aerospatiale

SA 315 B
LAMA

VOLUME 1

NOTE

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

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

It never replaces the manuals delivered with the helicopters.

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SUMMARY

CHAPTER 1

GENERAL

CONTENTS

1.00.- INTRODUCTION TO THE AIRCRAFT

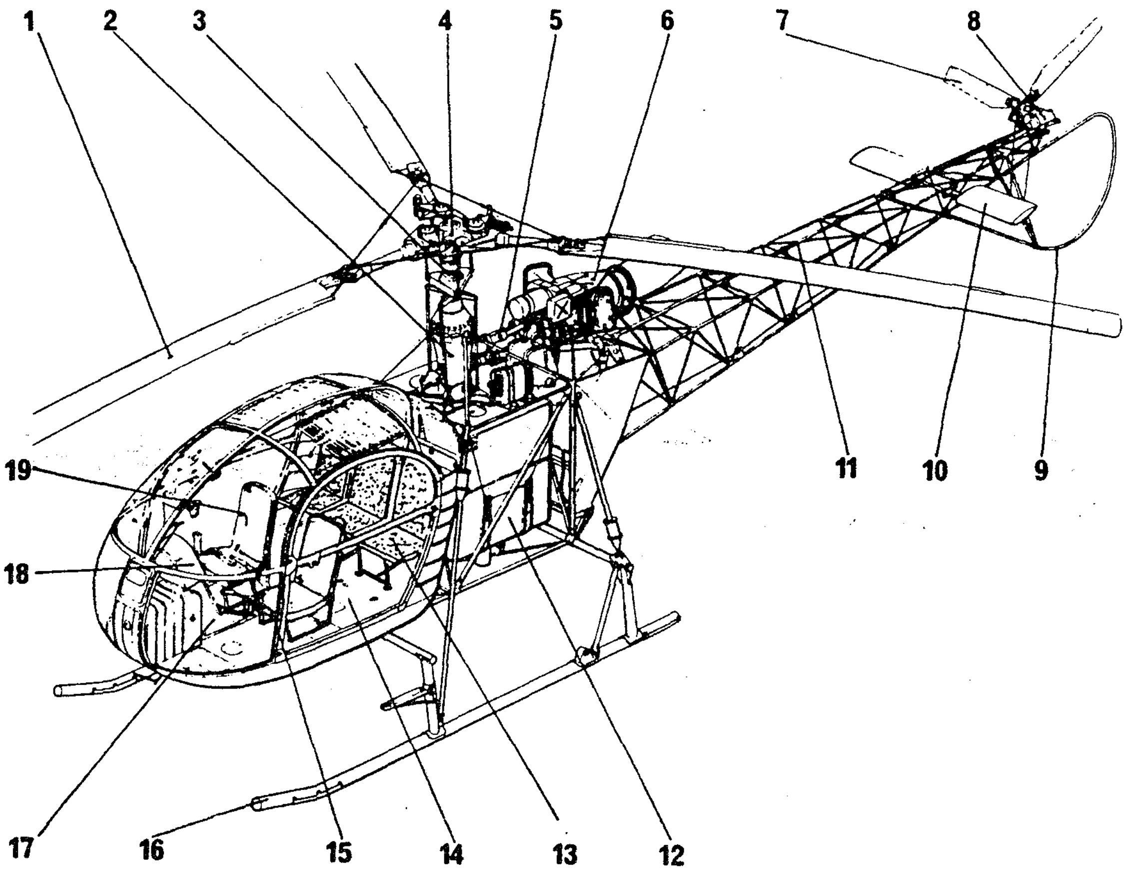
1.00.1.- OPERATING ROLES

The SA 315 B helicopter is designed for a wide range of civil or military missions, e.g. :

- Personnel transport (4 persons plus the pilot)
- Load transport,
- Casualty evacuation,
- Rescue operations.

The lightness of its structure with respect to its effective power makes this helicopter particularly suitable for aerial work (transporting of loads), in which field its performance capabilities can be used to advantage.

1.00.2.- INTRODUCTION TO THE AIRCRAFT



1.- Main rotor blade	10.- Horizontal stabilizer
2.- Main gear box	11.- Tail rotor drive shaft
3.- Rotor shaft	12.- Fuel tank
4.- Main rotor head	13.- Rear seat
5.- Main drive, clutch unit, free wheel	14.- Door
6.- Engine	15.- Front seat
7.- Tail rotor blade	16.- Skid-type landing gear
8.- Tail rotor gear box	17.- Control pedestral
9.- Tail rotor guard	18.- Instrument panel
	19.- Pilot's seat

Figure 1 - Introduction to the aircraft

1.00.3.- GENERAL CHARACTERISTICS

A.- WEIGHTS :

- Minimum empty weight .... 995 kg
- Maximum weight with load in cargo compartment 1 950 kg
- Maximum weight with load on sling .... 2 300 kg

B.- DIMENSIONS :

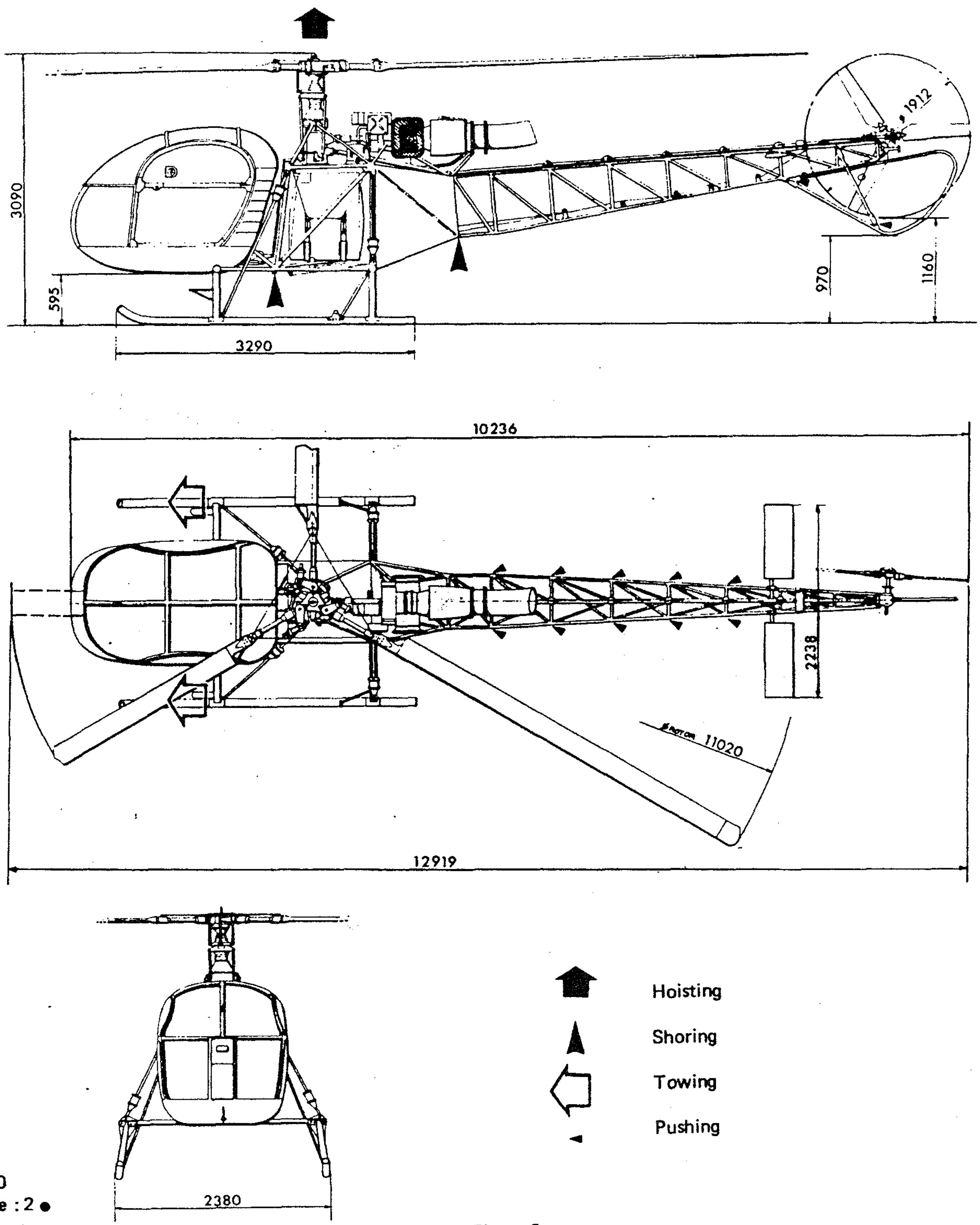


Figure 2

1.10.- MAJOR COMPONENTS AND SYSTEMS

1.10.1.- STRUCTURAL ASSEMBLIES (Figure 1)

1.- Cabin
2.- Forward structure (monocoque structure)
3.- Central body structure (welded tube construction)
4.- Tail boom (welded tube construction)
5.- Horizontal stabilizer

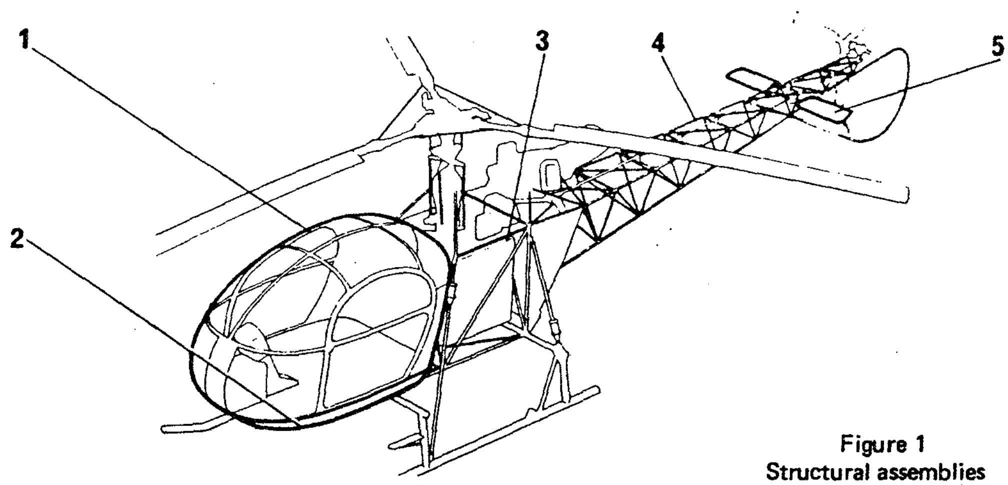


Figure 1
Structural assemblies

A.- ACCESS DOORS, FAIRINGS AND COWLINGS (Figure 2)

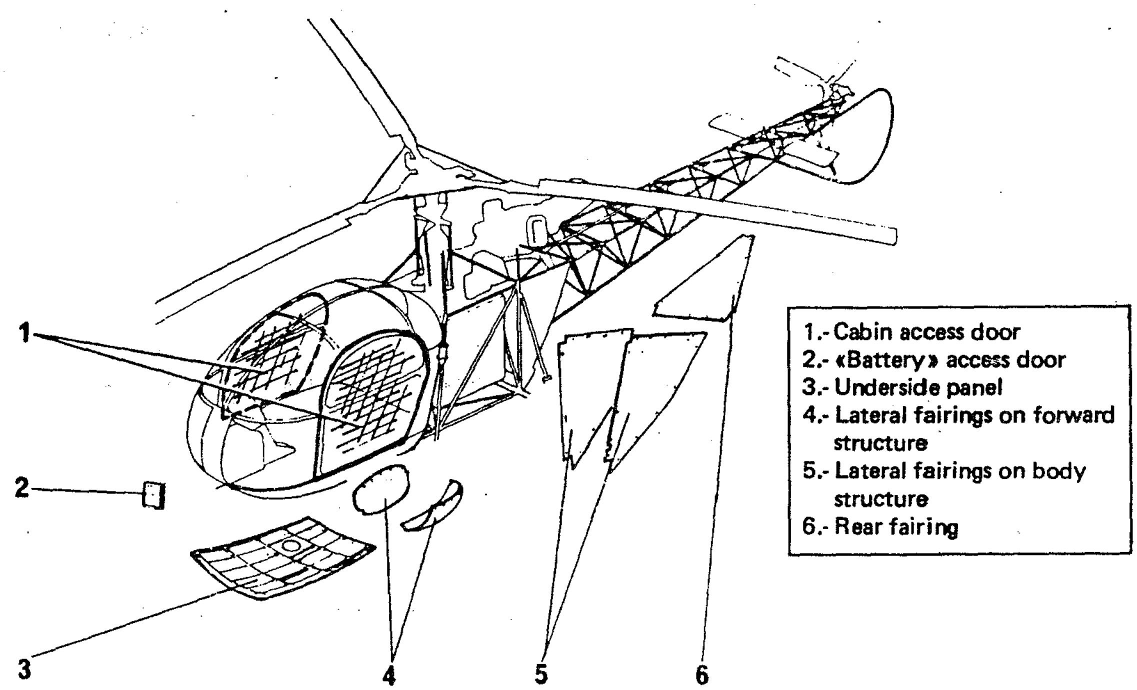
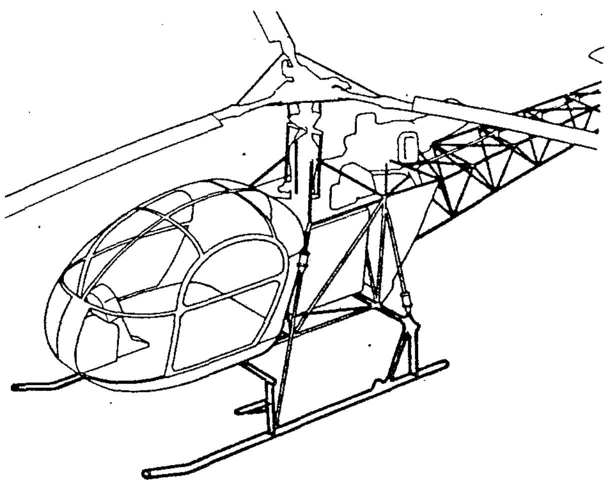


Figure 2
Doors, fairings and cowlings

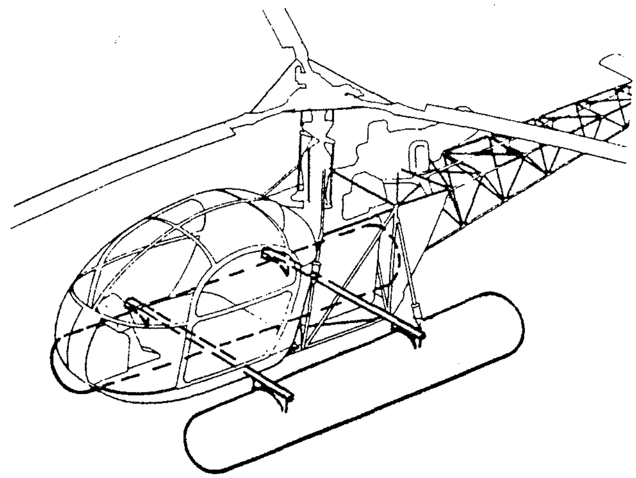
1.10.2.- LANDING GEAR (Figure 3)

3 options available :

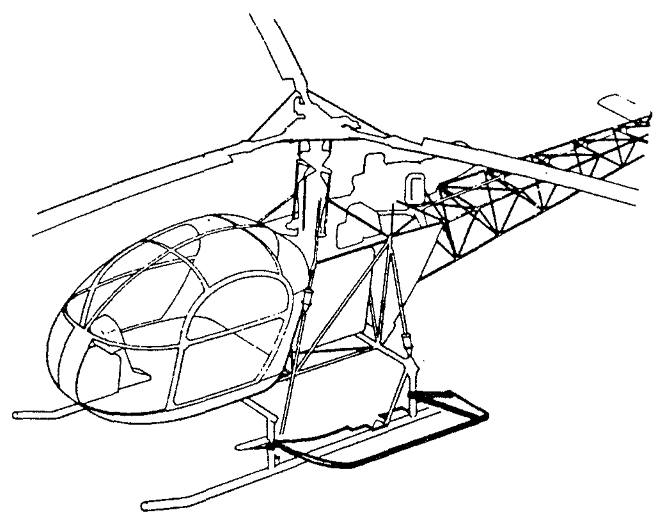
A - Skid - type landing gear
B - Float - type landing gear
C - Ski - type landing gear



A - Skids



B - Floats



C - Skis

Figure 3
Landing gear

A - SKID - TYPE LANDING GEAR

The skids are fitted on two cross bars. They are equipped with a retractable and removable wheel (taxiing). On each skid, two hydraulic shock absorbers prevent ground resonance.

B - FLOAT - TYPE LANDING GEAR

Two floats made of rubberized fabric and divided into five compartments are mounted instead of the wheel - type gear - Hydraulic dampers are provided.

C - SKI - TYPE LANDING GEAR

Two skis may be fitted on the skids. With the skis installed, the helicopter can still taxi on its wheels.

With all types of landing gear, a bow - shaped tail rotor guard is fitted.

1.10.3.- ENGINE

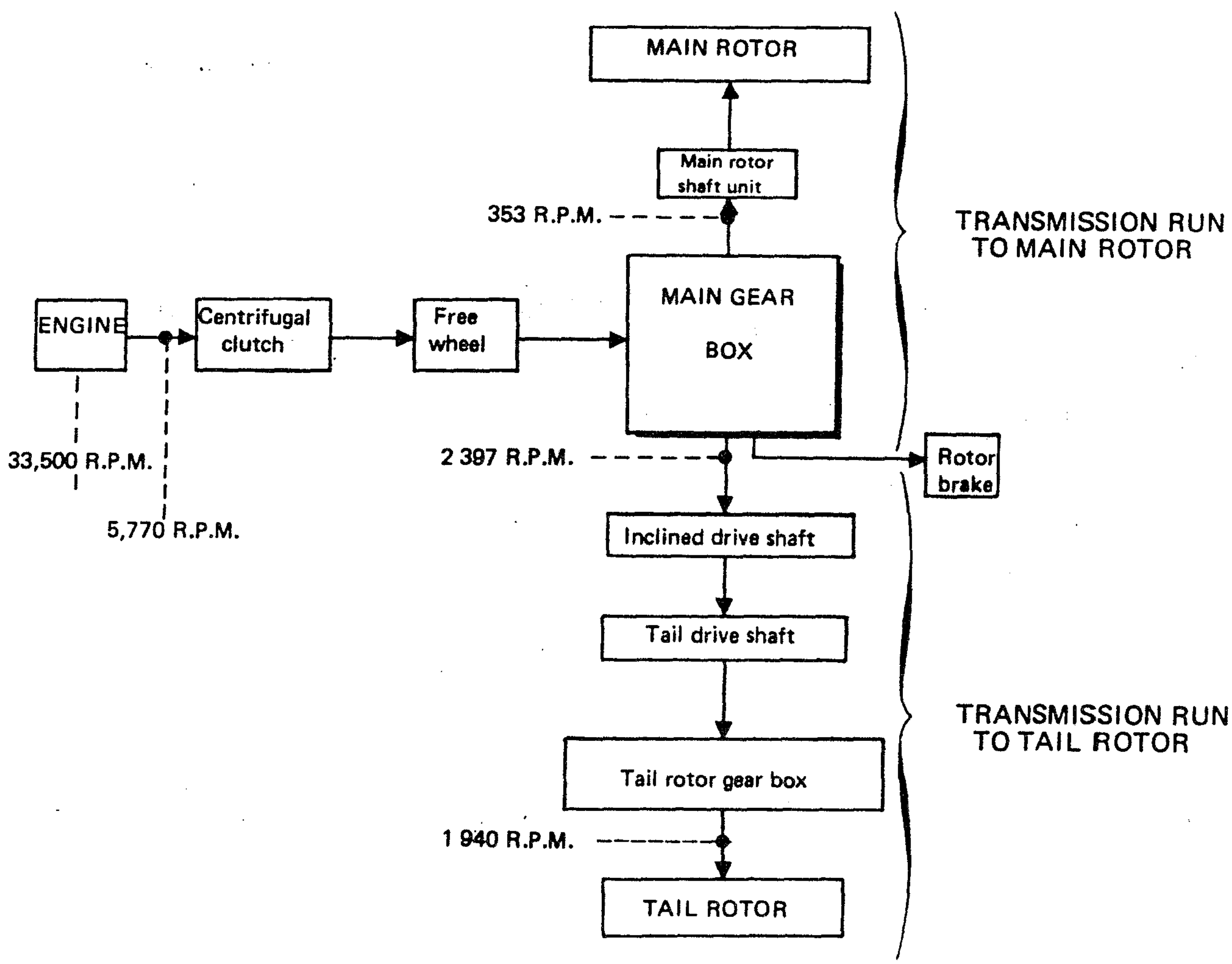
Type : TURBOMECA «ARTOUSTE III B»

Characteristics :

- The power turbines and the compressor impeller are mounted on the same shaft. (A clutch is therefore required between the engine output shaft and the main gear box input shaft.).
- Constant rotational speed. The power developped varies with the engine torque. Engine R.P.M. is maintained constant through the action of a centrifugal governor.
- Maximum take-off rating : 420 KW
- Engine rated speed : 33 500 R.P.M. ± 200
- Engine reduction gear output shaft speed : 5,770 R.P.M.

1.10.4.- TRANSMISSION SYSTEM

Two transmissions runs :
- Transmission run to the main rotor,
- Transmission run to the tail rotor.



1.10.5.- ROTORS

A .- MAIN ROTOR

- Main rotor diameter : 11.020 m (36 ft 1.86 in.)
- Direction of rotation (top view) : clockwise.
- Rotational speed : 353 R.P.M.

The main rotor blades may be quickly folded and unfolded using an optional tool kit.

1.- MAIN ROTOR BLADES

- Nature : metal construction
- Number : three
- Airfoil section : NACA 63 A at 11.5 %
- Chord : 350 mm
- Twist : 6^{o} 30'.

2.- MAIN ROTOR HEAD

- Type : 3-bladed
- Articulation :
  - In the flapping plane : A centrifugal droop restrainer permits blade flapping when the rotor revolves at 185 R.P.M.
  - In the drag plane : Blade oscillations on their drag hinge are dampened by means of hydraulic dampers.
  - Incidence

The three blade sleeves are interconnected by blade spacing cables which ensure symmetrical angular distribution about the rotor centre line during the rotor spinning phase.

Grease fittings provide for lubrication of the hub hinge pins.

B.- TAIL ROTOR

- Tail rotor diameter .... 1.912 m
- Direction of rotation (R.H. view) .... anti-clockwise
- Rotational speed .... 2,001 R.P.M.

1.- TAIL ROTOR BLADES

- Nature : metal construction
- Number : Three
- Airfoil section NACA 00.15 to 00.18.
- Trapezoidal shape
- Twist : none

2.- TAIL ROTOR HEAD

Type : 3-bladed; articulated to permit incidence and flapping .
Grease fittings provide for lubrification of hinges.

1.10.6.- FLIGHT CONTROLS

The main rotor controls modify the incidence of the main blades (cyclic and collective pitch variations) by actuating the swash plate assembly sliding along the rotor shaft.

The tail rotor controls modify the incidence of the tail blades (collective pitch variation).

A.- MAIN ROTOR CONTROLS :

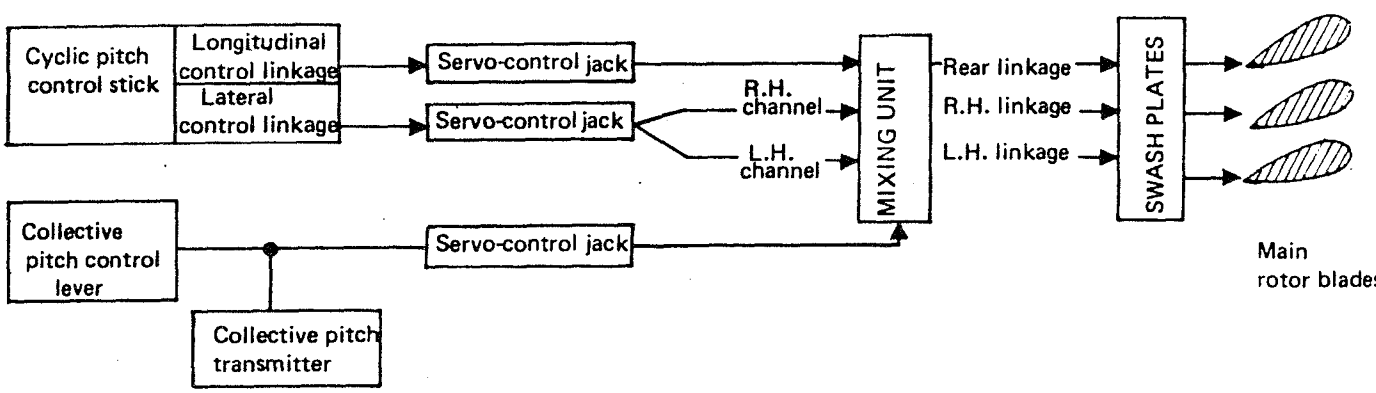
- Rigid control linkage : rods
- Three channels
  - Longitudinal pitch channel
  - Lateral pitch channel
  - Collective pitch channel

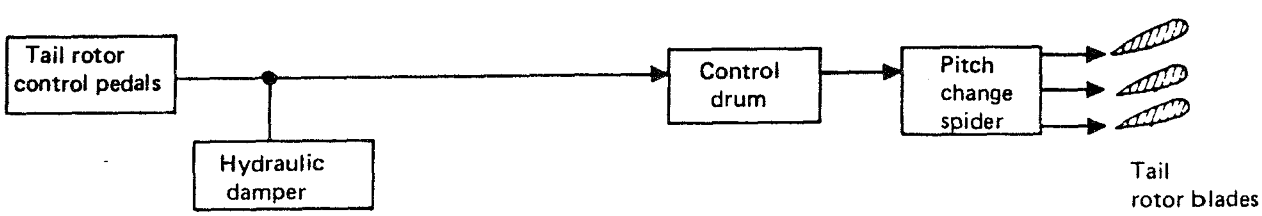
  } Cyclic pitch control system
- A mixing unit (specially hinged linkage assembly) makes it possible to combine the collective pitch and cyclic pitch control movements:
- A hydraulic servo-unit on each channel eliminates excessive pilot effort. (on both cyclic stick and collective pitch lever).

B.- TAIL ROTOR CONTROLS

- Control linkage : rods in forward and central structure ; cables along the fuselage and tail boom.
- Tail rotor control vibration is absorbed by a hydraulic damper.

The co-pilot's cyclic pitch control stick and collective pitch control lever are of the quick removal type.





1.10.7.- HYDRAULIC SYSTEM

The hydraulic system supplies power to the flight servo-control units

A hydraulic pump, driven by the main gear box, draws fluid from a reservoir and forces it into the pressure system whence it is returned to the reservoir.

1.10.8.- FUEL SYSTEM

- Light-alloy tank :
  - full capacity : 575 litres.
  - useable fuel capacity : 573 litres.

An electric booster pump immersed in the tank delivers fuel to the engine , through a filter with by-pass and a fuel shut-off cock. The filter is equipped with a clogging indicator.

The fuel tank may be fitted with a quick-drain installation.

— Undrainable capacity : 200 litres
— Draining rate : 200 litres in 1.5 minutes.

1.10.9.- ELECTRICAL POWER

The electrical power is obtained from :

- an engine-driven starter-generator
  (power : 4 000 W – voltage : 28.5V)
- a 40 A/h battery (voltage : 26V)

On the ground, the aircraft circuits may be energized from a ground power unit connected to the aircraft external power receptacle.

1.10.10.- LIGHTING

A.- INTERNAL LIGHTING

<u>Cabin</u> : 1 swivelling light,

<u>Instrument and control pedestal panels</u> : lighting fitment

B.- EXTERNAL LIGHTING

— 3 position lights and 2 rotary anti-collision lights.
— 1 retractable landing light (rotates partially in the vertical plane).

1.10.11.- INSTRUMENTS

All the monitoring and control instruments are contained in the aircraft cabin, on an instrument panel and a control pedestal panel.

- Pitot-static system (static pressure, dynamic pressure) : feeds the altimeter, airspeed indicator and the rate-of-climb indicator.
- A vacuum system (originating in a «venturi» «convergent-divergent» ejector mounted on the engine P2 pressure pick-off drives both the directional gyro and the artifical horizon gyro.

1.10.12.- FURNISHINGS

A - CABIN INSTALLATION (Figure 4)

- 2 front seats (1),
- 2 rear benches (2),
- 1 document-holder (3) per seat,
- 1 instrument panel support (4),
- 1 instrument panel (5).

B - OTHER INSTALLATIONS

- Windshield wiper

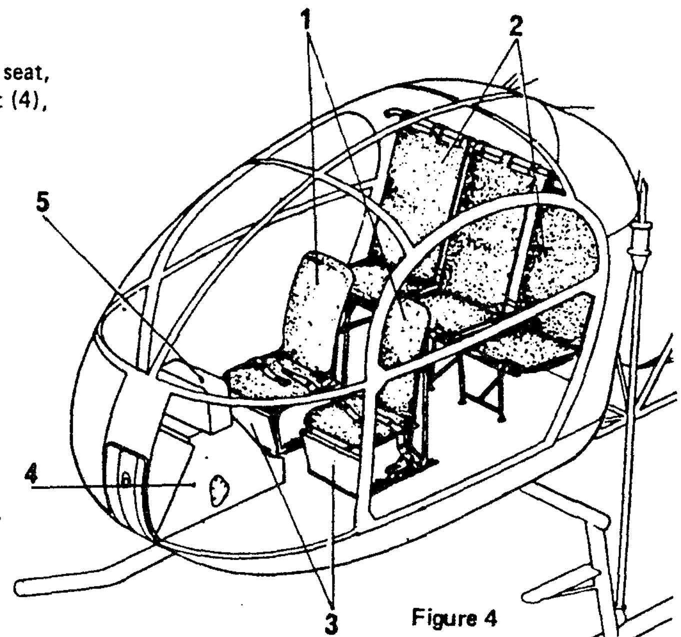


Figure 4
Cabin furnishings

1.10.13.- SPECIAL OPTIONAL EQUIPMENT

In order to enable it to perform specific roles, the following items of optional equipment may be fitted to the standard version of the aircraft :

- Rescue hoist installation
- Cargo-sling

- Emergency flotation gear
- Fuel jettison valve
- Sand filter
- Dual controls
- Heating - Demisting system
- Ambulance installation
- Battery temperature sensor
- Main rotor blade quick folding

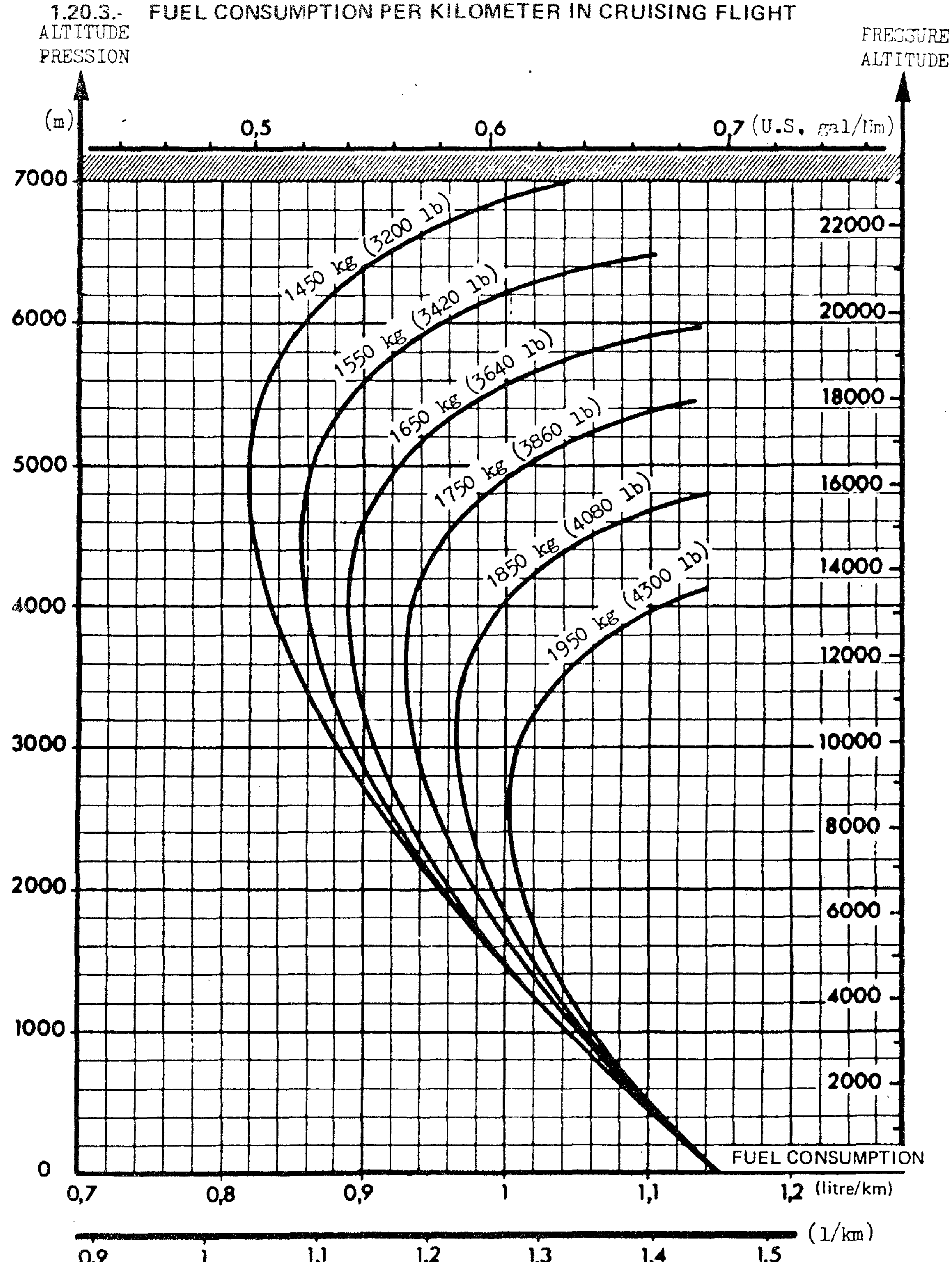
CHAPTER 1

GENERAL

CONTENTS

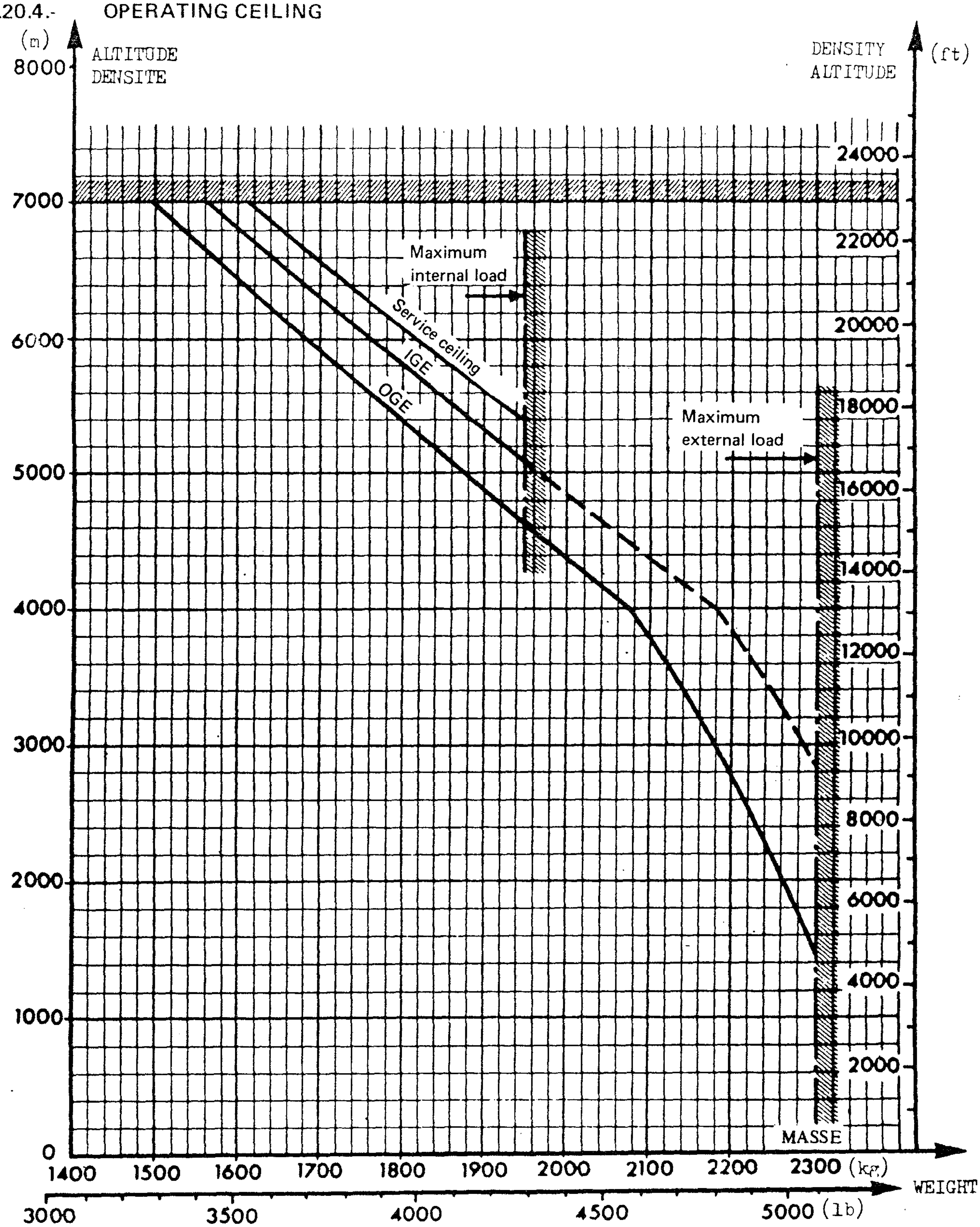
1.20.- FLIGHT ENVELOPE AND PERFORMANCE (Continued)

1.20.3.- FUEL CONSUMPTION PER KILOMETER IN CRUISING FLIGHT



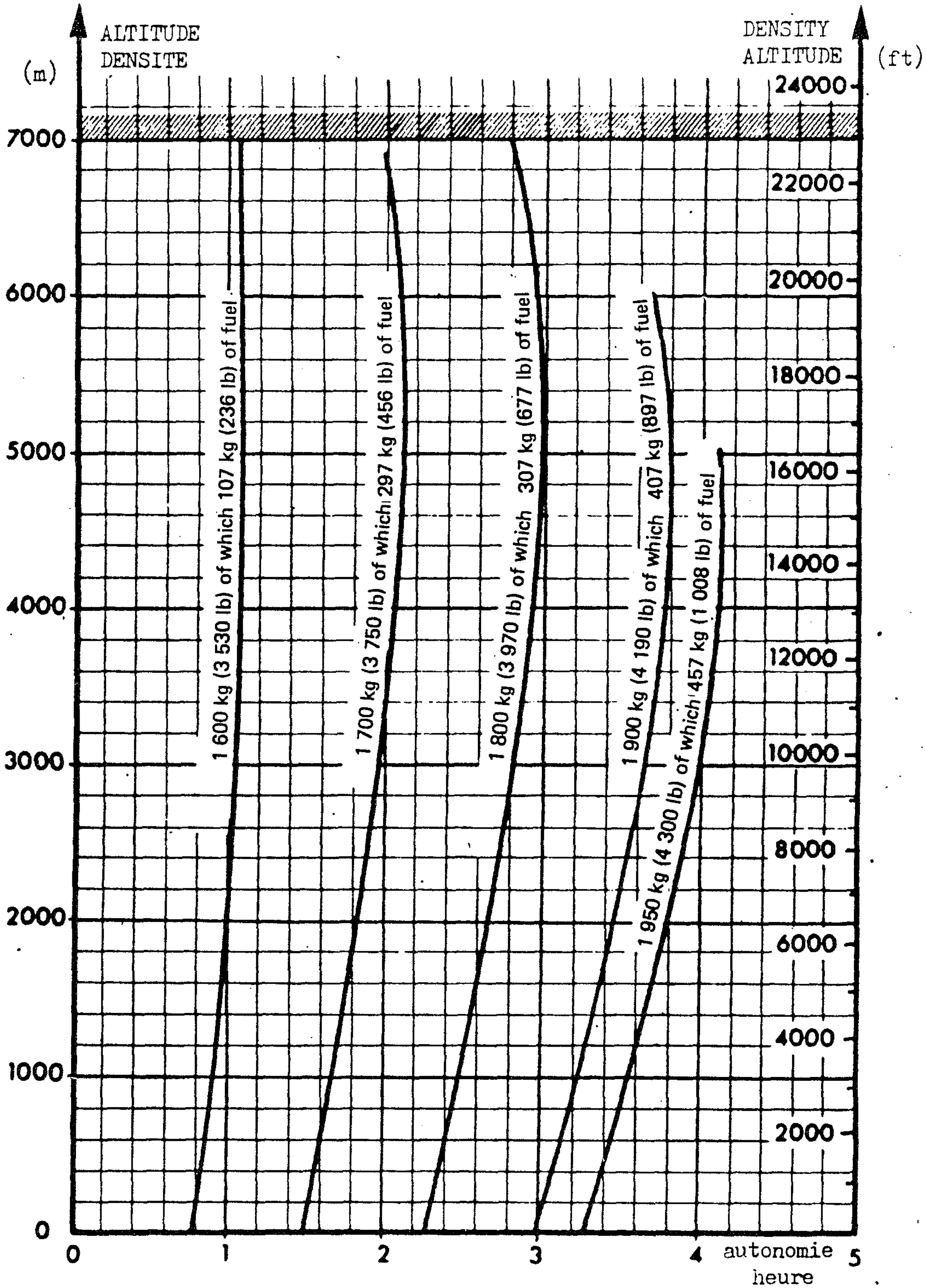
1.20.- FLIGHT ENVELOPE AND PERFORMANCE (Continued)

1.20.4.- OPERATING CEILING



1.20.- FLIGHT ENVELOPE AND PERFORMANCE (Continued)

1.20.5.- ENDURANCE (in terms of altitude and weight)



Empty weight	:	1 043 kg
Useful load	:	450 kg
C.A.S.	:	95 to 100 km/h

1.30.- OPERATION

The data given in this chapter pertains only to general considerations, such as definitions, points or areas involded, means, etc.

The following operations are described :

1.30.1.- Ground handling
1.30.2.- Folding of main-rotor blades
1.30.3.- Parking and mooring
1.30.4.- Shoring and lifting
1.30.5.- Filling- Draining
1.30.6.- Bleeding
1.30.7.- Greasing
1.30.8.- Inflation

NOTE : The «Levelling» and «weighing» operations are described in Chapter 2.

1.30.1.- GROUND HANDLING

Ground handling can be carried out manually or using a tractor.

A.- AIRCRAFT FITTED WITH SKID - TYPE LANDING GEAR (Figure 1)

1 - Special tools and equipment etc.

- Operators : two
- One set of wheels (1)
- One lifting bar (5)
- One towing cable (9) or one handling trolley (7)

2 - Instructions

- Push only on authorized pushing points
- Towing speed must not exceed 10 km/h

NOTE : Aircraft fitted with skis : Ground handling may only be carried out with towing cable.

1.-	Wheel assembly
2.-	Pin
3.-	Wheel support
4.-	Wheel lifting fitting
5.-	Lifting bar
6.-	Trolley attachment hook (on cross bar of landing gear)
7.-	Handling trolley
8.-	Attachment fitting for towing cable
9.-	Towing cable

1.30.1.- GROUND HANDLING (Continued)

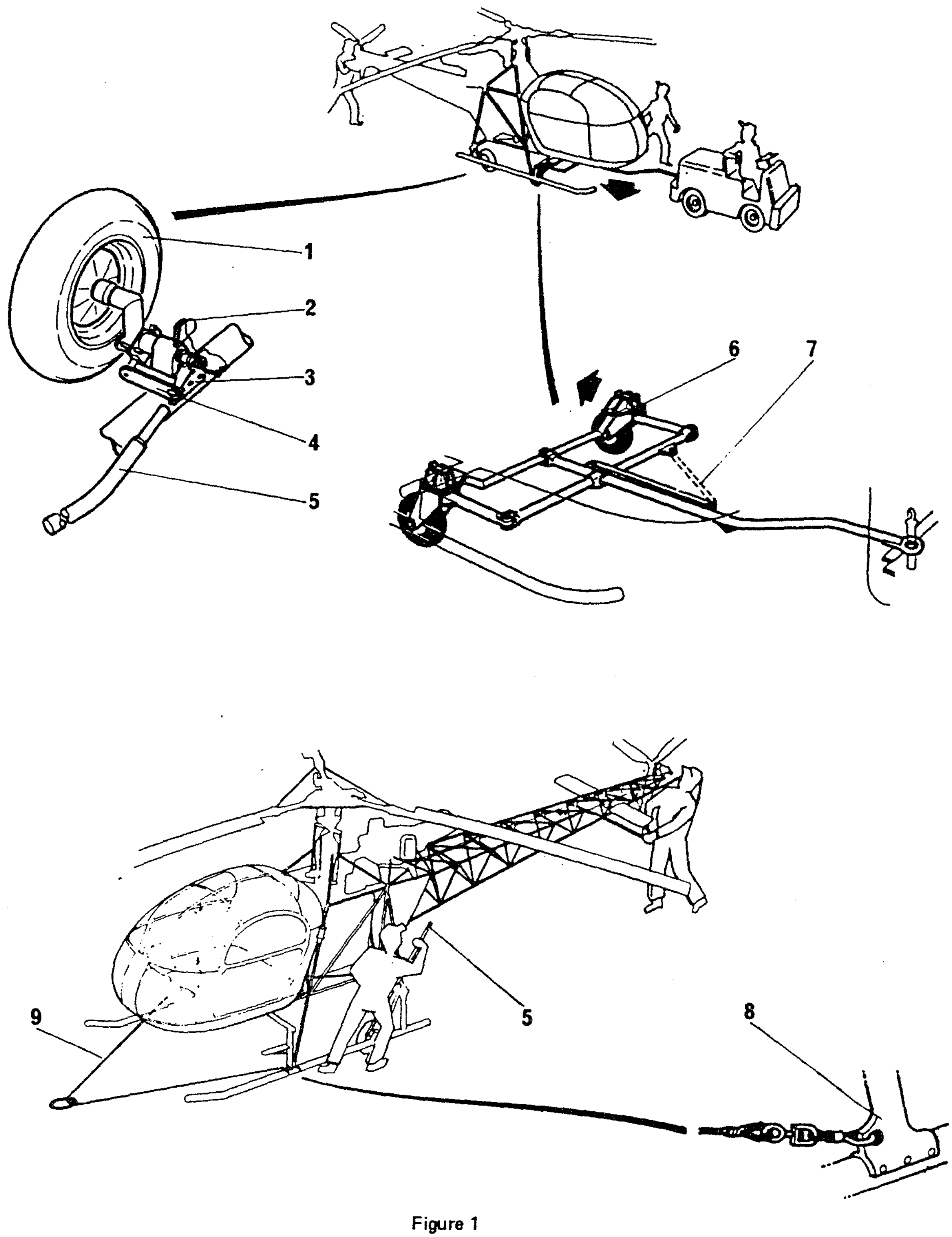


Figure 1
Ground Handling

1.30.2.- FOLDING OF MAIN ROTOR BLADES (Figure 2)

T he helicopter overall dimensions can be reduced by folding the main rotor blades ; this is possible on all the aircraft, using the special tools.

NOTE : On specially modified helicopters, quick blade folding and spreading (about 3 minutes) requires the use of an «optional equipment» tool kit.

A.- SPECIAL TOOLS AND EQUIPMENT

Blade folding equipment includes :

- 1 blade support cradle (1) attached to the tail boom,
- 3 poles (5),
- 3 blade clamps (4)

B.- OPERATION

The use of standard blade folding equipment does not require any modification of the aircraft; In particular the blade-folding operation utilises one of the pins that hold the blade cuff to the sleeve, as a hinge (the other pin being removed).
The blade folding equipment can be used irrespective of the type of landing gear fitted to the aircraft.

1.-	Blade support cradle
2.-	Control cable for the latch (7)
3.-	Lugs for attaching cradle on the tail boom
4.-	Blade clamp
5.-	Pole
6.-	Pole socket
7.-	Pole latch

1.30.2.- FOLDING OF MAIN ROTOR BLADES (Continued)

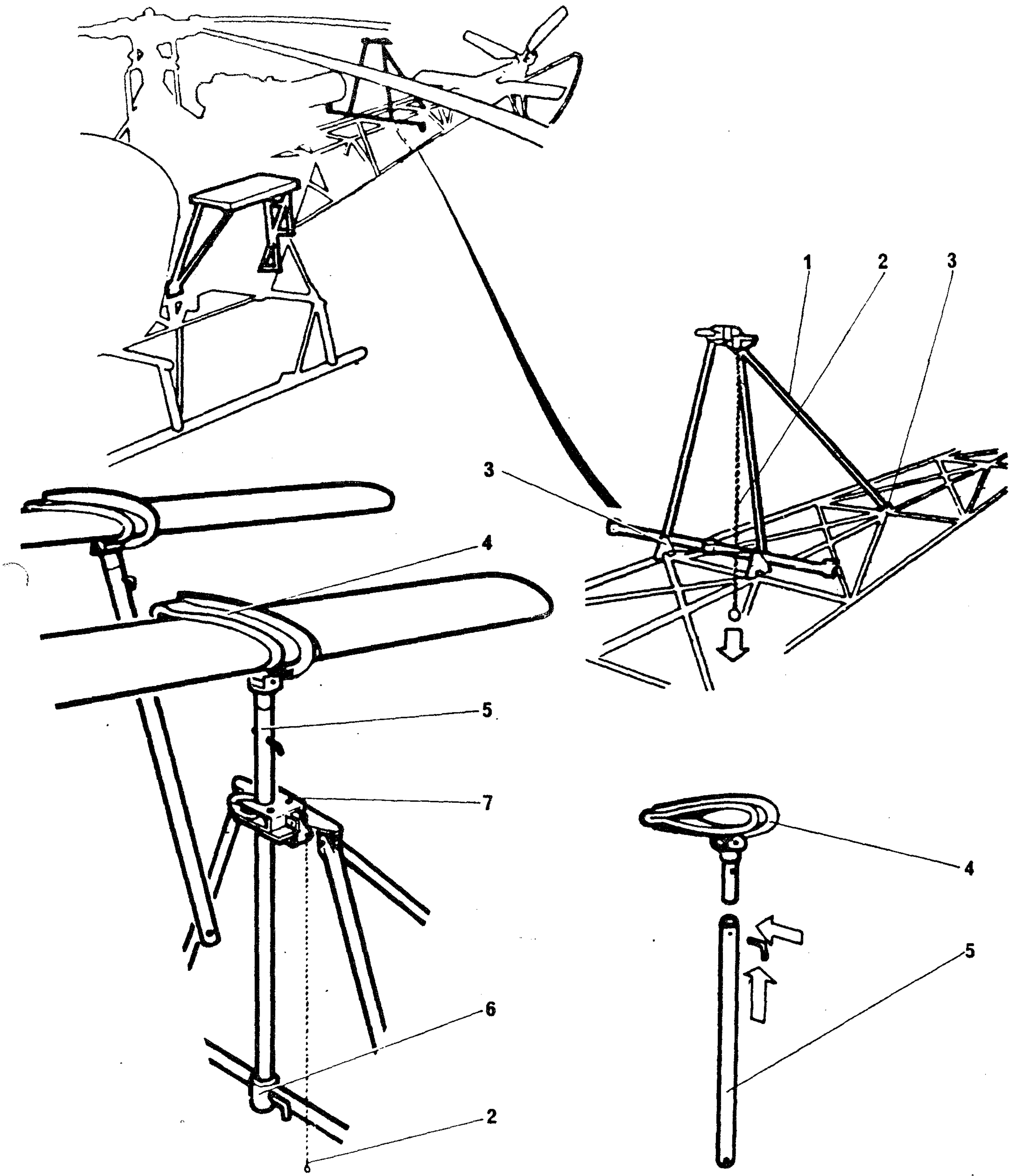


Figure 2
Folding of main rotor blades

1.30.3.- PARKING - MOORING

Depending on the atmospheric conditions, the parking operations will be as follows :

	OPERATIONS	UNDER SHELTER	IN THE OPEN		
			LIGHT WIND	HIGH WIND	RAIN
1	Aircraft headed into the wind		—	—	—
2	Battery switch off	—	—	—	—
3	Engine air intake blank	—	—	—	—
4	Engine tail pipe blank	—	—	—	—
5	Pitot head cover	—	—	—	—
6	Cabin doors closed (1)	—	—	—	—
7	Cabin cover (2)		—	—	—
8	Tie-down stakes		—	—	—
9	Tie-down cables		—	—	—
10	Rotor brake on		—	—	—
11	Lashing of main blades		—		—
12	Tip covers for main blades (3) (6)			—	—
13	Rotor cover			—	—
14	Tail rotor blades locked			—	
15	Blades folded			—	
16	Covers for main transmission components (4)			—	—
	locked				
19	Engine cover (5)		—	—	—
20	Engine and sand filter cover			—	—
21	Hoist cover			—	—

NOTA :

1.- Under intense sunshine, leave the sliding doors open.

2.- Beforehand bring the sides-lip indicator to low position

3.- Install static - discharger protections

4.- Install shields on oil level sights.

5.- Even in case of short stops.

6.- In icing conditions, coat the blades with glycerine.

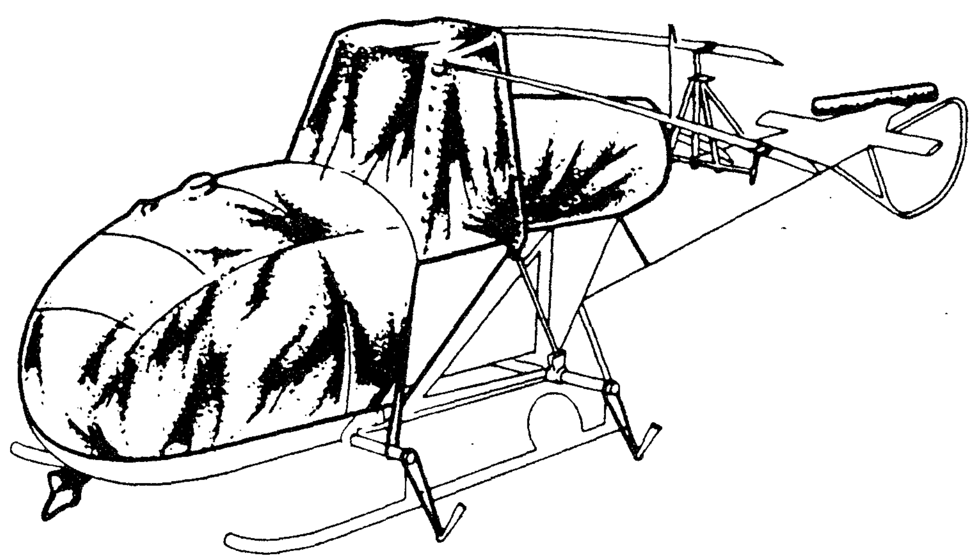


Figure 3 - Typical example of parking in the open and tying down.
(Skid - type landing gear - Blades Folded)

1.30.4.- LIFTING AND SHORING

Lifting is effected by means of :
- The main rotor lifting eye (1), main blades removed,
- a special sling (2), main rotor blades,head and rotor shaft and tail boom removed.

Shoring is effected by means of special jacks positioned under the appropriate jacking points of the structure : two at the front (4), one at the rear (3).

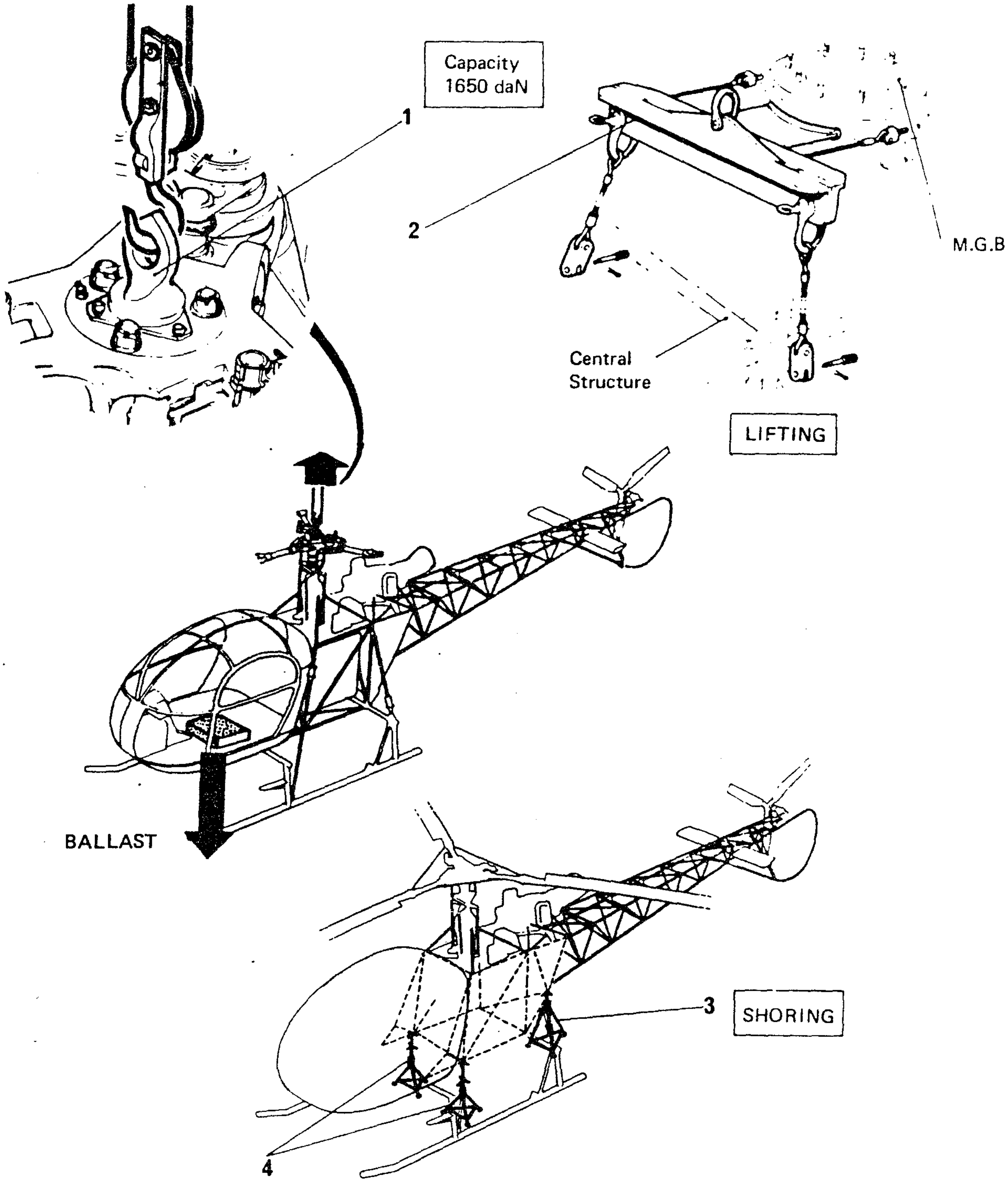


Figure 4
Lifting and shoring of aircraft

1.30.5.- FILLING AND DRAINING

The lubricating oil and hydraulic fluids must be periodically drained.
The appropriate draining intervals are specified in the Maintenance Manual (Chapter 5).

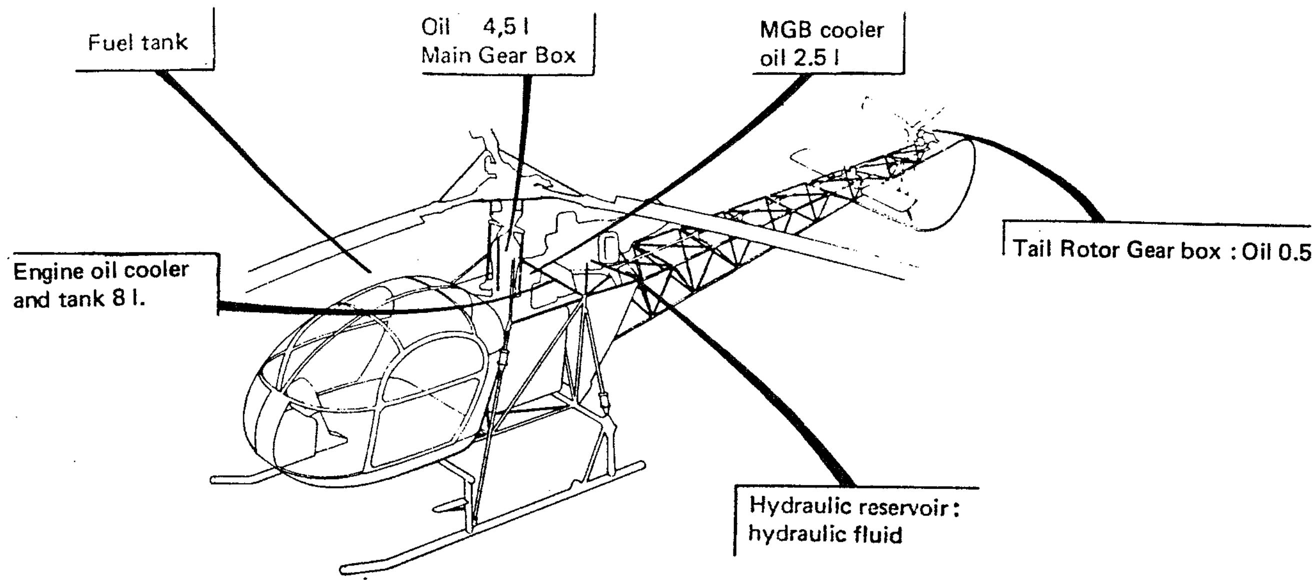


Figure 5 - Draining and Replenishing points.

1.30.6.- WATER DRAIN POINTS

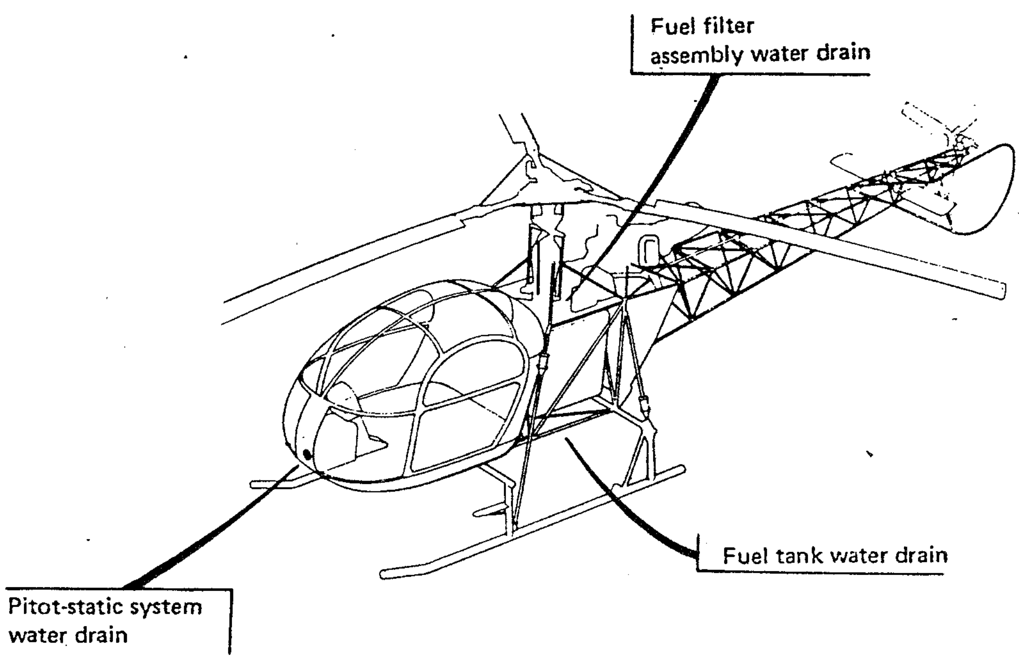


Figure 6 - Water drain points

1.30.7.- LUBRICATION

Periodic lubrication is to be carried out. The appropriate lubrication intervals are specified in the Maintenance Manual (Chapter 5).

