-004. The idling speed was calculated at 2,000 rpm. However, further tests are required in order to determine the actual idling speed and the final dimensions of the spill piston. During previous tests the engine was controlled by an improvised hand-operated fuel control device. See picture 7. The control for the exhaust cone was tested separately. Experiments with the power unit are planned, first with the exhaust cone control being hand-operated, and in further tests with the device being coupled to the revolution control device.

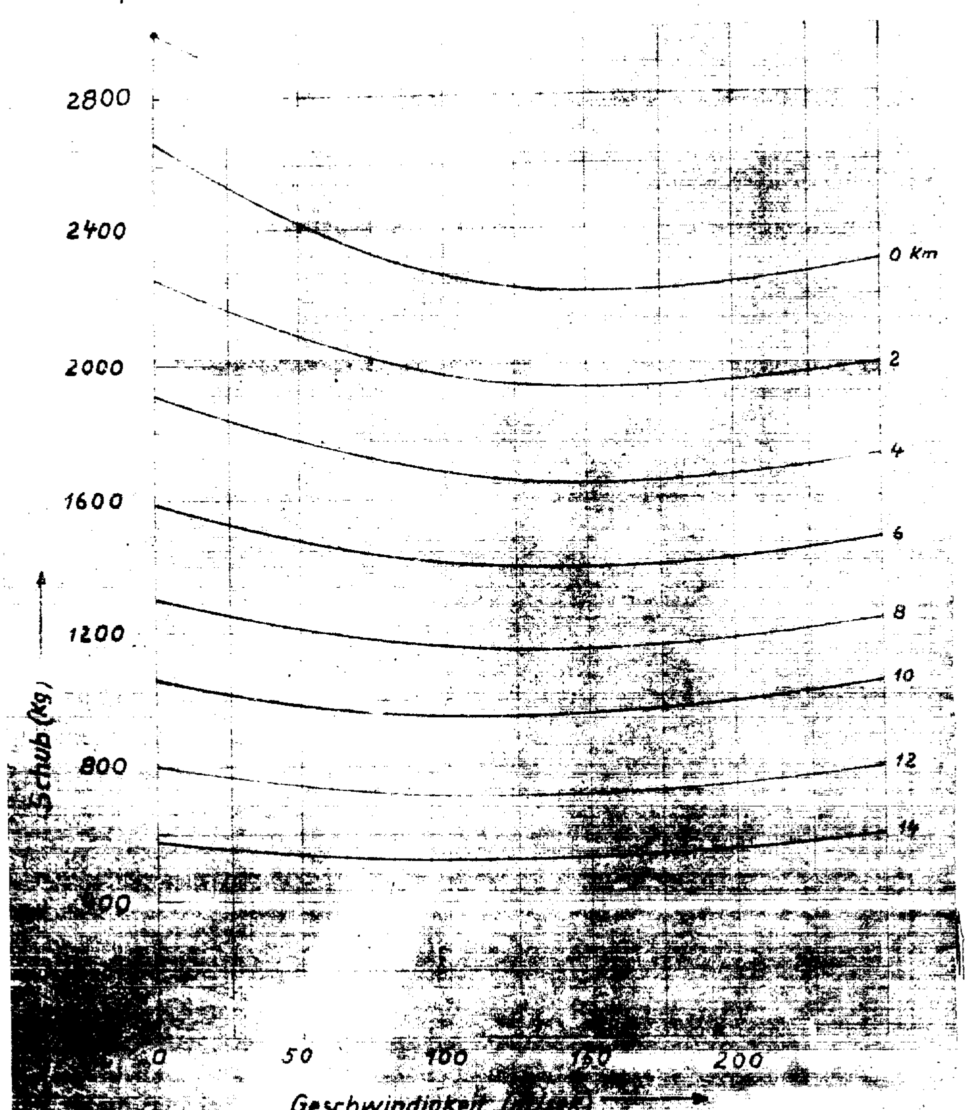
25X1A [redacted] Comment. For pictures referred to [redacted] see Annex. The design study originated in the project department of the SKTB No 1. A similar study on the same engine was given to the Russians in 1946. From German scientists it is known that important improvements have been achieved in Upravlencheski, especially with regard to the starter unit and the power control devices. However the main constructural features of the engine are believed to correspond to the ones contained in the present study. 25X1

25X1A *[redacted] Comment. Cannot be identified from available reference material. However, the coordinates given would place the locality in the Kuibyshev area.

