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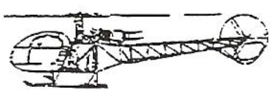
APPENDIX

DESCRIPTION

This appendix, issued to supplement the information given in the Flight Manual, may be modified by specific amendments independent of those issued against the basic Flight Manual.

IMPORTANT NOTE

This document supports the helicopters delivered by both AEROSPATIALE and EUROCOPTER FRANCE.
Revisions to this manual are made by EUROCOPTER FRANCE using the same procedures as AEROSPATIALE.



EUROCOPTER FRANCE Etablissement de Marignane
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APPENDIX D

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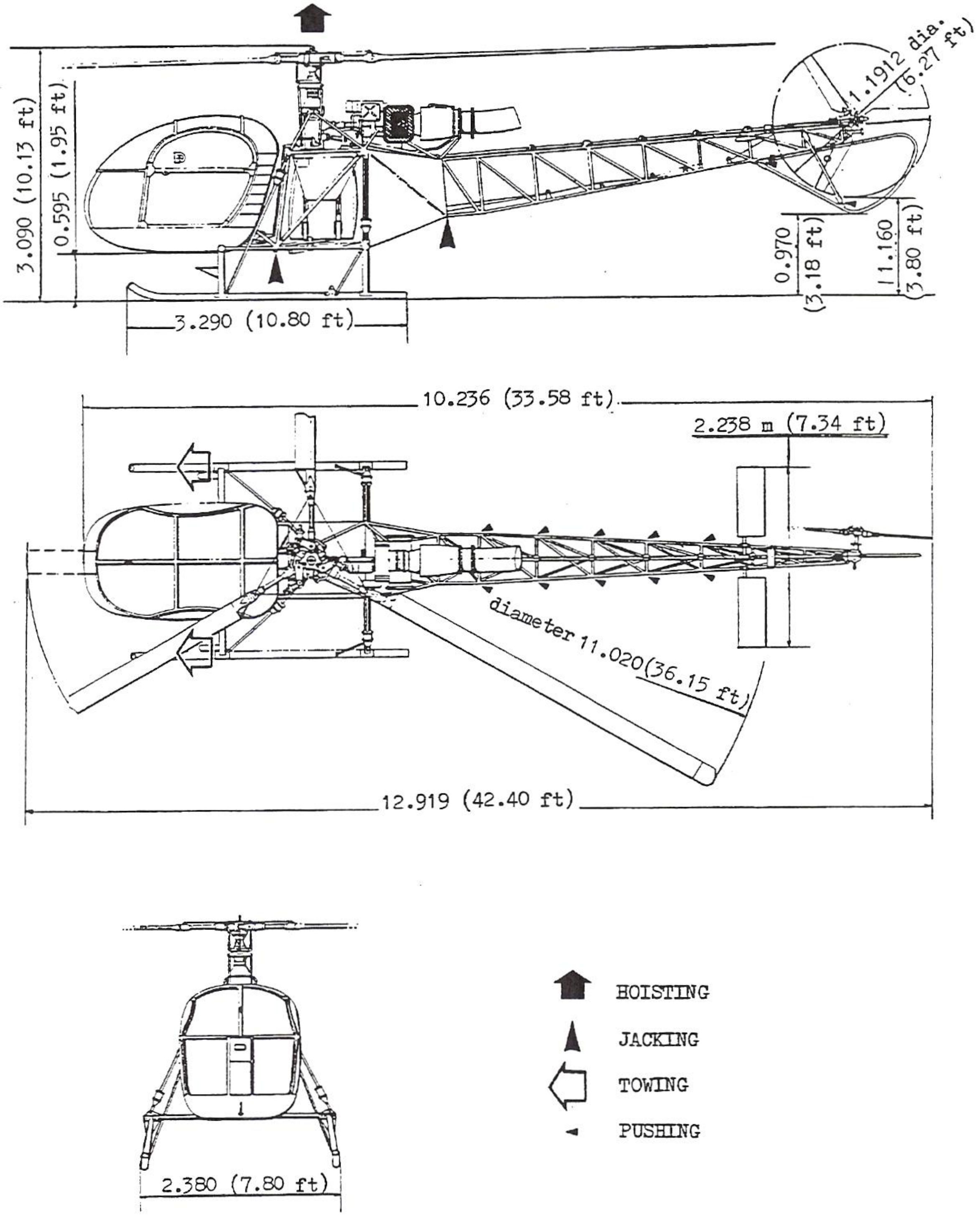


High skid type landing gear

Printed in France

APPENDIX D

2 - ENGINE

A. GENERAL

The ARTOUSTE III is a single shaft turbine engine with a forward reduction gear. It rotates at a nominal constant speed of 33500 r.p.m., i.e. 5864 r.p.m. at the output shaft.

It consists essentially of :

- A co-axial reduction gear with two intermediate shafts and two reduction stages.
- An air intake casing, the rear part of which supports the accessory mounting flange.
- A compressor with one-axial stage and one-centrifugal stage compressor.
- An annular combustion chamber with centrifugal fuel injection.
- A direct flow three-stage turbine.
- An exhaust diffuser.

B. ENGINE CONTROLS AND INSTRUMENTS

1) General

In flight, the engine and rotor speeds are automatically stabilised by the governor, acting, by means of a metering device, on the flow of fuel. The metering device opens and closes automatically as the helicopter rotor absorbs more or less power. Thus, the pilot has no need to take care of the engine handling once normal speed is attained : the governor is in control.

Two engine control levers are located on the control quadrant at the bottom of the control pedestal :

2) The fuel flow control lever, which controls the governor unit flow valve, via a "Teleflex" cable.

. The rear position corresponds to the starting and idle positions.
. The forward position corresponds to the normal flight position.

A micro-switch on the fuel cock prevents operation of the automatic starting unit if the lever is not in the "rear idle stop" position.

Two micro-switches on the fuel flow control lever ensure :

. Switching off of the "ALARM" light, when the lever is at the extreme forward position.
. Disabling the "OFF"position of the engine selector switch in flight (this micro-switch is located in the "fuel cock open" half of the control lever).
Post. Mod. 2293, a misadjustment of the micro-switch is indicated by the illumination of the "ALARM" warning light.

3) The fuel shut-off cock control lever, on the left, which operates, through mechanical linkage, the fuel shut-off cock located on the fuel supply line, upstream of the engine. This lever should always be lockwired in the forward, or open, position, and should be operated only in a emergency.

