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OPERATING AND SERVICING INSTRUCTIONS for ENGINE GTD-350

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Foreign language version approved by manufacturer under delegated authority by CACA.

Signed by: Kaczmarowski
authorized manufact. representative

Serial Number [ ] Regist. Number [ ]

P R E A M B L E

This Manual lays down pronciples for the operation and servicing of GTD-350 Engines, all Series.
The first digit of the Engine Reference Number is provided to denote Engine Series, e.g.:

161674096 - Series I Engine
261682052 - Series II Engine
361683022 - Series III Engine
361693014D- III series engine repaired with modification onto IV series
471674005 - IV series engine
361694031DW-III series reinforced engine version W
4716810l6W -IV series reinforced engine version W

In helicopters, engines of the same or different series can run together, but in case of engine mounting of an optional series and the W version engine, the compression turbine rotation speed of takeoff range in version W should be decreased by 1,5 ÷ 2%, that means the maximal fuel expenditure of the W version engine should be decreased according to the procedure in point 6.2 page 911, chapter 9.
In such a case a readjusted engine is not W version engine any more and should be operated as a normal engine.
The present instruction includes regulations concerning the way of operating and servicing of the GTD-350 engine arising from operating bulletines, index of which is given on pages E, F, G, G-I.
All the amendments and supplements to occur in the meantime will be introduced to this Manual in the form of Bulletins.

INDEX OF CONTENTS

SHEET TO REGISTER AMENDMENTS

ISSUED IN THE FORM OF BULLETINS

IT.	BULLETIN REF. No.	DATE OF ISSUE	PACES REFERRED TO ACC. TO BULLETIN	SIGNATURE RESPONSIBLE FOR AMEND-MENTS
1	2	3	4	5
1	E-1621/78	May 1978	accordance to spec.on page G	J Kaczmarczyk
2	E-1601/78	15.9.1978	-"-	J Kaczmarczyk
3	E-1627/79	April 1979	-"-	J Kaczmarczyk
4	E-1632/79	April 1980	-"-	[illegible]
5	E-1635/80	May 1980	-"-	[illegible]
6	E-1636/80	October 1980	-"-	[illegible]
7	E-1643/81	July 1981	-"-	[illegible]
8	E-1647/81	January 1982	-"-	[illegible]
9	E-1648/81	April 1982	-"-	[illegible]
10	E-1649/82	August 1982	-"-	[illegible]
11	E-1651/82	May 1982	-"-	WSK Rzeszów
12	E-1652/82	June 1982	-"-	WSK Rzeszów
13	E-1661/83	February 1984	-"-	WSK Rzeszów
14	E-1663/84	February 1984	-"-	WSK Rzeszów
15	E-1664/84	July 1984	-"-	WSK Rzeszów
16	E-1679/86	April 1987	-"-	WSK Rzeszów
17	E-1681/86	June 1987	-"-	WSK Rzeszów
18	E-1682/87	June 1987	-"-	WSK Rzeszów
19	E-1687/87	September 1988	-"-	WSK Rzeszów
20	E-1690/88	January 1990	-"-	WSK Rzeszów

IT.	BULLETIN REF. No.	DATE OF ISSUE	PACES REFERRED TO ACC. TO BULLETIN	SIGNATURE RESPONSIBLE FOR AMEND-MENTS
1	2	3	4	5
21	E-1688/88	October 1990	accordance to spec.on page G	WSK Rzeszów
22	E-1697/93	January 1993	accordance to spec.on page G-I	WSK Rzeszów
23	E-1699/93	August 1993	accrdance to spec.on page G-I	WSK Rzeszów

Sheet to Register Amendments Issued in this Manual

The vertical thisk line on the sheet margin indicates the place of change.
The line has been not written in if more than a half of the page has been changed or if the contents was not subject to change and only the page arrangement has changed.

I.T.	The Bulletins issued	The new pages added to this Manual	The pages amended by the User
1	E-1621/78 /December 1977/	C,D,E,G,107, 108, 216, 308, 328, 601 throu 618, 659 throu 672, 703, 735 throu 740 and 820.	209, 313, 626, 627, 637, 619 throu 658, 715, 716 and 718.
2	E-1601/78 /June 1978/	G, 637, 638, 639, 652.	648
3	E-1627/79 /January 1979/	G, 612 throu 617.	-
4	E-1632/79 /October 1979/	-	G, 810
5	E-1635/80 /January 1980/	G, 514, 666 throu 674	110
6	E-1636/80 /February 1980/	G, 307, 608, 709	-
7	E-1643/81 /February 1981/	G, 609, 675, 676	108, 602, 603, 660, 663, 664, 672.
8	E-1647/81 /July 1981/	-	G, 214
9	E-1648/81 /September 1981/	G, 627, 724, 725	626
10	E-1649/82 /January 1982/	708, 709	G, E
11	E-1651/82 /May 1982/	-	G, 813, 816, 817.
12	E-1652/82 /June 1982/	677	G,603,609,672,674.
13	E-1661/83 /July 1983/	-	E, G, 602, 609, 676

I.T.	The Bulletins issued	The new pages added to this Manual	The pages amended by the User
14.	E-1663/84 /January 1984/	-	607 ; 608
15.	E-1664/84 /February 1984/	-	213
16.	E-1679/86 /August 1986/	678, 679	108, 110, 603
17.	E-1681/86 /December 1986/	-	110, 917
18.	E-1682/87 /January 1987/	-	110
19.	E-1687/87 /November 1987/	H,108, 110, 813	D, E, G, 708, 711, 712, 723, 735
20.	E-1690/88 /November 1988	G-1, 626,627, 628, 654	E, H
21.	E-1688/88 /April 1988/	208, 216, 217, 320, 321, 322, 323, 324, 335, 336, F.	G-I
22.	E-1697/93 /January 1993/	C, 204, 205, 209	F, G-I
23	E-1699/93 /August 1993/	214	F, G-I

SPECIFICATIONS

of Numbers of Standards Mentioned in this Operating Instruction

Item	Product Name	Standard Number before change	Standard Number after change	Standard No. after subsequent change	Standard No. after subsequent change	Notes
1	2	3	4	5	6	7
1	T-1	GOST-10227-62	GOST-10227-86			
2	T-2	GOST-10227-62 with addition of PMAM-2	GOST-10227-86 with addition of PMAM-2			
3	TS-1	GOST-10227-62	GOST-10227-86			
4	T-7 /TS-1G/	GOST-12308-66 with addition of PMAM-2	GOST-12308-80 with addition of PMAM-2			The T-7/TS-1G/ grade of fuel is not mentioned in GOST-12308-80 Standard
5	PSM-2	PN-72/C-96026	PN-86/C-96026			
6	RT	GOST-16564-71	GOST-10227-86			
7	PL-6	CSN 65 6518	-			
8	JET A-1	DERD 2494	-			
9	B-3W	TU38-101295-75	-			
10	ASTO-500	MIL-L-23699	-			
11	CASTROL 5000	MIL-L-23699C	-			
12	CASTROL-98	DERD 2487	-			
13	ELF TURBOJET II	MIL-L-23699	-			

Revised

1	2	3	4	5	6	7
14	NK-50	PN-54/C-96155	-	-	-	Withdrawn as outdated
15	NK-50	BN-74/0536-21	-			
16	MK-8	GOST-6457-53	GOST-6457-66			
17	Transformer oil	GOST-982-56	GOST-982-80			
18	UN technical vaseline	GOST 782-59	-	-	-	Withdrawn as outdated
19	UN technical vaseline	PN-69/C-96120	-			
20	Neutral gun grease	GOST 3005-51	GOST 19537-83			
21	PWK	GOST 10586-63	GOST 19537-83			
22	K-17	GOST 10877-76	-			
23	Special pliers RSKm-125	PN-64/M-64419	PN-71/M-64419			

NOTE: If a given Standard/Specification is Substituting that found in this table, the products made on the basis of both Standards/Specifications /the old and the new/ may be used provided they meet their requirements.

CHAPTER 1

OVERALL SPECIFICATIONS

Issue 2/1975

CHAPTER 1 - Index of Contents

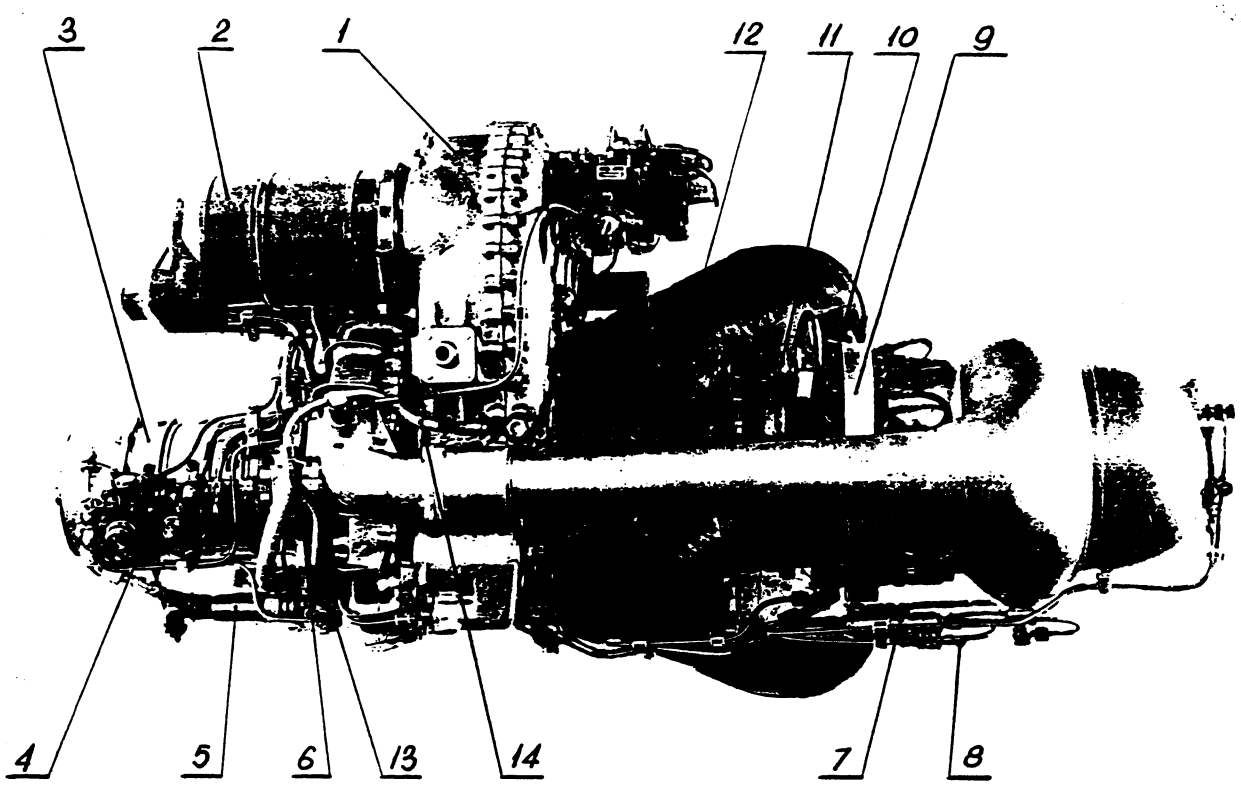

Fig.1.1. /Series III/ Engine as seen from the left-hand side

1. Reducer casing. 2. Generator-starter assembly. 3.Compressor casing. 4. Automatic air bleed control. 5. Anti-icer valve solenoid. 6. Oil pressure transmitter bracket. 7. Drain valves /set/. 8. Drainpipe. 9. Thermocouple collector /for measuring temperature of dases prior to entering compressor turbine/. 10. Compressor turbine casing. 11. Power turbine casing. 12. Exhaust collector cover. 13. Flange for mounting tube to evacuate air via air bleed valves. 14. Line for feeding air to the output shaft seal.

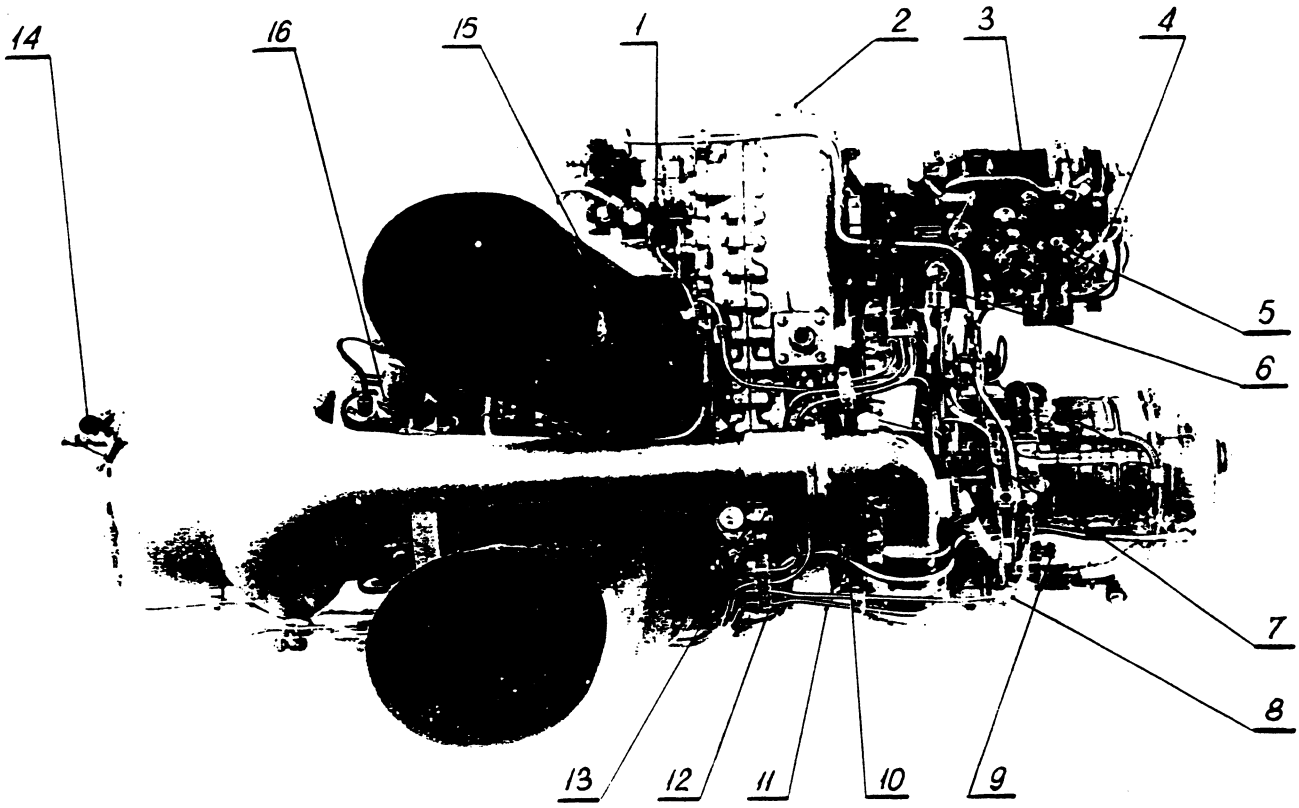

Fig.1.2. /Series III/ Engine as seen from the right-hand side

1. Engine venting. 2. Upper "engine/helicopter" mounting point. 3. Fuel pump. 4. Engine control lever. 5. Cutoff valve lever. 6. Connector for feeding fuel to the engine. 7. Starting system, constant fuel pressure valve. 8. Air bleed and anti-icer valve set. 9. Connector for taking air to the helicopter board installations. 10. Fuel accessories drainage pipe /drainpipe/. 11. Engine/helicopter mounting point. 12. Reducer oil drain plug. 13. Engine/cooler oil transfer stub pipe. 14. Semiconductor ingniter plug. 15. Exhaust pipe. 16. Bearing III air filter.

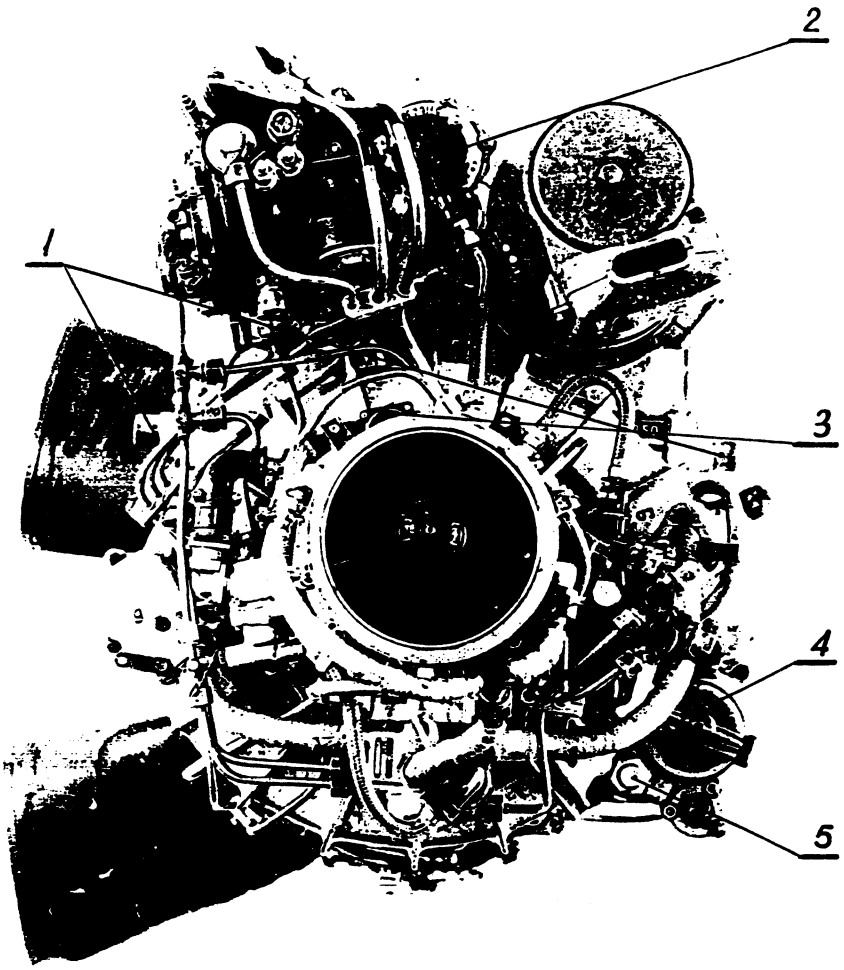

Fig.1.3. /Series III/ Engine as seen from its front.

1. Engine handling journals. 2. Engine-speed indicator power transmission stopper. 3. Main contact plug. 4. Oil filter. 5. Connector pipe for feeding oil from the tank.

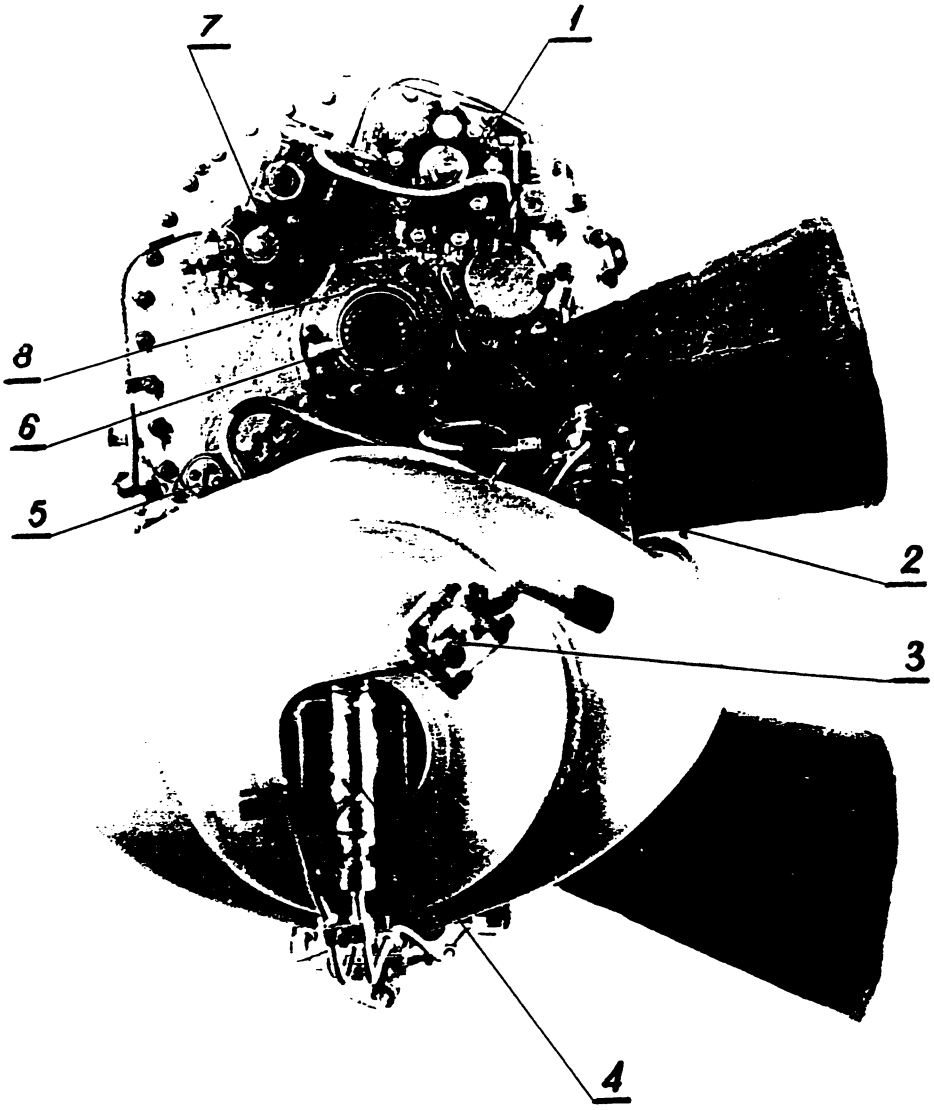

Fig.1.4. /Series III/ Engine as seen from its rear.

1. Free turbine speed limiter. 2. Bearing III air filter. 3. Starting burner. 4. Working burner. 5. Thermocouple connection point. 6. Engine output shaft. 7. Turbines synchronizer. 8. Output shaft labyrinth cover.

Basic Technical Data for all Series of GTD-350 Engines

1. Designation	GTD-350
2. Engine Type	Turbine engine with free power turbine
3. Turbocompressor, sense of rotation while locking in the flying direction	Left-hand /anticlockwise/
4. Engine output shaft, sense of rotation	Right-Hand /clockwise/
5. Compressor	Axial-flow centrifugal--stage compressor /seven axial and one centrifugal-flow stage/
- maximum compresion ratio at H = 0, V = 0 under "MAW" conditions	5.95 for Series I 6.05 for Series II, III and IV
6. Combustion chamber form	Cylindrical
7. Compressor turbine	Axial-flow, single-stage
8. Free /power/ turbine	Axial-flow, double-stage
9. Engine speed reducer	Single-stage with cylindrical gears
- gear ratio	0.246

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December 1977

10. Dry engine weight	$139,3^{+2\%}$ /kG/
Dry engine weight includes the weight of engine-mounted accessories except for generator-starter assembly; engine-speed transmitter; oil pressure transmitter; oil temperature transmitter; thermocouples and exhaust pipes.	The engines equipped in accessories PNRP-3 /HP-40TA/ and OOWT-3 /PO-40TA/ $137,7^{+2\%}$ /kG/ - the other engines
11. Maximum basic engine dimensions:	
11.1. Length	1385 /mm/
11.2. Width	626 /mm/
11.3. Height	760 /mm/
12. Engine installation life prior to a major repair	As per Engine Log Bock
13. Guaranteed engine life	As per Engine Log Bock
14. Fuel grade	T-1 acc. to GOST-10227-86 T-2 acc. to GOST-10227-86 with an admixture of PMAM-2 TS-1 acc. to GOST-10227-86 TS-1G /T-7/ acc. to GOST-12308-80 with an admixture of PMAM-2; PSM-2 acc.to PN-86/C-96026 RT acc. to GOST-10227-86 PL-6 acc. to CSN 65 6518 JET A-1 acc. to DERD 2494
15. Engine-fed fuel screen mesh size	0.012 - 0.016 /mm/

Revised

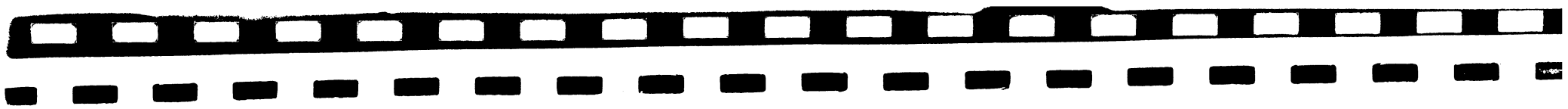
16. Engine inlet fuel pressure	0.4 - 1.2 /kG:cm^2/
17. Maximum temperature limitation for gases prior to entering compressor turbine	Hand control
18. Fuel system and control system accessories plus control devices:	
18.1. Fuel pump	Plunger type with flow controller
Designation,reference	PNRP-1 /HP-40T/ or PNRP-2 /HP-40T/ or PNRP-3 /HP-40TA/
18.2. Free /power/ turbine speed limiter	Centrifugal type
Reference designation	OOWT-1 /PO-40T/ or OOWT-2 /PO-40T/ or OOWT-3 /PO-40TA/
18.3. Turbine synchronizer	Combined hydraulic and pneumatic design
Reference designation	ST-1 /CO-40/
18.4. Air bleed control device, automatic	Combined hydraulic and pneumatic design
Reference designation	ASUP-1 /DS-40/ or ASUP-2 /DS-40T/
18.5. Starting fuel valve	Contant-pressure-solenoid-valve controller type

...	18.6. Starting burner	Radial single-passage type
	18.7. Working burner	Radial two passage type
	18.8. Thermometer for gas temperature measurement - indicator	electric WUTT200...1100°C /ИТГ-1/ or an interchangeable one WUTT200...1100°C /ИТГ-1М/ /refer to indicator certificate for indicator service life/.
19.	Oil grade	B-3W /synthetic/ acc. to MRTU-38-1-157-65 Spec.; B-3W /synthetic/ acc. to TU-38-101295-75 AEROSHELL TURBINE OIL 500 /ASTO-500/ acc.to MIL-L-23699 CASTROL 5000,acc.to MIL-L-23699C CASTROL-98 acc. to DERD 2487 ELF TURBOJET II acc. to MIL-L-23699

Refer to page 678 para 22 for the method of change from one grade of oil to another.

20.	Portion of oil to be poured into helicopter tank	12,5 /1/
21.	Lubrication system	Circulating closed-circuit with separate suction facilities to remove oil from engine transmission and shafting bearings.
22.	Lubrication system accessories:	
	22.1. Oil Pumps, set	Delivery pump and four suction pumps
	22.2. Oil filter	Gauze type with pressure reducing and check valves

... 22.3. Air breather	Centrifugal type
23. Starting system electrical items:	
23.1. Starting control box	Transmitter type with programming mechanism
Reference designation	PSG-14A /PSG-14A/ or PSG-14A Series 2
23.2. D.C. Generator-starter	STG-3
23.3. Timer-distributor	SKND-11-1 or SKND-11-1A
23.4. Ignition plug	Semiconductor /solid-state type/ SP-18U or SP-18UA
24. Starting system power supplies	Two batteries 12SAM-28 24 volts with change-ever switch to 48 volts at starting.
25. Anti-icing system	Air type /inlet device heated with air from behind the compressor/
26. Set of air bleed valves:	
- Air-to-atmosphere bleed valve	Automatically controlled
- Air-to-Anti-Icing-System bleed valve	Hand operated by pilot
- Bleed for airframe needs	Hand operated by pilot



CHAPTER 2

BASIC PARAMETERS AND OPERATING LIMITATIONS

Issue 2/1975

CHAPTER 2 - Index of Contents

1. Worktimes Acc. To Operating Range

1.1. Continuous running time for the takeoff range, maximum — 6 /min./

Total running time for the takeoff range during normal installation life, maximum — 5 /% installation life/

1.2. Continuous running time for the nominal range, maximum — 60 /min./

Total running time for the nominal range during normal installation life, maximum — 40 /% installation life/

C A U T I O N

CONTINUOUS RUNNING TIME FOR THE NOMINAL AND TAKEOFF RANGE TAKEN JOINTLY IS ALLOWED TO LAST MAXIMUM 66 MINUTES /INCLUDING 60 MINUTES FOR THE NOMINAL AND 6 MINUTES FOR THE TAKEOFF RANGE/ WHEREAFTER THE ENGINE MUST NECESSARILY BE ALLOWED TO COOL DOWN IN THE FLYING OR LOWER RANGES.

1.3. Continuous running time for the idling range, maximum — 20 /min./

N O T E S

1. Operating range of the engine is to be established according to actual speed of the turbocompressor in use.

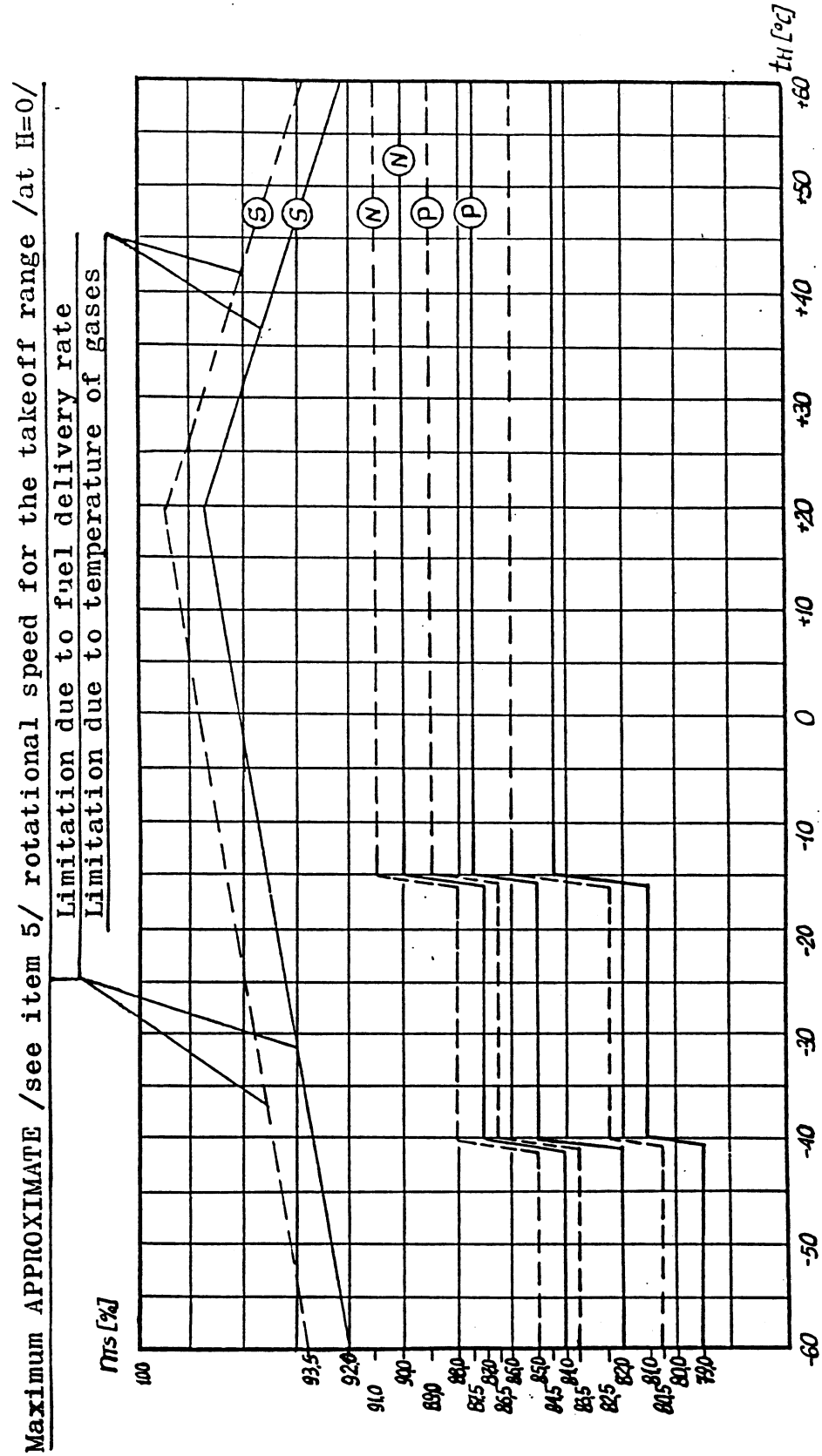
... Rotational speeds of the compressor turbine for various ranges are to be established prior to flihgt in accordance with the prevailing ambient temperature and diagram in Fig. 2.1.

Depending on the ambient temperature, the same rotational speed of a turbocompressor /n_{TS}/ can correspond to another operating range of the engine /e.g. at a temperature of t_H= -20°C and n_{TS}= 89,5% the engine will work in a takeoff range and can be run so for 6 minutes non-stop, whereas at the same n_{TS} = 89,5% but temperature t_H = +20°C it will do its work in the nominal range and can be run so non-stop for 60 minutes/.

Rotational speeds found in this way apply to a maximum altitude of 1000 mtrs only, independently from the actual flight velocity.

2. The upper value of rotational speeds, for the nominal and flying range I is allowed to be stepped up by 1% as soon as the altitude of 1000 mtrs has been reached, being then increased by 1% for each 500 mtrs of added altitude, but not more than 4% jointly for the nominal range of W version engines and by 5% for remaining engines, and by 2% for flying range I W version engines, and by 3,5% for remaining engines.

Under any conditions, the temperature of gases prior to entering the turbine cannot exceed the level as prescribed for the given operating range.



Legend:

broken line - W version engines
solid line - remaining engines
letter (S) - maximal n_{TS} of takeoff range
letter (N) - maximal n_{TS} of nominal range
letter (P) - maximal n_{TS} first flihgt range

Fig. 2.1. Operating ranges of the Engine according to temperatures of the ambient air /applicable for altitudes from 0 to 1000 mtrs/.

... The exceeded maximum allowable temperature of gases for the specified range means that a higher operating range has been reached.

3. No maximum allowable temperature of gases is allowed to be exceeded.

4. Operating range for a pair of engines is dictated by this engine which is run in the higher range.

5. Maximum rotational speeds of a turbocompressor, for a takeoff range, as shown in Fig. 2.1. are to be regarded as approximate only, applying to the engine when run on ground.
With the increasing flight altitude, there grows also rotational speed of a turbocompressor, in its takeoff range, until maximum fuel pump revolutions begin to be limited by the governor.
Should the rotational speed be found to have increased by more than 101 %, it will yet have to be limited by hand down to 101 % /by moving both the pitch and power lever in the downward direction/ with the flight continued normally thereafter. When the task has been completed, readjust the maximum fuel pump revolutions governer.

1.4. Starting time, maximum	**40 /s/ with deck batteries used for the purpose; 30 /s/ with external scurce of power supply used for the purpose.**

1.5. Time required to reach the takeoff range revolutions from the moment of starting, maximum

- when on ground — 5 /min/
- while in flight — 1 /min/

1.6. Acceleration time — 10 to 15 /s/

2. Compressor Turbine Speeds

2.1. Maximum allowable rotational speed of a turbocompressor, takeoff range, at discretional flight velocities and altitudes, maximum — 101 /%/

2.2. Rotational speed of turbocompressor, idling range, at H = 0 — 57 ± 3 /%/

NOTE: With the rising flight altitude idling range revolutions may grow up to 65 - 70 %.

2.3. With a pair of engines in operation, in ranges specified, differences in the engine turbocompressor speeds must be as given hereunder :

OPERATING RANGE	MAXIMUM PERMISSIBLE DIFFERENCE IN ROTATIONAL SPEEDS /%/	
	Engines of One Series	Engines of Various Series
Takeoff	3	3
Nominal	2	3
Flying I	2	4

When the engines are run in variable ranges, flight range II and lower ones, no difference in rotational speed are specified for the turbocompressors.

3. Helicopter Rotor Speeds

3.1. Ground test /H=0; V=0/ speed		
Takeoff range		79 $\pm^{1}$ /%/
Nominal range		82 $\pm^{1}$ /%/
Flying range I, II	max	84 /%/
Idling range		50 $\pm^{4}_{10}$ /%/
3.2. Rotor speeds during flight with engines run in the specified ranges		78 - 84 /%/

N O T E S

1. When the engine is run in its transitional ranges, a short-lasting /up to 30 sec/ increase in the helicopter rotor speed is allowed provided it does not exceed n_{WN}= 86 /%/, and a short-lasting /up to 15 sec./ decrease in helicopter rotor speed provided it does not fall below n_{WN} = 75 %.

2. During flight, with the engines run in their idling range, a short-lasting /up to 5 sec./ increase in the helicopter rotor speed is allowed provided it does not exceed n_{WN} = 92 %.

CAUTION: IT IS FORBIDDEN TO CARRY OUT LANDINGS WITH SUDDEN REDUCTION OF SPEED BY LOADING MAIN ROTOR BLADES CAUSING A DROP OF SPEED TO BELOW 76 PER CENT.

4. Temeperature of Gases

4.1. The maximum allowable temperature of gases prior to entering the turbine /in ^{o}C/ at discretional flight velocities and altitudes shall be , as follows:

OPERATING RANGE	ENGINE SERIES			
	I	II	III,IV	III,IV W version
Takeoff	985	985	970	985
Nominal	940	940	920	920
Flying I	900	900	890	890
Accelerations	1005	1005	990	990

4.2. Maximum allowable temperature of gases during starting

- when on ground — In accordance with Fig. 2.2.
- when in flight — 870 /^{o}C/

4.3. Maximum allowable temperature of gases prior to entering the turbine with the engine run in its idling range — 790 /^{o}C/

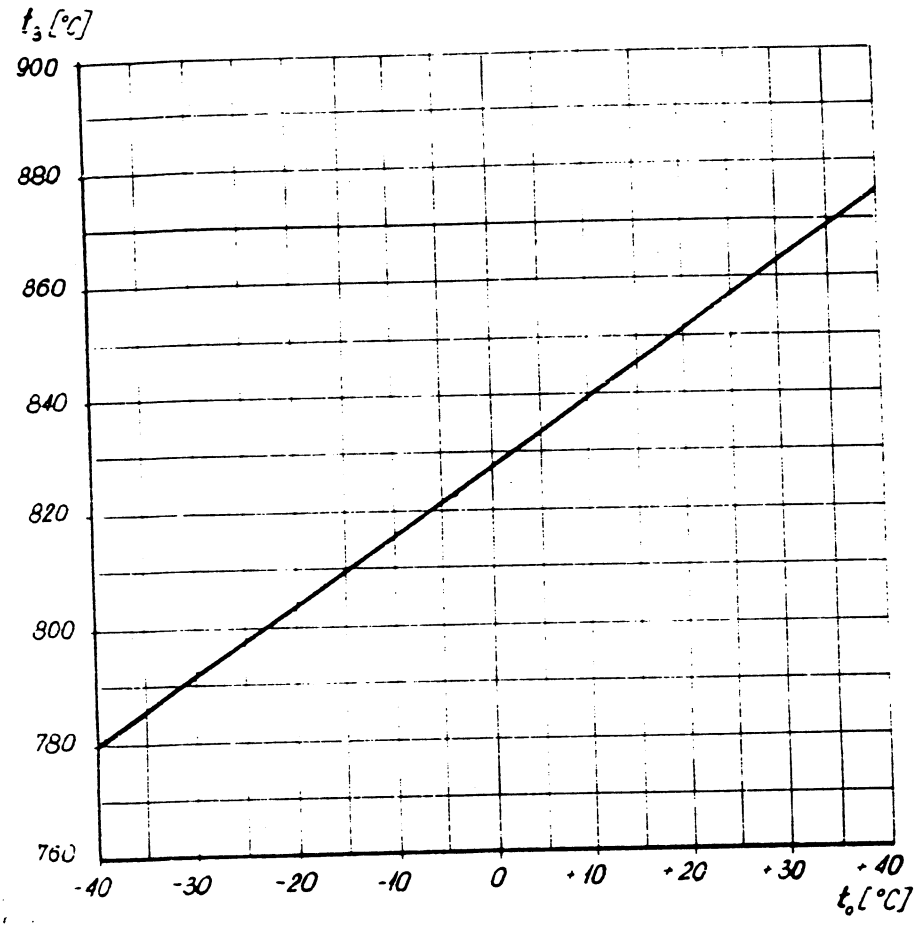


Fig.2.2. Maximum allowable temperatures of gases /t_3 °C/ prior to entering compressor turbine during starting as a function of air temperature /t_o °C/ prevailing at the engine inlet.

5. Air Bleeder

5.1. Air intake for airframe needs is permitted provided the temperature of air at the engine inlet remains lower than +15 /°C/

C A U T I O N

DURING ENGINE STARTING, THE VALVE FOR TAKING AIR TO MEET AIRFRAME REQUIREMENTS SHOULD REMAIN CLOSED.
THIS LIMITATION IS DICTATED BY THE FACT THAT AIR TAKEN RESULTS IN AN INCREASE OF GAS TEMPERATURE PRIOR TO TURBINE.