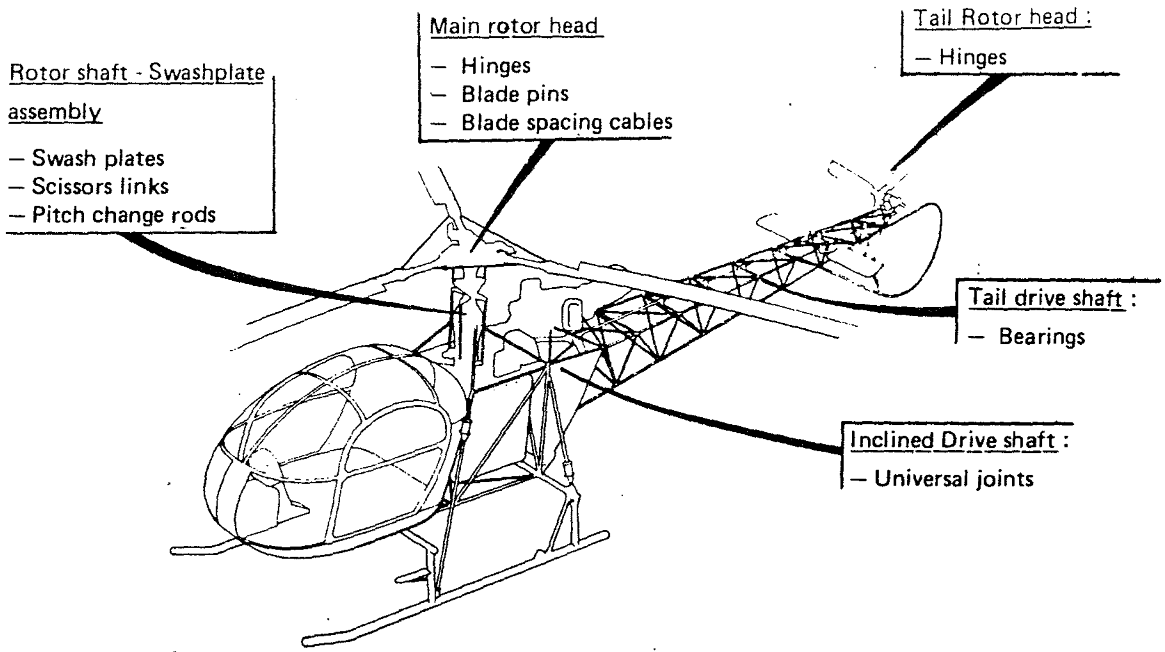
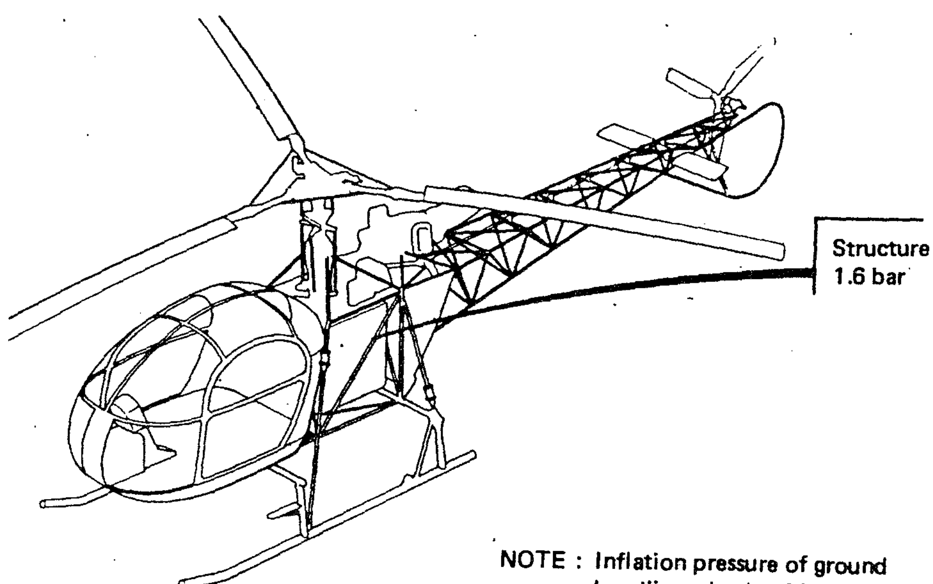


Figure 7 - Lubrication points

1.30.8.- INFLATING



NOTE : Inflation pressure of ground handling wheels : 4 bars

Figure 8 - Inflation/Pressurization points

1.40.- MAINTENANCE SCHEDULE

1.40:1.- GENERAL

A.- DEFINITION OF MAINTENANCE OPERATIONS

The maintenance operations are classified on the following basis :

- nature :
  - Servicing : (pre-and post-flight inspection, servicing).
  - Periodic maintenance : (according to operating time or ageing),
  - Occasional maintenance : (emergency servicing).
- Volume of tools and equipment needed

ACCOUNTABLE	DEGREE	PLACE	NATURE OF WORK
OPERATOR	1st line	Runway	Pre-and post-flight inspection servicing
OPERATOR	2nd line	Shed	All «in situ» maintenance operations (periodic inspection, adjustment, testing).
OPERATOR	3rd line	Specialized service shops	Repairs, reconditioning, preservation for storage
CERTIFIED MA-NUFACTURER OR REPAIRER	4th line	Approved FACTORY OR WORKSHOP	Overhaul, major reconditioning and repairs.

B.- MAINTENANCE PUBLICATIONS

The information available to the user includes :

— Aircraft documentation

1 - The Maintenance Manual, providing all necessary information for operation and «in situ» maintenance (1st and 2nd line).

2 - The Repair Manual, dealing with the maintenance of structural units produced by the aircraft constructor (3rd degree).

3.- The illustrated Parts Catalogue for easy identification of spare parts.

4.- Service Bulletins, usually modifying operation or maintenance of aircraft.

— Equipment publications :

In the form of data sheets, provide all information (maintenance, repair, identification) relating to the equipment items.

1.40.2.- MAINTENANCE SCHEDULE FOR THE «ALOUETTE III» HELICOPTERS

The information hereunder is given as an example of :
- pre-and post-flight inspection plan.
- periodic inspection intervals.
- sample inspection schedule taken from the Maintenance Manual.

A.- SERVICING (Pre and post flight).

- Typical inspection round.

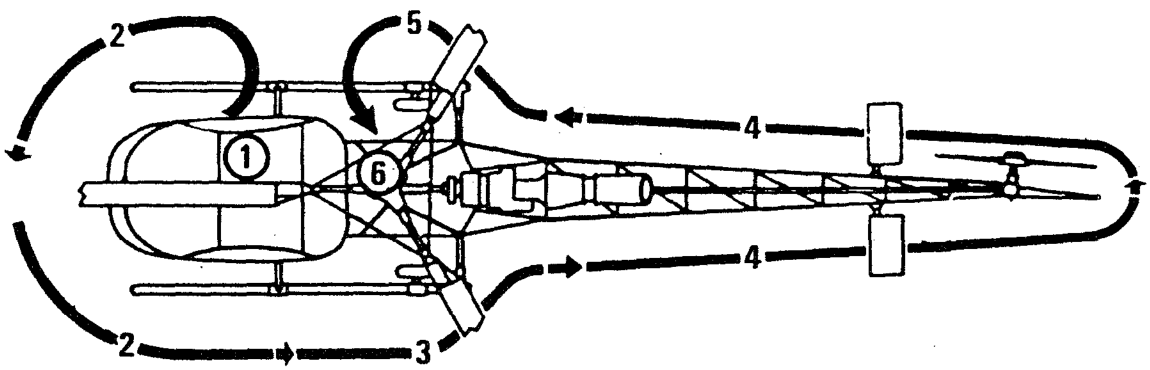


Figure 1 — Pre-and post-flight inspection round

1.- INSIDE CABIN (contacts)	4.- TAIL BOOM, TAIL DRIVE SHAFT, TAIL ROTOR GEAR BOX and TAIL ROTOR BLADES (fluid levels, appearance).
2.- OUTSIDE CABIN (overall appearance, bleeds/water drains).	5.- CENTRAL STRUCTURE, ENGINE AND MAIN gear box, landing gear (right side) (fluid levels, appearance).
3.- CENTRAL STRUCTURE, engine and main gear box, landing gear (left side), overall appearance, fluid levels, bleeds/water drains).	6.- MAIN GEAR BOX, ROTOR SHAFT, SWASH PLATES, ROTOR HEAD, MAIN BLADES : (appearance, fluid levels, bleeding).

NOTE : — Special checks for failure should be provided after each flight :
- Check for leaks,
- Check for overheating marks,
- Check for impact marks, etc.

— Replenishing operations where necessary :

1.40.2.- MAINTENANCE SCHEDULE FOR «ALOUETTE» HELICOPTERS (Continued)

Examples from the Maintenance Manual, chapter 5

B.- PERIODIC INSPECTION CYCLES

Type of inspection	Time limit in operating hours				Time limit absolute	Tolerances		Definition of inspection
T1	400		1200		12 months	+20h	+1 month	Elementary routine inspection
T2		800				+30h		Intermediate inspection (T1 + additional operations).
GV				1600		+ 30h		Extensive inspection: MAJOR MAINTENANCE

OPERATION DESIGNATION	WORK CARD	CYCLE T1 (400)	CYCLE T2 (800)	CYCLE GV (1600 or 12 mo)		OBSERVATIONS
CHAPTER 28 – FUEL (Continued)						
– Test of filter clogging pressure switch	28-30-503		X	X		
– Summary test of controls and supply system monitoring	28-30-502	X				
– Inspection of fuel system	28-20-601	X	X	X		
– Leak test of fuel system	28-00-501			X		
FUEL JETTISON VALVE						
– Operating test	28.41.501	once a year if the installation ha not operated				OPTIONAL
– Inspection - test of installation	28.41.601					
CHAPTER 29 – HYDRAULIC SYSTEMS						
– Removal - installation of hydraulic pump	29-11-401					
– Removal - installation of servo-controls	29-20-401					
– Removal - installation of hydraulic reservoir	N.D.					
– Removal - installation of hydraulic system	N.D.					
– Removal - installation of 20 µm filter	29					
– Removal - installation of 50 µm filt						
– Check of power supply						
– Check of pump dri						
– Check of						
– Check o						

1.40.3.- DEFINITIONS RELATING TO ASSEMBLIES AND EQUIPMENT WITH A SPECIFIC SERVICE LIFE (reminder)

When the service life of an assembly or equipment item is independent of the life of its support (for instance : the main gear box), it is called a «lifed part». Such assemblies and equipment, as well as those whose service life is associated with the supporting component life, are to be checked during the aircraft periodic inspections; moreover, they are subjected to «operating time limits «hours)» implying :

- testing or checking in the workshop
- overhauls.

Definition :

- THE INSPECTION INTERVAL is the number of operating hours for a component between two inspections.
- THE OVERHAUL LIFE is the number of operating hours between major overhauls.
- THE SERVICE LIFE LIMIT is the number of operating hours at which the equipment or unit must be withdrawn from service.
- MAINTENANCE «ACCORDING TO CONDITION» is another method which eliminates the «schedule» considerations. The equipment is no longer subject to systematic periodical overhaul but, when required, on evidence of malfunction or fall-off in performance.
- THE V.N.I.P. (continuous Inspection) covers an inspection or reconditioning which, although significant, does not affect the inspection cycle.

CHAPTER 2

STRUCTURE

CONTENTS

2.- STRUCTURE

2.00.- GENERAL

The structure is composed of :

- The «cabin - forward structure» assembly (1)
- The , central, body structure (2)
- The rear structure (3).

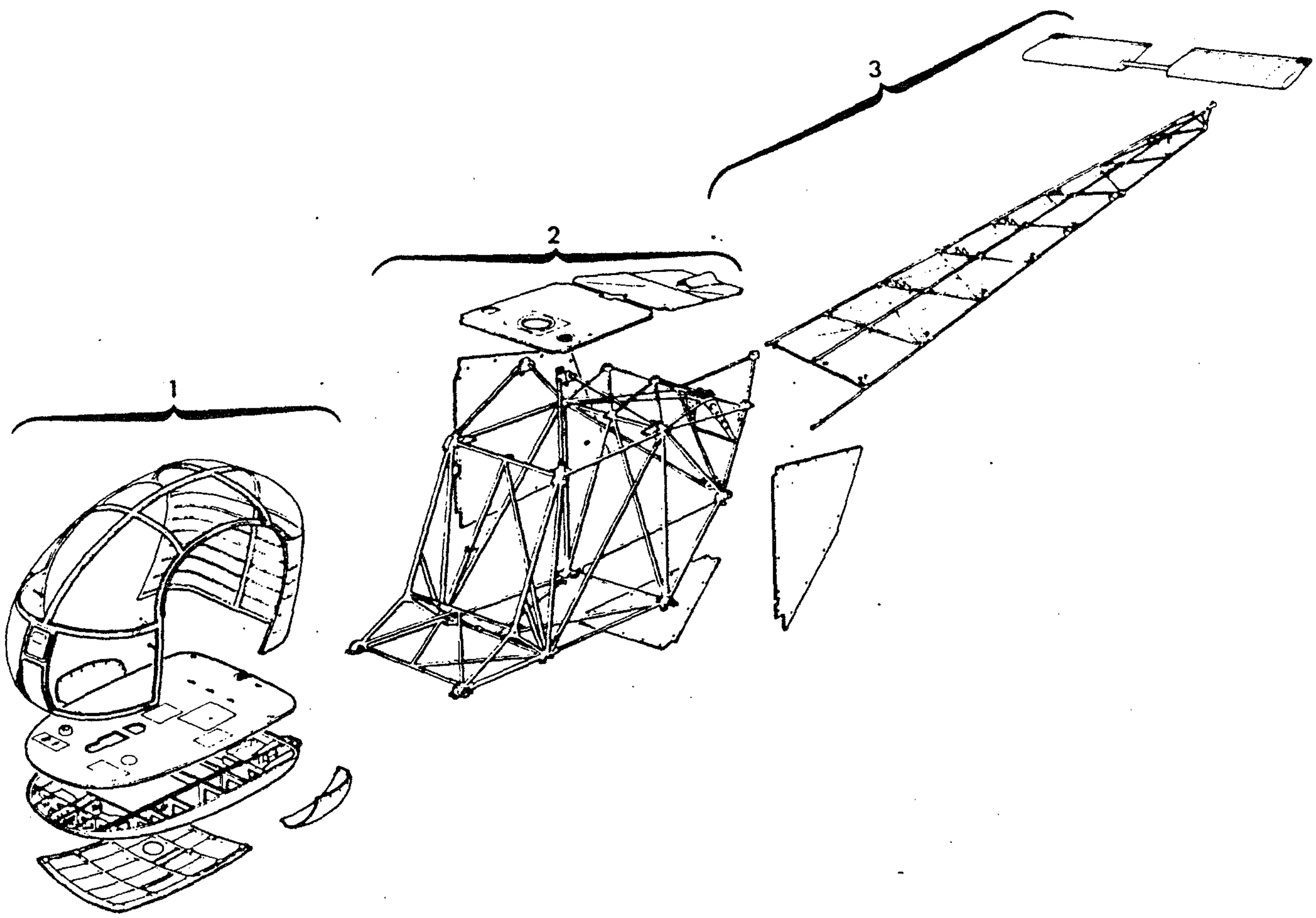


Figure 1
Structural Units

2.10.- THE CABIN-FORWARD STRUCTURE ASSEMBLY

2.10.1.- THE CABIN (Figure 1).

The cabin is composed of :

- The canopy consisting of :
  - a skeleton framework of light alloy formers (1) ,
  - transparent panels (2),
  - a rear panel (3),
- The forward doors (9) which are hinged and fitted with a jettisoning mechanism.

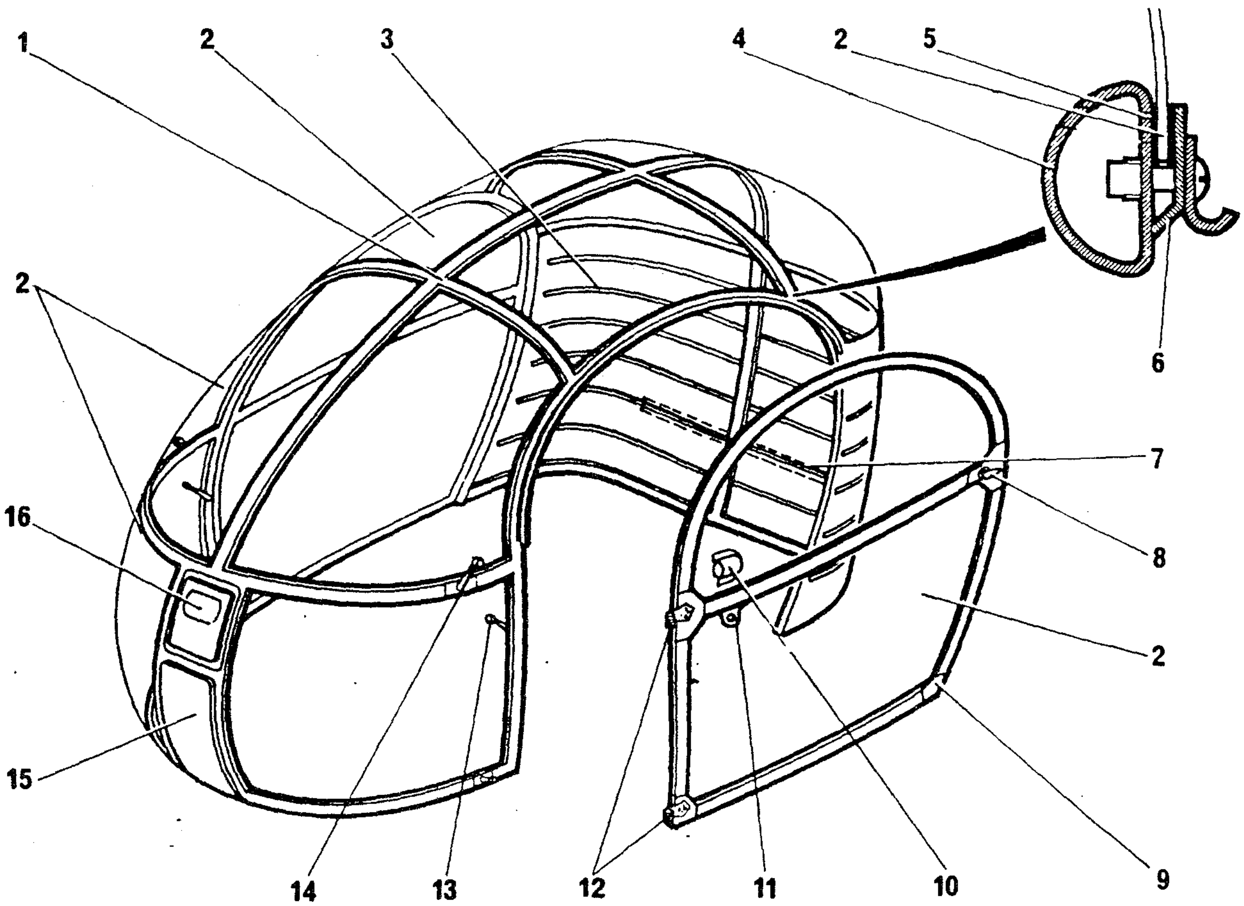


Figure 1
Cabin

1.-	Cabin framework	9.-	Door
2.-	Plexiglas panels	10.-	Diffuser and deflector
3.-	Rear panel	11.-	«Door open» stop
4.-	Cabin former	12.-	Door hinges
5.-	Rubber seal	13.-	Door jettison control
6.-	Cover strip	14.-	Locking hook, «door open»
7.-	Rear panel reinforcement	15.-	Battery access door
8.-	Door lock	16.-	Ventilation flap

2.10.2.- FORWARD STRUCTURE (Figure 2)

The forward structure supports the cabin. It is composed of :

The bottom structure : a riveted assembly composed of two beams (14), five cross members (9) and panels (10.- 15). The beams carry fittings (8) by which the bottom structure is attached to the central structure.

The removable floor (1) attached by means of screws ; The floor consists of an aluminium honey comb core between two light alloy sheets ; the floor is coated with a special non - slip paint.

The lower panel (11) attached to the structure by means of «DZUS» fasteners.

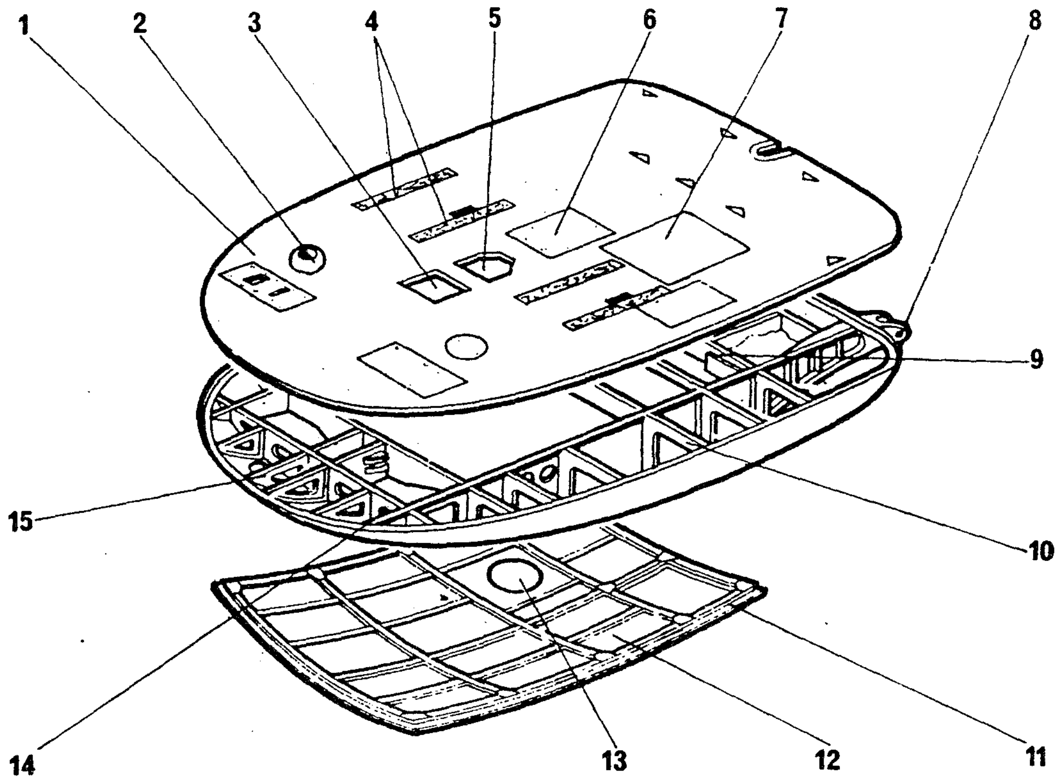


Figure 2
Forward structure

1.- Floor	9.- Cross members
2.- Cyclic pitch lever cut-out	10.- Side stub frame
3.- Electric cables cut-out	11.- Underside panel
4.- Friction plates	12.- Message chute door
5.- Engine controls cut-out	13.- Landing light cut-out
6.- Collective pitch lever cut-out	14.- Longitudinal beam
7.- «Message» chute hatch	15.- Forward stub frame
8.- Fitting for attachment to central body structure	

2.20.- CENTRAL BODY STRUCTURE

2.20.1.- GENERAL

The central or body structure is composed of :
- a welded tubular steel framework
- sub-assemblies :

2.20.2.- CENTRAL AIRFRAME STRUCTURE

The welded tubes of the structure form clusters. Each weld cluster is identified by a number followed by a letter which signifies the position of the cluster (D or R = Right - M = Middle - G or L = Left)

KEY POINTS OF THE BODY STRUCTURE (Figure 1)

1.- Attachment of M.G.B. vee frames
2.- Engine forward mount
3.5.- Attachment of engine rear support vee frame (on same clusters as upper attachment of tail boom)
4.- Attachment of intermediate bearing
6.- Lower attachment of tail boom
7.- Rear jacking point
8.- Removable diagonal bar (removal installation of fuel tank)
9.- Attachment of landing gear rear cross member
10.- Forward jacking point
11.14.- Attachment of forward structure
12.- Attachment of landing gear forward cross member
13.- Location of pressure control gauge

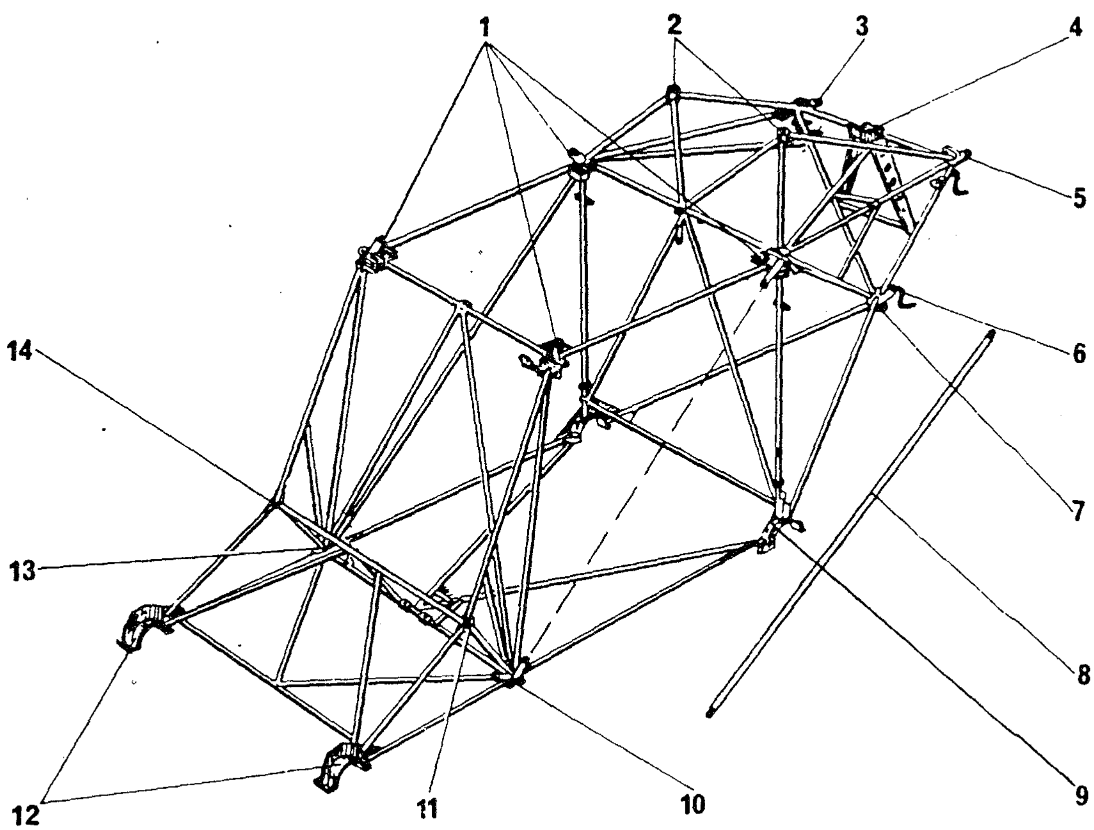


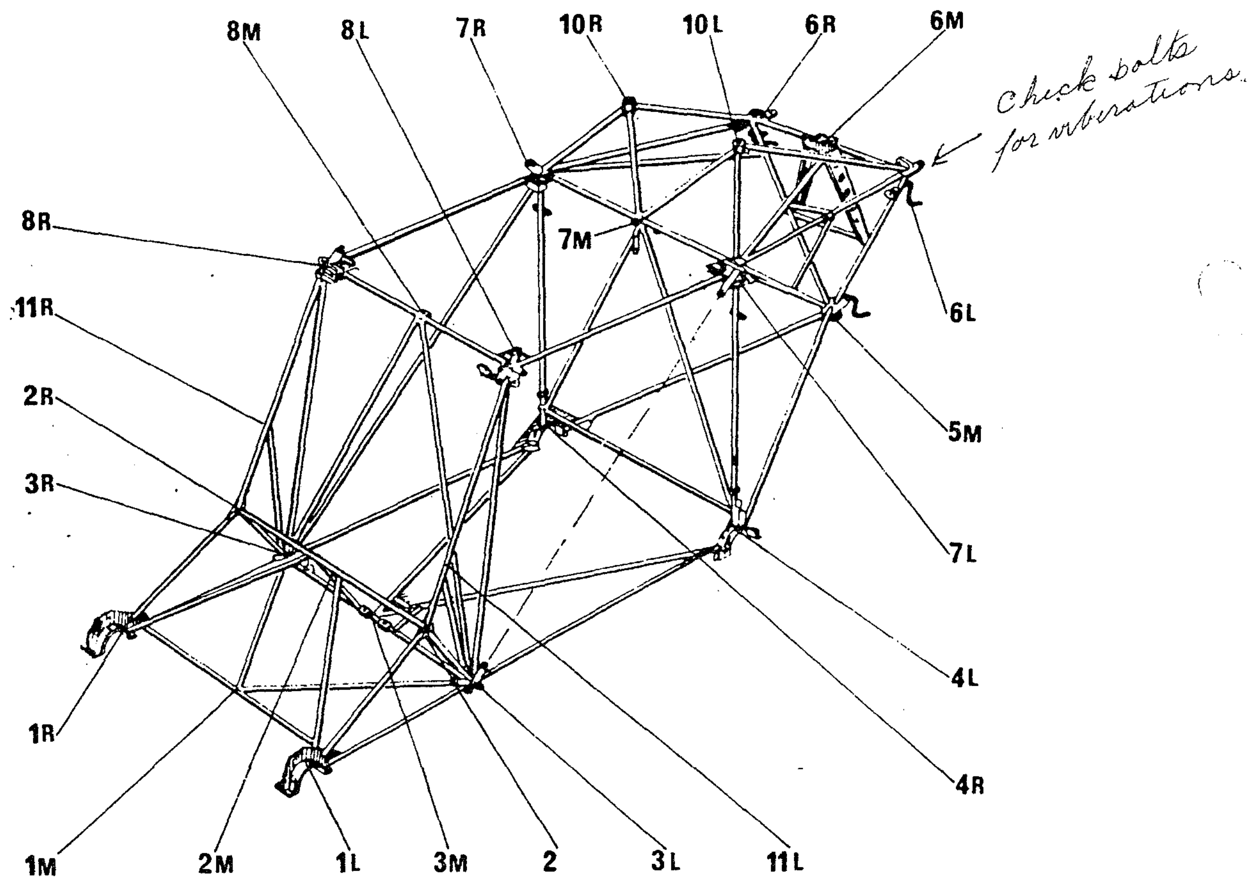
Figure 1
Body structure

2.20.3.- BODY STRUCTURE SUB - ASSEMBLIES (Figure 3)

The sub-assemblies of the body structure consist of :

- M.G.B. vee frames (14). They are made of steel and transfer the loads of the main rotor to the structure.
- Engine rear attachment vee - frame (10) made of steel.
- Transmission support platform (1). Reinforced plate of stainless steel.
  The M.G.B. is secured to the transmission support platform.
- Firewall (3) (4) of light alloy. The cowling (5) protects the intermediate bearing of the tail rotor transmission shaft.
- Fairings
  . R.H. side fairing (15) and L.H. side fairing (16) of fiberglas laminate. The upper section of the L.H. fairing is removable and gives access to the electrical equipment cabinet.
  . lower fairing (18) of light alloy.

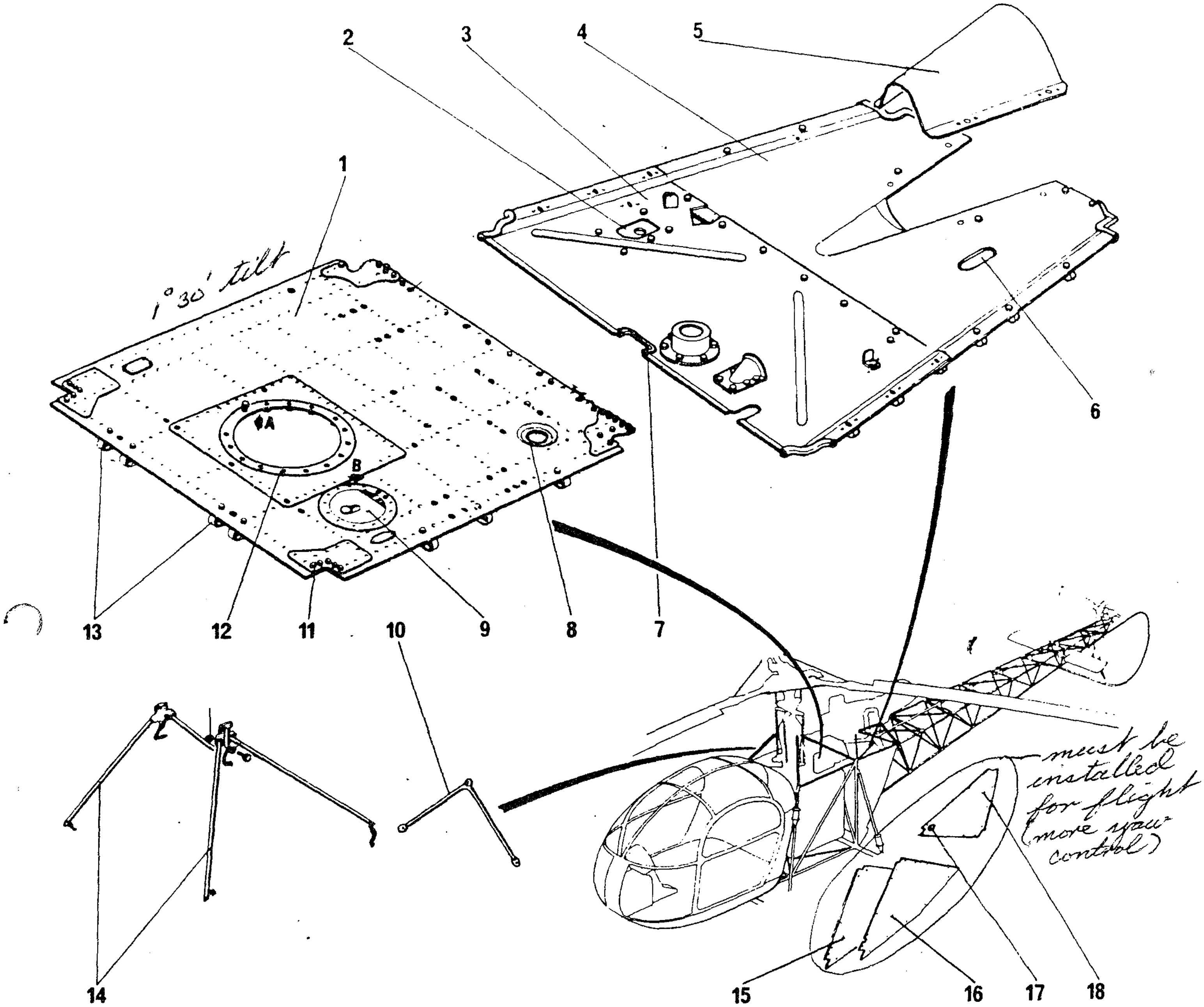
Tilt -1° 30'



NOTE : Cluster identification numbers and letters are not marked on the body structure

Figure 2
Location of body structure clusters

2.20.3.- BODY STRUCTURE SUB - ASSEMBLIES (Continued)



1.- Transmission support platform	
2.- Fuel pipes feed through	
3.- Fireproof plate (forward section)	12.- M.G.B. mounting plate
4.- Fireproof plate (rear section)	13.- Transmission support platform attachment gussets
5.- Tail drive shaft protection tunnel	
6.- Fuel flow control feed through cut out	14.- M.G.B. vee frames
7.- Engine cables cut out	15.- R.H. side fairing
8.- Access oil tank water drain access hole	16.- L.H. side fairing
9.- Fuel gauge access door	17.- Engine drain feed through
10.- Engine vee frame (engine rear mount)	18.- Lower fairing
11.- Transmission support platform mounting plate	

Figure 3 - Body structure sub-assemblies

2.20.4.- CENTRAL BODY STRUCTURE - LEAK TEST (Figure 4)

A.- GENERAL

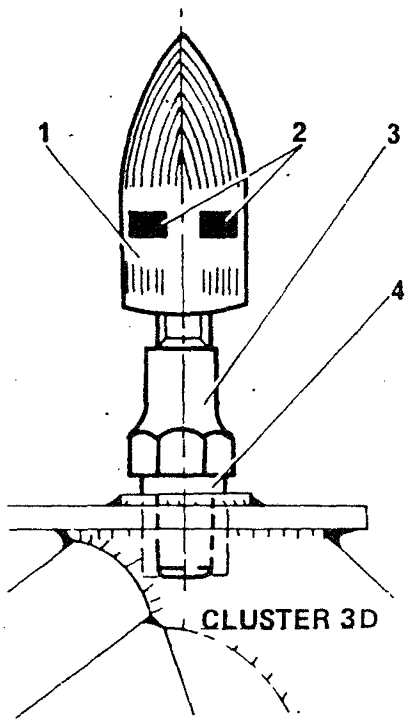
The tubes of the central body structure form an airtight network which is pressurized internally with nitrogen gas. A drop in the pressure of this system indicates the presence of a flaw or crack in the structure: Re-pressurising is carried out through a valve (3) fitted at weld cluster 3R. A visual pressure controller (1) may be fitted to this valve. The white windows of this control gauge show red if the nitrogen pressure drops to the minimum allowable threshold.

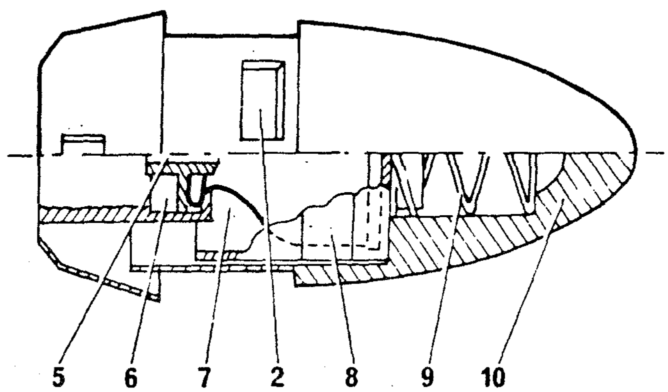
B.- PRESSURE CONTROLLER OPERATION

The plunger (5) presses against the core of the pressurizing valve. The chamber (7) becomes internally subjected to the nitrogen pressure. The chamber is capped by a piston (8), the upper part of which is painted red.

(1) If the nitrogen pressure in the chamber is greater than that exerted by the spring (9) then the piston is pushed into the main body to abuttment, (10) and the unpainted part of the piston appears at the inspection window.

(2) If the internal pressure of the structure drops and becomes less than that exerted by the spring, the spring pushes away the piston and its chamber, and the red portion of the piston appears at the window.





1.-	Pressure control gauge
2.-	Inspection window
3.-	Pressurising valve
4.-	Seal
5.-	Plunger
6.-	Seal
7.-	Chamber
8.-	Piston
9.-	Spring
10.-	Control gauge body

Figure 4
Pressure control gauge

2.30.- TAIL UNIT STRUCTURE

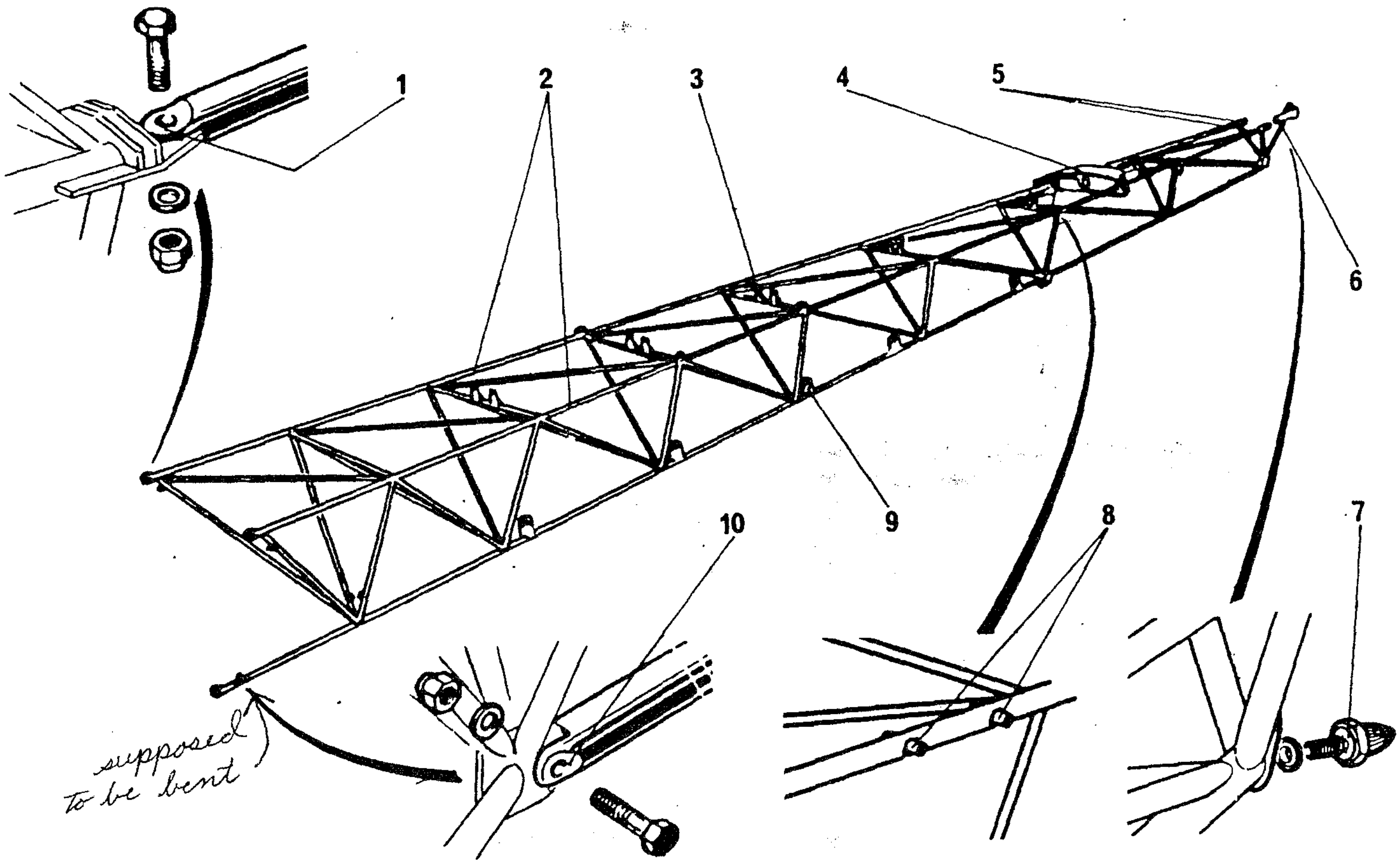
2.30.1.- GENERAL

The tail unit structure consists of :

- the tail boom
- the stabilizers

2.30.2.- TAIL BOOM (Figure 1)

The tail boom consists of a triangulated welded tube structure. It is secured to the body structure at three points (1) (10) by means of bolts ; the tail boom supports : the tail drive shaft, the T.R.G.B, and the stabilizers. A pressure control gauge (7) (identical to the pressure control gauge of the body structure) is fitted on the end of the tail boom).



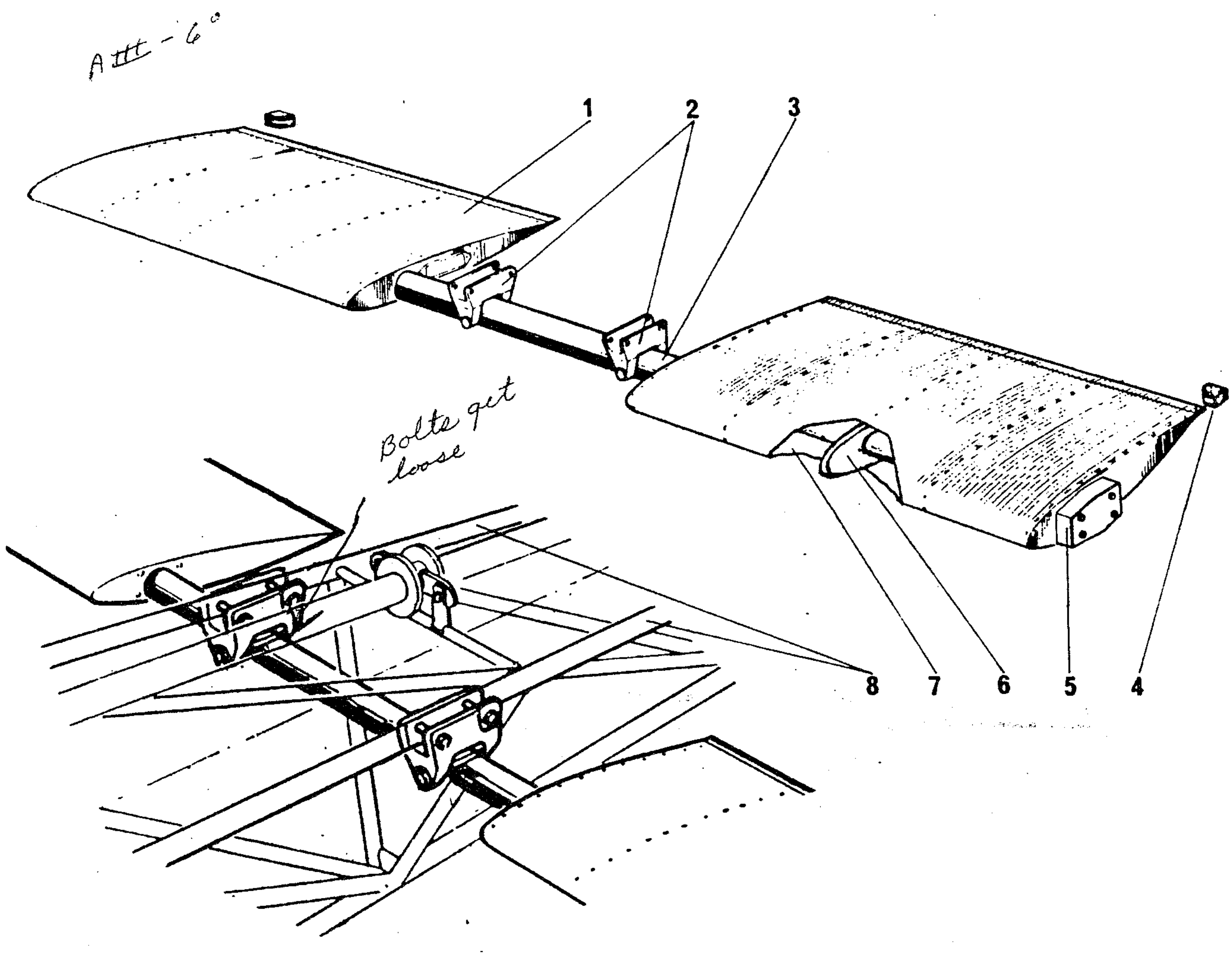
1.- Upper yoke (attachment to body structure) 2.- Spar tubes 3.- Tail drive shaft bearing bracket 4.- Drive shaft guard 5.- T.R.G.B. attachment points	6.- T.R.G.B. brace strut 7.- Pressure control gauge 8.- Stabilizer attachment studs 9.- Flying controls pulley bracket 10.- Lower yoke (attachment to body structure)

Figure 1 - Tail boom

2.30.3.- STABILIZERS (Figure 2)

The stabilizers consist of two airfoil assemblies (1) fitted on one spar tube (3). The spar is secured to the tail boom by means of two fittings (2).

STABILIZER SETTING : – 5°

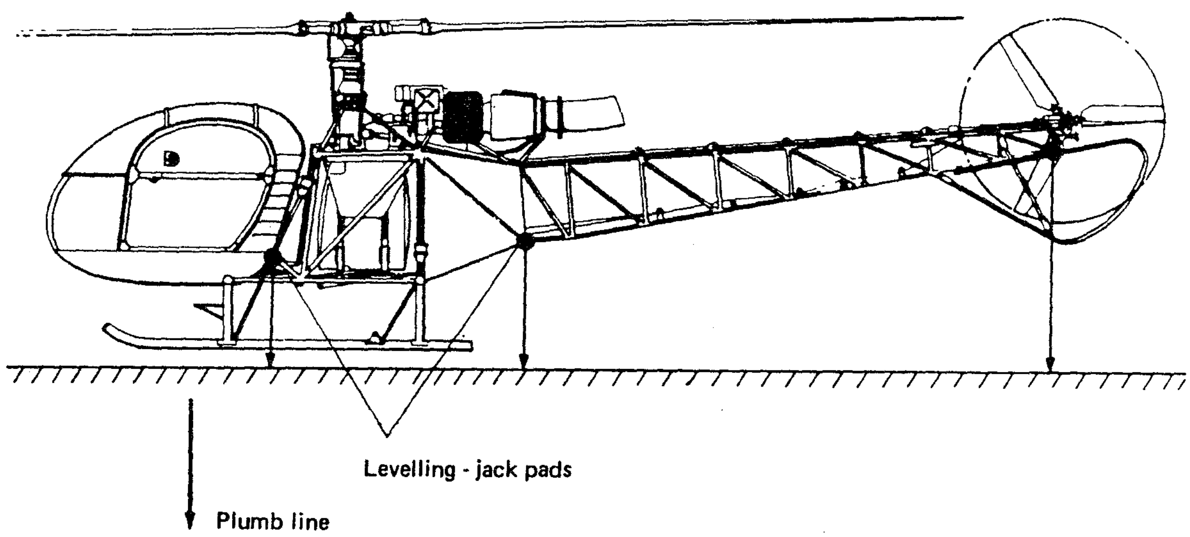


1.-	Stabilizer panels
2.-	Fittings for attachment to tail boom
3.-	Spar tube
4.-	Rubber, protective corner piece
5.-	Balancing weight
6.-	Rib
7.-	Skin (light alloy sheet)
8.-	Tail boom tubes

Figure 2 - Stabilizers

2.40.- STRUCTURAL REFERENCE POINTS FOR ALIGNMENT, LEVELLING AND WEIGHING

2.40.1.- REFERENCE POINTS FOR ALIGNMENT OF THE STRUCTURE (Figure 1)



The plumb lines are located at clusters 1M and 5M of body structure and at end cluster of tail boom. One string passing through the projection of clusters 1M, and 5M materializes the aircraft centerline. The plumb point of the tail boom cluster shows the amount disalignment with respect to the string.

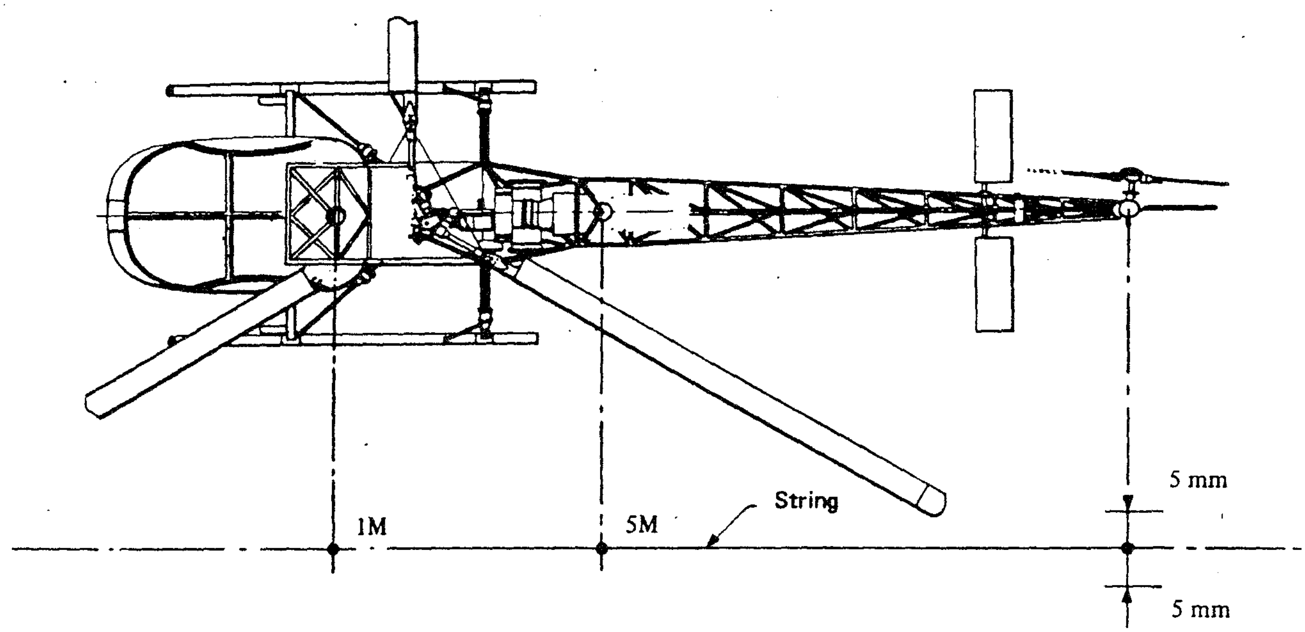


Figure 1
Airframe alignment reference points

2.40.2.- REFERENCE POINTS FOR LEVELLING (Figure 2)

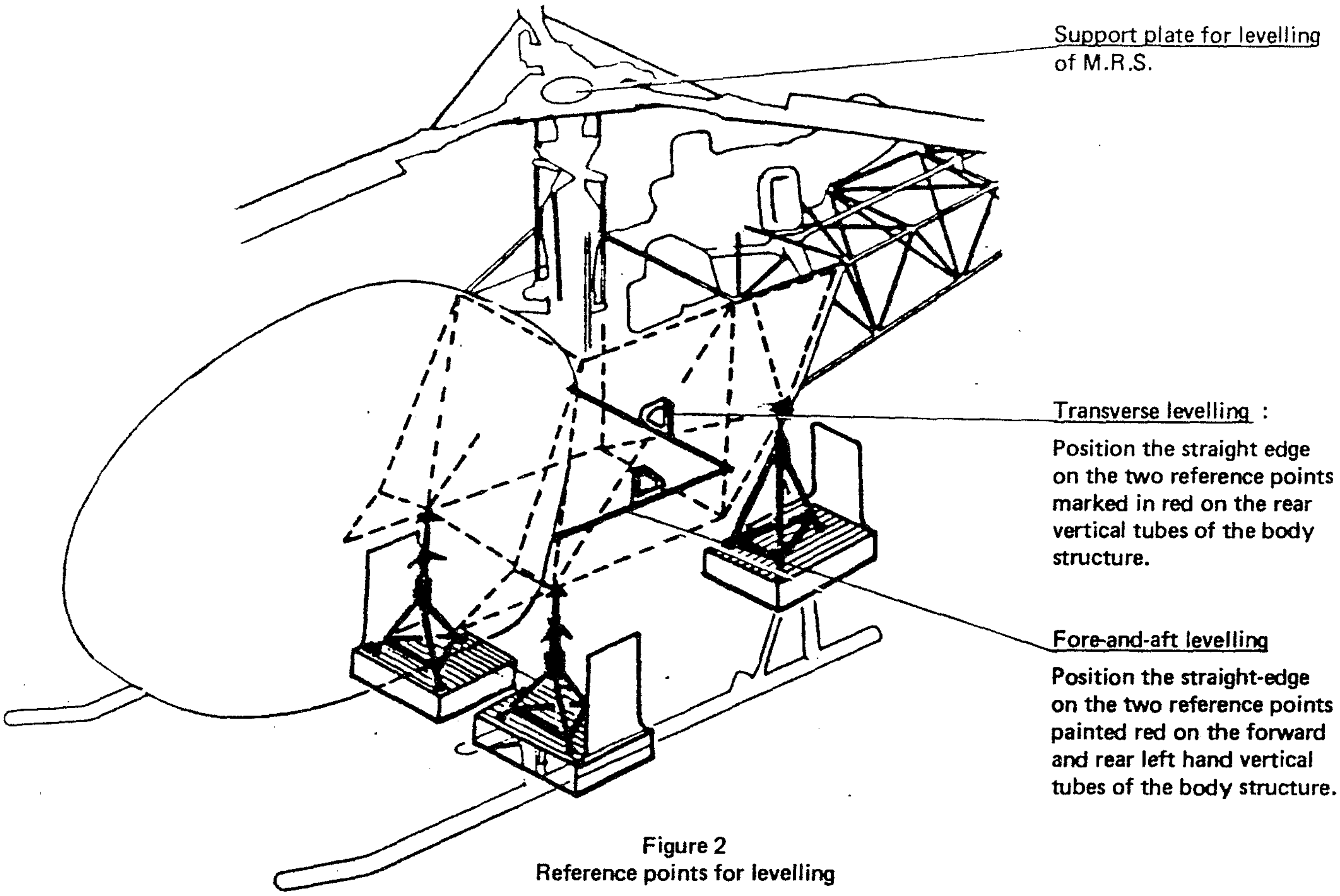


Figure 2
Reference points for levelling

2.40.3.- REFERENCE POINTS FOR WEIGHT AND C.G. COMPUTATIONS (Figure 3)

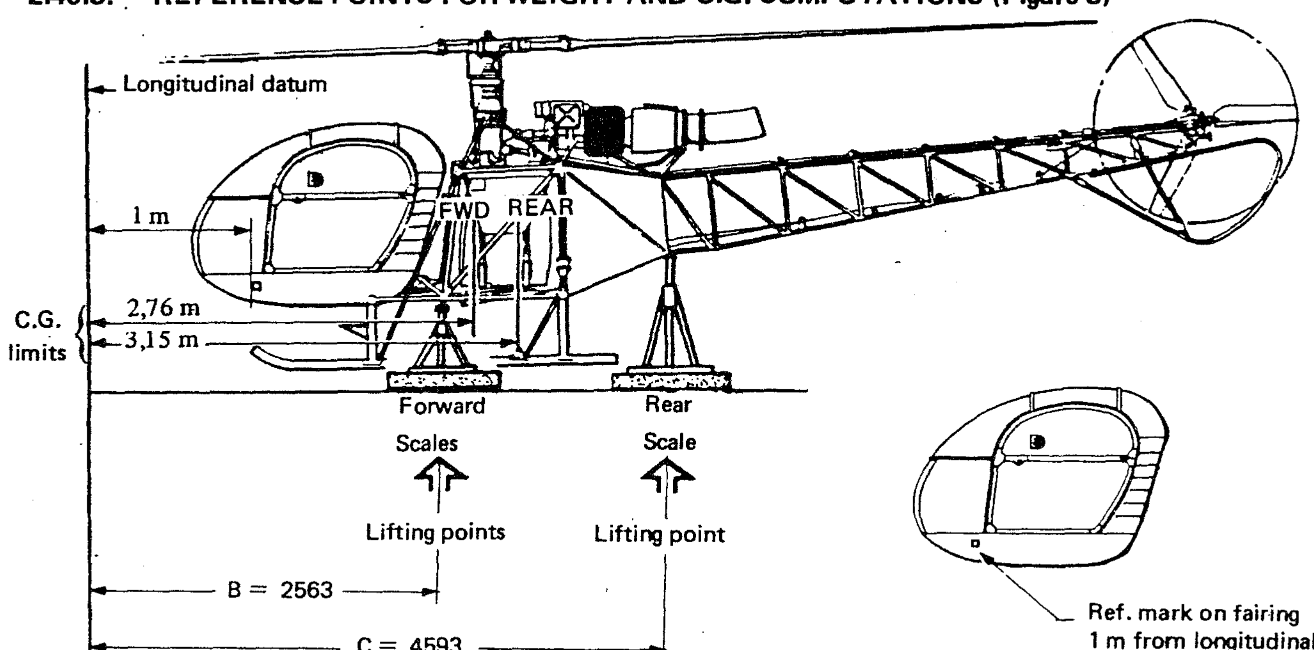


Figure 3
Reference points for weighing and c.g. computations

2.40.3.- REFERENCES FOR WEIGHT AND C.G. COMPUTATIONS (Contd)

DEFINITION OF AIRCRAFT CENTRE OF GRAVITY (EXPLANATION OF FIG. 3)

1.- BASIC THEORY

The position of the centre of gravity is defined with respect to two perpendicular reference planes :
- plane 0, perpendicular to the longitudinal (fore-aft) axis : longitudinal c.g. datum.
- plane O'along the longitudinal axis : lateral c.g. datum.

The centre of gravity depends upon the distribution of masses within the helicopter.

It is expressed by the moment of the whole weight (W) with respect to the chosen reference plane :

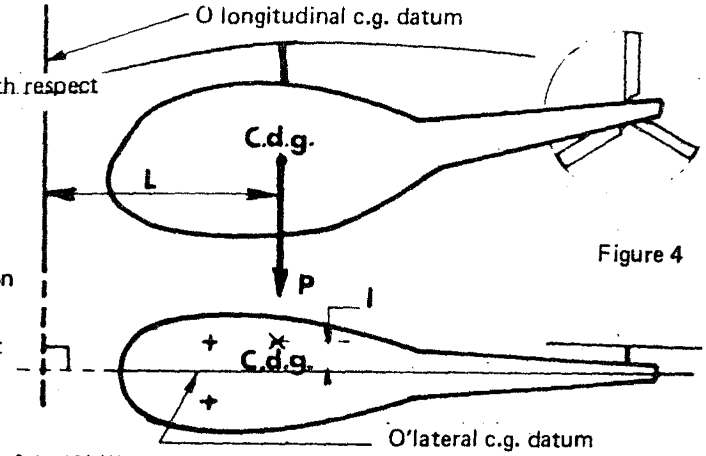


Figure 4

$$\partial M\,(0)\,W = L.W \;\longrightarrow\; L = \frac{\partial M\,(0)\,W}{W} \quad \text{(longitudinal c.g. position)}$$

$$\partial M\,(0')\,p = L.W \;\longrightarrow\; l = \frac{\partial M\,(0')\,W}{W} \quad \text{(lateral c.g. position)}$$

2.- C.G. UNLADEN AND WITH WORKING LOAD

The unladen a/c c.g. corresponds to the empty weight as defined in the Flight Manual. THIS IS THE REFERENCE from which the loaded a/c c.g. is itself defined i.e. the machine's c.g. in the flight configuration for a given role is :

loaded longitudinal c.g. : $L = \dfrac{\partial M\,(0)\,W + \Sigma\, \partial M\,(0)\,w}{W + \Sigma\, w}$

where w = mobile load necessary for the role.

The weights and moments of mobile loads (fuel, crew etc:) are to be found in the flight Manual.

3.- C.G. LIMITS

The Flight Manual defines both the loaded and empty a/c c.g. limits. It should be noted that, under normal conditions, the lateral c.g. limits are not reached in operation.

4.- DETERMINATION OF THE LONGITUDINAL C.G. OF EMPTY HELICOPTER BY WEIGHING.