4) Instruments : Five instruments make monitoring of the engine parameters possible.

- An engine tachometer combined with the rotor tachometer. It carries two needles which must be superimposed during "power-on" flight.
- A pyrometer indicating t4 temperature.
- An oil temperature indicator.
- An oil pressure gauge (according to version).
- A collective pitch indicator.

5) Operation and control of starting : this assembly consists of :

a) The booster pump ON-OFF switch which controls the submerged motor-operated booster pump. This pump supplies fuel under pressure to the engine fuel system. When the switch is in the OFF position, the booster pump is automatically cut in by the automatic starting unit during the combustion chamber light-up sequence. When in the ON position, it controls booster pump starting directly without any possibility of interference by the automatic starting unit. This switch shall be set to "ON" before starting the engine, and remain in this position throughout the flight.

b) The engine selector switch :

This is a dual 3-position switch. It can be left in the "OFF" or "ON" position, but from the "VENTILATION" (CRANKING") position it automatically returns to OFF when released.
The automatic starting sequence is initiated by moving the switch to the "ON" position. When the engine is running the switch must be left in the "ON" position at all times.
Engine shutdown is accomplished by moving the selector switch to the "OFF" position after fully retarding the fuel flow control lever.
When the fuel flow control lever is fully retarded, moving the switch to "VENTILATION" (CRANKING") and holding it in that position, causes motoring action which ceases automatically immediately the switch is released.

c) A green "DEM" ("START") indicator light : This light is normally "ON" during the starting sequence and goes out when the engine reaches self-sustained speed.

d) An amber "ROBINET" ("COCK") indicator light : This light comes on during starting when the electric cock is open and stays on as long as the micro-pump and the ignition coil operate.

e) A red "BLOC" ("STOP") warning light : This light comes on in the event of the engine stopping, either because of a faulty start or normal stopping. Re-starting is impossible until the light has gone out.

f) Alarm lights

- An engine oil pressure warning light.
- A red "ALARM" warning light which comes on :
  . when the fuel flow control is not in the max. forward position, or
  . when the micro switch which disables the "OFF" (shut-down) function of the starting selector switch is misadjusted.(Post. Mod. 2293)

C LUBRICATION

Lubrication is ensured by a self-contained system comprising a reservoir ; the minimum capacity of the reservoir is 12 litres and the capacity corresponding to the minimum level is 7 litres.

The lubrication system consists of three separate circuits :

- The pressure circuit incorporating a pump drawing the oil from the lower part of the reservoir, and delivering it through a filter to the engine components.

- The scavenge circuit incorporating four pumps designed to return the oil to the tank.

- The oil vapour return circuit connected to the oil tank.

- Oil filter

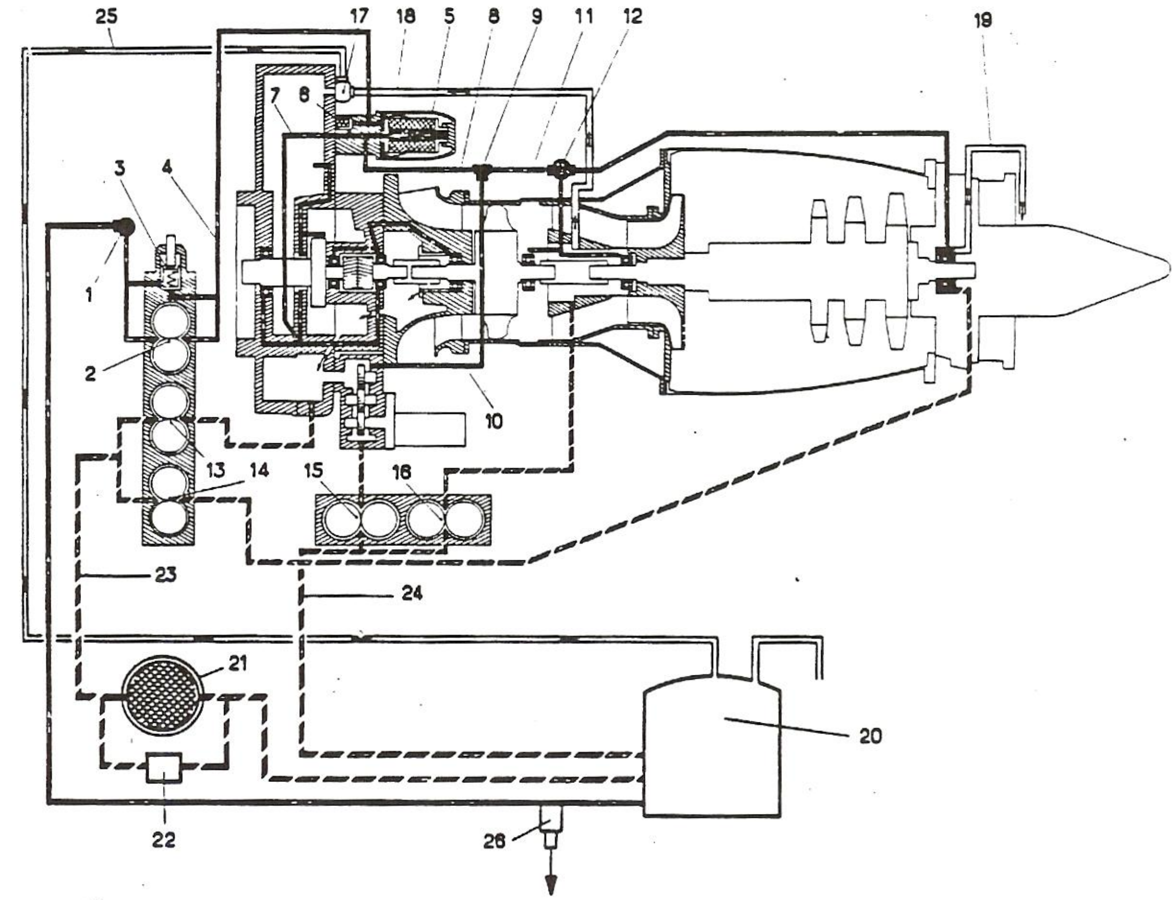
  Oil filter is located between the pressure pump and the engine parts to be lubricated. It consists essentially of a body in which a filtering element with a cover is mounted.
  It includes a valve to by-pass the filtering element in case of clogging.

