aerospatiale

SA 315 B
LAMA

VOLUME 2

NOTE

This manual is intended for the personnel of the operators of AEROSPATIALE helicopters.

Its main object is to offer a working knowledge of AEROSPATIALE aircraft and it cannot be brought up to date on detail points.

It never replaces the manuals delivered with the helicopters.

aerospatiale

Issue : March 1976

aerospatiale

SUMMARY

CHAPTER 7

HYDRAULIC SYSTEM

(SERVO-CONTROL UNITS)

CONTENTS

5606

7. - HYDRAULIC SYSTEM (SERVO-CONTROL UNITS)

7.00. - GENERAL (Figure 1)

The hydraulic system provides the energy required for the operation of the servo-unit installation. It consists of :

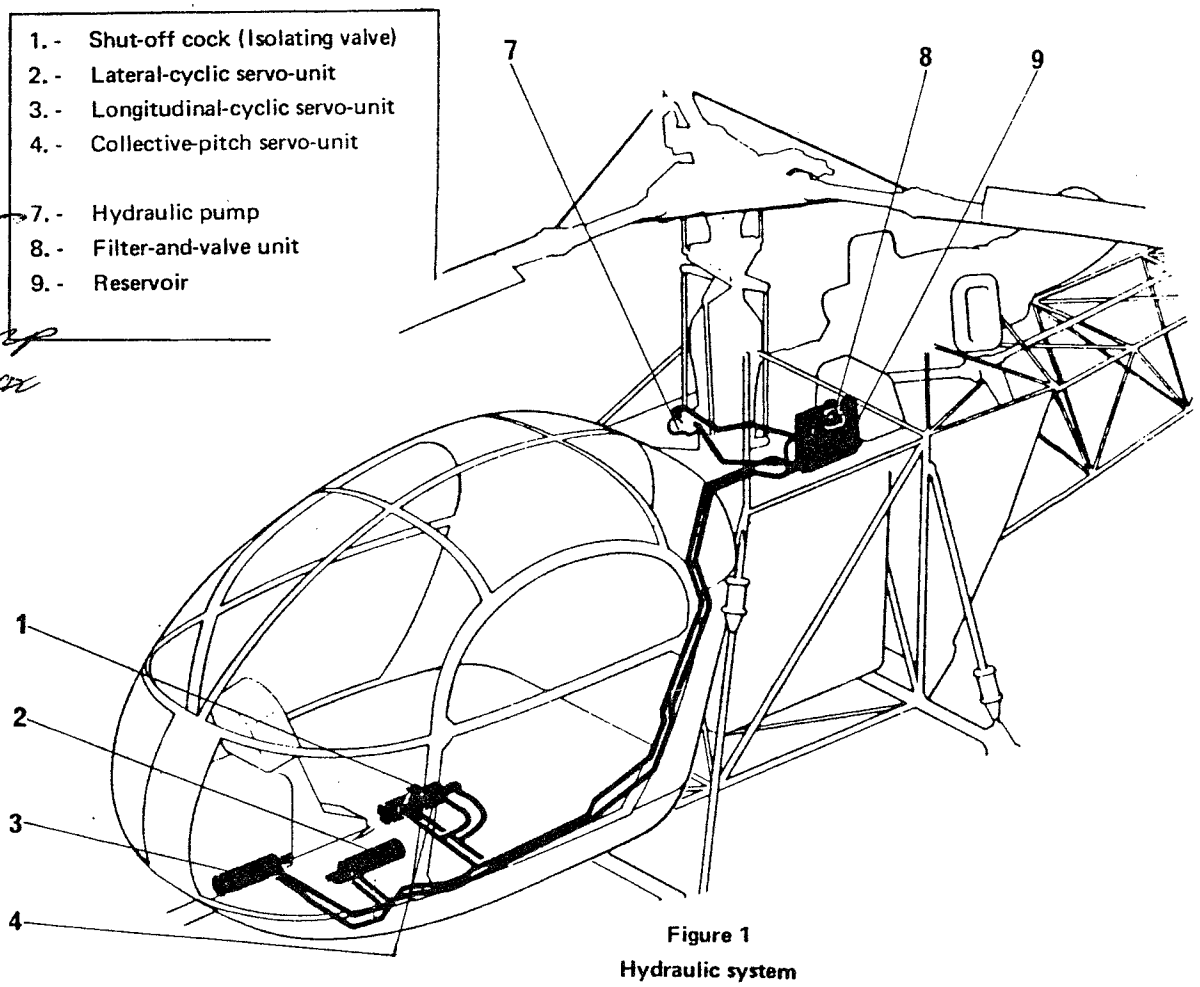
A hydraulic power generating system including :

- 1 reservoir (9)
- 1 filter-and-valve unit (8)
- 1 pump (7)

The consumer services including :

- 3 servo-units (2) (3) (4)
- 1 shut-off cock (1)

The servo-units are provided to eliminate control loads on the cyclic-stick and the collective-pitch control lever. Their action is irreversible, which means that there is no feedback to the pilot's controls. Since the aircraft remains flyable without using the servo-units, there is no monitoring installation for the hydraulic system.



ON oil pump
on MGBox

Figure 1
Hydraulic system

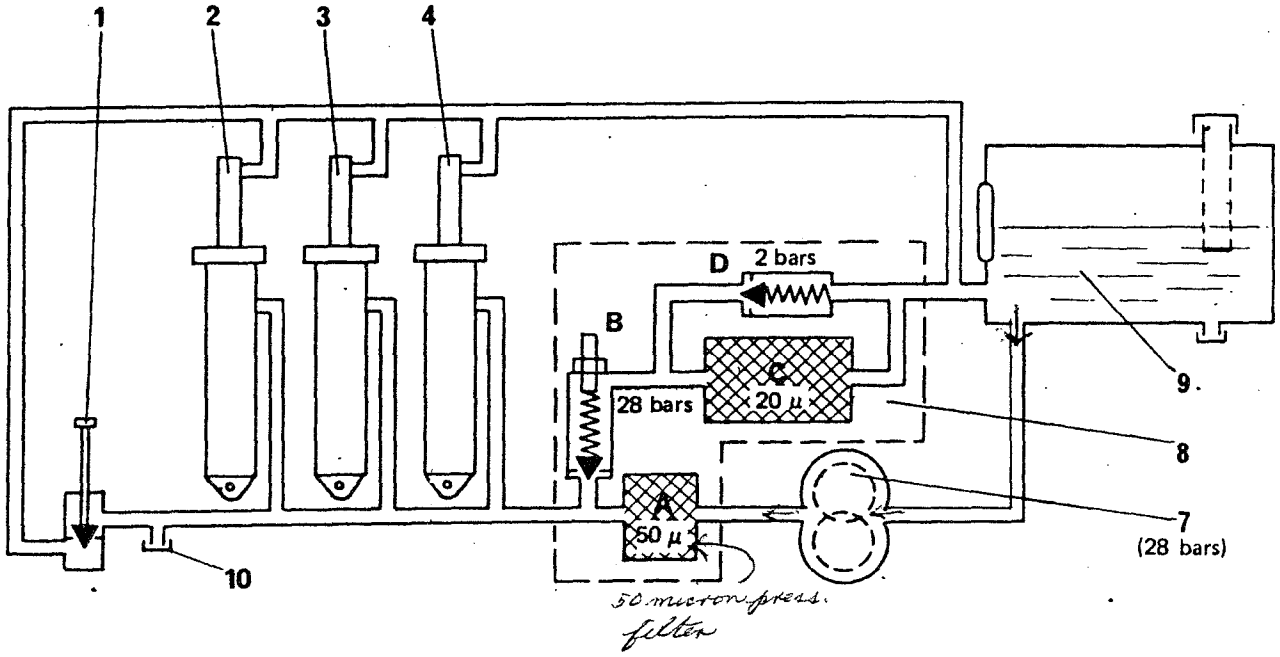
7.10. - DESCRIPTION AND OPERATION OF THE HYDRAULIC SYSTEM

7.10.1.- GENERAL OPERATION OF THE HYDRAULIC SYSTEM (Figure 1)

The nominal operating pressure in the circuit is 28 bars.(400 psi). Servo-unit efficiency is maintained down to 6 bars (85 psi) minimum pressure, and therefore, servo-unit operation may be initiated as soon as the rotor starts to rotate.
The pump (7), driven by the main gear box, draws the liquid from a reservoir (9) and delivers it, through a 50-micron protective filter (A), to the servo-units (2) (3) (4), from which the hydraulic fluid is returned to the reservoir.
While the servo-units are operating, the cock (1) is closed to isolate the pressure lines from the return lines.

When the controls are not actuated, the flow rate in the pressure system is reduced (to the minimum permanent servo-unit consumption) ; the resulting pressure increase causes opening of a safety valve (B) set at 28 bars (400 psi) and the fluid discharged by this valve returns to the reservoir through a 20-micron (C) filter.

In the event of a hydraulic power failure, moving the control cock (1) to OFF position opens communication between the pressure and return lines ; the hydraulic back-pressures are thus cancelled at the servo-unit level, which results in alleviating the pilot's control input forces.



1.- Shut-off cock (Isolating valve)
2.3.4.- Servo-units
7.- Hydraulic pump
8.- Filter-and-valve unit
A - C = Filters
B = Discharge valve
D = C-filter by-pass
9.- Reservoir
10.- Pressure pick-off for pressure gauge

Pressure
Suction
Return

Figure 1

Hydraulic system - Block diagram

7.10.2. - MAIN COMPONENTS OF THE HYDRAULIC SYSTEM

A. - HYDRAULIC PUMP (Figure 2)

This is a gear-type pump mounted on the front of the main gearbox and driven by the gearbox oil pump.

Characteristics :

- Rotational speed	:	2 500 r.p.m.
- Delivery rate	:	6 l/min.
- Operating pressure	:	28 bars
- Torque under working pressure	:	0.27 m.daN

1. -	Roller bearing
2. -	O-ring
3. -	Seal
4. -	Half-body
5. -	Half-body
6. -	Driving pinion
7. -	Seal
8. -	O-ring
9. -	Driven pinion
10. -	Roller bearing
11. -	Flange

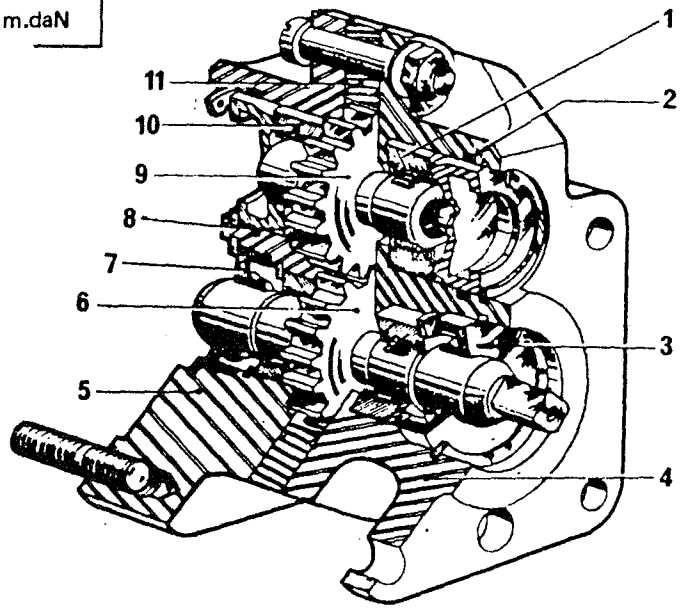


Figure 2
Hydraulic pump

B. - FILTER-AND-VALVE UNIT (Figure 3)

The filter-and-valve unit is located on the R.H. side of the reservoir, and consists of :

- 1 50-micron pressure filter (13)
- 1 discharge valve (11) set at 28 bars (400 psi)
- 1 20-micron return filter (10) downstream from the discharge valve (11)
- 1 by-pass valve set at 2 bars (28 psi), across the 20-micron filter

C. - RESERVOIR (Figure 3)

The reservoir (1) is located on the transmission support platform, L.H. side of main gearbox, and it is flat-shaped in order to improve cooling of the hydraulic fluid. It consists of :

- 1 filler neck (3) fitted with a strainer (4)
- 1 oil level sight gauge (5) with various scales and markings corresponding to the different models of aircraft
- 1 drain plug (6)
- 1 suction line connection (8) and a return connection (7)

7.10.2. - MAIN COMPONENTS OF THE HYDRAULIC SYSTEM (Continued)

1. - Reservoir
2. - Reservoir attachment straps
3. - Filler neck
4. - Strainer
5. - Oil level sight gauge
6. - Drain plug
7. - Return connection
8. - Suction line connection
9. - Filter-and-valve unit
10. - 20-micron filter
11. - Discharge valve
12. - By-pass valve of filter (10)
13. - 50-micron filter
14. - Seals
15. - Retaining ring
16. - Nut
17. - Filter elements
18. - Filter bowl
19. - Filter element retainer
20. - Spring
21. - Pressure adjustment screw

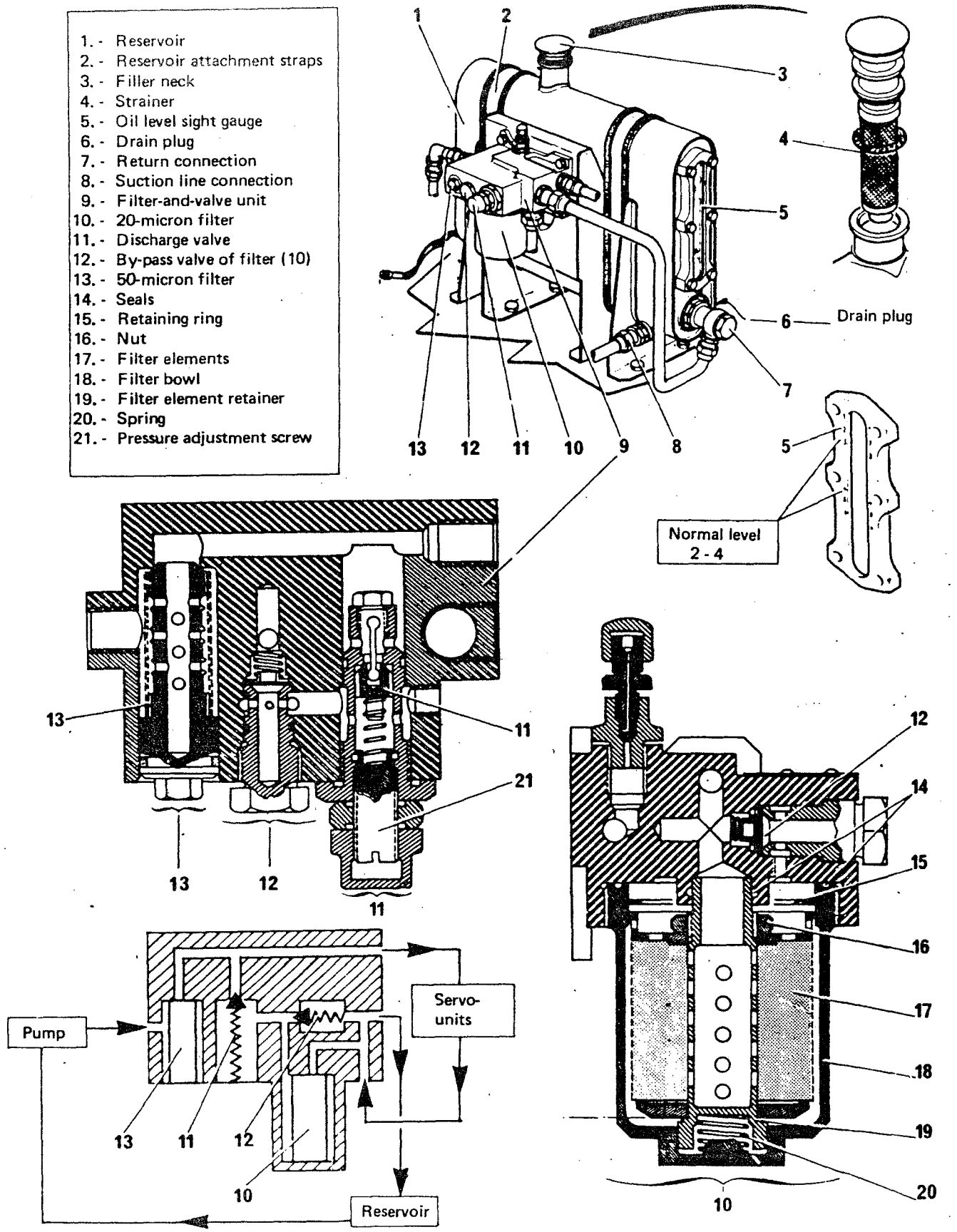


Figure 3
Reservoir and filter-and-valve unit

7.10.2. - MAIN COMPONENTS OF HYDRAULIC SYSTEM (Continued)

D. - HYDRAULIC SERVO-UNIT

(1) GENERAL

a - Purpose of servo-controls

Helicopter handling as a rule is made difficult by the aerodynamic forces exerted on the blades, that the pilot must overcome to operate his controls (and handling may become impossible in the case of heavy tonnage aircraft). The installation of servo-controls in the flying control linkage :

- facilitates handling by substituting the hydraulic power of a jack for the pilot's muscular force
- transmits to the control linkage the pilot's control input movements, WITHOUT ALTERING THEM.

A servo-control is therefore a system by which the output movement is slaved to the input movement, i.e. to the pilot's action.

b - Design principle of a servo-control unit (Figure 4)

A hydraulic servo-control unit generally consists of :

- A fluid distributor slide-valve : control reference system.
- A hydraulic jack : motive element, fed by the distributor ; its output movement is slaved to the input movement.
- A connection with «pilot's action» from the pilot's control to the distributor slide valve.
- A connection with «jack reaction» from the jack piston to the distributor body.
- A direct «input-output» connection with an input play (J) , allowing the pilot's action to be applied to :
  - . the distributor slide valve, when the servo-control is pressurized
  - . the control linkage directly, when the servo-control is not pressurized.

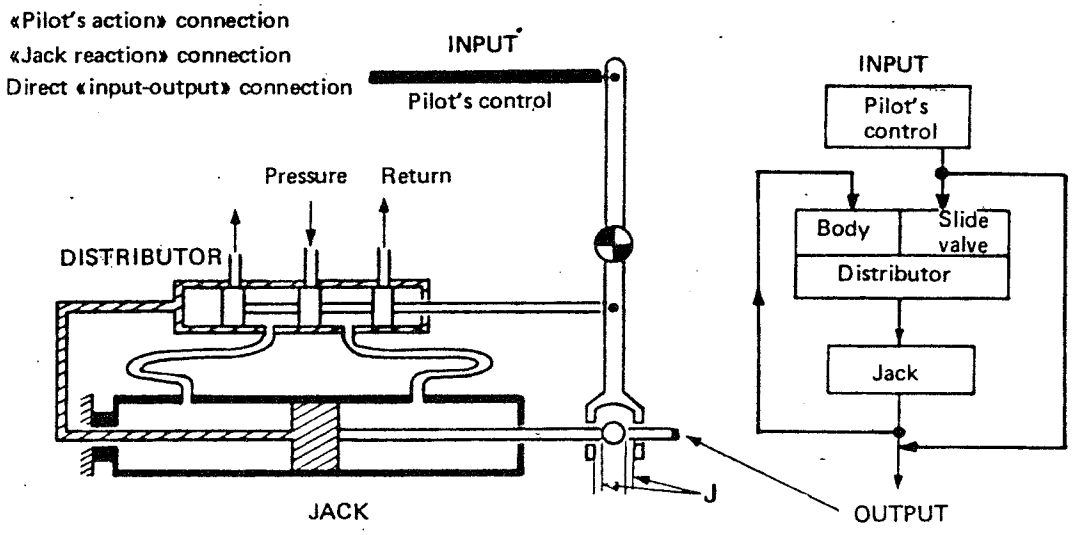


Figure 4

PILOT'S ACTION ⟶ slide valve displacement (references shifted) :
THE JACK STARTS MOVING

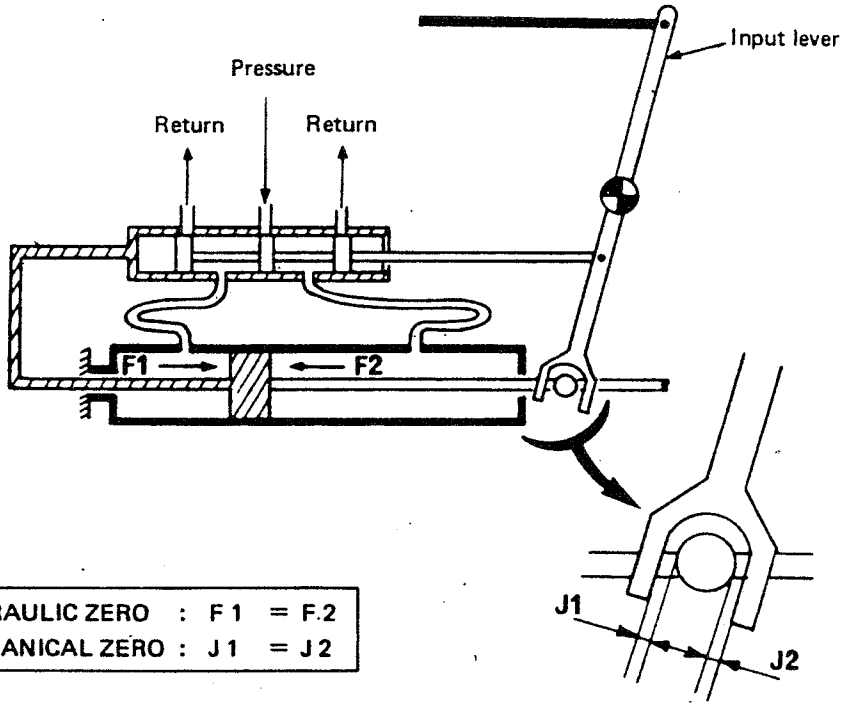
JACK REACTION (When pilot's action stops) ⟶ distributor body displacement (references centered again)
THE JACK STOPS

7.10.2. - MAIN COMPONENTS OF THE HYDRAULIC SYSTEM (Continued)

D. - HYDRAULIC SERVO-UNIT (Continued)

c - Definitions (Figure 5)

- The hydraulic zero (or «neutral» position of the distributor slide valve) is the slide valve position for which the servo-control jack remains motionless while the supply circuit is under pressure.
- The mechanical zero (or «neutral» position of the input lever) is the relative «input lever - servo-control output» position which centres the input play about the lever. Thus, the pilot's action «command» is symmetrically distributed on the distributor slide valve : a movement of the pilot's control in either direction brings about the same opening of the distributor ; in other words, displacement speed of the jack piston equal in both directions.



HYDRAULIC ZERO	:	F 1	= F.2
MECHANICAL ZERO	:	J 1	= J 2

Figure 5

A servo-control is balanced when the mechanical and hydraulic zeroes coincide.
The «mechanical zero» and «hydraulic zero» are irrespective of the jack position : for each jack stop, there is a return to the mechanical and hydraulic zeroes.

The drift of a servo-control is the slow displacement of the jack produced by a shift of references (mechanical zero - hydraulic zero). For the drift of a servo-control to be noticed, the input linkage should be maintained set on the mechanical zero ; otherwise, the references would be re-centered after an imperceptible displacement of the mechanical zero.

A WELL-ADJUSTED SERVO-CONTROL SHOULD NOT DRIFT.

7.10.2. - MAIN COMPONENTS OF THE HYDRAULIC SYSTEM (Continued)

D. - HYDRAULIC SERVO-UNIT (Continued)

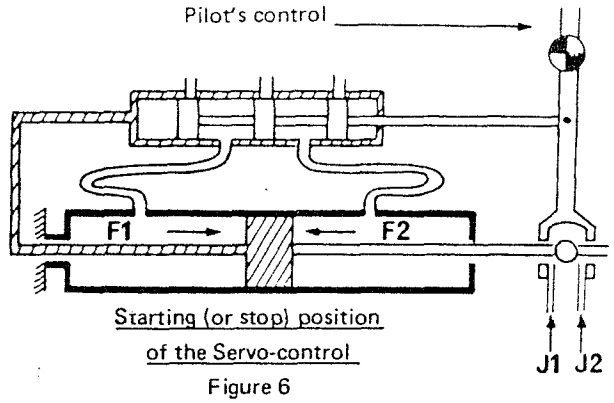
d - Operating principle (Figure 6)

Servo-control starting position

- Pilot's control at rest
- Jack piston in any position
- Servo-control in balanced position : F1 = F2
- Input play centered : J1 = J2

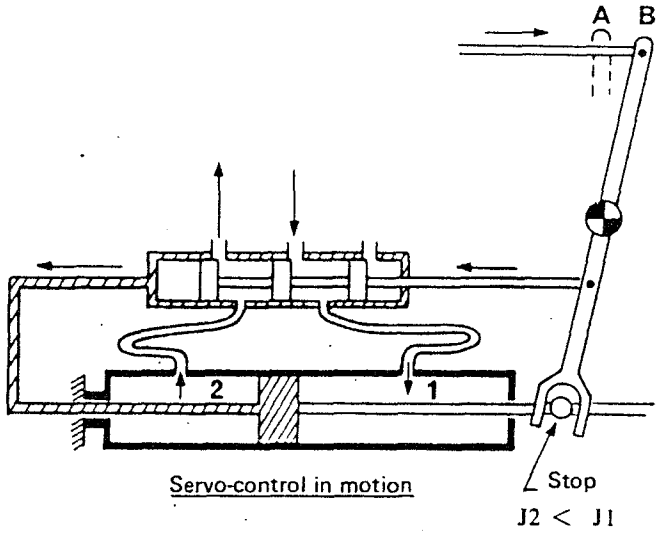
Pilot's action : control movement initiated. The control movement, for instance to the right (from A to B) produces slide valve displacement to the left, within the limits of the input play. Chamber (1) of the jack is then supplied with hydraulic pressure, while chamber (2) is connected to the reservoir return line. The piston starts moving to the left, driving the distributor body.

Actual control movement. As long as the control movement is maintained, the slide valve is pushed to the left. As the jack piston drives the distributor body in the same direction, no related slide valve - body displacement occurs.
The jack is still fed and continues to move in the same direction, at the same speed.



Starting (or stop) position of the Servo-control

Figure 6



Servo-control in motion

Control movement discontinued. As soon as the pilot's control movement decreases, the distributor body displacement, driven by the piston (jack reaction), becomes preponderant and tends to close the distributor, by differential displacement of the distributor body and slide valve and therefore to reduce the piston speed.

When the pilot's action is discontinued, the slide valve comes back to its neutral position, but the piston displacement continues until the distributor body (travelling with it) reaches the «hydraulic zero». Then, the piston is balanced and ceases moving. Simultaneously, the stop which determines the input play with respect to the input lever (mechanical zero) is re-centered by the jack output rod.

SUMMARY :

- *The slide valve is displaced in a given direction by the Pilot's action.*
- *The distributor body is displaced in the same direction by the jack reaction.*
  Action speed greater than reaction speed : distributor opens - Jack speed increases.
  Action speed equals reaction speed : distributor opening remains constant.
  Action speed lower than reaction speed : distributor closes - Jack speed decreases.

7.10.2. - MAIN COMPONENTS OF THE HYDRAULIC SYSTEM (Continued)

D. - HYDRAULIC SERVO-UNIT (Continued)

e - Operation of the servo-unit in «Manual control» (Figure 7)

In the event of a hydraulic power failure, the control linkage may be directly actuated by the pilot, through the input lever, after taking up of input play. The slide valve displacement preceding the pilot's action on the control linkage (input play) makes it possible to actuate the piston.

Example : Control movement to the right : The jack chamber (A) is connected to the reservoir return line ; chamber (B) is in communication with the supply circuit. Displacement of the piston drives the fluid from chamber (A) to the reservoir, and results in suction from the supply circuit (chamber (B) volume increases).
If the control movement was made to the left, reverse results would be obtained.

The required operating force resulting from the «pump effect» is significant.

To moderate it, open the cock so that the pressure and return lines are connected.

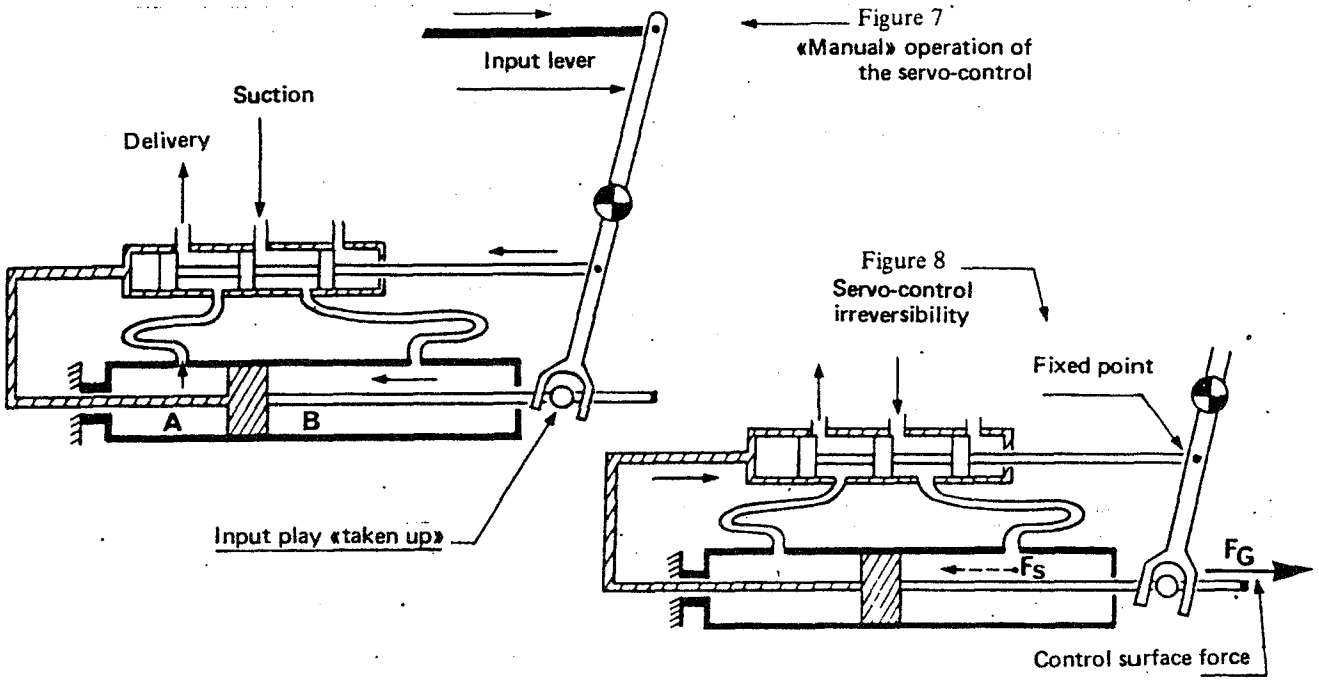


Figure 7
«Manual» operation of the servo-control

Figure 8
Servo-control irreversibility

f - Servo-control irreversibility (Figure 8)

A hydraulic servo-control is an irreversible device, preventing the transmission of «control body - control linkage» forces.

In fact :

1. - When the servo-control is operated, the blade aerodynamic forces are balanced or exceeded by the jack force.

2. - When the servo-control is fixed, the control body forces (F_G) are noticeable on the piston rod and tend to displace both the piston and its associated distributor body. The distributor slide valve remains motionless, on account of the input play. The resulting relative displacement «slide valve - distributor body» leads to the distributor opening in the direction that will produce a jack displacement opposite to the control surface force. Therefore, the assembly will remain in a state of equilibrium (FG = FS).

7.10.2. - MAIN COMPONENTS OF THE HYDRAULIC SYSTEM (Continued)

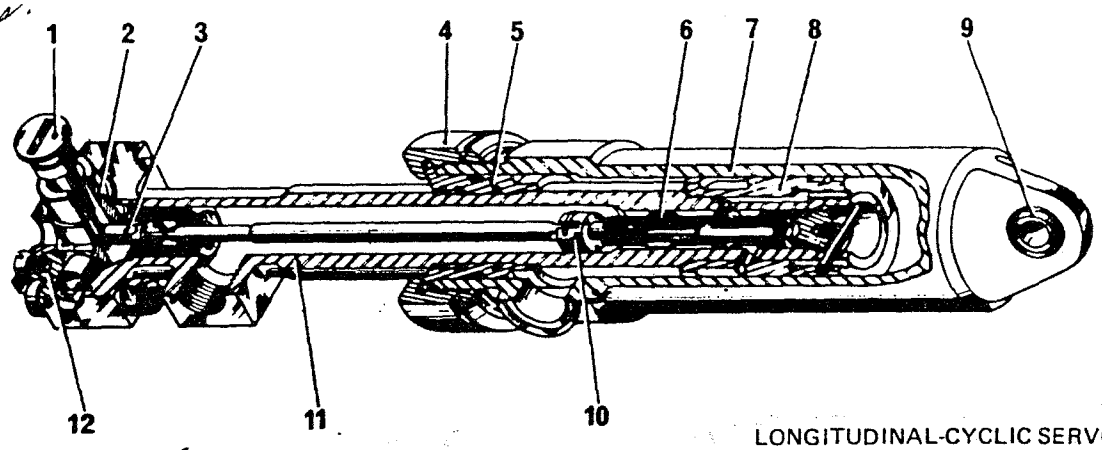
D. - HYDRAULIC SERVO-UNIT (Continued)

(2) SERVO-CONTROL UNIT MODEL : SAMM-4300

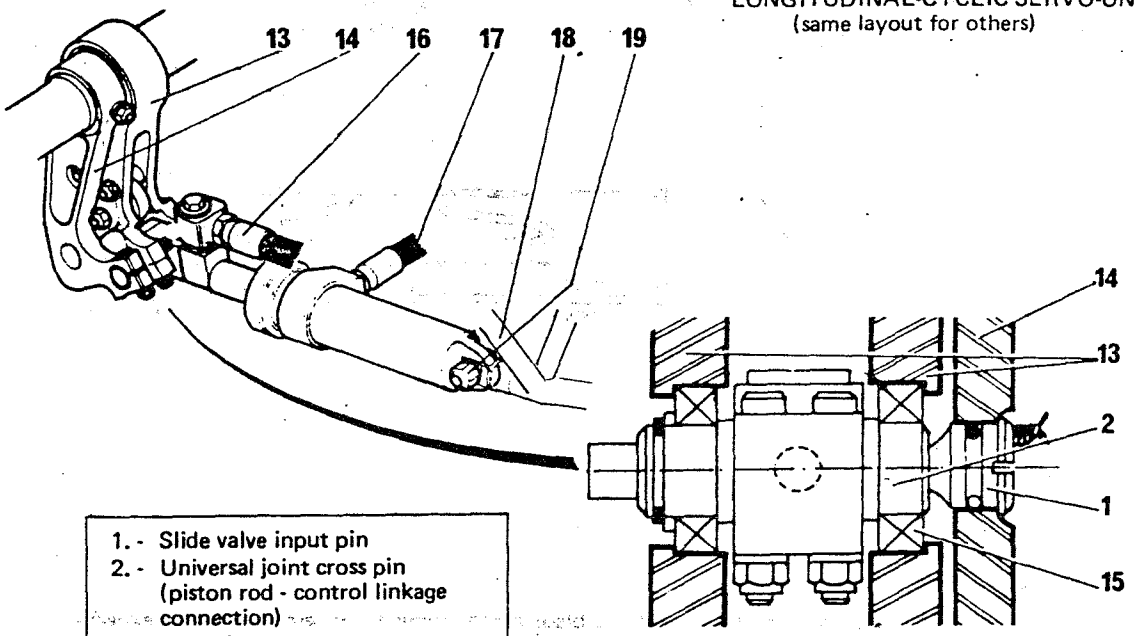
a - Characteristics

- Operating pressure : 28 bars
- Maximum flow rate : 2.4 l/mn
- Maximum stroke : 86 mm
- Working stroke : 78 mm
- Dead stroke of hydraulic control : ± 0.04 mm
- Maximum speed empty : 120 mm/sec.
- Maximum force under 28 bars : 110 daN
- Permanent consumption : 200 cm3/min.

b - Description (Figure 9)



LONGITUDINAL-CYCLIC SERVO-UNIT
(same layout for others)



1. - Slide valve input pin
2. - Universal joint cross pin (piston rod - control linkage connection)
3. - Ball joint
4. - Nut
5. - Packing-holder
6. - Slide valve
7. - Jack body
8. - Piston
9. - Attachment lug with self-aligning bearing
10. - Slide valve end fitting
11. - Piston rod
12. - Attachment cap (cross pin)
13. - Mobile arm } Pilot's controls
14. - Fixed arm }
15. - Bearing
16. - «Return» hose
17. - «Pressure» hose
18. - Servo-control jack mounting bracket
19. - Attachment pin

Figure 9
Servo-control unit

7.10.2. - MAIN COMPONENTS OF THE HYDRAULIC SYSTEM (Continued)

D. - HYDRAULIC SERVO-UNIT (Continued)

c - Operation (Figures 10 and 11)

- The actuating pin (4), linked to the slide valve (5), is displaced by the pilot's action.
- The actuating pin is driven by the fixed arm (1).
- The piston rod (6) is coupled to the mobile arm (2) at the point of connection with the control linkage.
- A stop pin (3) determines the input play.
- The jack chamber (A) is permanently fed (constant force F_A applied to the piston)
- The sectional area of chamber B is twice that of chamber A. When pressure is supplied to chamber B, the force applied on the piston is $F_B = 2F_A$ and opposed to F_A.

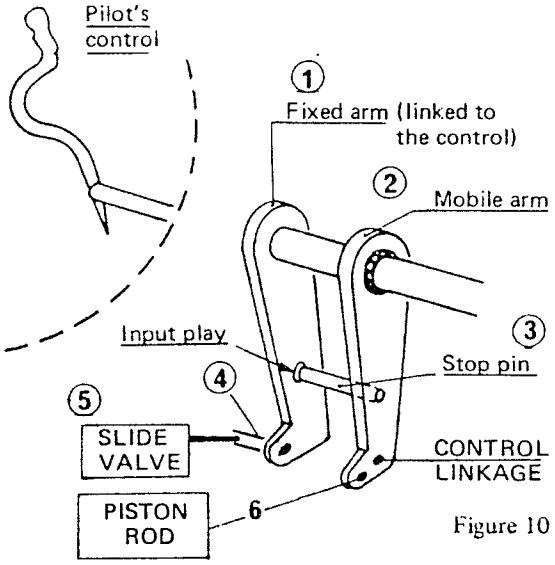
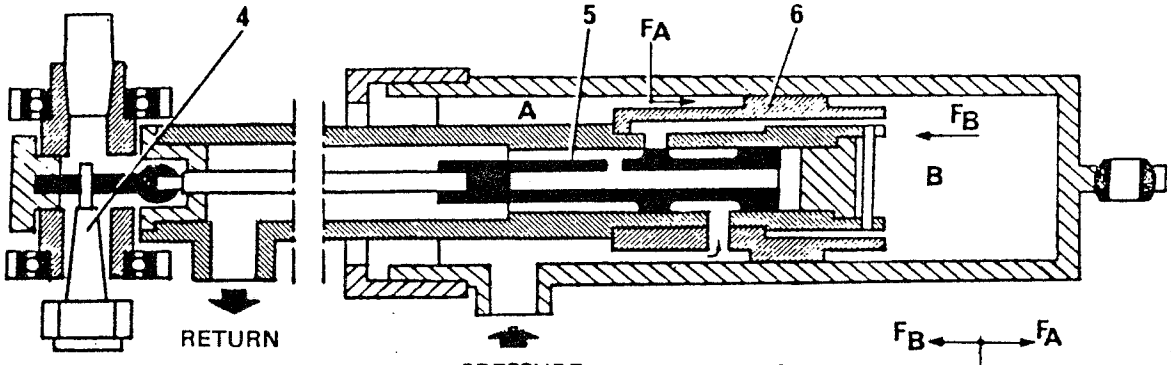
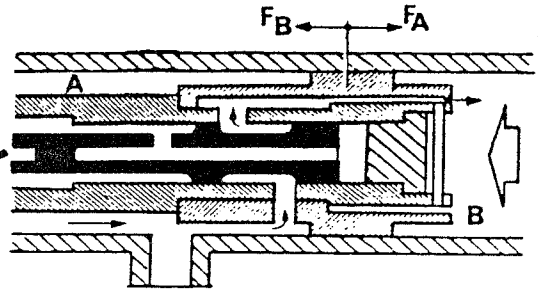


Figure 10



SLIDE VALVE DISPLACED TO THE LEFT

- Chamber B supplied with pressure
- The piston moves to the left under a force $F_B - F_A = F_A$.
- Since chambers A and B are interconnected there is no fluid return to reservoir.



SLIDE VALVE DISPLACED TO THE RIGHT

- Chamber B connected to the reservoir return line.
- The piston moves to the right under the force F_A.

WHEN PILOT'S ACTION IS DISCONTINUED

- Differential displacement of slide valve and piston, resulting in the repositioning of the assembly to «hydraulic zero».
- The piston stops and the input play is re-centered.

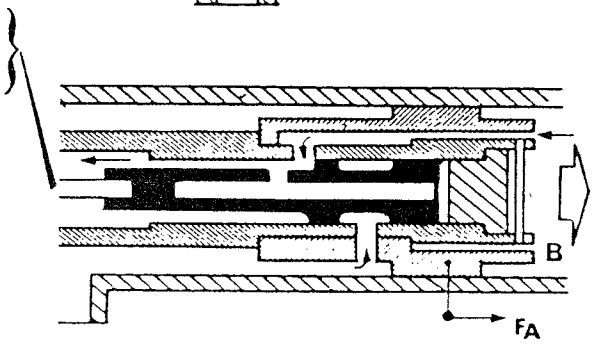


Figure 11

7.20. - HYDRAULIC SYSTEM MAINTENANCE PRINCIPLES

The principles stated hereunder are intended to inform the mechanic of the reason for certain actions. They shall not be considered as a maintenance schedule.

7.20.1. - HYDRAULIC PRESSURE CHECK (Figure 1)

A pressure connector (1), located under the cabin floor, permits the connection of a pressure gauge for testing pressure in the circuit.

PRINCIPLE : Since the pressure is correctly set initially, any pressure variation beyond tolerances indicates an anomaly.

CONSEQUENTLY : Never re-adjust the pressure calibration screw (2) on the discharge valve (3) without first finding the cause of pressure variation (such action might conceal an incipient defect and allow it to develop).

SEARCH OF POSSIBLE CAUSES

- A pressure drop may be due to :
  . a flow-rate increase in the system (for instance, internal leakage ; an external leak would be visible)
  . a flow-rate decrease upstream of the pressure inlet (for instance, filter clogged)
  . jamming of discharge valve in «open» position, or valve spring weakening
  . a pump failure

- A pressure rise may be due to :
  . a flow-rate decrease in the system downstream from the pressure inlet (obstruction)
  . jamming of discharge valve.

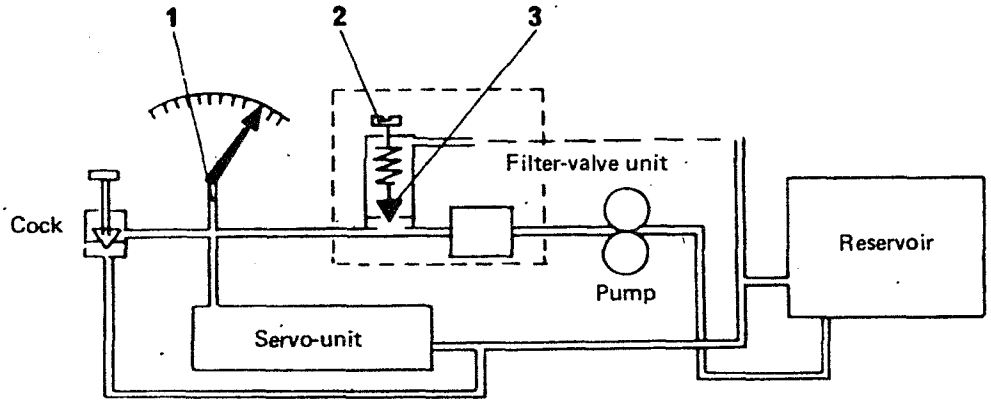


Figure 1
Hydraulic pressure check

7.20.2. - SERVO-UNIT SLIDE-VALVE ADJUSTMENT (Figure 2)

A - PRINCIPLE

When a servo-unit is in the «hydraulic zero» (neutral) position, the control of the distributor slide valve should be set at the mechanical zero (i.e. input play centered). When these two references coincide, symmetrical operation of the servo-control is ensured in both displacement directions (same reaction to a pilot's action). This setting by which a helicopter reference (mechanical zero) is matched to an equipment reference (hydraulic zero) must be made after any installation of a servo-unit.

B - ADJUSTMENT

Preliminary steps : The fixed (4) and moving (5) arms (or bellcranks) are pinned so as to centre the input play and eliminate its effect (a special tool is used for this purpose).
In this configuration, the servo-control pressure supply should not induce any displacement of the jack (drift). If drift is noted, it implies that the distributor slide-valve (1) is not set at the hydraulic zero.

Adjustment consists in : moving the slide valve (1) to the hydraulic zero position, by rotating the eccentric (2) of the actuating pin (3).

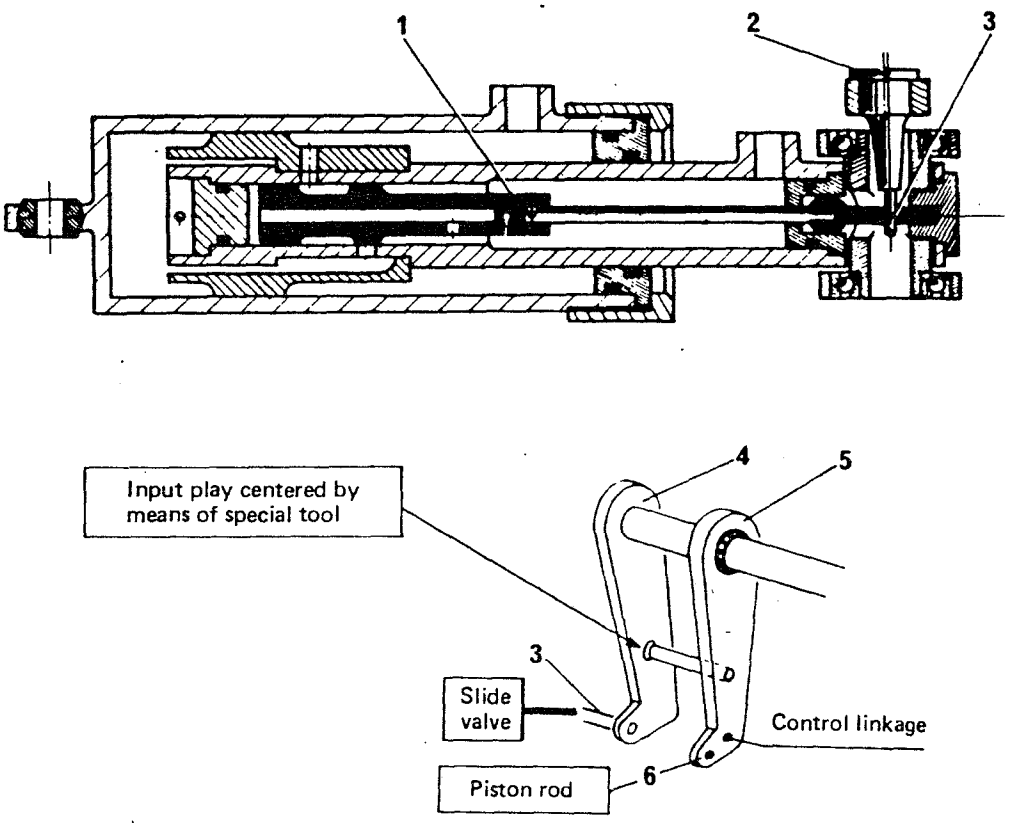


Figure 3
Servo-unit slide-valve adjustment

7.20.3. - SERVO-UNIT CLEARANCE CHECK (Figure 3)

PRINCIPLE : When the controls are in extreme positions (against mechanical stops), a clearance G shall be provided between the fixed and moving parts of the servo-control jack.

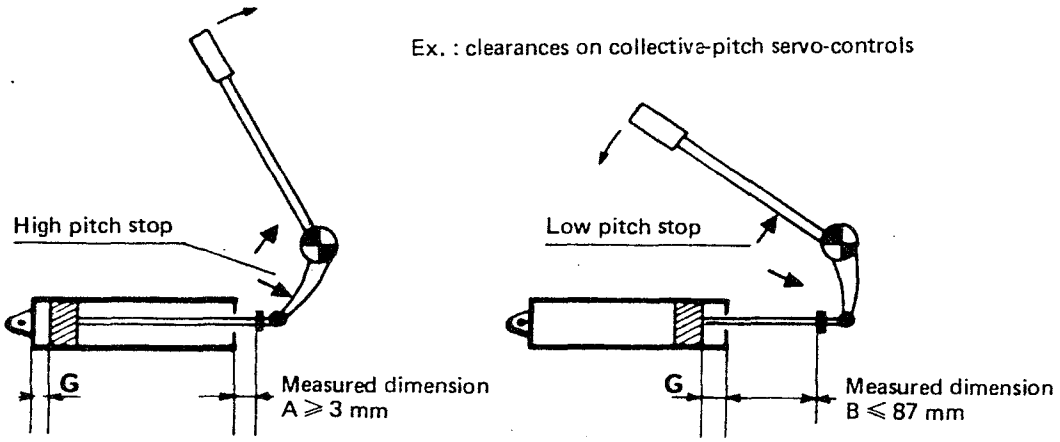


Figure 3
Servo-control clearances

The clearances (G) ensure complete travel of the control linkage, without the servo-control jack being damaged.
These «end of travel» clearances shall be checked after each re-setting of the control stops.

REMARKS :

- The total jack travel is 86 mm
- The clearance measurements, at tolerance limit values, give the following working stroke : B − A : 87 − 3 = 84 mm
  Under such limit conditions, the clearance is therefore : $\frac{86 - 84}{2} = 1$ mm.

