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FLIGHT MANUAL FOUGA

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CM 170

FLIGHT MANUAL FOUGA

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TABLE OF CONTENTS

TABLE OF FIGURES

CHAPTER 1

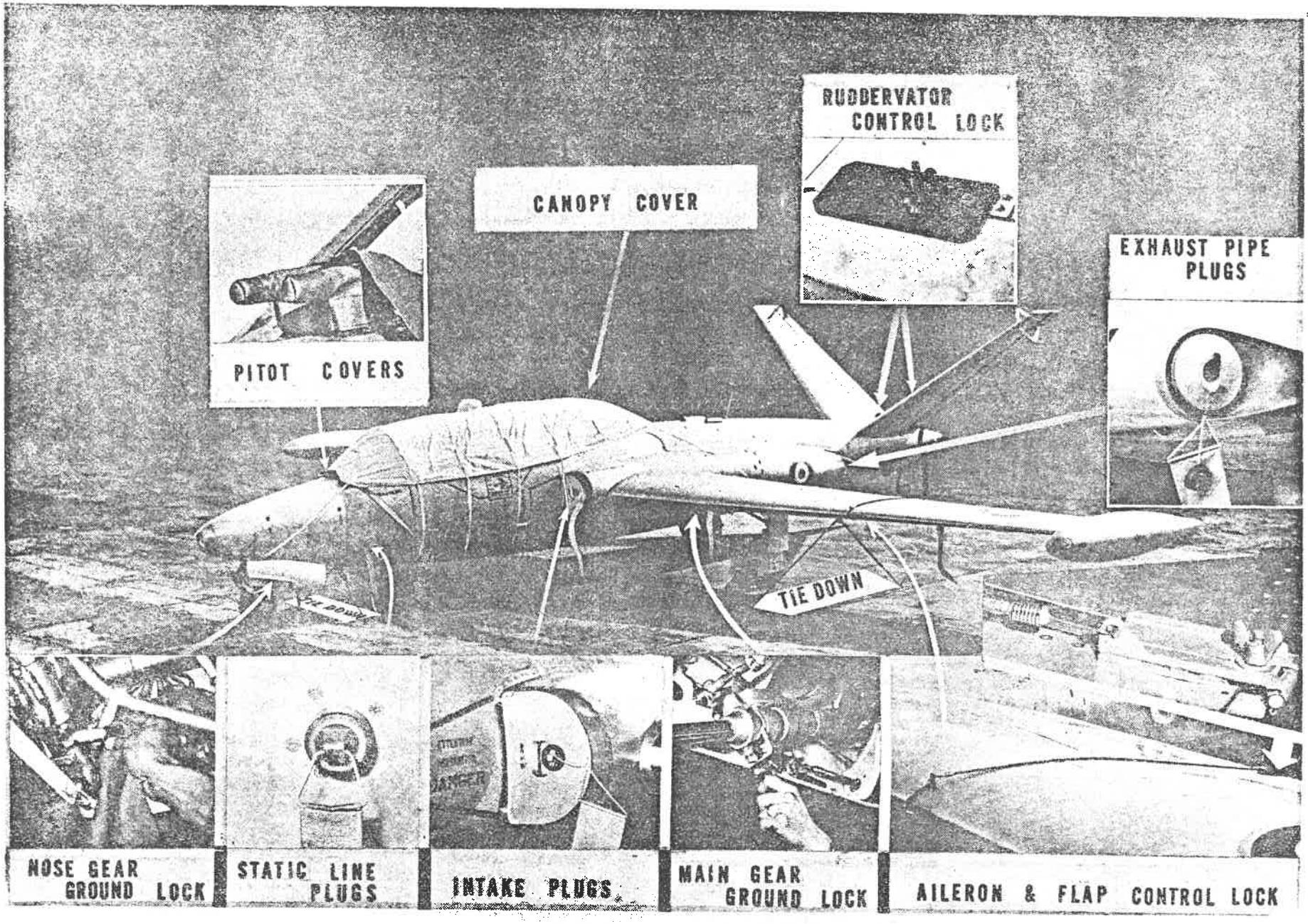
SECTION 1 DESCRIPTION ILLUSTRATIONS

CHAPTER II

SECTION II UTILIZATION

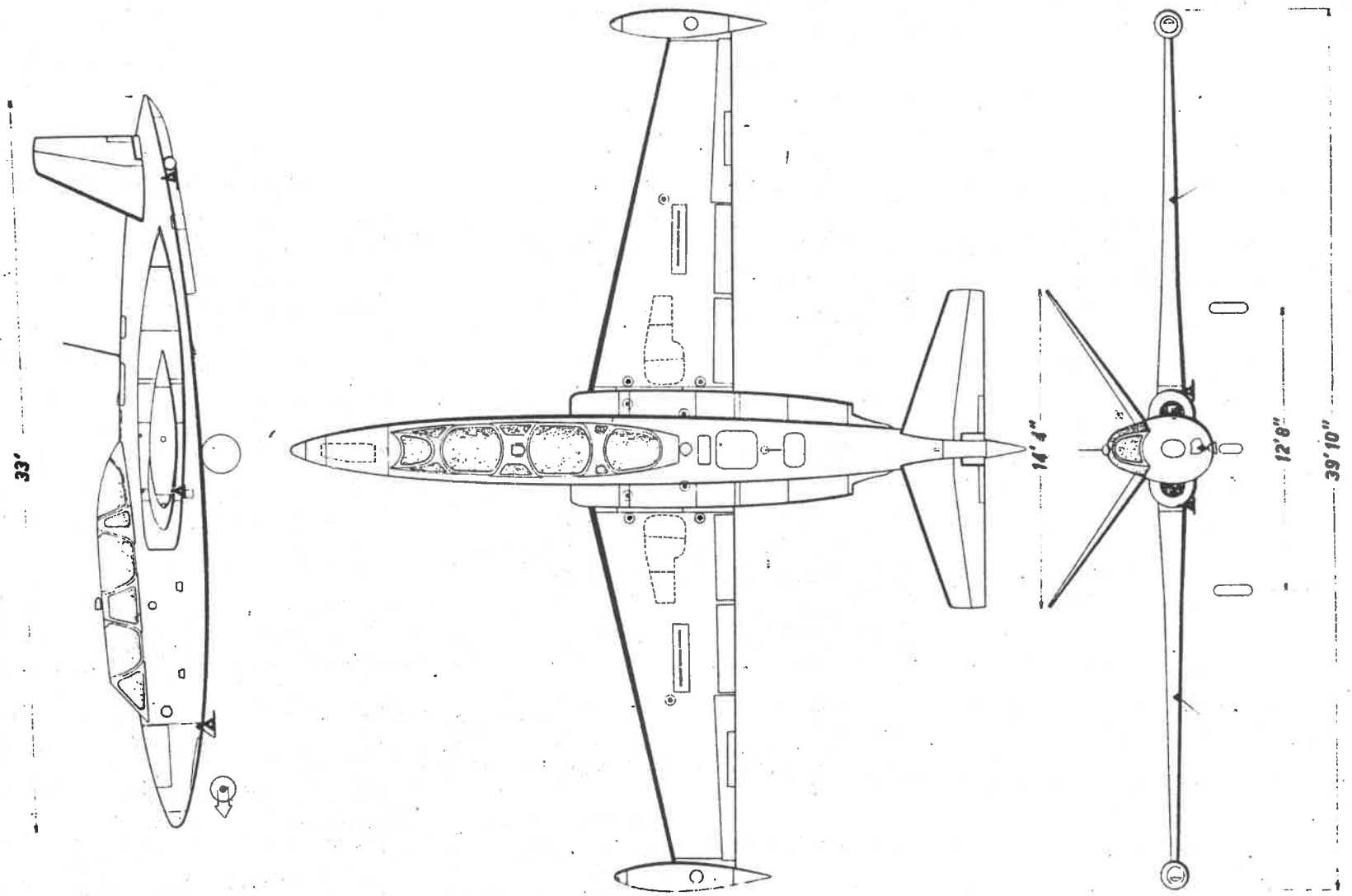
2.1.	Exterior inspection	20 Exterior inspection
2.2.	Cockpit check	
2.3.	Checks before starting engines	
2.4.	Starting engines	
2.5.	Checks before taxying	
2.6.	Leaving the parking area	
2.7.	Taxi	
2.8.	Take-off	21 Take-off distance 22 Engine failure at take-off
2.9.	Climb	23 Climb with full throttle, full tip tanks
2.10.	Normal flying cruise	24 Range [illegible] 25 [illegible] 26 Range at 20.000 RPM 27 Range at [illegible] RPM 28 [illegible] 29 Distance covered per [illegible] liter 30 Hourly consumption vs. Speed 31 Total hourly consumption
2.11.	Descent, circuit and landing	32 Descent data (a, b, c)
2.12.	Checks after landing	
2.13.	Engines shut down parking checks	
2.14.	Before leaving the Aircraft	
2.15.	Landing away from base	

AL I



OUTDOOR STORAGE

Fig. 1



TOWING
JACKING
MOORING
HOISTING

3 GENERAL VIEWS

Fig:2

CM.170

CHAPTER I

SECTION 1 - DESCRIPTION

1.1. AIRCRAFT

1.1.1. GENERAL DESCRIPTION (FIG 1)

The CM.170 is a monoplane of metal construction.
The undercarriage is of the tricycle type.
The tail unit is of the 'V' or butterfly type.
The aircraft is powered by two turbojets (Fig 5).

1.1.2. DIMENSIONS (FIG 2)

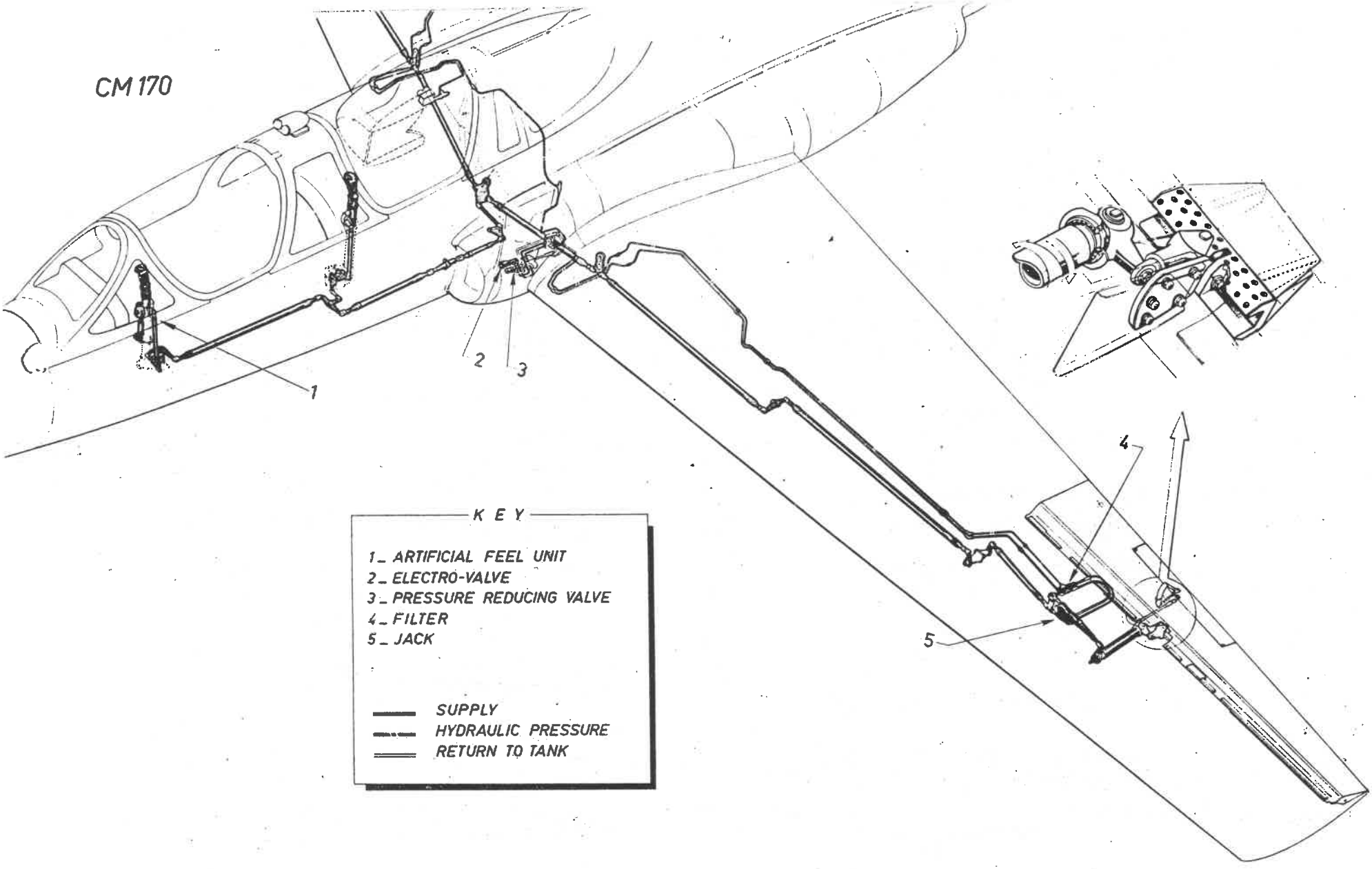
1.1.3. WEIGHT

Empty weight, equipped	2287 kg
Total weight without armament and with full tip tanks . .	3032 kg

1.1.4. CONTROL SURFACES

- Ailerons
  The ailerons are mechanically connected to the stick. A hydraulic boost system is provided for.
- Elevator - Rudder
  Since the tail unit is of the 'V' type, the same control surfaces are used for elevator and rudder functions. These controls are made up of conventional type flaps located on the trailing edge of the tail unit.
  When using the butterfly tail as an elevator, the two flaps are deflected in the same direction and at the same angle.
  When operating as a rudder, the two flaps are deflected by the same angle, but in opposite directions.

CM 170



_ AILERON CONTROL (WITH BOOST) _

Fig. 3

1.1.5. UNDERCARRIAGE - WHEELS - BRAKES

The tricycle undercarriage is of the rectractable type. The main gear retracts in the wings towards the fuselage and the nose gear is retracted into the nose section of the fuselage, towards the rear.

Each strut is equipped with a single wheel, and only the two main wheels are fitted with brakes. For controlling the undercarriage retraction and the brakes, see paragraph 1.6.

1.2. FLIGHT CONTROLS

1.2.1. AILERONS (FIG 3)

In each wing a hydraulic servo control booster jack is connected to the last rod before the torque tube operating the aileron.

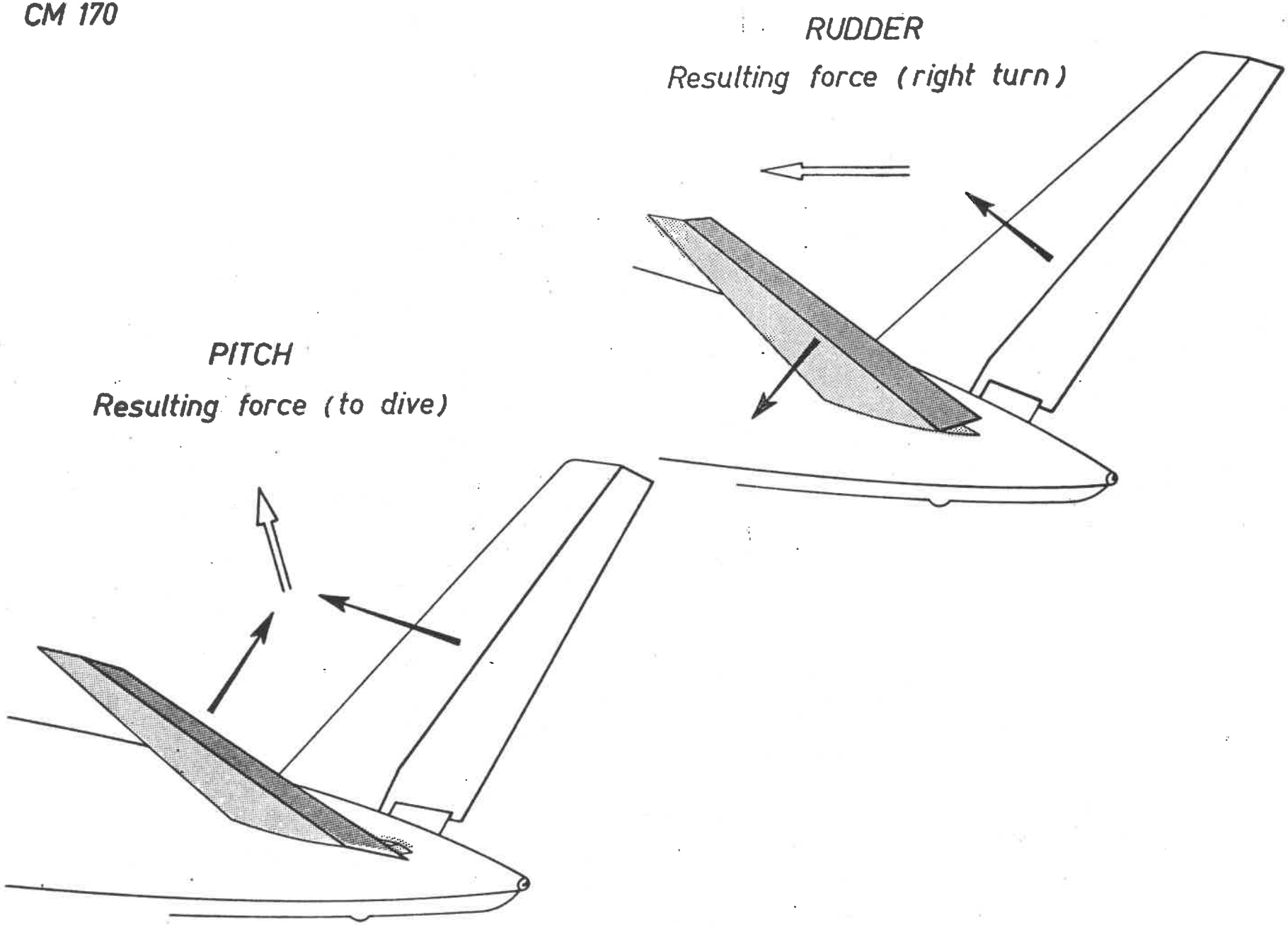
A switch located on the front cockpit instrument panel cuts off the hydraulic supply, to simulate the case of a booster failure.

When the booster is in operation (switch 'ON') the pilot's action on the stick displaces a rotary selector incorporated in the jack. This selector sends the hydraulic pressure into the jack, thereby deflecting the aileron in accordance with the corresponding stick action.

The aerodynamic reaction of the aileron is then absorbed by the booster jack and is not felt by the pilot. To give the pilot a certain feeling of resistance in the stick, a spring assembly is installed (on the stick in the front cockpit) which offers a feeling of resistance which is relative to the aileron deflection.

This artificial feel device also returns the ailerons to the neutral position when the pilot releases the stick. The 'zero position' of the feel device is adjusted by means of the knurled button located at the lower part of the device.

When flying with booster inoperative (switched off or failure of the hydraulic system or electric circuits), the rotary selector control level is locked to the body of the booster jack.



TAIL UNIT OPERATION

Fig 4

The jack then acts as a simple rod transmitting the aerodynamic aileron reaction to the pilot. A disconnecting device for the artificial feel system is provided for this eventuality. It is controlled by a finger located at the top part of the artificial feel device.

For operation of the hydraulic booster system : see § 1.6.6.

1.2.2. DIRECTION (FIG 4)

The control may be actuated from either cockpit by moving the rudder pedals. This control is made up of a system of rigid rods actuating by push and pull the differential assembly for pitch and direction of the butterfly tail.

In each cockpit, the two rudder pedals may be moved forward or backward, in one piece, so as to adjust their distance from the seat to comply with the pilots size.

This adjustment of the pedals is controlled by a crank located in the front cockpit on the lower part of the instrument panel, and in the rear cockpit, on the right hand console.

1.2.3. ELEVATOR (FIG 4)

The elevation control may be operated from either cockpit by moving the stick forward or backward.

A linkage system made of rigid push-pull rods, connects the base of the stick to the differential assembly for elevation and direction.

For the elevation, the stress compensation is provided for by an electrically controlled tab on each tail flap. These two tabs move simultaneously and at the same angle.

In the cockpits, the tab control is a switch, set in the stick.

An indicator is provided for in each cockpit, to inform the pilot as to the tab position.

1.2.4. DIFFERENTIAL ASSEMBLY FOR PITCH AND DIRECTION

The purpose of this assembly is to transform the control motions made by the pilot on the elevator and rudder controls, into simultaneous or differential movements of the flaps of the butterfly type tail unit.

1.2.5. LANDING FLAPS

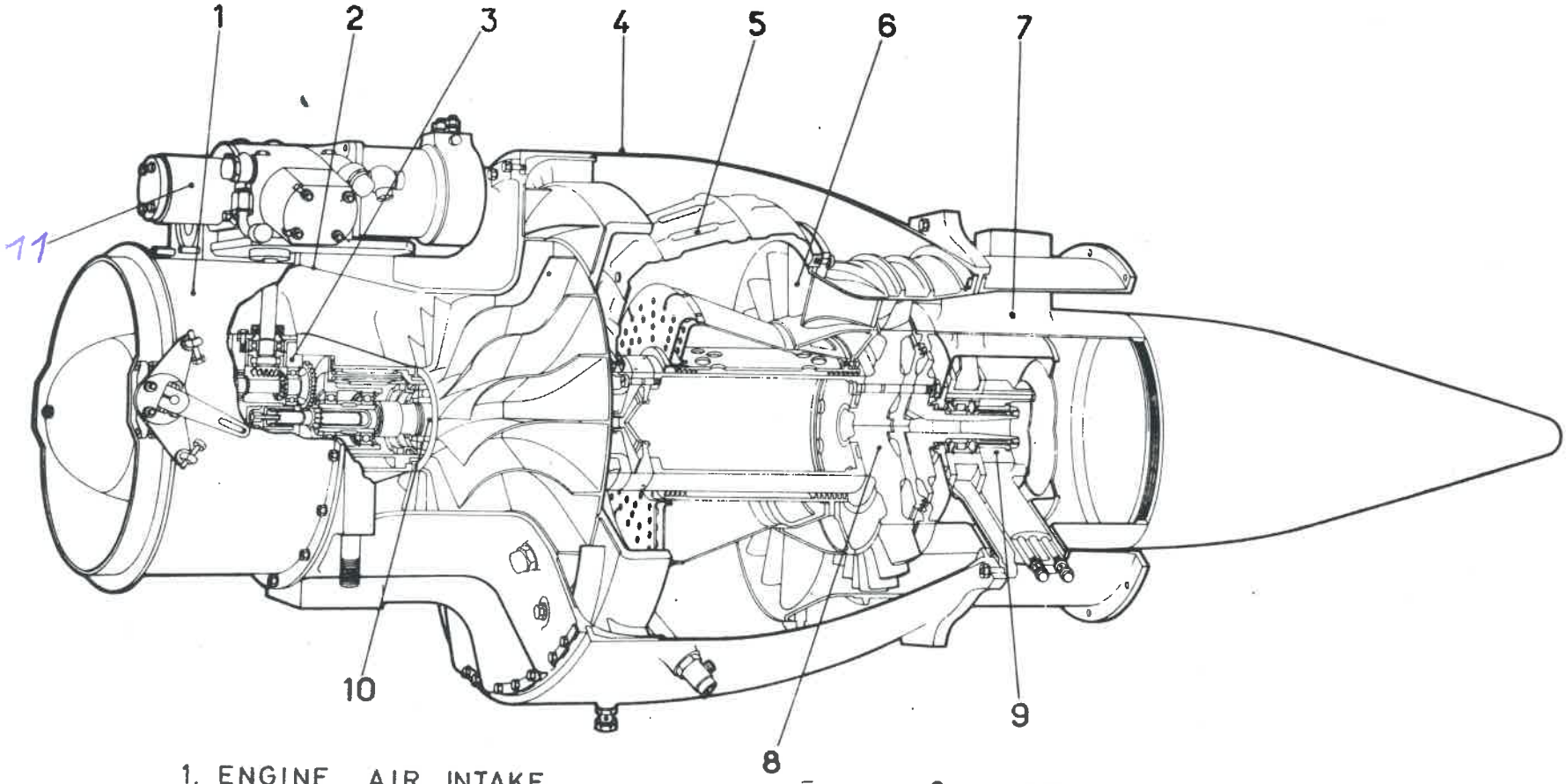
Flaps are located on the trailing edge of each wing, near the root.
Each wing carries two flap sections.
The control is electro-hydraulic. The switch located in each cockpit on the left console controls an electro valve.
Control priority is given to the rear cockpit.
The indicator in each cockpit indicates the deflection of the flaps at all times.
The maximum deflection of the flaps is 40°.

1.2.6. AIRBRAKES (FIG 12)

The airbrakes consist of plates which come out of the underwing and overwing surfaces, turning about axes perpendicular to the wing span. They are controlled electrically and operated hydraulically. The switch located on the throttle in each cockpit controls an electro valve.
Control priority is given to the rear cockpit (instructor).
There is no indicator for the airbrakes position.

1.2.7. EMERGENCY AIRBRAKES CONTROL

This control is located in the front cockpit and is used for actuating the airbrakes in the case of a failure of the hydraulic or electric circuits.



1. ENGINE AIR INTAKE
2 COMPRESSOR CASING
3 ACCESSORY GEARBOX
4 TURBINE CASING
5 COMBUSTION CHAMBER
6 NOZZLE
7 EXHAUST CONE
8 TURBINE ROTOR
9 REAR BEARING SUPPORT
10 FRONT BEARING SUPPORT
11 RELAY BOX

FIG 5

It is located at the front part of the left console.
It is a 3-position selector "OUT" - "NORMAL" - "IN". If the selector is set to "OUT" or "IN", the action of the hand pump causes the airbrakes to be operated in the desired direction.

1.3. POWER UNITS (FIG 5)

1.3.1. GENERAL

The CM.170 is powered by two TURBOMECA "MARBORE II" turbojets. They run on JP-4 fuel.
The main characteristics of the engine are as follows :

- Single stage centrifugal compressor
- Single stage turbine
- Centrifugal injection
- Annular combustion chamber
- Maximum RPM . . . . . 22,600 RPM
- Maximum static thrust at sea level . . . . . 400 kg
- Static thrust equivalent to 40.000 ft . . . . . 80 kg
- Electric starter.

1.3.2. PILOT CONTROLS

- Power control : This control consists of two throttle handles located on the left side of each cockpit. To Step up the engine, push the handle forward. In the front cockpit, the lever beneath the throttles is used for blocking them in any desired position.
- Fuel Cut-off cock control : The levers placed below the throttle handles, against the left console of each cockpit, are used for controlling the low pressure fuel cocks (cut-off cocks). To open the cocks, push the levers forward.

- Starting control : The three position switch (Left - Off - Right) is used for powering the electric starter of either engine. The warning light informs the pilot that one of the starters has been engaged. There is no ignition if the starter CB is OUT.
- Injection and ignition control : Each cut-off cock control lever is fitted with a push button.
  This button is pushed to initiate the ignition and to control the initial injection (via the ignitor plugs) of the fuel ignited in the jet engine combustion chamber.

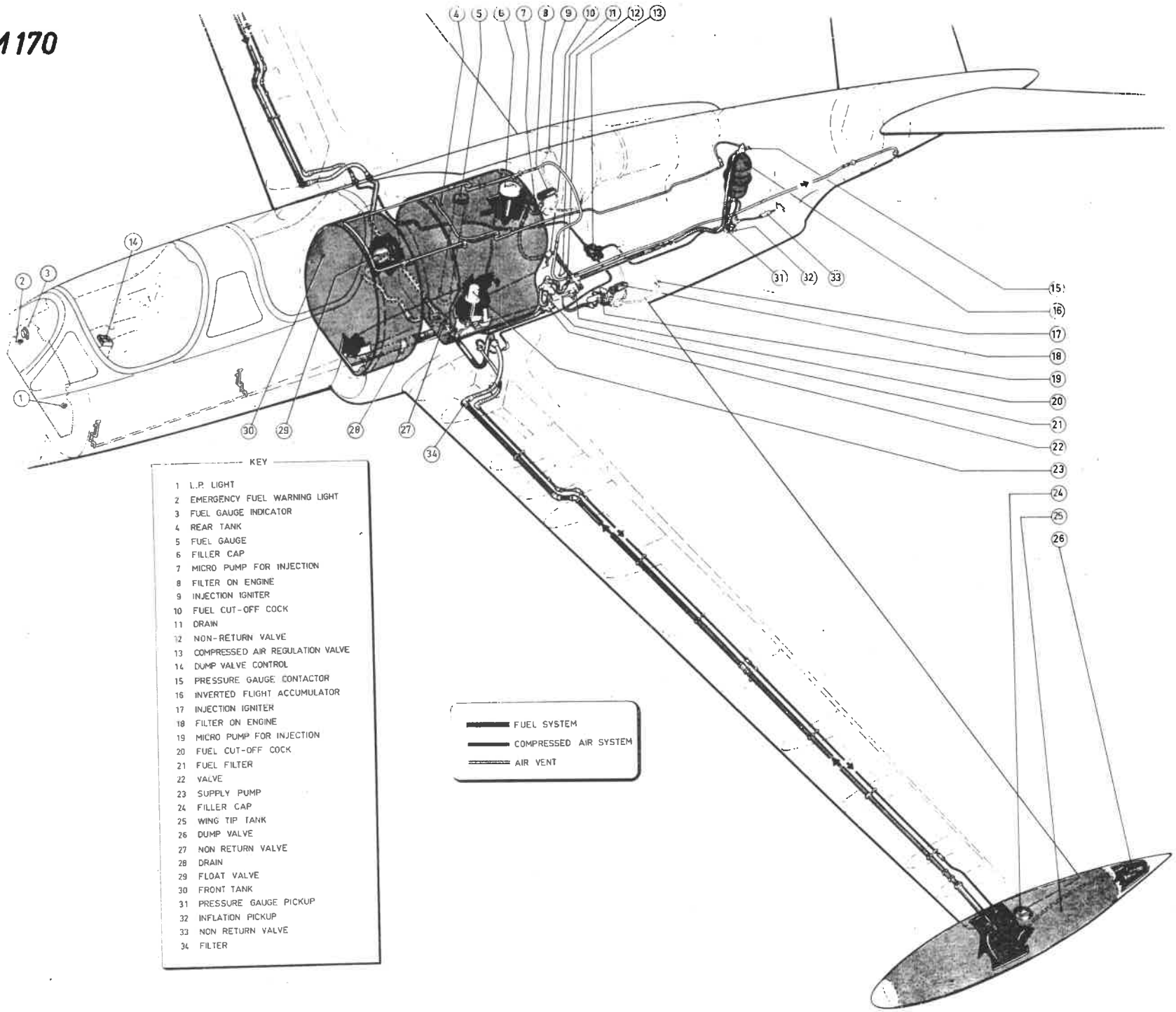
1.3.3. ENGINE AND FUEL INSTRUMENTS (FIG 19)

The front cockpit comprises :

- Dual tachometer. It has two pointers G and D, corresponding to the left and right engine; they make 1 and $\frac{1}{4}$ the revolution of the dial for 25.000 RPM.
- An exhaust gas temperature (E.G.T.) indicator
- An oil thermometer.
- An oil pressure gauge.
- A "fuel pressure warning light" which illuminates either when the pressure falls below 0,35 hpz or if the pump fails, or if the inverted flight accumulator is empty.
- A fuel gauge.
- A fuel low level warning light which lights up when only 150 liters are left in the tank.
- 2 fire warning lights.

In the rear cockpit

- A dual tachometer identical to the one in the front cockpit.
- An exhaust gas temperature (E.G.T.) indicator
- An oil thermometer
- Oil pressure signal lights, each light illuminates when the oil pressure of the corresponding engine drops below 0,7 hpz.
- 2 fire warning lights.



FUEL SYSTEM

Fig. 6

1.3.4. ENGINE FUEL CONTROL

The fuel control enables the pilot to control the engine speed by means of a single handle by supplying the fuel necessary for smooth operation of the engine and by maintaining the engine within the limits of material resistance. The control elements are the following :

Throttle valve : below 16.000 rpm, the throttle valve is the only element controlling engine fuel supply according to the position of the throttle handle.

Centrifugal governor : above 16.000 rpm, the centrifugal governor controls a regulating piston which maintains a balance between the action of a spring connected to the throttle and the centrifugal force generated by the rotation of counterweights.

Acceleration control : regulates the increase or decrease in fuel supply during engine acceleration or deceleration. The acceleration or deceleration time depends on total pressure.

NOTE : The action of the acceleration control is insufficient. Throttle must therefore be used with caution at all altitude and speeds.

Altitude control : governs the fuel supply in terms of total pressure

1.4. FUEL SYSTEM (Fig 6)

1.4.1. GENERAL

The fuel necessary for the operation of the engines is located in two fuselage tanks, two wing tip tanks and an inverted flight accumulator The compressed air required for the operation of the inverted flight accumulator and for the fuel transfer from the tip tanks, is tapped from the engines, downstream of the compressor.
The inverted flight accumulator makes it possible to carry out 30 seconds of inverted flight, with full throttle, at sea level.

1.4.2. TANKS

- There are two fuselage tanks, which are permanently interconnected.

  Type : Rubber, not self -sealing.

  Capacity : . . . . . Front : . . . 255 Liter

  Rear : . . . 475 Liter

  Total : . . . 730 Liter

  Non-consumable fuel . . . . . about . . . 10 Liter

  They are filled by gravity, through the filler cap located on the rear tank.

- There are two wing tip tanks, one on each wing.

  Type : Metal, non-jettisonable

  Capacity per tank : . . . . . 125 Liter

  Each tank is filled separately, by gravity, through the filler cap located on the upper part, under an inspection door.

  Transfer is carried out by compressed air. The wing tip tanks drain into the front fuselage tank.

  In flight, fuel release is done by an electrically controlled dump valve.

- The inverted flight accumulator is a separate tank, divided into two compartments.

1.4.3. OPERATION OF THE SYSTEM

During normal flight (see fig.6) :

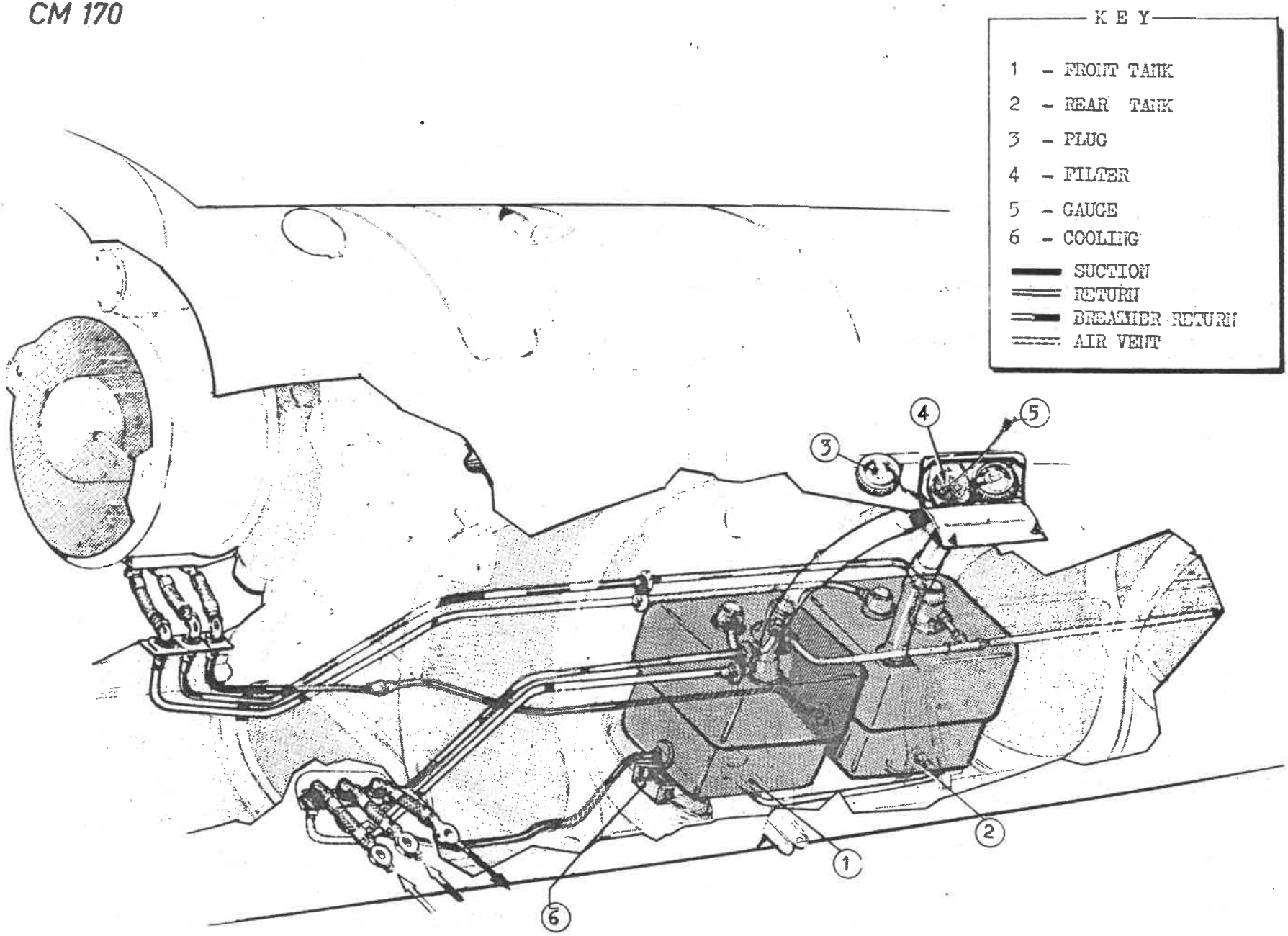
The immersed booster pump located in the rear tank sends fuel to the two engines via the filter and a non-return valve.