- Oil temperature measurement

  The oil temperature is measured by a resistor-type probe which transmits data to the dual indicator located on the control pedestal upper panel.

- Low-pressure switch

  A pressure switch causes a red warning light on the instrument panel to come on in case of a pressure drop in the engine oil system.



Item N°	Description	Item N°	Description
1	Banjo union	14	Scavenge pump
2	Pressure pump	14	Scavenge pump
3	Relief valve	16	Scavenge pump
4	Oil line	17	Special QUINSON union
5	Oil filter	18	Oil line
6	Valve	19	Rear bearing vent line
7	Oil line	20	Oil tank
8	Oil line	21	Oil cooler
9	Tee fitting	22	By-pass valve
10	Oil line	23	Oil line
11	Oil line	24	Oil line
12	Dual banjo union	25	Oil line
13	Scavenge pump	26	Temperature bulb

Engine oil system diagram
Figure 1

3 - ROTORS AND TRANSMISSION SYSTEM

A. ROTORS

1) Main rotor

The 11 metre diameter main rotor rotates clockwise when viewed from the pilot's seat. It comprises the main rotor head and three blades.

a. Main rotor head. The main rotor head is splined onto the top of the main rotor shaft. It comprises :

- a hub
- three blade sleeves
- three blade drag dampers
- the blade-spacing cables
- the droop restrainers which prevent excessive blade droop at rest and at low r.p.m.

b. Blades. The main rotor blades are attached to the outboard end of the blade sleeves. They consist essentially of a light alloy spar and an aluminium skin packed with synthetic resin foam filler material. They have a 6°30' built-in twist and carry balance weights under a removable tip fairing.

They can be folded rearwards.

2) Tail (anti-torque) rotor

The 1.912 m diameter variable pitch tail rotor comprises three metal blades individually hinged in the flapping plane only.

B. TRANSMISSION SYSTEM

1) General

The transmission system transmits engine power to the main and tail rotors and reduces rotational speeds.

It comprises the following components :

2) Main drive shaft

This shaft is attached at one end to the clutch and at the other end to the main gearbox so as to transmit engine power to the latter. A freewheel unit incorporated in the shaft assembly permits autorotative flight.

3) Clutch unit

The centrifugal type dry clutch unit is designed to synchronize rotor speed with engine speed through the main drive shaft.

The driving assembly is constituted essentially of a set of shoes lined with friction material. The shoes, sliding in a radially bored support ring, are pressed against the driven assembly surface by the effect of centrifugal force, opposed by clutch shoe retaining springs, the support ring being driven by the engine output reduction gear shaft.

The shoes of the driven assembly slip during acceleration, and grip when normal operating speed is reached (there is no mechanical lock). The driven assembly of the clutch unit drives the main gearbox, through the main drive shaft and freewheel assembly which allows the rotor to turn independently of the engine in autorotative flight.

The clutch must fulfil a threefold requirement :

- Protect the engine against the application of excessive torque loads at low engine speeds, and consequently against engagement of rotor drive below a predetermined engine speed.
- Dissipate the heat generated by friction during acceleration of the rotor up to synchronization.
- Transmit the required torque in flight at nominal engine speed, without slipping.

  Clutch engagement is a delicate operation which requires gentle control throughout on the part of the pilot with strict observance of the instruction contained in Section 2 of basic manual.
- An over-high rate of rotor acceleration may produce cracks due to local overheating.
- An insufficient rate of acceleration will cause general overheating due to prolonged friction, resulting in transformation of the metal grain structure.

4) Main Gearbox

The main gearbox drives the main rotor and transmits power to the tail rotor drive, stepping down engine speed from 33500 r.p.m. to 353 r.p.m. and 1937 r.p.m. respectively.

It comprises :

- an input bevel gear assembly which is connected to the main drive shaft, reduces the speed and drives the two-stage planetary gear situated above.
- a two-stage planetary reduction gear which drives the main rotor shaft.
- a bevel gear power take-off which connects up with the inclined shaft of the tail rotor drive system.

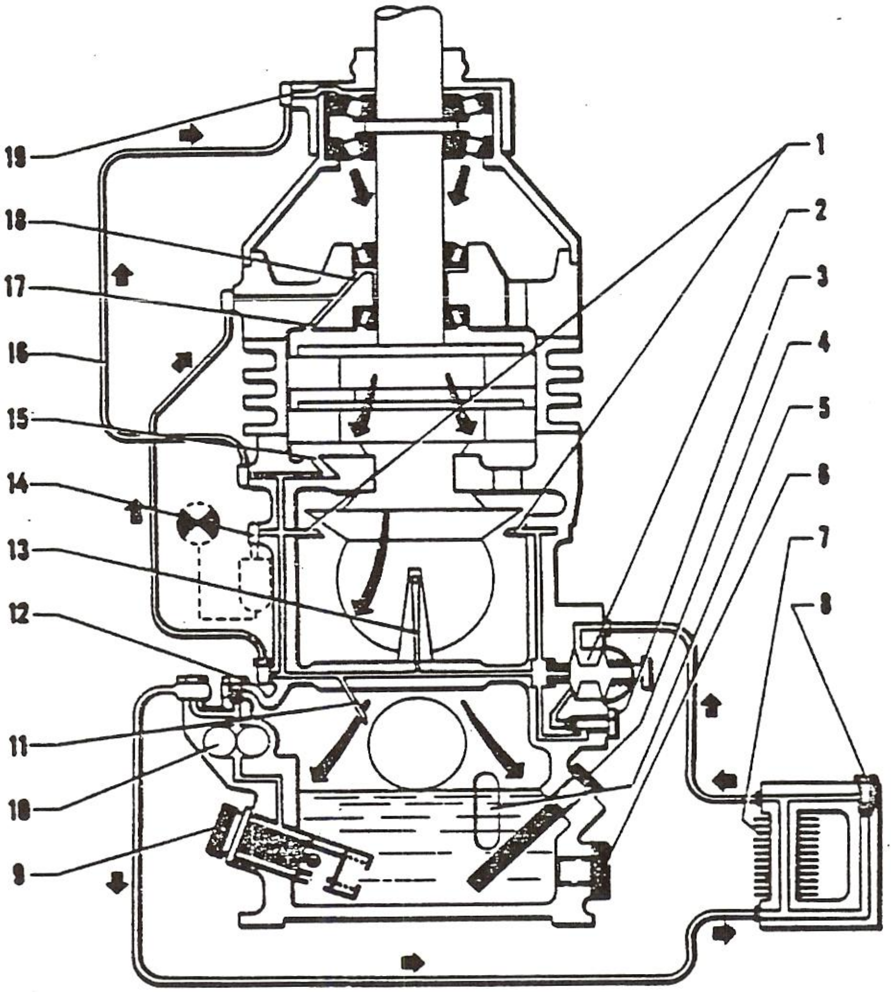
Main Gearbox Lubrication System

The lower housing of the main gearbox is an oil sump ; its capacity is approximately 4.5 l (1.2 U.S. gallons). It is provided with an oil level window. A gear-type oil pump delivers oil at a pressure of 5 ± 1 bars (73 ± 15 p.s.i.) through the oil cooler to the pressure filter from where it is distributed to :