CHAPTER 8

FUEL SYSTEM

CONTENTS

8. - FUEL SYSTEM

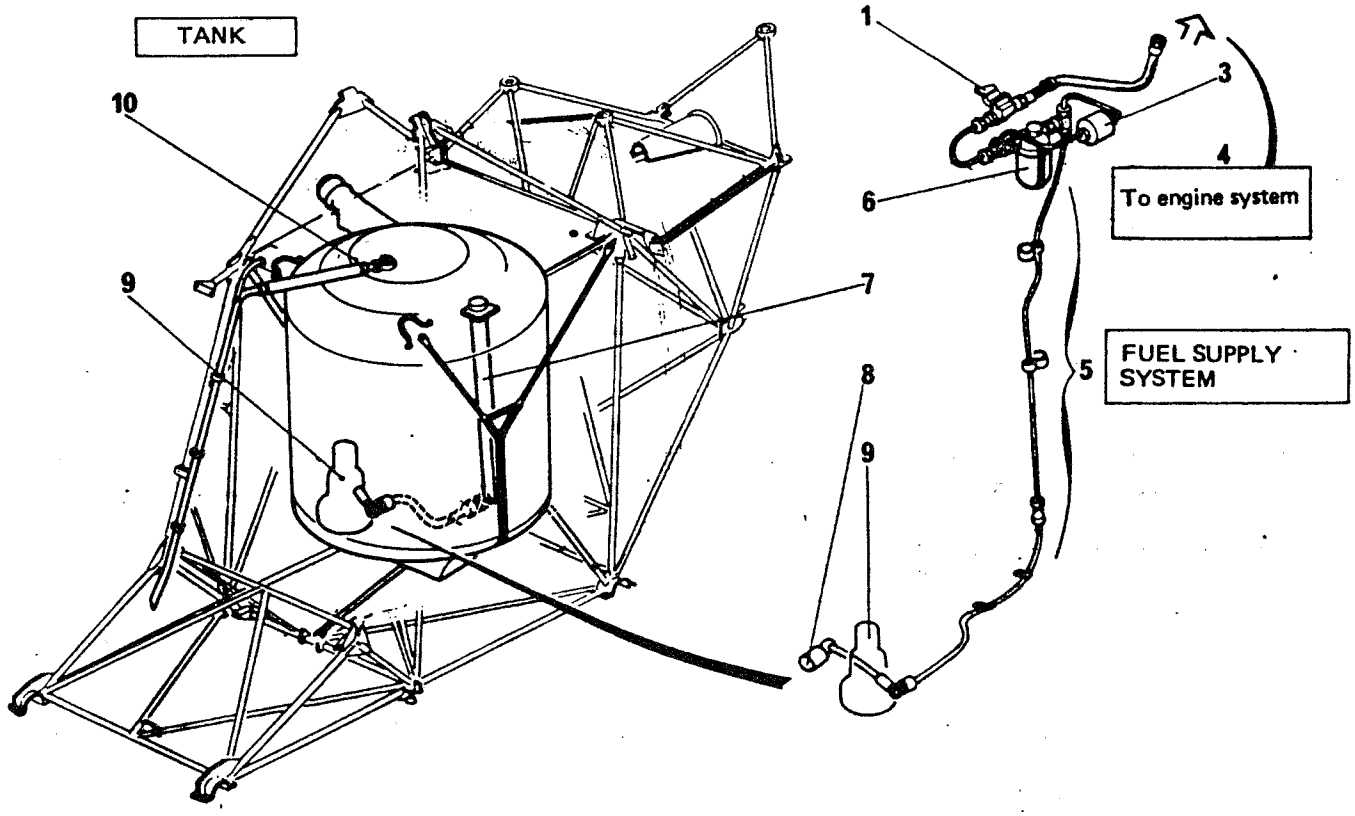
8.00. - GENERAL

8.00.1. - DESCRIPTION OF THE FUEL SYSTEM (Figure 1)

The fuel system consists of :

- the fuel tank (10)
- the fuel supply system (6)
- the engine system (4) - (This is mentioned here for information only as it is described in the engine manufacturer's publications and covered during the TURBOMECA course).
- a control and monitoring system

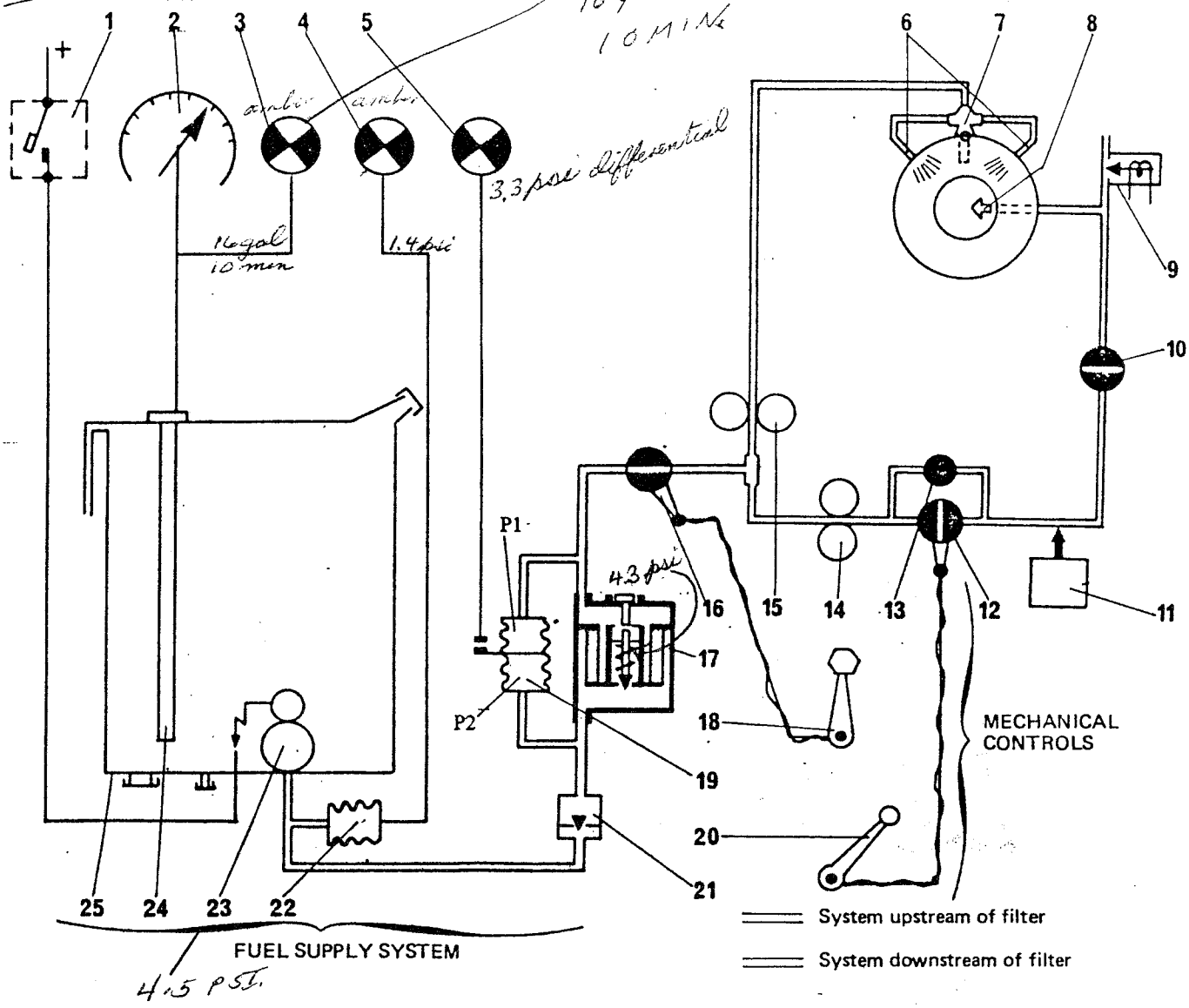
The fuel contained in the tank is delivered by a booster pump (9) via the fuel supply system filter (6) to the engine system.



1. - Fuel shut-off cock	6. - Inbuilt filter by-pass valve
	7. - Fuel gauge transmitter
	8. - Booster pump switch
3. - Filter clogging differential pressure switch	9. - Booster pump
	10. - Tank
4. - Engine system	
5. - Fuel supply system	

Figure 1
Description of the fuel system

8.00.1. - DESCRIPTION OF THE FUEL SYSTEM (Continued)



1. - Booster pump switch	14. - Engine fuel pump
2. - Gauge indicator	15. - Starting micro-pump
3. - «Low level» indicator light	16. - Fuel shut-off cock
4. - «Booster pump pressure» indicator light	17. - Filter by-pass valve and clogging indicator
5. - «Filter clogging» indicator light	18. - «Fuel shut-off» handle
6. - «Torch» igniters	19. - Filter clogging differential pressure switch
7. - Four way union	20. - Fuel flow control lever
8. - Circular injection rack (Injection wheel)	21. - Non-return valve
9. - Starting valve	22. - «Booster pump pressure» switch
10. - Electric cock	23. - Electric booster pump
11. - Regulator	24. - Fuel gauge transmitter
12. - Fuel flow control valve	25. - Tank
13. - Barostatic idling valve	

Figure 2

Fuel system - Functional diagram

8.00.2. - SPECIFICATION AND GENERAL OPERATION OF THE FUEL SYSTEM (Figure 2)

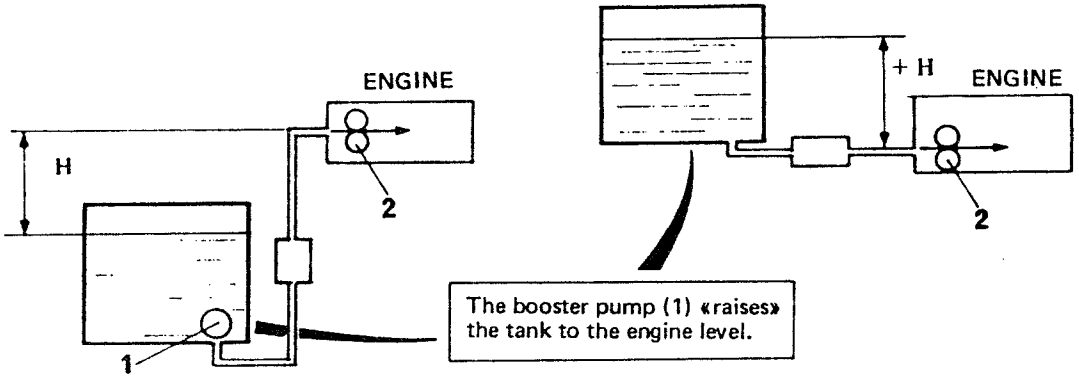
A - SPECIFICATION

- Tank total capacity : ..... 575 litres
- Usable capacity : ..... 573 litres (when aircraft is horizontal)
- Minimum pressure at booster pump outlet : ..... 300 millibars
- Delivery at minimum pressure : ..... 500 litres/hr
- Filter efficiency (filtering capacity) : ..... 10 μ
- Opening threshold of filter by-pass valve : ..... 280 millibars
- Illumination of «booster pump» warning light : ..... $P \leqslant 100$ millibars $^{+10}_{0}$
- Illumination of «low level» warning light : ..... $Q \leqslant 60$ litres $^{+10}_{0}$
- Illumination of «filter clogging» warning light : ..... $\Delta P \geqslant 140$ millibars $^{+10}_{0}$

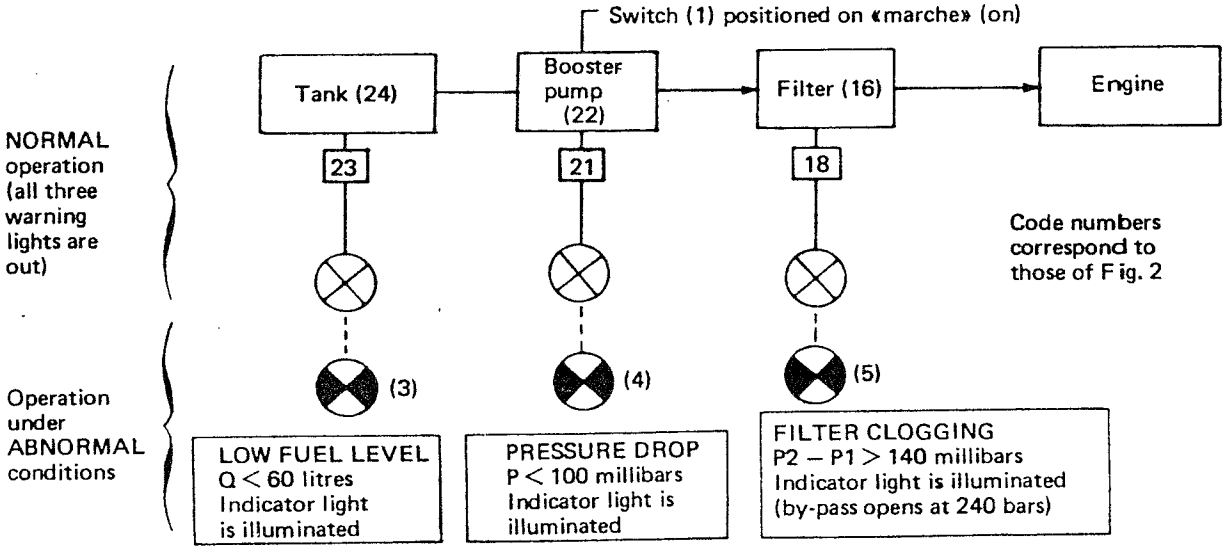
$\Delta P = P2$ (inlet pressure) $- P1$ (outlet pressure)

B - GENERAL OPERATION

The fuel supply system is designed essentially to «raise» the tank fuel to the engine level and to filter the fuel.



The booster pump (1) saves the engine fuel pump (2) the work of sucking the liquid through a significant head height (-H); it thereby eliminates any risk of engine pump starvation.
NOTE that if the booster pump fails, the fuel pump is able to continue supplying the engine, (that is, if the fuel supply system is perfectly airtight).



early bank square

149 gals

146 usable

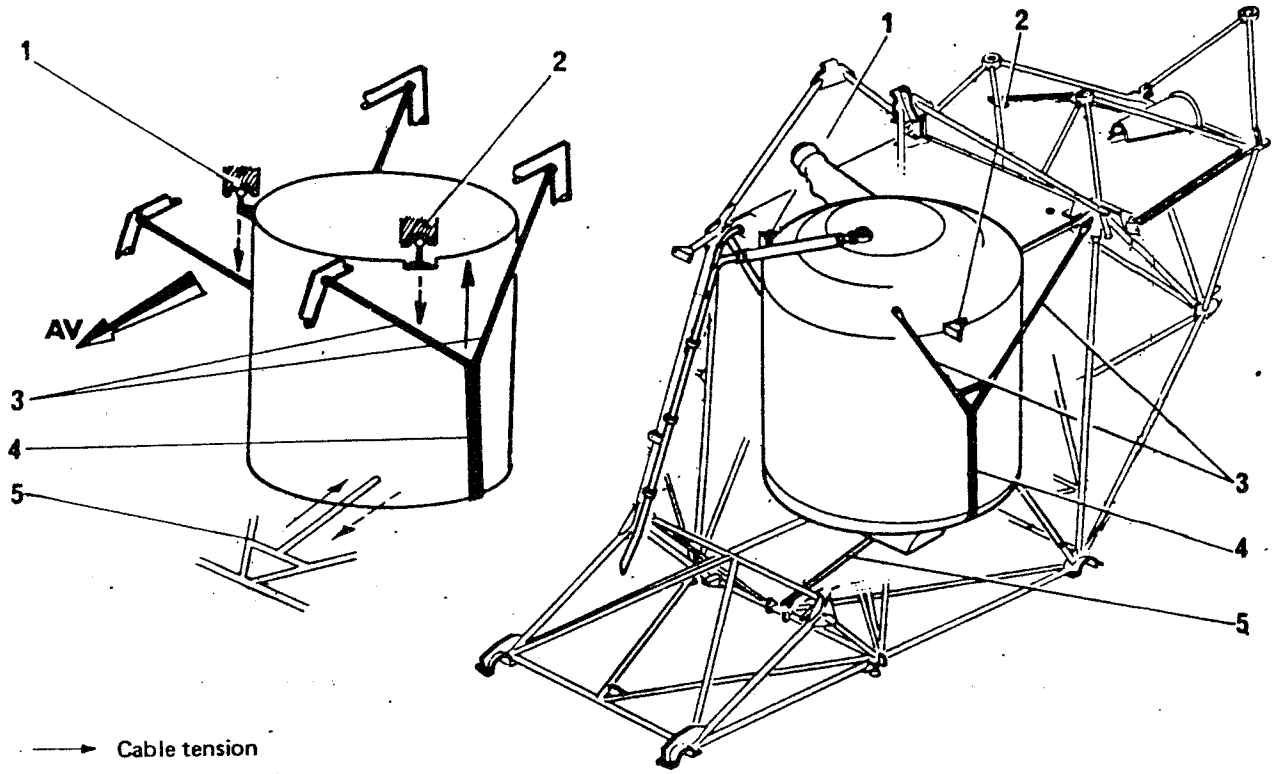
round corner
torque it empty full
& torque again.
if attachment points
Quadralobic 151.99 ft lbs
all metal 151.3 useable

8.10. - FUEL TANK

8.10.1. - FUEL TANK MOUNTING (Figure 1)

The fuel tank is located inside the central body structure. It is attached by the following means :

- a strap (4), which is secured to the structure, on both sides, by tension cables (3) fitted with turnbuckles
- two pins (1) (2) which fit into two conical shaped sockets (6) on the structure and constitute the upper location points for the tank. Pin (2) can be adjusted to different heights to centre the tank laterally in relation to the structure.
- a brace strut (5) connected to the bottom of the tank balances the effort of the tension cables which tend to make the tank turn about the two pins.



→ Cable tension

- - → Structure reaction

Adjustment of cable tension

Empty tank values :
- Front cables : 220 ± 5 da.N
- Rear cables : 195 ± 10 da.N

1. - Fixed locating pin
2. - Adjustable locating pin
3. - Cables equipped with turnbuckles
4. - Strap
5. - Brace strut
6. - Locating pin socket on structure
7. - Locating pin bracket

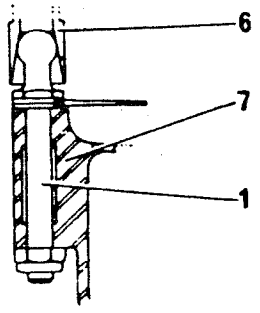
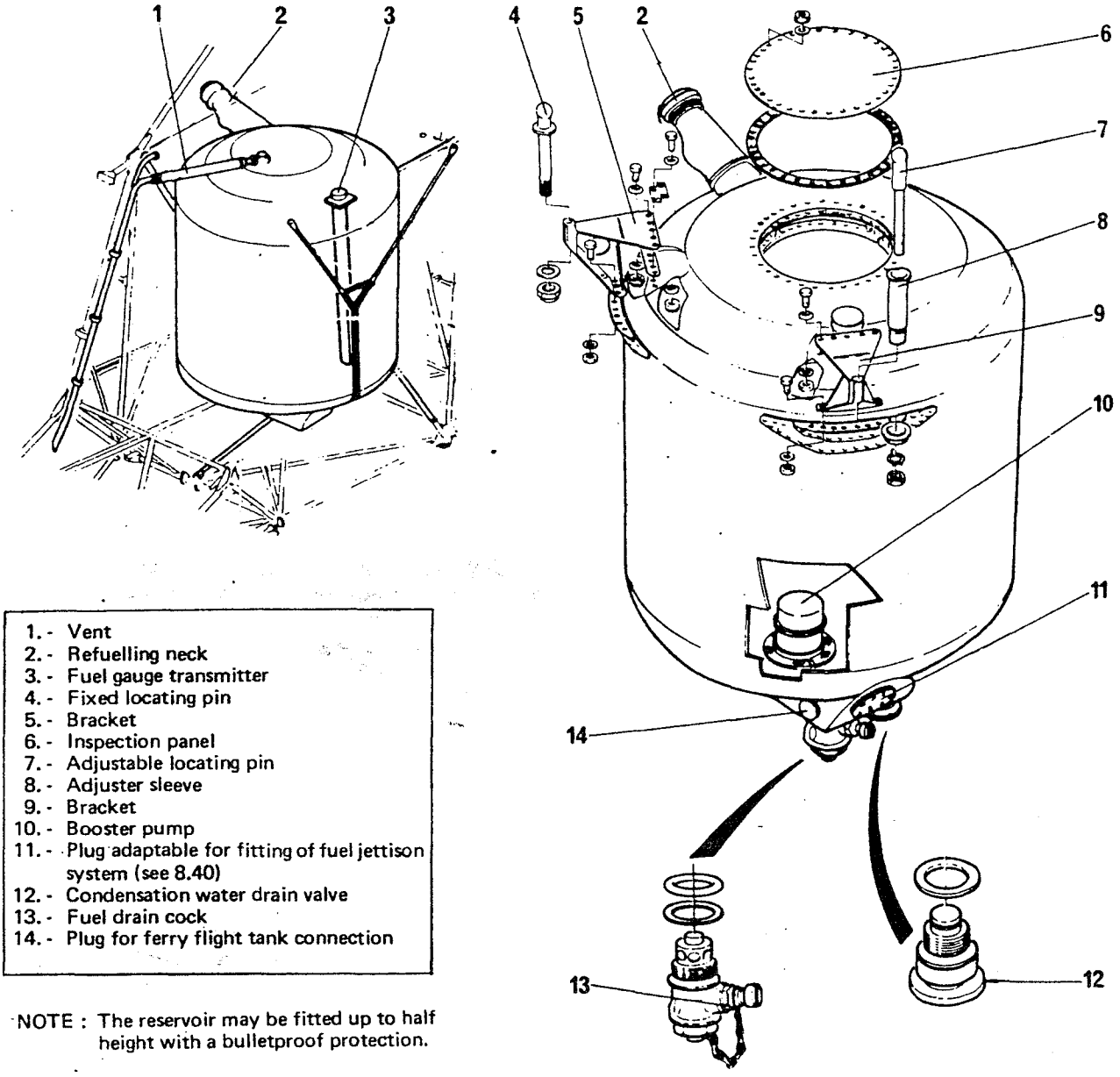


Figure 1
Fuel tank mounting

8.10.2. - FUEL TANK FITTINGS AND EQUIPMENT (Figure 2)

The tank is a rigid sheet metal construction. It is internally fitted with two vertical perpendicular baffle plates;they cross in the centre of the tank and lessen the swashing of the fuel. The tank is equipped with the following accessories :

- an immersed booster pump (10)
- a fuel gauge transmitter (3)
- a drain valve (13)
- a condensation water drain valve (12)



1. - Vent
2. - Refuelling neck
3. - Fuel gauge transmitter
4. - Fixed locating pin
5. - Bracket
6. - Inspection panel
7. - Adjustable locating pin
8. - Adjuster sleeve
9. - Bracket
10. - Booster pump
11. - Plug adaptable for fitting of fuel jettison system (see 8.40)
12. - Condensation water drain valve
13. - Fuel drain cock
14. - Plug for ferry flight tank connection

NOTE : The reservoir may be fitted up to half height with a bulletproof protection.

Figure 2
Fuel tank fittings and equipment

8.10.3. - MAIN FUEL TANK ACCESSORIES

A - BOOSTER PUMP (ELECTRIC PUMP) (Figure 3)

(1) SPECIFICATION

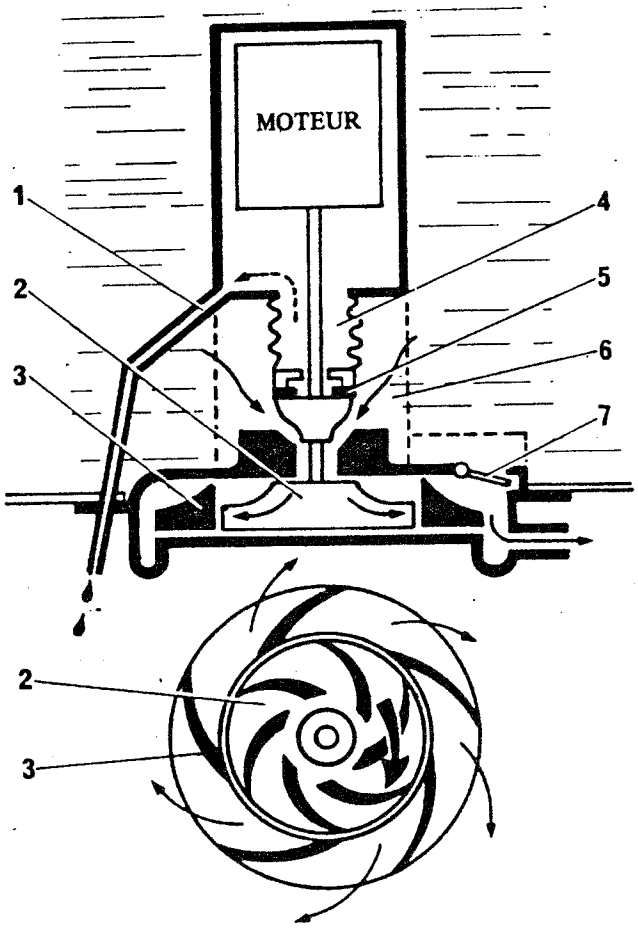
— Motor: non-inflammable, suppressed, supply voltage 28.5 V.D.C.

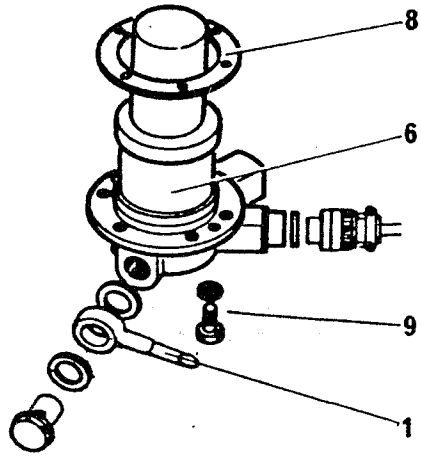
— Current draw : 2.5 Amps maximum at 19V
3.1 Amps maximum at 30V

— Maximum output : 500 litres per hour (at a minimum pressure of 300 millibars)
4.5 - 4.7 psi

(2) OPERATION

The pump is immersed in the fuel. The turbine (2) draws in the fuel directly, and delivers it to the fuel supply system via the diffuser (3).
When working normally, the valve (7) is held closed by the pressure of the swirling liquid. Should the pump fail, the main engine fuel pump draws in fuel directly via the valve (7), thus avoiding kinetic losses through the intake.
A rotary seal (5) ensures the leakproofing between the fixed and moving parts of the pump. The bellows (4) keeps the seal in contact with its seat. The drain pipe (1) warns the mechanic of any fault in the seal (5). Should leakage occur, the fuel that passes the seal drains off to the exterior.





1. - Leakage drain
2. - Turbine
3. - Diffuser
4. - Bellows
5. - Rotary seal
6. - Filter
7. - Valve
8. - Pump mounting gasket
9. - Fixing screw

Figure 3
Booster pump

8.10.3. - MAIN FUEL TANK ACCESSORIES (Continued)

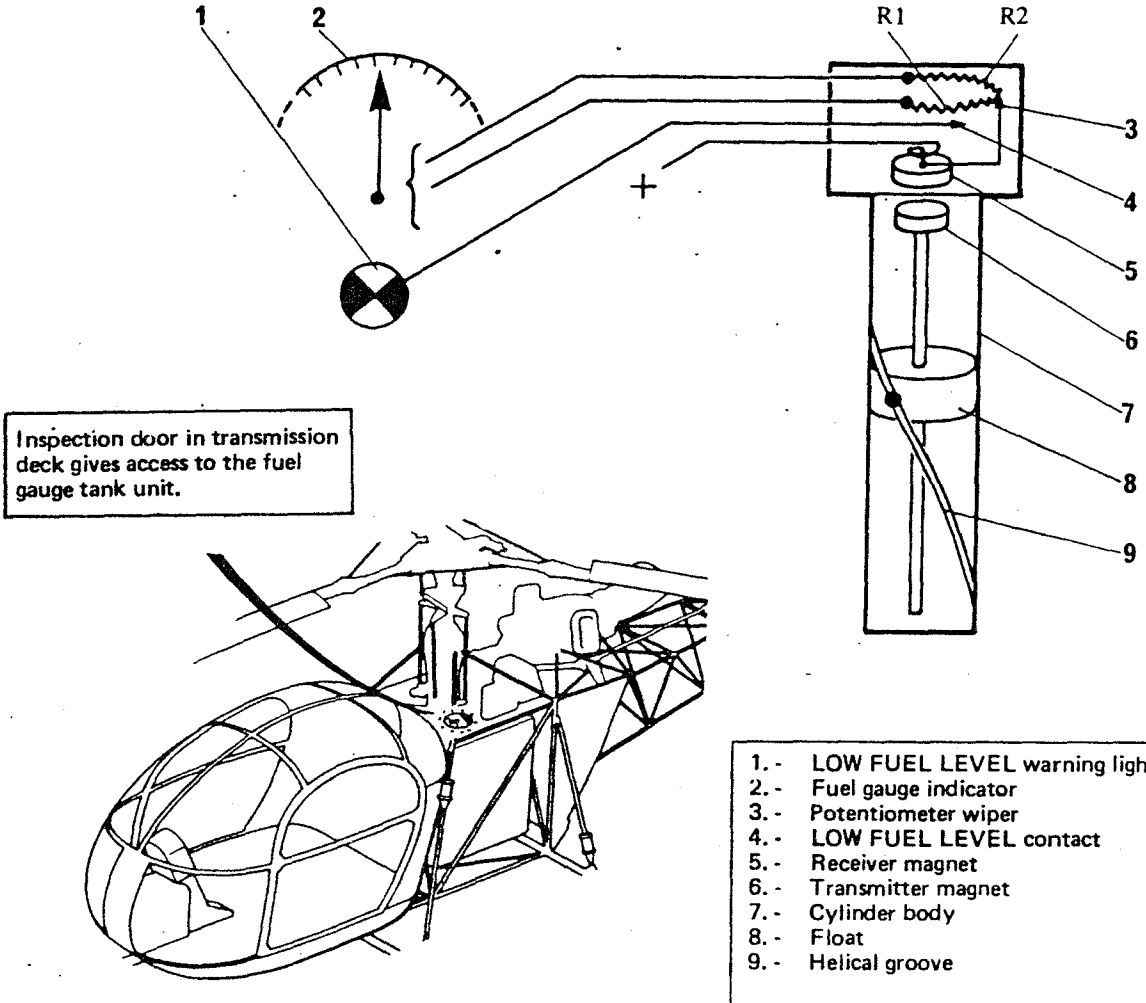
B - FUEL GAUGE TANK UNIT (Figure 4)

(1) SPECIFICATION

- Working voltage : 27 V.D.C.
- Potentiometer : R = 122 Ω - R used = 77 Ω
- Maximum current at contacts : 0.1 amps

(2) OPERATION

The float (8), guided by the helical groove (9) in the body, turns as it moves either up or down, turning the transmitter magnet (6) as it does so. Each liquid level corresponds to a particular (and unique) transmitter magnet position and consequently a particular and unique position of the receiver magnet (5) and of the potentiometer wiper (3) which is linked to it.
The gauge indicator (2) which is of the logometric type is connected to the terminals of the resistances R1 and R2 of the poteritiometer. These resistances send a current which is a differential function of the fuel level (see 8.30).
When the descending fuel level reaches 60 litres, the wiper comes into contact with the contact (4) causing the LOW FUEL LEVEL warning light to come on (1).



1. - LOW FUEL LEVEL warning light
2. - Fuel gauge indicator
3. - Potentiometer wiper
4. - LOW FUEL LEVEL contact
5. - Receiver magnet
6. - Transmitter magnet
7. - Cylinder body
8. - Float
9. - Helical groove

Figure 4

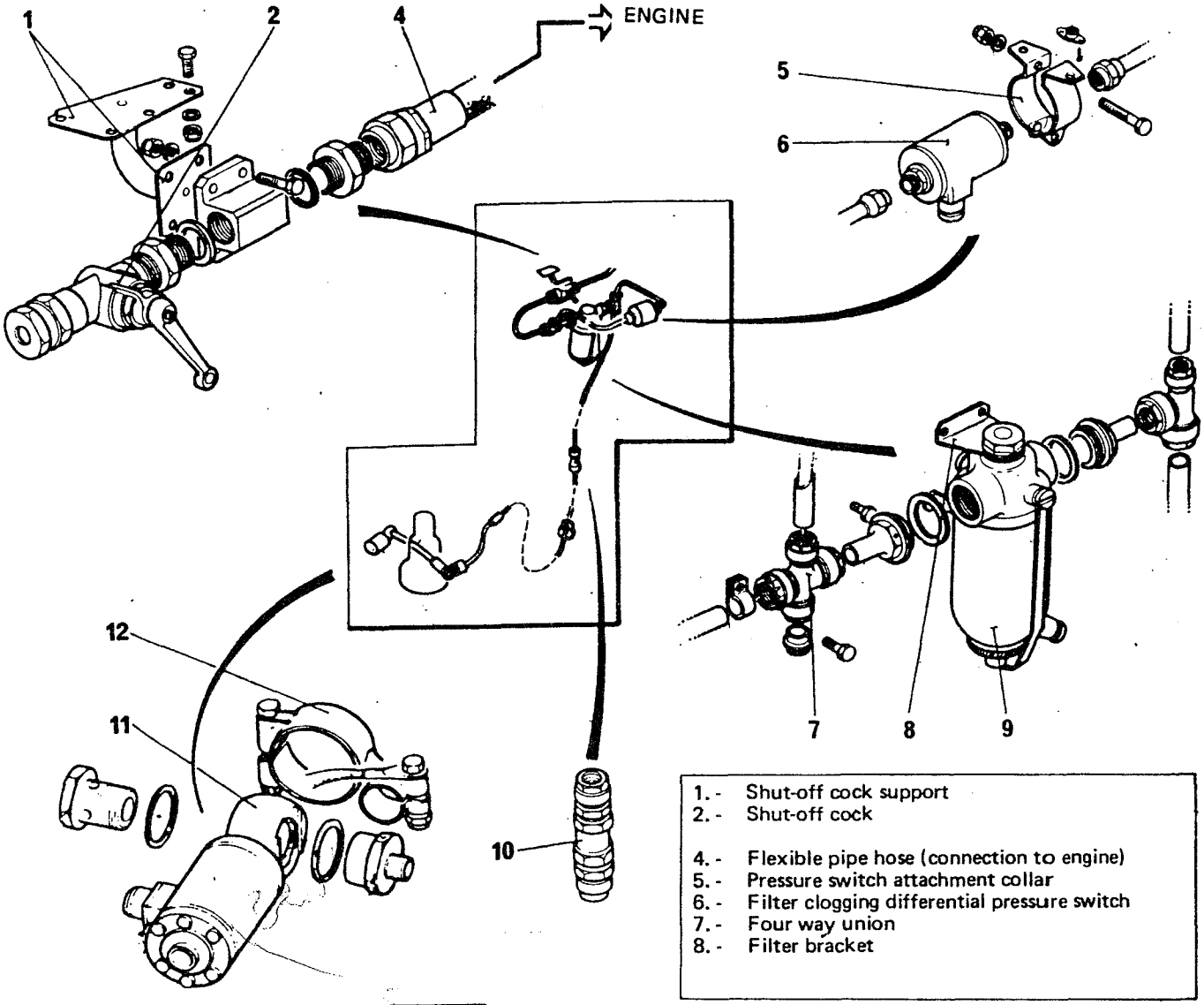
Fuel level gauge tank unit

8.20. - FUEL SUPPLY SYSTEM

8.20.1. - GENERAL (Figure 1)

The fuel supply system, which starts at the booster pump and terminates at the engine, consists of :

- pipework
- accessories : Fuel filter (9), shut-off cock (2), non-return valve (10),booster pump pressure switch (11), and filter clogging differential pressure switch (6).



1. - Shut-off cock support
2. - Shut-off cock

4. - Flexible pipe hose (connection to engine)
5. - Pressure switch attachment collar
6. - Filter clogging differential pressure switch
7. - Four way union
8. - Filter bracket

9. - Fuel filter
10. - Non return valve
11. - Booster pump pressure switch
12. - Pressure switch attaching collar

Figure 1

Fuel supply system accessories

8.20.2.- MAIN COMPONENTS OF THE FUEL SUPPLY SYSTEM

A - FUEL FILTER (Figure 2)

(1) SPECIFICATION

- Filtering capacity : 10 μ
- Setting of the by-pass valve opening : 280 millibars
- Nature of the filter element : paper

(2) OPERATION

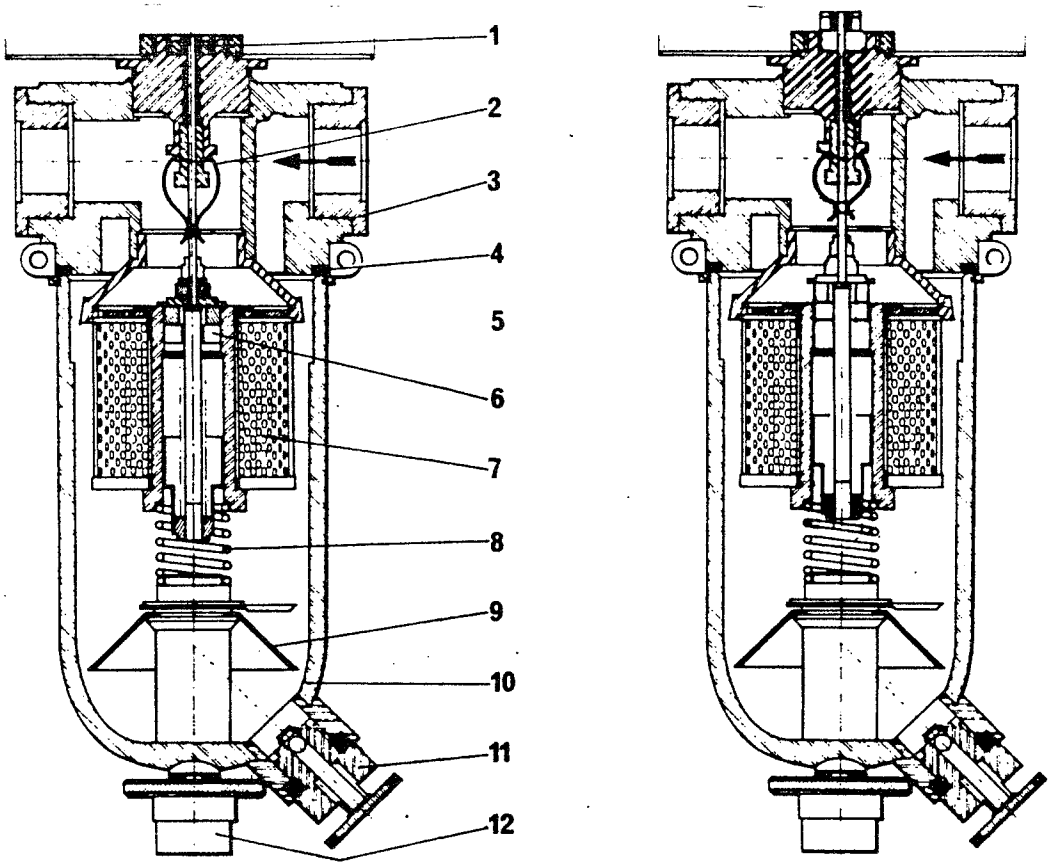
Normal operation : By-pass valve (6) is closed. The fuel passes through the filter element (7). The impurities held back by the filter fall to the bottom part of the cup (10) where they are extracted from the swirl by a vibrating deflector (9). Decanted residues are expelled through the water drain valve (11).

Clogging of the filter element. When the filter pores of the element are clogged, the fuel flow through the filter is decreased ; inlet pressure P2 increases and outlet pressure P1 decreases ($P2 - P1 = \Delta P$). When in the progressive process of clogging ΔP reaches 230 millibars, valve (6) comes into the «open» position, pushing the clogging indicator (1) which starts «emerging». For the values between $\Delta P = 230$ millibars and $\Delta P = 280$ millibars, the valve remains closed and the clogging indicator gradually emerges. At 280 millibars the valve opens, «by-passing» the filter element.

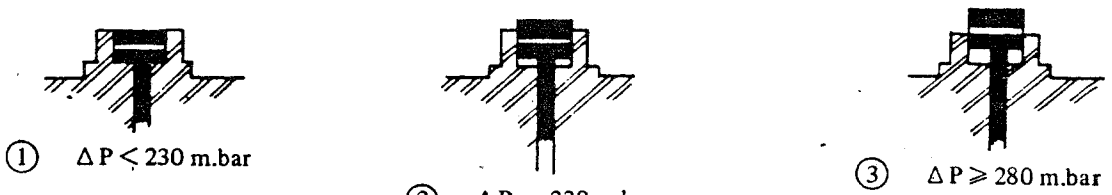
The engine is supplied with non-filtered fuel. The clogging indicator (1) is completely out (the red stripe is showing) and kept in this position by the spring (2).

1.- Clogging indicator
2.- Lock-spring of clogging indicator
3.- Filter body
4.- Gasket
5.- Seal
6.- By-pass valve
7.- Filter element
8.- Maintaining spring
9.- Deflector
10.- Filter bowl
11.- Water drain valve
12.- Knurled nut (bowl-to-body assembly)

8.20.2. - MAIN COMPONENTS OF THE FUEL SUPPLY SYSTEM (Continued)



Clogging indicator operation



ΔP croissant →

Figure 2 - Fuel filter

8.20.2. - MAIN COMPONENTS OF THE FUEL SUPPLY SYSTEM (Continued)

B - BOOSTER PUMP PRESSURE SWITCH (Figure 3)

Specification :

- Operating voltage : 27V D.C.
- Maximum current draw : 0.1 A
- Proof pressure : 4 bars
- Circuit closes at : 100 millibars (decreasing pressure)

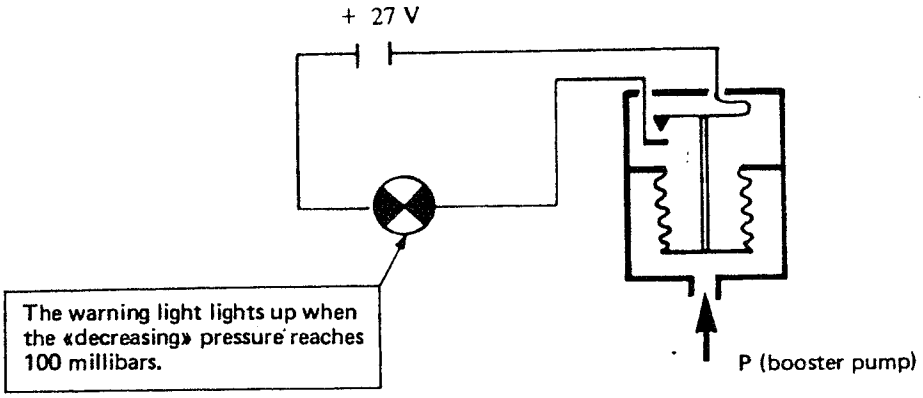


Figure 3

C - FILTER CLOGGING DIFFERENTIAL PRESSURE SWITCH

Specification :

- Operating voltage : 27V D.C.
- Proof pressure : 4 bars
- Circuit closes when : P2 – P1 = 140 millibars

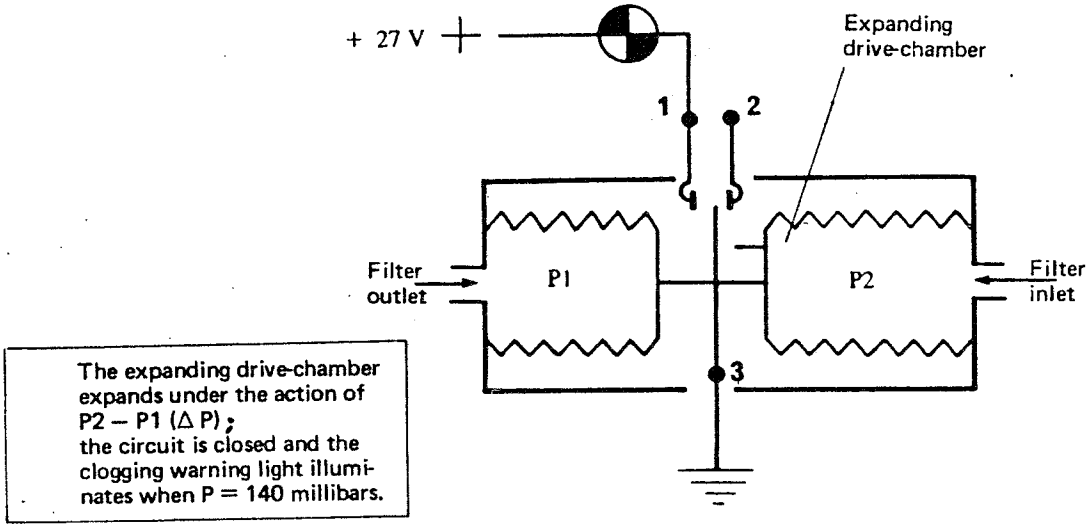


Figure 4

8.30. - CONTROL AND MONITORING OF THE FUEL SYSTEM

8.30.1. - GENERAL (Figure 1)

The fuel system control and monitoring installation consists of :

- a booster pump switch (2)
- a fuel shut-off control lever (4)
- a fuel gauge transmitter (6) and indicator (7)
- a «low fuel level» warning light. The warning light (8) is incorporated in the fuel gauge indicator.
- a booster pump «low pressure» warning light (1) and pressure switch (5)
- a «filter clogging» warning light (9) and pressure switch (3)

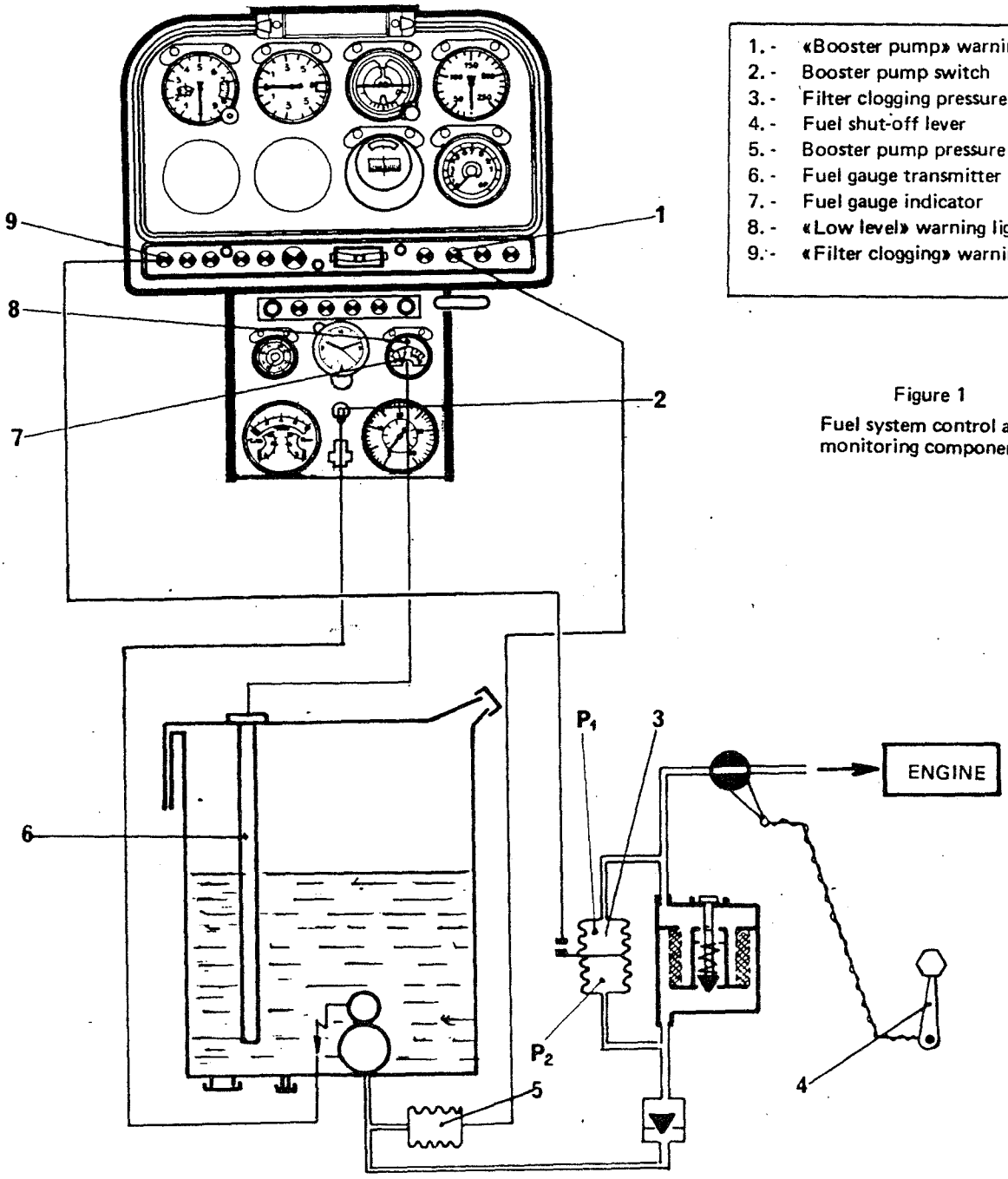


Figure 1

Fuel system control and monitoring components

8.30.2. - MAIN CONTROL AND MONITORING ACCESSORIES OF THE FUEL SYSTEM

A - FUEL GAUGE INDICATOR (Figure 2)

The fuel gauge indicator is of the logometric type ; its dial is graduated in litres (or gallons) and a low level warning light is incorporated.

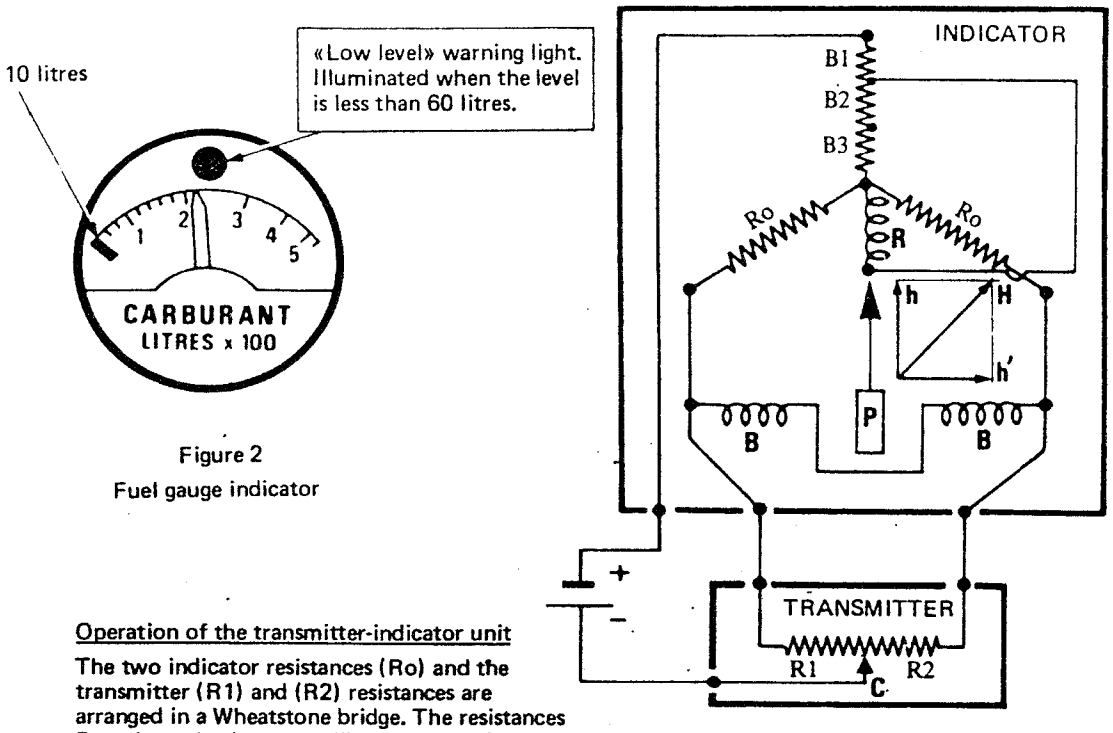


Figure 2
Fuel gauge indicator

Operation of the transmitter-indicator unit

The two indicator resistances (Ro) and the transmitter (R1) and (R2) resistances are arranged in a Wheatstone bridge. The resistances Ro, of equal value, are calibrating coils. Resistances R1 and R2 are variable. Their value depends on the position of wiper (C), i.e. of the fuel level inside the tank (see 8.10. Par. 3.B.).
If R1 = R2 the bridge is in equilibrium. The coils of field B are not energized. The return coil R creates a field h which causes the orientation of the magnetic frame P. The needle is in the middle of the dial.
If R1 is different from R2, a current circulates through the field B coils creating a field h'. The fields h and h' form a resulting field H which determine the movement of the needle. The direction and the degree of the needle-shift depends on the difference in resistance between R1 and R2 which determines the direction and strength of the current in the field coils.
The consumption coil B1 determines the current strength in the system.
The coil B1 regulates the needle travel.
The compensating nickel coil B3 makes the unit insensitive to temperature variations.

B - OTHER ACCESSORIES

- The fuel gauge transmitter is described in 8.10.3.B.
- The booster pump pressure switch and the filter clogging differential pressure switch are described in 8.20.2.B.
- The shut-off cock control is described in chapter 12.

8.40. - FUEL JETTISON SYSTEM

8.40.1. - GENERAL (Figure 1)

Through the jettison system, the aircraft can be drained rapidly of a part of its fuel, so lightening it for towing or «deck-landing» patrol missions.
The fuel is drained by gravity :

- Non-drainable capacity : 200 litres
- Flow rate of jettison system : 130 litres/minute

The system consists of :

- A stack pipe (2) which penetrates inside the tank and determines the non-drainable quantity
- An electric cock (3)
- Connection pipes (4) and drain pipe (5)
- An electrical control unit : a switch fitted with a safety guard, and a circuit breaker on overhead panel

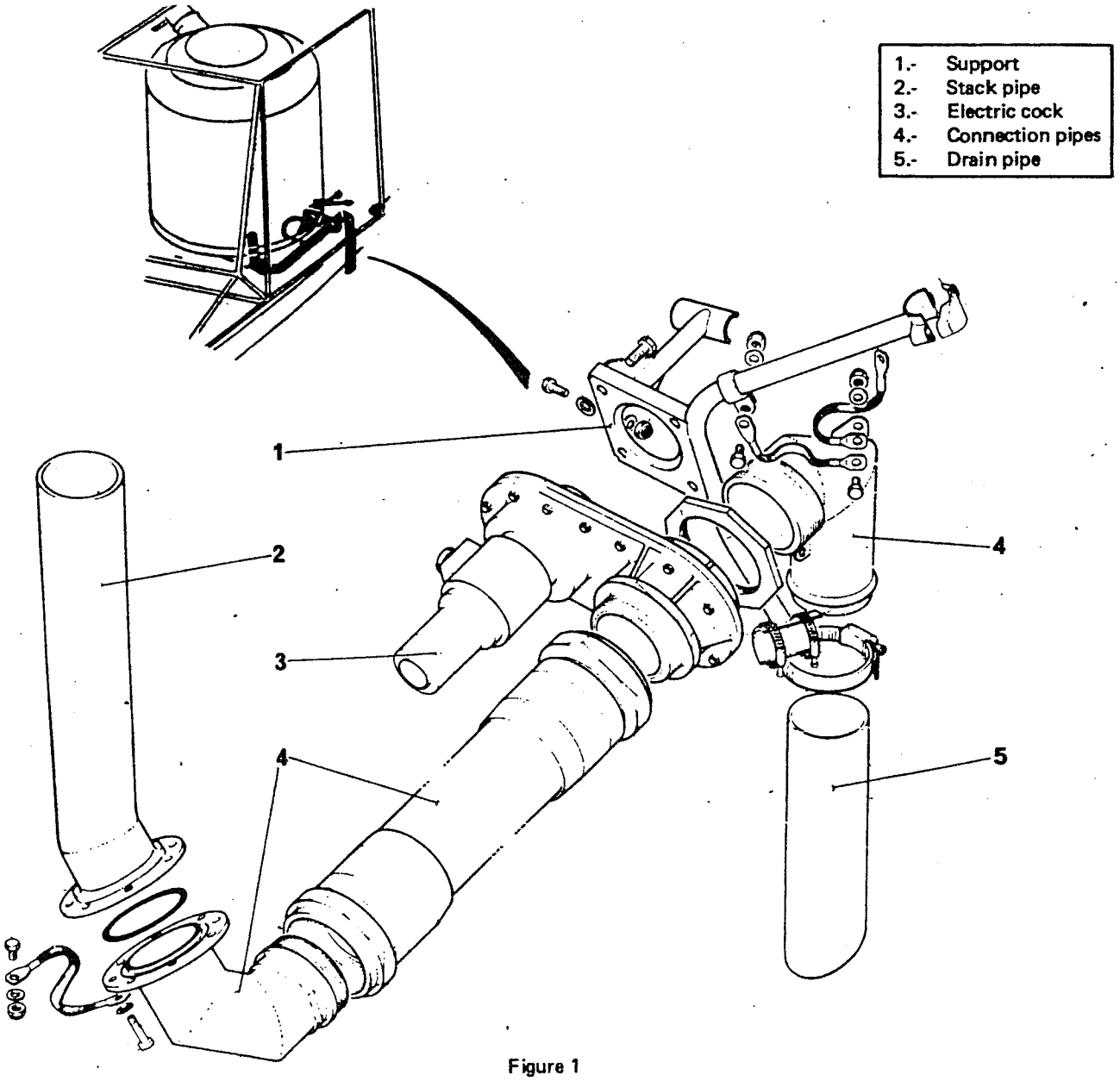


Figure 1
Fuel jettison system

8.40.2. - FUEL JETTISON SYSTEM OPERATION (Figure 2)

When the electric cock is open, the fuel is freed and flows out by gravity until its level reaches that of the outlet stack pipe.
The cock is of the «blade» type. A blade, controlled by an eccentric cam (1) forming part of the motor, blocks the drain pipe. The electric motor moves the cam in both directions and is fitted with two end-of-travel micro-contacts. (MC.O and MC.F. - open/closed).