5.2. Automatic closing of air bleed valve in accordance with Fig. 2.3.

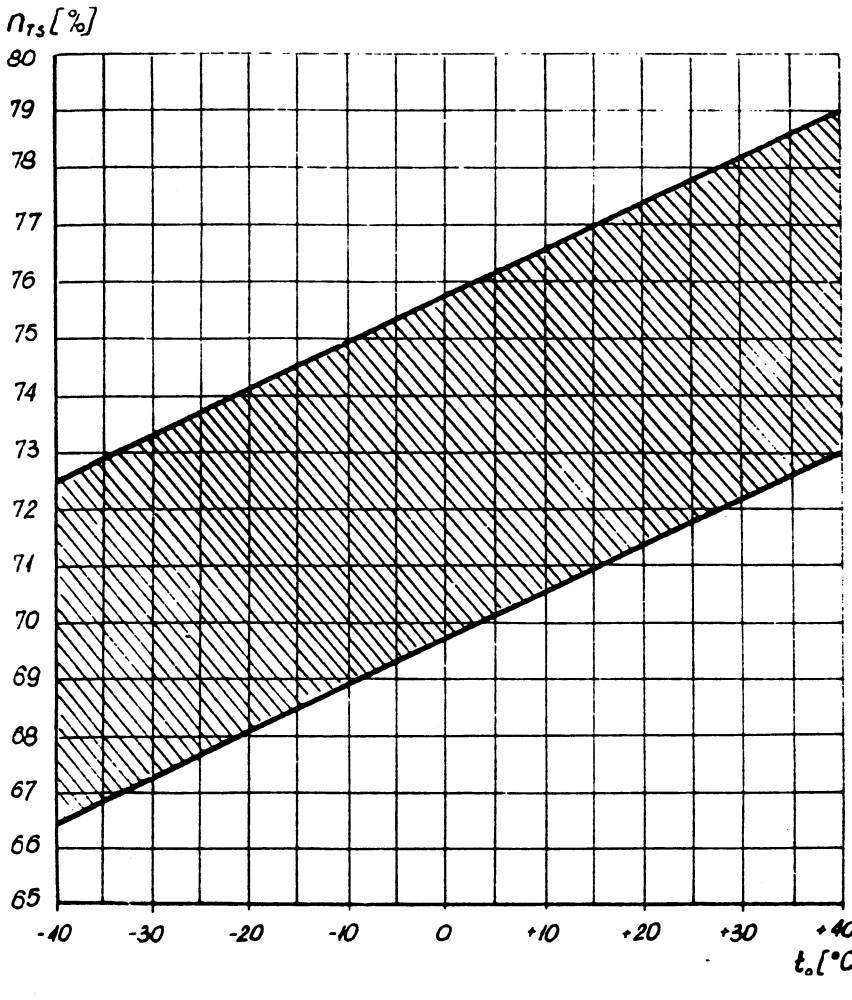


Fig.2.3. The range of compressor turbine revolutions /rotational speeds/ at which an automatic closure of the air bleed valve follows acc. to ambient air temperature level.

6. Parameters of oil within the Engine Lubrication System

6.1. Temperature of oil at the engine outlet:	
- maximum	+ 150 /°C/
- minimum prior to bringing the engine into operating ranges higher than idling	+ 30 /°C/
- recommended maximum	+ 140 /°C/
- minimum for the long-lasting work in flying I and higher ranges	+ 80 /°C/

NOTE: At ambient temperature of minus 40 /°C/ and lower, the minimum oil temperature for long-lasting operation at flight range I and higher flight ranges provided that oil pressure in engine is within $3^{\pm 0,5}$ kG /cm^2.

	+ 60 /°C/
- minimum temperature of oil at starting without preheating of the engine	- 40 /°C/
6.2. Pressure of oil with the engine operated in one of the following ranges:	
- Flying II and higher ones	$3^{\pm 0,5}$ /kG:cm^2/
- Idling, minimum pressure	1,5 /kG:cm^2/
6.3. Consumption of oil not to exceed	0,3 /l:hour/

Revised
February 1984

7. Change the oil in the Lubrication System.

Oil in the Engine Lubrication System is to be changed in the following instances.

7.1. After each 350 hours of engine operation, for B-3W oil after each 250 hours of engine operation.

7.2. Two years after the last change of oil /for oil B-3W after one year/ notwithstanding the actual time of engine work.

7.3. When tar deposits are formed on more than 50% of the entire oil filter gauze area.

7.4. After each 150 hours /for B-3W oil after each 100 hours/ of engine operation where conditions of such an operation include heavy dustiness of atmosphere, or contamination of the atmosphere with chemicals.

8. Overall Operational Requirements

8.1. For washing of parts and engine components only the unleaded petrol is to be used. The B-70 grade of petrol seems to be the best for the purpose.

8.2. During and overhaul combined with the stripping of engine to pieces, or with the replacement of some of the parts or engine components with rubber seal rings mounted thereon, a thin film of the B-3W grade of oil is to be applied to the surface of said rings prior to their reassembly.

8.3. Oil spread over painted surfaces, rubber parts, electrical wires, outlet tubes /exhaust pipes, etc., must be immediately removed.

8.4. With oil changed in the Lubrication System, oil filters inspected for their fitness, or oil system lines replaced by new ones, it will be necessary to apply a cold turning of the engine in order to remove air entrapped inside the Lubrication System.

8.5. With the temperature of oil in the engine being lower than minus 40°C, the engine will have to be heated prior to starting with a jet of hot air.

8.6. It is forbidden to drain fuel out of the fuel system for a time longer than 24 hours without applying thereto a previous preservation of the fuel system.

8.7. After an inspection of the fuel filter, replacement of fuel lines, and in the event of an other type of work, where air could have entered the system of fuel lines, the application of venting is absolutely necessary to remove air entrapped inside.

8.8. The successive starting of the engine on ground can fellow no sooner than after 3 /three/ minutes from the complete arrestment of line shafting.

8.9. During the starting operation it is forbidden to manipulate the pitch and power lever, correction control and control lever. They should remain in their idle running position.

8.10. When the engine has been put out of operation for a time longer than 10 minutes, a cold turning should be applied some two minutes after the engine has been brought to a stop.
Engines having removable bearing III oil injector do not require any cold turning.

8.11. When the helicopter remains idle, air inlet ducts leading to the compressors and exhaust pipes ought to be blanked off with stoppers, being also covered with protective blankets should the stanstill be expected to last longer than the usual time.

8.12. For takeoffs and landings, and for the inspection of engines, only hard ground or grass land sites must be chosen.
Permanent landing sites ought to be covered with a layer of concrete, or be protected in some other way to prevent dust from being entrained by wind. Should it be possible that a cloud of dust is entrained by the past-rotor jet of air, the place around the helicopter will have to be sprinkled with water.

8.13. Avoid such phases of flight in which there is a need of sudden loading or unloading of the main rotor with rapid shift of pitch and power lever causing a drop of main rotor speed beyond the range of 78 to 84 per cent, e.g.:

- rapid transition from quick descent to horizontal flight or climbing,
- sudden transition from horizontal flight to climbing,
- sudden transition from quick climbing to horizontal flight.

8.14. While performing single-engine flights of the helicopter with second engine operated at a reduced range, its r.p.m. are to be kept within 65 - 70 per cent of n_{ts} speed.

8.15. The operation of WR-2 main gear with one engine /second engine being switched off or idling/ is to be limited to minimum. Record the WR-2 main gear operation time, while driven from one engine, in full detail in the gear certificate.

CHAPTER 3

STANDARD PROCEDURE

CHAPTER 3 - Index of Contents

1. MAKING THE ENGINE READY FOR FLIGHT

During normal service, in parallel with other action taken about the helicopter, the following preparatory work is to be also completed on the Engine /hereinafter called preparations/ in order to arrive at the required degree of operational fitness :

- Initial preparation;
- Preflight Preparation;
- Postflight Preparation;
- Repeated Flight Preparation.

Initial Preparation

Initial preparation of the Engine is to be carried out parallelly with the initial preparation of a helicopter. This is the basic type of preparation for the Engine before flight.

Initial preparations of the Engine is usually completed after a longer standstill of the machine /or after replacement of the Engine/, being a usuwal procedure for the days or nights on which flights are expected to take place.

An interval between the day of initial preparation and the day/night of flight cannot last longer than seven days.

An initial preparation includes steps, as follows :

... - Visual /postflight type/ inspection of the Engine to check its overall condition and readiness for a flight to come in conformity with Inspection Table. No. 3.1.;

- Repair /removal of defects/ faults noticed during inspection;
- Verification of the control and measuring devices /instrumentation/ of the Engine;
- Checking for oil and fuel levels to be made up, if necessary;
- Checkings and entries made in the Service Documentation /Engine Log Bock and Accessories Information Cards/.

Preflight Preparation

A preflight preparation/is to be completed at the start of the day/ night on which a flight is expected to take place, along with the preflight preparation of the helicopter as a whole.

This consists of the following steps:

- Preflight inspection in conformity with Inspection Table No. 3.1.;
- Making-up of fuel and oil reserves;
- Checking the engine for operation;
- Repair /removal of defects/ faults.

Postflight Preparation

Postflight preparation of an Engine takes place after each flying day or night along with similar duties and steps being taken about the helicopter as a whole. It is

... intended to restore normal operational reliability of the Engine and includes steps, as follows :

- Check inspection in conformity with Inspection Table No. 3.1.;
- Repair /removal of defects/ faults noticed during inspection and under flight conditions;
- Making-up reserves of fuel and oil;
- Entries passed in the Documentation.

Repeated Flight Preparation

Preparation of the Engine for repeated flight consists of the following steps :

- Repair /removal of defects/ faults noticed during flight;
- Takeoff inspection of the Engine in conformity with Inspection Table No. 3.1.;
- Making-up of fuel and oil reserves.

Inspection Types and Their Scopes in Preparing an Engine for Flights

IT.	PROCEDURE	INSPECTION TYPES		
		PREFLIGHT	TAKEOFF	CHECK-UP
1	2	3	4	5
1	Visual inspection of engines for possible presence of mechanical defects	-	-	+

continued from page 3/306 .....

1	2	3	4	5
2	Inspection of compressor inlet to lock for damaged vanes and oil leakage. Not permitted are the visible individual nicks and dents from foreign objects on leading and trailing edge and on airfoil surface of visible blades of axial compressor rotor /missing enamel is permitted/.	+	+	+
3	Inspection of engine fixing points	-	-	+
4	Visual inspection of line joints for presence of leaks	+	-	+
5	Visual inspection of accessories for reliability of their attachment	-	-	+
6	Visual inspection of electrical accessories to reveal damaged wire connections and to see the condition of instrumentation. With power applied to instruments, pointer of the oil pressure gauge should read zero and this of oil temperature gauge ambient oil temperature.	+	-	+
7	Checking control bars for their secure attachment to fuel pump levers. Checking engine control lever for smoothness of movements	+	-	+
8	Visual inspection of the engine magnetic plug	-	+	+

1	2	3	4	5
9	Visual inspection /by aid of lamp/ of exhaust pipes and exhaust manifold covers for the presence of crackings.	-	-	+
10	Manual rewolving of turbo-compressor impeller, with compressor stage I Vanes held with the hand. Compressor must revolve with no jamming or grating sounds being heard therefrom.	-	+	+
11	Visual inspection to see for fuel or oil leaks in various engine sections. Checking the oil consumption	-	+	-

NOTES: 1. "+" denotes need for action.
2. Compressor is to be revolved /see It.10/ clockwise when looking at compressor from its front.

CAUTION: IT IS FORBIDDEN TO REVOLVE COMPRESSOR IN THE OPPOSITE DIRECTION AS THIS MAY RESULT IN THE OIL BEING SUCKED INSIDE.

1.1. Checking the control and measuring devices /instrumentation/ for reliability of readings

The checking of Engine control devices, along with the routine action for this type of instrumentation, is to be carried out simultaneously with the inspection of helicopter unit control devices in full conformity with the helicopter Service Manual.

1.2. Repair /removal of defects/ faults

Repaired or removed ought to be all the defects or faults noticed during inspection of the Engine and during its checking on the ground, and also those observed during flight and then reported by the pilot. Should the defects/faults noticed during flight be impossible to be confirmed at the inspection of the Engine, a diagnostic procedure would have to be applied about the Engine while in motion.

Having repaired defects noticed, set the Engine going to observe for two to three minutes how it really operates in various ranges to make oneself sure about its functional reliability.

If the fault cannot be referred to the Lubrication or Control Systems, no functional reliability test will have to be carried out on an operating Engine.

Defects/faults noticed, their repair or removal, and protection measures applied will have to be written down in the Service Documentation.

1.3. Refilling of the Lubrication System

Refilling takes place when the level of oil in the tank has dropped beyond the permissible limits.

Prior to refilling, check the engine for oil consumption rate and the cooler with oil feed lines for freedom from leaks. See also the Certificate for the usefulness of the specified grade of oil in service.

Refilling ought to be done so as to render impossible contamination of oil and system.

To inspect the tank for quantity for oil see scratches marked on the measuring line /bayonet/.

Two kinds of refilling methods are to be distinguished:

- first filling of the "dry" engine;
- making-up of oil reserves.

1.3.1. The first filling is to be done, as follows :

- Pour 12.5 litres of oil into the tank;
- Perform cold turning of the Engine;
- Start the Engine and run it in the idling range for 4 to 5 minutes to allow the oil to penetrate into the entire Lubrication System;
- Stop the Engine and add some more oil so as to arrive at the upper level scratch of the scale.

Oil is to be poured through a strainer with the sieve mesh not exceeding 0.063 mm x 0.063 mm in size.

1.3.2. To make up oil reserves, add the required portion of oil to reach the level wanted.

- The maximum allowable reserve of oil in the tank is 12.5 ltrs.;
- Recommended reserve of oil in the tank prior to flight is also 12.5 ltrs.

CAUTIONS:

1. IT IS FORBIDDEN TO OPERATE THE ENGINE WITH THE RESERVE OF OIL IN THE TANK EXCEEDING 12.5 LITRES AND TO START A FLIGHT WHEN THE RESERVE OF OIL IN THE TANK IS FOUND TO BE LESS THAN 8 LITRES.

2. THE RESERVE OF OIL IN THE TANK AFTER FLIGHT CANNOT BE SMALLER THAN 6 LITRES.

1.4. The Rate of Oil Being Consumed by the Engine

The rate of oil consumption can be found from comparison made between oil level in the tank prior to flight and after the flight. Measurement is to be carried out possibly at the same oil temperatures /difference in oil temperatures should not be greater than 10°C/.

The rate of oil consumption is to be determined no sooner than after 3 to 4 hours of continuons Engine operation.

Under quite specific circumstances, the rate of oil consumption can be found from the Engine run on ground for 20 to 30 minutes.

Should after a flight, the reserves of oil in the tank be found according to scale readings, to be less than 6 litres, it would be necessary to trace the cause for such a loss of oil.
If the loss of oil has not been due to the operation of Engine, but can be seen e.g. as an effect of leaks through the system, it will be necessary to remove the probable cause of oil losses and then to adept measures, as follows :

- See the magnetic plug and oil filter for the presence of possible swarf;

- With no swarf found during the inspection, add some more oil to the tank so as to make up the reserve of oil to 12.5 ltrs in volume whereafter proceed with a 30 minutes Engine ground test.

  Should no distinct looses of oil be stated during this test, the Engine will have to be tested out once again in flight.

When the rate of oil consumption, operation of the Engine and its parameters are found to be correct /i.e. operation of the impellers of turbocompressor and power turbine will be smooth, the time of run-out of the impellers after their stoppage will be in acceptable limits, and no swarf will be found to be present either on the oil filter or on magnetic plug, there is no hindrance to continue further operation of the Engine.

- Work thus completed is to be specified in Chapter XIV of the Engine Log Book.

C A U T I O N S

1. IT IS FORBIDDEN TO INTERMIX OIL GRADE B-3W WITH OTHER GRADES OF OIL.

2. OIL SPREAD OVER PAINTED SURFACES; RUBBER COMPONENTS, ELECTRIC WIRES; EXHAUST PIPES; ETC., OUGHT TO BE IMMEDIATELY WIPED AWAY.

3. WHEN THE SPECIFIC OIL CONSUMPTION IS OBSERVED TO RISE OVER 0.3 MTRS/HOUR, NO FURTHER OPERATION OF THE ENGINE WILL BE ALLOWED WITHOUT TRACING FIRST THE CAUSE FOR AN INCREASED OIL CONSUMPTION.

W A R N I N G S

1. **SINCE THE PRODUCTS OF OIL B-3W DECOMPOSITION ARE TOXIC, IT IS FORBIDDEN TO MAKE USE OF THE COMPRESSOR-FED AIR FOR PILOT'S AND PASSENGERS'NEEDS WITHOUT ITS PREVIOUS SPECIAL TREATMENT.**

2. **HAVING ENDED THE WORK WITH THE B-3W GRADE OF OIL CAREFULLY WASH YOUR HANDS WITH WATER AND SOAP, PRIOR TO TAKING A MEAL IN PARTICULAR.**

1.5. Refilling of the Fuel System

For Fuel System refilling instructions refer to the Mi-2 Helicopter Service Manual.

No readaptation of the Engine Fuel System is necessary when changing over from one fuel grade to another.

C A U T I O N

IT IS FORBIDDEN TO DRAIN FUEL FROM THE ENGINES FOR A TIME LONGER THAN 24 HOURS WITHOUT APPLYING THEREAFTER AN INTERNAL PRESERVATION OF THE FUEL SYSTEM.

1.6. Keeping a Service Documentation

Troubles noticed during flight or inspections, and their proposed remedies, ought to be written down in the Helicopter Flight Preparation Card /book/ and Engine Log Book.

Entries to be made in the Engine Log Book should also include the following: every completed helicopter flight, worktime in various ranges on the ground and in flight for each day; effective operating parameters of the Engine; and all the operations completed on the Engine when in service.

The Engine Log Book should include information about routine duties, oil exchange, work done in connection with the preservation and unpreservation of the Engine, renewal of accessories and all the adjustments employed.

Corresponding obserwations should also be written down in the Accessory Information Cards.

Installation life of an Engine includes its total

/100 %/ time of operation in the air and one fifth /20 %/ of its ground work time.

Worktimes in the takeoff and nominal range are to be summed up separately.

2. STARTING AND CHECKING THE ENGINE FOR ITS OPERATION

2.1. General

The following operating parameters have to be checked for an Engine in normal service:

- Turbocompressor revolutions /rotational speed/;
- Rotational speed of power turbine measured as the speed of rotor;
- Temperature of gases prior to entering compressor turbine;
- Engine outlet oil temperature;
- Oil pressure;
- Oil consumption /by checks made on the tank for oil level/.

Starting of the Engine can be done by making use of one of the following supply sources;

- Board batteries 12 SAM-28 /internal power source/;
- Aerodrome-installed sources of power supply APA-2M and APA-35;
- Generator of the adjacent working engine /internal source of power supply/.

NOTE: Also starting with the aid of other sources of direct-current power is possible. At ambient air temperatures ranging from -60°C to +60°C, each of these sources is expected to ansure the following electrical conditions:

- Voltage on starter terminals, at the end of each hot start, to be not less than 25 $\pm$ 1 V;

- Amperage of starting current to be maximum 450 A.

Each source ought to be such as to withstand current surges up to 1000 A.

The term. "At the end of starting" is to be understood as an end duty cycle of the start control box /i.e. about 25 seconds from the moment of actuating starting push-button/.

It will be necessary to abide by the following recommendations when starting an Engine:

2.1.1. See that the rise in Temperature of gases to enter compressor turbine does by no means exceed the permissible value /Refer to Fig.2.2. page 210/ and that compressor turbine revolutions be at no time suspended /i.e. that they do not change in a time of 3 sec/.

C A U T I O N

1. WITH THE TEMPERATURE OF GASES RISING OVER THE PERMISSIBLE LEVEL, OR COMPRESSOR TURBINE REVOLUTIONS HAVING A TENDENCY TO BEING SUSPENDED, THE STARTING WORK MUST BE STOPPED IMMEDIATELY BY CLOSING THE CUTOFF VALVE AND DEPRESSING THE "BREAK STARTING" PUSH-BUTTON.

2. IT IS FORBIDDEN TO PROCEED WITH THE STARTING OF ENGINE WHEN CONTROL DEVICES /INSTRUMENTS/ SEEM TO BE OUT OF ORDER.

2.1.2. Watch rise in oil pressure which at the end of starting is expected to range from 1.5 to 3 kG/sq.cm.

2.1.3. After an unsuccessful starting, the subsequent one can be done no sooner than after a cold turning of the engine /blow-through operation/.

2.1.4. When the Engine is started again after less than 2 /two/ hours of standstill, a cold turning operating /blow-through/ will be required.

Where no external source of power supply is made available, cold turning and starting of the first engine is to be made from helicopter batteries to go then over to the generator of the engine already in operation while proceeding with the cold turning and starting of the second engine.

2.1.5. Board batteries are allowed to be used for no more than three starting operations without being charged again /time intervals between separate starting operations are to be 3 minutes at least/.

2.1.6. When the voltage of board batteries /measured with the deck ammeter/ is found to drop at the end of hot starting below 14 volts, batteries will have to be renewed or recharged.

2.1.7. When starting the engines from deck batteries, then to make such a starting more economical /economy

... of batteries/ it will be necessary to depress, as scon as the idling range has been reached, the push-button "BREAK STARTING" in order to disengage starting control box and to break thus the source-starter connection.

2.1.8. Where the airport source of power supply is utilized for starting, it will be permissible to produce 5 startings at a time with time intervals between each of them lasting no less than 3 minutes.

2.1.9. After 5 consecutive startings, the starter and timer-distributor must be left idle for 30minutes to let them cool down.

2.1.10. After two consecutive /with 3 minutes interval in between/ alleged startings, or two cold turnings, the starter must necessarily be left idle for 30 minutes to cool down.

2.2. Preparations for starting

- Release rotor brakes;

- See that the pitch and power lever is in its bottom position, abutting against the stop, and that the correction control remains in its anti-clockwise position /corresponding to the idling range operation/;

- Adjust levers for the selective control of engines to their neutral position and lock them in this position;

- Make sure that the cutoff valve remains in its CLOSED position;

... - Adjust the "TURNING - STARTING" switch to its STARTING position;

- Adjust the "EXTERNAL SUPPLY - BATTERIES" switch to its BATTERIES position in the event of deck battery starting, or to its EXTERNAL SUPPLY In the event of starting based on the power supplied from the airport source.

2.3. Starting with Board Batteries Used as a Source of Power Supply

First Engine Starting:

Starting from board batteries is to follow this pattern of sequence:

- Get ready for starting /i.e. carry out the necessary starting work/;

- Signalize that starting is to begin;

- Switch ON helicopter supply pump;

- Open fire-safety valve of the fuel system;

- Switch ON power supply to operate Engine and Drive control devices;

- Set ENGINE STARTING switch to the required position /L.H. or R.H. Engine starting position/;

- Depress starting button and keep it depressed for 2 to 3 seconds whereafter change the cutoff valve lever over to its OPEN position.

Second Engine Starting:
To start the second engine make use of the board

batteries, or generator of the engine already in operation.
Starting of the second engine, with the aid of board batteries, is to proceed in a similar manner as that of the first one, but generator of the engine already in operation must remain switched OFF during the time of starting.

When starting the second engine, using generator of the engine in operation as the source of power supply, its range of operation should be n_{TS}= 82 - 85 %.

With engaged generator of the engine already in operation, starting of the second engine should pursue the same guidelines as that of the engine One.

NOTE: When starting the engine by use being made of the generator from the engine already in operation, there can appear some variations in the parameters of helicopter wiring system. These variations are visible when the process of starting is rather intense.

To obviate this process, wait nntil engine started reaches the speed of n_{TS} = 40 - 45 % in a time shorter than 13 seconds, and then use the BREAK STARTING push-butten to disconnect the start controlling box; after the disconnection of box, idling speed will soon be reached by the engine.

This remark does not apply to helicopters fitted with Series II control boxes.

2.4. Starting with External Source of Power Supply Used for the Purpose

Prior to starting an engine with the external source used as power supply, do the following:

- Connect the external source of power supply to the wiring system of helicopter:
- Set the power supply switch in position EXTERNAL SOURCE.

Further sequence of the starting operation is to follow the pattern of board battery starting. Having started the engine, disconnect the external source of power supply.

2.5. Checking Engine Operation

The checking of engine operation on individual ranges is as a rule done sumultaneously. If it is necessary to check only one engine on higher ranges, the other engine is to be adjusted to a range of 65 - 70 % of n_{ts} speed.
Checking the operation of both engines at the same time is necessary in follwing cases:

- Prior to the first flight of helicopter with a newly installed engine;
- After the 50-hour routine procedure has been completed;
- After any type of work completed around engine control system in the helicopter;
- After replacement or readjustment of the fuel system accessories /like e.g. fuel pump, free turbine speed limiter, speed synchronizer/;
- When functional irregularities have been noticed in the mating of engines during flight.

2.5.1. With the engines in operation carry out checks, as follows:

- Checking air bleed valve for rotational speed of its closure:

  This check is to be done on a hot engine by slowly increasing revolutions of the compressor turbine. The moment of a complete closure is to be assessed according to a characteristic noise being no more heard from the turbine: this check can be also done with the hand applied to the bleed valve lines to see that no more air is flowing thereout:

- Checking for operating parameters in all ranges:

  Keep the engines going for 10 to 15 seconds in every range higher than idling. Check engines for their operating parameters and compare same with the data stated in Chapter 2;

- Acceleration check - to be necessarily made each time a new engine has been installed.

C A U T I O N S:

1. AN ENGINE CAN BE ALLOWED TO BE RUN INTO OPERATING RANGES HIGHER THAN IDLING ONLY WHEN THE TEMPERATURE OF OIL AT THE ENGINE OUTLET HAS REACHED MINIMUM +30°C, THE TIME OF WARMING-UP BEING THEN AT LEAST ONE MINUTE.

2. EXCEPT FOR ROTOR BLADE TRACKING TEST, THE 54 - 75 % ROTOR SPEED RANGE IS TO BE TRATED AS TRANSITIONAL WITH MAX. TRANSITION TIME OF 20 SEC.

Revised
April 1988

NOTE: If the automatic control system of the helicopter gives rotor speed below 54% when both engines are working at a range of idle speed with pitch and power lever in lower position /general pitch of 1 deg. acc. to blade pitch angle indicator reading/ and correction knob turned anticlockwise to the stop, it is recommended to adjust lower rotational speed of the rotor by increasing the general pitch angle within the range of 1.5 to 2.5 deg. with pitch and power lever while correction knob remains turned fully anticlockwise. In this case, the pitch and power lever is to be shifted to lower position.

2.5.2. Checking Operation of One Engine.

In order to enter with engine the higher operation ranges, proceed as follows:

- Turn the correction knob on pitch and power lever fully clockwise;
- Shift the lever of separate control of the checked engine fully upwards;
- Adjust the pitch and power lever to the required operation range of the engine.

In order to bring the engine back to idle speed range the correction knob is to be turned to fully anticlockwise position; shift the pitch and power lever to lower position and the separate control lever to neutral position.

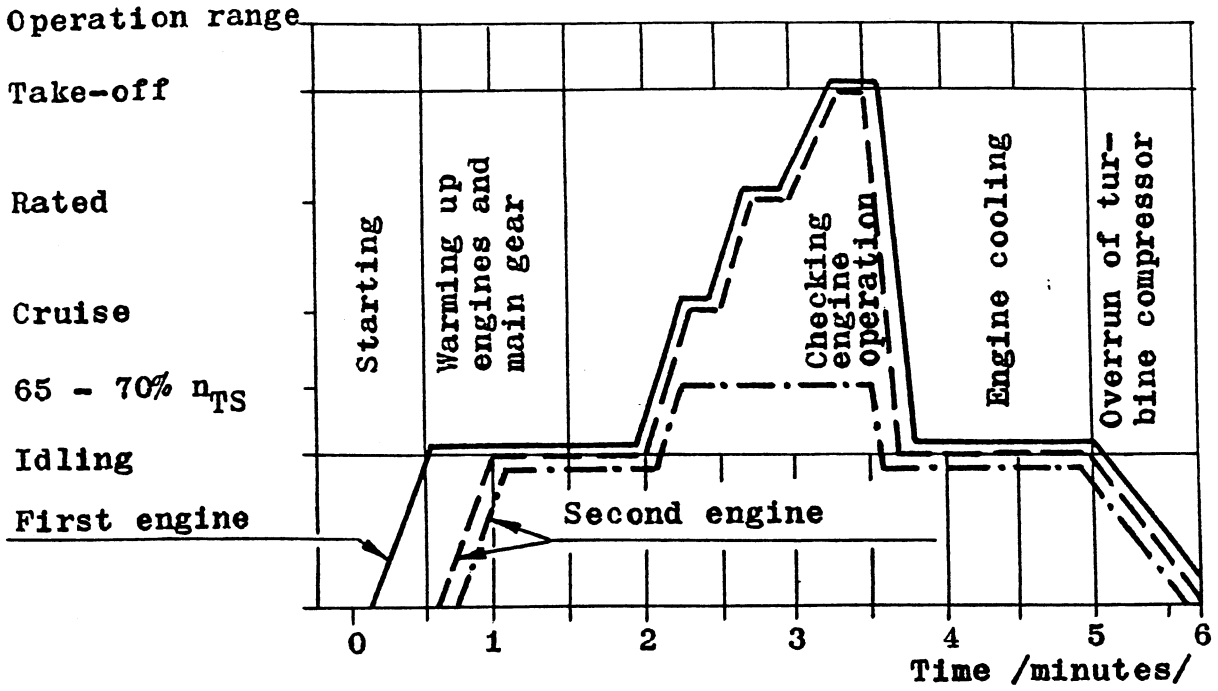


Fig.3.1. Checking operation of engines while performing startings from airfield power supply.

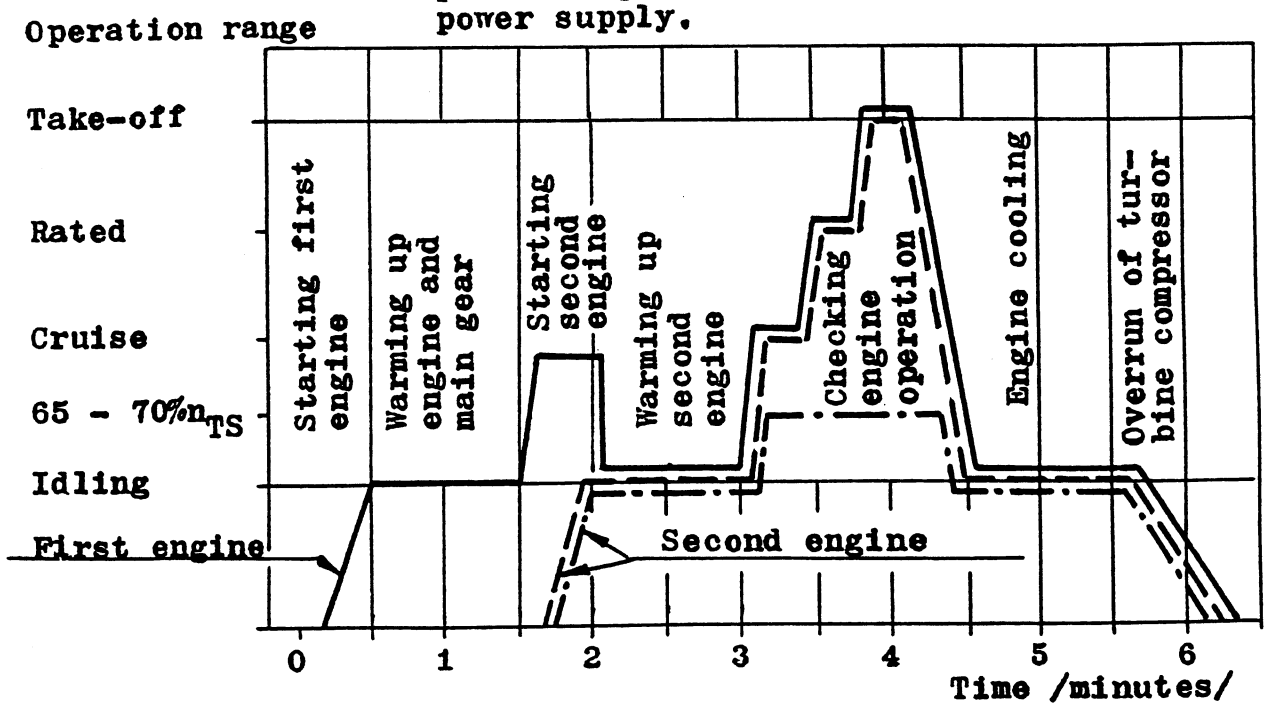


Fig.3.2. Checking engine operation while performing starting of second engine from the generator of operating engine.

NOTES:

1. If during checking of operation of one engine the other engine is also working, proceed as follows:

   - bring the not-checked-engine speed to a range of 65 - 70 % of n_{ts} by shifting down the separate control lever of that engine;

   - while the pitch and power lever is being shifted upwards, the speed of not-checked engine is to be kept at 65 - 70 % of n_{ts}, by turning the correction knob anticlockwise or further, by shifting downwards the separate control lever of that engine.

2. While checking the engine operation after depreservation the anti-icing valve is to be switched twice for one minute each with one minute break in between at idling range and once for a period of 30 to 60 s at rated and 1st cruise ranges each.

   After switching the valve on the temperature of gases before turbine may rise by 20 deg. After switching the valve off, the temperature should get lower to the value as before switching it on.

2.5.3. Simultaneous operation of engines

To achieve simultaneous control of engines make use of the PITCH AND POWER lever, moved to the required position, the correction being fully clockwise.

When stopping up the angle of rotor incidence, its rotational speed will diminish in conformity with the static characteristic of power turbine limiter.

Rotational speeds of compressors in the operating engines are compensated by means of the turbines synchronizer.
With two engines simultaneously in operation, no maximum allowable difference is laid down for the temperature of gases prior to entering compressor turbine in both engines.

NOTE: With a limitation of the temperature of gases observed in the takeoff range, rotational speed of the rotor can be higher than 80 %.

CAUTION: DURING FUNCTIONAL TESTING OF AN ENGINE, OR ENGINES, BY A MECHANIC, THE HELICOPTER MUST BE KEPT ANCHORED.

2.5.4. Engine acceleration checks :

Acceleration checks are to include ranges from idling up to the takeoff range.

Acceleration check is to be made on a warmed-up engine after the takeoff range speed and tempera-

... ture of gases have been verified.

Acceleration procedure is as follows:

- Move selective control lever into its uppermost position, with the PITCH AND POWER lever adjusted to its minimum angle and correction set fully anticlockwise;

- Apply a load to the rotor by a suitable positioning of the PITCH AND POWER lever so as to arrive at the maximum turbocompressor speed /at high ambient temperatures, when there is a limitation imposed upon ranges by the temperature of gases prior to the turbine, this will be the speed at which said temperature reaches the maximum allowable level/;

- With the rotor-blade pitch left unchanged, bring the engine into its idling range by moving the selective control lever into its downward direction;

- Produce acceleration. Move selective control lever into its uppermost position in a time ranging from 1.5 to 2 seconds;

- Acceleration time is to be measured from the moment, the lever has begun movement from its IDLING position, up to the moment the turbocompressor rotor has reached a speed 1 to 1.5 % lower than this of the takeoff range.

... ture of gases have been verified.

Acceleration procedure is as follows:

- Move selective control lever into its uppermost position, with the PITCH AND POWER lever adjusted to its minimum angle and correction set fully anticlockwise;

- Apply a load to the rotor by a suitable positioning of the PITCH AND POWER lever so as to arrive at the maximum turbocompressor speed /at high ambient temperatures, when there is a limitation imposed upon ranges by the temperature of gases prior to the turbine, this will be the speed at which said temperature reaches the maximum allowable level/;

- With the rotor-blade pitch left unchanged, bring the engine into its idling range by moving the selective control lever into its downward direction;

- Produce acceleration. Move selective control lever into its uppermost position in a time ranging from 1.5 to 2 seconds;

- Acceleration time is to be measured from the moment, the lever has begun movement from its IDLING position, up to the moment the turbocompressor rotor has reached a speed 1 to 1.5 % lower than this of the takeoff range.

... - Gas temperature overrides at acceleration cannot acceed the takeoff range temperature of gases, or the limitation temperature, by more than 20°C.

NOTE:

If both engines are in operation, correction is to be locked prior to acceleration in its FULLY ANTICLOCKWISE position; and during the leading of rotor, engine which is not under examination should be kept idling, and to achieve this the selective control lever of this engine must be moved downwards.

2.6. Stopping the Engine

Prior to complete arrestment, the engine must be allowed to cool down by being idled for 1 to 2 minutes.

Under winter conditions, to prevent deformation of hot parts of the engine, the cooling-down time must be extended to 2 - 3 minutes.

To stop the engine, move the cutoff valve lever to its STOP position.

When the engine is running out, see that no knocks, jamming or abnormal sounds are to be heard during the slowing-down of turbines.

In doubtful cases, measure the turbocompressor run-out time which is assumed to be not shorter than 25 sec.

The run-out time is that time which elapses from a start of the cutoff valve lever movement up to a complete arrestment of the turbocompressor rotor.

With the engine stopped for a time longer than 10 minutes, apply cold turning 2 minutes after arrestment.
Engines having removable bearing III oil injector do not require any cold turning.

When no external source of power is made available, to save power of the battery supply stop only one engine after cooling and do its cold turning by making use of the generator of engine in operation whereafter bring to a stop also the other engine.

Cold turning of the other engine is to be made while making use of the board batteries.

2.7. Alleged Starting

Alleged starting /i.e. starting without fuel being ingnited/ takes place in one of the following cases:

- Functional checking of systems taking part in the starting operation;
- Checking for rotational speed to be attained by the turbocompressor using starter operated from the specified source of power supply;
- Preservation and unpreservation of the engine.

Alleged starting follows the same pattern of action as a normal starting. It can be done equally well with an open, as well as, closed cutoff valve:

- Closed-cutoff-valve starting is usual for speed checks of the turbocompressor being run up, for functional checking of the ignition plug, igniter, and for blowing through the engine after its unpreservation;

- Open-cutoff-valve starting is usuwal for the preservation, unpreservation and checking of the systems taking part in the starting process.

CAUTION:

BEFORE AN ALLEGED STARTING WITH THE OPEN CUTOFF VALVE, DO NOT FORGET TO ISOLATE LOW-VOLTAGE CONNECTION FROM THE TIMER-DISTRIBUTOR ASSEMBLY.

NOTE:

Once the alleged starting with an open cutoff valve has been completed, proceed with the cold turning of engine.

During alleged starting, the time of control box duty cycle is identical with that of normal starting, being 31 to 35 seconds.

2.8. Cold Turning of the Engine

Cold turning of the engine is necessary to blow through the combustion chamber after an unsuccessful starting, this to cool down the engine.

Cold turning is to be done with the closed cutoff valve, the STARTING - GOLD TURNING switch being then in its COLD TURNING position.

During cold turning, the time of control box duty cycle, is 31 to 35 seconds. During the cold turning cycle, the control box does not switch the batteries over to 48 V operation mode and does make operative the power supply system of the ignition plug and igniting fuel control solenoid valve.

C A U T I O N

DURING COLD TURNING, IT WILL BE ABSOLUTELY NECESSARY TO OPERATE THE FEED PUMP AND TO LEAVE FIRE PREVENTION VALVE OPEN.

3. OPERATION OF THE ENGINE WHILE ON GROUND AND DURING FLIGHT

An engine can be regarded as ready for flight when all the steps under a routine procedure programme have been completed along with the preflight preparations, reserves of the fuel and oil have been made up, installation life of the engine has not yet run out, and during ground tests all its parameters /like rotational speed, temperatures of gases and oil, and oil pressure/ have been found to be within the limits as specified in Chapter 2.

To control operation of either of the two engines, or both at a time, the PITCH AND POWER lever should be used under FULLY CLOCKWISE correction conditions irrespective of the fact whether this is to be a ground or airborne operation of the engine/engines. When the flight is continued with only one engine, the selective control lever of this engine is to be in its top position abutting against the stop.

In flight, rotational speed of the rotor is automatically maintained within 78 to 84 % limits under all specified ranges except for autorotation, AS the power required by helicopter rotor continues to grow, rotational speed of the rotor diminishes in conformity with the static characteristic of the power turbine limiter.

During autorotation, revolutions of the helicopter rotor can be mantained at a steady level through a suitable selection of the rotor-blade pitch.

In transitional flight ranges, revolutions of the rotor are allowed to increase or decrease in accordance with the Chapter 2 data.

3.1. Takeoff and Climb

Takeoff and climb can be performed both in the takeoff as well as nominal range, limitations referred to in these Instructions being also taken into account.

To make full use of the takeoff power, the pilot must readjust rotor-blade pitch in such a manner as to artive at 79 $\pm$ 1 % of the rotational speed.

With limitations occurring in the maximum speed of turbocompressor, or in the temperature of gases prior to the turbine, rotational speed of the rotor in its takeoff range can exceed 80 %.

Along with an increase in the altitude of flight, rotational speed of the turbocompressor is allowed to rise to 101 % in the takeoff range.

3.2. Horizontal Flight

Horizontal flight can be performed in any operating range, with limitations as referred to in Chapter 2 being also taken into account.

C A U T I O N:

WHEN PERFORMING FLIGHTS INTENDED FOR SPRINKLING OF CHEMICALS, NECESSARY STEPS MUST BE TAKEN TO PREVENT THESE CHEMICALS FROM ENTERING THE ENGINES /also WHEN LOADING THE HELICOPTER/.

WHEN CARRYING OUT A SPRINKLING OPERATION AVOID FLIGHTS TO BE DONE IN THE SPRINKLED CHEMICALS.