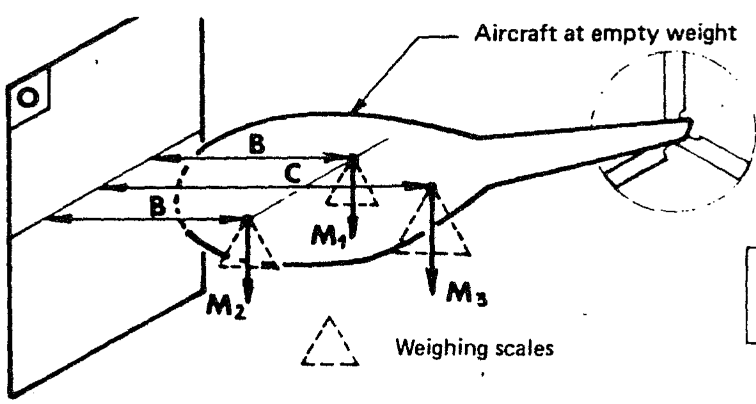


Figure 5

$$L = \frac{B\,(M1 + M2) + C.\,M3}{M1 + M2 + M3}$$

CHAPTER 3

LANDING GEAR

CONTENTS

3.- LANDING GEAR

3.00.- GENERAL

The helicopter may be equipped with :

- high skid-type landing gear (A)
- float-type landing gear (B)

A curved metal frame (D) attached to the tail boom protects the tail rotor during approach and landing.

The skid-type landing gear may be adapted to accommodate :

- a ski installation (C)
- an emergency flotation installation

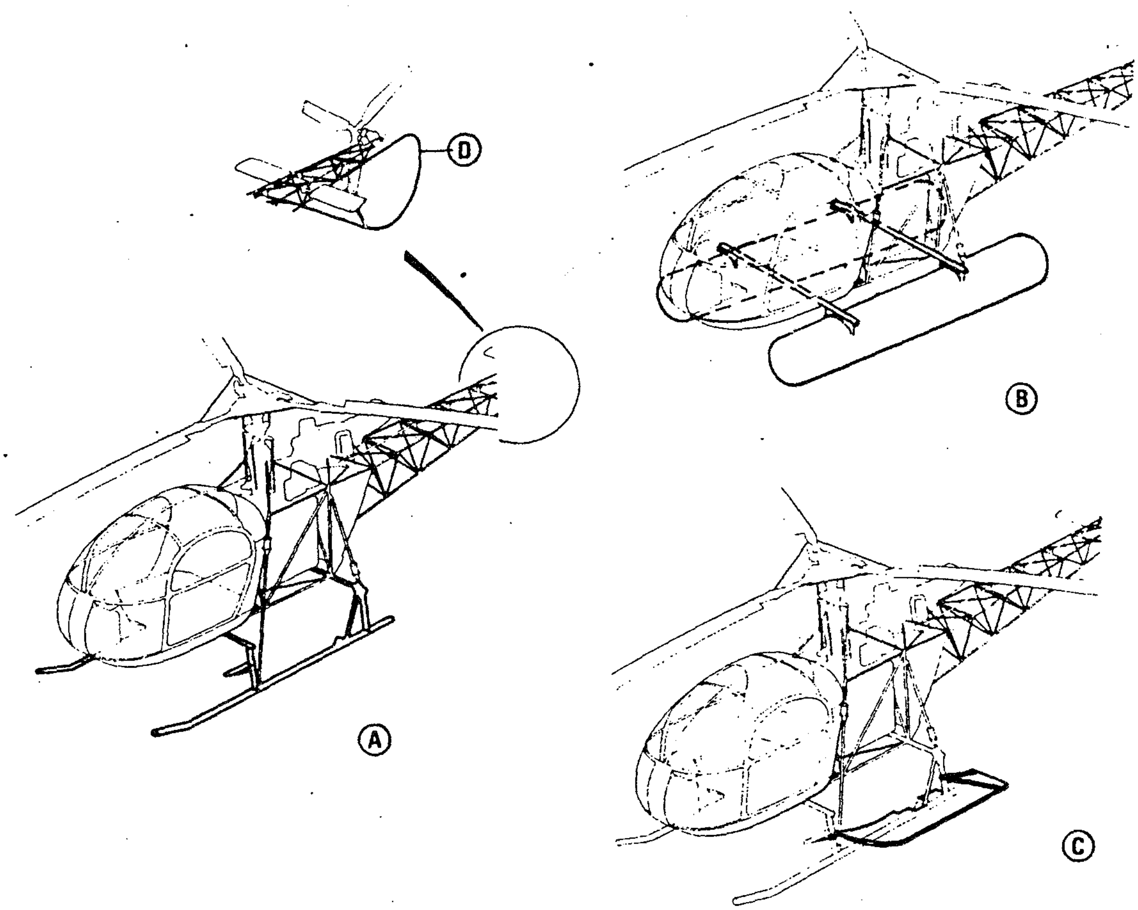


Figure 1
Landing gear

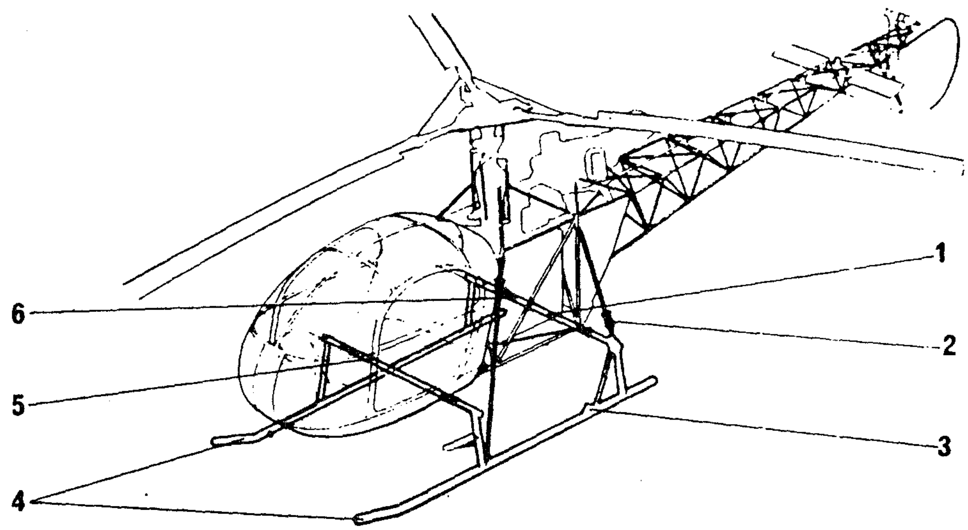
3.10.- HIGH SKID-TYPE LANDING GEAR

3.10.1.- GENERAL (Figure 1)

The high skid-type landing gear is composed of :

- two steel cross bars (1) (5) of internal taper cross-section for absorbing the landing impact
- two light alloy tube skids (4) fitted on the cross bars
- four hydraulic shock absorbers (2) (6) to prevent ground resonance.

Ground handling wheels (special tools) inflated to a pressure of 4 bars, may be fitted on two brackets (3) on the skids.



1.- Rear cross bar
2.- L.H. rear hydraulic shock absorber
3.- Ground-handling wheel bracket
4.- Skids
5.- Forward cross bar
6.- L.H. forward hydraulic shock absorber

Figure 1
High skid-type landing gear

3.10.2.- INSTALLATION OF SKID-TYPE LANDING GEAR (Figure 2)

The two cross bars (2) (14) supporting the skids are secured to the body structure by means of half-clamps (19) fitted with rubber lining pads (20). The light alloy skids (13) (15) are fitted on the cross bars by means of two bolted posts (7). The hydraulic shock aborbers (3) (16) are fitted as brace struts ; they are secured by yokes (1) (4) (6) on the body structure, the rear cross-bar and the forward post of the skids.

1.-	Upper attachments points for shock absorbers	11.-	Friction plate for hoist cable
2.-	Rear cross-bar	12.-	Footrest
3.-	Rear shock absorber	13.-	L.H. skid
4.-	Lower attachment point for rear shock absorber	14.-	Forward cross-bar
5.-	Skid wear shoe	15.-	R.H. skid
6.-	Lower attachment point for forward shock absorber	16.-	Forward shock absorber
7.-	Skid post	17.-	Body structure (clusters 4 R and 4 L)
8.-	Brace strut	18.-	Electrical bonding clamp
9.-	Handling wheel bracket	19.-	Attaching half-clamp
10.-	Skid wear shoe	20.-	Rubber lining pads
		21.-	Half-clamp (cross bar locating)

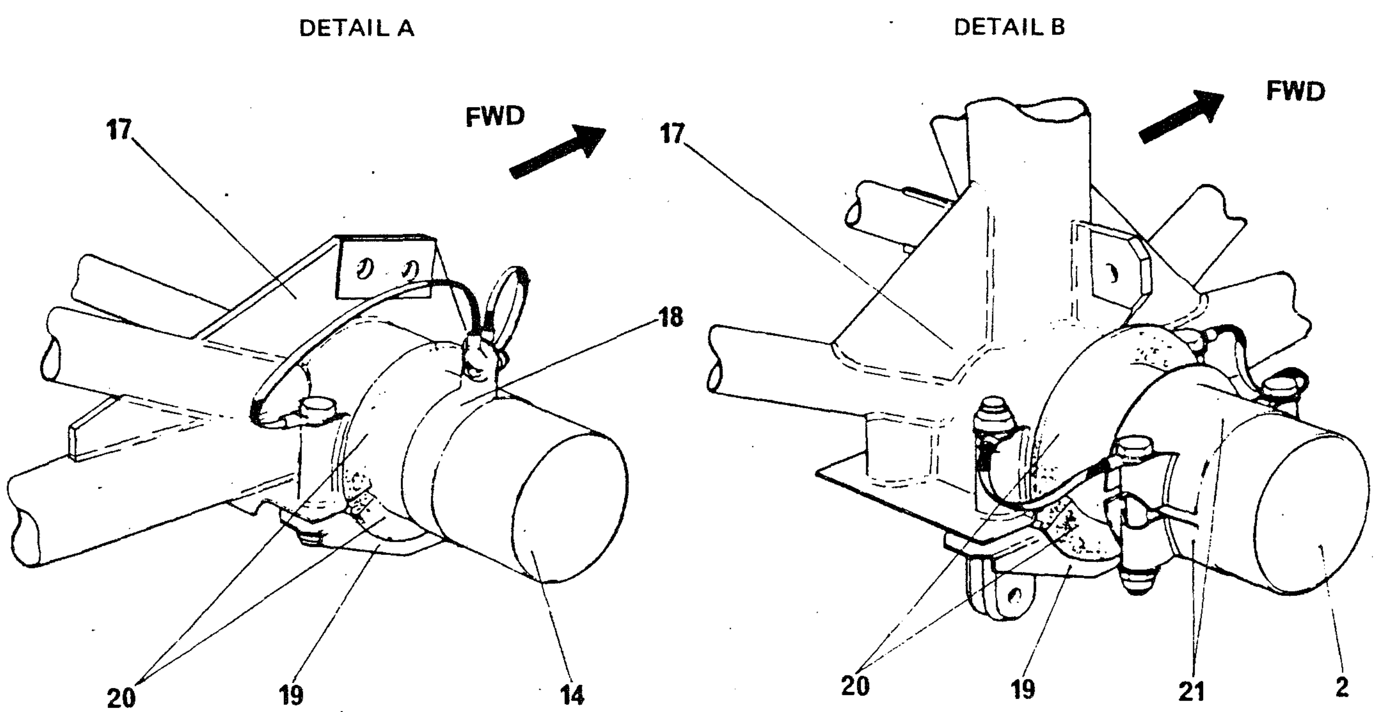


Figure 2A - Installation of landing gear

3.10.2.- INSTALLATION OF HIGH SKID TYPE LANDING GEAR (Contd.)

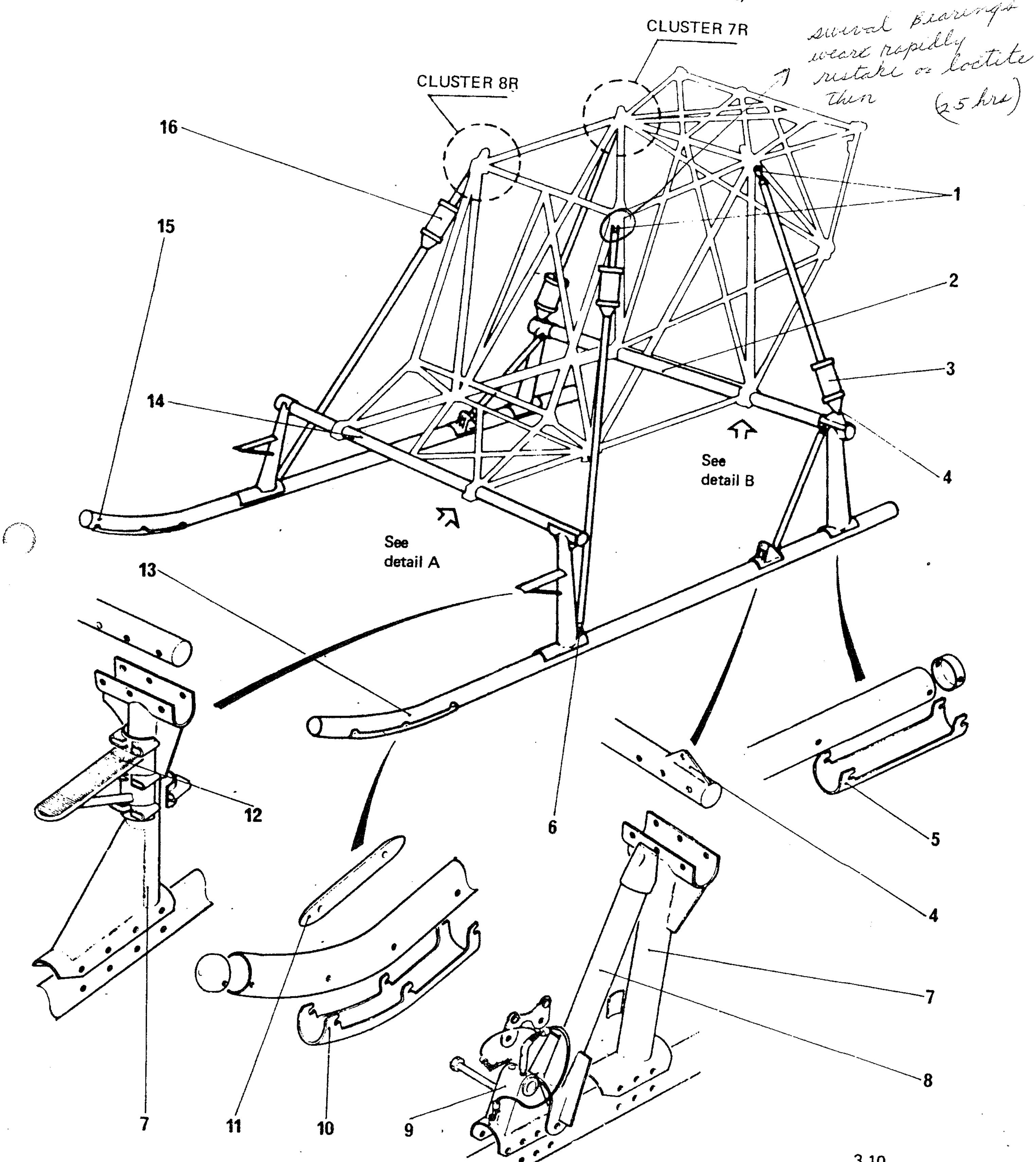


Figure 2B
Installation of landing gear

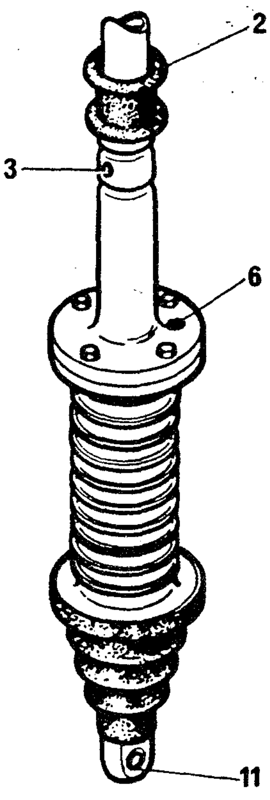
3.10.3.- HYDRAULIC SHOCK ABSORBER (Figure 3)

The hydraulic shock absorber consists of :

- A cylinder (7) and tube (4) rigidly joined and attached by a yoke (1) to the structure.
- A piston (9), the piston rod of which (8) is attached by an eye end (11) to the rear cross tube. The piston is fitted with two pressure-relief ball valves, mounted in opposition (10). The filler hole (3) is blanked by a sleeve (2). The ball (5) makes a non-return valve between the cylinder (7) and the fluid reserve in the tube (4).

The shock absorbing effect to absorb vibration on the ground is effected by metering of the liquid between the piston (9) and the cylinder (8). The valves (10) open to relieve excess pressure.

5606 Hyd. oil



1.-	Shock absorber body yoke
2.-	Filler hole blanking sleeve
3.-	Filler hole
4.-	Tube
5.-	Non return valve
6.-	Bleed screw
7.-	Cylinder
8.-	Piston rod
9.-	Piston
10.-	Pressure relief valves
11.-	Eye end
12.-	Piston rod boot

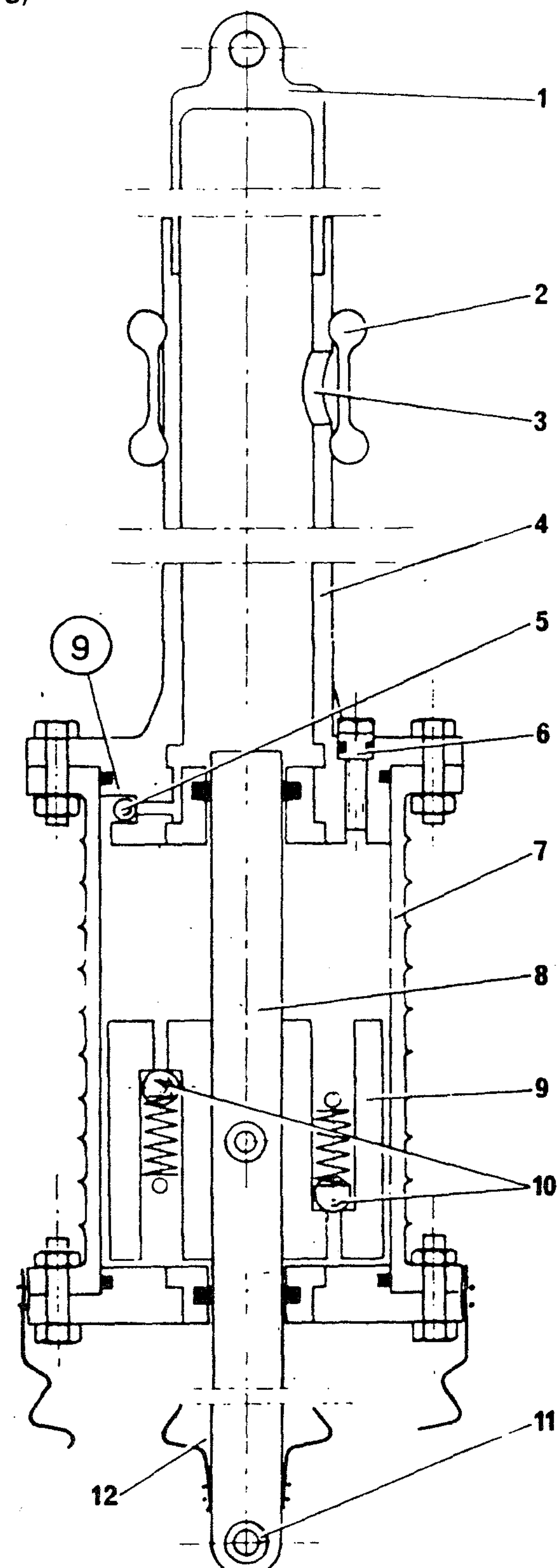


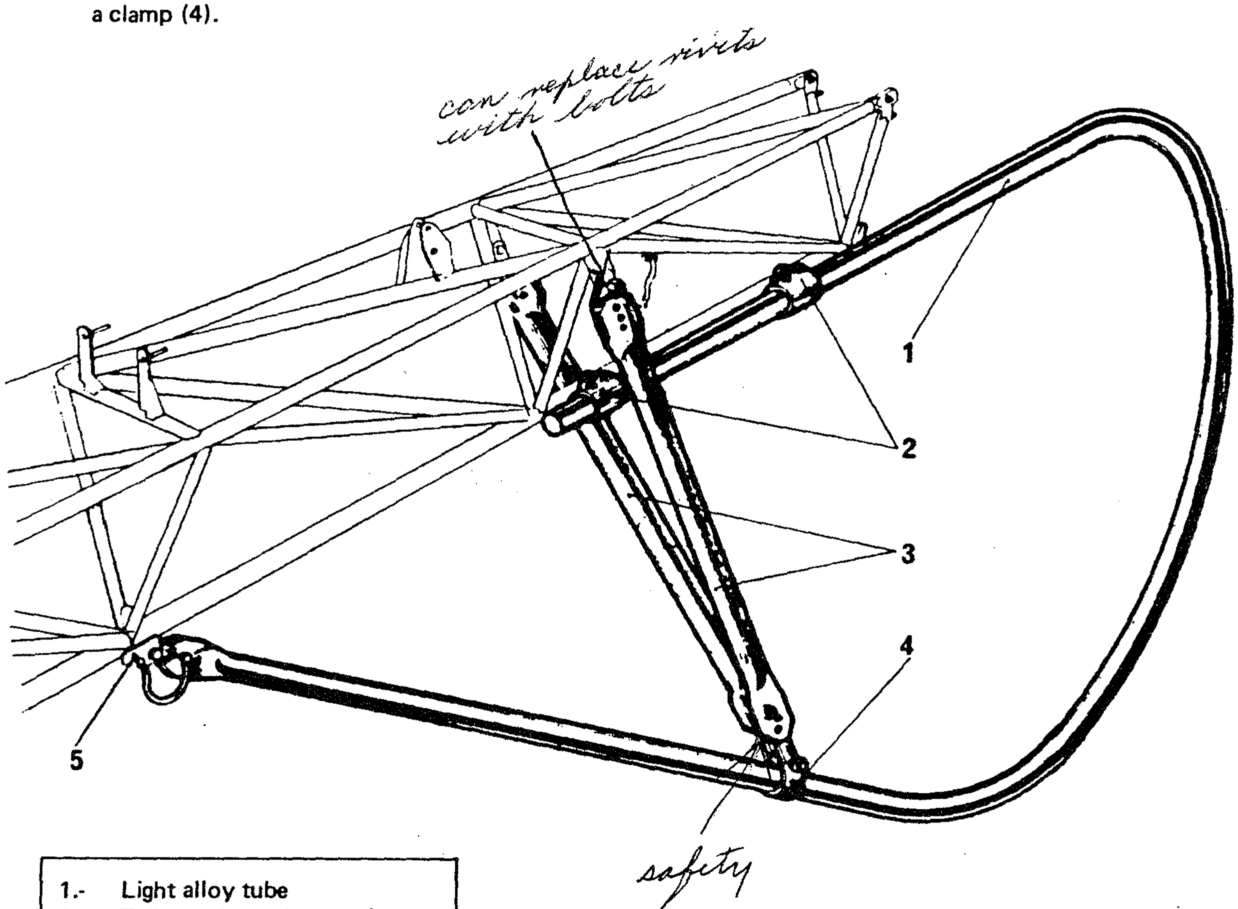
Figure 3
Hydraulic shock absorber

3.20.- TAIL ROTOR GUARD

The tail rotor guard protects the tail rotor blades on landing and shows the lower limit of the tail rotor disc for the ground operators.

The assembly is composed of :

- a formed light alloy tube (1) ; its forward end (5) is provided with an eye end-fitting for attachment to the tail boom.
- two clamps (2) for attaching the upper tube section
- two light alloy brace struts (3) fitted on the tail boom by means of bolts and attached to the tube by a clamp (4).



1.-	Light alloy tube
2.-	Tail guard attachment clamps
3.-	Reinforcing brace struts
4.-	Brace strut attachment clamp
5.-	Attachment eye end-fitting

Figure 1
Tail rotor guard

3.30.- SKI-TYPE LANDING GEAR

3.30.1.- GENERAL (Figure 1)

The skis are designed for landing on snow-covered ground but they can be used on normal ground.

The installation consists of two skis (2) of light alloy plate, attached to the skids by clamps (1) (3) (4). On the rear end of the skis, a brace strut (5) is connected to the skid rear post.

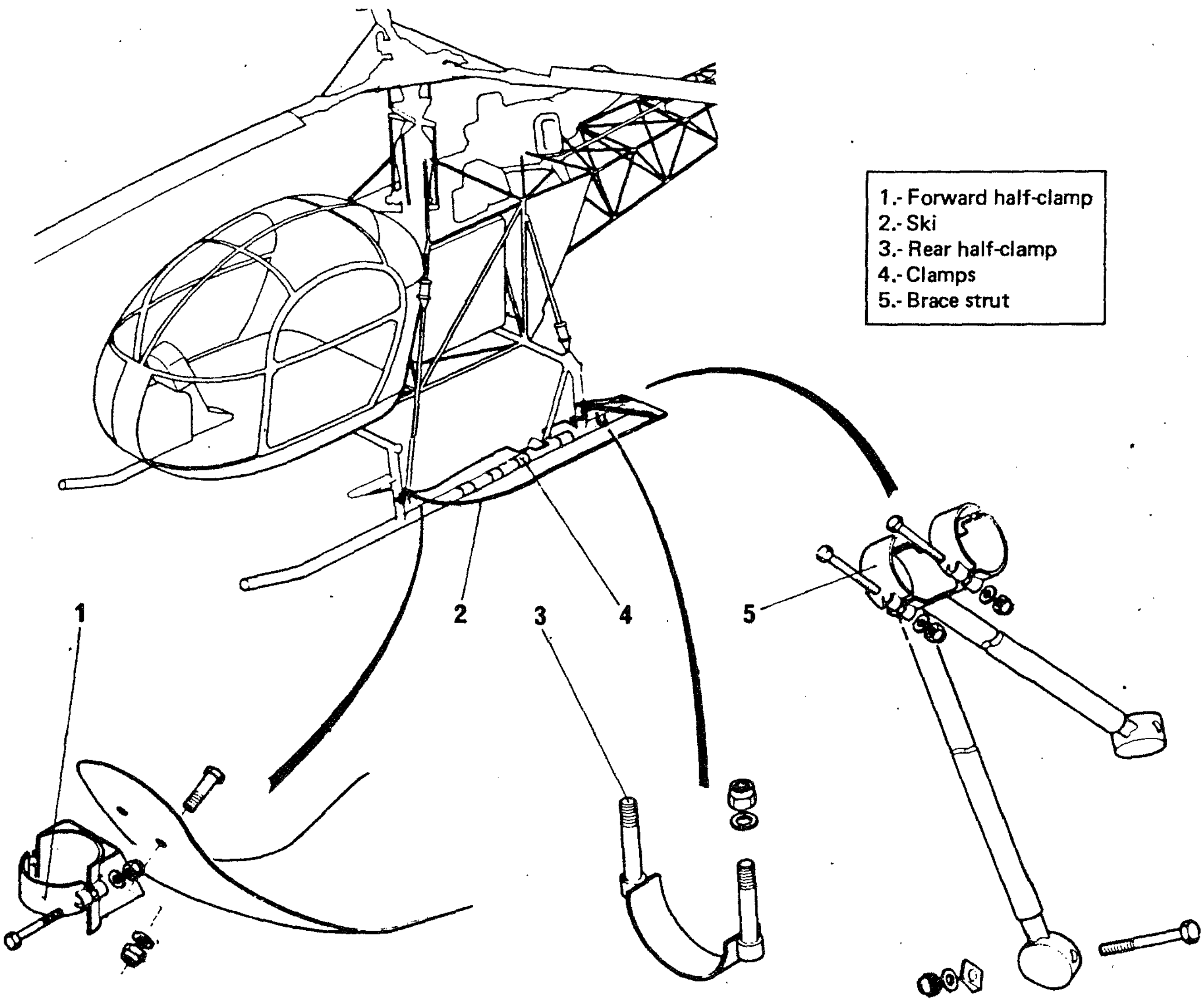


Figure 1 - Ski-type landing gear

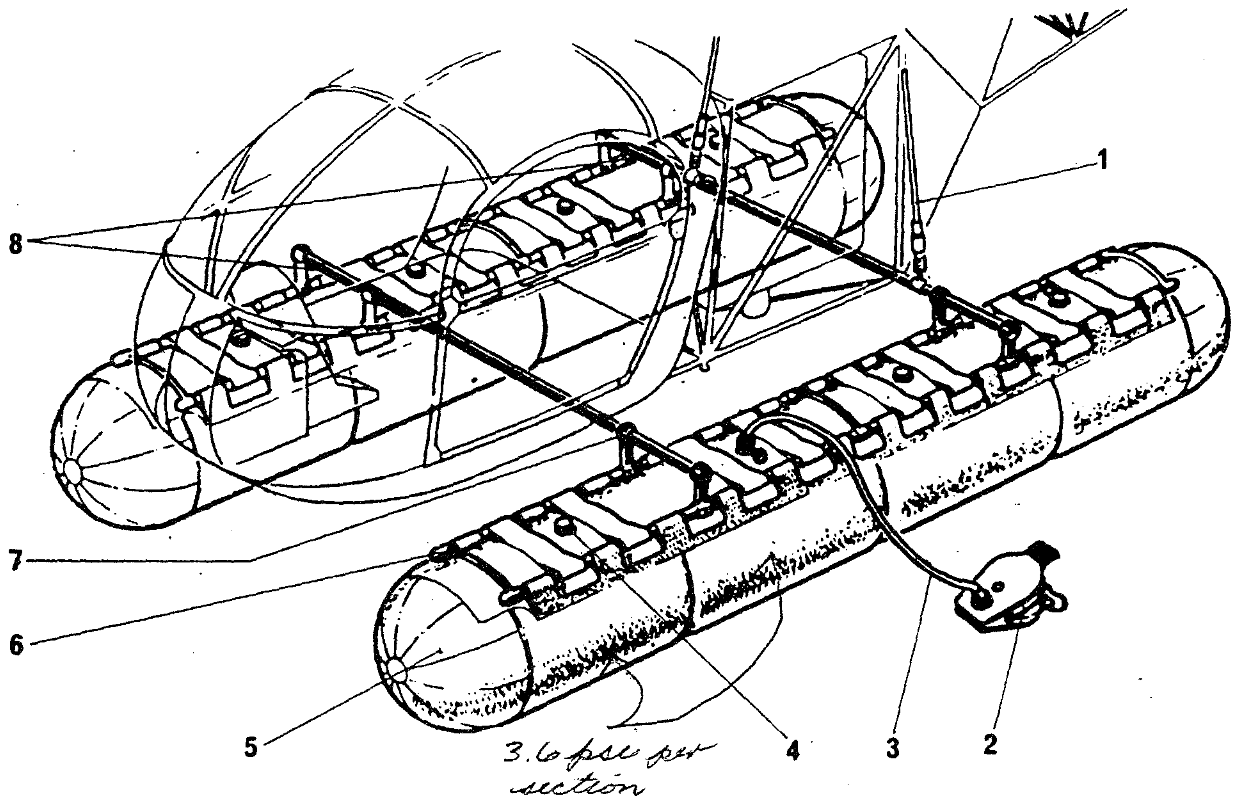
3.40.- FLOAT TYPE LANDING GEAR

3.40.1.- GENERAL (figure 1)

The float-type landing gear consists of :

– two floats made of rubberised fabric (5) which are partitioned and mounted on cradles (6).
– two steel cross tubes (8) supporting the floats, attached to the central structure by a collar (7)
– two shock absorbers (1) mounted between the rear cross tube and the structure. Their function is to prevent ground resonance.
– An inflation bellows pump (2) that attaches to the inflation sockets.
– A pressure gauge.

Float inflation pressure varies with altitude. Inflation pressures versus altitude, with the corresponding operating altitude range are specified in the aircraft Flight Manual.



NOTE : Description of hydraulic shock absorber (1) : see 3.10.3.

1.-	Shock absorber
2.-	Inflation pump
3.-	Connector pipe
4.-	Inflation sockets
5.-	Float
6.-	Bearer
7.-	Bearer attaching collar
8.-	Cross tubes

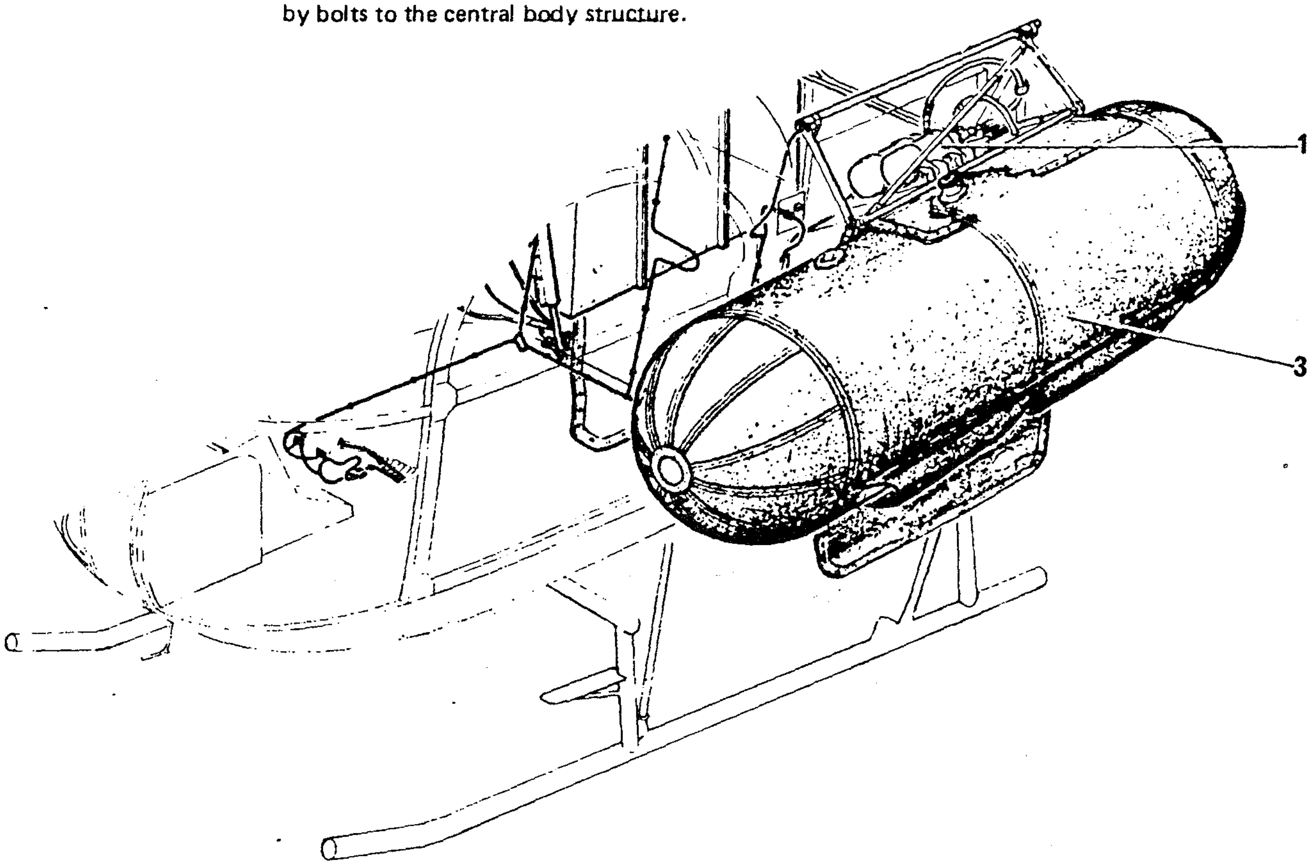
Figure 1
Float type landing gear

3.50.- EMERGENCY FLOTATION GEAR

3.50.1.- GENERAL (figure 1)

The emergency flotation gear is mounted above the wheel type landing gear. Its function is to ensure the evacuation of personnel and the salvage of the aircraft in the event of a forced landing at sea. In such a case, the aircraft in the event of a forced landing at sea. In such a case, the aircraft may be towed at a maximum speed of 10 knots.

The installation consists of two inflatable floats (3), connected to CO_2 cylinders (1) that are located in line with the main rotor axis. An electrical signal from the pilot station activates the inflation mechanism. In the «folded» position, the floats are stored in two containers (2) attached by bolts to the central body structure.



1.-	CO_2 Cylinders
2.-	Container with destructable lacing cords
3.-	Inflated float

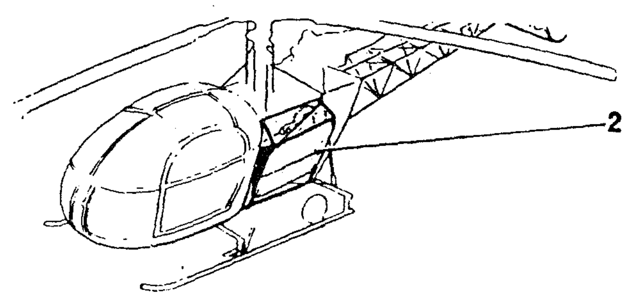


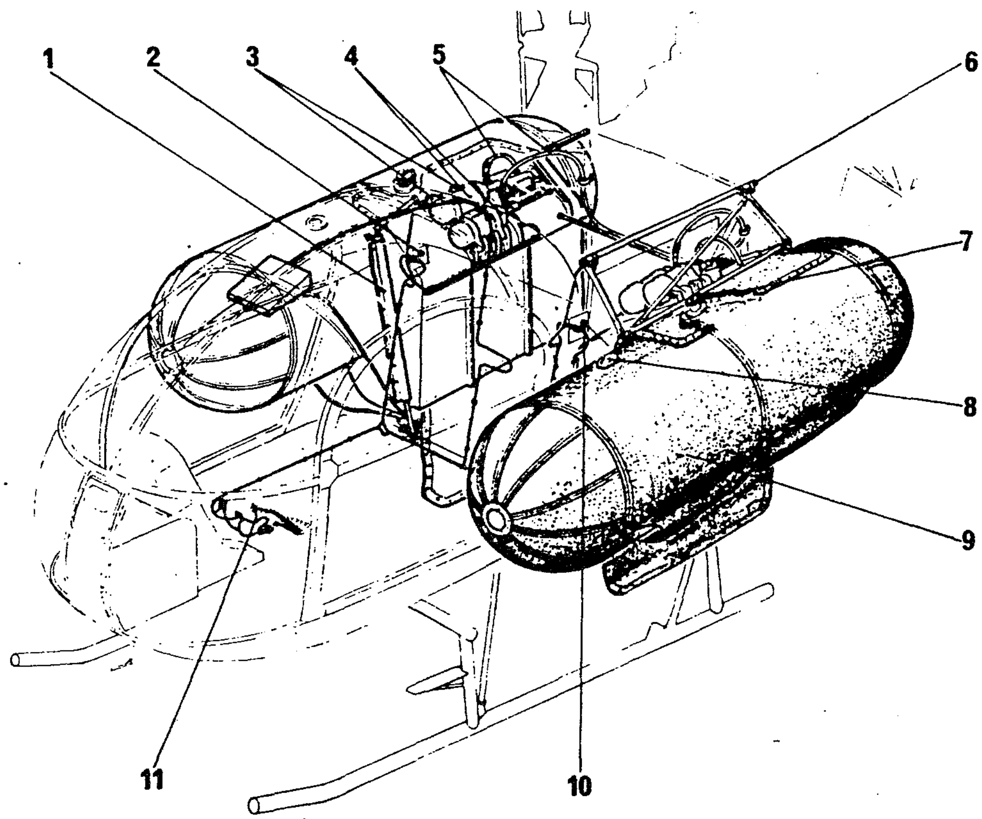
Figure 1
Emergency flotation gear

3.50.2.- DESCRIPTION OF EMERGENCY FLOATATION GEAR (Figure 2)

The installation consists of two opposite handed assemblies (R.H. and L.H.). Each assembly is composed of :

- an inflatable float (9) supported by a tubular structure (6) on the body structure.
- a container/cowling (1) closed by a shroud made of several flaps assembled with breakable strings. The folded float is stowed under the container/cowling
- a set of two CO2 cylinders (4) fitted on a support (3)
- a pipe assembly (5) which connects the CO2 cylinders and the floats. (the «crossed connection of the R.H. and L.H. pipes provides balanced in flation of the two floats).
- An electrical control to ignite the cartridges which operate the CO2 cylinders (see 3.50.3).

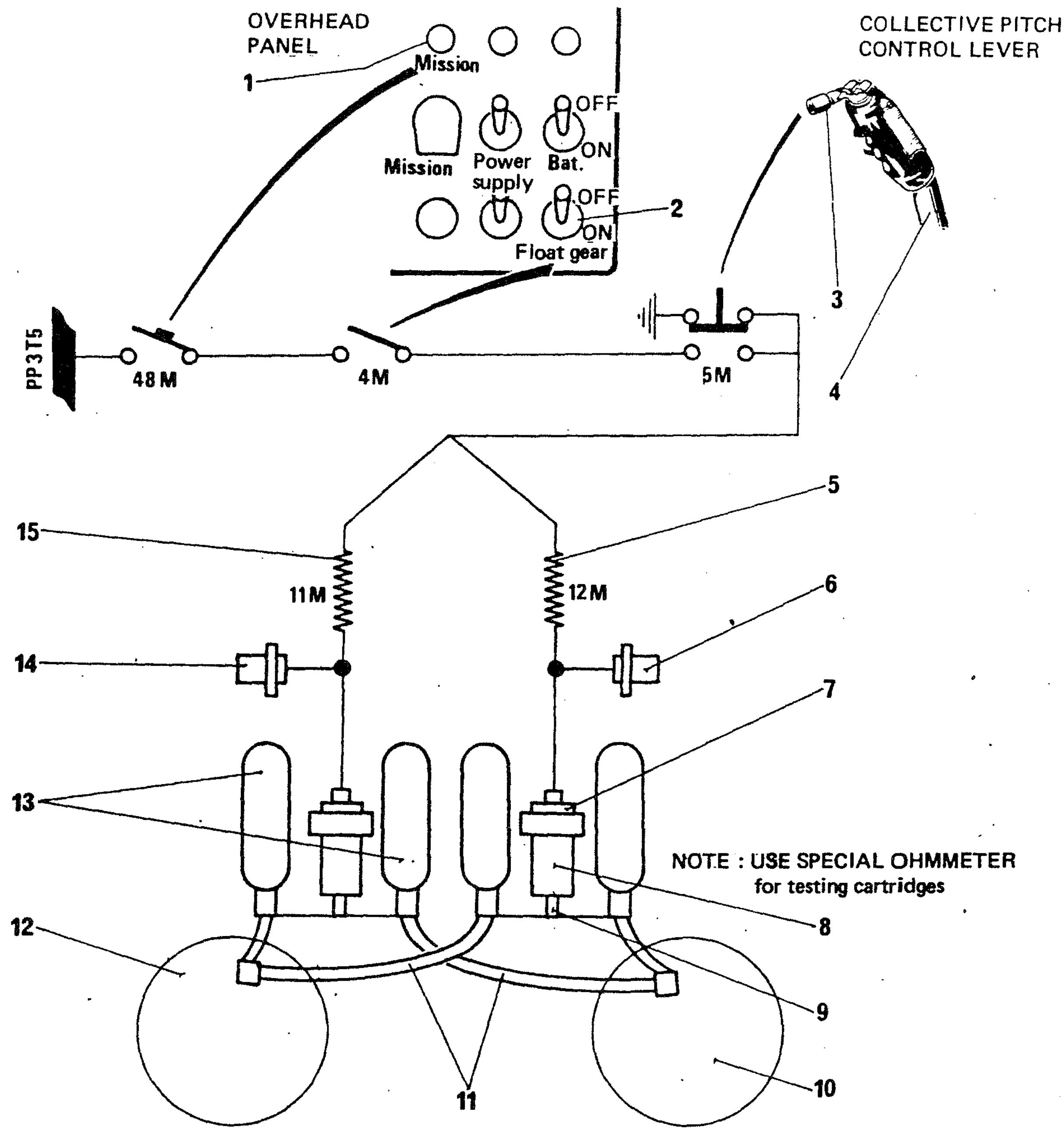
Operation : In case of emergency when flying over water, the pilot ignites the cartridges by pressing on the push button (11). The CO2 is released from the cylinders. Under the action of the gas pressure, the floats are inflated and expelled from their container, the strings of which are snapped. The CO2 which is cooled by expansion slowly warms again and excess pressure is released by safety valves (8). The inflation time is approximately 30 seconds.



1.- Float container/cowling	7.- Inflating union
2.- «R.H. cartridge» test connector	8.- Safety valve
3.- CO2 cylinder support	9.- Float
4.- CO2 cylinders	10.- «L.H. cartridge» test connector
5.- Hoses	11.- Control push-button for firing the cartridges (on collective pitch control lever)
6.- Tubular float support	

Figure 2 - Emergency floatation gear

3.50.3.- EMERGENCY FLOATATION GEAR ELECTRICAL CONTROL SYSTEM (Figure 3)



1.- Circuit breaker	9.- Cylinder firing cable loom assembly
2.- Switch	10.- R.H. float
3.- Push-button	11.- Cross feed hoses
4.- Collective pitch control lever	12.- L.H. float
5.- R.H. resistor	13.- CO2 cylinders
6.- R.H. cartridge test connector	14.- L.H. cartridge test connector
7.- R.H. cartridge	15.- L.H. resistor
8.- R.H. control unit	

CHAPTER 4

MECHANICAL TRANSMISSION SYSTEM

CONTENTS

4.- MECHANICAL TRANSMISSION SYSTEM
4.00.- GENERAL

The main and tail rotors are driven by a mechanical transmission system consisting of :
- A main drive shaft and a coupling shaft assembly (1)
- A transmission system to the main rotor (2)
- A transmission system to the tail rotor (3)

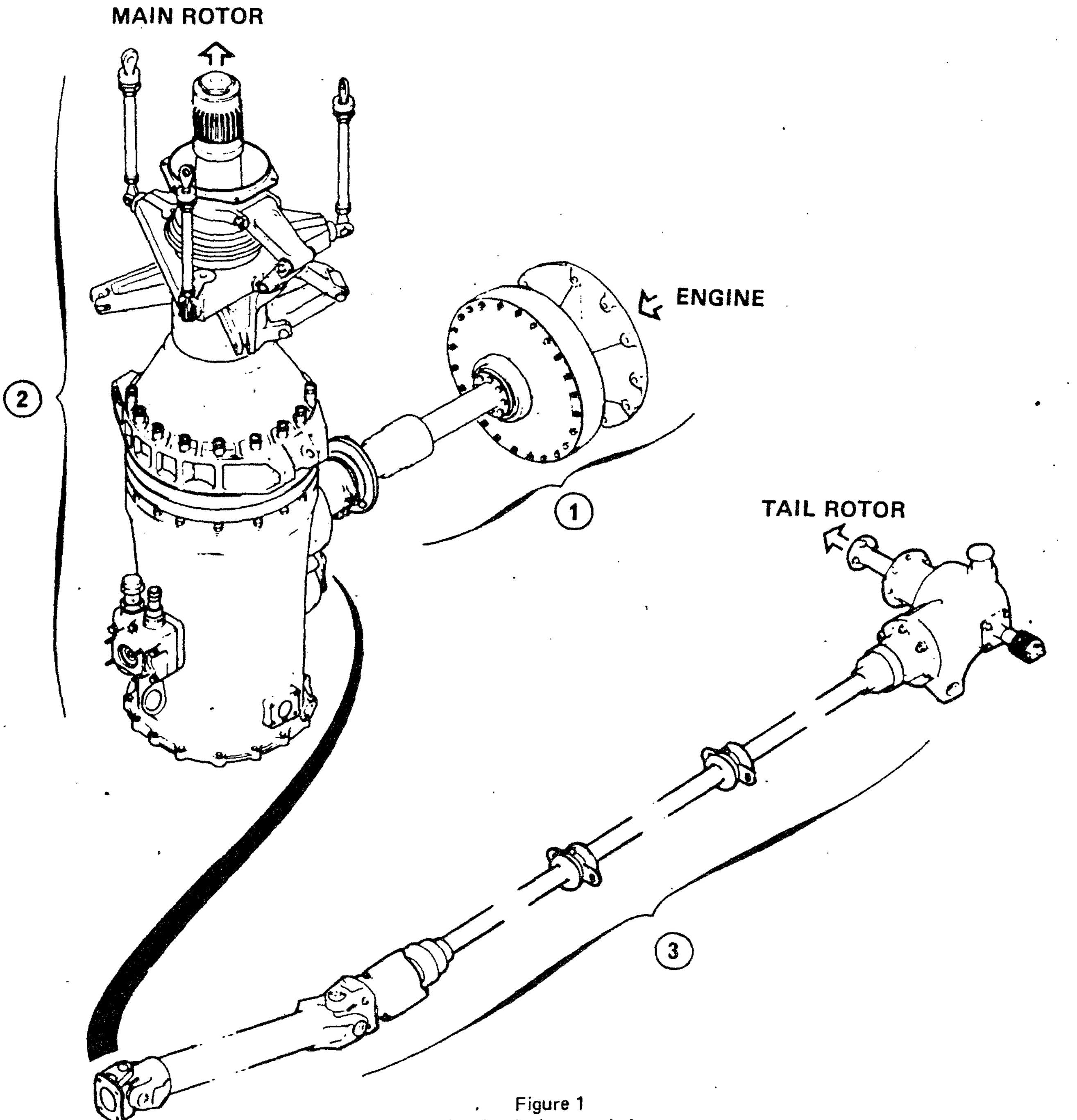


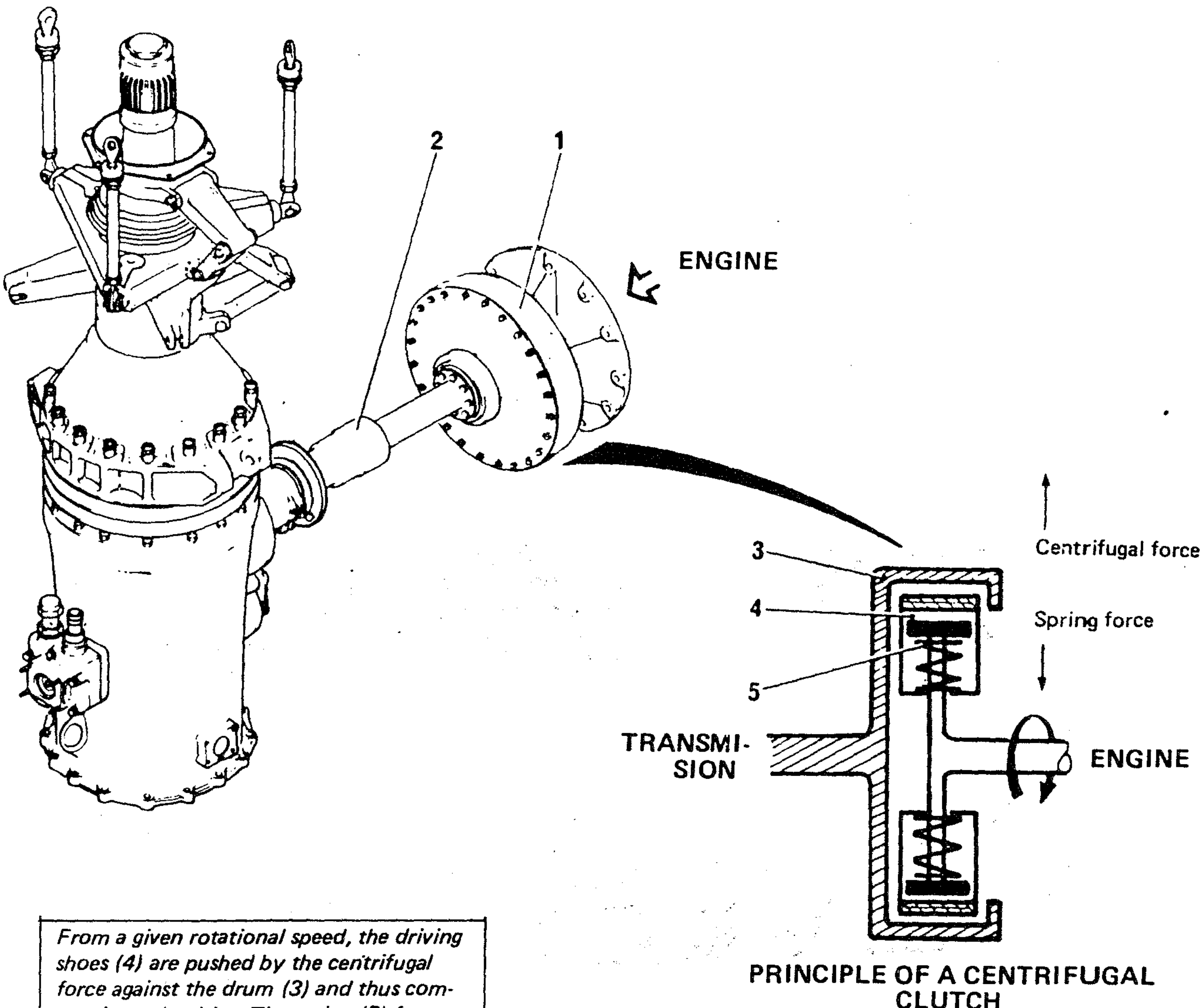
Figure 1
Mechanical transmission system

4.10.- MAIN DRIVE AND COUPLING SHAFT ASSEMBLY

4.10.1.- GENERAL (Figure 1)

The main drive and coupling shaft assembly connects the power plant to the main gear box. It comprises the following :

- main drive shaft - clutch unit (1)
- coupling shaft - freewheel (2)



From a given rotational speed, the driving shoes (4) are pushed by the centrifugal force against the drum (3) and thus communicate the drive. The spring (5) force, opposing the centrifufal force, returns the shoes back to the «disengaged» position.

Figure 1 - Main drive shaft and clutch unit assembly

4.10.2.- MAIN DRIVE – CLUTCH UNIT (Figure 2)

The dry type centrifugal clutch ensures :

- power plant isolation from the transmission system during starting operations
- progressive coupling of the transmission load to the power plant. Synchronization speed (engine output - transmission) ranges from 19 500 to 24 000 rpm.

The «main drive shaft - clutch unit» assembly consists of :

- a housing (6) fixed on the front end of the engine, driven by the engine and including :
  - . a splined driving shaft (9)
  - . a driving wheel (24) fitted with ten shoes (25) with friction linings. The driving wheel and the shoes are interlocked in rotation by means of tie bars (23) mounted on the drive shaft. Spring cup washers (16) located under the head of the tie bars and acting against the centrifugal force, form the return springs for the shoes.
- a driven part, including :
  - . a copper drive drum (2) held between two flanges (1) (4)
  - . the rear flange (4), serving as a hub, is carried by two bearings (7) (8) which are mounted in the main drive casing (6).
  - . the front flange (1) drives the freewheel - coupling shaft via splined coupling assembly (20).
  - . a bearing (21) centres the driven part with respect to the driving part.

As soon as the engine causes the driving assembly to rotate, the clutch shoes are subjected to centrifugal forces. When the engine speed reaches 19 500 rpm, the centrifugal forces exceed the opposing force of the resilient washers (16) and the shoes, applied against the drum, cause rotation of the driven assembly.

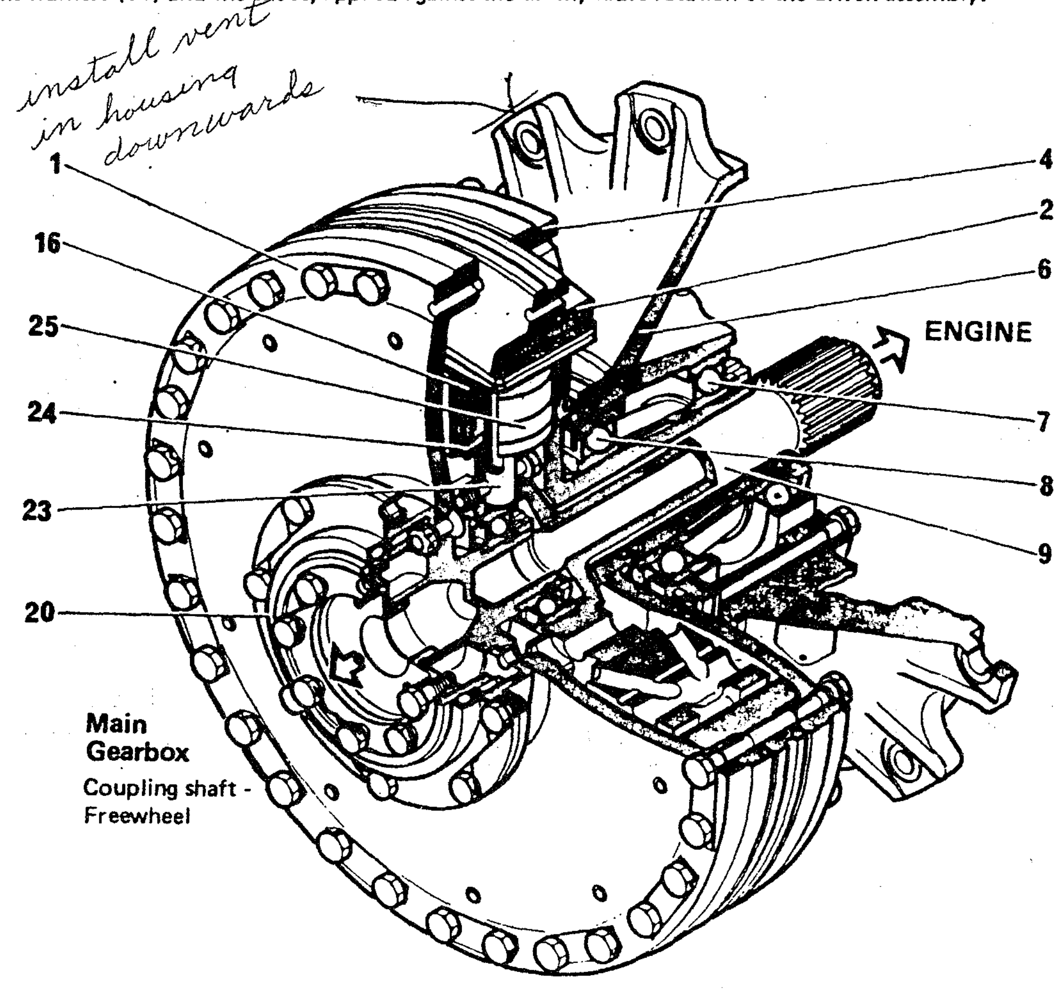
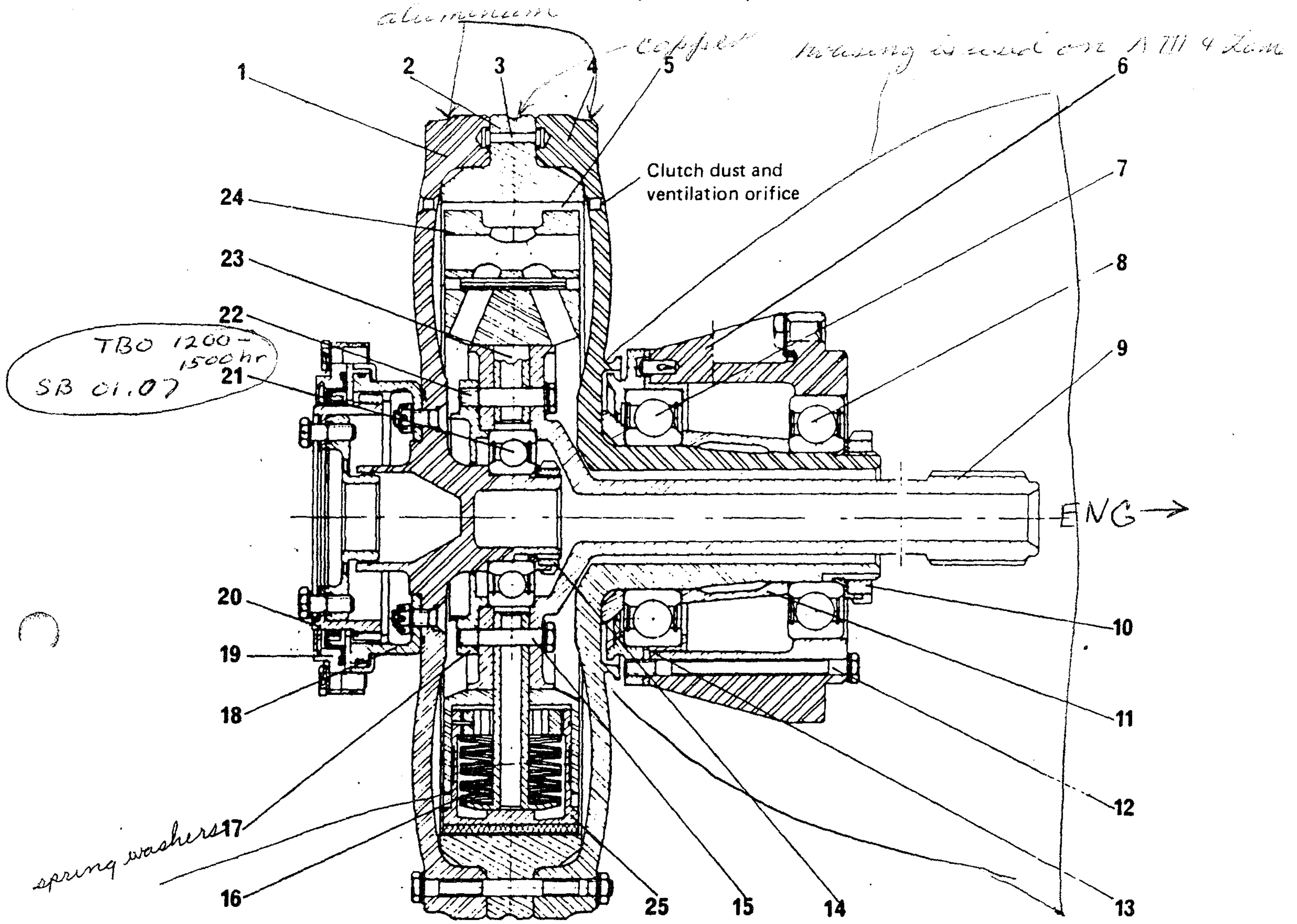


Figure 2
Main drive - clutch unit

type only
engage at 19,500 RPM
replace at 24,000 RPM

engage at 23,000
replace at 27,000

4.10.2.- POWER TAKE-OFF – CLUTCH UNIT (continued)



1.- Front flange	14.- Ring nut
2.- Driving drum	15.- Clamp screw tiret bearing retainer (17)
3.- Drum assembly bolt	16.- Resilient washers
4.- Rear flange	17.- Bearing retainer
5.- «Ferodo» friction lining	18.- Splined coupling housing
6.- Main drive casing	19.- Coupling seal retainer
7.- Bearing	20.- Splined coupling ring
8.- Bearing	21.- Bearing, Clutch support
9.- Drive shaft	22.- Assembly screw - tie bar
10.- Ring nut	23.- Tie bars
11.- Bearing spacer	24.- Guide ring - driving shoes
12.- Assembly screw of housing (13)	25.- Driving shoes
13.- Bearing retainer	

Figure 3 - Main drive - Clutch unit

2 types on [illegible]

(1) normal a) fits only one type of helicopter engine adapter permanent

B) engage by 19,500 when new or overhauled

replace when engagment reaches 24000 RPM

4.10.2.- MAIN DRIVE - CLUTCH UNIT (Figure 3A)

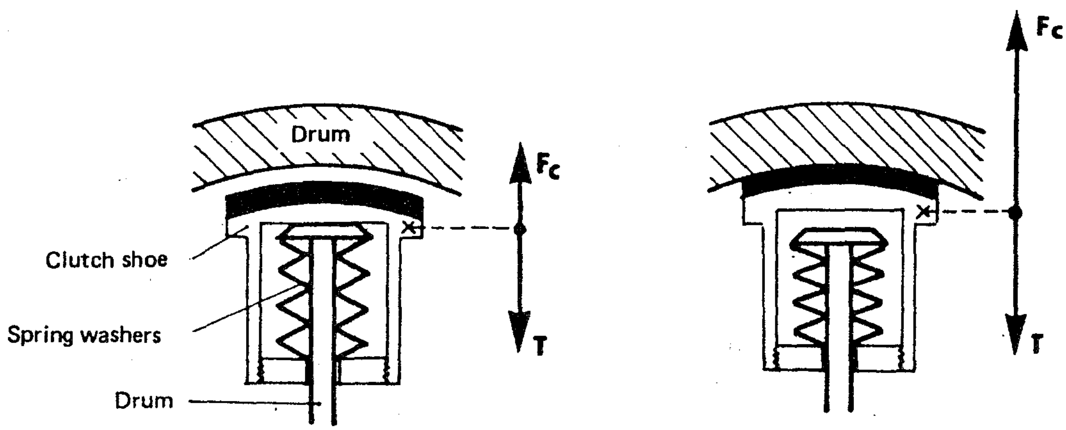
The dry type centrifugal clutch installed on the engine output shaft ensures :

- power plant isolation from the transmission system during starting operation
- progressive coupling of the transmission load to the power plant.