- the input bevel gear
- the freewheel oil jet
- the 1st stage planetary gear
- the pressure-switch connection
- the rotor shaft bearings, through an external hose
- the 2nd stage planetary gear, also through an external hose.

The oil returns by gravity to the lower housing.

A pressure switch causes a warning light, on the instrument panel, to come on immediately the oil pressure falls below 1.5 bars (22 p.s.i.) and a thermal switch causes a second warning light to come on whenever the temperature exceeds 110° C.



1. Main bevel gear oil jets
2. Pressure filter
3. Pressure filter by-pass valve
4. Filler plug
5. Oil level sight gauge
6. Drain plug
7. Oil cooler
8. Cooler by-pass valve
9. Suction filter with magnetic plug
10. Gear-type pump
11. Tail rotor power take-off gear oil jet
12. Pump pressure relief valve
13. Main drive shaft oil jet
14. Pressure switch
15. 1st stage reduction gear oil jet
16. External hose
17. 2nd stage reduction gear oil jet
18. Upper bearing oil jet
19. Main rotor shaft bearing oil jet

Main gear box lubrication diagram
Figure 2

5) Inclined drive shaft and tail rotor shaft
The tail rotor drive consists of the inclined drive shaft, the coupling shaft and the tail rotor drive shaft, the latter being connected to the tail rotor gearbox.

6) Tail gearbox
The tail rotor gearbox changes the angle of drive by 95 degrees toward the tail rotor.
The tail rotor gear box has an oil capacity of 0.50 l (0.13 U.S. gallons) usable, and is provided with an oil level window. The gears, bearings and other internal components are splash-lubricated.

C. Rotor brake
The rotor brake is controlled mechanically and actuated by means of a lever in the flight compartment.
- The "FORWARD" position corresponds to the "BRAKE RELEASED" position
- The "REAR" position corresponds to the "BRAKE APPLIED" position.

4 - FLYING CONTROLS

A. GENERAL
The flying controls include :

1) The main rotor controls which consist of :

a) The cyclic pitch control system (pilot's stick)
b) The collective pitch control system (pitch lever).

These systems consist of control rods and bellcranks and are power assisted by hydraulic servo-units.

2) The directional control (anti-torque tail rotor).

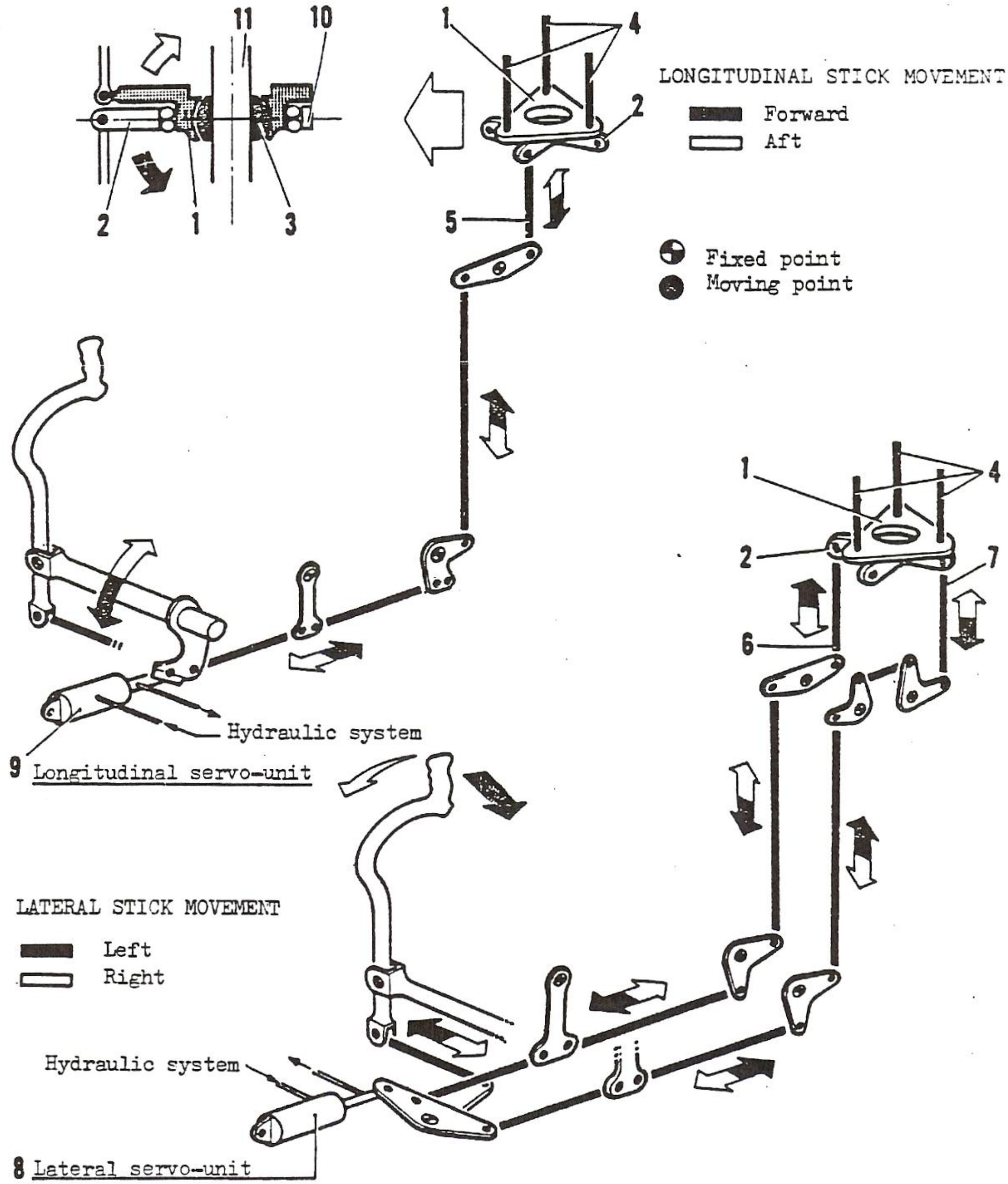
B. CYCLIC PITCH CONTROL (Figure 3)
Cyclic-pitch variation is controlled through a swash-plate assembly consisting of a rotating star (1) connected to the pitch change rods (4), and a non-rotating star (2) connected to the cyclic control stick.