Jumo 012

Leistungsschaubild

(gerechnet)



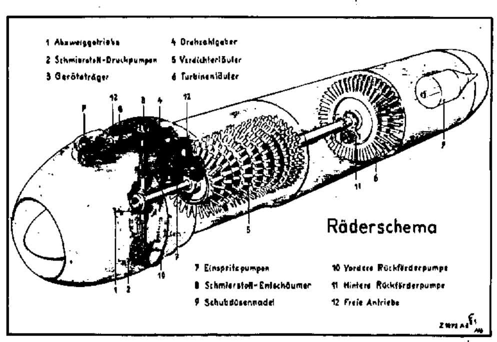
PICTURE 2

JUMO 012

8. Leistungen (gerechnet)

Flughöhe	h = 0 m	h = 0 m	h = 8000 m
Fluggeschwindigkeit	v = 0 m/sec	v = 250m/sec	v = 250m/sec
Schub in kg	3000	2300	1240
Drehzahl in U/min	6000	6000	6000
Spez.Kraftstoff-verbrauch in kg/kgh	1,30	1,48	1,51

Trockengewicht 2150 kg

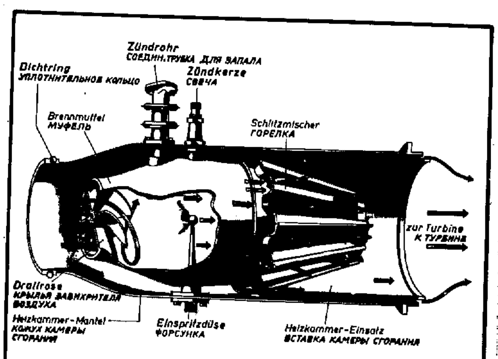


PICTURE 2

Heißgasströme auf und führt diese Gase in einem Ringspalt zur Turbine.

5. Brennkammern

Durch den Hals des Brennkammer-Mantels tritt die vom Verdichter kommende Luft in die Brennkammer ein. Abb.1011. In der Brennkammer verzweigt sich die Luft. Der eine Teil der Luft tritt in die Muffel ein, wo sie durch eine Drallrose in drehende Bewegung versetzt wird. Eine Einspritzdüse spritzt der strömenden Luft den Kraftstoff fein zerstäubt entgegen. In der Muffel wird durch Fremdzündung die Verbrennung eingeleitet. Die Verbrennung erfolgt darauf kontinuierlich und zwar zunächst bei geringem Luftüberschuß ind der Muffel mit teilweisem Ausbrand. Nach Durchströmen der Muffel und erfolgter Zumischung von Luft durch den Schlitzmischer findet der restliche Ausbrand im Brennkammerende und Sammlerraum bei hohem Luftüberschuß statt. Die Luft hierzu wird um die Muffel herumgeführt und dient zunächst zur Kühlung der Brennkammer, wozu sie mit hoher Geschwindigkeit an den Wänden entlanggeführt wird.