3.3. Planing

Planing can be done in any operating range provided limitations as referred to in Chapter 2 are taken into account.

3.4. Taxiing

Taxiing can be done in any operating range of the engine, starting with idling.

Engine parameters at taxiing cannot go beyond those specified for the given range.

When taxiing pay attention that the dust raised by other helicopters does not penetrate into inlet passages of the engines.

When taxiing, or waiting for takeoff, it should be remembered that the time of idling cannot exceed 20 minutes.

3.5. Verification of Parameters during a Test Flight

A test flight takes usually place after the installation of a new engine, or after the replacement of an engine fuel pump.

During flight, carry out the following checks;

3.5.1. Functional check of the engine in its takeoff, nominal, flying I and II ranges, and at planing in the idling range.
Parameters of the engine ought to be in line with those specified in Chapter 2.

3.5.2. Functional check of the automatic system for maintaining rotational speed of the rotor in variable ranges: takeoff, passover to climbing and horizontal flight, passover to engine planing and leaving the planing behind.
Rotational speeds of the helicopter rotor ought to remain within the specified limits.

3.5.3. Functional check of the engines for synchronization in the specified ranges.

3.6. Operation under Vinter Conditions

3.6.1. Prior to starting, remove covers from the inlet and outlet passages:

See that neither ice nor snow have been left in the inlet passage, and that compressor impeller vanes have not frozen fast. To see this, rotate impeller of the compressor with the hand by holding the first-stage vanes.

In the presence of ice, or fast-frozen compressor impeller, warm up the engine with a jet ot hot air at a temperature not exceeding 80°C, using for this purpose an airport heater, whereafter check the impeller for smooth opera-

tion and for the presence of ice.
Engine started in the presence of ice in an inlet passage may be easily damaged.

3.6.2. Under winter conditions, starting of the engine is possible provided the temperature of oil in the engine is not lower than minus 40°C.
When the temperature of oil falls below minus 40°C, it will be necessary to warm up the engine prior to starting /with hot air/ until the temperature of oil rises to about minus 30°C acc. to board indicator readings.

Hot air at a temperature of 80°C maximum is recommended to be applied to the engine inlet passage.

3.6.3. Where icing is possible, anti-icing system should be actuated before starting. The risk of icing is highest when the temperature of ambient air oscillates around 0 °C /in the range from -10°C to + 5°C/, and there is a dense fog, rain or wet snow outside.

With the switched ON anti-icing system, relevant pilot lamp should light up.

After actuation of the anti-icing system, the temperature of gases in the operating ranges may rise by 20°C. With the engaged anti-icing system, one must be careful about the temperature of gases, which in this specific case cannot exceed levels specified for the given operating ranges.

With the switched OFF system, the temperature of gases should return to its original level.

C A U T I O N :

ANTI-ICING SYSTEM IS TO BE OPERATED BY THE PILOT AS SOON AS HE GETS AN ICING SIGNAL FROM THE HELICOPTER.

3.6.4. Where a longer standstill of the helicopter is required, and the temperature of ambient air falls below minus 50°C, oil should be drained from the lubrication system /tanks and coolers/ through the common drainage valve of the helicopter.
Oil should be drained right after the stoppage of engine/engines.
Before a new oil is transferred into the tank, it should be heated to 60 - 70°C.
Also prior to starting, the engine will have to be warmed up with a jet of hot air, as described above.

3.6.5. In winter conditions, when oil in the main gear requires warming up to a temperature of normal operation, the starting of both engines is to be carried out, if possible, from the airfield power supply or from a set of rechargeable batteries. In such cases the starting of second engine should be done from the generator of the engine already working, because that would require longer operation of one branch of WR-2 main gear at unfavorable conditions of lubrication of the idling one-way clutch. Thus, the warming-up is to be carried out exclusively in the condition of both engines working.

3.6.6. If, after 20 minutes of operation in the idling range, the temperature of oil does not rise to plus 5°C in the Main Drive WR-2, engines will have to be stopped for some 5 minutes to be re-started again after this time for a new 20 minuts duty cycle.

3.7. Operation under High Ambient Temperatures

At ambient temperatures exceeding plus 20°C, there may occur limitations of the operating ranges due to temperature of gases prevailing prior to the turbine.

C H A P T E R 4

EMERGENCY PROCEDURE

Issue 2/1975

CHAPTER 4 - Index of Contents

1. In-Flight Engine Starting

In-flight engine starting proceeds in a similar way as the starting on ground, with internal source of power supply used for the purpose.

Starting of the engine in flight is recommended to be performed at approximately 5 % turbocompressor autorotation speed /never greater than 20 % since interlock provided in the starting system will make impossible operation of the control box at turbocompressor speeds exceeding 20 %. Accordingly, no starting can take place when rotational speed of the turbocompressor exceeds 20 %/.

When performing starting from the generator of an engine in operation on altitudes exceeding 2 500 mtrs, rotational speed of the letter should be such as not to exceed that of the nominal range.

Reliability of starting is ensured up to an altitude of 3 000 mtr.

C A U T I O N:

IT IS FORBIDDEN TO START AN ENGINE BEING REMAINS INOPERATIVE DUE TO A FAILURE.

2. In-Flight Engine Stoppage

Prior to an anticipated stoppage of engine in the flight, it must be smoothly run down into its idling range to remain operative in this range for at least one minute before it can be completely run out.

W A R N I N G:

IN EMERGENCY CASES THE ENGINE MAY BE STOPPED NO MATTER WHAT ITS OPERATING RANGE IS, WITHOUT ADOPTING THE PROCEDURE OF A SMOOTH TRANSITION TO THE IDLING RANGE AND COOLING STAGE.

2.1. An emergency stoppage of the engine /on ground or in flight/ can occur in one of the following cases:

- Sudden drop in oil pressure in the engine or main drive;
- Sudden rise in the temperature of gases prior to compressor turbine;
- Sudden drop in rotational speed of the compressor turbine;
- Heavy firing with flames evading out of the exhaust pipes.

N O T E:

In the event of cutoff valve failure, the engine may be brought to a stop by closure of the fire prevention valve.

C A U T I O N:

WHEN IT IS THE ENGINE UNDER GUARANTEE PERIOD WHICH HAS BEEN STOPPED BY CLOSURE OF THE PREVENTION VALV., A FURTHER OPERATION OF THIS ENGINE CAN BE TAKEN UP NO SOONER THAN AFTER CONSULTATION WITH ITS MAKERS. THE POSSIBILITY OF PUMP FAILURE EXISTS IN THE CONTARY CASE.

3. Drop in Oil Pressure

When oil pressure in the engine has dropped below 2.5 kG/sq.cm, operating range of the engine is to be lowered to the flying range. In this range, the flight can be continued with the oil pressure level being not under 2 kG/sq.cm.

C A U T I O N:

WHEN THE PRESSURE OF OIL DROPS BELOW 2 kG/sq.cm, ENGINE MUST BE BROUGHT OUT OF ACTION.

4. Increase in the Temperature of Gases

When is comes to an increase in the temperature of gases upstream of the compressor turbine so that it goes over the upper limit value, operating range of the engine must be adequately lowered. When in this lovered operating range the temperature of gases remains within the permissible limits /for the given range/, the flight can be continued.

C A U T I O N :

WHEN THE TEMPERATURE OF GASES IN THE LOWERED OPERATING RANGE IS SUCH AS TO EXCEED PERMISSIBLE LIMIT VALUES, THE ENGINE MUST BE BROUGHT OUT OF ACTION.

5. Instrumentation Failure

Should any one of the devices for monitoring action of the engine become inoperative /like e.g. engine-speed indicator, gas temperature or oil temperature gauge/,

with all the remaining operating parameters being in line with the requirements, the flight can be continued provided an increased /more close/ attention is given to the engine performance.

6. Extinguishing of Fire

When it comes to a fire on the engine, immediately turn OFF /close/ the cutoff valve and fire prevention valve,

For further measures to be adopted at the extinguishing of fire refer to the Helicopter Service Manual.

W A R N I N G:

WITHOUT HAVING DETECTED AND CLEARED UP THE CAUSE OF FIRE DO NOT START THE ENGINE AGAIN !

C H A P T E R 5

TROUBLE SHOOTING CHART

/DIAGNOSIS AND REMEDIES/

Issue 2/1975

CHAPTER 5 - Index of Contents

Index of Contents - continued Page

1. Stalling of Speed at Starting

1.1. Check starter-generator wire connections for reliability of their attachment.

1.2. Check compressor impeller for smooth and unobstructed revolving /impeller to be rotated manually/.

1.3. Check turbocompressor revolutions during alleged starting with power supplied from an external source. Rotational speed of the turbocompressor is expected to be as follows :

at $t_o = -40^oC$ $n_{TC} \geqslant 21$ %

at $t_o = 0\ ^oC$ $n_{TC} \geqslant 22$ %

at $t_o = +40^oC$ $n_{TC} \geqslant 23$ %

current taken by the starter being not greater than 450 A.
Should the current exceed 450 A, it will be necessary to replace the starter-generator set.

1.4. At the board battery starting mode, batteries will have to be renewed when voltage at the end of starting becomes less than 14 volts.

1.5. Check closure of the air bleed valve for airframe needs /this valve must remain closed/.

1.6. Use petrol to wash air filter, aneroid filter and fuel pump automatic starter air nozzles.

1.7. Make sure that no failure is to be traced on air

... feed lines leading to the automatic starter /AR/; the same applies to the air filter and fuel pump connections.
Check nuts if securely tightened.

1.8. With starting performed after removal of preservatives, and after a longer standstill, throttling pack of the fuel pump is to be washed.

1.9. Check fuel pressure at the fuel pump inlet. This pressure should remain within 0.75 to 1.2 kG/sq.cm limits. To take measurements, make use of the fuel pump connector pipe 2 /Fig. 6.12/. The measurement is to be taken with the cutoff valve left open.

1.10. Carry out a functional check of the working burner drain valve. The amount of fuel leaking out of the helicopter drain tank during starting cannot be larger than 200 ccm.

1.11. Check the pressure of fuel upstream of the burner at the end of alleged starting. This pressure should not be lower than 7 kG/sq.cm. To take measurements, make use of the fuel pump connector pipe 2 /Fig. 6.12/.

2. No Fuel Flare-Up or Delayed Flare-Up /12 to 15 sec.delay/

2.1. Release air accumulated in the fuel system.

2.2. Carry out a functional check for the plug and burner during an alleged starting, with the cutoff valve being closed at this check.

With no sparks appearing on the plug check electrical wires, leading to the plug and burner for their continuity. If electrical connections are found to be in good working order, replace the plug and burner in the sequence stated.

2.3. Check starting fuel supply for pulsatinn and pressure. At the end of alleged starting, fuel pressure should be $2 \begin{smallmatrix} + 0.6 \\ - 0.1 \end{smallmatrix}$ kG/sq.cm. Pulsatinn should last from 4 ± 1 up to 11 ± 2 seconds for the Series 2 PSG-14A starting box, or from 4 ± 1 up to 12 ± 2 seconds /starting cycle/ for the PSG-14A box.

With no pulsation, or fuel pressure varying drom this stated above, check the solenoid valve for its power supply. When no fault is found to exist in the power supply, replace constant pressure valve together with the solenoid valve.

2.4. Check starting fuel for spray:

To do this, build up an igniting arrangement and connect it via a rubber hose to the engine fuel line. Carry out alleged starting. Fuel should flow out sprayed without any visible jets.
With no spray produced, igniter must be replaced by a new one.

2.5. Carry out a functional check of the working burner drain valve and investigate fuel pressure prior to working burner; to do this, adopt procedure from para 1.10 and 1.11 of this Chapter.

2.6. Check fuel pump blocking valve for its opening. This valve is expected to open at a speed of n_{TC} = = 14 to 18 %.

3. Temperature of Gases Rising during Starting over the Permissible Level

3.1. Check compressor impeller if its revolving is smooth and unobstructed /impeller to be driven manually/.

3.2. Check during the alleged starting run-up of the turbocompressor by following instructions given in para 1.3 of this Chapter.

3.3. When performing starting with board batteries used as a source of power supply, check their charge by carrying out alleged starting with the closed cutoff valve. Voltage at the end of starting must be not less than 14 volts.

3.4. See that the air bleed valve for airframe needs remains closed.

3.5. Check external and internal air nozzles of the automatic starter and automatic air bleeder for their correct mounting.

Wash nozzles, air filter and aneroid filter in the automatic starter.

4. Difference of Turbocompressor Speeds during Operation in the Specified Ranges Exceeding Permissible Limits

4.1. Check PITCH AND POWER system for its correct adjustment.

4.2. Wash automatic starter nozzles.

4.3. Check working burner drain valve for fredom from leaks.

4.4. Check anti-icing valve and air bleed valve for their closing.

4.5. Check turbines synchronizer air feed lines for correct connection and freedom from leaks.

4.6. Replace turbines synchronizer in the engine showing a lower rotational speed.

5. Selfreduction of the Compressor Turbine Speed or Engine Stalling

5.1. Make fuel analysis to find actual percentage of water and mechanical impurities.

5.2. Inspect fuel filters.

5.3. Check turbocompressor and free turbine impellers for smooth working.

5.4. Inspect oil filter and magnetic plug.

5.5. Inspect air nozzles in the automatic starter for cleanliness.

5.6. Inspect lines for feeding air to the automatic starter, plus air filter and fuel pump connections, for freedom from cracks and damages.

... Make sure that nuts have been properly tightened.

5.7. Check drain valves for freedom from leaks.

5.8. Remove air accumulated in the fuel system.

6. Rise in Temperature of Gases in the Specified Operating Ranges

6.1. Check gas temperature indicator and replace same, if necessary.
Error in readings at 1000°C of the new indicator must be such as not to differ more than ± 3°C from errors of the factory-adjusted indicator /see Engine Log Book/.

6.2. Check compressor impeller and free turbine for smoothness and lightness of their revolutions. Inspect compressor inlet and the visible flow-part of the compressor.

6.3. Check air bleed valves, anti-icing valves and air bleed valves /airframe needs/ for their closure.

6.4. Check thermocouples for their resistance, including compensating resistance. This resistance should remain within the 7.5 ± 0.05 Ohms limits to ambient temperatures of 20 ± 5°C.

7. Drop in Temperature of Gases in the Specified Operating Ranges

7.1. Inspect gas temperatnre indicator and replace same, if necessary, by following instructions para 6.1. of this Chapter.

7.2. Check thermocouple collector for insulance between connection socket pins and engine frame. Insulance must be not smaller than 20 kOhms.

NOTE:

To carry out these measurements use Class 1.5 Wheatstone bridge or a direct-current 100 V megger.

7.3. Resistance check:

- Check resistance of thermocouples together with compensating wires. This resistance should range to 7.5 ± 0.05 Ohms at ambient temperatures of 20 ± 5°C;

- For the set thermocouples, resistance is expected to be 0.164 ± 0.003 Ohms, or in the event of resistance specified in the Engine Log Book it should have value stated with a tolerance of ± 0.003 Ohms.

  With resistance greater than that, check once again resistance of each thermocouple separately. Resistance of a thermocouple should be 0.23 ± 0.01 Ohms.

N O T E S:

1. A break in the circuit of one thermocouple steps up resistance of the set by about 0.02 Ohms.

2. Resistance measurement to be made with the Class 1 Thomson bridge.

3. It is allowed to change one thermocouple per set.

Should more than only one thermocouple be required to be changed, then replace the entire set of thermocouples together with the indicator. This set should be selected by engine makers.

8. Incorrect Closing of Air Bleed Valve

8.1. Inspect air feed lines connected to the fuel pump air filter for freedom from leaks. Wash air nozzles in the automatic starter.

9. No Oil Pressure When Blowing Through the Engine After Its Unpreservation

9.1. Inspect engine oil feed and discharge lines for their correct connections.

9.2. Check oil pressure transmitter and indicator.

9.3. Check oil pressure measuring circuit.

10. Engine Pumpage

10.1. Check sealing compound or compressor vane edges for sand-blast cleaning /material losses/.

11. Increase in the Turbocompressor Speed over 101 %

11.1. Call factory representative to readjust maximum speed limiter. Until his arrival, operate the engine by manually limiting rotational speed of the turbocompressor.

12. Swarf Presence on Lubrication System Magnetic Plug

12.1. Check compressor impeller for smoothness of operation.

12.2. Make oil analysis.

12.3. Fill lubrication system with a fresh portion of oil.

12.4. Complete cold turning of the engine.

12.5. Inspect magnetic plug.
In the absence of swarf, complete steps as follows:

12.6. Start the engine and allow it to run for about 10 minutes. With the engine coming to a rest, measure the run-out time for the turbocompressor and power-transmission shaft.

Inspect magnetic plug. In the absence of swarf proceed with the flight test. After flight, inspect magnetic plug onee again. If no swarf is there, the engine can be regarded as airworthy. Should swarf be found on the magnetic plug during these checks, representative of the engine producing works in to be called for consultation.

13. Failure of the Exhaust Collector, Exhaust Pipes or Covers

13.1. Cracked exhaust pipes or covers require to be repaired or renewed.

13.2. Cracked exhaust collector requires that representative of the engine producing works is called to the site.

14. Gases Leaking Through the Thermocouple Mounting Planes

14.1. Replace thermocouple washer damaged.

15. Oil Leaking Through the Compressor/Reducer Joint

15.1. Call for a representative of the engine producing works.

16. Oil Leaking from under the Output Shaft

16.1. Make air feed lines leading to the output shaft labyrinth clean /by following procedure stated in Chapter 7/.

16.2. Should the oil leakage repeat itself, call for a representative of the engine producing works.

17. Oil Leaking from Exhaust Pipe or Compressor Bearing I During Helicopter Parking

17.1. Inspect and wash non-return valves and the pressure reducing valve in the engine lubrication system.

17.2. In case of failure, replace rubber seal rings in the engine oil filter.

18. Smoke Evading from the Engine after Stoppage, or Excessive Oil Consumption

18.1. Complete steps as para 17.1 and 17.2, if necessary, of this Chapter.

18.2. Inspect bearing III air filter. Replace Rubber seal rings.

18.3. Check the free passage of the pipe veriting the III abutment to reduction gear /No. 16.75.0660/ and in case of clogging with carbon deposit it is to be cleaned according to method given in para 19 on page 666.

CHAPTER 6

ROUTINE PROCEDURE

Revised
December 1977

CHAPTER 6 - Index of Contens

General Remarks Concerning the Routine Procedure

Routine procedure is to be based on the use of board tools. Work completed in this connection, and defects cleared up, are to be written down in the Engine Log Book.

When defects likely to cause failure of the engine as a whole have been revealed /say, swarf found in the oil filter, occurrance of cracked parts and power unit, etc./, any further use of the engine will be allowed no otherwise as after consulting with representatives of the engine producing works.

After having removed from the engine accessories and component units, the open places are to be covered with polyvinyl chloride film or with an airplane cloth.

Washing the air nozzles and filter elements of all the sieve filters is to be made in petrol by aid of brush with the short /about 15 mm/ rigid natural hair.

After having blowed through with a compressed air it is to be checked if there are no brush hair left on the surfaces of the parts being washed.

Preliminary and postflight preparations constitute a basic type of work to be done about an engine and form a part of the routine procedure programme.

1. Routine Procedure after the First Checking of a Newly Installed Engine.

Steps to be completed after checking a power unit of the helicopter on the ground are as follows:

1.1. Do the same work as for a check inspection.

1.2. Change the oil in the engine lubrication system. Oil is to be drained via main helicopter drain valve right after the arrestment of engines.

1.3. Inspect and wash the oil filter.

1.4. Inspect the fuel filters:

- in fuel pump
- in the helicopter fuel system

Inspection to follow the normal procedure as per Helicopter Service Manual Instructions.

1.5. Vent the fuel system.

1.6. Perform cold engine cranking.

1.7. Check the engine for its operation.

2. Routine Procedure to be Applied after the First Flight

2.1. Do the work as prescribed for check inspection.

2.2. Inspect the oil filter.

2.3. Inspect the engine output shaft for correct alignment with the main drive coupling shaft /proceed in full compliance with Main Drive Servicing Instructions/.

2.4. Perform a cold engine cranking.

3. Routine Procedure after Each 25±5 Hours of Engine Operation.

3.1. Do the work as prescribed for check inspection.

3.2. Inspect and wash bearing III air filter.

4. Routine Procedure after Each 50±5 Hours of Engine Operation.

4.1. Do the work as prescribed for every 25 hours of engine operation.

4.2. Inspect and wash oil filter.

4.3. Inspect brushes and commutator of the starter-generator set for their overall condition.

When soiled, the commutator must be wiped clean with a flannel soaked in petrol and than blown through with a jet of compressed air. With the height of brushes reduced below 18 mm /on the longer side/, brushes must be renewed.

The replaced brushes must be run-in in accordance with the recommended practice as laid down in the Starter-Generator Set Information Card.

4.4. Inspect and wash fuel pump air filter.

CAUTION: THE ABOVE OPERATIONS MUST ALSO BE PERFORMED BEFORE THE FIRST STARTING OF ENGINE UPON EXPOSURE TO SAND STORM.

4.5. Inspect and wash, if necessary, the fuel pump control levers.

4.6. Perform a cold engine cranking.

4.7. Check the engine for its operation.

4.8. Check the engine for the acceleration.

5. Routine Procedure after Each 100^{+10} Hours of Engine Operation.

5.1. Do the work as prescribed for every 50 hours of engine operation.

5.2. Wash in petrol air nozzles 7, 9, 10, 11 and seat 8 of automatic fuel pump starter.

CAUTIONS:

1. THE PROCESS OF DISASSEMBLY, WASHING AND REASSEMBLY OF NOZZLES IS TO BE DONE IN A DUE SUCCESSION SO AS NOT TO MISTAKE NOZZLES MOUNTING PLACES.

2. THE ABOVE OPERATIONS MUST ALSO BE PERFORMED BEFORE THE FIRST STARTING OF ENGINE UPON EXPOSURE TO SAND STORM.

5.3. Inspect and wash in petrol fuel pump filter /fuel filter/.

5.4. Having mounted the filter in its position proceed with the fuel pump deaeration.

5.5. Remove the starter-generator set from the engine. See the starter-generator set drive for traces of oil leakage.

Oil leaks in an amount not exceeding 20 ccm during 100 hours of engine operation are tolerable. Use a piece of cloth to wipe clean the area around the drive.

Replace starter-generator onto engine. Make sure that starter-generator shaft fits exactly in the spline of drive gear. If the shaft hits the sleeve of graphite sealing it may cause the lose of tightness.

5.6. Perform cold engine cranking.

5.7. Check the engine for its operation.

6. Routine Procedure after Each 250^{+10} Hours of Engine Operation.

The above mentioned work is performed only on engines having removable 3-rd bearing oil injector.

6.1. Clean the pipe and the venting passage for III bearing space.

7. Work to be Done about Engines during Helicopter Lay-off

When fuel system is filled up with fuel, and oil system of helicopter with oil, measures to be adopted are then as follows:

7.1. Every 5 to 7 days inspect the external surfaces of engines. The areas showing moisture accumulation are to be wiped dry.

7.2. Every $10^{\pm 2}$ days perform alleged starting, and then also cold engine turning.

7.3. Every $20^{\pm 2}$ days work for 3 to 5 minutes in the II flying range.

7.4. Every $30^{\pm 5}$ days do the work about fuel pump control levers.

C A U T I O N:

WHEN FUEL HAS BEEN REMOVED FROM THE HELICOPTER FUEL SYSTEM, THE ENGINES MUST BE PRESERVED WITHIN 24 HOURS FROM THE MOMENT OF FUEL DRAINAGE.

8. Inspection of the Fuel Pump Filter

8.1. Unlock and remove nut 1 from the connector pipe 3 of pump fuel feed line.

8.2. Remove connector pipe 3.

8.3. Unscrew mandrel 4 and remove filter 5.

8.4. Inspect fuel filter.

8.5. To reassemble the filter, adopt reversed sequence of steps. Having installed the filter, secure the nut 1 with a piece of wire.

C A U T I O N S:

1. WHEN INSTALLING THE FILTER BACK IN ITS POSITION TAKE CARE ABOUT THE CONDITION OF SEALING RUBBER RINGS AND REPLACE SAME, IF NECESSARY, BY TAKING NEW PIECES FROM THE 1 : 1 SET OF PARTS.

2. SHOULD ANY DIRT BE FOUND ON THE SCREEN DURING INSPECTION OF FILTER, IT MUST BE WASHED UP IN PETROL B-70 PRIOR TO ITS REASSEMBLY AND THEN ALSO BE DRIED WITH A JET OF COMPRESSED AIR.

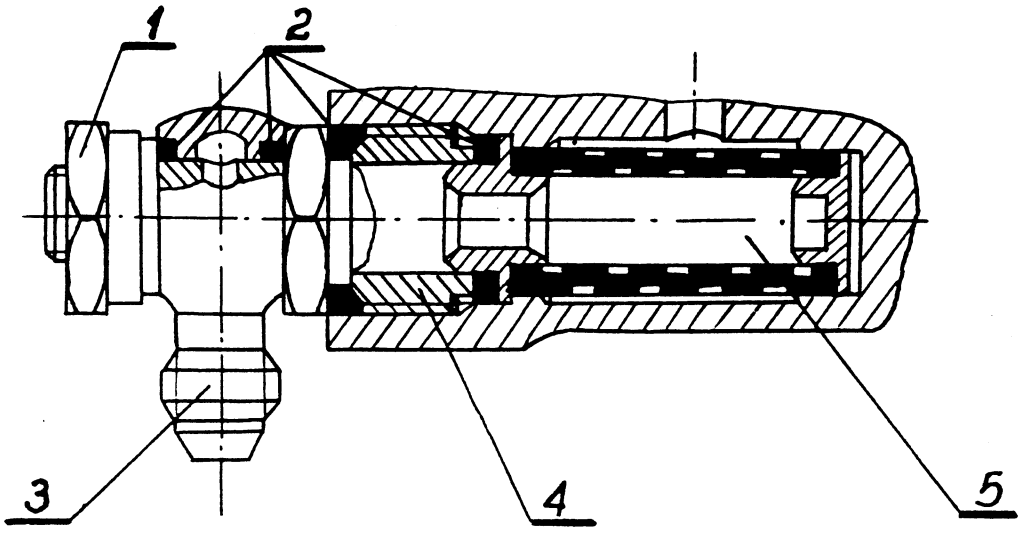


Fig.6.1. Fuel pump - Fuel filter

1. Nut. 2. Packing washer. 3. Fuel feed connector pipe. 4. Mandrel. 5. Filter.

9. Inspection and Washing of Bearing III Air Filter

CAUTION

IF CONSIDERABLE SOILING OF FILTER IS FOUND /AGRO - OPERATIONS, HIGH DUSTINESS/ FILTER IS TO BE INSPECTED AND WASHED AFTER EVERY TEN OR EVEN 5 HOURS OF OPERATION.

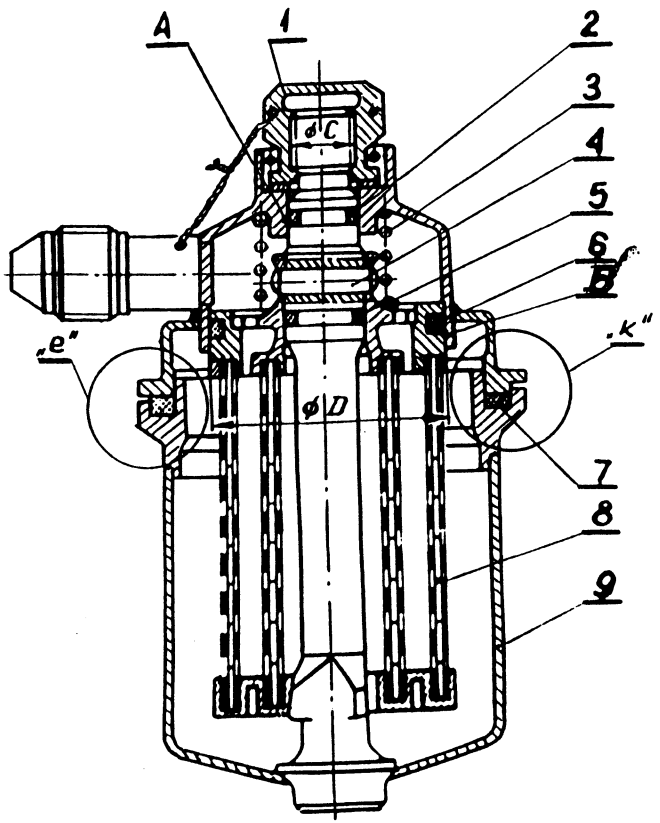
9.1. For engines having filter mounted above the combustion chamber /Fig. 6.2/.

9.1.1. Unlock and unscrew nut 1.
Remove lower body 9.
If lower body 9 is turning together with nut 1 being unscrewed, it is to be held by the lug at the bottom /using the spanner S = 14/.

9.1.2. Remove spring 3 from the mandrel, pull out pin 4 and remove filter element 8.

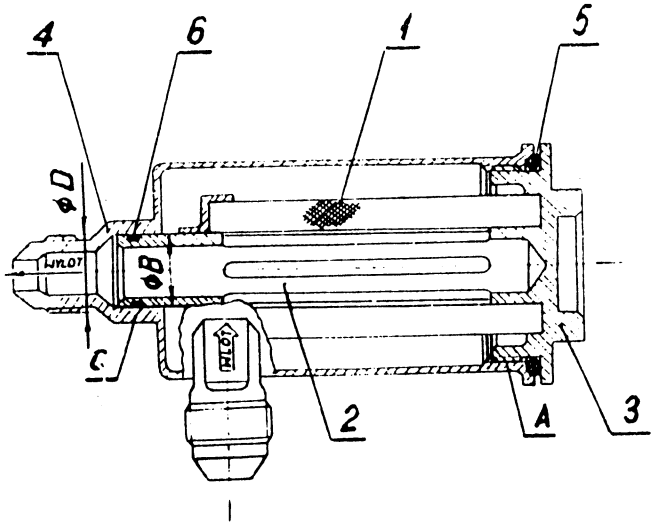
9.1.3. Wash filter element in petrol and blow it with compressed air applying it inside filter between outer and inner screen.
Check the cleanliness of filter element against the source of light.

Filter mounted over combustion chamber



1. Nut 2,5,6 and 7 Sealing rings.
3. Spring. 4. Pin. 8. Filter element.
9. Lower body.

Filter mounted on reduction gear



1. Filter element. 2. Mandrel
3. Nut. 4. Body with stub pipes
5 and 6. Sealing rings.

Fig.6.2. Bearing III air filter

9.1.4. Wash in petrol the internal surfaces of body 9.

9.1.5. Make sure that the faying surfaces of sealing rings are completely free from any residues of adhering rubber. If any - remove them by cleaning up.

Filter assembly

9.1.6. Replace all sealing rings which demand obligatory change with new ones.

CAUTION

FOLLOWING RINGS ARE TO BE CHANGED WITH NEW ONES:

- RING 7 after every 25 hours
- RINGS 2,5 and 6 - if damaged

9.1.7. Preserve ring 5 with B-3W oil
Put filter element 8 on the mandrel. Clamping on ring 5 must be sensible.

9.1.8. Preserve rings 2 and 6 with B-3W oil
Install pin 4 and spring 3.
Apply thin layer of ZS or NK-50 grease onto mandrel thread.
While assembling, pay attention thatsealing rings are not twisted.

9.1.9. When putting lower body with filter elements into upper body with connector pipes - the overlapping the locating surfaces A and B in relation to dia C of mandrel and dia D of filter pack must be alligned parallel without misalignment.

9.1.10. The nut is to be tightened carefully till the moment when resistance offered by rubber sealing ring 7 becomes noticeable. Wire-lock the nut.

9.1.11. Upon changing the sealing ring 7 with new one the nut 1 is to be tightened once after the first flying day as in para 9.1.10.

NOTE: 1. Any deformation of the dome of upper body or the bottom of lower body due to tightening with too large torque is not permissible.

2. The design of upper body has been aftered in order to improve the tightness of filter Instead of flat flange pressing the sealing ring /Fig. 6.2. detail "e"/ the flange with pressing projection /Fig.6.2. detail "k"/ has been introduced.
Both designs are currently in operation.

9.2. Operations performed on filter mounted on engine reduction gear.

9.2.1. Unlock and unscrew nut 3 /spanner S = 24/, while holding hexagon "C" of body 4 with spanner S = 19.
Remove filter element 1 with nut 3 out of body.

9.2.2. Thoroughly wash filter in petrol.
Filter element may be blown with compressed air /applying air inside/.
Check if filter is clean and in good condition /no defects/.

9.2.3. Inspect sealing rings 5 and 6.
Change them if damaged. Ring 5 is to be replaced with new one after every 50 hours.

9.2.4. Clean the inside of body 4 with cotton cloth soaked in petrol.

9.2.5. Check the cleanliness of surfaces to which rubber gaskets adhere.
The surfaces are to be cleaned if the rests of rubber were found.

9.2.6. Preserve sealing rings 5 and 6 with B-3W oil.

9.2.7. Preserve the thread of nut 3 with ZS or NK-50 grease.

9.2.8. Put filter with nut in body 4 and screw it home while holding hexagon "C" of body 4 with spanner S = 19.

9.2.9. Wire-lock the screw 3.

10. Inspection and Washing the Oil Filter

Mount filter out of the engine in conformity with procedure specified in Chapter 7.

To wash a filter proceed in the following way:

10.1. Remove from the filter valve 7 together with spring 8.

10.2. Blank off the port with a rubber plug /furnished together with the board tooling kit/.

10.3. Wash filter in petrol.

10.4. Remove rubber plug out of the filter and insert the valve and spring assembly.

10.5. When the filter is found to be heavily soiled, prior to washing place it for 10 to 15 minutes in kerosene.

C A U T I O N:

WHEN INSTALLING THE FILTER IN ITS POSITION, TAKE CARE ABOUT WORKING CONDITION OF THE RUBBER SEALING RINGS. IF NECESSARY, REPLACE THE RINGS BY PROVIDING NEW ONES FURNISHED WITH THE 1 : 1 SET OF SPARES.

3. NOZZLES 7 AND 11 AS WELL AS TRANSFER BOLTS 13 AND 14 ARE NOT ALLOWED TO BE INTERCHANGED: TO PRECLUDE POSSIBLE INTERCHANGE DISTINCTION MARKS HAVE BEEN STAMPED ON THE FACES OF BOLTS 13 AND 14 /SEE FIGS. 6.6. and 6.7./ THE BOLT WITH NOZZLE 9 IS MARKED "1.00" WHEREAS THIS WITH NOZZLE 10" - "1.20"/.

14.3. Wash automatic starter aneroid air filter.

To do this, proceed as follows:

14.3.1. Unlock and remove plug 1 together whith the filter.

14.3.2. Wash filter in petrol and blow through with a jet of compressed air. When washing, do not remove the rubber sealing ring.

14.3.3. Replace the plug and filter in their original position and lock up with wire.

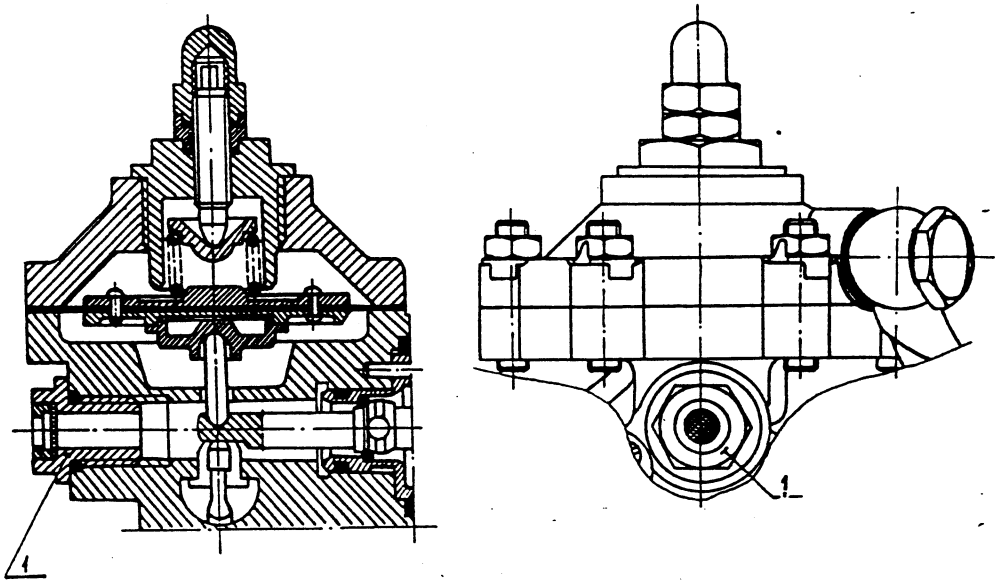


Fig. 6.8. Membrane in the Automatic Starter /Cross-Sectional and general view/

1. Plug and filter

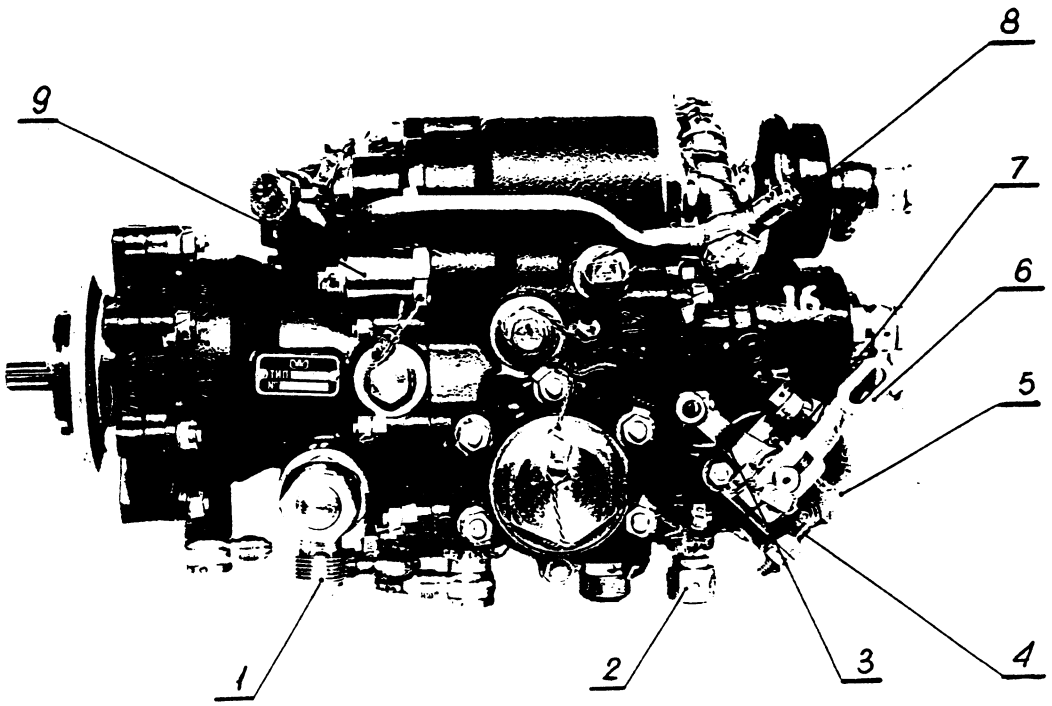


Fig. 6.9. Fuel Pump PNRP-2 /HP-40T/

1. Fuel feed connector pipe. 2. Connector pipe for measuring fuel.pressure upstream of blocking valve. 3. Cutoff valve control lever. 4. Maximum speed stop. 5. Sector. 6. Engine control lever. 7. Minimum speed stop. 8. Automatic starter nozzle. 9. Acceleration package.

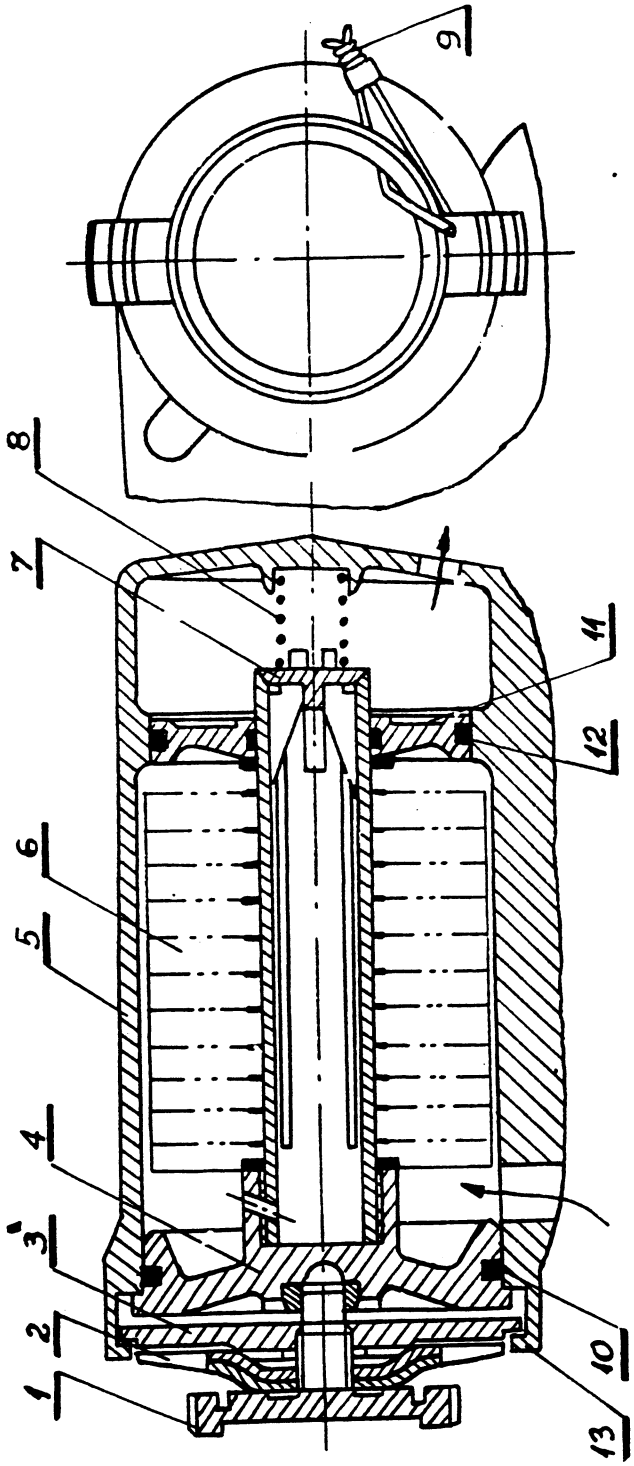


Fig.6.3. Oil Filter Layout

1. Screw. 2. Spring. 3. Filter beam. 4. Filter cover. 5. Filter body. 6. Filter element. 7. Valve. 8. Valve spring. 9. Lock wire. 10. Sealing ring. 11. Stop collar. 12. Sealing ring. 13. Filter body protrusions.