The «main drive - clutch unit» assembly consists of :

- A housing (7) fixed at the front of the engine
- A driving assembly, driven by the engine and including :
  - . a splined driving shaft (10)
  - . a splined ring (5) fitted on the shaft and equipped with ten friction lined shoes (1). Tie bars (27) fixed on the splined ring support the «spring» washers (28) which oppose the centrifugal force on the shoes.
- A driven assembly, including a copper driving drum (3) held between two flanges (2) (4) which are centered on the splined driving ring by means of two rigid bearings (13) (16). The front flange (2) drives the «freewheel - coupling shaft assembly through splined ring (24)

As soon as the engine causes the driving assembly to rotate, the clutch shoes are subjected to centrifugal forces. When the engagement speed is reached, the centrifugal forces exceed the opposing force of the «spring» washers, and the shoes therefore cause the driven assembly to rotate.



- Centrifugal force (Fc) less than spring force (T) : the shoes are held back by the «spring» washers ; therefore the drum is not driven.
- Fc greater than T : the shoes are applied against the drum which is thus driven.

ENGAGEMENT SPEED RANGE :	23,000 rpm	to 27,000 rpm
	New or over-hauled clutch	Maximum values (with worn clutch)

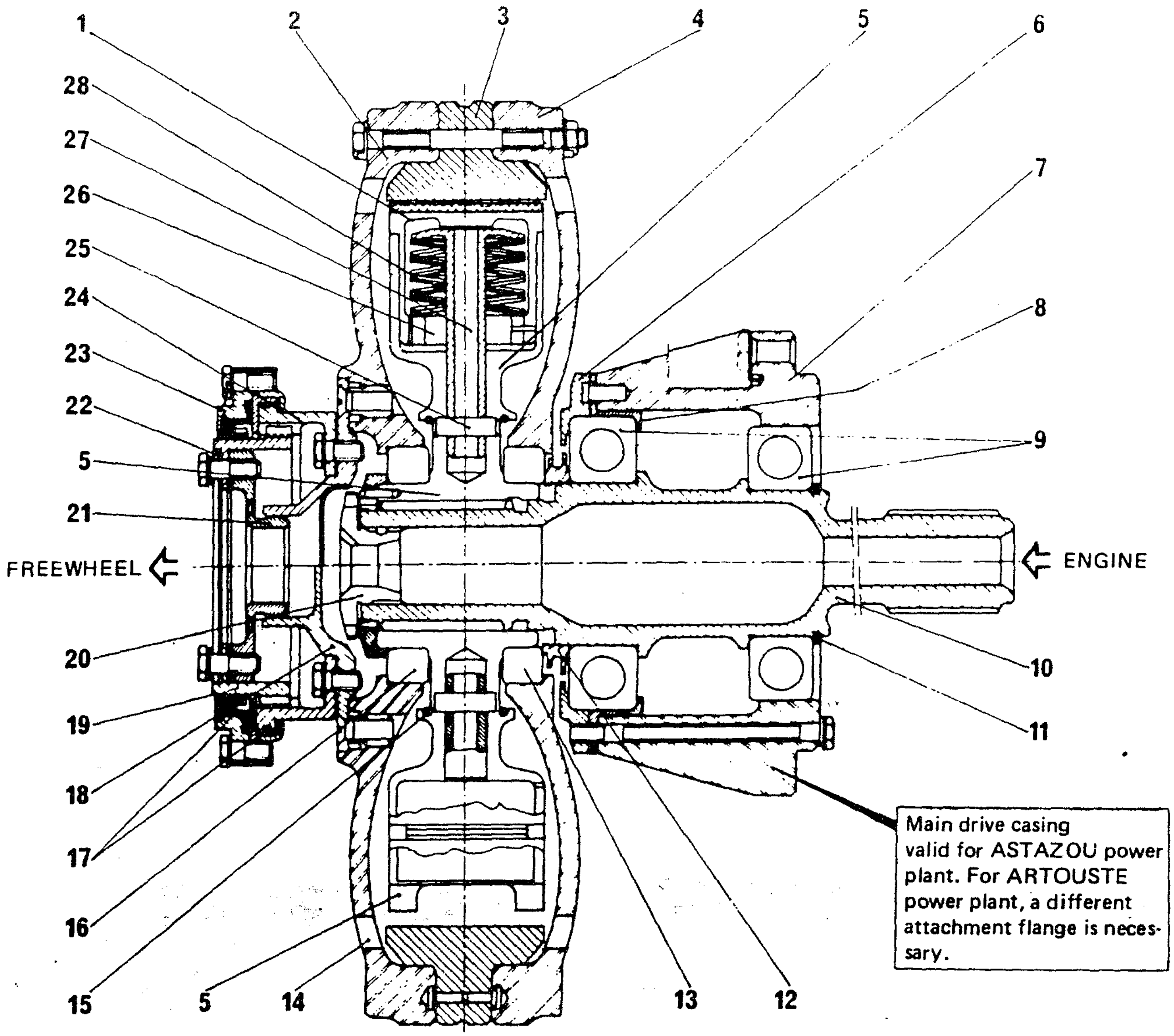
engagment time 30-45 sec.
T4 NOT up more than 50°

(2) unified clutch or universal or standard clutch
a) comes without attached adapter plate which allows it to fit more than one model

Figure 2 A
Clutch operation

New engages 23,000 RPM
Replace 27000 RPM

4.10.2.- MAIN DRIVE - CLUTCH UNIT (continued)



support Bearings has a TBO of 1200 - 1500 hrs.

1.- Driving shoes	16.- Rigid bearings
2.- Front flange	17.- Seals
3.- Drum	18.- Flange
4.- Rear flange	19.- Splined coupling ring
5.- Driving ring	20.- Nut
6.- Bearing retainer	21.- Ball joint
7.- Main drive casing	22.- Seal
8.- Bearing case	23.- Clamping plate
9.- Bearings	24.- Coupling housing
10.- Drive shaft	25.- Tie bar anchoring pin
11.- Snap ring	26.- Nut
12.- Spacer	27.- Tie bar
13.- Rigid bearing	28.- Spring cup washers
14.- Dust exhauster and ventilation orifice	
15.- Retaining ring	

Figure 3A
Main drive - Clutch unit

4.10.3.- MAIN DRIVE SHAFT-FREEWHEEL (Figure 4)

The freewheel unit, located between the clutch unit and the main gearbox, allows engine power to be transmitted to the rotor. In the case of autorotation, when the rotor becomes the power source, the freewheel units prevents any rotor-engine feedback. It consists of the following :

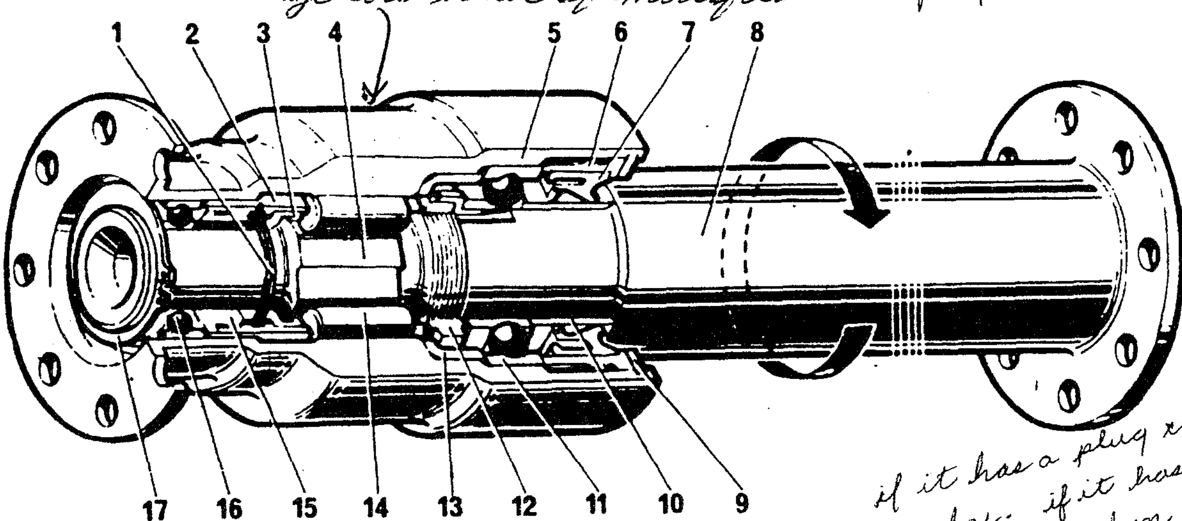
- A driving assembly : a torque shaft (8) bolted to the driven component of the clutch unit. An eight-lobed drive cam (4) is machined on the shaft.
- A driven assembly : a ring (5) bolted to the main gear box drive splined coupling.
- An intermediate assembly including eight rollers (13) operating in a roller retainer cage (2) maintained in counterrotational direction on the drive cam by two return springs (1).

The roller-and-bearing assembly is lubricated by oil from the main gearbox (see chapter 4.20).

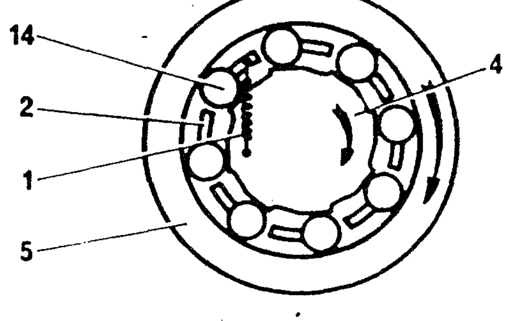
Operation : As long as the engine torque is applied to the driving assembly, the rollers (13) are trapped between the drive cam (4) and the ring (5). The driven ring is driven without slip : the freewheel is engaged . In auto-rotation, when the rotor supplies the power, the torque applied to the driven ring releases the rollers and the freewheel operates as a simple bearing : it is then disengaged.

The springs (1) apply the rollers against the drive cam lobes and the driven ring, thus avoiding harsh engagement of the freewheel during engine torque variations.

yellow band if modified or plug installed



if it has a plug check every 25 hrs. if it has no plug ch. 25 hrs then every 100 hrs.



1.-	Roller retainer cage return spring (2)	10.-	Spacer ring
2.-	Freewheel roller retainer	11.-	Bearing
3.-	Roller retainer locating ring	12.-	Nut
4.-	8- lobe drive cam	13.-	Backing ring
5.-	Driven ring	14.-	Rollers
6.-	Seal housing	15.-	Thrust ring
7.-	Lipped seal	16.-	Bearing
8.-	Freewheel torque shaft	17.-	Circlip
9.-	Circlip		

Figure 4 - Main drive shaft - freewheel

4.20.- TRANSMISSION SYSTEM TO MAIN ROTOR

4.20.1.- GENERAL (Figure 1)

The engine power transmission system to the main rotor consists of :

- a main gearbox (3)
- a rotor shaft unit (1)
- a rotor brake unit (2)

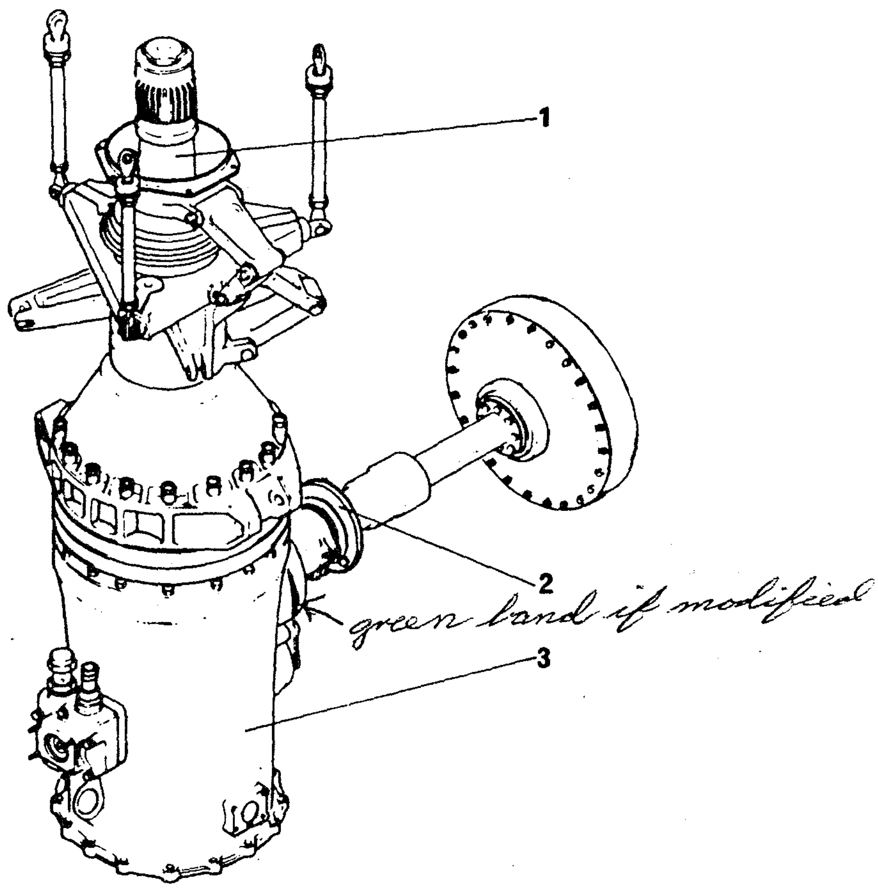


Figure 1
Main rotor transmission system

4.20.2.- MAIN GEAR BOX (M.G.B.)

A.- GENERAL (Figure 2)

The main gearbox reduces the rotational speed and transmits to the main and tail rotors the power required for flight. The rotational speed is stepped down from 5770 rpm at main gearbox input, to :

– 353 rpm at main gearbox input
–2480 rpm on tail rotor shaft.

The main gearbox consists of :

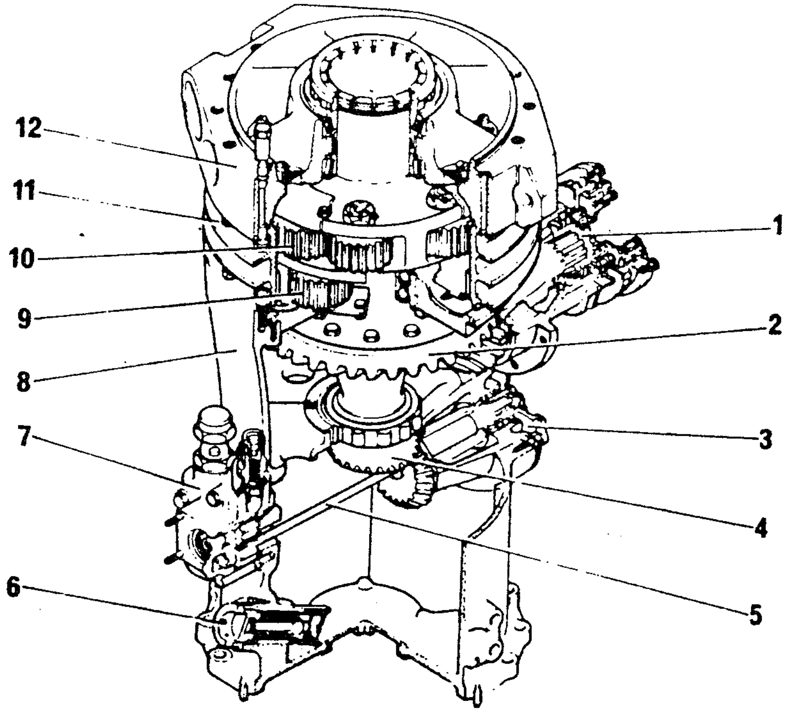
– mechanical components, assembled in a magnesium housing (8) and in a steel ring gear (11). These components include :
  . the main bevel gear assembly (2) driven by the power input shaft (1)
  . the tail drive bevel gear (4) and the power output shaft (3) for the tail drive
  . the 2-stage epicyclic type reduction gear : first stage planetary gear (9), second stage planetary gear (10)
  . the oil pump drive (5)
– oil system components including :
  . oil pump (7)
  . a suction strainer (6) and magnetic plug assembly
  . a filter (23) and by-pass valve assembly
  . oil level sight gauge (14)
  . filler plug (17)
  . drain plug (21)

A special cooler (outside main gearbox system) is provided for cooling the lubricating oil.

– Monitoring instruments
  . a tachometer generator (15) for monitoring the rotational speed.
  . a pressure transmitter (13) for monitoring the oil pressure
  . a thermal contact switch (16) for monitoring the oil temperature

1.- Power input coupling	10.- Second stage planetary gear
2.- Main level gear	11.- Reduction gear fixed ring
3.- Tail drive output shaft	12.- Upper housing assembly
4.- Tail drive bevel gear	13.- Pressure transmitter
5.- Oil pump drive shaft	14.- Oil level sight gauge
6.- Suction strainer	15.- Tachometer generator
7.- Oil pump	16.- Thermal contact switch
8.- Main housing	17.- Filler cap
9.- First stage planetary gear	18.- Oil outlet (to cooler)
	19.- Pump by-pass valve
	20.- Main gear box mounting bolt
	21.- Drain plug
	22.- Oil return duct
	23.- Filter

4.20.2.- MAIN GEAR BOX - GENERAL (Continued)



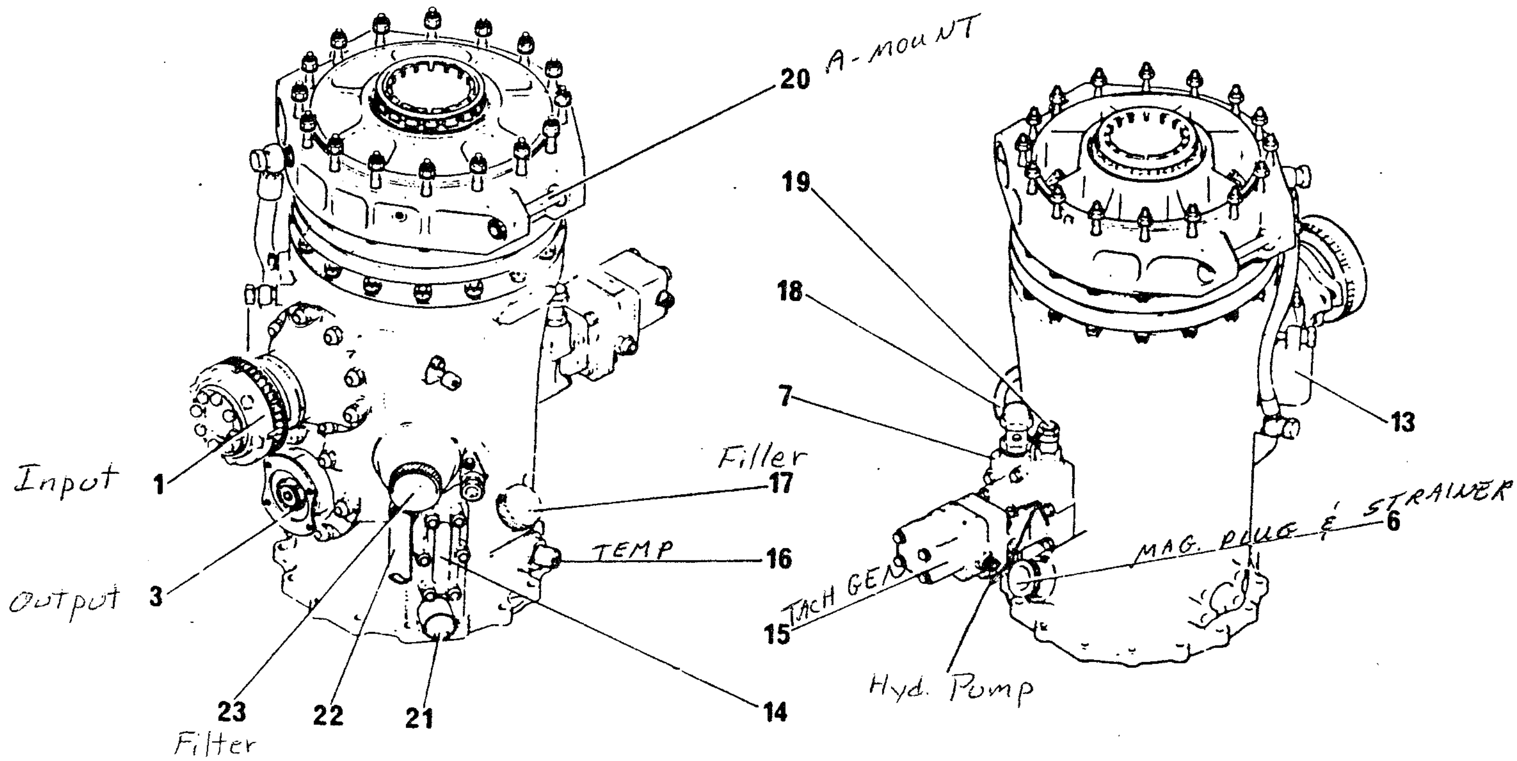


Figure 2
Main gear box

4.20.2.- MAIN GEAR BOX (Continued)

B.- GEAR BOX MECHANISM (Figure 3)

1 - OVERALL SYSTEM

1.- 2nd-stage planet pinion carrier	23.- Gearbox bottom cover
2.- Bearings	24.- Suction strainer
3.- Upper housing	25.- Oil pump quill shaft
4.- Oil hose adaptor tiret to lubricating jets for bearings (2) and reduction gear	26.- Oil pump
5.- Planet pinion shaft (2nd stage)	27.- Bevel gear (tail rotor drive)
6.- 2nd stage planet pinions	28.- Bearing
7.- Reduction gear fixed ring	29.- Bevel wheel flared shaft
8.- Planet pinion shaft (1st stage)	30.- Bevel wheel
9.- Planet pinions (1st stage)	31.- Bearing
10.- Bevel wheel upper shaft	32.- Flange of planet pinion carrier (1st stage)
11.- Input housing	33.- 1st stage sun gear
12.- Coupling housing (rotor brake disc drive)	34.- Planet pinion carrier (1st stage)
13.- Splined coupling ring	35.- Flange of 2nd stage planet pinion carrier
14.- Bearing	36.- Bearing spacer
15.- Input bevel pinion	37.- 2nd stage sun gear
16.- Oil jet (lubrication of coupling shaft - freewheel)	38.- Bearing needles
17.- Bearing	39.- Main gear box «A» frame attachment fitting
18.- Tail rotor drive output flange	40.- Rotor shaft housing - to - M.G.B upper housing attachment pillars
19.- Output housing	41.- Nut
20.- Bearings	42.- Nut
21.- Bevel pinion (tail rotor drive)	
22.- Nut	

4.20.2.- MAIN GEAR BOX (Continued)

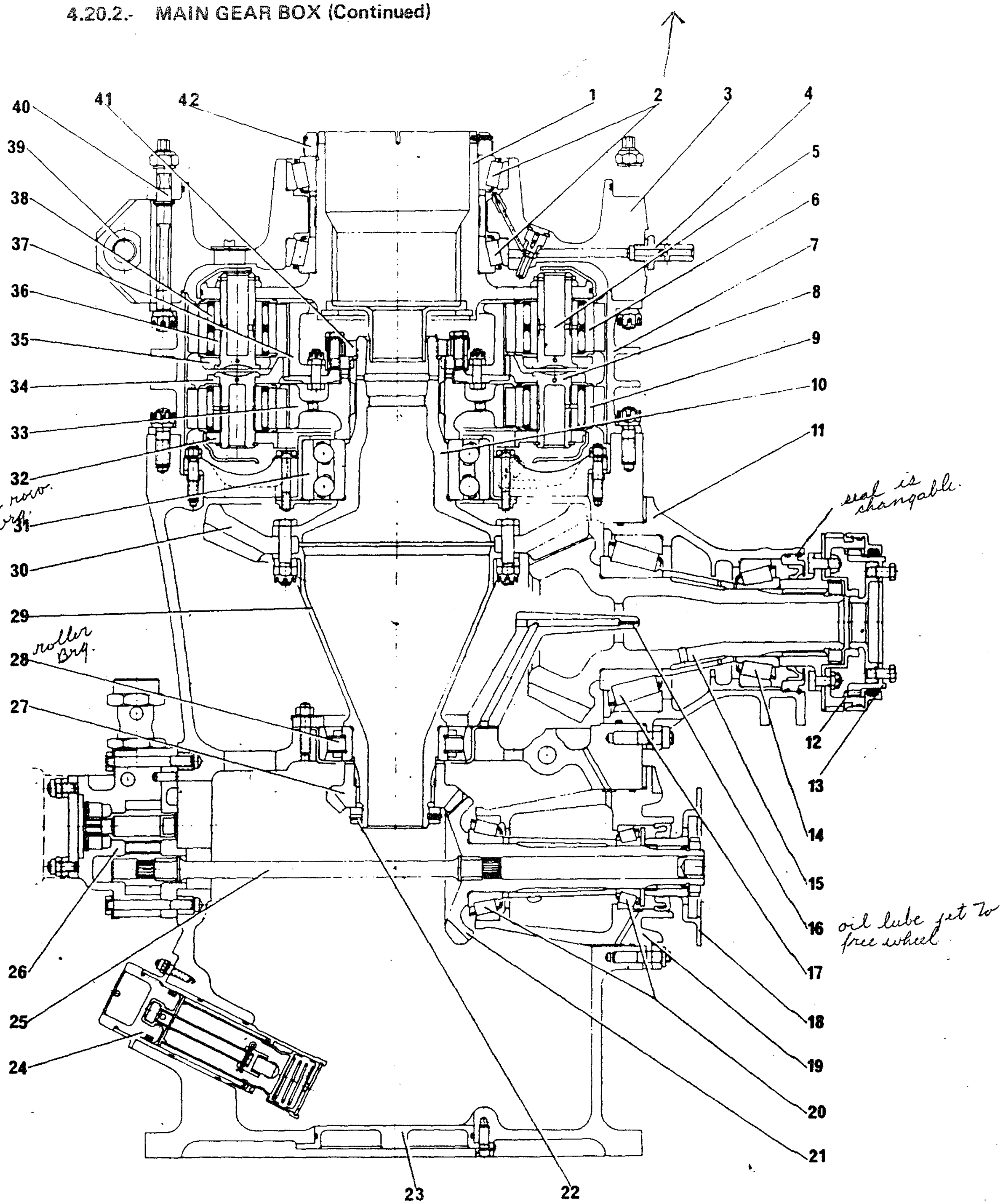


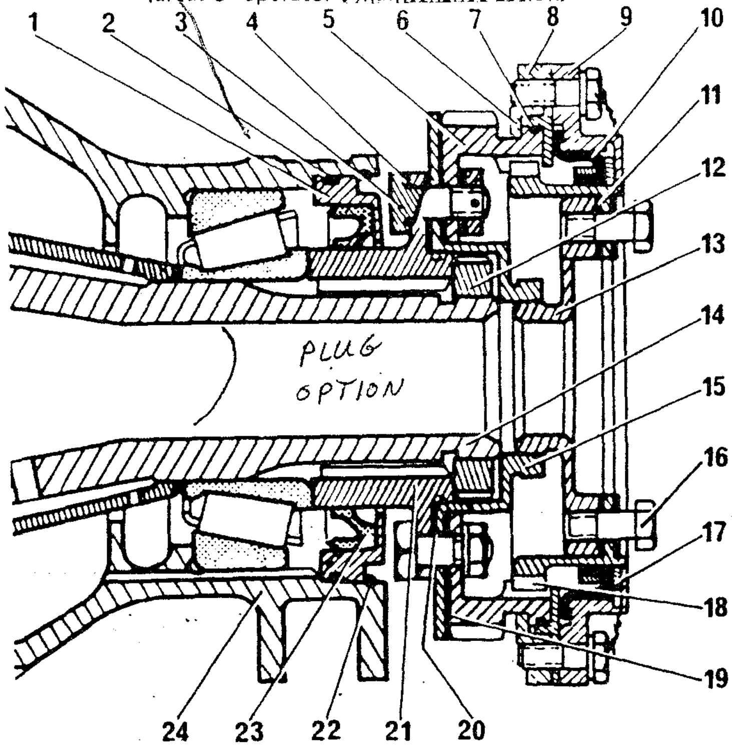
Figure 3
Main gear box

grease stripe if plugged   yellow – on freewheeling unit

4.20.2.- MAIN GEAR BOX (Continued) - GEAR BOX MECHANISM

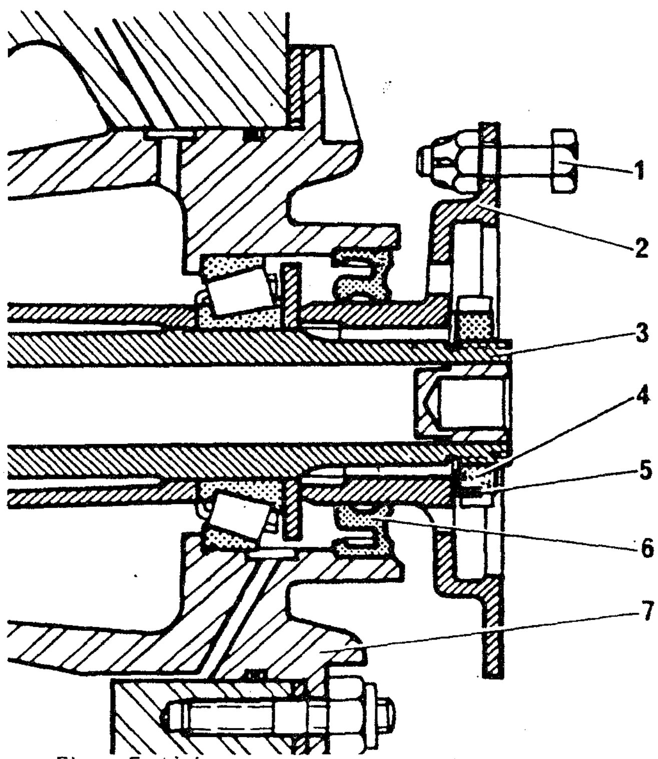
2 - MAIN DRIVE – DETAILED DIAGRAM

(areas of operator's maintenance action)



1.- Seal retainer
2.- Seal
3.- Bolt
4.- Seal
5.- Coupling housing (brake disc drive)
6.- Flange
7.- Seal
8.- Backing ring
9.- Clamping ring
10.- Seal
11.- Seal
12.- Ring nut
13.- Centering ball joint
14.- Driving bevel pinion shank
15.- Ball joint socket
16.- Connecting screw (freewheel shaft)
17.- Shim
18.- Splined coupling ring
19.- Paper gasket
20.- Paper gasket
21.- Driving flange
22.- Retaining ring
23.- Lipped seal
24.- Input housing

Figure 4 - Main gear box power input drive



1.- Connecting screw (tail drive shaft)
2.- Driving flange
3.- Bevel pinion shank
4.- Ring nut
5.- Tab washer
6.- Lipped seal
7.- Output housing

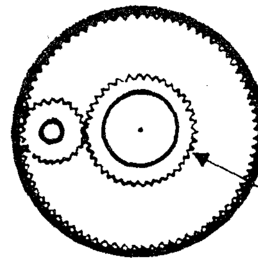
Figure 5 - Main gear box power output drive to tail drive

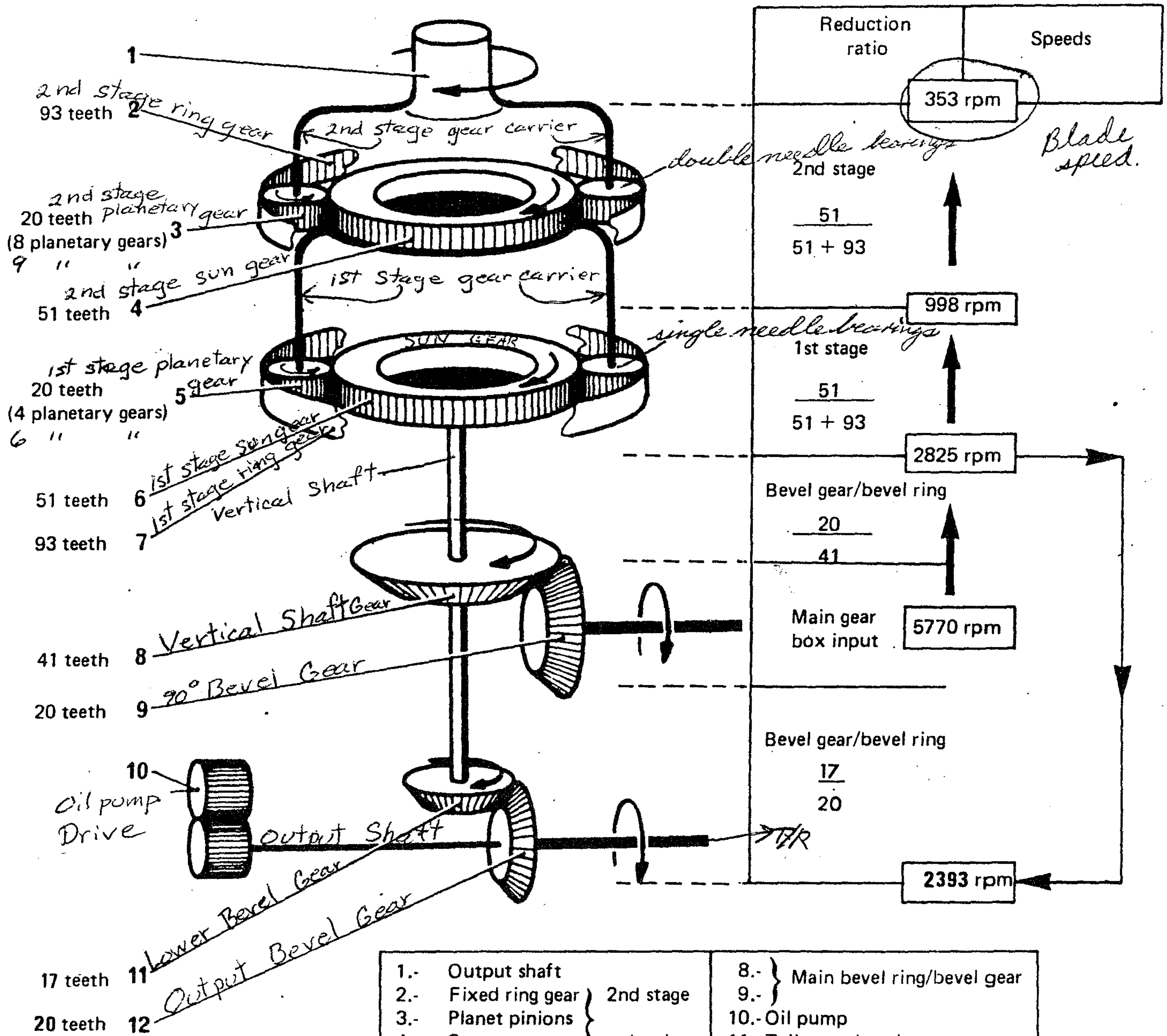
4.20.2.- MAIN GEAR BOX - MECHANISM (Continued)

3 - MAIN GEAR BOX KINEMATICS (Figure 6)

Reminder - Reduction ratio of an epicyclic gear

$$R = \frac{N1}{N1 + N2}$$





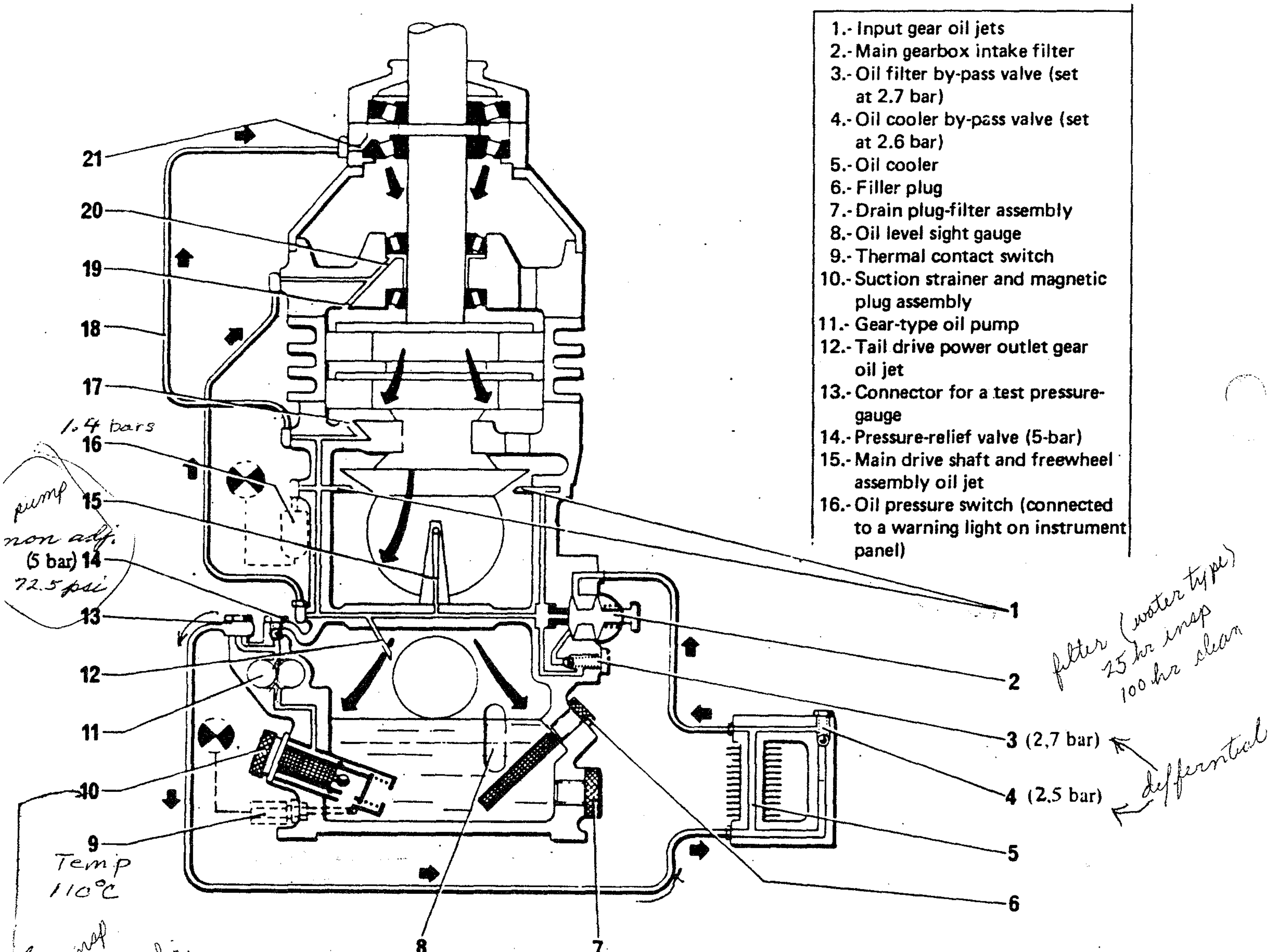
1.-	Output shaft		8.- } Main bevel ring/bevel gear
2.-	Fixed ring gear	2nd stage	9.- }
3.-	Planet pinions		10.- Oil pump
4.-	Sun gear	reduction	11.- Tail rotor bevel
5.-	Planet pinions	1st stage	12.- ring/bevel gear
6.-	Sun gear		
7.-	Fixed ring gear	reduction	

Figure 6 — Main gear box : Principle of operation

4.20.2.- MAIN GEAR BOX (Continued)

C.- MAIN GEAR BOX OIL SYSTEM (Figure 7)

The gear-type oil pump (10) draws, through a filter (9), the lubrication oil contained in the bottom of the main housing. A 5-bar pressure drives the oil into the cooling system : through oil cooler (5), to the main gearbox intake filter (2). From this filter, the oil is delivered to the various oil jets installed near the units to be lubricated (see hereunder). The oil returns by gravity to the sump in the bottom of the main housing.



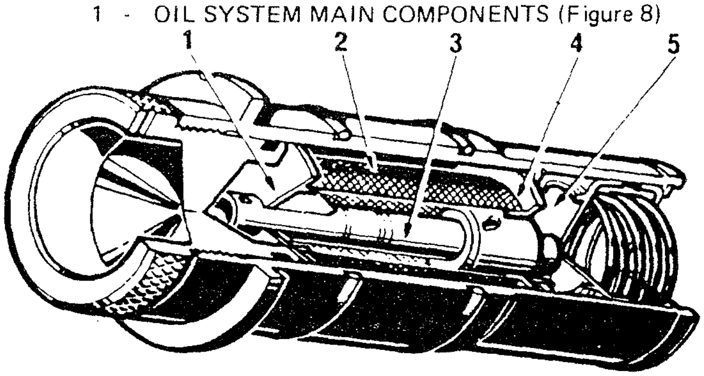
1.- Input gear oil jets
2.- Main gearbox intake filter
3.- Oil filter by-pass valve (set at 2.7 bar)
4.- Oil cooler by-pass valve (set at 2.6 bar)
5.- Oil cooler
6.- Filler plug
7.- Drain plug-filter assembly
8.- Oil level sight gauge
9.- Thermal contact switch
10.- Suction strainer and magnetic plug assembly
11.- Gear-type oil pump
12.- Tail drive power outlet gear oil jet
13.- Connector for a test pressure-gauge
14.- Pressure-relief valve (5-bar)
15.- Main drive shaft and freewheel assembly oil jet
16.- Oil pressure switch (connected to a warning light on instrument panel)
17.- First stage reduction gear oil jet
18.- External hoses
19.- Second stage reduction gear oil jet
20.- Upper bearing oil jet
21.- Rotor shaft bearings oil jet

Fig. 7 - Main gear box oil system.

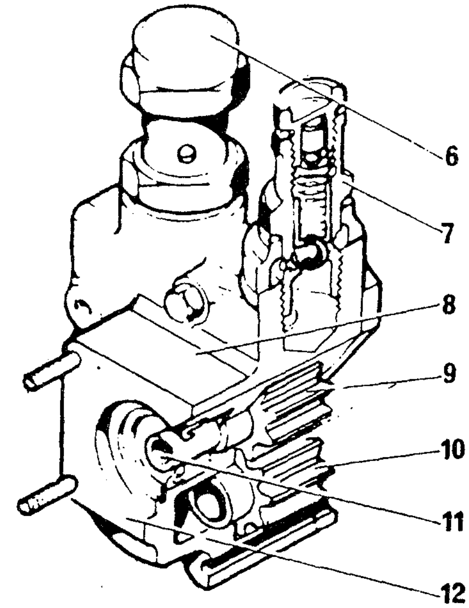
4.20.2.- MAIN GEAR BOX (Continued)

C.- MAIN GEAR BOX OIL SYSTEM

1 - OIL SYSTEM MAIN COMPONENTS (Figure 8)

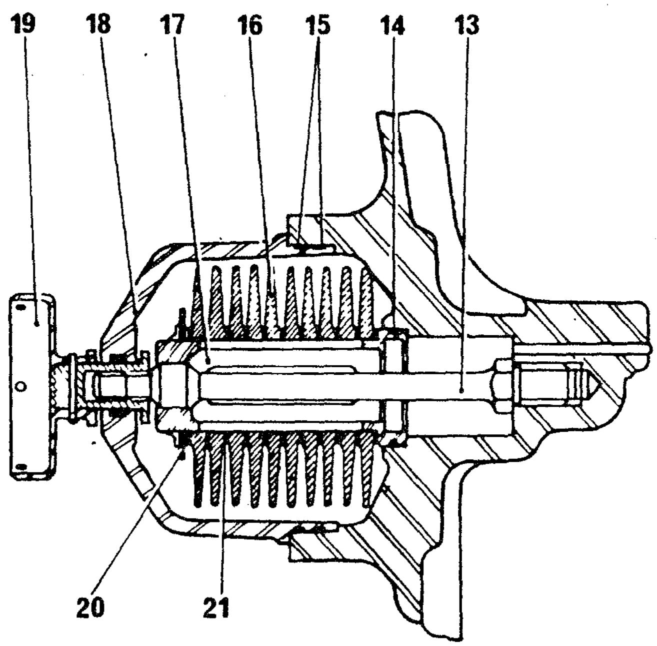


SUCTION FILTER



GEAR-TYPE OIL PUMP

1.- Flange 2.- Cylindrical metal gauze filter element 3.- Magnet 4.- Flange 5.- Self-sealing valve 6.- Oil outlet union	7.- Pressure relief valve 8.- Pump body 9.- Driven gear 10.- Driving gear 11.- Drive square for the hydraulic pump 12.- Hydraulic pump mounting land



MAIN GEAR BOX OIL INLET FILTER

25 hr. insp.
100 hr clean

has bypass 2.7 bo
but no indication
in cockpit.

13.- Filter attachment stud	18.- Filter cover
14.- O-ring	19.- Knurled knob (filter attachment)
15.- O-rings	20.- Self-locking ring
16.- 10 brass gauze filter discs	21.- Filter disc spacers
17.- Slotted sleeve (filter disc holder)	

→ do not take apart when cleaning.

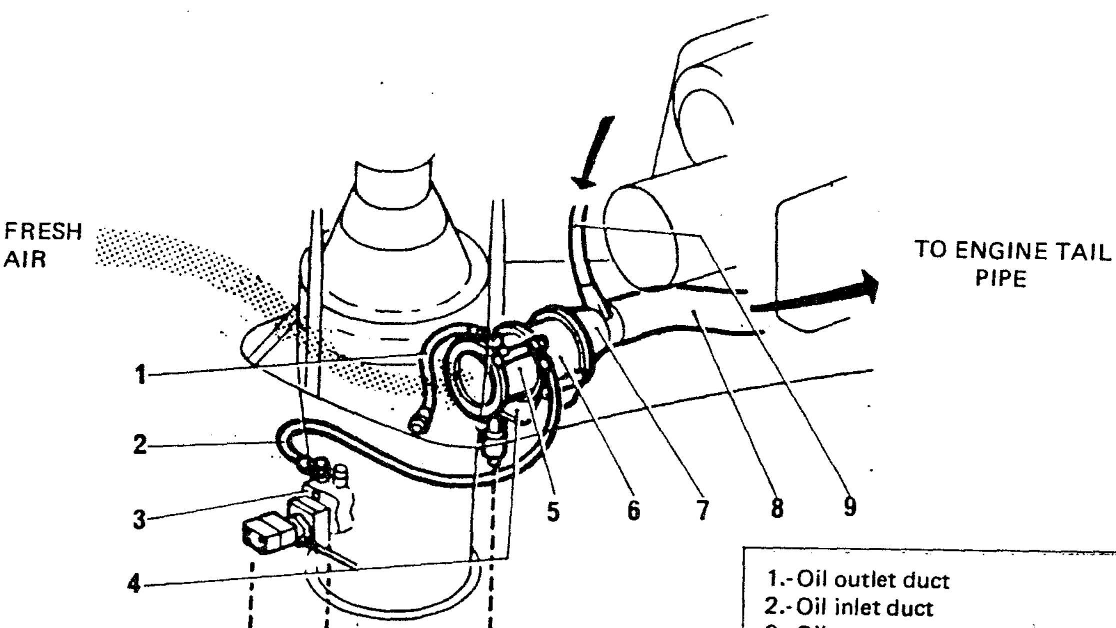
Figure 8 - Oil system major components

4.20.2.- MAIN GEAR BOX (Continued)

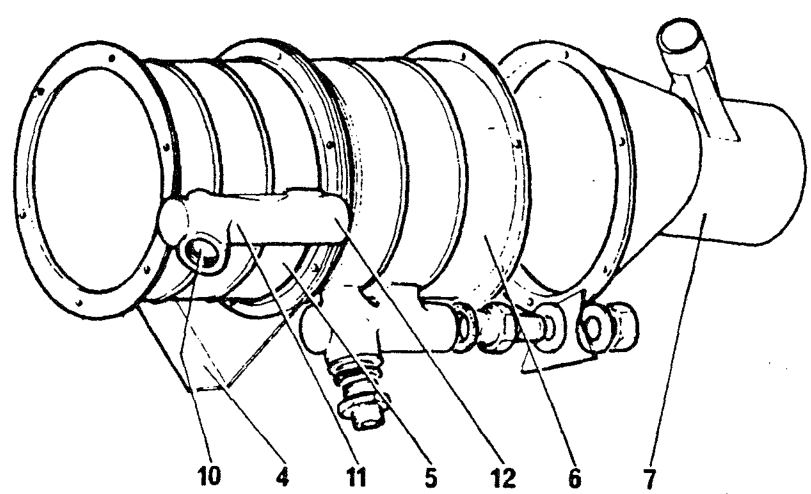
C - MAIN GEAR BOX OIL SYSTEM

2 - OIL COOLING SYSTEM (Figure 9)

The oil cooling system consists of an oil cooler (5) connected to the main gear box via an oil inlet duct (2) and oil outlet duct (1). The oil cooler is located on the transmission deck. It is composed of two similar units : a front unit (5) for cooling the main gearbox oil ; a rear unit (6) for cooling the engine oil. It is fitted with a drain plug and a relief valve, set at a given pressure,which by-passes the units when the oil is cold or in case of internal clogging of the matrix. The cooling air is drawn in through the front face, passes through the two cooler units, and is exhausted through the engine tail pipe by means of a diffuser (7) and an insulated pipe (8).



1.- Oil outlet duct
2.- Oil inlet duct
3.- Oil pump
4.- Cooler mounting bracket
5.- Cooler front unit - Main gear box
6.- Cooler rear unit - Engine



7.- Diffuser
8.- Insulated pipe
9.- Cooling air pipe to the starter-generator
10.- Oil outlet connection
11.- By-pass valve
12.- Oil inlet connection

Figure 9
Main Gear Box oil cooling system

4.20.2.- MAIN GEAR BOX (Continued)

D.- M.G.B. MONITORING SYSTEM

1 - ROTATIONAL SPEED MONITORING

An electrical tachometer generator (6) driven by the main gear box is connected to an R.P.M. indicator (3) located on the instrument panel.

2 - LUBRICATING SYSTEM MONITORING

(a) Oil pressure : a pressure switch (5) installed on the oil line controls the red warning light (1), on instrument panel, which comes on when pressure falls below 1.5 bar

(b) Oil temperature : a thermal contact switch (4) controls a red warning light (2), on instrument panel, which comes on when the oil temperature exceeds 110° C.

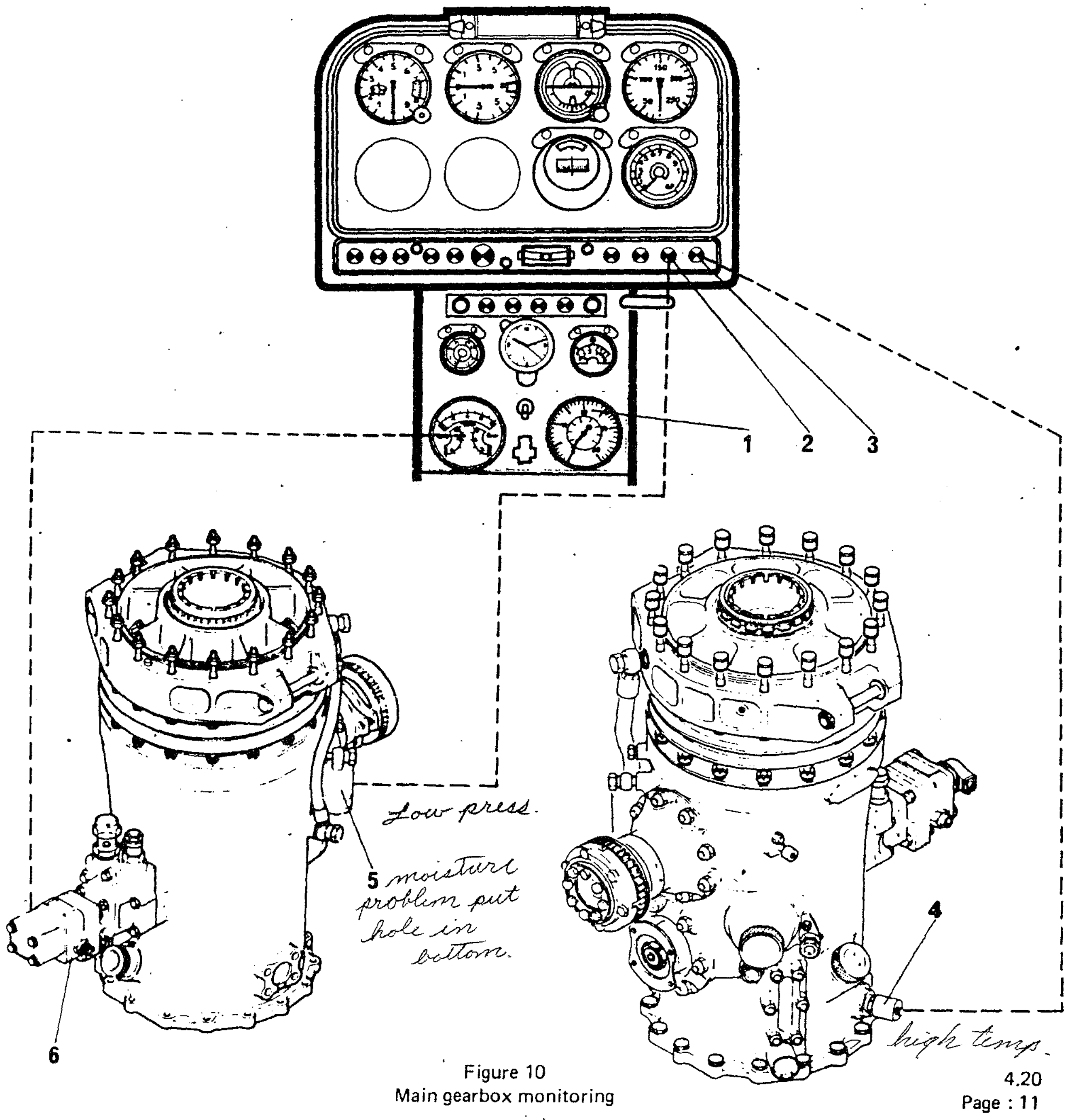


Figure 10
Main gearbox monitoring

4.20.3. ROTOR BRAKE INSTALLATION (Figure 11)

The rotor brake installation provides quick stopping of the rotor, on the ground.

It consists of :

- the rotor brake (1) attached to the M.G.B. input drive housing (4) ;
- a control handle (2) actuated from the pilot's cabin.

A.- ROTOR BRAKE (Figure 11)

The rotor brake consists of :

- a rotating disc (3) bolted to a support ring (10) splined on the coupling housing (9) of the M.G.B. power output shaft.
- a clamp support (6) bolted to the M.G.B. input housing (4)
- 2 clamp levers (16 and 17) hinged on the housing (6) on either side of the rotating disc press against 2 plates fitted with friction linings (13) (15) and sliding along 2 guide pins (14). Both clamp levers (16) (17) are controlled by a control lever (7) and a cam (18).

1.- Rotor brake
2.- Brake control handle
3.- Rotating disc
4.- M.G.B. power input bevel gear housing
5.- Clamp support attaching screw
6.- Clamp support
7.- Control lever
8.- Pin securing the disc to the splined support (10)
9.- Coupling housing
10.- Splined disc, support
11.- Attachment bolts (splined support)
12.- Attachment lug
13.- Plate fitted with friction linings
14.- Guide pin
15.- Pressure plate fitted with friction lining
16.- Clamping lever
17.- Clamping lever
18.- Jaw control cam
19.- Jaw hinge pin

Max. speed 175 RPM

On at 170 RPM & rotor should stop in 12-15 sec.

warped disk can cause a high freq.

some side play no up & down play

do not apply more than 175 RPM

at 170 RPM stop in 12-15 sec.

to adjust move rod out to quicker

shear pins come in 3 over sizes. turn 180° for temp repair

Blue color for overheat.

4.20.3.- ROTOR BRAKE INSTALLATION (Continued)

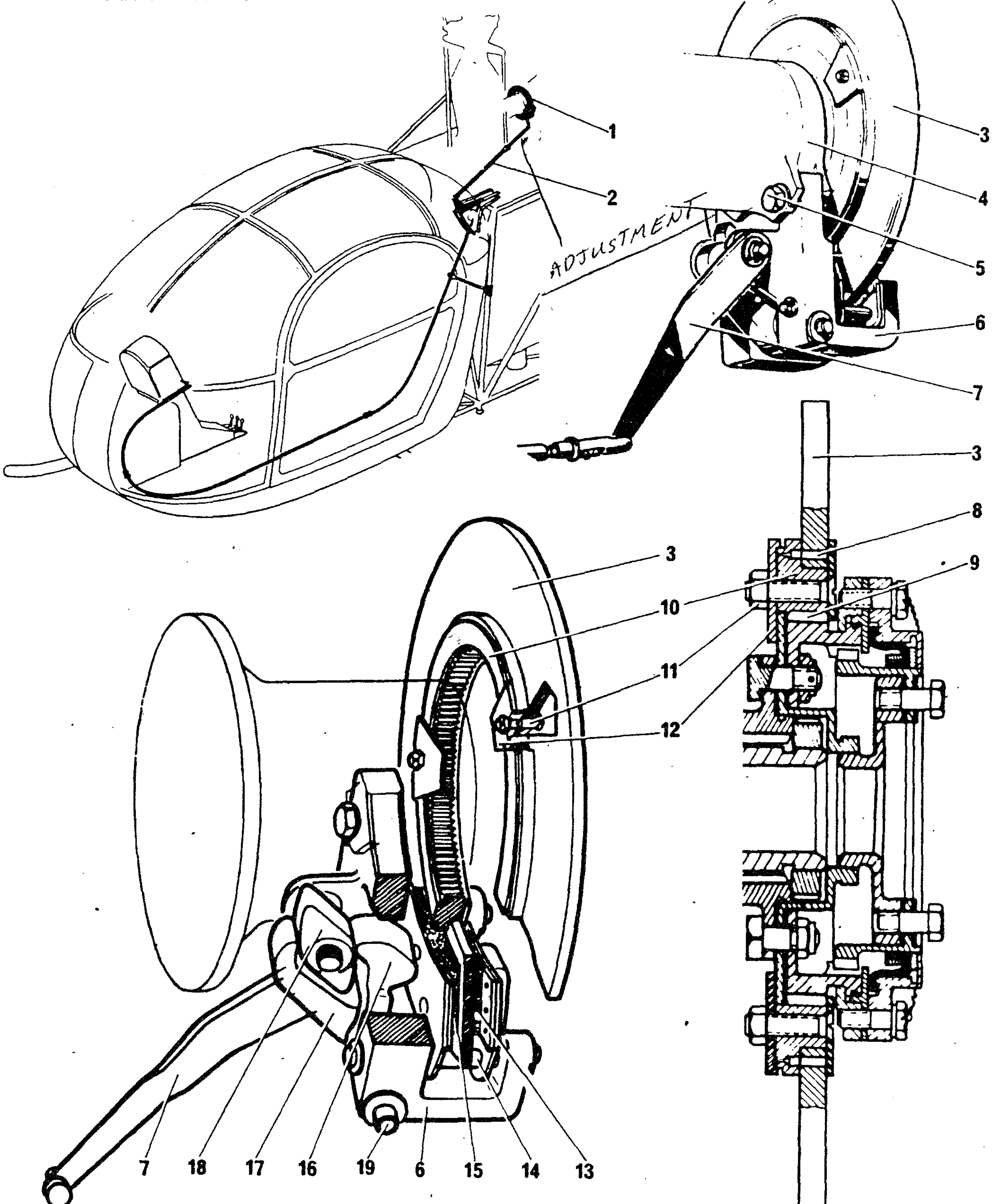


Figure 11
Rotor brake

4.20.3.- ROTOR BRAKE INSTALLATION (continued)

B.- ROTOR BRAKE CONTROL (Figure 12)

The rotor brake control consists of :

- a handle (9) located on the left side of the instrument panel
- a TELEFLEX flexible cable (8)
- a bellcrank (7) on transmission platform
- a spring-loaded rod (6), connected to the brake control lever (5), which limits the effort.

Operation - Pulling the handle (9) drives the control lever (5). This will cause the cam (1) (integral with the lever) to rotate thereby actuating the two levers (3) ; the levers, hinged on pin (4), cause the two friction linings (2) to be pressed against either side of the rotating disc. The time required to stop the rotors in no wind conditions ranges from 12 to 15 seconds at 170 rpm.

CAUTION : DO NOT APPLY ROTOR BRAKE AT A SPEED HIGHER THAN 175 rpm.