The air tapped from the engines is expanded by the air regulating valve to the pressure of 0,215 hpz and is sent to the wing tip tank.

If a minimum of 100 liters has been used in the fuselage tanks, the float valve opens and the fuel flows from the wing tip tanks pushed by the compressed air, penetrates into the fuselage tanks, where the level is maintained constant during the entire transfer.

Inverted flight :

The supply pump is no longer immersed during inverted flight.



LUBRICATION SYSTEM

Fig. 1

The inverted flight accumulator empties under the action of the air pressure. The non-return valve closes to prevent the accumulated fuel from returning to the tank. The engines are supplied until the accumulator is empty.

1.4.4. CONTROLS AND INSTRUMENTS

The fuel cut-off control, in each cockpit, under the throttle handles.

The dump valve control for the wing tip tanks.

The electric fuel gauge. The transmitter is housed in the rear fuselage tank. The indicator is on the front instrument panel. With the C.B. "Fuel indicator" out, the indicator will not drop to zero but may indicate any quantity (usually around 450 L).

The fuel low level warning light. This light illuminates when only 150 liters are remaining in the fuselage tanks.

Fuel pressure warning light. This light illuminates when the pressure drops below 0,35 hpz in the case of a pump failure or if the inverted flight accumulator is empty.

1.5. OIL SYSTEM (FIG 7)

1.5.1. GENERAL

Each engine is lubricated from an oil tank. The overflow and air vent are common to both tanks.

The oil circulation is provided by pumps located on the engines. These pumps suck oil from the tanks.

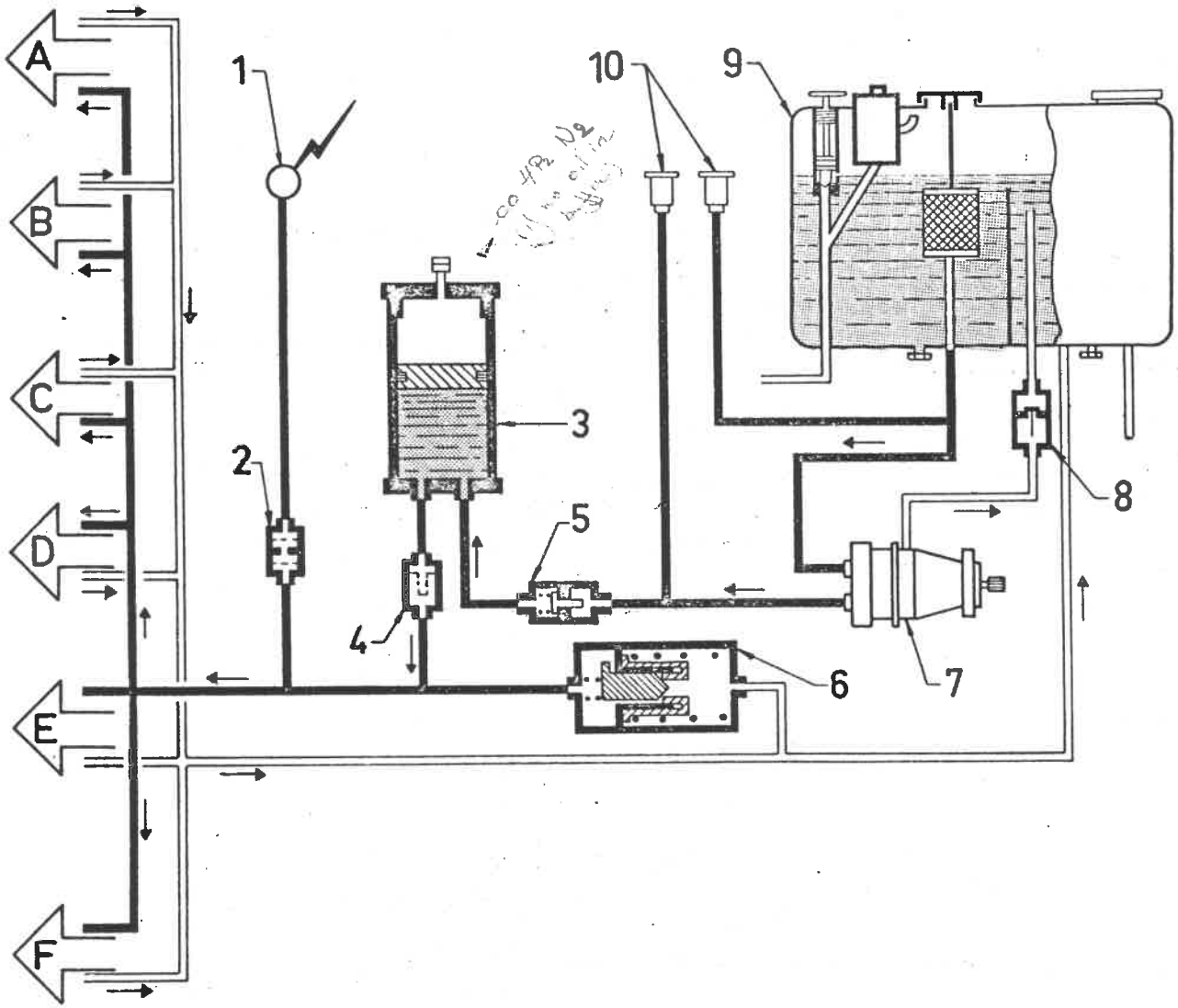
1.5.2. TANKS

Number 2

Type . . . . . metal tanks

Capacity per tank . . . . . 12,2 liters

The overflow limits each tank to about 6 liters. The remaining volume is used for the de-gassing of the emulsions.



KEY

1 PRESSURE GAUGE
2 RESTRICTOR
3 BUFFER ACCUMULATOR
4 FILTER
5 NON RETURN VALVE
6 RELIEF VALVE
7 SELF REGULATING PUMP
8 NON RETURN VALVE
9 TANK
10 AIRCRAFT CONNECTIONS
A TO UNDERCARRIAGE
B TO BRAKING
C TO LANDING FLAPS
D TO AIRBRAKES
E TO AILERON BOOST
F TO GUM ARMING

LINE UNDER PRESSURE
RETURN LINE TO TANK

NORMAL HYDRAULIC SUPPLY

Fig. 9

1.5.3. CONTROLS AND INSTRUMENTS

Oil temperature :

A dual thermometer in each cockpit (fig 19A)

Oil pressure :

A dual pressure gauge (fig 19A)

Two warning lights are installed in the rear cockpit (left and right engine). They illuminate when the oil pressure of the respective engine falls below 0,7 hpz.

Tank filling level :

Dipstick gauges located under the filling caps are used on the ground.

1.6. HYDRAULIC SYSTEM (FIG 8)

1.6.1. GENERAL DESCRIPTION

The hydraulic system of the CM.170 is used for operating the undercarriage, the brakes, the landing flaps, the air-brakes, the machine-gun re-arming and the aileron boost.

During normal utilization, (fig 8) the pressure (250 hpz) is provided by a pump installed on the necessary gear box driven by the left engine.

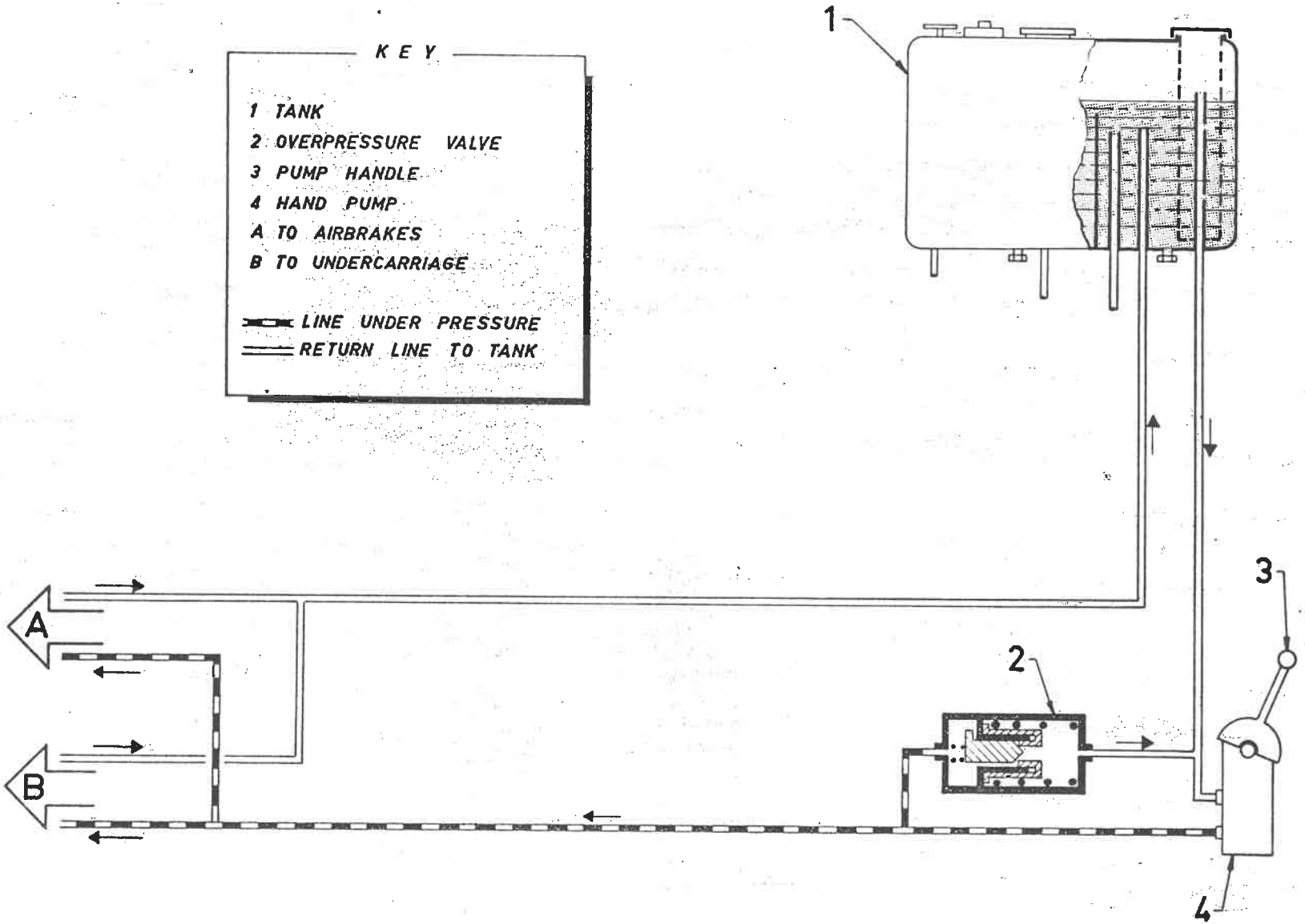
Two accumulators are installed downstream of the pump.

The first one, located near the pump, is used for storing liquid under pressure, for all the hydraulic ancillaries. The other one, located in the front end of the aircraft, is used only for the emergency brakes.

During emergency operation, (fig 9) the pressure is porvided by a hand pump actuated by the front pilot. The only functions he can carry out with this pump are :

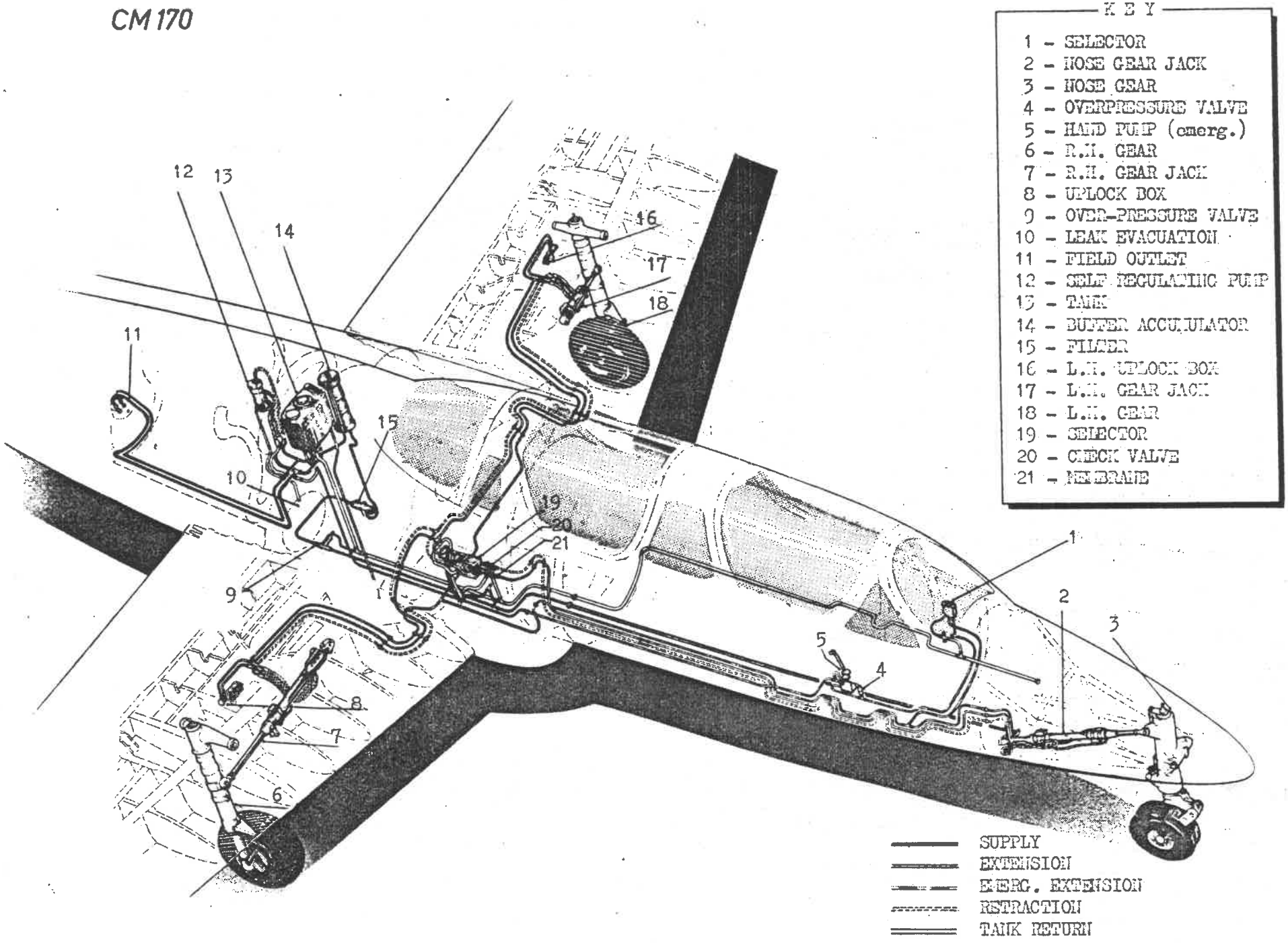
- Undercarriage extension
- Actuation of the airbrakes.

The liquid used for supplying both pumps is stored in a tank having a capacity of 6,5 liters, of which 1,4 liters is reserved



EMERGENCY HYDRAULIC SUPPLY

Fig. 9



UNDERCARRIAGE HYDRAULIC SYSTEM AND SUPPLY

Fig. 10

The dual pressure gage indicates the pressure in each circuit : left pointer indicates the pressure in the accumulator of the normal system and the right one the pressure in the accumulator for the emergency brakes. After engine shutdown the pressure of the main hydraulic system is allowed to drop 10 hpz every 5 min. It should not drop to zero between two flights (± 40 min)

1.6.2. UNDERCARRIAGE OPERATION SYSTEM (FIG 10)

1.6.2.1. NORMAL OPERATION CONTROL

An undercarriage control panel is installed in each cockpit. Each panel is equipped with a two position lever (Up and Down), which controls the position of the undercarriage, and an override push button which has the following purpose : if the pilot wishes to retract the undercarriage during ground run, he must press the button which releases the landing gear lever. The override press button should never be actuated to raise the undercarriage in the air.

1.6.2.2. EMERGENCY CONTROL

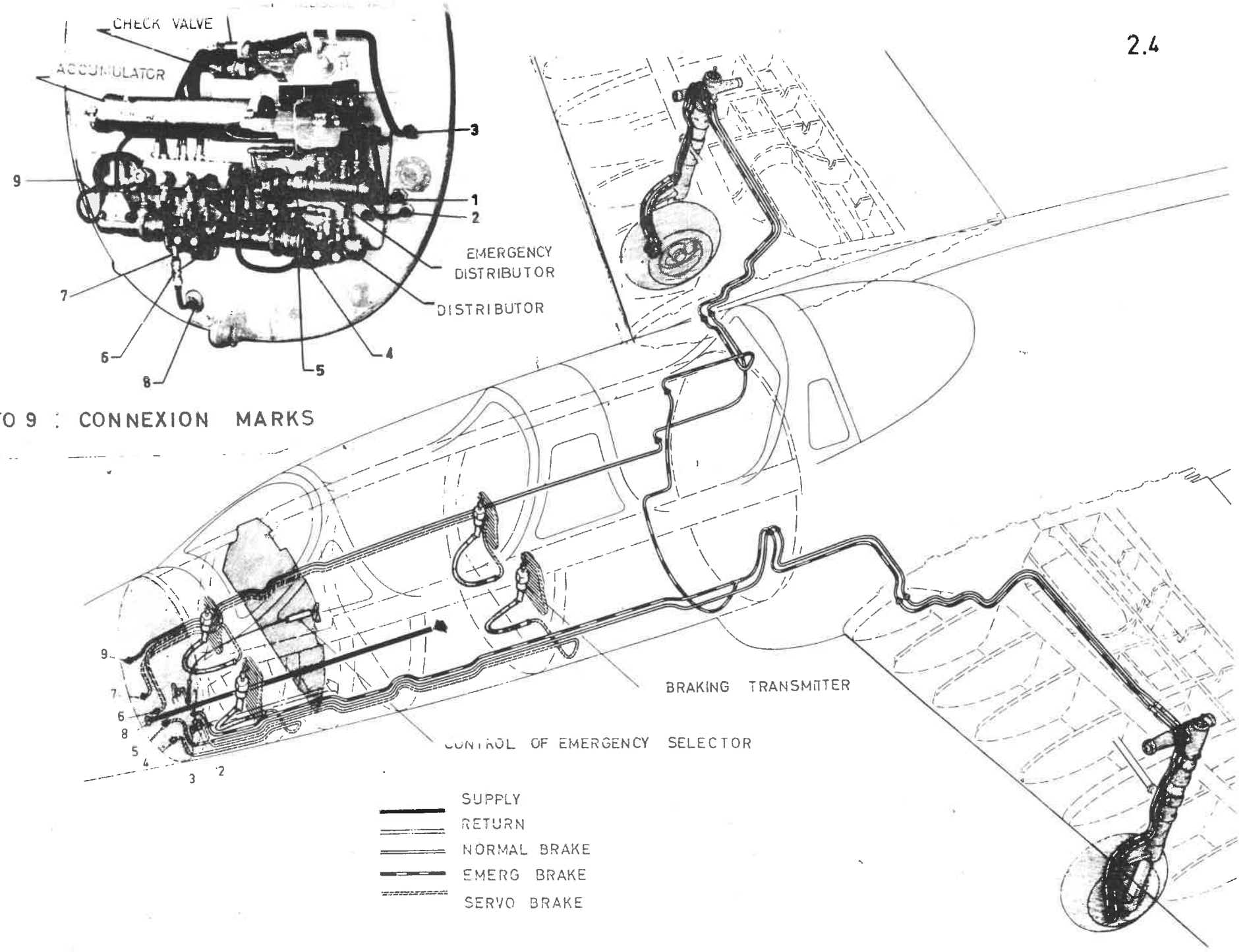
The emergency distributor is located in the front cockpit on the left hand console. It is composed of two push buttons, one in and the other out. For emergency undercarriage extension, press the push button marked "EMERGENCY" and actuate the hand pump.

NOTE : Before carrying out this manoeuvre, pull the circuit breaker "UNDERCARRIAGE CONTROL" on the left hand console.

This precaution will prevent the undercarriage form retracting accidentally should normal hydraulic pressure be re-established after extension by the emergency procedure.

1.6.2.3. LANDING GEAR POSITION INDICATOR

- In each cockpit, a landing gear position indicator is provided on the instrument panel. The upper part of the indicator carries 3 red lights, corresponding respectively to each landing gear leg. This lamp illuminates if the leg is not locked up or down (landing gear in movement) or if the undercarriage door is open.



HYDRAULIC BRAKING SYSTEM

FIG 11

6 green lamps are located at the lower part of this indicator only 3 of these lights may be seen at any one time. Each pair of green lights (one visible, one masked) corresponds to its respective landing gear leg, and the visible light illuminates if the leg is locked "Down".

The following are located in the center of the indicator :

(1) A test-button. When pressing this button at either of the cockpits, the red and green lights should illuminate in both cockpits.

(2) A horizontal 3-position switch, 1, 2 and 3 can be actuated by either pilot for reducing the glare of the lights during night flying.

(3) A vertical 2-position switch, 1 and 2, which is used for unmasking either group of 3 green lights.

In summary, when one of the legs of the landing gear is locked down, the corresponding green light illuminates. When a leg is locked up, the corresponding green light and red light are extinguished. When the leg is not locked, the red light is illuminated.

- In the front cockpit only : warning light for undercarriage. This light blinks when the throttles are retarded below 1/3 of throttle range (approximately 16.000 RPM) and when at least one undercarriage leg is not locked in the down position.

1.6.3. BRAKING SYSTEM (FIG 11)

Normal braking :

By actuating the pedals.

Emergency brakes :

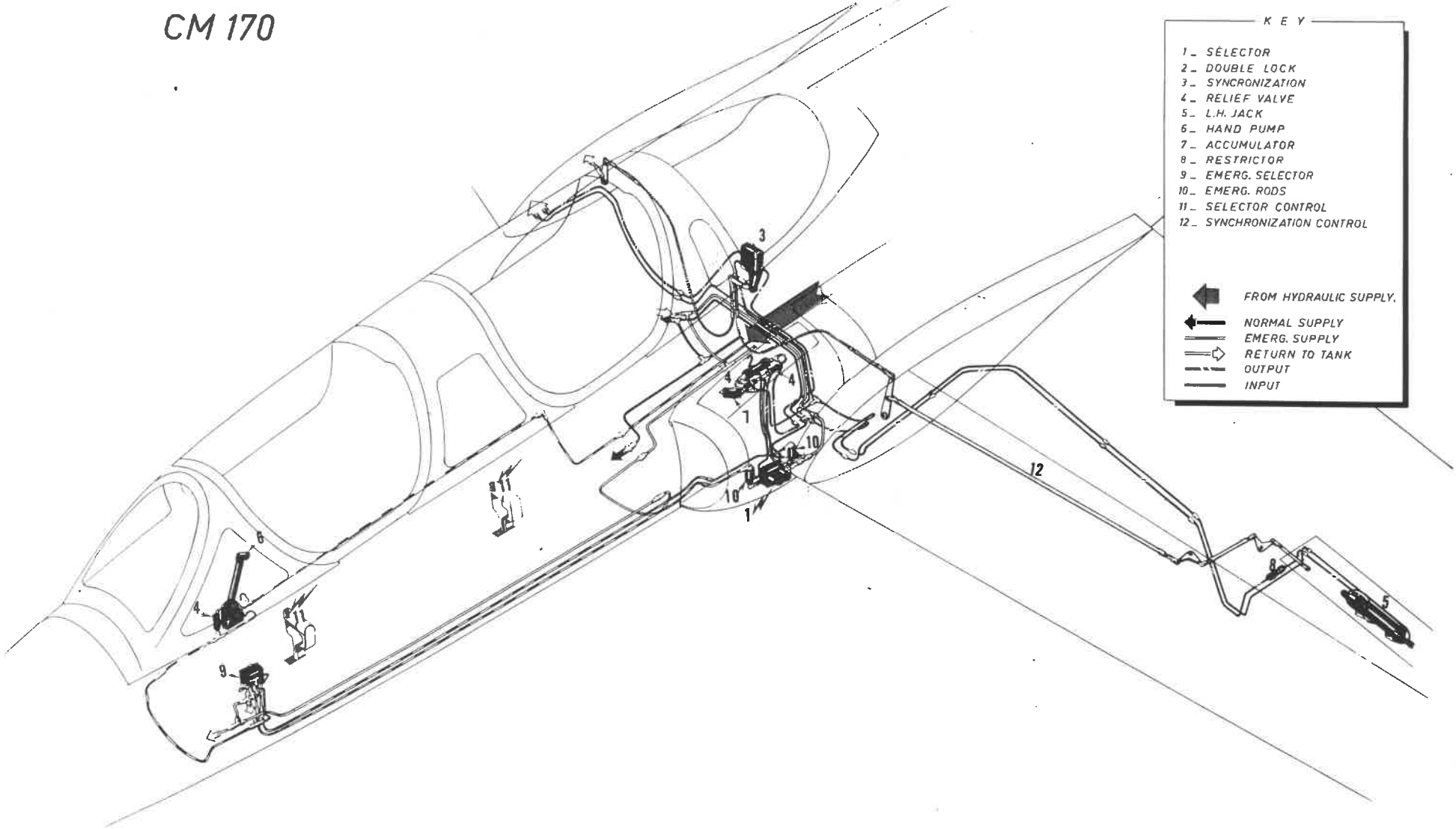
By pulling action of the pilot on the emergency handle.

This braking action is very effective. Care must be taken to handle very smoothly.

Pressure indicators (fig 19A) :

The dual pressure gage indicates, with the right pointer; the pressure of the emergency brake accumulator.

CM 170



_ AIRBR KES _ HYDRAULIC UNIT _

FIG 12

Important notes regarding the use of brakes :

1. It is forbidden to actuate the toe brakes and the emergency brakes simultaneously.
2. In the case of a failure of the hydraulic system, when the pressure of the circuit (buffer tank) is 110 Hpz the last operation of the toe brakes causes it to drop to zero, the same thing will happen if the pressure of the emergency braking accumulator is 90 Hpz.
3. When the circuit has failed and the emergency brake accumulator is completely inflated (250 Hpz) approximately 20 brake thrusts are possible.

1.6.4. LANDING FLAP SYSTEM

The maximum flap deflection is 40°.

Controls : (fig 19B)

In each cockpit, on the left hand console, a 3-position switch is provided, which automatically returns to the centre position.

As long as the pilot actuates this switch, the flaps are displaced in the desired direction. When he releases the switch, the flaps stop their course; if both pilots simultaneously actuate this switch in opposite directions, the flaps are controlled by the rear pilot.

A deflection indicator is provided in each cockpit (fig 19A).

1.6.5. AIRBRAKES ACTUATING CIRCUIT (FIG 12)

Normal operation :

A three positions switch springloaded in the neutral position is used to control the normal operation.

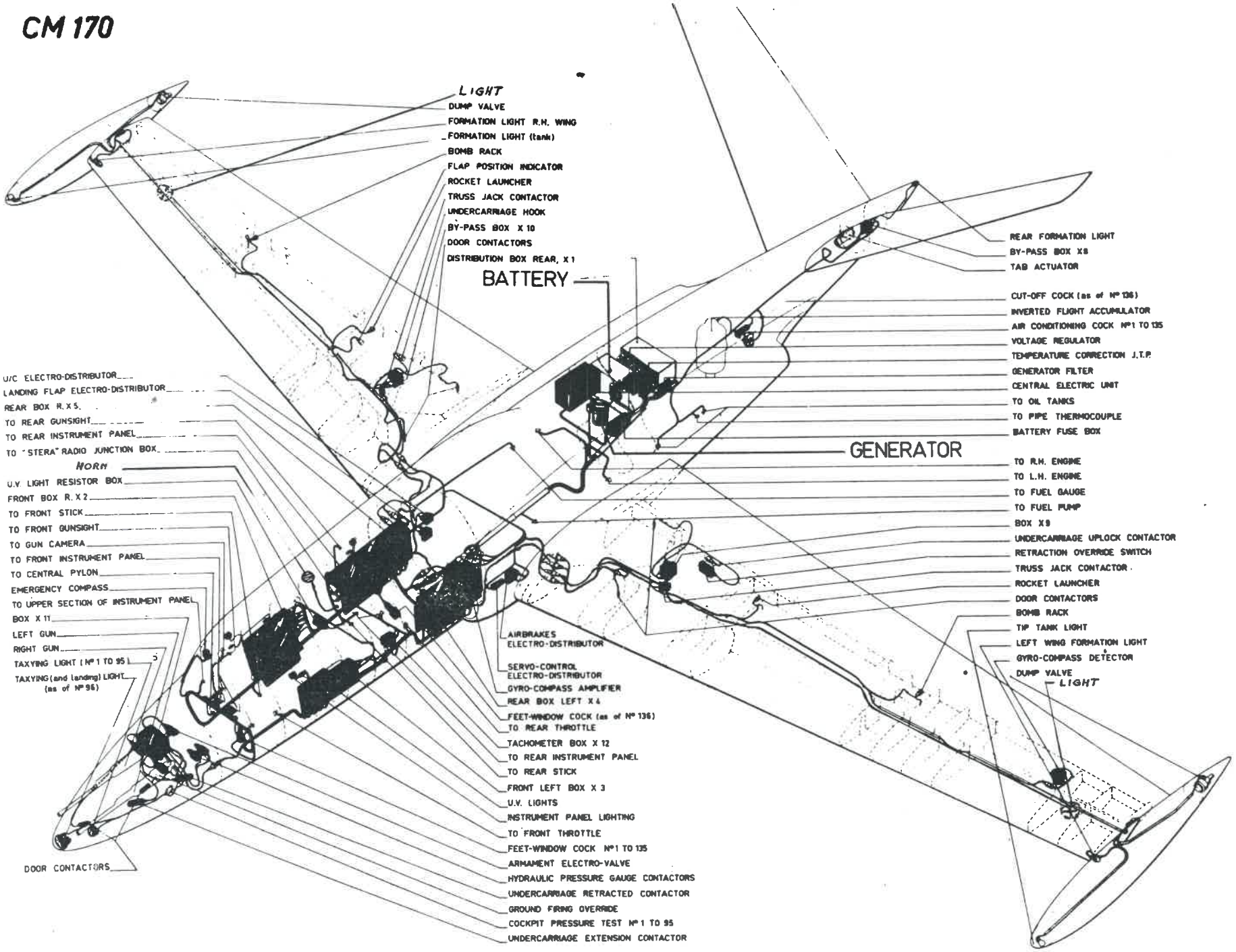
Emergency operation :

If the emergency selector is "OUT" or "IN", the liquid under pressure coming from the hand pump is sent to the same circuit as for normal operation, via the emergency hydraulic selector.

Controls :

In each cockpit, the main control switch is located on the right side of the throttle handle (fig 19B).

CM 170



ELECTRIC INSTALLATION

Fig: 1

In the case of simultaneous action by both pilots, but in opposite directions, the airbrakes are controlled by the pilot in the rear cockpit.
The emergency selector is located on the left hand console of the front cockpit. It is a rotating 3-position switch "IN" - "NORMAL" "OUT". When setting to "IN" or "OUT", it is necessary to actuate the hand pump in order to operate the airbrakes (Fig 19 B and C)

1.6.6. AILERON BOOST SYSTEM (FIG 3)

Operation with booster system on :
The boost system is in operation when the hydraulic system is under pressure, the boost circuit breaker engaged, the boost switch set to "ON" and electrical power is available.
Operation with aileron boost cut-off :
The pilot should switch off the artificial feel device in order to prevent excessive stick effort.

1.7. ELECTRICAL SYSTEM (FIG 13)

1.7.1. GENERAL

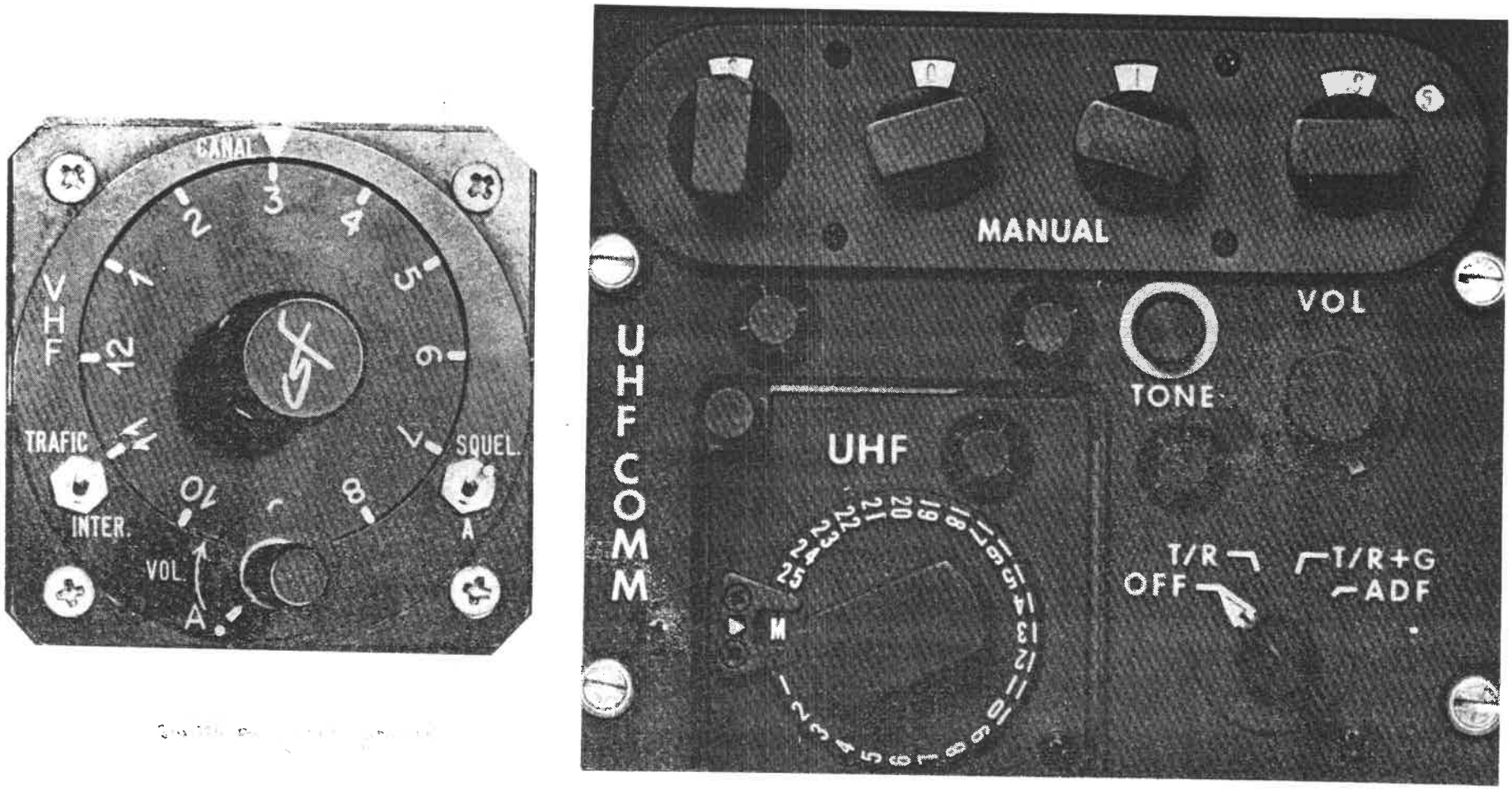
The electric installation of the CM.170 operates on 28.5 D.C.

1.7.2. CURRENT SOURCES

A 2500 watt generator is installed on the accessory gear box, driven by the left engine.
A 35 AH cadmium nickel battery is charged permanently by the generator.
A ground connector located above the right engine cowling is used for powering the installation from a field power unit.

1.7.3. TRANSFORMATION COMPONENTS

An inverter supplying a 3-phase 115 volt 400 c/s current is used for feeding the gyro compass and the gyro horizon devices. It is installed under the seat of the rear cockpit.