«OPEN» END OF TRAVEL MC.O (open) contact opens, shutting off the motor's supply current - MC.F (closed) contact is closed, and energizes the motor so that it moves in the cock closing direction.

«CLOSING» END OF TRAVEL MC.F contact opens, MC.O contact is closed.

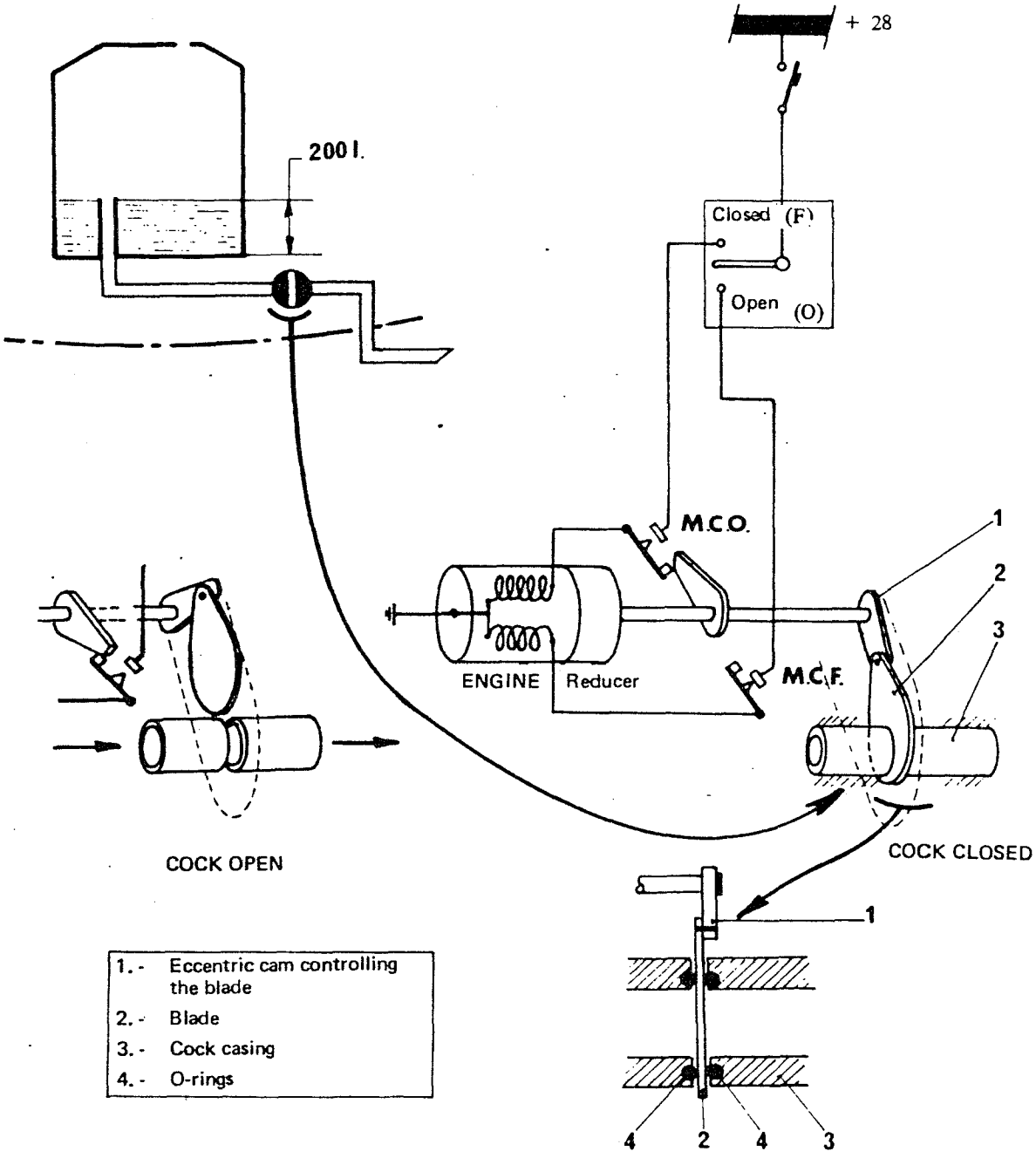


Figure 2
Operation of the fuel jettison system

8.30.3.- FUEL CONTROL AND MONITORING CIRCUITS

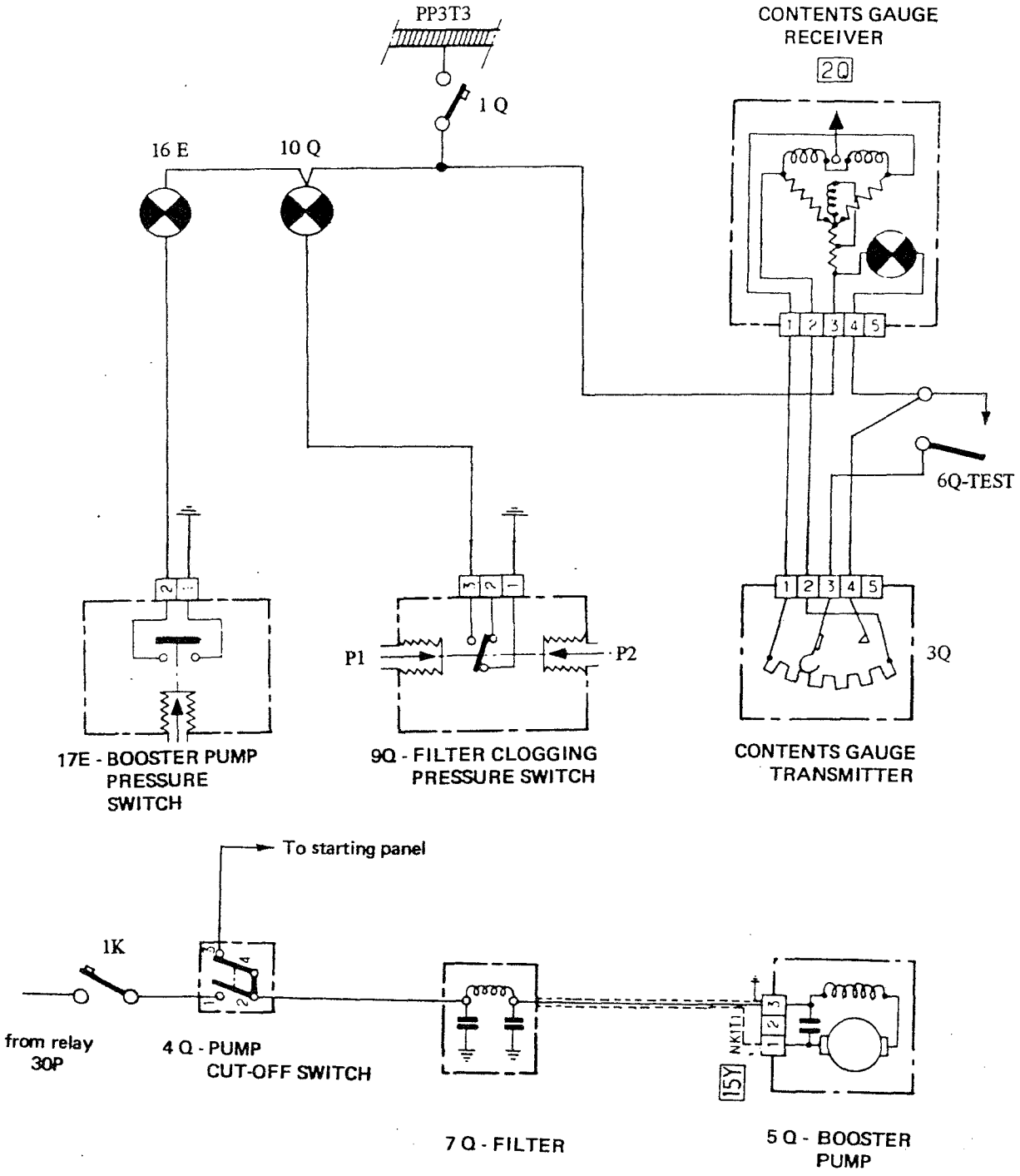


Figure 3
Fuel control and monitoring
Functional diagram

CHAPTER 9

ELECTRICAL SYSTEM

CONTENTS

9. - ELECTRICAL SYSTEM

9.00. - GENERAL

The aircraft electrical system consists of :

Power generating systems
Consumer circuits

The consumer circuits are dealt with in the relevant chapters concerning the various equipment to which they belong.

The lighting circuits which constitute a complete electrical system are dealt with in the present chapter.

9.10.- ELECTRICAL POWER GENERATING SYSTEMS

9.10.1.- GENERAL

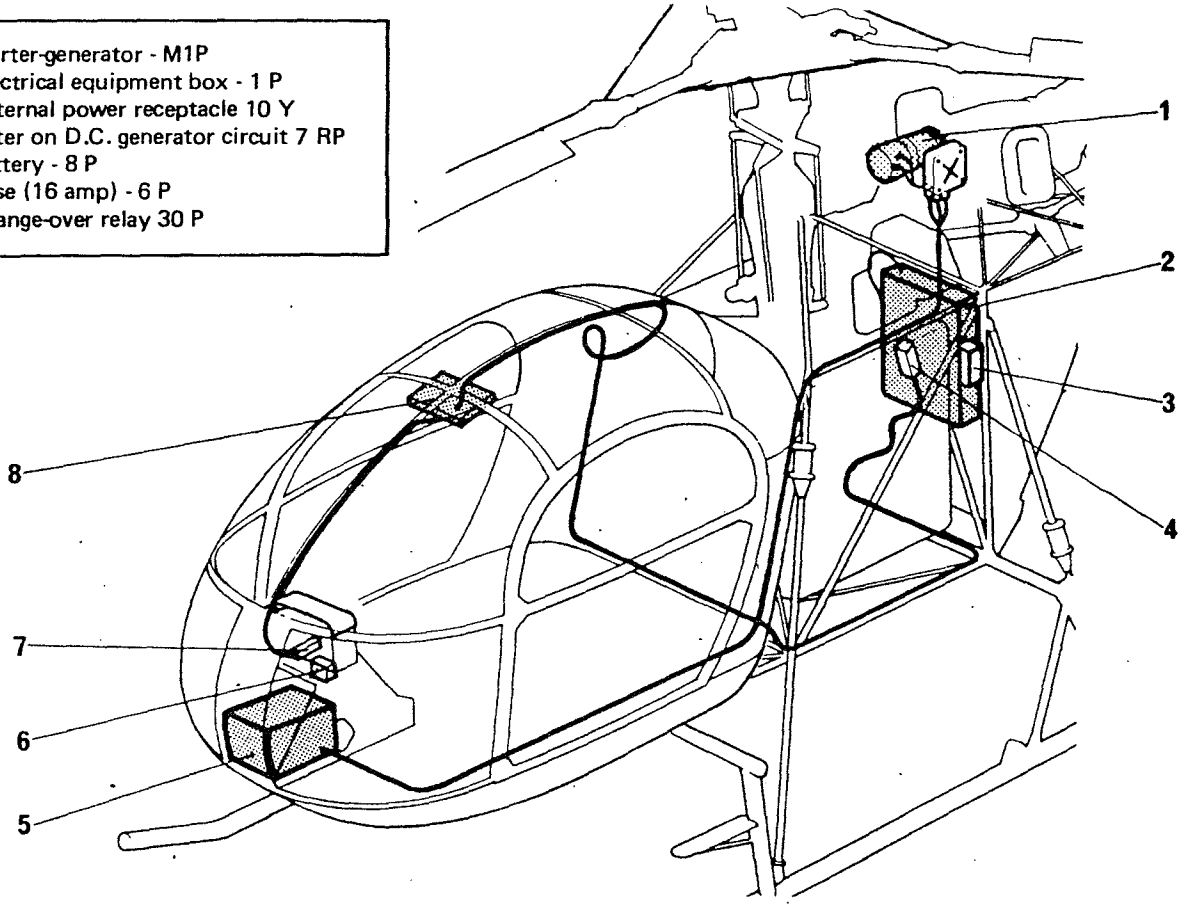
A - DESCRIPTION OF ELECTRICAL POWER GENERATING SYSTEMS (Figure 1)

The aircraft electrical circuits are supplied a 28.5 volt d.c. power generating system.

The d.c. generating system consists of :

- A 40 amp. hr battery (6)
- A 4 Kw starter-generator (1)
- An external power receptacle (3) circuit.

1.- Starter-generator - M1P
2.- Electrical equipment box - 1 P
3.- External power receptacle 10 Y
4.- Filter on D.C. generator circuit 7 RP
5.- Battery - 8 P
6.- Fuse (16 amp) - 6 P
7.- Change-over relay 30 P



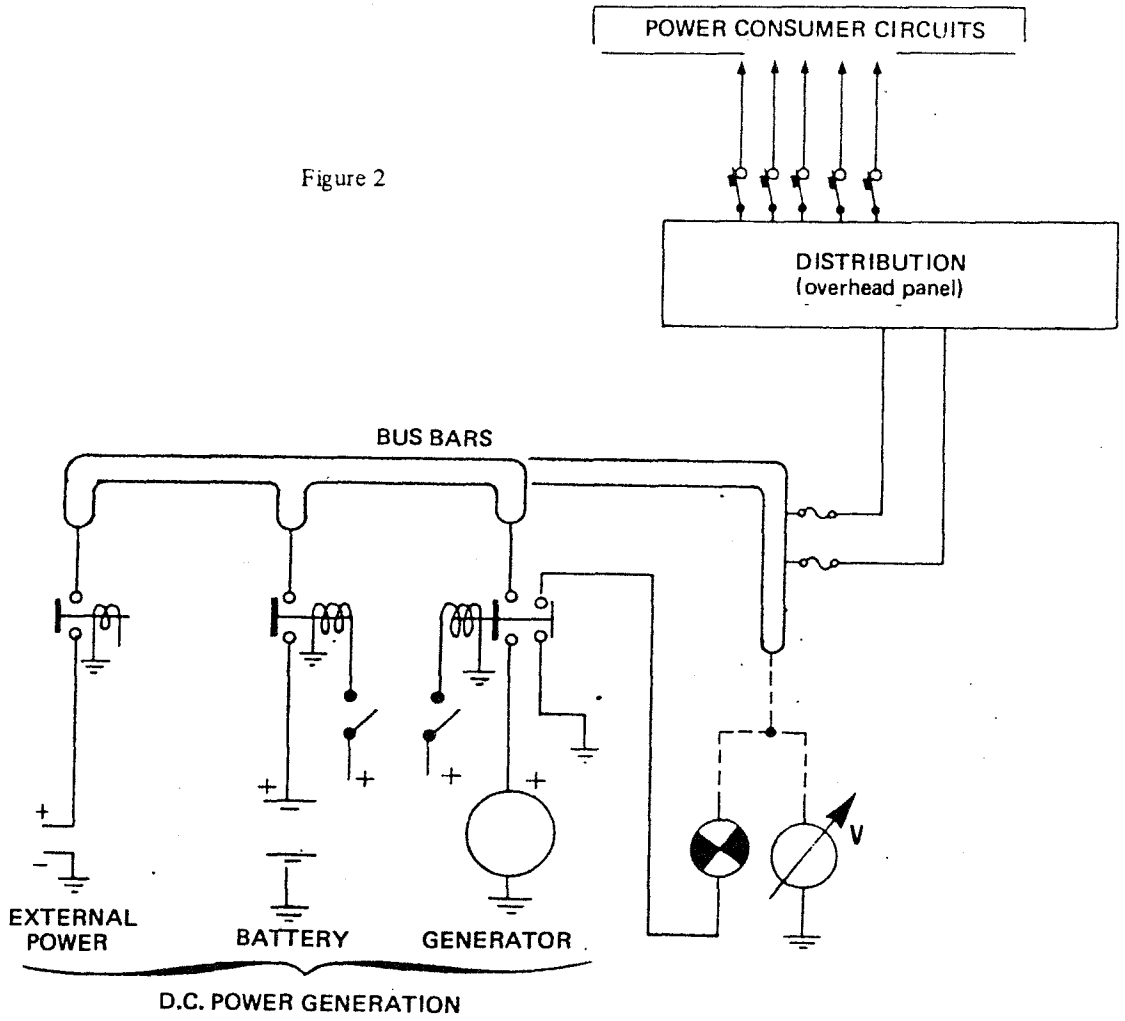
- The electrical equipment box (2) contains all the necessary parts for d.c. power generation (contactors, relays . . .) and the fuses which protect the d.c. generating systems.
- On the overhead panel (8) are grouped the control components of the generating systems and the circuit-breakers which protect the power consumer circuits.

Figure 1
Electrical power generating system layout

9.10.1. - GENERAL (Continued)

B - FUNCTIONAL DIAGRAM OF THE ELECTRICAL POWER GENERATING SYSTEMS (Figure 2)

Figure 2



The external power receptacle, battery and generator supply current to a bus bar through a relay allowing the chosen generator to be placed in operation.

- To the external power receptacle can be connected an external power source (ground power unit) to be used for starting the engine, or for check-ups or maintenance requiring the aircraft electrical network to be energized.
- The battery will supply the aircraft network as long as the engine-driven-starter generator cannot supply sufficient voltage (starting the engine). When the generator voltage supply is sufficient, it is coupled automatically to the bus bar (reverse current relay). Thereafter, it supplies all the networks and charges the battery.
- The bus bars distribute d.c. current to the generation monitoring circuits (voltmeter and circuit breaker indicator light), to the inverter and to the distribution bus bars on the cabin overhead panel, above the pilot, where the power consumer circuits are connected.
- The closing of the «battery» and «generator» generating systems is controlled by two switches. A third switch controls the supply of the alternating current generation inverter.

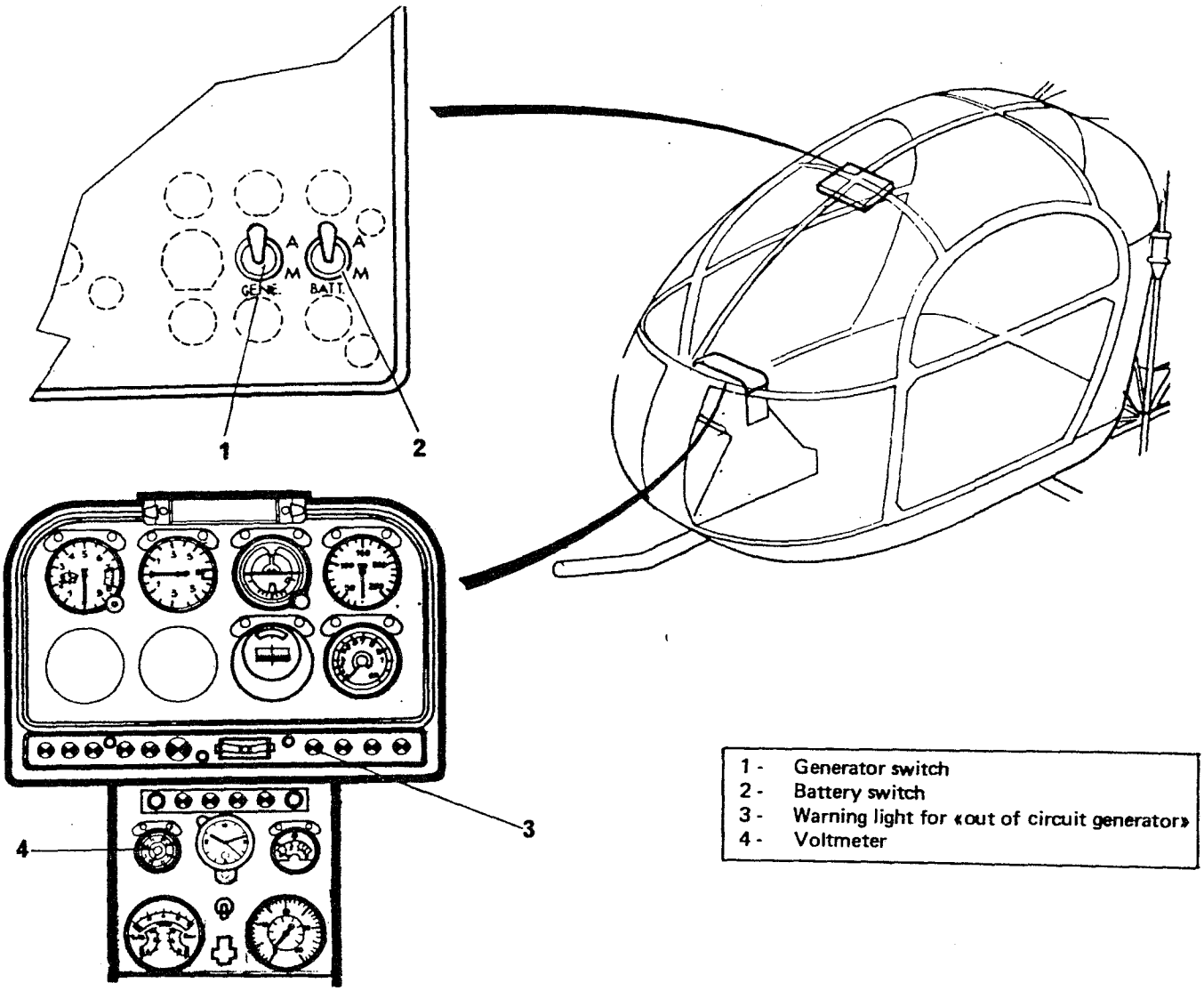
9.10.1.- GENERAL (Continued)

C - CONTROL AND MONITORING OF THE ELECTRICAL POWER GENERATING SYSTEM (Figure 3)

The control and monitoring components consists of :

On the overhead panel :
- a «GEN» switch (1) controlling the closing of the generator circuit
- a «BATT» switch (2) controlling the closing of the battery circuit

On the instrument and control pedestal :
- a voltmeter (4) indicating the voltage output of the generator in operation
- a «GEN» red warning light (3) which lights up when the generator is out of circuit.



1 - Generator switch
2 - Battery switch
3 - Warning light for «out of circuit generator»
4 - Voltmeter

Figure 3
Control and monitoring of the electrical power generating system

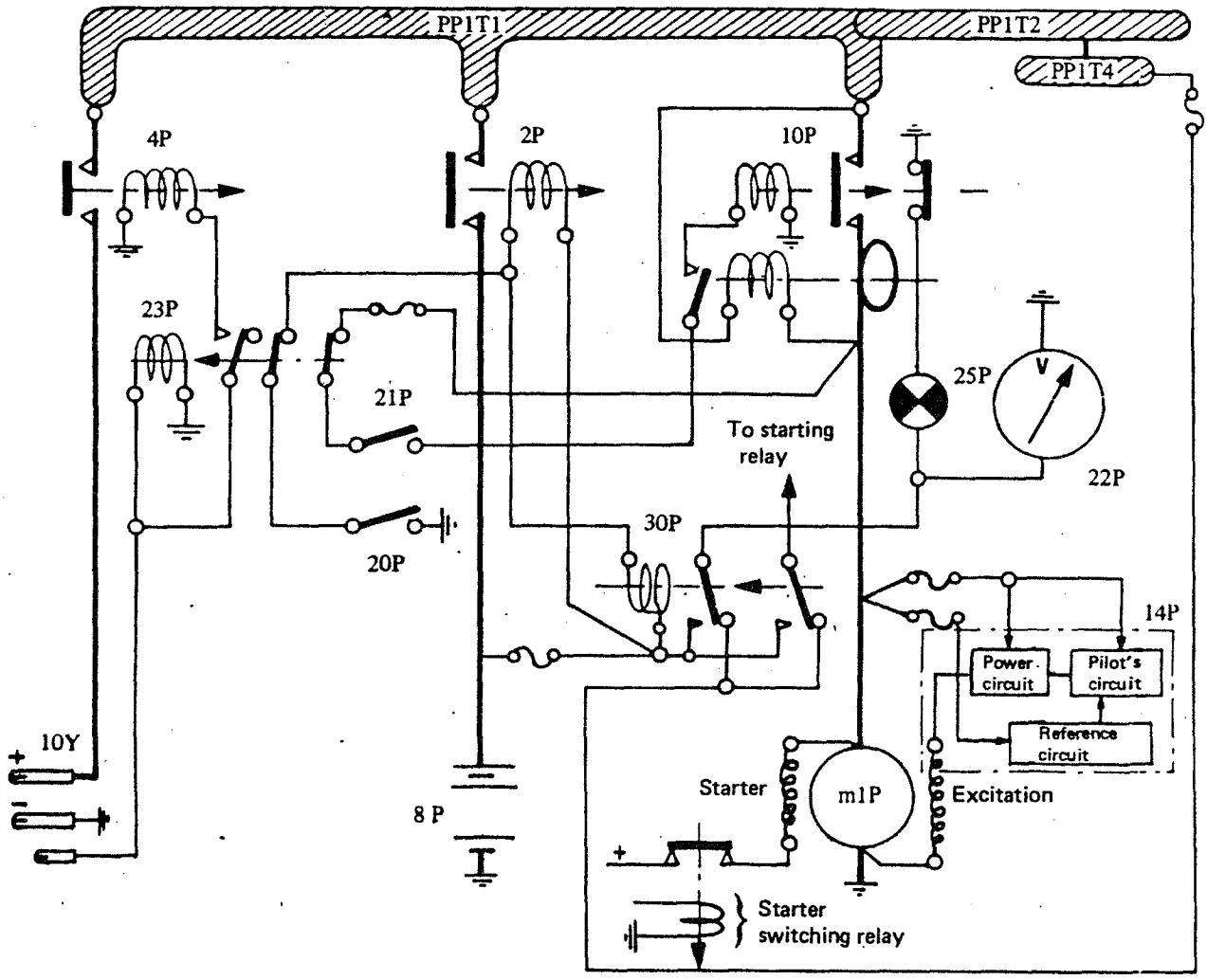
9.10.2. - D.C. POWER GENERATING SYSTEM

A - GENERAL (Figure 4)

The electrical power generating system consists of :

- the external power receptacle circuit comprising an external power receptacle 10 Y, a control relay 23P and a line relay 4P
- the battery circuit comprising the battery 8P and a line relay 2P
- the generator circuit comprising the starter generator m1P, a reverse current relay 10P, a voltage regulator 14P
- the distribution bus bars PP1T1, PP1T2 and PP1T4.
- the control and monitoring components : battery switch 20 P, generator switch 21 P, generator warning light 25P and voltmeter 22P.

Change over relay 30P allows the engine starting to be made directly from battery (simplified wiring)



2P - Battery line relay	23P - External power receptacle auxiliary control relay
4P - External power receptacle line relay	25P - Generator warning light
8P - Battery	30P - Change over relay
10P - Reverse current relay	PP1T1 -
14P - Voltage regulator	PP1T2 - Bus bars
20P - Battery switch	PP1T4 -
21P - Generator switch	m1P - Generator
22P - Voltmeter	10Y - External power receptacle

Figure 4

Electrical power generating systems - Functional diagram

9.10.2.- D.C. POWER GENERATING SYSTEM (Continued)

B - PRINCIPAL UNITS AND COMPONENTS OF THE D.C. ELECTRICAL POWER GENERATING SYSTEM (Figure 5)

(1) BATTERY :

a - Description
- Type : cadmium-nickel
- Instant discharge power at 25°C : 10 KW (11.8 V - 840 A)
- Capacity : 40 Amp. hr.
- Voltage : 26 V
- Internal resistance : $0{,}0150\Omega < R < 0.0175\ \Omega$

b - Installation :

The battery is intalled in a support tray (3) to which it is fastened by two tie rods (2). The support tray is mounted in two slides (5) integral with the structure. The assembly is held at the back by two locating pins (6) and at the front by a ball pin lock (4).
A socket (7) provides connection with the aircraft network.
The installation comprises a ventilating system :
— Ram air inlet (1) fitted in the forward door,
— Air outlet pipe (8) at the back (this pipe comes out under the fuselage).

NOTE : The battery can be equipped with a temperature detector (chapter 11).

(2) GENERATOR

- Shunt-dynamo : with a series-connected coil for operation as starter
- Output peak value at start : 700 - 750 A (this value falls down to 250 A at the end of starting cycle)
- Power : 4 KW
- Rotational speed : 6500 r.p.m.
- Cut-in speed : 3700 r.p.m. (slightly lower rate than the engine idling speed).

(3) EXTERNAL POWER RECEPTACLE

The external power receptacle is located on the left hand side of the aircraft and it is secured to the electrical equipment box. It is a three-pin plug : there are two power pins (+ and —) and an auxiliary + pin which controls the closing of the line relay «external power receptacle» when the ground power supply is being plugged in. The ground power supply voltage must be limited to 24 V. (Limitation imposed by the starting sequence of the engine).

(4) ELECTRICAL EQUIPMENT BOX

Located in the central body structure, the electrical equipment box contains (rear left hand side) :

- the external power receptacle line relay 4P (22)
- the battery line relay 2P (12)
- the reverse current relay 10P (18)
- the voltage regulator 14P (13)
- the external power receptacle auxiliary control relay 23P (21)
- the bus bars and fuses protecting the circuits.

1 - Ram air inlet	12 - Battery line relay - 2P
2 - Battery tie-rods	13 - Voltage regulator - 14P
3 - Support tray	14 - Fuse holder base
4 - Ball pin lock	15 - Bus bar PP1T1
5 - Slide	16 - Bus bar PP1T2
6 - Locating pin	17 - Fuses
7 - Socket	18 - Reverse-current relay 10P
8 - Ventilating air outlet pipe	19-20- Fuses
9 - Fuseholder base	21 - External power receptacle control relay - 23P
10 - Fuses	22 - External power receptacle line relay
11 - Electrical Equipment Box case	23 - External power receptacle

9.10.2. - D.C. POWER GENERATING SYSTEM (Continued)

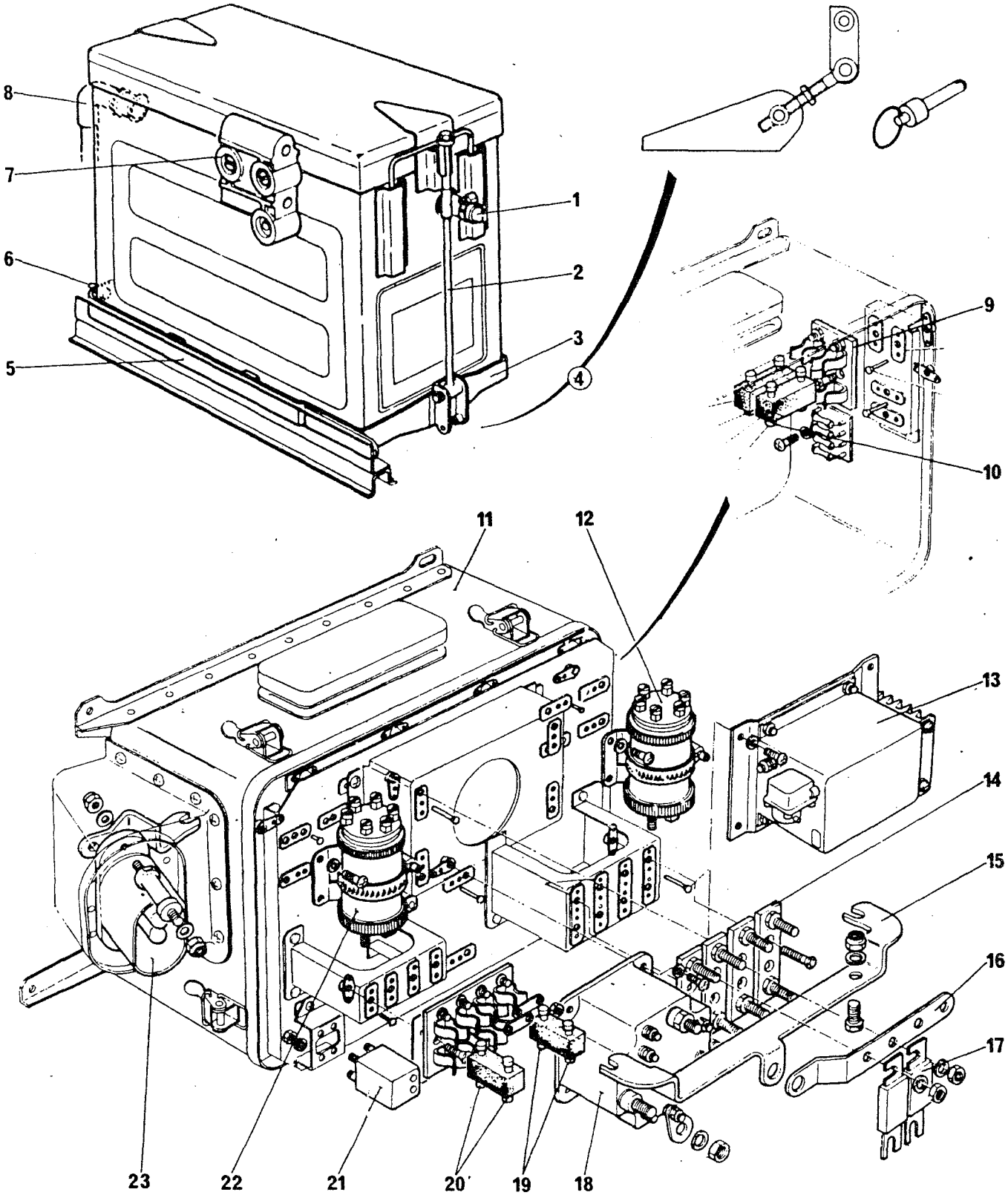


Figure 5
Battery and electrical equipment box

9.10.2. - D.C. POWER GENERATING SYSTEM

C - OPERATION OF POWER GENERATING SYSTEMS

(1) EXTERNAL POWER RECEPTACLE CIRCUIT (Figure 6)

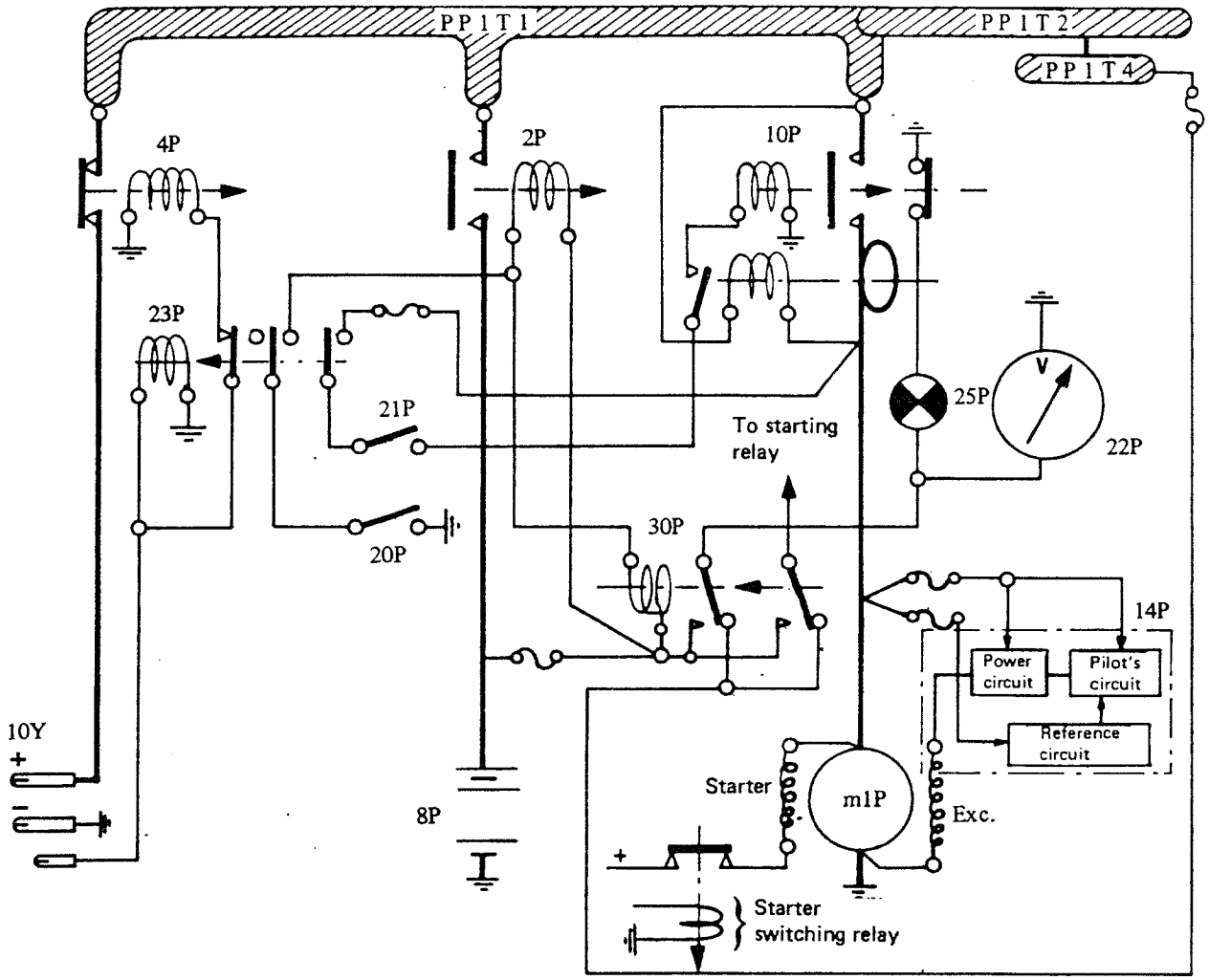


Figure 6

External power receptacle circuit

The external power receptacle line relay 4P AUTOMATICALLY closes the «external power receptacle - bus bar» circuit when the external power receptacle is energized.

The insertion of the ENERGIZED plug of the ground power supply produces in the first instance a + and − contact on the power pins, that is to say the energizing of the aircraft receptacle. At the end of the process, the auxiliary terminal of the external power intake (which is shorter than the power terminals) supplies the auxiliary control relay P23 which trips into «working» position and establishes the control circuit of line relay 4P which closes :

- the ground power unit supplies current to bus bar PP1T1
- the «GEN» red warning light 25P lights up (non-connected generator)
- the voltmeter indicates the external power supply voltage.

NOTE : When the ground power receptacle is energized, relay 23P breaks the control circuits of battery line relay 2P and of the reverse current relay 10P ; any accidental connecting of the battery and of the starter generator is thus prevented (no risk of feedback currents occurring between generators).

9.10.2.- D.C. POWER GENERATING SYSTEM (Continued)

C - OPERATION OF POWER GENERATING SYSTEMS (Continued)

(2) OPERATION OF BATTERY CIRCUIT (Figure 7)

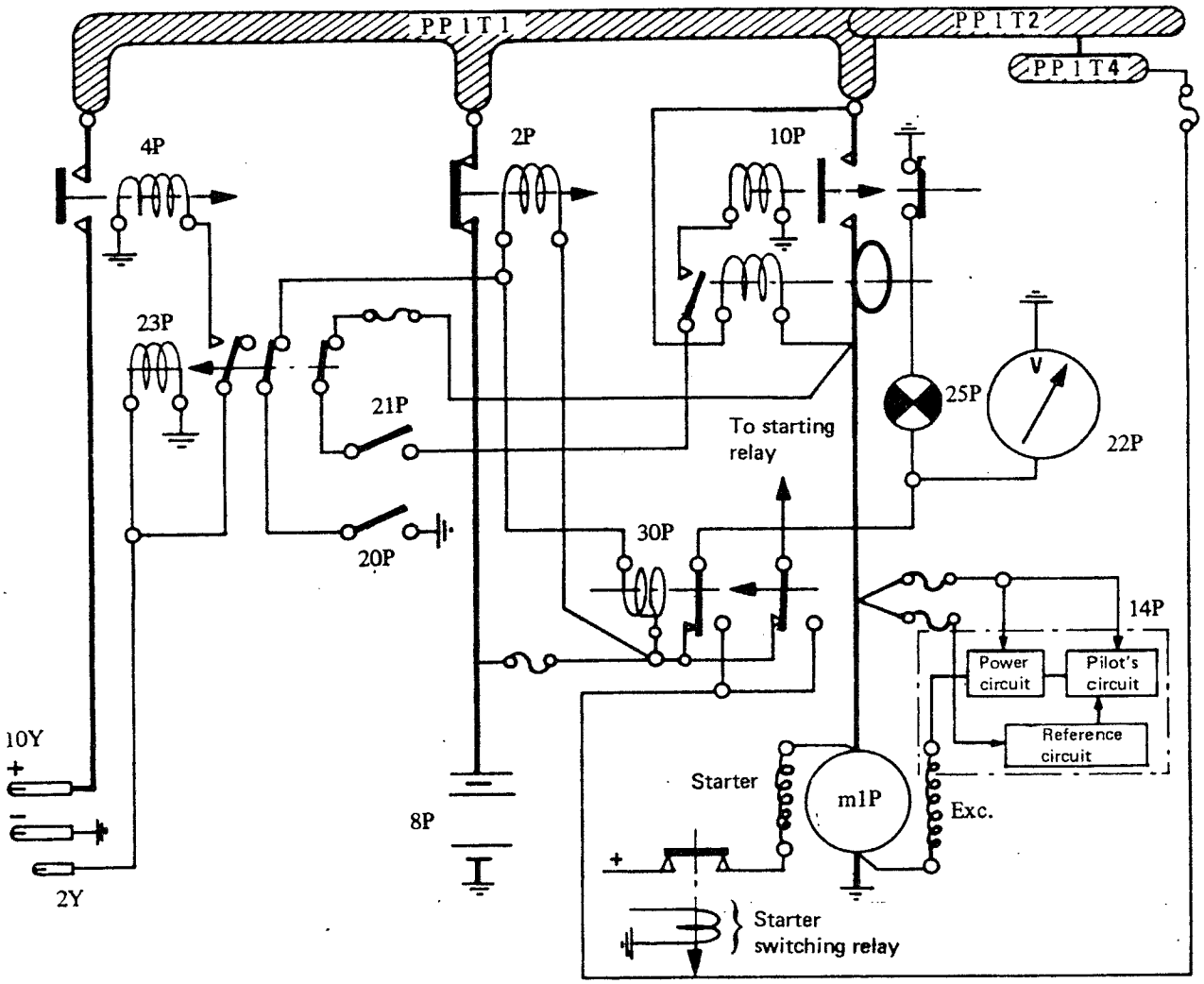


Figure 7
Battery circuit

The battery line relay 2P closes the «battery-bus bar» circuit when (the external power receptacle being de-energized) the «battery» switch 20P is positioned on «marche» (ON).

Closing the «battery» switch 20P establishes the excitation circuit of line relay 2P and change over relay 30P through the auxiliary relay of the external power receptacle 23P (relay 23P is in rest position, the external power receptacle being de-energized).

Line relay 2P is excited and closes :

- the battery supplies current to bus bar PP1T1
- the change-over relay switches to «work» position
- the «GEN» red warning light 13P lights up (generator not connected)
- the voltmeter indicates the battery voltage.
- the starting circuit is energized

WHEN THE EXTERNAL POWER RECEPTACLE IS ENERGIZED, THE CONTROL CIRCUIT OF LINE RELAY 2P IS OPEN AT RELAY 23P ; THE BATTERY IS ISOLATED FROM THE BUS BAR.

9.10.2. - D.C. POWER GENERATING SYSTEM (Continued)

C - OPERATION OF POWER GENERATING SYSTEMS (Continued)

(3) OPERATION OF GENERATOR CIRCUIT (Figure 8)

The reverse current relay 10P :
- Closes the «generator-bus bar» circuit whenever the generator voltage is higher than the battery voltage (CONNECTION).
- Opens the «generator-bus bar circuit» whenever the current from the battery is higher than the current from the generator (DISCONNECTION).

Winding A of the reverse current relay which controls the closing of the line relay is excited by a current from the generator + terminal via the external power receptacle auxiliary relay 23P, (at rest when the external power receptacle is not energized), through the «GEN» switch 21P and the control relay contact D of the reverse current relay.
The control relay is biased and controlled by windings B and C :
- the generator + output travels through winding C in the «generator-bus bar» direction and creates a magnetic field which tends to close the relay contact.
- the battery return current travels through winding B in the «bus bar-generator» direction and creates a magnetic field which tends to open the contact.
  The dominant current will cause the opening or the closing of the contact.

A - GENERATOR CUT-IN

Initial conditions :
- External power intake not energized, therefore relay 23P at rest
- «GEN» switch21P, closed
  At first, the reverse current relay contactor is open and the «GEN» warning light 25P is on.

Cut-in :
The generator voltage increases with the engine speed and, when it becomes higher than the battery voltage, a current travels through the reverse current relay voltage winding B and causes the closing of the control relay contact D.
Winding A is excited and causes the closing of the contactor :
- the generator supplies current to the bus bar
- the «GEN» warning light goes out (the warning light circuit is broken by the contactor)

B - GENERATOR CUT-OUT

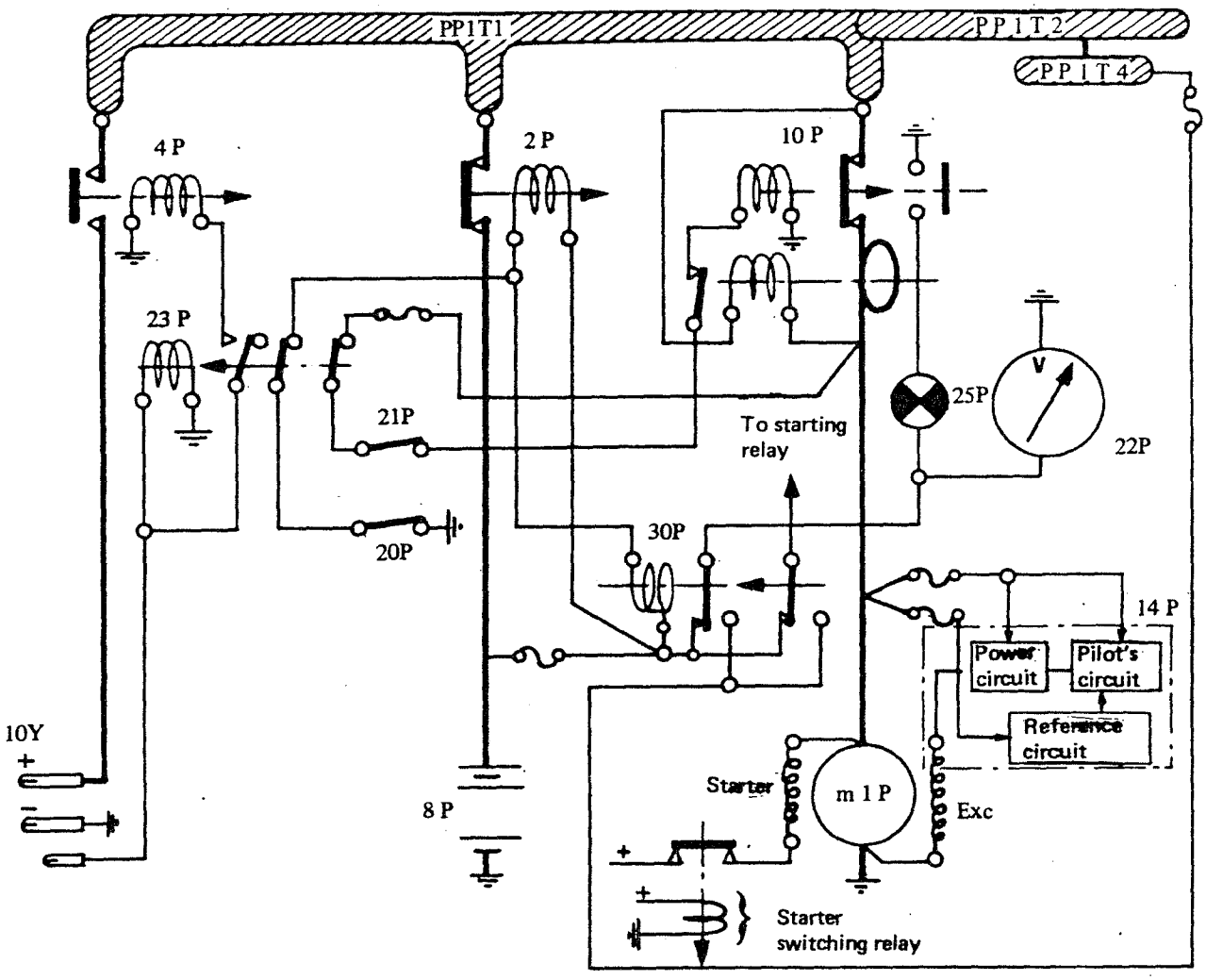
When the generator voltage becomes lower than the battery voltage (slowing down of the engine, or failure), the battery return current travelling through winding C causes the opening of control relay contact D, which cuts off the power supply to contactor winding A :
- the generator is cut out : the contactor opens and the «GEN» warning light comes on.

C - REGULATOR

Regulator 14P is connected with the excitation circuit of the generator. It keeps the generator voltage at a constant level through automatic variation of the excitation circuit resistance, and thereby of the excitation current.

9.10.2. - D.C. POWER GENERATING SYSTEM (Continued)

C - OPERATION OF POWER GENERATING SYSTEMS (Continued)



A -	Contactor winding
B -	Voltage winding
C -	Return winding
D -	Differential control relay contact

CUT-IN : When the generator voltage is higher than the battery voltage by 0.35 to 0.65 V, the current travelling through winding B closes contact D. Winding A is energized, the contactor closes : CUT-IN

CUT-OUT : When the battery return current reaches 9 to 22 A in winding C, contact D opens. Winding A is no longer energized, the contactor opens : CUT-OUT

WHEN THE EXTERNAL POWER RECEPTACLE IS ENERGIZED, THE CUT-IN CONTROL CIRCUIT IS OPEN AT THE AUXILIARY RELAY 23P : THE GENERATOR IS ISOLATED FROM THE BUS BAR.

Figure 8
Generator circuit

9.20. - ELECTRICAL POWER DISTRIBUTION

The consumer circuits are connected with the overhead panel bus bars PP2T3 and PP3T3 energized by the electrical equipment box bus bar PP1T2. Each consumer circuit is protected by a circuit breaker. All the circuit breakers are grouped on the overhead panel.