1.- Brake control cam
2.- Friction linings
3.- Clamping levers
4.- Clamp hinge pin
5.- Control lever
6.- Spring - loaded rod
7.- Bellcrank
8.- TELEFLEX cable
9.- Control handle

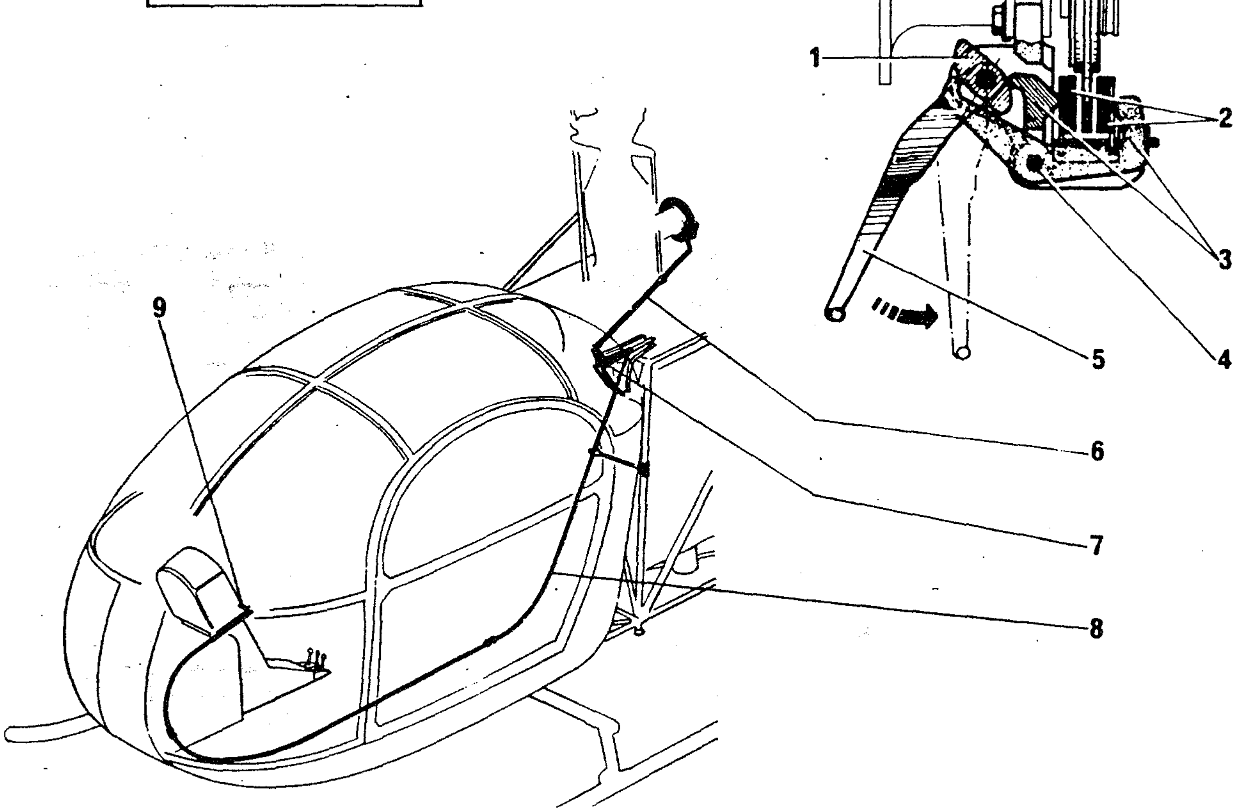


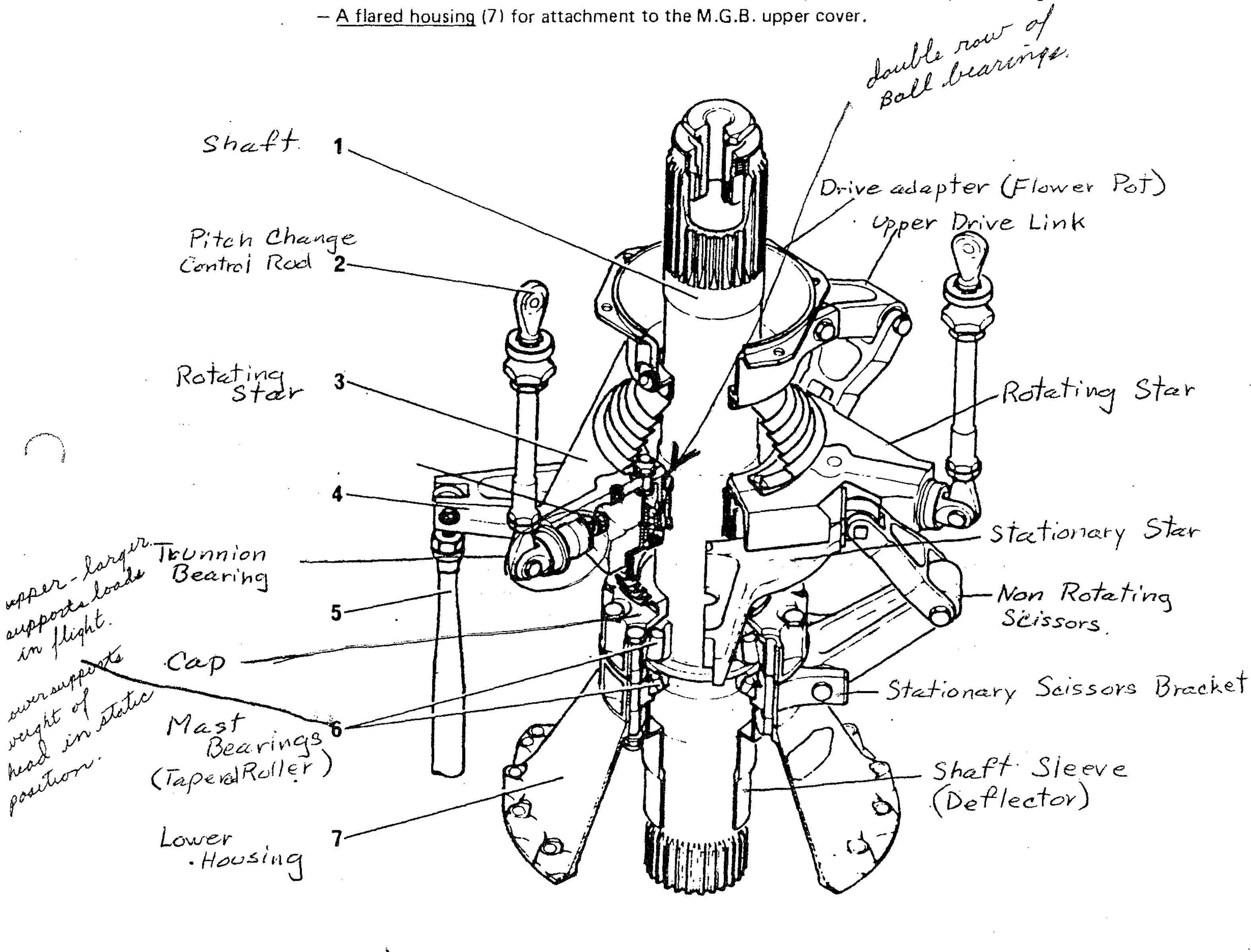
Figure 12
Rotor brake control

4.20.4.- MAIN ROTOR SHAFT UNIT

A.- GENERAL (Figure 12)

The main rotor shaft unit consists of :

- the rotor shaft (1), transmitting the M.G.B. drive to the main rotor hub
- the swash plates (3) and (4), sliding along the rotor shaft and transmitting the movements of the flight control rods (5) to the main rotor blade sleeves by means of three pitch-change links (2).
- A flared housing (7) for attachment to the M.G.B. upper cover.



1.-	Rotor shaft	5.-	Flight control input rod
2.-	Pitch change link	6.-	Taper roller bearings
3.-	Rotating swash-plate star	7.-	Flared housing
4.-	Non-rotating swash-plate star		

Figure 13
Main rotor shaft unit

4.20.4.- MAIN ROTOR SHAFT UNIT (Continued)

B.- ROTOR SHAFT (Figure 13)

The main rotor shaft consists of a hollow steel shaft (1), splined at both ends. The lower splines mate with those of the main gear box second stage planetary reduction gear ; the upper splines drive the main rotor hub which is fixed by the attachment bolt (2). The shaft turns on two taper roller bearings (12) (13) which are supplied with oil at pressure from the main gearbox lubrication system (Refer to above paragraph 2 C). The upper bearing (12) supports the aircraft in flight, while the lower bearing (13) supports the rotor at rest.

C.- SWASH PLATE ASSEMBLY (Figure 13)

The light-alloy swash plate assembly consists of :
– a rotating star (7) driven by a scissors link (4) secured to the rotor hub.
– a non-rotating star (8) locked by stationary scissors link (9) secured to a bracket (11) .

The swash-plate assembly is mounted on a steel ball (18) which slides along the rotor shaft permitting combined movement :
– vertical (collective pitch change)
– oscillation about the steel ball (cyclic pitch change).

The non-rotating star is mounted on the rotating plate on a double, angular contact bearing (25) which is lubricated on installation. Each of the three arms of the rotating star carries a yoke (26) mounted in a trunnion (27) and receiving the pitch change link (5).

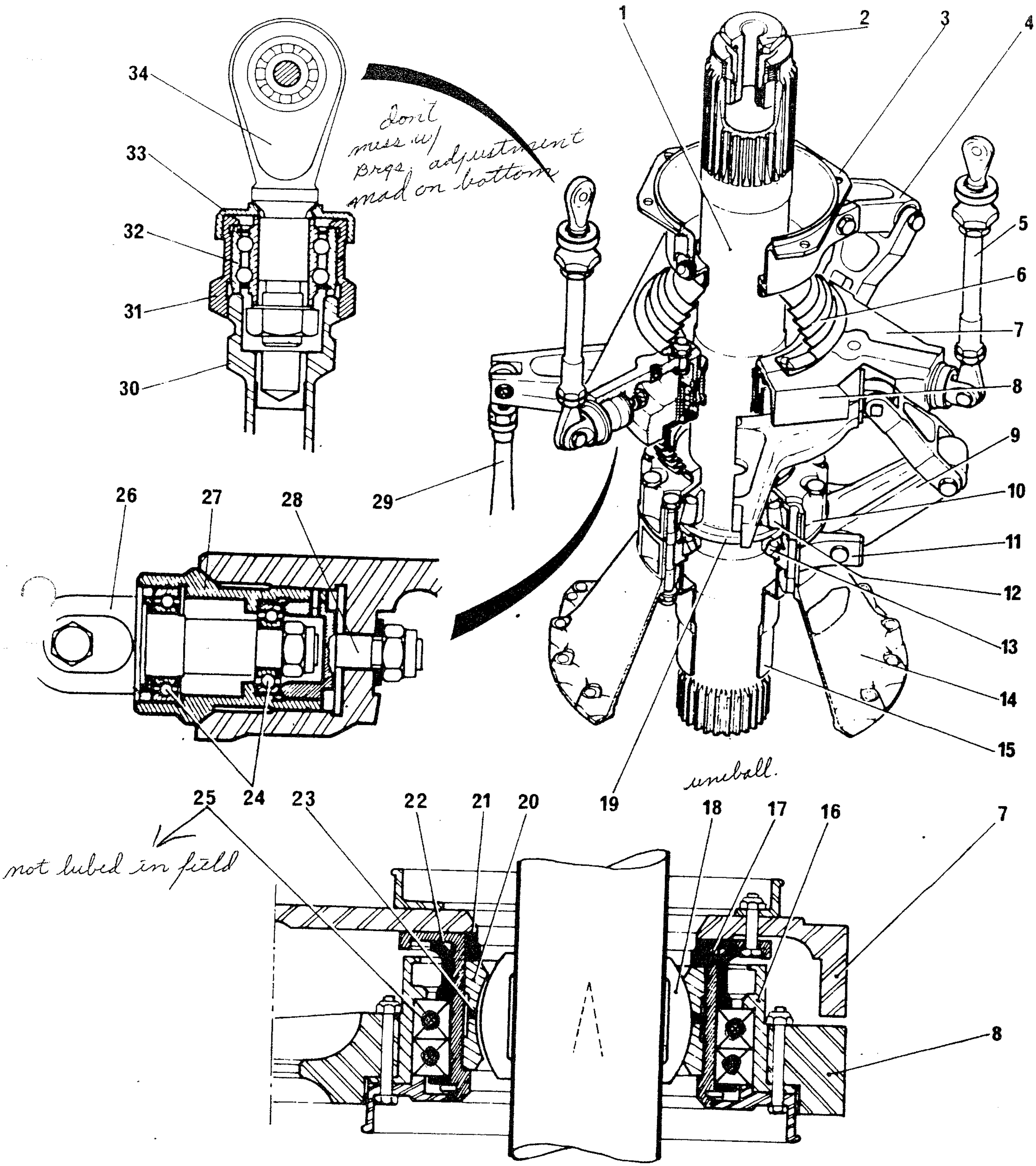
D.- FLARED HOUSING (Figure 13)

The cap (10) and the stationary scissors support ring (11), housing the rotor shaft bearings, are both secured to the flared housing by means of through-bolts. The bolts are not equispaced, to prevent any error of installation.

1.- Rotor shaft	18.- Steel bearing ball
2.- Main rotor hub attachment bolt	19.- Bearing retainer
3.- Rotating star drive adaptor	20.- Bronze bearing socket
4.- Rotating scissors	21.- Spacer
5.- Pitch change link	22.- Spacer
6.- Protective boot	23.- Shim (swashplate ball/socket fit adjustment)
7.- Rotating star	24.- Bearings
8.- Non-rotating star	25.- Double-row bearing
9.- Stationary scissors	26.- Yoke
10.- Cap	27.- Trunnion
11.- Stationary scissors bracket	28.- Trunnion attachment screw
12.- Rotor shaft bearing	29.- Flight control rod
13.- Rotor shaft bearing	30.- Pitch change link body
14.- Flared housing	31.- Pitch change link bearing housing
15.- Oil deflector	32.- Bearing
16.- Bearing housing	33.- Cap
17.- Swashplate hub	34.- Self aligning end fitting

Flower pot - oil daily or every 5 hrs.
Uniball - chrome plated stainless free floating

4.20.4.- MAIN ROTOR SHAFT UNIT (Continued)



SWASHPLATE INSTALLATION

Figure 14
Main rotor shaft unit

4.30.- TAIL ROTOR DRIVE

4.30.1.- GENERAL (Figure 1)

The tail rotor drive transmits the engine torque from the main gearbox to the tail rotor. It consists of :

- the inclined drive shaft and coupling shaft assembly (1)
- the tail rotor drive shaft (2)
- the tail rotor gearbox (3).

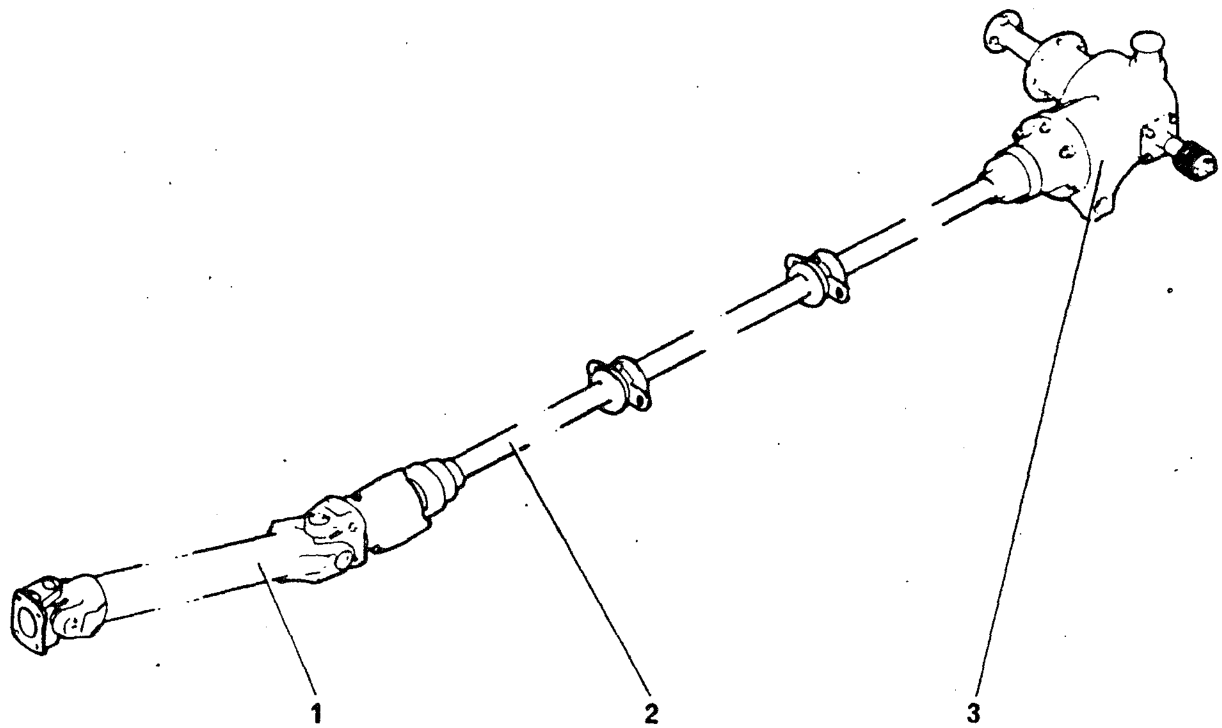


Figure 1
Tail rotor drive

4.30.2.- INCLINED DRIVE SHAFT AND COUPLING SHAFT ASSEMBLY (Figure 2)

The inclined drive shaft and coupling shaft assembly consists of :
— a tube terminated at each end by a universal joint (1)
— an intermediate bearing (2)

A.- TUBE AND UNIVERSAL JOINT ASSEMBLY (Figure 2)

The inclined drive shaft, driven by the main gearbox, consists of :

- a steel tube (1)
- 2 universal joints including a yoke (12), a cross-piece (14) and a flanged yoke (15). The cross-piece bushes are lubricated through grease nipples (11).

B.- INTERMEDIATE BEARING (Figure 2)

The intermediate bearing (2) forms a coupling shaft connected between the inclined drive shaft and the tail drive shaft assembly. It consists of :

— a shaft (9)
— a bearing housing (22) mounted on the airframe bracket (6)
— 2 bearings (21) (23)
— a splined coupling ring (7) mates with the tail drive shaft coupling assembly.
The coupling shaft housing is filled with grease on assembly.

1.-	Inclined drive shaft	15.-	Flanged yoke
2.-	Intermediate bearing (coupling shaft)	16.-	Seal retainer
5.-	Bearing shield tunnel	17.-	Needle bearing cup
6.-	Bearing bracket	18.-	Coupling flange
7.-	Splined coupling ring	19.-	Bearing cap
8.-	Splined coupling housing	20.-	Seal
9.-	Shaft	21.-	Bearing, Roller
10.-	Well	22.-	Bearing housing
11.-	Grease nipple (universal joint)	23.-	Bearing, Roller
12.-	Yoke	24.-	Seal
13.-	Cork seal	25.-	Circlip
14.-	Cross-piece	26.-	Plug
		27.-	Retaining ring

install grease nipples 1 on each end 180° apart.

4.30.2.- INCLINED DRIVE SHAFT AND COUPLING SHAFT ASSEMBLY (Continued)

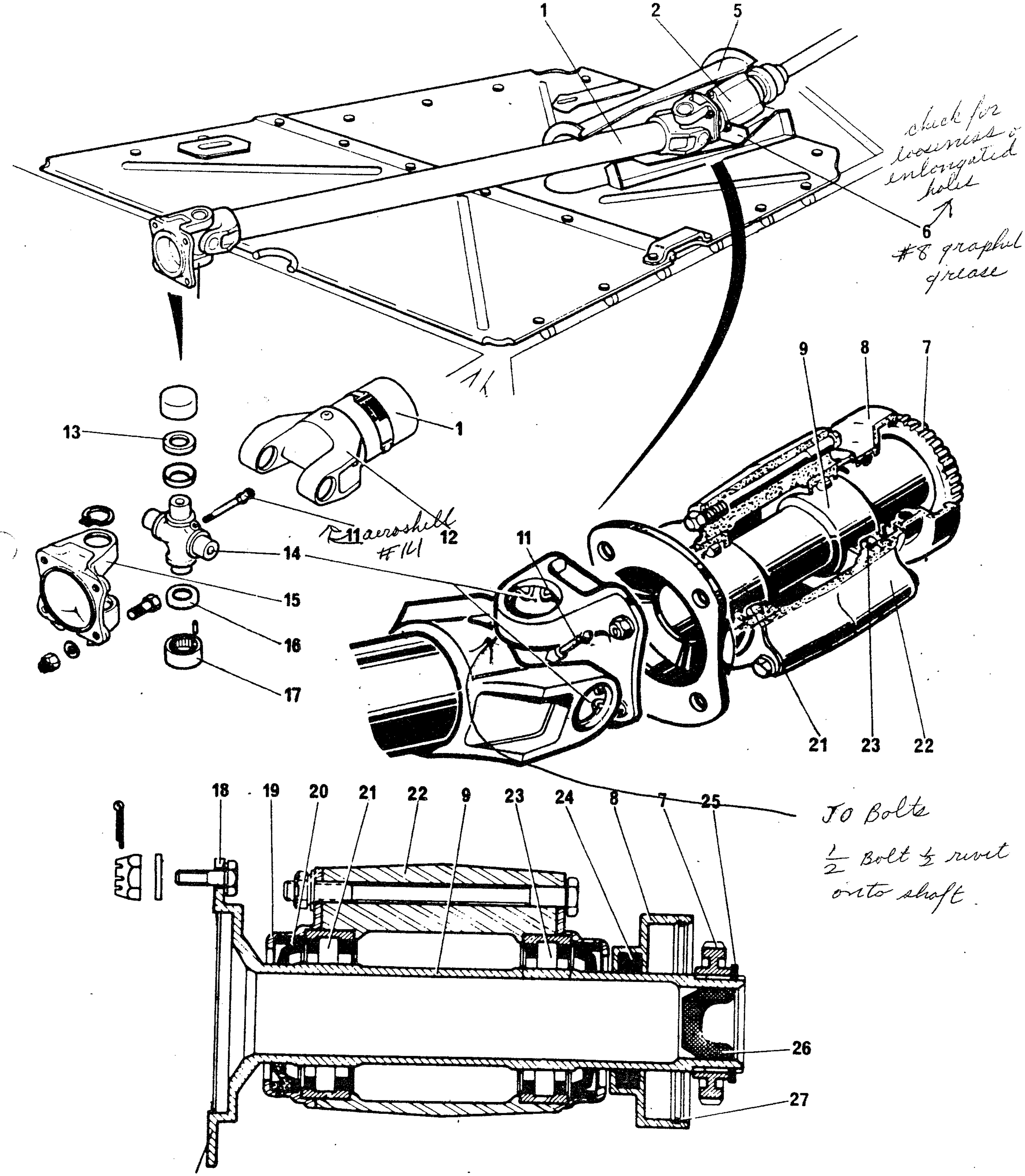


Figure 2
Inclined drive shaft and coupling shaft assembly

4.30.3.- TAIL DRIVE SHAFT ASSEMBLY (Figure 3)

The tail drive shaft assembly consists of :
- a steel tube (6) carrying five bonded sleeves (10)
- two bell couplings (2) splined to the tube ends (5)
- five floating bearings (7)

Each bearing assembly includes :

- an OILITE (self-lubricating) plain bearing (14) made of porous sintered bronze ;
- an oil cavity (11) supplied from a grease nipple (13). Two rubber sealing collars (8)
- a duralumin bearing support (9) with two integral slotted lugs (12) permitting both vertical and lateral movement of the complete bearing assembly (with respect to the bearing support pins 19).

The bearings float on supports including :
- a bracket (21) with a pin (19)
- a clip (17) and spring (16) assembly
- a steel bushing (18)

The R.H. bracket lug has been made more flexible than the L.H. one so as to facilitate bearing alignment.

1.- Seal	11.- Oil reserve
2.- Splined coupling housing	12.- Bearing mounting lugs
3.- Housing retaining circlip	13.- Grease nipple
4.- Shaft sealing plug	14.- Self-lubricating bearing liner
5.- Shaft splines	15.- Washer
6.- Tube	16.- Spring
7.- Floating bearing	17.- Clip
8.- Rubber sealing collar	18.- Bush
9.- Bearing box	19.- Attachment pin
10.- Bonded sleeve	20.- «Ferodo» friction washers
	21.- Bearing bracket.

red lines on ends to check for max. of 6° twist.

discolloration of journal means brgs. cocked.

oil bearings the nite before if possiable

every 400 hrs remove bearings and soak in warm oil.

4.30.3.- TAIL DRIVE SHAFT ASSEMBLY (Continued)

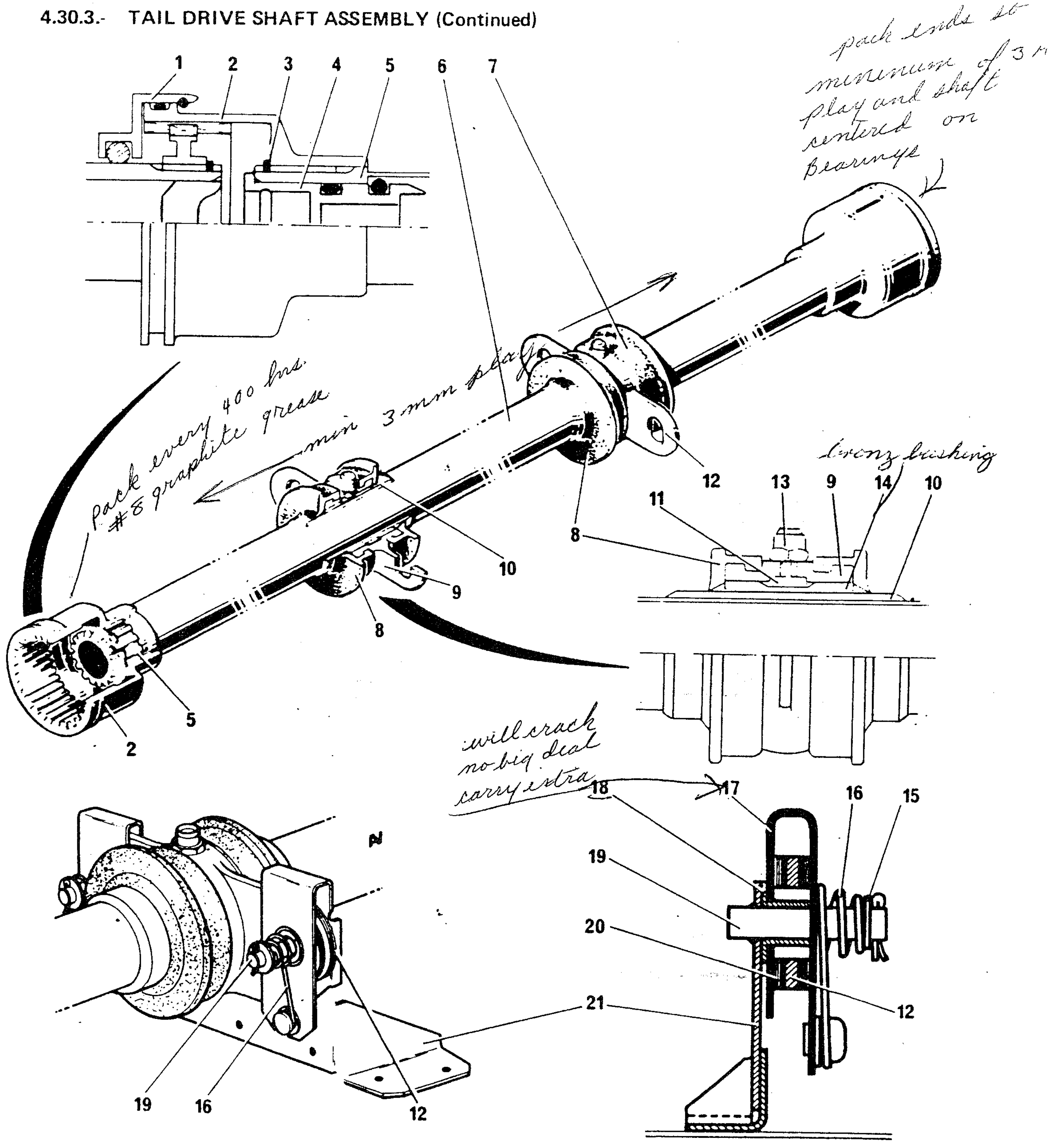


Figure 3
Tail drive shaft assembly

4.30.4.- TAIL ROTOR GEAR BOX (Figure 4)

The tail rotor gear box changes the angle of drive by 95° and steps down the rotational speed of the tail drive shaft in the ratio of $1/_{1.24}$ (input speed : 2480 rpm, output speed : 2001 rpm). The tail rotor gear box is splash lubricated.

It consists of :

- the input housing (1) containing a bevel gear (24) supported in two bearings (25) (27). The outer end of the drive shaft carries a splined ring (28) which mates with the tail drive shaft coupling.
- the main housing (3) ; a light-alloy casting with flanges to accommodate the input housing and the output housing (2). Attachment to the tail boom is effected by means of three lugs : two front lugs (14) and one rear lug (11). Lubrication in the main housing is effected through a filler plug (4) at the top, fitted with a strainer (5), a drain plug (13) and an oil level window (8).
- the output housing (2) ; a steel shaft carrying the driven bevel gear (21) which is splined onto the rotor shaft (18). The rotor shaft rotates in two roller bearings (17) (25) ; at one end there is a flange to which the tail rotor hub is bolted.
- the pitch-change axial control (10) ; converts the push-pull movement of the tail rotor control cables into longitudinal displacement conveyed to the rotor hub. The pitch-change rod (15) is driven by the control cable wound on a helically-grooved drum (23), and the rotational movement is transformed into a translation movement by a worm gear (22).

1.- Input housing	15.- Pitch-change rod
2.- Output housing	16.- Rotor hub attachment flange
3.- Main housing	17.- Ball bearing
4.- Oil filler plug	18.- Rotor shaft
5.- Strainer	19.- Rotor shaft (18) - bevel gear (21) splines
6.- Seal	20.- Roller bearing
7.- Seal	21.- Output bevel gear
8.- Oil level window	22.- Worm gear
9.- Oil level frame	23.- Drum
10.- Pitch-change axial control	24.- Input bevel gear
11.- Rear attachment lug	25.- Roller bearing
12.- Seal	26.- Input shaft
13.- Drain plug	27.- Bearing
14.- Front attachment lug	28.- Coupling splines

to use synthetic oils must have mag. plug

Rig check:
① slot parallel to ground. } pedals should be neutral
② swede slot forward
~~③ outboard ...~~
③ inboard cable over top of drum.
④ full right pedal drum comming out from gearbox

4.30.4.- TAIL ROTOR GEAR BOX (Continued)

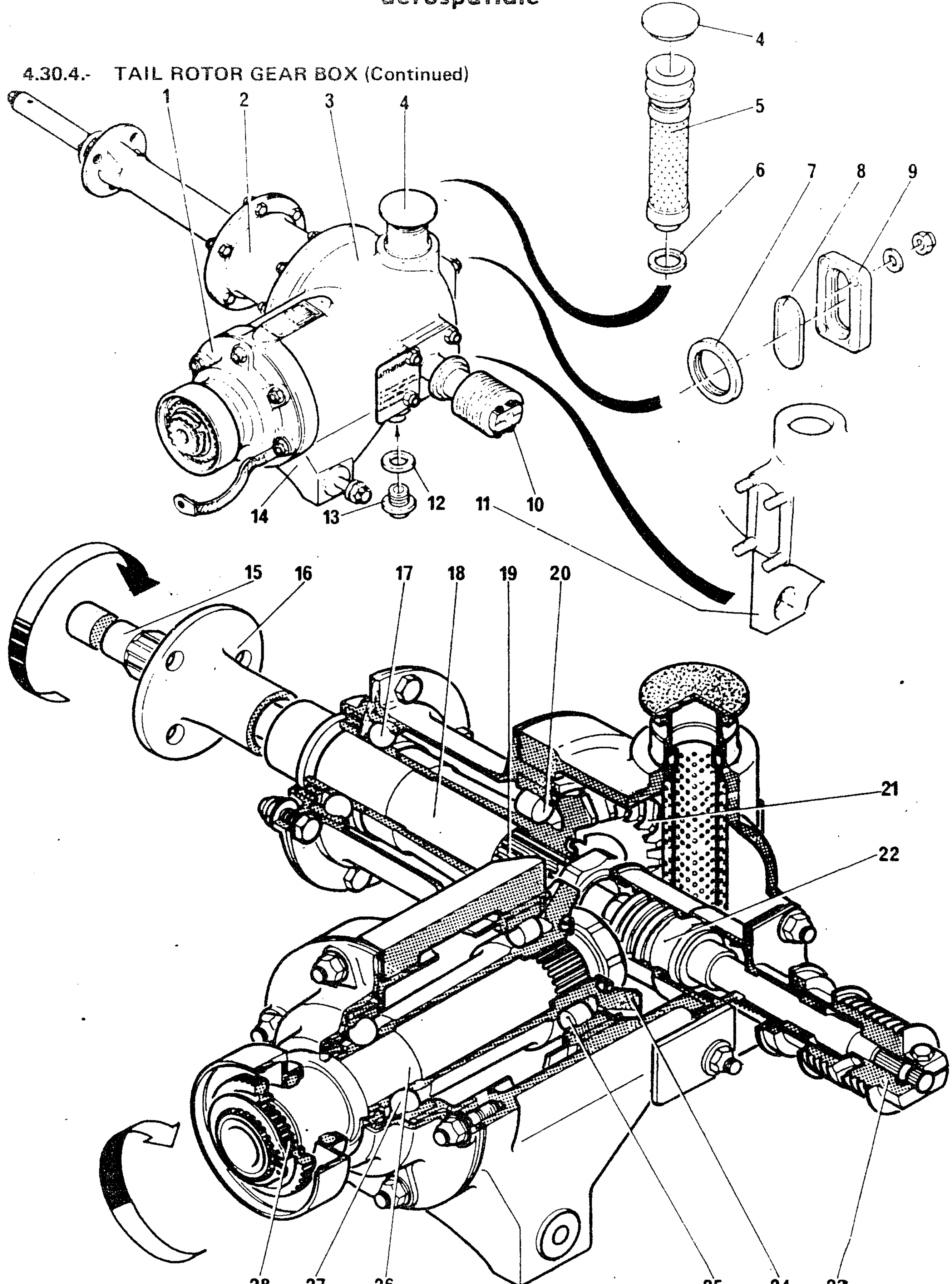
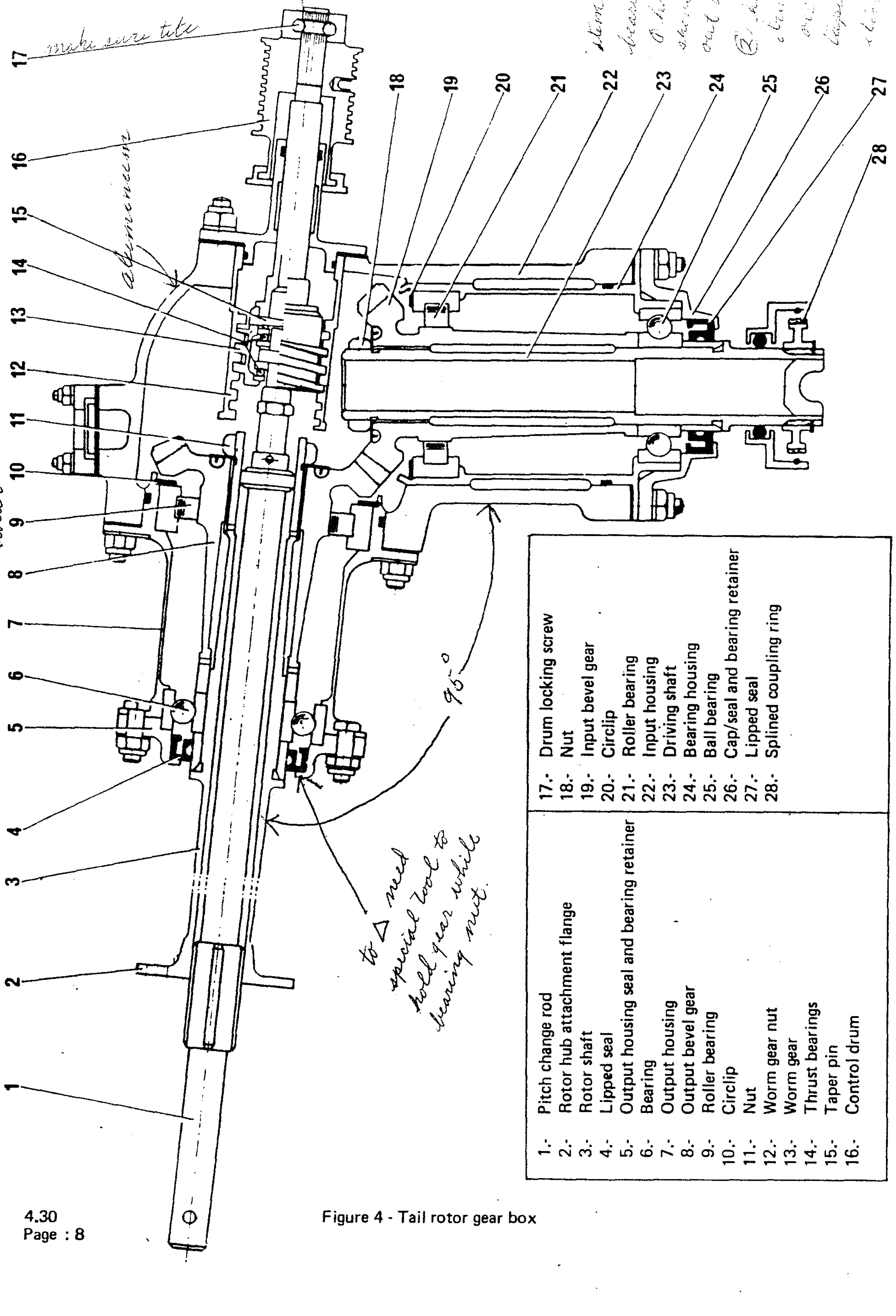


Figure 4
Tail rotor gear box

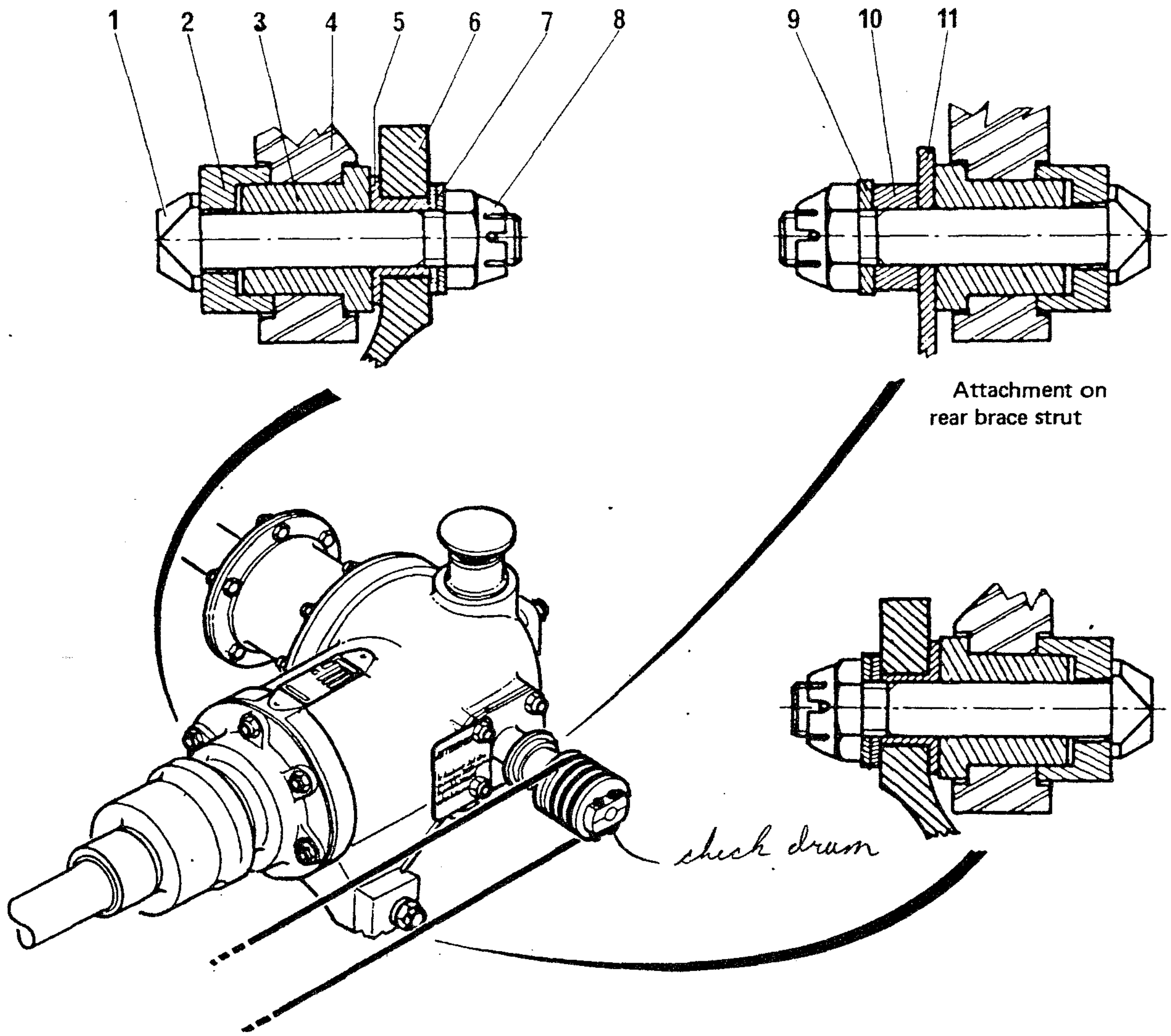
4.30.4.- TAIL ROTOR GEAR BOX (Continued)



1.- Pitch change rod	17.- Drum locking screw
2.- Rotor hub attachment flange	18.- Nut
3.- Rotor shaft	19.- Input bevel gear
4.- Lipped seal	20.- Circlip
5.- Output housing seal and bearing retainer	21.- Roller bearing
6.- Bearing	22.- Input housing
7.- Output housing	23.- Driving shaft
8.- Output bevel gear	24.- Bearing housing
9.- Roller bearing	25.- Ball bearing
10.- Circlip	26.- Cap/seal and bearing retainer
11.- Nut	27.- Lipped seal
12.- Worm gear nut	28.- Splined coupling ring
13.- Worm gear	
14.- Thrust bearings	
15.- Taper pin	
16.- Control drum	

Figure 4 - Tail rotor gear box

4.30.4.- TAIL ROTOR GEAR BOX (Continued)



1.- Attachment shaft 2.- Thrust cup 3.- Flanged bush 4.- T.R.G.B. housing 5.- Flanged bush 6.- Tail boom fitting	7.- Washers (Qty : 2) 8.- Nut 9.- Washer 10.- Ring 11.- T.R.G.B. brace strut

Figure 5
T.R.G.B. attachment

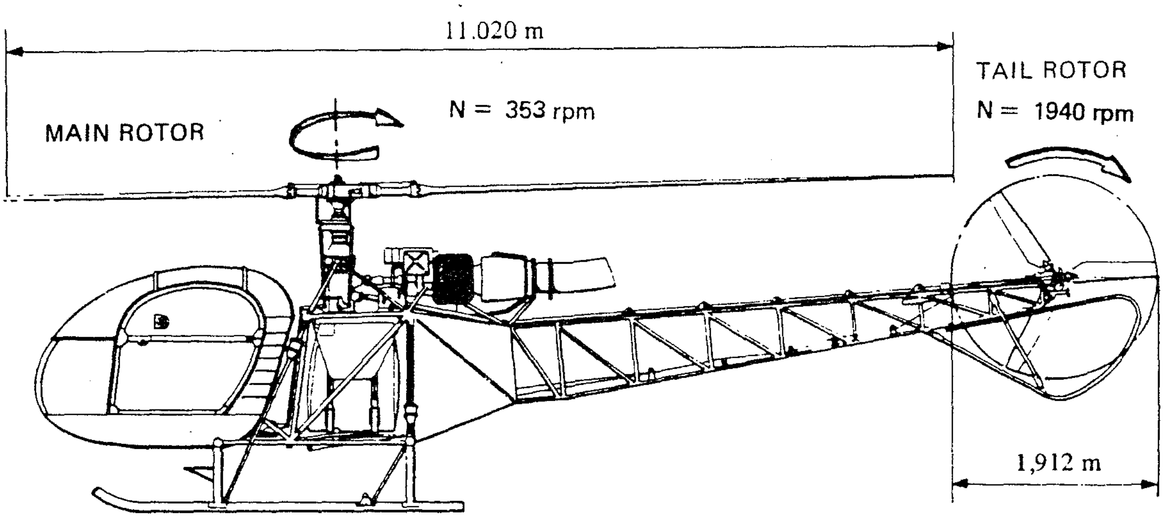
CHAPTER 5

ROTORS

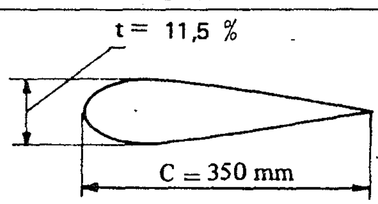
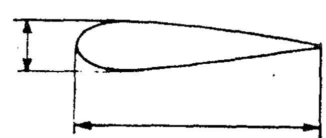
CONTENTS

5.- ROTORS

5.00.- GENERAL



GENERAL CHARACTERISTICS

MAIN ROTOR BLADES	TAIL ROTOR BLADES
 Airfoil profile : NACA 63 A at 11.5 % Twist : 6° 30' Length : 4 655 mm Weight : 34,800 kg	 Airfoil profile : NACA 0015 - 0018 Twist : none Length : 838 mm Weight : 1.360 kg
MAIN ROTOR HEAD	TAIL ROTOR HEAD
Type : 3-bladed, articulated Blade articulated in : . Flapping plane . Drag plane . Feathering plane Drag hydraulic dampers Lubrication of joints through grease nipples Approximate weight : 106 kg	Type : 3-bladed Blade articulated in : . Flapping plane . Feathering plane Lubrication of joints through grease nipples Weight : 9 kg

5.10.- MAIN ROTOR

5.10.1.- GENERAL

The main rotor consists of :

- the main rotor head (2)
- 3 blades (1)

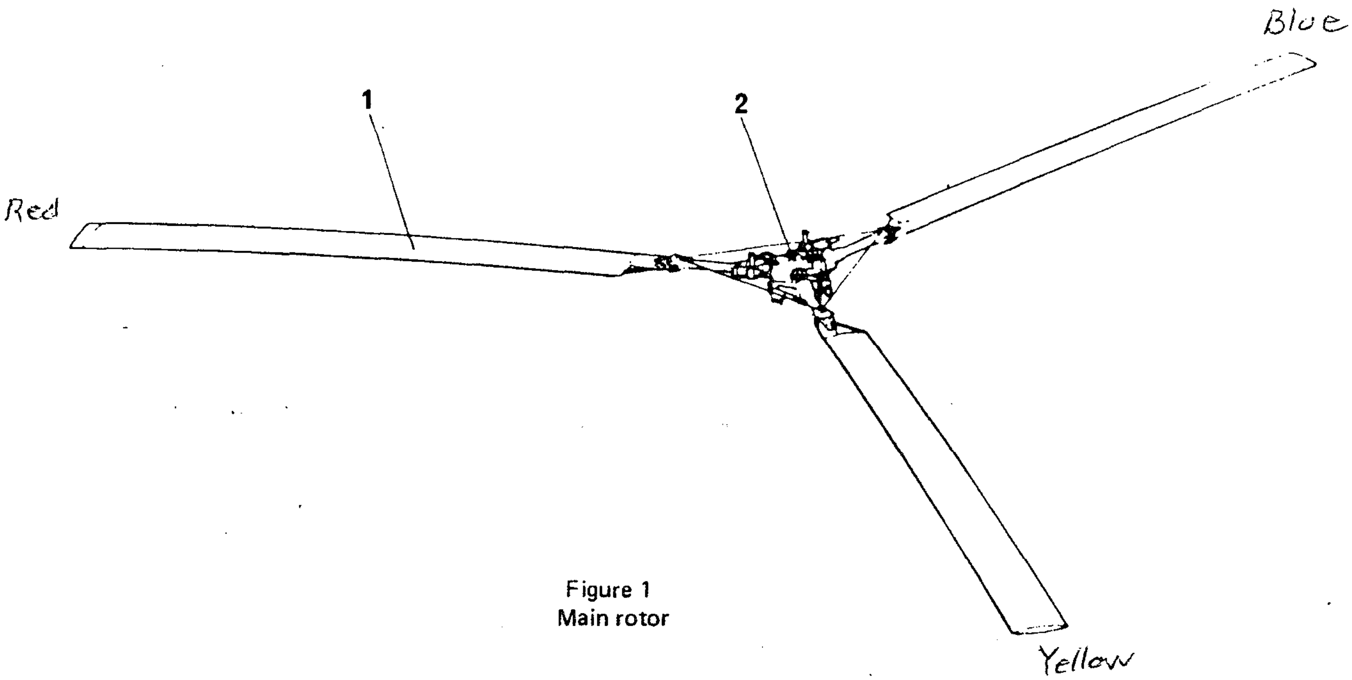
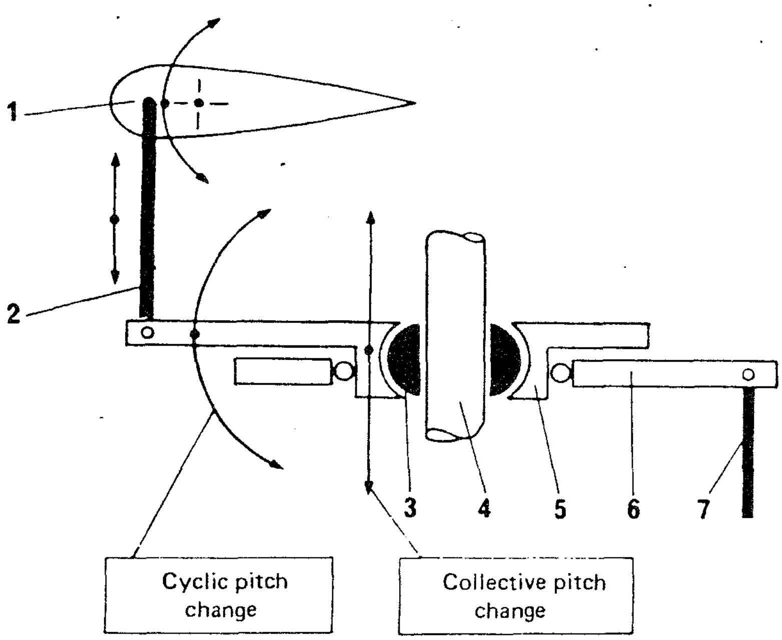


Figure 1
Main rotor



CONTROL OF
PITCH CHANGE
ON MAIN ROTOR BLADES
– DIAGRAM –

3 control rods (7) displace the non-rotating swash-plate star (6). The swashplate assembly, mounted on a ball ring (3) sliding along the rotor shaft (4), carry the control rod movements to the blade sleeves (1) by means of 3 pitch change links (2) attached to the rotating star (5).

Figure 2

5.10.2.- MAIN ROTOR HEAD

A.- GENERAL (Figure 3)

The main rotor head is of the 3-bladed type, articulated in the flapping and drag planes.

The flapping hinge limits the bending loads applied to the blade root as a result of the cyclic lift variations. The drag hinge limits the bending loads applied to the blade root as a result of Coriolis acceleration forces deriving from the blade flapping. (Refer to the «Helicopter flight general theory»). Blade oscillations on the vertical drag hinge are dampened by hydraulic dampers.

The rotor head assembly consists of :

- the rotor hub (5) mounted on the rotor shaft and carrying the three flapping hinge pins (4)
- the horizontal, flapping hinge pins (4)
- the vertical, drag hinge pins (3)
- the sleeve and spindle assemblies (1) which constitute the blade-to-hub attachment link and the feathering hinge.
- the blade spacing cable assembly (2) interconnects the 3 blade sleeves, thus limiting the blade angular spacing unbalance which would produce vibration (ground resonance hazard).
- the drag dampers (6)

1.- Sleeve and spindle assembly
2.- Blade spacing cable assembly
3.- Vertical, drag hinge pin
4.- Horizontal, flapping hinge pin
5.- Rotor hub
6.- Drag damper
7.- Pitch-change lever (blade horn)
8.- Lifting eye
9.- Damper arms
10.- Taper pin (blade attachment)
11.- Sleeve
12.- Spindle
13.- Centrifugal stop
14.- Link

5.10.2.- MAIN ROTOR HEAD (Continued) - GENERAL

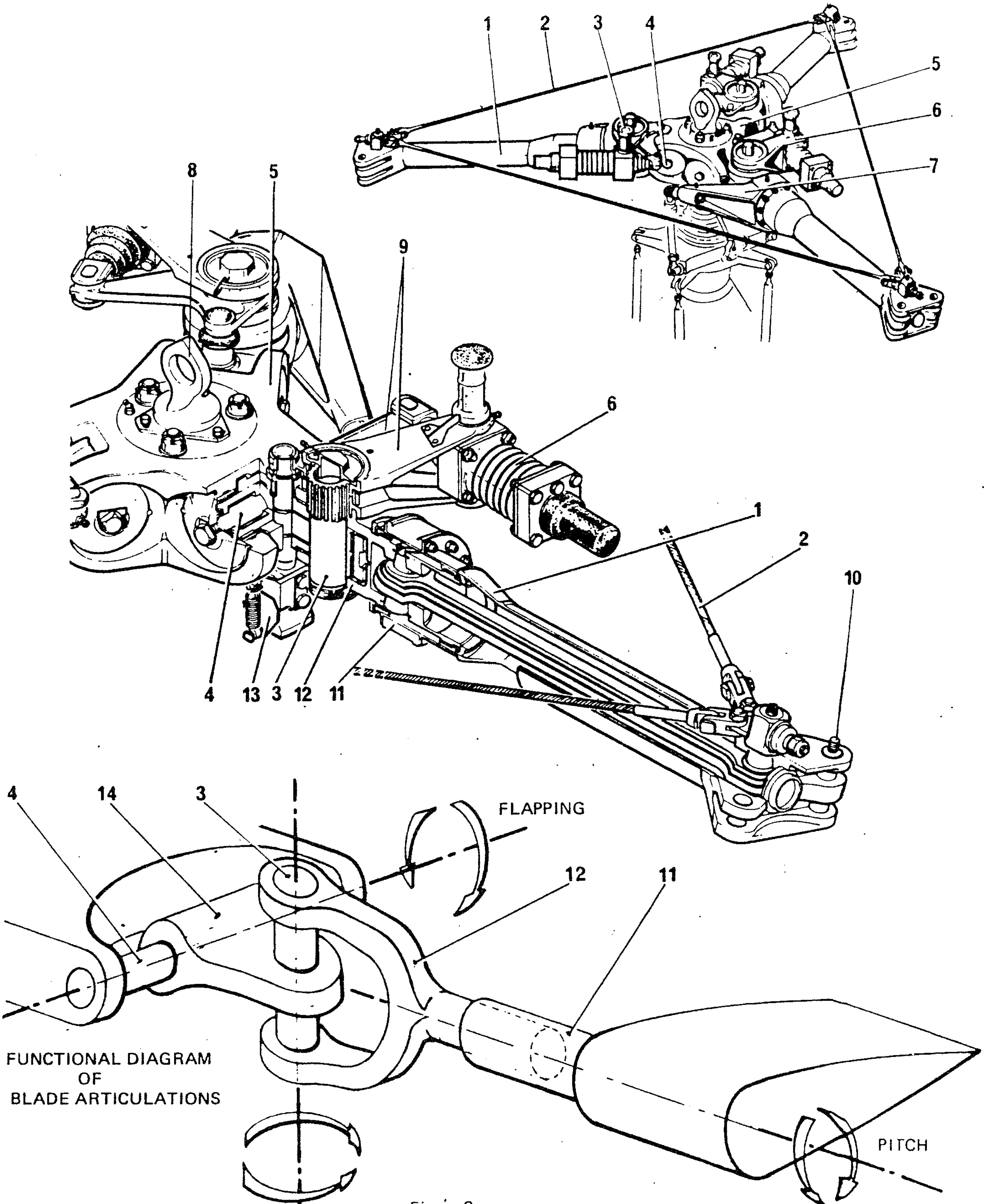
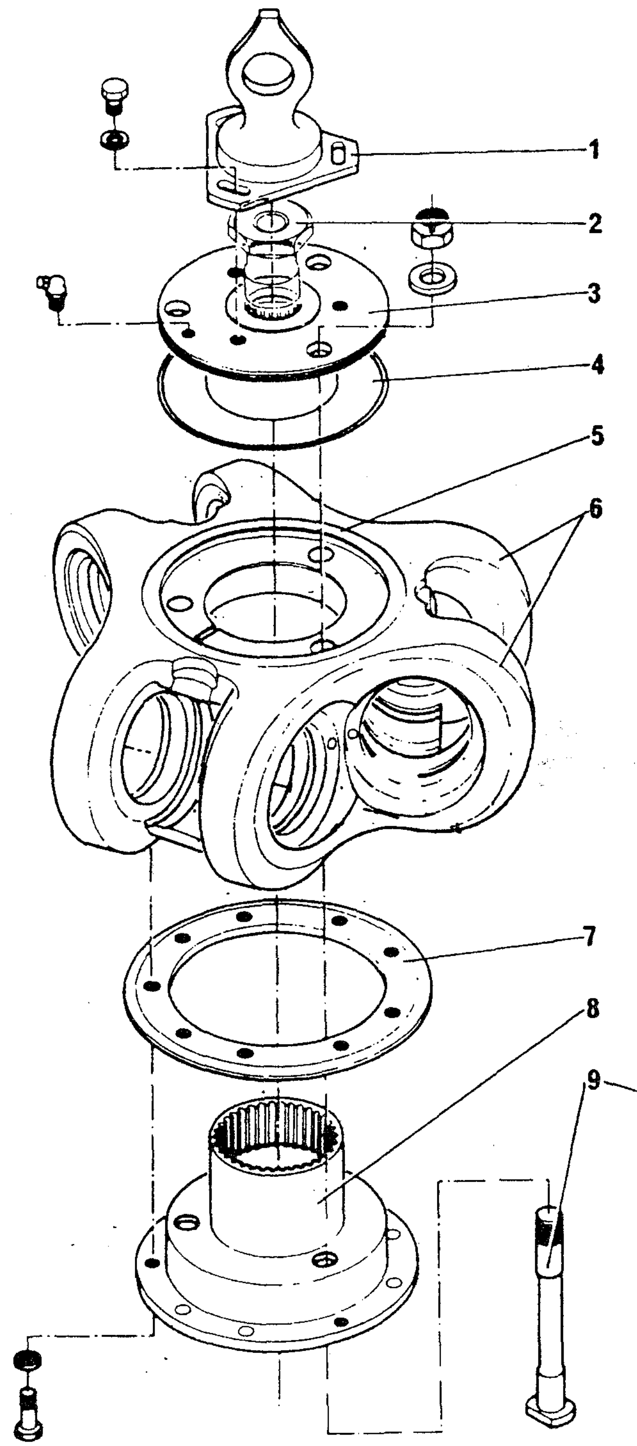


Figure 3
Main rotor head

5.10.2.- MAIN ROTOR HEAD (Continued)

B.- ROTOR HUB (Figure 4)

The light-alloy rotor hub (5) includes three fork joints (6) which hold the flapping hinge pins. It is installed on the rotor shaft (13) by means of two splined liners (3) (8). It is secured to the main rotor shaft by a hub retaining bolt (2). Hinge pin lubrication is provided by three grease nipples (11).



1.- Lifting eye
2.- Hub retaining bolt
3.- Upper splined liner
4.- O-ring
5.- Rotor hub
6.- Fork-joint
7.- Droop stop ring
8.- Lower splined liner
9.- Liner assembly through-bolt
10.- Main gear box air vent (breather)
11.- Grease nipple (for flapping and drag hinge pins)
12.- Tapped bolt (screwed and bonded in main rotor shaft)
13.- Rotor shaft

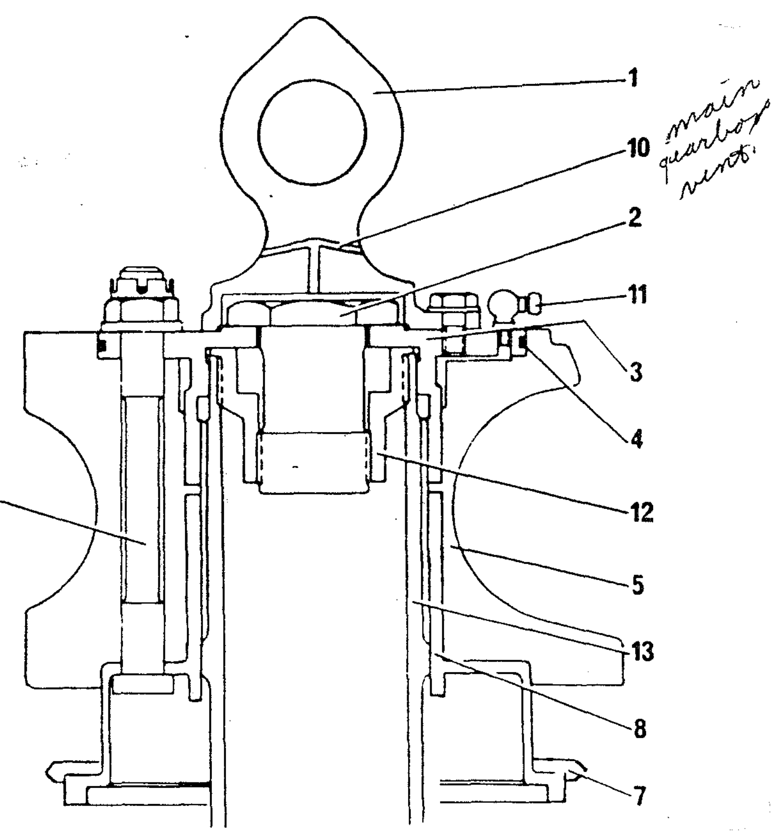
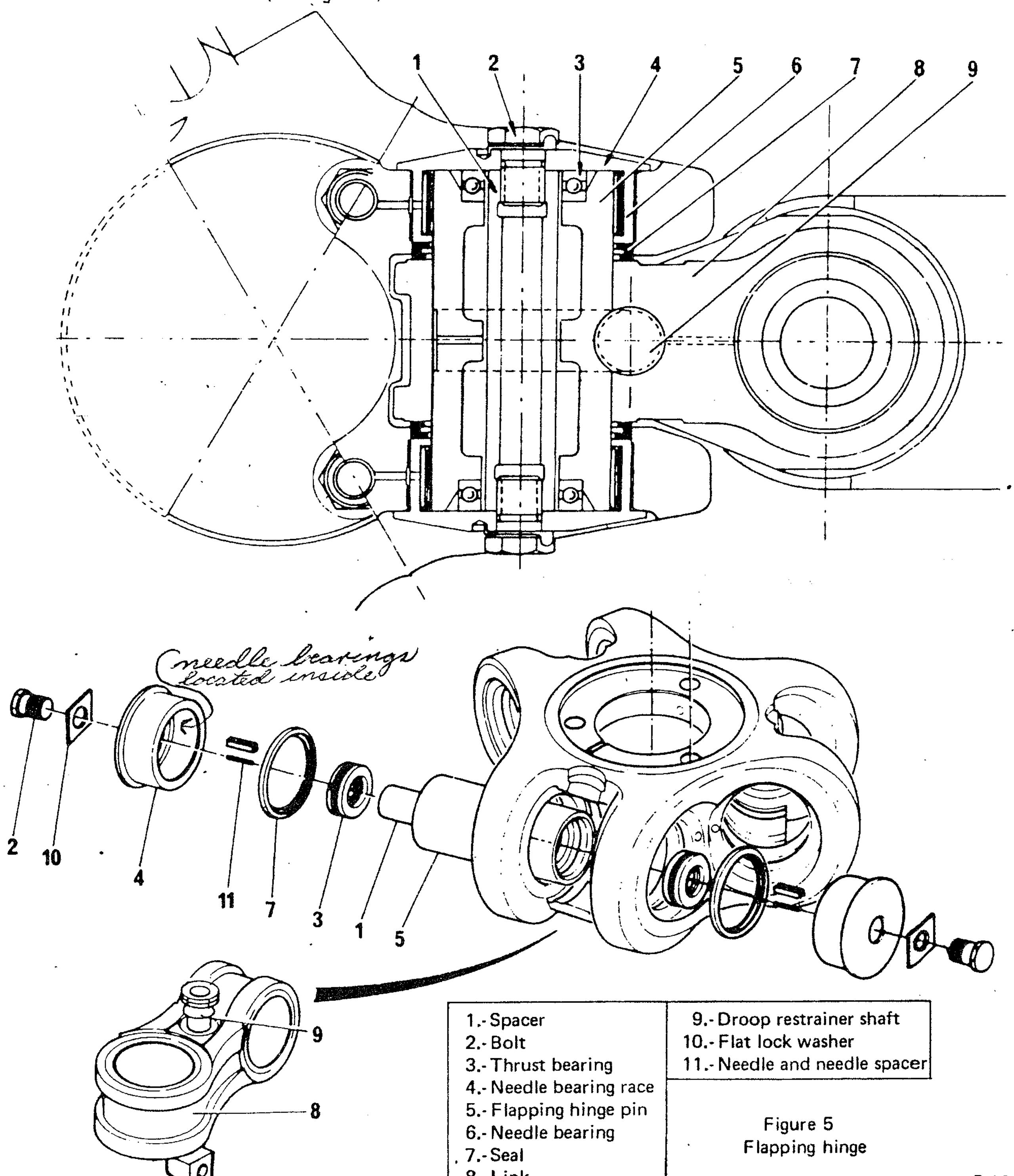


Figure 4
Rotor hub

5.10.2.- MAIN ROTOR HEAD (Continued)

C.- FLAPPING HINGE (Figure 5)

The blade link (8) is a die steel piece connecting each sleeve and spindle assembly to the rotor hub. 2 holes at right angle accommodate the drag and flapping hinge pins.
The flapping hinge consists of a pin (5) secured in the link by a droop restrainer shaft (9). The flapping hinge pin pivots on two needle bearings (6). Two thrust bearings (3) take up the flapping hinge pin axial loads. The grease nipple located on the rotor hub provides proper hinge lubrication (see Figure 4).