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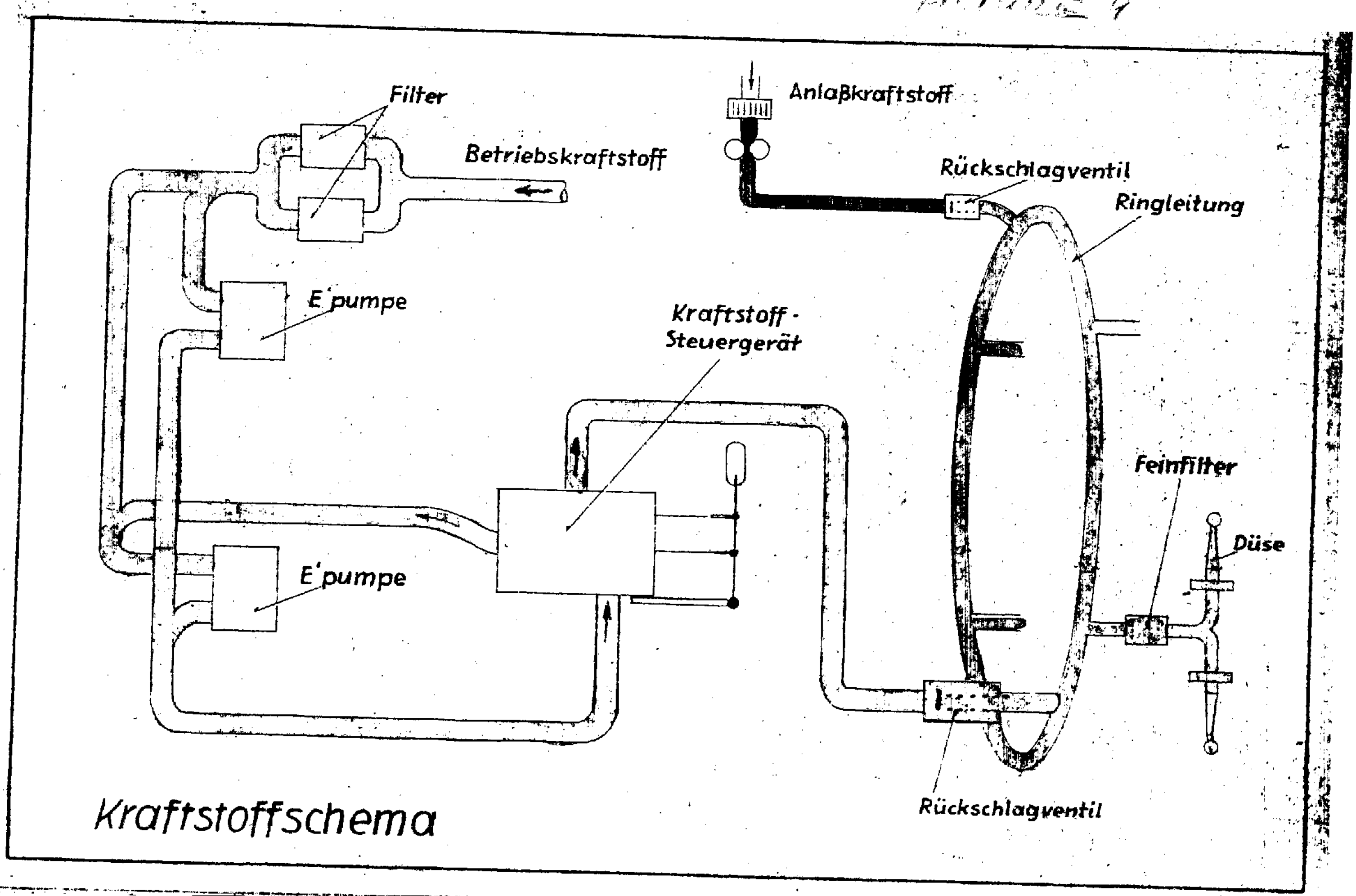