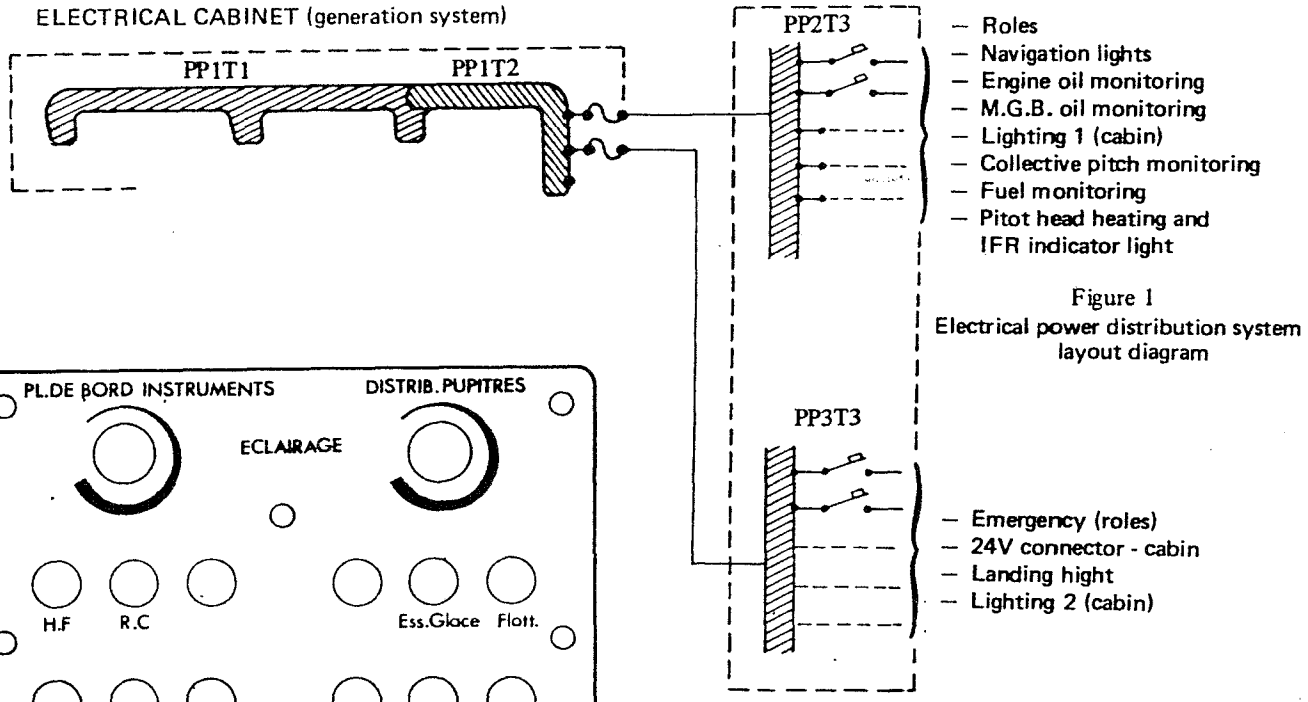


Figure 1
Electrical power distribution system layout diagram

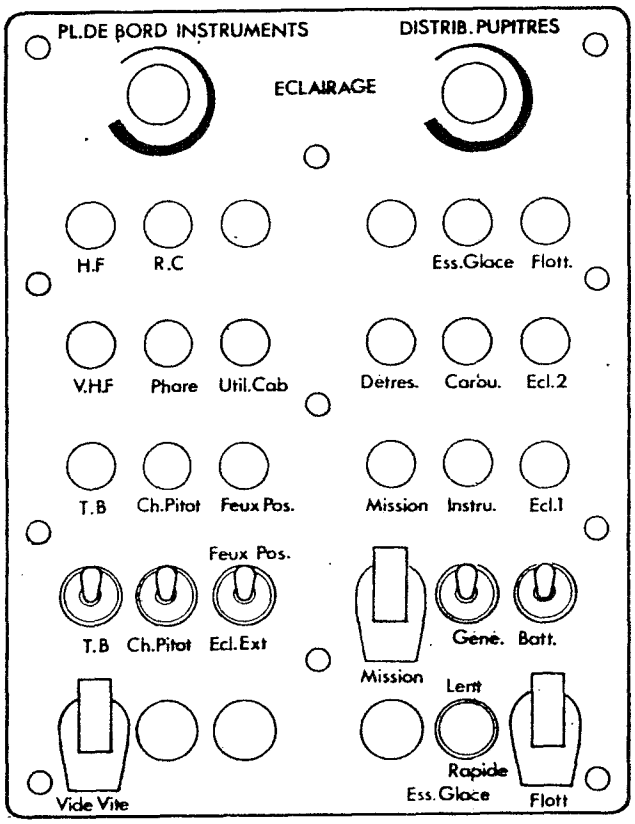


Figure 2
Overhead panel

NOTE : The overhead panel layout varies according to the optional equipment chosen by the «customer»

9.30. - LIGHTING

9.30.1. - GENERAL (Figure 1)

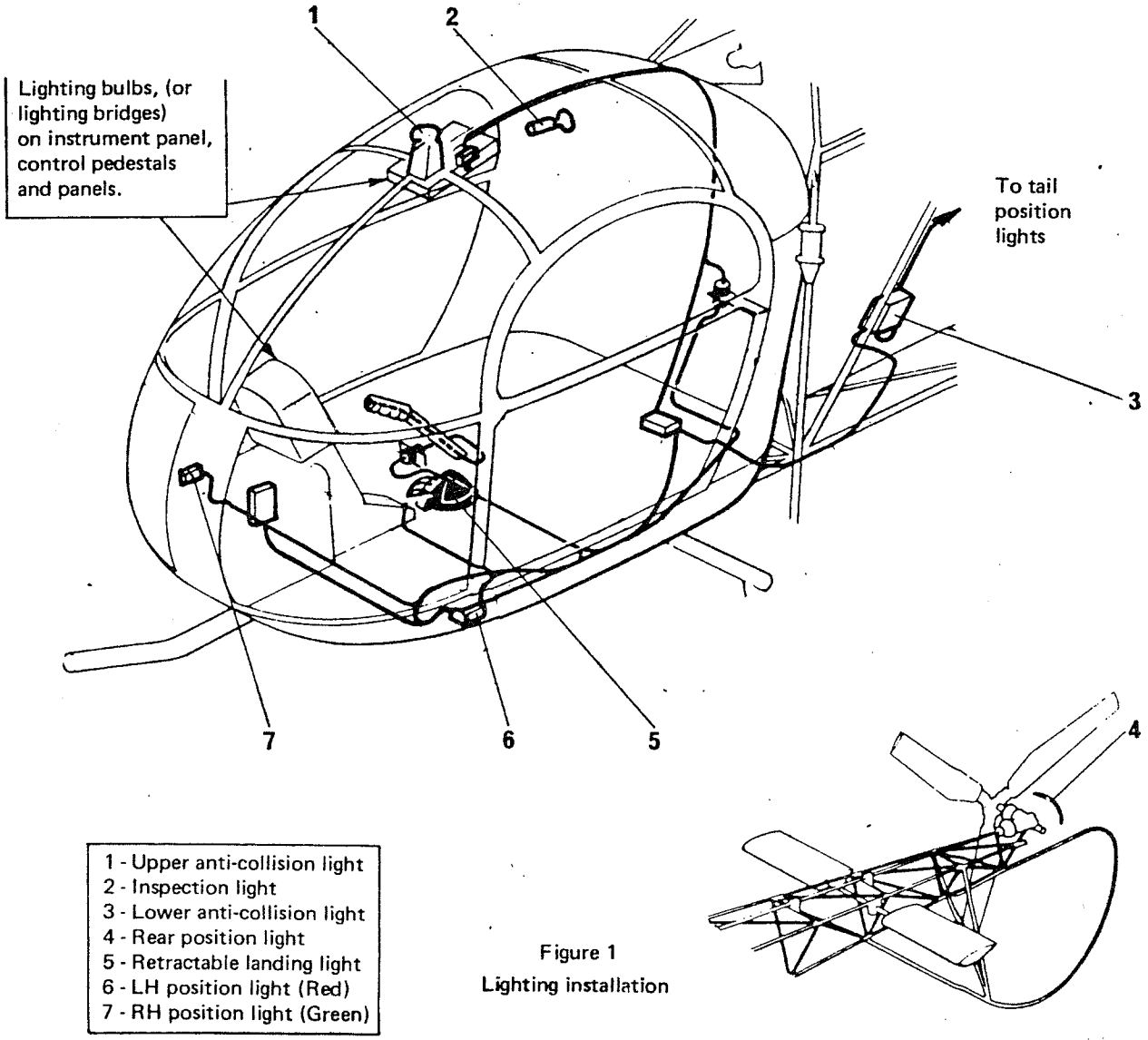
The lighting installation comprises :

The internal lighting system consisting of :

- cabin lighting : inspection lamp (2)
- instrument panel and control pedestal lighting, panel lights (lighting bridge and bulbs)

The external lighting system consisting of :

- position lights (4) (6) (7)
- rotary anti-collision lights (1) (3)
- retractable landing light (5)



1 - Upper anti-collision light
2 - Inspection light
3 - Lower anti-collision light
4 - Rear position light
5 - Retractable landing light
6 - LH position light (Red)
7 - RH position light (Green)

Figure 1
Lighting installation

9.30.2.- INTERNAL LIGHTING

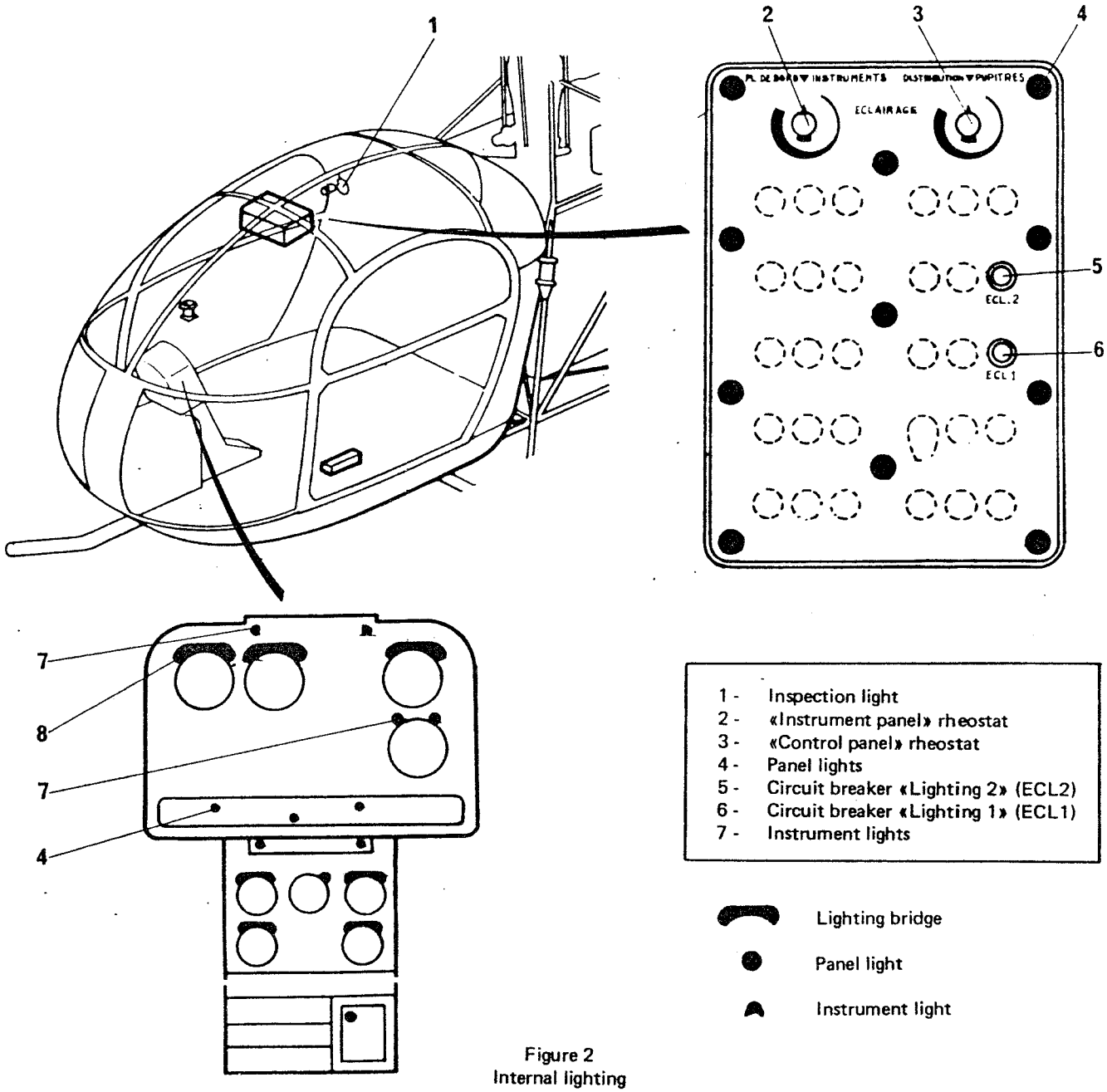
A - CABIN LIGHTING (Figure 2)

Cabin lighting is provided by an inspection light (1) secured to the overhead panel and equipped with an in-built potentiometer switch.

B - INSTRUMENT PANEL, CONTROL PEDESTAL AND PANEL LIGHTING (Figure 2)

The lighting of instruments and controls is provided by bridges (8) and instrument lights (7)lighting bulbs (4). The instruments panel, control pedestal and panel lighting is controlled by two dimming switches (rheostats) which adjust the brightness of the panel lighting :

- an «instrument panel» switch (rheostat)(2)
- a «control panel» switch (rheostat) (3)



1 - Inspection light
2 - «Instrument panel» rheostat
3 - «Control panel» rheostat
4 - Panel lights
5 - Circuit breaker «Lighting 2» (ECL2)
6 - Circuit breaker «Lighting 1» (ECL1)
7 - Instrument lights

Lighting bridge

Panel light

Instrument light

Figure 2
Internal lighting

9.30.2.- INTERNAL LIGHTING (Continued)

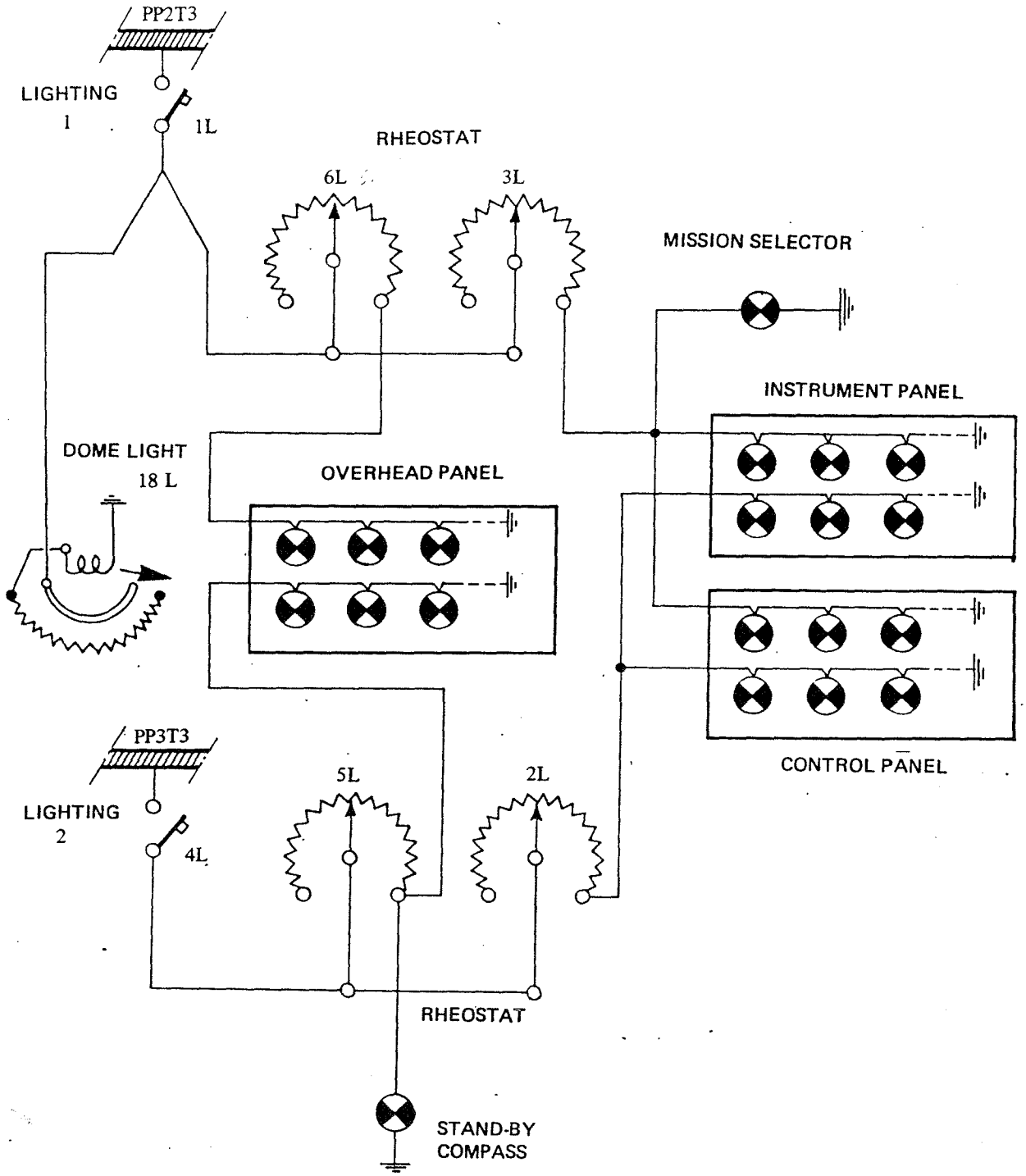


Figure 3
Internal lighting circuits - Schematic

9.30.3. - EXTERNAL LIGHTING

A - NAVIGATION LIGHTS (Figure 4)

Navigation lights comprise :

- three position lights (5) (7) (9)
- two rotary anti-collision lights (3) (4)

They are controlled by a three-position switch (2) :

- when the switch is on «ECL. EXT.» («EXT. LTS.») (external lighting) the position lights and anti-collision lights are illuminated
- when the switch is on «FEUX POS.» (POS. LTS.») (position lights) only the position lights are illuminated.

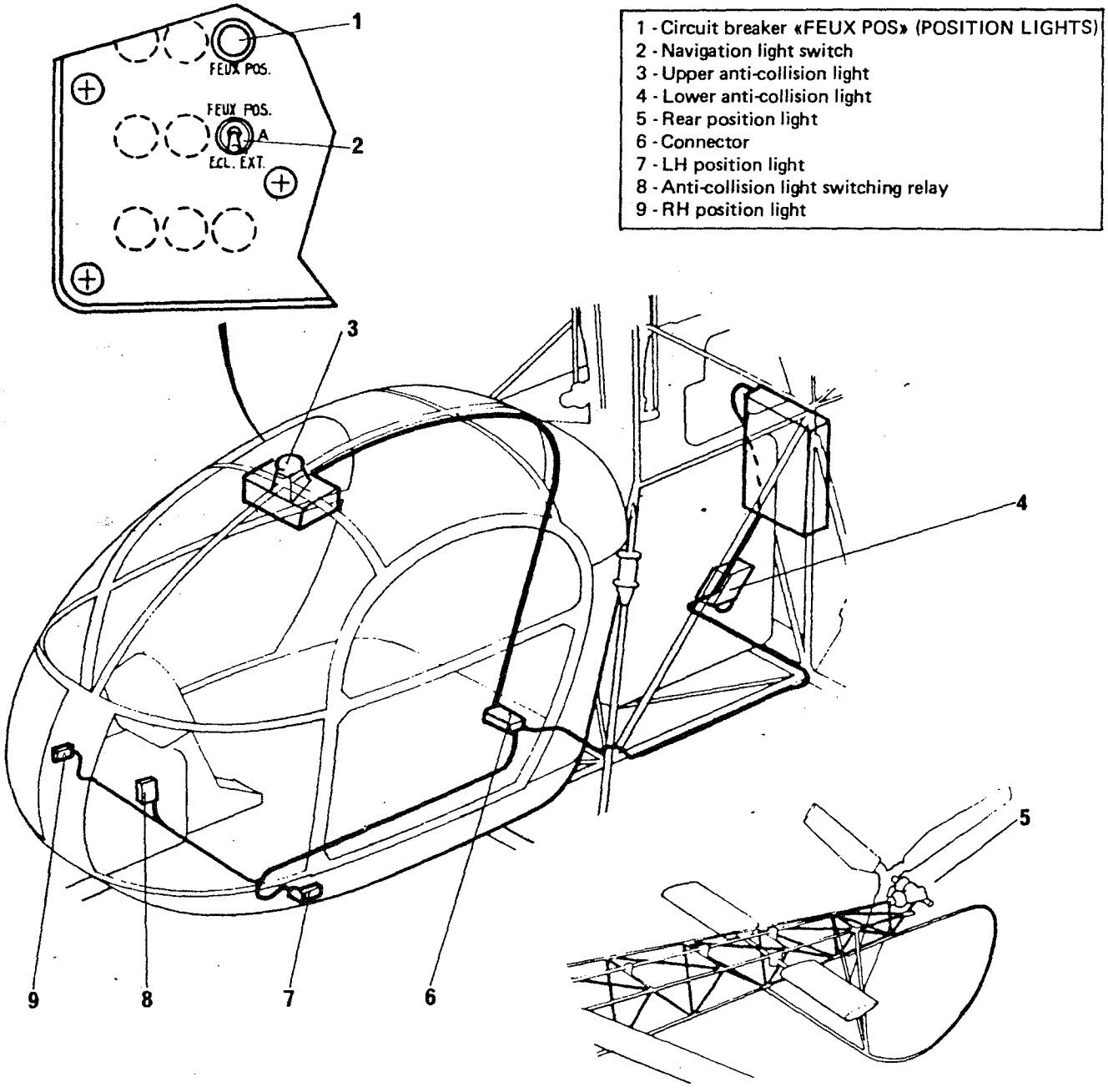


Figure 4

External lighting - Navigation lights

9.30.3. - EXTERNAL LIGHTING (Continued)

(1) OPERATION OF NAVIGATION LIGHTS (Figure 5)

- Three-position switch on «FEUX POS.» («POS. LTS.») (position lights) : all three position lights are illuminated.
- Three-position switch on «ECL. EXT.» («EXT. LTS.») (external lighting) : the control relay is excited and in working position : the anti-collision lights are energized (motor and lamps) and the position lights are illuminated.

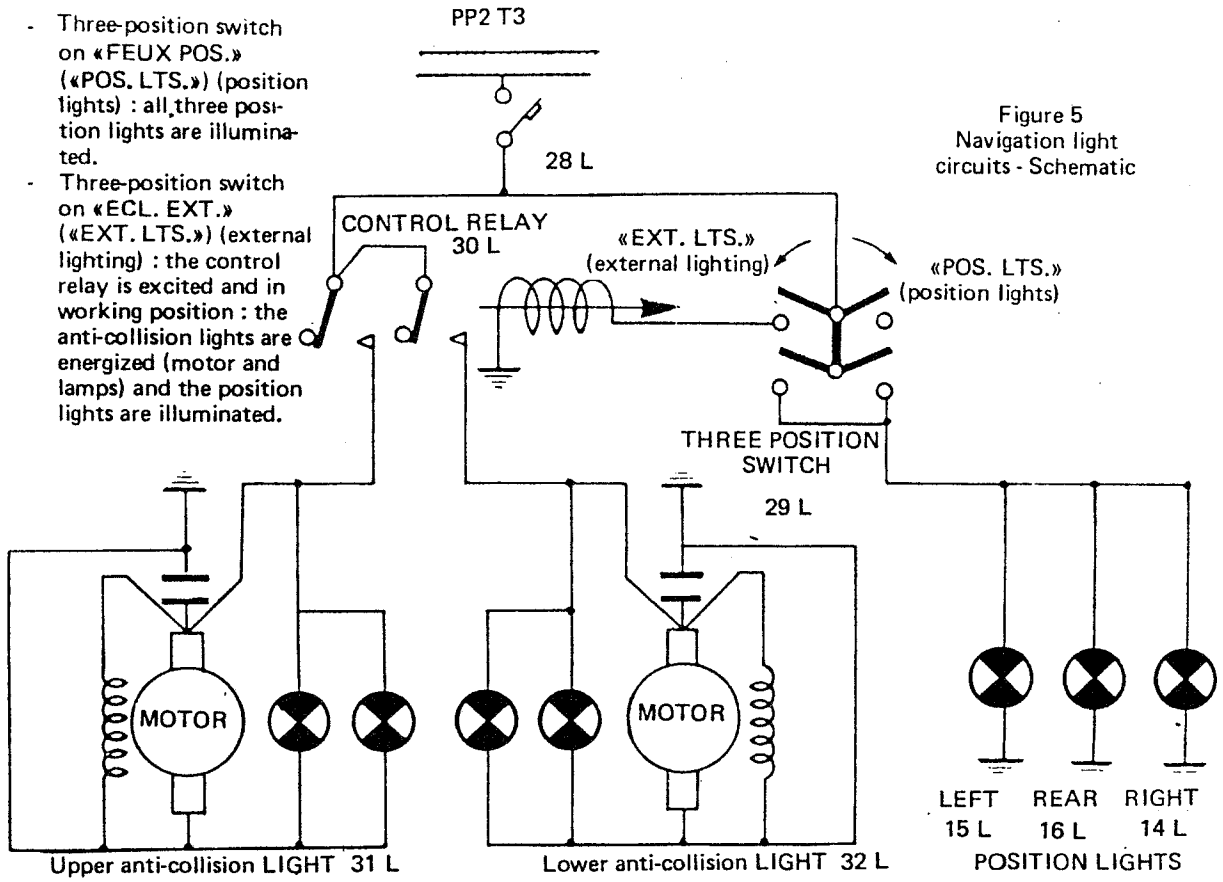


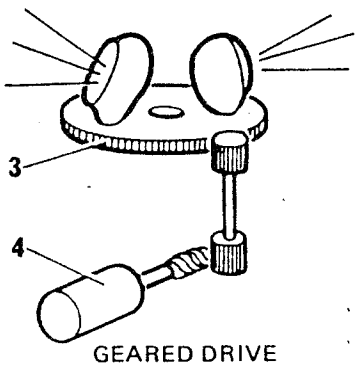
Figure 5
Navigation light circuits - Schematic

(2) ANTI-COLLISION LIGHT (Figure 6)

The electric motor (4) actuates a gear wheel (3) supporting two lamps (8). The lamp-support wheel turns at the rate of 45 r.p.m. carrying the two lamps which emit two diametrically opposed light beams.

Characteristics :

Lamp consumption : 3 A
Motor consumption : 0.3 A
Motor speed : 10 500 r.p.m.
Lamp power : 40 W



1. - Dome (red glass)
2. - Dome securing collar
3. - Lamp-support gear wheel
4. - Motor
5. - Attachment flange
6. - Casing
7. - Seal
8. - Lamps

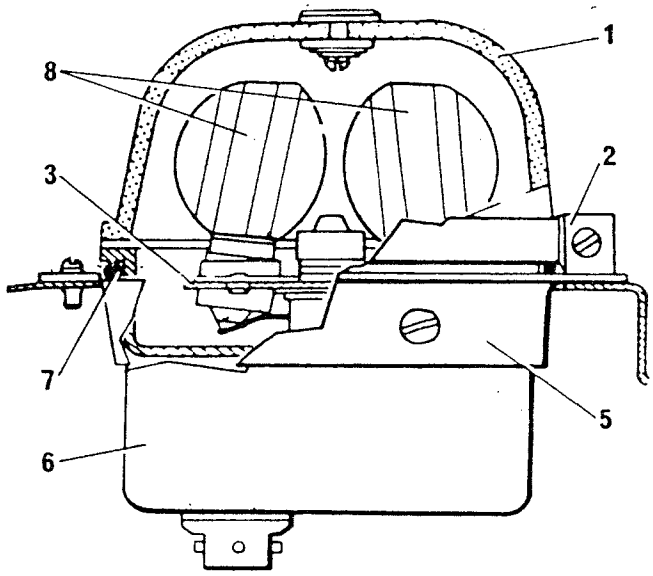


Figure 6
Anti-collision light

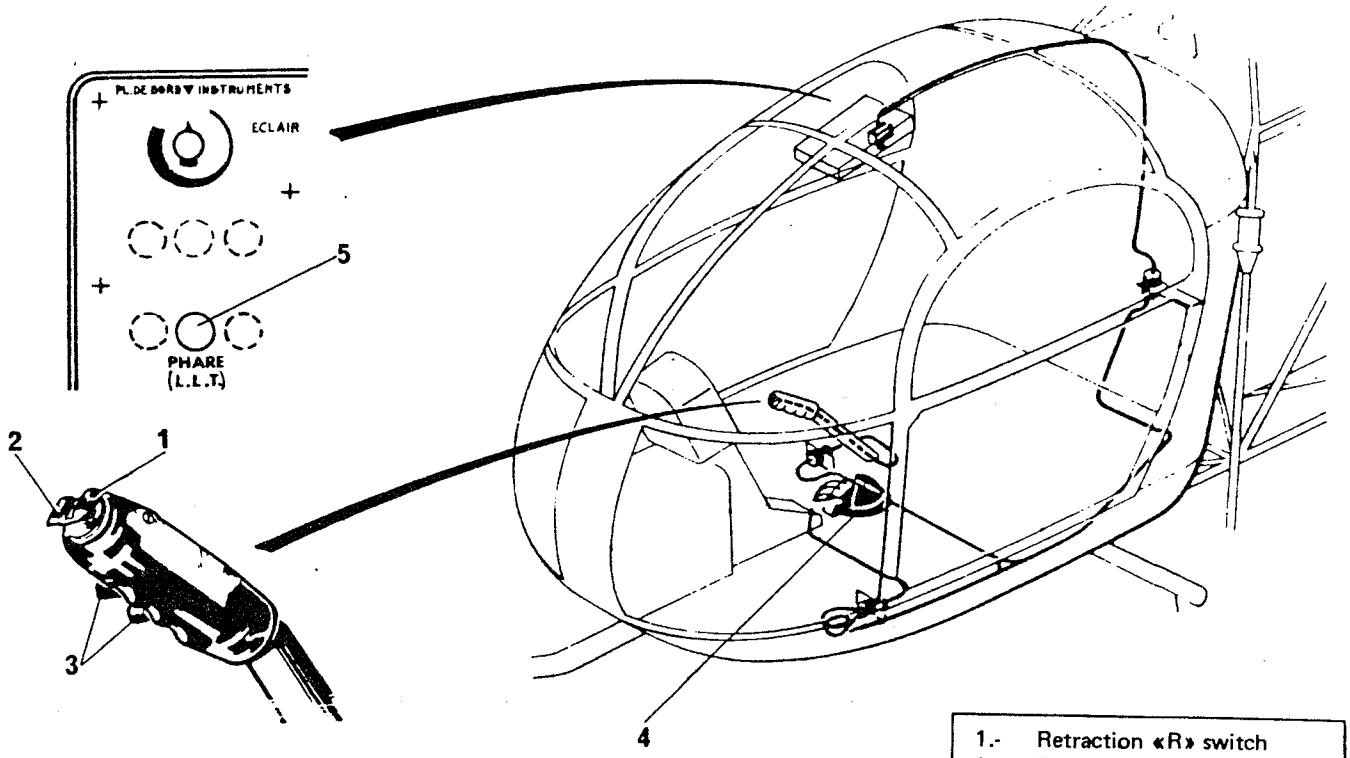
9.30.3.- EXTERNAL LIGHTING (Continued)

B.- LANDING LIGHT

(1) GENERAL (Figure 7)

Secured to the front structure lower panel, the landing light (4) illuminates the runway for landing and taxiing. It can be positioned in elevation by retraction of the optical unit. The landing light is controlled from 2 switches located on the grip handle of the pilot's collective pitch lever :

- a retraction «R» (in) - Extention «S» (out) control switch
- a lighting control switch - Red button : light off
  Black button : light on.



1.- Retraction «R» switch
2.- Extension «S» switch
3.- Dual control lighting switch
4.- Landing light
5.- Landing light circuit-breaker

Figure 7
Landing light

(2) LANDING LIGHT OPERATION (Figure 8)

Illumination of landing light. When set to on, the dual control lighting switch (9L) energizes the relay (R) which, in its working position, supplies power to the lamp.

Extension or retraction of optical unit. When the control switch (8 L) is in «extension» or «retraction» position, the corresponding winding of the landing light motor (M) is energized through the end-of-travel contact : the optical unit extends or retracts. The movement can be stopped at any point of its progress by releasing the switch. At the end of the «extension» or «retraction» travel a cam, which actuates the corresponding end-of-travel contact, cuts off the motor power supply.

9.30.3. - EXTERNAL LIGHTING (Continued)

B - LANDING LIGHT (Continued)

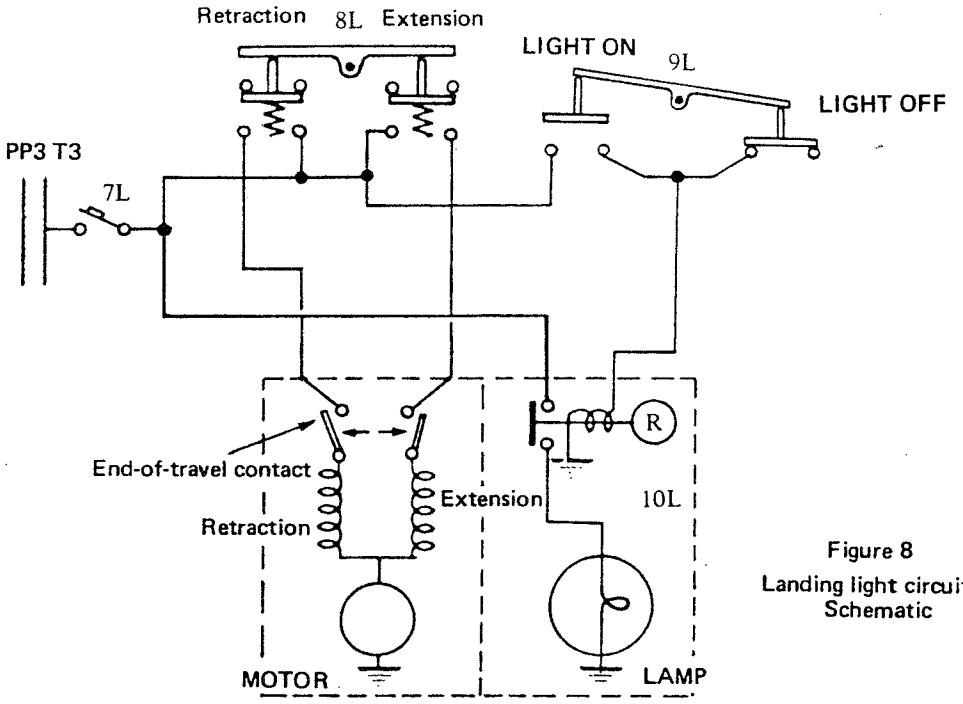


Figure 8
Landing light circuits
Schematic

(3) DESCRIPTION OF LANDING LIGHT (Figure 9)

Description :

MOTOR	OPTICAL UNIT
- Type : «Series-wound» - Maximum consumption : 1.3 A - Service : intermittent - working : 3 min. - rest : 17 min.	- Power : 250 W - Maximum consumption : 10 A - Service : intermittent - working : 15 min. - rest : 45 min.

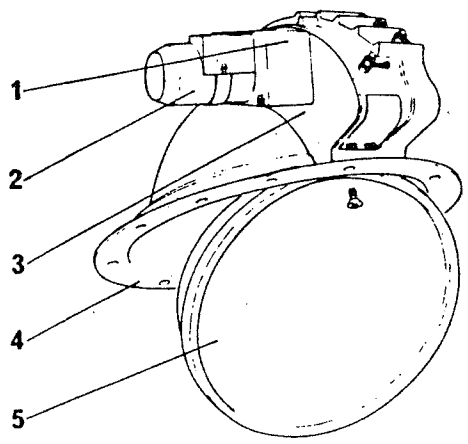
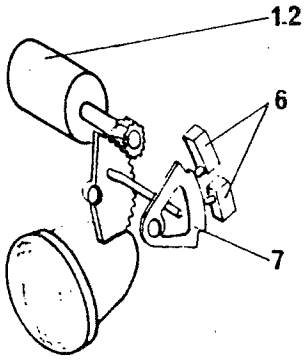


Figure 9
Landing light

SIMPLIFIED diagram of mechanism



1. - Reducer
2. - Motor
3. - End-of-travel control unit
4. - Optical unit support
5. - Mobile optical unit
6. - End-of-travel contacts
7. - Cam

CHAPTER 10

INSTRUMENTS

CONTENTS

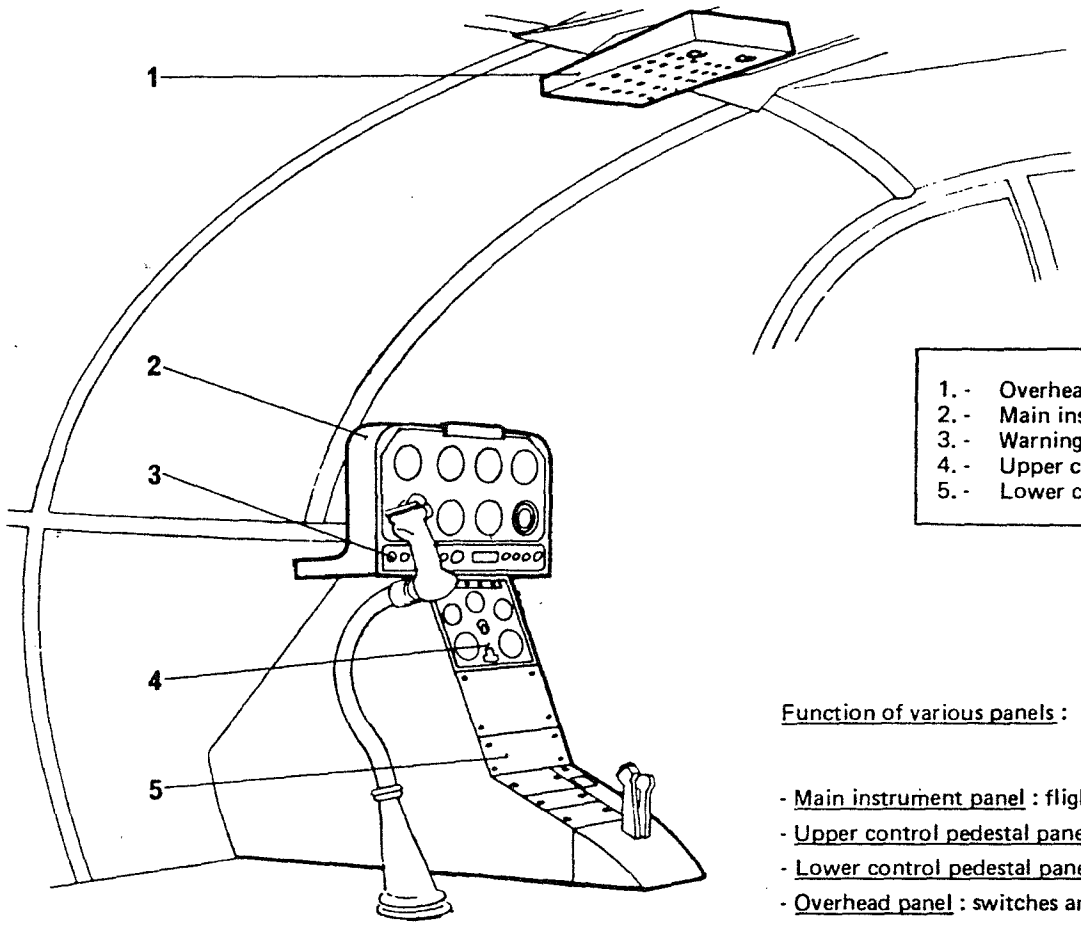
10. - INSTRUMENTS

10.00. - GENERAL

10.00.1. - INSTRUMENT MOUNTING PANELS (Figure 1)

The monitoring units (instruments, indicator ights, etc . . .) the control units (switches) and electrical circuit protection devices (circuit breakers) are all grouped by function on the following panels :

- Main instrument panel (2)
- Upper and lower control pedestal panels (4) (5)
- Overhead panel (1)



1. - Overhead panel
2. - Main instrument panel
3. - Warning and indicating panel
4. - Upper control pedestal panel
5. - Lower control pedestal panel

Function of various panels :

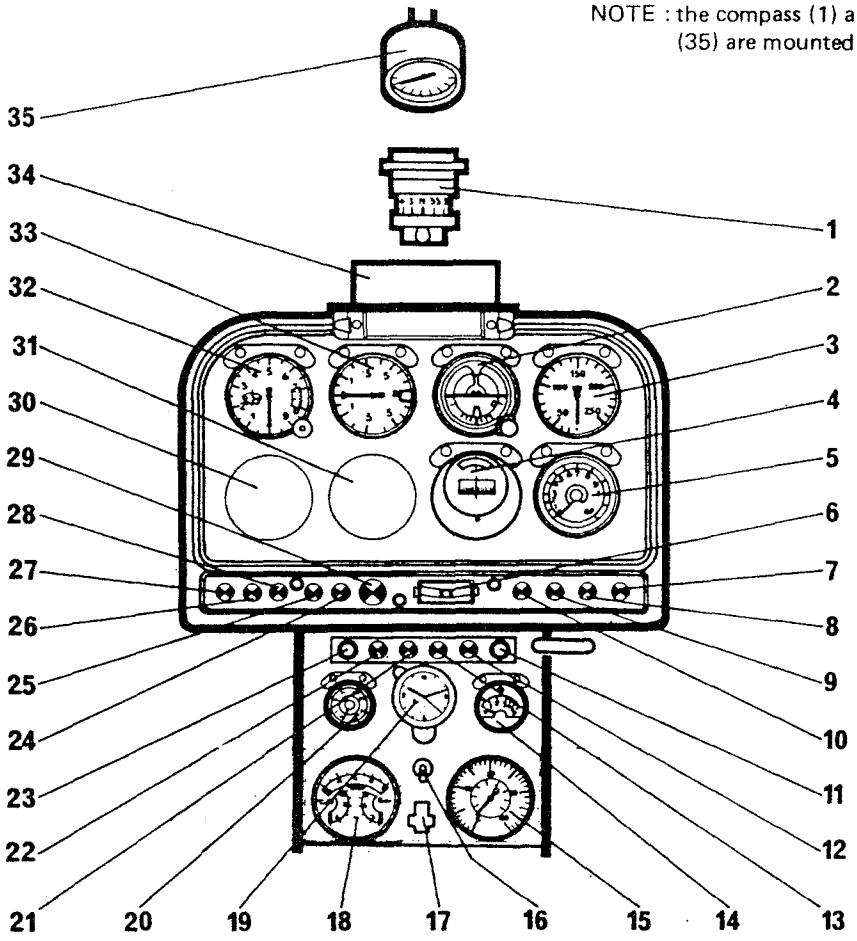
- Main instrument panel : flight monitoring instruments
- Upper control pedestal panel : engine control and monitoring
- Lower control pedestal panel : radio systems
- Overhead panel : switches and circuit breakers

Figure 1
Main instrument panel, control pedestal panels, circuit breaker and warning panels

10.00.2.- LOCATION OF INSTRUMENTS, INDICATOR LIGHTS AND SWITCHES

A.- ON MAIN INSTRUMENT PANEL AND UPPER PANEL

NOTE : the compass (1) and O.A.T (35) are mounted on the canopy

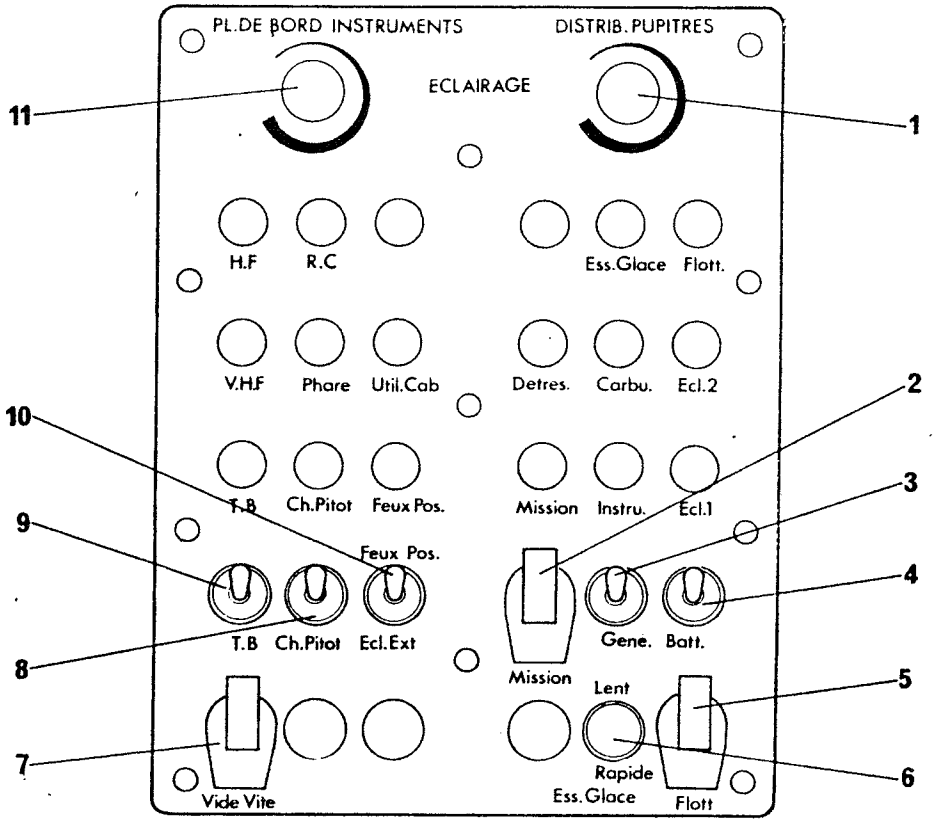


1 - Magnetic compass
2 - Artificial horizon
3 - Airspeed indicator
4 - Directional gyro
5 - Collective pitch indicator
6 - Bank indicator
7 - M.G.B. oil temperature warning light (red)
8 - M.G.B. oil pressure warning light (red)
9 - Fuel booster pump warning light (amber)
10 - Generator cut out warning light (red)
11 - Fuel contents gauge test
12 - Engine oil pressure warning light (red)
13 - «Stop start» warning light (red)
14 - Fuel contents indicator
15 - RPM dual indicator (engine/rotor)
16 - Booster pump switch
17 - Starter switch
18 - Triple indicator (engine oil pressure - engine temperature, tail pipe temperature (T4)
19 - Chronometer
20 - Voltmeter
21 - Engine electric cock warning light (amber)
22 - Starter indicator light (green)
23 - Circuit breaker (starter circuit)
24 - Reserved
25 - Reserved
26 - Fuel filter clogging warning light (amber)
27 - Battery temperature warning light
28 - «Sling» indicator light (green)
29 - Alarm warning light
30 - Reserved
31 - Reserved
32 - Altimeter
33 - Rate of climb indicator
34 - «Radio frequencies» placard
35 - Outside air temperature indicator

Figure 2
Main instrument panel and upper pedestal panel

10.00.2.- LOCATION OF INSTRUMENTS, INDICATOR LIGHTS AND SWITCHES (Continued)

B.- ON OVERHEAD PANEL



1 - Pedestal lighting rheostat
2 - Role selector switch (MISSION)
3 - Generator switch (GENERATRICE)
4 - Battery switch (BATTERIE)
5 - Emergency flotation gear switch (FLOTTABILITE DE SECOURS)
6 - Windshield wiper switch (ESSUIE-GLACE)
7 - Fuel jettison switch (VIDE-VITE)
8 - Pitot head heating switch (CHAUFFAGE PITOT)
9 - Interphone switch (TELEPHONE DE BORD)
10 - Position lights/anti-collision lights selector switch (FEUX DE POSITION - FEUX ANTI-COLLISION)
11 - Instrument panel lighting rheostat.

NOTE : The layout and function of switches may vary depending on optional equipment installed on the aircraft.

Figure 3 - Overhead panel

10.10. - SYSTEM OPERATION MONITORING INSTRUMENTS

10.10.1. - GENERAL

The various operational installations are monitored by :

- indicators which permanently show the variations of the parameter to be monitored (for instance, pressure, temperature, etc . . .)
- warning light, which indicates that the characteristic condition of a parameter has actually been reached (for instance, minimum pressure in a circuit, maximum temperature, etc . . .)

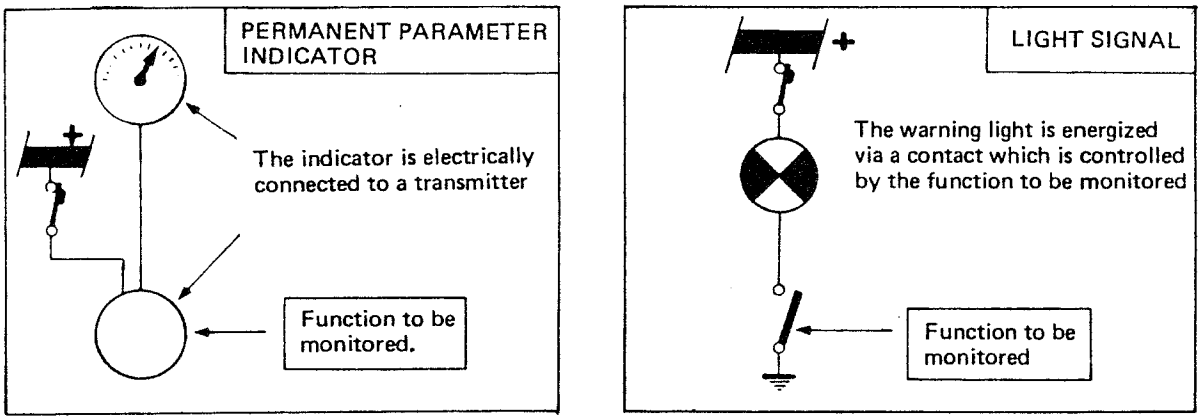


Figure 1

The various monitoring circuits are dealt with under the corresponding installation : for instance, the fuel contents indicator is described in Chapter 8 : «Fuel system». Here, the monitored operation parameters are simply given in synthetical form.

INSTALLATION	MONITORED PARAMETER	MONITORING MEANS USED
Power plant (engine)	- Oil pressure - Oil temperature - Rotational speed - E.G.T. temperature T4 - Starting sequences	- Pressure indicator - Thermometer - Tachometer - Thermocouple - Indicator lights
Fuel system	- Fuel level in the tank - Low fuel level - Booster pump pressure drop - Filter clogging	- Fuel gauge - Warning light - Warning light - Warning light
Transmission system	- M.G.B. oil pressure - M.G.B. oil temperature	- Warning light - Warning light
Flying controls	- Collective pitch	- Pitch indicator
Electrical power	- Voltage - Generator cutout	- Voltmeter - Warning light
Flight control instruments	- Pitot tube heating - Gyroscopic instruments vacuum	- Pilot light - Warning light

10.10.2. - INSTRUMENTS : PRINCIPLE OF OPERATION (Reminder)

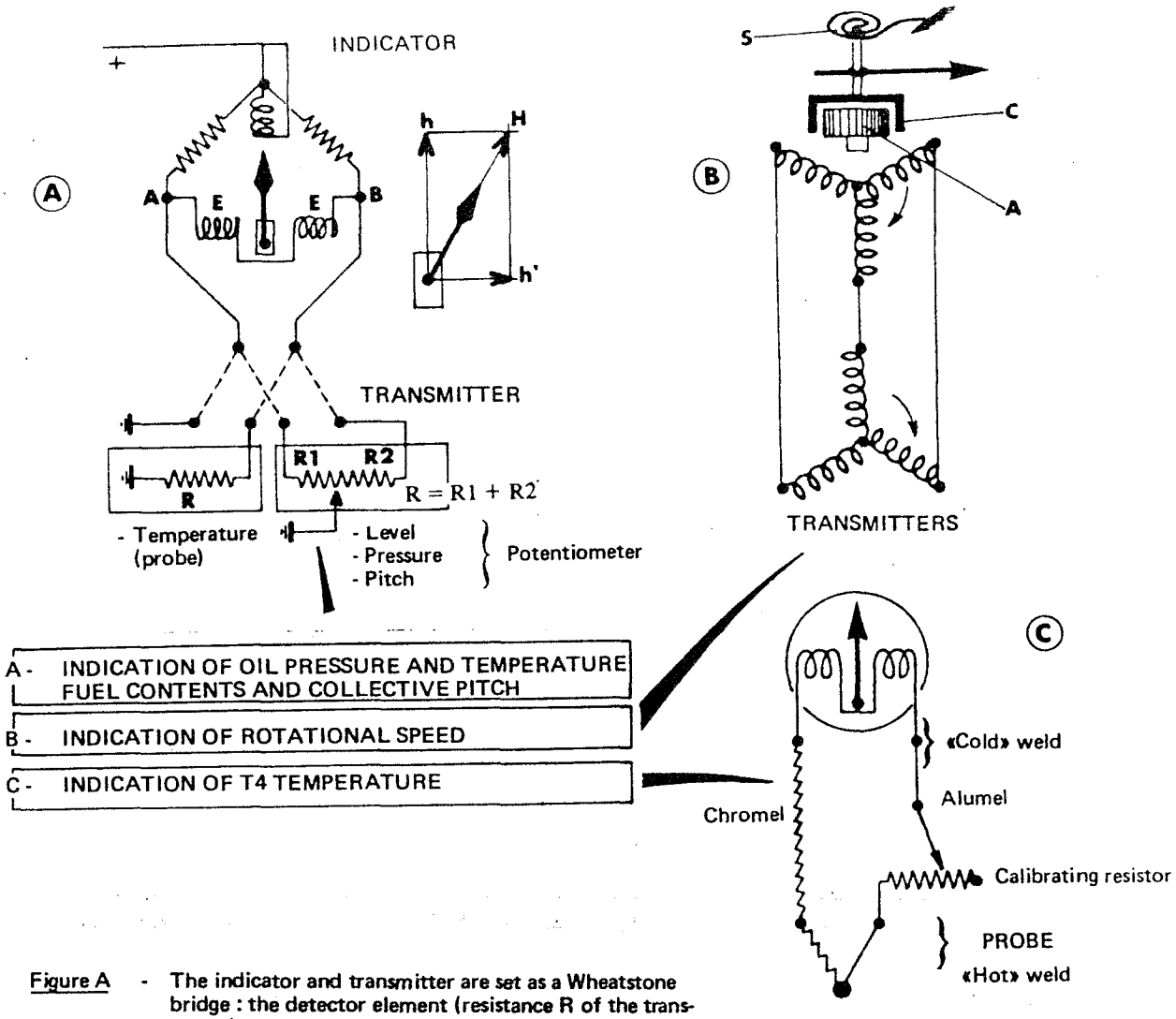


Figure 2

Figure A - The indicator and transmitter are set as a Wheatstone bridge : the detector element (resistance R of the transmitter) varies with the parameter to be measured.
- When the parameter can be translated by a displacement (level, pressure, pitch, etc . . .), the variable resistance is a potentiometer.
- When the parameter is a temperature, the resistance is immersed in the fluid to be measured, and its value varies together with the fluid temperature. The indicator needle orientation depends upon the resultant magnetic field H created by the magnetic field of the coils E - field h' - and the field (h) of the return winding. The current flowing through the coils E is a function of the differential resistance between points A and B of the bridge ; it is therefore primarily a function of the variable element value (R or R1 and R2).