The cyclic-stick control tilts the swash-plate assembly to move the pitch-change rods vertically.

Three control tubes are connected to the non-rotating star. The two diametrically opposed tubes (6) and (7) provide lateral control by differential action while the third tube (5), which lies in a plane at right angles to that of the lateral control tubes, transmits longitudinal control movements.

A nut, located at the base of the cyclic control stick, within the pilot's reach, is used to adjust the friction provided by the clamping of a steel cup on a ball secured to the floor. An adjusting collar located above the nut, limits loosening of the latter by the pilot, thus providing the required residual friction.

Both control channels (longitudinal and lateral) are provided with servo-units (8 and 9) to reduce loads to be applied to the cyclic control stick.



Cyclic-pitch control system operating diagram
Figure 3

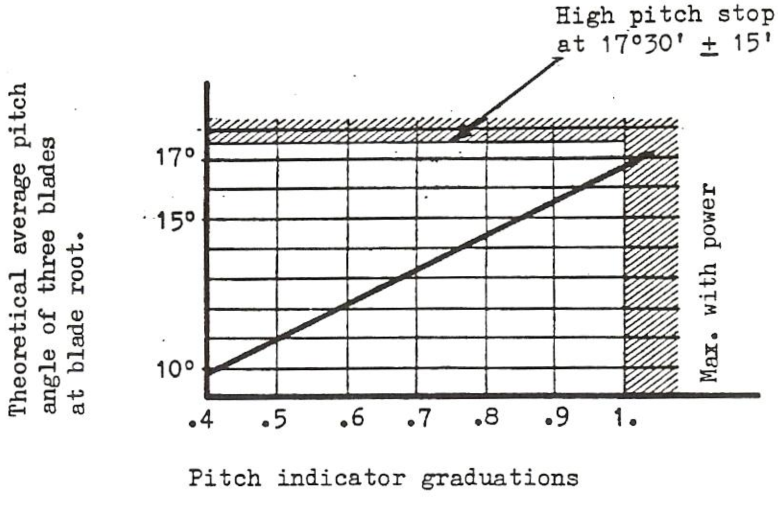
C - COLLECTIVE PITCH CONTROL (Figure 4)

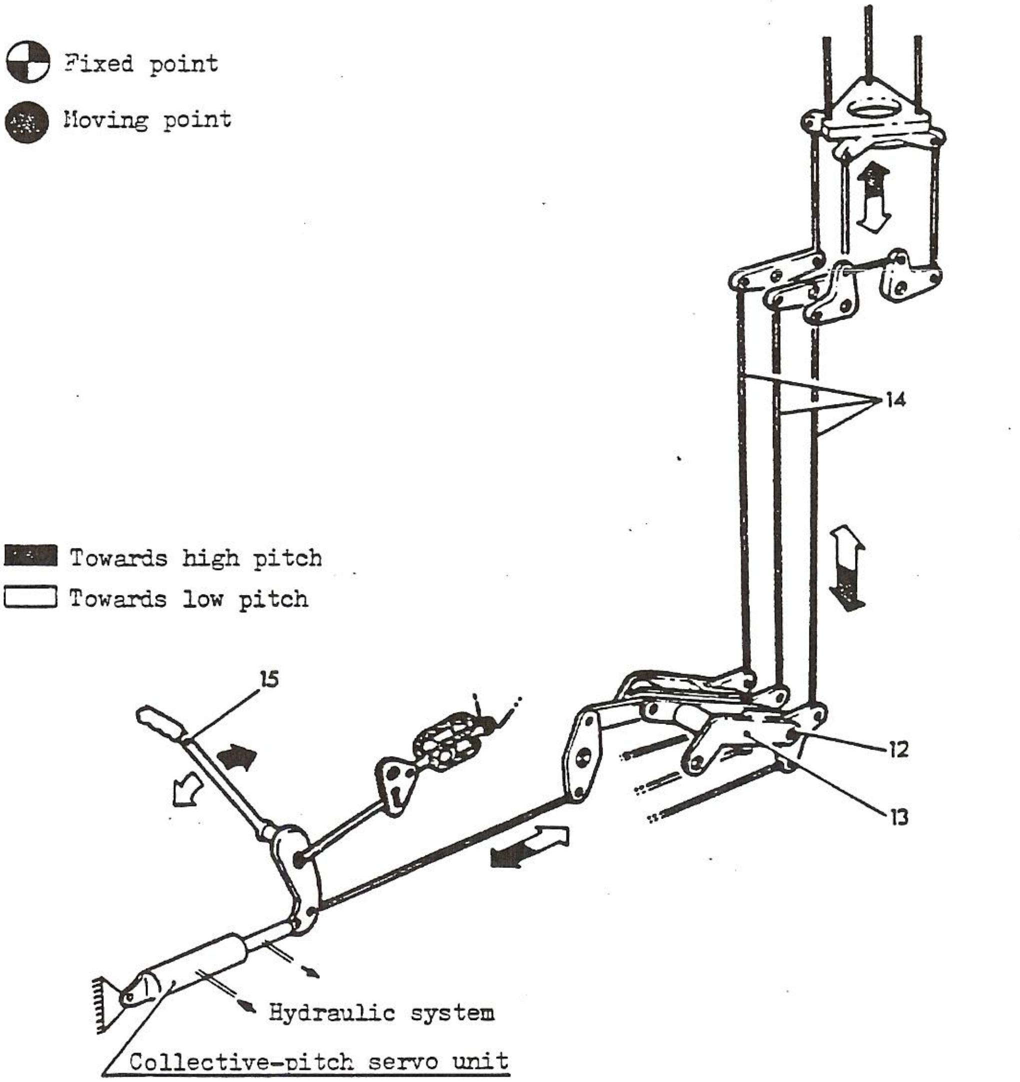
The three mixing unit bell-cranks are pivoted on a common hinge pin (12) carried by the collective bell-crank (13) connected to the collective-pitch control lever (15). The substantially vertical movement of this hinge pin (12) is, therefore, transmitted simultaneously to the three swash-plate control tubes (14) causing the swash-plate assembly to move vertically on the rotor shaft, thereby varying the pitch of the three blades by the same amount.