CONTROL PANEL VHF and UHF

fig 14

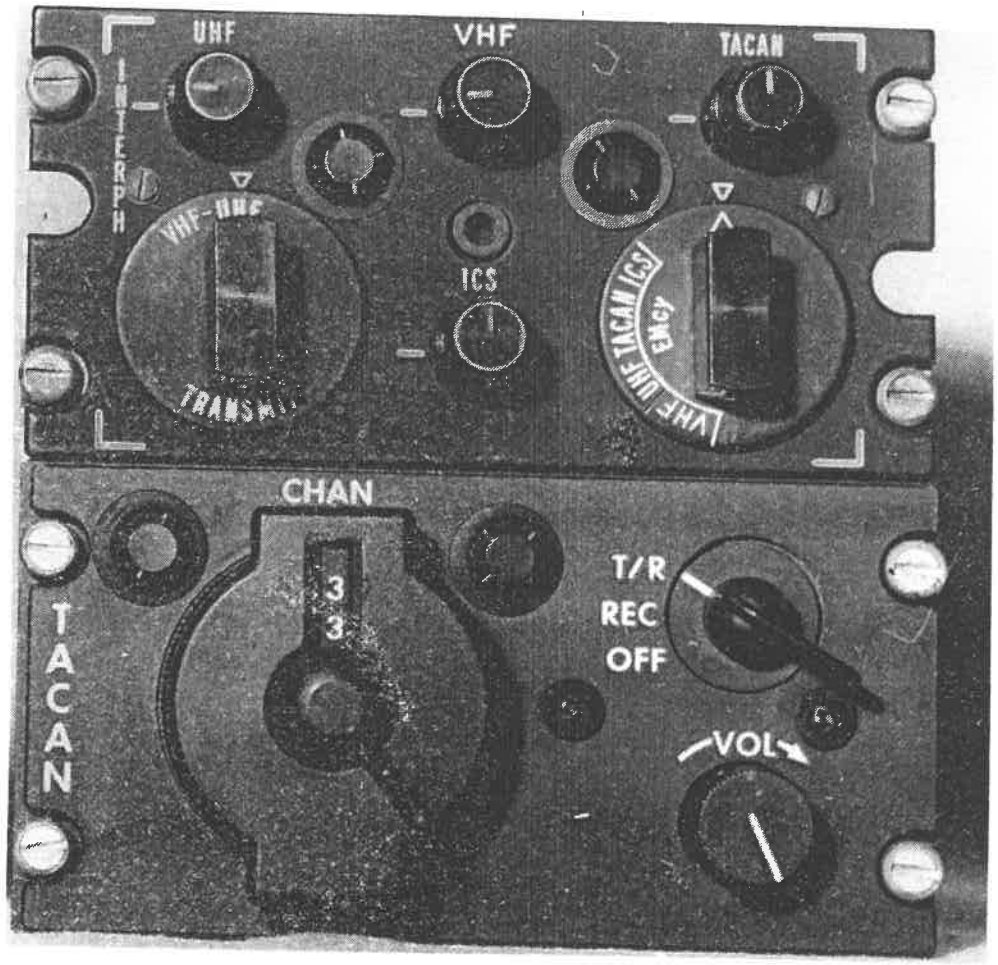
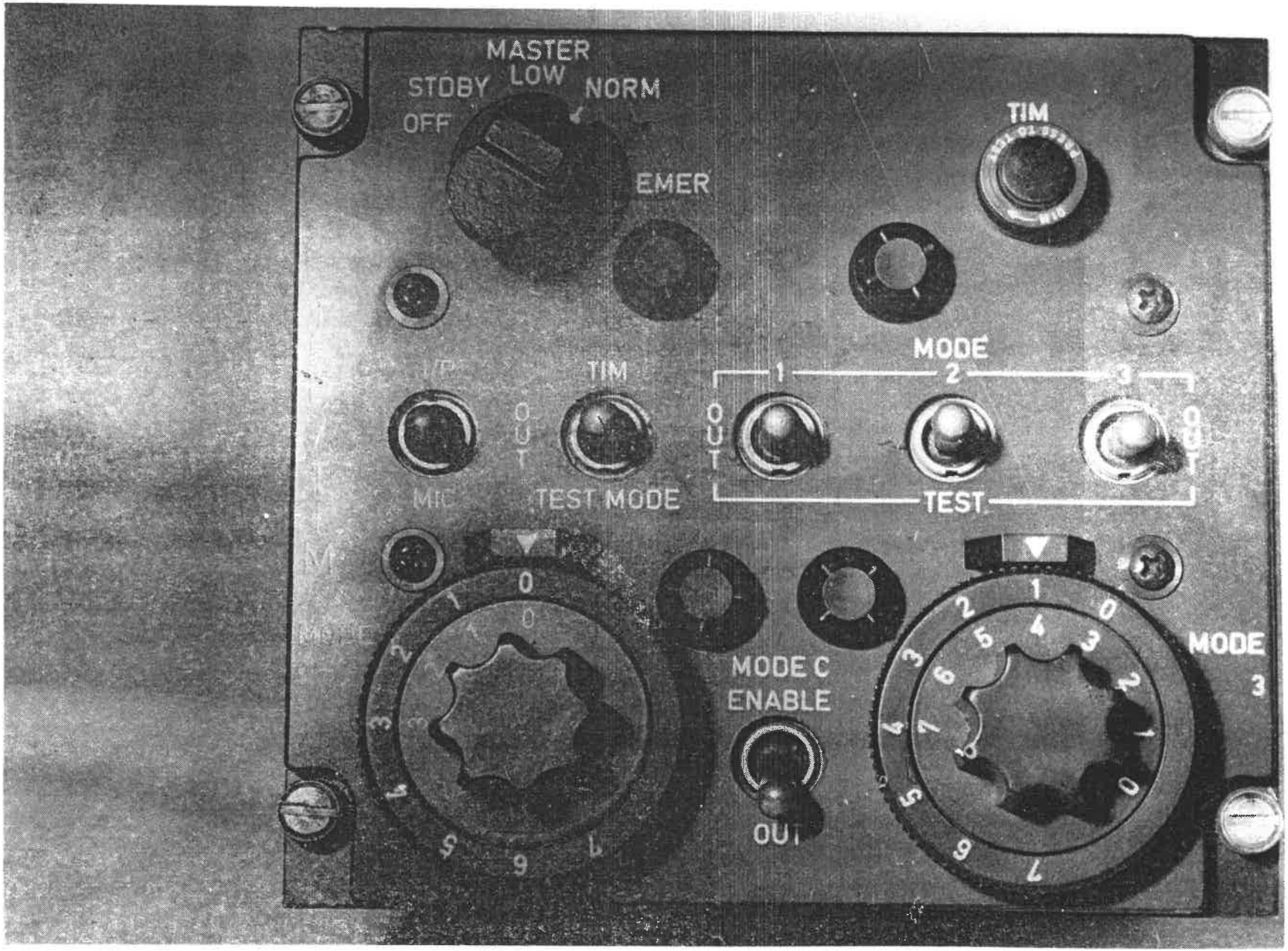


fig 15


MASTER
STDBY
LOW
NORM
OFF
EMER
TIM
MODE
1
2
3
TIM
OUT
OUT
MIC
TEST MODE
TEST
MODE C
ENABLE
OUT
MODE
3

fi- 16

A special inverter is installed to provide current to the TACAN and IFF-sets.

1.7.4. CONTROLS (FIG 19A)

Generator switch.
Battery switch.
Battery circuit breaker. When an accidental overload occurs between the distribution bar and the battery, this circuit breaker will disengage. It is re-engaged by pressing the button.
Panels of circuit-breakers on right and left hand console of front cockpit.
Inverter switch (on right console) for the IFF/TCN-inverter.

1.7.5. CHECKING INSTRUMENTS

Voltmeter.
Generator warning lights : illuminate whenever the generator is off the line.

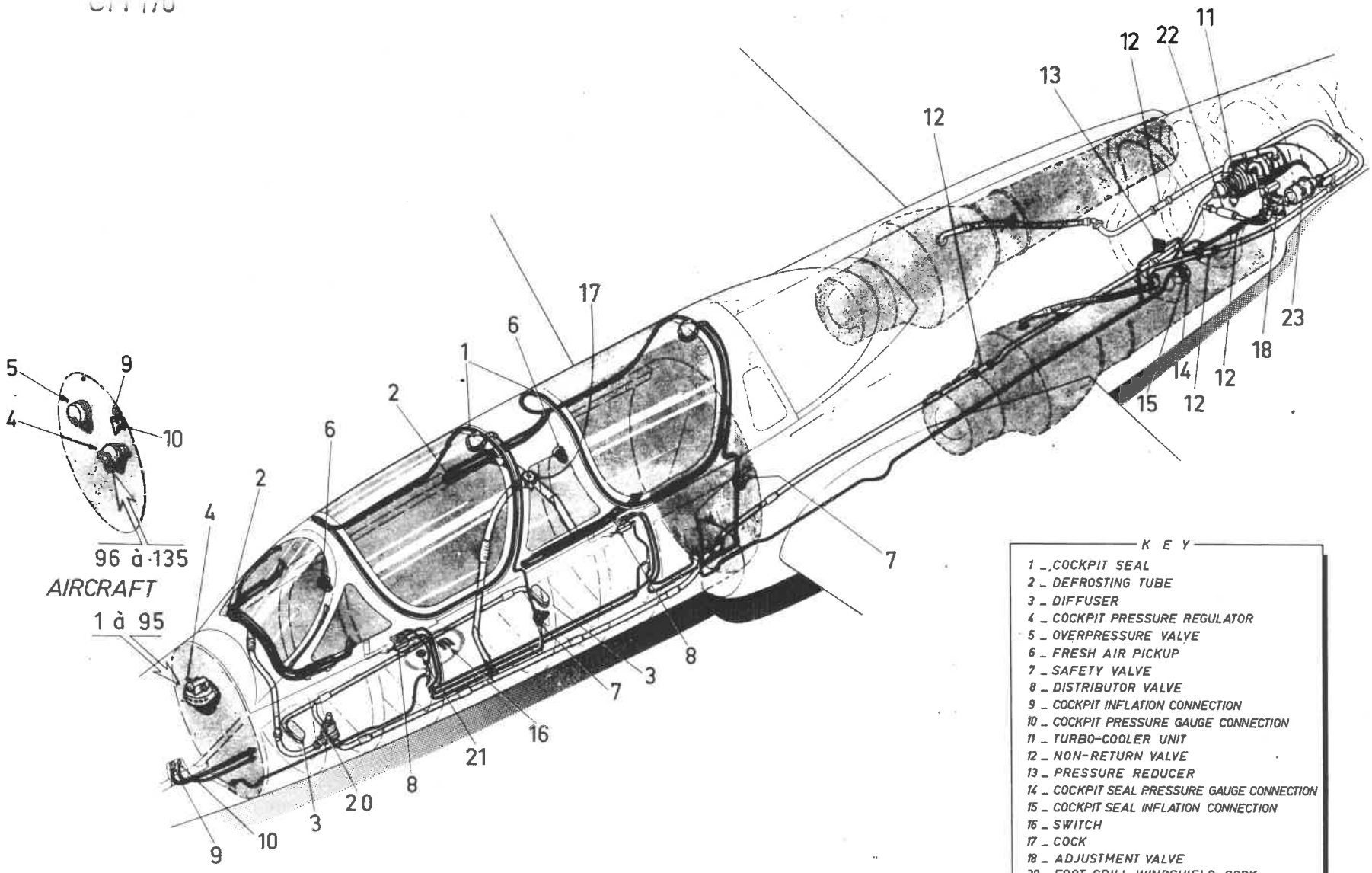
1.7.6. SPECIAL PRECAUTIONS

If the generator warning light illuminates during flight, immediately cut off the generator switch.
If both TCN and IFF are inoperative, the TCN/IFF inverter should be switched off.

1.8. RADIO INSTALLATION (FIG 14-14bis, 15, 16-16bis)

The installation includes the following equipment :

- UHF Collins 201
- VHF C.S.F. - CC - 262
- Interphone system TF-AP-10A
- TACAN Hoffman AN/ARN - 21 - C
- IFF Siemens RT.555 - APX - 46



K E Y

1 _ COCKPIT SEAL
2 _ DEFROSTING TUBE
3 _ DIFFUSER
4 _ COCKPIT PRESSURE REGULATOR
5 _ OVERPRESSURE VALVE
6 _ FRESH AIR PICKUP
7 _ SAFETY VALVE
8 _ DISTRIBUTOR VALVE
9 _ COCKPIT INFLATION CONNECTION
10 _ COCKPIT PRESSURE GAUGE CONNECTION
11 _ TURBO-COOLER UNIT
12 _ NON-RETURN VALVE
13 _ PRESSURE REDUCER
14 _ COCKPIT SEAL PRESSURE GAUGE CONNECTION
15 _ COCKPIT SEAL INFLATION CONNECTION
16 _ SWITCH
17 _ COCK
18 _ ADJUSTMENT VALVE
20 _ FOOT GRILL-WINDSHIELD COCK
21 _ INDICATOR
22 _ FLOW LIMITER
23 _ AIR FILTER

Insulation
AIR CONDITIONING LINE
SEAL SYSTEM

_ AIR CONDITIONING _ AIRCRAFT 1 to 135 _

Fig: 17

1.9. INSTALLATION OF EQUIPMENT AND COCKPIT LAY-OUT

1.9.1. COCKPIT AIR CONDITIONING AND PRESSURIZATION SYSTEM (FIG 17).

1.9.1.1. GENERAL

The cockpit of the CM.170 is pressurized and air conditioned by air tapped from the engine compressor.

The pressure regulator keeps the cockpit at the following pressures :

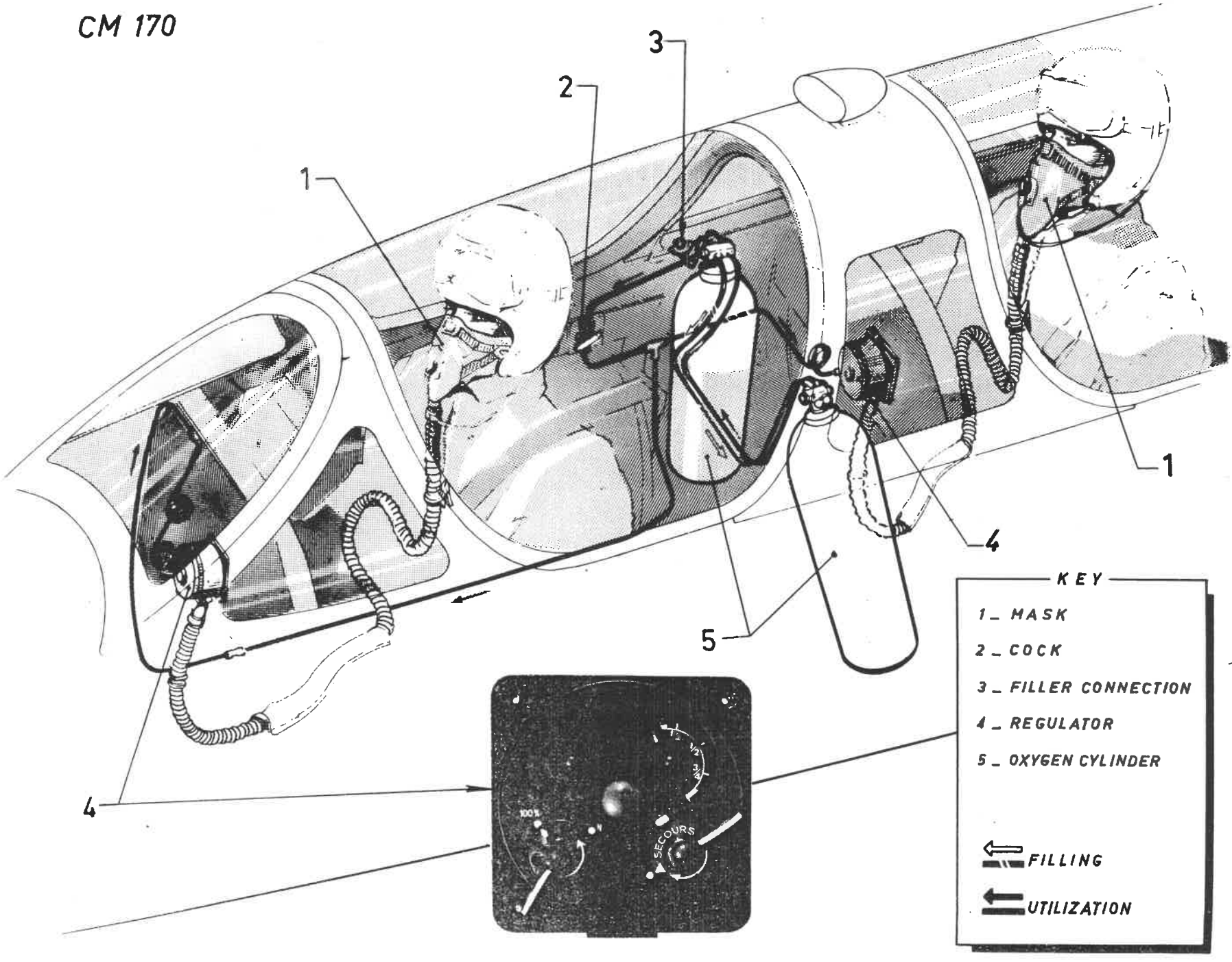
- From 0 to 10.000 ft cockpit pressure = outside pressure.
- From 10.000 to 20.000 ft the cockpit pressure remains the same as the atmospheric pressure at 10.000 ft.
- Above 20.000 ft the cockpit pressure = the outside pressure + 250 gr/cm^2 : for every increase of 5000 feet (above 20.000 ft) the cabin altitude increases only 3000 feet.

The sealing between the canopy and fuselage is provided for by two strips of inflatable rubber.

1.9.1.2. THE CABIN CONTROLS (FIG 19B)

1. The air conditioning and defrosting control is located on the L.H. console of the front cockpit and is a rotary switch with 7 positions : "OFF, PRESS.COLD, PRESS., PRESS.HOT, DEFROST.COLD, DEFROST., DEFROST.HOT".

   The switch remains in place when set to : "OFF, PRESS., DEFROST"
   When set to : "PRESS.COLD., PRESS.HOT"
   the switch returns to PRESS. when released.
   Similarly, from DEFROST.COLD or DEFROST.HOT, it returns to DEFROST.
   Operation is as follows :
   - In position OFF, no air enters the cockpit.
   - In position PRESS., air arrives in the cockpit via the defrosting manifold and the foot grills.
     If the pilot finds this air to be too cold, he holds the switch on PRESS.HOT for an instant.
     To cool, the same procedure is carried out, except that the switch is set to PRESS.COLD.



O X Y G E N

FIG 18

- When set to DEFROST., all the air arrives at the defrosting manifolds.

2. The defrosting cock for the rear window is located on the rear instrument panel (fig 19).

3. The controls for inflating the canopy seal are incorporated in the controls for closing the respective canopy. An emergency device is provided for deflating the seal in flight without opening the canopy (for example : for evacuating fumes). This is controlled by two push buttons located on the canopy opening crank. When pressing the button marked off, the canopy seal will deflate. The other button, located near this first one, is for reinflating the seal (marked ON).

4. The position of the temperature regulating cock is given by the indicator in the front cockpit.

5. The cabin altimeter is located in the front cockpit.

1.9.2. OXYGEN

Brief description and operational principle (fig 18) :
Each cockpit is equipped with a regulator. Both regulators are supplied by the same cylinders, having a total capacity of 13,33 litres which at the inflation pressure of 150 hpz represents 2000 litres of expanded oxygen.
In each cockpit, the regulator is of the demand type, without automatic overpressure control.
Pilot's controls :
The selectors are located on the regulator. One is used for obtaining either diluted oxygen (NORMAL position), or pure oxygen (position 100 %). The other one has two positions : NORMAL, at which the regulator operates upon demand, and EMERGENCY, at which the oxygen is permanently supplied.
Pilot's checks :
The blinker, located at the upper left hand part of the regulator, is used for checking that the "demand" service is operating correctly. The white flap should appear at each inhalation.

AL I

The pressure gauge is scaled in 1/4 of the normal filling pressure of the cylinders (150 hpz).
The red warning light, located in the middle of the regulator, lights up when the oxygen pressure drops below 40 hpz.
Special precautions :
At parking, select 100%.

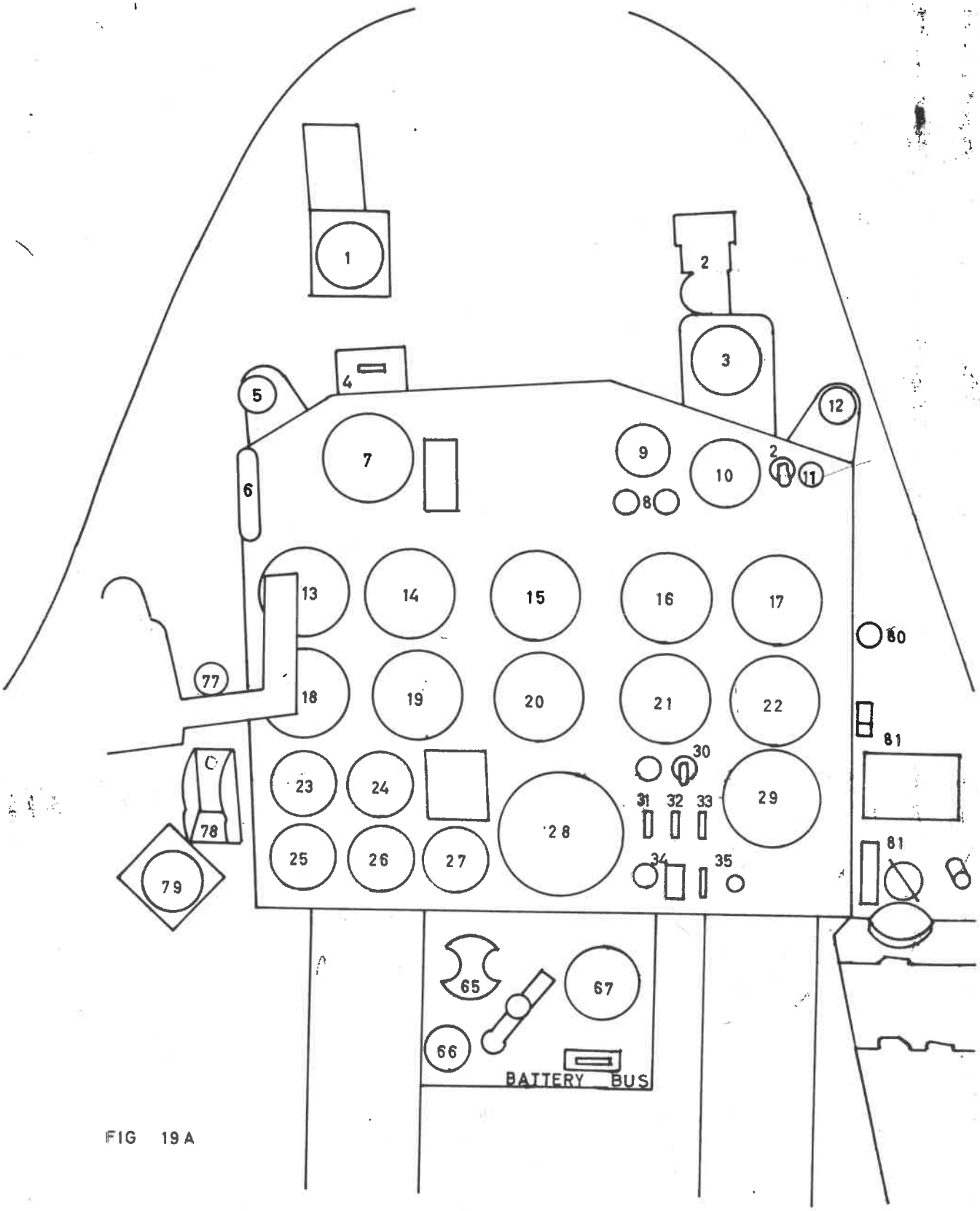
1.9.3. PITOT SYSTEM

Description :
The lines to both cockpits are entirely independent.
The ram pressure is detected by two heated pitot tubes located in front of the windshield. The left hand head supplies the instruments of the front cockpit and the right hand head those of the rear cockpit.
The static pressure is detected by two outside ports located to the right and the left of the front pilot's feet.
Controls and instruments (fig 19A and 19D)
The instruments in the front cockpit are as follows :
- Machmeter (visible from the rear cockpit).
- Air speed indicator.
- Altimeter.
- Vertical speed indicator.

The following are installed in the rear cockpit :
- Air speed indicator.
- Altimeter
- Vertical speed indicator.

1.9.4. DEFROSTING

General :
Besides the interior defrosting of the windshield, mentioned in the chapter on the air conditioning system, the CM.170 is fitted with an external defrosting system for the windshield and a defrosting system for the pitot heads.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BATTERY BUS

FIG 19A

The external defrosting is done by spraying isopropylic alcohol against the windshield.
Spraying is carried out by a pump situated at the top of the instrument panel in the front cockpit.
The handle of this pump (push-pull type) is normally held flush by a bayonet lock. The lock is released by turning the control handle and a spring inside the pump extracts the handle, thereby spraying alcohol on the windschield. When the handle is pushed in again, the pump is automatically primed.
About 60 to 65 pump strokes are necessary to empty the tank.
The pitot heads are defrosted electrically.
Each pilot has a switch and warning light to control and check heating of the pitot head.
The light burns as long as the pitot is not being heated, either because the switch is set to "OFF" or because the resistor is burnt out.

1.9.5. LAY-OUT OF THE FRONT COCKPIT (FIG 19)

Above the instrument panel :

1. Stopwatch
2. Standby-compass with illumination switch
3. Fuel quantity indicator
4. Aileron boost switch
5. Undercarriage warning light
6. Emergency brake
7. Machmeter
8. Fire warning lights
9. Deicing pump
10. Accelerometer
11. Canopy warning light
12. Starter warning light

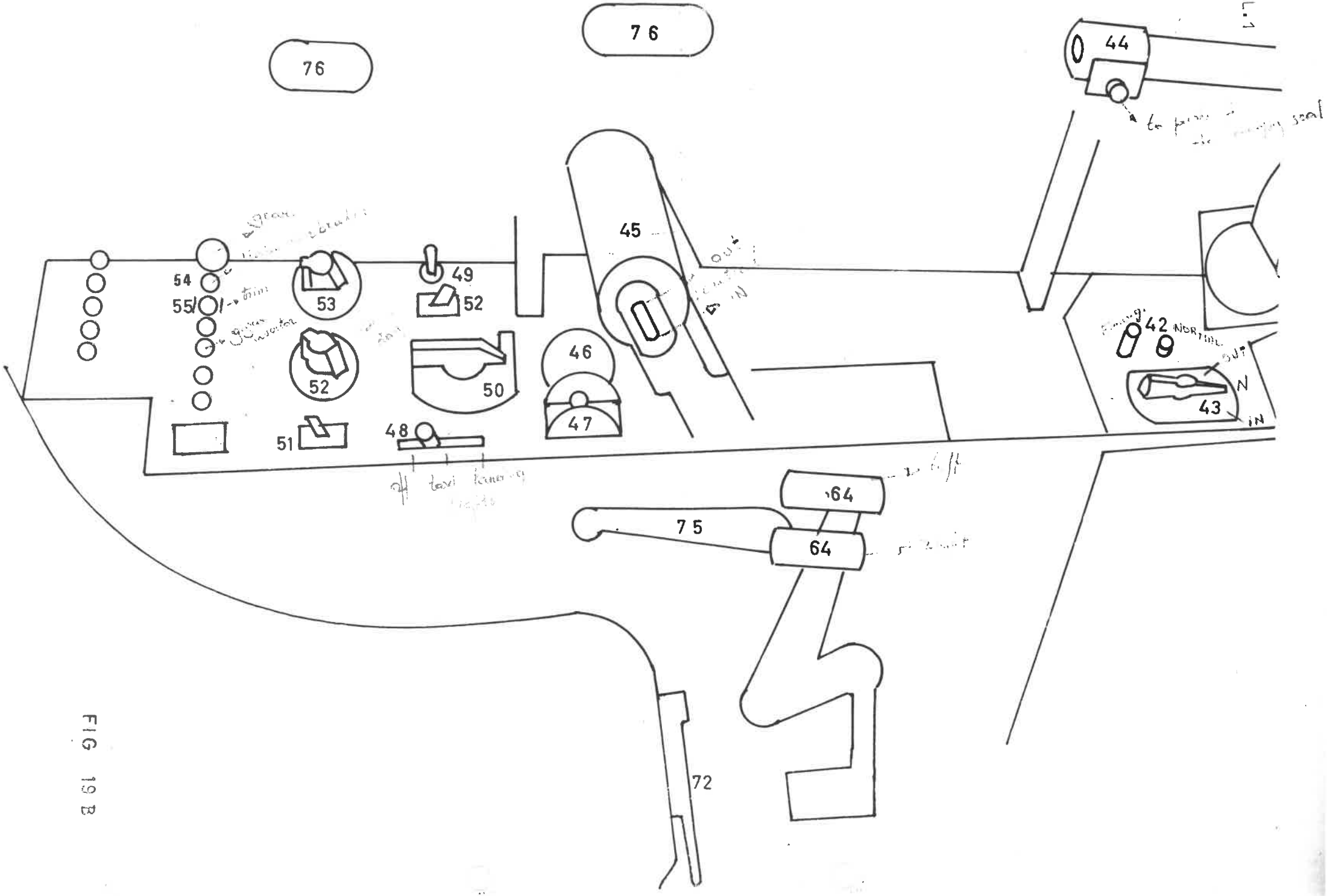


FIG 19 B

On the instrument panel :

13. RPM - indicator
14. Airspeed indicator
15. Gyro magnetic compass
16. Attitude gyro
17. Distance meter TACAN
18. Exhaust gas temperature indicator (E.G.T.)
19. Altimeter
20. Vertical speed indicator
21. Turn and bank indicator
22. Tacan bearing indicator
23. Undercarriage indicators
24. Oil temperature indicator
25. Flap indicator
26. Oil pressure indicator
27. Cabin altimeter
28. Oxygen control panel and indicator
29. Weapon selector switch
30. Gyro magnetic compass switch
31. Pitot heater switch and warning light
32. Attitude gyro switch
33. Compas switch
34. Generator switch and warning light
35. Battery switch and circuit breaker

Left console :

42. Landing gear emergency selection button
43. Air brakes emergency selection switch
44. Canopy handle with cockpit seal button
45. Throttle levers with dive brake selection switch
46. Cabin temperature control indicator
47. Flap selector switch
48. Landing light switch
49. Navigation light switches
50. Temperature, pressurization and defrosting selector switch.

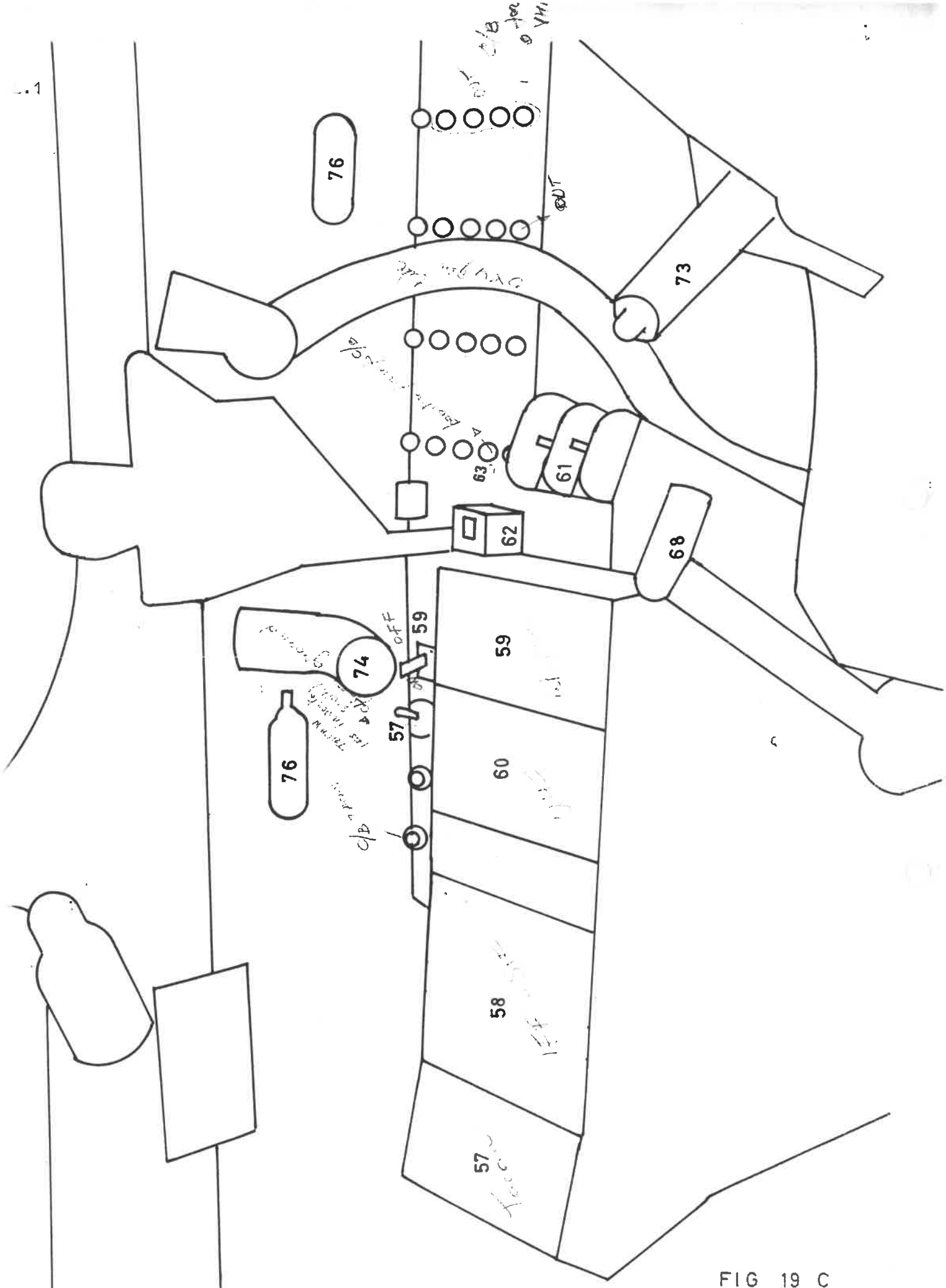


FIG 19 C

51. Console light switch
52. UV - light switch and rheostat
53. Emergency light rheostat
54. Undercarriage circuit breaker
55. Elevator trim tab circuit breaker
56. Armament interdiction switch
75. Throttle friction lever

Right console

57. TACAN control panel and inverter switch
58. IFF/SIF control panel
59. Interphone control panel and switch
60. UHF radio control panel
61. Fuel dump valve switches
62. Starting switch
63. Boost pump circuit breaker
74. Fresh air scoop

Below instrument panel

65. Normal and emergency hydraulic pressure gages
66. Voltmeter
67. VHF radio control panel

Cockpit and control column

64. Fuel cocks
68. Emergency hydraulic handpump
69. Radio transmitter button
70. Elevator trim tab
71. Artificial feeling for ailerons

ON STICK

72. Harness locking lever
73. Seat height adjustment lever
76. Cockpit UV Lights
77. Fuel low pressure warning light
78. Undercarriage selector and override switch
79. Trim position indicator
80. Fuel low level warning light
81. UHF radio illumination control

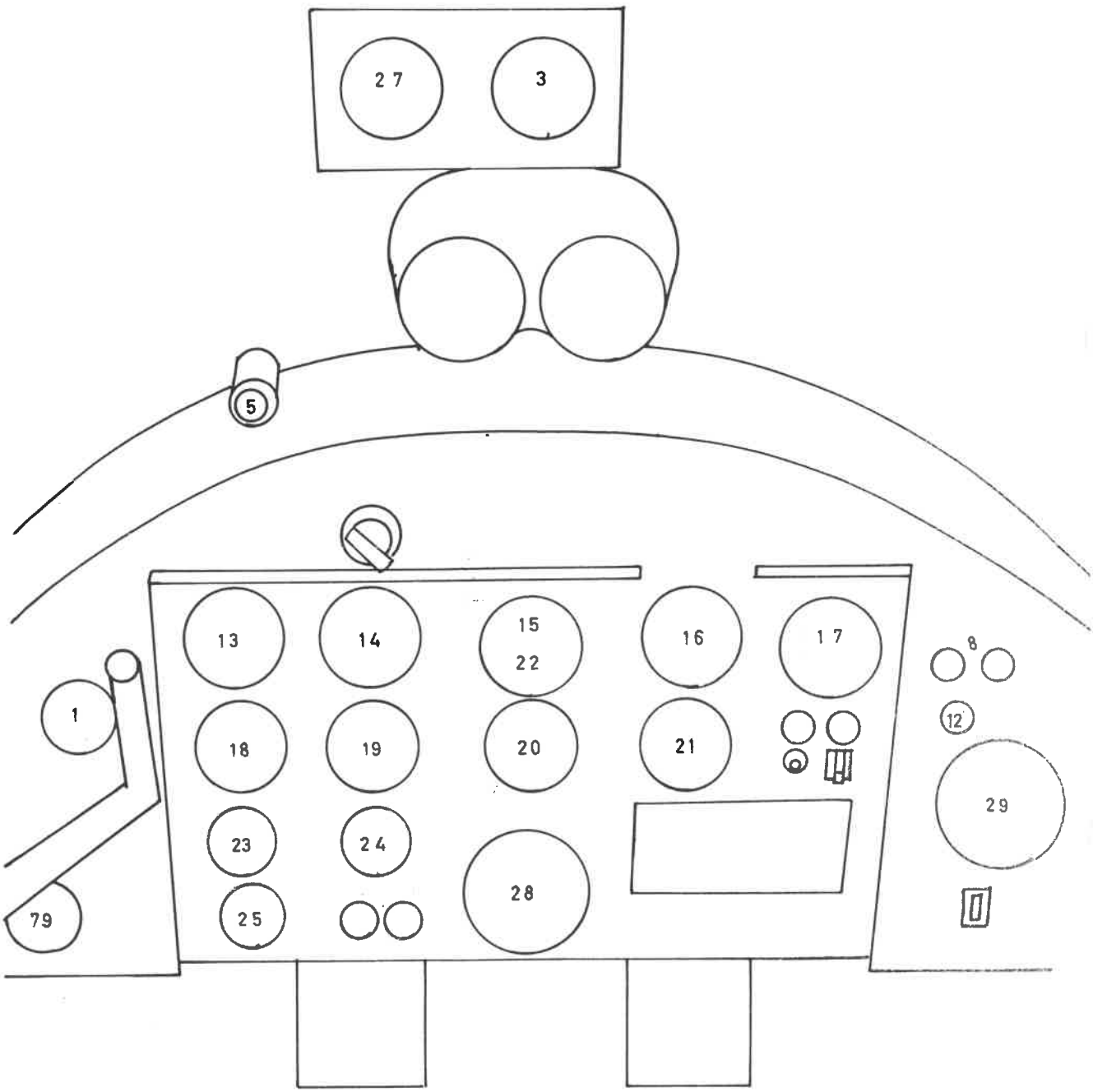


FIG 19 D

1.9.6. LAYOUT OF THE REAR COCKPIT

a. Engine instruments :

All instruments are identical to those in the front cockpit except for the oil pressure instrument which is replaced by two red warning lights.

b. Flight and navigational instruments :

- The TACAN bearing indicator is incorporated in the gyrocompas.
- The gyro compas, the turn and bank indicator and the attitude indicator can only be controlled from the front cockpit.

c. The interphone control box and call button are situated on the right lower bottom of the instrument panel.

d. The crank for adjusting the rudder pedals is situated on the right console.

e. The rear cockpit can be fitted with a blind flying hood.