Revised

11. Fuel System Venting

Procedure associated with venting takes also place after the removal of preservatives from engine surfaces.

11.1. Unlock and then also undo cap 4 from the fuel pump air-release valve /Fig. 6.10/.

11.2. Screw air releasing device /furnished with the board tooling kit/ upon pump valve.

11.3. Insert end of drainage line 3 in the prepared wessel.

11.4. Switch ON feed pump to produce fuel pressure.

11.5. Depress stem 1 of the device and rotate it trought 90 degress.

Bleeding of fuel /or oil/ to be continued until air bubbles cease to be seen in the stream of fuel /or oil/ flowing out of the valve.

11.6. Rotate stem 1 into its original position and switch OFF fuel feed pump.

11.7. Unscrew air release device.

11.8. Tighten cap 4 on the pump air-release valve and lock it with wire.

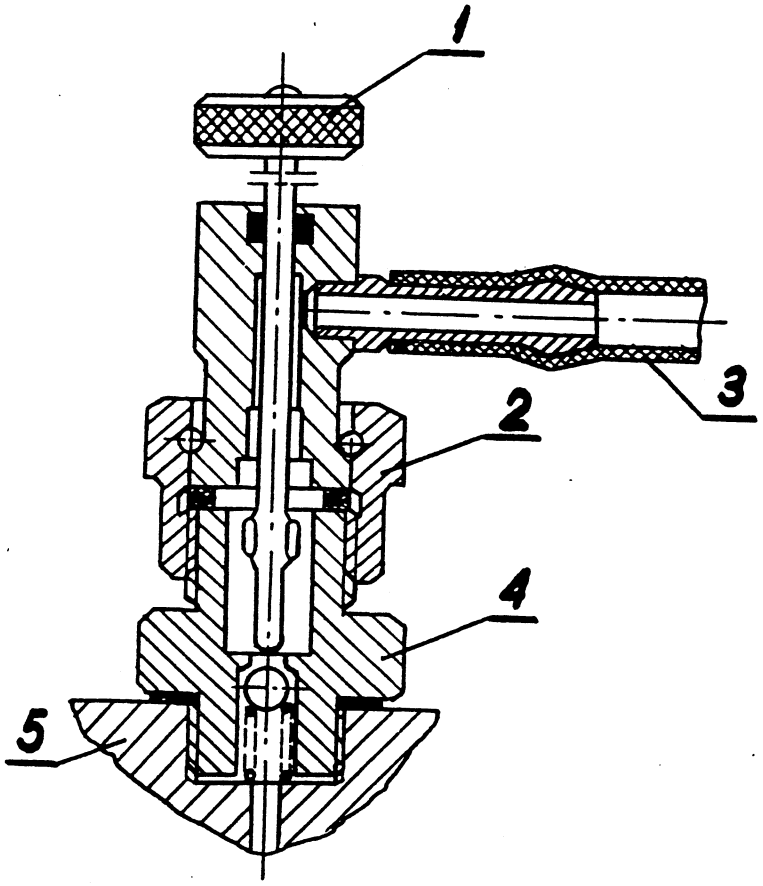


Fig. 6.4. How to connect air-release device to the fuel system

1. Pressure exerting stem. 2. Nut. 3. Drainage line. 4. Accessory ball valve. 5. Accessory body.

12. Inspection and Washing of Fuel Pump Control Lever

12.1. Apply 10 to 15 drops of kerosene to slot "A" between washers 1 of the pumpe whereafter move engine control lever 3 eight to ten times from one extreme position to another.

12.2. Remove dirt which gathered in slot "A" and wash it out with petrol or kerosene. Front faces of the washers 1 are to be coated with a thin film of MK-8, or transformer grade oil.

12.3. Move cutoff valve lever 2 to position OPEN.

12.4. Move engine control lever 3 two or three times from one end position IDLING into another end position START, there and back.
See that during the movement of lever 3 no simultaneous shifting is observed in the position of cutoff valve lever 2.

A simultaneous shifting of the cutoff valve lever 2 by 1 to 2 mm can be tolerated.

12.5. Should during the movement of lever 3 also lever 2 tend to shift towards the closure of cutoff valve, slot "A" will have to be carefully washed once again and steps from para 12.1. to 12.4. repeated twice with a break between steps of 10 to 20 minutes.

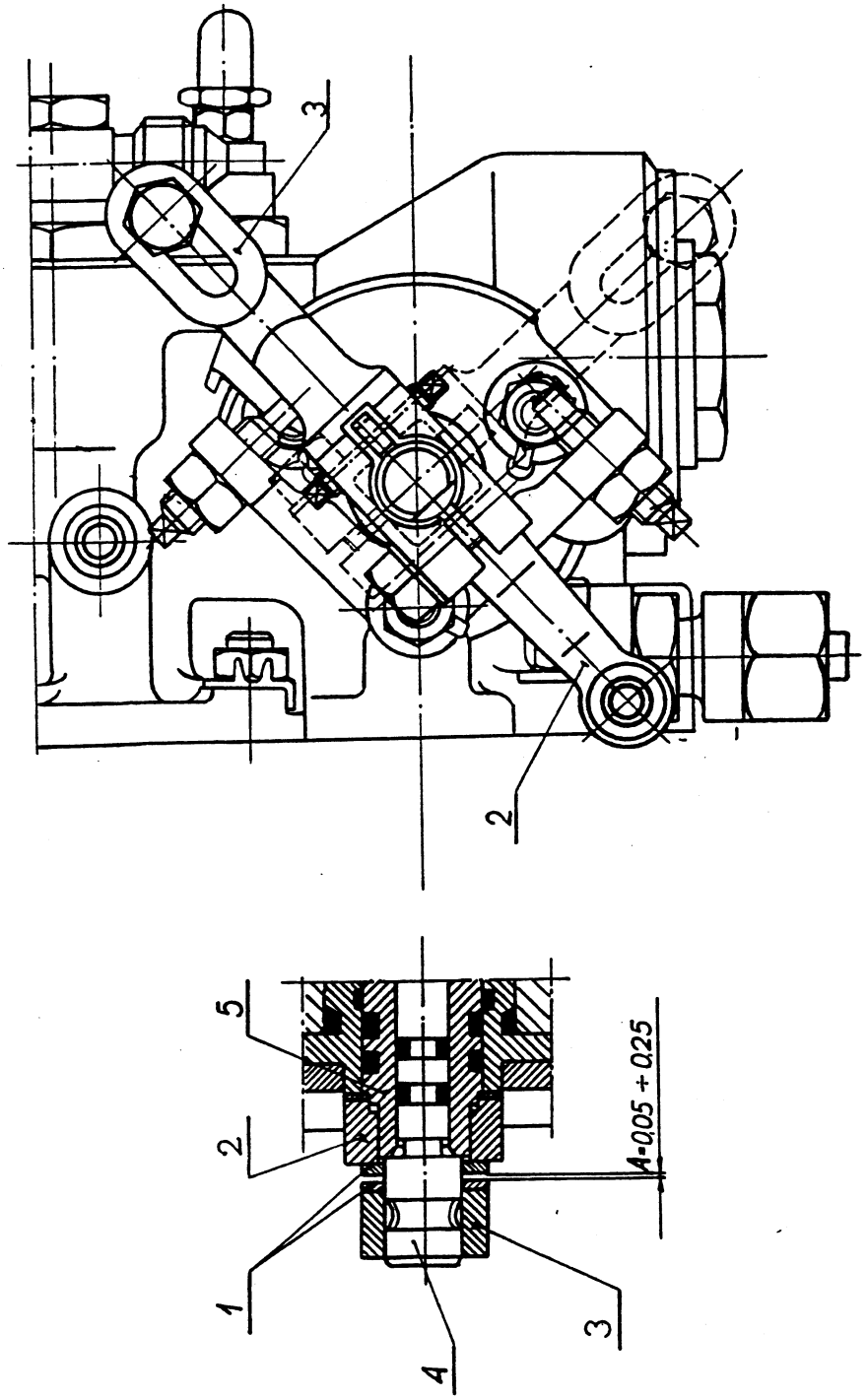


Fig. 6.5. Governer Pump Control Levers

1. Washers. 2. Cutoff valve lever. 3. Engine control lever.
4. Engine control lever shaft. 5. Cutoff valve lever sleeve.

Revised

13. Inspection and Washing of Fuel Pump Air Filter

13.1. Series I Engines

13.1.1. Unlock and undo the rotary clamp nut 2 provided to hold in position tube designed for the delivery of air from behind of compressor /downstream air/ to the fuel pump filter.

13.1.2. Unlock nut 1 and hexagon "A" of screw 3. By holding hexagon "A" in position with a spanner undo the nut which holds down the filter.

13.1.3. Remove from the transfer bolt 3 fitting 2 and packing washers 17.

13.1.4. Screw out of the pump transfer bolt 3 by applying spanner to hexagon "A" whereafter remove bolt 3 together with the pump air filter.

13.1.5. Remove from bolt 3 filter cup 15, spring 5, filter element 6, filter cover 4 and packing washers 17.

13.1.6. Wash in petrol cup 15 and filter cover 4, filter element 6, and clear up port "O" in the filter cup.

13.1.7. To reassemble and install the filter adopt reversed sequence of steps compared to dismounting. After the installation of filter, lock nuts with wire.

C A U T I O N S :

1. CONDENSATE DRAINAGE PORT "O" TO BE FACING DOWNWARDS.
2. FILTER ELEMENT 6 AFTER WASHING TO BE MOUNTED IN POSITION AS SHOWN.

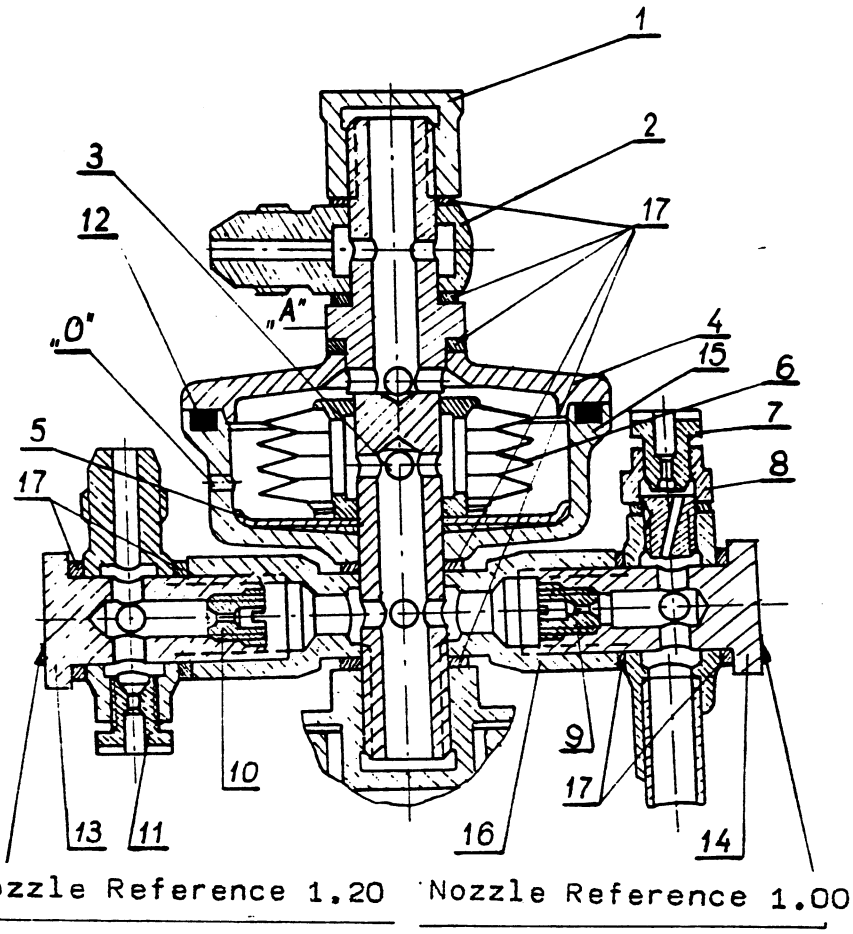


Fig. 6.6. Combined set of Series I fuel pump air filter and nozzles.

1. Cap nut. 2. Rotary fitting. 3. Transfer bolt. 4. Filter cover. 5. Spring. 6. Filter element. 7. Automatic starter outlet nozzle /external/. 8. Nozzle seat. 9. Automatic starter inlet nozzle /internal/. 10. Signal transmitter inlet nozzle /internal/. 11. Signal transmitter outlet nozzle /external/. 12. Sealing ring. 13. Transfer bolt with nozzle dia 1.20. 14. Transfer bolt with nozzle dia 1.00. 15. Filter cup. 16. Reducer casing. 17. Packing washers. 18. "O" Condensate drainage port. "A" Transfer bolt 5 hexagon.

13.2. Series II, III and IV Engines.

13.2.1. Complete steps acc.to paragraphs 13.1.1 trough 13.1.2 as for Series I engines.

13.2.2. Remove from transfer bolt 5 the washer 17, fitting 2, ring 3, filter cup 4, spring 18, filter element 6, filter cover 15 and washer 17.

13.2.3. Wash in petrol the cup 4, filter cover 15, filter element 6, spring 18, the outer surfaces and side holes of the transfer bolt 5, except for "ØD" holes and clean hole "O" in the filter cup. The inner surface of the transfer bolt 5 is to be washed with cotton cloth /8-10 mm wide and about 200 mm long/ moistened with petrol and fixed in folded-in-half and twisted wire /e.g. dia. 0,8 mm length about 300 mm/.

NOTE: If any dirt is present in /partially covered sections of/ holes "dia.D", the operations in paras 13.2.4 to 13.2.6.

13.2.4. Screw out from the pump the transfer bolt 5 while putting the spanner onto hexagon "A".

13.2.5. Unlock and unscrew the transfer bolt 14. Remove the washer 17.

13.2.6. Unlock and unscrew the nut on the connector 19 mounting the pipe supplying air from the filter of air bleed control unit. Remove the pasing of reducer 16 from bolt 20. Wash with petrol the holes "dia.D" of bolt 5 and the outer and inner surface, as well as side holes of bolt 20 and then blow with compressed air.
The inner surface and side holes of bolt 20 are to be washed with cotton cloth prepared according to recommendations given in para. 13.2.3.

13.2.7. Assembling and installing of reducer casing 16 and filter are to be carried out in reverse sequence to dismounting. After installing the filter the nuts and other dismounted parts are to be secured with wire.

C A U T I O N S :

1. CONDENSATE DRAINAGE PORT "O" TO BE FACING DOWNWARDS.

2. FILTER ELEMENT 6 TO BE MOUNTED ON TRANSFER BOLT 5 WITH CROWN-LIKE CUTS ON FRONT "B" TO BE FACING FILTER CUP 4.

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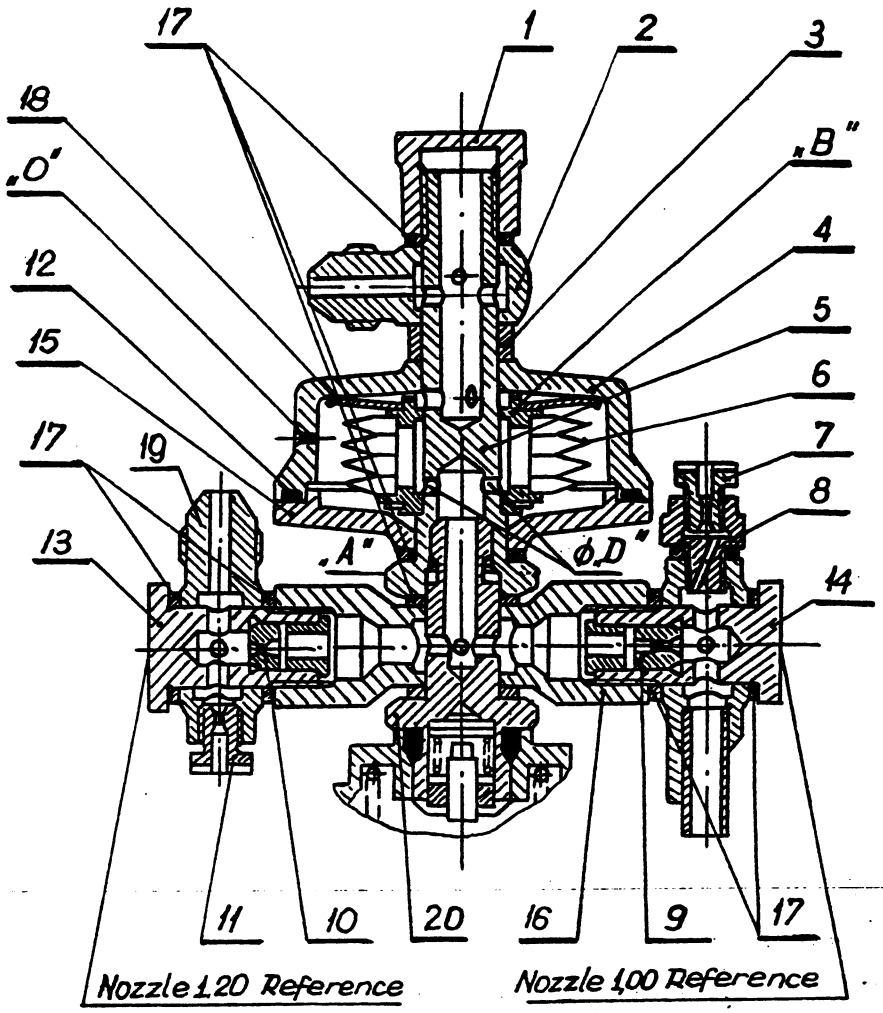

Fig. 6.7. Combined set of fuel pump air filter and nozzles /Series II, III and IV Engines/

1. Cap nut. 2. Rotary fitting. 3. Sealing ring. 4. Filter cup. 5. Transfer bolt. 6. Filter element. 7. Automatic starter outlet nozzle /external/. 8. Nozzle seat. 9. Automatic starter inlet nozzle /internal/. 10. Signal transmitter inlet nozzle /internal/. 11.Signal transmitter outlet nozzle /external/. 12. Sealing ring. 13. Transfer bolt with dia 1.20 nozzle. 14. Transfer bolt with dia 1.00 nozzle. 15. Filter cover. 16. Reducer casing. 17. Packing washer. 18. Spring. 19. Connector. 20. Bolt. "O" Condensate drainage port. "A" Hexagon of transfer bolt 5. "B" Filter front with crown--like cutouts. "dia.D" - Holes in transfer bolt 5.

3. ON SERIES II, III AND IV ENGINES, THE SEQUENCE OF MOUNTING STEPS FOR FILTER CUP AND COVER ON BOLT 5 IS REVERSED COMPARED TO SERIES I ENGINES.

4. SHOULD WASHER 17, UNDERLYING CAP NUT 1, BE FOUND DEFECTIVE, A NEW WASHER MUST BE PROVIDED IN ITS PLACE FROM THE 1 : 1 SPARES KIT.

14. Washing of Fuel Pump Air Nozzles.

14.1. Washing of /external/ outlet nozzles 7 and 11 /see Fig. 6.6 or 6.7/:

14.1.1. Unlock and then also remove nozzle 7 and seat 8.

14.1.2. Wash nozzle 7 and seat 8 in petrol whereafter blow through with a jet of compressed air.

14.1.3. Screw back the nozzle and seat in their positions and lock the assembly with wire.

14.1.4. Apply the same procedure for nozzle 11 as for nozzle 7.

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14.2. Washing of /internal/ inlet nozzles 9 and 10 /see Fig. 6.6 and 6.7/:

14.2.1. Unlock and unscrew transfer bolt 13 and nozzle 10 /Dia 1.20/.

14.2.2. Wash nozzle 10 in petrol /together with bolt 13/ and blow through with a jet of compressed air.

14.2.3. Screw transfer bolt 13 in its position and lock with wire.

14.2.4. Apply the same procedure for nozzle 9 as for nozzle 10.

C A U T I O N S :

1. IT IS FORBIDDEN TO USE MECHANICAL MEANS /LIKE E.G. WIRE; NAIL; ETC./ TO CLEAN CUT FUEL PUMP AIR NOZZLES.

2. IT IS FORBIDDEN TO REMOVE INTERNAL NOZZLES 9 AND 10 FROM TRANSFER BOLTS 13 AND 14.

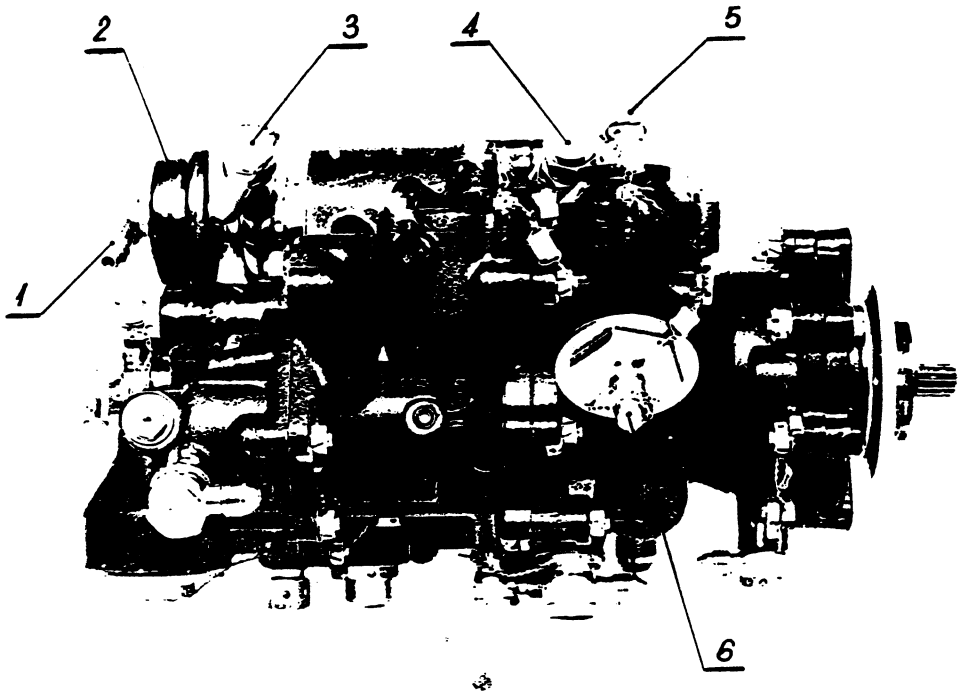

Fig. 6.10. Fuel Pump PNRP-2 /HP-40T/

1. Connector pipe to feed air from the compressor /P_S/. 2. Air filter. 3. Signal transmitter nozzle. 5. Air-release valve cap. 5. Automatic starter control screw. 6. Altitude corrector screw.

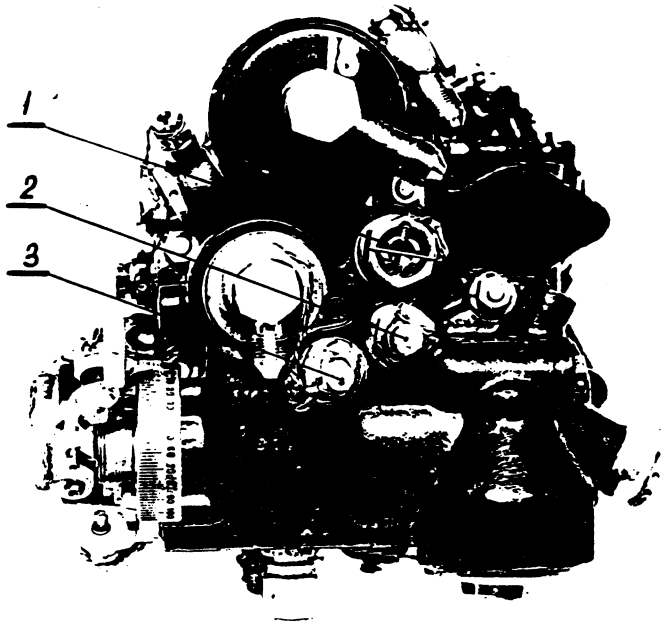

Fig. 6.11. Fuel Pump PNRP-2 /HP-40T/

1. Maximum speed control screw. 2. Minimum speed control screw. 3. Maximum fuel delivery control screw.

Revised

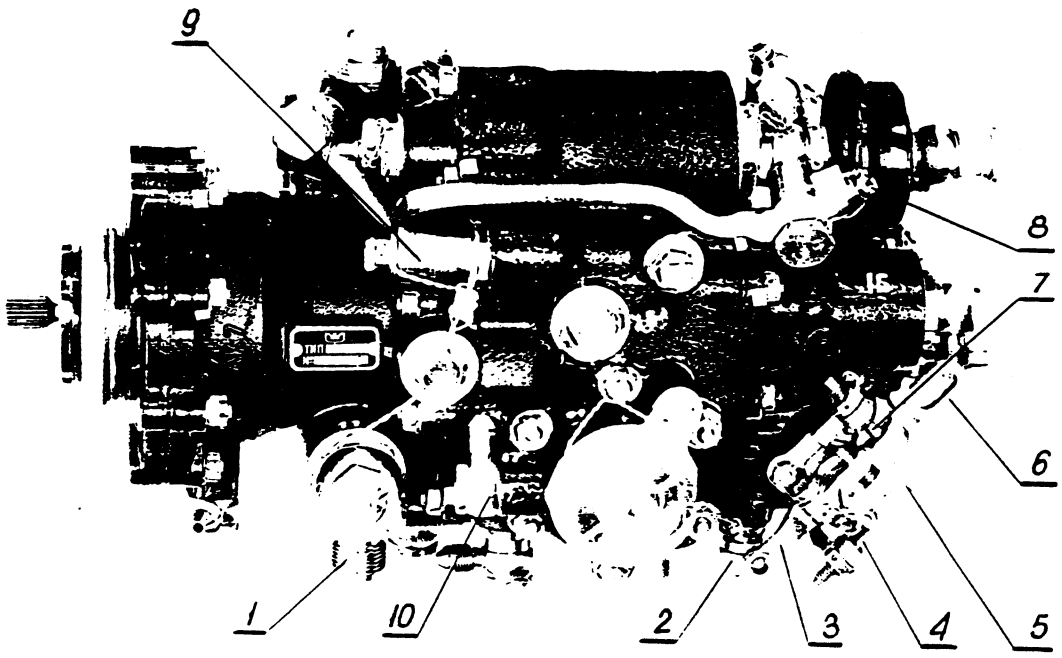

Fig. 6.12. Fuel Pump PNRP-3 /HP-40TA/

1. Fuel feed connector pipe. 2. Connector pipe for measuring fuel pressure upstream of the blocking valve. 3. Cutoff valve control lever. 4. Maximum speed stop. 5. Sector. 6. Engine control lever. 7. Minimum speed stop. 8. Automatic starter nozzle. 9. Acceleration package. 10. Emergency valve fuel drain connector pipe.

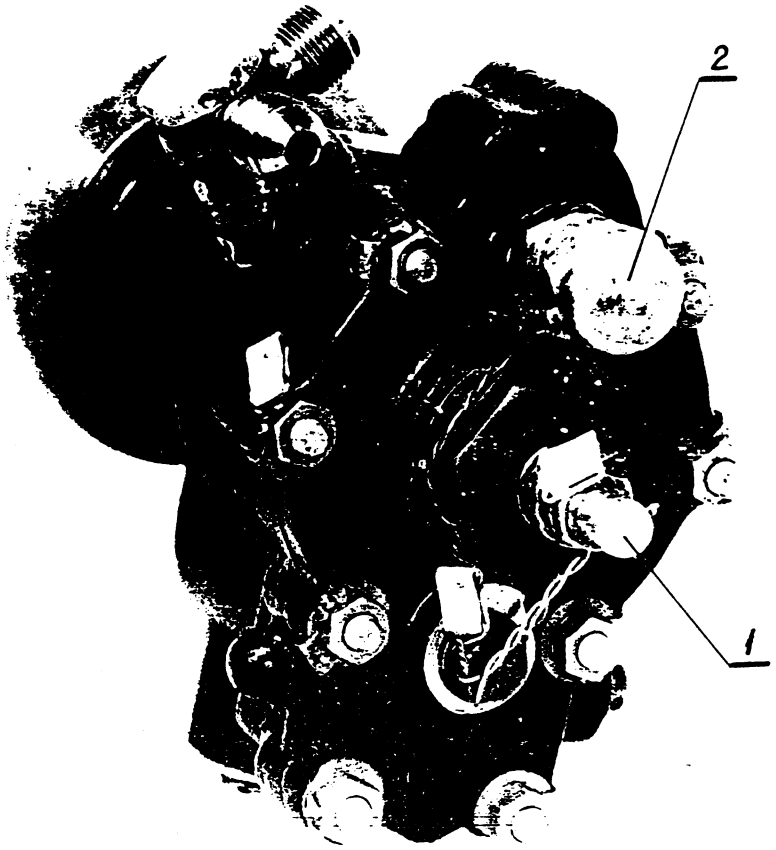

Fig. 6.13. Free Turbine Speed Limiter
00WT-2 /P0-40T/

1. Free turbine speed control screw. 2. Maintenance and air-release velve cap.

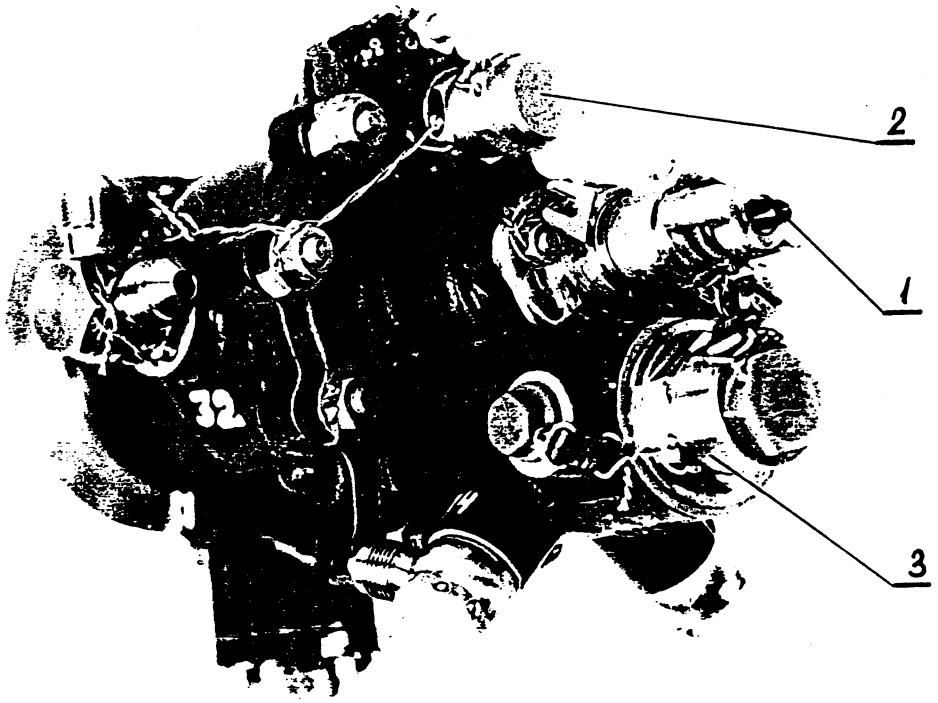

Fig. 6.14. Free Turbine Speed Limiter
OOWT-3 /PO-40TA/

1. Free turbine speed control screw /helicopter rotor/. 2. Maintenance and air-release valve cap. 3. Engine emergency disengagement valve.

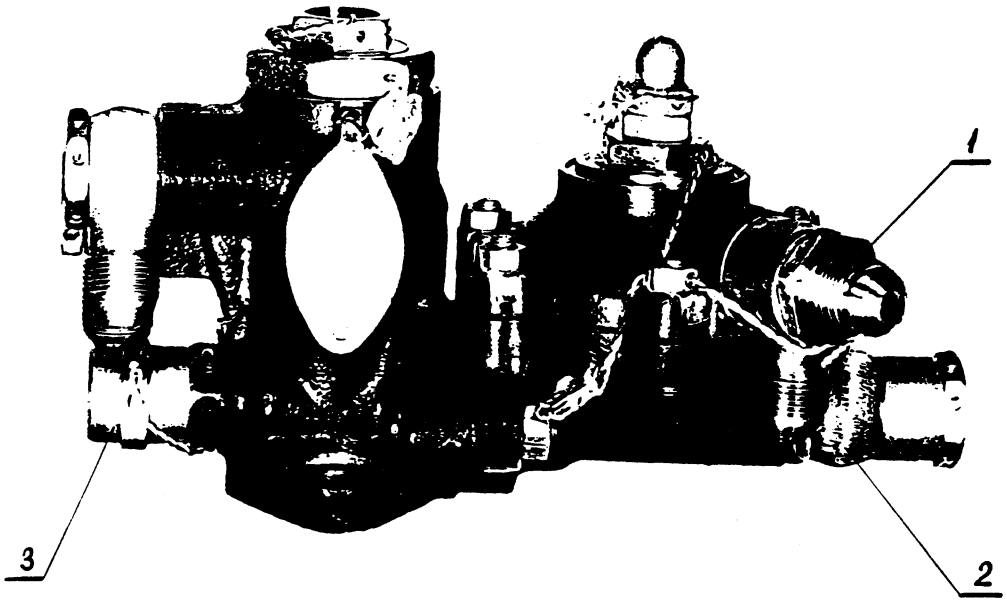

Fig. 6.15. Turbines Synchronizer ST-1 /CO-40/

1. Connector pipe to take air to the synchronizer of neighbouring engine turbines. 2. Connector pipe for taking air to the neighbouring engine. 3. Maintenance and air-release valve cap.

16. Checking bearing III Assembly for the Rate of Oil Flow

16.1. General Rules:

16.1.1. The check of oil flow at engines being in period of warranty by specially trained representatives of user's unit or representatives of manufacturer's factory is performed.

16.1.2. The instrumentation necessary for carrying out the routine checks /as specified in list, item 16.4, page 650/ delivers the manufacturer's factory when an order by users is placed. /Pressure-gauge, item No. 11 of list, is delivered by manufacturer's factory or user/.

16.2. Qualifying the engines for checking

The checking undergo GTD-350 engines of 3-rd series which have not removable oil injector of 3-rd bearing.

First checking the flow of oil flowing through 3-rd bearing assembly after 500^{+10}_{-} hrs has to be performed.

The next checking has to be performed according to oil flow quantity obtained during last checking in accordance with below shown table:

Oil flow value obtained during last check Q /ltr./min./	Next check after /hrs/
from 1,30 to 1,50	$50^{\pm 5}$
above 1,50 to 2,00	$100^{\pm 10}$
above 2,0	$200^{\pm 10}$

W A R N I N G

ENGINES WITH A FLOW SMALLER THAN 1.3 LTRS/MIN. ARE TO BE WITHDRAWN FROM SERVICE.

N O T E S :

1. Worktime in the case of engines that passed a guarantee repair is to be calculated as from the start of their operation.
2. Worktime in the case of engines that passed a major repair /general overhaul/ is to be calculated starting from the moment of repair completion.
3. Joint worktime in the case of engines, including permissible time of operation after the last check, must be such as not to exceed installation life specified.
4. For the engines produced till 1974, to which the warranty time between overhauls 1000 hrs with time limitation to 750 hrs has been granted, the above mentioned limitation of the time between overhauls is

cancelled, provided that the work according to item 16 of this chapter will be performed.

5. In case of engines operation in heavy conditions /agricultural work, high dustiness, lay-off/ or when oil flow values obtained at first checking /i.e.after 500 hrs. of running/ for GTD-350 engines of 3-rd series are low, the operation time limits should be lowered to the first checking /e.g. up to 300 or 400 hrs./.
In such a case oil flow check should cover also engines of 1-st and 2-nd series which have not removable oil injector at 3-rd bearing and are ~~not~~ run in similar condition as engines of 3-rd series.
Decision in this matter makes the user himself.

16.3. Checking Procedure:

16.3.1. Drain contents of the oil tank /forming part of the helicopter whose engine is under inwestigation/ into a clean container protected against possible soiling.

N O T E :

To shorten the time of checking procedure, it is permissible to isolate from the engine its oil feed line and to complete the steps para 16.3.4 and 16.4.16 without draining oil from the tank.
Thus isolated oil feed line must be raised at its end above tank level and fixed against some engine or helicopter details to obviate oil leakage. Prior to starting the engine, reserves of oil in the tank must be topped up.

Revised

16.3.2. From oil temperature transmitter P-2, forming an output device of the neighbouring engine, withdraw the plug terminating electrical connection coming from 2TUE-1 indicator, dismount the transmitter and blank off the hole left after this transmitter with a stopper 4 /Fig. 6.16/.

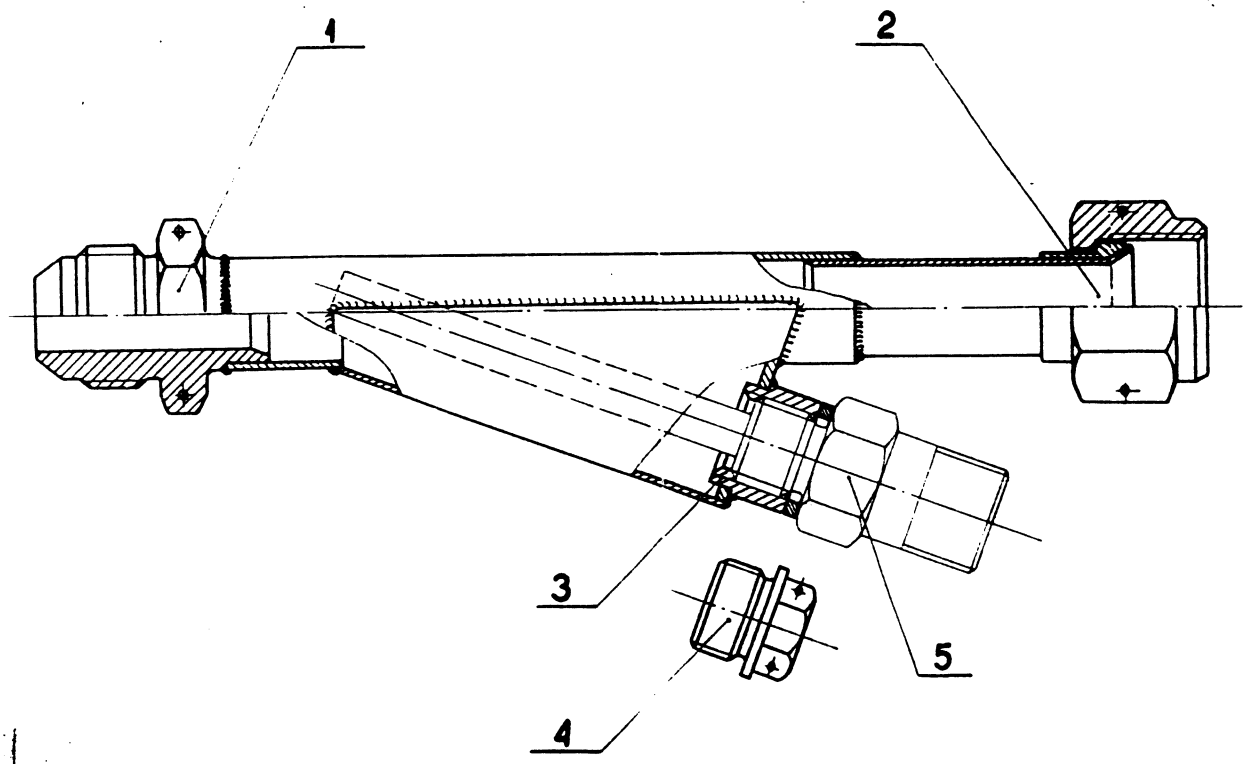

Fig. 6.16. Special Tube 16.08.0320

1. Connector for receiving the tube with tank oil feed line. 2. Nut for joining the tube and oil feed connector. 3. Area for mounting temperature transmitter. 4. Stopper. 5. Temperature transmitter P-2.

From the transverse fire safety baffle clear the removable cover to thread therethrough a special electrical connection.