Collective-pitch friction is adjusted by the pilot by means of a large knob at the base of the pitch lever.

A servo-unit is fitted to reduce loads to be applied to the collective control lever.

An adjustable low pitch stop determines rotor r.p.m. in autorotative flight conditions. Collective-pitch values are transmitted by an electrical transmitter, connected by a link to the collective-pitch lever torque shaft, to an indicator on the instrument panel.



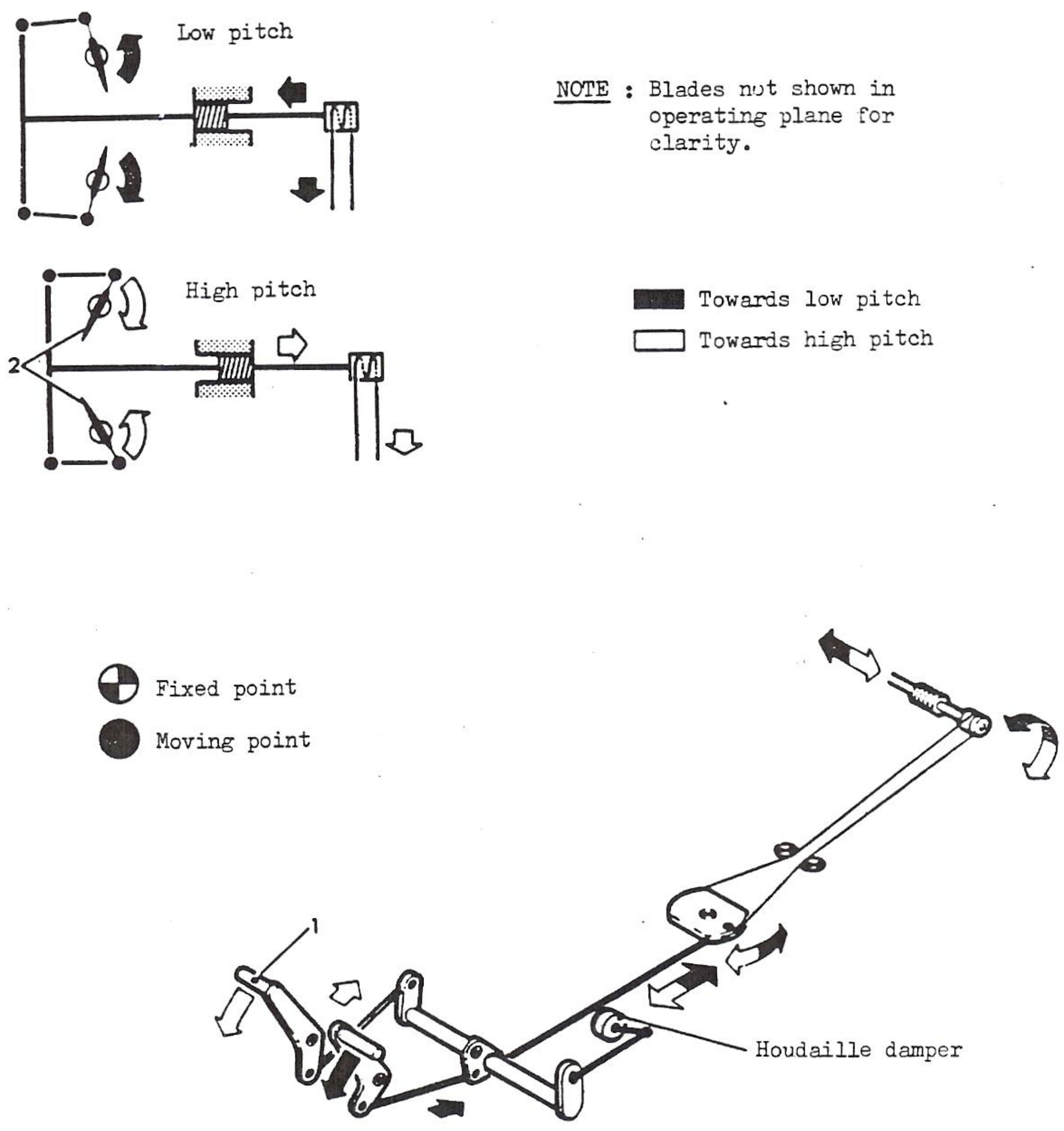


Collective-pitch control system operating diagram
Figure 4

APPENDIX D

D. YAW CONTROL (Figure 5)

Yaw control consists in varying the pitch angle of the tail rotor blades (2) by action on directional control pedals (1). As the tail rotor is located below the main rotor plane, the aircraft shows a slight tendency to bank towards the right in power-on-flights.



Yaw control system functional diagram
Figure 5

5. FUEL SYSTEM

Fuel down from the tank by the booster pump passes through a filter provided with a by-pass valve, and then through a shut-off cock to a fitting where the fuel system branches out into two lines :

- the torch igniter supply line (engine starting)
- the main supply line (normal engine operation)

A pressure switch on the filter delivery line is connected to a warning light on the instrument panel, whereby the pilot is informed of excessive fuel pressure in the event of the filter becoming clogged. A clogging tell-tale (red) is installed on the filter for checking operation of the by-pass valve.

A. ENGINE STARTING SYSTEM

The torch igniter supply line operates as soon as starting is initiated. It ceases to operate as soon as this sequence, controlled automatically by the electrical starting unit, is ended.

It includes :

- a micropump, electrically operated, which pressurises fuel delivered to the torch-igniters and controls opening of the electric cock on the main supply line through a pressure switch.
- two torch igniters which atomize and ignite the fuel.

B. MAIN SUPPLY SYSTEM (Figure 6)

The main supply system adjusts fuel supply up to the injection wheel of the combustion chamber.