1.10. SAFETY EQUIPMENT

1.10.1. FIRE PROTECTION

The CM.170 is equipped with a fire detection installation in the jet engine compartments, but no extinguisher system has been provided for.

Three fire detectors are placed around each engine exhaust pipe and three around the front part.

Any unusual rise of temperature around the engine causes a red light to illuminate in each cockpit. In each cockpit there are two lights, corresponding to their respective engines.

1.10.2. PARACHUTES

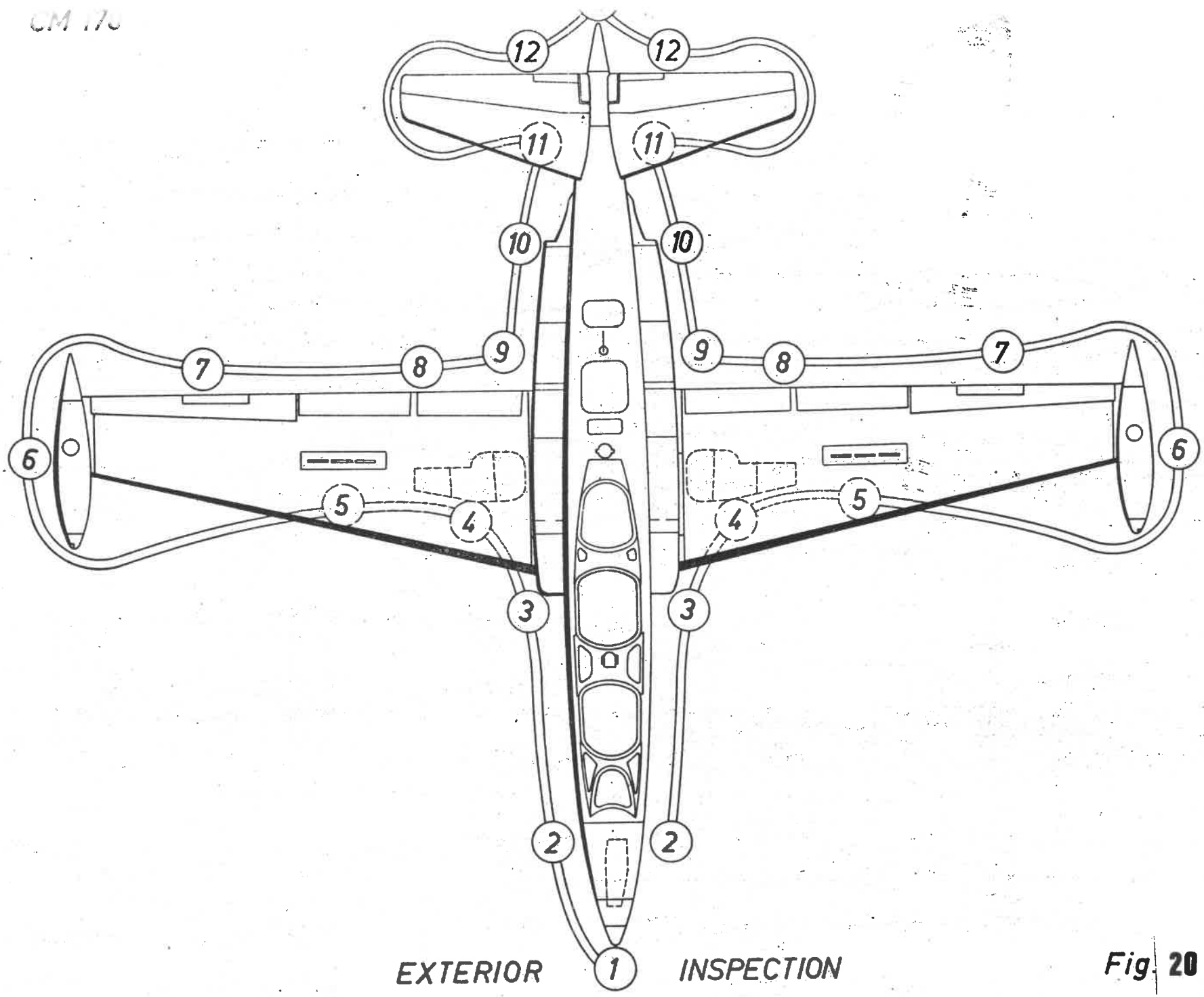
Both pilots have seat parachutes.

1.10.3. JETTISONABLE CANOPY

The mobile canopy of each cockpit may be jettisoned in flight in order to enable the pilots to leave the aircraft by parachute.
The jettison controls are the same as for normal opening on the ground.
Once the controls have been actuated, it might be necessary to push the canopy slightly upwards if it does not leave the aircraft immediately.
Wind tunnel tests have shown that in all circumstances of speed, angle of attack, skid and acceleration, the canopy will leave the aircraft following an effort of less than 20 kg without contacting neither the pilot nor the rear structure of the aircraft.
Jettisoning of the front canopy opens air deflectors intended to increase comfort in the cockpit.

1.10.4. EMERGENCY OPENING OF THE CANOPY ON THE GROUND

In the case of a crash landing or an indisposition on the part of the pilot on the ground, it might become necessary to open the canopy from the exterior.
The corresponding handle is located between the two cockpits, on both sides. It consists of two handles protected by a plexiglass window. To open the canopy, break the glass and pull the handles.
The canopies are then open and access may be gained to the cockpit.



EXTERIOR INSPECTION

Fig. 20

CHAPTER II

SECTION II - UTILIZATION

2.1. EXTERIOR INSPECTION (fig.20)

Prior to start exterior inspection : battery on - check voltmeter ~~24V~~ 25,5\
- check fuel cocks closed
- landing gear lever down, 3 greens
- trim neutral
- emergency brake on

battery OFF

Beginning in front of the aircraft, the pilot proceeds clockwise around the aircraft.

1. Condition of landing light cover. Front shock absorber height (the shock absorber should not go to the stop position when increasing the weight on the nose).
   Nose wheel tire : slippage - marks and condition.
   Shimmy damper lever down and locked.
   Nose wheel downlock pin removed and door condition.
2. Nose fairing locked.
   Gun shell access door locked.
   Static line cover removed.
   Pitot tube cover removed.
   Canopy emergency release glass condition.
3. Engine air intake duct cover removed; check inside for condition and foreign objects.
   Condition of TACAN - antenna.
   Condition of upper and lower surface air intake cowling.
4. Shock absorber height of the starboard undercarriage (a minimum of three fingers for an aircraft full of fuel).
   Undercarriage door condition.
   Tire condition and slippage marks.
   Gear downlock pin removed.
5. Access doors lower part of the wing locked.
6. Tip tank : condition, cap tightened and door closed.
7. Aileron locks removed, trim tab condition and play.
   Wing surface condition (airbrakes flush).

AL 1

- Oxygen hose connected and secured to the shoulder harness.
- Oxygen pressure and blinker operation checked; set to "NORMAL".

2.3. CHECKS BEFORE STARTING ENGINE

The cockpit check is carried out from left to right. Switches are "ON" when they are either up, forward or in the outward position.

- Battery circuit breaker "IN" - Battery "ON" - Check for ~~24 V~~ 25,5V minimum - Interphone ON.

CHECK FROM LEFT TO RIGHT :

- All circuit-breakers left console : IN.
- Switches and cockpit lighting rheostat "OFF" - landing light "OFF"
- Pressurization "OFF" and cockpit seal button pressed in.
- Throttles and fuel cocks closed - ignition buttons free.
- Undercarriage system selector on "NORMAL"
- Airbrakes : pump 1/2 out in emergency and then return to normal system
- Undercarriage lever down
- Emergency brake "ON"
- Clock set and rewound
- Aileron boost "OFF"
- Machmeter at 12 o'clock of instrument
- Accelerometer : check reading (max. and min.)
- Deicing pump locked. Check if icing conditions are suspected in flight.
- Fuel quantity indicator : 725 liters
- Stand-by compass : heading and condition
- Instrument panel
  - RPM and ASI : on zero and red dot respectively
  - EGT : between 0° and 100°C
  - Altimeter set at field elevation
  - VSI on zero
  - Oil T° indicator between 0° and 40°C
  - Turn and bank indicator : no red cross
  - Hydraulic pressure : normal and emergency system : 0-250 HPZ
  - Pitot heater OFF (warning light on)
  - Attitude gyro - gyro compass : OFF

- Armement panel : switches off
- Tacan switches off and preselect desired channel
- IFF OFF and preselect desired channel
- UHF OFF and preselect desired channel
- Intercomm sw. on and intercom control box emergency sw. on "NORMAL"
- Fresh air scoop closed
- Starter switch neutral and cover down
- Dump valve switches OFF
- Right console circuit-breakers IN except armement but gunsight CB should be I VHF "ON", check VHF lights ON and OFF.

CHECK LIGHTS :

- Three greens for landing gear on
- Generator light on
- Pitot heater light on
- Canopy warning light on

TEST LIGHTS :

- Fuel low pressure warning light
- Undercarriage warning light
- Red lights of landing gear position indicator and alternate set of green lights
- Fire warning lights
- Starter light
- Fuel low level warning light
- Dump valve lights

2.4. STARTING ENGINE

Starting of the engines is normally done with the aircraft battery. Make sure the aircraft is free of obstruction. Fire extinguisher in place. Check throttles and fuel cocks fully closed.
Pilots left hand must be bare in order to be able to feel position of ignition-injector button during start.

2.4.1. NORMAL STARTING

- Lift thumb in order to alert the crewchief.
- Select starter switch to left engine (light "ON" and voltmeter drop).
- At 1200 RPM (transition to 2nd cycle), press the ignition-injection button for two seconds, then slowly open the fuel cock while maintaining the injection button depressed (this sequence should last 4 sec.) Release injection button when EGT reaches 200°C position.

AI T

- Make sure injection button is not stuck.
- Continue opening fuel cock slowly
- EGT should normally not exced 250°C before 3000 rpm
- The engine picks up speed by itself
  At 5.000 RPM, return starter switch to neutral (light "OFF")
- Check hydraulic pressure build-up (maximum 250 hpz)
  Idle : 6.200 to 7.000 rpm.
  EGT : 500° max
  Oil pressure : 0,5 HPZ minimum
- Increase RPM to 15.000. The generator warning light should be out above 7.500 RPM.
- Hydraulic pressure 250/250 - Give sign : "Chocks removed"
- Switch on :
  - Gyro magnetic compass
  - Gyro compass
  - Gyro-horizon : cage before switching ON
  - Pitot heater : check light OUT
  - TCN on REC
  - IFF/SIF on stand by
  - UHF T/R + G
- Use same starting procedure for the right engine, but maintain it on idle.

2.4.2. STARTING INCIDENTS

- If an engine does not start rotating as soons as the switch is actuated, switch back to neutral; check that the throttle is fully closed. (A micro-switch actuates the starting circuit).
  Try again. (check C/B STARTER 600)
  If no result, do not re-attempt, since the engine might be frozen.
- If the temperature exceeds 600°C while starting (650°C for the left engine during winter operations) close the cock, switch starter "OFF" and pull fuel booster pump circuit breaker.
- Maximum starter running-time : 30 sec.
- If ignition-injection button remains stuck :
  - shut fuel cock immediately
  - leave starter on for 20 seconds
  - pull starting circuit breaker (first one on the right)
  - cancel mission.
- If there is no increase on the EGT 10 seconds after the fuel cock is opened, close the fuel cock and return the starter switch to neutral. Allow the turbine to stop completely and start all over again. If again there is no result, investigate.

2.4.3. BATTERY CART UTILISATION

In order to save the aircraft battery, a battery cart may be used to start the engines.

After the cockpit check as previously described, have the battery plugged in, and use the normal starting procedure (as 2.4.1.). The generator warning light will remain on. Have the battery cart disconnected and the generator light will go off with the left engine running above 7.500 RPM.

NOTE :
The battery cart may be plugged in with or without the aircraft battery switch on. However, it is recommended to switch the aircraft battery on as soon as the battery cart is plugged in.

2.5. CHECKS BEFORE TAXIING

T - Throttles - 15000 RPM on left engine, right engine idle.
- Check throttle friction.

T - Trim - Check complete travel and set to 0°
A - Airbrakes - In

C - Controls - Artificial feeling connected.
- Aileron boost "ON".
- Check controls, check for hydraulic pressure drop when moving ailerons.

U - Undercarriage - Down...
F - Flaps - Fully down, then "UP" to 15° in two times.

F - Fuel - Check for leaks.

I - Instruments
- Switches "ON"
- Gyros : synchronise gyro-compas
- Check static pressure instruments
- Check engine instruments : tail pipe t°, Oil t° and pressure.
- Check hydraulic pressure and voltage.

O - Oxygen - Normal and emergency "OFF"
- Check pressure and blinker
- Check connections

AL I

H - Hood - Canopy closed and locked, light out.
- Fresh air scoop closed.
- Canopy seal "ON", pressurization "ON" and check temperature.

H - Harness - Tight and locked.

H - Helmet - Chin strap connected - visor down

Request taxy clearance - check for taxy obstacles - signal the crewchief.

2.6. LEAVING THE PARKING AREA

- IFF invertor "ON" - TCN on REC for 2 minutes and then on T/R
- Hold aircraft with brakes, increase right engine to 15.000 RPM and release emergency brake.
- Release brakes, when aircraft moves test the foot brakes.
- Taxy in a straight line for about 10 meters.
- Reduce engines to 10.000 RPM and brake slightly in the direction of the turn.
- About 20° before reaching desired direction increase engines to 15.000 RPM, and reduce to 10.000 RPM when desired taxy speed is reached.

2.7. TAXY

1. Put 10.000 RPM on both engines and taxy with rudder in neutral position.
2. Use brakes smoothly.
3. Keep 100m from preceding aircraft.
4. Perform vital actions as follows :

   a. Pressure instruments :
      - Pitot heater ON
      - ASI on red dot
      - Altimeter : note maximum error : ± 75
      - V V I on zero

   b. Gyro instruments :
      - Switches ON, NO OFF flags
      - Make L & R turns : Gyro proper motion, St by compas following.
        Artificial horizon : 5° max. pression
        Turn & bank : correct indication

TAKEOFF GROUND RUN DISTANCE

No wind.

Weight on takeoff : 3.100 kg (tiptanks full).

PA = Pressure Altitude

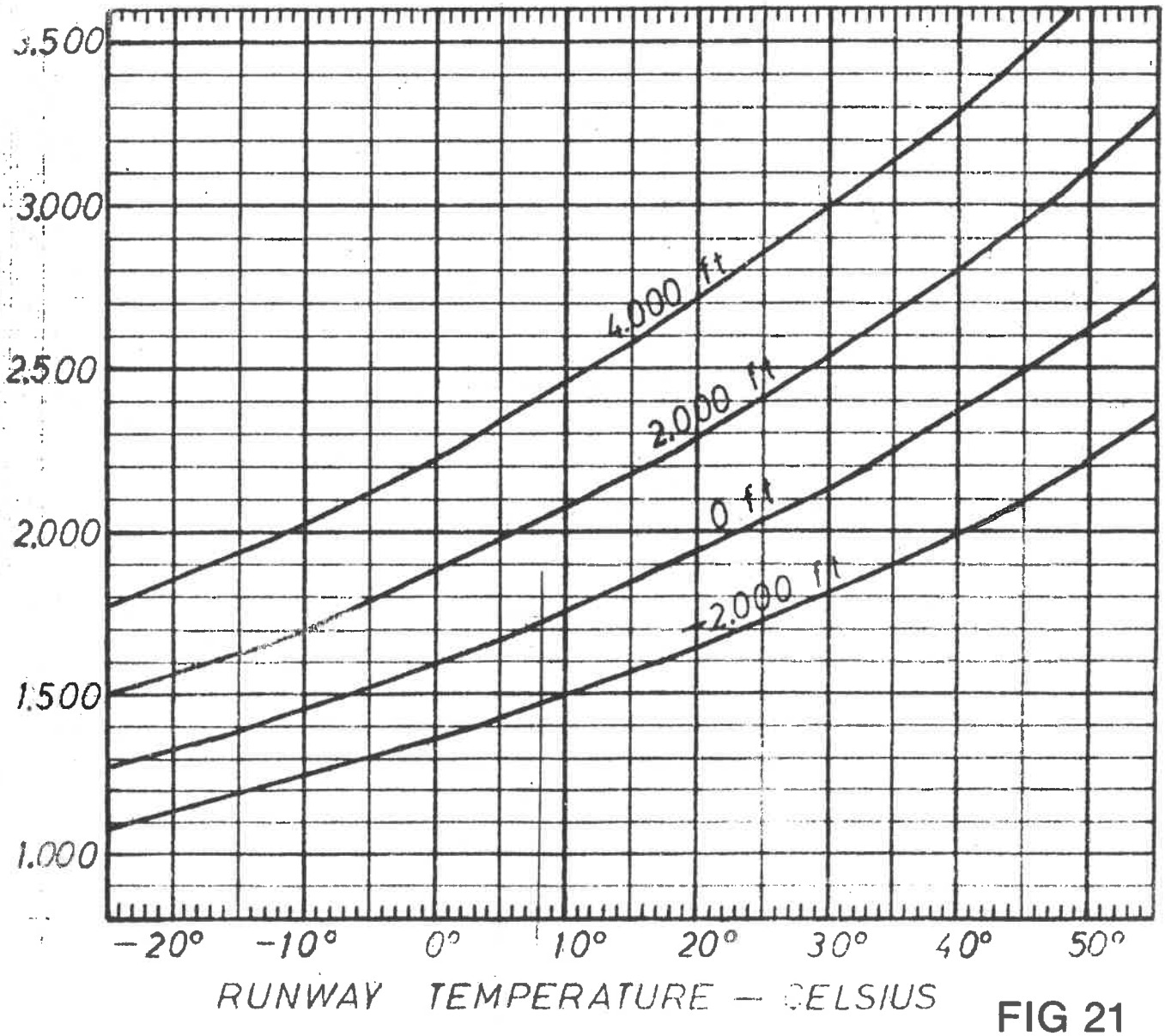


FIG 21

c. Miscellaneous instruments :

- Voltmeter, Hydraulic pressure
- Engine instruments
- Test emergency brakes
- Test clock
- TAC on T/R and identification
- IFF check.

5. Stop the aircraft with the nose in the wind with an angle of 30° to 45° to the taxy track direction.

CAUTION

1. Use throttle handles smoothly to prevent overheating and rumbling.
2. Keep at least 10.000 RPM on left engine to insure 28,5 voltage from the generator.
3. When the aircraft comes to a stop, increase both engine to 15.000 RPM.

2.8. TAKE OFF

Increase to full power (22.600 RPM)

C - Controls : check stick for free movement

R - Red : no red lights - landing light on

E - Engine : 22.600 RPM (+ 50, -100) EGT ⩽ 665°C
Oil pressure : 3,5 - 4,5 Hpz Hydraulic pressure:250 Hp
Oil temp : 10° - 85° Voltmeter 28,5 V

S - Slaved gyro : on runway heading

T - Time : Engage stopwatchwhile releasing brakes.

- Release the brakes. Use them if necessary to keep the aircraft straight during the first part of take-off.
- Rudder control is effective around 40 to 50 kts
- Ease the nose wheel off at 70 kts
- Take-off at minimum 90 kts
- When safely airborne and definitively climbing : A - Airbrakes "IN"
  B - Apply brake smoothly
  U - Undercarriage "UP" : must be retracted before 140kts
- AT 120 Kts : F - Flaps "UP"

- Reach climbing speed at + 500/1000 ft min climb
- For take-off distances, refer to fig.21.

If, after retracting the gear, one or several red lights remain on, lower the gear again between 120 kts and 140 kts.
Wait a few seconds until the hydraulic pressure builds up to the maximum and retract the gear again at a safe altitude.
Total time to retract should be around 4 seconds. Should the red light persist, lower gear, dump fuel in tip tanks and land.

ATTENTION

In cross-wind conditions, put aileron into the wind.

NOTE

a. On wet runway, lift nosewheel off as soon as possible in order to prevent flame-out due to water ingestion.

b. Taxi and landing lights : With exception for the aircraft of the acrobatic team, the landing and taxi lights turn automatically off, independently of the position of the switch in the cockpit, whenever the undercarriage is raised and locked up. The gun sight C.B. must be "IN".
For the aircraft of the acrobatic team, this can only be achieved after the ARM-REARM selector has been set on SAFETY position.

c. To use the landing light in flight, gunsight circuitbreaker IN and push on the press-to-test landing gear light center button.

2.9. CLIMB (Fig.23)

- After take-off, maintain 200 kts constant air speed until .42 MACH is reached (around 18.000ft). Then maintain .42 MACH.
- 22.600 RPM are limited to 15 minutes. This means up to about 25.000 ft. Then throttle back to 21.750 RPM. (limited to 30 minutes) See limitations § 3.1.1.
- Every 5.000 check :

  F - Fuel : Quantity and leaks

  I - Instruments : Engine, voltmeter and hydraulic

  O - Oxygen : Normal/Normal, quantity, blinker and connections

  H - Hood : Red light out, pressure, cabin altimeter

  H - Harness : Tight

- Adjust the cabin temperature

NOTE : when passing through transition ~~level~~ altitude display altimeter setting 1013.2

2.10. NORMAL FLYING AND CRUISE

2.10.1. NORMAL FLYING

- Maximum continuous power : 21.000 RPM
- Whatever the altitude, and for a mission that does not require the optimum utilisation of fuel, a power setting of 20.000 RPM is a good compromise. All manoeuvres may be performed, including formation flying.
- The red light for fuel illuminates when 150 liters are remaining.

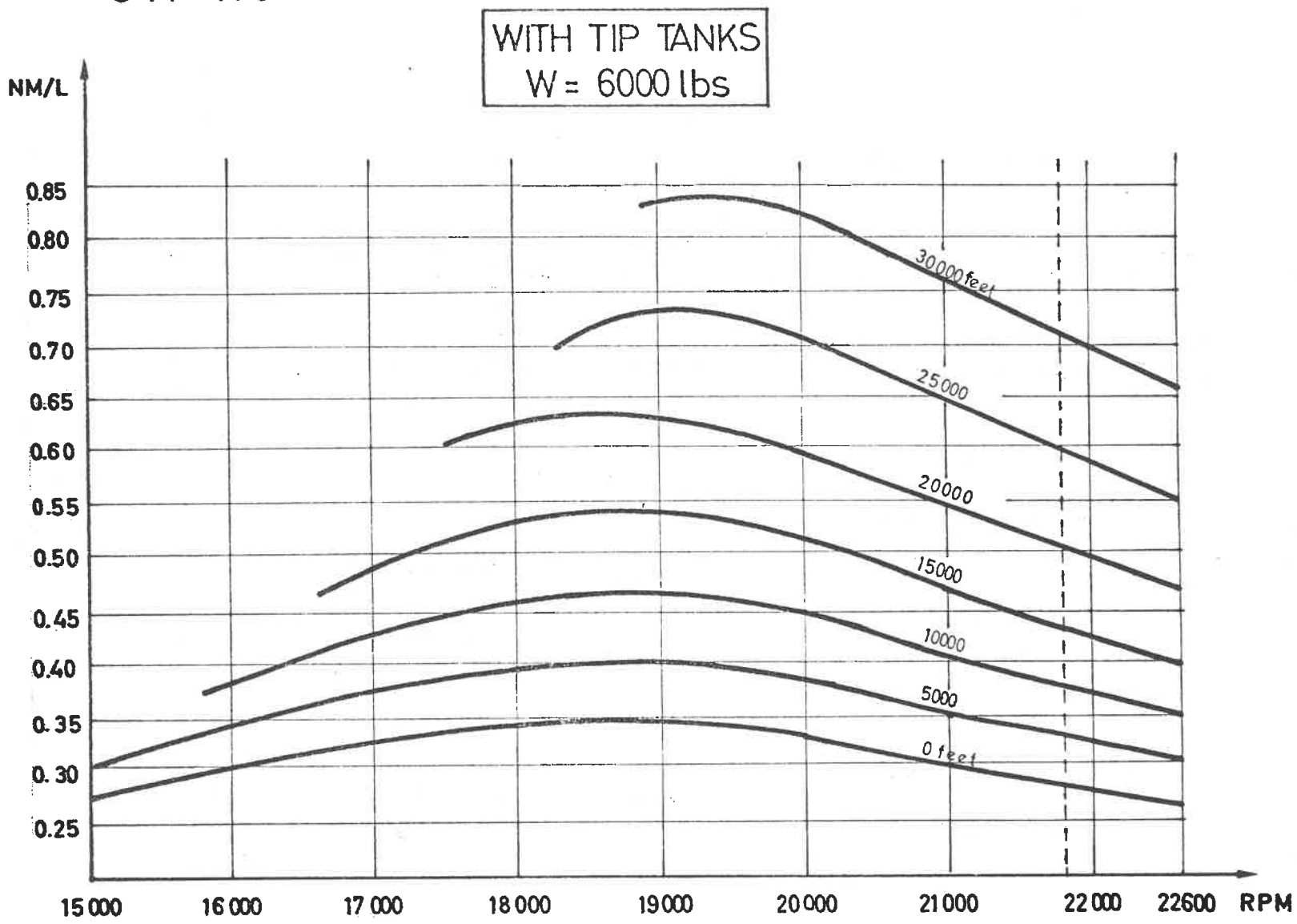
- For specific utilisation, check attached charts and performance data (fig.24 ~~to 32~~).

2.10.2. HEADWIND CRUISE

At 2.500 ft : till 50 knots headwind : keep 21.000 rpm.
For stronger headwinds : add 200 rpm for every 10 knots till 21.500 rpm.

AL I

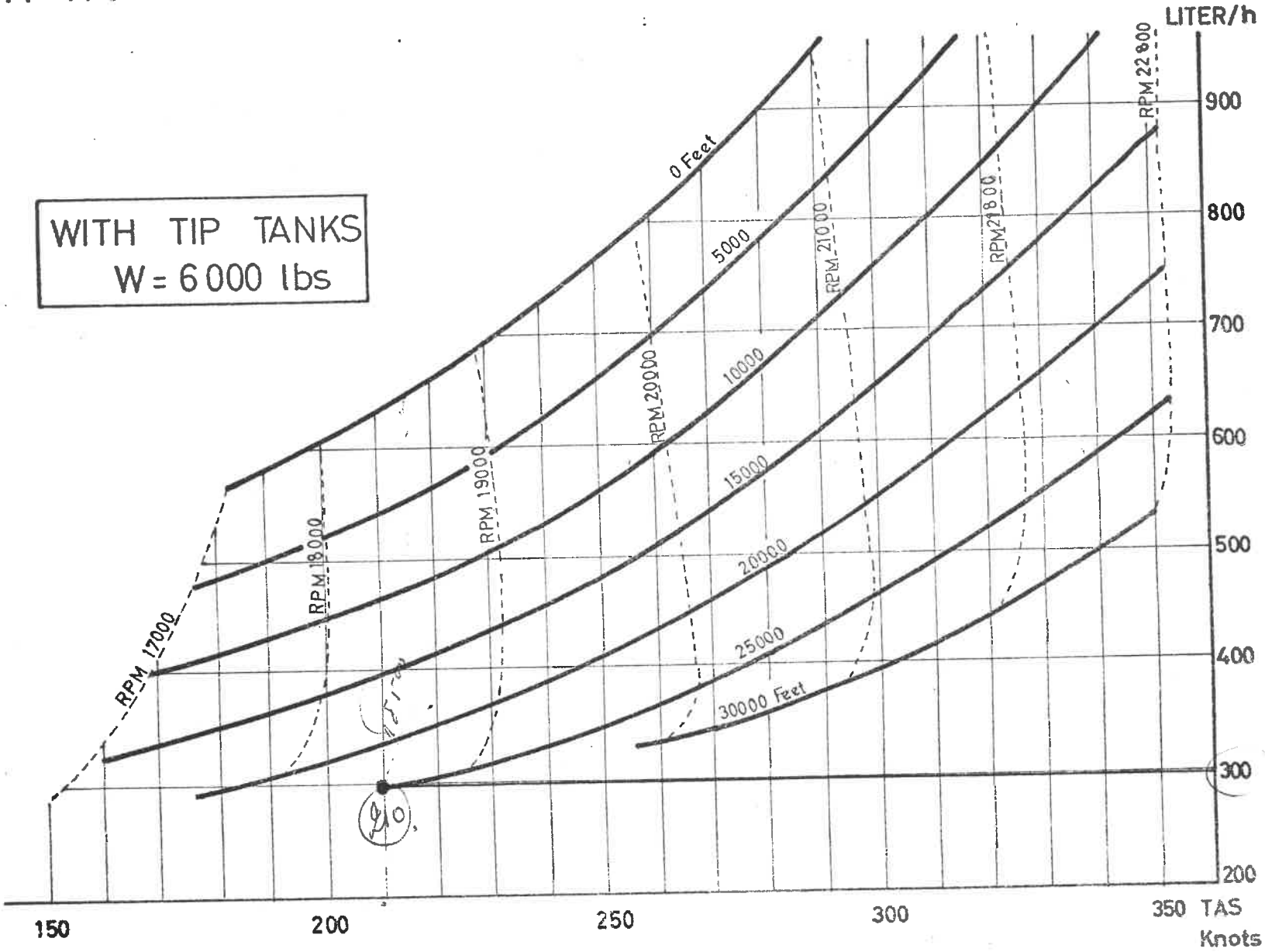
C M 170



DISTANCE COVERED PER LITER

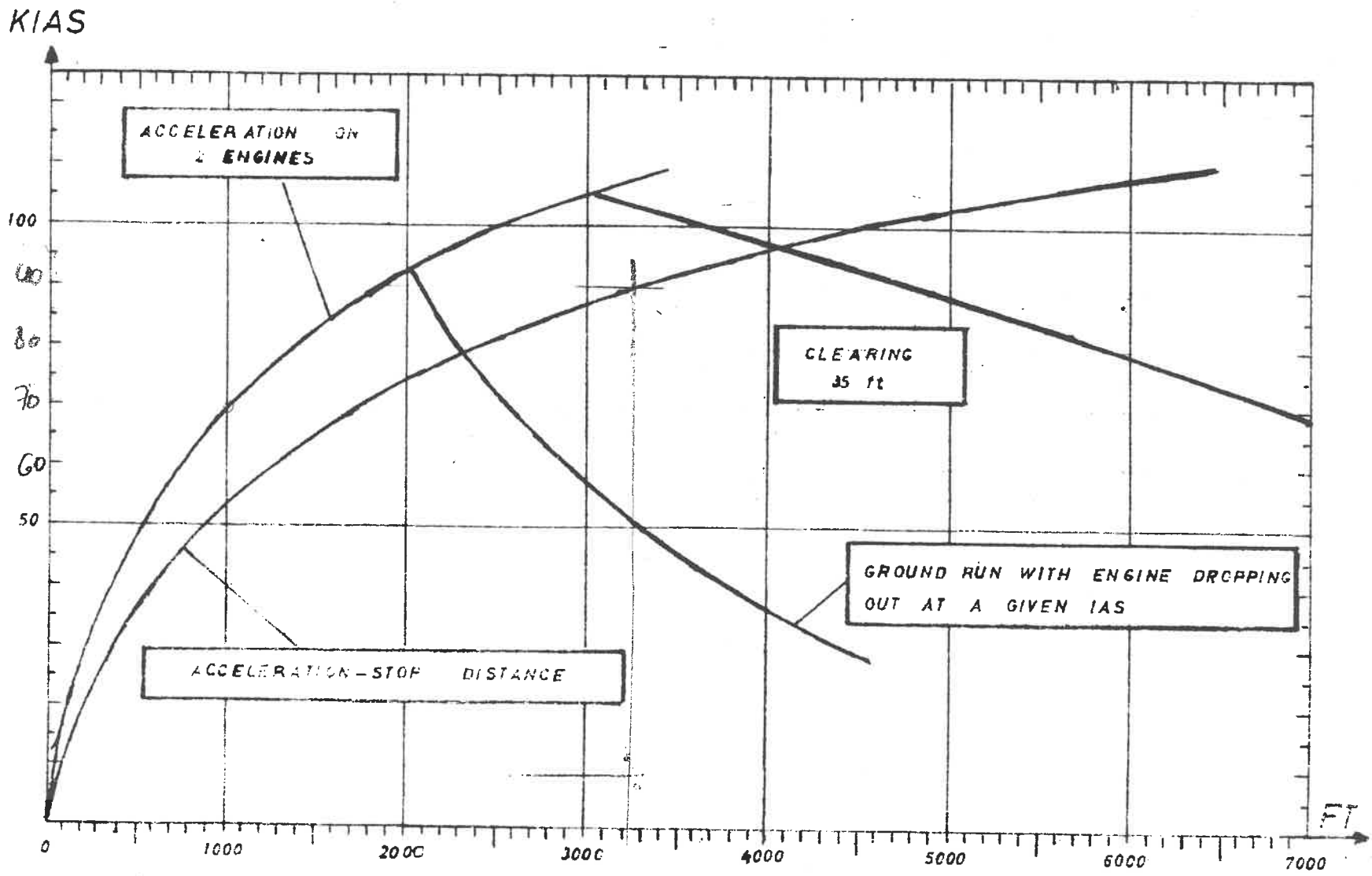
FIG 29

C M 170



HOURLY CONSUMPTION Vs SPEED

FIG 30



ENGINE FAILURE AT TAKEOFF

STANDARD ATMOSPHERIC CONDITIONS — NO WIND

FIG 22

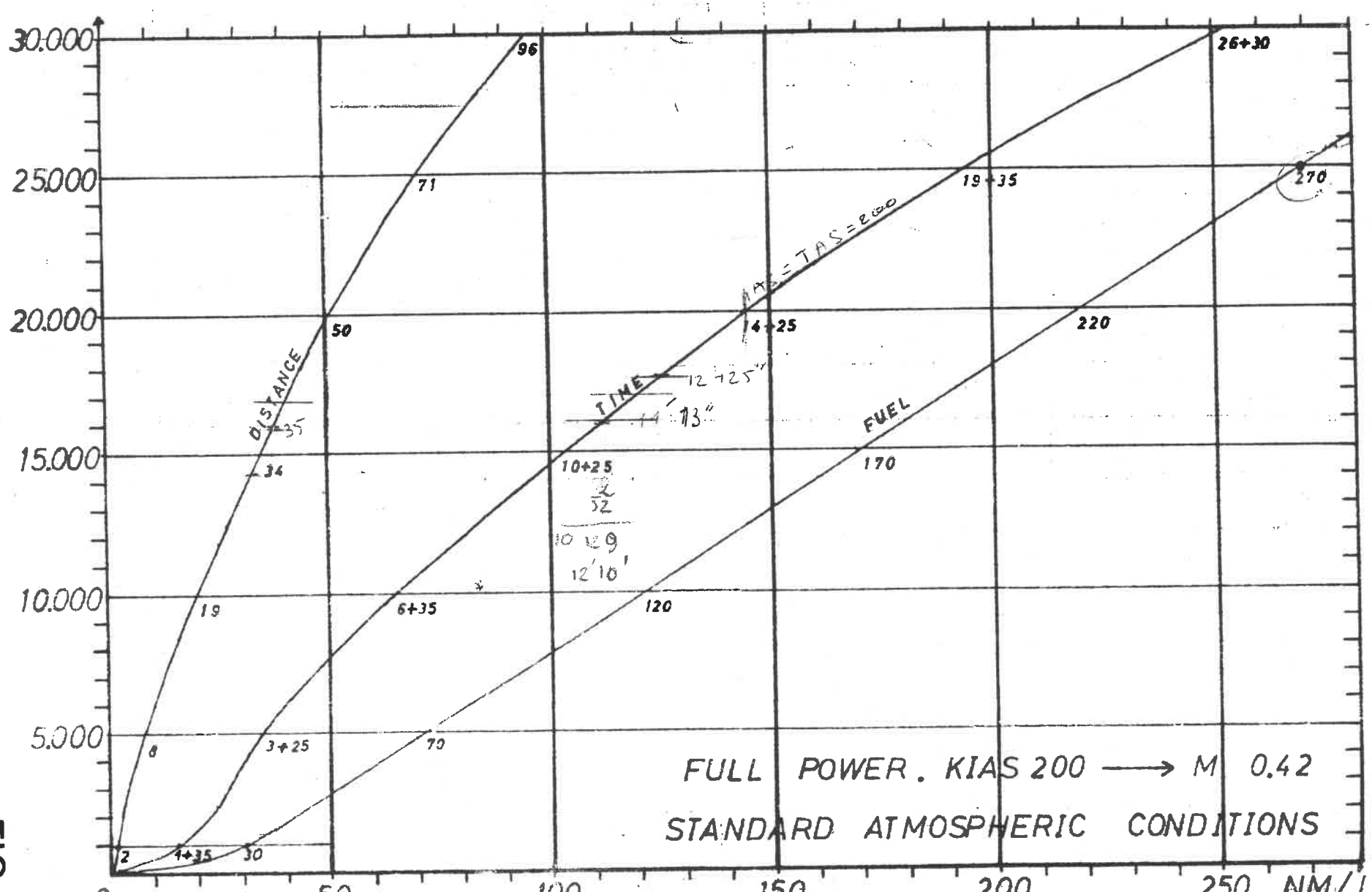
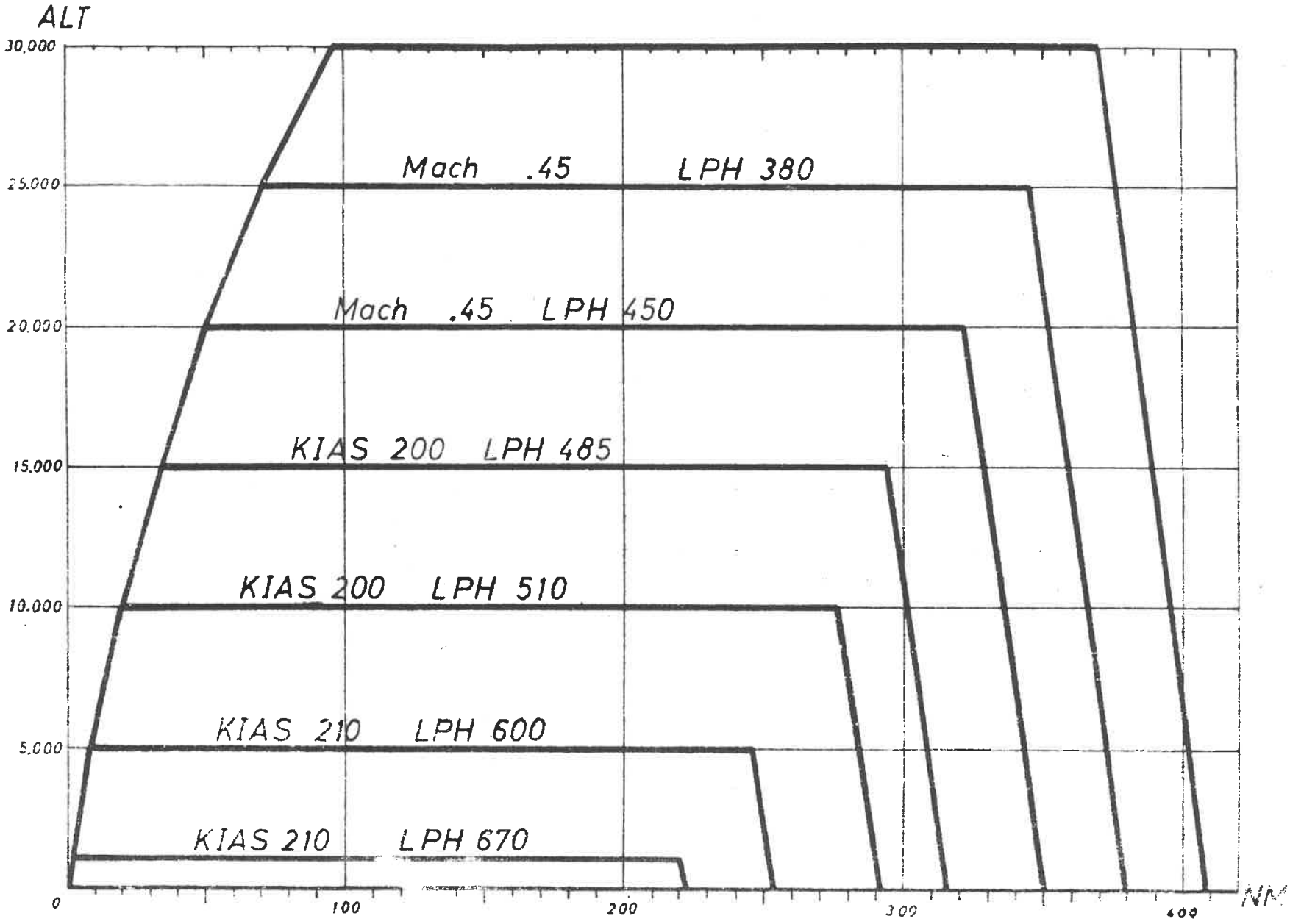