1.- Spacer	9.- Droop restrainer shaft
2.- Bolt	10.- Flat lock washer
3.- Thrust bearing	11.- Needle and needle spacer
4.- Needle bearing race	
5.- Flapping hinge pin	
6.- Needle bearing	
7.- Seal	
8.- Link	

Figure 5
Flapping hinge

5.10.2.- MAIN ROTOR HEAD (Continued)

D.- DRAG HINGE (Figure 6)

The drag hinge pin (1) rotates in the link (6) on two needle bearings (4). Axial loads are transmitted through two bronze thrust washers (3). The drag hinge pin carries external splines (9) mating with the splines on the spindle (2), and on the drag damper (see paragraph H). Grease nipples on the rotor hub provide hinge lubrication (see Figure 4).

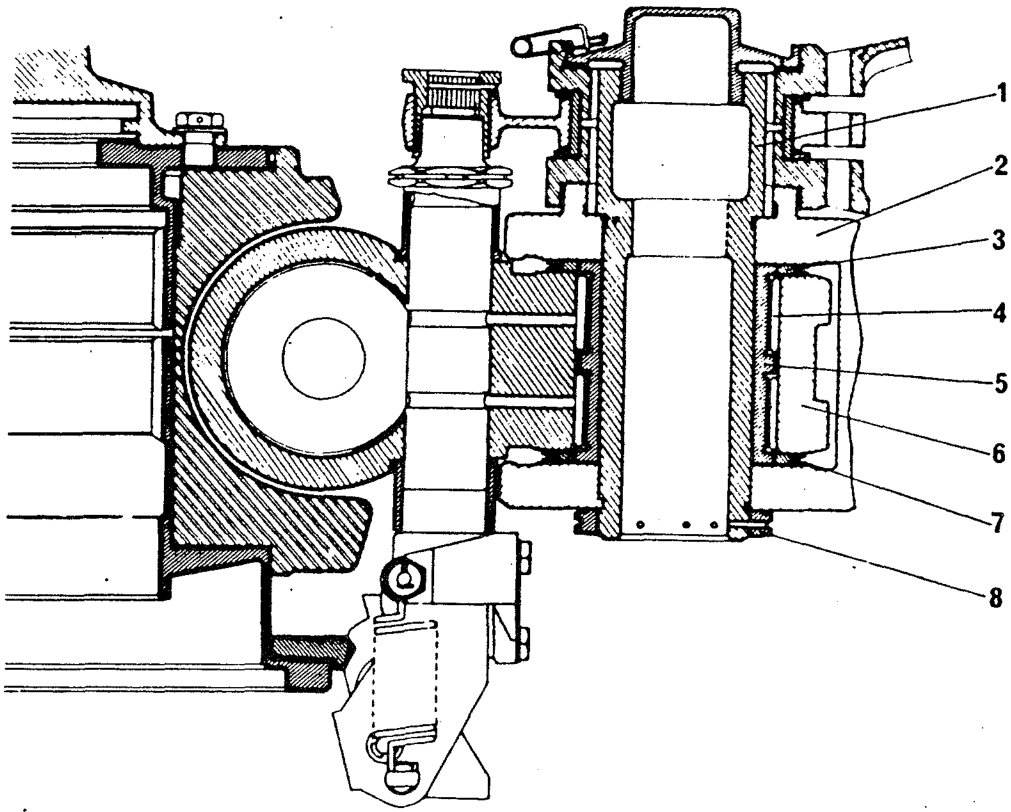


Figure 6
Drag hinge

5.10.2.- MAIN ROTOR HEAD (Continued)

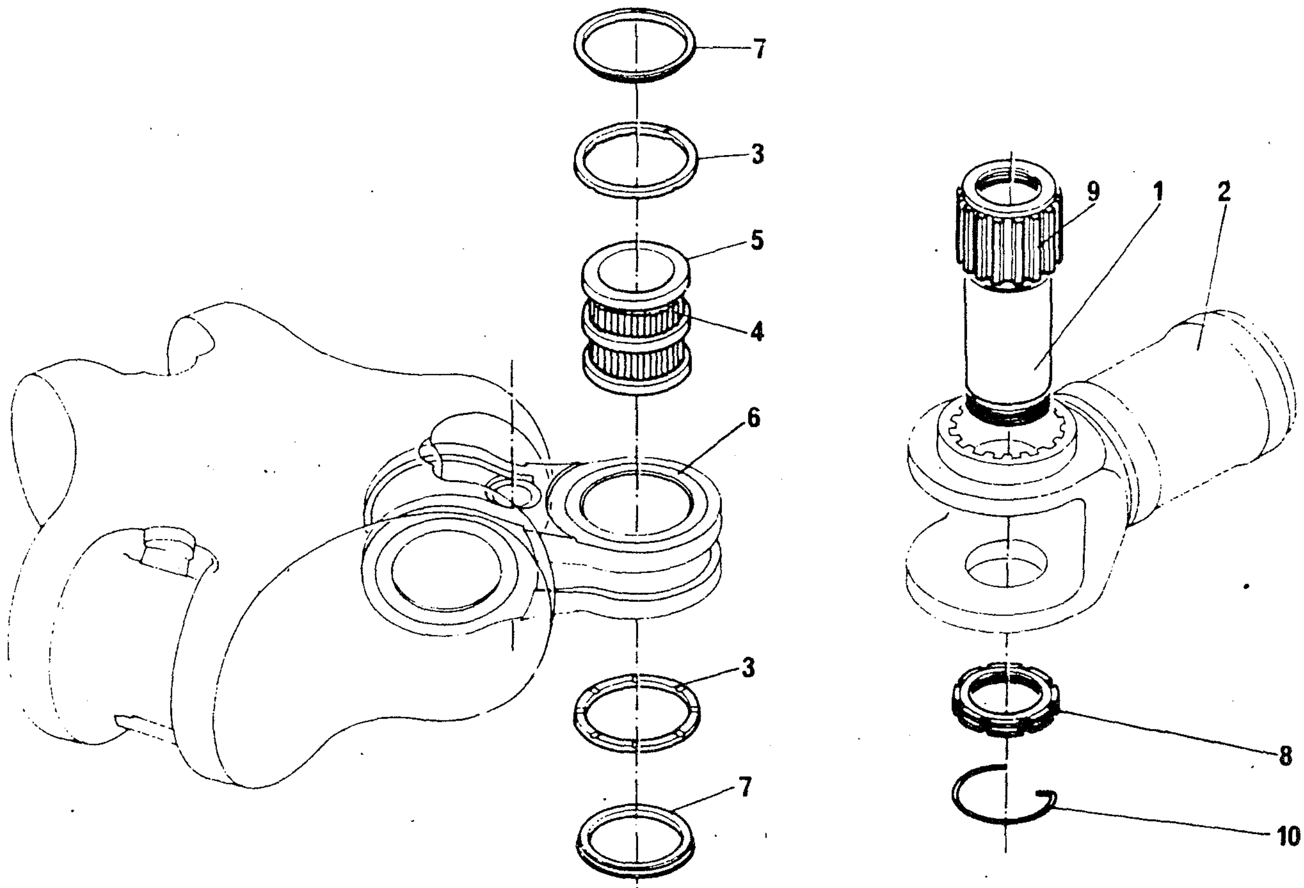


Figure 7
Drag hinge

1.- Drag hinge pin	6.- Link
2.- Spindle	7.- Seal
3.- Thrust washer	8.- Drag hinge pin retaining nut
4.- Needle bearing	9.- Splines
5.- Bearing race	10.- Retaining ring

5.10.2.- MAIN ROTOR HEAD (Continued)

E.- BLADE SLEEVE AND SPINDLE ASSEMBLY (Figures 8 and 9)

Each blade «sleeve and spindle» assembly consists of :

- the die-forged steel blade spindle (2) with a fork end splined onto the drag hinge pin (1).
- the forged steel blade sleeve (13) rotating on the blade spindle on two needle bearings (5) (9). On the outboard end of the blade sleeve is machined a double yoke (21) that connects with the blade cuff. A T-T (tension-torsion) strip assembly (14), of stainless steel, carries the centrifugal forces while permitting the sleeve to rotate. The extremity of the sleeve is sealed with a plug (23) that is also used for balancing the sleeve assemblies, making them interchangeable.
- the blade horn (16) is a light-alloy forging fitted with a trunnion yoke (17) for coupling with the pitch-change link actuated by the cyclic swash plate.

Each blade sleeve is provided with a grease nipple (7).

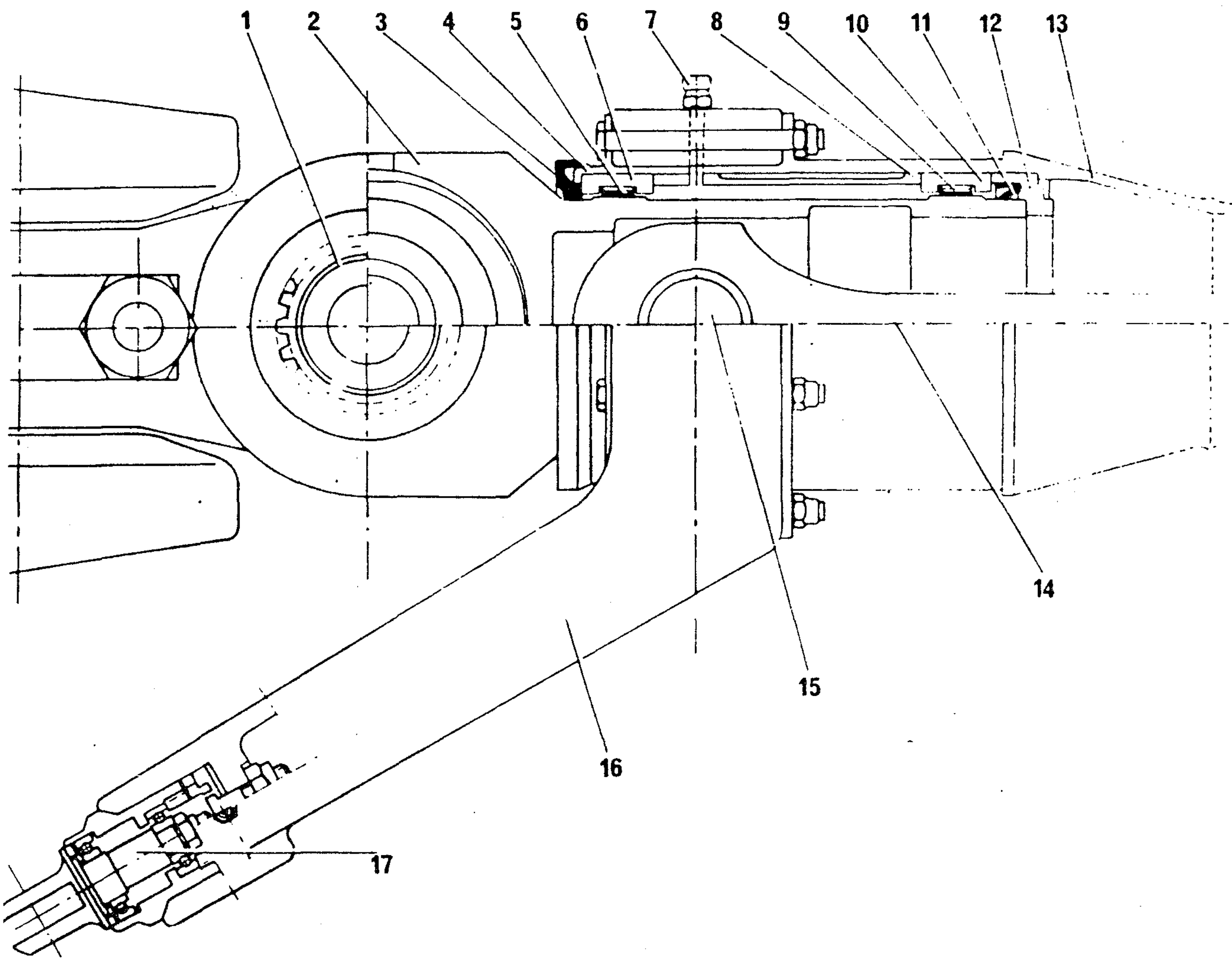


Figure 8
Blade sleeve and spindle assembly

5.10.2.- MAIN ROTOR HEAD (Continued)

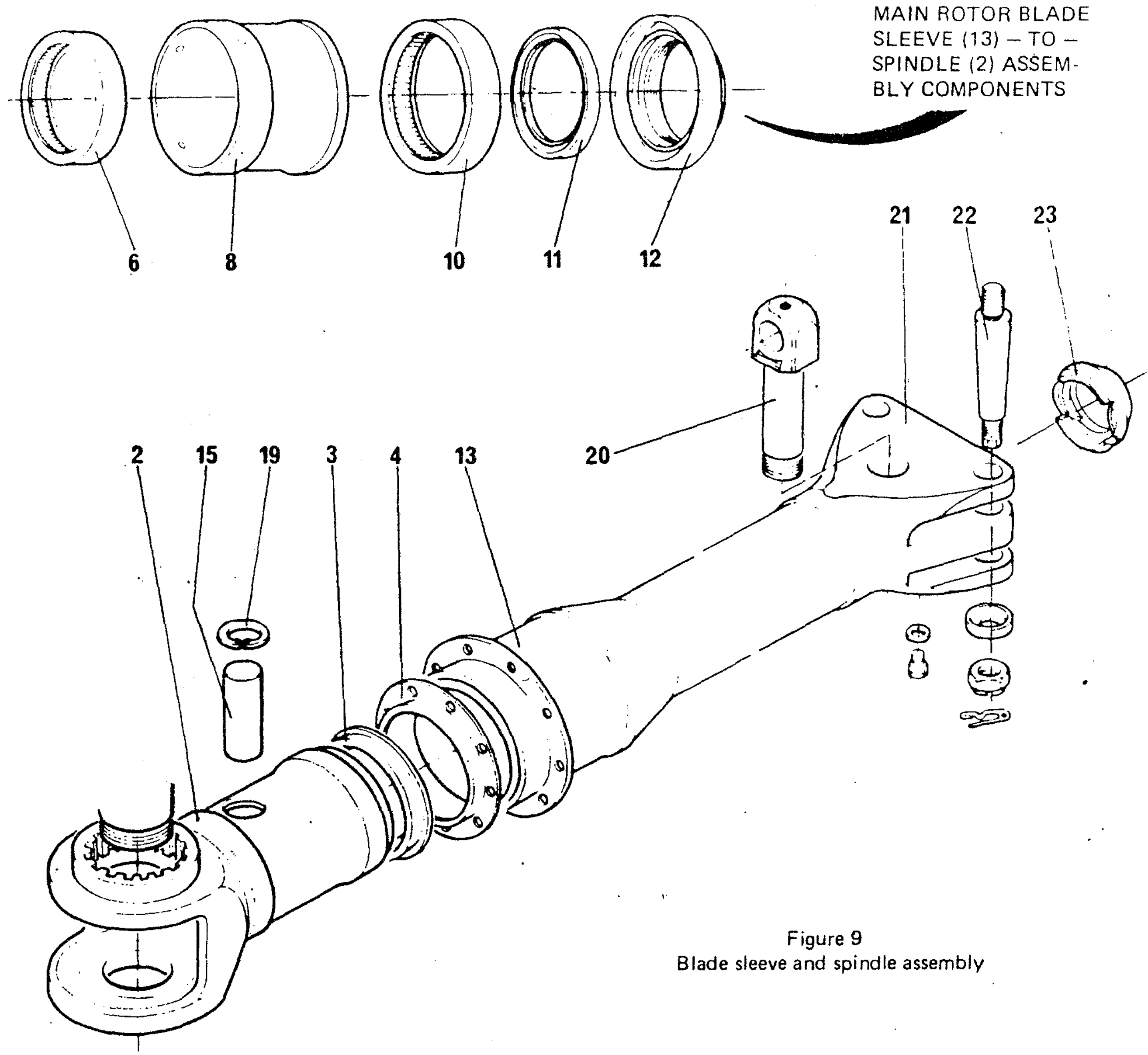


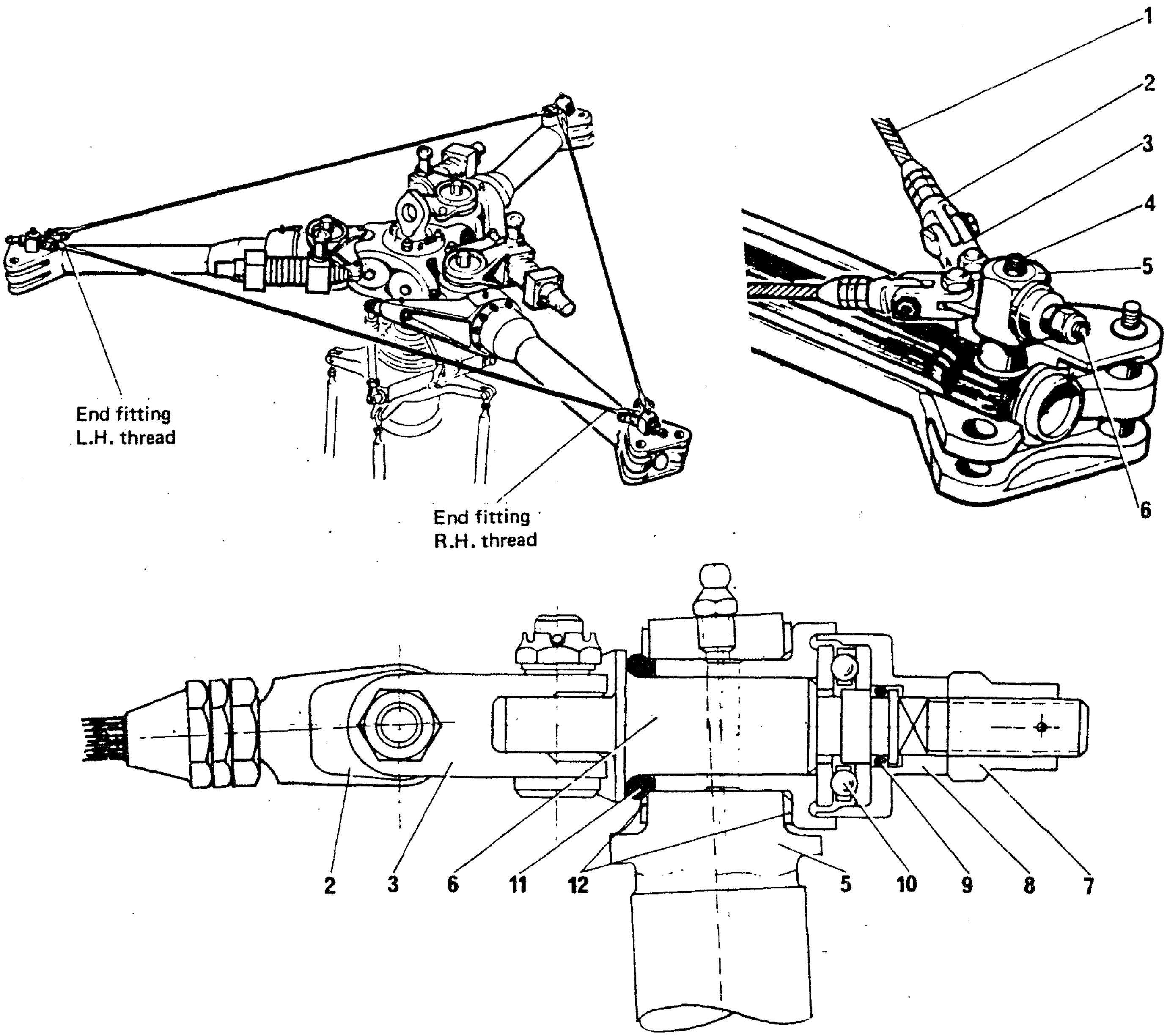
Figure 9
Blade sleeve and spindle assembly

1.- Drag hinge pin	13.- Sleeve
2.- Spindle	14.- Tension-Torsion strip assembly
3.- Sleeve seal	15.- T-T strip anchoring pin
4.- Sleeve cap	16.- Blade horn
5.- Needle bearing	17.- Trunnion yoke
6.- Bearing race	18.- Trunnion protective cover
7.- Grease nipple	19.- Circlip
8.- Spacer	20.- T-T strip assembly anchoring post
9.- Needle bearing	21.- Double yoke for blade cuff
10.- Bearing race	22.- Taper pin (blade attachment)
11.- Seal	23.- Sleeve end plug
12.- Seal retainer/thrust ring	

5.10.2.- MAIN ROTOR HEAD (Continued)

F.- BLADE-SPACING CABLES (Figure 10)

The three blade sleeves are interconnected by blade-spacing cables (1) which are secured in the head of the T.T strip assembly anchoring post (5) through a trunnion fitting (6), which rotates on a ball thrust bearing (10).



1.- Blade spacing cables	7.- Nut
2.- Adjustment cable end-fitting	8.- Cover
3.- Link	9.- Seal
4.- Grease nipple	10.- Ball thrust bearing
5.- Anchoring post	11.- Seal
6.- Spindle	12.- Bonded washers

Figure 10
Blade-spacing cables assembly

check ring for damage and a tension check on spring

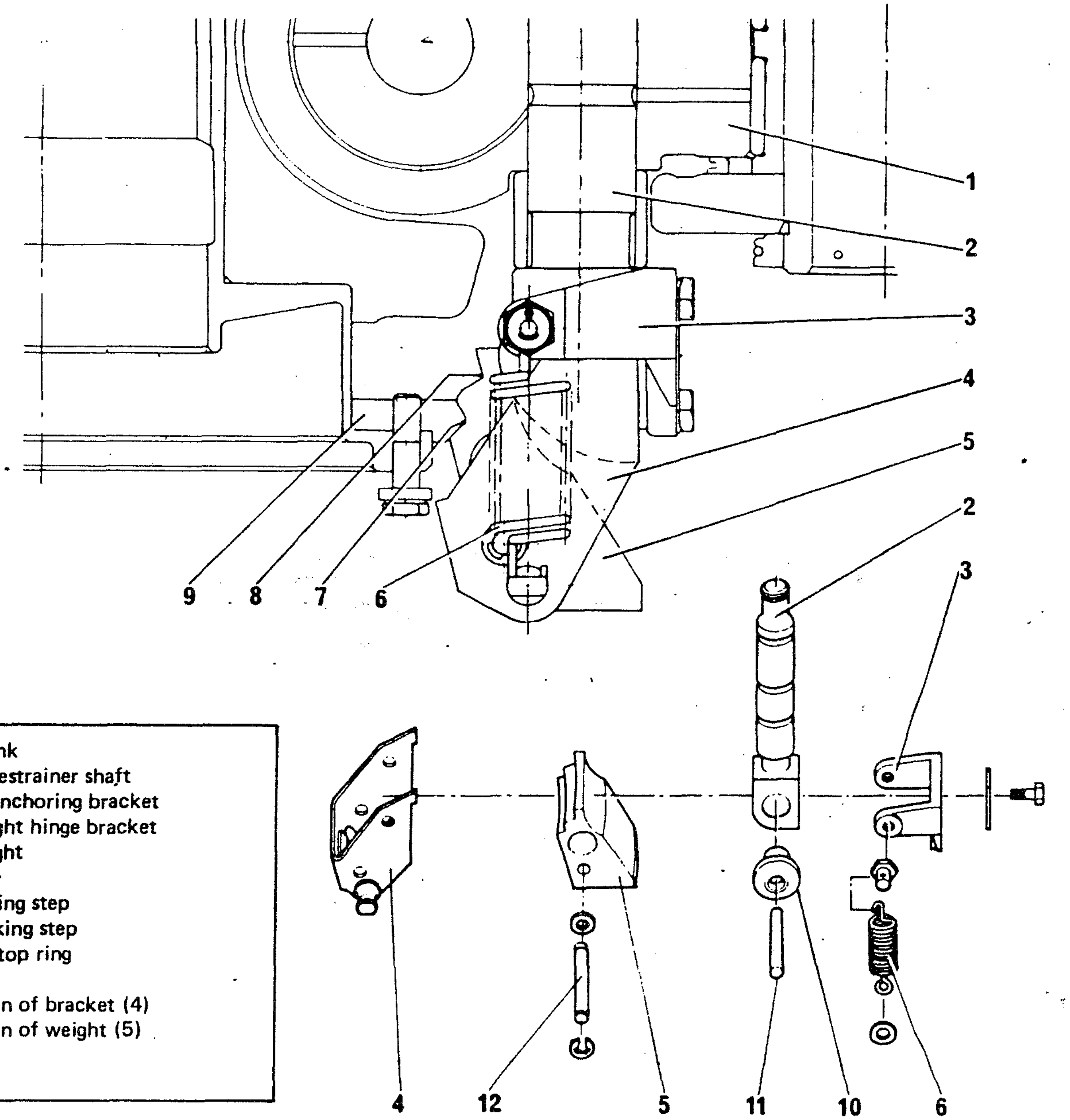
5.10.2.- MAIN ROTOR HEAD (Continued)

G.- DROOP RESTRAINER (Figure 11)

The centrifugal-type droop restrainers are mounted on a shaft (2), carried in the link (1) at each flapping hinge.

For speeds of up to 185 rpm, the centrifugal force applied to the fly-weight (5) does not exceed the spring load (6) ; therefore the weight is held back by the spring and engaged on the common low position stop ring (9). The blade sleeve is then locked in low position.

For speeds higher than 195 rpm, the fly-weight (5) is raised from the low stop ring (9) and the blade sleeve is freed in the flapping plane.
In the case of defective operation, the blade is locked on the second step of the stop (8).



1.- Blade link
2.- Droop restrainer shaft
3.- Spring anchoring bracket
4.- Fly-weight hinge bracket
5.- Fly-weight
6.- Spring
7.- 1st locking step
8.- 2nd locking step
9.- Droop stop ring
10.- Ring
11.- Hinge pin of bracket (4)
12.- Hinge pin of weight (5)

Figure 11
Droop restrainer

5.10.2.- MAIN ROTOR HEAD (Continued)

H.- DRAG HINGE DAMPER (Figure 12)

The hydraulic dampers consist of :

- a flange (5) supporting a small hydraulic fluid reservoir (3) made of transparent plastic material
- a cylinder (9) mounted on the flange, and communicating with the reservoir (3)
- a piston (7) incorporating two opposed, single action ball-type relief valves (8) (12).

2 arms (1) (15) connect the drag hinge pin (24), to the cylinder.
The piston rod is connected to a fixed lever (16) centered on the drag hinge pin and splined to the droop restrainer shaft (19).

Operation : the blade oscillations about the drag hinge pin (24) cause levers (1) (15) to pivot and the damper cylinder to move in relation to the piston which remains motionless. A dampening action results from the restriction of hydraulic fluid flow between the piston and the cylinder. The relief valves (8) (12) let the fluid through in the event of overpressure resulting from excessively rapid blade displacements (for instance, during clutch engagement or rotor braking).
The inlet valve (2) provides fluid replenishment for the cylinder by gravity, and pressure relief to compensate for fluid expansion.

1.- Upper arm (flange attachment)	16.- Fixed lever (piston attachment)
2.- Fluid inlet valve	17.- Grease nipple
3.- Hydraulic fluid reservoir	18.- Eccentric (fixed lever centering on drag hinge pin)
4.- Seals	19.- Droop restrainer shaft
5.- Damper flange	20.- Pin
6.- Grease nipple	21.- End cap
7.- Piston	22.- Bush
8.- Relief valve	23.- Bush
9.- Cylinder	24.- Drag hinge pin
10.- Piston rod	25.- Bush
11.- Seal	26.- Friction washer
12.- Relief valve	27.- Arm spacer
13.- Grease nipple	28.- Friction washer
14.- Seal	29.- Cap washer
15.- Lower arm (flange attachment)	

come in a set timed whithin 3/10 of sec of each other.

Bleed
① remove from A/c
② " bleed valve.
③ stand on end bleeder hole up
④ let it bleed itself 24 hrs,

△ in color of fluid
① sun (straw)
② H2o

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5.10.2.- MAIN ROTOR HEAD (Continued)

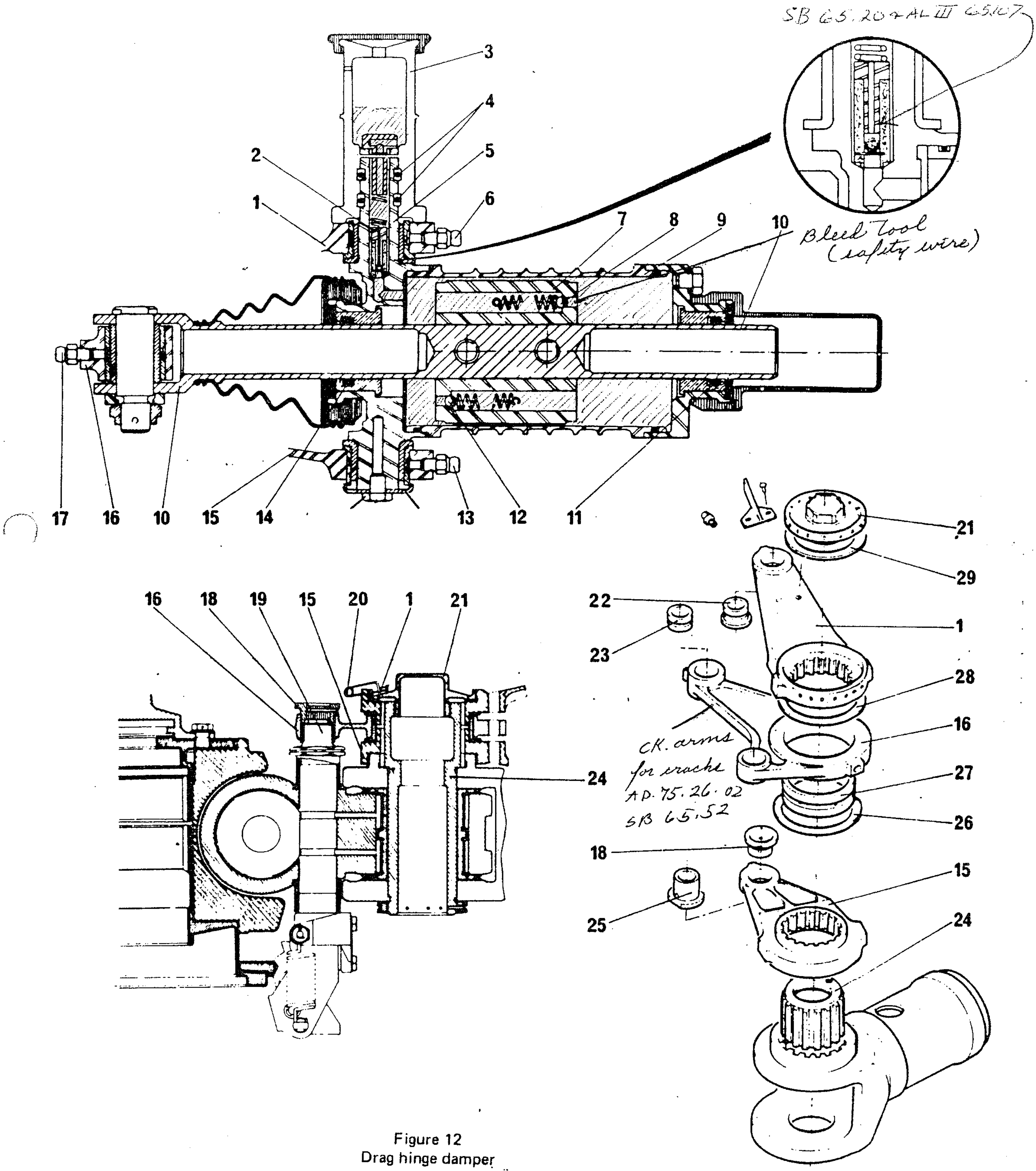


Figure 12
Drag hinge damper

5.10.3.- MAIN ROTOR BLADES

A.- DEFINITION RE-STATEMENT - INSTALLATION ANGLE

All blades cannot be so manufactured as to have strictly identical aerodynamoc performance. On a dynamic test bench, they are compared with a master blade built to 12°40′ incidence.

The installation angle is the angle of attack required for any blade to produce a lift which, under test conditions, is identical with that of the master blade. For instance, if a blade requires an incidence angle of 12° 48′ for its lift to match the master blade lift, this 12°48′ angle is called the «installation angle».

The installation error (Δ i) is the difference between the installation angle and the master blade incidence angle. In the above example, the blade incidence correction, or installation error is Δ i = 12°48′ – 12°40 = + 8′. This value may be positive or negative. The «incidence correction» is written on the blade under-surface, at the root end. On blade installation, this constitutes essential data for adjustment purposes.

Example : A 3-blade (A, B, C) set shows the following incidence correction values, respectively :
A = + 8° B = – 5′ C = – 10′

On assembly, these blades will be adjusted (by means of the pitch-change rods) at the following values, with respect to the master blade :

A = 12°48′ B = 12°35′ C = 12°30′

These corrections will result in an equal lift for. all three blades.

B.- DESCRIPTION (Figure 13)

The main rotor blades consist of :

- a light-alloy spar (2) fitted with a yoke-shaped steel cuff (3).
- a light-alloy sheet skin (7) is bonded to the spar, and bonded and riveted at the trailing edge (6) to a full span sheet metal strip. Blocks of moltoprene filler material (8) are bonded in the free space left between the spar and the skin.
- the skin is attached to two inboard and outboard end ribs (4) (9).
- a light-alloy tip fairing (12) is screwed to the outboard rib (9).

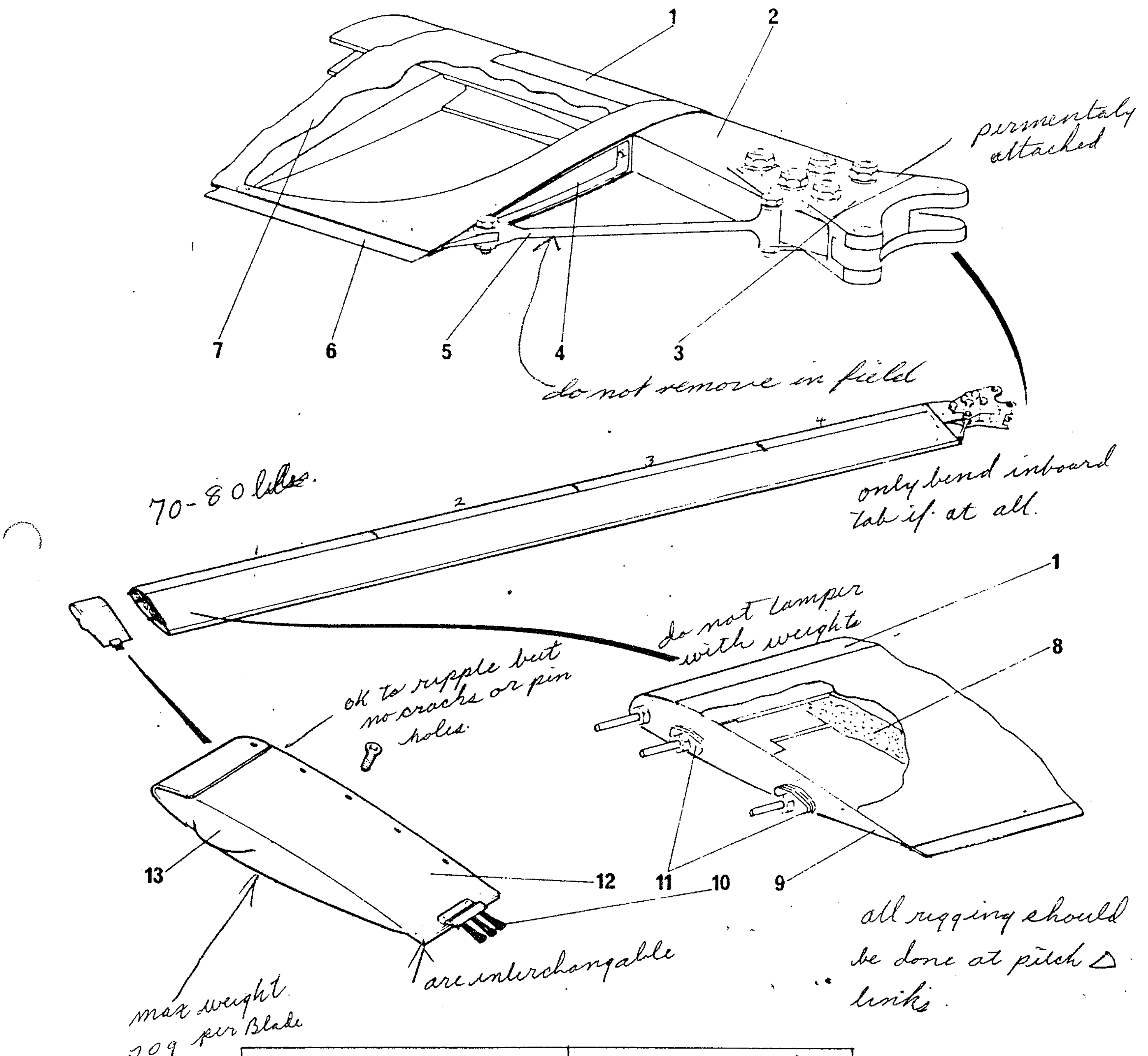
The leading edge of the blade is protected by bonded, stainless steel erosion strips (1). Blade balancing is carried out on the test stand, through the appropriate distribution of balance weights (11) on the outboard rib.

– 6° Twist in blades for lift throughout length of blade.
span 34′ 1.86″

for out of balance conditioned wrap tape then wade it up in a ball & stick in cap.

Replace A S H set.

5.10.3.- MAIN ROTOR BLADES (Continued)



1.- Leading edge erosion strips (stainless steel) 4 ea.	7.- Skin
2.- Spar	8.- Moltoprene block
3.- Yoke-shaped steel cuff	9.- Rib
4.- Rib	10.- Static wick
5.- Strut steel	11.- Balance weights
6.- Trailing edge strip	12.- Tip fairing
	13.- Tracking marker

Figure 13 - Main rotor blade

info. on blade ID plate

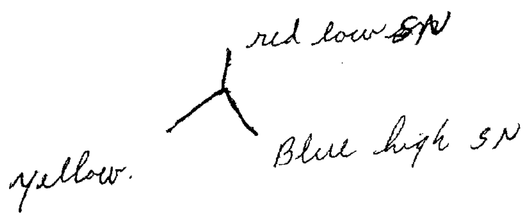
date
part #
serial #

ΔI = +17' → difference from 12° 40'
(Δ = difference)

M.C.P. = mean collective pitch

a perfect blade 12° 40' at M.C.P.
→ designed angle.

* blade closest to M.C.P. (usually has lowest serial #)
make it red blade & put it over sissors



M.C.P.	12° 40'	design ∠	(DA)
I	12° 57'	installation ∠	(DA)
ΔI	+ 17	installation error	(IE)
after tracking	12° 50'	actual angle.	(AA)
	+ 10'	actual error	(AE)

5.20.- TAIL ROTOR

5.20.1.- GENERAL

The tail rotor consists of :

- a tail rotor head (1)
- 3 rotor blades.

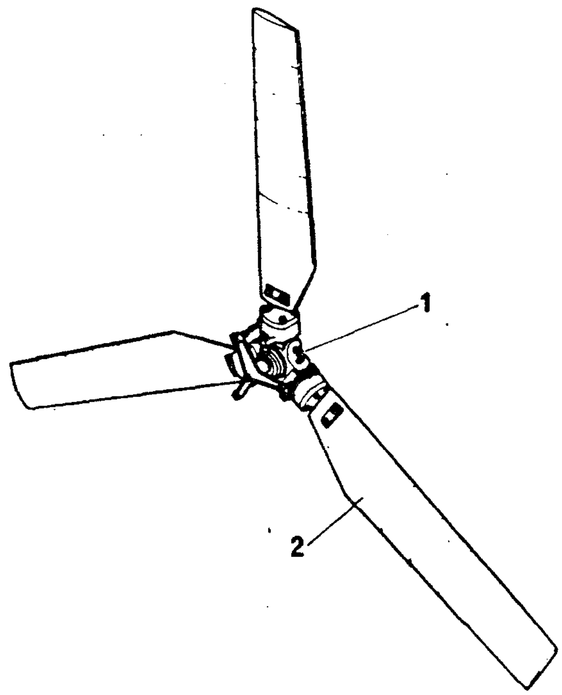
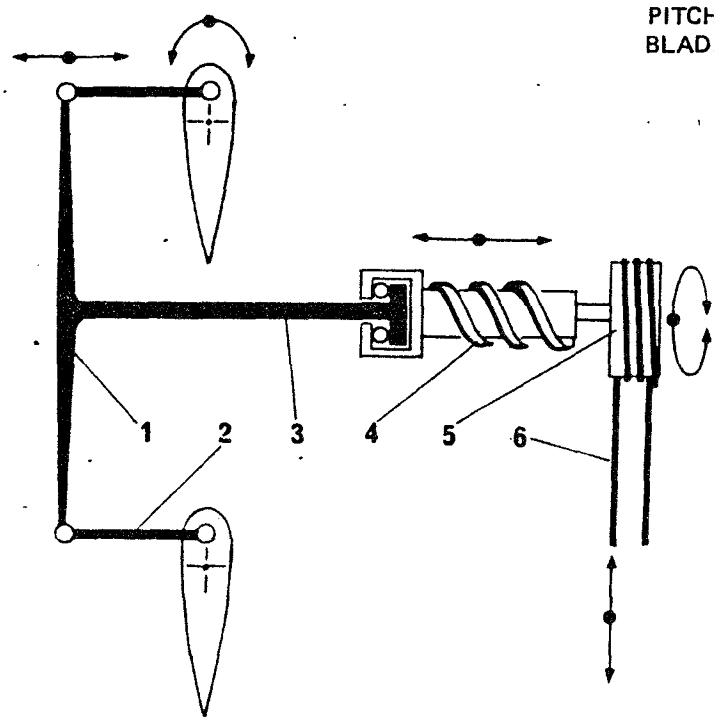


Figure 1
Tail rotor

PITCH-CHANGE CONTROL OF TAIL ROTOR BLADES – FUNCTIONAL DIAGRAM



The control cable (6) turns the drum (5). The worm gear (4) converts this rotational movement into a translational movement which is carried to 3 pitch-change links (2) by means of a rod (3) and a spider (1).

Figure 2

5.20.2.- TAIL ROTOR HEAD

A.- GENERAL (Figure 3)

The tail rotor head is of the three-bladed type articulated in the flapping plane. It consists of :

- The rotor hub (9) which is connected to the rotor shaft of the tail rotor gear box.
- The flapping hinges (6) which are intended to limit bending stresses in the blade root area. The flapping hinge pin rotates on two needle bearings (7) pressed on to the rotor hub ; it receives the yoke of the incidence or feathering hinge (4). The flapping angle is limited by two stops on the rotor hub (14).
- Feathering hinges : consisting of : a spindle (4) fixed to the flapping hinge pin, and a blade sleeve and horn (2) which rotate about the spindle on three angular contact ball bearings (1). The rotor blade is carried by the blade sleeve (2) and attached by a screw (3).
- The pitch-change controls transmit to the blade spindle the movements of the sliding pitch-change shaft of the tail rotor gear box (11). The pitch-change spider (10) is fixed to the pitch-change shaft and connected to the blade spindles by three pitch-change links (13).

Grease nipples (5) (8) provide lubrication of the flapping and pitch hinges. The pitch-change shaft is protected by a boot (12).

1.- Angular contact bearing	8.- Grease nipple
2.- Blade sleeve	9.- Tail rotor hub
3.- Blade attachment stud	10.- Pitch-change spider
4.- Spindle	11.- Pitch-change shaft (control)
5.- Grease nipple	12.- Protective boot
6.- Flapping hinge	13.- Pitch-change link
7.- Needle bearing	14.- Flapping angle stops

aero-shell 14 only

5.20.2.- TAIL ROTOR HEAD (continued)

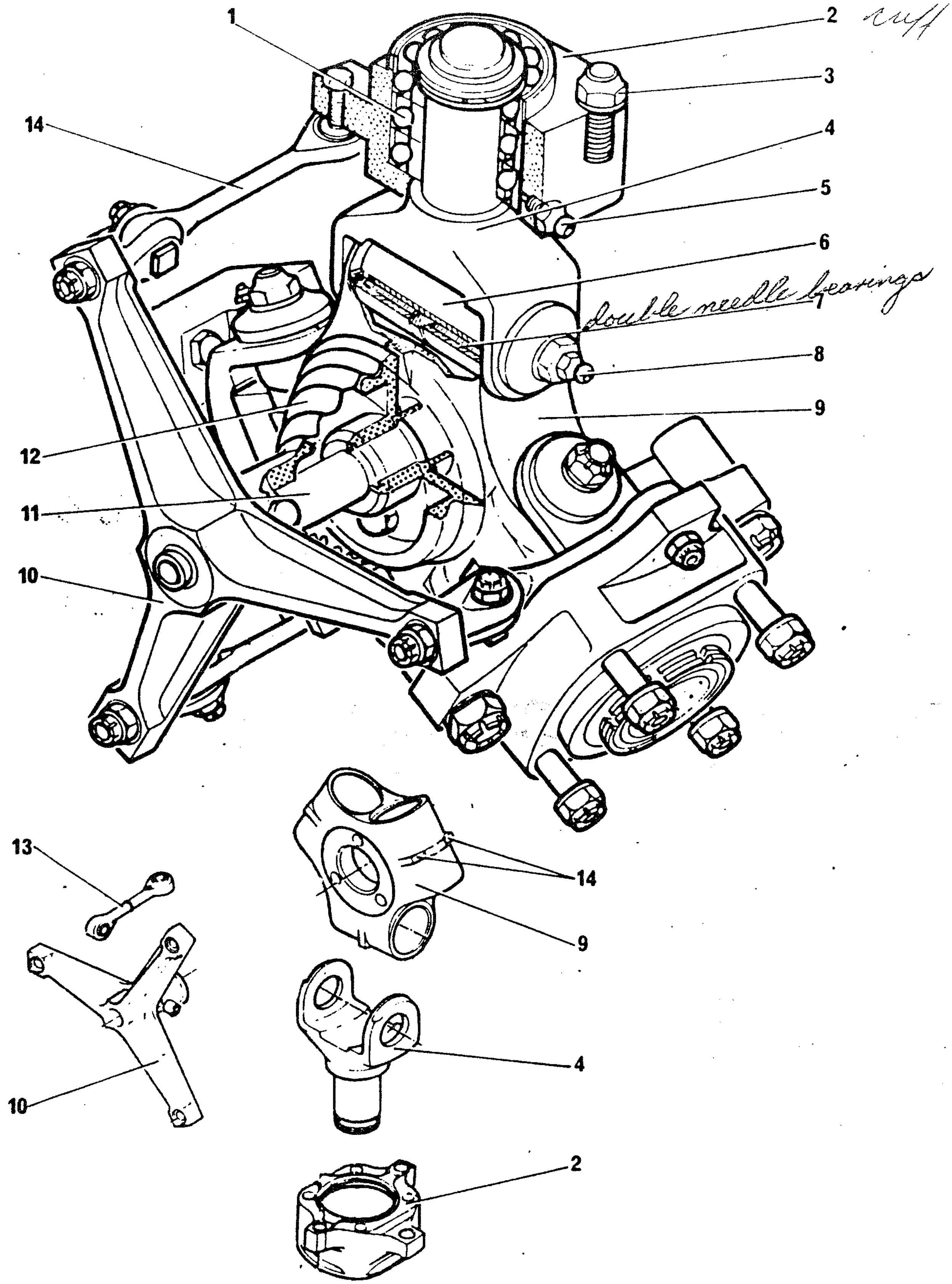
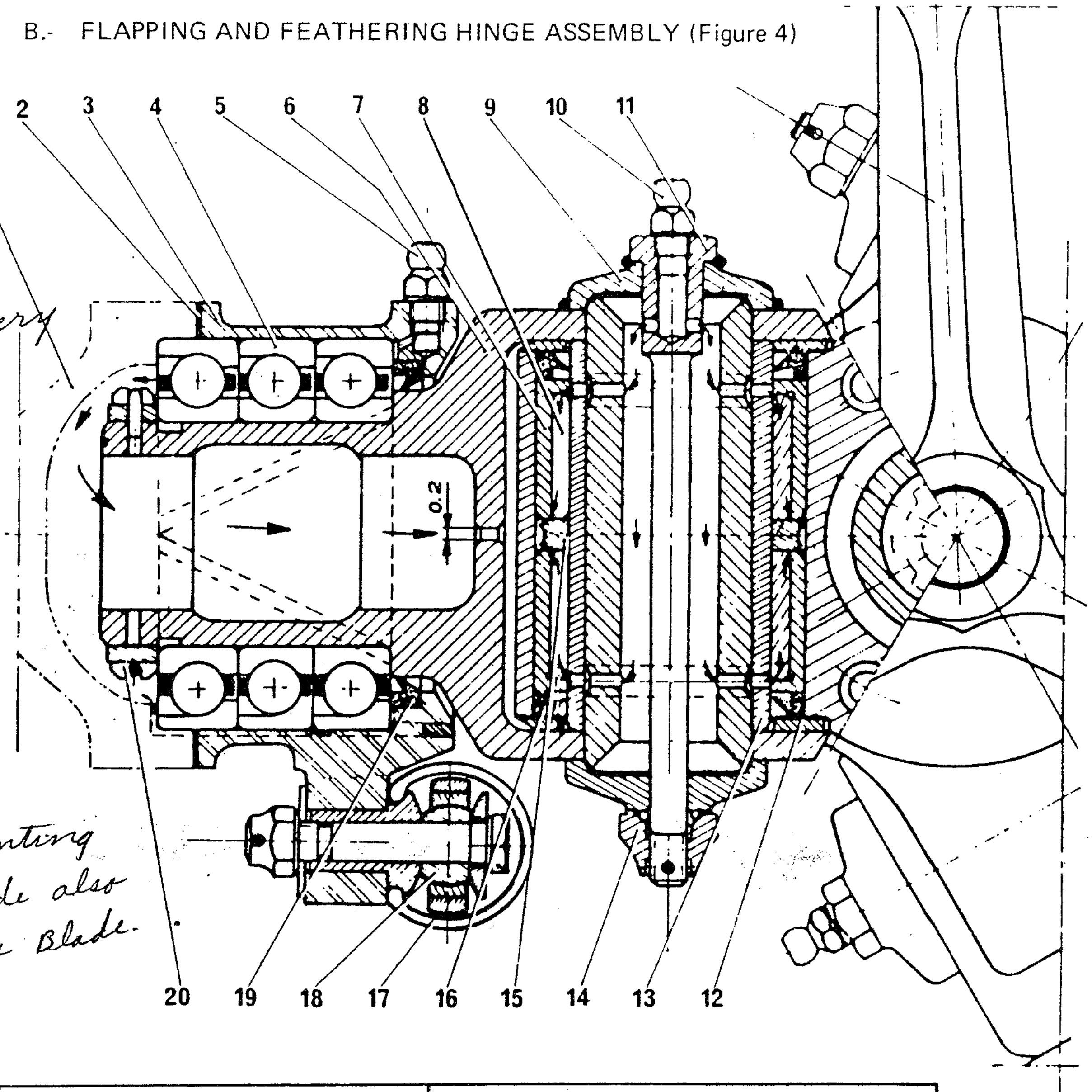


Figure 3 - Tail rotor head

5.20.2.- TAIL ROTOR HEAD (continued)

B.- FLAPPING AND FEATHERING HINGE ASSEMBLY (Figure 4)



✩ spin cuff to grease every 25 hrs disconnect p/c links at hub end

APEX
have ∧ pointing towards blade also # 1 towards Blade.

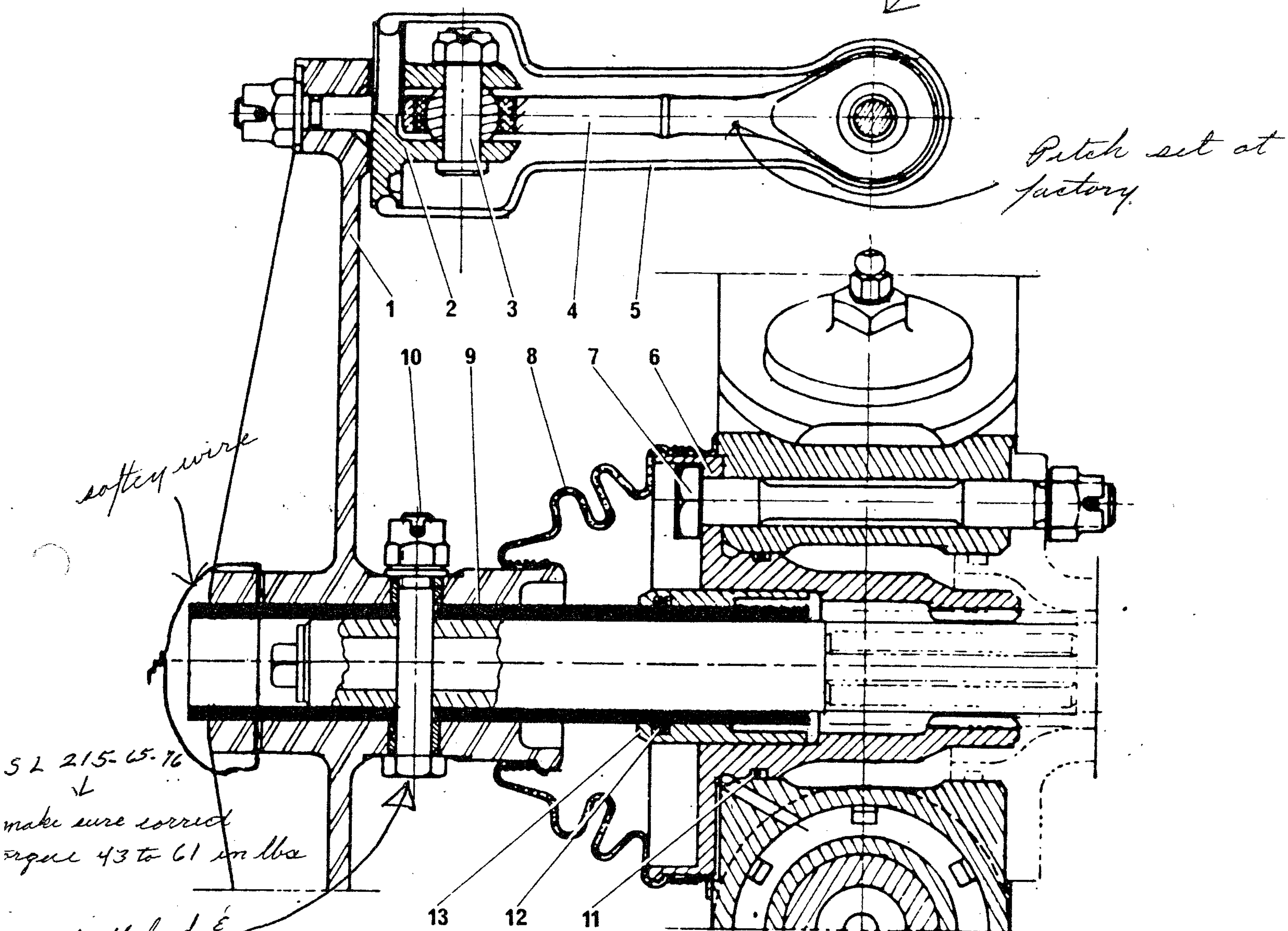
1.- Blade	11.- Retaining bolt
2.- «Teflon» seal (blade assembly)	12.- Thrust washer
3.- Blade sleeve	13.- Needle bearing inner race
4.- Angular contact bearings	14.- Nut
5.- Grease nipple	15.- Spacer ring
6.- Spindle	16.- Seal
7.- Needle bearing outer race	17.- Rubber boot (link end bearing)
8.- Bearing needles	18.- Pitch-change link
9.- Hinge pin end cap	19.- Seal
10.- Grease nipple	20.- Blade spindle - sleeve assembly nut

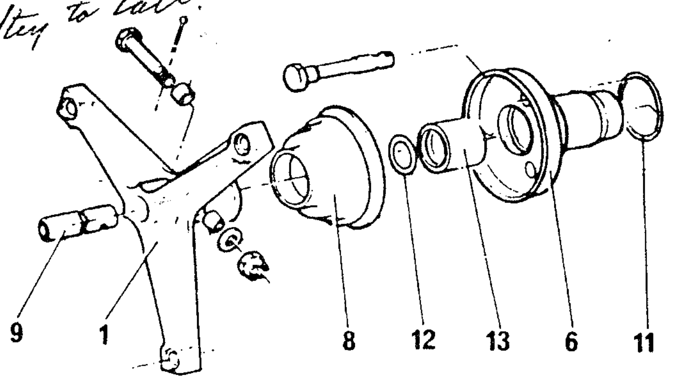
Figure 4
Tail rotor blade flapping and feathering hinge assembly

Lama. S.B. 65.24
latest fix on spider boot

5.20.2.- TAIL ROTOR HEAD (Continued)

C.- PITCH-CHANGE CONTROL (Figure 5)





1.-	Pitch control spider
2.-	Yoke
3.-	Link-to-horn clevis bolt
4.-	Pitch-change link
5.-	Protective rubber boot
6.-	Pitch-change shaft guide
7.-	Guide retainer bolt
8.-	Protective boot
9.-	Sleeve
10.-	Spider - pitch-change link assembly bolt
11.-	Seal
12.-	Seal
13.-	Guide bush

Figure 5
Tail rotor pitch-change control

5.20.3.- TAIL ROTOR BLADES (Figure 6)

The tail rotor blades consist of :

- a blade spar (6) of formed light-alloy sheet.
- a light-alloy sheet skin (5) is bonded in position on the blade spar ; a stainless steel erosion strip is bonded to the skin along the leading edge (4). The trailing edge is bonded and riveted (12).
- two ribs (1) (3) : the inboard rib (1) is bonded and riveted to the skin ; the outboard rib (3) is bonded and riveted to the spar and the skin. Both are provided with a vent hole (12).
- a blade cuff (9) is clamped to the spar by means of two bolts (10) and two plates (11) ; connection with the tail rotor hub is effected by a flange and four bolts (14). A teflon joint (13) is inserted between the blade cuff flange and the blade sleeve of the tail rotor hub.

The tail rotor blades are not twisted. The difference of lift between root and tip is compensated by the taper in chord and thickness.

The out-board rib (3) of cast light alloy supports the three studs for the static and dynamic balancing weights.

1.- Inboard rib
2.- Trailing edge
3.- Outboard rib
4.- Leading edge erosion strip
5.- Skin
6.- Spar
7.- Plug
8.- Seal
9.- Blade cuff
10.- Cuff attachment bolt
11.- Plate
12.- Vent hole
13.- Teflon joint
14.- Blade attachment stud

2 types of blades

early had fiberglass outer rib.
" must be replaced as set.

Later model blades have alu. rib with 3 studs for static and dynamic balancing weights. — can be individually replaced.

SL. 183-65-74 replacement of rivets if popped.