16.3.3. Transmitter thus removed is to be threaded into end opening 3 of a special tube No. 16.08.0320 /Fig. 6.16/.

16.3.4. Isolate tank oil feed line from the engine. Mount special tube 16.08.0320 with the transmitter provided therein on the engine by screwing end nut 2 onto its oil feed connector ; /Connector 1, Fig. 6.17/.

Connect tank oil feed line to connector 1 of the 16.08.0320 tube.

Prior to this, remove batch front cover and withdraw the damper from the lengitudinal fire safety baffle.

C A U T I O N:

HAVING CONNECTED TANK OIL FEED LINE TO CONNECTOR 1 OF TUBE 16.08.0320 GIVE ATTENTION TO ITS LAY. AN EXCESSIVELY SHARP BEND OF THE LINE MAY LEAD TO A DROP IN THE ENGINE OIL PRESSURE.

16.3.5. Use a special electrical conductor / Fig. 6.18 / to connect transmitter mounted in tube 16.08.0320 to the airframe wiring system lead plug isolated in para 16.3.2.

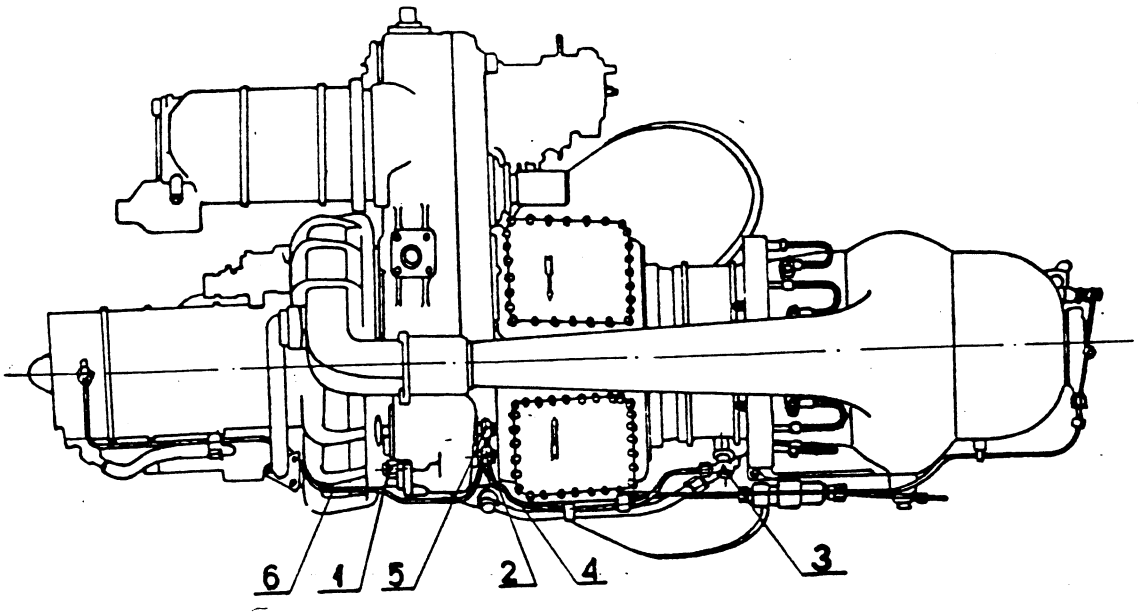

Fig. 6.17. View of the Engine

1. Connector pipe for feeding oil to the engine. 2. Connector pipe for taking oil from filter to the bearing III assembly. 3. Connector pipe for taking oil to the bearing III assembly. 4. Oil feed line coating with the bearing III assembly. 5. Connector pipe for taking oil from the filter to bearing I assembly. 6. Oil feed line coacting with the bearing I assembly.

N O T E:

Special connecting wire is to be threaded through the transverse fire safety baffle /the space underlying the engine/, and longutudinal fire safety baffle at the point where damper has been removed, so as to permit closing of the engine and drive covers.

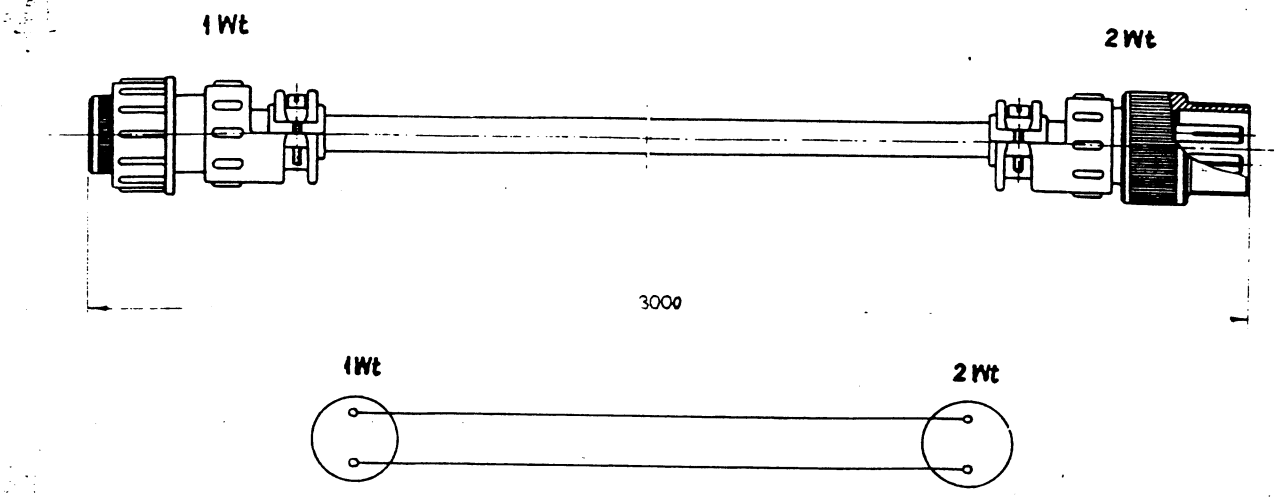

Fig. 6.18. Electrical Connection 16.08.0370

16.3.6. Out of connectors 2 and 3 /Fig.6.17/ remove in succession bolts that connect oil tube 4 with the oil filter and power turbine I stator, and in their place provide special screws 16.08.0148 /see Fig. 6.19/.

N O T E:

While removing screws 3 from power turbine I stator use another spanner to hold in position the sleeve /against its hexagon/ into which the screw has been driven.

Revised

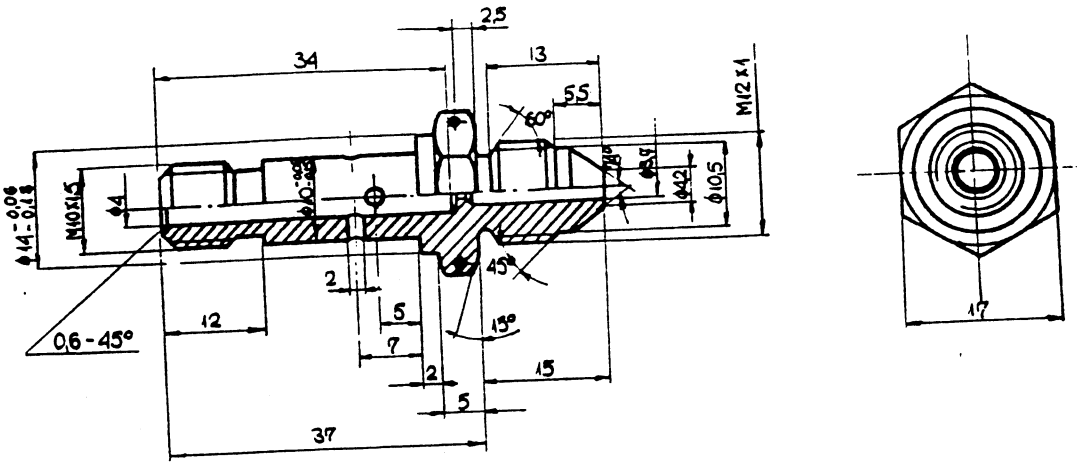

Fig. 6.19. Special Screw 16.08.0148

16.3.7. Connect special tubes with rubber hoses and pressure gauges, Accuracy Clasa 0,6, 0-4 kG/sq.cm measuring range and elementary graduation of 0.02 kG/sq.cm /Fig. 6.20/, to the ends of screws 16.08.0148.

Pressure gauges to be located near each other in vertical position, on one level, so as to be readily legible /readings/.

C A U T I O N:

WHEN PERFORMING THE WORK ACCORDING TO THIS CHAPTER CARE MUST BE TAKEN ABOUT THE FOLLOWING:

- BEHAVE SO AS NOT TO DAMAGE FIRE ALARM TRANSMITTERS;
- WHEN MANIPULATING DO NOT CHANGE ANGULAR POSITION OF THE TRANSMITTERS;
- MAKE SURE THAT NO ONE OF THE NEWLY INSTALLED PARTS ABUTS AGAINST ANY OF THE TRANSMITTERS /THIS NOTE APPLIES IN PARTICULAR TO THE ENGINE

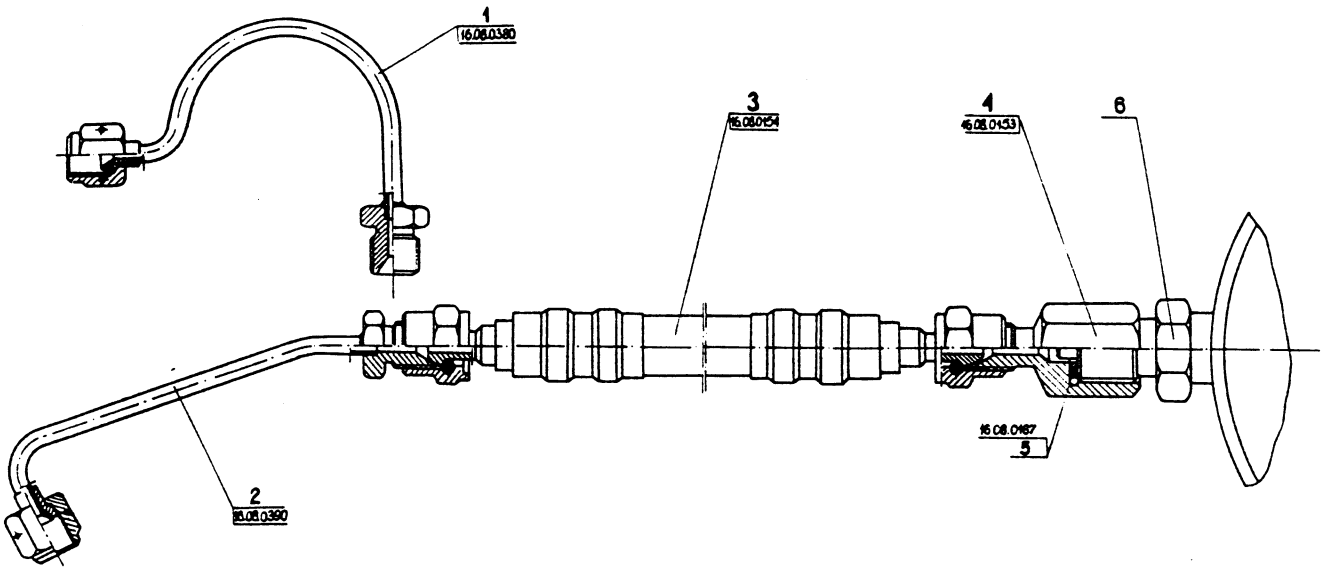

Fig. 6.20. Oil Pressure Gauging Unit

1. Tube for connecting the unit to connector pipe for feeding oil to the bearing III assembly. 2. Tube for connecting the unit to connector pipe on the oil filter outlet. 3. Rubber hose. 4. Fitting. 5. Washer. 6. Pressure gauge.

16.3.8. Transfer into tank that oil which has been drained in conformity with para 16.3.1.

16.3.9. Carry out cold turning to release air from the engine oil system and lines leading to the pressure gauge.

Lines leading to pressure gauges, in order to be vented, require that the nut for connecting the line to the pressure gauge is loosened until some oil flows out from under it.

Revised

..... As soon as, oil starts to flow out from under the nut, tighten the nut again.
Cold engine turning is to be repeated if not all the air present inside both lines could have been removed during one turning operation.

16.3.10. Add some more oil to the tank so as to top up oil reserves to 12.5 ltrs in volume.

16.3.11. Start the engine and warm up oil present in the engine and drive, in compliance with the Service Instruction requirements.

Readjust rotational speed of the compressor turbine to n_{TK} = 84.5 %.

When the temperature of oil at engine inlet /see indicator connected in compliance with para 16.3.5/ has reached the value of 60 to 65°C, note the readings and indications of both pressure gauges - accurate to 0.01 kG/sq.cm.

N O T E: When the measurement of pressures is made at low ambient temperatures and it is impossible to warm up oil to the required temperature of 60 to 65°C at the inlet to the engine /this applies to warming-up operations done in the engine operating ranges, including the takeoff range/, the engine must be stopped and the shortened cycle tap in the tested engine lubrication system changed over to position as for the winter operation.

..... To reach the required temperature level it is recommendable to wrap tightly, from its top, also the oil cooler of the engine under examination.

16.3.12. Find the defference in oil pressures from this equation:

$$\Delta_p = p_2 - p_3 \quad kG/cm^2$$

wherein:

Δ_p = drop in oil pressure across tube 4 /see Fig. 6.17/ provided to feed oil to bearing III.

p_2 = oil pressure at the outlet from connector pipe 2 /or 5 acc. to Fig. 6.17/ downstream of the engine oil filter.

p_3 = oil pressure at the inlet to connector pipe 3 /see Fig. 6.17/ upstream of bearing III assembly.

16.3.13. From fig. 6.21 find delivery of oil flowing through the bearing III assembly as a function of Δ_p.

16.3.14. In addition to para 16.3.6., to facilitate the work acc. to Bulletin with regard to the right-hand engine, it is admissible /unlike for the lefthand engine/ to take the pressure drop difference Δ_p measurements at connector pipes 5 and 3 instead of connector pipes 2 and 3 /Fig. 6.17/. For this purpose, the special screw 16.08.0148 /see Fig. 6.19/ on the right-hand engine is to

be driven into connector pipe 5 instead of connector pipe 2 /see Fig. 6.17/ for receiving a special-purpose tube /Fig. 6.20/ with a rubber line and a pressure gauge connected thereafter to it.

Should during such a measurement the delivery of oil flowing through bearing III be found to remain within the limits from 1.1 to 1.3 ltrs/min, it will be absolutely necessary to gauge the drop in pressures Δ_p following across connector tubes 2 and 3 /see Fig. 6.17/, and then to decide if the engine under examination can be passed over for further service or not.

When determining the magnitude of pressure difference Δ_p across connector pipes "5 and 3", and "2 and 3", the final assessment of the rate of oil delivery for the oil flowing through bearing III is to be based on Δ_p found for connector pipes "2 and 3" /Fig. 6.17/.

16.3.15. Analyse the obtained results of measurement. In case of doubtful data, the process of measurement will have to be repeated ence again.

16.3.16. Having brought the process of measurement to an end stop the engine, evacuate oil from the oil tank, remove special-purpose parts mounted for the time of measurement and provide instaad engine and airframe parts which are in normal use.

Refill helicopter oil tank and perform cold engine turning. Use petrol to wipe spots soiled with oil.

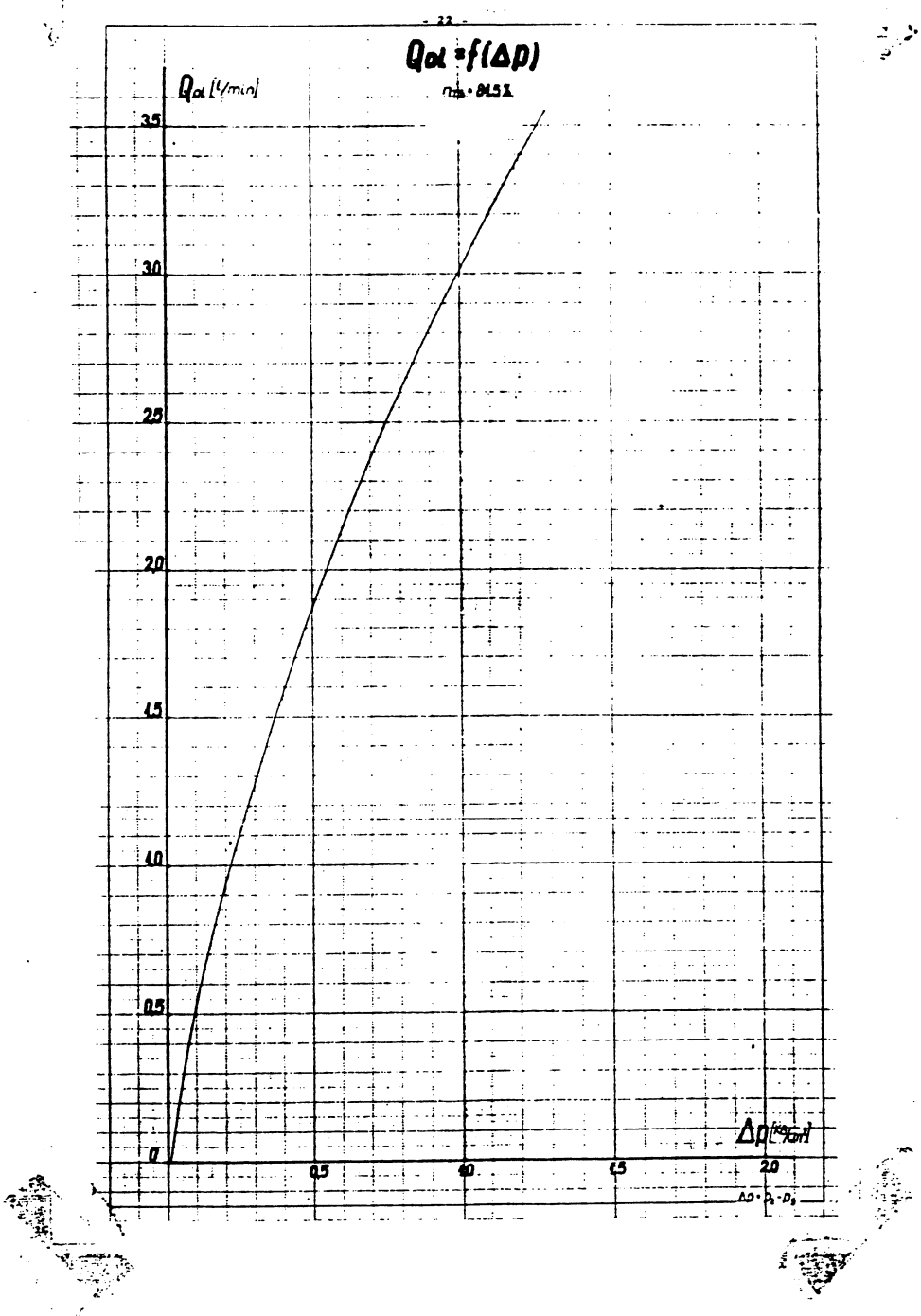

Fig. 6.21. The Rate of Oil Delivery Plotted as a Function of Pressure Difference.

Revised

16.3.17. Set the engine going for 4 to 5 minutes in its various operating ranges, in their number including also the takeoff range, to check lubrication system line joints for freedom from leaks.

16.3.18. Work done and results noted are to be written down in Chapter IX of the Engine Log Book.

An Example of Entry

Bearing III assembly has been checked for delivery of oil after .... hours of engine run under normal service scheme.

Engine has been operated /or not operated/ in connection with agronavigational programmes.

Results are as follows:

n'_{TK} = 84.5 %

t_{oil} /engine inlet/ = 62°C

p_{oil} = 2.8 kG/cm^2

p_2 = 3.00 kG/cm^2

p_3 = 2.11 kG/cm^2

Q = 2.80 ltrs/min.

16.4. List of Instruments to Carry out the Check:

ITEM	DESCRIPTION	REFERENCE NO	NO OFF PER SET
1	2	3	4
1	Stopper for blanking off oil temperature transmitter hole		1 pc.

List of Instruments - Continued

1	2	3	4
2	Special-purpose oil tube	16.08.0320	1 pc
3	Special-purpose conductor	16.08.0370	1 pc.
4	Special-purpose screw for holding oil tube	16.08.0148	2 pc.
5	Packing washers for oil tube holding screws	16.08.0126 89.06.0659	2 pcs.[1/] 2 pcs.
6	Special-purpose tube for taking oil pressure measurements at filter oil outlet	16.08.0390	1 pc.
7	Special-purpose tube for taking oil pressure measurements at the outlet to power turbine stator I	16.08.0380	1 pc.
8	Line to connect pressure gauges	16.08.0154	2 pcs.
9	Adaptor to connect pressure gauges to rubber hoses	16.08.0153	2 pcs.
10	Packing washer for the pressure gauge	16.08.0167	2 pcs.
11	Pressure gauge for oil Pressure readings with 0 - 4 kG/cm^2 measuring range and 0.02 kG/cm^2 elementary division.	Class 0.6	2 pcs.

1/ Number required for only one check.

Revised
December 1977

16.5. Determination of pressure gauges' readings errors.

16.5.1. By comparison of readings with those of reference /standard/ pressure gauge.

Readings of the pressure gauge to be checked compare with those of reference /standard/ pressure gauge at the test-bench in order to determine readings errors of these pressure gauges.

The value differences between the readings of pressure gauge checked and these of reference one should not be more than $\pm$0,03 kG/scm.

16.5.2. By remeasurement of oil pressure drop ΔP perform a remeasurement of oil pressure drop ΔP at the pipe supplying oil into 3-rd bearing, at the same time during the remeasurement the pressure gauges' locations should be changed /i.e. pressure gauge which at first measurement ΔP measured e.g. oil pressure behind oil filter of engine, at the remeasurement ΔP will measure oil pressure before the 3-rd bearing assembly/. The difference of value obtained ΔP should not be higher than 0,08 kG/scm.

16.5.3. In case, when indications error of pressure gauge exceeds above given values, the pressure gauge could not be used to measure the pressure drop.

The check of pressure gauges perform after each 10 measurements of oil flow or one time per month.

The certificate of checking pressure gauges at the test-bench, containing table with pressure gauge deviations or value of difference obtained ΔP, should be present in the set of instrumentation.

17. Additional Checking of Engines Fitted with PNRP-3 /HP-40TA/ and OOWT-3 /PO-40TA/ Accessories

17.1. Principles of operation.

17.1.1. Engines fitted with accessories as per heading are to be operated with emergency valve set to its working position.

C A U T I O N:

SHOULD THE EMERGENCY VALVE SET TO ITS WORKING POSITION HAVE OPERATED DURING SERVICE /ENGINE STOPPED/, DECISION ABOUT FURTHER BEHAVIOUR MUST BE TAKEN BY REPRESENTATIVES OF THE ENGINE PRODUCING WORKS.

17.1.2. Emergency valve is to be changed over into its checking position only for the time of valve operation tests /checking for rotational speed/.

17.1.3. Emergency valve operation is to be verified in the following cases:

- After a new engine has been installed on the helicopter;
- Each time preservatives have been removed from the engine;
- Another OOWT-3 /PO-40TA/ unit has been mounted on the engine;
- After each readjustment of the OOWT-3 /PO-40TA/ unit;
- Each time the helicopter has been left idle for a time longer than 3 months and is to be prepared for a test flight.

- After each 200±20 hours of engine operation.

In all those cases a single functional check is to be carried out in conformity with para. 17.2.

17.1.4. Emergency valve is to disengage the engine at rotational speeds of the helicopter rotor /n_{WN} % / as specified below:

- not lower than the minimum value written on page 10 /3 9. "OPERATIONAL NOTES"/, Information Card for the given accessory CCWT-3 /PC-40TA/; this value can vary according to accessory;

- not higher than 85% of the n_{WN}.

NOTES:

1. When rotational speed of the emergency-valve-actuation falls below the minimum level permissible for the specified accessory, its readjustment is to be carried out in conformity with para 17.3 to step up rotational speed of the emergency-valve actuation.

2. Should the emergency valve fail to act before reaching the 85% of speed by the helicopter rotor two more functional test should be carried out. If the valve does not act, representative of the producing works is to be called to the site.

17.1.5. To readjust the valve drive screw 2 /Fig. 6.22/ to such a depth that operational speed of the emergency valve is equal to, or higher /no more than 2% / than, the minimum allowable speed.

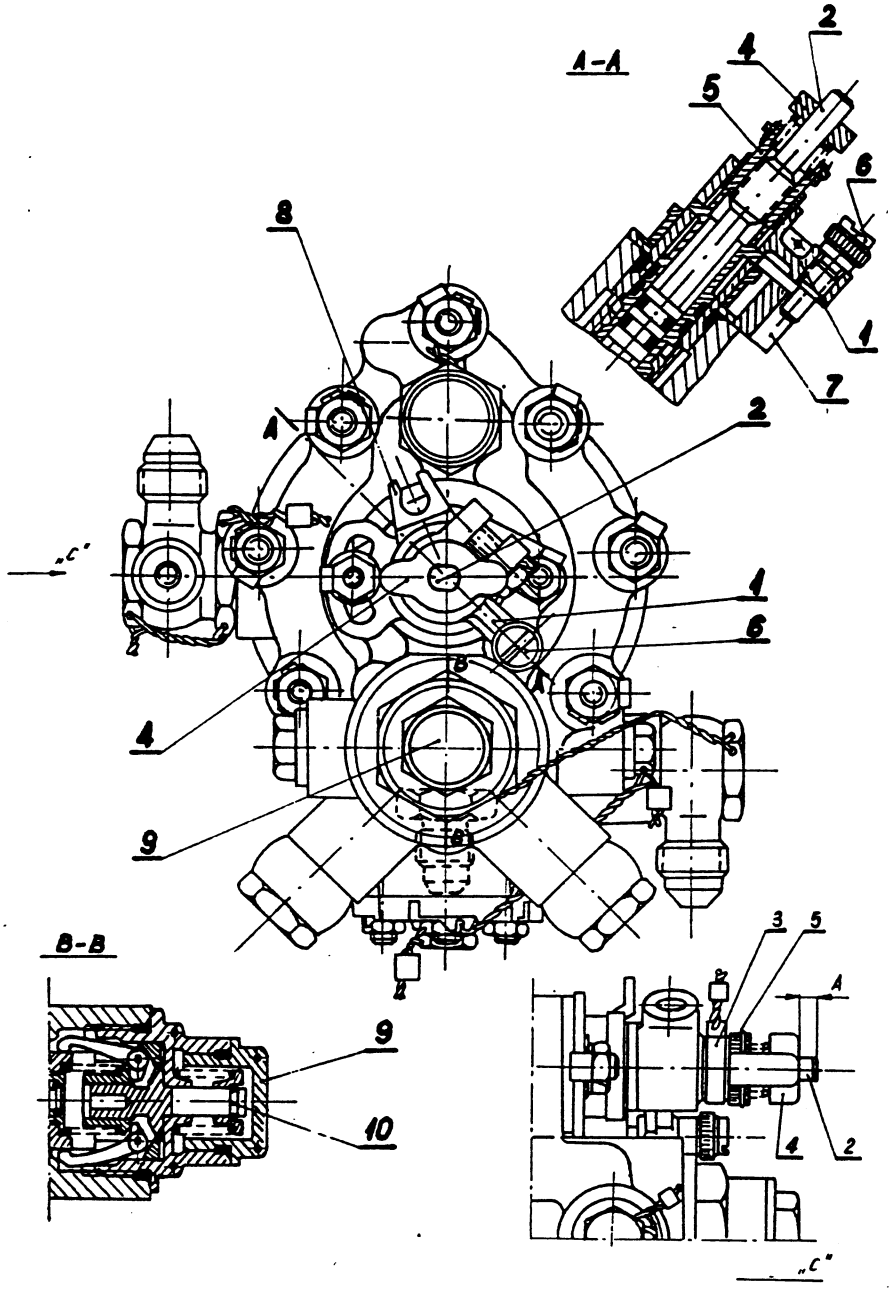

Fig. 6.22. OOWT-3 /RO-40TA/ Accessory Unit.

1. Lever for setting emergency valve in its checking or working position. 2. Control screw. 3. Band protection. 4. Control screw piece. 5. Cavity to form control screw piece. 6. Lever 1 retainer screw. 7. Working position passage. 8. Checking position passage. 9. Stopper. 10. Mandrel for unblocking the valve.

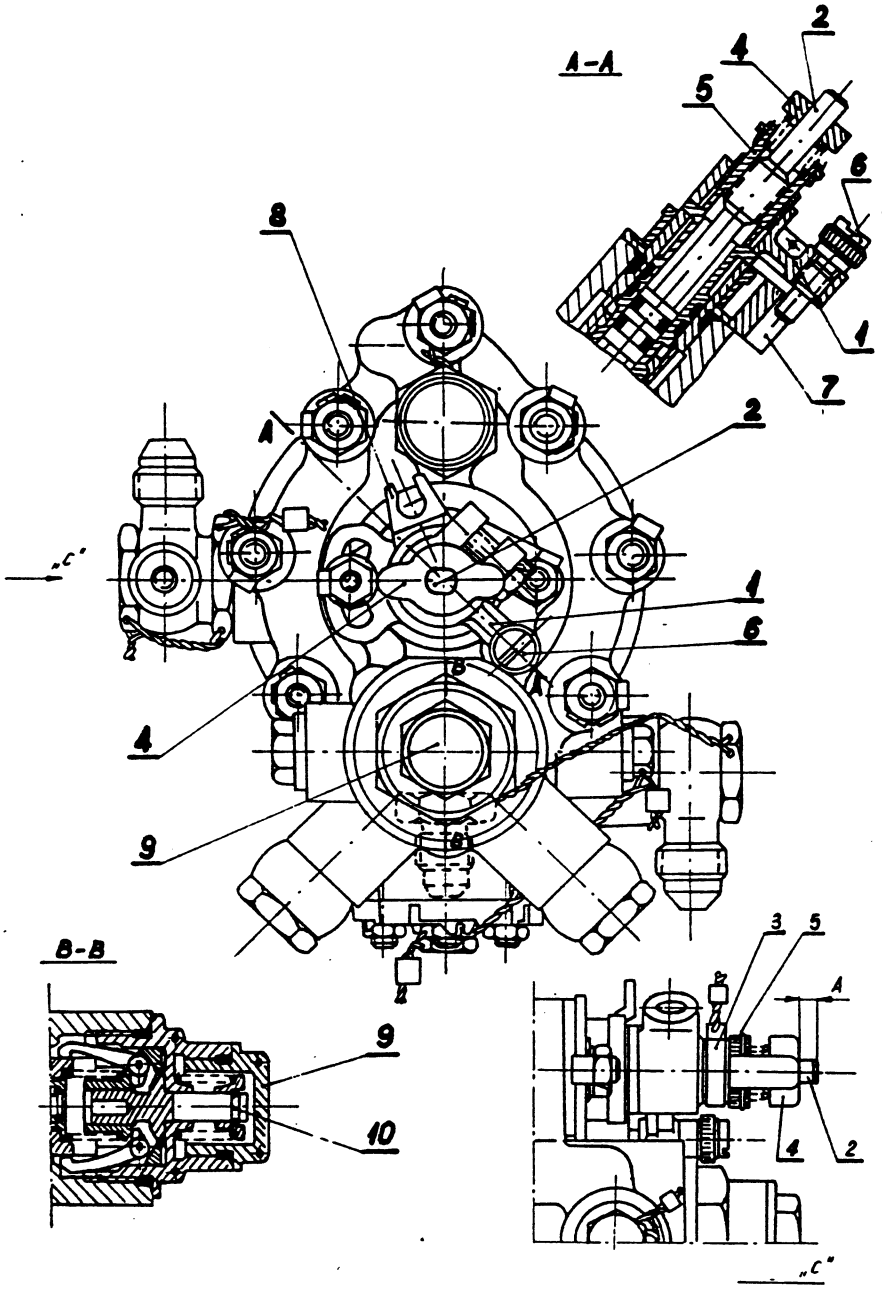

Fig. 6.22. OOWT-3 /RO-40TA/ Accessory Unit.

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..... - Turn lever 1, together with screw 6, clockwise so that the screw 6 can arrive over passage 7, decisive fot its working position;

- Drive screw 6 into passage 7;

- Lock screw 6 in this position and seal with lead.

17.3. Free Turbine Speed Limiter Adjustment /Fig. 6.22/:

- Remove leaden seal and band protection 3;

- Measure dimension "a" of control screw 2;

- Depress control screw 4 piece and turn it clockwise through the required amount; this will cause the control screw to go deeper into the body.

N O T E S:

1. The screw when driven in by one full rotation will increase rotational speed of the emergency valve by about 4 % n_{WN}.

2. It is permitted to drive the screw inside by one rotation further than the adjustment of accessory maker, i.e. the dimension "a" can be reduced by a maximum of 0.5 mm compared to this noted in the 00WT-3 /PO-40TA/ information Card; see page 4, It. 2 of Table, Column "Data Required acc. to Specifications".

- After readjustment measure dimension "a", replace band protection 3, secure it in its position and seal with lead.

Revised
December 1977

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- After readjustment measure dimension "a", replace band protection 3, secure it in its position and seal with lead.

Revised

Adjustment thus carried out is to be written down into the OOWT-3 /PO-40TA/ Information Card, para 9 "Operational Notes". Specifity the dimension of screw prior to adjustment, after the adjustment, and inform about operational speed of emergency valve prior to adjustment and after it.

18. Replacement of Injector 16.43.0320 to Feed Oil on III Bearing

18.1. Unscrew the clip fastening the oil feed pipe 16.75.0890 to III abutment from bracket /bracket to fasten the screen of thermocouples collector/.

18.2. Unlock and undo nut clamping oil pipe 16.75.0890 from connector pipe feeding oil to III stop /connector pipe on the steering apparatus of the I step of power turbine/. Pull off the pipe from connector pipe, and to facilitate the replacement of injector 16.43.0320 shift the turnbuckle into lower part of pipe.

18.3. Remove the connector pipe with injector 16.43.0320, labyrinth sleeve 16.43.0212 - 16.43.0215 /one off four/, distance washer 16.43.0191 - 16.43.0195 /one off five/, gaskets 16.43.0186 and 16.43.0187 /Fig.6.24/ from the steering apparatus-body.

To this end it should be performed the steps as follows:

- unlock and unscrew the three bolts 89.00.0054
- screw in the turnbuckles 16.08.0450 /Fig.6.25/ into two holes of triangular connector pipe flange with injector 16.43.0320, and at the same time screw them in clockwise.

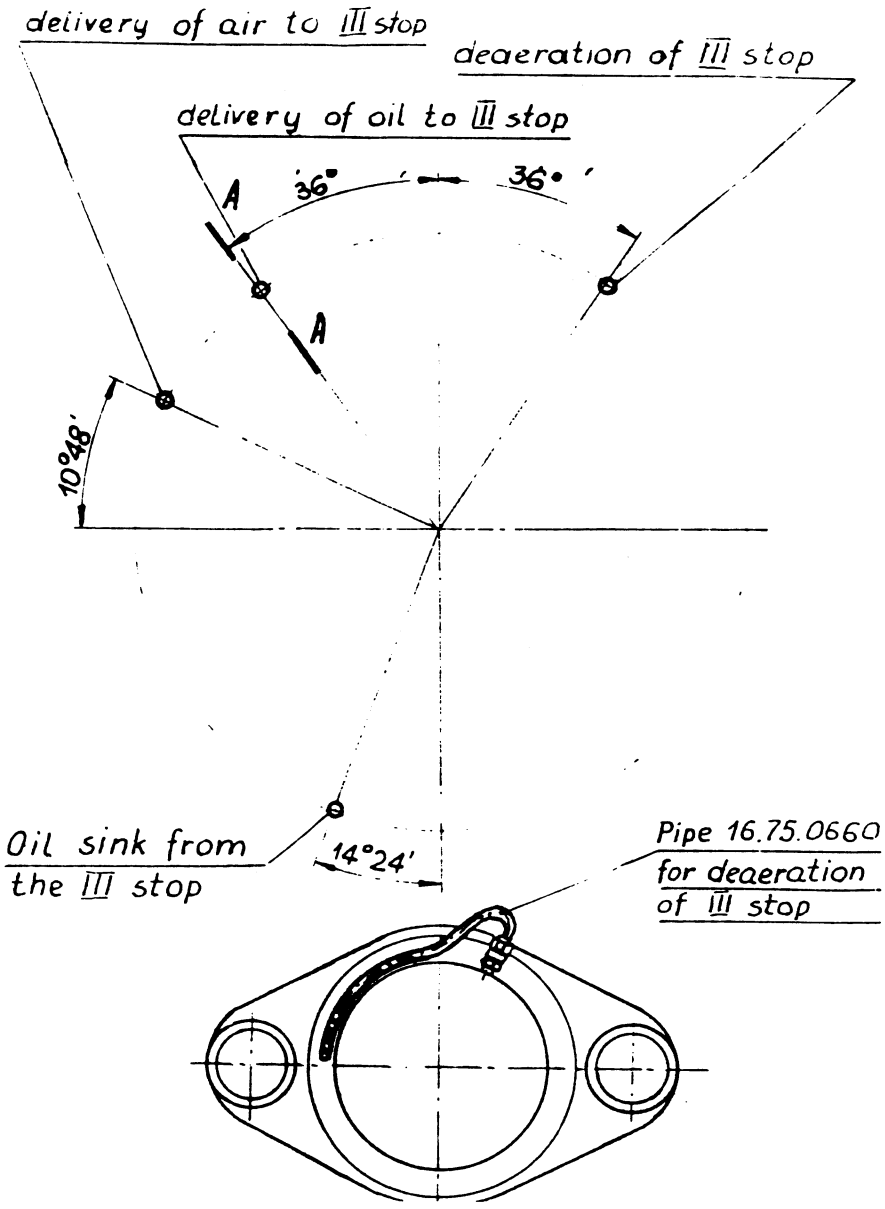


Fig. 6.23. Scheme of sparing of connector pipes for feeding and carrying away oil and air from III bearing assembly.

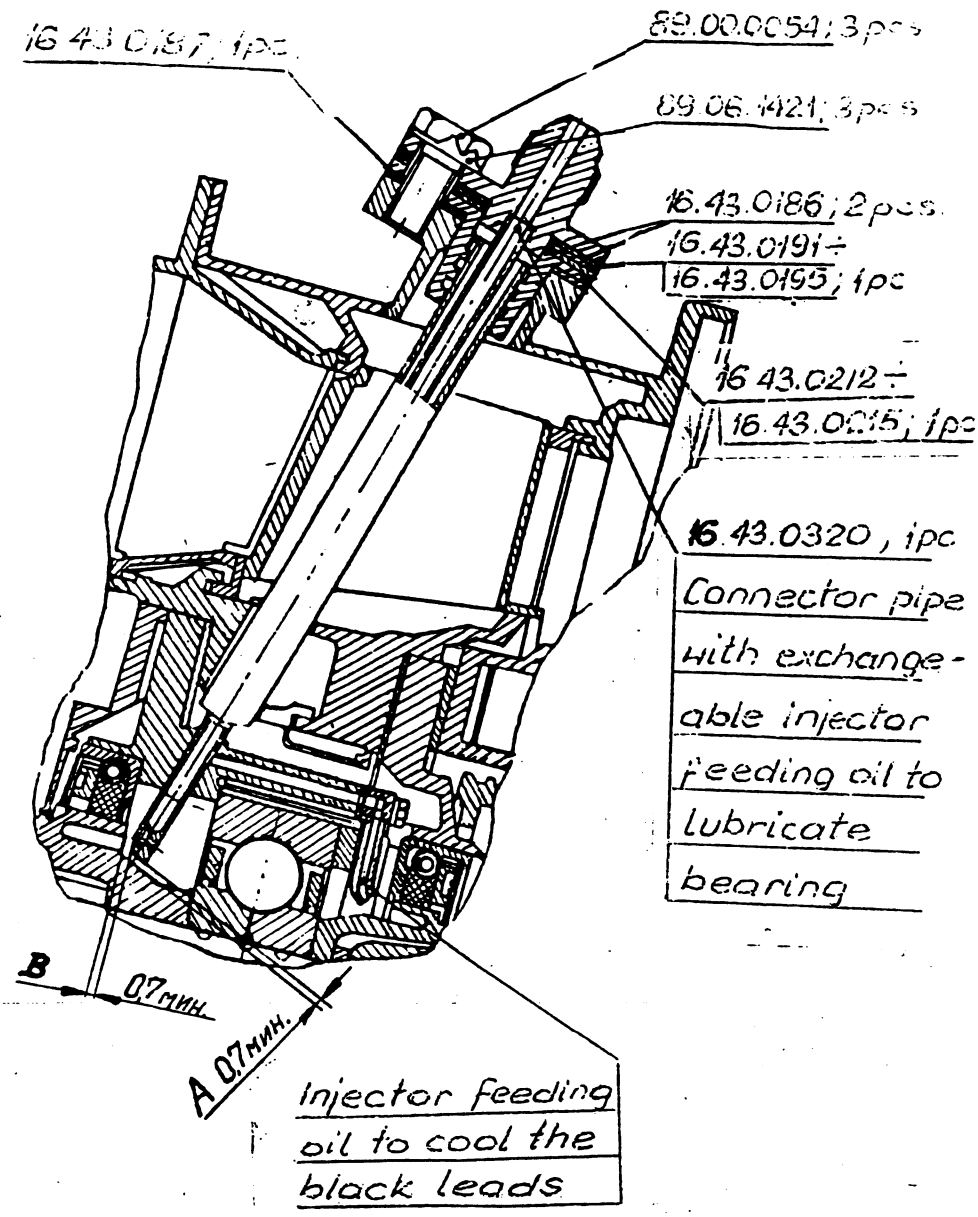


Fig. 6.24. Scheme of injector feeding oil to III bearing

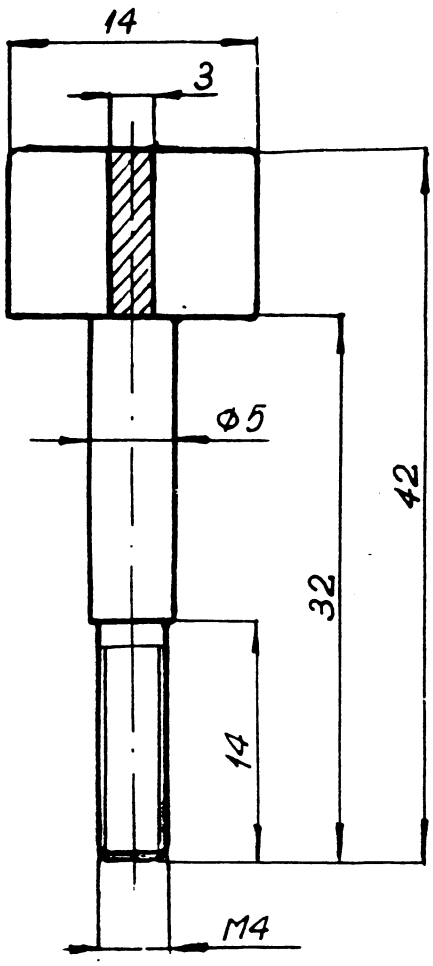


Fig. 6.25. Turnbuckle 16.08.0 450 for removing the oil injector

NOTE:

The thread under turnbuckles is made in flange of labyrinth sleeve 16.43.0212-0215:

- prior to removing the connector pipe with injector 16.43.0320 screw out previously the turnbuckles 16.08.0450. When pulling off connector pipe with injector 16.43.0320 it should be smoothly turned so that position of shaped recess with connector pipe flange passes the bracket fastening air filter.
- take the gaskets 16.43.0186 with the distance washer 16.43.091 - 0195 off connector pipe of steering apparatus, remove labyrinth sleeve 16.43.0212 - 0215, and take off gasket 16.43.0187.