FIG 23

CLIM? CHART Fouga

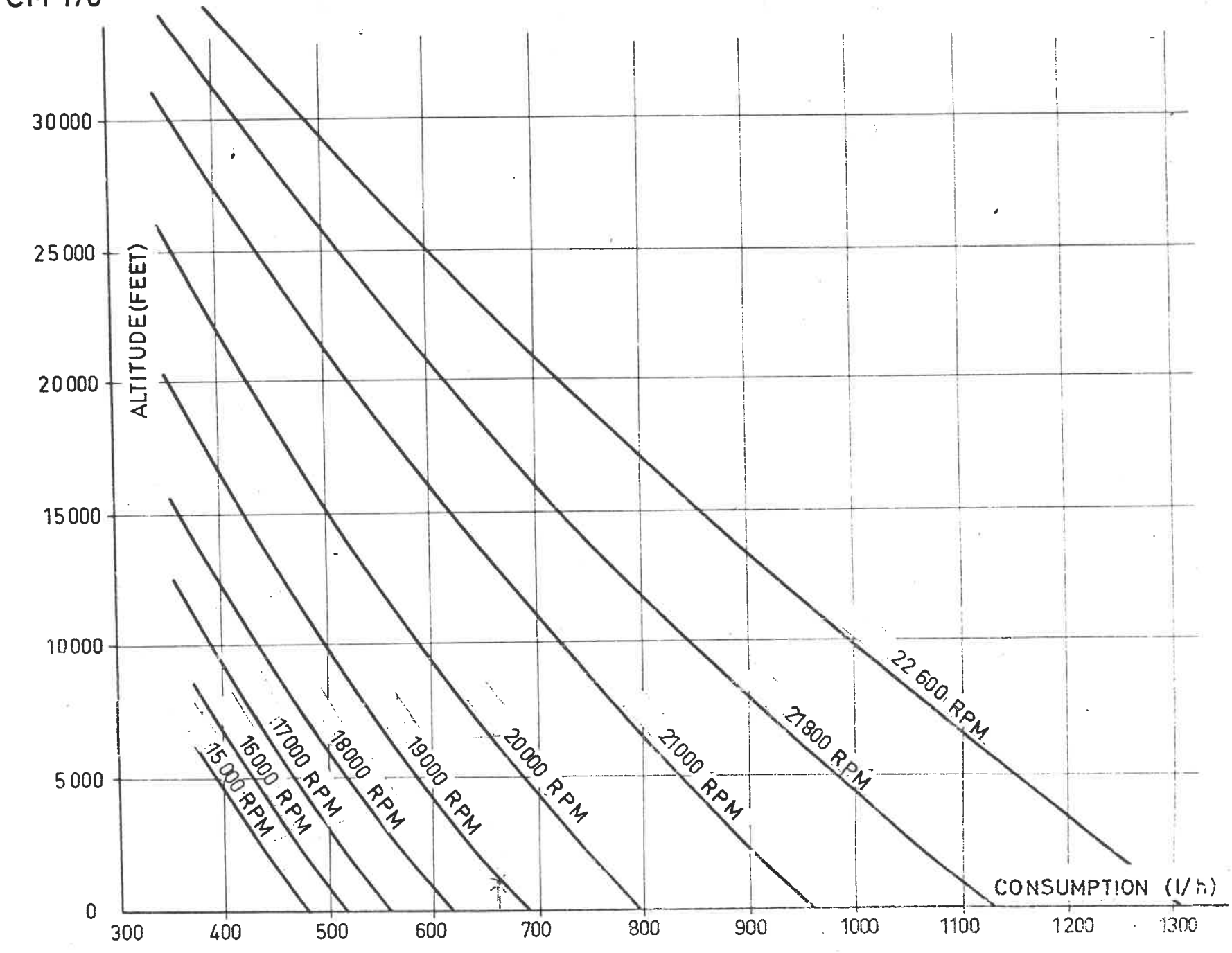


RANGE CHART Fouga

NORMAL CLIMB — IFR DESCENT — FUEL RESERVE · 200 Liters

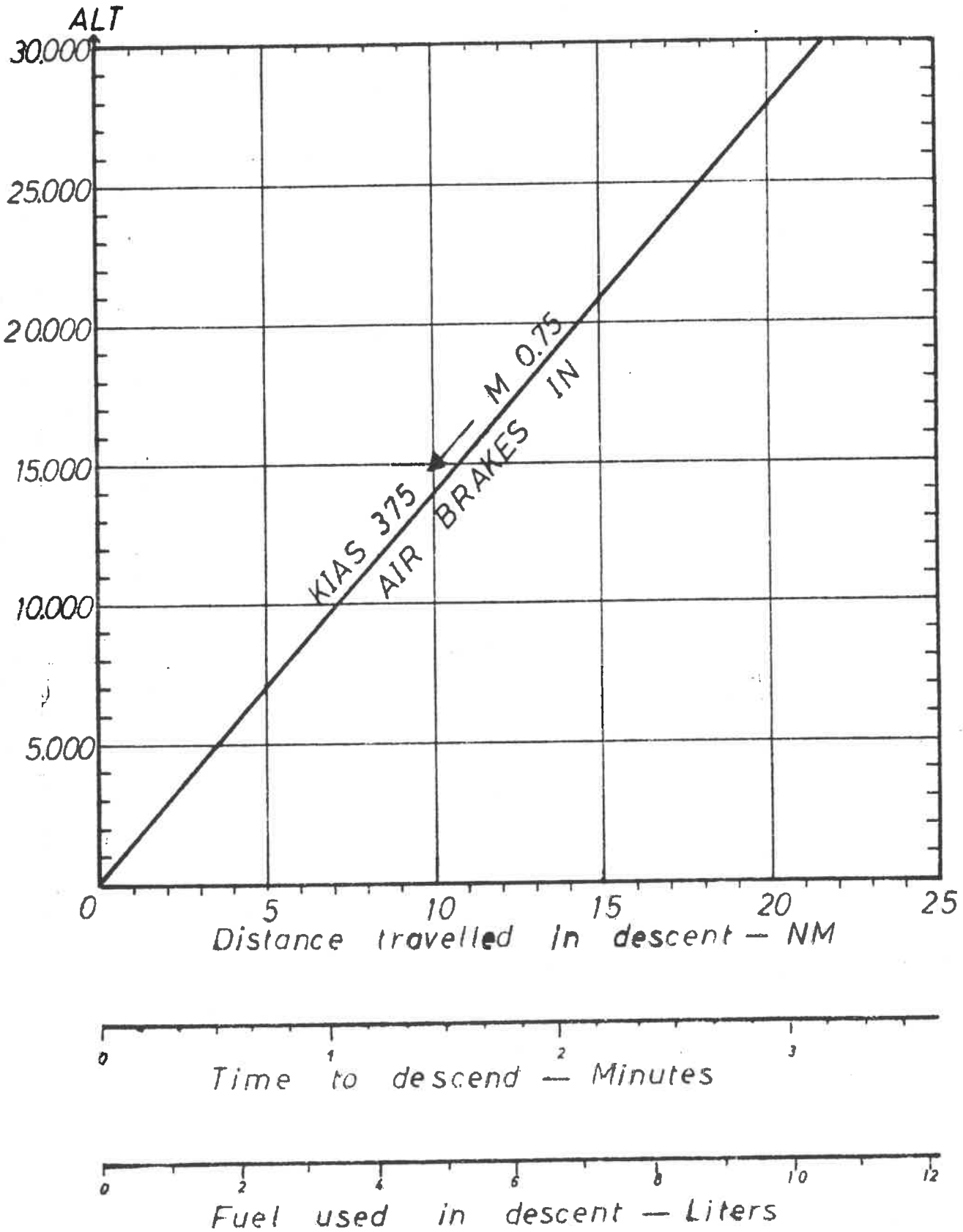
FIG 24

CM 170



TOTAL HOURLY CONSUMPTION

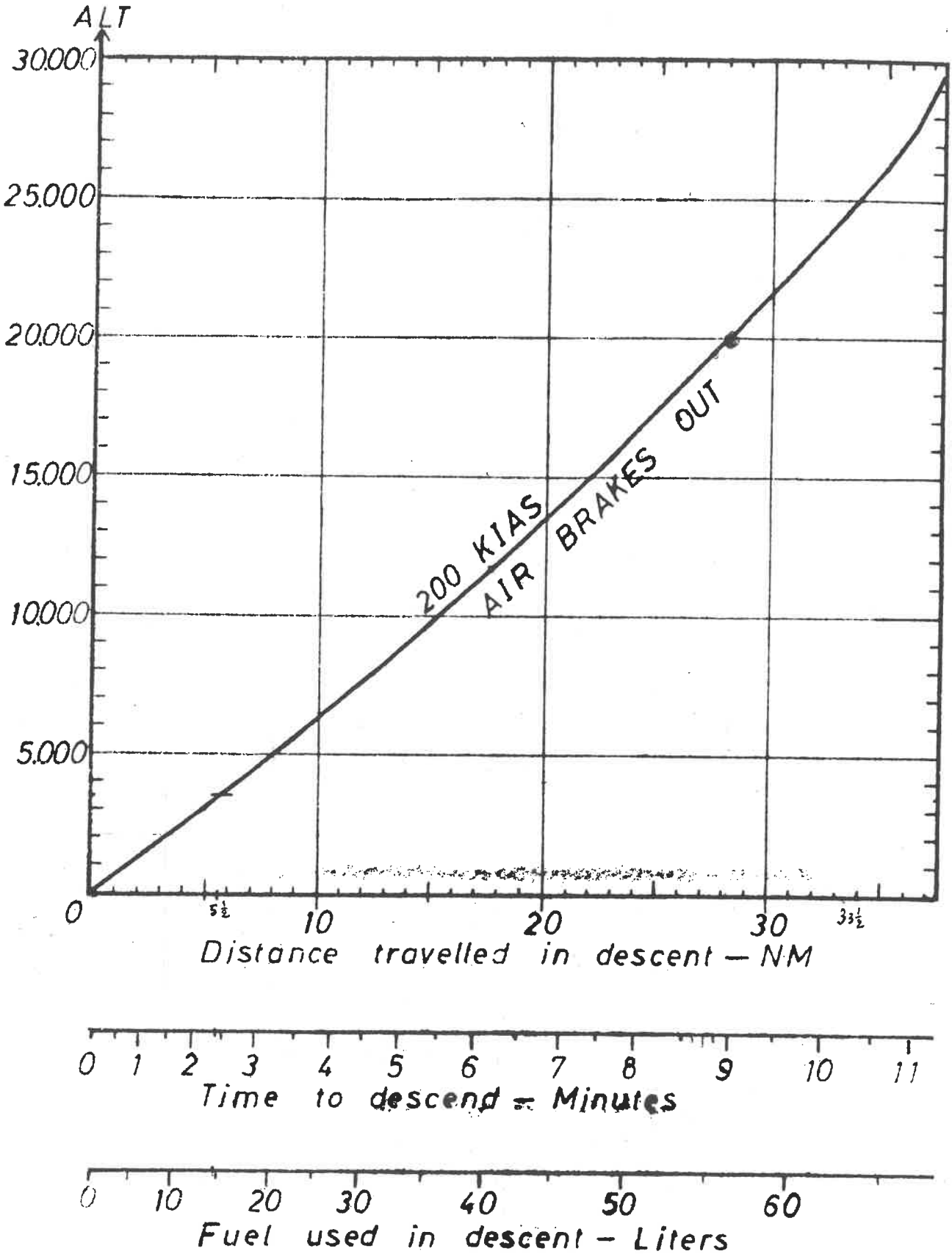
FIG 31



HIGH SPEED DESCENT

Power-off

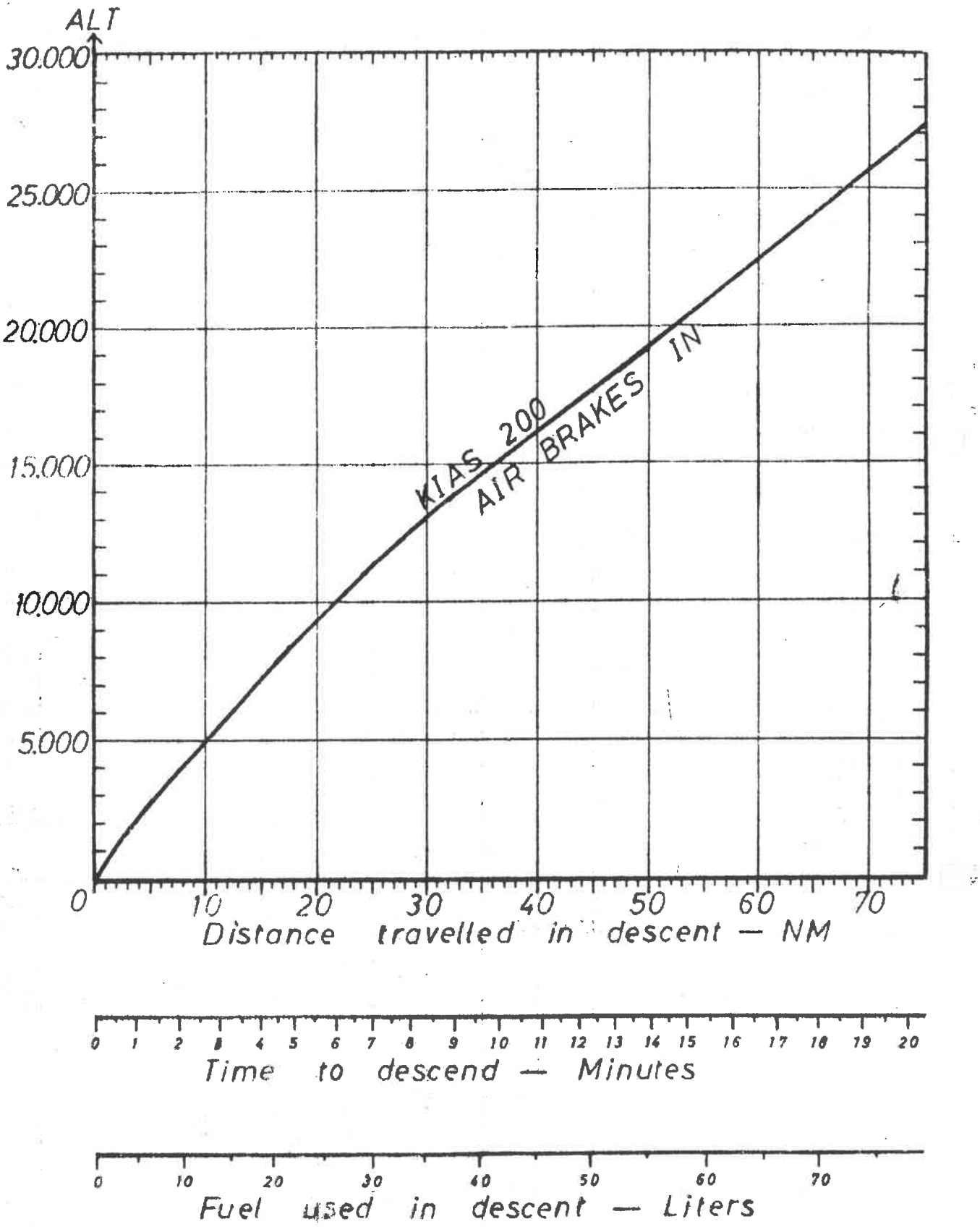
FIG 32 a



IFR DESCENT : Power-on

POWER SETTING : $\frac{18{,}000 \text{ RPM}}{17{,}000 \text{ RPM}} \rightarrow$ 20,000 ft

FIG 32 b



LONG RANGE DESCENT

Power-off

FIG 32 c

The fuel consumption per kilometer is the same for the following cases :

W/V = 100 kts headwind - Altitude 25.000 ft = 21.500 rpm

W/V = 50 kts headwind - Altitude 15.000 ft = 20.000 rpm

NOTE

A perceptible increase in indicated airspeed will be noticed in flight as fuel tanks empty. The attached charts have been established for an average weight of 6.000 lbs (Main tank half empty).

- Perform the "FIOHH"-check every 5 minutes.

2.11 DESCENT, CIRCUIT AND LANDING

2.11.1. RAPID DESCENT IN CLEAR SKY

- Airbrakes "IN"
- Power : 17.000 rpm above 15.000 ft
  idle below 15.000 ft
- Above 15.000 ft .75 MACH
- Below 15.000 ft 375 knots IAS

2.11.2. ECONOMICAL DESCENT

Economical descent which gives the maximum range :

- Airbrakes "IN"
- Power idle
- 200 Kts IAS

2.11.3. INSTRUMENT LET DOWN

- Airbrakes "OUT"
- Power : 18.000 rpm from 30.000 ft down to 20.000 ft then 17.000 RPM and maintain throttle setting down to level off.
- 200 kts IAS

NOTE :

To prevent icing from developping inside the cockpit, set pressurisation selector to "DEFROST" and adjust heat as required.

2.11.4. ICING CONDITIONS

ATTENTION

If severe icing forms on the aircraft :

1. Use following settings for descent and final GCA :

	Penetration	GCA final	GCA glide path
RPM	19500	20.500	20.500
KIAS	⩾ 250	130-140	120 - 130
Airbrakes	OUT	OUT	OUT
Undercarriage	UP	DOWN	DOWN
Flaps	UP	UP	DOWN

2. Make a final GCA only if weather conditions dictate; in this case, reduce power only when sure to make the runway.
3. Change power settings on the right engine first, then on the left engine.

2.11.5. CIRCUITS AND LANDING

Rejoining the circuit should be made at 1.000 ft AGL, 200 kts IAS (± 18.000 RPM) unless otherwise specified, for instance under icing conditions (REF : 4.8.4.).

2.11.5.1. NORMAL BREAK (typical)

Brake over the middle of the runway, airbrakes "OUT" with ± 45° bank angle.

Check landing light switch forward (ON)

Downwind

- 140 kts KIAS undercarriage "DOWN" airbrakes "IN" Flaps 15° abeam the carav
- keep 130 Kts KIAS
- When beginning of runway disappears under the leading edge start turning towards runway, reduce to 11.000 RPM and descend at 130 KIAS.
- Perform BUFAP - check - BUFAP = B - Brakes for pressure
  U - Undercarriage down - 3 greens
  F - Flaps : fully "DOWN"
  A - Airbrakes : "IN"
  P - Pressure 250/250 Hpz

270° point : speed 120 KIAS

Final approach : speed 110 KIAS

Boundary : speed 100 KIAS

Landing and touchdown : - Keep nose up
- Put nose wheel down at slow speed
- Keep direction with rudder
- Use brakes to slow down and keep direction

NOTE

The airbrakes may be used as required for approach and landing. They have no influence on the attitude of the aircraft and only increase the gliding angle.

CAUTION

When landing with one full and one empty tip tank :

- Final approach speed : 120 kts
- Boundary : 110 kts

2.11.5.2. GO-AROUND

Use full power; when safely airborne perform "ABUF" check (raise flaps with 15° increments).

2.12. CHECKS AFTER LANDING

T - Trim neutral

A - Airbrakes "IN"

C - Controls : aileron boost and artificial feeling "OFF"

F - Flaps "UP"

I - Instruments : Inverter, IFF and TCN "OFF", booster pump circuit-breaker out and landing light off

O - Oxygen : 100%

H - Hood : pressure "OFF", seal "OUT".

2.13. ENGINE SHUT-DOWN - PARKING CHECKS

- At the parking area have the shocks installed (do not apply the ~~parking~~ emergency brake with hot brakes)
- Allow the engines to run at 15.000 RPM for about 30 sec
- Shut fuel cock of the right engine. When rpm drops through 5000 rpm, shut fuel cock of left engine.
- Shut off all ancillaries (pitot heater, directional gyro, horizon...)
- Cut off battery
- Open the canopy

2.14. BEFORE LEAVING THE AIRCRAFT

- Disconnect radio plug and oxygen hose
- Release shoulder and lap harness. Put lap belt buckle back on closed position.

2.15. LANDING AWAY FROM HOME BASE

After flight

- Check forward and rear cockpit for all switches off (fuel cocks closed, throttles fully back)
- Check exterior condition of aircraft (airframe, landing gear, tires, possible leaks, access doors in place and locked)
- Check oil level 15 minutes minimum after engine shut-off
- Check hydraulic fluid level

- Check alcohol (reservoir inside nose compartment)
- Refuel the aircraft (980 l full capacity)
- Service oxygen tanks (140 hpz minimum pressure)
- If possible, park aircraft inside hangar (ATTENTION : do not leave emergency brake ON)
- In case of outside parking : put covers on, shocks in place, till down (ATTENTION : do not leave the emergency brake ON)

Before flight

- Plug in battery cart (eventually)
- If solo flight : check rear cockpit : - canopy seal ON
  - canopy closed and locked

SECTION III - OPERATING LIMITATIONS

3.1. ENGINES

3.1.1. MAXIMUM VALUES (NOT TO BE EXCEEDED)

PHASE	POWER SETTING	E.G.T.	STATIC THRUST	DURATION
Run-up Take-off Climb	22.600 RPM +50 -100	665° 675°	880 lbs 400 DaN	15'
Climb after 15 min	21.750 RPM	600°C	790 lbs 360 DaN	30 min
Maxi continuous cruise	21.000 RPM	550°C	705 lbs 320 DaN	Unlimited
Approach idle*	~~14.500~~ 11.000 rpm*	450°C	120 lbs 55 DaN	Unlimited
Idle at ground	6.200 RPM to 7.000 RPM	500°C	33 lbs 17 DaN	15 min

NOTE : At start of climb at maximum rpm, a steady increase in rpm may be noticed, causing the latter to reach 22.800 rpm around 10.000 ft. Above this altitude the rpm will decrease as a result of the action of the altitude corrector.
EGT should never exceed 675°C.
Whenever either of these values is reached, pilots should retard the throttles. Any exceeding of these values must be noted in the aircraft forms, with details about the duration and the amount of the overspeed and/or overheat.

* Minimum RPM permitted during approach.

3.1.2. OIL SYSTEM

	Ground	MINI	NORMAL	MAXI
Oil pressure	0,5 hpz	hpz 0,8	hpz 2 to 4	hpz 4,5
Oil temperature	20°	10°C*	50°C	85°C

* During cold weather operations, minimum for take off

The rear cockpit instrument panel is not equipped with an oil pressure gauge, but two red lights (one for each engine) illuminate when the oil pressure drops below 0,7 (12 p.s.i.)
Despite zero oil pressure, if absolutely necessary, an engine may be run for 10 to 15 minutes. Shutting down the engine will somewhat reduc the damage although the windmilling speed is great enough to damage th engine after some time.
The oil tank cooling air intake duct cannot be adjusted in flight but on the ground only. The operating range is wide enough to keep within the limits during normal utilization.

3.1.3. ACTUATING THE THROTTLES

In flight, the throttles must be moved carefully due to poor acceleration control. Too fast a movement may lead to surging and overheating. The engine acceleration time depends upon altitude and airspeed. For example, at low altitude and at an airspeed of 110 KTAS it takes about 10 seconds to go from idle to full power.
Surging and overheating must be avoided at all times.
Surging manifests itself by loud blasts, similar to gun firing, and an increase in E.G.T.
Surging may occur at any RPM but most likely between 15000 and 20 000
The addition of several compressor stalls (surging) may cause engine explosion. Therefore every compressor stall will be entered as a discrepancy in the FORM 781 (altitude, speed, RPM) in order to initiate the necessary technical actions.

3.2. AIRCRAFT

The limitations are the same with or without tip tanks whether full or empty.

3.2.1. HIGH INDICATED AIRSPEED FLYING

The maximum permissible indicated airspeed is 400 knots (which may be reached jointly with .82 Mach).

3.2.2. HIGH MACH NUMBER FLYING

The maximum permissible Mach number is .82.

3.2.3. LOAD FACTORS

- The maximum permissible load factors are as follows :
  - Positive +5.5.g
  - Negative -3 g

With ailerons fully deflected, do not exceed + 3 g.

3.2.4. CEILING

Efficient ceiling : 35.000 ft.
Maximum ceiling : 40.000 ft.

- Normal altitude limitations

  Due to frequent flame-outs of the Marbore II engine above 25.000' mostly caused by throttling back, the normal operating ceiling should not exceed 25.000 ft.

  When operating above 20.000', the following procedure must be applied :

  - first reduce right engine : when rpm has stabilized at the desired value, reduce left engine
  - keep at least 21.000 rpm for cruising
  - keep airspeed at or above 200 kts.

3.2.5. CENTER OF GRAVITY LOCATION

In all cases of possible loadings (1 or 2 pilots, with or without armament, tip tanks, full or empty), the aircraft remains within the approved center of gravity positions.

3.2.6. PROHIBITED MANOEUVRES

- 125 l.tip tanks not empty : spins, stalls in turns
- inverted loops
- snap rolls

3.3. OPERATING LIMITATIONS OF SOME SYSTEMS

3.3.1. UNDERCARRIAGE

The gear should be locked up or lowered at a maximum of 140 knots IAS.

Duration of operation : Extension : 5 seconds
Retraction : 3.5 seconds

3.3.2. FLAPS

The maximum airspeed to select and/or maintain 15° flaps is 140 KIAS. For full flaps, the maximum speed is 130 KIAS.

The back seat control switch overrides the front seat control switch.

3.3.3. AIRBRAKES

No limitations.
The back seat control switch overrides the front seat control.

3.3.4. AILERONS

Full deflection of the ailerons may be used up to the maximum speed, regardless of the aircraft configuration, up to a maximum "g" load factor of 3.

3.3.5. INVERTED FLIGHT

The maximum inverted flight time at 15.000 ft with 20.000 RPM is 1 minute due to possible fuel starvation.
The oil tank is only capable of ensuring adequate lubrication during 20/30 sec.

3.3.6. TIP TANKS

The tiptanks cannot be jettisonned; they can however be emptied within ± 3 min by use of the fuel dumping valves.

AL I

3.3.7. ELEVATOR TRIM

The elevator trim at low altitude and high speeds must be used with extreme caution.

3.3.8. TCN/IFF INVERTOR

If TCN and IFF are both inoperative the inverter should be switched "OFF".

SECTION IV - SPECIAL FLIGHT CHARACTERISTICS

4.1. STALLS

4.1.1. 1 "g" STALLS

CONFIGURATION	AIRSPEEDS knots	REMARKS
Cruise - Airbrakes in	87	Buffeting beginning at 90 knots
Cruise - Airbrakes out	90	Buffeting added to the vibrations due to the airbrakes.
Undercarriage down, flaps 15°, Airbrakes in	85	Slight warning buffeting
Undercarriage down, flaps 40°, Airbrakes in	78	Slight warning buffeting
Undercarriage down, flaps 40°, Airbrakes out	80	Buffeting beginning at 85 knots
Undercarriage down, no flaps, Airbrakes out	92	Slight buffeting beginning ar 95 knots

When the stall occurs, the nose of the aircraft usually drops straight forward, but occasionally a wing may drop.

4.1.2. ACCELERATED STALLS

In a turn, the stall, characterized by a sudden roll, is preceded by a slight buffeting. As in the preceding case, recovery is easy by relaxing the stick pressure.

4.2. SPINS

4.2.1. INTENTIONAL SPINS

Intentional spins must be performed with undercarriage and flaps up and airbrakes retracted. The tip tanks must be empty. They are accomplished as follows :

a. Conventional entry

Check first that tip tanks are empty and that trim is set for straight and level flight at 200 kts. Reduce throttles to idle and maintain straight and level flight (VSI zero).
At 95 KIAS apply full rudder in the desired direction.
When the wing drops and the nose passes below the horizon, pull stick fully back while maintaining ailerons neutral. The aircraft will then enter a spiral, may roll on its back after half a turn and only be in a spin one turn after the entry.

b. Spin characteristics

During the next two turns, rather important pitch, roll and yaw oscillations are observed accompanied by a distinct elevator buffeting. After three turns, the spin stabilizes.

c. Recovery

Recovery is accomplished conventionnally by applying opposite rudder to the direction of rotation, move stick forward until the rotation stops while maintaining the ailerons neutral.

When the rotation stops, neutralize the rudders.

- Recovery is effective after a half or a full turn
- Altitude lost per turn : ± 1.000 ft
- Height needed for pull-out after spin has stopped : 1.500 to 2.000 ft.

4.2.2. ACCIDENTAL SPIN

An accidental spin has to be stopped immediately :

- Reduce throttles
- Retract ~~flaps~~ flaps, gear and airbrakes if they were extended
- Apply the normal recovery procedure

4.3. COMPRESSIBILITY EFFECTS

4.3.1. INTENTIONAL COMPRESSIBILITY RUN

- Minimum starting altitude : 28.000 ft
- Advance slowly one throttle to full power, then the other one,
- At 200 KIAS, trim the elevator - Do not retrim afterwards
- Make a steep diving turn (minimum 60° dive)
- Observe the machmeter

At mach = 0,78 buffeting starts, at the same time forward pressure on the stick tends to decrease

At mach = 0,79 forward pressure on stick decreases, general buffeting of the aircraft

At mach = 0,80 no more pressure on stick, aileron depressions tend to roll the aircraft

At mach = 0,82 slight nose down tendency, aileron depressions increase, general vibrations increase.

Mach 0,82 may be sustained till 400 KIAS.

4.3.2. RECOVERY

Recovery may be made as follows :

by reducing power (smoothly and partially)
by extending the airbrakes
or by executing a smooth pull-out, airbrakes extended and power reduced.

NOTE : The speed limit is : 400 KIAS or 0,82 Mach
It is better to start diving with a steep angle and have a steeper pull-out rather than running after the desired mach number.
The change in elevator pressure will be more pronounced when flying with an aft center of gravity.

4.3.3. UNINTENTIONAL COMPRESSIBILITY RUN

Rarely encountered with this type of aircraft, and not serious if Mach.82 is not exceeded. Pull-out is carried out as described in the preceeding paragraphs.

4.4. AEROBATICS

All conventional aerobatics are permissible. Snap and inverted aerobatics are prohibited.

4.4.1. INVERTED FLIGHT

Inverted flight is possible through a fuel reservoir especially installed (11,5 litres). Duration of inverted flights depends on fuel consumption, that is to say, altitude and power setting; for exemple, at 15.000 ft and 20.000 RPM, the engines could stop after 1 minute and 20 seconds.

CAUTION

- While flying inverted, watch the oil pressure. When it drops to 0 (before the fuel is consumed) come back to normal flying.
- Do not fly inverted if the fuel low pressure warning light is illuminated.
- If, while flying inverted, the fuel low pressure warning light illuminates, return to normal flying.

4.4.2. STANDARD AEROBATICS

- Recommanded power settings : ~~21.000~~ 2.500 RPM

The series of classic aerobatics may be accomplished within an altitude belt of 4.000 feet and with a maximum acceleration of 3.5 "g".

- Recommended airspeeds to start the manoeuvres :
  - Chandelle, lazy eight : 240 Kts IAS
  - Slow roll, barrel roll, Split "S" : 260 Kts IAS
  - Loop, cuban eight : 280 Kts IAS
  - Immelman : 300 Kts IAS

CAUTION

Do not perform aerobatics if the fuel low pressure warning light is illuminated.

NOTE

1. Aerobatics are permitted with tip tanks full or partly full and balanced. However, aerobatics are more enjoyable when the tip tanks are empty.
2. After aerobatics, stabilize the aircraft in straight and level flight, reset the gyro-compass and cage the artificial horizon with the springloaded knob. Check hydraulic pressure 250 hpz. Dry-running of hydraulic pumps is frequent during aerobatics. In general, the pressure comes back 10-15 ~~min~~ sec after advancing throttles to full power, or by pumping the airbrakes out and in with the emergency system.

4.5. FORMATION FLYING

There is no special difficulty in performing formation flying.

4.5.1. TAKE-OFF IN CLOSE FORMATION

Set power to 22.000 RPM against the brakes and take-off normally. The leader maintains 21.750 RPM during the climb.

CAUTION

In case of water puddles on the runway, do not perform formation take-off. See paragraph 4.8.2.

4.5.2. CLOSE FORMATION MANOEUVRES

The smooth response of the engine to the throttle displacement above 17.000 rpm and the efficiency of the airbrakes make it easy for the wingmen to maintain position.

4.5.3. COMBAT FORMATION MANOEUVRES

No special problems are involved.

4.6. INSTRUMENT FLYING

The aircraft is suitably equipped for instrument flying in the clouds. A mobile instrument hood is installed in the rear cockpit : it can be easily manoeuvered.

CAUTION

Before descending, set pressurization selector to "DEFROST".

4.6.1. INSTRUMENT LET DOWN

Letdown is performed in the following way :

- airspeed 200 kts
- 17.000 rpm
- airbrakes out and maintain 200 KIAS

4.6.2. PENETRATION AND GCA

Penetration is made as follows :

- Take 200 kts
- Power setting 17.000 rpm
- A/B OUT. Maintain 200 kts

Level-off

At GCA level off height given by controller, reduce airspeed in level flight without changing rpm.

a) see § 2.11.4. (icing conditions)

b) Level-flight without airbrakes
   - at 140 kts : undercarriage DOWN
     airbrakes IN
     set 18.000 rpm
     select 15° flaps and maintain 130 kts.

Final approach

When ordered by GCA controller, set full flaps and start descending at 120 kts and ± 450 fpm.
Maintain 120 KIAS by adjusting power.

4.7. NIGHT FLYING

4.7.1. EXTERIOR INSPECTION

Same as during day-time

In addition :

- keep battery ON
- navigation lights steady - check
- check cockpit lighting
- check landing light

4.7.2. COCKPIT CHECK

Once the pilot is strapped in the aircraft :

- Keep battery ON (or battery cart, if available)
- Switch on the red cockpit lighting, console lighting and navigation lights flashing
- Carry out the checks before starting as in day-time
- After having tested all the lights, put landing gear position indicator in number 2 position (dim).

4.7.3. STARTING

Same as during day-time

4.7.4. AFTER STARTING CHECKS

Same as during day-time

In addition :

- switch on and adjust the U.V. lights
- adjust intensity of radio control panel lighting by means of the rheostat located on the front of the right console
- carry out the before taxi checks as described in § 2.5

AL I

4.7.5. TAXY

No special problem. In case of doubt, use taxi light.

NOTE : Do not taxy with left engine idling.
Keep at least 10.000 rpm to have the generator charging normally.

4.7.6. TAKE-OFF

Take-off normally. When the aircraft has left the ground (vertical speed and altimeter definite indications of climb) :

A - Airbrakes IN
B - Apply brakes smoothly
U - Undercarriage UP
F - Flaps UP at 120 KIAS
- take climbing speed according to local procedures.

4.7.7. LANDING

- Presents no special problems.
  Land as in daytime
  Use of the landing light is recommended.