5.20.3.- TAIL ROTOR BLADES (Continued)

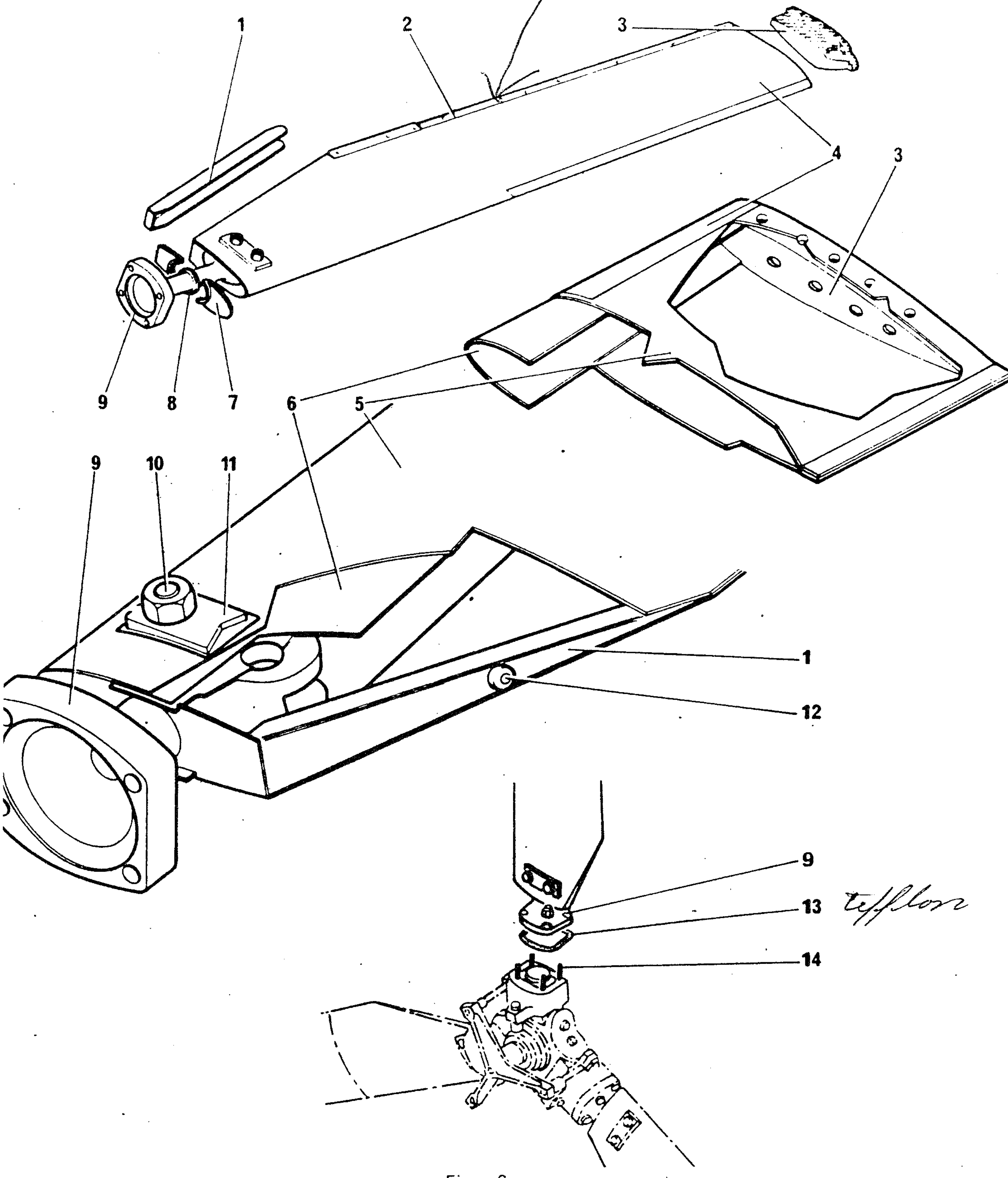


Figure 6
Tail rotor blade

CHAPTER 6

FLIGHT CONTROLS

CONTENTS

6.- FLIGHT CONTROLS

6.00.- GENERAL

6.00.1.- DESCRIPTION

The flight controls act upon the angle of attack of the blades of the main and tail rotors, giving control over the roll, pitch, heading, altitude and speed of the helicopter. The flight controls consists of :

- the main rotor controls comprising :
  - . the cyclic pitch control which controls the roll and pitch attitude of the aircraft (inclination of the main rotor disc)
  - . the collective pitch control which controls the altitude and speed of the aircraft (regulation of power supplied to main rotor)
- the tail rotor control which controls the yawing of the aircraft (regulation of power supplied to tail rotor)

To eliminate pilot input loads, a hydraulic servo-mechanism is installed in each run of the main rotor control system. The servo-system installation is described under chapter 7 «Hydraulic system)

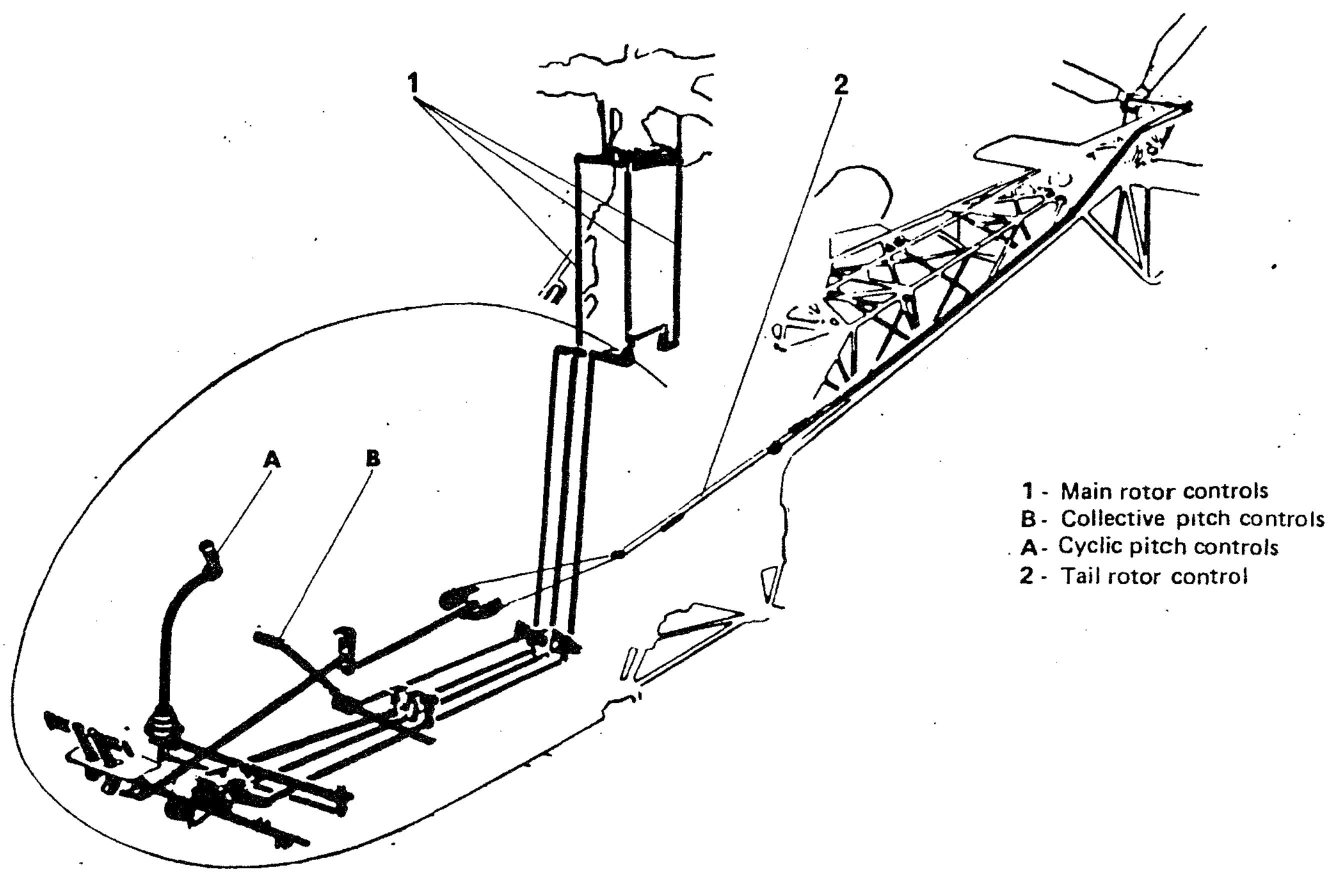


Figure 1
Flight controls

6.00.2.- THEORY OF FLIGHT CONTROL OPERATION

A.- MAIN ROTOR CONTROLS

(1) CYCLIC PITCH CONTROL (Figure 2)

Movement of the swash plate : Variation of the cyclic pitch is obtained by inclination of the swash plate. The inclination is controlled by the cyclic pitch stick via rods and bellcranks. The swash plate is tilted by three rods which correspond to three steering commands (forward-right-left). The points at which these rods are attached define the two tilt axes of the plate (figure 2A). (points e-f-h).
– the longitudinal tilt axis (YY')
– the lateral tilt axis (XX')
Displacement of the cyclic pitch stick along the longitudinal axis of the aircraft (aft- ore fore to-aft) brings an inclination about the YY' axis.

Displacement of the cyclic pitch stick along the lateral axis of the aircraft (left-right or right-left) brings an inclination about the XX' axis.
Swash plate and rotor blade settings (figure 2A) : The three branches of the fixed swash plate (e-f-h) are set 30° before the axes of the aircraft in the sense of rotor rotation. The angle formed by the pitch rod articulation points and the blade axes is 60°. As a result, when a pitch change rod hinge passes vertically by a branch of the fixed swash plate star, then the corresponding blade is in alignment with one of the axes of the aircraft. (longitudinal or transversal).

a - Action of the fore-and-aft control

The stick is moved forward : the swash plate moves about the axis YY' (the tilt angle of the plate being proportional to the degree of movement of the stick). The lowest point of the plate is at e, the highest point at g.
The change of incidence is maximum in one direction when the blade passes through d (on the lateral axis) 60° before the point of application of the pitch rod. It is at a maximum in the other direction when the blade passes through b (180° after). At a and b the incidence variation is zero, as the pitch stick is in the neutral lateral position.

The aerodynamic thrust is greatest at b and least at d : the rotor is subjected to a tilt couple Fo,Fo' (figure 2E). The gyroscopic effect of the rotor re-orientates this couple through 90° in the direction of rotor rotation, that is at a and c.
The couple F1, F1' causes the rotor to tilt to the fore about the transversal axis.
It thus causes a translation forwards (or an increase in the speed of forward translation).

Displacement of the cyclic pitch stick to the rear produces the opposite effect.

6.00.2.- THEORY OF FLIGHT CONTROL OPERATION (contd.)

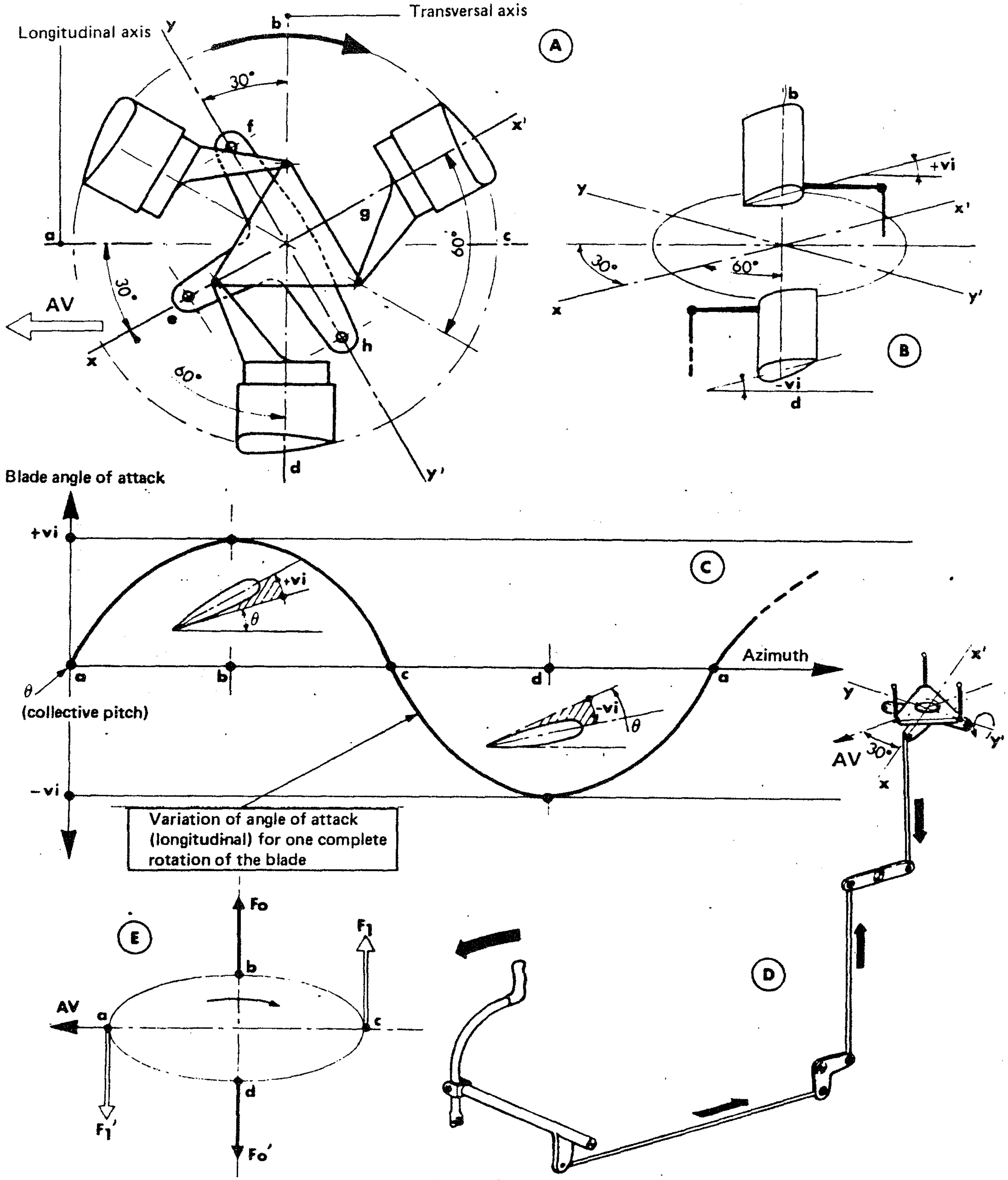


Figure 2
Action of the cyclic control
(longitudinal)

6.00.2.- THEORY OF FLIGHT CONTROL OPERATION (contd.)

b - Lateral movement of the stick (figure 3)

Moving the stick from right to left causes the swash plate to tilt to the left about the axis XX'. For the same reasons as above, this movement of the swash plate causes a cyclic variation in the angle of attack of the rotor blades (Vi).

- Vi is maximum and positive at a
- Vi is maximum and negative at c

Because of the gyroscopic precession, the rotor tilts to the left and the aircraft also moves to the left.

An opposite movement of the stick causes an opposite effect.

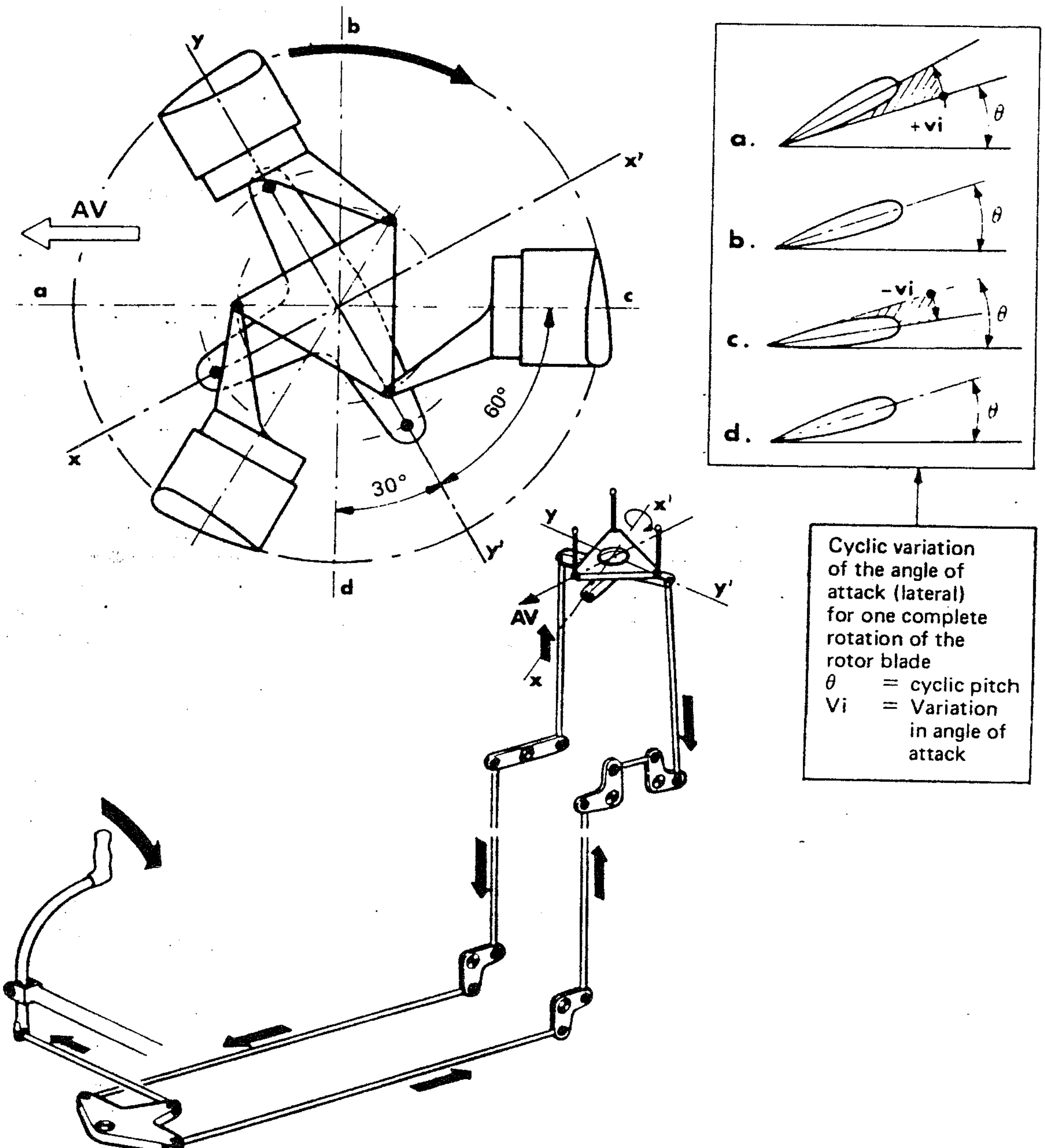


Figure 3
Action of the cyclic control
(lateral)

6.00.2.- THEORY OF FLIGHT CONTROL OPERATION (contd.)

(2) COLLECTIVE PITCH CONTROL (Figure 4)

Movement of the collective pitch control lever gives a simultaneous and equal displacement of the three swash plate control rods, which undergo displacement parallel to the plate causing no change to the cyclic incidence variation which stays the same.
Pulling up the collective pitch control lever causes the swash plate to move upwards and the incidence of all three blades increases by the same amount.
The aircraft gains altitude or the translational speed increases.
Pushing down the control produces an inverse effect.

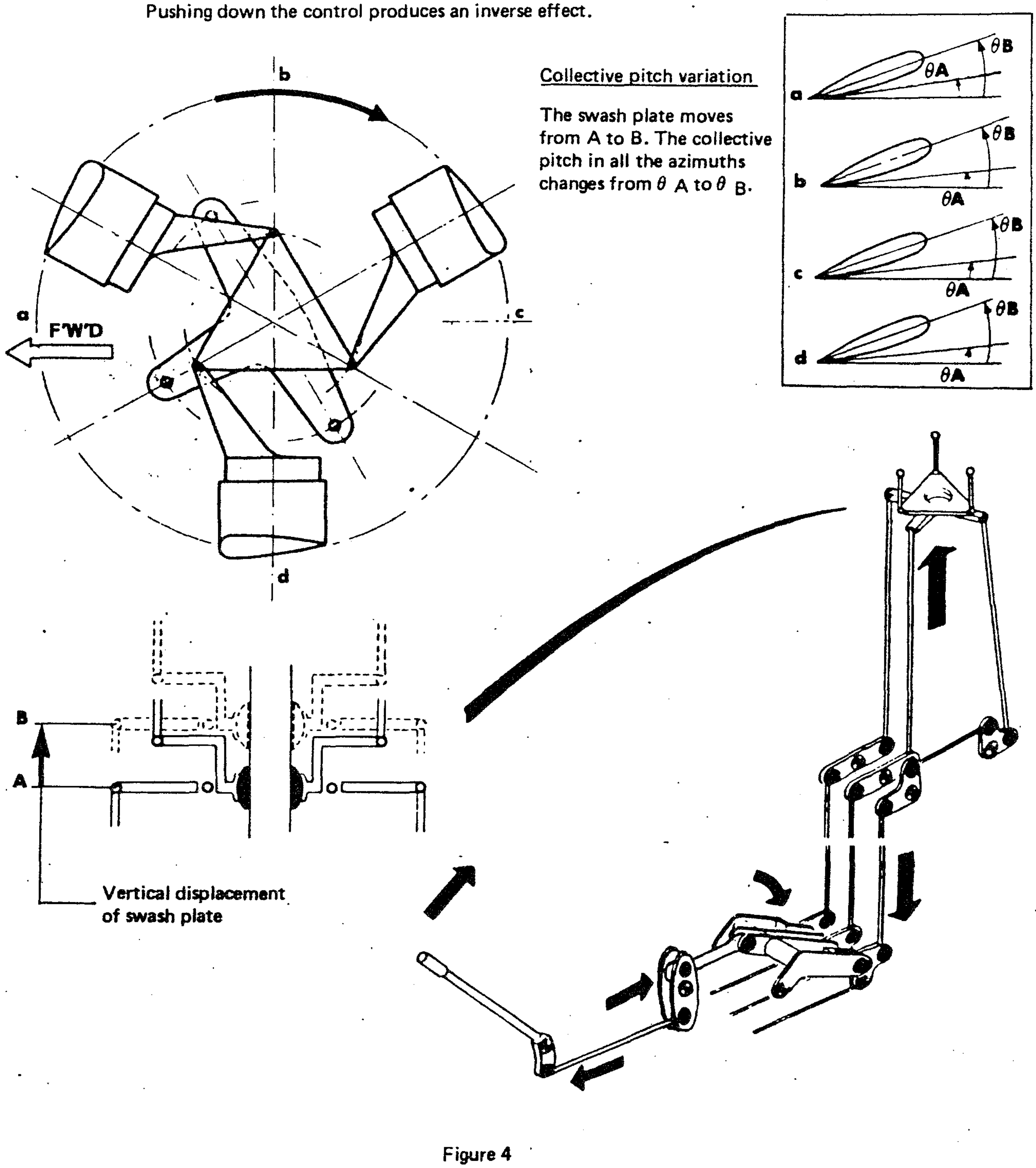


Figure 4
Action of the collective pitch control

6.00.2.- THEORY OF FLIGHT CONTROL OPERATION (contd.)

B.- TAIL ROTOR CONTROL (Figure 5)

Movement of the tail rotor pitch control pedals (3) brings about, through differential displacement of the control cables, rotation of the control drum (2) and axial displacement of the control rod and the plate (1) which is connected to the tail rotor blades by three links.
Depression of the right pedal causes the control rod to retract and the angle of attack of the tail rotor blades to increase. The «Main rotor reactional torque - tail rotor thrust» equilibrium is broken : the aircraft tends to turn to the right on its yaw axis.

Depressing the left pedal produces an inverse effect.

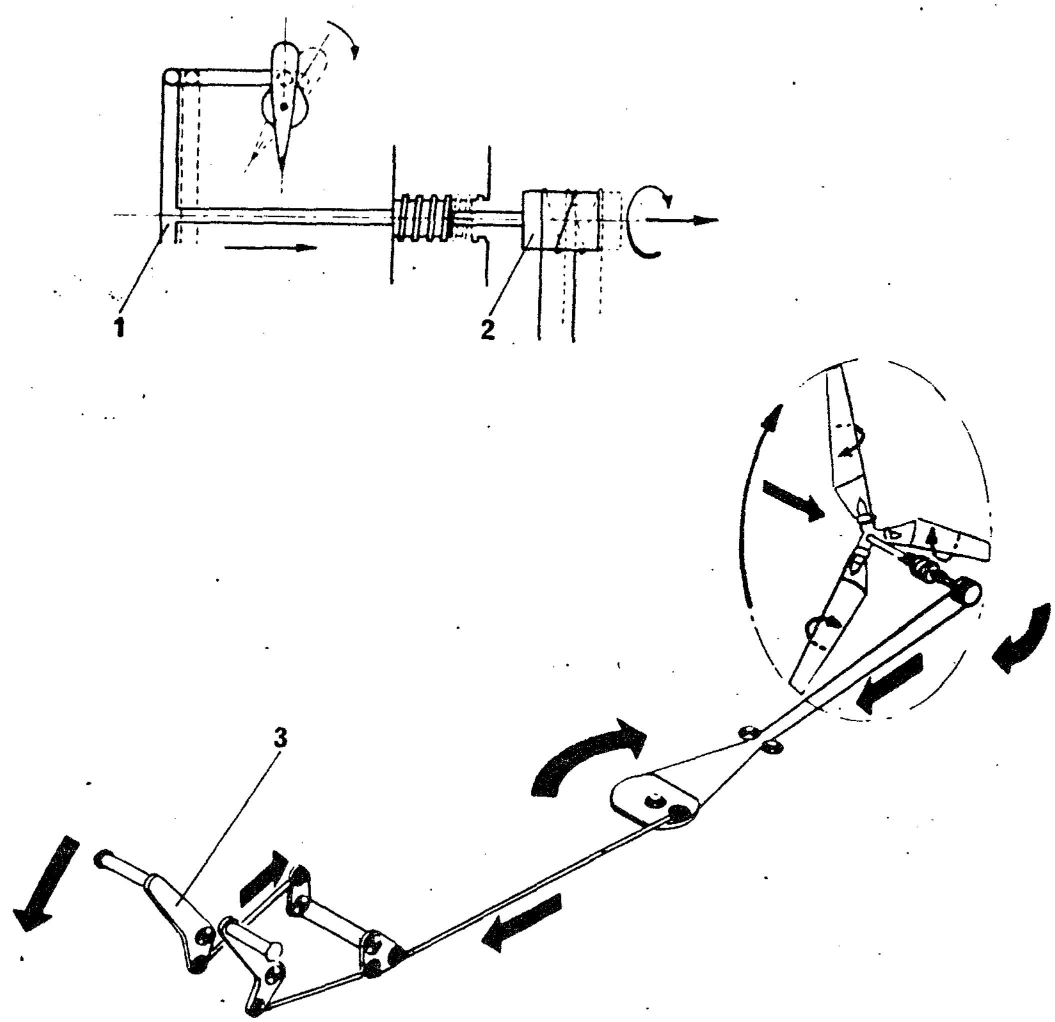


Figure 5
Action of the tail rotor control

6.10.- MAIN ROTOR CONTROLS

6.10.1.- CYCLIC PITCH CONTROL

A.- GENERAL (Figure 1)

The cyclic pitch control consists of :

- the cyclic pitch control stick assembly (12) which, via three control runs, causes inclination of the swash plate (4) about both its tilt axes : XX' and YY'.
- the fore-and-aft (or forward) control run, consisting of the fore-and-aft servo (15), a series of rods (5) (7) (9) (11), relay (10) and bellcranks (8) (6) terminating at the forward branches of the fixed swash plate star.
- the lateral control runs, consisting of the lateral bellcrank (14) to which are attached the lateral servo (13) and the right and left linkage runs which comprise rods, relays and bellcranks terminating at the right (1) and left (3) branches of the fixed swash plate star.

1.- R.H. branch of swash plate
2.- Forward branch of swash plate
3.- L.H. branch of swash plate
4.- Swash plate
5.- Swash plate input rod
6.- Rocker lever
7.- Rod
8.- Bellcrank
9.- Rod
10.- Relay
11.- Rod
12.- Cyclic pitch control stick
13.- Lateral control servo jack
14.- Lateral control bellcrank
15.- Fore-aft servo-jack

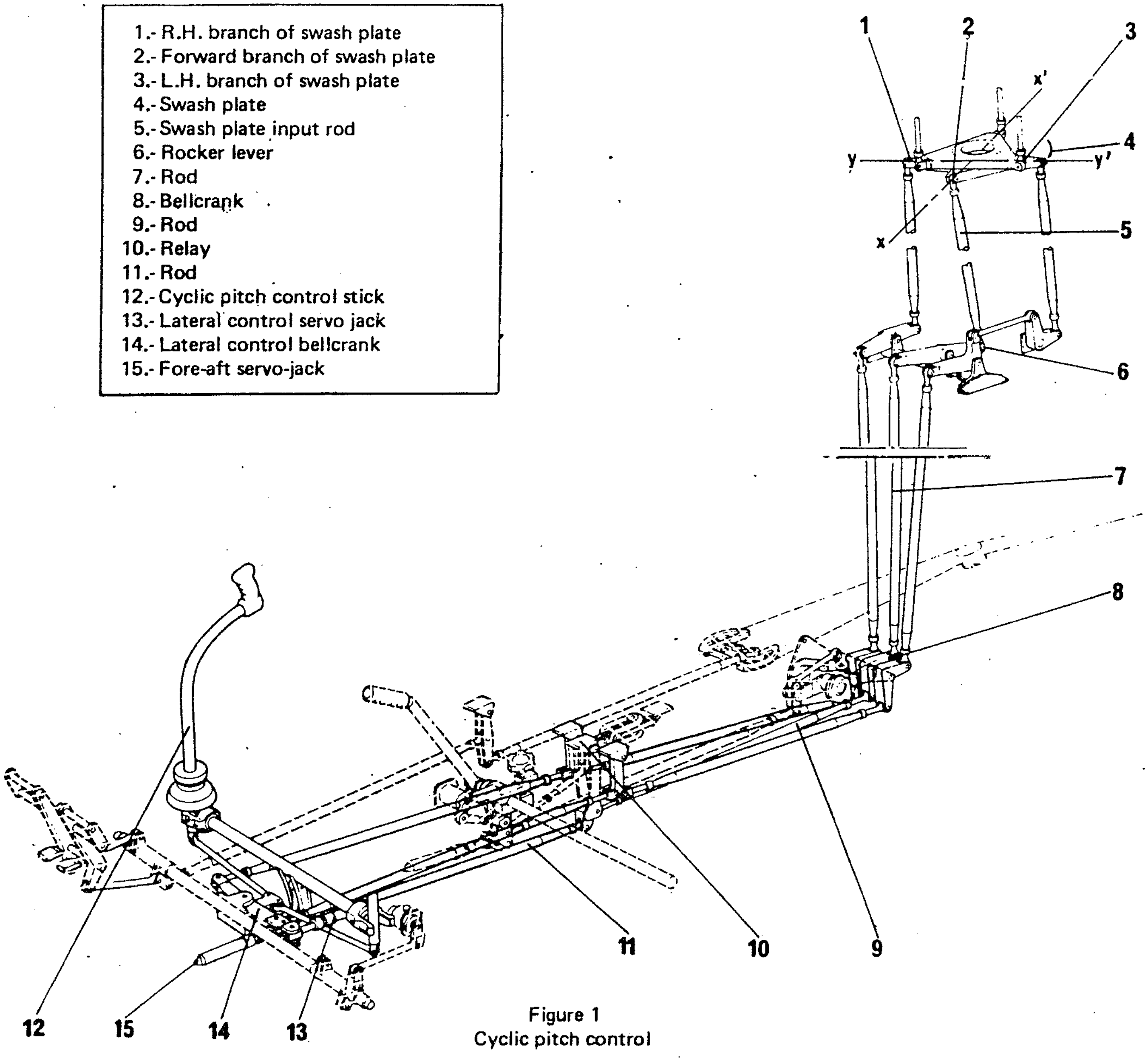


Figure 1
Cyclic pitch control

6.10.1.- CYCLIC PITCH CONTROL (contd.)

B.- CONTROL LINKAGE - OPERATION (Figure 2)

Fore-and-aft action (Figure 2A). The cyclic pitch control stick (5), by actuating the forward rod (2), causes the swash plate (1) to tilt about the YY' axis, represented by the push rods (3) (4).

Lateral action (Figure 2B). By differential displacement of the two lateral push rods (3) (4), the cyclic pitch stick causes the swash plate to tilt about axis XX' represented by the forward push rod (2).

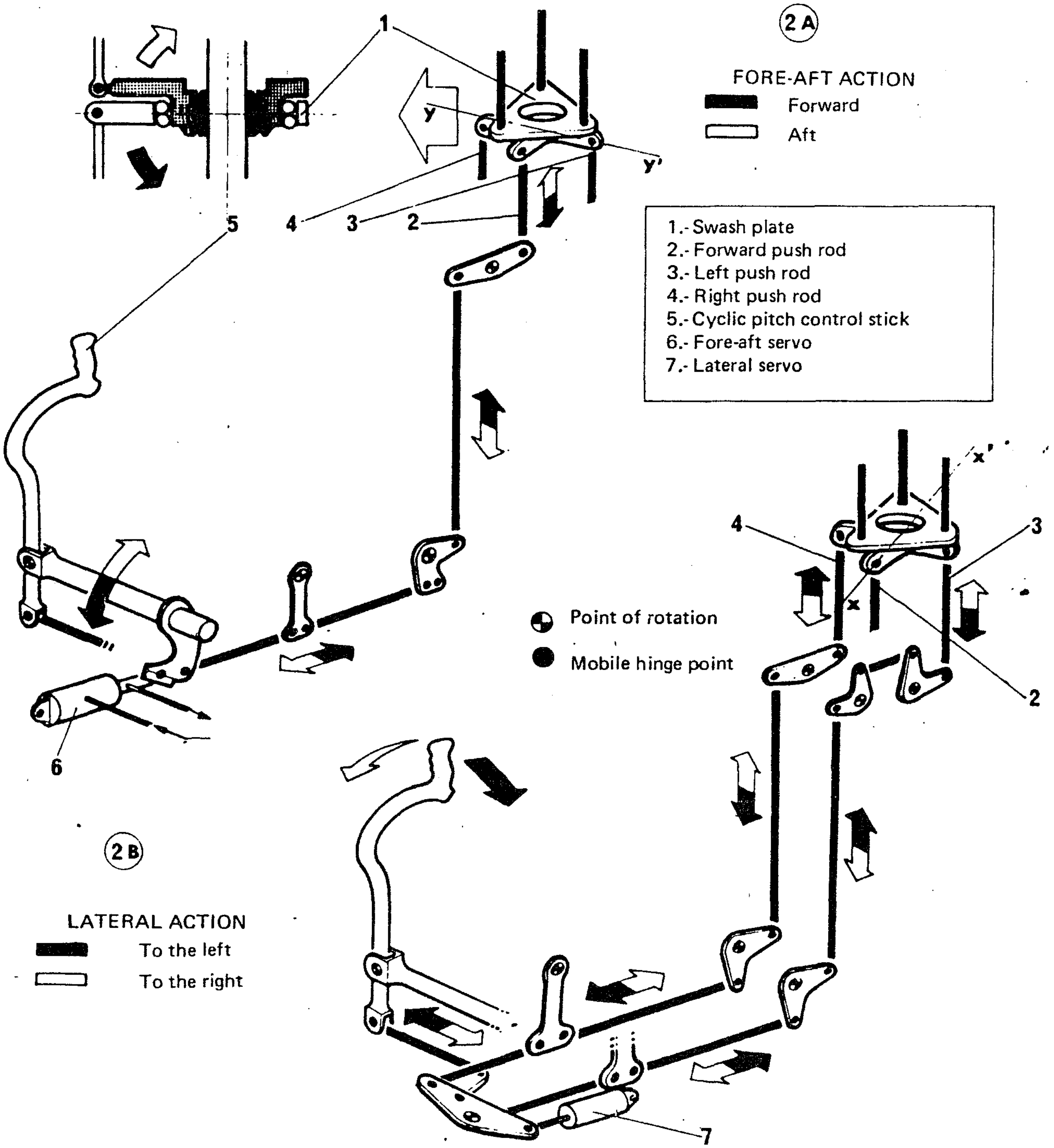


Figure 2
Operation of the cyclic pitch control

6.10.1.- CYCLIC PITCH CONTROL (contd.)

C.- MAIN COMPONENTS

With the exception of the components described below, the control linkage runs consist of rods and bellcranks of a simple technology presenting no particular interest.

(1) Swash plate - The «swash plate» assembly is described in chapter 4

(2) Servo-jacks - The servos are described in chapter 7

(3) Cyclic pitch control stick assembly (Figure 3)

The cyclic pitch control stick assembly consists of :

- The pilot's cyclic pitch stick (10) articulated both laterally and longitudinally on a dual bearing(11). The cyclic pitch stick is fitted with an adjustable friction device consisting of a friction ball (7), a friction cup (5) and spring washers (4). The tightening wheel (2) regulates the compression of the washers and hence the friction between the ball and cup.
- The synchronizer assembly which provides the possibility of dual controls (co-pilot's stick). The assembly consists of a torque tube (12) in the longitudinal linkage and a rod (15) in the lateral linkage. The tube and rod interconnect the base of the pilot stick and the base tube for the co-pilot's stick (4).
- The control run linkage components : lateral control (14) and lateral control bellcrank (16) ; fore-and-aft control lever fixed to the torque arm. The movement of the cyclic pitch stick is limited, longitudinally and laterally, by the friction ball (7) which acts as a mechanical stop.

1.-	Friction stop (1/2 clamp)	11.-	Bearing
2.-	Friction tightening wheel	12.-	Torque tube
3.-	Retainer	13.-	Cyclic stick hinge
4.-	Spring washers	14.-	«Lateral» control rods
5.-	Friction cup	15.-	«Lateral» synchronizer rod
6.-	Removable cup	16.-	Lateral control bellcrank
7.-	Friction ball	17.-	Copilot's cyclic stick end-fitting
8.-	Lateral servo-control	18.-	Longitudinal control lever
9.-	Lateral control rod	19.-	Bellcrank support
10.-	Pilot's cyclic control stick		

M.C.P 65 to mechanical linkage to gage.

6.10.1.- CYCLIC PITCH CONTROL (contd.)

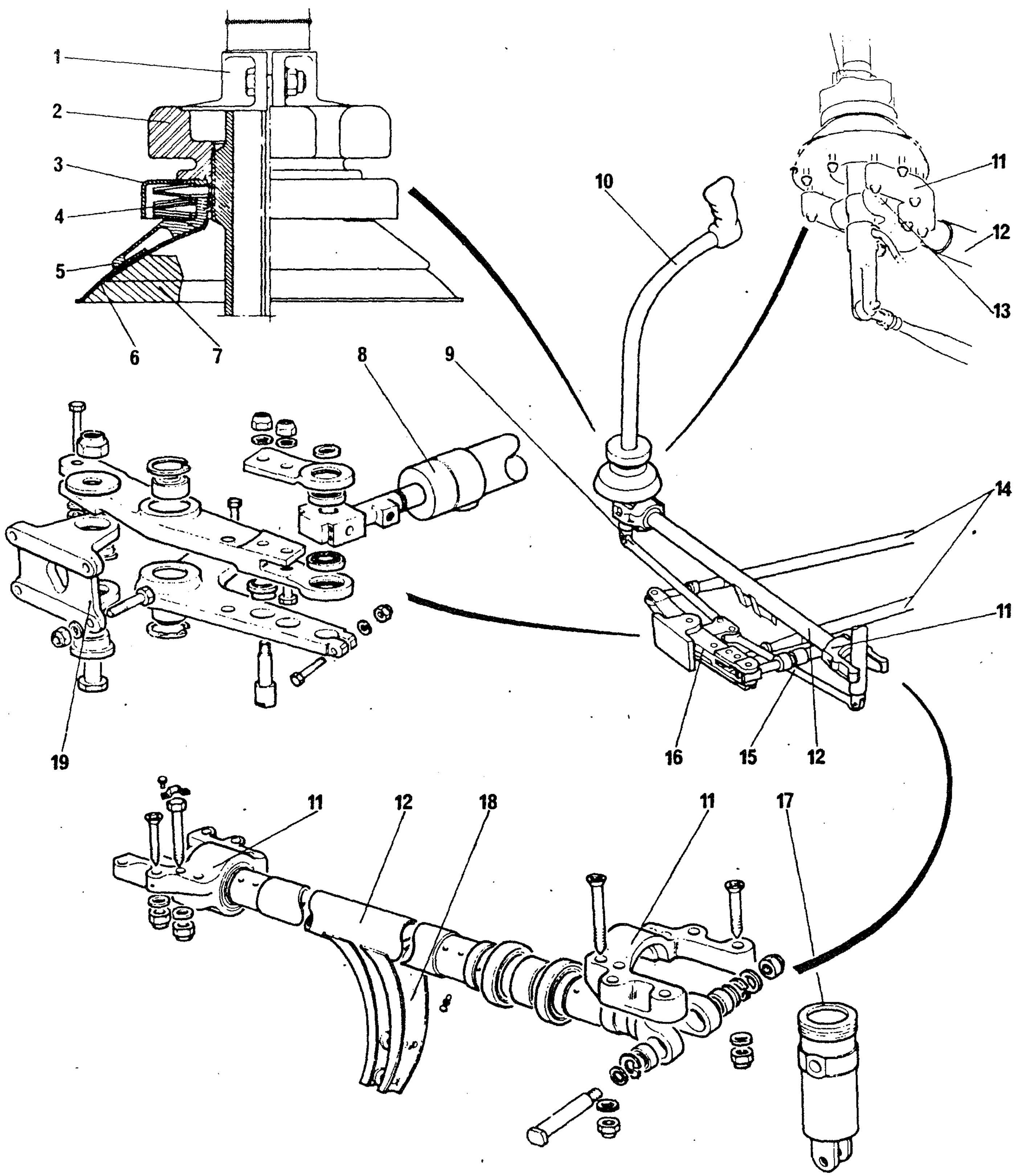


Figure 3
Cyclic pitch control stick assembly

6.10.2.- COLLECTIVE PITCH CONTROL

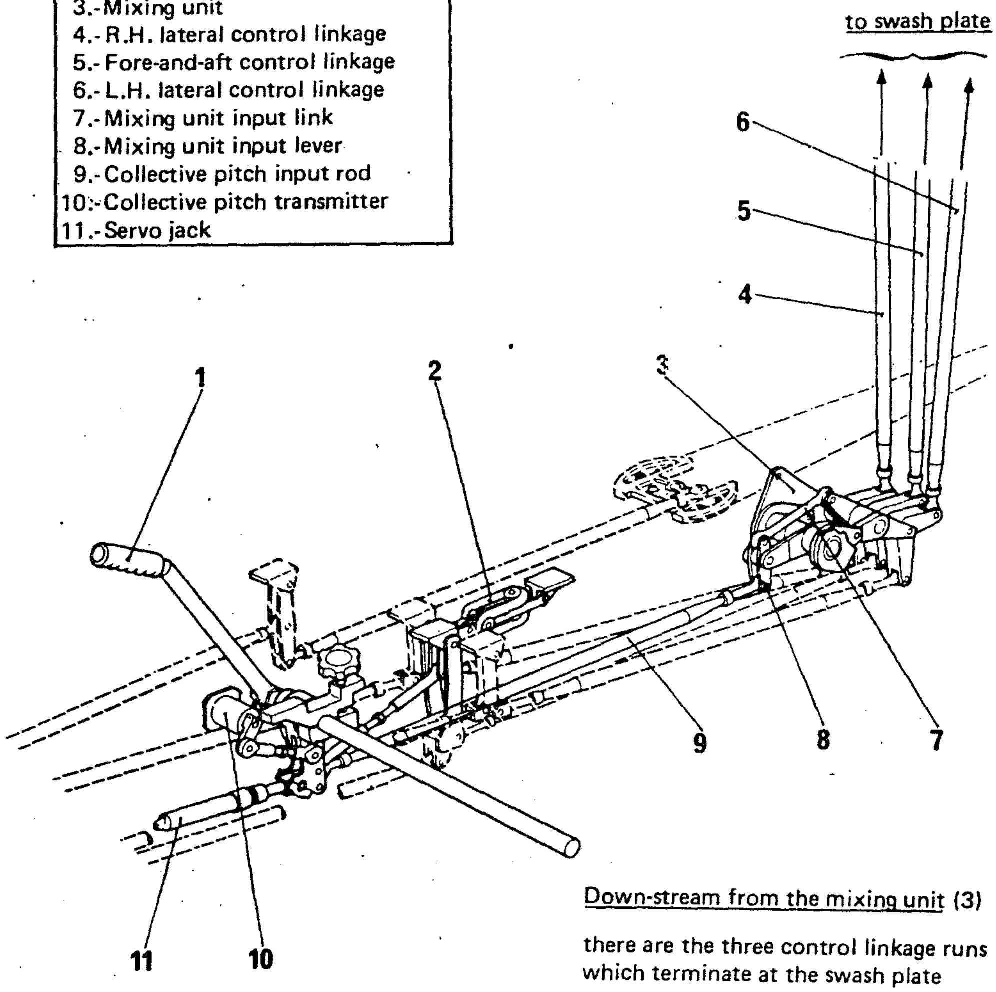
A.- GENERAL (Figure 4)

LAMA SB. 67.07

The collective pitch control consists of :

- the collective pitch control lever assembly (1)
- a mixing unit (3) actuated by the rod (9) which is controlled by the collective lever. The unit allows the collective pitch variation to be superimposed on the cyclic pitch variation. Movement of the collective pitch lever results in a simultaneous and equal displacement of the three rods on the downstream side of the mixing unit (4, 5 and 6) (see operation of mixing unit § B)
- A servo-jack (11) - In case of failure in the servo system, an elastic cord pitch compensator (2) neutralises the load on the collective pitch control lever.
- A collective pitch monitoring system consisting of an electric pitch transmitter (10) relayed to a monitoring dial indicator on the instrument panel.

1.- Collective pitch control lever
2.- Pitch compensator (elastic cord)
3.- Mixing unit
4.- R.H. lateral control linkage
5.- Fore-and-aft control linkage
6.- L.H. lateral control linkage
7.- Mixing unit input link
8.- Mixing unit input lever
9.- Collective pitch input rod
10.- Collective pitch transmitter
11.- Servo jack



Down-stream from the mixing unit (3)

there are the three control linkage runs which terminate at the swash plate

NOTE : Mixing unit input link (7) and input lever (8) may be replaced by a bellcrank embodying a friction disc which dampens the vibration feedback in the control run at altitude.

Figure 4
Collective pitch control

6.10.2.- COLLECTIVE PITCH CONTROL (contd.)

B.- COLLECTIVE PITCH CONTROL - OPERATION (Figure 5)

The three control relay bellcranks R1, R2, R3 of the forward, right and left linkage runs are hinged at A on the collective bellcrank (2) of the mixing unit which is connected to the collective pitch input rod (1). If the cyclic pitch stick is immobile, movement of the collective pitch lever causes the collective bellcrank to turn about its fixed point B. The collective bellcrank moves the three relay bellcranks R of which :

. The pivot point A turns about the fixed point B
. The pivot point C turns about the fixed point D, i.e. the pivot point of the cyclic pitch control rod.
. The free ends E move along a vertical path operating the three control linkages, forward,right and left.
The swash plate moves parallel to its first position causing collective incidence variation of the three blades.

N.B. When the cyclic pitch control stick is actuated, the mixing unit collective bellcrank acts as a simple support for the bellcranks R which turn about their fixed hinge point A.

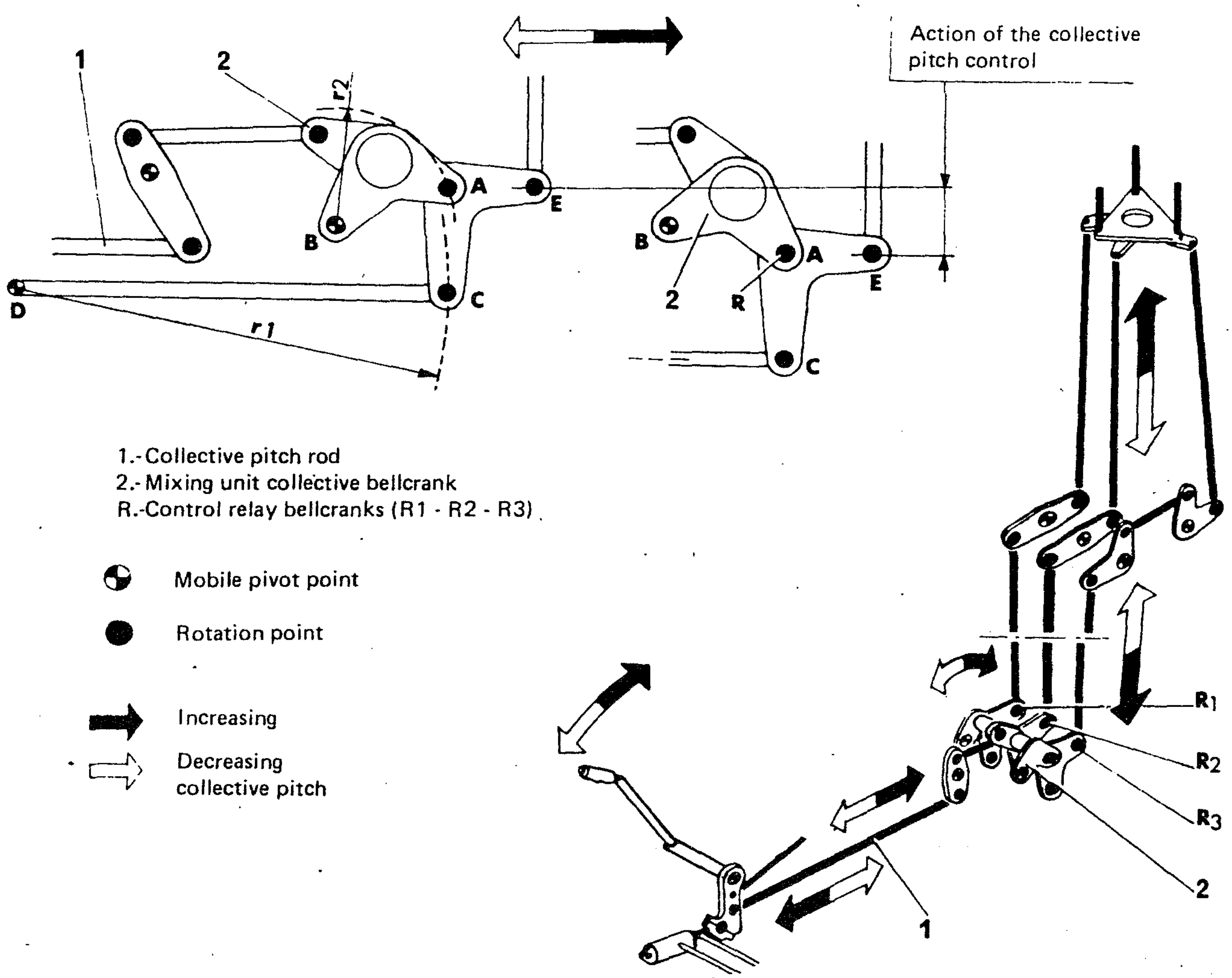


Figure 5
Collective pitch control operation

6.10.2.- COLLECTIVE PITCH CONTROL (contd.)

C.- MAIN COMPONENTS

(1) Collective pitch control lever assembly (Figure 6)

The collective pitch control lever assembly consists of :

- The pilot's collective pitch control lever (1) solid to a torque shaft (7). The collective pitch control lever is fitted with an adjustable friction clamp consisting of two jaws (14) which grip the torque tube ; tightness is adjusted by a knob (2).
- A torque shaft (7) which allows the mounting of a copilot's collective pitch control lever on the end-fitting (8). The torque shaft turns in two bearings (6).
- linking components. The control lever assembly (11) solid to the torque shaft receives :
  - . the collective pitch control rod (5)
  - . the pitch compensator - elastic cord (14) rod (3)
  - . the pitch transmitter link (9)
  - . the servo-unit attaching pin, held in two ball bearings (19)
- A mounting block for the adjustable stops (15) The screw (16), the low pitch stop, provides adjustment of the rotor r.p.m. in auto-rotation. The high pitch stop, consisting of a screw (18) limits forward travel of the arm (17) fixed to the end of the collective pitch control lever.

The input adjustment pin of the servo-unit is located on the arm (12) which is attached to the torque tube. The arm (11) to which the collective pitch rod (5) and the servo-unit power piston rod are attached, turns in two bearings (19) ; its relative movement, with respect to arm (12) is limited by a stop which controls the play of the servo-jack input adjustment pin.

NOTE : The same mounting principle is to be found on the lateral control bellcrank.

1.-	Pilot's collective pitch control lever	10.-	Bearing of collective pitch lever
2.-	Friction clamp tightening knob	11.-	Control lever (input)
3.-	Pitch compensator rod	12.-	Control lever (output)
4.-	Pitch compensator (elastic cord)	13.-	Pitch transmitter
5.-	Collective pitch rod	14.-	Friction jaws
6.-	Torque shaft bearing	15.-	Stop mounting block
7.-	Torque shaft	16.-	«Low pitch» stop
8.-	Copilot's cyclic pitch lever end-fitting	17.-	Stop lever
9.-	Pitch transmitter link	18.-	«High pitch» stop

6.10.2.- COLLECTIVE PITCH CONTROL (contd.)

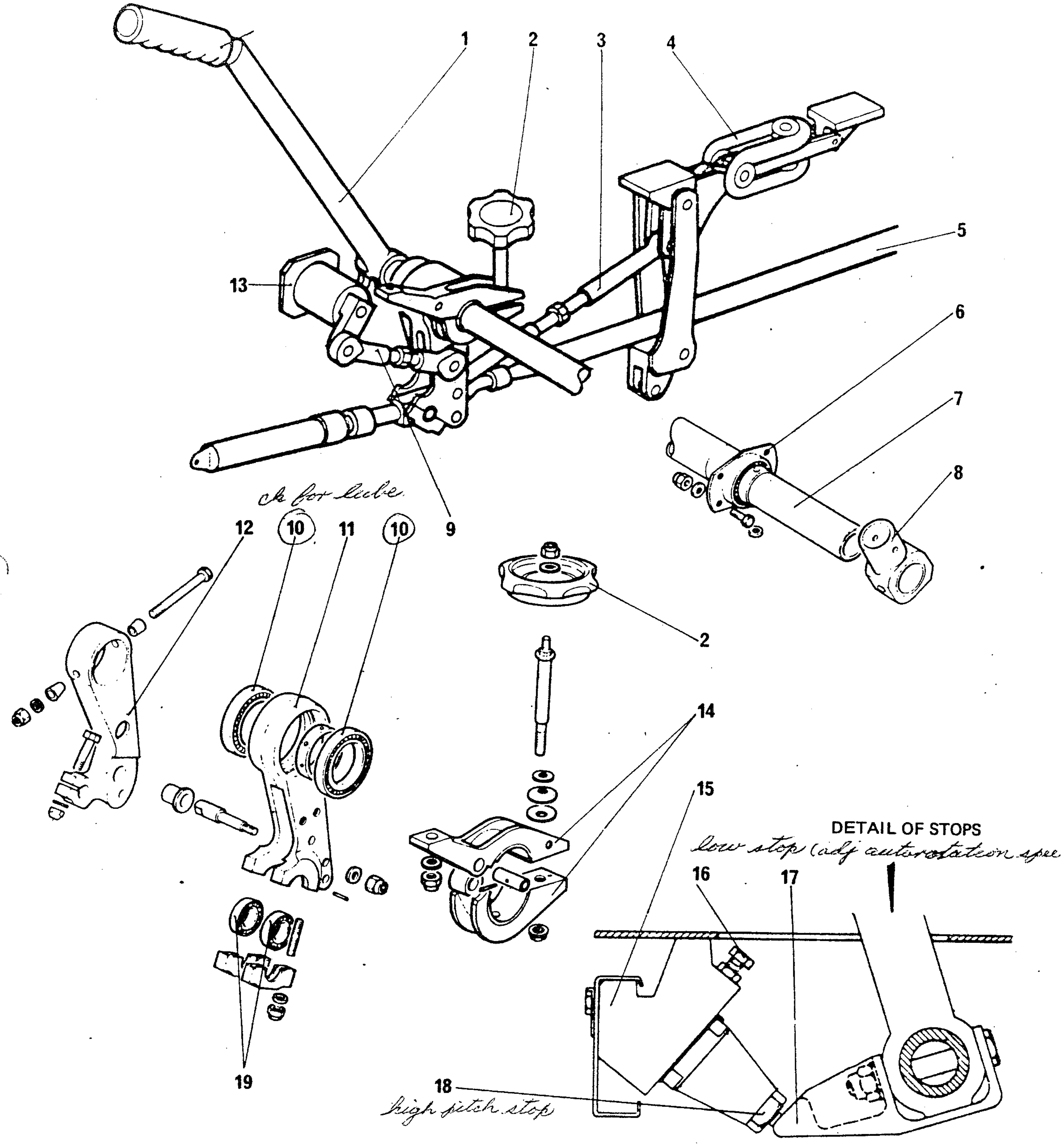


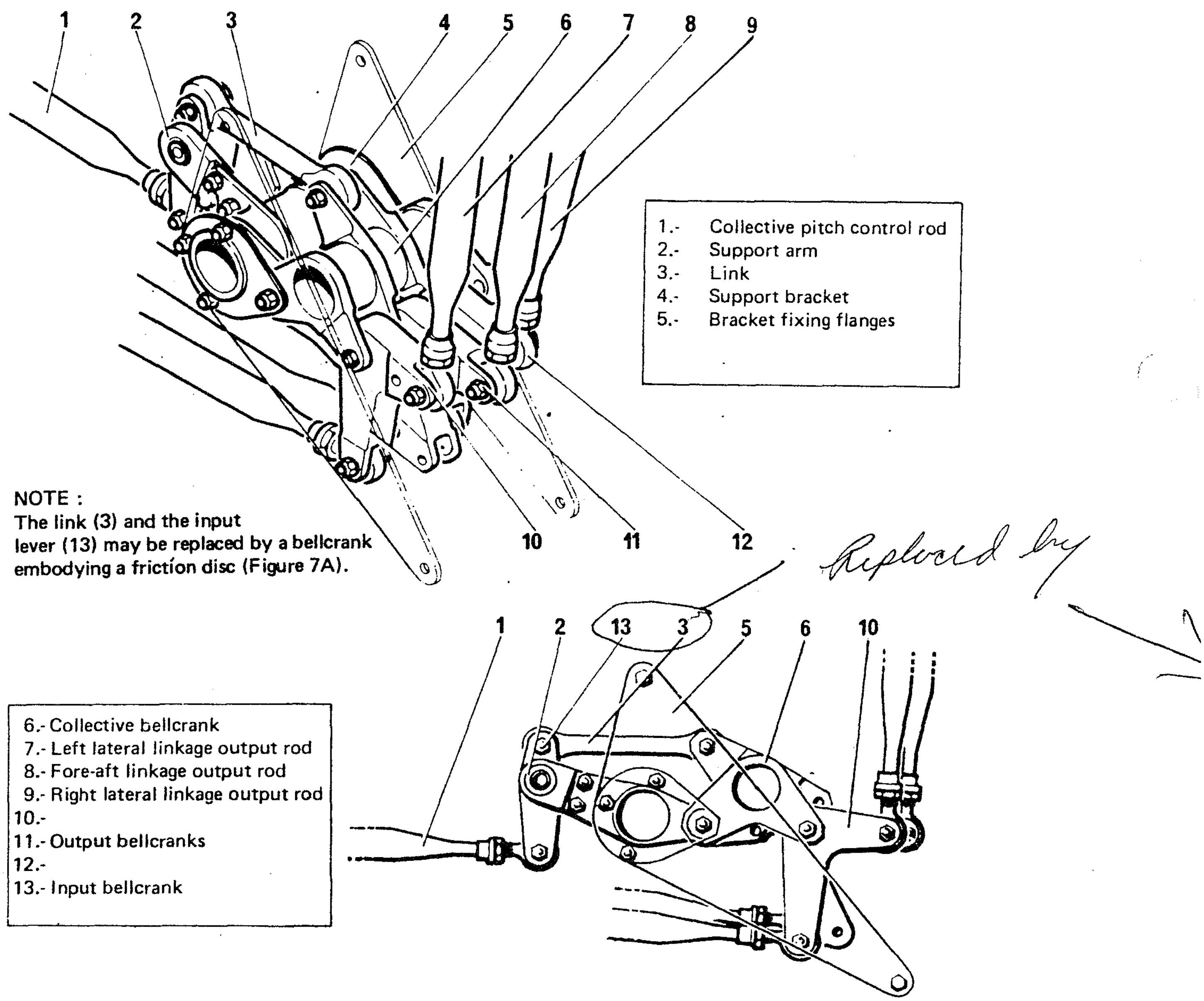
Figure 6
«Collective pitch control lever» assembly

6.10.2.- COLLECTIVE PITCH CONTROL - MAIN COMPONENTS (contd.)

(2) Mixing unit (Figure 7)

The mixing unit consists of :

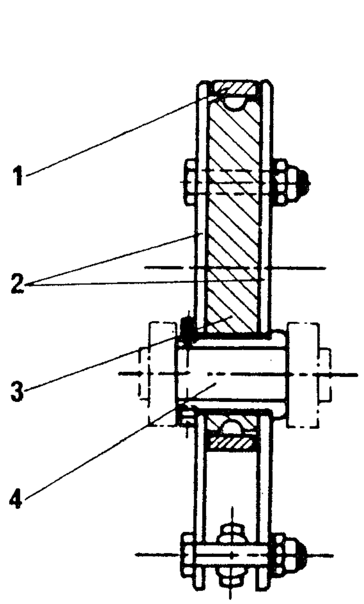
- a support bracket (4) attached to the structure by two flanges (5)
- an input lever (13) articulated on a support arm (2) attached to the bracket (4)
- a collective bellcrank (6) articulated on the support bracket
- three output bellcranks (10-11-12), connected to the collective bellcrank by a rod (3) and actuated by the collective pitch rod (1). The fore-and-aft (8), right lateral (1) and left lateral (7) control rods are attached to the output bellcranks.

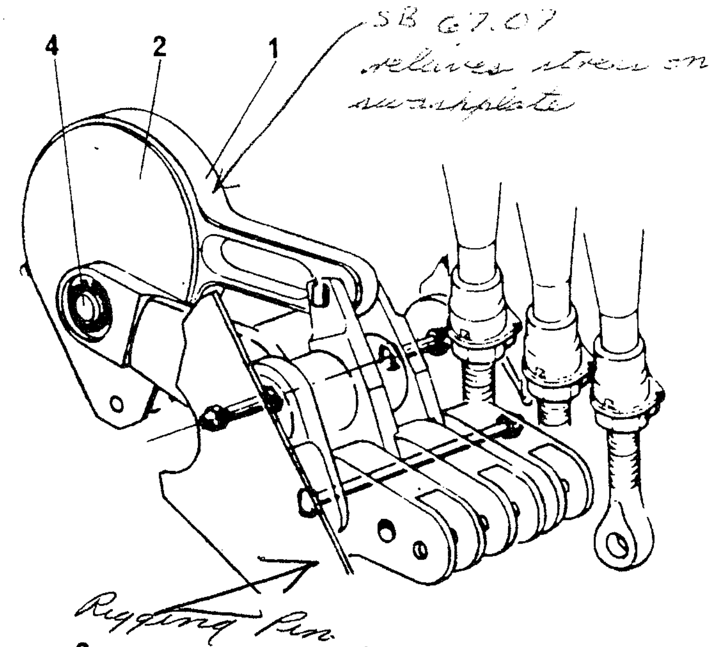


NOTE :
The link (3) and the input lever (13) may be replaced by a bellcrank embodying a friction disc (Figure 7A).

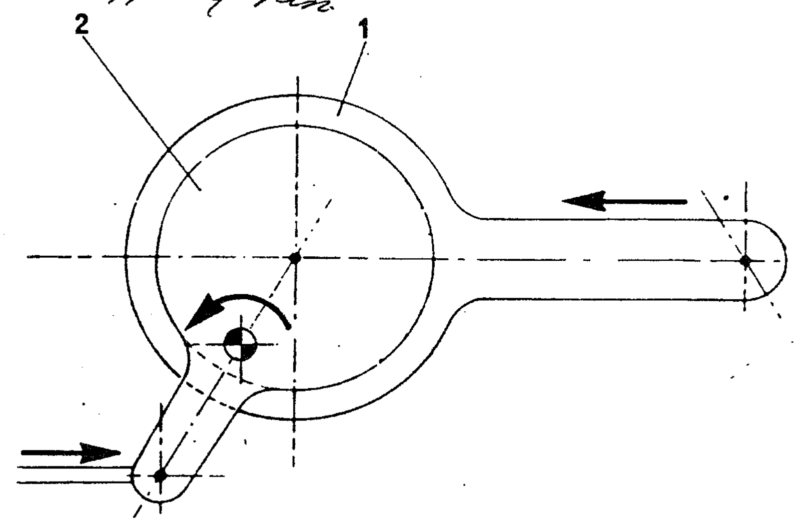
Figure 7
Mixing unit

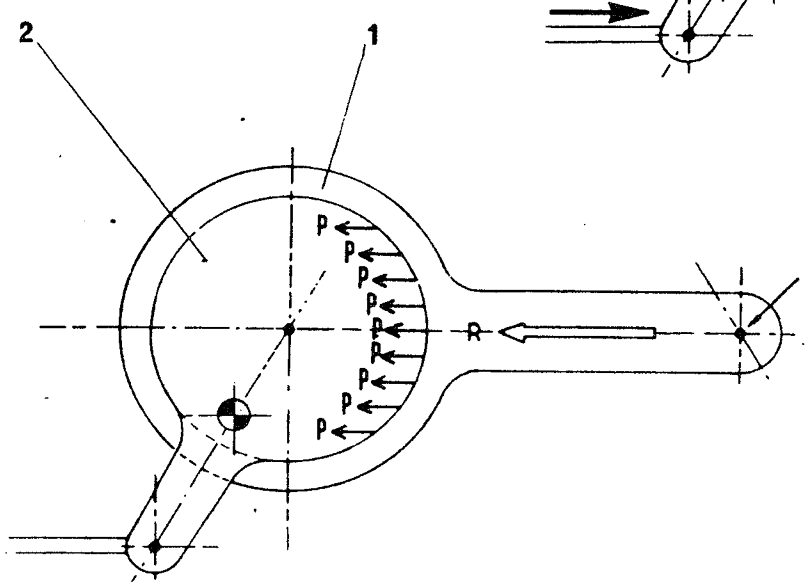
6.10.2.- COLLECTIVE PITCH CONTROL - MAIN COMPONENTS (contd.)





1.-	Rod
2.-	Bellcrank plate
3.-	Disc (eccentric)
4.-	Disc and bellcrank hinge pin (fixed point)





1.- <u>Action on the collective pitch control lever</u> The eccentric disc (2) drives the rod (1).