18.4. Disassembled pack is to be washed in petrol and blown through with a jet of compressed air /apart from connector pipe with injector/.

18.5. Renew connector pipe with injector 16.43.0320 for a new one /one off three being added to engine/ as well as gaskets 16.43.0186 /2 pes/, and 16.43.0187 /1 pc/. The distance washer 16.43.0191 - 0195 should be left the same because it assures a proper.size of clearances "A" and "B" /Fig. 6.24/.

NOTE:

Any replacement of connector pipe with injector 16.43.0320 for ones coming from other engine is not permitted.

18.6. Pack of parts which have been previously disassembled according to point 18.3 in reversed order as by the assembly put into connector pipe of steering apparatus /the new connector pipe with injector 16.43.0320, labyrinth sleeve 16.43.0212-0215, distance washer 16.43.0191-0195, and new gaskets 16.43.0186, and 16.43.0187/.

NOTE:

1. Prior to mounting the pack, the new connector pipe with injector 16.43.0320 is obligatory to be washed in petrol and blown with a jet of compressed air.

2. The assembly of the connector pipe with injector is to be done so that the shaped recess in connector pipe flange passes bracket fastening air filter.

3. Mutual position of holes for bolts 89.00.0054 in connector pipe with injector 16.43.0320, labyrinth sleeve 16.43.0212-0215, distance washer 16.43.0191-0195 and in connector pipe of steering apparatus body is made in a such matter that it is possible only one position of parts enterring into the composition of pack allowing to screw in the mountings bolts.

18.7. Having the pack put into connector pipe of steering apparatus it is tobe secured by means of bolts 89.00.0054 replacing previously the lockwashers 89.06.1421 for the new ones. Look up the bolts by bending up the washers teeth.

Revised

18.8. The end of oil feed pipe put onto connector pipe. tighten turnbuckle and lock it up.
The clip taken off according to point 18.1 is to be fastened on its place.
At the running engine is to be made the test for tightness of connection.

19. Cleaning up the Pipe 16.75.0660 and the Passage to Vent III Abutment Space.

19.1. Unscrew with spanner RWKt-1-R two clips to fasten pipes 16.75.0660 for deaerating III abutment space off the flanges of steering apparatuses /flange for connection of steering apparatus of power turbine I step with stearing apparatus of power turbine II step/.

19.2. Unlock and undo the nut fastening the deaerating pipe 16.75.0660 off the connector pipe for deaerating III abutment space /connector pipe on steering apparatus of power turbine I step/.

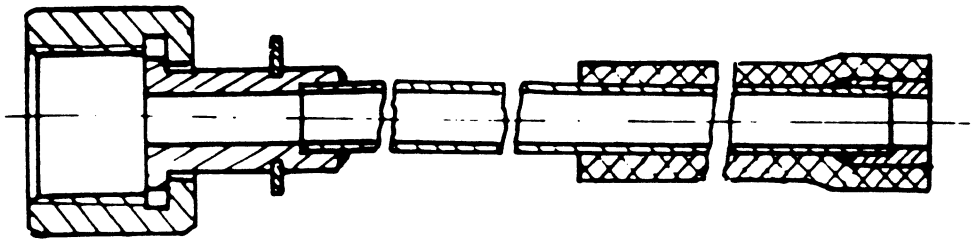
19.3. Take pipe off connector pipe.

19.4. Undo two nuts fastening deaeration pipe 16.75.0660 off the engine speed reducer.

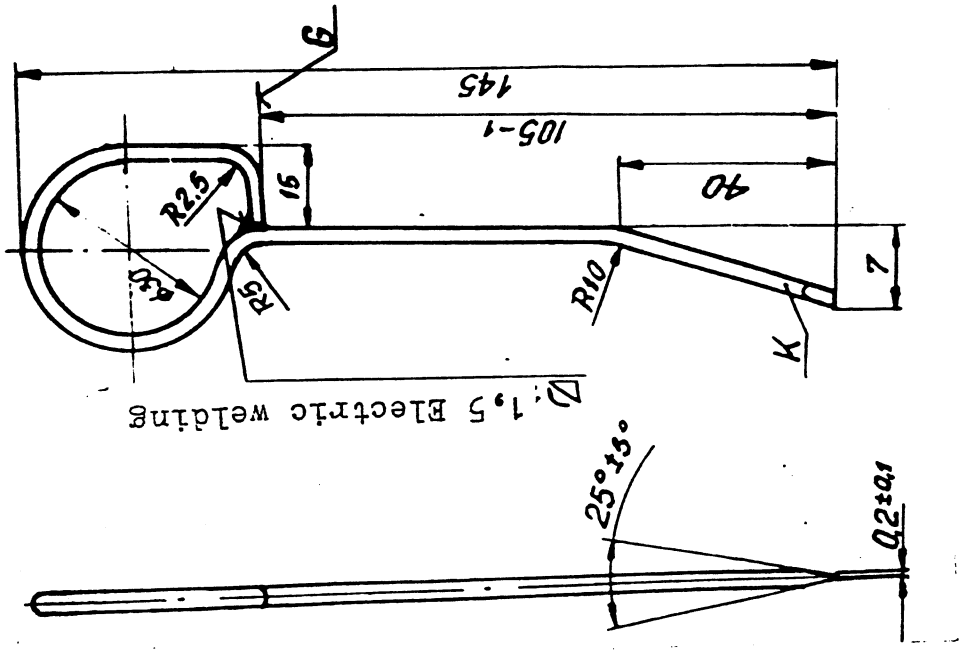
19.5. Take deaeration pipe 16.75.0660 of III abutment space off engine.

19.6. Put the cleaning rod 16.08.0172 into the open stub pipe for venting the III abutment space /the rod

Drg.No.6.27. Guiding jacket UMR-888R



Drg.No.6.26. Cleaning rod No.16.08.0172



has to be previously amended acc. to drawing No. 6.26/ so that the bent off end "K" /Drg.No.6.26/ is directed towards the supercharger.

In case the pipe is fully clogged with carbon deposit the cleaning rod should be reciprocated with simultaneous turning it to left and right.

Cleaning rod should be pressed into the pipe for every motion cycle until it rests with its handle against the stub pipe on the unit.

After initial cleaning with cleaning rod the guiding jacket UMR-888R /Drg.No.6.27/ should be screwed on the stub pipe. Then put the end of cleaning rod UMR-888R-1 /Drg.No.6.28/ into so screwed-on jacket and introduce it entirely by turning the crank.

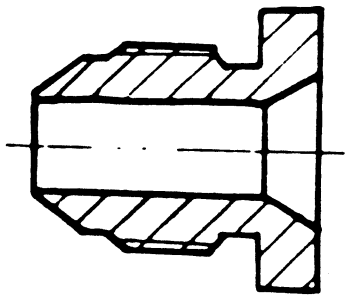
Upon completing the cleaning unscrew the jacket from the stub pipe and remove the cleaning rod.

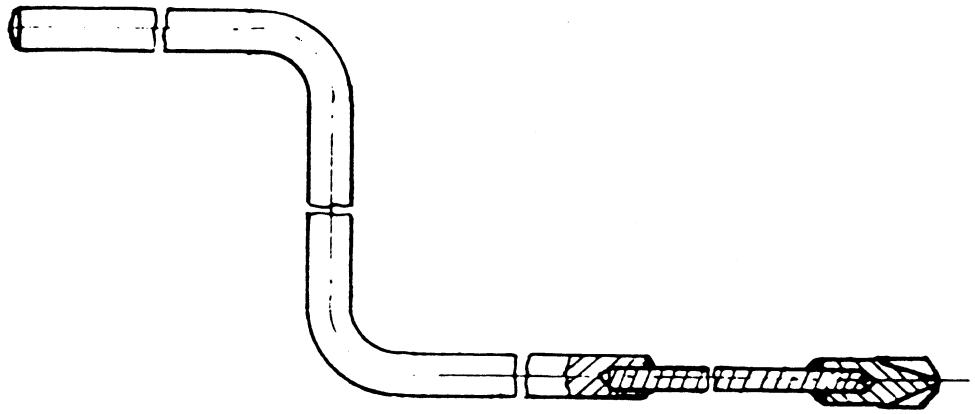
Next check the passage of the unit with cleaning rod 16.08.0172 introduced to resistance against face "G". Maximum clearance between face "G" of the cleaning rod and the stub pipe of the unit may be 2 mm.

19.7. After cleaning the rods should be washed in kerosene or petrol and stored for further use.

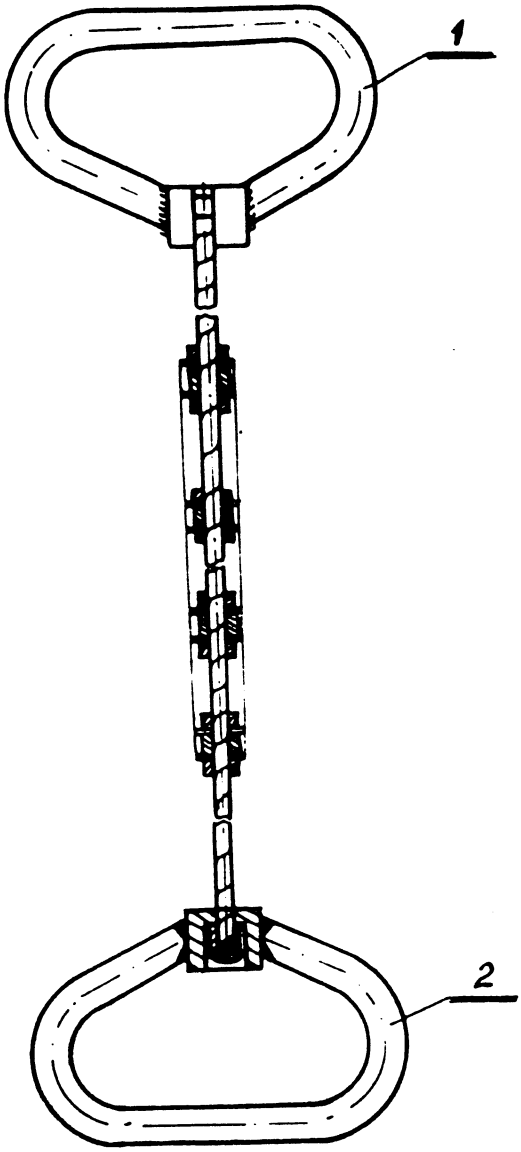
19.8. Dismantled pipe 16.75.0660 in para 19.5 should be deaned with wire, dia 1,5-2 mm.

The pipe is to be cleaned only from the side of its mounting to venting stub pipe on guide-vane





Drg.6.28. Cleaning rod for UMR-888R-1 Drg.6.29. Protective sleeve UMR-887R



Drg.6.30. Cleaning rod for pipe UMR-881R

section. Then the protective sleeve UMR-887R /Drg. No.6.29/ is to be screwed into pipe nut to the resistance thus protecting the pipe cone against unjuries.

Cleaning rod UMR-881R /Drg.6.30/ is to be put into the secured pipe.

Before doing that the eye /1 or 2, Drg.No.6.30/ has to be removed and, when the rope comes out on the other side of the pipe, the eye is to be replaced onto the rope. Then the rope is to be drawn several times through the opening of the pipe so that the brushes on the rope clean the whole length of the pipe interior.

Upon cleaning and removal of rope from the pipe the protection is to be unscrewed from pipe cone, the pipe interior is to be washed with kerosene and blown through with ~~xxx~~ compressed air.

19.9. After cleaning pipe 16.75.0660 and passage to deaerate III abutment space put pipe 16.75.0660 on engine in its original position.

Having put pipe on engine fasten it by means of nuts 16.94.0021 to engine reducer body, replacing previously the spring washers 89.06.0875 and gasket 16.61.0267 for the new ones.

19.10. Lead the end of deaerating pipe 16.75.0660 to connector pipe, tighten turnbuckle and lock it up.

Clips taken off according poin 19.1 are to be

secured on its place, replacing previously lock - washers 89.06.0387 for the new ones. The bolts and nuts lock up by bending up washers.

Procedures according to point 18 and 19 are to be made without taking the engine off the helicopter.
Equipment required for carrying out periodical checks by the representatives of the User /acc. to Specification given on page 672/ is delivered by Manufacturer, except for items Nos. 9, 10, 11, 12 for which the order should be placed at the Manufacturer.

SCHEDULE

of spare parts and tooling necessary to proceed procedures according to point 18, 19 and 21.

Ref.No.	Designation	Pieces	Manner of delivery
1	2	3	4
1	Interchangeable oil injector to smear III bearing Drawing No. 16.43.0320	3 pcs	It is added to individual set of spare parts for each engine.
2	Puller to take the parts pack of oil feed connector pipe on the steering apparatus of I step TN Drawing No. 16.08.0450	1 set /2 pcs/	It is added to board tools

1	2	3	4
3	Spring washer 89.06.0875 - under the bolt to fasten oil feed pipe, - under the nut to fasten the pipe to deaerate III stop to reducer.	3 pcs 6 pcs	It is added to individual set of spare parts for each engine.
4	Lock-washer 89.06.1421 under bolts to fasten parts pack on the steering apparatus	9 pcs	It is added to the individual set of spare parts for each engine.
5	Gaskets: - 16.43.0186 under connector pipe with injector and distance washer - 16.43.0187 under labyrinth sleeve	6 pcs 3 pcs	-"- -"-
6	Lock-washer 89.06.0387 under nuts and heads of bolts to fasten clips for III stop deaeration pipe	12 pcs	-"-

1	2	3	4
7	Cleaning rod 16.08.0172	1 pc	It is added to the board tools
8	Washer 16.61.0267 under end of pipe to deaerate III stop for fastening to reducer	3 pcs	It is added to a individual set of spare parts for each engine
9	Protective sleeve UMR-887R	1 pc	Suplied by Manufacturer against special order
10	Cleaning rod for UMR-881R pipe	1 pc	-"-
11	Cleaning rod for UMR-888R pipe	1 pc	-"-
12	Spanner RWKt-1-R	1 pc	-"-
13	Sealing ring 89.29.1421 for vent pipe 16.75.0990	6 pcs	Added to single spare part set of each engine

20. Replacement of the modified injector feeding oil to the III bearing /Fig. 6.31/

20.1. Undo four bolts 1 mounting injector with spring washers 2.
Then screw the turnbuckles 16.08.0450 /to be found in the set of board tools/ into two holes of the flange of injector 3 and evenly screw them in clockwise.

20.2. Take out the injector 3 and washers 4 and 6.

20.3. Take from 1:1 spares set the new injector 3 and washers 4 and 6 and then install them onto Engine according to Fig. 6.31.

20.3.1. The position of injector in relation to guide vanes is guaranteed by the arrangement of holes for bolts.

NOTE:

Before installation, the injector, washers and the places of assembly of these parts on the case 5 of guide vane assembly, are to be washed with gasoline and blown with air.

20.4. Upon replacement of the oil injector the engine starting should be carried out and the engine should be operated at idle speed for about 5 minutes. Upon stopping the engine it is to be checked for tightness of connections. No leakage of oil is permitted.

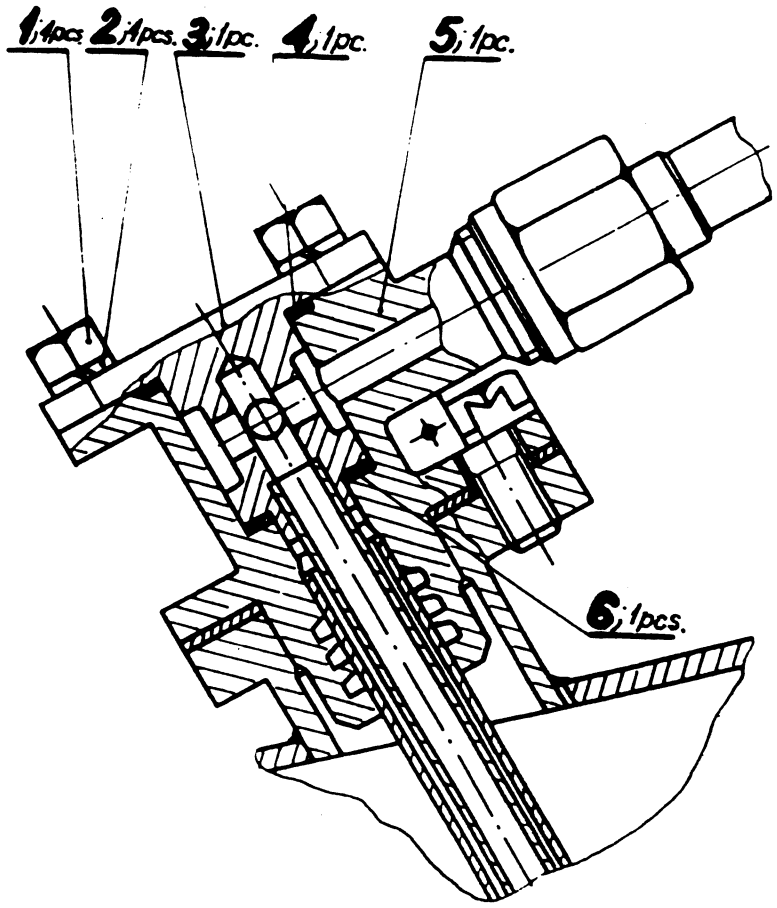


Figure 6.31. Sketch of new-design oil injector of III bearing

NOTE: Because of the lenghtening of service life of oil injectors feeding oil to III-bearing to 1000 hours, the procedures of the change of injectors from para. Nos. 18 and 20 lose their applicability, as well as some of the informations under para. 19 are out of date /Schedule on page 672/. Those procedures are left though in their hitherto wording, to be used in cases when for some reasons, not planed in normal operation, the dismantling and inspection of oil injector should become necessary.

21. Cleaning of the pipe 16.75.0990 for venting the III bearing space /Fig. 6.32/.

21.1. Unlock and unscrew the nut mounting the pipe to vent stub pipe of III bearing space.

21.2. Remove the pipe from engine by sliding it out of the hole in the reduction gear.

21.3. Clean the pipe by means of tools and in a way given in p. 19 page 666.

21.4. Replace two sealing rings 89.29.1421 with new ones.

21.5. Install the pipe onto engine, screw on the nut and lock it.

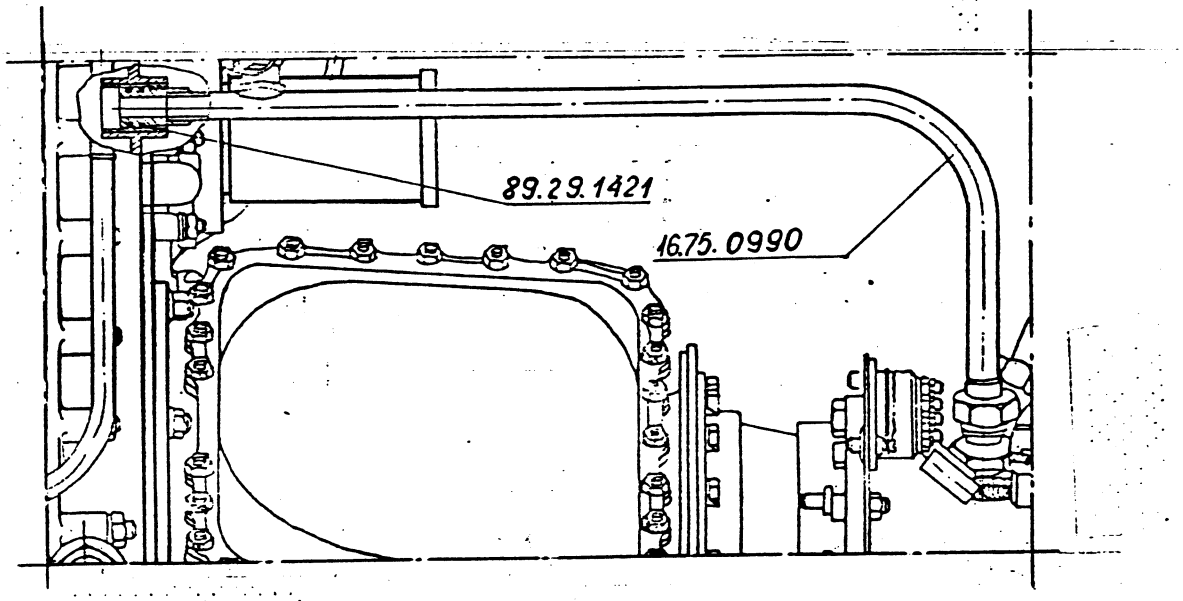


Fig. 6.32. Vent pipe 16.75.0990 of the III bearing assembly.

22. Method of Change from One Grade of Oil to Another.

22.1. Drain old oil from engine and from helicopter system.
Wash engine oil filter in petrol.

22.2. Pour new oil into the system.

22.3. Turn the engine crank in cold condition.
Check oil level in the **oil tank.**

22.4. Start engine, warm oil to a temperature of cooler thermostat opening i.e. to t_{ol} = 75 °C min.
Stop the engine after about 3 minus of operation with oil flowing through coolers.

22.5. Drain oil from engine and system.
Wash engine oil filter.

22.6. Repeat one more time the operations as per paras. 22.2, 22.4 and 22.5.

22.7. Pour new oil into the system.
Engine is now ready for operating.

NOTES:

1. Prior to changing oil in the engine, measure the engine oil consumption /with oil which is to be changed/ inspect oil filters and the magnetic plug of engine oil system. On estimating the oil consumption and achieving satisfactory results of above mentioned inspection, oil change operation may be started with.

2. After $10^{\pm 1}$ hours of operation since changing to new oil grade an additional estimation of oil consumption should be carried out as well as the inspection of oil filters and of engine magnetic plug.

3. The results of oil consumption estimation and those of filters and magnetic plug inspection from both before and after change are to be recorded in engine log book.

4. Every change to new oil grade is to be recorded in the engine log book.

5. In case the engine is to be preserved it is to be filled with fresh oil of the same grade on which engine was operated.

CHAPTER 7

RENEVAL OF COMPONENT UNITS AND ACCESSORIES

Issue 2/1975

CHAPTER 7 - Index of Contents

Index of Contents - Continued

1. General

Component units or accessories showing sings of defective operation, whose repair appears to be impossible in the light of these instructions, must be replaced by the new ones.

New component units and accessories can be installed only if having relevent certificates or information cards signed by product quality control people and military representatives.

Hereinbelow is given the list of component units and accessories liable to replacement during service:

1.1. Fuel pump

1.2. Free turbine speed limiter

1.3. Turbines synchronizer

1.4. Signal transmitter

1.5. Starter-generator assembly

1.6. Timer-distributor

1.7. Ignition plug

1.8. Flame igniter

1.9. Solenoid fuel valve in the starting system

1.10. Constant fuel pressure valve in the starting system

1.11. Air bleed and anti-icing valve system

1.12. Valve drain system

1.13. Drain tank, combustion chamber drain valve, working burner drain valve.

1.14. Thermocouples

1.16. Fuel delivery lines; fastening holders; seat for connection of thermocouples; screws; pins washers and other smaller details.

1.17. Control devices /monitoring instruments/.

1.18. Bearing III air filter.

N O T E :

Control devices /i.e. monitoring instruments/ are to be interchanged according to instructions issued by the helicopter producing works.

C A U T I O N S :

1. ACCESSORIES LISTED AS ITEMS 1.1 TO 1.4 HAVE TO BE INTERCHANGED ON ENGINES LIABLE TO GUARANTEE PROVISIONS ONLY BY REPRESENTATIVES FROM THE ENGINE PRODUCING WORKS.

2. WHILE REMOVING FUEL SYSTEM ACCESSORIES FOR A TIME LONGER THAN 24 HOURS, INNER PRESERVATION OF THE FUEL SYSTEM OUGHT TO BE CARRIED OUT PRIOR TO SUCH A REMOVAL.

3. EACH TIME A RENEWAL OF ACCESSORIES OR REPAIR OF DEFECT HAS TAKEN PLACE IN THE FUEL, LUBRICATION OF ELECTRICAL /WIRING/ SYSTEMS, THE ENGINE IS TO BE SET WORKING FOR TWO TO THREE MINUTES IN EACH OF THE OPERATING RANGES TO SEE HOW THE GIVEN SYSTEM OPERATION IS.

4. REMOVAL OF ACCESSORIES TO CARRY OUT THEIR REPAIR IS PROHIBITED.

2. Principles for the Renewal of Accessories and Component Units

2.1. Every opening or surface uncovered in connection with the disassembly operations is to be immediately blanked off with a protective cover washed before in pure petrol.

2.2. It is inadmissible to use a screwdriver, or any other metal item, when separating surfaces joined together; it is admissible, on the other hand, to make use of a rubber or wooden hammer to tap about flanges, collars, casings or solid bodies.

When removing parts or complete assemblies, such parts or assemblies can be gently swung to sides or tilted.

2.3. Before installing a new accessory, after its external unpreservation done with a brush moistened in petrol, there should be carried out visual inspection of such an accessory.

No nicks, identations, corrosion, spalling of lacquer coats, damages of connector pipe counterlocks, stoppers or nuts can be tolerated on items being inspected.

Surfaces of the accessory power transmission shaft splines must be coated prior to reassembly with a thin film of lubricant.

2.4. Accessories removed are to be assembled and preserved in conformity with recommendations stated in relevant Information Cards /Certificates/ and

..... in this Manual.

Write adequate notes in the Information Cards and Engine Log Book.

2.5. When installing new accessories and component units, it is forbidden to make use of the old safety devices, washers or rubber seal rings.

2.6. When releasing or tightening connector pipe nuts, the latter must be held in position to prevent same from turning. It is inadmissible to bend the lines screwed down to the connector pipes.

Nuts to fasten accessories and component units must be tightened uniformly and in a due succession.

2.7. The sequence of steps when installing accessories and component units is reversed compared to the dismantling operations.

2.8. Safety devices to lock nuts and screws in their position must be bent down so as to abut against their planes, never edges.

2.9. Holders and clamps having metallized surfaces /fuel system lines, fire safety connections, etc/ ought to be mounted on suitably precleaned mating areas.

2.10. After renewal of accessories a functional check is to be carried out and care must be taken obout freedom of their joints from leaks.

2.11. When interchanging various accessories or component parts, or clearing possible defects, make always

use of the 1:1 spare parts kit, board instruments and tools, and if necessary, also of the group set.

N O T E :

When replacing an accessory also removal of all the mating connections, coating with the given item, is to be envisaged. It is also possible to isolate only the lines connected to the accessory being removed, and to loosen their opposite ends. But, no excessive pressure must be exerted during this operation on the connecting line as this may easily lead to its deformation.

3. Reneval of Starter-Generator Assembly

To replace the starter-generator assembly adopt procedure as follows:

3.1. Undo four screws fastening the cover on the wiring connection board.

3.2. Isolate electric wire connections.

3.3. Isolate cooling air line connection.

3.4. Unlock and undo fastening ring bolts.
In case of ring with steel tape unlock and undo the tape clamping bolt. Hold the starter-generator while unscrewing. Remove the mounting ring.

3.5. Clear the starter-generator assembly of the engine.

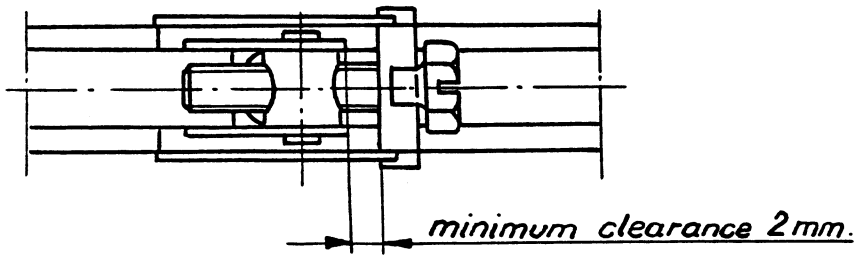
To install a new starter-generator assembly proceed as follows:

3.6. Apply thin coat of NK-50 grease onto the surface of splines of starter-generator power-transmission shaft.

3.7. Replace starter-generator onto engine.
Make sure that starter-generator shaft fits exactly in the spline of drive gear.
If the shaft hits the sleeve of graphite sealing it may cause the lose of tightness.
Wiring connection board ought to be situated in the

lower part of the starter-generator assembly.

3.8. Install and bolt together the mounting ring, lock bolts with lock-washers /from 1:1 set/, which are to be put on before bolting. Half-rings are not permitted to touch each other. In case of ring with tape the latter is to be put on half-rings and its ends bolted with a screw, using the screwdriver from board-tools.
The screw is to be locked with lock-washer /from 1:1 set/ installed prior to bolting. After bolting the ring the clearance between the ends of tape lock should remain minimum 2 mm /as shown on the drawing/.



If the clearance is less than 2 mm the tape should be replaced by new one. Mounting-rings of both designs are interchangeable.

C A U T I O N:
IN CASE OF RING WITH TAPE IT IS FORBIDDEN TO USE SPANNER FOR BOLTING TAPE ENDS.

3.9. Having replaced the starter-generator assembly, carry out an alleged starting with the cutoff valve turned off and external power supply used for the purpose.
Verify rotational speed of the compressor impeller, which speed at the end of alleged starting is expected to be as follows:
at $t_w = -40^oC$ - $n_{TS} \geqslant 21\%$
at $t_w = 0^oC$ - $n_{TS} \geqslant 22\%$
at $t_w = +40^oC$ - $n_{TS} \geqslant 23\%$
the current in the starter-generator assembly winding being during this test not higher than 450 A.

3.10. Carry out engine starting operation in the idling and takeoff ranges to check starter-generator as-

sembly for operation as a generator. Generator voltage should be 28.5 to 30 volts.

4. Renewal of Timer-Distributor

To replace timer-distributor proceed as follows:

4.1. Unlock and remove low and high voltage wires connected to the timer-distributor assembly.

4.2. Unlock and undo the clamping screws. Remove the timer-distributor assembly.

4.3. Install a new timer-distributor assembly. Connect and secure electric wires in their position.

4.4. After renewal of the timer-distributor assembly verify the ignition plug for its operation during the alleged starting.

The presence of spark can be verified with the plug installed in the engine /by hearing/, or with the plug removed from the engine /the body of the plug has to be connected to the engine frame/.

Having ascertained functional reliability of the timer-distributor assembly, the engine can be stopped by depressing STOP/START push-button.

W A R N I N G :

1. IT IS FORBIDDEN TO DISMANTLE THE TIMER-DISTRIBUTOR ASSEMBLY AND TO ADJUST IT THIS OR ANOTHER WAY.

IN THE EVENT, OF TIMER-DISTRIBUTOR ENCLOSURE FAILURE ONE MUST FOLLOW INSTRUCTIONS CONCERNING ITS OPERATION AND ASSEMBLY.

2. TO VERIFY THE TIMER-DISTRIBUTOR ASSEMBLY FOR ITS FUNCTIONAL RELIABILITY, BY CONNECTING THE HIGH VOLTAGE WIRE TO THE ENGINE FRAME, IS FORBIDDEN.

5. Reneval of the Igniter together with Starting Burner and Ignition Plug

To replace igniter proceed as follows:

5.1. Unlock and isolate high-voltage wire connected to the ignition plug.

5.2. Unlock and undo the nut fastening fuel feed line connected to the starting burner.

5.3. Unlock and undo four clamping screws of the igniter body.

5.4. Remove the igniter.

To install a new igniter proceed as follows:

5.5. Apply to the new washer /from the 1:1 spare parts kit/ a thin coat of the sealing compound GF-024.

5.6. Apply a thin coat of "ZS" or NK-50 grease onto the threads of clamping screws.

5.7. Screw the igniter together with its washer down to the combustion chamber.

5.8. Lock screws in their position with a chromium-nickel wire.

5.9. Connect fuel feed line to the burner and lock the nut in position with a steel wire.

5.10. Connect high-voltage wire to the ignition plug and lock the nut using a brass wire.

5.11. Carry out alleged starting with the turned OFF cutoff valve; inspect joints for freedom from leaks.

5.12. Start the engine to carry out functional check of the ignition device.

6. Reneval of Ignition Plug

To replace ignition plug proceed as follows:

6.1. Isolate high voltage wire connected to the ignition plug.

6.2. Unlock and remove three clamping screws holding the plug against igniter body.

6.3. Remove the plug. While removing the plug take care in order not to damage the insulator.

When installing a plug proceed as follows:

6.4. Apply a coat of rubber-graphite mixture to the new washer /from the 1:1 spare parts kit/.

6.5. Apply a coat of "ZS" or NK-50 grease onto the threads of clamping bolts.

6.6. Screw the new ignition plug together with its washer into the igniter.
Connect high voltage wire to the plug.

6.7. Screws to be locked in their positions with the chromium-nickel wire.

W A R N I N G S :

1. IT IS FORBIDDEN TO INSTALL AN IGNITION PLUG WCHICH RECEIVED A STRONGER KNOCK OR WAS DROPPED TO THE FLOOR /PACKED OR UNPACKED/.

2. IT IS FORBIDDEN TO KNOCK /TO TAP AT/ THE IGNITION PLUG.

6.8. Each time an ignition plug has been replaced, carry out an engine starting operation.

7. Renewal of Solenoid Fuel Valve /Together with Constant PRESSURE Valve/ in the Starting System

To replace a solenoid valve proceed as follows:

7.1. Unlock and undo clamp nuts holding down the fuel lines /high pressure, drainage, drain and starting fuel lines/.

7.2. Unlock and remove male connector plugged into the valve.

7.3. Undo three clamp nuts holding the solenoid valve bracket against the compressor casing.

7.4. Remove the bracket together with solenoid valve.

7.5. Unlock and undo three clamp nuts holding solenoid valve against its bracket and remove the valve.

7.6. To install a new solenoid valve reverse the sequence of steps adopted when removeing the old one.

When installing a solenoid valve with bracket, three spring washers /from the 1:1 spare parts kit/ must be replaced.

7.7. When installing the solenoid valve, use a steel wire to lock clamp nuts, for holding down bracket against compressor casing and the fuel line nuts in their proper positions.

Male connector after being plugged into the solenoid valve must be locked with brass wire.

7.8. Having installed a new solenoid valve check it for its operation during an alleged starting by measuring the level of the starting fuel pressure which must be within the limits of $2^{+0,6}_{-0,1}$ kG/sq.cm.

After having stopped the engine, inspect joints for fredom from leaks.

8. Renewal of Constant Fuel Pressure Valve in the Starting System

The constant pressure valve is installed on the solenoid valve body.

To replace constant pressure valve proceed as follows:

8.1. Unlock and undo the fuel line nuts /high pressure and draining lines/.

8.2. Unlock and undo four clamp nuts holding the constant pressure valve against solenoid valve body.

8.3. Remove the constant pressure valve.

To install a constant pressure valve proceed as follows:

8.4. Mount a new seal ring from the 1:10 spare parts kit into the valve bore chamber /settling recess/. Prior to mounting, apply a thin film of oil MK-8 /or MS-20/ to ring faces.

Take care that the ring is not twisted during its mounting.

8.5. Further process of mounting is to be effected in the reverse order of operations, compared to removal. After installation, nuts for clamping fuel lines and for holding down the valve against solenoid valve body are to be locked in their positions with a piece of steel wire.

8.6. Having replaced the constant pressure valve, carry out an operational check during an alleged starting with the turned OFF cutoff valve. Measure starting fuel pressure whose level should be in the limits $2^{+0.6}_{-0.1}$ kG/sq/cm.
having stopped the engine, inspect joints for freedom from leaks.

9. Renewal of the Set of Air Bleed Valves and Anti-Icing Valves.

The air bleed valves and anti-icing valves represent together a complete set protected by one enclosure.
On Series II and I engines, the valve remains fastened via a bracket to the compressor collective spiral casing, whereas on Series III and IV engines the valve is mounted right on the axial compressor casing behind its sixth stage.

To replace valves proceed as follows:

9.1. Unlock and undo the high pressure fuel line nut.

9.2. Unlock and undo the draining line nut.

9.3. Unlock and undo the nut of the pipeline via which control pressure is being applied to the signal transmitter.

9.4. Unlock and undo the drainage line nut /applicable to Series I and II engines/.

9.5. Unlock and remove the anti-icing valve solenoid contact plug.

9.6. Unlock and undo nuts on the lines via which hot air is fed to the anti-icing system and to meet the helicopter needs, as well as, nuts for clamping air-to-valve feeding lines.

9.7. Unlock and undo clamp nuts which hold the air bleed and anti-icing valve in position against axial compressor casing /Series III and IV engines/, or against the bracket /Series I and II engines/.

9.8. Remove the valve.

To remount the set of air bleed and anti-icing valves proceed as follows:

9.9. Apply a thin coat of sealing compound GF-204 to the surfaces of the newly installed washer.

9.10. Mount the new valve together with washer into its place and screw it down. New lock-washers are to be provided on the nuts /washers from the 1:1 spare parts kit/.

9.11. To remount the fuel lines adopt reversed procedure compared to the process of their removal.

Having ended the remounting process, lock nuts of the fuel lines with steel wire and the contact plug with a brass wire in their positions.

9.12. Having replaced the air bleed and anti-icing valves start the engine and run it trough each of the ranges for 2 do 3 minutes.

With the engine in operation, carry out the following checks:

9.13. Check air bleed valve /by hearing/ for rotational speed of its closure, which ought to be consistent with that specified in Fig. 2.3, page 212.

When checking rotational speed of the air bleed valve closure, pay also attention to how the air bleed valve of the other engine tends to close.

9.14. Check anti-icing valve for its operation. After switching ON the anti-icing system in the pilot's cockpit, warning lamp should light up and the temperature of gases in the nominal range may be expected to rise by 20°C.

N O T E :

Having stopped the engine, swing back engine cowilings to feel with the hand pipeline via which hot air is fed to the compressor inlet stator /it should be warm/, and inspect fuel lines for freedom from leaks.

C A U T I O N :

HAVING REPLACED THE AIR BLEED AND ANTI-ICING VALVE UNPRESERVE THE ANTI-ICING VALVE / REMOVE PRESERVATIVES THEREFROM/.

10. Renewal of the Drain Valve Block

/Series II, III and IV Engines/

To replace a drain valve block proceed as follows:

10.1. Unlock and undo the nuts that hold fuel lines against the valve block, and then loosen also the nuts which secure opposite ends of the fuel lines.

10.2. Unlock and undo four clamping screws which hild the valve block against its bracket whereafter remove the block.

10.3. To remount the block proceed in the reverse order compared to the disassembly procedure.

10.4. Having reinstalled the block, use steel wire to lock bots nuts and screws, securing the block against its bracket, in their positions.

10.5. To verify functional reliability of the replaced block start the engine and run it through its various operating ranges 2 to 3 minutes each range.
Having stopped the engine check its connections for freedom from leaks.

11. Renewal of the Draining Tank, Combustion Chamber Drain Valve, Working Burner Drain Valve /Series I Engines/

To replace draining tank, combustion chamber drain valve and working burner drain valve, proceed as follows;

11.1. Unlock and undo clamp nuts holding fuel lines against the drain valves, and slacken also nuts on the other end of these lines.

11.2. Unlock and undo clamping screws holding drain tank in its position against the bracket /on the stator/ and against a collar of the combustion Chamber whereafter remove the tank together with valves.

11.3. Remove drain valve, to be replaced, from the tank and install a new one; when installing a new tank, mount thereon drain valves removed from the old one. When reassembling drain valves on the tank do not forget to install new paranith washers.