4.8. ALL WEATHER OPERATION

4.8.1. RECOMMENDED AIRSPEED IN TURBULENCE

Maintain 210 knots IAS, which corresponds roughly to 18.000 RPM.

4.8.2. RAIN

In the rain, visibility through the windshield is relatively poor, but remains good through the lateral front windows.
If landing on a slippery runway in rain, keep nose high as long as possible (aerodynamic braking) and use the brakes with caution to prevent skidding.

Water puddles on the runway :

Large water puddles on the runway might cause one or both engines to flame out, because of the nose wheel throwing water inside the engine air intakes. In case of flame-out, close the fuel cock immediately.

DO NOT attempt a single engine take-off

4.8.3. HAIL

Hailstones might damage the aircraft; reduce the airspeed to 210 KIAS and fly away from the hail area as soon as possible.

4.8.4. ICING

If ice, clear or rime, forms along the leading edges of the wings, the lift will decrease. As soon as possible, fly away from the critical area, preferably climbing.
Flame-outs due to altitude : owing to possible flame-outs at altitude with MARBORE engines, caution should be exerted above 20.000 ft when reducing power (cfr § 3.2.4.). Incidents have been observed during descents with low power setting. Flame-out may occur due to ice ingestion in the engine during thermal deicing in the lower layers. It is therefore recommended to perform penetration under icing conditions using the following parameters :
- power setting : 20.000 rpm
- speed : 250 kts minimum - airbrakes OUT
- make power changes on the right first, then on the left engine.
If weather conditions (ceiling and visibility) permit, do not perform a GCA. Rejoin overhead the airfield keeping as much altitude and airspeed as possible (IAS 250 kts till the break) even if deicing seems to be terminated.

The windshield alcohol de-icing pump is, in fact, an anti-icing device which should be used to prevent icing from forming. In case the airspeed and altimeter readings become obviously erroneous (static ports iced up), correct airspeed and altimeter readings may be obtained by breaking the machmeter or vertical speed indicator glass (use the radio plug) and putting the pressurization OFF (cockpit seal deflated).

4.8.5. THUNDERSTORM

In a thunderstorm, reduce the airspeed to 210 KIAS at once. The atmospheric static noise is important and decreases radio reception.

SECTION V - EQUIPMENT UTILISATION

5.1. RADIO EQUIPMENT (see fig.14, 15 and 16)

5.1.1. GENERAL

The radio equipment installed in the aircraft consists of

- 1 VHF transmitter receiver
- 1 UHF transmitter receiver
- 1 TACAN transmitter receiver
- 1 IFF transmitter receiver
- ONE interphone system

All equipment can be switched on simultaneously. The radio, TACAN and IFF equipment can only be switched on and off from the front cockpit.

5.1.2. INTERPHONE CONTROL PANEL UTILISATION

5.1.2.1. NORMAL OPERATION

On the interphone control panel, the emergency rotary selector must be on the triangular index Δ (Fig.15).

a. INTERPHONE

After switching the interphone "ON" by means of the switch on the right console, the interphone is operating.
Adjust the volume by using the "ICS" audio knob as required.

b. UHF. On the UHF comm. box, switch to T/R + G and open volume completely. On the interphone control panel, turn the transmit rotary switch to UHF. Individual volume control can be obtained by using the audio knob marked UHF.

c. TACAN. On the control panel, switch to REC and open volume completely. Individual volume control can be obtained by using the audio knob marked TACAN on the interphone panel. After lock on and identification switch to T/R.

d. VHF. On the VHF control panel, switch VHF rotary switch on and open volume completely. On interphone panel, turn the transmit rotary switch on VHF. Individual volume control can be obtained by using the audio-knob marked VHF.

NB. For the normal use of the UHF-VHF and TACAN the interphone system must be switched on.

5.1.2.2. Emergency operation

In case there is no reception on either ICS, VHF, UHF or TACAN due to a failure of the individual amplifier proceed as follows: Rotate the "Emgy"-rotary switch until the needed equipment abbreviation is under the index; this is to be done in both cockpits.

- With the rotary switch on ICS only the interphone is available.
- With the rotary switch on VHF the C.S.F. CC-262 can be used as a VHF radio and as an interphone
- With the switch on UHF the Collins 201 can be used as a UHF radio and as an interphone.
- With the switch on TACAN, only the TACAN reception is possible.

NB. The VHF-UHF TRANSMIT rotary switch is only operative with the EMgy rotary switch on "Δ"; its use has no importance when another selection is made.

5.1.3. USE OF THE VHF - C.S.F. - CC-262 (FIG.14)

The equipment is located on the consoles situated between the pilot's legs.

- The radio is switched on by turning the central bottom (volume) knob to the right; be sure the VHF-circuit breaker on the right console is "IN".
- Turn the selector knob until the desired channel number appears below the top index.
- When the yellow light is out receiver and transmitter are ready for operation.
- The volume can be adjusted by use of the "VHF" audio knob on the interphone control panel.
- The "SQUEL"-switch, situated on the right side of the radio switch makes it possible to switch the circuit off when put in the "A" position.
- ~~The left switch on the radio-set can only be used when a micro phone is connected. The switch should always be on the "TRAFFIC" position.~~ AL 2

A two-position switch below the radio-set makes it possible to feed the VHF-set with the aircraft battery or a separate battery installed especialy for that purpose.

AL I

Change of frequencies : To change frequencies turn the knob until the desired channel number appears below the top index.

Transmission : To transmit, the button on the control stick has to be pressed. The button of the rear seat overrides the front seat button.

5.1.4. USE OF THE UHF - COLLINS 201 (FIG.14)

The radio set has two separate parts :

a. A frequency keyboard "MANUAL" which enables the pilot to tune in 3500 frequencies (with a spacing of 50 Kc) ranging from 225.000 Mc to 399.95 Mc.

b. A rotary switch which enables the pilot to tune in 26 preselected channels. The rotary switch is easily removable to change preselected frequencies.
In addition to the 26 numbers a stop marked "M" eliminates the preselected channels and permits manual tuning. A stop marked "G" switches the set to guard channel (243.00 Mc). Reception only of the guard frequency is possible on any preselected frequency provided the 4 position switch is switched to T/R + G. When reception of the guard frequency is desired when tuned to a manual frequency the letter "G" should appear besides the index. A "TONE" button transmits a modulated tone for easy homing by ground equipment.

5.1.5. INTERPHONE

The interphone permits communication between the front and rear cockpit without the use of a transmitter button provided the circuitbreaker is in and the system switched on in the front cockpit. Three different modes can be used :

a. Interphone "TEAM"

When switched on, the volume is set by the use of the ICS-audio knob on the interphone control panel. The interphone can be used with the "EMgy"-switch in the "Δ" or the "ICS" position.

UHF RADIO

SECTION I

DESCRIPTION

1-1. GENERAL.

1-2. This manual covers intermediate level maintenance instructions for the AN/ARC-164(V) Radio Set. The AN/ARC-164(V) Radio Set, as described in this manual, consists of the Line Replaceable Unit (LRU's) listed in table 1-1.

1-3. This manual also covers the Radio Sets with the 25KHZ baseband channel separation modification. The 25KHz modification is accomplished by replacing Remote Receiver-Transmitter RT-1145/ ARC-146(V) with Remote Receiver-Transmitter RT-1145B/ARC-164(V) and replacing Panel Mounted Receiver-Transmitter RT-1168/ARC-164(V) with Panel Mounted Receiver-Transmitter RT- 1168B/ ARC-164(V). The receiver-transmitters are referred to as RT-1145 and RT-1168 or RT-1145B and RT-1168B, respectively, throughout this manual. The maintenance instructions that apply to receiver-transmitters RT-1145 and RT-1168 also apply to receiver-transmitters RT-1145B and RT- 1168B unless otherwise specified.

1-4. Commonality of Shop Replaceable Units (SRU's) exists among the RT-1168, RT-1168B, RT-1145, and RT-1145B, and the control units; therefore, the RT-1168 and RT-1168B are discussed completely, and the RT-1145, RT-1145B and the control units are discussed only to the extent of the differences between these units and the RT-1168 or RT-1168B. Frequency Channel Indicator ID-1961 or ID-1961A, Power Supply PP-7117, and the mounting adapters are discussed separately as specific items since no commonality exists.

1-5. MAJOR CHARACTERISTICS.

-6. The AN/ARC-164(V) Radio Set operates in the 225.00 MHz to 399.975 MHz military band. It provides a 7000-channel uhf tuneable receiver; a nominally 243.000 MHz (tuneable from 238.000 to 248.000 MHz, with crystal replacement and realignment) auxiliary guard receiver; and a 7000- channel, 10 watt carrier transmitter for am voice communications. The AN/ARC-164(V) Radio Set can be used as a replacement set for existing radio sets or as the originally installed radio.

1-7. The LRU's of the radio set are shown in figure 1-1.

1-8. The AN/ARC-164(V) Radio Set has two basic configurations: a remotely controlled configuration and a console or panel mounted configuration. Variations in panel lighting are 28 volt, red; 28 volt, white; 5 volt, red; and 5 volt, white, and 5 volt, blue-white depending on aircraft configuration.

1-9. Purpose of Equipment.

1-10. The AN/ARC-164(V) Radio Set provides air-to-air, air-to-ground, or ground-to-ground voice communications in the 225.000 MHz to 399.975 MHz military band on 7000 separate channels.

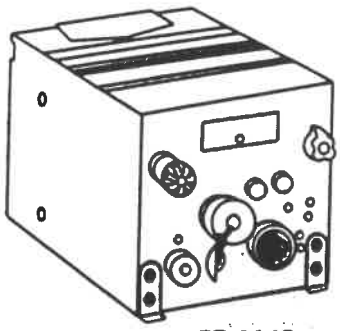
1-11. MAINTENANCE CONCEPT.

1-12. Maintenance Instructions are given to isolate a fault to an SRU and, in some cases, to a subassembly or a module. Fault isolation consists of performing minimum performance tests and trouble analysis procedures. The trouble analysis procedures are given in the form of logic flow charts. After a fault has been isolated, repair instructions are provided. Repair instructions consist of removal and replacement instructions or adjustment procedures.

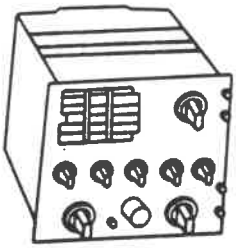
1-13. OPERATING CONTROLS.

1-14. Operating controls for the radio set are shown in figure 1-2 and are listed in table 1-2. The same front panel assembly (Switching Unit SA-2061/ARC-164(V) or SA-2061A/ARC-164(V) is used for the RT-1168 and RT-1168B receiver-transmitter and for the control units; the operating controls, as listed in table 1-2, are identical for all these units. However, squelch adjustment in the remotely controlled configuration is done from the RT-1145 or RT-1145B front panel (Data Converter CV-3297/ ARC-164(V) (figure 1-3) and not from the main and guard squelch potentiometers on the Switching Unit.

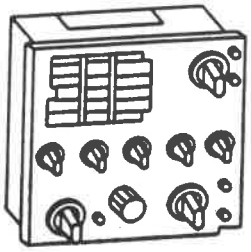
RADIO CONTROL BOX



RT-1145,
RT-1145B

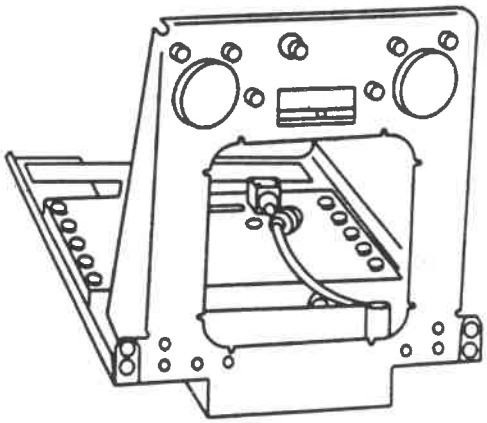


RT-1168,
RT-1168B

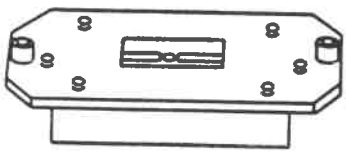


C-9533, C-9680
C-9681, C-9682

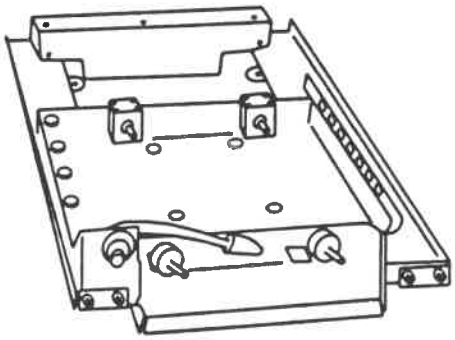
ID-1961,
ID-1961A



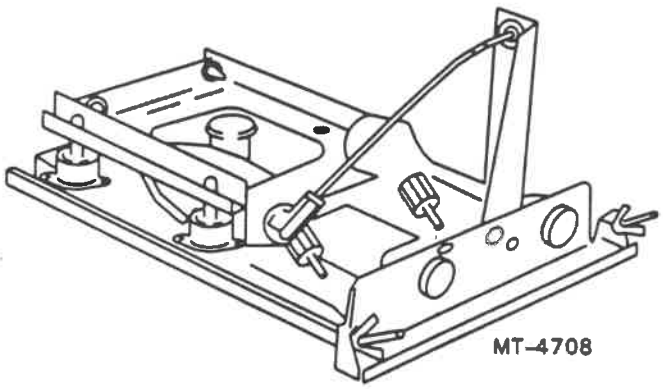
MT-4647



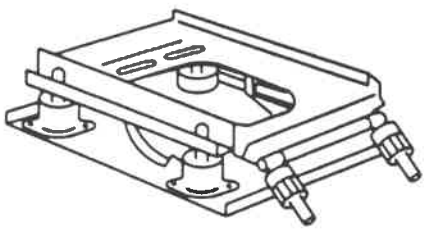
PP-7117



MT-4646



MT-4708



MT-4838

RC164-BL-80F

Figure 1-1. Line Replaceable Units of the AN/ARC-164(V)

1-21. The procedure for presetting any of the 20 preset channels is as follows:

a. Set the Function Selector switch to the MAIN position.

b. Set the MANUAL-PRESET-GUARD switch to the PRESET position.

c. Use the Manual Frequency selector switches to select the frequency to be placed in the memory.

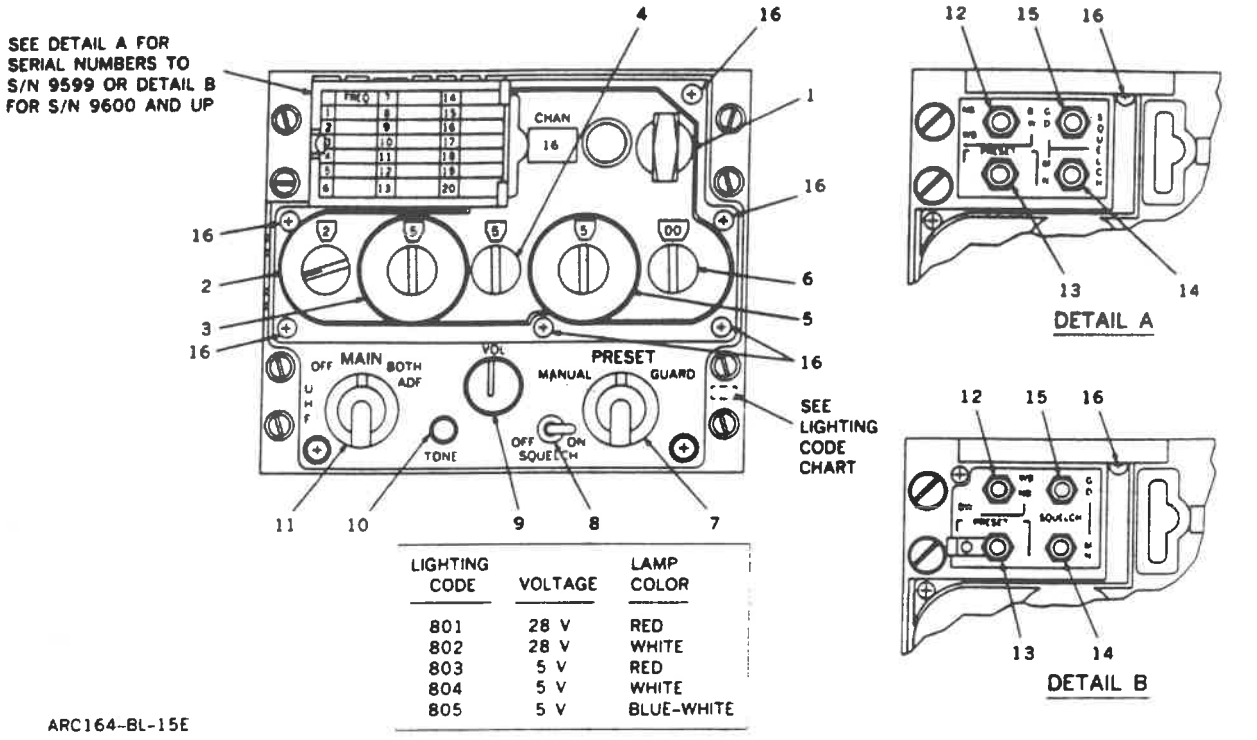
d. Turn the Preset Channel selector switch to the desired channel number.

e. Press the PRESET switch.

f. Using a soft lead eraseable pencil, record the frequency selected for the channel number used on the chart provided on the front panel of the switching unit. When using Scotchcal Label (P/N 3457-1) record frequency selected with typewriter type or indelible ink. Use AF Form 764 to order this decal in accordance with AFR 6-4, from: 2853 ABG/DAPE Robins AFB, GA. 31098-5280.

Table 1-1. AN/ARC-164(V) Radio Set LRU's

LINE REPLACEABLE UNIT	DESCRIPTION/APPLICATION
RT-1168/ARC-164(V) and	Console/Panel Mounted Receiver-Transmitter
RT-1168B/ARC-164(V)	
28 volt, red panel lights	
28 volt, white panel lights	
5 volt, red panel lights	
5 volt, white panel lights	
5 volt, blue-white panel lights	
RT-1145/ARC-164(V)	Remote Receiver-Transmitter
and RT-1145B/ARC-164(V)	
C-9533/ARC-164(V)	Control for New Installations
28 volt, red panel lights	
28 volt, white panel lights	
5 volt, red panel lights	
5 volt, white panel lights	
5 volt, blue-white panel lights	
C-9680/ARC-164(V)	Control for AN/ARC-34 Replacements
28 volt, red panel lights	
28 volt, white panel lights	
5 volt, red panel lights	
5 volt, white panel lights	
5 volt, blue-white panel lights	
C-9681/ARC-164(V)	Control for AN/ARC-27 Replacements
28 volt, red panel lights	
28 volt, white panel lights	
5 volt, red panel lights	
5 volt, white panel lights	



LIGHTING CODE	VOLTAGE	LAMP COLOR
801	28 V	RED
802	28 V	WHITE
803	5 V	RED
804	5 V	WHITE
805	5 V	BLUE-WHITE

Figure 1-2. Switching Unit Front View

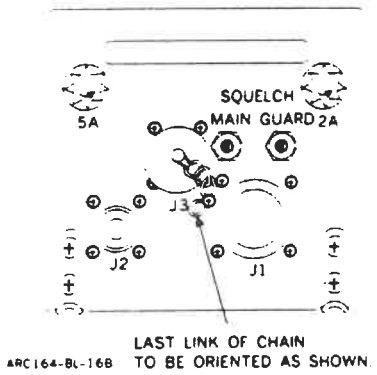


Figure 1-3. Signal Data Converter. Front View

1-15. DIAL MASK REALIGNMENT PROCEDURE. To realign the dial mask to increase the viewing angle of front panel numerals, perform the following procedure.

a. Remove the seven dial mask mounting screws (item 16, figure 1-2).

NOTE

If necessary, apply heat to heads of screws, using soldering iron, to soften locking compound.

b. Apply ND Industries Vibra-tite (NavOrd Part No. S186721-1) sparingly to threads and allow to dry completely. (Removal of existing staking lacquer is not required.)

c. Push dial mask to extreme upward position and reinstall seven mounting screws.

CAUTION

Do not overtighten screws as overtightening could deform the mask.

1-16. PERFORMANCE CHARACTERISTICS.

1-17. Physical characteristics for the radio set are listed in table 1-3. Electrical characteristics are listed in table 1-4.

1-18. ADDITIONAL INFORMATION.

1-19. Refer to the following documents for additional information on the AN/ARC-164(V) Radio Set.

TO 12R2-2ARC164-4, Illustrated Parts Breakdown

TO 12R2-2ARC164-3, Depot Maintenance

1-20. PRESET CHANNEL SELECTION PROCEDURE.

Table 1-1. AN/ARC-164(V) Radio Set LRU's - Continued

LINE REPLACEABLE UNIT	DESCRIPTION/APPLICATION
5 volt, blue-white panel lights	
C-9682/ARC-164(V)	Control for AN/ARC-51 Replacements
28 volt, red panel lights	
28 volt, white panel lights	
5 volt, red panel lights	
5 volt, white panel lights	
5 volt, blue-white panel lights	
ID-1961/ARC-164(V) or ID-1961A/ARC-164(V)	Frequency Channel Indicator
28 volt, red panel lights	
28 volt, white panel lights	
5 volt, red panel lights	
5 volt, white panel lights	
PP-7117/ARC-164(V)	ADF Power Supply
MT-4646/ARC-164(V)	Mounting Adapter for AN/ARC-34 Replacements
MT-4647/ARC-164(V)	Mounting Adapter for AN/ARC-27 Replacements
MT-4708/ARC-164(V)	Mounting Adapter for AN/ARC-51 Replacements
MT-4838/ARC-164(V)	Mounting Adapter for New Installations

Table 1-2. Operating Controls

REFERENCE (FIGURE 1-2)	NOMENCLATURE	FUNCTION
1	Preset Channel Selector Switch	Selects one of 20 preset channels
2	Manual Frequency Selector Switches	Selects 100's digit of frequency (either 2 or 3)
3		Selects 10's digit of frequency (0 through 9)
4		Selects unit's digit of frequency (0 through 9)
5		Selects tenth's digit of frequency (0 through 9)
6		Selects hundredth's and thousandth's digits of frequency (00, 25, 50, or 75)
7	MANUAL-PRESET-GUARD Switch	Selects mode of frequency selection MANUAL - Frequency is manually selected using the five frequency selector switches PRESET - Frequency is selected using the Preset Channel Selector Switch and for programming the 20 channels.

Table 1-2. Operating Controls - Continued

REFERENCE (FIGURE 1-2)	NOMENCLATURE	FUNCTION
		GUARD - The main receiver and transmitter are automatically tuned to the guard frequency, and the guard receiver is disabled.
8	SQUELCH ON-OFF Switch	Enables and disables squelch of Main Receiver
9	VOL Control	Adjusts audio level
10	TONE	Enables transmission of a 1020 Hz tone on the selected frequency
11	Function Selector Switch	Selects operating mode OFF - Shuts down equipment MAIN - Enables main receiver and transmitter BOTH - Enables main receiver and transmitter and guard receiver ADF - Enables ADF or homing system (if installed) and main receiver
12	BW Switch (NB-WB)	Selects wideband or narrowband selectivity of main receiver
13	PRESET Switch	Stores selected frequency in selected preset channel
14	SQUELCH-MN (Main Squelch) Control*	Adjusts level of squelch for main receiver
15	SQUELCH-GD (Guard Squelch) Control*	Adjusts level of squelch for guard receiver
	*Not operable on control units. For remote operation configurations, squelch adjustment is done from RT-1145 or RT-1145B Front Panel (figure 1-3).	

Table 1-3. Physical Characteristics

CHARACTERISTICS	DESCRIPTION
GENERAL	
Equipment Compatibility	
Interface Communication Sets	AN/AIC-10, AN/AIC-18, and AN/AIC-25
Antenna	52 ohm uhf stub
Direction Finder Groups OA-8697/ARD	AN/ARA-25, AN/ARA-25A, AN/ARA-48, AN/ARA-50,
Secure Speech Equipment	TSEC-KY-28, TSEC/KY-58, TSEC/KY-57
Operating Temperature	-54° to +71° C
Storage Temperature	-62° to +85° C
Altitude	50,000 ft (15.24 km) max
Vibration	5 g's to 2000 Hz
Shock	52 g's, 11 milliseconds duration

b. VHF C.S.F. - CC-262

When the VHF-set is switched on, the "TRANSMIT" rotary switches in both cockpits should be set to "VHF". The VHF audio knob controls the volume over the interphone.

c. UHF - Collins 201

Put both rotary switches in both cockpits on "UHF" and switch the UHF-set on. The UHF audio knob controls now the volume over the interphone.

IMPORTANT

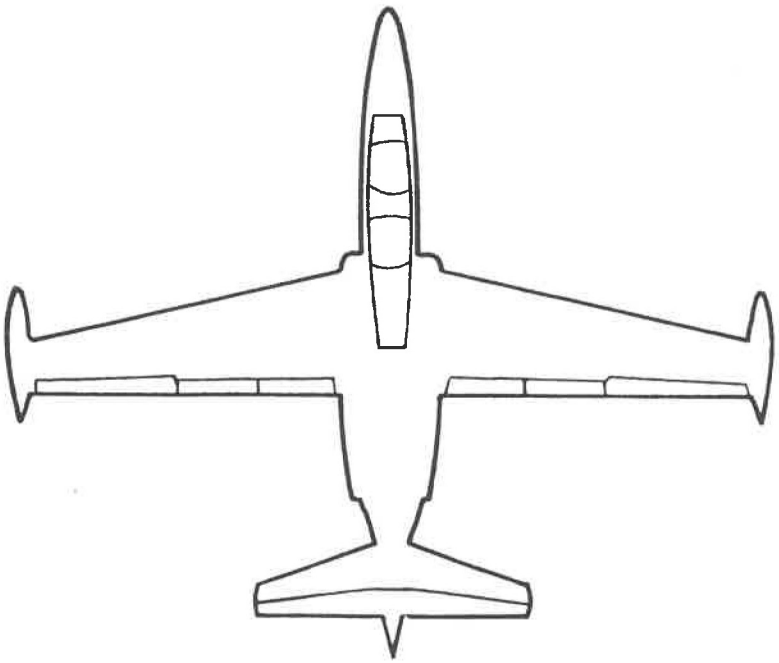
If the pilot in the rear seat cannot communicate with the pilot in the front seat because the latter turned the volume of the interphone too low he is still capable of talking to the front seat pilot by pushing the button : "appel téléphonique de bord" (intercom override) situated at the right hand side of the rear cockpit control panel; both interphone control boxes should be on the "Δ" position.

5.1.6. TACAN HOFFMAN AN/ARN - 21 - C (FIG.15)

The TACAN-set can only be operated from the front seat.
Put the TACAN inverter on by means of the switch situated on the right console next to the UHF-radio set. Put the three position switch on "REC" and wait for two minutes in order to let the set warm-up. Select the appropriate channel with the rotary switch. The inner ring is operated with a key going from 0 to 9. The outer ring rotates from 1 to 12; 129 different stations can be selected. When the set is warmed up the three position switch is turned to "T/R" to obtain bearing and distance since in the "REC" position only bearing information is obtained.
The volume is set by the audioknob.

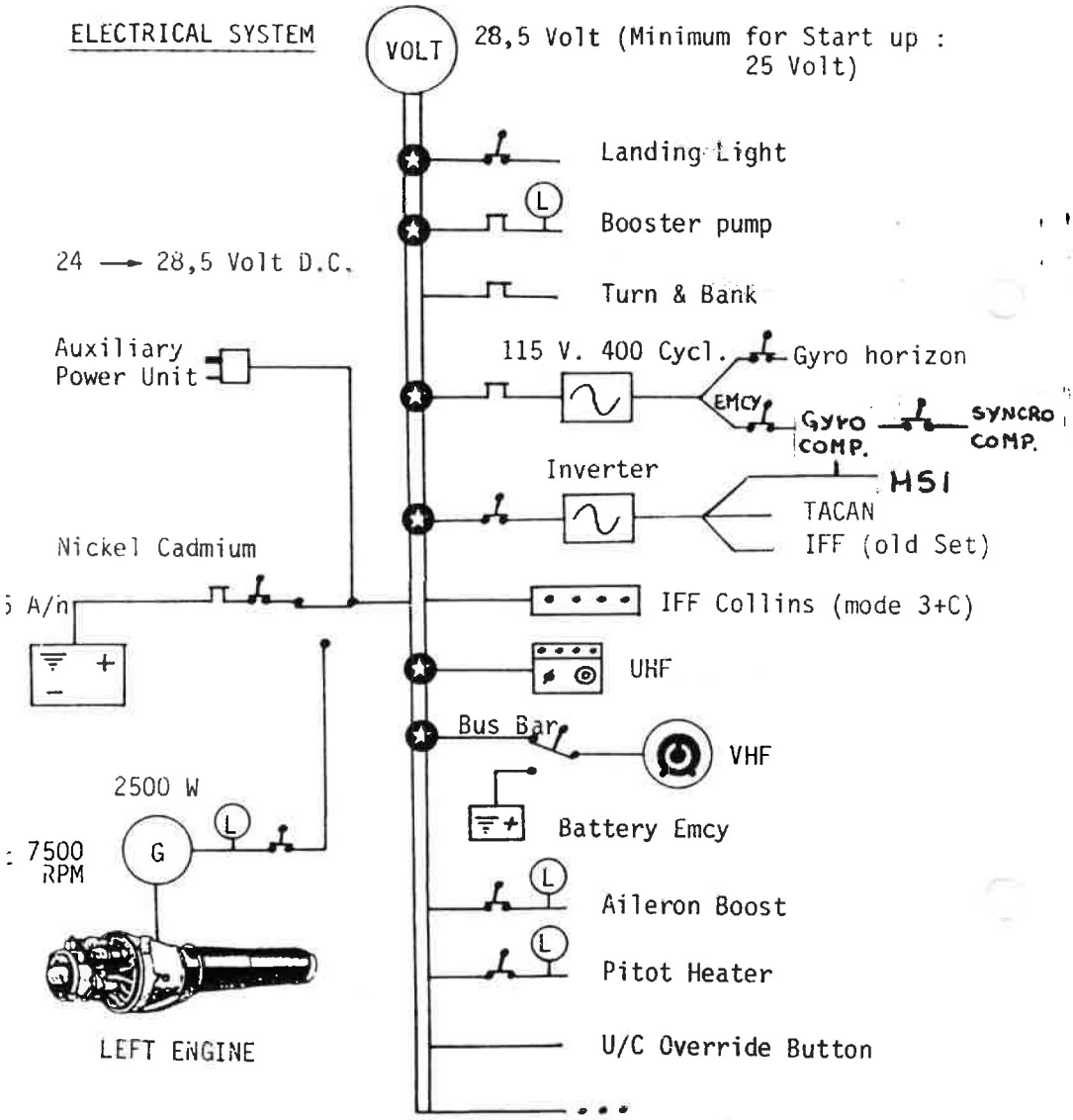
CHECKLIST

MODIFICATION FOUGA (TCN HSI)



FOUGA MAGISTER

CM 170

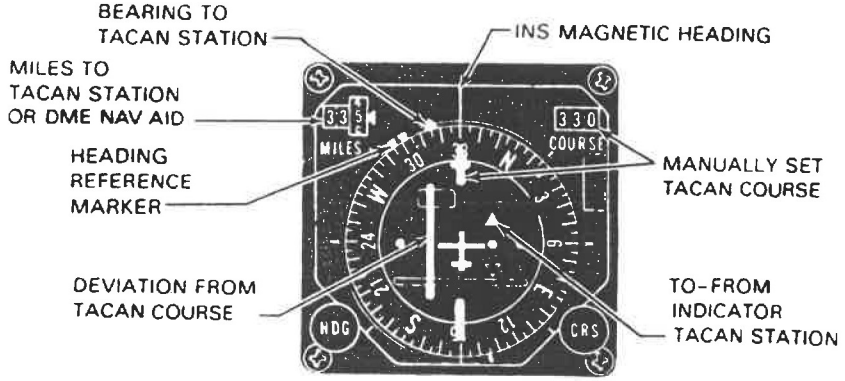

ELECTRICAL SYSTEM
VOLT
28,5 Volt (Minimum for Start up : 25 Volt)
Landing Light
Booster pump
24 → 28,5 Volt D.C.
Turn & Bank
Auxiliary Power Unit
115 V. 400 Cycl.
Gyro horizon
EMCY
GYRO COMP.
SYNCRO COMP.
Inverter
HSI
TACAN
IFF (old Set)
Nickel Cadmium
IFF Collins (mode 3+C)
UHF
Bus Bar
VHF
2500 W
7500 RPM
G
Battery Emcy
Aileron Boost
Pitot Heater
U/C Overriide Button
LEFT ENGINE
Main Electrical load to be reduced
→ before Start up - to ask a clearance
→ in case of Electrical failure
Circuit directly and protected by a Circuit Breaker
Switch
Red warning light

TACAN

The TACAN system provides continuous bearing and distance information from any selected TACAN station within a line-of-sight distance up to approximately 390 miles, depending upon terrain and aircraft altitude. Only distance information is presented when a DME navigational aid is selected. There are 252 channels available for selection. Two antennas, one on the bottom of the fuselage, provide omnidirectional coverage regardless of aircraft attitude.

The TACAN works in conjunction with the HSI and through the communication panel for audio output. TACAN information is presented on the HSI. Refer to figure

Instrument Mode (TCN)

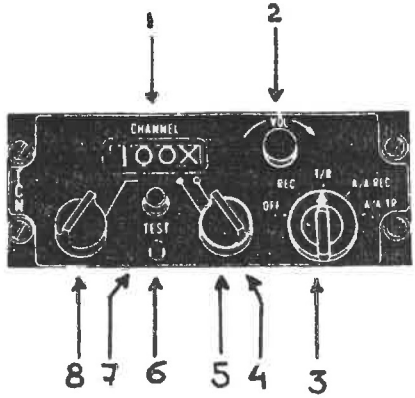


HSI

	HSI PRESENTATION				
INSTRUMENT MODE SELECTED	RANGE INDICATOR	COURSE ARROW & COURSE SELECTED	COURSE DEVIATION BAR	TO — FROM INDICATOR	BEARING POINTER
TCN	RANGE TO TACAN STATION OR DME NAV AID	MAN SET SELECTED COURSE	DEVIATION FROM SELECTED COURSE	IN VIEW	BEARING TO TACAN STATION

TACAN Control Panel

1. CHANNEL Display
2. Volume (VOL) Knob
3. Function Knob
4. X/Y Channel Ring
5. Units Channel Knob
6. TEST Pushbutton
7. Test Light (Red)
8. Hundreds-Tens Channel Knob



The TACAN control panel is located on the right console.

TACAN FUNCTION KNOB

Functions are :

OFF - **Power off.**

REC - **Receive mode. The system receives signals which result in a bearing and course deviation display on the HSI and audio in the headset. TACAN range window (MILES) on HSI is shuttered.**

T/R - **Transmit/receive mode. Same as REC and in addition, interrogates the TACAN ground station for DME information; distance (nm) is displayed in the HSI range window (MILES).**

A/A REC - **Air-to-air receive mode is not used.**

A/A TR - **Air-to-air transmit-receive mode.TACAN system interrogates and receives signals from aircraft having air-to-air capability, providing slant range (nm) distance between aircraft operating 63 TACAN channels apart. Up to five aircraft can determine distance from a sixth lead aircraft. Lead aircraft can only determine distance from one aircraft. Audio identification is not provided.**

VOL KNOB

The VOL knob controls the volume of the audio signal.

X/Y CHANNEL RING

The X/Y channel ring is the outer portion of the units knob. The ring provides for the selection of X or Y channels as viewed in the channel display. Each mode has 126 channels available.

UNITS CHANNEL KNOB

The units channel knob is used to select the units digit of the channel (0-9) as viewed in the channel display.

HUNDREDS - TENS CHANNEL KNOB

The hundreds - tens channel knob is used to select the tens and hundreds digits (00-12) as viewed in the channel display.

CHANNEL DISPLAY

The CHANNEL display displays the digital readout of the selected TACAN channel.

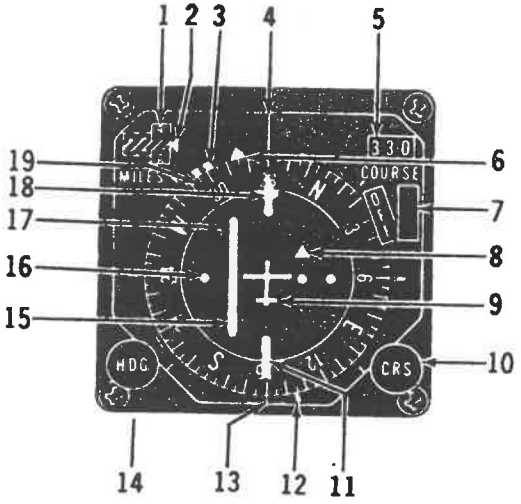
TEST PUSHBUTTON

The TEST pushbutton initiates system self-test when depressed momentarily. The self-test checks the entire system except the antennas.

TEST LIGHT

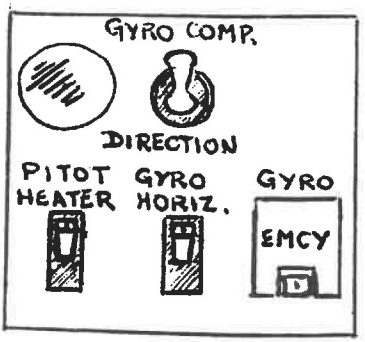
The TEST light illuminates when a malfunction occurs during manual or automatic system self-test. If the system fails self-test in the T/R mode but not in the REC mode, the TACAN may be used for bearing information.