It consists of :

- a speed governor and pump assembly which ensures :
  . supply of fuel
  . governing of the engine rotational speed to a constant value of 33500 rpm.
- a motor-operated cock controlled by the automatic starting unit. The position of the cock is indicated by an index visible through a window.

  From the motor-operated cock the fuel enters the engine through a dual inlet fitting and, through internal drillings in the engine casings and then the fuel supply tube, is conveyed to the injection wheel whence it is sprayed into the combustion chamber. On starting, excess fuel is drained off through a valve installed on the outlet of the electric cock.

C. MONITORING AND SAFETY DEVICES

A fuel contents gauge on the control pedestal indicates the quantity of fuel contained in the tank.

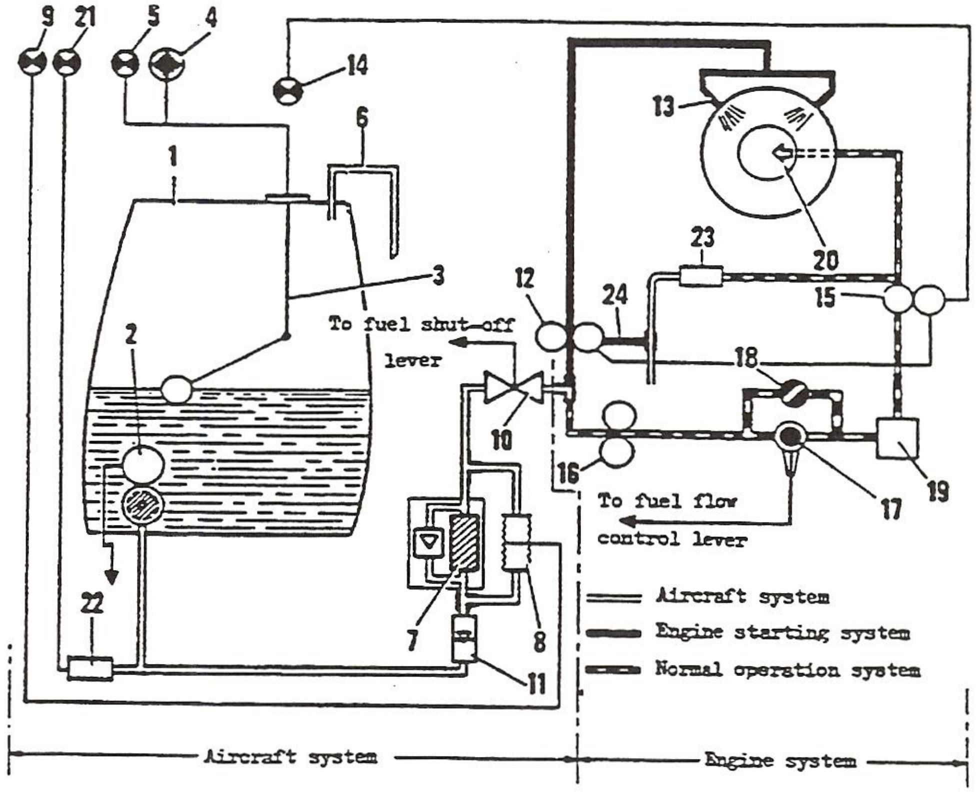
For aircraft fitted with a standard tank, a red line marked on the dial indicates that the last 10 litres of fuel cannot be used.

For aircraft fitted with a four-lobe tank, a red line marked on the dial corresponds to the fuel contents gauge stop position.

A red warning light mounted on the gauge indicator warns the pilot that there are only about 60 litres of fuel left in the tank, i.e. :

- approximately 10 mn of flight.

This flying time has been defined to ensure in case of unexpected flight manoeuvres (steep attitude angles).
The warning light can be checked for correct operation by using a switch provided on the instrument panel.



Fuel system functional diagram
Figure 6

1	Fuel tank	14	Motor-operated cock warning light
2	Booster pump	15	Motor-operated cock
3	Fuel contents transmitter	16	Fuel pump
4	Fuel contents gauge	17	Fuel flow cock
5	Low fuel warning light	18	"Starting" metering walve
6	Vent	19	Governor
7	Filter and by-pass valve unit	20	Injection wheel
8	Filter-clogging pressure switch	21	Fuel pressure warning light
9	Filter-clogging warning light	22	Fuel pressure switch
10	Fuel shut off cock	23	Starting valve
11	Check valve	24	Micro pump drain
12	Micropump		
13	Torch igniters		