11.4. To lock clamping screws, holding drain valve in its position against the tank, use a chromium-nickel wire.

11.5. To reinstall the tank together with drain valves reverse the sequence of steps adopted for the dismounting procedure. After reinstallation, clamping screws of the tank and nuts holding fuel lines must be locked with a chromium-nickel wire.

11.6. To verify functional reliability of the replaced drain valves, or draining tank, start the engine and run it through its various operating ranges so as to allow it to work 2 to 3 minutes each range.

Having stopped the engine again, inspect its connections for freedom from leaks.

12. Oil Filter Renewal

To remove oil filter from its casing proceed as follows:

12.1. Unlock filter cover, undo the screw and release beam 3.

12.2. Turn the beam round to remove if from under protrusions 13 of the filter casing 5.

12.3. Drive screw 1 into and locate the beam coutside casing 5 so as to make it abut against prorusions 13.

12.4. Slowly drive screw 1 out until the cover is clear off the casing.

12.5. To reassemble the filter, reverse the dismantling procedure.

12.6. Having reinstalled the filter, lock its cover in the established position with a steel wire.

12.7. Carry out a cold turning operation, and then also normal starting of the engine, to verify oil pressure in various operating renges.
Having stopped the engine inspect filter cover for freedom from leaks and sse oil tank for the level of oil.

To remove an oil filter from the Serie I engines /see Fig. 6.3., Page 619/, proceed as follows:

12.8. Unlock filter cover, undo screw 1 and release spring 2.

12.9. Slide beam 3 out of the filter 13 casing protru-

12.10. Mount on the filter casing a puller /supplied with the board tooling kit /and with its aid remove filter element 6.

12.11. To reinstall the filter reverse the sequence of operations. Filter element 6 can be remounted without the use of an aid.

12.12. Having reinstalled the filter, aecure its cover with steel wire and complete steps from para 12.7

13. Renewal of Thermocouples

To replace thermocouples proceed as follows;

13.1. Remove the upper and lower cover from thermocouple collector. To do this, unlock and undo 12 clamping screws holding the collector guard.

13.2. Move Teflon insulating tubes away from the points where terminals of the thermocouples are connected to the leads and undo clamping screws.

13.3. Remove two clamping screws holding down the thermocouple in the combustion chamber seat, withdraw the thermocouple out of the seat, together with a sleeve, should this sleeve be loosened or out of its place.

13.4. Undo clamping screws shich secure the termocouple holder to the collector.

N O T E :

Repeat steps 13.2 through 13.4 for the remaining seven thermocouples.

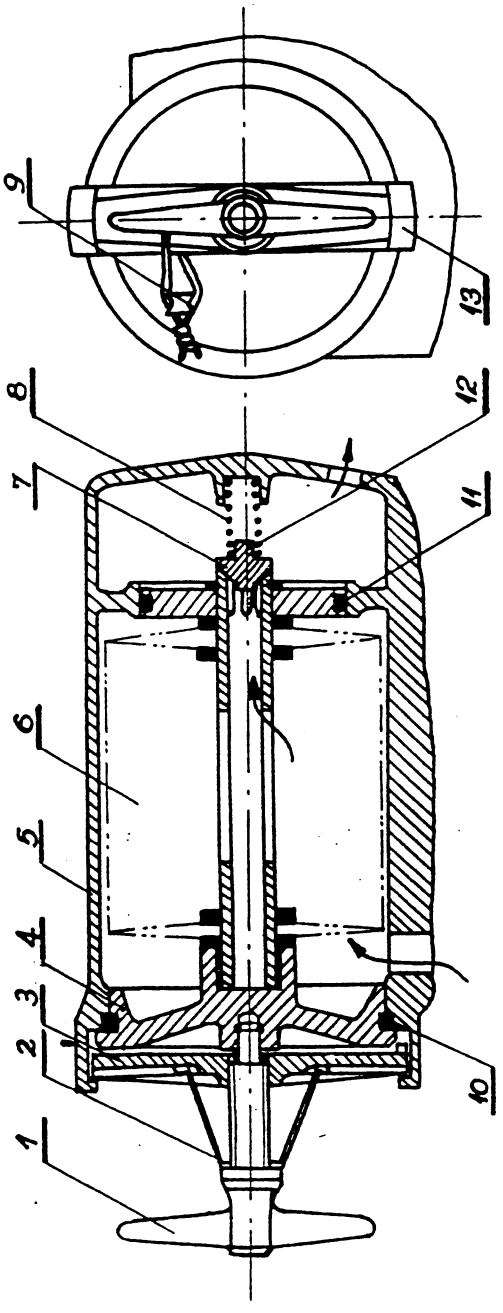


Fig. 7.1. Oil Filter

1. Screw. 2. Spring. 3. Filter beam. 4. Filter cover. 5. Filter casing. 6. Filter elements. 7. Valve. 8. Valve spring. 9. Lock wire. 10. Seal ring. 11. Seal ring. 12. Valve head flange. 13. Filter casing protrusions.

To remount a thermocouple proceed as follows:

13.5. See that the thermocouple sleeve rests in the seat.

C A U T I O N :

SLEEVE PROTRUDING BEYOND THERMOCOUPLE CLAMPING FLANGE CANNOT BE TOLERATED.

13.6. Should the thermocouple sleeve have left its seat proceed as follows:

- Remove from sleeve surfaces the sealing compound by washing it in petrol or toluene.
- Apply a thin coat of sealing compound GF-024 to the faying surfaces between the sleeve and seat.
- Insert the sleeve with the applied coat of sealing compound in the seat.

13.7. Use petrol or toluene do wipe clean planes of the thermocouple seat and thermocouple flanges.

13.8. Apply a coat of sealing compound GF-024 to the faces of new thermocouple gasket /furnished with the 1:1 spares/.

13.9. Remount the gasket onto thermocouple and insert the latter in the seat.

13.10. Bolt the thermocouple to the combustion chamber. Apply a thin film of "ZS" or "NK-50" grease onto bolt threads.

To remount a thermocouple proceed as follows:

13.5. See that the thermocouple sleeve rests in the seat.

C A U T I O N :

SLEEVE PROTRUDING BEYOND THERMOCOUPLE CLAMPING FLANGE CANNOT BE TOLERATED.

13.6. Should the thermocouple sleeve have left its seat proceed as follows:

- Remove from sleeve surfaces the sealing compound by washing it in petrol or toluene.
- Apply a thin coat of sealing compound GF-024 to the faying surfaces between the sleeve and seat.
- Insert the sleeve with the applied coat of sealing compound in the seat.

13.7. Use petrol or toluene do wipe clean planes of the thermocouple seat and thermocouple flanges.

13.8. Apply a coat of sealing compound GF-024 to the faces of new thermocouple gasket /furnished with the 1:1 spares/.

13.9. Remount the gasket onto thermocouple and insert the latter in the seat.

13.10. Bolt the thermocouple to the combustion chamber. Apply a thin film of "ZS" or "NK-50" grease onto bolt threads.

are also used for the connection of "A" and "X" terminals of temperature indicator.

13.12.6. Remount and tighten the previously removed nuts on pins of the thermocouples female connector.

C A U T I O N :

WHILE UNSCREWING AND TIGHTENING THE NUTS MOUNTING THE EXTENSION AND COMPENSATING LEADS OF THE THERMOCOUPLES AND INDICATOR TO CONNECTION SOCKET IT IS ESSENTIAL TO TAKE CARE TO AVOID DAMAGE /CRACK/ OF PORCELAIN.

13.13. Having replaced a thermocouple /or thermocouples/ start the engine to verify thermocouples for their readings produced during 2 to 3 minutes of engine operation in each of the ranges.

14. Renewal of Fuel, Oil and Air Lines

When interschanging lines as per heading follow reccomendations listed below:

14.1. It is forbidden to mount new lines having a poor fit.

14.2. Ends of the lines ought to easily adhere to the connector pipes under forces of elasticity.
A sag of no more than 3 mm and a play of no more than 1 mm can be tolerated.
The nut must revolve with case to move alongside the line across a distance of minimum 15 mm.

14.3. Misalignment between the line and connector pipe cannot be greater than 3 mm /this is to be checked with the lines secured in their holders/. Having retightened the nuts on connector pipes, lines are expected to enter holder resesses after

being slightly pressed with the hand.
To ensure the required amount of axial alignment and to eliminate possible shifts of lines, use can be made of connector pipes, holders and brackets to change their positions as required, and of clearances existing in the holes to benefit from them during adjustment of the mating elements.

14.4. To fulfil technical conditions when reassembling the lines, lines being assembled can be bent a little with the aid of special instruments, or by hand without such instruments / a wooden holder or vulcanized fibre holder, rubber hammer or any other type of tools to ensure slight bending of a line without damaging its surfaces and without applying any loads to the points being welded or soldered/, so as to arrive at the figures specified in Table 7.1.

T A B L E 7.1.

LINE DIAMETER / mm /	LENGHTH OF ARM MINIMUM / mm /	ALLOWABLE AMOUNT OF BEND / mm /
6 x 1	120	10
8 x 1 & 10 x 1	150	10

Lines to be bent must be carefully inspected through a x 4-7 magnifying glass to see places being bent if free from cracks.

14.5. Line securing nuts when tightened with fingers should easily go as far as 2/3 of the connector pipe thread length.

Having tightened the nuts with a spanner lock same in their positions.

14.6. Clearances between lines and the engine parts must be not less than 3 mm.

14.7. Having replaced the lines, inspect their joints for freedom from leaks. To do this, start the engine and run it through its various operating ranges, including takeoff range, for 2 to 3 minutes each range. Should leaks be revealed, retighten the nuts and check joints once again for freedom from leaks.

C A U T I O N S :

1. HAVING REPLACED ENGINE LUBRICATION SYSTEM LINES, PERFORM PRIOR TO STARTING COLD TURNING OF THE ENGINE.

2. IT IS FORBIDDEN TO BEND DOWN THE LINES ALREADY CONNECTED TO THE STUB PIPES, TO BEND THEM DOWN AT POINTS DISTANT FROM THE WELD LESS THEN 10 MM, AND TO BEND THEN DOWN BY MEANS OF A MANDREL INSERTED IN THE LINE BORE.

14.8. If necessary, lap rolled-down line cone against the stub pipe.

15. Renewal of Bearing III Air Filter

To replace bearing III air filter /see Fig.7.2/ proceed as follows:

15.1. Unlock and undo nuts 1 and 2 which secure the in-and out-going air lines.

15.2. Unlock and loosen nuts 4 and 5 to permit deflection of lines 6 and 7 away from the filter.

15.3. Unlock and undo nuts 3 holding the filter in position against bracket 9.

15.4. Remove the filter from bracket 9.

To mount a new filter reverse the sequence of steps. Having installed the filter, lock with a chromium-nickel wire nuts 3 holging the filter against its bracket and also the line securing nuts.

16. Renewal of the Exhaust Collector Covers /Stoppers/

Should it be found necessary to replace covers 16.52.0010 and 16.52.0020 /See. Fig. 7.3./ in the exhaust collector, adopt the following procedure:

16.1. Unlock clamp nuts which hold the covers down against exhaust collector.

16.2. Undo the nuts and remove covers from the exhaust collector.

16.3. To replace the covers reverse the a/m procedure. Having threaded exhaust collector locating pins through respective cover holes, mount set sleeves

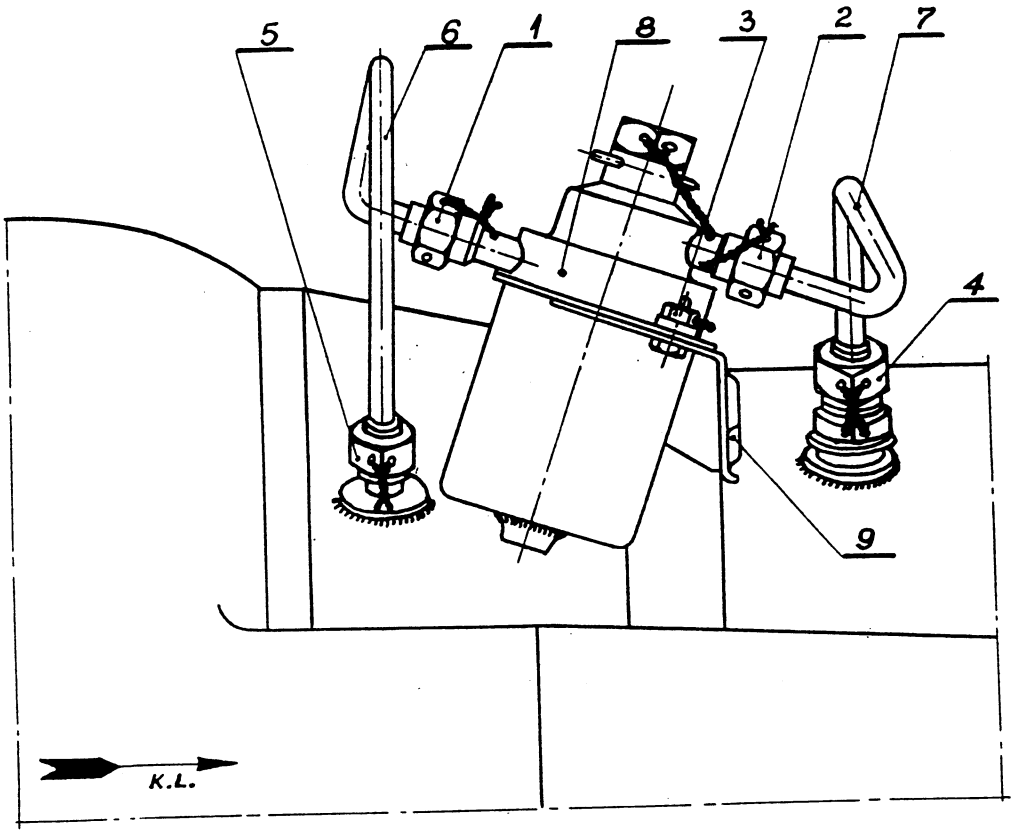


Fig. 7.2. Bearing III Air Filter

1. Nut. 2. Nut. 3. Nut. 4. Nut. 5. Nut. 6. Filter ingoing air line. 7. Bearing III ingoing air line. 8. Upper filter casing. 9. Bracket.

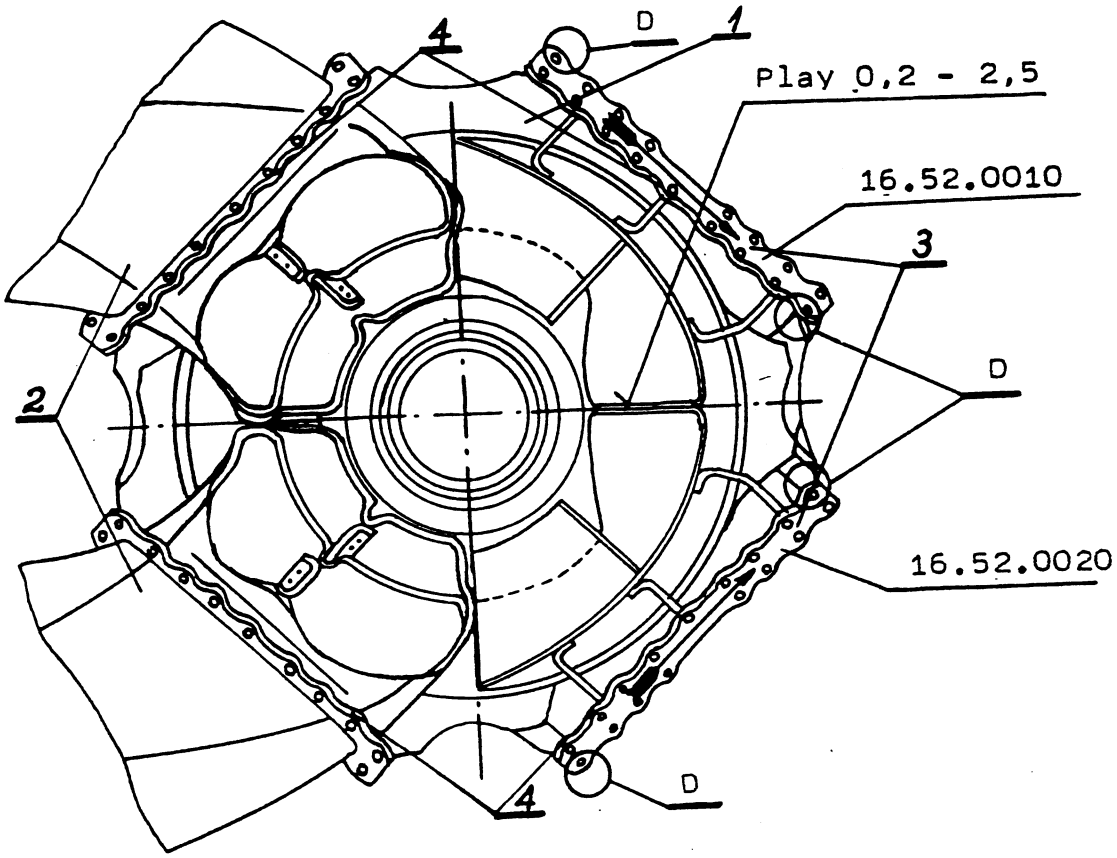


Fig. 7.3. Exhaust Collector

1. Exhaust collector. 2. Exhaust pipes. 3. Covers /stoppers/. 4. Exhaust collector windows.
"D" letter to mark set sleeve mounting points.

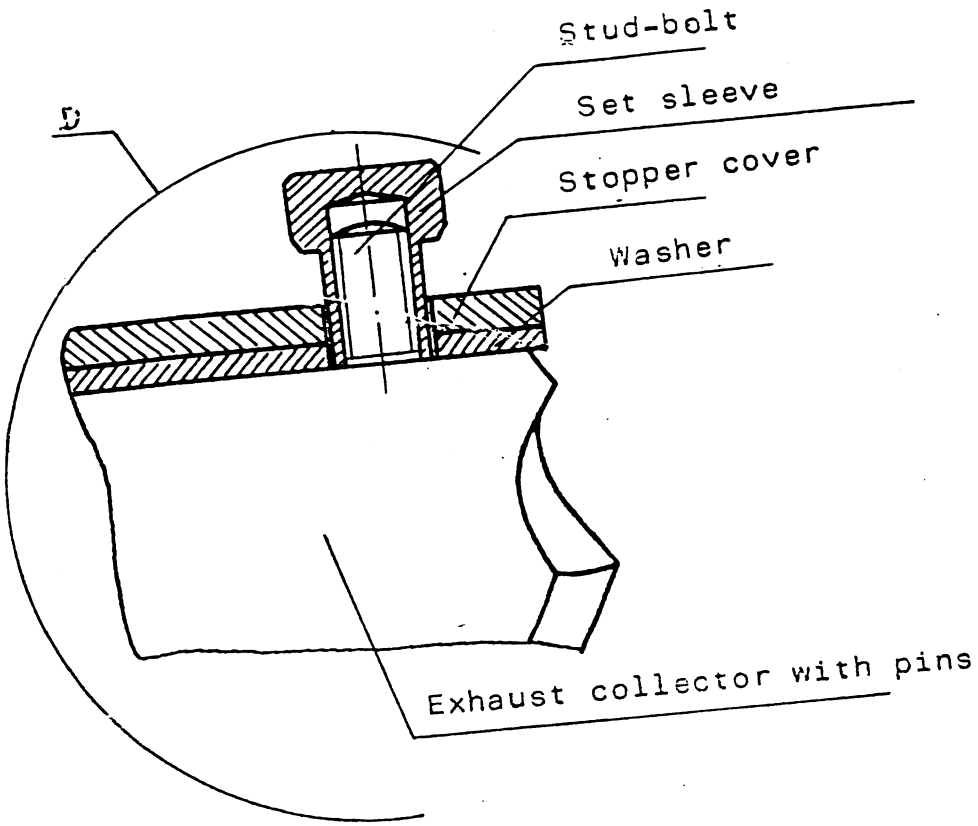


Fig. 7.4. How to insert a set sleeve

as shown in Fig. 7.4. into two opposite holes in the cover corners /see Fig.7.3.; detail "D"/.

16.4. Mount lock washers on the exhaust collector screws. Without removing set sleeves, screw the cover down with several nuts.

16.5. Remove set sleeves and screw down the stopper using the remaining nuts.
Having tightened the nuts, lock same in their positions by bending down their washers.

NOTE:
To secure exhaust pipes and exhaust collector covers, use the same nuts and lock washers. possible

neighbouring bolts are missing, the total amount of missing bolts on the collector window circumference being then no smaller than five.

C A U T I O N :

EXHAUST COLLECTOR COVERS MUST BE MOUNTED SO THAT THE ARROWS ON COVERS ARE POINTED TOWARDS ONE ANOTHER AS SHOWN IN FIG. 7.3. and FIG. 8.1. /PAGE 804/.

17. Cleaning of Air Feed Lines Leading to the Engine Output Shaft Labyrinths

Should oil be found to leak out from under the engine output shaft, cleaning of the engine reducer air passages will be indispensable.

To clean out these passages proceed as follows:

17.1. Remove the shaft via which the engine communicates with drive WR-2. To remove this shaft and to remount it proceed in conformity with the Helicopter Mi-2 Service Manual instructions.

17.2. Undo eight clamp nuts securing the cover and clear the latter off the labyrinth /It. 8; Fig. 1.4. page 106/.

Use petrol to wash out sleeve 2 labyrinth and its cover together with air passage.

17.3. Remove the line for feeding air to the seal /It. 14, Fig. 1.1.; Page 103/. Wash out the line with petrol and blow through with compressed air.

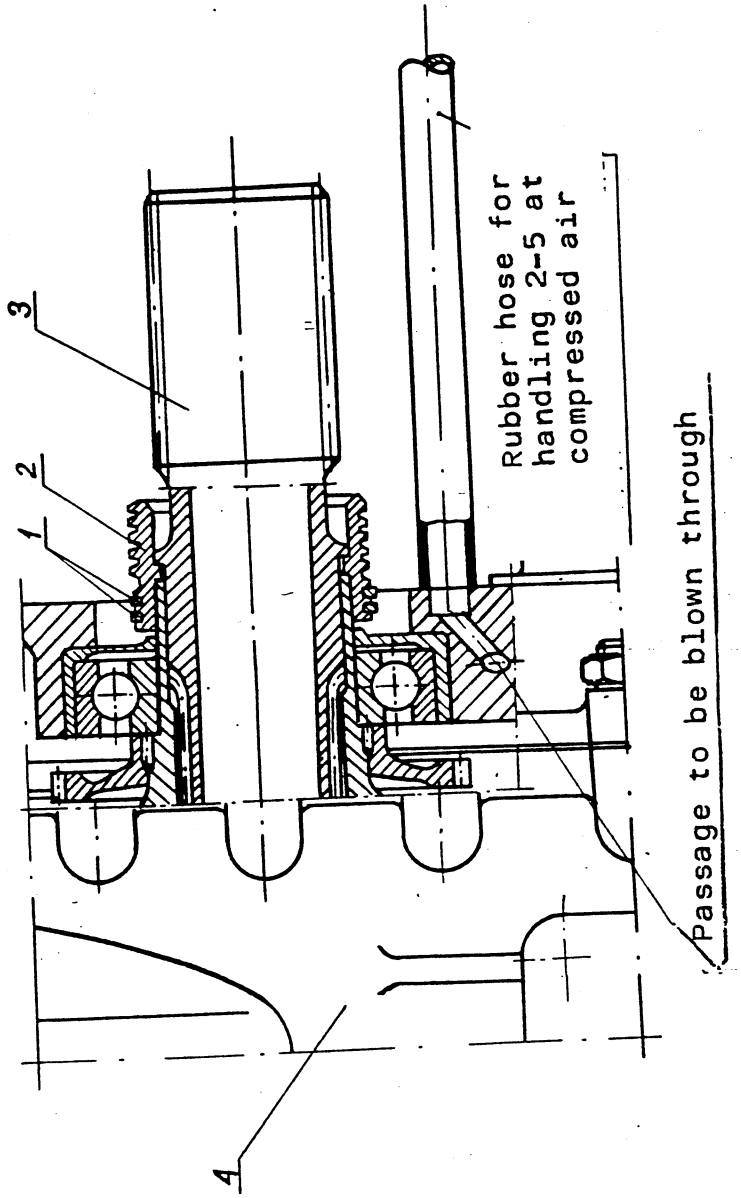


Fig. 7.5. Output Shaft Seal /Cover Removed/

1. Sealing rings. 2. Labyrinth sleeve. 3. Output shaft. 4. Engine reducer.

... 17.4. Use 2 - 5 kG/cm^2 compressed air to blow through the air delivery passage in the reducer casing.

The jet of air is to be applied from the engine seal side /see Fig. 7.5/.

17.5. Remount the line removed previously and lock the nuts in position with wire. Prior to final assembly provide new packing washers and a lock washer.

17.6. Remount labyrinth cover. Prior to remounting provide a new washer and new rubber seal rings for the through-feed sleeve and labyrinth cover. Provide also new spring washers for the cover clamp nuts.
When remounting the cover see that no damage is done to the rubber sealing ring.

17.7. Remount the removed power transmission shaft via which the engine is connected to drive WR-2.

N O T E :

The necessary washers and gaskets to be provided in the place of the worn ones must be taken from the 1:1 parts kit.

17.8. Operations completed are to be written down into the Engine Log Book.

C A U T I O N :

PRIOR TO MOUNTING THE OUTPUT SHAFT COVER SEE THAT SEAL RINGS 1 ON THE LABYRINTH SLEEVE 2 ARE SET SO AS TO HAVE THEIR LOCKS ON BOTH SIDE OF THE SHAFT.

18. Reneval of oil filter elements

The reneval of filter elements, when damaged, is made by the users their selves.
To carry out these procedures the board tools, and additionally the special pliers RSKm-125 /see Fig.76/, are necessary for the removal and re-assembling of lock-ring 89.27.0058.
Parts to be exchanged, indicated in the specification, and pliers are furnished by WSK "PZL Rzeszów" when ordered by an User.

How to accomplish the procedures /Fig. 7.7/ :

18.1. Take the lock-ring 89.27.0058 and plate 16.71.0308 /16.71.0053/ off the filter frame.

18.2. Remove the sealing ring 89.29.1425 /89.29.0989/, filter elements 16.71.0130 and washer 16.71.0055, 89.06.0139 and 89.06.0784.

18.3. The taken off elements wash in petrol and dry.

18.4. Damaged elements are to be replaced for new ones. Clean up small defects /hair crackc, cuts/ or other elements.

18.5. Put the washer 89.06.0784 onto filter frame.

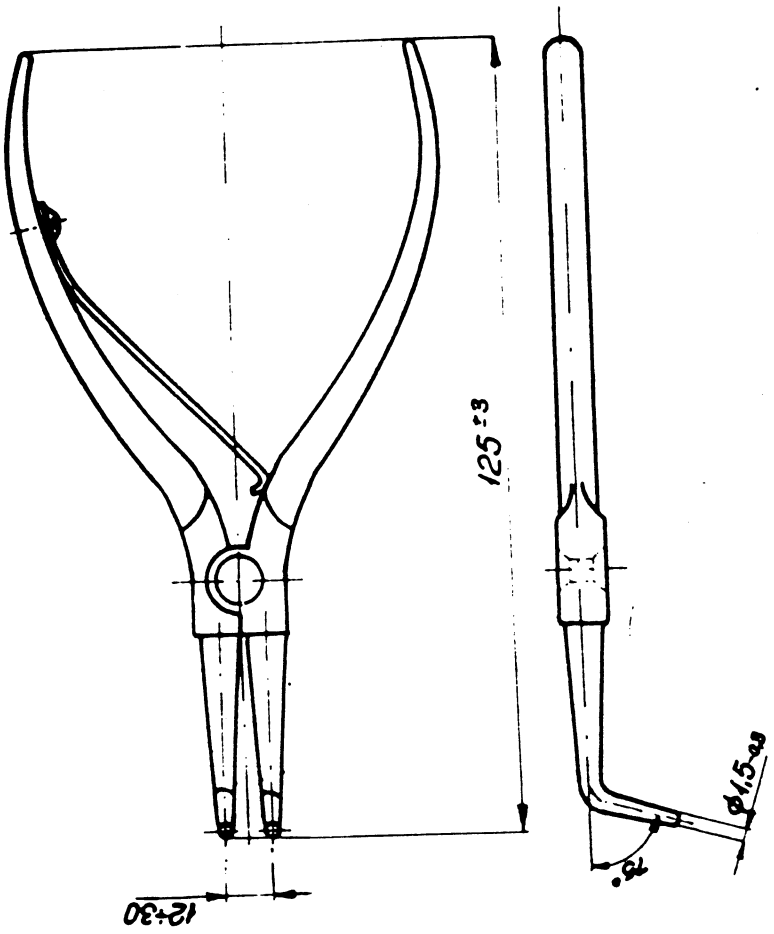


Fig. 7.6. Pliers for removing and putting the lock-ring 89.27.0058.

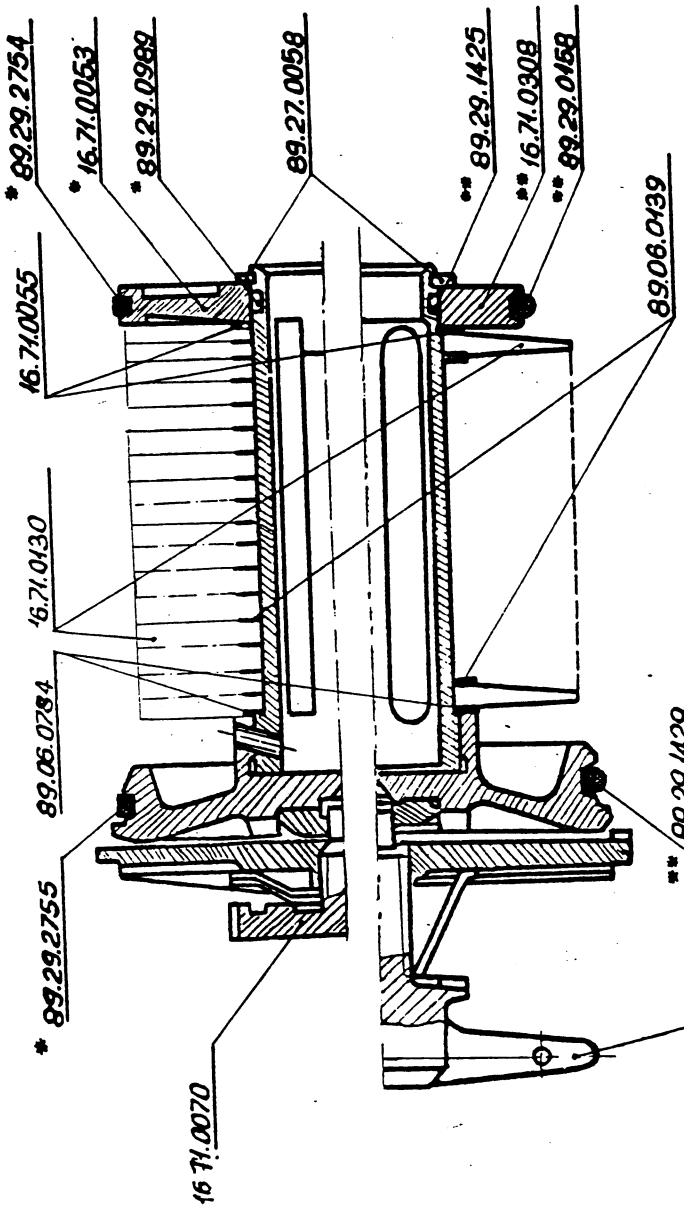


Fig. 7.7. Soheme of oil filter

18.6. Install the filter elements 16.71.0130 and washer 89.06.0139.

Elements and washers to be install alternately.

NOTE: Filter elements 16.71.0130 can occur in quantity between 15 to 16 pieces.

18.7. Install washer 16.71.0055 and sealing ring 89.29.1425 /89.29.0989/.

18.8. Lubricate with oil the hole in plate 16.71.0308 /16.71.0053/. Install the plate onto filter frame, clamp the pack and install the lock-ring 89.27.0058.

C A U T I O N S:

1. Allowable local clearance between filter elements and washers is not to be greater than 0,05 mm.

2. To assure proper adhesion of the individual filter elements it is allowed on installation of additional washers 89.06.0139 on the right and left side of pack. The quantity of washers on filter 16.71.0330 can be between 15 and 16 pieces and on filter 16.71.0070 between 14 and 17 pieces.

3. The sealin rings 89.29.1425 and 89.29.0989 are interchangeable.

At present in serial production and during overhaul are used rings 89.29.1425.

4. Elements designated on Fig. 7.7 with one asterisk are installed only on I series engines, and elements designated with two asterisk on the II, III and IV series engines. The elements not designated with asterisk are interchangeable.

Specification of parts which could be replaced in oil filter assembly.

Ref.no.	Designation	Drawing number
1	Filter elements	16.71.0130
2	Washer	89.06.0784
3	Washer	89.06.0139
4	Washer	16.71.0055
5	Lock-ring	89.27.0058
6	Sealing ring	89.29.1425

Revised
December 1977

CHAPTER 8

ENGINE MOUNTING AND DISMOUNTING PROCEDURE; REMOVAL OF PRESERVATIVES; PRESERVATION; STORAGE; CARRIAGE; UNPACKING AND PACKING PROCEDURES.

CHAPTER 8 - Index of Contents

1. Getting the Engine Ready for Mounting on the Helicopter

Prior to mounting on engine adopt procedure as follows:

1.1. Check serial number of the engine for its conformity with the number stated in the Engine Log Book, and to the same with the numbers of accessories by comparing same with those stated in their Information Cards.

1.2. Carry out a visual inspection of the engine.

1.3. Remove preservatives from under engine surfaces.

1.4. Unscrew lateral handling and engine journals /Fig. 1.3.; page 105/ and remove shipping stoppers /painted red/ and the stopper mounted on the air bleed valve.

1.5. Get ready the spece for mounting the engine inside the helicopter.
Clean it from dust, oil and fuel and remove foreign objects, like nuts, screws, etc.

1.6. The right- or left-hand version of the engine is to be assessed according to the position of exhaust pipes. The factory uses odd numbers to denote left--hand versions, and even numbers to denote right--hand versions of the engines.

In service, exhaust pipes can be interchanged in their positions.

Having completed a/m steps you can regard the engine as prepared for mounting in the helicopter.

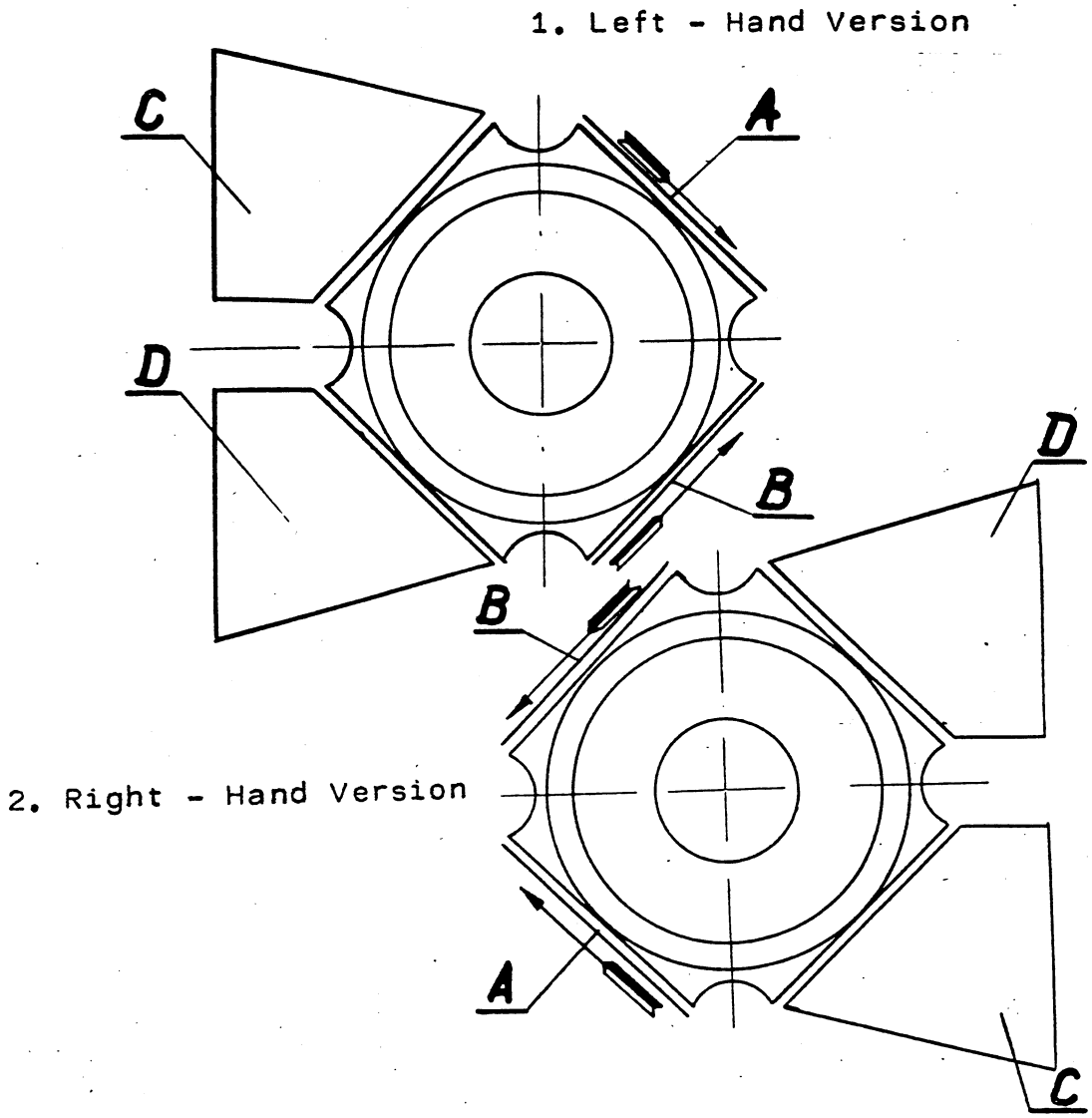


Fig. 8.1. Mounting versions for exhaust pipes and exhaust collector covers /as viewed in the flying direction/.

C A U T I O N :

1. WITH THE ENGINE RUN THROUGH ALL ITS INSTALLATION LIFE AND PRIOR TO INSTALLING A NEW ENGINE, THOROUGHLY WASH EVERY PART OF THE LUBRICATION SYSTEM EXCEPT FOR THE OIL COOLER AND ITS CONNECTION LINES.

2. SHOULD A NEW ENGINE HAVE BEEN MOUNTED IN PLACE OF THE OLD ONE WHICH WAS SUBJECT TO A FAILURE, WITH A CONSEQUENTIAL LIKELY CONTAMINATION OF THE LUBRICATION SYSTEM /SWARF FOUND IN THE COOLER OR OIL TANK/, EACH PART OF THE OLD ENGINE LUBRICATION SYSTEM MUST BE THORUOUGHLY WASHED OUT AND THE OIL COOLERS REPLACED PRIOR TO MOUNTING A NEW ENGINE.

3. WHEN CHANGING EXHAUST PIPES FROM ONE VERSION TO ANOTHER, COVERS MUST BE MOUNTED SO THAT ARROWS MARKED ON SAME ARE POINTED TOWARDS EACH OTHER AS SHOWN IN FIG. 8.1.

2. Engine Mounting Procedure

To raise the engine use the grip screwed into the top engine fitting pin.

The are two points provided to secure the engine to the airframe.

- In its lower part a bracket is fitted, bolted down to the engine reducer;

- In its upper part a stirrup is screwed into the pin, being connected via a rod to a grip on the Main Drive.

When installing the engine in the helicopter proceed as follows:

2.1. Install on the engine transmitters specified hereunder:

- Turbocompressor impeller speed transmitter;
- Oil pressure transmitter

Connect to these transmitters contact plugs and lock same with the wire.
Connect the main contact plug and lock it with wire.

2.2. Connect fuel feed line.

2.3. Connect tank oil feed line.

2.4. Connect engine-cooler oil feeding line.

2.5. Connect drain valve block and the fuel system accessories drainage to the small helicopter tank.

2.6. Connect air-release line to the engine reducer vent connector.

2.7. Connect helicopter control system with that of the engine.

2.8. Connect cutoff valve coupling bar.

C A U T I O N :

THE ENGINE AND CUTOFF VALVE CONTROL RODS MUST BE ADJUSTED SO THAT THE PLAY BETWEEN LEVERS AND FUEL PUMP STOPS, WITH THE CONTOL LEVER IN PILOT'S COCKPIT MOVED TOWARDS RESTS, IS WITHIN 0,2 TO 0.5 MM LIMITS.

2.9. Connect compensating wire of the thermocouples for measuring the temperature of gases prior to the turbine.

2.10. Connect the line via which cooling air is fed to the starter-generator assembly.

2.11. Connect electric wires to the starter-generator assembly.

2.12. Connect lines via which the air is taken from the bleed valve.

2.13. Mount the shaft via which the WR-2 drive is connected to the otuput shaft of the engine and carry out alignment in conformity with the Main Drive WR-2 Operating and Servicing Instructions.