Horizontal Situation Indicator (HSI)



1. Range Indicator
2. Warning Flag — Range
3. Heading Reference Marker
4. Upper Lubber Line
5. Course Selector Window
6. Bearing Pointer
7. OFF Warning Flag — HSI Power
8. TO-FROM Indicator
9. Miniature Aircraft
10. CRS Set Knob
11. Course Arrow Tail
12. Bearing Pointer Tail
13. Lower Lubber Line
14. HDG Set Knob
15. Course Deviation Indicator
16. Course Deviation Scale
17. Warning Flag — Course Deviation
18. Course Arrow
19. Compass Card

Front Seat Instrument Panel Display



NORMAL PROCEDURES

AFTER START UP LEFT ENGINE

3. Increase to 15000 rpm

- above 7500 rpm generator light	- check out
- hydraulic pressure	- 250/250

4. Stand by switches (back seat pilot) - advise

- pitot heater	- on
GYRO COMPASS	- ON
gyro horizon (cage before)	- on
+ GYRO COMP EMCY (COVERED)	- STAYS OFF
- IFF (collins 3+C)	- stand by
IFF (APX46 old set)	- OFF
- tacan	- rec
- TCN/IFF INVERTER	- ON
(Check - HSI Power Flag - Course Deviation Flag)	- BOTH AWAY

DURING TAXI

TIVIP

T	Tacan	- ON T/R
I	Instruments	- HSI Check all flags AWAY (3)
		- L & R Turn - Gyri's & HSI FOLLOWING

EMERGENCY PROCEDURES

* INVERTER (TCN/IFF) FAILURE

  - INVERTER (TCN/IFF) OFF
  - EMCY GYRO SWITCH (COVER UP) ON

  RMK - You loose the HSI in BOTH COCKPIT
  - The OLD GYRO COMPASS will provide CORRECT HEADING (Syncronise if necessary)

  WARNING

  The EMCY GYRO COMPASS and the TCN/IFF INVERTER should NEVER be switched ON SIMULTANEOUSLY

* GENERATOR FAILURE OR LEFT ENGINE FLAME OUT

  THE TCN/IFF INVERTER MUST STILL BE SWITCHED OFF TO SAVE BATTERY ENDURANCE.

HSI & TACAN

GENERAL DESCRIPTION

SELF TEST

Section I

GENERAL INFORMATION

1-1. GENERAL. Section I provides general information to be used by maintenance personnel to further their understanding of the purpose and main features of Horizontal Situation Indicator AQU-13A/A (see figure 1-1).

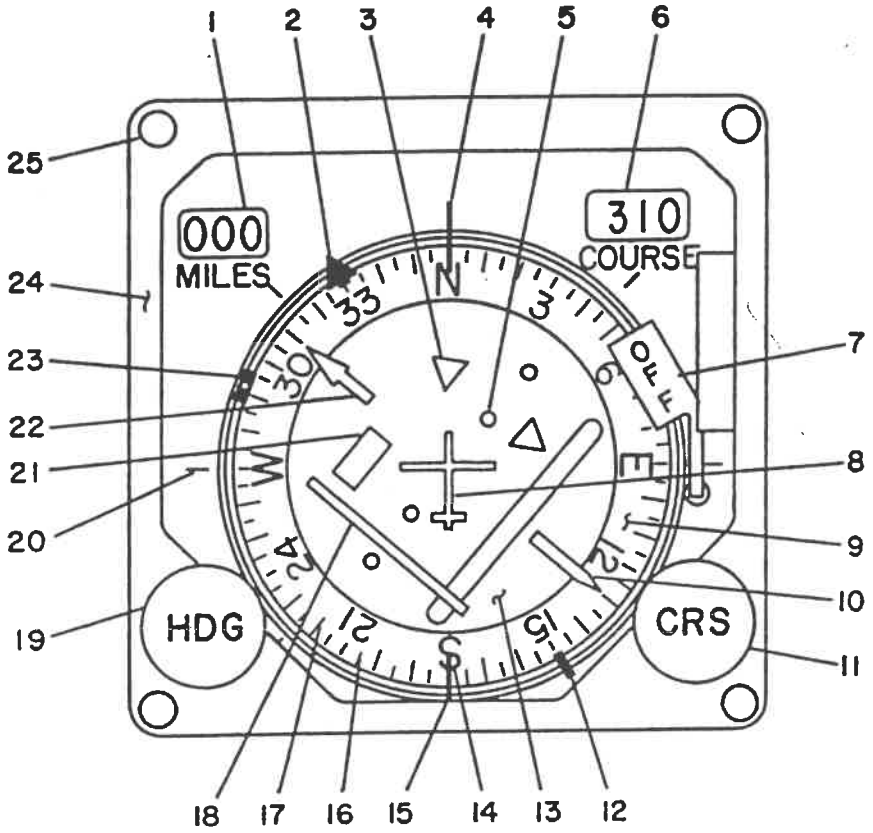
1-2. PURPOSE. The purpose of Horizontal Situation Indicator AQU-13A/A (indicator), which is a panel mounted instrument, is to display flight information in a high performance aircraft that has an integrated panel. The indicator displays flight information on the aircraft heading, command (selected) heading, command (selected) course, course deviation, bearing marker, radio range distance, and to-from arrow. Power failure warning information may also be displayed. The information displayed is controlled by reference sources and remote command sources which provide the transmitter synchro output signals and dc meter movement signals. Course pointer (22, figure 1-2), course deviation bar (18), deviation alarm/DF flag (21), to-from arrow (3), course deviation dots (5), and reciprocal course index (10), on the central portion of the display, rotate as a unit. The central portion of the display turns with azimuth dial (9), as the aircraft heading changes. Airplane symbol (8), which is marked on lighting wedge, (4, figure 3-2, sheet 1), represents the position of the aircraft in relation to the movement of the display.

a. Aircraft Heading. The aircraft heading information is indicated by azimuth dial (9, figure 1-2). The aircraft heading, which is the stabilized magnetic compass heading provided from the master directional reference, is accurate to within 1°. The azimuth is read on the 5° incremental mark (16), 10° incremental mark (17), or N, E, S, or W cardinal point marking (14) on azimuth dial (9) under top lubber line (4).

b. Command (Selected) Heading. The command (selected) heading information which is set in manually is indicated by heading marker (23, figure 1-2). The heading marker rotates around the outer edge of azimuth dial (9). The command heading information is accurate to within 1°. The heading marker may be set to any mark on azimuth dial (9) by turning heading (HDG) set knob (19). After the heading marker is manually set to indicate the command heading, the heading marker rotates in synchronism with the azimuth dial.

c. Command (Selected) Course. The command (selected) course information is indicated by course pointer (22, figure 1-2), which is manually or automatically rotated around the inner edge of azimuth dial (9). The command course, which is provided from a remote source or the desired course is set in manually and displayed by the course pointer and numerical indication, is accurate to within 1°. The course pointer, which is mechanically attached to course deviation dial (13), may be positioned manually to the selected course by turning course (CRS) set knob (11). After the course pointer is manually set, the course pointer, along with the course deviation dial, rotates in synchronism with the azimuth dial. The scale reading on the azimuth dial at the tip of the course pointer is the selected or course track. COURSE display (6) also presents the selected course numerically. The reciprocal display of the selected course is indicated by reciprocal course index (10), which is also mechanically attached to the course deviation dial. Whenever the course pointer moves the reciprocal course index also moves.

d. Course Deviation. The course deviation information is indicated by course deviation bar (18, figure 1-2) and course deviation dots (5) on course deviation dial



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1. MILES Display
2. Bearing pointer
3. To-from arrow
4. Top lubber line
5. Course deviation dots
6. COURSE display
7. Power OFF flag
8. Airplane symbol
9. Azimuth dial
10. Reciprocal course index
11. Course (CRS) set knob
12. Reciprocal bearing marker
13. Course deviation dial
14. Cardinal point marking
15. Bottom lubber line
16. 5° incremental mark
17. 10° incremental mark
18. Course deviation bar
19. Heading (HDG) set knob
20. Fixed marker
21. Deviation alarm/DF flag
22. Course pointer
23. Heading marker
24. Case flange
25. Mounting hole

Figure 1-2. Indicator Display

(13). Any displacement of the aircraft, from a manually or automatically selected track, causes the course deviation bar to move to the right or left of course pointer (22) to indicate the amount and direction of the course deviation. The course deviation bar moves across the course deviation dots on the face of the course deviation dial in parallel with the axis and between course pointer (22) and reciprocal course index (10). The range of the displacement of the course deviation bar is ±2 dots. The deviation warning and display mode information is indicated by deviation alarm/DF flag (21), which appears behind the rectangular shaped cutout on the course deviation dial. When the deviation alarm/DF flag display is red the course deviation information is invalid. When the display is black the course deviation information is valid. When the display shows the black letters DF on a yellow background the course deviation information is operating in the direction finder mode.

e. Bearing Marker. The bearing marker information is indicated by bearing pointer (2, figure 1-2), which rotates around the outer edge of azimuth dial (9). The bearing pointer, which displays the bearing to the selected station or target is accurate to within 1°. The reciprocal information of the bearing marker is indicated by reciprocal bearing marker (12).

f. Radio Range Distance. The radio range distance information is indicated by MILES display (1, figure 1-2). The numerical indication of the radio range distance in nautical miles, on the MILES display, is the distance to the transmitting radio source or target. The range of the MILES display is from 000 to 999. Whenever the radio range distance information is invalid, the diagonally striped red and white range counter flag (2, figure 3-10) covers the MILES display (the units digit is only partially covered). Whenever 28 Vdc is applied to rotary solenoid M4 (31, figure 3-4), range counter flag disappears from view.

g. To-From Arrow. The to-from indication for a selected radio facility is displayed by to-from arrow (3, figure 1-2), which appears behind one of the two arrow (triangular) shaped cutouts on course deviation dial (13). When the to-from arrow appears on the same side as course pointer (22) it indicates that the heading is to the selected radio facility. When the to-from arrow appears on the same side as reciprocal course index (10) it indicates that the heading is from the selected radio facility.

h. Power Failure Warning. Power failure warning information is provided by power OFF flag (7, figure 1-2). The flag, which is red with black letters, appears whenever the 115-volt power to the indicator is interrupted. The flag disappears from view (black background showing) when the 115-volt power is applied to the indicator.

1-3. LEADING PARTICULARS. The leading particulars for the indicator are presented in table 1-1.

1-4. MAIN FEATURES. The internal mechanism assembly of the indicator is contained in the hermetically sealed housing assembly. The internal mechanism assembly contains the electronic circuitry, synchros, solenoids, motors, and gear trains for operating the display devices. The indicator is integrally lighted.

Table 1-1. Leading Particulars

Parameter	Specification
Power Requirements	
Primary Power	115V (108V to 121V), single phase, 400 Hz ±80 26 Vac ±2 derived from the 115V primary power
Distance Shutter Mechanism	28 Vdc (22V to 30V)
Lighting Circuit	0V to 5V ac or dc
Stabilized Magnetic Compass Heading	Within 1° provided from master directional reference
Command Heading Information	Within 1° set in manually
Command Course	Within 1° provided from remote source or desired course set in manually
Environmental Condition:	
Operating Temperature	-54° to +71° C
Storage Temperature	-62° to +85° C
Altitude	From sea level to 70,000 feet
Relative Humidity	Up to 95 percent
Friction Error	Not more than 1/2° of error of reading as a result of friction between moving parts.
Overall Dimensions and Weight	3.25 inches high, 3-25 inches wide, 10.25 inch long, and 6.0 pounds (max)
Standard Atmospheric Test Conditions	Atmospheric pressure approximately 29.92 inches Hg and at approximately 77° F (25° C) room temperature.

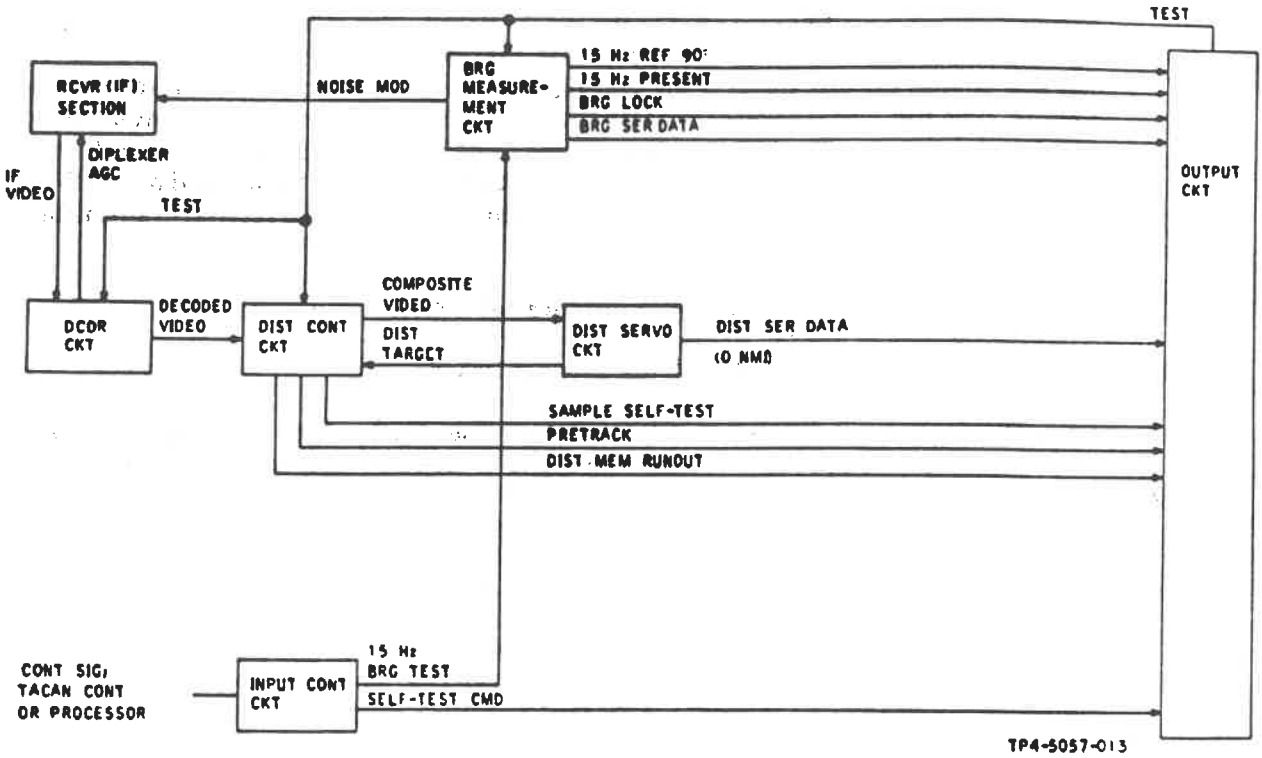


Figure 3-14. Manual and Automatic Self-Test Mode of Operation

(d) When the self-test is initiated, the bearing measurement circuits switch to the bearing search mode looking for the 15-Hz test signal from the input control circuit. The search signal causes the bearing measurement circuit to produce a 15-Hz reference, 90-degree signal that is supplied to the output circuit. For nominal 7 seconds, while the output circuits inhibit the display of the test results, a bearing of 270 degrees will be generated by the adapter. After this time, the bearing of 180 degrees will be displayed.

(e) The distance servo circuit applies a 0-nmi distance target to the distance control circuits each interrogation period. When the self-test mode is initiated, the distance control circuit replaces the decoded video pulses with the 0-nmi distance target. The distance target is applied to the distance servo circuits as the composite video signal. The distance circuits lock on the 0-nmi distance target after a nominal 7 seconds and apply the 0-nmi distance information to the output circuit as distance serial data. This causes the indicator to indicate 0 nmi after a nominal 7 seconds and a bearing of 180 degrees. During the first 7 seconds, the bearing and distance flags are in view because the circuits are in the search submode. When the distance circuits switch from pretrack to track submodes, the distance control circuit produces a sample self-test signal that is supplied to the output circuit. The sample self-test signal causes the output circuits to check the monitor circuits that determine the status of the distance and bearing information. If the distance and bearing circuit calculations are incorrect after the sample self-test signal occurs, the output circuit produces distance and bearing flag signals that are supplied to the system indicators. The flag signals cause the appropriate flags to come in view. If the malfunction is a radio receiver-transmitter problem, the output circuit produces a radio receiver-transmitter flag signal that is applied to an external indicator that warns the flight crew of the radio receiver-transmitter malfunction.

(6) Automatic Self-Test Mode Operation. (Refer to figure 3-14.) The 15-Hz present; 15-Hz reference, 90-degree; and bearing lock signals from the bearing measurement circuit are supplied to the output circuit. The pretrack and distance memory runout signals from the distance control circuit are supplied to the output circuit. The output circuit checks that all signals are normal. If one signal is not normal, the output circuit switches to automatic self-test and applies the test signal to the bearing measurement, distance control, and decoder circuits. The test signal causes the same circuit operation as described for manual control, and decoder circuits. The test signal causes the same circuit operation as described for manual self-test mode (paragraph 3-3b(5)), except that the test is terminated before the result (180 degrees) is displayed. The following conditions cause the radio receiver-transmitter to switch to automatic self-test.

(a) Loss of bearing circuit lock, with distance not locked.

(b) Bearing memory runout, with distance not locked.

(c) Distance circuit does not switch to track, or loses track, which indicates the distance signal is not acquired or the distance signal is lost, with bearing not locked.

(d) Distance memory runs out, with bearing not locked.

(7) Channel Reset Operation. (Refer to figure 3-15.) When a new channel is selected, the input control circuit senses the channel data change in the control word initiated by the system rt control or the processor. The input control circuit applies a channel change signal to the antenna switching circuit. If antenna lobing is used, the channel change signal allows the antennas to switch at 5 second intervals until a usable signal is located from the new station. The antenna switching circuit produces an input channel change signal that is supplied to the output circuit. The input channel change signal resets the output circuits and produces a channel reset signal that is supplied to the bearing measurement, distance measurement, and decoder circuits. The channel reset signal resets the bearing and distance measurement circuits to search for the information from the new station. The decoder circuit switches the AGC signal supplied to the receiver section which readjusts the receiver gain during search for the selected station signal.

(8) Input Control Operation. (Refer to figure 3-16.)

(a) General. The input control circuits receive the rt control or RNAV (processor) control word and decode the control information contained in the control word to program the radio receiver-transmitter to the correct channel for the selected TACAN station and selected operational mode.

(b) Operation.

1. The rt control and RNAV (processor) ternary control words, the RNAV flag signal, and the rt control signal from the radio receiver-transmitter power connector are supplied to the control word selector circuit. When the rt control signal is present, the control selector circuit applies the rt control ternary control word to the control word decoder circuit. When the RNAV flag signal is present (which indicates the RNAV system is operational and producing valid information), and the rt control signal indicates that channel 00 is selected (RNAV operation), the control word selector circuit applies the RNAV (processor) ternary control word to the control word decoder circuit.

5.1.7. IFF - SIEMENS RT 55 AN/APX 46 S (FIG.16)

Verify the IFF circuit breaker, put the inverter on and let the set warm up during two minutes by putting the 5 position switch to "STD-BY".

Switch to "MASTER LOW" or "NORM" depending on the distance. The Mode 1-2-3 switches can be operated in the "TEST" position or in the "MODE" position. Mode 1 and 3 can be coded by the use of the "SIF", mode 2 being coded by ground personnel.

A flash identification feature is provided by putting the "I/P-MIC" switch either in the springloaded "I/P" position or in the "MIC" position; in the latter the set will flash each time the pilot pushes the VHF/UHF transmitter button.

5.2. AIR CONDITIONING AND PRESSURIZATION SYSTEM (Fig.17)

5.2.1. GENERAL

A certain amount of air is diverted from the engines to insure the functioning of different ancillaries (tip tank transfer, inverted flight feeding) and in particular, three functions in the cabin :

- Pressurizing the cabin to obtain a higher pressure than the flight altitude pressure.
- Heating or cooling the pilots'compartments as the air enters the cabin directly or through the turbo cooler.
- De-icing or defrosting the inside of the transparant cockpit enclosure.
- The last two functions simultaneously supply the cabin pressurization.

A single switch located on the front left hand console allows for air flow and temperature adjustment and selection between foot grill and windshield defroster. It has three stable or spring-loaded positions ± closed, pressurized, defrost.

A gage shows the position of the cabin temperature mixing valve.

5.2.2. PRESSURIZATION

a. Inflation of the pneumatic canopy rubber seal is insured, individually, by the locking of each canopy provided the inflating button on the canopy handle marked ON is pressed in. Whatever the position of the canopy, open or closed, the button may be actuated to inflate or deflate the seal.
In flight, this operation should be carried out below 10.000 feet only.

b. The cabin is pressurized when operating the switch located on the front left hand console.
Turn the switch clockwise to "pressurise". A slight increase in cabin pressure will be felt in the ears. Then the diverted air enters the cabin, half through the feet inlets, half through the perforated windshield tube.
The cabin pressure regulator is designed to start pressurization at 10.000 feet; cabin pressure increase steadily up to 20.000 feet, and reaches a maximum of 250 g/cm^2 (Cabin altitude is 10.000 feet up to flight altitude of 20.000 feet).
The cabin pressure differential of 250 g/cm^2 is automatically maintained.
Proper operation of pressurization is checked through the cabin altimeter (front cockpit).
Set pressurization on at the parking line, during the checks before taxiing (see 2,5).

CAUTION

If flying solo, make sure that the rear canopy seal button is pressed in prior to locking the canopy. Except in emergency, the canopy seal should not be deflated in flight.

5.2.3. AIR CONDITIONING

a. Through the pressurization system :
The cabin pressurization and temperature selector controls the temperature adjustment of the diverted air from full cold (through the turbo cooler) to full hot (directly from the engines).

The position of the temperature mixing valve, which allows all intermediate positions, is indicated on the cabin temperature gage. It should be noted that the thermal inertia of the inlet tubes and especially of the cabin is considerable, and the desired temperature stabilisation is realised but after a few minutes.
As an example :

- With a ground temperature of below 0°, take off with the temperature gage needle on the 2nd division and adjust progressively to full heat above 20.000 feet.

b. Through the cabin ventilation system :
Open the outside air scoops (right hand side of the fuselage) by rotating the mill-edged muff as desired. Adjust the direction of the air stream by adjusting (swivelling) the appropriate fitting.

CAUTION

Since the air scoop is not fitted with an automatic shut-off device, it should be used below 10.000 feet only.
When flying solo, make sure the rear air scoop is closed.
To get cool air at low altitude, proceed as follows :

- Set air conditioning to full cold.
- Open the outside air scoop, if flying at a low power setting.

5.2.4. INTERIOR DEFROSTING

In case of mist or frost on the inside of the transparent enclosure, rotate the switch to "defrost" position. Then all the air is directed to the front and rear demist tubes, if the latter is opened.
The air temperature may be adjusted by impulses on either side of "defrost" position.
The rear demist tube is opened separately by a rotating switch located on the top part of the rear instrument panel. It is fed permanently, if the front switch is set to "pressurized" or "defrost"

CAUTION

It is recommended that "defrost" position be selected when anticipating a rapid descent or an instrument let down, because selecting "defrost" at a low altitude may cause the transparent surfaces and mainly the windshield to cloud or frost temporarily.

5.3. EXTERIOR DE-ICING

5.3.1. PITOT TUBES

The front and rear cockpit circuits are independent and fed individually by a heated tube.
A pitot heater switch is located on each instrument panel. Each pilot has to switch it on before take-off.
If in flight, the front red warning light illuminates a failing of the pitot heating is present, affecting the front air speed indicator and machmeter.
If the rear red warning light illuminates only the air speed indicator of the rear cockpit if affected.

5.3.2. WINDSHIELD (FIG.17)

The windshield de-icing is insured by alcohol sprayed from an external perforated tube.
The pump handle is located on top of the front panel. Unlock by turning counter clockwise one fourth of a turn and pump until the alcohol spreads out on the windshield.
It is preferable to use alcohol to prevent icing when anticipated rather than attempt to make ice melt.

5.3.3. WING LEADING EDGES - ENGINE AIR INTAKES

Wing leading edges and engine air intakes are not equipped with de-icing devices.
When entering an icing area, it is recommended to leave it as soon as possible, preferably by climbing.
Avoid changing throttle settings. Maintain a high RPM and avoid reducing throttles.
See § 4.8.4. Icing.

SECTION VI

INCIDENT FAILURES AND CORRESPONDING EMERGENCY PROCEDURES

6.1. EMERGENCY PROCEDURES FOR :

UNDERCARRIAGE, AIRBRAKES, FLAPS AND AILERONS

6.1.1.1. UNDERCARRIAGE.

Extension of the undercarriage is feasible in emergency.
In case of failure of the normal hydraulic system, if the accumulator pressure is normal (250 hpz = 3500 p.s.i.), it is sufficient to lower and lock down the undercarriage without using the emergency procedure. Then the remaining pressure allows for two extensions and retractions of the airbrakes and for twelve toe-brake applications.
However, to save the pressure for braking action, the emergency procedure for the undercarriage must be used and the aileron boost switched off in the following types of failure :

- low hydraulic pressure
- left engine failure
- complete electrical failure.

Emergency gear extension is carried out as follows :

- reduce the airspeed below 140 knots
- pull-out the circuit-breaker "L/G CONTROL" on the left console.
- press in the red knob "EMERG L/G"
- when speed is below 140 KIAS place undercarriage lever down.
- extend the telescopic handle of the hydraulic hand pump
- pump out the gear till the three green lights glow and a block pressure stop is felt (35 strokes).

After an actual emergency, the circuit breaker "L/G CONTROL" should not be pressed in again and the button "EMERG L/G" should not be set back to "NORMAL".

After an emergency procedure has been used for training purposes : carry out one complete normal operation of the undercarriage before landing.

If the landing gear cannot be extended in emergency mode :

- land with full flaps
- landing should be made with a moderate angle of attack, avoiding a high speed or a flat touch down.
- avoid a high angle of attack which may cause the aircraft to fall heavily on the nose.

NOTE : If it is not possible to depress the red knob "EMERG L/G", push alternately on the NORMAL and EMERG knobs.
If this operation has no result, take a last chance by hitting the EMERG knob violently.

6.1.1.2. LANDING GEAR LEVER STUCK IN THE "DOWN"-POSITION

The override press button should never be actuated to raise the undercarriage in the air.

When the landing gear lever is stuck :

- keep airspeed below 140 KIAS
- empty tanks
- land

6.1.1.3. ONE RED LIGHT AFTER RETRACTING LANDING GEAR

This could be an indication either of a damaged wheelbay, or a failure of a wheel to be locked "UP" or a malfunction of the microswitch. IN this case :

- do not exceed 140 KIAS and check hydraulic pressure

If pressure is normal :

- lower the landing gear at safety height
- raise the landing gear

If the red light remains on

- let verify if possible the wheelbays or wheels by the tower or another aircraft
- lower the landing gear and empty the tiptanks before landing.

6.1.1.4. ONE OR MORE RED LIGHTS AFTER LOWERING LANDING GEAR

This indicates or an unlocked condition of one or more legs or a micro switch malfunction. Verify the normal hydraulic pressure.

a. Pressure ≈ 250 HPZ

Recycle the gear once. If red light persists, have the gear position checked; switch on emergency system and pump until pressure lock is felt. If this is unsuccessful switch back to normal system, have gear position checked :
If the landing gear seems safe, make a precautionary landing. Wait for crash crew at end of landing run, left engine running.

b. Pressure less than 250 HPZ : follow emergency extension procedure.

6.1.1.5. NOSE WHEEL NOT DOWN

If it is not possible to lower the nose wheel either by the normal or by the emergency system :

- make a normal circuit
- when crossing boundary, shut off the fuel cocks, generator, battery.
- make a normal landing on the main wheels and keep the nose off as long as possible
- do not use brakes before the nose has contacted the runway. When the nose has come down, brake firmly
- when crossing boundary, shut off the fuel cocks, generator, battery.

6.1.1.6. ONE MAIN GEAR NOT DOWN

If one of the main gears is not down and locked (check has been made by control tower), do not try to land on one wheel.
Raise the landing gear and make a belly landing on a hard surfaced runway.
If it is impossible to raise the landing gear, land on a hard surfaced runway on the side of the extended gear.When crossing boundary, shut off the fuel cocks, generator and battery. Keep the wing on the side of the raised gear off as long as possible.

6.1.1.7. TWO MAIN GEARS NOT DOWN

Raise the nose wheel and make a belly landing.

6.1.1.8. GEAR RETRACTION ON THE GROUND

Press the landing gear lever override switch (above the gear lever). Raise the landing gear lever. Electric current is needed.

6.1.2. AIRBRAKES

6.1.2.1. EMERGENCY AIRBRAKES OPERATION

Extension and retraction of the airbrakes can be achieved by means of the emergency hydraulic system. The emergency procedure is necessary only when the main hydraulic circuit fails with the accumulator pressure down to zero. However, it is recommended to use the emergency procedure in case of a left engine failure in order to preserve the hydraulic pressure for flap extension and brakes.
Proceed as follows :

- Extend or retract the airbrakes as required by selecting the lever (emergency airbrakes) to "OUT" or "IN". Pump out or in until obtaining the desired amount or feeling the stop position for a complete operation (7 strokes).
  (In case of simultaneous extension of undercarriage and airbrakes, the latter will extend first).

6.1.2.2. ASYMETRIC AIRBRAKE EXTENSION

In case of asymetric extension of the airbrakes, retract the latter by means of the normal or emergency system.
Reduce airspeed.
If retraction is impossible make a controllability check at 8000 ft with gear and flaps extended down to a speed of 110 kts IAS.
If the aircraft is not controllable below 130 kts IAS, a landing should be made on a 8.000 ft runway.

6.1.3. WING FLAPS

No emergency system is available for the flaps.

6.1.3.1. FLAPS INOPERATIVE

Check - circuit breaker in
- hydraulic pressure normal.

6.1.3.2 ASYMETRIC FLAP RETRACTION OR EXTENSION

Stop the travel at once.

During retraction :

- do not insist
- keep airspeed below 120 kts IAS
- perform controllability check at low speed at 8000 ft
- land

During extension :

- retract flaps
- land without flaps
- if retraction is not possible :
  - perform controllability check at low speed at 8000 ft
  - land

NOTE :

If landing speed must be above 130 kts IAS, an airfield with a 8000 ft runway should be selected.

6.1.3.3. NO FLAPS LANDING

Approach speed is the same as for a normal landing.
The approach is flat and touching down at the desired point is more difficult.
Pass over the boundary at 105 kts. It is recommended to use airbrakes to increase glide angle and have better precision touching down.

AL 2

NOTE

It is recommended not to use airbrakes when performing a flapless landing.

6.1.4. AILERONS

In case of electrical failure or hydraulic pressure drop, the aileron control becomes manual (unboosted) automatically.

AI 1

In this case, to reduce the parasitic aileron control forces :
- set the aileron booster switch to "OFF"
- disengage the artificial feeling device
- operate the ailerons once on each side to engage the locking devices of the aileron booster cylinders.

For training purposes, use the same procedure.
In this case, to get the aileron booster operating again :
- engage the articial feeling by orientating the trigger so that the digit engages.
- switch on the aileron booster.

In case of left engine failure, switch off the aileron booster and disengage the artificial feel.

CAUTION

1) If manual aileron control is desired, disengage the artificial feeling device after the aileron booster is off.
2) Engage the artificial feeling device before the aileron booster is on.

NOTE

1) In flight, a slight bump is felt when aileron booster is switched off, due to the ailerons being deflected slightly upwards. Simultaneously, a slight tendency to nose-up appears. The ailerons go back to their initial position after engaging the locking digits of the aileron booster cylinders.
2) The aileron deflection speed is limited by fluid flow speed in the cylinders. About 0.2 second is necessary for full deflection from neutral position.

6.2. AIRSPEED INDICATOR FAILURE

6.2.1. DUAL FLIGHTS

Since the pitot static systems in the front and the rear cockpit are independant, there is no difficulty if one airspeed indicator fails.

6.2.2. SOLO FLIGHTS

In case of solo flights or in the exceptional case of a simultaneous failure in front and rear cockpits (dual flights) the ideal solution consists in making a formation landing with another aircraft or a PAR final observing GCA settings plus 500 rpm. If GCA is not available, fly a LOW LEVEL TACAN PATTERN observing normal settings plus 500 rpm.

6.3. EMERGENCY BRAKE OPERATION

In case of one or both toe-brakes failure, use the emergency brake system (it is fed by a special accumulator which allows about 25 brake actions).
Pull the handle progressively, the best procedure being to support the thumb against the top part of the instrument panel.
The emergency brake has the same effectiveness on both wheels. It is progressive but powerful.
If circumstances are such that it is necessary to retract the gear on the ground proceed as follows :

- press-in the red button located above the gear normal retraction lever (override button) and raise that lever. Electrical current is needed.

NOTE : Do not attempt to taxi back to the parking area with doubtful brakes or low hydraulic pressure or with the emergency brake only.

WARNING : never use normal and emergency brakes simultaneously.

CAUTION

In case of a hydraulic system failure, the braking possibilities may be known according to the pressure gauge indications :

a) Main accumulator 250 HPZ, emergency accumulator 250 HPZ -

After a normal extension of the undercarriage, airbrakes and flaps, the remaining pressure allows for :

12 toe braking actions

and 25 emergency brake actions

b) Main accumulator 150 HPZ = 2.100, emergency accumulator 250 HPZ = 3.500 p.s.i.

Only a few toe-brake actions are available, but enough pressure remains for 25 emergency brake actions.

6.4. GO-AROUND

6.4.1. BOTH ENGINES

Carry out the operations in the following order :

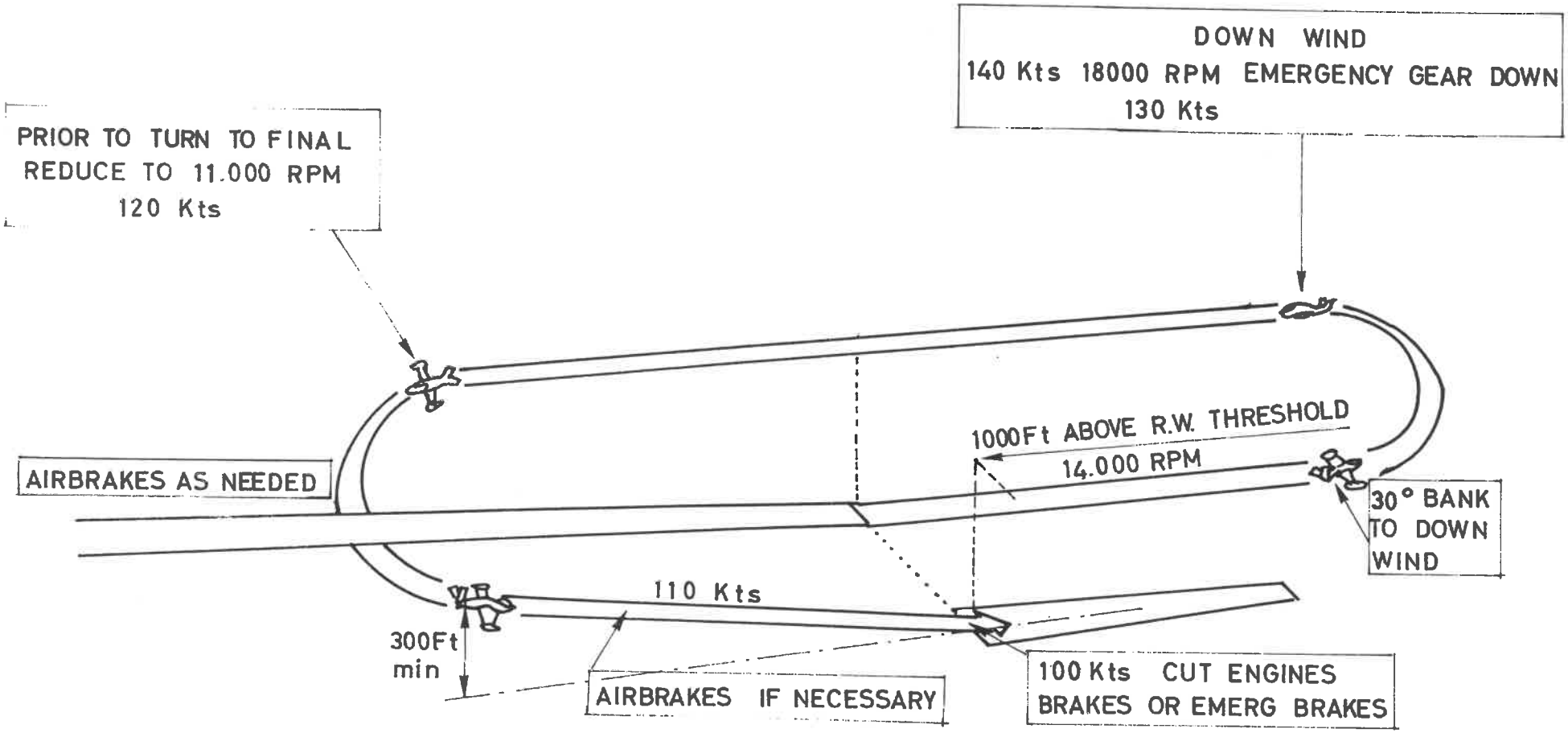
- apply full power gradually and retract the airbrakes at the same time
- adopt a positive angle of attack
- trim the elevator if necessary
- raise the undercarriage
- retract the flaps

6.4.2. SINGLE ENGINE

The manoeuver is delicate and has to be avoided whenever possible. Therefore the single engine approach has to be executed carefully and the decision to go-around has to be taken above 300 ft AGL.