Figure B - The indicator is a synchronous motor ; the transmitter is a three-phase alternator, the frequency of which is proportional to rotational speed. The indicator motor drives a magnet A which, by induction (eddy current type) applies a torque to the drag cup C ; this torque is balanced by a hairspring S.

Figure C - The indicator is a galvanometer measuring the current intensity in a thermo-couple (chromel wire - alumel wire), the hot junction of which (probe) is inserted in the engine exhaust diffuser. An adjustable resistance allows the line to be calibrated.

10.20. - FLIGHT AND NAVIGATION MONITORING INSTRUMENTS

10.20.1. - GENERAL

Flight and navigation are monitored by use of the following :

- Pitot-static pressure system and associated instruments :
    - Air speed indicator
    - Altimeter
    - Rate of climb indicator
- Gyroscopic navigation instruments :
    - Artificial horizon
    - Directional gyro (heading indicator)
- Navigation instruments not associated with a system :
    - Clock
    - Outside air temperature indicator
    - Magnetic compass
    - Bank indicator (ball)

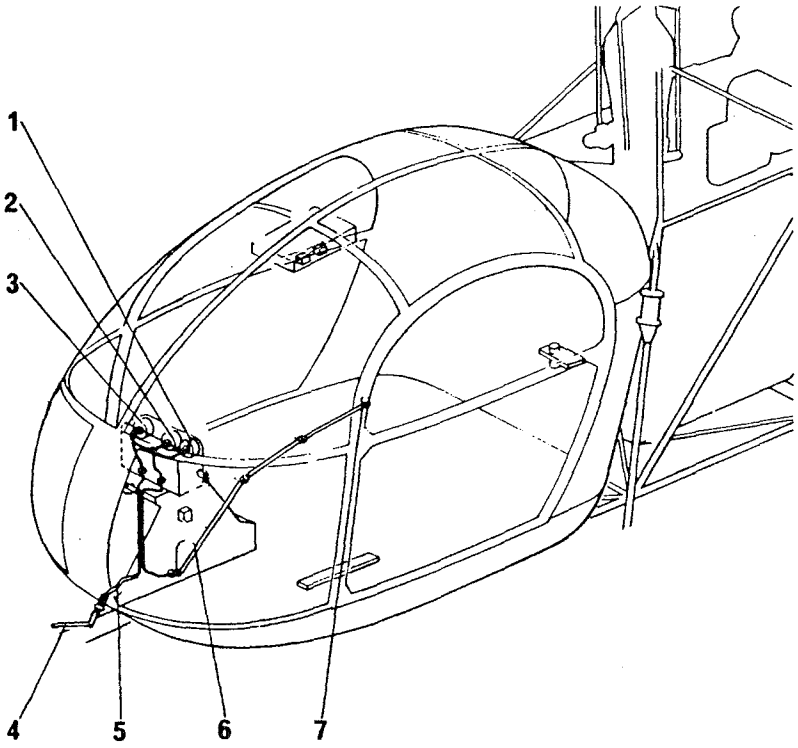
10.20.2. - PITOT-STATIC PRESSURE SYSTEM AND ASSOCIATED INSTRUMENTS

A - GENERAL (Reminder) (Figure 1)

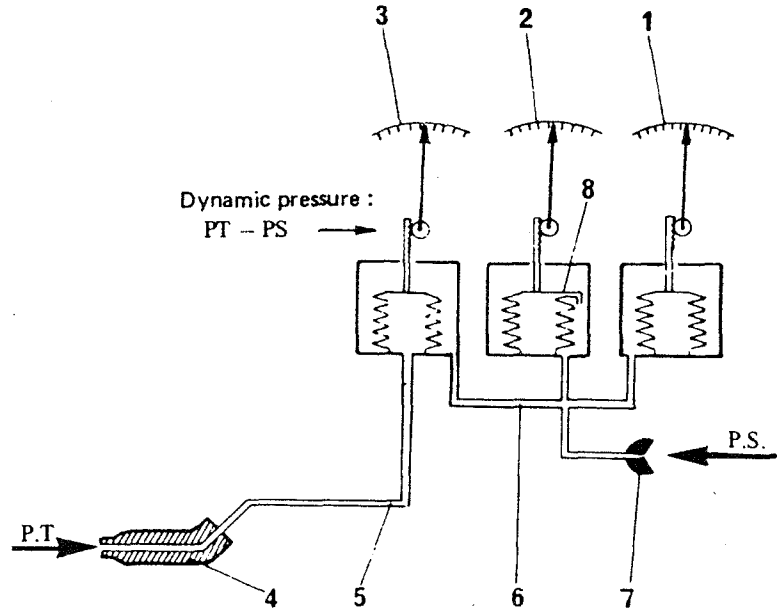
The Pitot-static system consists of :

- The ram air pressure system (5) : the ram air pressure is picked up by a Pitot tube (4) fitted in the nose of the aircraft and connected, through a line, to the airspeed indicator (3) which gives the relative speed of the helicopter with respect to the air.
- The static pressure system (6) : the static vent (7) (barometric pressure) is located on the left side of the aircraft and supplies the following :
  - the altimeter (1), indicating the altitude as compared with sea level
  - the rate-of-climb indicator (2), indicating the vertical velocity of the aircraft

Both the static vent and pitot tube are located far from the eddy currents induced by the aircraft flight. The total pressure tube (Pitot head) is fitted with a heating coil (electrical resistance) for de-icing.



1. - Altimeter
2. - Rate-of-climb indicator
3. - Airspeed indicator
4. - Pitot head
5. - Total pressure lines
6. - Static pressure lines
7. - Static vent



P.T. : Ram air pressure

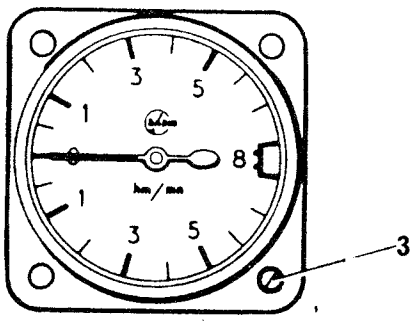
P.S. : Static pressure

Static pressure delayed by capillary tube (8)

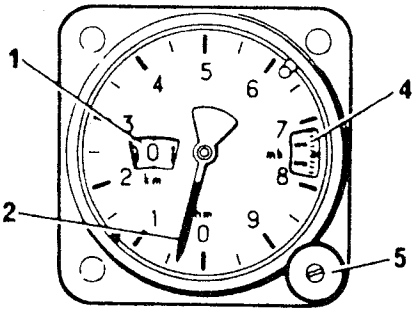
Figure 1 - Pitot static system

10.20.2. - PITOT-STATIC PRESSURE SYSTEM AND ASSOCIATED INSTRUMENTS (Continued)

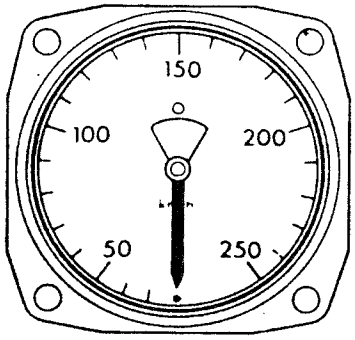
B - INSTRUMENTS (Figure 2)



RATE-OF-CLIMB INDICATOR



ALTIMETER



AIRSPEED INDICATOR

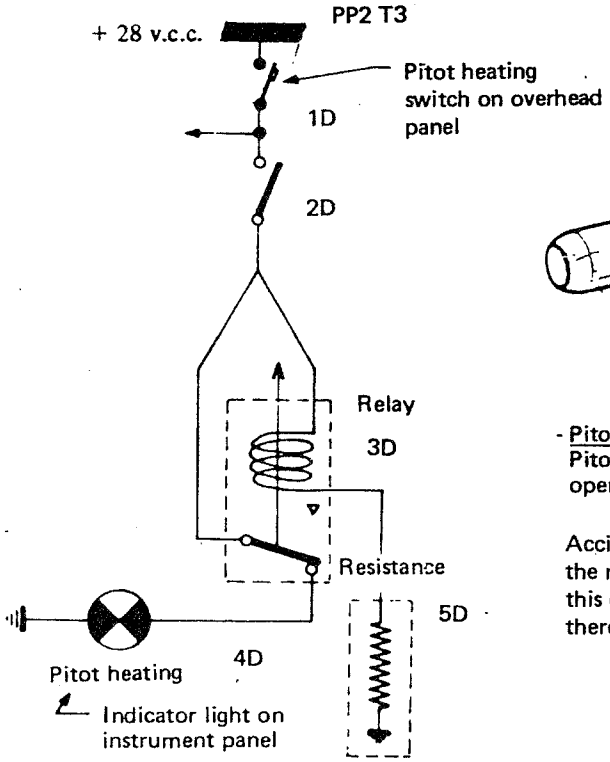
THE RATE-OF-CLIMB INDICATOR is graduated from 0 to 8 hm/min. It measures the difference between the instantaneous static pressure noted in the casing and the static pressure in the aneroid capsule which is delayed by a capillary tube. This pressure difference is directly proportional to the vertical velocity of the aircraft. The setting screw (3) permits the zero adjustment of the pointer to be corrected.

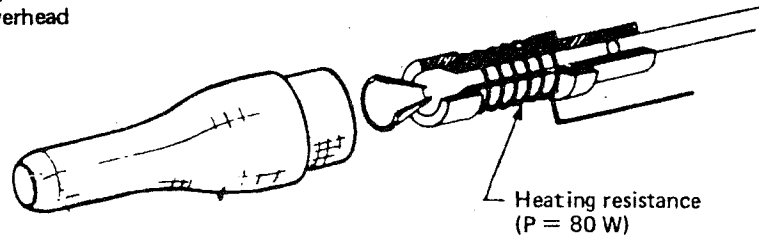
THE ALTIMETER is graduated from 0 to 12 000 m
- the pointer (2) indicates the hundreds of meters.
- the disc (1) indicates the thousands of meters.
- the setting knob (5) is used to display barometric pressure, between 930 and 1 040 mb, in the aperture (4)

THE AIRSPEED INDICATOR is graduated from 0 to 250 km/h.

Figure 2

C - PITOT HEAD HEATING SYSTEM (Figure 3)





- Pitot heating switch ON : The resistance is energized and the Pitot heating warning light is off. The warning light circuit is open at the relay, which is energized.

Accidental break of the resistance circuit :
the relay, not being excited, is in rest position ;
this closes the circuit of the warning light which therefore comes on.

Figure 3
Pitot head heating system

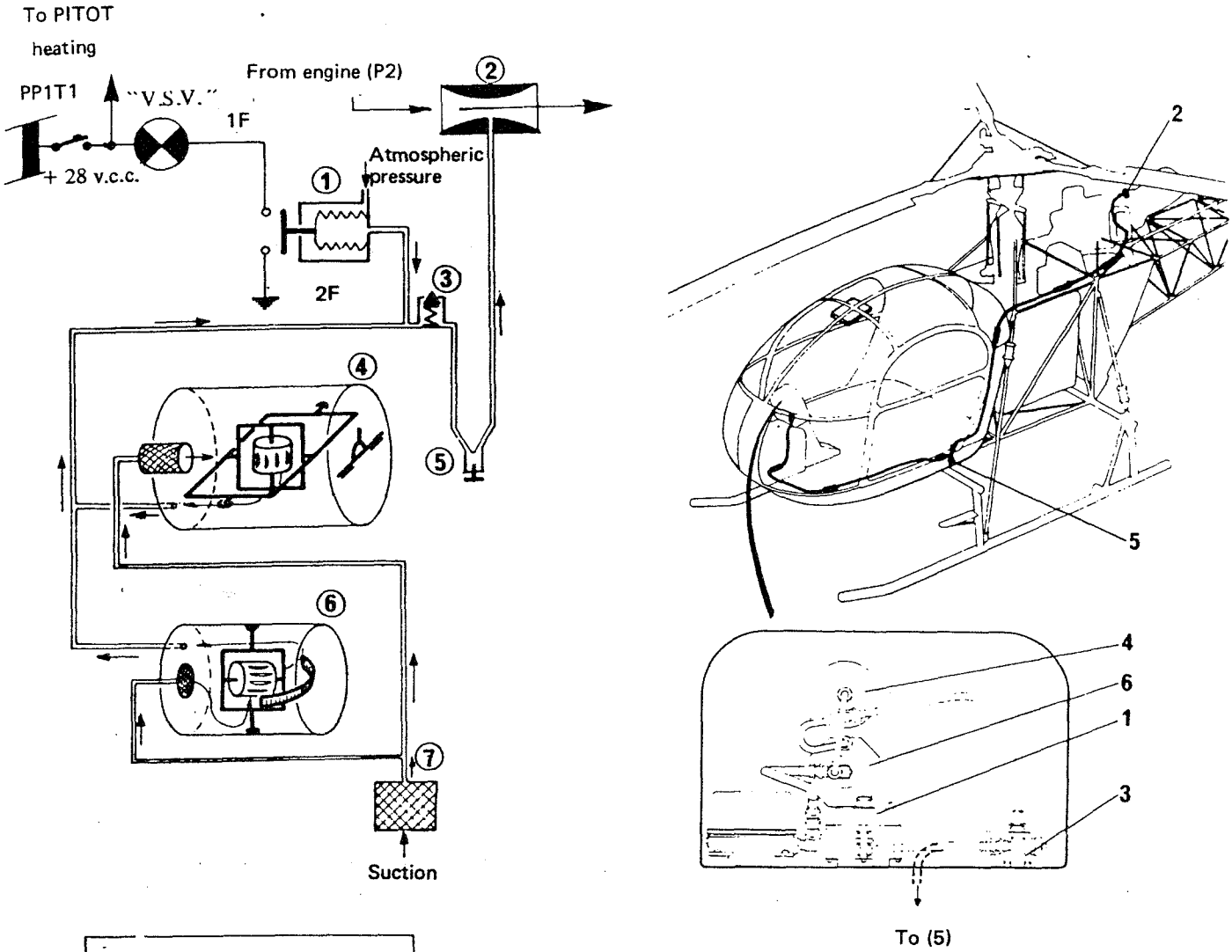
10.20.3. - GYROSCOPIC INSTRUMENTS

A - GENERAL (Figure 4)

The gyro instruments installation comprises :

— A vacuum circuit which provides the suction required for operation of the instruments. It includes :
- a vacuum generator : a VENTURI tube (2) mounted on the engine air-bleed (hot) connection
- a regulating valve (3) which limits the vacuum cutting-in whenever the vacuum value attains 150 mb
- a pressure switch (1) controlling the IFR vacuum indicator light
- a filter (7) and a drain valve (5) providing outlet for condensation water

— The gyroscopic instruments :
- an artificial horizon indicator (4) indicates the aircraft pitch and roll inclinations
- a directional gyro (6) permits the heading indication given by the compass to be set and maintained.



1. - Pressure switch
2. - Venturi
3. - Regulating valve
4. - Artificial horizon
5. - Drain valve

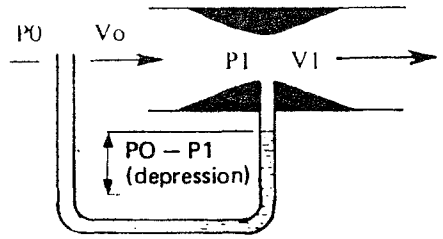
6. - Directional gyro
7. - Filter

Figure 4
Vacuum circuit and gyroscopic instruments

10.20.3. - GYROSCOPIC INSTRUMENTS (Continued)

B - VACUUM CIRCUIT OPERATION (Figure 4)

The vacuum is created at the venturi (2) (vacuum : 150 mb)



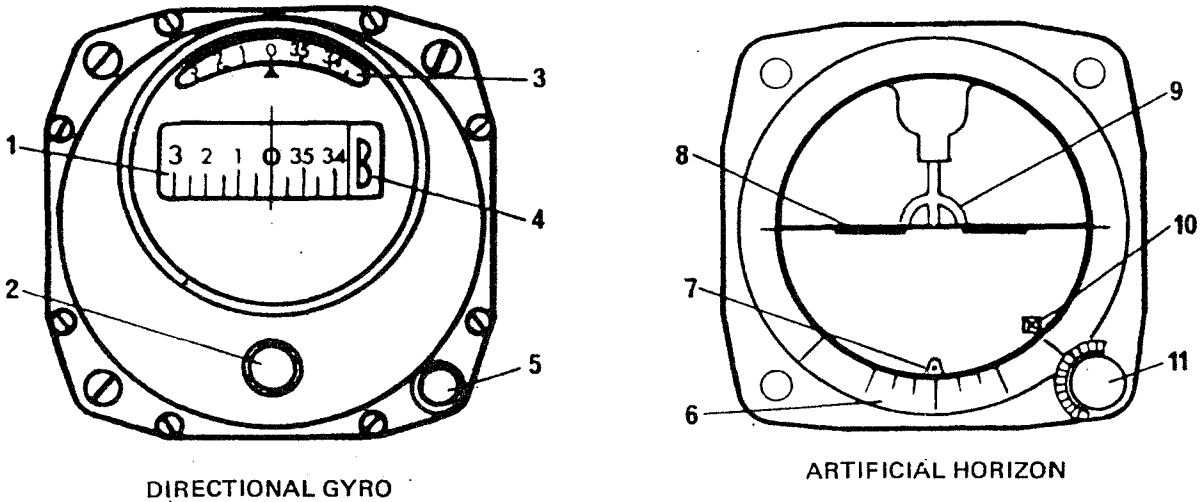
P = pressure V = speed

The air acceleration perpendicular to the ejector neck (V1 > VO) causes a depression PO – P1 at the neck

$$PO - P1 = V_1^2 - V_0^2$$

The air sucked through the filter (7) passes through the artificial horizon indicator (4) and the directional gyro (6), driving the gyroscope turbines. The regulating valve (3) opens when the vacuum exceeds 150 mbar. The resulting circuit connection with atmospheric air limits the vacuum to this value. If the vacuum falls below 110 mbar, the pressure-switch (1) closes and consequently the I.F.R. INDICATOR LIGHT COMES ON.

C - GYROSCOPIC INSTRUMENTS (Figure 5)



DIRECTIONAL GYRO

ARTIFICIAL HORIZON

Figure 5 – Gyroscopic instruments

THE DIRECTIONAL GYRO provides the pilot with a stable directional reference, permitting him to maintain a determined heading and to perform precise turns.

The card (1) and the dial (3) are graduated in 5-degree increments from 0 to 360°

Air flow rate ; 12 l/min. (732 cu. in/min.)

The graduated dial is adjusted by means of a heading setting knob (2)

Another knob (5) allows :

- caging (flag (4) appears) of the gyro assembly, when pressed
- the card (1) to be set to the desired heading, when pressed and rotated

THE ARTIFICIAL HORIZON provides the pilot with a stable reference with respect to the true horizon.

Graduations in roll : 0°, 10°, 20°, 30°, 60° and 90° in both directions.

Graduations in pitch : the dial has a zero centre from which it is graduated in one-degree increments up to 8° nose-up and 7° nose-down

The horizon indicator comprises :

- a miniature aircraft (9)
- a horizon line (8)
- a roll index (7) moving in front of a graduated dial (6)

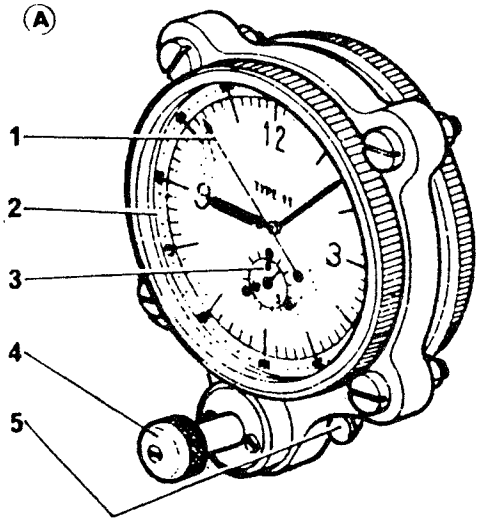
Air flow-rate : 20 l/min.

The knob (11) is for :

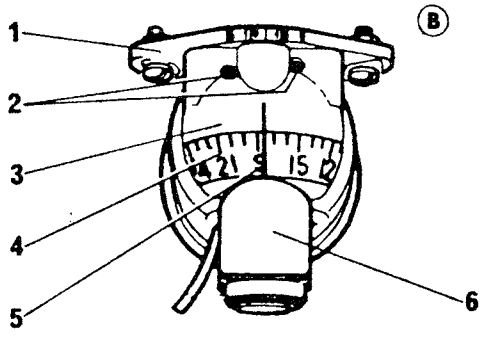
- setting the miniature (9). Rotation of knob
- resetting the horizon line. Pulling the knob
- caging the gyro assembly. Pull and rotate the knob 1/4 turn clockwise. The «caged» warning flag (10) appears.

10.20.4. - INSTRUMENTS NOT ASSOCIATED WITH A SYSTEM (Figure 6)

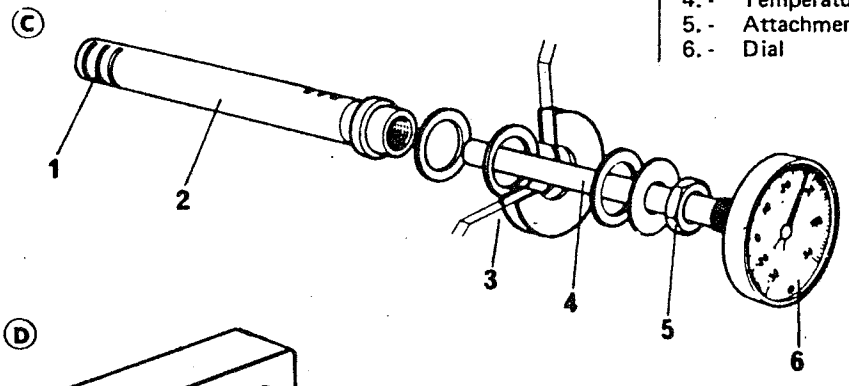
The instruments not associated with any particular system are :
- a clock (A)
- a stand-by magnetic compass (B)
- an outside air temperature indicator (C)
- a bank indicator (with ball) (D)



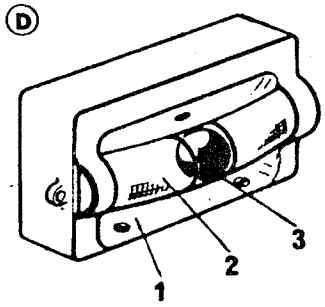
1. - Seconds hand
2. - Minute dial
3. - Minute hand
4. - Knob for starting, stopping and return to zero of the hands ; and setting to correct time
5. - Stop-watch push-button



1. - Flange assembly
2. - Adjuster screws (semi-circular compensation)
3. - Transparent dome
4. - Mobile unit
5. - Lubber line
6. - Lighting fitment



1. - Vent slot
2. - Sleeve
3. - Canopy window
4. - Temperature probe
5. - Attachment nut
6. - Dial



1. - Attachment plate
2. - Glass tube filled with White Spirit, to dampen the movements of the ball
3. - Black glass ball

Figure 6

Instruments not associated with a system

10.- APPENDIX

1 - THE COLLECTIVE PITCH INDICATOR COMPUTER

The pitch indicator computer is used to determine the following parameters :

1.- THE DENSITY-ALTITUDE
2.- THE MAXIMUM PERMISSIBLE PITCH
3.- THE MAXIMUM TAKE-OFF WEIGHT
4.- THE INSTANTANEOUS WEIGHT OF THE HELICOPTER

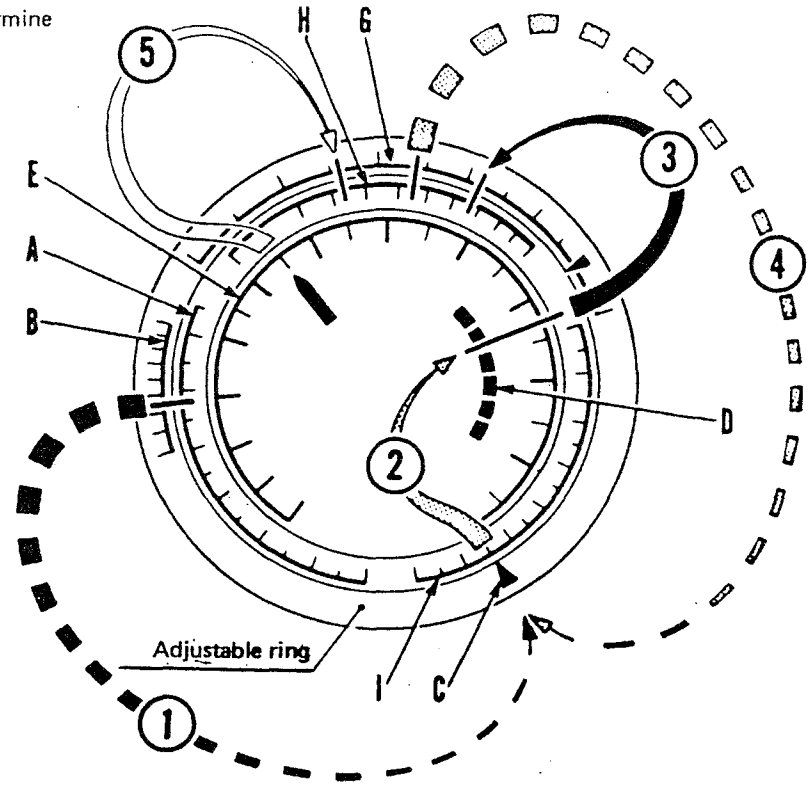


Figure 2
Collective pitch indicator computer

1.- DENSITY-ALTITUDE

By adjusting the ring line up :
- the O.A.T. value (SCALE B) transferred from the O.A.T. indicator
- the pressure-altitude (SCALE A), transferred from the altimeter set at 1013 mb

Read the corresponding density-altitude value opposite arrow C.

2.- MAXIMUM PERMISSIBLE HOVERING COLLECTIVE PITCH

Transfer to SCALE D the density-altitude (km) value ; then read opposite, on SCALE E, the pitch corresponding to this density-altitude.
To determine the maximum permissible collective pitch, add to the value obtained :
- 03 if the aircraft is equipped with a 3160-type main gearbox
- 05 if the aircraft is equipped with a 319-type main gearbox

3.- MAXIMUM HOVERING TAKE-OFF WEIGHT (O.G.E)

Transfer the maximum permissible pitch to SCALE G, and read opposite, on SCALE H, the maximum permissible weight.

4.- THE CURRENT GROSS WEIGHT OF AIRCRAFT, during hover O.G.E.

Set the rotating circle as in paragraph 1 («Density-altitude»)
Read on SCALE E the pitch angle indicated by the needle.
Transfer the above value to SCALE G and read opposite, on SCALE H, the weight corresponding to this pitch angle.

2. - PRINCIPLE OF MAGNETIC COMPASS COMPENSATION (Reminder)

A - COMPASS DEVIATION

The compensation of the magnetic compass is intended to offset the deviation of the magnetized mobile unit as compared with the magnetic North.
These deviations originate in the presence, aboard aircraft, of a disturbing magnetic field resulting from magnetic metals (steel, iron) as well as electric currents. The direction and intensity of the disturbing field vary with the aircraft orientation and bring about a variable deviation changing direction every 180° (see Figure 3).

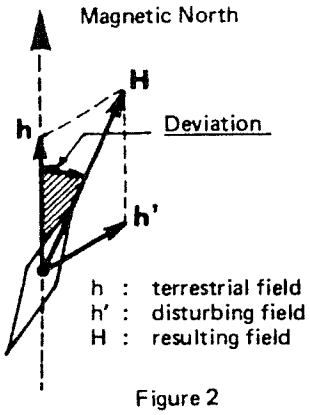


Figure 2

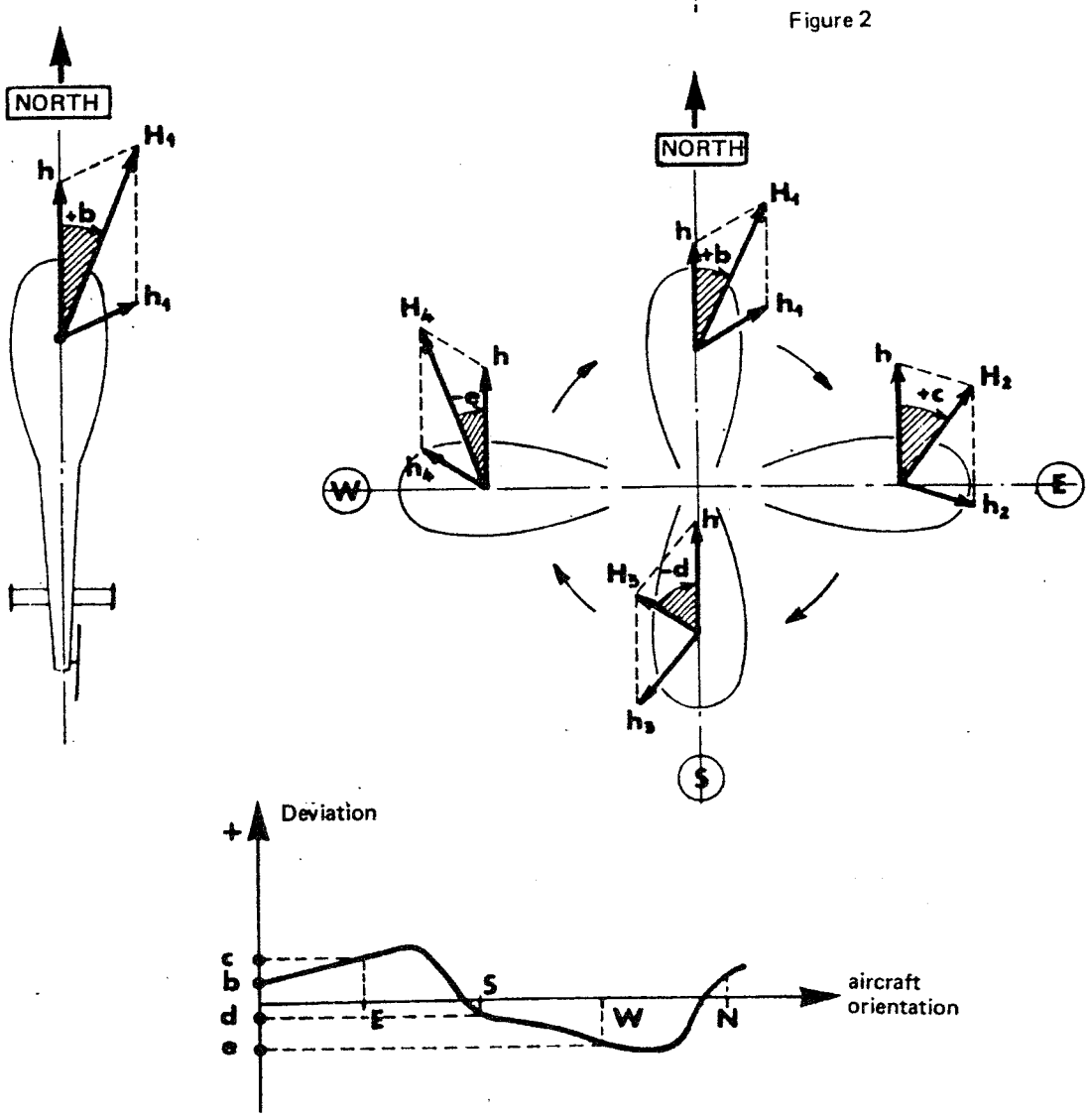


Figure 3 - Compass deviation

B - PRINCIPLE OF COMPASS COMPENSATION

To make up for the deviation, a correcting field can be applied in opposition to the disturbing magnetic field with a view to eliminating its action : this is called SEMI-CIRCULAR COMPENSATION (Figure 4). The lubber line is shifted with respect to the compass card : this is a CONSTANT DEVIATION CORRECTION.

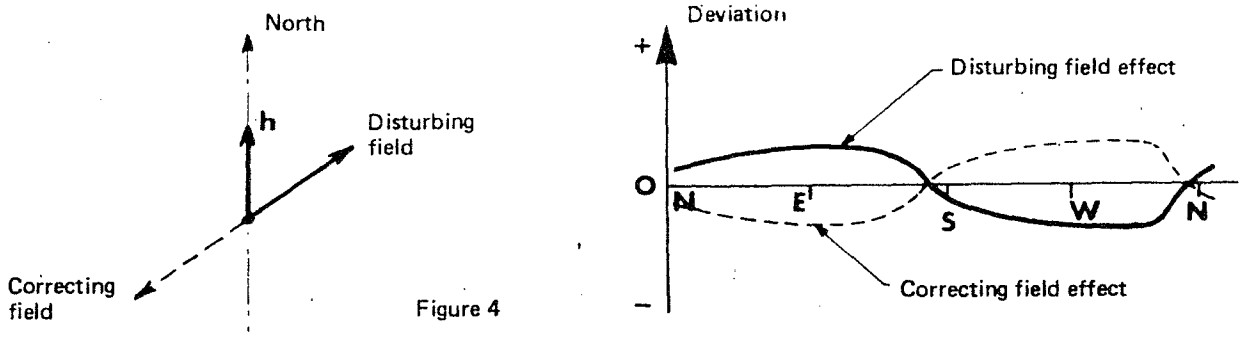


Figure 4

(1) SEMI-CIRCULAR COMPENSATION (Figure 5)

The correcting field is obtained with small adjustable magnets (B) (C) placed near the compass mobile unit. By turning a screw (1), the «magnet-bearing» helical wheels may be brought to a given position, which means that the intensity of the resulting field may be altered as required.

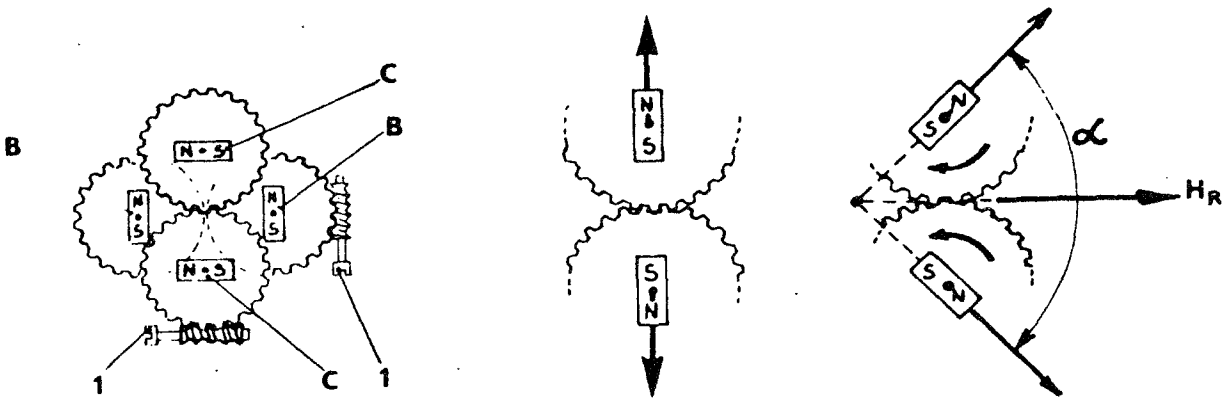


Figure 5

To compensate for the semi-circular deviation, the aircraft should be directed successively :

- ON THE MAGNETIC NORTH HEADING : the deviation will be cancelled by setting the magnets C
- ON THE MAGNETIC EAST HEADING : the deviation will be cancelled by setting the magnets B
- ON THE MAGNETIC SOUTH HEADING : the residual deviation is reduced by half, by setting the magnets C
- ON THE MAGNETIC WEST HEADING : the resioual deviation is reduced by half, by setting the magnets B.

(2) CONSTANT DEVIATION CORRECTION

To determine the value and direction of the constant deviation, take the algebraic mean of the deviation values recorded on the eight different cardinal and intercardinal points.

$$\text{Constant deviation} = \frac{\text{Algebraic mean of deviations}}{8}$$

To correct the constant deviation, the compass bowl unit should be rotated, by the calculated value, (lubber line displacement), in the opposite direction from the deviation.
The compass mounting plate is made adjustable to facilitate this operation.

CHAPTER 11

FURNISHINGS

CONTENTS

11. - FURNISHINGS

11.00. - GENERAL

Under the heading of «Furnishings» are listed the various items of equipment, optional or otherwise, which :

- do not pertain to the essential functions described in the preceding chapters
- are not specific to a role function or a particular use

NOTE : Those equipment items that are specific to a role or a definite use are described in chapter 13 : «OPERATIONAL EQUIPMENT».

Furnishings comprise :

- The cabin furnishing

and the following installations :

- cabin ventilation,
- heating and defrosting,
- windscreen wipers
- oxygen supply
- battery temperature monitoring

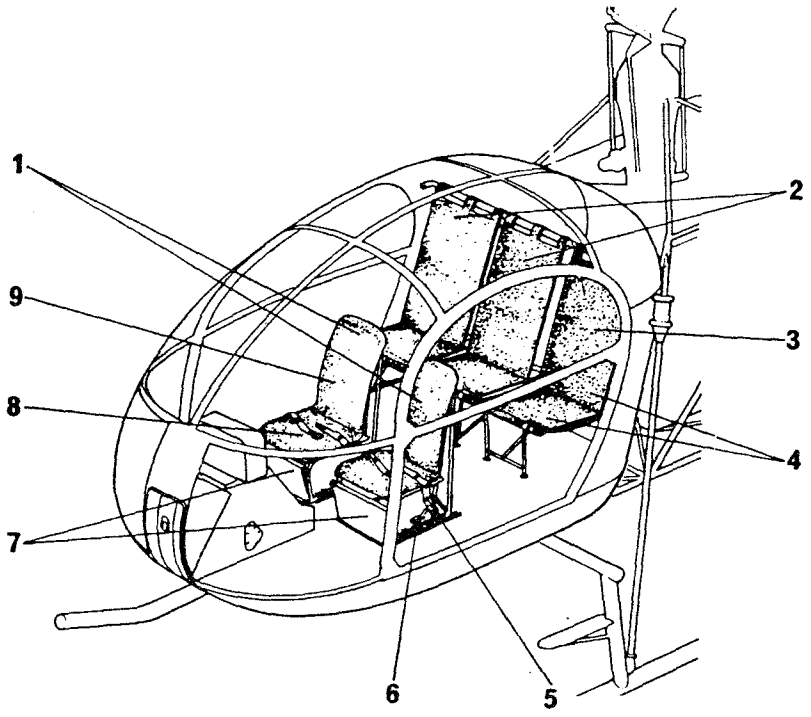
11.10.1.- GENERAL (Figure 1)

Cabin furnishings comprise :

- two front seats (1)
- two rear seats: onetwo-place seat (2) and one single seat (3)

Front seats consist of a light alloy tube frame covered with a squab (8) and cloth back-rest (9). The longitudinal positioning of seats is adjustable. A locking device (6) makes it possible to immobilise a seat in the chosen position. Each seat is equipped with seat belts (5) and a belt adjuster.
On the front part of the seats is fitted a document case (7).

Folding rear seats consist of a steel tube frame which accomodates a squab and a cloth back-rest (4).



1.-	Front seat (Pilot seat)	6.-	Seat locking control
2.-	Rear seat, two-place	7.-	Document case
3.-	Rear seat, single	8.-	Squab
4.-	Squab and back-rest	9.-	Back-rest
5.-	Belts		

Figure 1 - Cabin fittings

11.20.- CABIN VENTILATION

11.20.1.- GENERAL (Figure 1)

The cabin is ventilated by an air intake system comprising :
— a flap (5) controlled by a handle (2) through a link-rod (3) and a bellcrank (4).

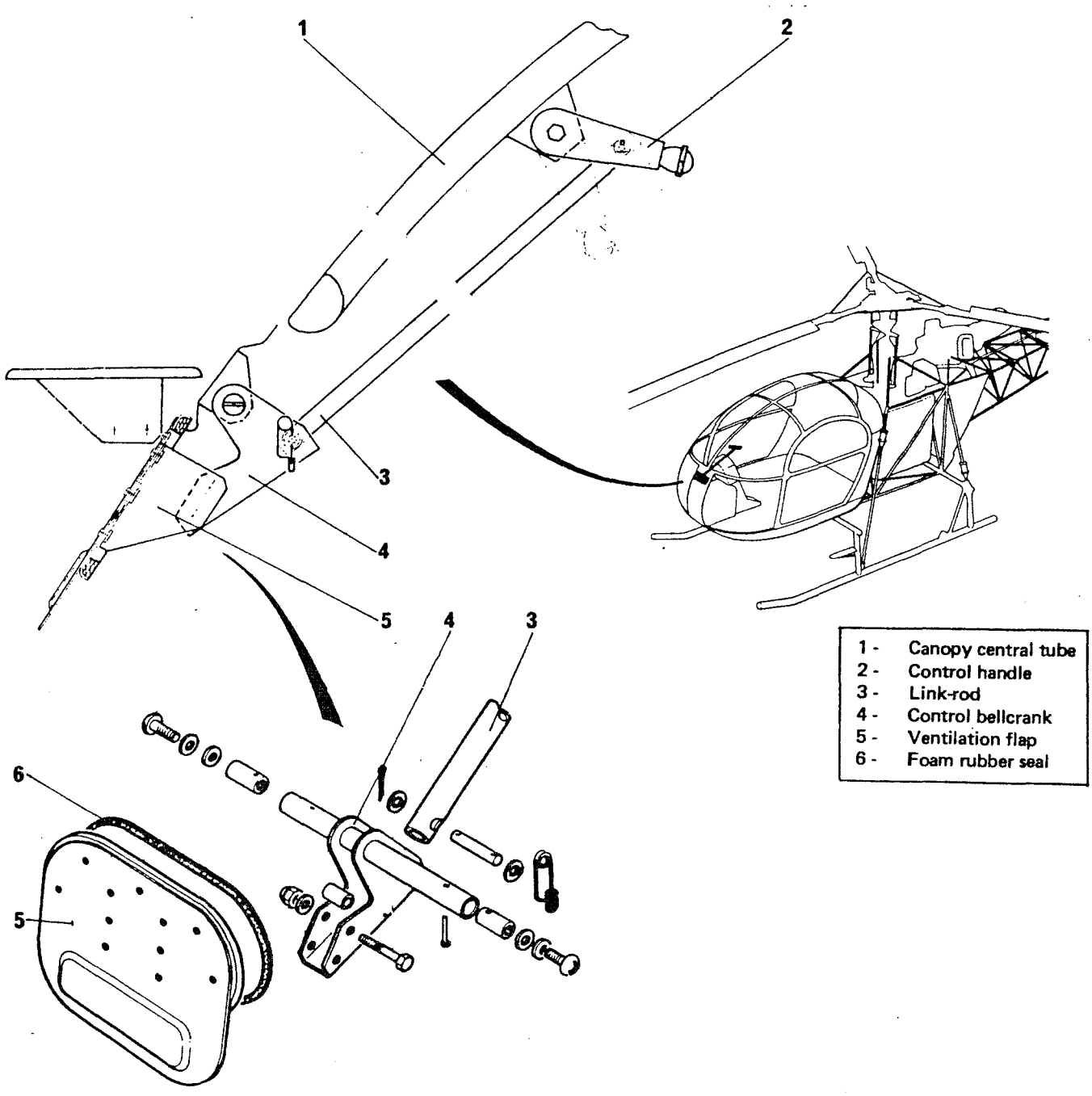


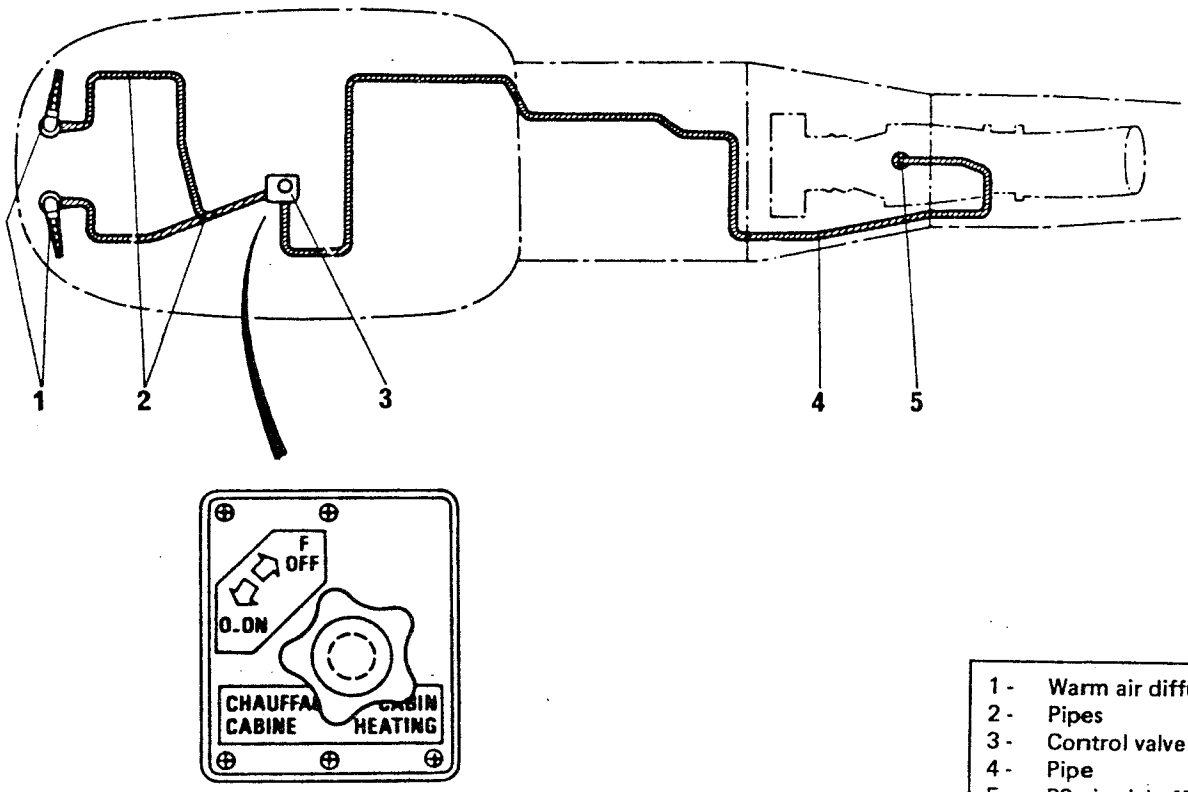
Figure 1
Cabin ventilation

11.30.- CABIN HEATING

11.30.1.- GENERAL (Figure 1)

The heating system diffuses a flow of warm air from the engine into the cabin.
The system consists of :

- A hot air (P2) pick-off probe (5) located on the engine turbine casing.
- A control valve (3) to adjust the hot air flow, located on the cabin floor to the left of the pilot station.
- Two air diffusers (1) discharging above the cabin floor and providing canopy demisting and cabin heating.
- Connecting pipes (2) and (4).

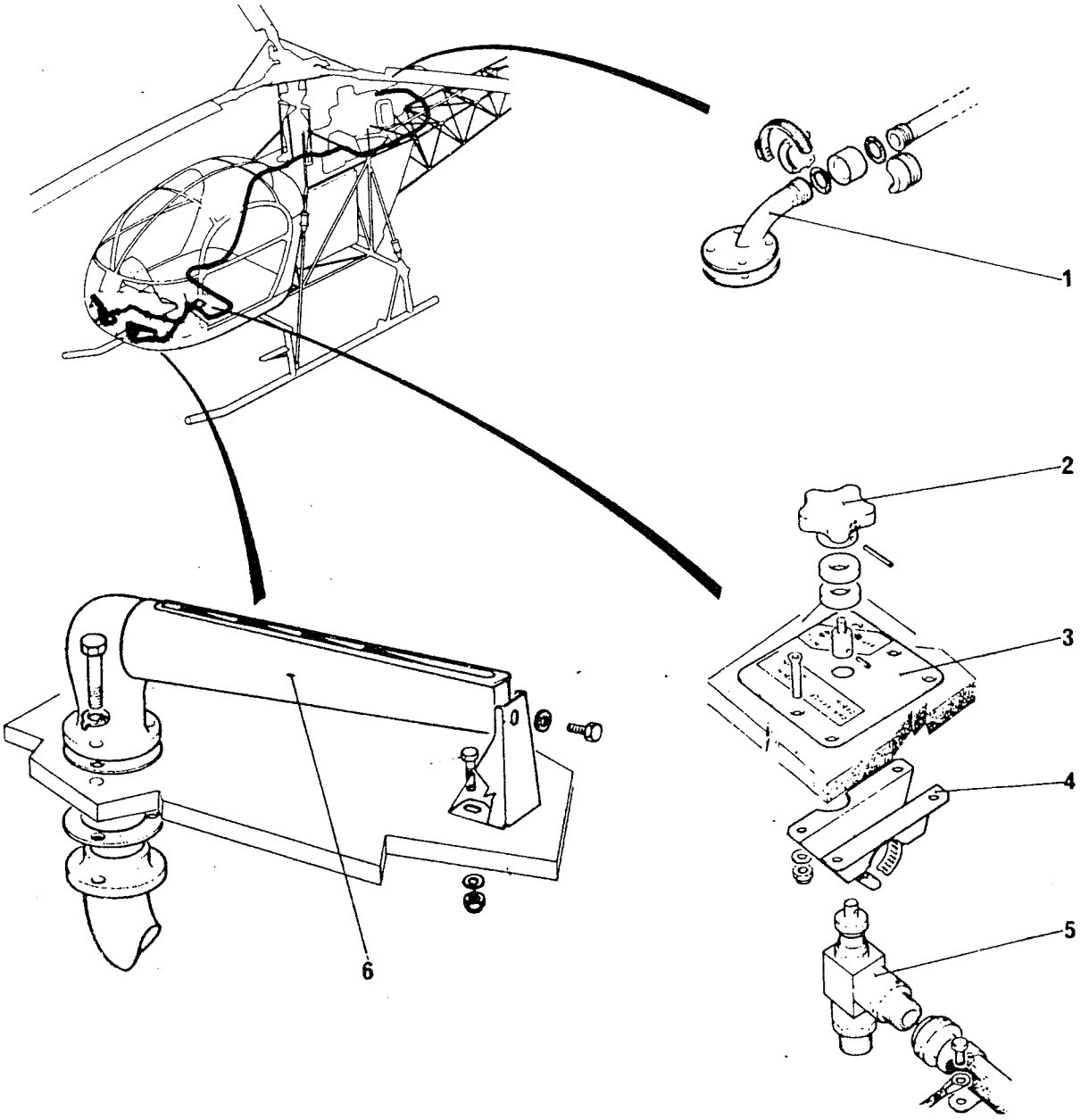


1 - Warm air diffusers
2 - Pipes
3 - Control valve
4 - Pipe
5 - P2 air pickoff probe

Figure 1
Heating system

The valve (3) controlling the warm air flow, allows the adjustment of heating to the desired temperature.
The P2 air pickoff probe supplies both the heating system and the pneumatic hoist system.
When the hoist is used, the heating system must be turned off by closing the P2 air valve (3).

11.30.2.- MAIN COMPONENTS OF THE HEATING SYSTEM



1 - P2 air pickoff probe
2 - Valve control knob
3 - Instruction plate
4 - Valve mounting
5 - Valve
6 - Diffuser

11.40.- WINDSCREEN WIPER

11.40.1.- GENERAL (Figure 1)

The windscreen wiper system comprises :
- an electric motor (8)
- a drive conversion mechanism comprising :
- an articulated rod (5) and a crank piece (6)
- an arm (3) equipped with a blade (10)
- an electrical control circuit : control switch (2), circuit breaker (1)

The motor which provide the wiper movement through the drive conversion mechanism, is supplied with 24V.
Its rate can be set to «slow» or «fast» depending on the switch (2) position.