2.14. Connect lines via which air is delivered from behind the compressor to the synchronizer of turbines for both engines /connect stub pipe 1 of the turbine synchronizer for left-hand engine with the stub pipe 2 of a similar synchronizer for the right-hand engine, and connect also stub pipe 1 of the right-hand engine with stub pipe 2 of the right-hand engine, as shown in Fig. 6.15;

2.15. Connect high-voltage wire to the ignition plug.

2.16. Complete steps falling under the check inspection procedure.

2.17. Remove preservatives off the engine.

3. Functional Check of a Newly Installed Engine

3.1. Perform the work as for an initial preparation of the engine.

3.2. Check the engine for reliability of its operation.

N O T E :

Should it be found impossible to achieve synchronization in the operation of engines; play in one of the engines can be slightly readjusted within the limits from 0.2 mm to 1.0 mm.

To readjust control rods /adjustment of clearances/ use the slide provided in lever 3 of the fuel pump /see Fig. 6.5.:/

3.3. Check the fuel and lubrication systems for freedom from leaks.

3.4. Carry out periodic operations acc. to para.1 on page 605.

4. Engine Dismounting Procedure

Engines removed from the helicopter must be preserved no matter what the reason of their dismounting was.

Prior to removal, the engine must be only internally preserved. Externally, the engine is to be preserved after having been built out.

C A U T I O N :

NO PRESERVATION IS APPLIED TO THE ENGINES WITH A BLOCKED SHAFTING.
FUEL SYSTEM ACCESSORIES IN THESE ENGINES, IN ORDER TO BE PRESERVED, MUST BE BUILT OUT OF THE ENGINE.

Before building an engine out of the helicopter, every engine-helicopter connection as referred to in Section "Engine Mounting Procedure" must be broken.

With all connections removed, the engine can be lifted out being held against the grip screwed-in into the upper engine clamping pin.

Having screwed down lateral pins, the engine may be secured to the shipping case support.

Every hole in the engine must be blanked off with a suitable cover.

5. Removal of Preservatives from Outer Engine Surfaces

External unpreservation is done to remove grease from outer surfaces of the engine.

To remove the grease, use brush soaked in petrol to wipe next surfaces of the engine dry with a cloth.
The engine preserved with thin-film "Defenzor-10" of brown color, before being installed in the helicopter, does not require depreservation.
The film of "Defenzor-10" is easily washed off with brush and kerosene or gasoline.

N O T E :

Solidified grease is to be warmed up with a jet of 70 to 80°C air.

C A U T I O N :

IT IS INADMISSIBLE THAT DROPS OF THE WARMED-UP GREASE CAN FALL ONTO ELECTRIC WIRES OR PLUGS OR FUEL PUMP AIR NOZZLES.

6. Removal of Preservatives from Inner Engine Systems

Internal unpreservation of the engine is done to remove oil from fuel system lines andyaccessories in order to refill same with the fuel. During unpreservation, lubrication system of the engine is to be refilled with a fresh portion of oil.

The unpreservation procedure includes steps as follows:

6.1. Drain oil out of the oil tank and coolers via helicopter draining valve /see M-2 Helicopter Service Manual Instructions/.

6.2. Refill engine oil tank with a fresh portion of the B-3W oil in an amount od 12.5 ltrs.

6.3. Wash air nozzles of the fuel pump and air filter of the automatic starter aneroid.

6.4. Remove air and preserving oil out of the fuel system by means of an air releasing instrument /complete steps as for fuel system venting/.

6.5. Isolate low pressure line from the timer-distributor assembly.

6.6. Proceed with the alleged starting, the cutoff valve being open during this time.
For the time of starting, engage the anti-icing system and check ....

- oil for pressure in the engine /this must range from 1 to 3 kG/cm^2/;
- engine for its operation by hearing;
- exhaust pipes for the emission of fuel.

... 6.7. Check draining system for its functioning by turning ON drain valve of the small draining tank; allow some 200 ccm of the fuel to flow out of this tank.

6.8. Proceed with the alleged starting, the cutoff valve being closed, to blow through the engine.

6.9. Connect low voltage wire to the timer-distributor assembly.

6.10. Add some oil to the tank so as to arrive at 12.5 ltrs in volume.

N O T E S :

1. After unpreservation of the engine, some residual quantities of oil can be left inside the fuel system thus making the first starting more difficult.

   After an unsuccessfull starting, cold turning of the engine /blow-through/ must be performed and starting repeated thereafter.

2. After unpreservation of the engine fitted with the NR-40TA /HP-40TA/ and OOWT-3 /PO-40TA/ accessories, check emergency valve for operation in conformity with the methodology stated in Chapter 3.

7. How to Presserve the Engine

Preservation is designed to protect the engine from corrosion during storage and transportation.

... Depending on the expected storage time, a full or partial preservation of the engine can take place.

Full preservation takes place when the time of storage is not longer than six months and the engine is removed from the helicopter; or the engine is left in the helicopter, but cannot be started.

Partial preservation is usual when the time of storage is not longer than 20 days and fuel has been drained out of the fuel system /engine is to be preserved no later than 24 hours after draining of the fuel/.

Also accessories built out of the engine require to be preserved.

N O T E :

One engine on the helicopter may be preserved while the other has been built out.

8. Oils and Lubricants to be Used for Preservation

GRADE OF OIL	REFERENCE STANDARD	APPLICATION
MK-8 Oil Transformer Oil	GOST 6457-66 GOST 982-80	Internal preservation of engine fuel system and its accessories
B-3W Oil	MRTU 38-1-157-65 TU 38-101295-75	Oil system preservation
UN Grease /petrolatum/ Neutral Gun Grease PWK Grease K-17 Grease	PN-69/C-96120 GOST 19537-83 GOST 19537-83 GOST 10877-76	External preservation of engine and fuel system

C A U T I O N S :

1. ONLY FRESH OILS ARE ALLOWED TO BE USED FOR PRESERVATION PURPOSES. IT IS FORBIDDEN TO MAKE USE OF THE REGENERATED OILS.

2. OILS AND GREASES TO BE USED FOR PRESERVATION PURPOSES MUST BE DEHYDRATED /ANALYSIS/.

3. WHEN PRESERVING FUEL SYSTEM SEE THAT OIL HAS BEEN WARMED UP TO A TEMPERATURE OF 60 TO 70°C.

N O T E :

To reduce viscosity of the gun grease, petrolatum or PWK grease, they must be warmed up prior to their use to a temperature of 70 to 90°C.

9. Full engine Preservation

Full preservation consists of the external and internal preservation of the engine.

9.1. Internal Preservation

During internal preservation, fuel system in to be filled with the MK-8 oil or transformer oil, and the oil system with fresh B-3W oil.

Procedure to be applied is as follows:

9.1.1. Isolate the line for feeding fuel to the engine and drain fuel out of the fuel system.

9.1.2. To speed up the process of draining fuel, connect air-releasing device and drive its

stem into the fuel pump connector pipe in order to open ball valve.

9.1.3. Drain old B-3W oil from the tank and coolers by using draining valve of the helicopter for this purpose.

9.1.4. Remove oil filter, wash it in pure petrol and mount again in position.

9.1.5. Isolate low voltage wire from the timer-distributor assembly.

9.1.6. Connect AMZ-53 device filled with transformer oil or MK-8 oil /minimum 10 liters/ to the fuel pump feed connector.

9.1.7. Fill oil tank with a fresh portion of the B-3W Oil in an amount of 8 to 10 liters.

9.1.8. Switch ON the AMZ-53 device with oil pressure preset to 0.8 - 1.0 kG/cm^2.

9.1.9. Allow the air mixed with fuel to bleed via the air releasing device out of the fuel pump, free turbine speed limiter, synchronizer of turbines, and the signal transmitter until pure oil starts to flow thereout.

9.1.10. Proceed with two or three alleged startings of the engine, cutoff valve being open during this operation, until oil comes to be seen in the exhaust pipes.

While turning the engine, operate 10 to 12 times the anti-icing system switch. During

... an alleged starting, 3 up to 3.5 ltrs of oil flow out of the preservation device tank.

9.1.11. Having stopped the engine, shut the cutoff valve and reduce pressure prevailing in the preservation device.

9.2. External Preservation of the Engine

External preservation is done on engine support, with the engine mounted out of the helicopter. When carrying out an external preservation make sure that ambient temperature or room temperature is not lower than +10°C. Preservation procedure may be started no sooner than the temperature of engine has reached that of the surroudings.

The sequence of steps to be adopted is as follows:

9.2.1. Every stopper and cover removed from the engine during its mounting onto the helicopter is to be washed in petrol.

9.2.2. Openings are to be blanked off with the stoppers while power transmissions of the accessories and exhaust pipes with the covers.

9.2.3. Outer surfaces of the engine are to be washed with a rag soaked in petrol and then wiped dry with a cloth.

9.2.4. Steel parts, non lacquered, are to be preserved with a coat of gun grease, PWK grease or K-17 grease applied thereto by means of a brush.

... 9.2.5. Non-ferrous metal parts or parts which are zinc or cadmium plated have to be coated with a film of UN grease, neutral gun grease or K-17 grease applied thereto by means of a brush.

9.2.6. No preservation is applied to the lacquered parts.

C A U T I O N S :

1. WHEN EXTERNAL PRESERVATION HAS BEEN CARRIED OUT AT AN AMBIENT TEMPERATURE LOWER THAN +10°C ITS LIFE WILL BE NO LONGER THAN ONE MONTH.

2. IT IS FORBIDDEN TO PRESERVE THE ENGINE OUT OF DOORS IN AN OPEN SPACE WHEN IT SNOWS OR RAINS.

3. NOT TOLERABLE IS THE PRESENCE OF GREASE ON JOINTS. WIRING SYSTEM LEADS, AND ON THE AIR NOZZLES OF THE FUEL PUMP.

10. PARTIAL Preservation

Partial preservation of the engine is to be carried out Identically as the internal one /para 9.1./ with the omission of steps as per para 9.1.3.; 9.1.4; and 9.1.7.

C A U T I O N :

SHOULD A PARRIALLY PRESERVED ENGINE BE KEPT IN STORAGE FOR MORE THAN 20 DAYS, FULL PRESERVATION WILL BE REQUIRED.

11. Preservation of the Fuel System Accessories Removed from the Engine in Service

Where no portial preservation of the engine is possible prior to removal of accessories, accessories will have to be preserved after their removal from engine, but not later than 24 hours thereafter.

Accessories will have to be preserved internally and externally.

11.1. Internal preservation of accessories:

11.1.1. Preservation of the fuel pump:

- Drain fuel remainders through the open connector pipes of the accessory / by changing its position/.

- Remove inlet fuel filter, wash it in pure petrol, allow it to dry out and mount back in its position.

- Pour preserving oil into inlet connector of the accessory and for 1 to 2 minutes turn power transmission shaft in the anticlockwise direction when looking from the powe transmission side.

11.1.2. Preservation of the free turbine speed limiter, signal transmitter and turbines synchronizer:

- Drain fuel remainders from accessories;
- Pour preserving oil into every fuel connector except for the air space of signal transmitter and turbines synchronizer.

11.1.3. Preservation of the working burner and igniter:

- Wash out fuel lines with pure petrol delivered at a pressure of 2-3 kG/cm^2.

- Allow the preserving oil to run through the passages until it appears in the burner nozzle.

11.1.4. Preservation of the drain valve block and starting fuel constant pressure valve:

- Remove fuel remainders from accessories;

- Pour preserving oil into the open connector pipes.

C A U T I O N :

AFTER INTERNAL PRESERVATION, MOUNT STOPPERS/CAPS BACK IN THEIR POSITIONS ON THE ACCESSORIES CONNECTOR PIPES.

N O T E :

Preservation of fuel system accessories mentioned in para 11.1. can be done on the engine by adopting measures as for aull preservation of the engine in conformity with paragraphs: 9.1.1.; 9.1.2.; 9.1.5.; 9.1.6.; 9.1.8.; and 9.1.9.

11.2. Excernal preservation of accessories:

11.2.1. Non-lacquered surfaces are to be wiped clean with a rag soaked in petrol, and then wiped dry again with a clean cloth.

11.2.2. Washed surfaces are to be coated with a preserving

11.2.3. Thus preserved accessory is to be wrapped in a paraffin paper.

C A U T I O N:

1. LACQUERED SURFACES MUST NOT BE PRESERVED.

2. WHEN PRESERVING THE GENERATOR-STARTER ASSEMBLY ONLY THE POWER TRANSMISSION SHAFT AND THE FIXING FLANGE ARE TO BE COATED WITH A THIN FILM OF GREASE.

12. How to Protect the Engine Installed in a Helicopter

12.1. With the helicopter left idle for less than twenty days, fuel and lubrication systems being filled during this time, no preservation of the engine will be required.

12.2. During the lay-out period of helicopter the procedures given in point 7, chapter 6 should be made on the engines.

12.3. When keeping a partially preserved engine idle on the helicopter, or when the helicopter is to be out of operation for less than 20 days, it will be necessary to inspect external surface of the engine each 5 to 7 days.
Should these surfaces be found to "sweat", they must be wiped dry with a cloth.
Under adverse atmospheric conditions /rain, snow/, the time of visual inspections can be adequately changed.

13. [illegible] Packed in a Case

[illegible], or furnished
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[illegible] ored in places which

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13.4. The clearance between cases and the edge of roof cannot be smaller than 500 mm.

13.5. The temperature of air in the storage spaces must be not higher than +35°C and not lower than +10°C.

Relative air numidity should not exceed 70 %. A short-lasting increase in humidity up to 80% can be tolerated.

Temperature and the hamidity of air must be checked early in the day and at the end of work.

14. Inspection and Servicing of the Engines Kept in Cases

14.1. Engines delivered for use from the producing works can be kept in totally enclosed spaces up to five years, and in the open area, but under roof, up to three years without being unpacked. This does not change in anything the terms of engine guarantee.

14.2. Once in three months it will be necessary to inspect the cases and to see the colour of silica gelindicator.

With the silica gel indicator assuming a pink hue, proceed to changing the silica gel dehumidifier and the silica gel indicator, and inspect the film in which the engine has been packed.

To renew the silica gel and to repair a damaged wrapper proceed as instructed below.

15. Protection of Engines Removed from the Helicopter

Engines removed from the helicopter, duly preserved and packed in cases, but having no hermetically sealed plastic film protection, can be held in the open no longer than 6 months.

16. Renewal of the Silica Gel

To renew silica gel of the dehumidifier, change both the silica gel outside the paper in which the engine is packed, as well as, that located right on the engine under the paper.

To change the silica gel proceed as follows:

16.1. Use scissors to cut off the seam of polyvinyl chloride film /right at the seam/.

16.2. Carefully roll back the film.

16.3. Replace all the bags with silica gel with bags containing dry silica gel, or change silica gel in the bags for a dried one /blue in colour/ fo the KSM or SzSM type.

16.4. Change humidity indicator or the silica gel indicator for a dried one /blue in colour/.

16.5. Wrap the engine in plastic film and weld its ends together.

16.6. Suck air out of the wrapper until the film starts to adhere to the engine surfaces.

After 4 to 6 hours see the film for tightness by attempling to pull it away from the engine surfaces. Gripe the film with two fingers to separate in gently from the engine body; a slight contact between the two speaks for hermetical seal of the wrapper.

C A U T I O N :

THE TIME FOR PLACING BAGS TO WELD THEIR LAST SEAM CANNOT EXCEED 60 MINUTES.

17. How to Desiccate the Silica Gel

To desiccate silica gel indicator place it in an oven at 120±3 °C for 1.5 to 2.0 hours, and to deciccate the silica gel itself leave it for 3 to 4 hours at 150 to 170°C and stir it occassionally.

Silica gel is being dried in an aluminium containers, the height of a silica gel layer in such a container being maximum 30 mm. To remove silica gel from an oven switch it OFF and wait until the oven is completely cool.

Before the dried silica gel is passed for packaging, it must be kept in a dry and hermetically sealed container.

Silica gel is being packed in bags right before its placing on the engine.

C A U T I O N :

A DRIED SILICA GEL GANNOT CONTAIN MORE THAN 2 % OF MOISTURE, I.E. IT MUST BE BLUE IN COLOUR.

18. Welding of the Polyethylene Sheeting and Polywinyl Chloride Film Wrappers

Welding procedure requires that an even board having a felt, thick felt and a woollen coat cloth cover plus several sheets of parchment is used.

Prior to welding the wrapper, both end of the film or sheeting must be brought together and slightly pulled in order to smooth up any folds or wrinkles present thereon. Right before welding, the ends must be wiped dry with a cloth soaked in petrol. Film/sheeting have to be welded in the longitudinal direction.

The following instruments may be used to weld the wrappers:

18.1. A portable welder consisting of an electrical part and a preheated manual device having the form of a skirt or tongs.

18.2. A bench instrument /e.g. flat iron/.

Procesudre to be applied when using a bench instrument:

When welding W-118 polyvinyl chloride film wrappers, the temperature of the working skid ought to range from 220°C to 300°C, and only from 150°C to 250°C in the case of polyethylene film.

During welding, the instrument must be moved alongside the seam at an uniform speed of 15 to 30 mm/sec.

While wedling, place a cellophane or tracing paper strip 5 to 6 mm wide under the instrument.

... The quality of welding may be assessed from the colour of the backing strip. Its colour must be darker than that of the seam welded.

Having welded the seam, remove those pieces of the backing strip which have separated therefrom.

With the film/sheeting pulled by hand in its transverse direction no separation of the seam can occur.

19. Transport of the Engine

Engine is passed over for installation in a wooden case, wrapped in a hermetically sealed film/sheeting with silica gel contained therein.

The weight of case including the engine is 310 kG.

The weight of case itself is 170 kG.

Case dimensions:

- Length	2030 mm
- Width	1140 mm
- Height	1125 mm

The engine packed in a case may be carried by road or rail.

The engine when packed in a hermetically sealed Wrapped and wooden case can be carried by air in non-pressurized speces up to an altitude of 10 000 mtrs, with closed hatches and heating switched ON.

20. Unpacking Preocedure

20.1. Inspect leaden seals on the nuts of bolts for securing the lid of wooden case, and see that no part of the case has been damaged in transport.

20.2. Tear down the seals, and undo four nuts on the bolts holding down case lid.

20.3. Raise the lid to clear it of the case and put it aside.

20.4. Ins ect humidity indicator placed in the wrapper.

20.5. Cut the wrapper near its seam.

20.6. Remove the wrapper and bags with the silica gel.

20.7. Inspect the engine in order to make sure that no harm has been done to it.

20.8. Verify documents, accessories and spares to corroborate their conformity with the packing list.

20.9. Prior to its installation remove preservative from external surfaces of the engine.

C A U T I O N :

1. CAREFULLY REMOVE THE LID FROM CASE WITHOUT CHANGING ITS FLAT HORIZONTAL POSITION.

2. WITH THE HUMIDITY INDICATOR SHOWING "DANGER",OR PINK COLOURATION OF THE SILICA GEL INDICATOR, UNPACKING OF THE ENGINE CAN PROCEED NO OTHERWISE AS ONLY AFTER CONSULTING WITH THE PRODUCING WORKS /FOR ENGINE/.

21. Packing Procedure

To pack an engine removed from the helicopter and duly preserved, place it in the shipping support of the case.

Packing procedure itself is as follows:

21.1. Mount lateral handling journals and boottm securing point bracket on the engine reducer casing.

21.2. Fit the engine in its position by making use of the journals and bottom securing point whereafter wrap with paper, tie round with twine and wrap in plastic film.

21.3. Assemble the engine in conformity with the list of accessories to be mounted thereon and replace the lid of the case.

21.4. Tighten nuts on case lid bolts and seal them with lead.

C A U T I O N :

1. IT IS FORBIDDEN TO STRIP THE ENGINE REMOVED FROM THE HELICOPTER.

2. IT IS FORBIDDEN TO PACK THE ENGINE IN THE OPEN AIR WHEN THERE IS RAIN OR SNOW.

3. THE FOLLOWING ENTRIES MUST BE PASSED IN THE ENGINE LOG BOOK:

   - Engine worktime;
   - Reasons for breaking normal service;
   - Reasons for renewal of accessories, if happened;
   - Notes on engine preservation together with dates and validity periods.

... 4. ENTRIES PASSED IN THE ACCESSORIES INFORMATION CARDS MUST INCLUDE THE ACTUAL WORKTIME FIGURES FOR EACH ACCESSORY.

CHAPTER 9

FUEL AND LUBTICATION SYSTEM ADJUSTMENTS

Issue 2/1975

CHAPTER 9 - Index of Contents

1. General

To facilitate servicing and to step up airworthiness of the equipment handled, the Manufacturing Works agree that some of the operating parameters will be adjusted and controlled by the users themselves.

1.1. Parameters to be adjusted by usersthemselves, with reservations as made in para 1.2, include:

- Rotational speed of the compressor turbine /n_{TS}/ in the idling range;
- Rotational speed /n_{TS}/ for closing the air bleed valve;
- Rotational speed of the rotor /n_{WN}/ in its nominal range;
- Difference in rotational speeds, n_{TS}, of two mating engines, the so-called "shears";
- oil pressure at engine inlet in the operating ranges higher than idling;
- acceleration;
- startings /time and temperature override/.

1.2. On engines covered by guarantee, users are allowed to adjust only parameters an spesified above except for the adjustment of startings.

1.3. For the work connected with the adjustment of engines, the user can designate only such representatives which have already acquired a long experience in the maintenance of equipment and are well

conversant with the principles of engine control operation.

1.4. When adjustments are carried out by users themselves, manufactureer's commitments concerning engines will remain valid provided adjustments are made in full conformity with the recommendations laid down in this Chapter.

C A U T I O N :

ADJUSTMENT CAN BE STARTED NO COONER THAN AFTER A THOROUGH INSPECTION OF THE ENGINE AS A WHOLE AND REPAIR OF ALL THE DEFECTS LIKELY TO HAVE A BEARING ON THE PARAMETER TO BE READJUSTED HAVE BEEN CARRIED OUT /e.g. metering system faults, presence of leaks, contamination of nozzles and filters, defects in the helicopter control system, power supply irregularities, etc./.

1.5. Should difficulties be encountered during an adjustment, or indispensable spares be found to be lacking, manufacturer's representative will have to be called for assistance.

1.6. Every adjustment carried out will have to be entered in the Engine Log Book and Accessory Information Card along with the cause for such an adjustment, parameters and settings prior to, and after, the adjustment.

1.7. As regards the remaining parameters, not specified in this Chapter, their adjustment can be entrusted to manufacturer's representatives only.

N O T E:

Stability of engine parameters is to a great extent dependent on the timely and accurately done routine procedure operations.

2. Adjustment Procedures

To carry out an adjustment, make use of revevant screws, nozzle and throttling packs.

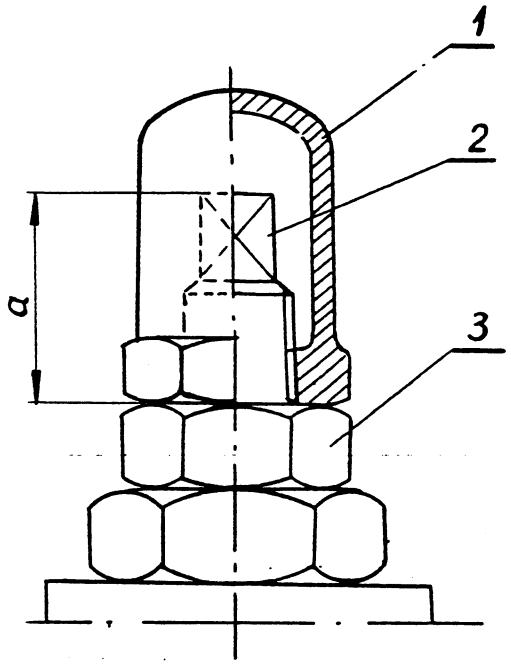

Fig. 9.1. Control Screw Layout

1. Protective cap. 2. Control screw. 3. Lock nut. "a" Screw dimension /mm/.

2.1. To perform adjustments with the type of screw as abown in Fig. 9.1. proceed as follows:

- By holding lock nut 3 in position, remove protective cap 1;
- Measure screw extension /dimension "a"/ accurately to 0.1 mm;
- By holding control screw 2 with a special box spanner 16.08.0060 loosen lock nut 3;

- Rotate control screw 2 in the required direction as needed;

- By holding control screw 2 with a special spanner tighten lock nut 3;

- Verify parameter having been adjusted and rectify adjustment, if necessary;

- at the end of adjustment measure the amount of screw extension /dimension "a"/;

- Mount protective cap back in its position, lock it and seal with lead.

2.2. Renewal of throttling nozzle:

- Remove leaden seal from nozzle and screw the nozzle out of its seat;

- Screw in a new nozzle in place of the old one, amking sure about the proper size of throttling diameter;

- Verify parameter having been readjusted and, if necessary, provide another nozzle;

- At the end of adjustment, lock nozzle in its position and seal with lead;

2.3. For the adjustment completed by means of other controls than those mentioned above, see sections dealing with the adjustment of parameters specified.

2.4. Engine parameters after adjustment are to be verified on a warmed-up engine run in the given operating range for 2 minutes at least

3. Idling Speed n_{TS} Adjustment

3.1. To make this adjustment use the minimum speed screw provided on the fuel pump.

3.2. To increase idling speed n_{TS} by about 10 % drive the screw in by one turn, and vice versa, where decrease in speed is required;

3.3. The minimum speed screw can be adjusted within ± 1 turn limits relatively its factory-adjusted position /this corresponds to a more or less ± 0.5 mm change in the screw extension amount/;

3.4. For the amount of screw extension relatively which said adjustment can be acrried out see Information Card of the Accessory and its Table in Column "Data Required acc. to Specifications" Item "37" -- "Control Screw Extension /Dimension "w"/ In Column "Actual Data" there is specified the amount of screw extension for an engine adjusted in the factory.

4. Air Bleed Valve Closing Speed n_{TS} Adjustment

4.1. This adjustment is done by means of the throttling nozzle of the signal transmitter, provided on the fuel pump.

4.2. To increase rotational speed n_{TS} of the air bleed valve by about 6 %, make diameter of the nozzle throttling hole larger by 0,1 mm, and vice wersa;

4.3. The range of possible throttling hole diameters of

nozzles is from 1.2 mm up to 1.8 mm.

4.4. Adjustment is to be made by a change in the nozzle themselves, such as to have new nozzle installed larger in their diameter by 0.05 mm, compared to the previous one.

N O T E :

1. A nozzle replaced by another one of an identical hole diameter may also result in a change of the air bleed valve closing speed, this being due to the manufacturing tolerances of nozzle holes.

2. Only the bleed valve closing speed is adjustable. With the decreasing speed of the compressor turbine, air bleed valve opens when rorational speed is by some 4 % lower than the closing speed.

5. Rotor Speed n_{WN} Adjusted in Nominal Range

5.1. To carry out this adjustment make use of the screw provided on the free turbine speed limiter.

5.2. To increase rotational speed of the rotor by about 4 %, with the compressor turbine speed remaining unchanged, drive the screw in by one turn.

5.3. The screw of free turbine speed limiter is allowed to be adjusted only in the ± 1 turn interval compared to its factory-adjusted positions /this corresponds to a change in the amount of screw extension by ± 0.5 mm for the OOWT-3 /PO-40TA/ accessories,

... and ± 1 mm for the OOWT-2 /PO-40T/ accessories.

5.4. For the amount of screw extention versus which it is possible to carry out adjustment in the range as above see the Accessory. Information Card Table, Column "Data Required acc. to Specifications". For the amount of screw extension after adjustment see same Table,. Column "Actual Data".

N O T E :

The above adjustment exerts also its effect on the difference in rotational speeds n_{TS} of the mating engines /"shears"/, and in the case of accessories OOWT-3 /PO-40TA/ also on rotational speed of the emergency valve. This is why, the a/m parameters are to be verified after each adjustment. Emergency valve operational check is to be done in conformity with para 17 of Chapter 6.

Desing of the OOWT-3 /PO-40TA/ speed limiter control screw differs from that described before.

5.5. Adjustment performed with the OOWT-3 /PO-40TA/ accessory screw /see Fig. 9.2./:

- Remove leaden seal and band protection 1;

- Depress screw 2 cap to release if from locating mesh 3;

- Rotate the screw cap in the required direction by a suitable amount;

- Releance the cap;
- Verify parameter adjusted and, if necessary, rectify it;
- Replace band protection 1 and seal it with lead.

6. Adjustment of Difference in the Speed n_{TS} of Mating Engines, The So-Called "Shears"

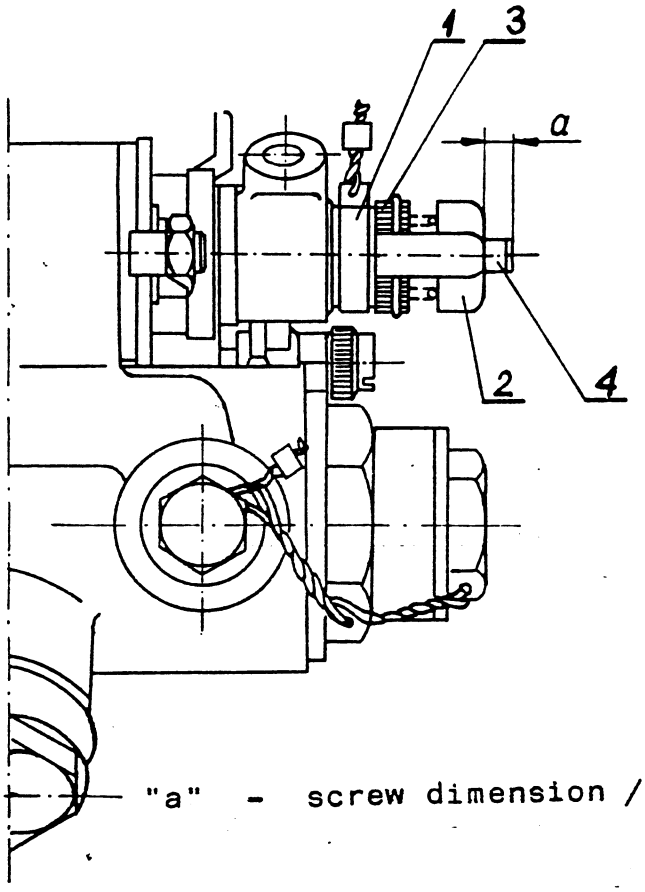

Fig. 9.2. OOWT-3 Accessory Control Screw Layout

1. Band protection. 2. Screw cap. 3. Cap locating mesh. 4. Control screw.

To readjust "shears":

6.1. Make use of the screw provided on free turbine speed limiter /as in para 5/.

6.1.1. To carry out this adjustment change screw position every 1/8 turn.

6.1.2. To decrease the difference in rotational speeds n_{TS} of the mating engines drive in the screw of this accessory whose engine revolves at a lower speed, or drive out screw of this accessory whose engine speed n_{TS} is higher.

6.2. Make use of the maximum fuel discharge screw provided on the fuel pump:

6.2.1. This screw can be used to readjust the "shears" only in the takeoff range.

6.2.2. To decrease rotational speed n_{TS} drive this screw in, and vice wersa.

A change in the position of screw by one turn gives in effect a change in the rotational speed by about 4 %.

6.2.3. Interval of the allowable screw adjustment is $\pm$ 1 turn relatively the factory-adjusted position of the screw /this corresponds to a change in screw extension by $\pm$ 0.8 mm/.

6.2.4. For initial amount of screw extension versus which the screw is allowed to be moved by 0.8 mm sce Information Card Table, Column "Data Required acc. to Specifications", Item "113" "Control Screw Extension/ Dimension "a"/.

For screw extension after the adjustment on engine see same Table, Column "Actual Data":

N O T E :

1. The maximum fuel discharge screw is allowed to be exclusively used for decreasing the compressor turbine speed. Accordingly, this screw can be only driven in /screwed in/.

   Driwing this screw results in the power of engine rising over the permissible level, and this may easily end in the failure of engine or main drive.

2. Adjustment is done by driving the screw by 1/8 and verifying the rotational speed.

6.3. Make use of the control screw in turbines synchronizer:

6.3.1. The effect due a change in the position of turbines synchronizer screw on "shears" appears to be generally small and depends upon the pressure ratio produced downstream of the compressors in the mating engines.

6.3.2. During adjustment, drive in the screw on that engine which shows a higher rotational speed.

6.3.3. It is permitted to control position of the screw driven-on only by one turn/this corresponds to a change in screw extension by 1 mm / relatively the factory adjusted location.

6.3.4. For the amount of screw extension versus which the screw can be driven in by 1 mm, refer

to Information Card of the accessory, Colum "Data Required acc. to Specifications"of Table.
Screw extension after its adjustment on the engine is also specified in said Table, Column "Actual Data".

6.3.5. Control screw is to be driven in right for the entire permissible depth. If this remains without bearing for the "shears", the screw must be left in this position.
No further adjustment using the screw is possible.

7. Adjustment of the Engine Oil Pressure in Operating Ranges Higher than Idling

7.1. This adjustment is to be done using a screw provided in the filter assembly /see Fig. 9.3./.

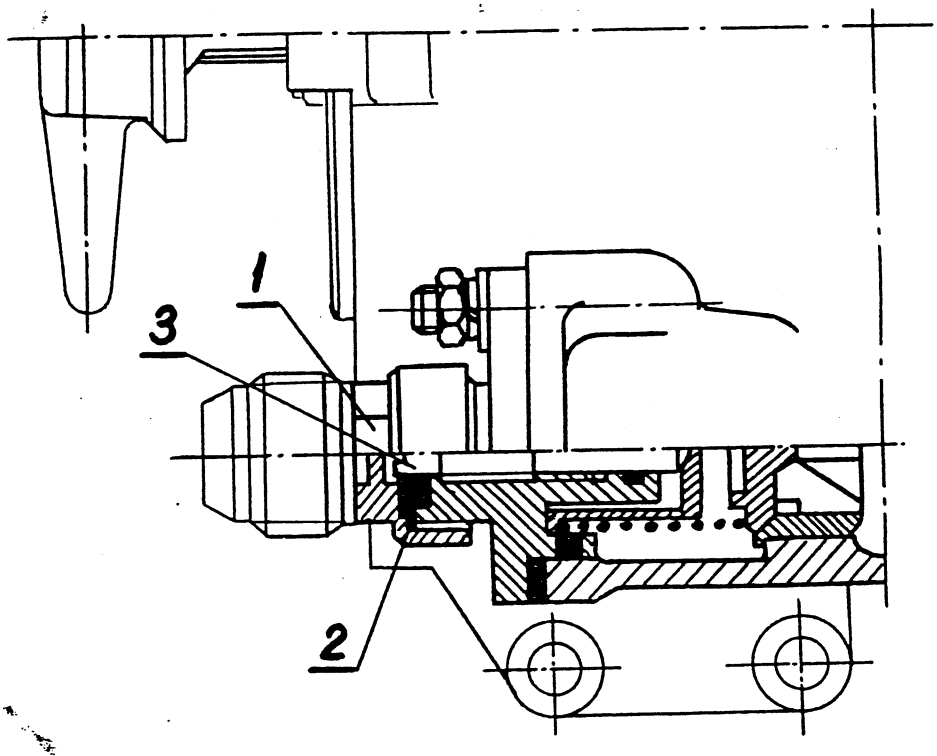

Fig. 9.3. Oil Pressure Valve Layout

1. Pressure reducing valve cap. 2. Screw retaining washer.
3. Control screw.

7.2. The screw when being driven in results in higher oil pressure, and vice versa.

7.3. Change produced in the position of control screw may according to engine differently infuence the pressure of oil. This is why, this adjustment is to be carried out by changing the position of screw only by 1/4 of a full rotation.

7.4. Adjustment procedure /see Fig. 9.3./:

- Remove leaden seal and undo protective cap 1 provided on the pressure reducing valve;
- Clear retaining washer 2 of screw 3;
- Use a screwdriver to rotate control screw 3 in the required direction;
- Replace retaining washer 2 upon screw 3 so that its protrusions may enter casing cutouts;
- Replace protective cap;
- Check for oil pressure and correct adjustment, if necessary;
- Lock protective cap 1 in position and seal with lead.

8. Adjustment of the Time of Acceleration from Idling to the Takeoff Range

8.1. This adjustment is done by replacement of throttling pack in the fuel pump /see Fig. 9.4./.

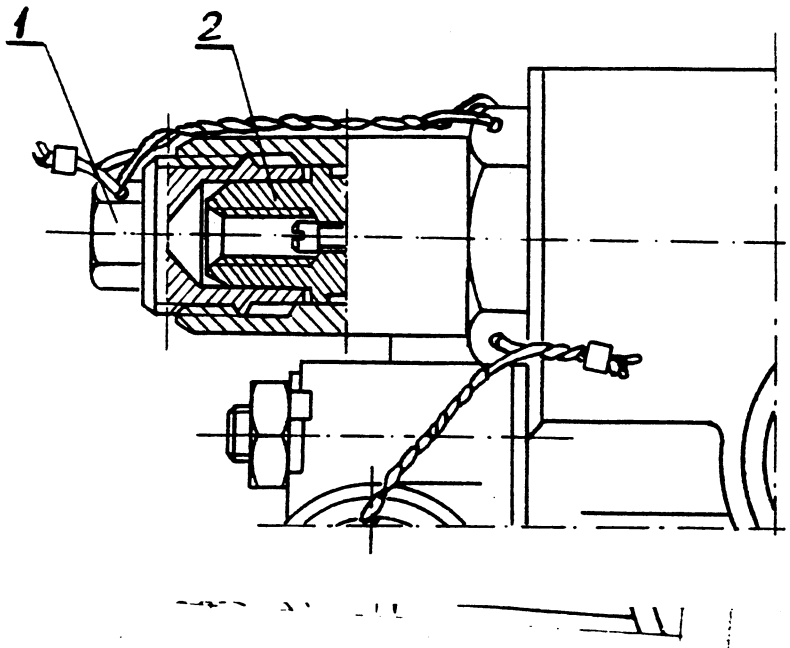

Fig. 9.4. Throttling Pack Assembly Layout

1. Throttling pack stopper. 2. Throttling pack.

8.2. To cut acceleration time down by 2 to 3 seconds increase throttling pack capacity by 20 ccm/min.,and vice versa.

8.3. For the tolerable range of pack capacities see Information Card of the given fuel pump.

To replace throttling pack /Fig. 9.4./:

- Remove leaden seal and clear stopper 1;
- Thread device 16.08.0109 into the throttling pack and with its aid clear the pack of its seat; see that two sealing rings are provided on the pack;
- Mount a new pack of a suitable capacity and prior to its installation inspect it for the presence of two rubber sealing rings;
- Drive stopper 1 into the throttling pack assembly;
- Release air from the fuel system;

- Check engine for acceleration and, if necessary, mount a new /another/ pack;

- Lock stopper 1 in its position and seal it with lead.

N O T E :

When adjusting acceleration time give attention to sudden changes in the temperature of gases prior to turbine.

When cutting down accelaration times, overriding in the temperature of gases goes up; the opposite effect in seen when acceleration times are being extended.

9. Adjustment of Valves

9.1. To control temperatures of gases upstream of the turbine during the starting operation, i.e. from the ignition of fuel up to the passover into idling range, use the following elements:

- Automatic starter screw;

- Automatic starter nozzle.

Both these control elements are provided on the fuel pump.

9.2. The screw, when used for adjustment, influences chiefly the process of temperature in the initial starting phase, i.e. up to 40 % n_{TS}, whereas adjustment done with the nozzles has more effect in the second starting phase, i.e. from the 40 % if n_{TS} up to the idling stage.

9.3. Driving-in the screw, and lowering of the throttling nozzle diameter, results in a higher starting temperature and reduces the time of passing over to the idle running; and vice versa.

9.4. Limits within which control elements can be changed:

- Control screw is allowed to be driven in by only one turn, and to be driven out by three turns, compared to the factory-adjusted position of said element in the accessories; this corresponds to a change in the screw extension from - 1 mm up + 3 mm respectively;

- Diameter of the throttling nozzle holes can be changed within 1.4 to 2.1 mm limits, with 0,05 mm gradiaton /stepping/.

9.5. For initial value of screw dimension from which the screw is allowed to be changed in its position within - 1 mm to + 3 mm limits see Information Card of the pump, Column "Data Required acc. to Specifications" in Table, Item "107" "Control Screw Extension" /dimension "q"/.

N O T E :

Since in-ertance of the system for measuring temperature of gases upstream of the turbine is high enough, the actual temperature of gases during starting is considerably higher than that indicated by gas temperature indicator and therefore, to avoid overheating of turbine blades, proceed as follows:

- Readjust startings only if there is no consistency with the requirements of the service Manual. It is forbidden to readjust startings in order to cut down times for achieving the idle running, if parameters are such as to meet their normal requirements
- During starting, watch increase in the temperature so that engines can be immediately stopped in the event of maladjustment; temperature of gases stipulated as a maximum for the particular ambient temperature cannot be exceeded.

10. List of Tools and Spares Deemed Indispensable to Carry Out Adjustments

10.1. Box spanner, Ref. No. 16.08.0060, supplied with the board tools.

10.2. Device for clearing throttling pack, Ref. No. 16.08.0109, supplied with the board tools.

10.3. Depth gauge or slide caliper to be provided by users themselves.

10.4. Throttling nozzles of the automatic starter and air bleed device to be ordered by users with the WSK Wrocław Works.

10.5. Nozzles of the automatic starter and air bleed device hafe identical Drawing Reference Nos.,i.e. PNRP1-281.

When ordering said nozzles, state their Ref.No., quantity desired and diameters.

.... 10.5. Throttling packs are to be ordered by users themselves with the WSK-Works in conformity with their actual needs.

Pack Drawing Ref. No. - "PNRPI - 040".

Capacities of throttling packs range from 120 to 200 ccm/min., being stepped every 10 ccm-minute.