6.4.2.1. RIGHT ENGINE OR LEFT ENGINE FAILURE

- apply full power on the live engine, slowly till 17000 rpm, then faster till 22.600 rpm
- check airbrakes in simultaneously
- raise landing gear, raise flaps to 15°
- adopt a positive angle of attack and climb up to circuit altitude at 110 KIAS
- take 120 kts IAS when level



LANDING PATTERN_HYDRAULIC FAILURE

FIG 34

6.5. CIRCUIT AND LANDING WITH HYDRAULIC FAILURE (Fig.34)

Aircraft configuration : - aileron booster OFF
- artificial feel OFF

Execution :

- align the aircraft parallel to the runway, slightly to the outside of the circuit
- altitude 1000 ft AGL
- reduce both engines to 14.000 rpm above runway threshold
- pull the landing gear circuit breaker
- push the landing gear emergency selector button marked EMERGENCY

Over the far end of the runway :

- altitude 1000 ft
- make a 180° level turn with 30° bank

Downwind :

- at 140 KIAS : set 18.000 rpm
- extend the landing gear by means of the emergency procedure :
  - lower landing gear lever
  - pull out the emergency hydraulic pump handle
  - actuate the hand pump until three green lights appear on the landing gear position indicator
  - put the airbrakes emergency selector valve on OUT
  - maintain 130 KIAS
  - at end of downwind : (when beginning of runway reappears behind the trailing edge)
    - reduce both engine to ± 11.000 rpm
    - start final turn - speed 120 KIAS

Final turn
- speed 120 KIAS
- perform : B - NO brakes check
  U - Down
  F - no flaps
  A - airbrakes ~~as needed~~ preselected OUT by emergency system.
  P - check pressure
- minimum 300 ft AGL at end of turn
- take 110 KIAS during roll-out
- airbrakes as needed, but not recommended.
- over threshold 100 KIAS

Landing :
- Engines cut-off when passing over threshold
- Use normal brakes if normal pressure remaining
- if not, use emergency brake

6.6. FORCED LANDING (fig.35)

In all cases, whether on a unprepared surface or on the runway, a forced landing should be carried out with the undercarriage extended.

6.6.1. WITH ENGINES

a. With undercarriage extended, select a landing field and perform the follwing manoeuvers :

- give the position by radio and indicate the type of incident

- dump the tip tanks
- drop external stores (if applicable)
- lock the shoulder harness

Make a normal approach with full flaps and airbrakes as required.

b. When entering the field, as soon as it is certain that the last obstacle can be cleared :
- shut the fuel cocks
- cut out the generator
- before the touchdown, jettison the canopies

Contact with the ground should be made at a normal landing angle.
Allow the nosewheel to touch down and begin braking.
When certain that retraction will NOT be necessary, cut out the battery.
As soon as the aircraft has come to a stop, unloosen harness and evacuate.

c. At sea level, all fields having a length of 650 metres (2000 Ft) may be used as emergency landing grounds.

6.6.2. WITHOUT ENGINE (FIG 35)

a. Immediate actions
- Convert speed in altitude or distance and take 140 Kts while turning in the direction of the most suitable airfield.
- Close cocks, close throttles
- Aileron boost off, artificial feeling off Start Clock
- Check TACAN position, inverter off as soon as practicable, unload electrical circuit
- [redacted]l.

b. Planning the descent
- Plan the letdown as to intercept the high key point, low key point or 270° point or to make a straight in.
(High key point : 3000 ft AGL)

f. Forced Landing pattern

(1) High key point, slightly right of runway at 3000 ft AGL :

- lower gear in emergency and take 130 kts
- Airbrakes emergency selector OUT

(2) Low key point :

- 1500 ft AGL
- Lower 15° flaps and take 120 kts

(3) 270° point :

- 1000 ft AGL

(4) Final :

- 110 Kts
- Flaps as needed
- A/B if needed
- Jettison canopy only when necessary and if barrier engagement is not anticipated.

(5) Landing :

- Make normal touchdown - use normal or emergency brakes
- When sure retraction of gear will not be necessary, cut off battery
- As soon as aircraft stops, unloosen harness, oxygen tube, radio connection and evacuate.

NOTE :

1. The optimum gliding speed with clean aircraft configuration is 140 kts. About 2 NM (4 km) are covered per 1.000 feet.
2. If before extending the flaps the main hydraulic accumulator has a pressure of 250 hpz approximately 210 hpz will be left after the extension, thus allowing for 7 complete manoeuvers of airbrakes.

6.7. DITCHING

No trial has been effected yet. Do not attempt a ditching, bail out.

If ditching cannot be avoided :

- fly a normal final approach at 110 knots, 15° of flaps
- lock the shoulder harness
- disconnect oxygen tube and radio plug
- before touch-down, jettison the canopies
- ditch parallel to the waves, with a moderate wind
- with strong wind, ditch according to the component of wind and wave
- leave the aircraft rapidly and swim away from the wreck.

6.8. FIRE

6.8.1. ON THE GROUND

While starting the engines, a certain amount of fuel accumulated in the combustion chamber might cause fire coming from the exhaust pipe and damaging the tail. In this case, immediately close the fuel cock and switch off the battery. The fire guard, who should stand by the tail pipe, can smother the fire with his extinguisher. There is no fire extinguisher in the aircraft.

6.8.2. IN FLIGHT

If a fire warning light illuminates, check E.G.T. and reduce throttles

If the E.G.T. IS NORMAL
Land as soon as practicable

If the E.G.T. IS HIGH OR ZERO
- Throttle idle
- Fuel cock OFF
- Check for black smoke

If there is BLACK SMOKE
- Dive to increase the ventilation
- Turn the pressurization OFF
- Select 100% oxygen

If there is NO BLACK SMOKE
Land as soon as practicable

If the fire stops
Land as soon as possible

If the fire doesn't stop
Bail OUT

NOTE. 1. If the fire doesn't seem to originate from an engine, switch off battery and generator (stopping of the L.P. pump does not cause the engines to stop.

2. During an airstart, the fire warning light may illuminate. Retard the throttle and dive : the light should go out. If it doesn't, close the fuel cock.

3. Never attempt an air start after a fire warning indication.

6.9. ENGINE FAILURE-AIR START AFTER A FLAME-OUT

6.9.1. CAUSES OF ENGINE FAILURE

The failure of one or both engines may have several causes.
Most of the time, an air start may be accomplished without inconvenience or difficulty. However, discrimination should be maintained and an air start should not be attempted with a damaged engine.

- Surging

This manifests itself by loud blasts (not unlike gun firing) and a momentary jet pipe overheating resulting from certain flight circumstances : high altitude, low indicated airspeed, high RPM, or a fast displacement of the throttle. In all cases, a slight throttle reduction should be made immediately.
In the event of a flame-out, shut off the fuel cock and accomplish an air start.

- Poor combustion

Poor combustion in idle may result in a flame-out while operating a fast descent at high speed or through a humid area at normal speed. In this case, shut off the fuel cock and attempt an air start.

- Fuel feeding

A damaged fuel pump at altitude or a fuel line failure may cause an engine to stop. In this event, of course, shut off the fuel cock and do not attempt an air start if fuel odor is smelled in the cockpit.

- Icing

Clear or rime ice on the air intakes may cause the engine to flame-out especially at low airspeed and high angles of attack or when advancing throttles in this attitude.

- Water puddles on the runway

Water puddles on the runway may cause a flame - out of both engines; the water being thrown inside the air intake duct by the nose wheel. It is recommended to ease the nose wheel off the ground as soon as possible when this condition exists on the runway.

6.9.2. ENGINE FAILURE DURING TAKE-OFF

The failure of one engine results in a yaw effect perceptible at low speed only, even with the other engine at full power. This yaw effect can be counteracted with a slight displacement of the

rudder. Therefore, in the event of engine failure during take-off, there is no minimum control speed.
Fig.N°22 indicates the take-off lengths and the distances to clear a 35 feet obstacle plotted versus the airspeed at which the failure occurs.
The procedure to be used should be adopted according to the runway length, aircraft weight, altitude and temperature.

6.9.2.1. IF THE AIRCRAFT IS NOT AIRBORNE

For an aircraft equipped with 125 l. tiptanks, in standard conditions, take-off is possible safely on a 700 meter runway. The critical point is then defined by the fact that the acceleration - stop distance and the take-off distance are both equal to 700 m. This point is situated at 420 m and corresponds to a speed of 90 knots.

Abort take-off : - throttles idle
- brake firmly
- shut fuel cocks
- request barrier eventually
- switch off the battery

CAUTION

Water puddles on the runway may result in a flame-out of one or both engines during the first part of the take-off ground roll. The water is thrown inside the air intake duct by the nose-wheel. Immediately shut off the fuel cock of the engine that has failed. Allow two minutes before restarting.

6.9.2.2. IF THE AIRCRAFT IS AIRBORNE

- Correct for yaw
- When safely airborne, undercarriage UP, leave 15° flaps
- Stabilise at 110 Kts, take climbing attitude and keep 110 Kts
- At 300 ft AGL, R/T call : "close single engine"
- At 500 ft AGL check which engine has failed :

If left engine OUT : - aileron boost and artificial feeling OFF
- inverter OFF

- Turn downwind ± 35° bank and call :
"Turning downwind"
- Level off at 1000 ft AGL, let speed increase to 130 Kts
- Reduce to 21.000 RPM
- Close throttle and cock of failed engine, note time
- Perform FEWFES (Fuel, Engine, Windmilling, Fire, Explosion, Smoke) and airstart if advisable.
- Perform single engine circuit. With left engine out, select U/C down in emergency

CAUTION

Under no circumstances must the throttles or fuel cocks be moved below 1000' AGL.

6.9.2.3. ENGINE FAILURE DURING GO-AROUND

a. Flame-out of right engine. The procedure is the same as for failure during take-off.

b. Left engine flame-out :
- retract airbrakes
- milk up flaps till 15° and keep them till 500' AGL
- take 120 KIAS as soon as possible while controlling altitude loss
- if pressure is left in hydraulic accumulator :
raise the landing gear
- climb straight ahead
- cut aileron booster, artificial feeling and inverter
- at safety height or if there are obstacles ahead turn with 20° bank while maintaining 120 KIAS
- at 500' AGL minimum, take 130 KIAS
- perform a close single engine circuit (§ 6.9.7.)

NOTE : The drag caused by full flaps being much higher than the drag caused by the landing gear it is essential to first raise the flaps to 15° and then raise the landing gear if the remaining hydraulic pressure is sufficient.
If not, leave the landing gear down.

6.9.3. DOUBLE FLAME-OUT

Before being airborne : abort take-off (§ 6.9.2.1.)
After becoming airborne : keep at least 120 KIAS
Crash land : before impact : - close fuel cocks
- jettison canopy
- switch off battery

6.9.4. IN FLIGHT FLAME-OUT

a. If a flame-out occurs in flight, shut off the corresponding fuel cock immediately. Endeavor to determine what caused the engine to stop before attempting an air start : surging, failure of fuel supply, poor combustion on idle, icing... etc.
If a mechanical failure is suspected, do not attempt an air start and land.

b. Engine frozen : There is possibility for the engine to freeze after a flame-out especially if the engine stopped because of turbine overheating (surging).
In this case, descend to a lower altitude, around 10.000 feet with the highest possible indicated airspeed. The engine should be windmilling again after about 5 minutes and may then be started. If the engine remains frozen, land on one engine.

CAUTION
Never attempt to engage the starter of an engine that is frozen.

6.9.5. AIRSTART

Whichever the cause of a flame-out, close the fuel cock immediately (except in case of flame-out on take-off or during go-around). If left engine has flamed out, cut off aileron booster, artificial feeling and inverter. After closing the fuel cock, wait approximately 1 minute before attempting an airstart : this will allow the fuel to drain out of the combustion chamber.

6.9.5.1. ABOVE 18000 ft

- do not attempt an airstart above 18.000 ft
- descend to an altitude of 18.000 ft or lower

6.9.5.2. BELOW 18.000 ft

- The airstart may be attempted 1 minute after closing of the fuel cock
- Windmilling speed : 1200 RPM
- An airspeed of 120. KIAS will give 1200 rpm windmilling
- Throttle fully back
- Start stopwatch and simultaneously slowly open the fuel cock (it should take 4 to 5 seconds to full open) while maintaining the injection -ignition button depressed (injection time 30 seconds maximum)
- watch EGT : as soon as the EGT rises the airstart has succeeded. However, it is recommended to maintain injection - ignition until the EGT has reached 300°.
- the higher the residual EGT, the better the chances of getting a successful airstart
- wait for the rpm to stabilize itself before moving the throttle.

NOTE : The optimum altitude for airstart is 8000 ft. Never attempt an airstart when the flame-out has been caused by an engine explosion.

CAUTION

- Never use the starter in flight
- If no increase of EGT after 30 seconds of injection-ignition, release button and close fuel cock immediately
- Attempt another airstart at a lower altitude or airspeed after waiting 2 to 3 minutes for ventilating and draining of the combustion chamber.

The airstart will be more difficult as the number of unsuccessful trials increases. Therefore, when making the first attempt :

- be sure to be in the best possible conditions
- observe the correct airspeed

6.9.5.3. PRACTICE AIRSTART (preferably right engine)

- recommended altitude 7000 ft
- throttle fully back
- wait for EGT to stabilize itself - Close fuel cock
- perform airstart as described in § 6.9.5.2.

6.9.5.4. FLAME-OUT DUE TO ICE INGESTION

a. Above 1000 ft AGL

1. Single engine flame-out
   - Raise flaps till 15°
   - Retract airbrakes
   - Throttle of dead engine fully back
   - Press injection-ignition button of both engines till airstart is effective
   - When the failed engine starts (EGT and rpm increasing) advance throttle to desired position

   NOTE : Do not change throttle setting of live engine

2. Double flame-out
   - Raise flaps to 15°
   - Retract airbrakes
   - Both throttles fully back
   - Press injection - ignition buttom of both engines till airstart is effective
   - When one or both engines start (EGT and rpm increasing) advance throttle(s) slowly till desired setting
   - Eventually prepare for forced landing

b. Below 1000 ft AGL (one or both engines)

PRESS BOTH INJECTION BUTTONS IMMEDIATELY WITHOUT TOUCHING THROTTLES, LANDING GEAR, FLAPS NOR AIRBRAKES.
If still unsuccessful, throttle(s) idle, press both ignition buttons again.

6.9.6. SINGLE ENGINE FLYING

6.9.6.1. Single engine flying involves almost no yaw effect - (bent tail pipes).

It is noticeable at high RPM and low speed only, that means essentially in case of engine failure during take-off, go around and climb. It is corrected by a rudder deflection representing a negligible force. In case of left engine failure, take into account that it drives the generator and hydraulic pump. Reduce electrical loads.

- Switch off the aileron booster in order to save hydraulic pressure and battery discharge (electric valve)
- Turn off artificial feel
- Lower landing gear and airbrakes by emergency procedure.

NOTE : During single engine flight, do not exceed 300 KIAS.

6.9.6.2. ABOVE 14.000 FEET

- Set 21.750 rpm on the remaining engine. Let the airspeed drop to 160 KIAS and maintain this speed. After 30 minutes, reduce to 21.000 rpm, maintain 160 KIAS.

At ± 14.000 ft (TAS = ± 220 Kts), 21.000 RPM and 160 K IAS, level flight can be maintained.

6.9.6.3. BELOW 14.000 FEET

According to altitude, with 21.000 RPM, level flight can be maintained and the speed will vary from 160 to 200 K IAS.

NOTE : Envisage a diversion, knowing that :

1. with no wind, single engine flying means :
   - a loss of 150 litres of fuel at 25.000 ft
   - a loss of 80 litres of fuel at 20.000 ft
2. the influence of the wind increases with decrease in TAS
3. safety height may be higher than maximum single engine altitude at 160 KIAS and maximum continuous power
4. the left engine may have failed

- If level off altitude is equal or lower than 18.000 ft, attempt an airstart (if advisable)
- If successful, climb to cruising altitude if necessary. As an example with 400 litres of fuel remaining, the distance covered will be the same at 15.000 ft or (climbing) at 25.000 ft.

6.9.7. SINGLE ENGINE LANDING

Rejoin the circuit with following settings :
- Speed 200 KIAS
- Altitude 1000 ft AGL
- 21.000 rpm

If the left engine has failed, switch off aileron boost, artificial feeling and inverter.

a. Right engine failure

At runway threshold
- altitude 1000 ft
- speed 200 KIAS
- reduce left engine to 18.000 rpm

At far end of runway
- altitude 1000 ft AGL
- perform 180° level turn at 30° bank

Downwind
- At 140 KIAS, set 21000 rpm
- Lower landing gear
- Maintain 130 KIAS
- lower 15° flaps
- set 11.000 rpm on left engine
- start final turn

Final turn
- speed 120 KIAS, power as required
- 45° bank maximum
- reduce speed to 110 KIAS during roll-out

Final approach
- speed 110 KIAS
- adjust power as required
- airbrakes if necessary

b. Left engine failure

Same procedure, but using right engine power settings and emergency hydraulic procedures as described in § 6.5. for landing gear, airbrakes and flaps.

6.9.8. MISCELLANEOUS ENGINE FAILURES

a. Throttle linkage locked or linkage failure

- carry out a normal landing pattern
- extend gear, flaps and airbrakes if necessary
- close the fuel cock of the affected engine, when the landing is assured

b. Turbine blade damaged

May pass unnoticed. If vibrations are felt, find out which is the faulty engine by changing the power settings. Try to find vibration free setting. If vibrations persist, shut off the fuel cock of the corresponding engine.

c. Vibrations

Even low amplitude vibrations can be dangerous. If possible, investigate and set to a vibrationless power setting. If not, shut the engine down.

d. Oil press. low or zero

- head for the nearest airfield
- if right engine is concerned, cut engine immediately
- if left engine is concerned, it shall only be cut when airfield in sight (flying in clouds for instance)

NOTE : Oil temperature indications might be a confirmation of a malfunction in the oil pressure system.

6.10. FUEL SYSTEM FAILURE

6.10.1. 'L.P.' PUMP FAILURE

The fuel low pressure pump failure does not cause engine failure. The main purpose of the pump in addition to insuring a better feeding of the engines is to fill up the inverted flight accumulator. If an 'L.P.' pump failure occurs, the accumulator will empty and the "L.P.'warning light will glow. There is no longer any engine feeding available for inverted flight.

6.10.2. STUCK FLOAT VALVE

a. Closed

This instance has never occurred to date. If it does, the main fuel tank only is usable. This failure is detected by watching the fuel gage which does not stabilize at 620 liters or 670 liters according to the aircraft attitude, while tip tanks are transferring.

b. Open

If the engines are running, the fuel leaks through the air vent under the fuselage.

- On the ground : Fuel will leak on the parking ramp. Shut down the engines and have the failure repaired.
- In flight : The fuel is pumped overboard and the fuel gage indicates the main tank is full while tip tanks are transferring. That is the only way, for the pilot of an isolated aircraft, to be aware of the failure. Open the tip tanks dump valves.
  It is preferable to land.

NOTE : It may be attempted to free the valve by successive positive and negative accelerations.

6.10.3. TRANSFER FAILURE

a. Uneven transfer

One tip tank may empty faster than the other one. It is preferable to maintain the wings level until the end of the transfer (the force is light) rather than to open the dump valves.

b. One tip tank is not transferring

It is caused either by a leaking filler cap (the overflowing fuel can be observed from the cockpit) or by a regulating valve malfunction.
It is preferable to open the dump valve to balance the aircraft.
It can also be landed with one tip tank full, under these conditions the aileron force to keep the wings level is light, but unpleasant in I.M.C.

NOTE

If the tip tank filler cap is not properly sealed, it is not unlikely that the dump valve will be less effective, as the pressurized air used for the transfer will escape through the leaking filler cap. The time needed to dump the fuel will be longer.

6.11. ELECTRICAL FAILURES

6.11.1. COMPLETE ELECTRICAL FAILURE

The only instruments available to the pilot are the airspeed indicator (without pitot heater), the altimeter, the standby compass, the vertical speed indicator, the ball, the oxygen pressure indicator and the rpm indicator. There is an indication of EGT, but it may be in error.
The aileron boost will be cut off automatically (§ 6.1.4)
The LP pump is inoperative, but the engines will run on the engine driven fuel pump. The crew members will have to use the emergency systems for undercarriage and speed brake operation.
Cabin pressurization will operate normally; cabin temperature will remain at last setting.

In case of complete electrical failure, proceed as follows :
- avoid flying at high altitude (no LP pump)
- switch off the aileron boost and artificial feel
- land as soon as possible - extend undercarriage and speed brakes by means of emergency systems; flaps will not be available

6.11.2. GENERATOR FAILURE

a. The pilot is warned of the failure by the illumination of the red generator warning light and by the voltmeter which indicates a voltage less than 24 V.
Switch off the generator.
The battery has a capacity of 35 A/H; when fully loaded, it will supply all electrical accessories during approximately 30 minutes, if TACAN inverter is cut off; 10 minutes with TACAN. Whenever possible, according to flight conditions, the electrical load must be decreased.
Especially :
- IFF/SIF and TACAN inverter
- gyro instruments inverter
- pitot heater
- interphone - VHF - UHF
- keep listening out on one radio set (in principle VHF switched on standby battery)
- maintain contact with a ground station
- if no contact switch to emergency channel
- avoid changing channels - transmit not more than necessary
- land as soon as practicable.

b. If a voltage regulator malfunction is noticed (voltmeter reading more than 29V), switch off the generator.
- keep battery switched on
- decrease electrical load as much as possible (§ 6.11.2.a) and land as soon as possible.

NOTE : To determine the battery voltage, switch the generator off.

6.11.3. BATTERY FAILURE

a. After starting the engines or in flight

There is no way for the pilot to detect this failure (unless the battery circuit breaker has popped out), since the electrical system is normally supplied by the generator.

b. On the ground, before starting

The pilot notices the failure when he sets the battery switch on and the generator warning light does not glow or the voltmeter reading is zero. Make sure the battery circuit breaker is pressed in.

6.11.4. ONE CIRCUIT BREAKER POPS OUT

If a circuit breaker pops out, press in the circuit breaker and if it pops out again, do not press it back. The circuit is definitely inoperative; take this into account for the remainder of the flight.

6.11.5. With battery switched on, one of the following circuits may be inoperative or fail in flight.

1. Starting controls, LP pump, dump valve, emergency jettison, oxygen warning, air conditioning, pitot heaters, interphone, normal VHF, UHF, TACAN (28 V).
2. Fuel quantity indicator, oil t° and pressure, EGT, guns, bomb and Rx firing, gun sight, hydraulic pressure gauges, VHF, radio panel lighting.
3. Gyro inverter, UV lights, trim tab, flaps, airbrakes, undercarriage controls, landing light, aileron boost.
4. Turn indicators, red cockpit lighting, fire warning, undercarriage position indicator, navigation lights.
5. Starter, IFF, TACAN (115 V)

Each of the first four circuits is protected by a circuitbreaker. The last circuit is protected by a high intensity fuse. These circuit-breakers and fuse are not accessible in flight.

6.11.6. ELEVATOR TRIM TAB FAILURE

The most likely malfunction is the jamming of the elevator trim tab switch, which causes the tab to move to maximum travel.

NOTE : With full deflection of the tab (10° nose-up, 5° nose down) the airplane remains controlable for airspeeds lower than 250 knots.

a. Solo flying

If the stick switch causes a runaway trim :

- Reduce power immediately while extending the airbrakes.
- As soon as the tab has reached full deflection, rock the switch on the reverse side to operate the tab in the desired direction. When the needle of the elevator trim tab position indicator comes across the neutral position, pull out the tab circuit breaker (on the left console).

b. Dual flying

- If the malfunction occurs to the front trim tab switch, the rear pilot can use his override switch and operate in the reverse direction of the runaway. As soon as the needle of the tab position indicator comes across the neutral position, the front pilot pulls out the tab circuit breaker.

6.12. EQUIPMENT FAILURE

6.12.1. ARTIFICIAL HORIZON, TURN AND SLIP INDICATOR FAILURE

For each one of these instruments the pilot is warned by a flag-alarm showing on the instrument face. Check gyro inverter circuit breaker and turn and slip circuit breaker.

6.12.2. GYRO-COMPASS FAILURE

The pilot is warned of the failure by a wrong reading of the instrument when matched with the standby compass. The failure may be checked by observing the "ball-cross" indicator.

NOTE : The gyro-compass and the artificial horizon are supplied by the same inverter. If it fails, both instruments will be unserviceable.

6.12.3. OXYGEN SYSTEM FAILURE

Symptoms :

- illumination of oxygen low pressure warning light
- breathing difficulties or symptoms of hypoxia
- oxygen indicator pressure drop at each inhalation (warped filter)

Proceed as follows :

- if at altitude, switch to EMERGENCY OX and descend below 10.000 ft
- if below 10.000 ft, pass on 100% OX, then on EMERG if first action has no effect
- return to base while watching the oxygen pressure; when the needle reaches the red sector, unfasten the oxygen mask.

6.12.4. PRESSURIZATION FAILURE

a. If, above 10.000 feet, the cabin altimeter does not read an indicated altitude lower than the instrument panel altimeter, check :
   - cockpit seal knob pressed in,
   - pressurization circuitbreaker in
   - cabin ventilation air scoops closed
   - pressurization switch set to "Pressurized" or "Demisting".

   If everything is normal and the cockpit seal effectively inflated, an important leak is likely, possibly resulting from a cabin pressure regulator jammed in the open position.

If so, deflate the canopy seal to preclude a sudden cabin inflation. Set oxygen to 100%. Descend if possible (weather, fuel). Return to base.

b. Defrosting unserviceable
- descend to 10.000 ft
- deflate canopy seal
- open fresh air scoops

c. If fumes or smoke should enter the cabin through the pressurization system, cut off the pressurization and set oxygen diluter lever to 100 %. Do not deflate the canopy seal nor open the cabin ventilation air scoops (unless heavy smoke) before the cabin altimeter shows the same altitude as the instrument panel altimeter; you may either wait at altitude (cabin pressure dropping slowly) or descend to 10.000 feet.
Look for possible fire - Return to base.

6.12.5. DEFROSTING

If the pressurization control switch fails, the valve remains at the same position. If impossible to select "defrosting", the cabin can be demisted or defrosted by a descent to 10.000 feet, canopy seal deflated and ventilation air scoops opened.

6.13. MISCELLANEOUS INCIDENTS

6.13.1. CANOPY BURST

This incident may occur at high altitude. The pilot experiences a brutal shock together with a sensation of cold. The air stream may cause breathing to be difficult and create a very unpleasant vibratory phenomenom. Proceed immediately as follows :
- slow down to less thân 200 knots with airbrakes extended and throttles at idle, set oxygen regulator to 100%, if necessary to "emergency"
- descend and land as soon as possible without exceeding 200 kts IAS.

NOTE :

If the front canopy bursts, never jettison the canopy, open the spoilers. To do this pull the chain, holding the arm as near as possible to the head, and on the side where a portion of plexiglass is left (the arm might be exposed to fraction otherwise). Once the deflectors are in place, rear cockpit comfort is correct up to about 180 knots.

6.13.2. ILLUMINATION OF THE CANOPY WARNING LIGHT IN FLIGHT

This type of incident may have two probable causes :

a. one of both canopies is not locked completely
b. the micro-switch of the canopy light is not adjusted properly.

Proceed as follows :
In all cases, check that both canopies are properly locked (handles fully forward) and return to base.

NOTE : Never perform vertical manoeuvres (stalls, spins, acrobatics... etc) with the canopy warning light illuminated ; also avoid accelerations.

6.13.3. MAIN WHEEL TIRE BURST

a. During take-off

Depending the speed of the aircraft at the moment a tire bursts, which could be noticed by a sinking of the aircraft, the pilot should react as follows :
If decision is made to stop :
- reduce to idle
- set the nose wheel on the ground and use the brake on the opposite side of the burst tire
- shut off the fuel cocks if the aircraft leaves the runway

If take-off is continued :
- do not retract the gear
- use "vide-vite"
- land as described hereafter.

b. During landing

If the pilot is aware of a burst tire :
- Inform the control tower
- Touch down on the opposite side of the runway of the burst tire
- Hold the sinking wing as long as possible
- Set the nose wheel on the ground and use the brake firmly on the opposite side of the burst tire
- Shut off the fuel cocks

If the burst takes place during landing, it is usually at the end of the run, caused by excessive braking. If the aircraft tends to veer to the right or left, cut engines.

6.13.4. FREEZING OF THE AILERON CANVAS

Heavy rain on a parked aircraft may moisten the internal aileron compensation canvas and freeze the ailerons during climb; an effort of 2 to 3 kg on the control column left and right will free the ailerons.

6.14. EMERGENCY JETTISON OF STORES

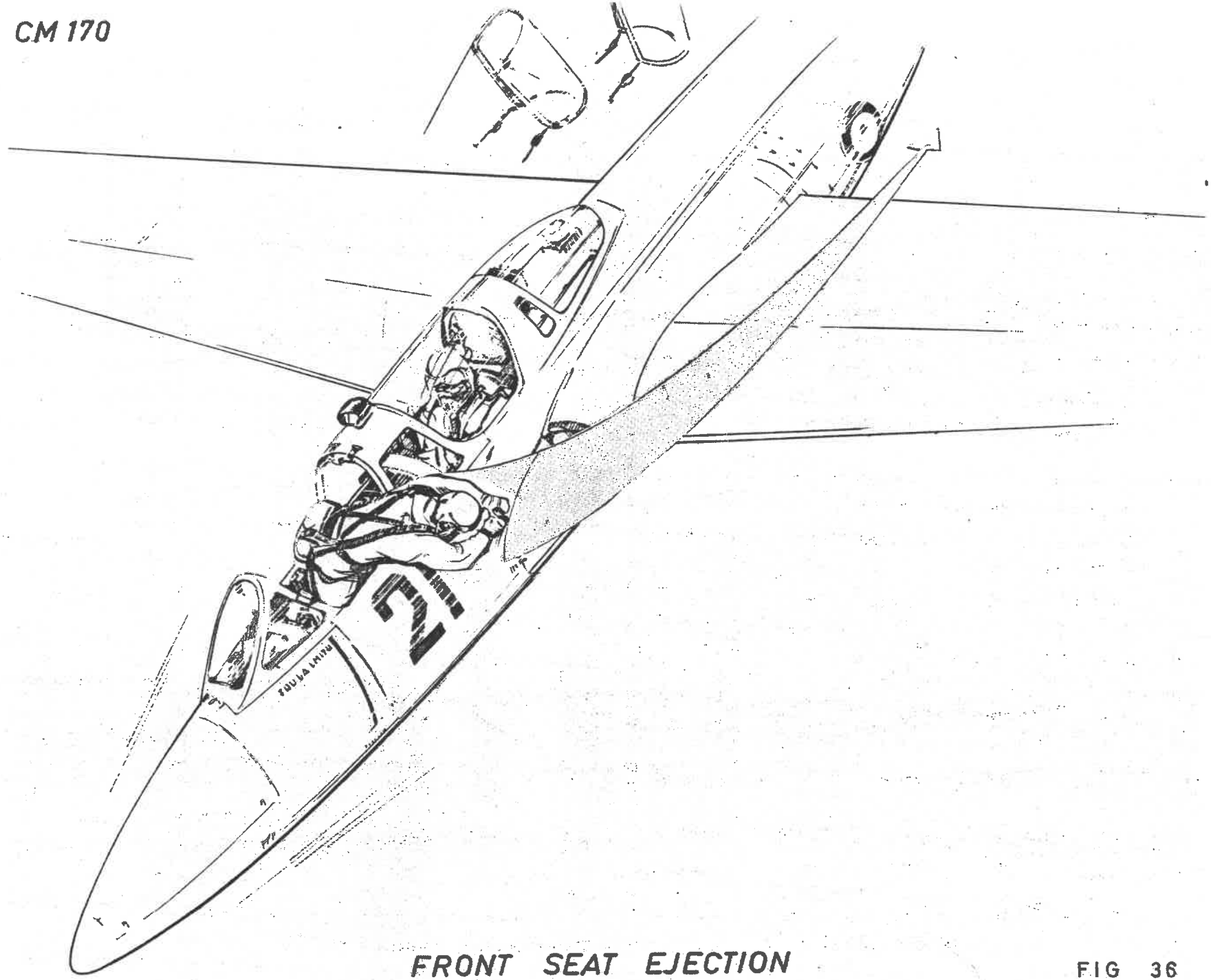
6.14.1. TIPTANKS

Tiptanks are not jettisonable : use the dump valves.
Tanks of 125 litres : average time to dump the fuel : 4 minutes.
After dumping, close the dump valves and set the switches in neutral position.

6.14.2. ROCKETS

Rockets are not jettisonable. If one or several rockets have not been fired, advise tower, follow local orders and make a precautionary landing.

6.14.3. BOMBS AND ROCKET LAUNCHERS (PM)



FRONT SEAT EJECTION
(A/C OUT OF CONTROL)

FIG 36

6.15. BAIL OUT

1. Bail-out altitude

Bail out has to be accomplished before reaching the minimum altitude of 5.000 ft AGL.
The optimum altitude is between 7.000 and 10.000 ft AGL.

2. Jettisoning of the canopies

The same handle is used for normal operation of the canopy and emergency release. It can be actuated with the seal inflated or not. The canopy, assisted by the air stream, is lifted in the opened position. The steel bolts holding the canopy struts break, and the axles of the hinges come free (when jettisoning the front canopy, it automatically releases the cockpit deflectors thus improving the habitability).
Wind tunnel tests have shown that :-
-for speeds below 180 kts moving the canopy handle is sufficient to slightly open the canopy which is then taken away by the air stream.
-for speeds equal or above 180 kts moving the canopy handle is not sufficient. The canopy sticks on the aircraft in the closed position.
It is necessary to hit the top and front of the canopy to obtain its opening.

NOTE : Since cockpit habitability is poor above 200 knots, the pilot will endeavor, as much as possible, to reduce the airspeed below 200 knots prior to jettisoning the canopies. Then the habitability is good enough to keep control of the aircraft even without visor, and carry out the prescribed operations to bail out.

CAUTION : Under no circumstances should the pilot stand up in the cockpit and pull the parachute ripcord. Leaving an uncontrolled aircraft in spin should be done on the inside of the spin.

6.16. ELECTRICAL SMOKES IN THE COCKPIT

These are easily identified by their acrid, irritating and suffocating odour.

- set oxygen at 100%
- descend to 10.000 ft trying to meet VMC
- switch off the pressurization, deflate the canopy seal
- open the fresh air scoop
- try to locate the origin of the smoke.

a. if the smoke seems to come from behind the rear seat :
   - switch off the TACAN-IFF inverter switch (right console)
   - if no result, pull the gyro inverter circuit breaker (left console).

   Both gyro and TACAN/IFF inverters are installed below the rear seat.

b. 1. if the smoke seems to come from a control box :
   - switch the equipment off at once and pull the circuit breaker

   2. if the origin of the smoke cannot be located :
   - cut battery, then generator
   - cut all electrical ancillaries while checking the corresponding circuitbreakers (UHF, VHF, IFF, TACAN, Gyro-compass)
   - switch battery and generator back on
   - switch the electrical ancillaries on one by one, checking their proper operation :

     VHF / UHF } radio check with other a/c or ground station

     IFF : check with ground stations

     TACAN : identification, bearing and distance check artificial horizon : the alarm flag must disappear

If one or several electrical ancillaries do not operate properly :

- Switch the failed equipment off and pull the circuitbreaker
- land as soon as possible

If smoke persists, cut battery and generator and proceed as for a complete electrical failure.

SECTION VII - ARMAMENT

Not applicable.

SECTION VIII - AIRCRAFT HANDLING IN EXTREME CLIMATIC CONDITIONS

8.1. COLD WEATHER OPERATIONS

Operation of the aircraft in cold weather does not pose a particular problem. It is recommended however to :

- inspect the surface and controls carefully. Do not take-off with ice or rime on the aircraft.
- make the first engine start of the day by means of a battery cart
- make sure the isopropylic alcohol tank is full. Check the pump for proper operation.

A crosswind will make it more difficult to hold the aircraft straight by means of the brakes.

8.1.1. ICY RUNWAY

Such a runway may be used when following precautions are taken :

- taxi slowly - use brakes with caution
- for take-off, do not set full power against the brakes. Advance throttles slowly, using slight taps on the brakes if necessary to keep straight until the controls become effective. Then use the rudder.
- On landing, touch down normally, brake smoothly at end of landing roll.

8.1.2. SNOW COVERED RUNWAY (PACKED OR ROLLED SNOW)

Follow the instructions given for use of icy runways.
In addition, between each flight have the undercarriage bays and doors cleaned : accumulating snow may prevent the undercarriage from being locked up after take-off, especially when snow is melting.
Do not perform touch and go landings.

8.1.3. UNPREPARED SNOW COVERED RUNWAY

If the snow is powdery, soft or melting :

- on take-off : lift nosewheel as soon as possible in order to avoid snow or water being ingested by the engines.
- on landing : maintain the nose high as long as possible. Brake smoothly at end of landing roll.

8.1.4. PENETRATION IN SEVERE ICING CONDITIONS

In order to prevent ice from accumulating and thus avoid flame-out, use following settings :

rpm : 20.000 rpm
IAS : 250 kt minimum
airbrakes : OUT

Any necessary change in power setting will be made on the right engine first, then on the left engine.

8.1.5. SINGLE ENGINE PENETRATION

- Come overhead at FL 180 (this flight level is not mandatory, but it will be the maximum possible in case of left engine failure (LP pump) - Set 21.750 rpm-IAS 140 kts
- start descent when ordered by ATC : 11° nose down (same attitude as normal) - let airspeed build up to 230 kts airbrakes OUT (in emergency if necessary) throttle back to 20.000 rpm.
- descend at 230 KIAS - rate of descent will be normal
- GCA level off : let airspeed decrease to 140 KIAS airbrakes IN (emergency system if necessary) undercarriage down (emergency system if necessary) keep 20.000 rpm.

Airspeed will stabilize itself around 125 Kts

- glide path : 15° flaps
  start descent at normal rate
  reduce throttle to 18500 rpm
  prepare for airbrake extension in emergency if necessary

Final speed is between 120 and 125 kts

Use airbrakes when sure to make the runway in order to shorten landing roll.