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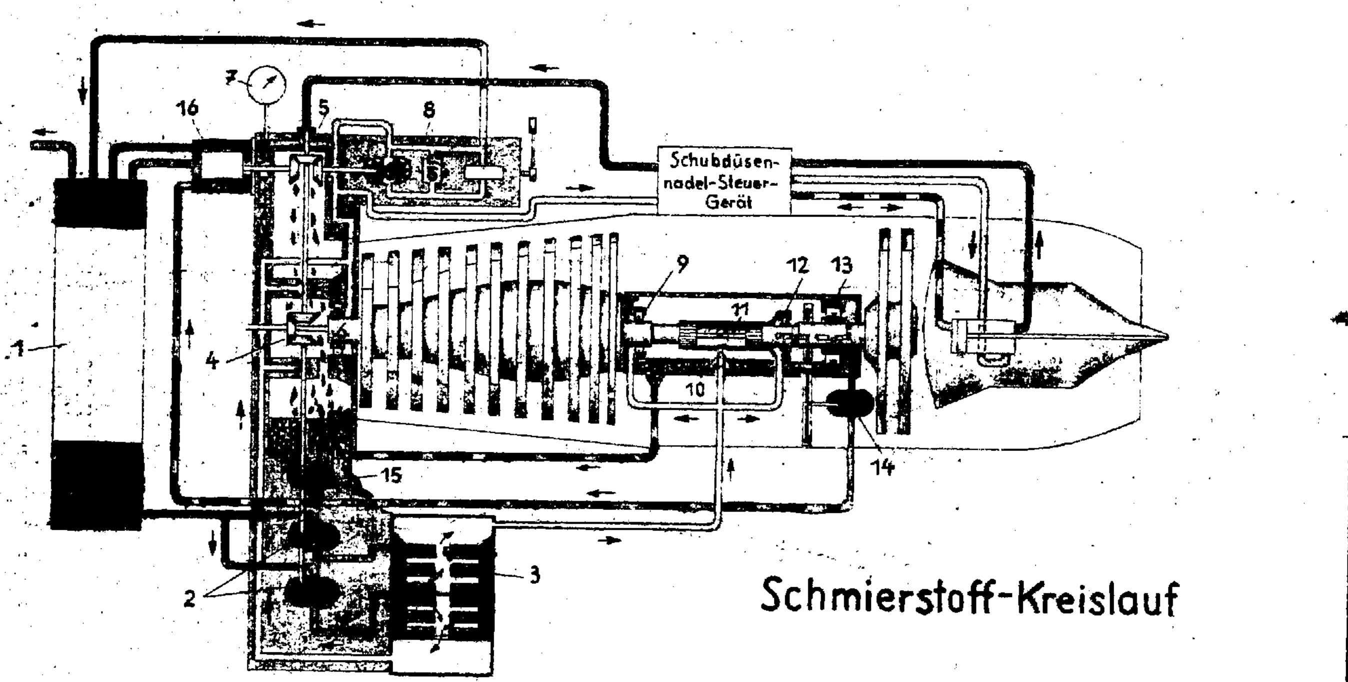
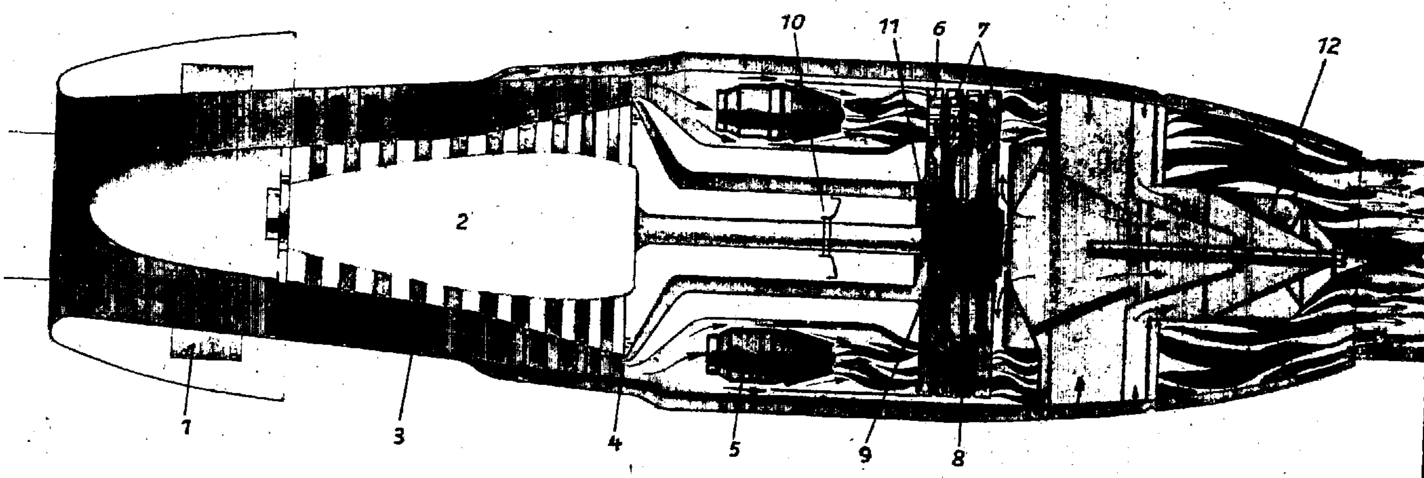