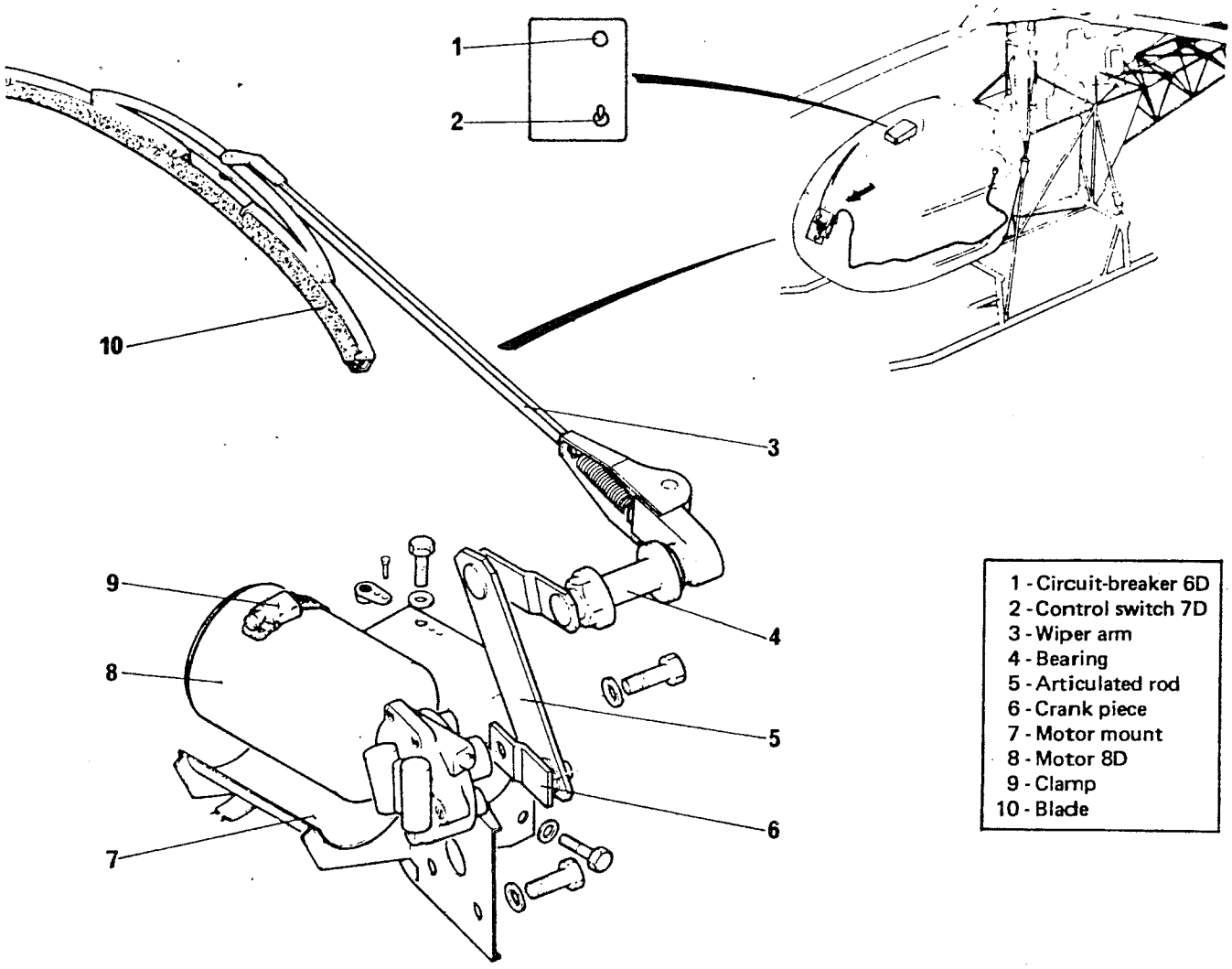


Figure 1
Wiper system

11.50.- OXYGEN SUPPLY SYSTEM

11.50.1.- GENERAL

Provided for high-altitude flying, the oxygen supply system consists of two independent circuits each comprising :

- two oxygen bottles (1) (2) fitted with a pressure gauge (4)
- a flexible pipe (3) interconnecting both bottles.

The bottles are opened and closed by means of a two position (open - closed) push-type valve (5). Since both bottles are interconnected, they must be simultaneously opened when the system is to be used. Oxigen masks should preferably be connected to rear bottle.

SPECIFICATIONS :

- Filling pressure of bottles (at 15°C) : 150 bars
- Mask supply pressure : 5 ± 1 bar
- Range of operating temperatures : − 40° C to +60° C

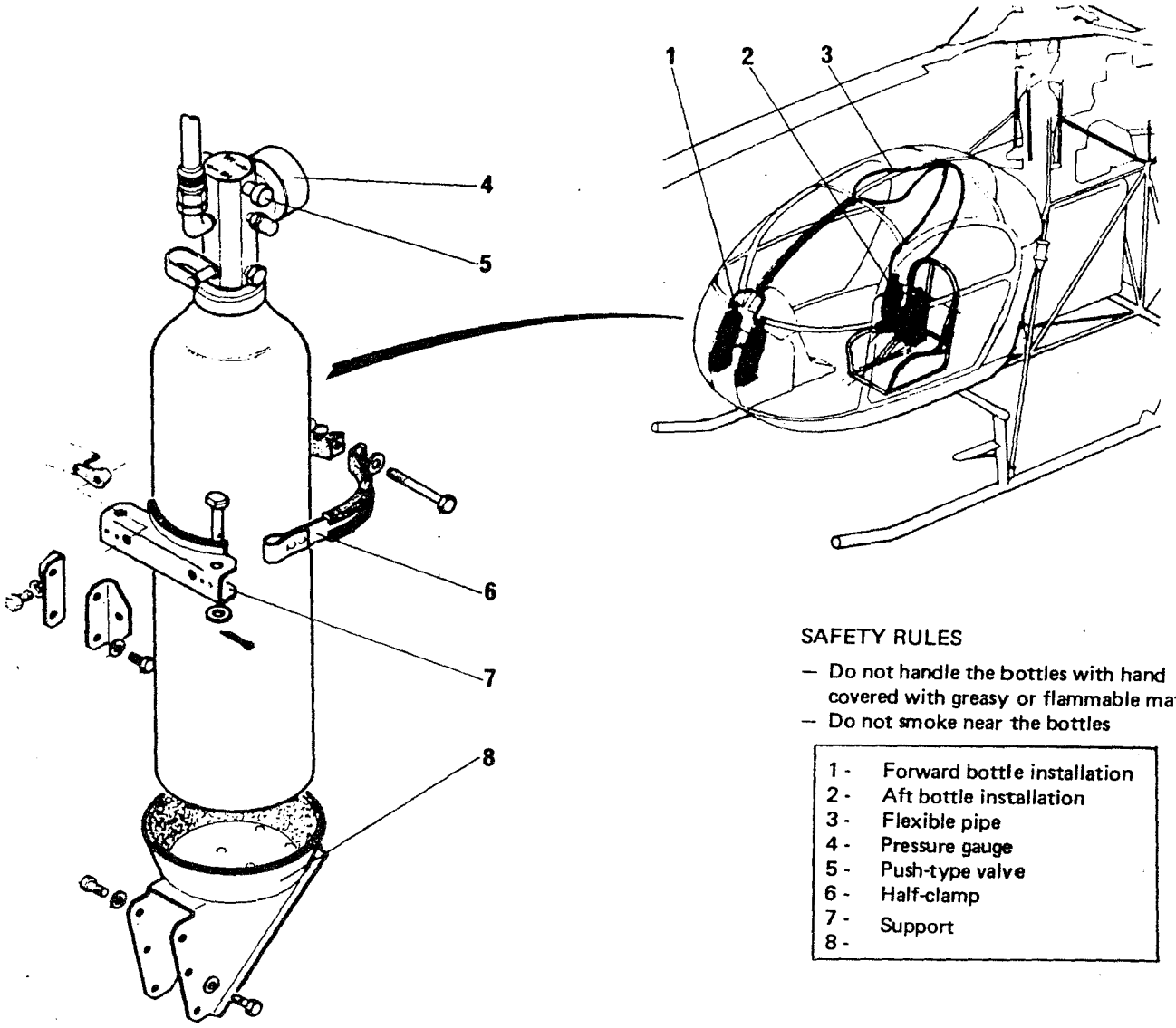


Figure 1
Oxygen supply system

SAFETY RULES

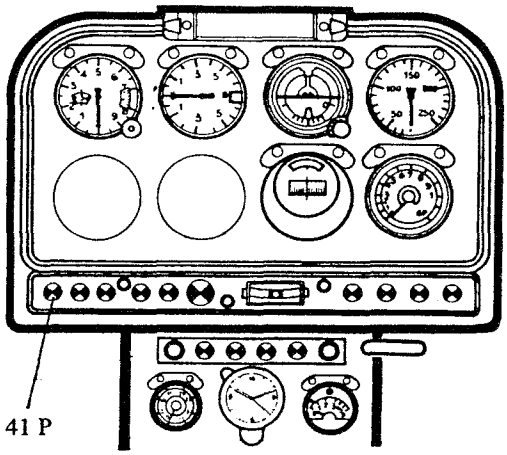
- Do not handle the bottles with hand covered with greasy or flammable material
- Do not smoke near the bottles

1 -	Forward bottle installation
2 -	Aft bottle installation
3 -	Flexible pipe
4 -	Pressure gauge
5 -	Push-type valve
6 -	Half-clamp
7 -	Support
8 -	

11.60.- BATTERY TEMPERATURE MONITORING

11.60.1.- GENERAL

The battery temperature monitoring system is designed to warn the pilot in the event of battery overheating.
It consists of a sensing probe fitted inside the battery and connected to a warning light mounted on the instrument panel.
When the battery temperature exceeds 71°C, the sensing probe closes the circuit to the warning light which illuminates.



8P - Temperature sensing probe
40P - Circuit-breaker (on lower control pedestal)
41P - Warning light

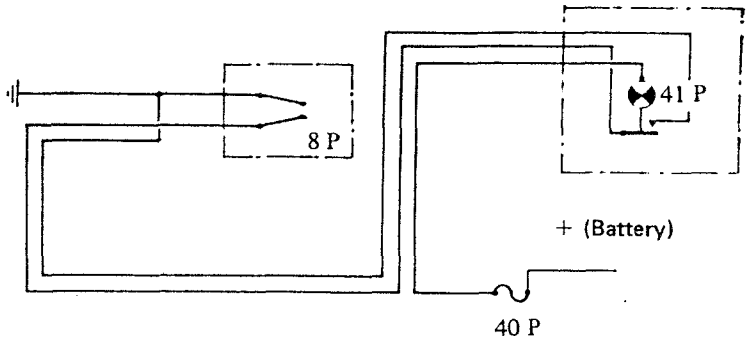


Figure 1
Battery temperature monitoring

CHAPTER 12

ENGINE INSTALLATION

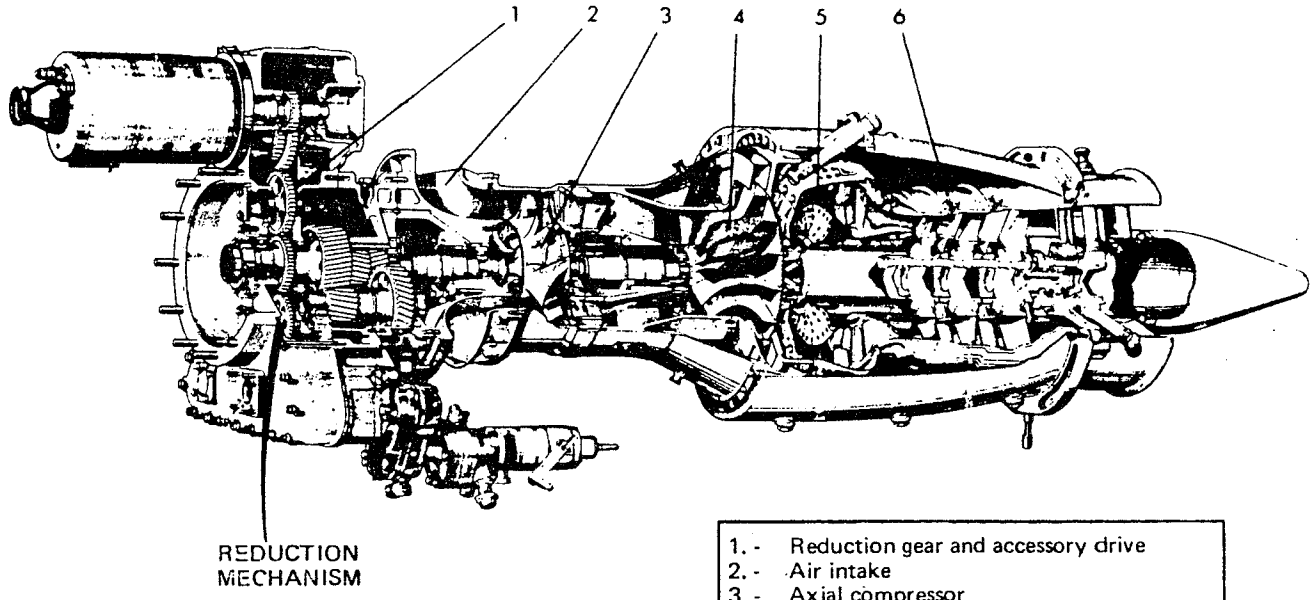
CONTENTS

12. - ENGINE INSTALLATION

12.00. - GENERAL

The engine installation consists of :

- The links with the airframe structure and systems (engine attachment and connections)
- The lubrication system
- The controls
- The monitoring devices
- The sand filters



1. - Reduction gear and accessory drive
2. - Air intake
3. - Axial compressor
4. - Centrifugal compressor
5. - Combustion chamber
6. - Engines

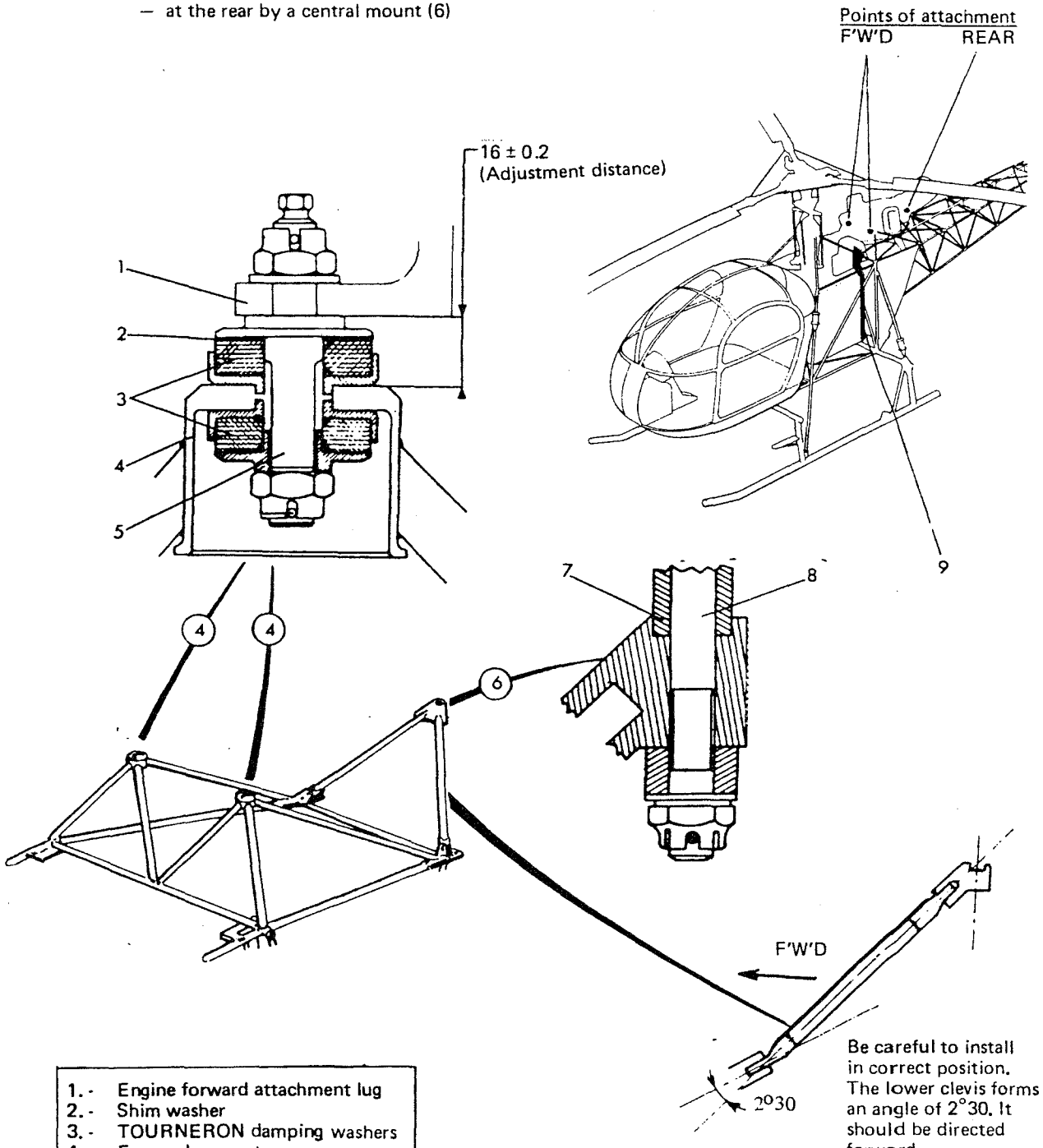
ENGINE DATA :
- Engines linked with compressors
- Eng. rotational speed : 33 500 r.p.m. (regulated speed)
- Power output speed : 5 770 r.p.m.
- Maximum take-off power : 470 KW
- Weight : 182.5 Kg
- Length : 1805 mm
- Width : 520 mm
- Height : 627 mm

Figure 1
ARTOUSTE III engine layout

12.10. - ENGINE MOUNTING (ATTACHMENT AND CONNECTIONS)

12.10.1. - ENGINE ATTACHMENT (Figure 1)

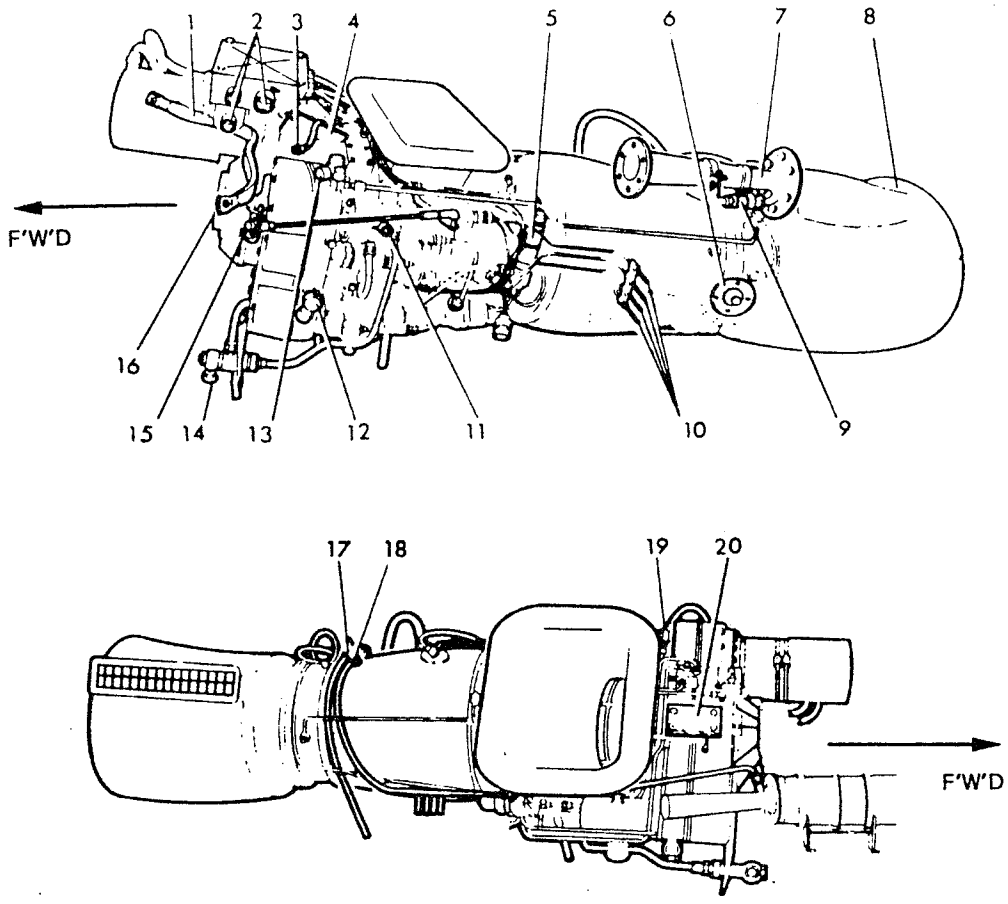
The engine is attached to the central body structure :
- at the front by two side mounts (4)
- at the rear by a central mount (6)



1. - Engine forward attachment lug
2. - Shim washer
3. - TOURNERON damping washers
4. - Forward support
5. - Fixing bolt
6. - Rear support
7. - Rear attachment lug
8. - Rear fixing bolt
9. - Engine drain pipe (Ref.)

Figure 1
Attachment of the engine

12.10.2. - CONNECTIONS (Figure 2)



1. -	Starter-generator bonding braid	11. -	Oil return line
2. -	Starting unit electrical connectors	12. -	Oil return line
3. -	Forward mount bonding braid	13. -	Oil delivery line
4. -	Engine mount (L.H., F'w'd)	14. -	Fuel line
5. -	Electrical connector (Micro-pump)	15. -	Fuel flow cock control
6. -	Engine mount (Rear)	16. -	Output shaft
7. -	Venturi (Cabin heating)	17. -	P2 pressure line (I.F.R. instruments)
8. -	Engine tail pipe	18. -	Air line (Oil cooler venturi)
9. -	P2 line (Cabin heating)	19. -	Breather vent liné
10. -	Drain line	20. -	Engine mount (R.H., F'w'd)

Figure 2

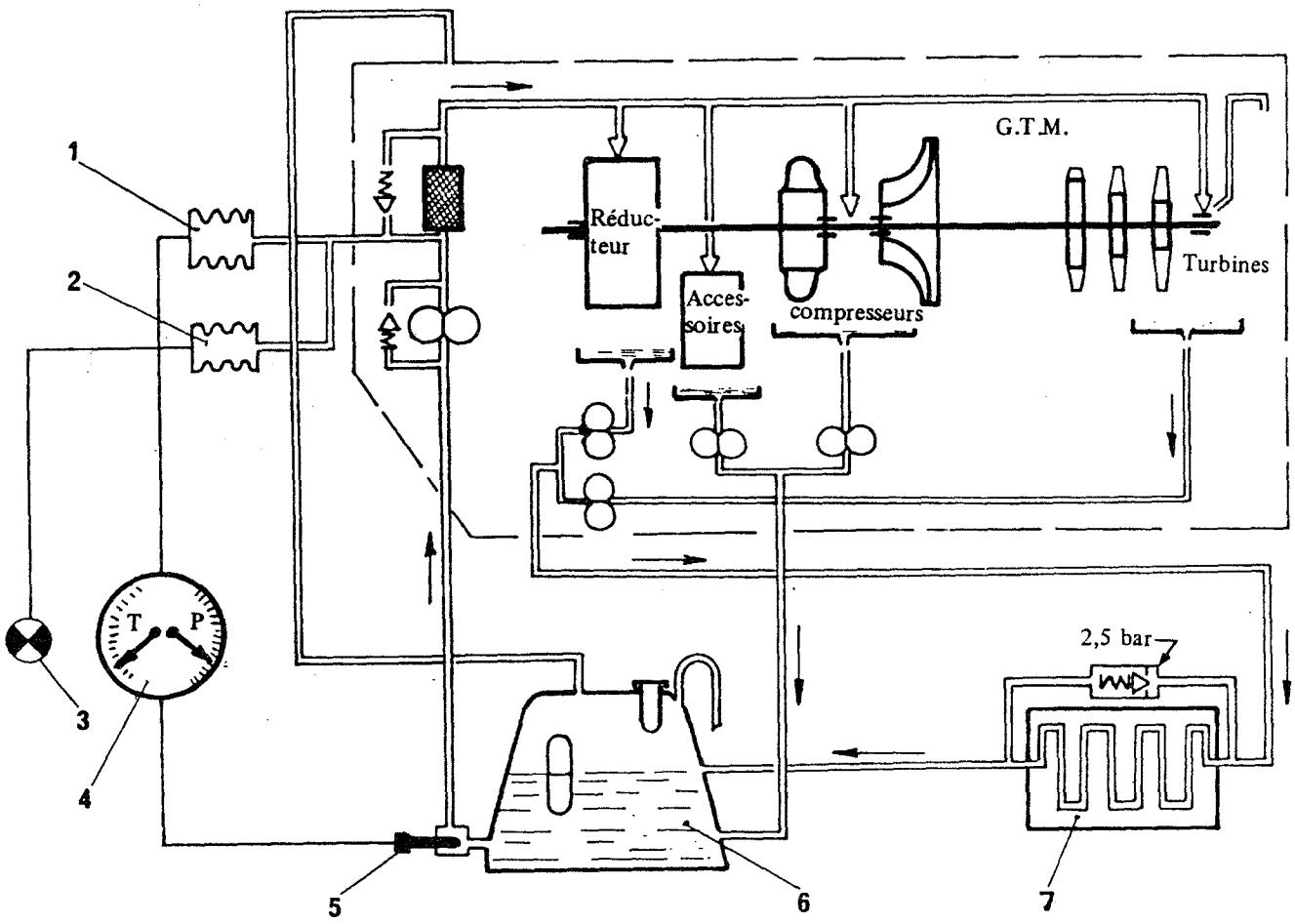
Engine connections

12.20.- ENGINE LUBRICATION SYSTEM

12.20.1.- GENERAL (Figure 1)

The «airframe» part of the engine oil system consists of :

- an oil tank (6)
- a radiator (7) (oil cooler)
  and the pipes which link them
- a monitoring installation, which comprises :
  - a temperature probe (5)
    and a pressure transmitter (1) connected to a dual temperature/pressure indicator (4).
  - a «min-oil pressure» warning light (3) energized by a pressure switch (2).



- Having lubricated the reduction gear and the turbine bearing, the oil is cooled as it passes through the oil cooler (7),
- Having lubricated the accessory drive and the compressor bearings, the oil returns directly to the tank (6).

1 - Pressure transmitter
2 - Pressure switch
3 - «Min. oil pressure» warning light (red)
4 - Oil pressure/temperature indicator
5 - Temperature probe
6 - Oil tank
7 - Oil cooler

Figure 1
Engine lubrication system - Functional diagram

12.20.2. - MAIN COMPONENTS OF THE ENGINE LUBRICATION SYSTEM

A - OIL TANK (Figure 2)

Total capacity : 13 litres Volume used : 7 litres

The oil tank is made of light alloy sheet and fastened to the transmission support platform by two straps (11).

Oil tank equipment : see figure 2 and key.

1. - Oil cooler
2. - «Return to cooler» pipe
3. - «Vapour recovery» pipe
4. - «Return direct to tank» pipe
5. - «Suction» pipe
6. - Temperature probe
7. - Filler/strainer plug
8. - Self-sealing drain plug
9. - Sump plug
10. - Oil level sight
11. - Securing strap
12. - Air vent
13. - «Return to tank» pipe

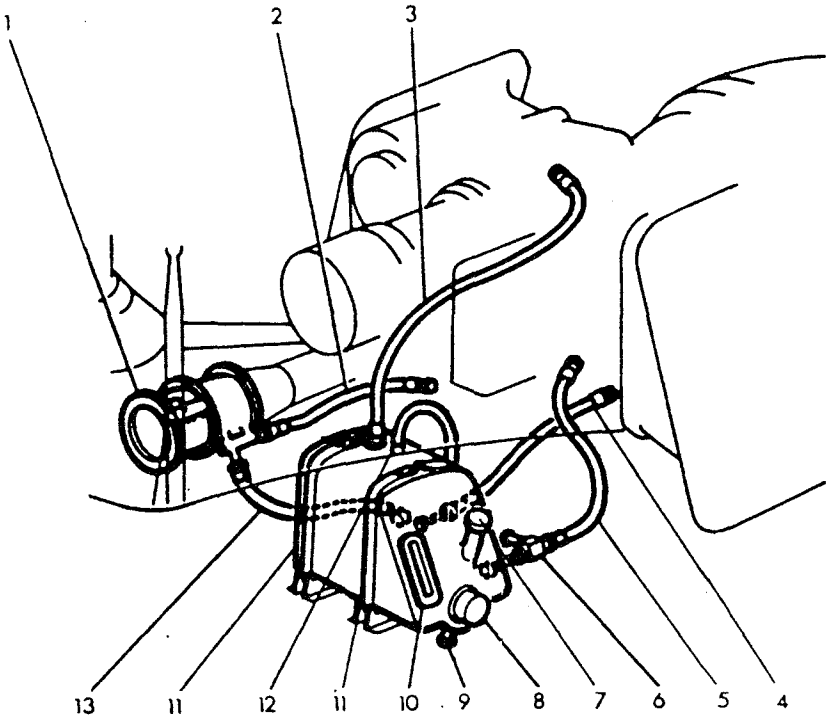


Figure 2 - Engine lubrication system

B - OIL COOLER (Figure 3)

The oil cooler is attached to the transmission support platform on a support (8). It consists of two like elements : the forward element (1) cools the main gear box oil, and the rear element (2) cools the engine oil. It is fitted with a drain plug and a by-pass (6) set at 2.5 bars.

1. - Forward element (M.G.B.)
2. - Rear element (Engine)
3. - «Starter-generator - cooling» linkage
4. - Diffuser (linked by an insulated pipe to the engine tail pipe
5. - Oil inlet union
6. - By-pass
7. - Oil outlet union
8. - Support

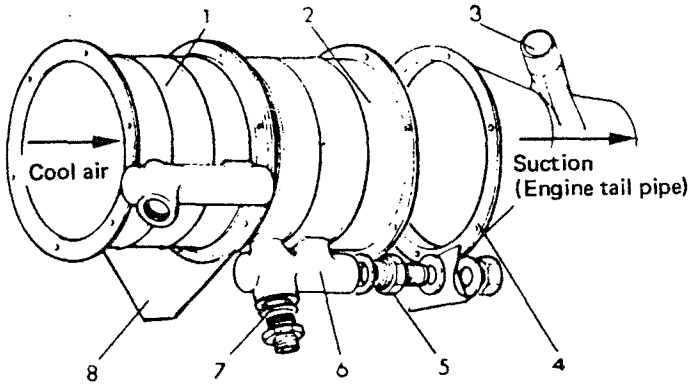


Figure 3
Oil cooler

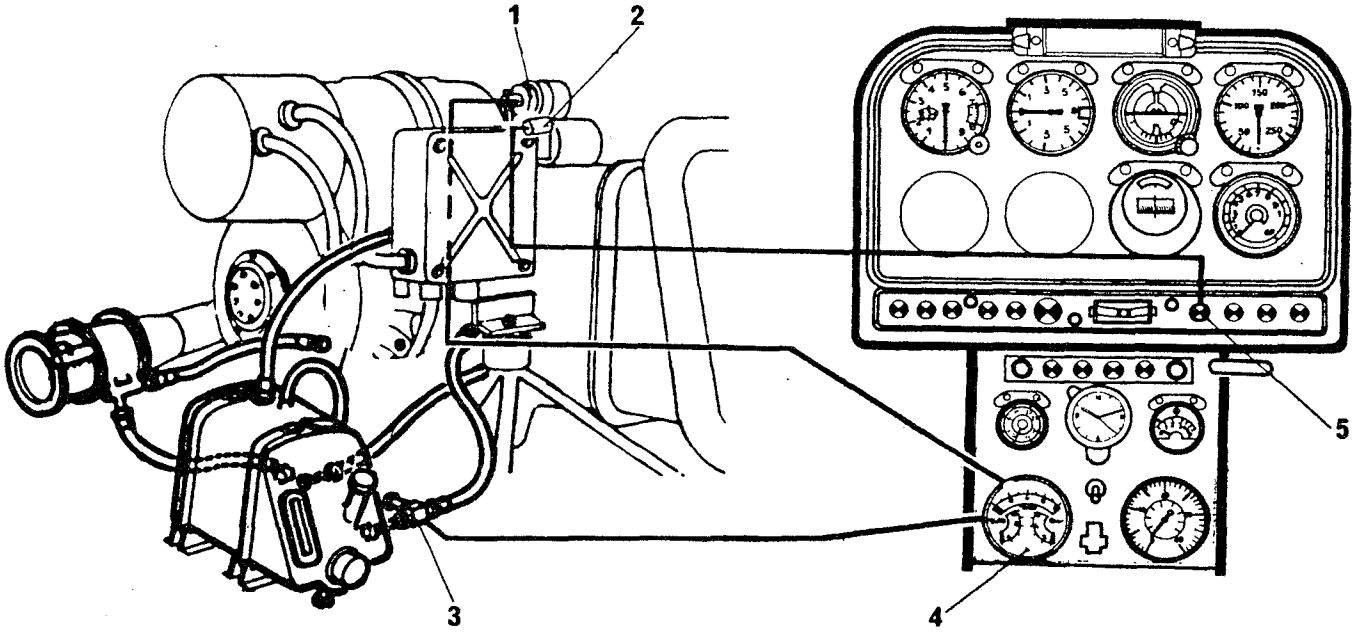
12.20.3. - ENGINE LUBRICATION MONITORING SYSTEM (Figure 4)

The lubrication monitoring system consists of :

- a temperature sensor (3)
- a pressure transmitter (1)

linked to a dual temperature/pressure indicator (4).

- a pressure switch (2) which energizes a warning light (5) in case of oil pressure drop.



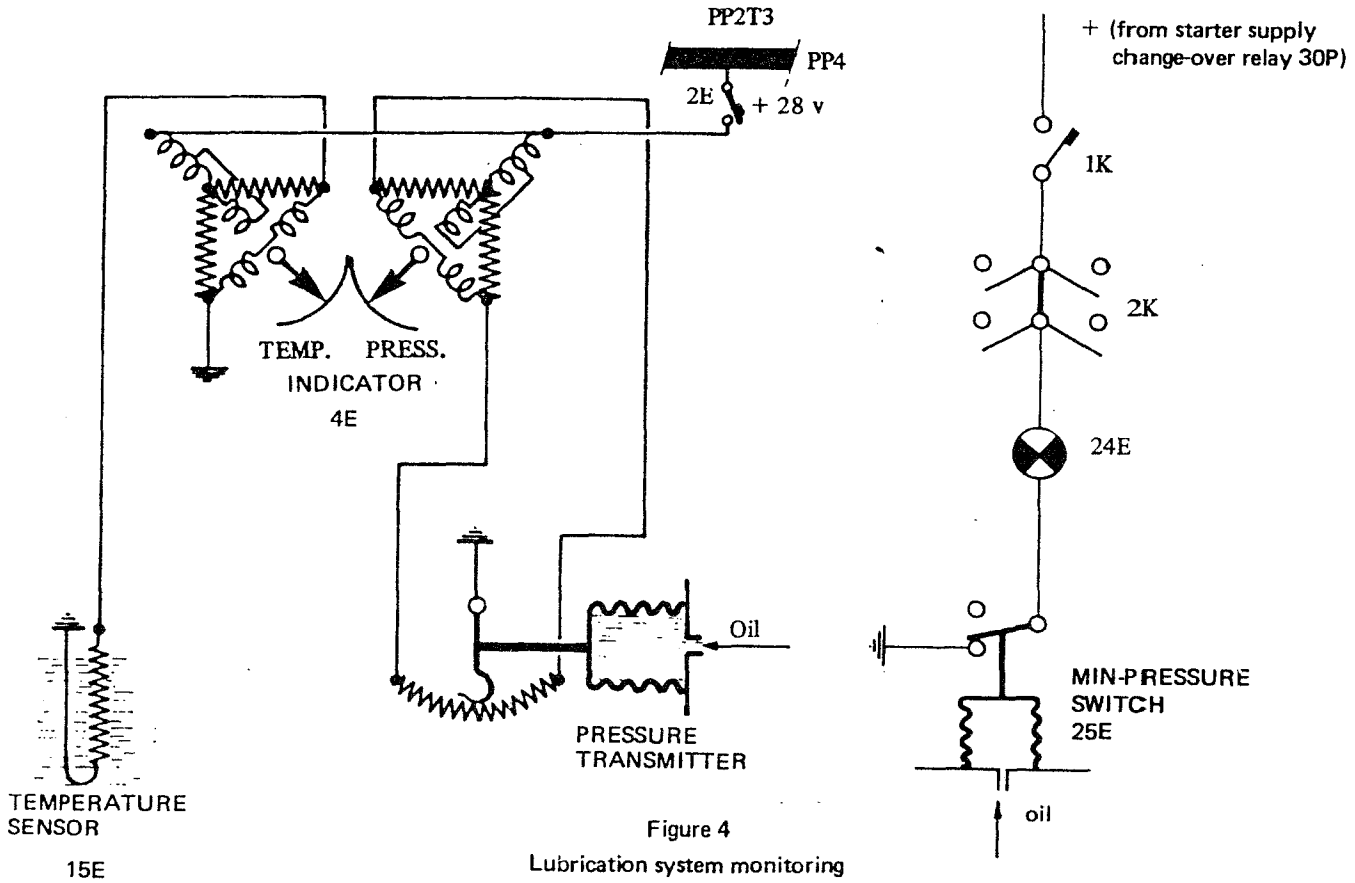


Figure 4
Lubrication system monitoring

12.30. - ENGINE CONTROLS

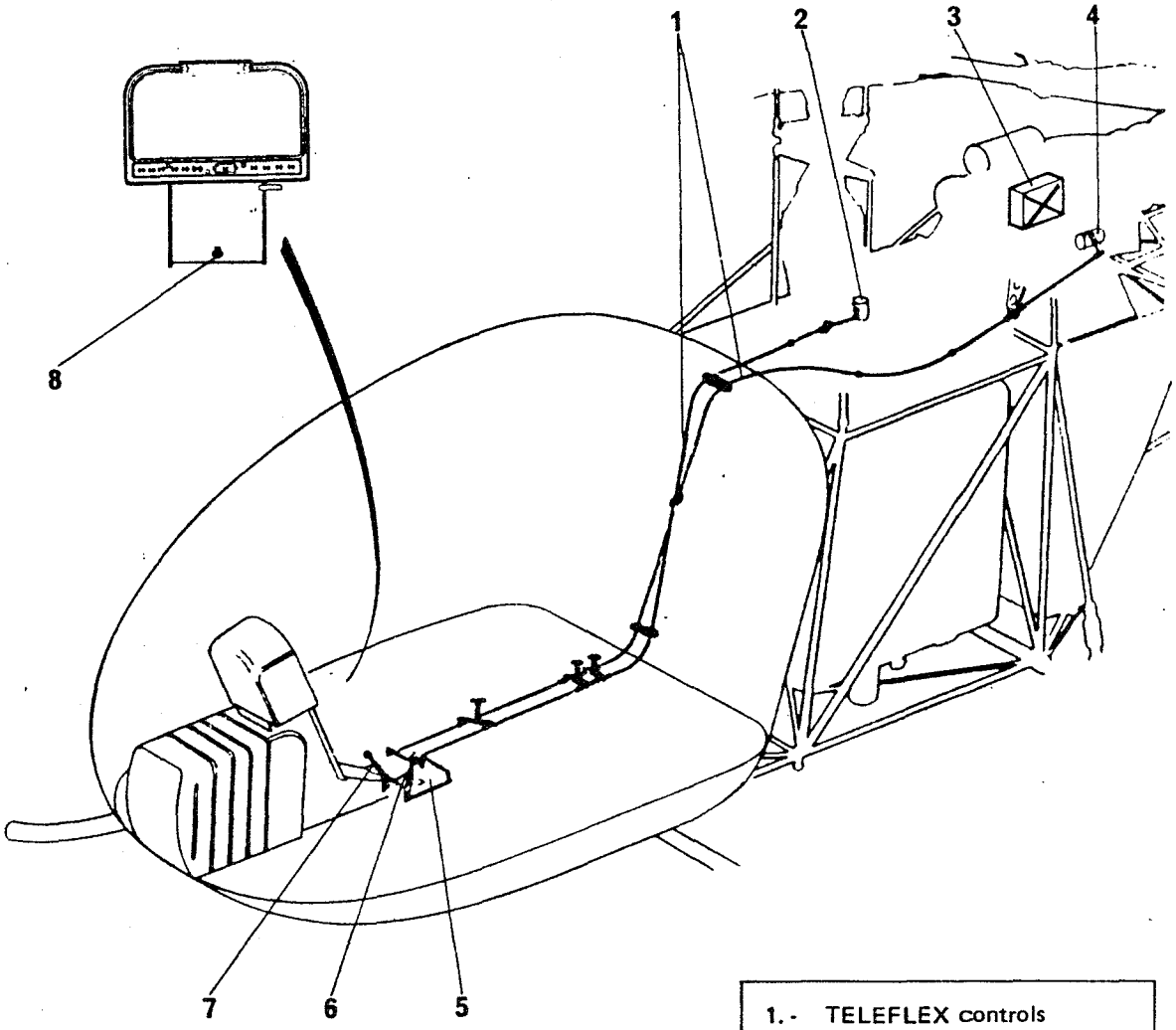
12.30.1. - GENERAL (Figure 1)

The engine controls consist of :

- The fuel flow control. A hand lever (7) controls the opening of the engine fuel flow control valve (4).
- The shut-off control. The shut-off cock (2) of the fuel supply system is actuated by a second hand control (6).

The two hand controls, fitted on a hand control quadrant (5), are linked to the fuel valve and shut-off cock by TELEFLEX flexible mechanical control cables (1).

- The electric starter control. A switch (8) initiates the automatic starting sequences which are themselves controlled by the automatic starting control unit (3), mounted on the Engine.



1. - TELEFLEX controls
2. - Shut-off cock
3. - Starting unit
4. - Fuel supply valve
5. - Hand control quadrant
6. - «Shut-off» cock hand control
7. - Fuel supply hand control lever
8. - Starter selector switch

Figure 1
Engine controls

12.30.2. - FUEL FLOW CONTROL (Figure 3)

The fuel supply hand control (1) actuates :

- the engine fuel flow control valve (7)
- two safety micro-switches (2) and (3) actuated by a cam (4).

The lever on the fuel flow control valve (6) actuates another micro-switch (1)

The fuel supply control has only two settings :

- hand control lever at rear stop (called the M.F. or control «closed» position) which is the position for starting the engine. The fuel flow control valve is shut.
- hand control at forward stop (called the F.C.M. or fully open position). This is the flight position. The fuel flow control valve is fully open.

Transition from one of these positions to the other (progressive opening or closing of the fuel flow control valve) is only made when :

- accelerating from idling to normal operating speed, after starting the engine, or
- decelerating from normal r.p.m., before stopping the engine.

Operation of the safety micro-switches

- The micro-switch (1) operated by the fuel flow control lever (6), will only permit starting if the fuel flow control valve is completely shut. If the valve is not shut, it cuts out the relay m (on) in the engine starting control unit.
- The micro-switch (2) (in-flight safety), makes it impossible for the engine to stop due to accidental manipulation of the starter selector switch, when the hand control is in the fully open position. At the middle of its travel, the hand control actuates this switch, cutting out the relay a (off) which controls the closure of the engine electric cock.
- The micro-switch (3) controls a red warning light «ALARM» :
  - hand control «fully open» (in the notch) : the warning light is off, authorising take-off.
  - hand control in intermediate positions : the warning light comes on.

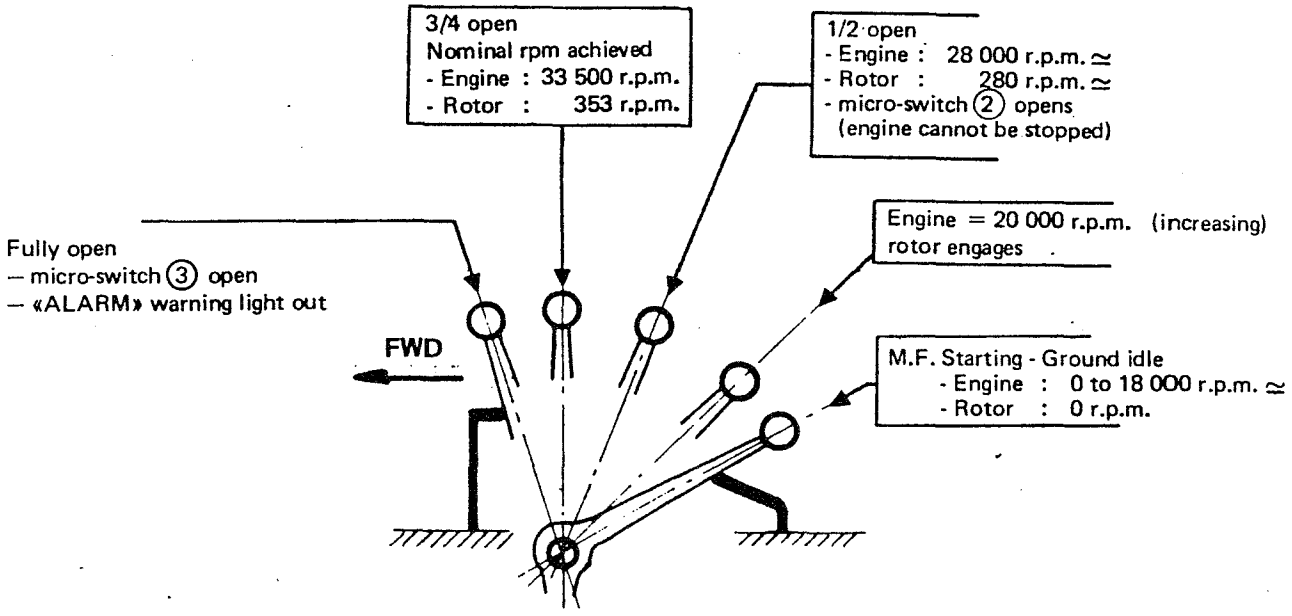


Figure 2

Characteristic positions of fuel flow control handle

12.30.2. - FUEL FLOW CONTROL (Continued)

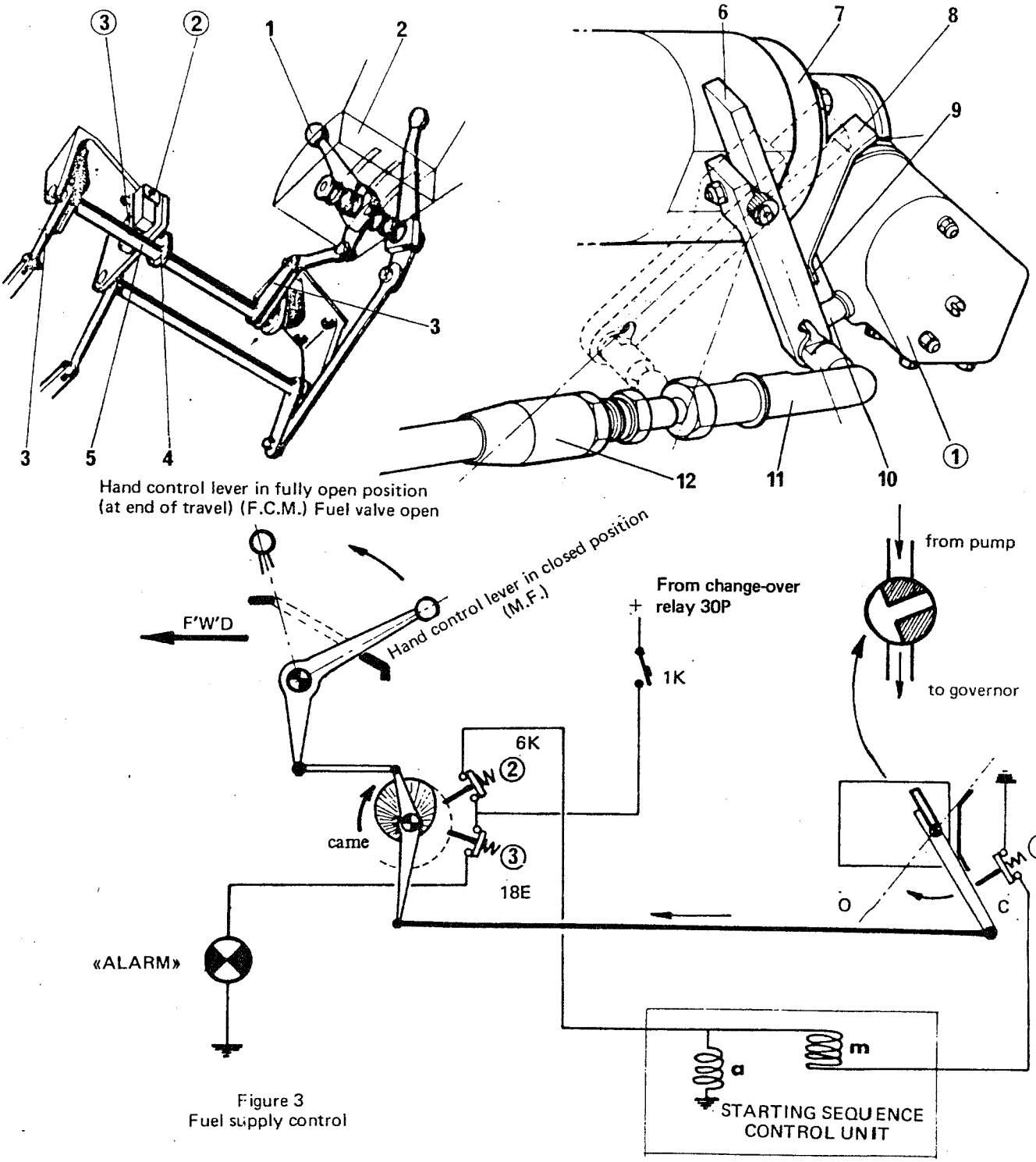


Figure 3
Fuel supply control

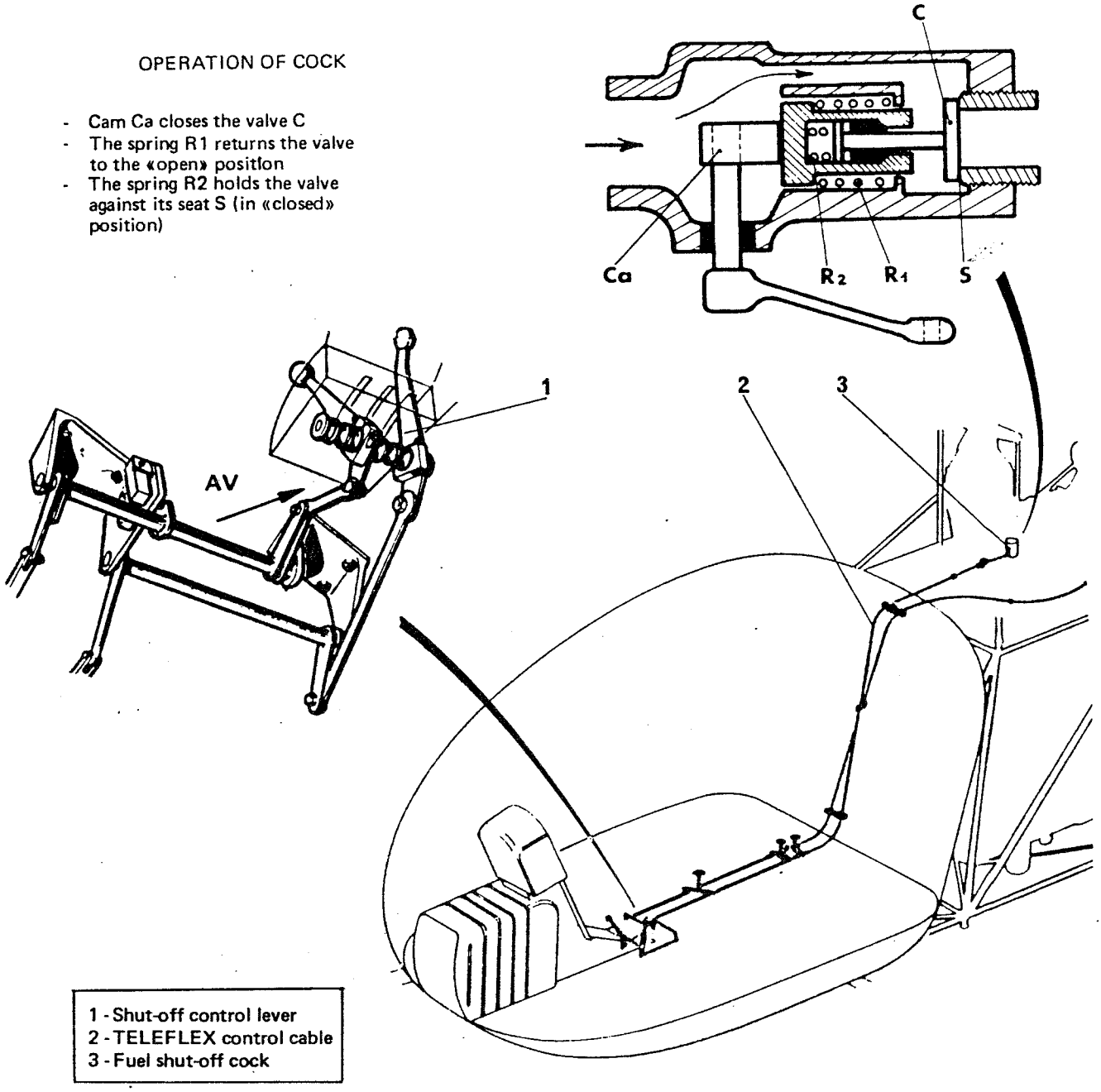
1. - Fuel flow control lever 2. - Control quadrant 3. - Bellcrank 4. - Cam 5. - Shaft 6. - Fuel flow control lever 7. - Fuel flow control valve	8. - Fuel flow valve «open» stop 9. - Fuel flow valve «closed» stop 10. - Plunger of micro switch (1) 11. - Shaft with knuckle joint 12. - TELEFLEX control (1) - (2) - (3) - Micro-switches

12.30.3. - ENGINE FUEL SHUT-OFF CONTROL (Figure 4)

The shut-off control makes it possible, in case of emergency, to instantaneously cut off the fuel supply to the engine, by closing the SHUT-OFF cock (3). It consists of a hand control (1) linked to the shut-off cock by a TELEFLEX flexible control cable (2).
The hand control is usually wired and sealed in the «Cock open» limit position.