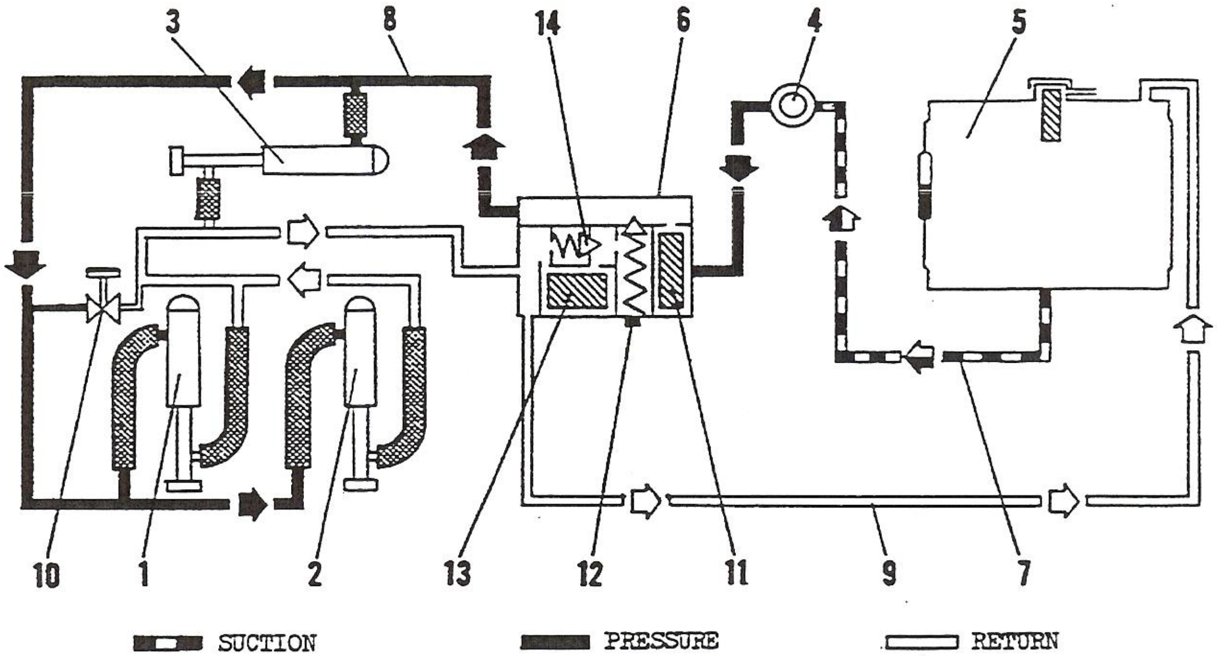
APPENDIX D

6 - HYDRAULIC POWER SYSTEM

A. SERVO-UNITS (Fig. 8)

Collective pitch lever and cyclic stick input efforts are eliminated by hydraulic servo units which also dampen out control system vibration and prevent feedback of control loads.

In the event of servo unit failure, flying is still possible for the servo units can then be cut out by means of a cock located within the reach of the pilot.



1. Fore-and-aft control servo unit
2. Lateral control servo unit
3. Collective-pitch servo unit
4. Pump
5. Reservoir
6. Filter unit
7. Suction line
8. Pressure line
9. Return line
10. Cock
11. 50-micron pressure filter
12. Safety valve, 28 bars (406 p.s.i.)
13. 20-micron by-pass filter
14. 20-micron filter valve.

Servo controls functional diagram
Figure 8

APPENDIX D

7 - ELECTRICAL POWER SUPPLY

A. D.C. POWER SUPPLY

Electrical power is supplied :

- For starting : either by 40 Amp. hour = 24 volt aircraft battery, or by an auxiliary starting unit connected to the external power receptacle located aft of the electrical equipment box.

- In flight by a 4000 watt starter-generator. In addition, a static convertor supplies the electrical horizon with a.c. power.

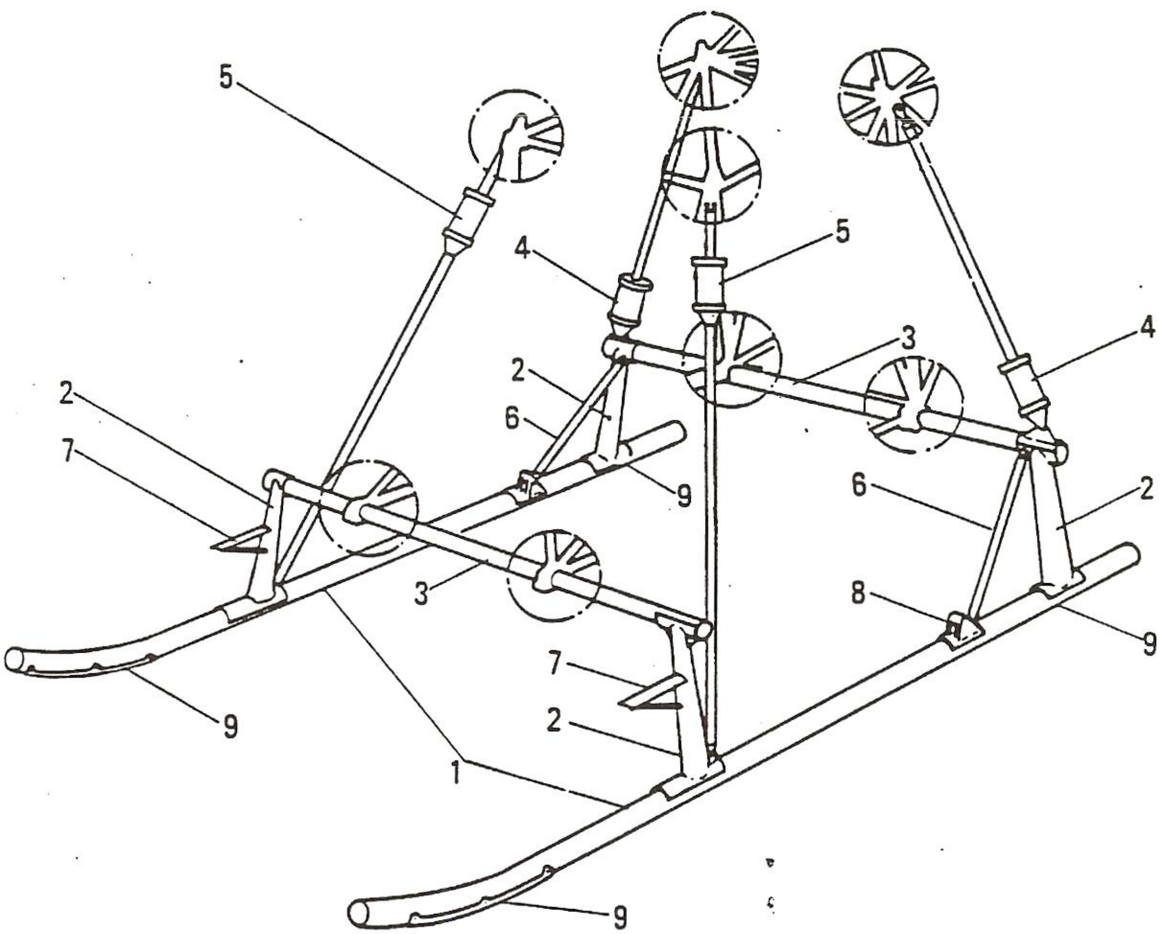
The electrical installation comprises :

- 4 main components : battery, starter-generator, electrical equipment box, automatic starting box.
- instrumentations : voltmeter, generator warning light
- 2 protection devices : fuses, circuit-breakers.
- 2 switches : battery master switch, generator ON-OFF switch.

8 - SKID TYPE LANDING GEAR

The skid type landing gear consists of two skids interconnected by two cross-tubes secured to the body structure. Two shock-struts are mounted on the front and rear cross tubes to damp out vibrations on the ground.

The skid-type landing gear is fitted with two wheels, for the sole purpose of facilitating ground handling. The two wheels are retractable. Four steel shoes are secured to the underside of the skids to prevent undue wear.



1	Skid	6	Strut
2	Post	7	Footstep
3	Cross tube	8	Jacking bracket
4	Rear shock absorber	9	Shoe
5	Front shock absorber		