Schmierstoff-Kreislauf

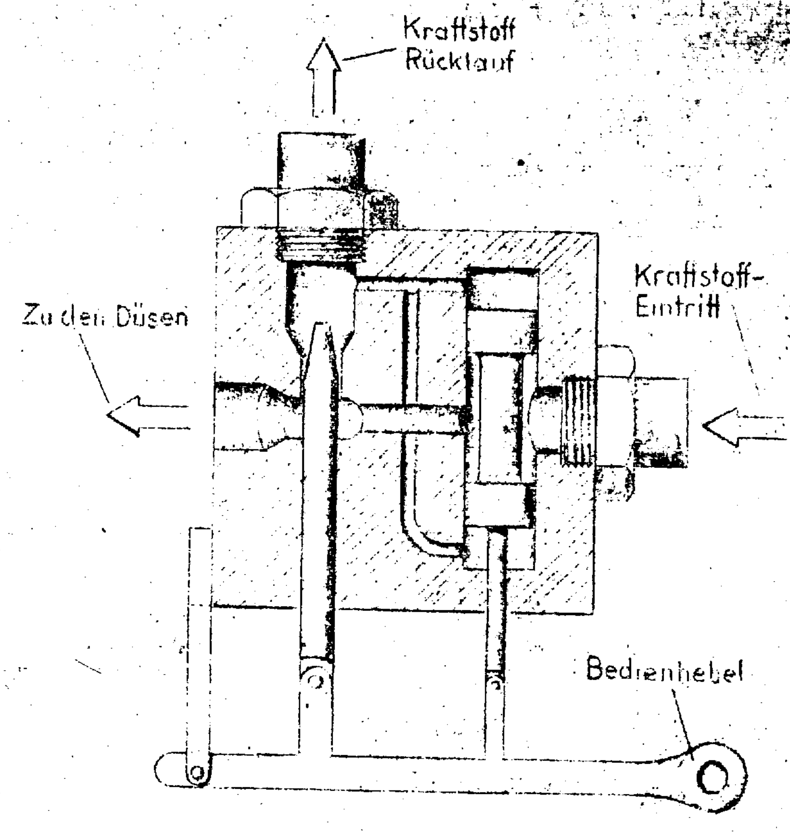
1 Behälter
2 Druckpumpen
3 Doppelfilter
4 Abzweiggetriebe
5 Geräteträger
6 Vorderes Verdichtungslager
7 Druckmesser
8 Drehzahlregler
9 Hinteres Verdichtungslager
10 Einspritzdüse
11 Hohlwelle
12 Vorderes Turbinenlager
13 Hinteres Turbinenlager
14 Hintere Rückförderpumpe
15 Vordere Rückförderpumpe
16 Schmierstoffschleuder

1 Schmierstoffbehälter
2 Verdichter
3 Verdichter-Leitapparat
4 Labyrinthdichtung am Verdichter
5 Brennkammer
6 Turbinen – Leitapparat I



7 Turbinenräder
8 Turbinen – Leitapparat II
9 Labyrinthdichtung an Turbine
10 vorderer Dichtringträger
11 hinterer Dichtringträger
12 Schubdüsennadel

Kühlluftführung



Kraftstoff-Steuergerät