OPERATION OF COCK

- Cam Ca closes the valve C
- The spring R1 returns the valve to the «open» position
- The spring R2 holds the valve against its seat S (in «closed» position)



1 - Shut-off control lever
2 - TELEFLEX control cable
3 - Fuel shut-off cock

Figure 4

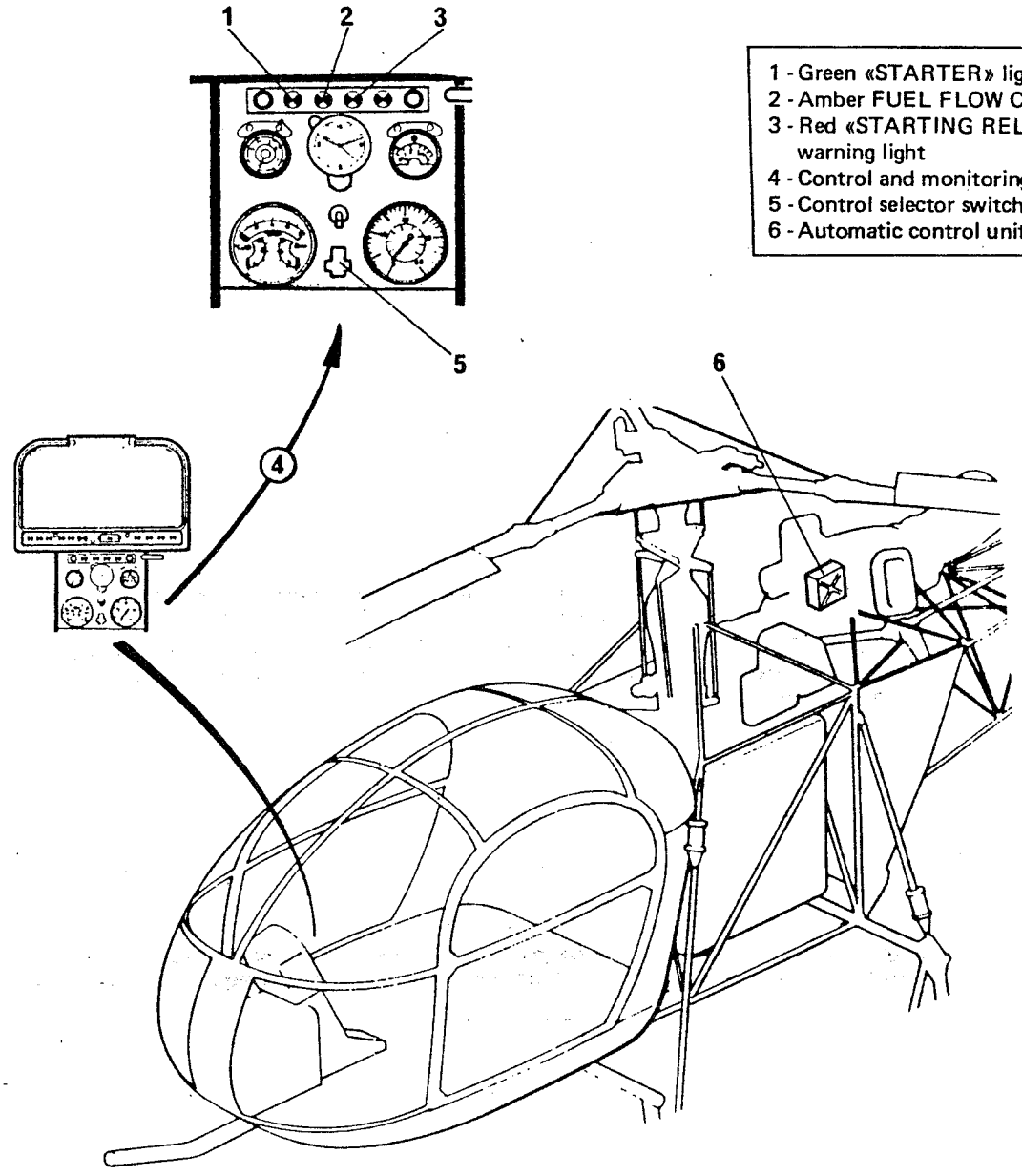
Fuel shut-off control

13.30.4. - STARTING CONTROL SYSTEM

A - GENERAL (Figure 5)

The electrical starting control consists of :
- the starter control and monitoring panel (4)
- the automatic control box (6)

NOTE : The automatic control box is installed by the engine manufacturer and consequently the description and detailed working of this component are not covered here. The function of the control and monitoring components is mentioned for information only.



1 - Green «STARTER» light
2 - Amber FUEL FLOW CONTROL VALVE
3 - Red «STARTING RELAY BLOCKAGE» warning light
4 - Control and monitoring panel
5 - Control selector switch
6 - Automatic control unit

Figure 5
starting control

12.30.4. - STARTING CONTROL SYSTEM (Continued)

B - STARTING CONTROL SYSTEM COMPONENTS

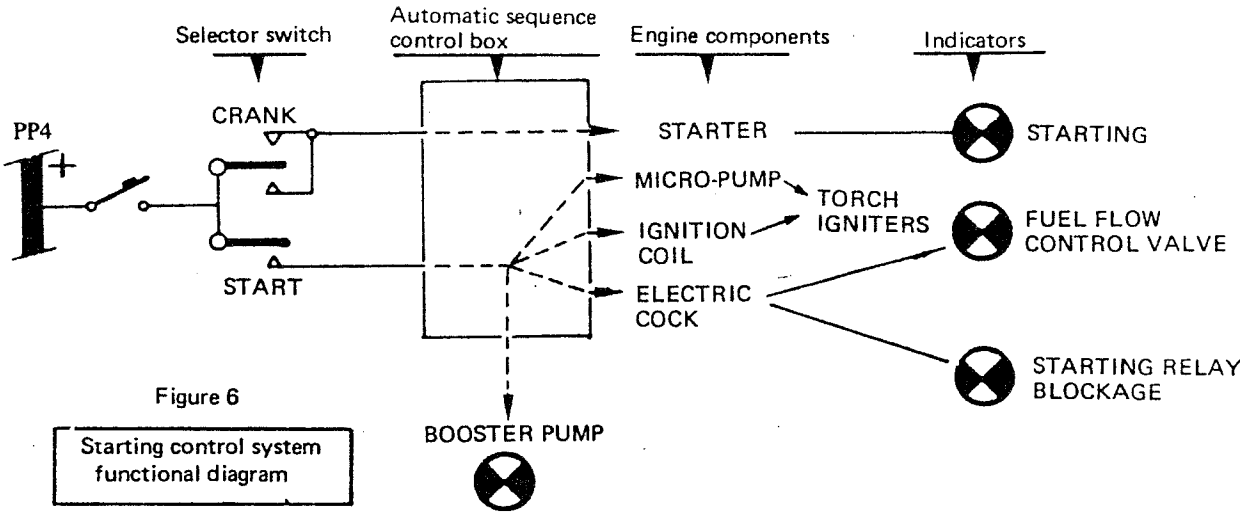


Figure 6

Starting control system functional diagram

Function of the various components

- Selector control switch - There are three settings :
  - «Arrêt» (STOP) — Controls the stopping of the engine
  - «Démarrage» (START) — Initiates starting sequence
  - «Ventilation» (CRANK) — The engine is driven by the starter motor (without fuel supply or ignition)
- Automatic sequence control box. Controls the starting and stopping sequences of the engine.
- Starter. In the first phase of starting, this drives the rotary part of the engine, thus ventilating the combustion chamber.
- Micro-pump. This supplies the necessary fuel for ignition in the combustion chamber.
- Ignition coil. Supplies the necessary H.T. current for ignition.
- Torch igniters. Supplied with fuel by the micro-pumps and with an H.T. current by the ignition coil, these produce a flame which is propagated throughout the combustion chamber.
- Electric cock. This opens the main fuel supply on starting. The closing of this cock stops the engine.
- «STARTER» pilot light. Lights up whenever the selector switch is set on START or CRANK. Extinguishes when the starter supply is automatically cut off.

  IF THE LIGHT IS ON, THE STARTER IS OPERATING
- MICRO-PUMP AND ELECTRIC COCK pilot light. Lights up when the micro-pump pressure is sufficient to supply the torch igniters. Extinguishes when the ignition sequence is finished and the electric cock open.

  LIGHT ON : «INJECTION-IGNITION» PHASE IN PROGRESS
- «BLOCKAGE» warning light. Lights up at the end of the stopping sequence. It stays lit (20 secs.) as long as the re-arm phase is in progress. The re-arm phase prepares for the next ignition.

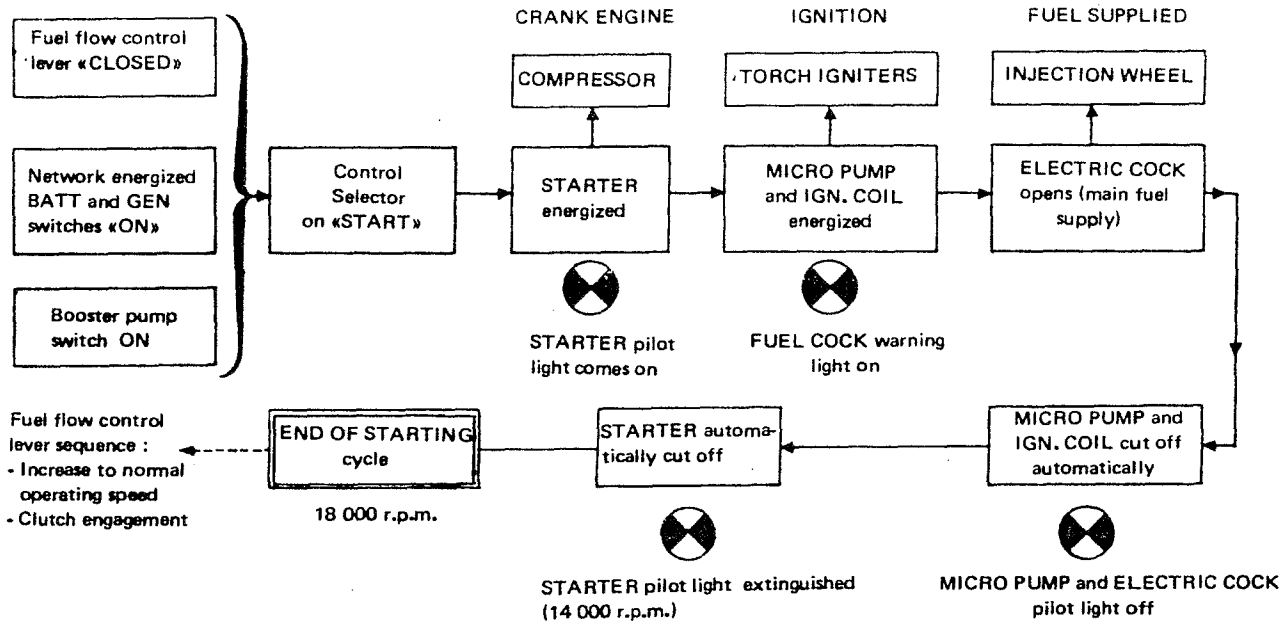
  LIGHT ON : STARTING IMPOSSIBLE

NOTE : The ELECTRIC COCK warning light flashes on when the electric cock closes when the engine is stopping.

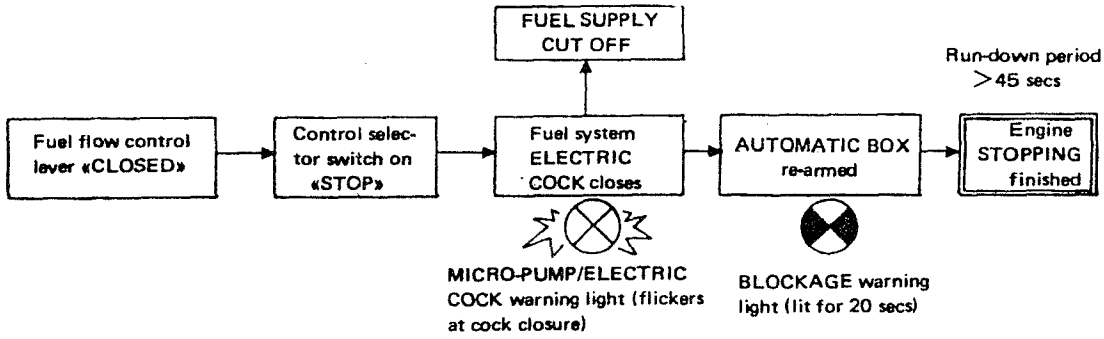
12.30.4. - STARTING CONTROL SYSTEM (Continued)

C - AUTOMATIC SEQUENCE

(1) STARTING CYCLE (50 secs. max. duration)



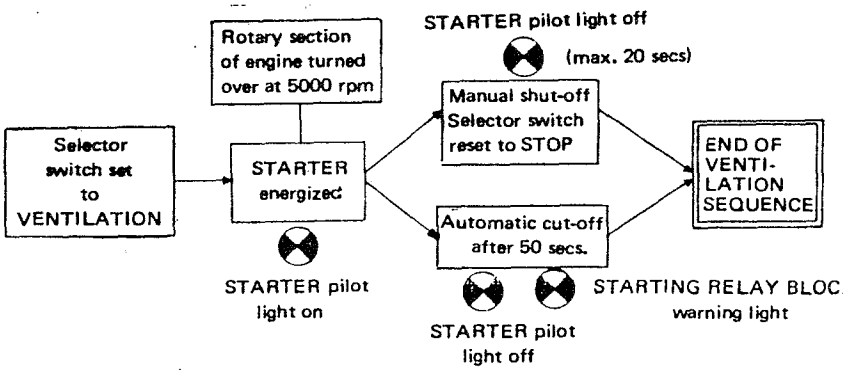
(2) STOPPING SEQUENCE



(3) VENTILATION (CRANKING)

The function of the «ventilation» sequence is to turn the moving parts of the engine without causing ignition. The reason for this is :

- to dispel any fuel present in the combustion chamber after an aborted start or after accidental stopping of the engine
- to cool off the air stream should the residual T4 be too high (T4 > 150°C) before commencing a starting sequence.



12.40. - ENGINE MONITORING

12.40.1. - GENERAL

The engine monitoring system consists of :

- The rotational speed monitoring equipment
- The exhaust gas temperature monitoring equipment
- The lubrication system monitoring equipment (see 12.20)

12.40.2. - ROTATIONAL SPEED MONITORING (Figure 1)

The engine rotational speed is monitored by a tachometric system consisting of :

- A tachometer generator (alternator) (2) mounted on the engine
- A tachometer receiver (1)

NOTE : Operation of the tachometer system is described in chapter 10 - Instruments.

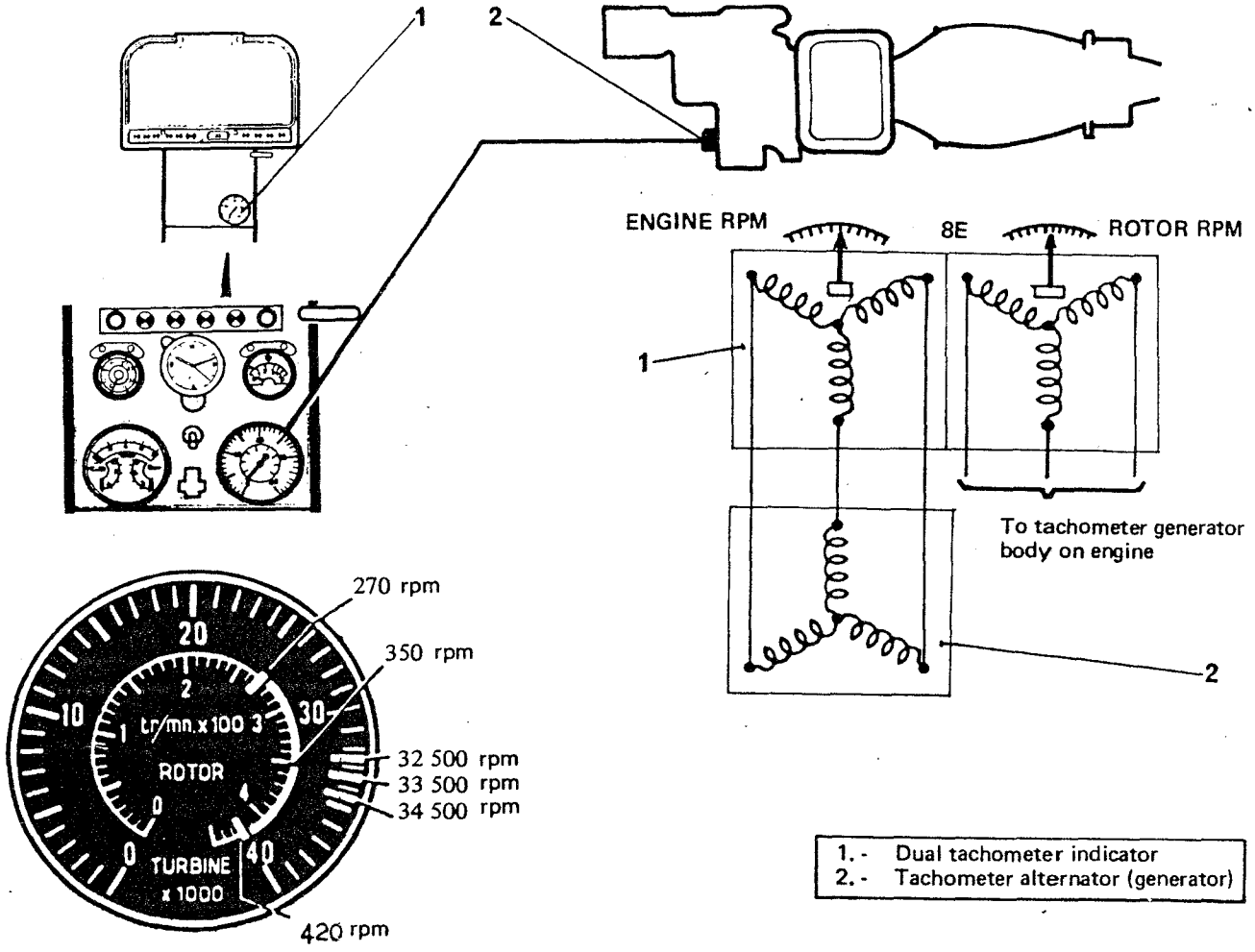


Figure 1

Engine rotational speed monitoring system

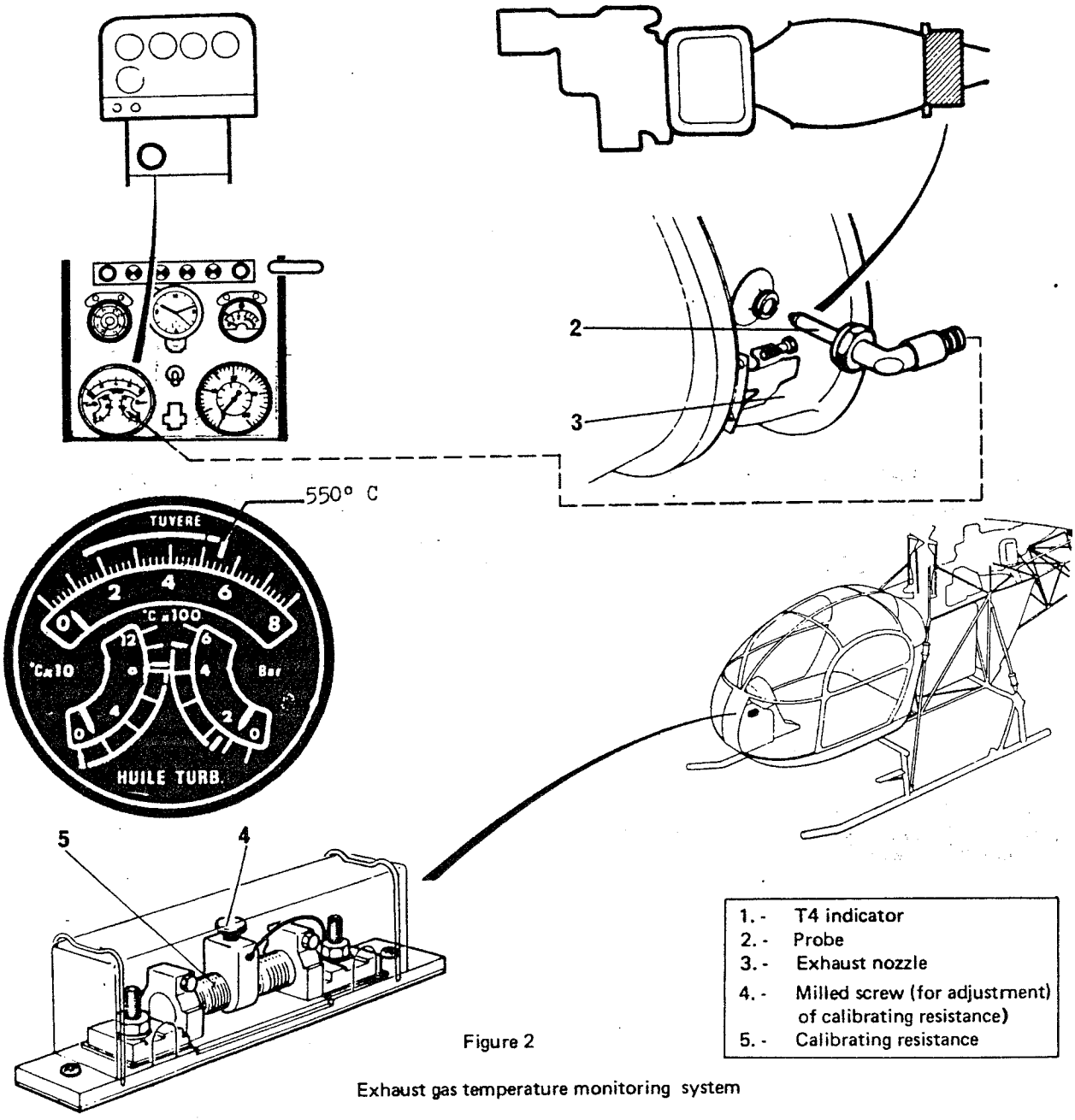
12.40.3. - EXHAUST GAS TEMPERATURE MONITORING (Figure 2)

A - GENERAL

The exhaust gas temperature (T4) is measured by :

- two thermo-couple type probes (2) connected in series
- an indicator (1)

The indicator is a galvanometer which measures the current intensity of a thermo-couple (Chromel - alumel). The hot junction (probes) of this couple is set in the engine exhaust jet at position 4 (exhaust nozzle). An adjustable resistance (5) allows the circuit to be calibrated accurately.



1. - T4 indicator
2. - Probe
3. - Exhaust nozzle
4. - Milled screw (for adjustment) of calibrating resistance)
5. - Calibrating resistance

Figure 2

Exhaust gas temperature monitoring system

12.40.3. - EXHAUST GAS TEMPERATURE MONITORING (Continued)

B - FUNCTIONNING OF A THERMO-COUPLE (theory)

A thermo-couple is composed of two metal conduetors of dissimilar nature (A-B) welded at points C and D. If the temperatures T and t of the probes C and D are different, then a current will flow in the circuit. The intensity of this current depends upon :

- the nature of the metals A and B
- the temperature difference between the probes (T-t)
- the circuit resistance (R)

A galvanometer graduated in degrees allows the intensity of the current i.e. the temperature difference (T-t), to be measured for a circuit of known resistance.

The HOT JUNCTION is the weld C at the point where the temperature is to be measured.

The COLD JUNCTION is the weld D situated far from the hot junction and at ambient temperature t.

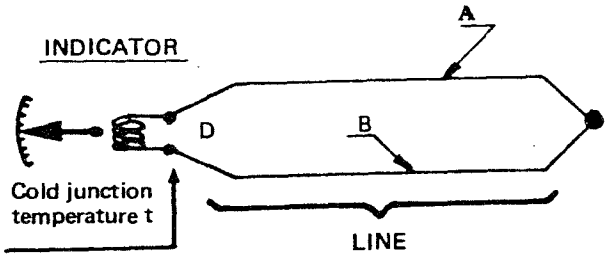


Figure 3 - Thermo-couple

C - THERMO-COUPLE COMPENSATION

The current intensity (i.e. the temperature indication) must be made to be independent of t and R. The influence of t is compensated for in the indicator itself.

(1) A bi-metallic strip linked to the moving frame of the indicator determines the equilibrium position of the needle. When hot junction = cold junction = t, the needle records the ambient temperature (t). This makes the measurement of T independent of t.

(2) A compensating coil, with a negative temperature coefficient makes the total circuit resistance independent of t.

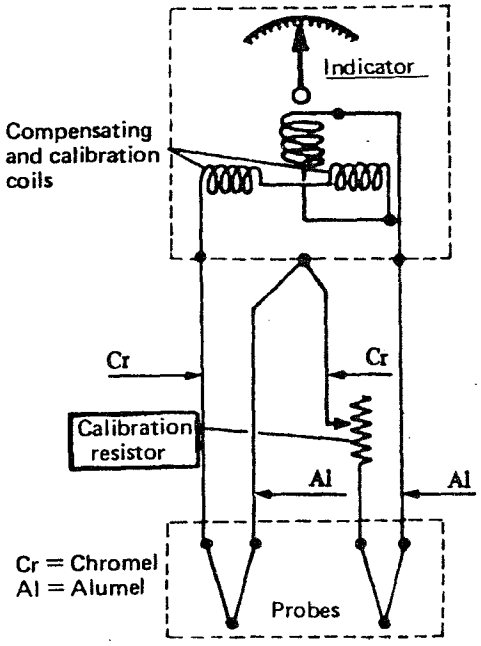


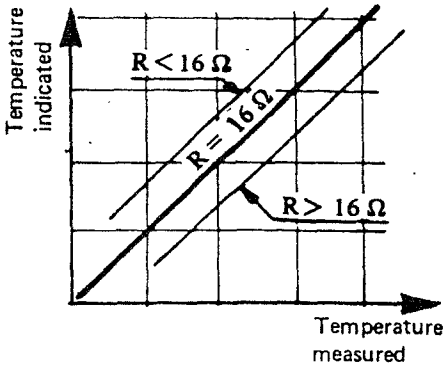
Figure 4
T4 temperature monitoring theory

INFLUENCE OF R (line resistance)

The indicator frame is graduated for a set line resistance (R = 16Ω). The line resistance must therefore be adjusted to this value to avoid error in readings.

THE CALIBRATING RESISTOR ALLOWS THE LINE RESISTANCE TO BE SET TO THE DESIRED VALUE.

- If R = 16 Ω the indicator shows the true temperature measured.
- If R < 16 Ω the indicated value is greater than the temperature measured.
- If R > 16 Ω the indicated value is less than the temperature measured.



12.50. - SAND FILTERS

12.50.1. - GENERAL

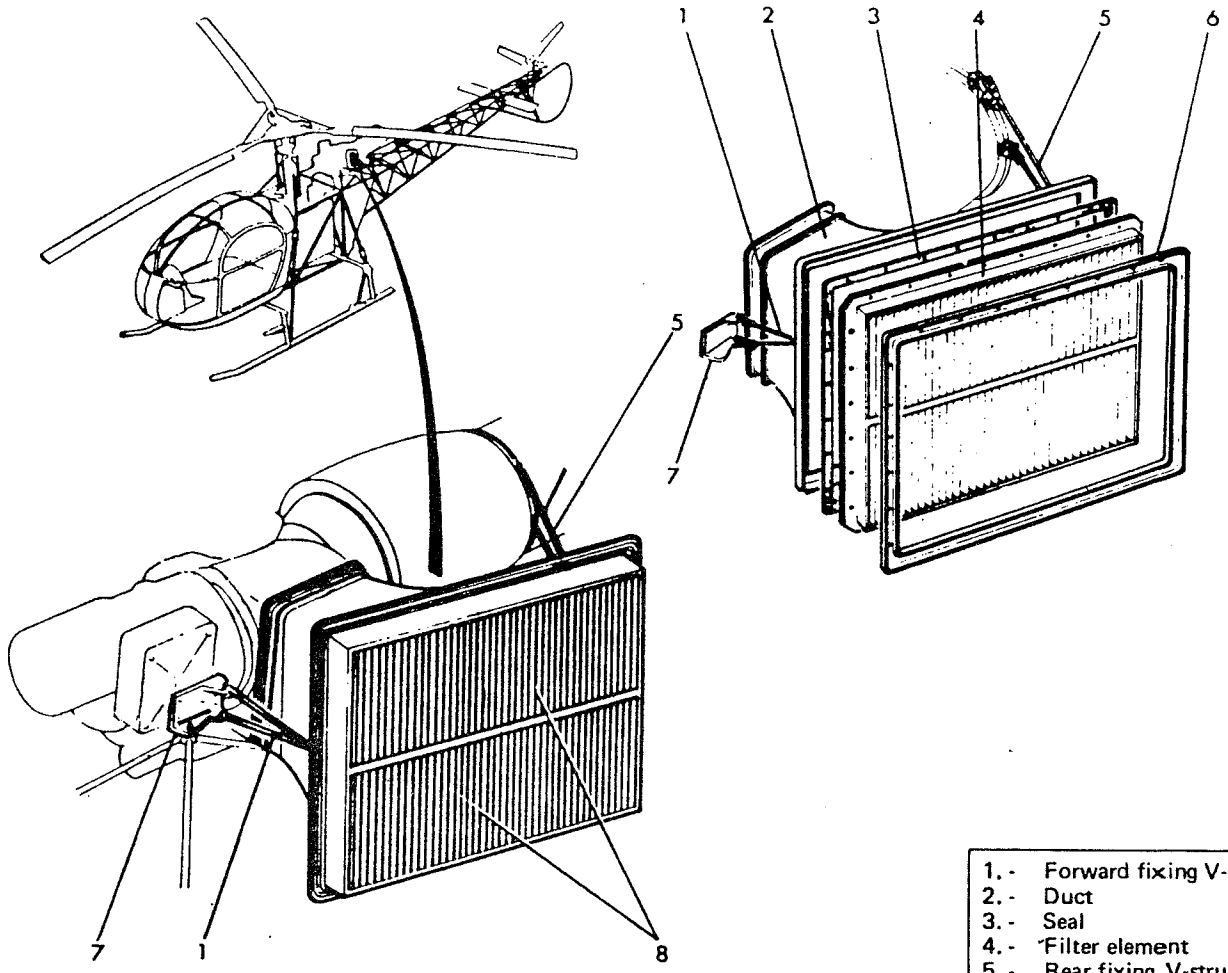
The engine may be fitted with sand filters, which are fitted on the air intakes to prevent erosion of the compressor blades when working in sandy conditions.

12.50.2. - SAND FILTER INSTALLATION (Figure 1)

The «gate-type» sand filters consist of :

- a fiberglas duct (2) connected to the engine air intake
- a filter element (4)
- a metal frame (6) holding the filter element
- fixing screws (1) (5) that are fixed to the f'w'd engine mounts (special sand filter supports) and to the rear flange of the engine turbine casing.

The filter element is made of pleated felt strips (8).



1. -	Forward fixing V-strut
2. -	Duct
3. -	Seal
4. -	Filter element
5. -	Rear fixing V-strut
6. -	Assembly frame
7. -	Engine mount
8. -	Felt strips

NOTE : 1) A pressure connection at the rear side of the filter allows the degree of clogging to be checked

2) Using the sand filters changes the dynamic stability of the rearward centre of gravity (see recommendations in flight manual)

Figure 1
Sand filters

12. - APPENDIX

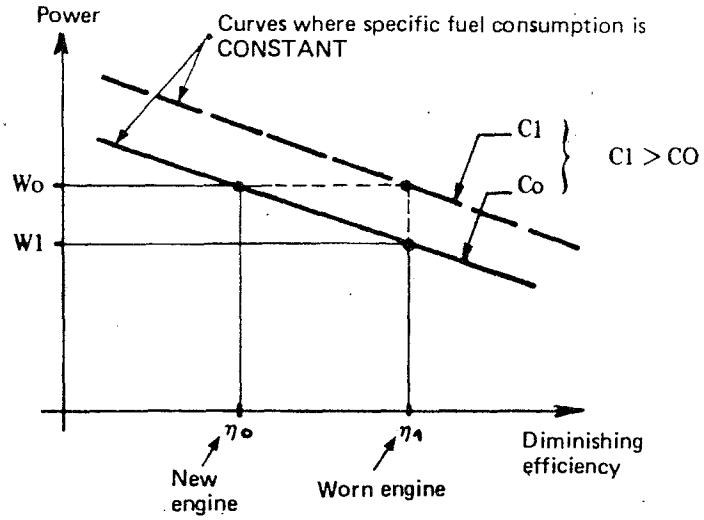
1. - ENGINE EFFICIENCY CHECK (GENERALLY CALLED ENGINE POWER CHECK)

A - REMINDERS

1) For a given constant fuel consumption the engine power diminishes with the engine efficiency η. When the efficiency passes from ηo to $\eta 1$, the power changes from Wo to W1.

2) With a worn engine, in order to obtain the power of a new engine then the specific consumption C must be increased.
Example : the performance of a worn engine is $\eta 1$. To re-establish the power Wo, a consumption of C1 is necessary (C1 > C0)

3) As the specific consumption increases, the internal energy of the gas increases and T4 temperature increases.



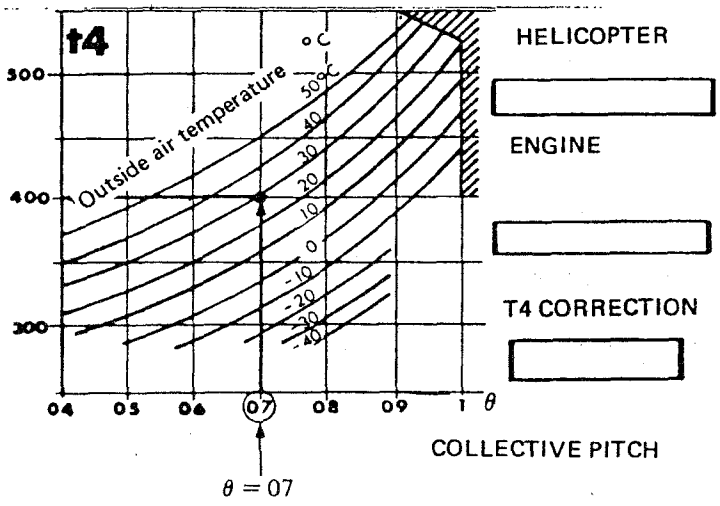
RESULT : FOR A GIVEN POWER OUTPUT THE T4 TEMPERATURE INCREASES AS THE EFFICIENCY DIMINISHES

B - EFFICIENCY CHECK - THEORY

It is immediately obvious that if the evolution of T4 is studied over a period of time and under similar load conditions, then a decrease in engine efficiency will be observed.
Real values of T4, measured in hover at 1.50 metres above the ground are compared with theoretical values obtained from a reference chart showing the values determined in similar collective pitch conditions θ and external temperature t.
The reference chart is located on a flap on the top of the instrument panel.

1) Determination of T4 reference values (use of the chart)

If $\theta = 0.7$ $t = 30^o$ $T = 384^o$ measurements taken during a trial hover flight.
The corresponding reference T4 is 400°C.



1.- ENGINE EFFICIENCY CHECK (Continued)

2) Checking method

— 1st measurement of T4 (after installing the engine)

After installing engine, θ, t and T are measured in hover at 1.50 metres above ground.

Example : $\theta = 0.7$ $t = 30^{o}$ $T = 384^{o}$

the chart allows the corresponding value of T4 with $\theta = 0.7$ and $t = 30^{o}$ to be calculated.

T4 (theoretical) = 400^{o}

The difference T4 (theoretical) — T4 (measured) is called :

THE ENGINE T4 CORRECTION

This difference may be positive or negative. It is positive as long as theoretical T4 is greater than measured T4. In the above example it is

$400^{o} - 384^{o} = +\ 16^{o}$

This value is recorded in the CORRECTION panel of the chart.

NOTE : The correction of T4 allows the engine system T4 shift with respect to the chart reference values to be taken into account at later calculations.

— Checking the progressive values of T4

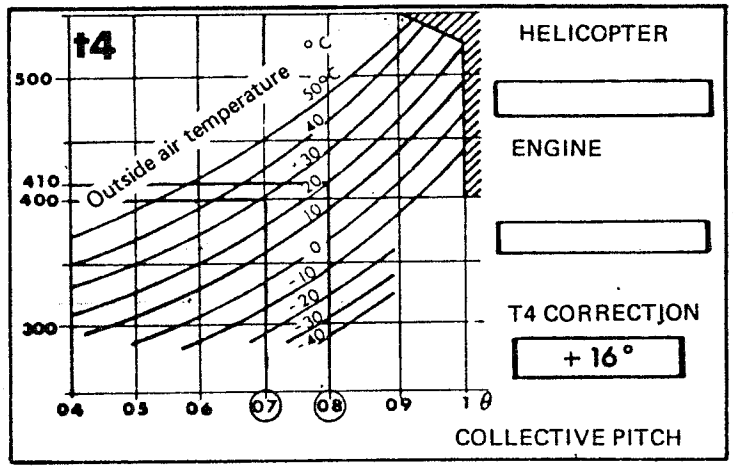
with the helicopter in hover at 1.50 metres, θ, t and T are measured.

Example : $\theta = 0.8$ $t = 20^{o}$ $T = 420^{o}$

- The T4 correction is added to the T4 read
  In the above example : $\boxed{420^{o} + 16^{o} = 436^{o}}$
- The chart is consulted for the theoretical T4 corresponding to $\theta = 0.8$ and $t = 20^{o}$
  In the above example : $\boxed{T = 410^{o}}$
- The difference T4 (read and corrected) — T4 theoretical = ΔT
  then :

$\Delta T = 436 - 410 = 26^{o}$

If $\Delta T < 40^{\circ}$ then the performance drop is within the tolerances.
If $\Delta T > 40^{o}$ check the monitoring instruments. If these are correct then the engine should be returned to the factory.



13.10 - RESCUE HOIST

13.10.1.- GENERAL

The pneumatic-type hoist permits lifting loads aboard the aircraft :
– The maximum load permissible using hoist assembly AE 76.300.100 is 160 Kg (353 lb).
The usable cable length is 25 metres.
To use the hoist, the rear two-place seat has to be removed and the rear single-seat displaced to the right.
The hoist system comprises :
– the hoisting assembly,
– electrical controls
The hoist pneumatic power is derived from the engine compressed air (P2 air pickoff).
The hoist is controlled by an electrical circuit.
NOTE : Since the hot air pickoff tap is common to the «cabin heating» and «hoist» systems, when the hoist is operated the cabin heating system must be imperatively shut off.

13.10.2.- GENERAL DESCRIPTION OF THE HOIST INSTALLATION (Figure 2)

A -HOIST ASSEMBLY

The hoist assembly consists of :

- The pneumatic hoist (5) fixed on a jib (6) ; this jib is made of four fully detachable parts.
- The pneumatic supply system, comprising :
  - A P2 air pickoff probe (7)
  - An air filter (8),
  - A hot air metering valve (9).
- The hoist operator equipment, comprising
  - A safety belt (12)
  - A movable hand control unit (14)

B -HOIST CONTROLS

The hoist electrical controls consist of :

- A normal operation control comprising :
  - A master switch «MISSION» (4)
  - A «MISSION» equipment selector switch (on control pedestal lower panel)
  - A rocker switch (15) on the hoist operator's control handle, which provides UP and DOWN control
- An emergency cable release control (DETRESSE)

  Push-button (1) on the pilot's cyclic pitch stick controls a cable shearing device.

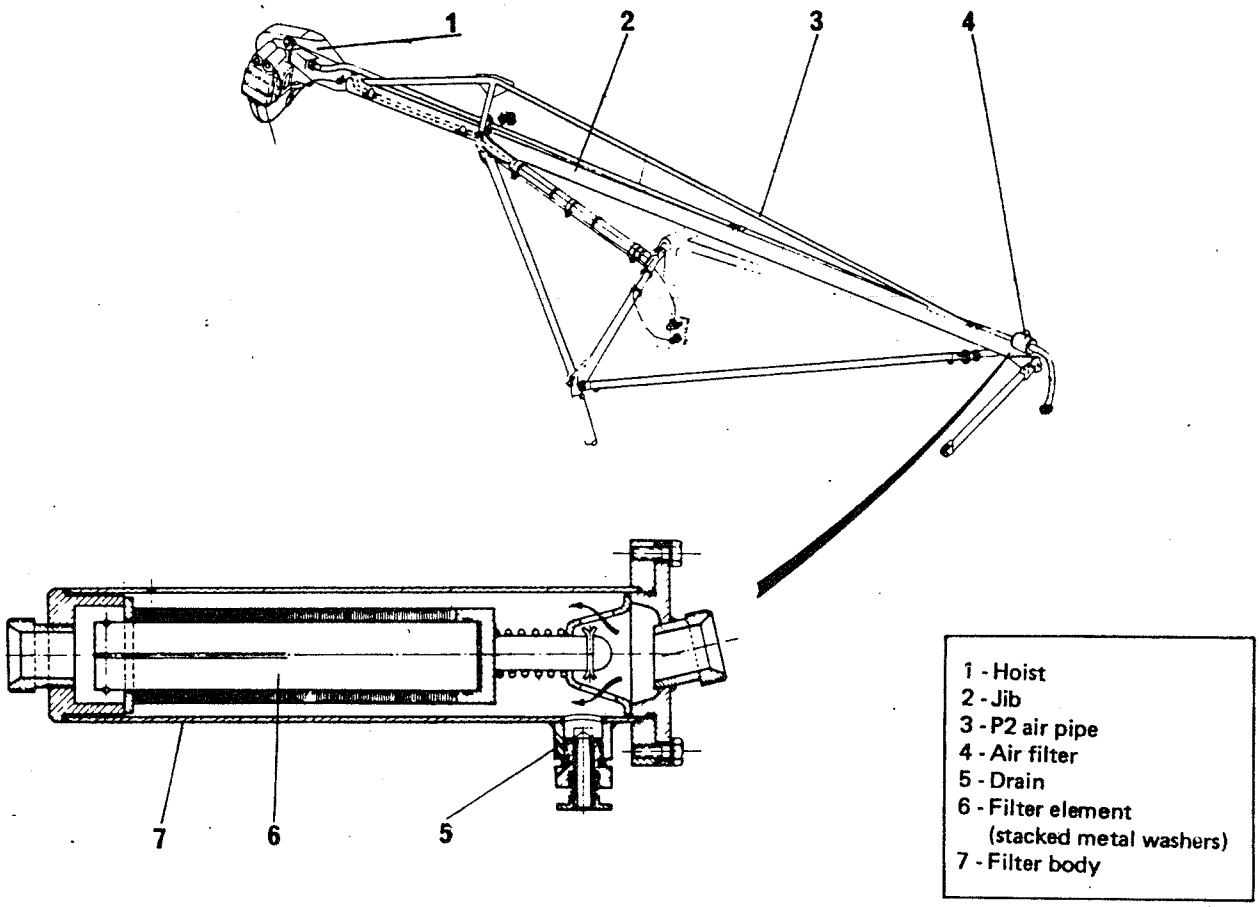


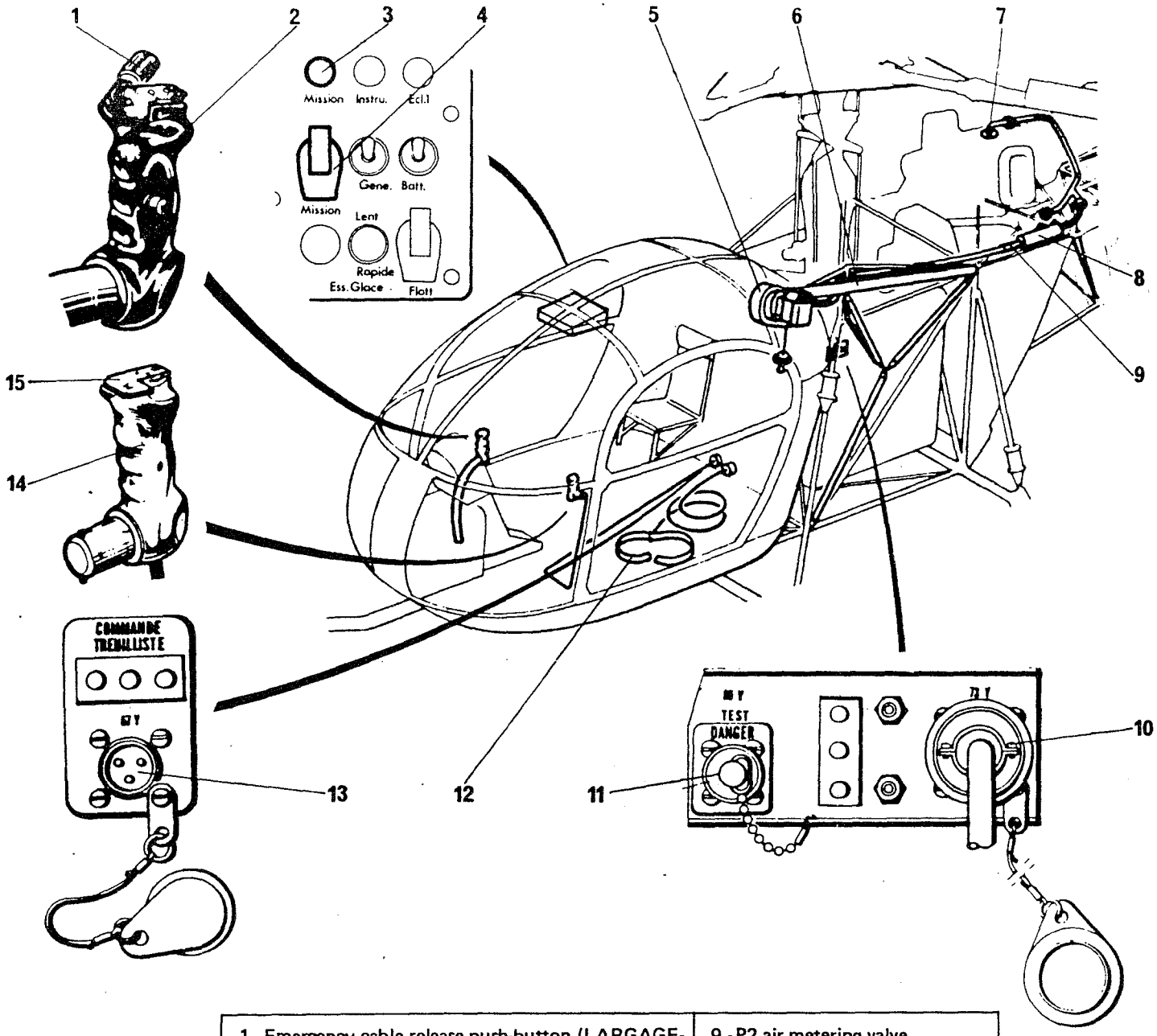
Figure 1
Hoist jib and air filter

CHAPTER 13

OPERATIONAL INSTALLATIONS

CONTENTS

13.10.2.- GENERAL DESCRIPTION OF THE HOIST INSTALLATION (CONTD)



1 - Emergency cable release push-button (LARGAGE-DETRESSE)	9 - P2 air metering valve
2 - Cyclic pitch stick	10 - Hoist electrical connector
3 - «MISSION» circuit-breaker	11 - «Squib» TEST connector
4 - «MISSION» selector switch	12 - Hoist operator belt
5 - Hoist	13 - Hoist operator control handle connector
6 - Hoist support jib	14 - Hoist operator control handle
7 - P2 air pickoff probe	15 - Hoist control rocker switch
8 - Air filter	

Figure 2
Rescue hoist system

13.10.3. - PNEUMATIC HOIST

A - CHARACTERISTICS

1. - HOIST :

- Weight of hoist with cable and hook excluding handle : 13 kg
- Maximum hoistable load : 160 kg with AE.76.300.100 hoist

- Hoisting speed (with 3 bars supply pressure) :
  - For a 100 kg load : $\geqslant$ 0.45 m/sec
  - For a 175 kg load : $\geqslant$ 0.40 m/sec
  - Without load : 0.30 m/sec ± 0.10 m/sec
- Slow wind-in speed at end of upward travel
  - For a 100 kg load : $\leqslant$ 0.35 m/sec
  - For a 175 kg load : $\geqslant$ 0.10 m/sec

2. - CABLES

- Type : Pre-formed, 7 x 7, galvanised steel
- Nominal diameter : 4.05 mm
- Shear load : $\geqslant$ 1300 kg
- Usable length : 24 metres

WARNING - NEVER GREASE THE CABLE

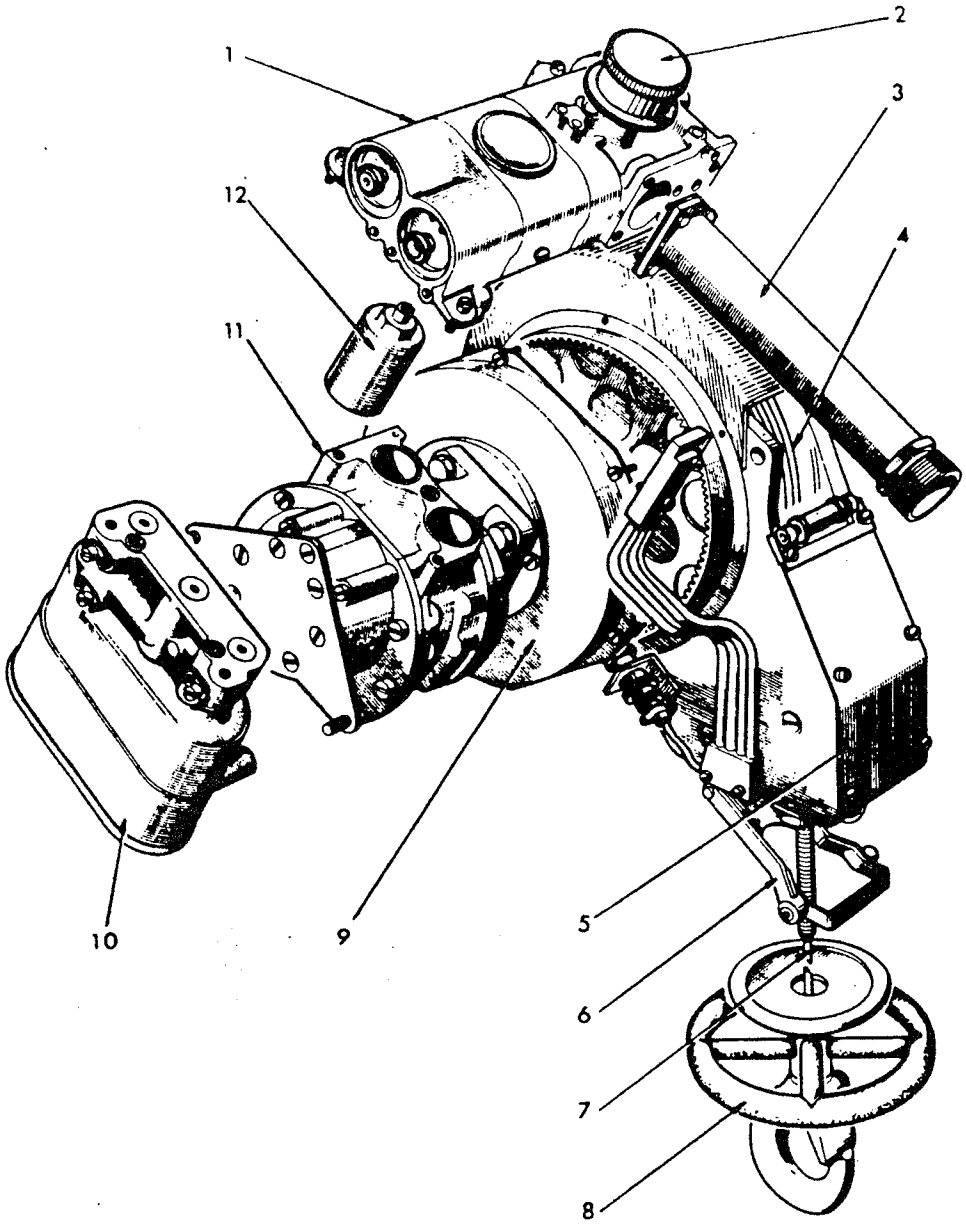
3. - AIR SUPPLY

- Supply pressure
  - nominal : 3 bars
  - maximum : 3.6 bars
- Maximum consumption : 40 g/sec
- Maximum temperature : 250°C

4. - ELECTRICAL POWER SUPPLY

- Nominal voltage : 28 Voc
- Consumption (under 24 V)
  - upward travel/no load : 2 A
  - upward travel/loaded : 4 A
  - downward travel : 2 A

13.10.3. - PNEUMATIC HOIST (Continued)



1. - Pneumatic servo-selector	8. - Hand wheel
2. - Filter	9. - Two-stage mechanical reduction gear and automatic disc-type brake
3. - Air intake pipe	10. - Solenoid-valves controlling the air intake
4. - Cable drum	11. - Vane type motor
5. - Mechanical cable extractor	12. - Load sensing pressure switch
6. - Automatic stopping device	
7. - Cable	

Figure 2.A.
Pneumatic hoist

13.10.3. - PNEUMATIC HOIST (Continued)

B – FUNCTIONAL DIAGRAM

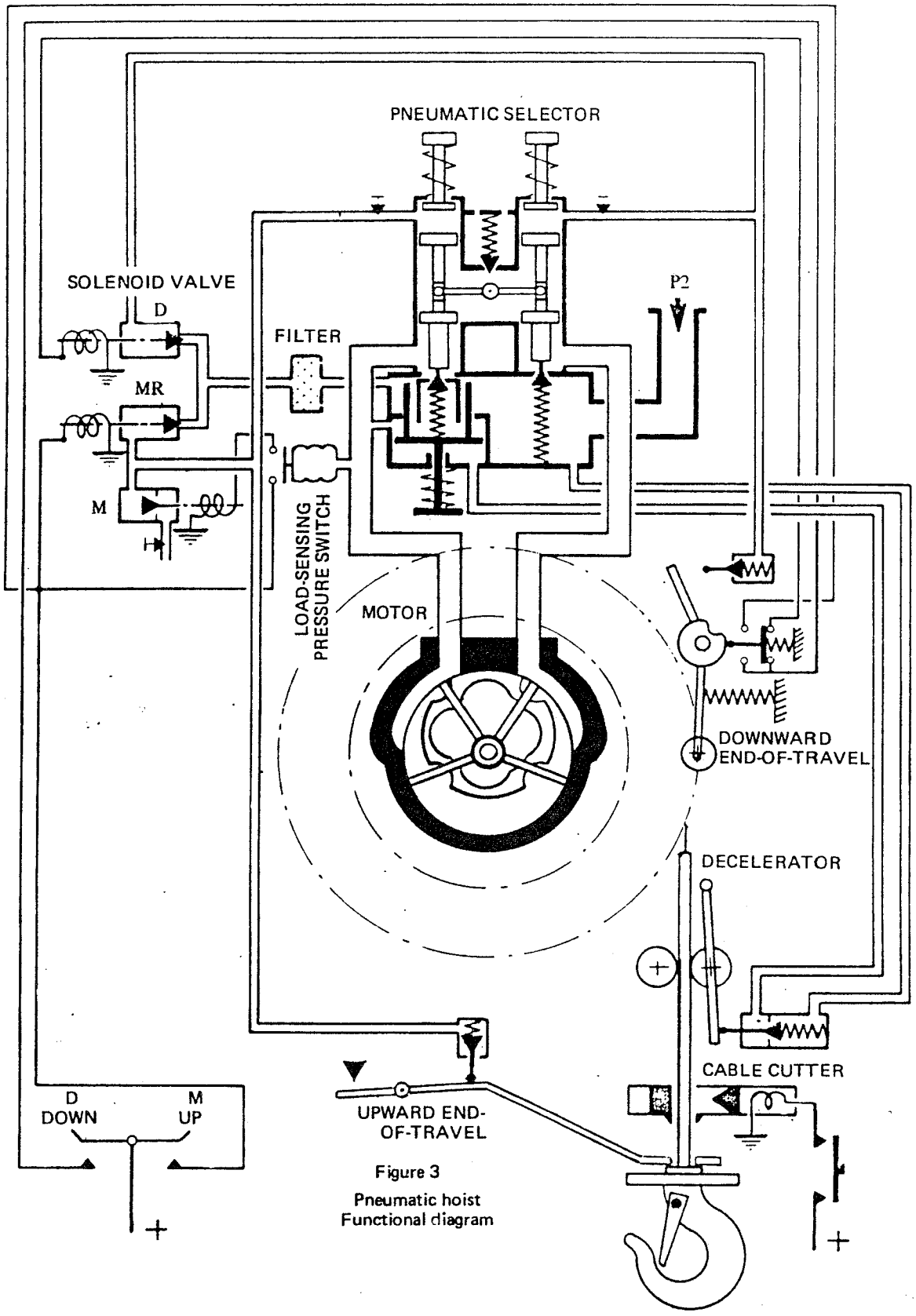


Figure 3
Pneumatic hoist
Functional diagram

13.10.4. - HOIST CONTROL ELECTRICAL SYSTEM (Figure 4)

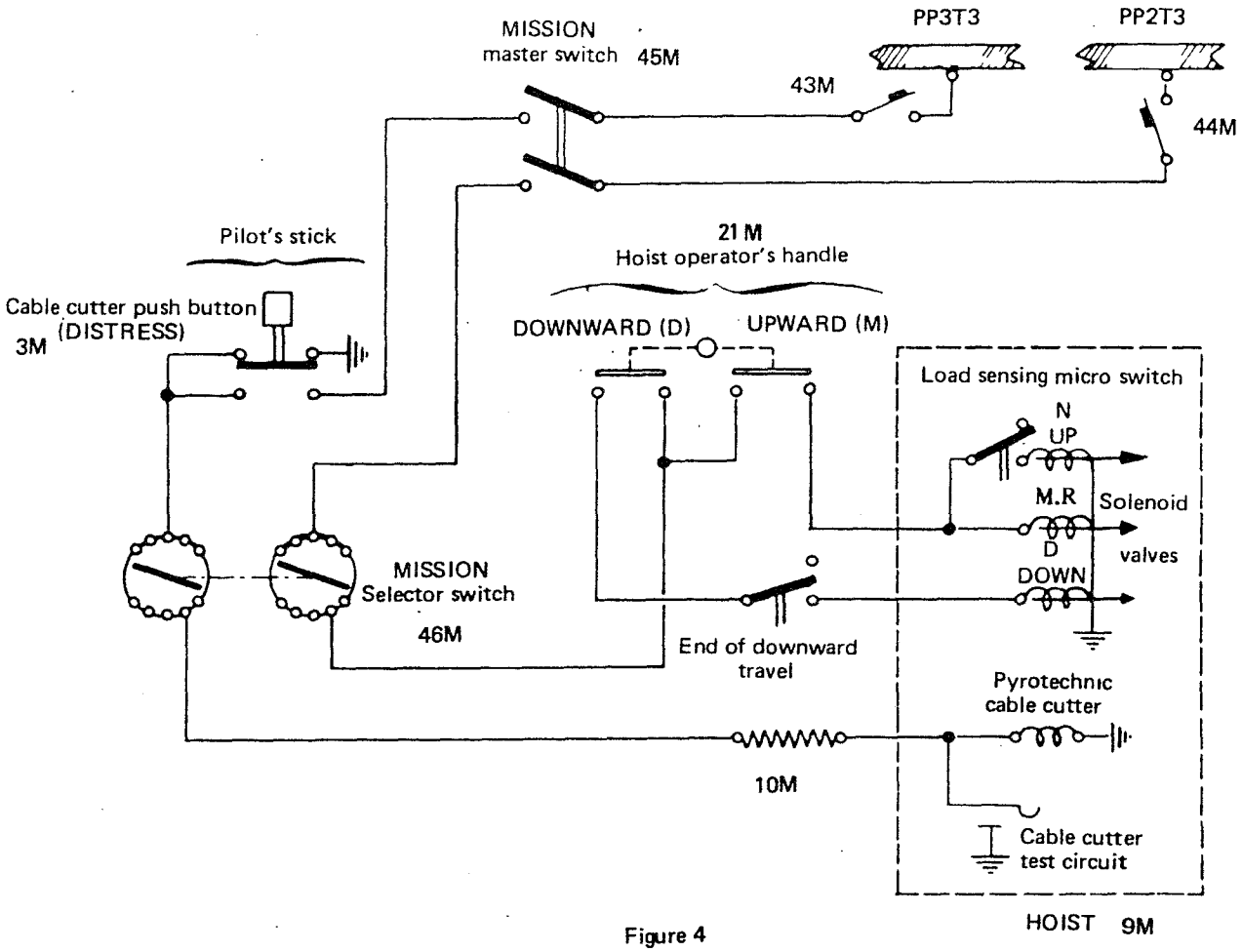


Figure 4

Hoist control electrical system

OPERATION

A - HOIST CONTROL

With the «MISSION» master switch in «MARCHE» (ON) position and the mission selector switch set to «TREUIL» (HOIST), actuation of the rocker switch on the hoist operator's control handle in either the D = DOWNWARD or M = UPWARD direction will cause the corresponding solenoid-valve to be energized. The solenoid-valve causes a change in the pneumatic pressure distribution of the hoist system. The hoist motor is actuated and drives the cable drum in the desired direction (up or down). DOWNWARD END-OF TRAVEL : At the end of the downward travel the «end of travel» micro-switch cuts out the solenoid valve D circuit. LOAD SENSOR : If the load is greater than 30 kg, the load sensing pressure switch closes and the two solenoid-valves M and M.R. are energized, and the hoist motor rotates at its normal speed. If the load is less than 30 kg, the pressure switch is open and only the M.R. solenoid-valve is energized causing the hoist motor to rotate at reduced speed.

B - CABLE-CUTTING CONTROL (DISTRESS)

Depressing the push button on the pilot's control stick causes the hoist pyrotechnic device to fire : THE CABLE IS SEVERED.

13.20.- TRANSPORT OF EXTERNAL LOADS

13.20.1.- GENERAL (Figure 1)

This installation allows loads to be transported, the loads being suspended from a release unit secured under the body structure.

MAXIMUM TRANSPORTABLE LOAD : 1 000 Kg

The external load transport installation consists of :
- a release unit support frame (4)
- a release unit (3)
- electrical controls and indicating components (1) and a mechanical emergency control (2) (release control)

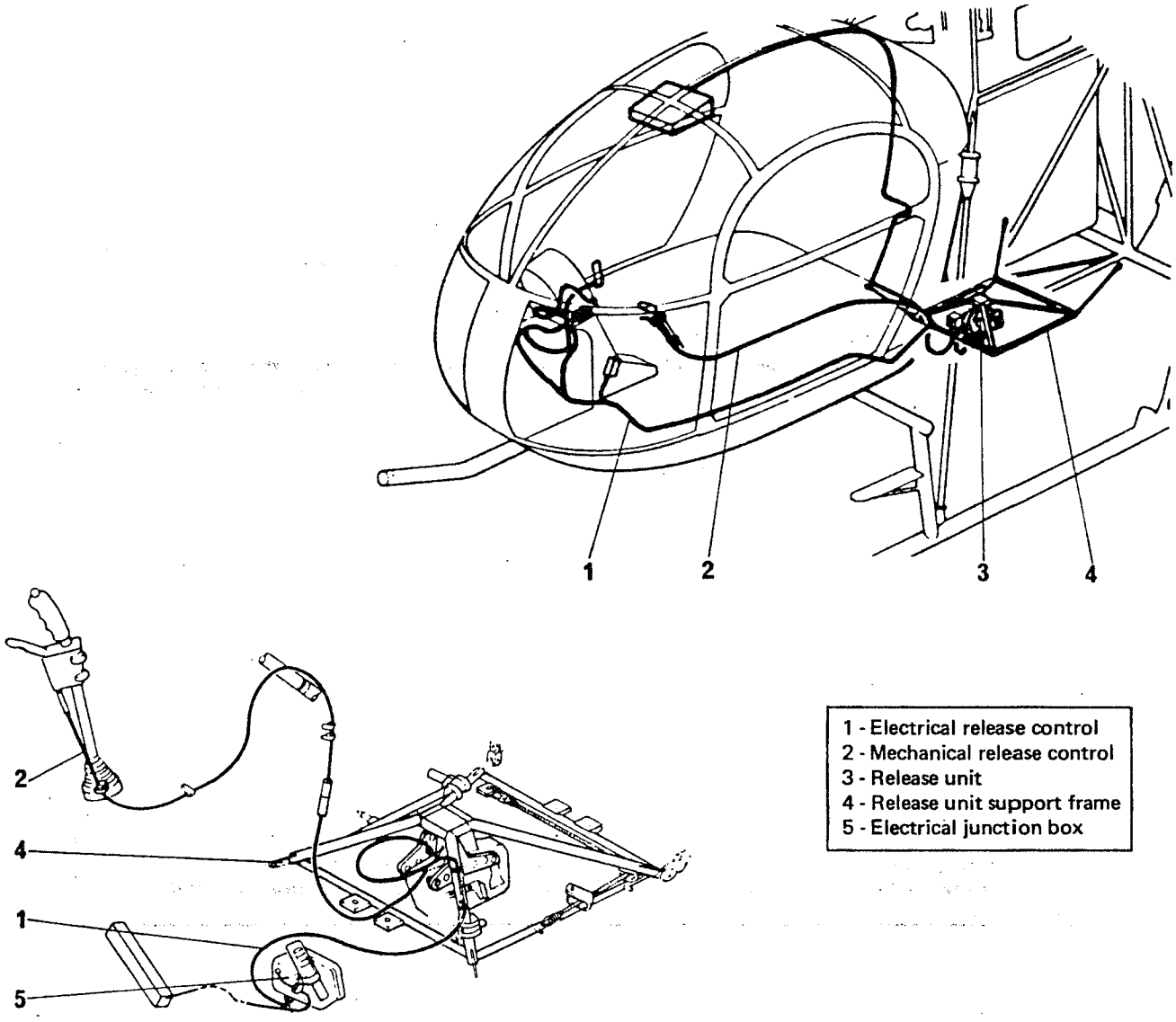


Figure 1
External load transport installation

13.20.2. - GENERAL DESCRIPTION OF THE EXTERNAL LOAD TRANSPORT TALLATION INSTALLATION (Figure 2)

A - RELEASE UNIT SUPPORT FRAME

This is a welded frame (10) which is secured to the body structure by four cables (3) and which holds the release unit between two hinged plates (15). The frame is fitted with an elastic cord (9) which maintains the release unit mechanism in «rest» position, a plug stowage socket (11), and four lugs (13) that accommodate the cables in «rest» position.

B - RELEASE UNIT (see 13.20.3.)

C - CONTROLS AND INDICATING

1 - ELECTRICAL POWER SUPPLY

- A MISSION circuit-breaker (1)
- A MISSION master switch (2)
- A mission selector switch (18)

2 - ELECTRICAL CONTROL

A rocker switch (20) on the pilot's cyclic stick, controls jettisoning of the release unit strop (12).
An amber warning light (19) comes on when this strop is released.
Interconnexion between the helicopter systems and the release unit is ensured by the electrical junction box (4) installed near the release unit and containing the control relay.

3 - MECHANICAL CONTROL (SAFETY)

The mechanical control allows the strop to be released should the electrical system fail. It consists of a control handle (17) which actuates the release mechanism via a flexible cable of the BOWDEN type (16).

4 - DIRECT CONTROLS ON RELEASE UNIT (see 13.20.3.)

1. - MISSION circuit-breaker	11. - Electrical plug stowage socket
2. - MISSION master switch	12. - Release unit strop
3. - Release unit frame attaching cable	13. - «Rest» position cable lugs
	14. - Release unit
5. - Release unit support frame	15. - Hinged plates holding the release unit on support
6. - Shackle	16. - BOWDEN cable
7. - Yoke	17. - «Mechanical release» control handle
	18. - Mission selector switch
9. - Elastic cord maintaining the release unit in «rest» position	19.- Amber indicator light (RELEASE)
10. - Welded frame	20. - Rocker switch (electrical release control)

13.20.2. - GENERAL DESCRIPTION OF THE EXTERNAL LOAD TRANSPORT INSTALLATION (Continued)

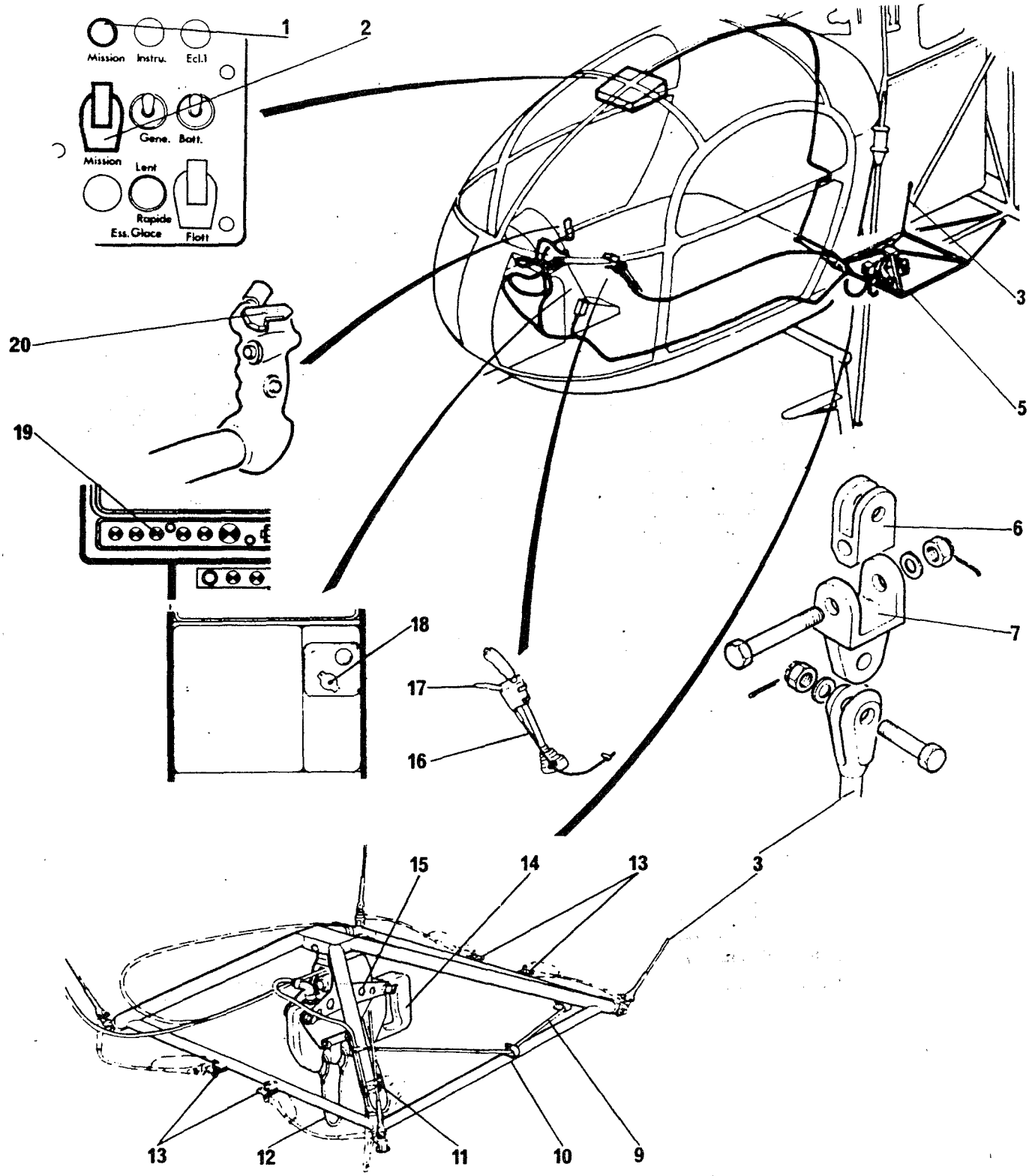


Figure 2

Transport of external loads-Details
(CARGO-SWING)

13.20.3. - RELEASE UNIT

A - CHARACTERISTICS

- Weight : 6 kg
- Working load : 2500 kg
- Maximum load : 3750 kg
- Supply voltage : 18 to 30 Volts
- Maximum current : 7 amps.

B - THEORY OF OPERATION (Figure 3)

Two cams (13) (15) located in the housing and controlled by a solenoid (5) hold the strop (14) connected to the load.
An electrical control in the cockpit energizes the solenoid which actuates the hooking cam (13). At the end of its travel, this cam frees the strop (the other cam being used only to change the strop).
Should the electrical system fail, a flexible cable linked to the control mechanism of the cam (13) substitutes for the solenoid.
A trigger (9) in the hand grip re-sets the mechanism after the strop has been positioned.

C - DESCRIPTION OF THE MECHANISM (Figure 3)

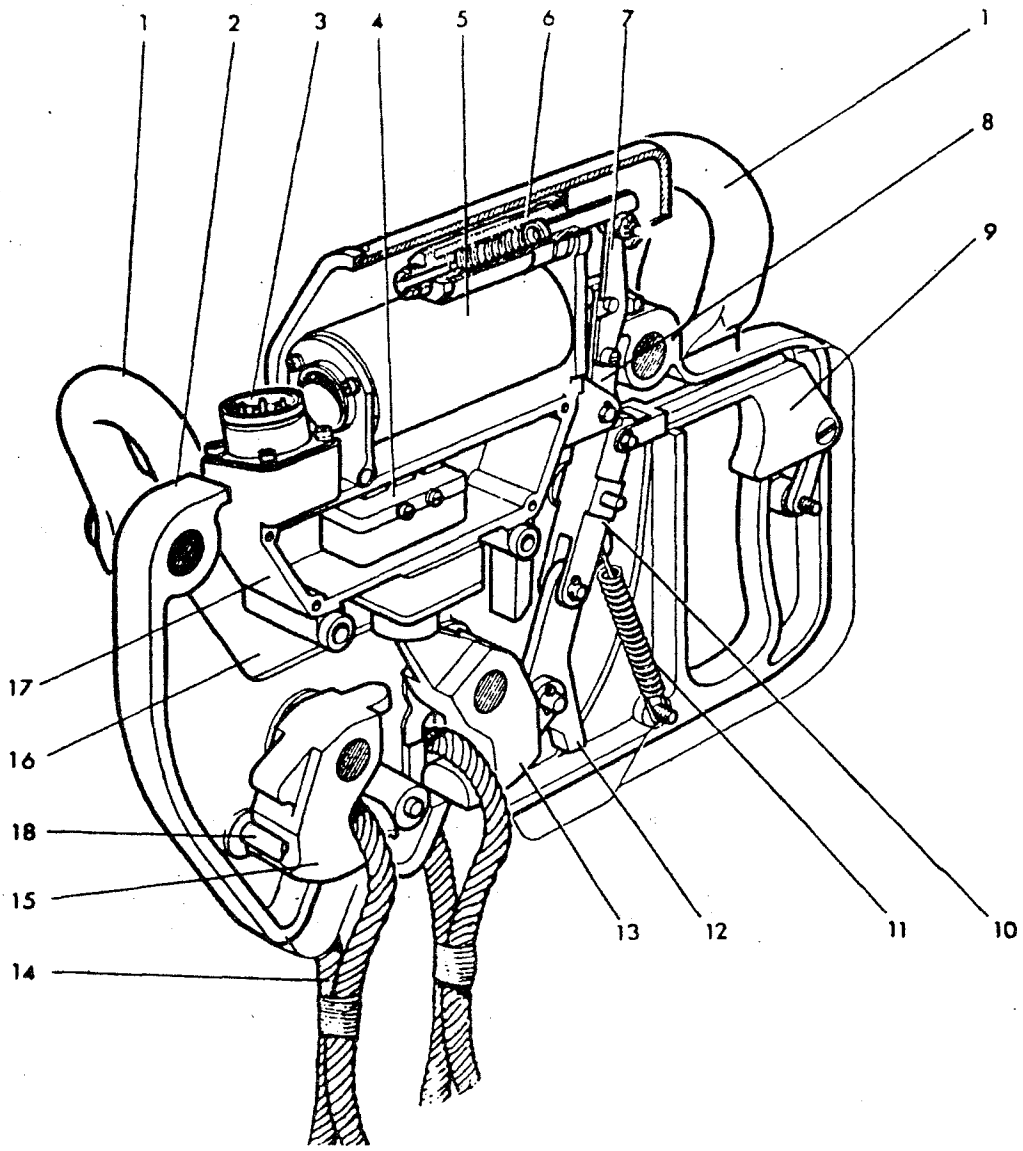
The body of the release unit contains the electrical triggering mechanism in its upper part, and the mechanical strop releasing mechanism in its lower part. It consists of two light alloy half-housings (2) fitted with two plates (16) that accommodate the triggering mechanism (17) in their upper part. The triggering mechanism is connected to the helicopter electrical system via a socket (3). This assembly includes a solenoid (5), the power connection, and the microswitch (4) which controls the «Release» warning light.

The lower part contains the release mechanism, consisting of :

- Two cams, one of which (15) is used solely to hold the strop (14), the other being retractable (13).
- Levers (8, 10 and 12) that control the cam (13)
- The control levers return spring (11)
- The re-setting trigger (9).

1. - Suspension shackle	9. - Re-setting trigger
2. - Half-housings	10. - Control lever
3. - Electrical power socket	11. - Return spring (control levers)
4. - Microswitch	12. - Control lever
5. - Solenoid	13. - Retractable cam
6. - Triggering mechanism	14. - Strop
7. - Control lever	15. - Fixed cam
8. - Control lever	16. - Plates
	17. - Triggering mechanism

13.20.3. - RELEASE UNIT (Continued)



To change the strop (14) : Remove the bolt (18) and swing the fixed cam (15) aside

Figure 3
Release unit

13.40.3.- FOLDING OF MAIN ROTOR BLADES OPERATING CONDITIONS

A- AIRCRAFT CONFIGURATION PRIOR TO FOLDING PROCEDURE

- Collective pitch lever : set to low pitch (friction lock tightened)
- Cyclic pitch stick : aft and 10° (approx.) to the right (friction lock tightened)
- Red blade toward the rear, along the aircraft centerline.
- Rotor brake : applied

B- FOLDING CONDITIONS

- The Red blade enclosed in its collar (7), is held on the rear stay (8) hooked on the tail boom attaching spools (11).
- With the blade sleeve restrainer ring (4) in place, the angle of Yellow and Blue blades is locked by the blade angle lock (12).
- The Yellow and Blue blades, enclosed in their collar (5), are held by the support arms (6), the blade cuff front pin (2) of these blades is removed using torque wrench (1) and extractor tool (3).
- With cuff pins removed, the Yellow and Blue blades are folded back to the rear using their support arm. Once fully folded the RH and LH support arms are hooked to the attaching ball-joints (9) (10) of the tail boom mounted stay.

NOTE : Both blade cuff pins removed are stowed in their support on either side of the M.G.B.

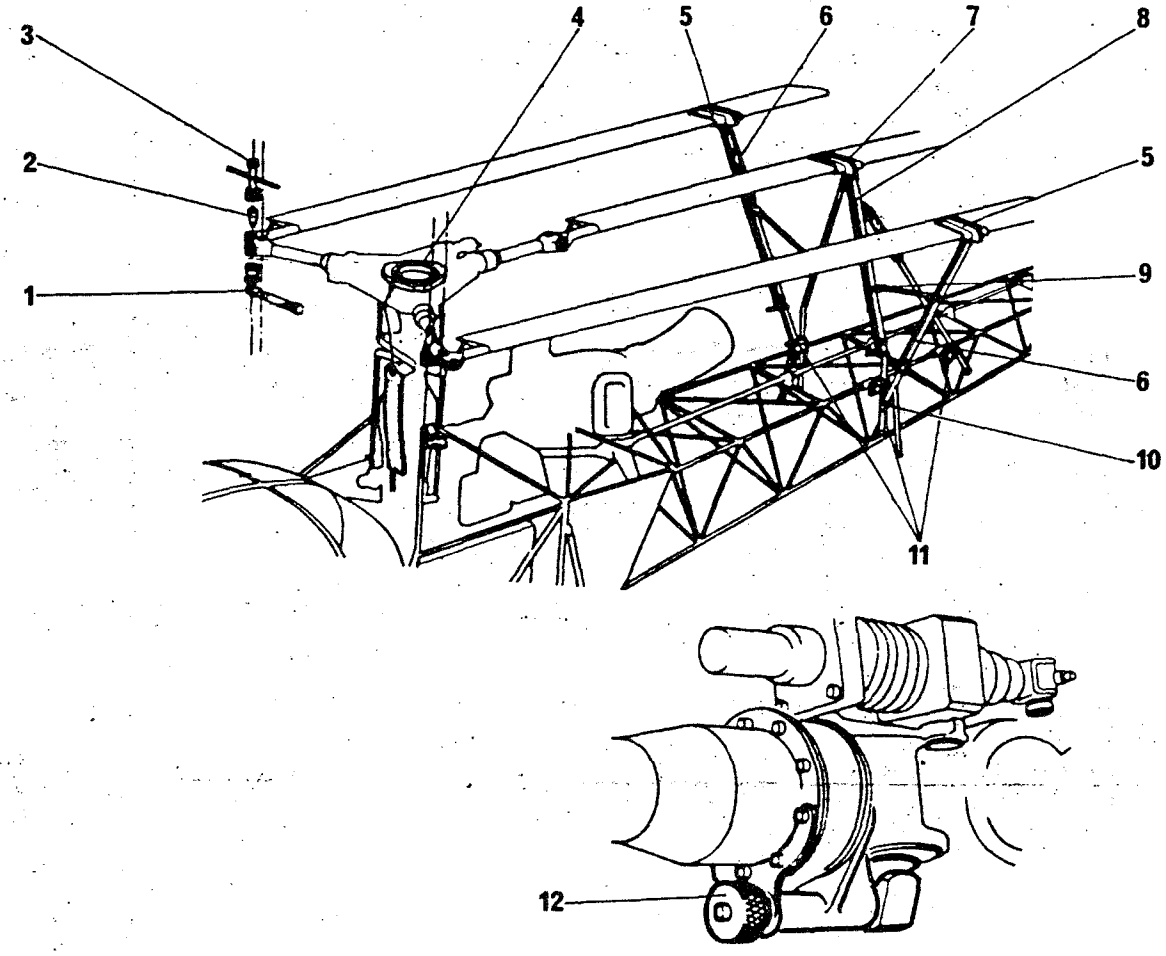


Figure 3
Folding of main rotor blades
Operating conditions

13.40.2.- BLADE FOLDING AND UNFOLDING TOOL KIT COMPONENTS

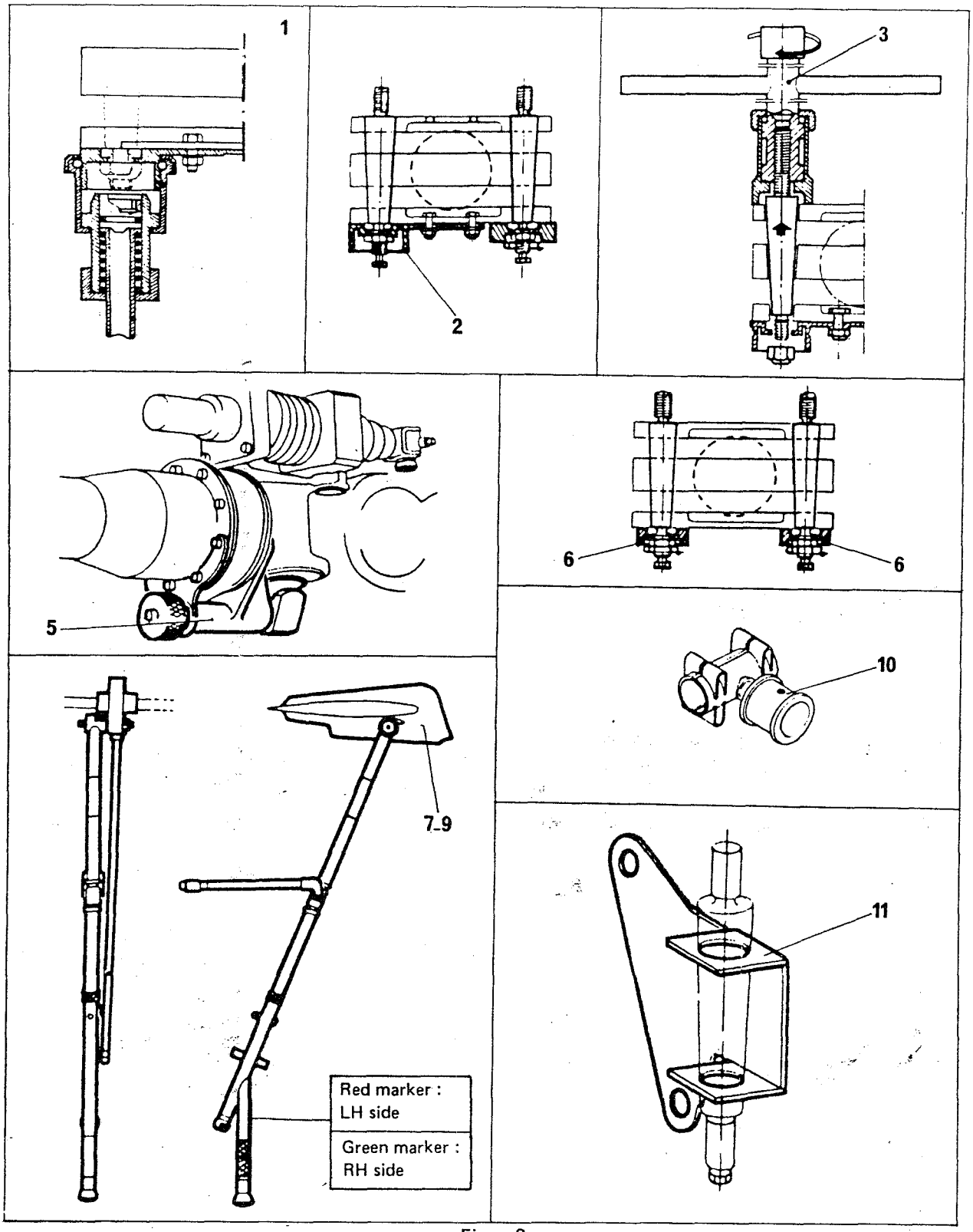


Figure 2
Quick folding and unfolding of main rotor blades
Tool details

13.20.3. - RELEASE UNIT (Continued)

D - OPERATION OF THE RELEASE UNIT (Figure 4)

1 - HOOKING UP THE LOAD

If the release unit is in the locked position, depress button (2) to bring it in the release position.
Place the free end of the strop in the cam housing (9) and squeeze the trigger (6) to lock the mechanism. The trigger should stay in the «squeezed» position. Locking is indicated on the control pedestal : the release warning light should go out.

2 - ELECTRICALLY CONTROLLED RELEASE

The pilot presses the rocker switch on the cyclic stick and energizes the solenoid (13). This frees the ratchet from (4) the lever stop (5). The action of the spring (7) is complemented by that of the ratchet (4) which initiates rotation of levers (8) and (5). The mobile cam (9) retracts, freeing the strop (10) and hence the load which is attached to it. Simultaneously the cam (9) frees the plunger (11) which no longer depresses the microswitch (12). The microswitch circuit is closed and the «release» warning light comes on.

3 - MECHANICALLY CONTROLLED RELEASE

The pilot, by actuating the mechanical release mechanism on the collective pitch lever, operates lever (3) via a flexible cable. This lever mechanically performs the function of the solenoid.

NOTE : USE OF THE RELEASE UNIT - PRECAUTIONS TO BE TAKEN

1) If a load net is used :
   - join the loops or rings of the net with a shackle
   - pass the strop through the shackle

2) If the load has a tendency to turn :
   - insert a ball type swivel hook
   - check the strop for condition after each flight

3) To prevent accidents at the time of hooking up the load, personnel beneath the helicopter should be warned that in case of an engine failure they should move away to the left, as that the pilot knows that he must move off to the right.

4) Should the load need to be positioned manually when close to the ground but before release, it is recommended, especially in damp conditions, to earth the load by contact with an earthed conductor in order to discharge any static electricity.

5) In extremely cold conditions, confirm that the controls and the release unit mechanism are not frozen.

13.20.3. - RELEASE UNIT (Continued)

D - OPERATION OF RELEASE UNIT (Continued)

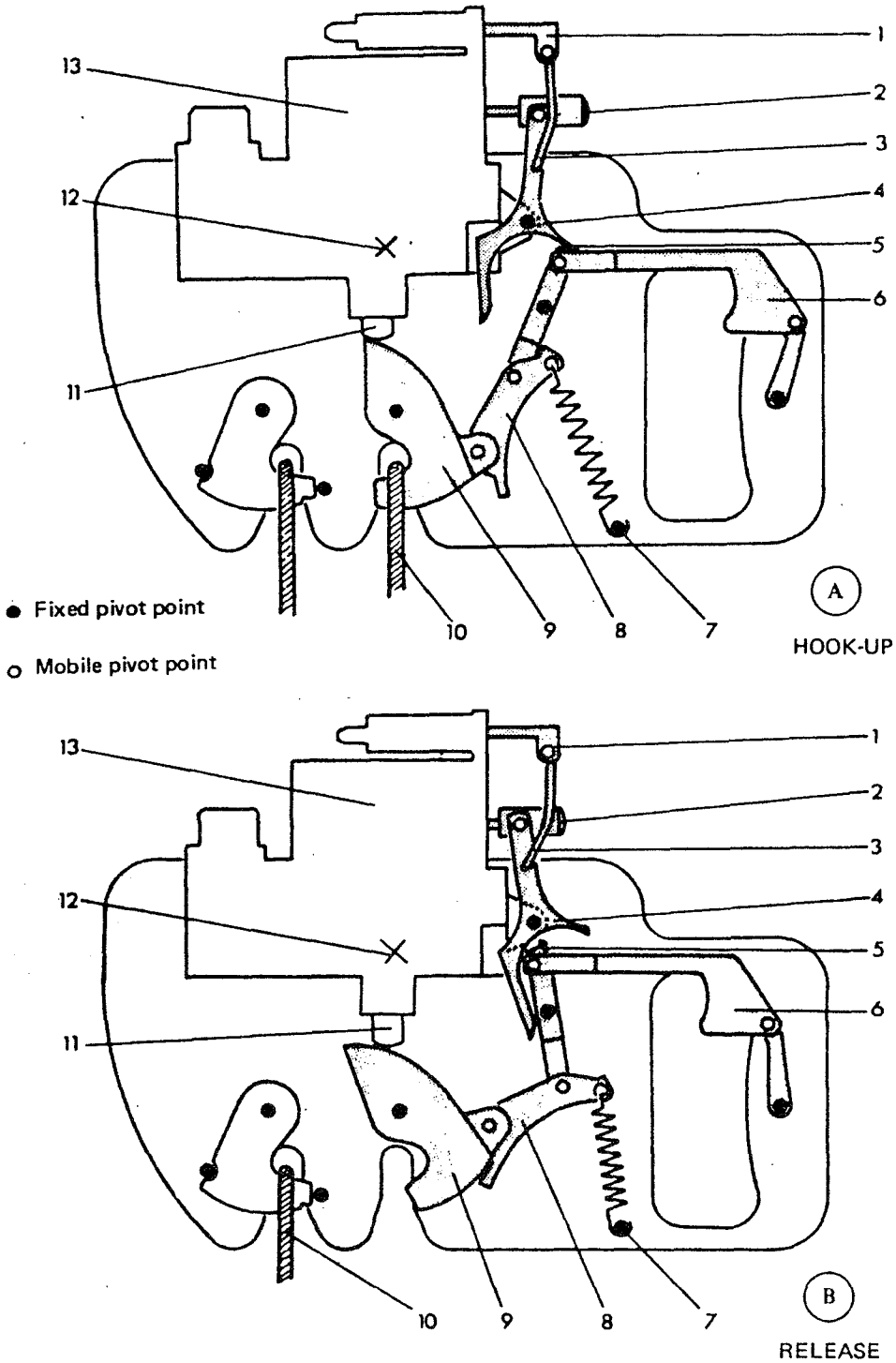


Figure 4
Operation of release unit

13.20.4. - ELECTRICAL CONTROL OF THE RELEASE UNIT (Figure 5)

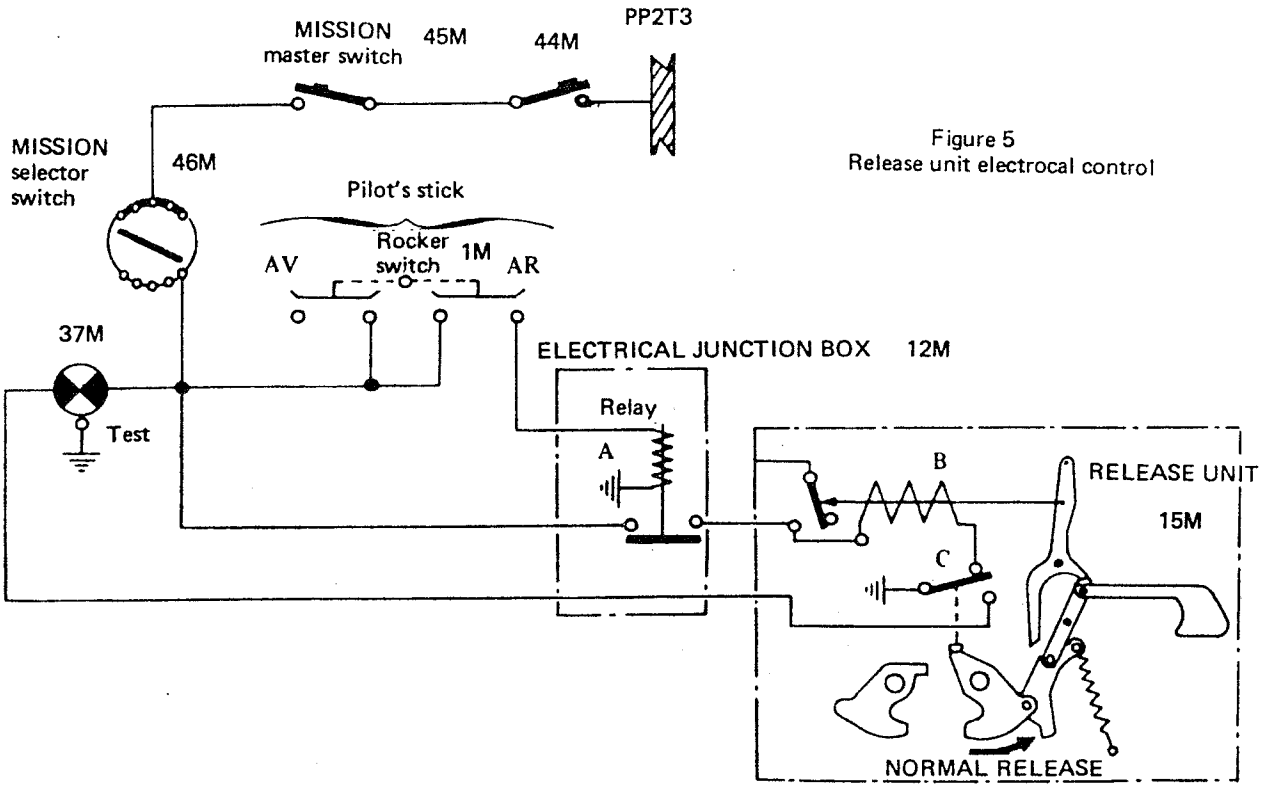


Figure 5
Release unit electrocal control

LOAD RELEASE

When the MISSION master switch is set to MARCHE (ON), and the MISSION selector switch is set to ELINGUE (SLING), actuating the rocker switch on the pilot's stick closes the control relay circuit A. The energized relay A moves to the «work» position thus completing the circuit of the solenoid B which closes across the micro-switch C. The plunger of the energized solenoid drives the opening mechanism of the release cam. The load is RELEASED. At the opening end-of-travel, the release cam reverses the micro-switch contacts C

- The solenoid B is no longer energized
- The release warning light comes on.

13.30.- AMBULANCE INSTALLATION

13.30.1.- GENERAL

The ambulance installation permits, once the copilot's seat is removed and the rear single seat is folded back the transport of :

- two persons stretched out in litters,
- one attendant (on the R.H. rear seat).

The installation comprises two detachable, superposed litters (1) (2). The bottom litter is fixed to the cabin floor by a clamp fitting (4). The top litter is mounted on foldable arms (3) made integral with the bottom litter.

NOTE : With the two-place rear seat folded back, the attendant may use the removed copilot's seat which can be secured behind the pilot's seat.

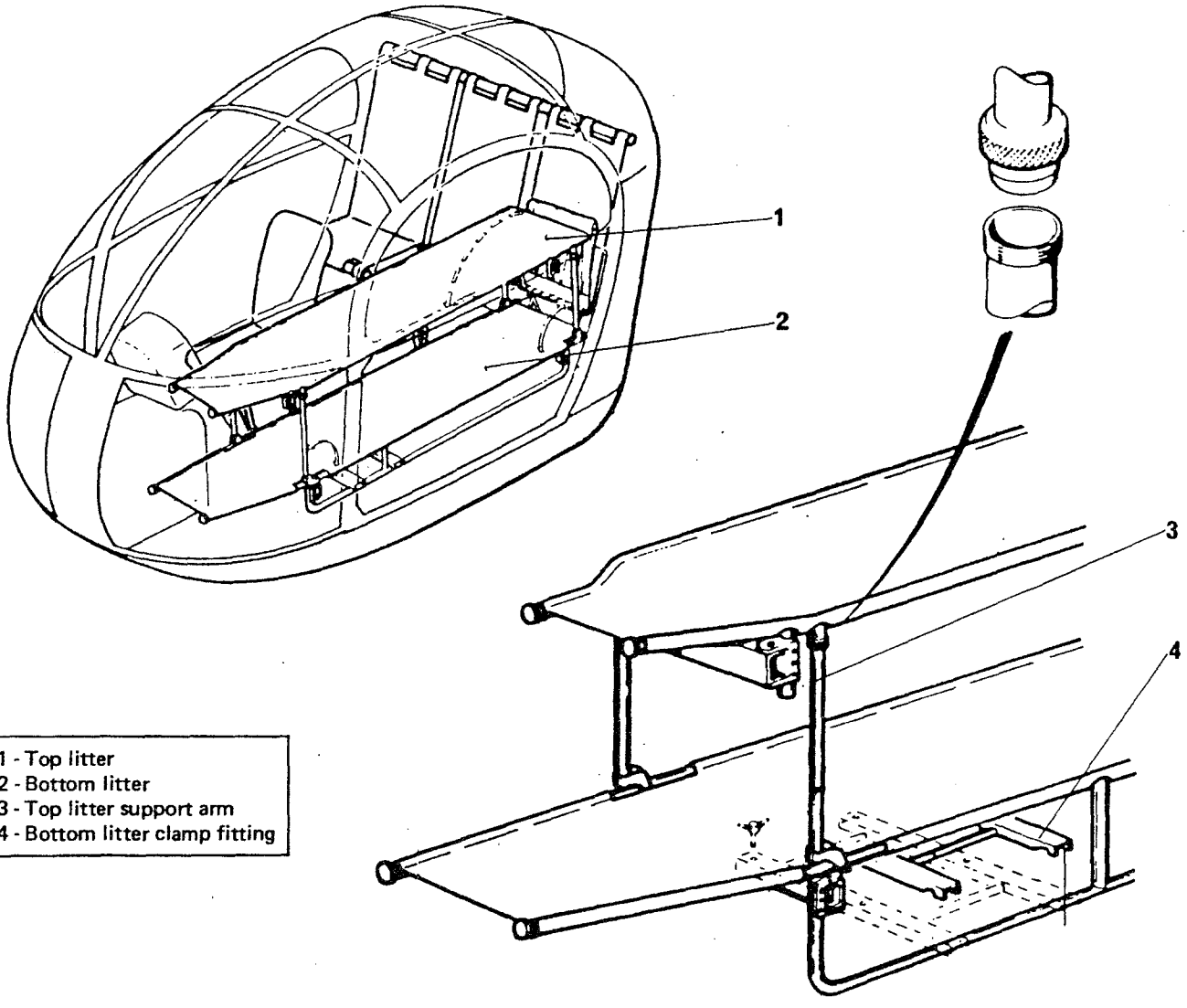


Figure 1
Ambulance installation

13.40.- QUICK FOLDING AND UNFOLDING OF MAIN ROTOR BLADES

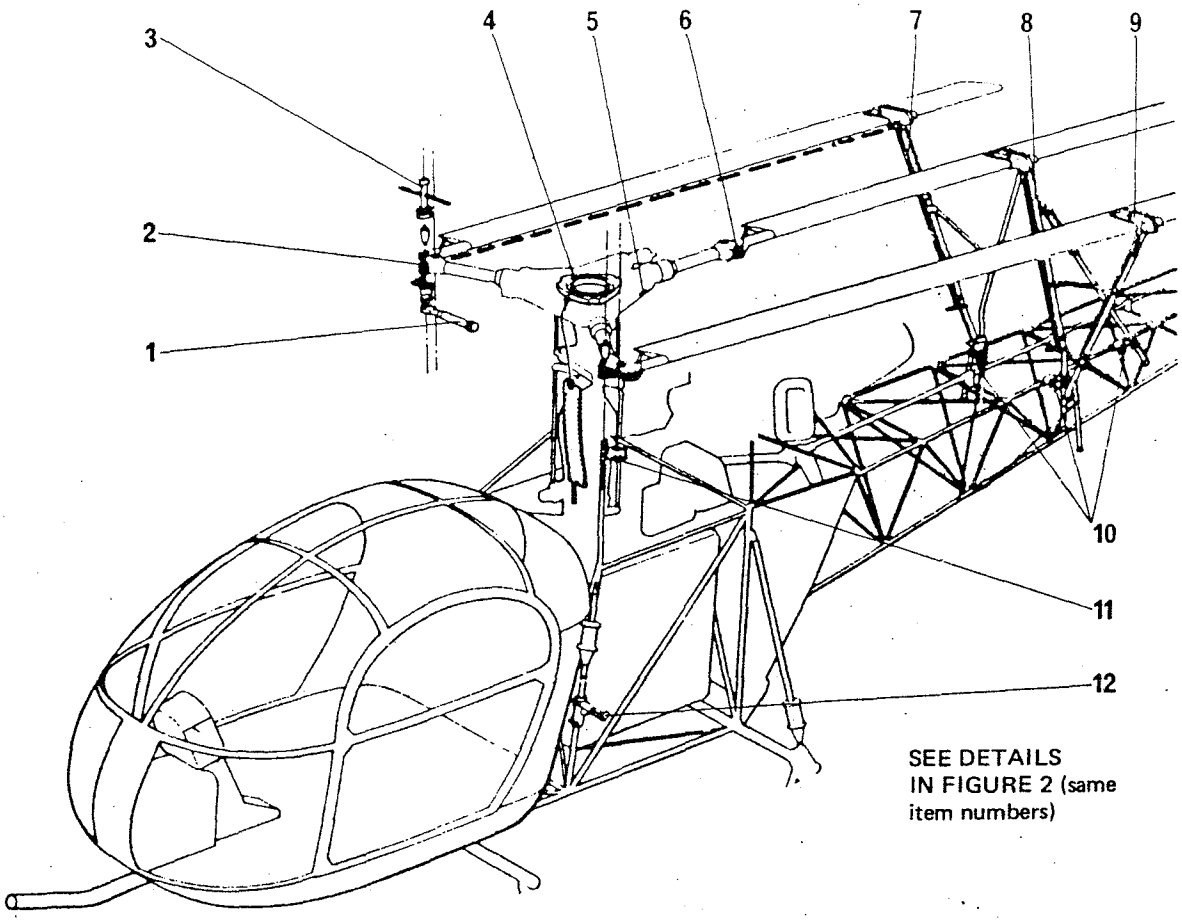
13.140.1.- GENERAL

The quick folding and unfolding of the main rotor blades is achieved with a special tool kit comprising :

- Fixed tools permanently mounted on the helicopter
- Movable tools, removed for flight duty, which are stowed in a bag attached by two straps on the RH external side of the center structure.

This system permits folding the «yellow» and «green» blades aftward, with the «red» blade directed to the back along the aircraft centerline.

13.40.2.- BLADE FOLDING AND UNFOLDING TOOL KIT COMPONENTS



MOVABLE TOOLS	FIXED TOOLS
1 - Preset torque wrench 3 - Extractor tool for blade hinge pins 7 - RH support arm equipped with blade collar 8 - Rear blade stay equipped with blade collar 9 - LH support arm equipped with blade collar	2 - Wrench-guide cup (under sleeve of «Blue» and «Yellow» blades) 4 - Restrainer ring for blade sleeves 5 - Blade angle lock (Yellow» and «Blue» blades). The sleeve of the «Red» blade is fitted with an equivalent weight 6 - Balance washers on «Red» blade (weight equivalent to the wrench-guide cups of «Blue» and «Yellow» blades) 10 - Rear blade stay hooking spools 11 - Blade rigging pin support 16 - Foot rest