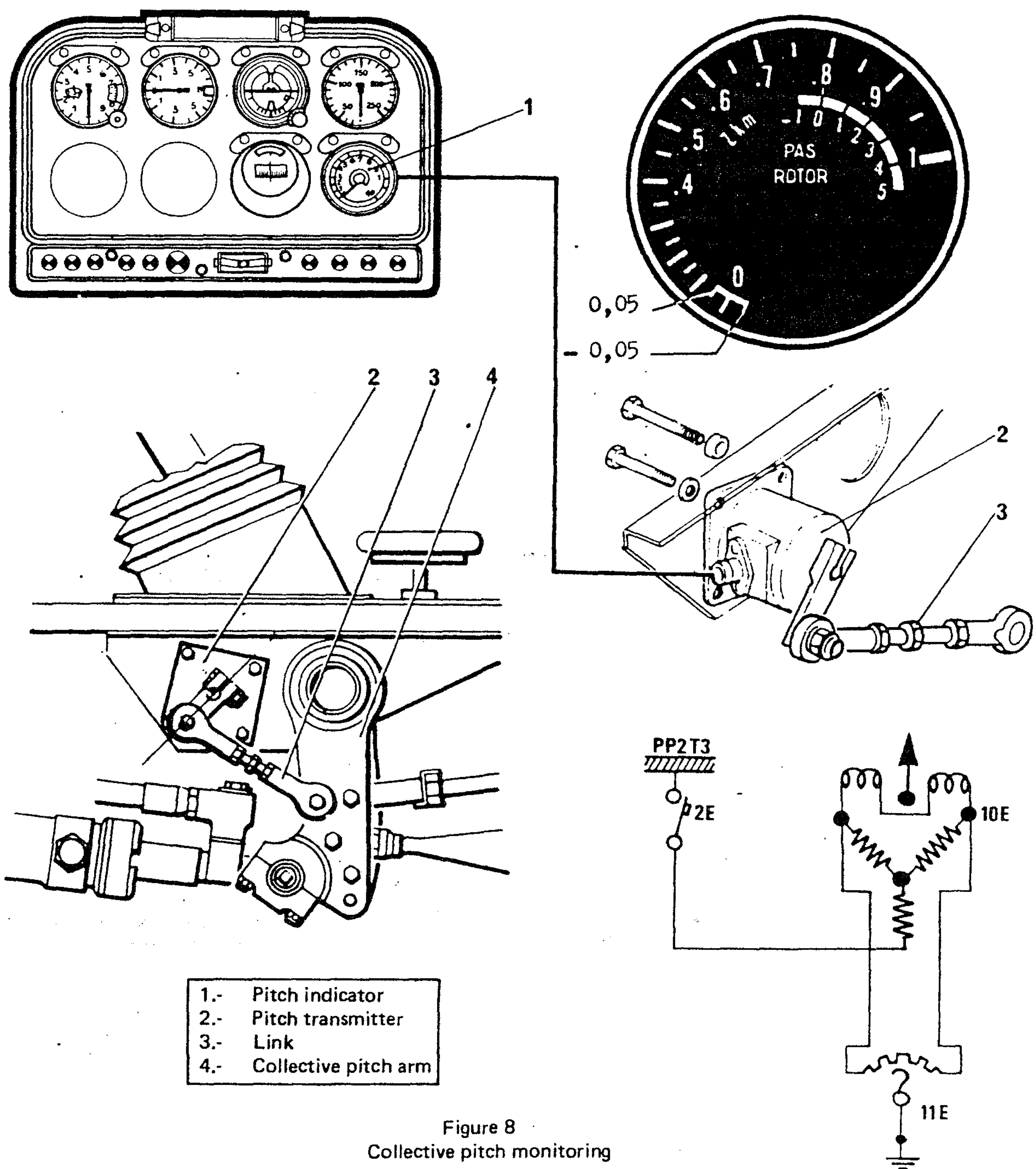
2.- <u>Stress from swashplate</u>
The force R, exerted on the rod (1) is dispersed as a number of thrust forces P distributed along the surface of the eccentric disc. The resulting friction prevents the disc from turning.

Figure 7A
Friction disc bellcrank on mixing unit input

6.10.2.- COLLECTIVE PITCH CONTROL - MAIN COMPONENTS (contd.)

(2) Collective pitch monitoring (Figure 8)
Visual indication of the collective pitch is furnished by an electric pitch transmitter (2). It is of the potentiometer type and its pick-off is controlled by a link (3) attached to the collective pitch control arm (14). The transmitter is wired to an indicator (1) on the instrument panel.

This indicator is graduated linearly from 0 to 1.0 (. . . . . .4, .5, .6, ... 1.0), these figures being proportional to the pitch values.



1.-	Pitch indicator
2.-	Pitch transmitter
3.-	Link
4.-	Collective pitch arm

Figure 8
Collective pitch monitoring

6.20.- TAIL ROTOR CONTROL

6.20.1.- GENERAL (Figure 1)

The tail rotor control adjusts the angle of attack of the tail rotor blades. It consists of :

- The «pedal unit» assembly (1)
- A control linkage comprising two rods (2) (5), a relay (3), a control quadrant (6) and cables (7) guided by pulleys (8) The cables terminate at the control drum (10) situated on the tail rotor gear box.
- A hydraulic damper (4) which limits the rate of displacement of the control pedals and absorbs the control vibration.

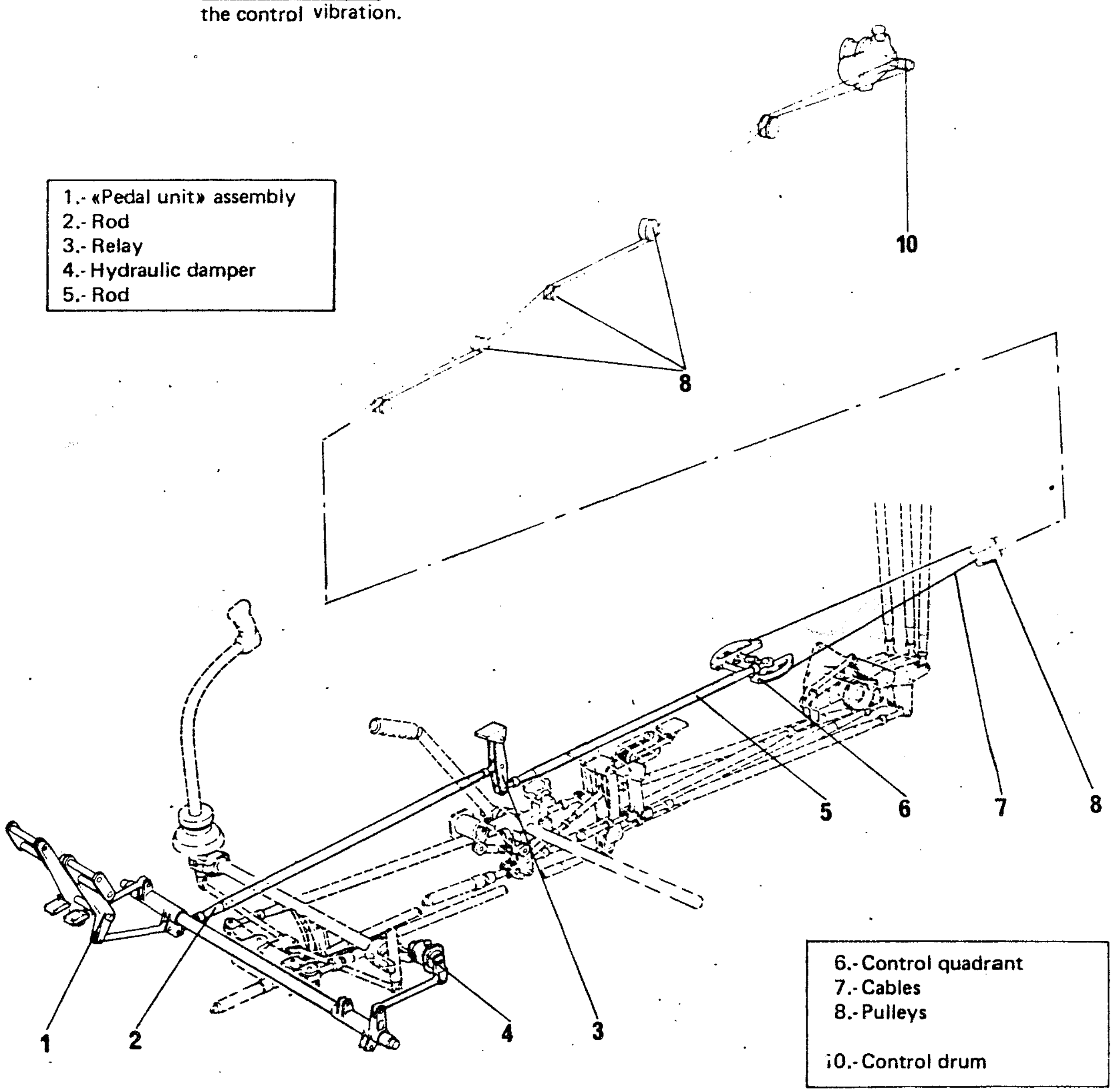


Figure 1
Tail rotor control

6.20.2.- TAIL ROTOR CONTROL OPERATION (Figure 2)

Movement of the pedals (4) causes the drum (1) to rotate. The movement is transformed by the drum into a lateral shift of the control spider (3), which, via pitch links (2), causes a change in angle of attack of the rotor blades.

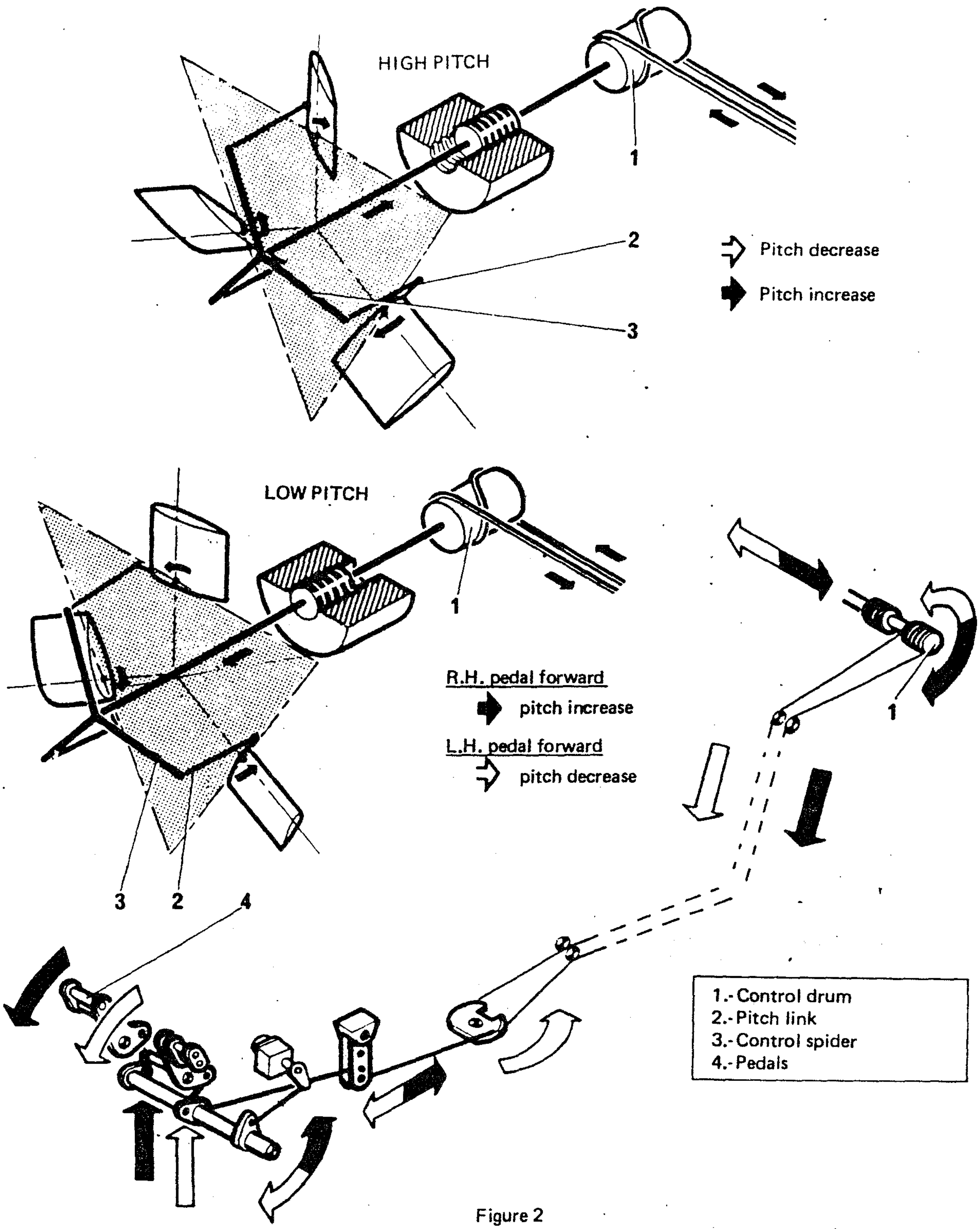


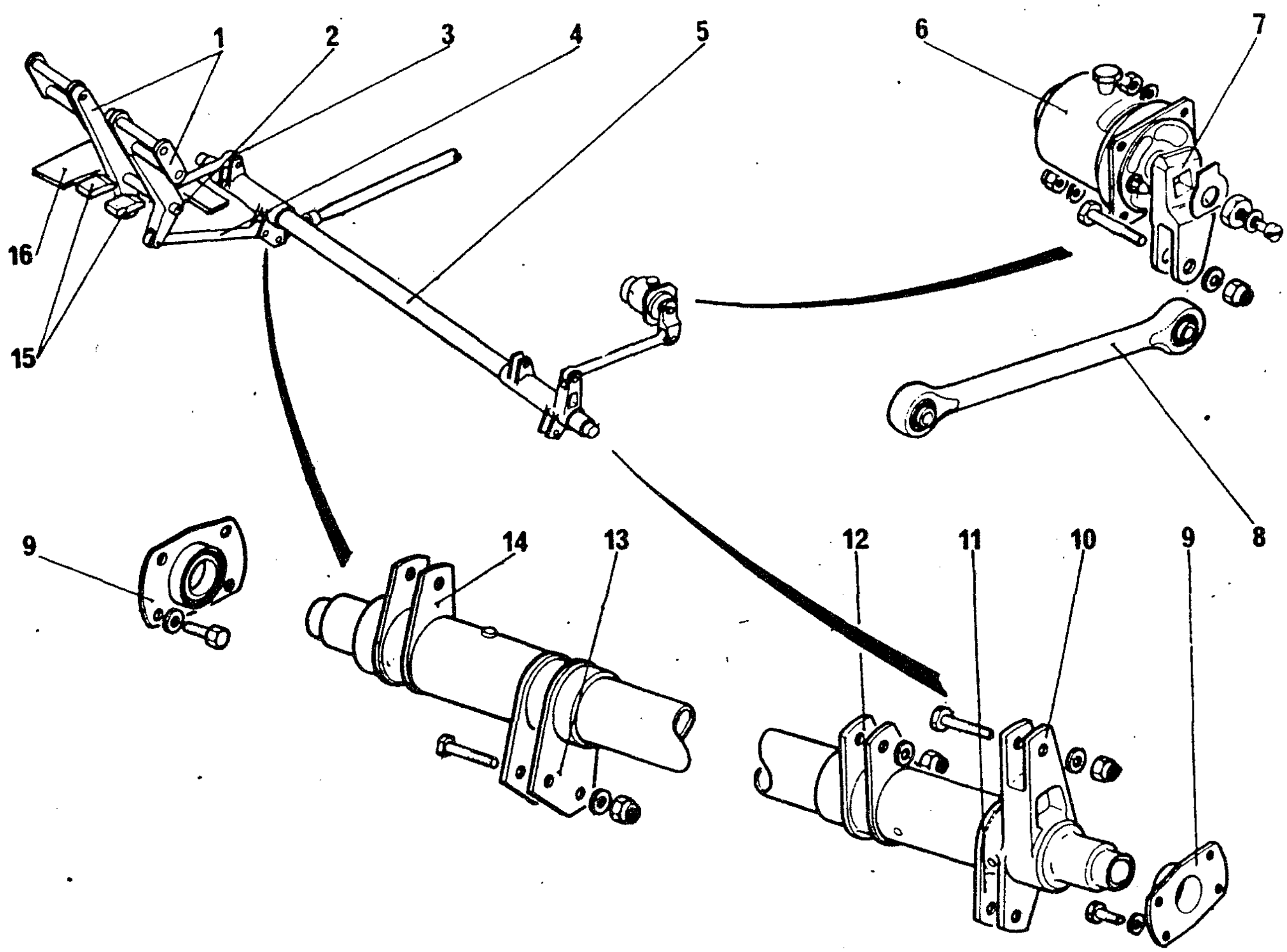
Figure 2
Operation of tail rotor control

6.20.3.- MAIN UNITS

A.- PEDAL UNIT ASSEMBLY (Figure 3)

The pedal unit consists of :

- two «pilot's» pedals (1) rotating on a shaft (2) and supported on a plate (16) on the cabin floor.
- A torque shaft (5) turning on two bearings (9). The «pilot's» pedals are connected to the shaft by two links (3) (4). The torque shaft allows a set of «co-pilot's» pedals to be fitted to the arms (11) (12). The tail rotor control linkage is attached to control arm (13) which is integral with the torque shaft.
- a stop assembly (15) which limits the travel of the pedals.

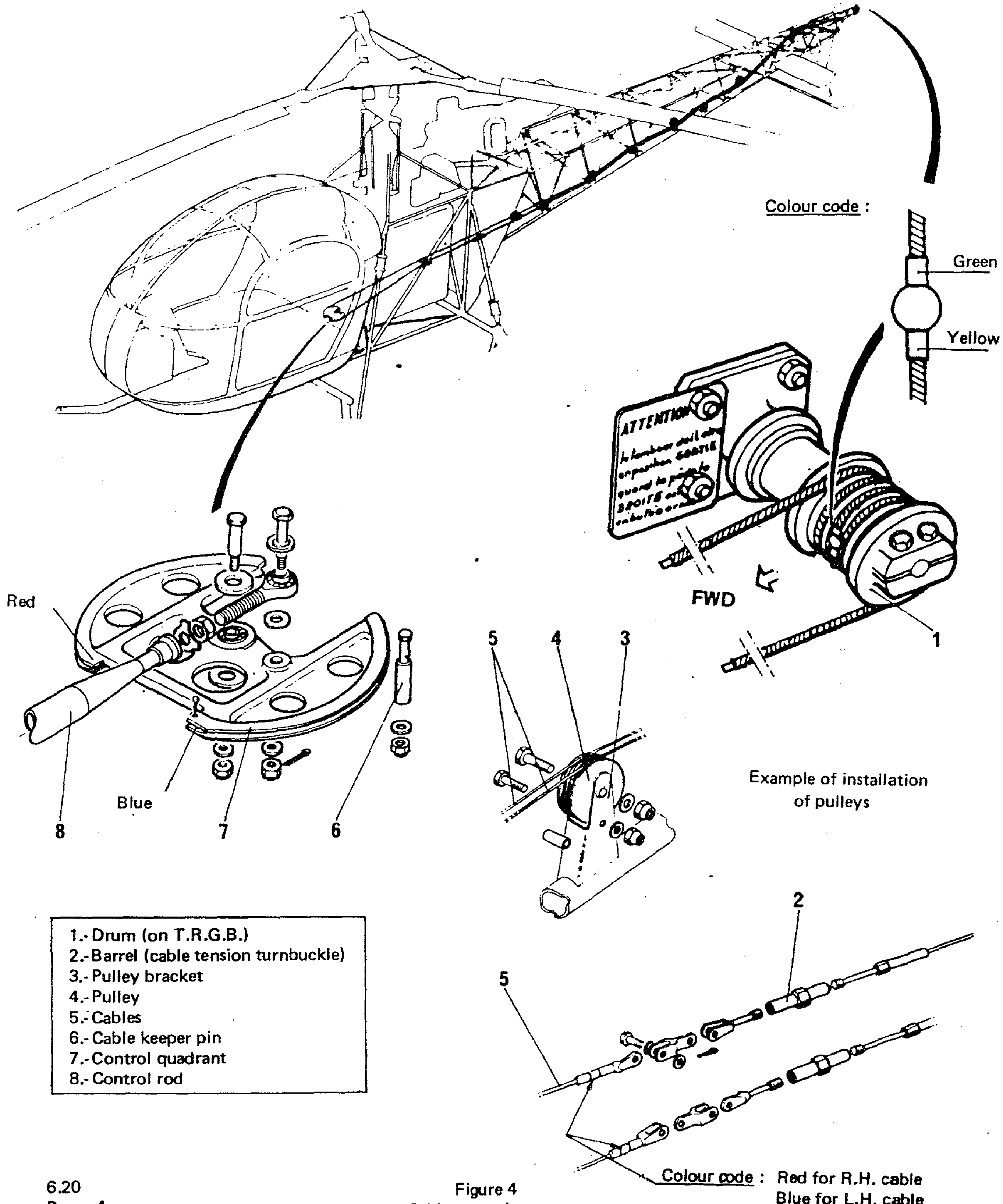


1.- «Pilot's» pedal unit	9.- Torque shaft bearings
2.- Pedal hinge pin	10.- Damper connecting lever
3.- Link	11.- } Co-pilot pedals adaptor arms
4.- Link	12.- }
5.- Torque shaft	13.- } Control arms
6.- Hydraulic damper	14.- }
7.- Damper arm	15.- Pedal stops
8.- Link	16.- Pedal unit support

Figure 3
Pedal unit assembly

6.20.3.- TAIL ROTOR CONTROL : MAIN COMPONENTS (contd.)

B.- CABLE CONTROL RUN (Figure 4)



1.- Drum (on T.R.G.B.)
2.- Barrel (cable tension turnbuckle)
3.- Pulley bracket
4.- Pulley
5.- Cables
6.- Cable keeper pin
7.- Control quadrant
8.- Control rod

Figure 4
Cable control system

5606

6.20.3.- TAIL ROTOR CONTROL - MAIN COMPONENTS (contd.)

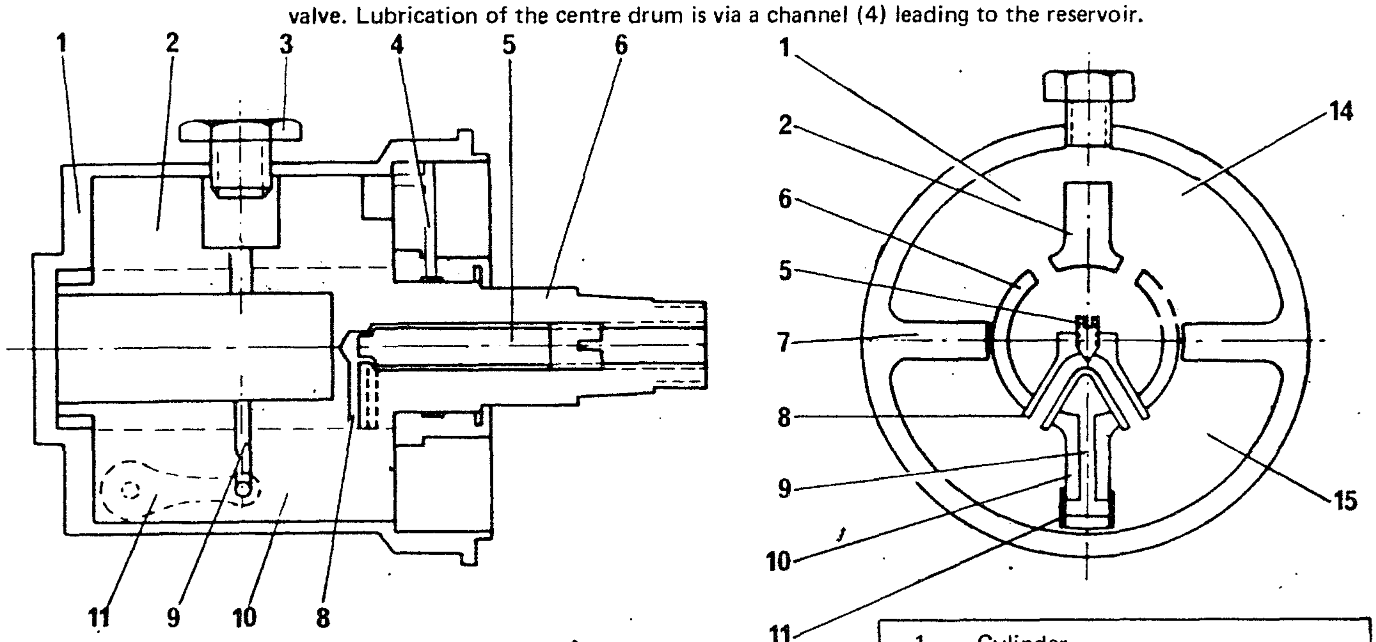
C.- HYDRAULIC DAMPER (Figure 5)

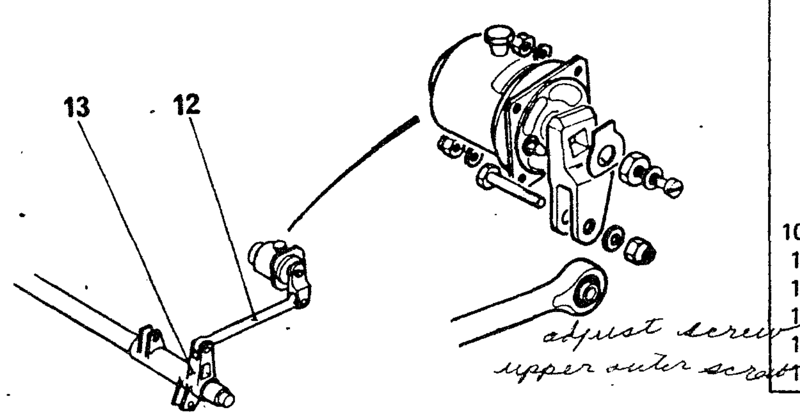
can cause erratic pedal movement.

The damper, which is of the semi-rotating type, consists of :

- a cylinder (1) divided by two webs (7) into two parts - a reservoir (14) and a shock absorbing chamber (15). The cylinder is filled with hydraulic fluid.
- a hollow centre drum (6) with two vanes : an active vane (10) which defines the two active spaces (A-B) and a balancing vane (2).

Driven by the rod (12), the centre drum (6) turns and the vanes move between the two webs (7). The movement of the active vane causes an increase in the fluid pressure in the active space (A or B according to the rotational direction). The compressed fluid flows into the other space via the restrictor channel (8), the flow capacity of which is regulated by the conical adjuster screw (5). The metering of the fluid at the pointed screw produces the dampening effect. The reservoir (14) connects with the active spaces via the feed channel (9). A membrane (11) acts as a non-return valve. Lubrication of the centre drum is via a channel (4) leading to the reservoir.





1.- Cylinder
2.- Balancing vane
3.- Filler plug
4.- Lubrication channel for centre drum
5.- Pointed screw (adjustment of flow)
6.- Hollow centre drum
7.- Web
8.- Shock absorbing channel
9.- Feed channel
10.- Active blade
11.- Membrane (non-return valve)
12.- Rod
13.- Arm
14.- Reservoir
15.- Shock absorbing chamber

NOTE : According to the modification standard (HOUDAILLE AV), hydraulic dampers supplied may differ from the model described :

- membranes (11) cancelled
- different filler system
- modified seals.

Figure 5
Hydraulic damper

6.30.- FLIGHT CONTROL RIGGING

6.30.1.- RIGGING THEORY

go to tables in maint. manual.

A.- DEFINITIONS

- The control - this is the element upon which the pilot acts (e.g, the cyclic pitch stick)
- The control surface - the element controlling the flight i.e. the blades or, more precisely, the «blade-control plate» assembly, which constitutes a unit to be adjusted, independently of the control linkage.
- The intermediate components - the relays, bellcranks, levers
- The connecting components - these are the rods which link the controls, the intermediate components and the control surfaces.

Basic positions of the controls and control surfaces

These important positions act as reference positions for rigging the control linkage or to verify results after rigging. The following distinctions are made :

- The mean position : the mid-travel position of the control or control surface.
- The neutral position : the inoperative position of a control or control surface. This is specific to the cyclic pitch linkage. The neutral position of the cyclic pitch stick is that for which there should be no cyclic variation of the blade incidence. The neutral position of the swash plate is defined by the perpendicularity «Swash plate - rotor shaft» and the parallelism «Swash plate - rotor plane».
- The extreme positions : these are the limit positions that a control or control surface may reach. These are determined at the level of the control, by the mechanical stops.

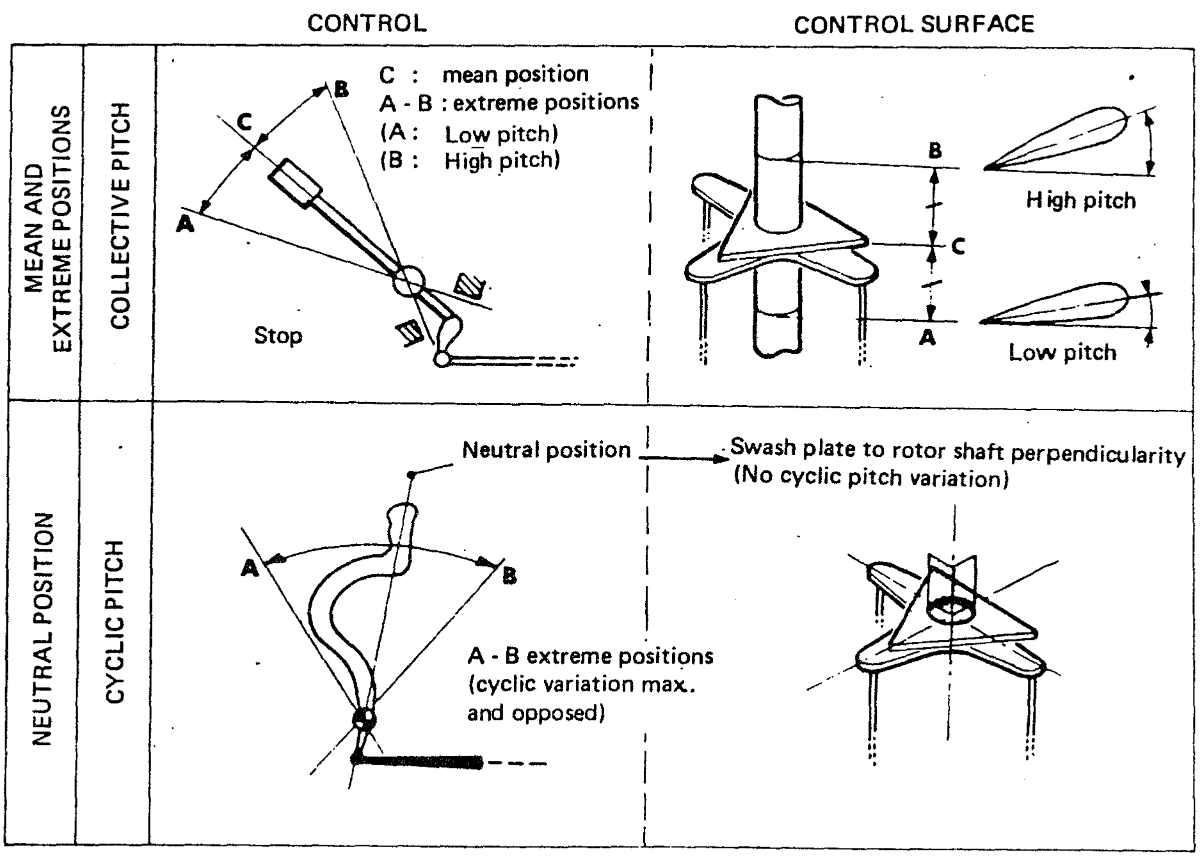


Figure 1
Characteristic positions of the controls and control surfaces (examples).

6.30.1.- RIGGING THEORY (contd.)

B.- THEORY OF FLIGHT CONTROL RIGGING

Flight control rigging consists essentially in :

(1) Setting and harmonising the basic positions of and between the control and the control surface.

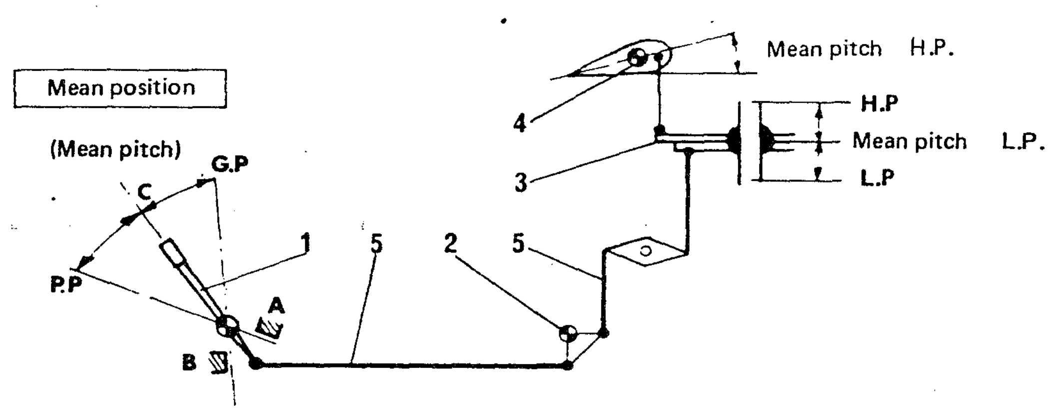
(2) Making sure that the travel limits of the control allow the control surfaces to attain the extreme positions.
The geometry of the control linkage runs is such that it is only necessary to achieve concordance of the mean (or neutral) positions of control and control surface ; the extreme positions will then automatically be correct.
Consequently, to adjust a control linkage, it is only necessary :

(1) - to set the control in the mean position (neutral in the case of cyclic pitch)
- to set the intermediate components in the mean position
- to set the control surface in the mean position (neutral in the case of cyclic pitch),
and, with the system thus set, connect up the link rods, adjusting the length of the rods as necessary.

(2) - To adjust the extreme positions of the control in such a way that the control itself has the correct travel and that the mean (or neutral) position is correct and also that the desired limit incidence is given to the control surfaces.

NOTE that the basic positions of adjustment are generally obtained by :
- pinning the components
- using a tool (gauge)
- measurement of distance or angle

EXAMPLE : THEORY OF COLLECTIVE PITCH LINKAGE RIGGING



(1) Control – control surface concordance	(2) Stick travel adjustment
- collective pitch control lever in mean position (1) - bellcrank (2) in mean position - swash plate in mean position (3) - blade at mean incidence (4) and rods (5) linked in this configuration	- stop B adjusted to give high pitch at the blade - stop A adjusted to give low pitch at the blade

Figure 2
Theory of collective pitch linkage rigging

6.30.2.- GENERAL

This chapter does not describe the rigging operations. It is intended to demonstrate the basic principle of these operations, a thorough understanding of which enables the detailed carrying out of the rigging operations outlined in the Manual, in full knowledge of their purpose.

A.- ADJUSTMENTS TO BE CARRIED OUT :

The following adjustments are to be made :
On the main rotor controls :
- basic adjustment of blade sleeves
- adjustment of control linkage
  . adjustment of control – control surface concordance
  . adjustment of control travel
  . checking and adjusting the cyclic pitch amplitudes
- other adjustments :
  . adjustment of collective pitch compensation
  . adjustment of parallelism of the cyclic sticks
  . adjustment of pitch transmitter

On the tail rotor controls :
- adjustment of the control linkage
  . adjustment of the control/control surface concordance
  . adjustment of the control travel

B.- GENERAL DATA CONCERNING THE ADJUSTMENTS

1 - READING OF ANGLES

The angular measurements necessary to adjustment (blade incidence, control position ..) are carried out with a clinometer. The reference used should be horizontal (i.e. aircraft on jacks, rotor head level).

2 - PROPER CONFIGURATION FOR INCIDENCE ADJUSTMENT

The adjustments made to give a proper reading of the blade incidence must be made with a certain precisely defined configuration of the aircraft. This is to avoid erratic readings arising from uncertain configuration.

The helicopter should be set to the following configuration :

- blades installed
- main rotor blade sleeves locked in drag by a rigging pin.
- sleeves resting on the first notch of the droop restrainer.
- spacer cables disconnected.

6.30.2.- GENERAL (contd.)

B.- GENERAL DATA CONCERNING THE ADJUSTMENTS (contd.)

3 - REMARKS CONCERNING THE MAIN ROTOR BLADES - REMINDERS

- The design angle, for basic blade sleeve setting is 12° 40'.
- With the blades installed on the rotor head, the installation error of each blade Ie (or Δi) necessitates a second basic blade sleeve adjustment (see chapter 5). The pitch links are then adjusted to take Δi into account.

Example : If Δi of a blade is +8' then the pitch link corresponding to that blade is lengthened so that, in the «rigged» configuration, the angle of attack of the blade is 12°48'.
Thus, during rigging or checking of the blade incidence, it is necessary to take the installation error into account in order to bring the values read to the basic setting values, and thus avoid confusion.

Example : When checking the pitch indicator, the incidence of the blade in the above example is 14°34'.
The value to be taken into consideration is therefore : 14°34' – 8' (Δ i) = 14° 26'

Other definitions :

Actual angle of a blade : this is the incidence measured after a flight.
It differs from the design angle by what is called the actual error (Ae).
The difference between the installation angle and the actual angle results from the minor «tracking» adjustments that are sometimes necessary.

Design angle + Ie (Δ i) = Installation angle

Design angle + Ae = Actual angle

Reference blade : this is the blade with the lowest Installation error Ie (Δ i)

6.30.3.- MAIN ROTOR CONTROL RIGGING

A.- BASIC SETTING OF THE ROTOR BLADE SLEEVES (Figure 3)

This setting is independant of the control linkage rigging and consists in setting the blade sleeves with respect to the swash plate.
It is a basic adjustment. The sleeve incidence reading is valid only when this adjustment has been made.

> *THEORY : 1.- When the swash plate is perpendicular to the rotor mast, the incidence of the three blades should be equal.*
> *2.- When the swash plate is at mid-travel, the three sleeves should be at the mean incidence (12° 40')*

Adjustment

The swash plate (1) is held in mid-position and perpendicular to the rotor mast by three adjustment «C» spacers (3) - a special tool.
In this configuration, the blade incidence is adjusted to 12°40' by adjusting the length of the pitch links (2).

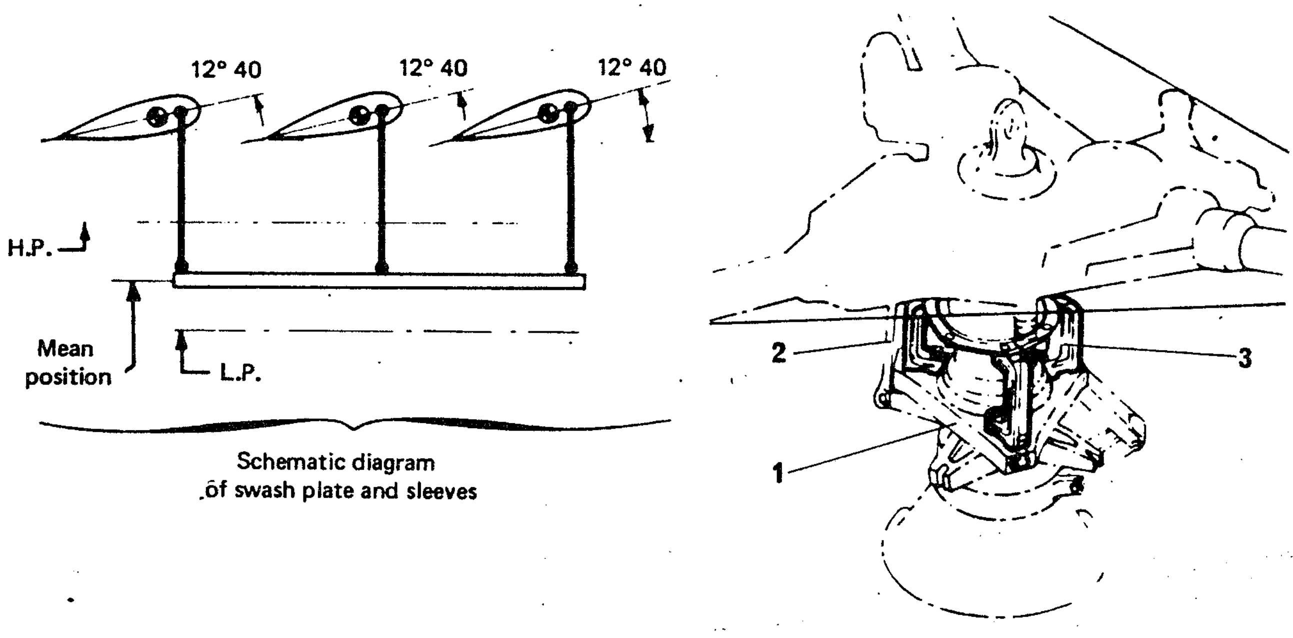


Figure 3
Adjustment of blade sleeves

NOTE :

1.- The sleeve incidence is measured with a clinometer (the rotor mast should be strictly vertical i.e. rotor head level)

2.- To check the blade sleeve setting, it is simply necessary to turn the rotor head through one complete rotation. During the rotation the incidence of the blades should not vary.

6.30.3.- MAIN ROTOR CONTROL RIGGING (contd.)

B.- CONTROL LINKAGE RIGGING (Figure 4)

THEORY :

(1) Cyclic pitch control : when the cyclic pitch stick is in the NEUTRAL position there should be no cyclic variation of the incidence of the blades, i.e. the swash plate should be perpendicular to the rotor mast.

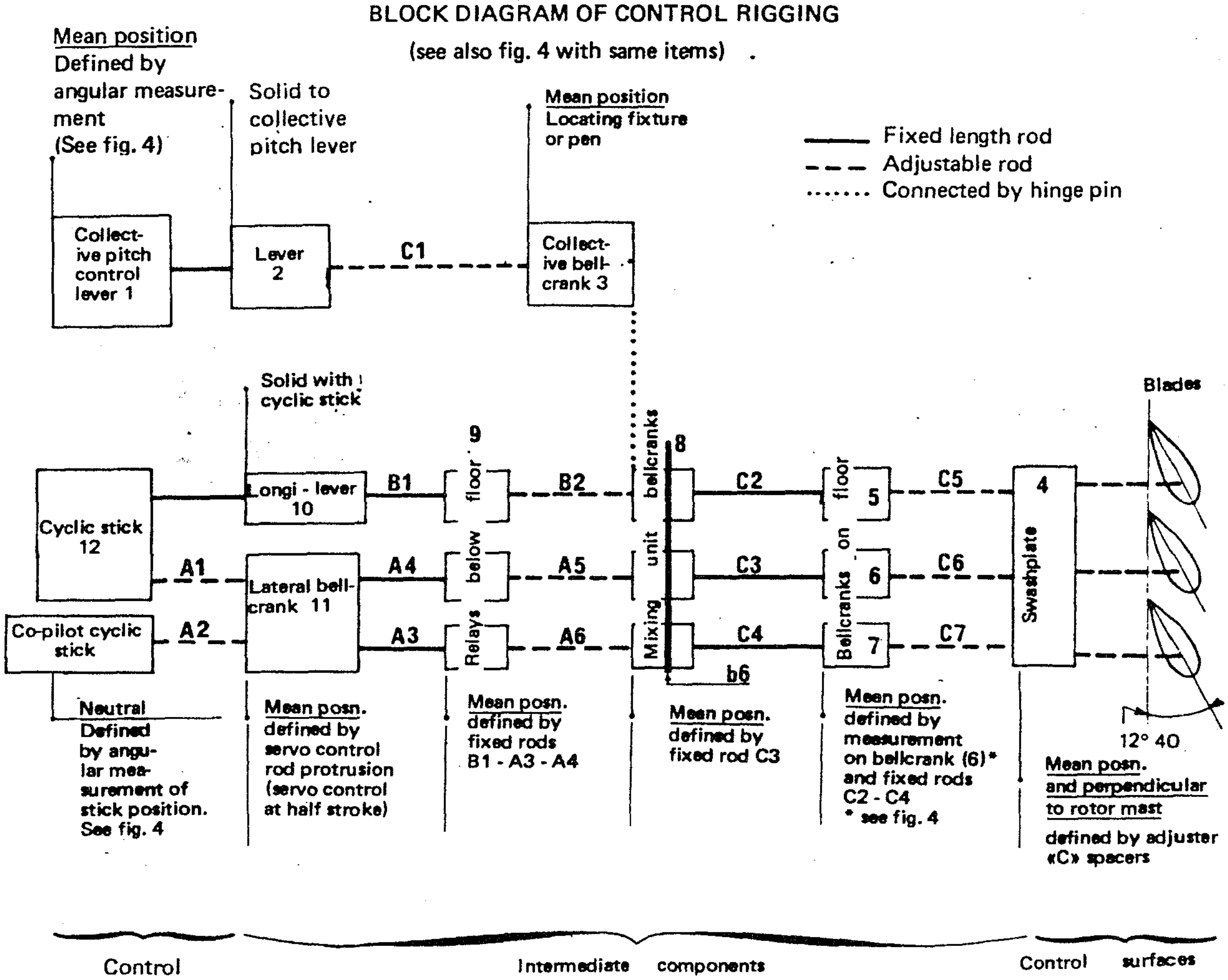
(2) Collective pitch control : When the collective pitch control lever is in the mean position, the swash plate should be in mid-position and the incidence of the blades should be $12^{o}40'$.

1.- ADJUSTMENT OF THE «BASIC CONTROL POSITION - BASIC CONTROL SURFACE POSITION» CONCORDANCE

To adjust the control linkage, it is necessary to :
- disconnect the adjustable link rods
- set the controls, the control surfaces and intermediate components in their basic adjustment positions defined below.
- adjust the length of the adjustable rods so that they can be connected to the various components set in the above conditions.

BLOCK DIAGRAM OF CONTROL RIGGING

(see also fig. 4 with same items)



NOTE : The input play of the servos is cancelled by pinning bellcrank (11) and levers (2) (10). Rigging pins b9 - b10

6.30.3.- MAIN ROTOR CONTROL RIGGING (contd.)

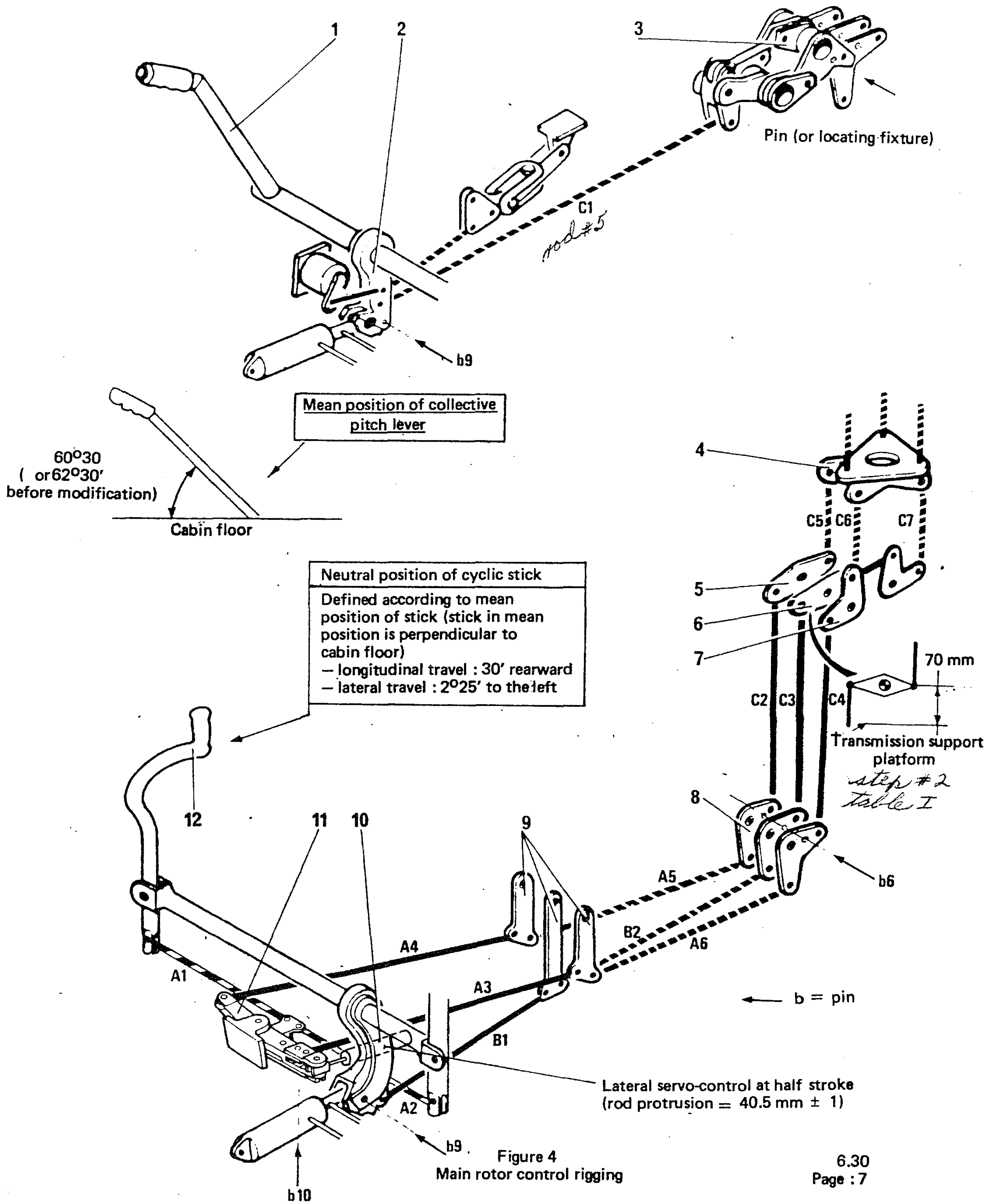


Figure 4
Main rotor control rigging

6.30.3.- MAIN ROTOR CONTROL RIGGING (contd.)

B.- ADJUSTMENT OF CONTROL TRAVEL (Figures 5 and 6)

In order that the rotor blades may attain the extreme incidence positions, the cyclic pitch stick and the collective pitch control lever should have a determined amount of travel. This is obtained by adjustment of the stops that are situated at the base of the cyclic stick and the collective pitch control lever.

WARNING : The travel of the controls should be limited by their stops and in no case should it be checked by the internal stops of the servo units. The protection i.e. clearance of these units should be checked after each adjustment of the control travel.

CYCLIC PITCH STICK TRAVEL (Figure 5)

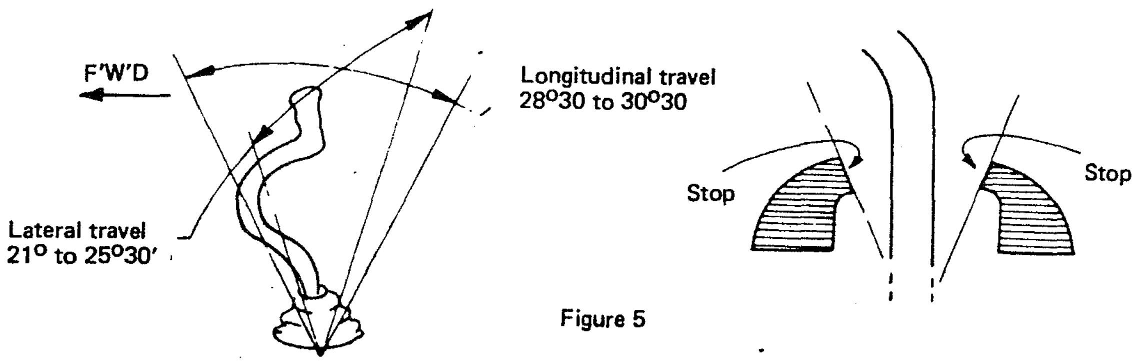


Figure 5

The stops of the cyclic stick are constituted by the friction ball, and are not adjustable. To allow the necessary travel of the stick at the ball it is necessary either to remove some of the material of the ball or else to replace it.

NOTE : Strictly speaking, the travel limits of the cyclic stick should be checked before each adjustment of the control linkage. The neutral position of the stick is, effectively, defined from a basis of the positions of the left and rear stops.

COLLECTIVE PITCH LEVER TRAVEL (Figure 6)

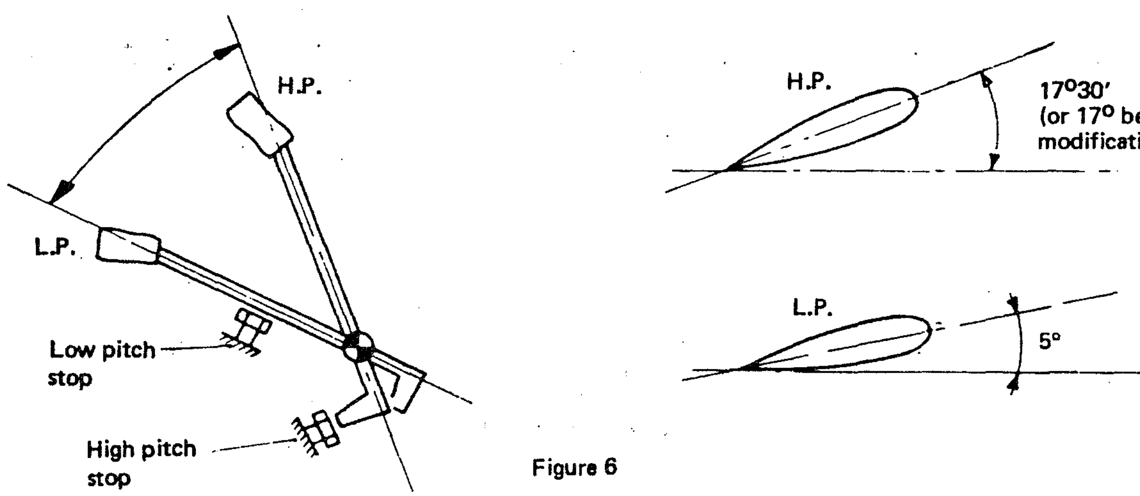


Figure 6

- Adjust the low pitch (L.P.) stop so that there is an incidence of 5° at the blade sleeves.
- Adjust the high pitch (H.P.) stop so that there is an incidence of 17°30 at the blade sleeves.

NOTE : The Low Pitch value may be different after correction of rotor r.p.m. in autorotation.

6.30.3.- MAIN ROTOR CONTROL RIGGING (contd.)

B.- CONTROL LINKAGE RIGGING (contd.)

3.- CHECKING THE CYCLIC PITCH AMPLITUDE AND DEFINITIVE ADJUSTMENT OF THE STICK «NEUTRAL» POSITION

The neutral position of the cyclic stick (datum position for forward and rearward longitudinal and left-and-right lateral cyclic control) determines the amplitude of cyclic pitch, that is to say, the maximum incidence change for a blade when the sleeve passes from neutral to the extreme position. But the neutral position is defined initially by a theoretical correction. Thus, the next step is to check that the neutral position thus determined gives the desired results at the blade sleeves. If the results are not within the permissible tolerance limits, it is necessary to adjust them to obtain results within tolerance by displacing the neutral position of the stick.

a - CYCLIC PITCH AMPLITUDE - CHECKING THEORY (Figure 7)

The cyclic pitch amplitude is checked from the mean collective pitch. The blade is placed, in turn, in each of the azimuths 0° (A) – 90° (B) – 180° (C) 270° (D) which correspond to the pivot axes of the swash plate. The following are checked :
- *the sole fore-and-aft control (the stick being held in the neutral lateral position).*
- *the sole lateral control (the stick being held in the neutral fore-and-aft position).*

The isolated fore-and-aft action causes the swash plate to pivot about the YY' axis.
At B and D, the incidence variation is maximum and opposite. At A and C it is zero.
The isolated lateral action causes the swash plate to pivot about the XX' axis. At A and C the incidence variation is maximum and opposite. At B and D it is zero.

EXAMPLE (figure 7)

Collective pitch 12°40
Fore-and-aft action : cyclic stick at forward stop

- at A and C the blade incidence is 12°40. This is the collective pitch mean value. There is no cyclic variation
- at B the blade incidence is 12°40 + Vi
- at D the blade incidence is 12°40 – Vi

The cyclic pitch amplitude is :
(12°40 + Vi) – (12°40 – Vi) = 2 Vi

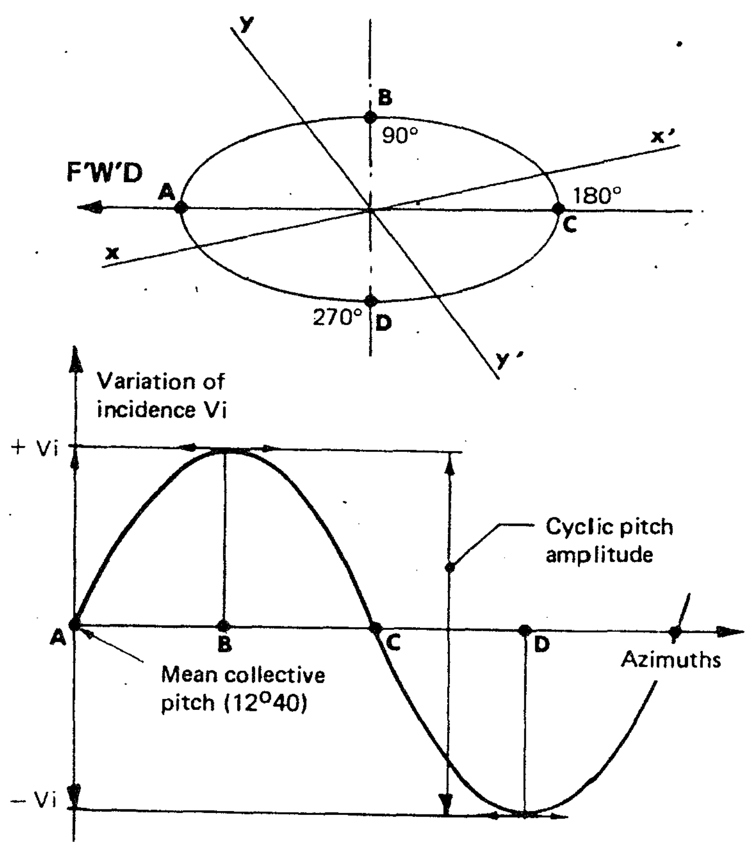


Figure 7

6.30.3.- MAIN ROTOR CONTROL RIGGING (contd.)

3.- CHECKING THE CYCLIC PITCH AMPLITUDE AND DEFINITIVE ADJUSTMENT OF THE STICK «NEUTRAL» POSITION (contd.)

b - THEORY OF THE DEFINITIVE ADJUSTMENT OF THE STICK «NEUTRAL» POSITION (Figure 8)

If, when checking the cyclic pitch amplitude, the results obtained do not fall within the required tolerances, then it is necessary to reset the theoretical neutral position so that the correct movement limits of the stick are obtained, (and thus the correct cyclic pitch amplitude) on both sides of the new lateral and longitudinal neutral positions.

Reset the stick :
- Longitudinally : by adjusting the length of rod (2)
- Laterally : by adjusting the length of rod (1)

Stick position	Pitch amplitude	Adjustment necessary
REAR STOP	Excessive	Lengthen rod 2
	Insufficient	Shorten rod 2
FORWARD STOP	Excessive	Shorten rod 2
	Insufficient	Lengthen rod 2
L.H. STOP	Excessive	Lengthen rod 1
	Insufficient	Shorten rod 1
R.H. STOP	Excessive	Shorten rod 1
	Insufficient	Lengthen rod 1

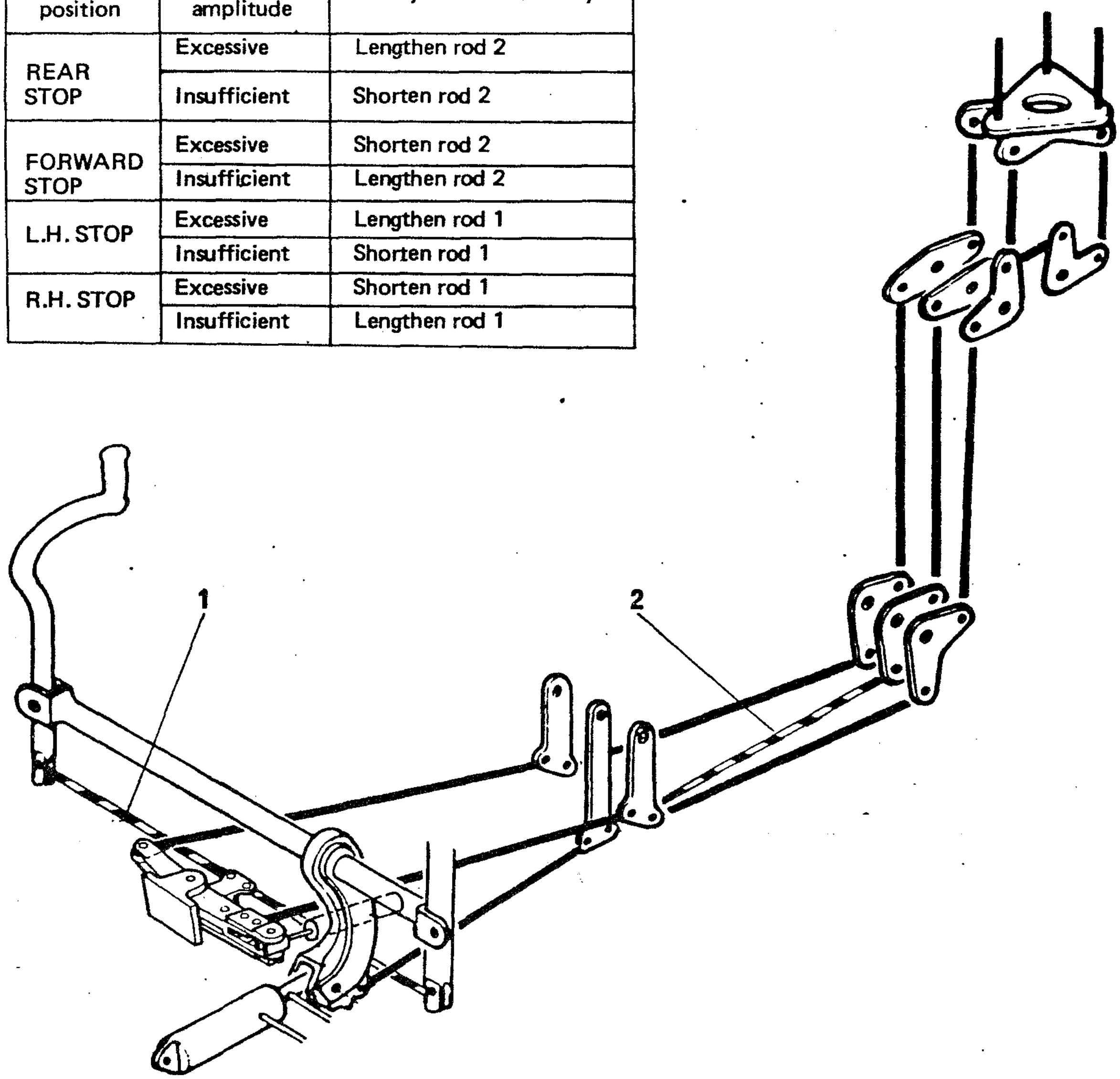


Figure 8
Definitive adjustment of neutral position of cyclic stick

6.30.3.- MAIN ROTOR CONTROL RIGGING (Contd.)

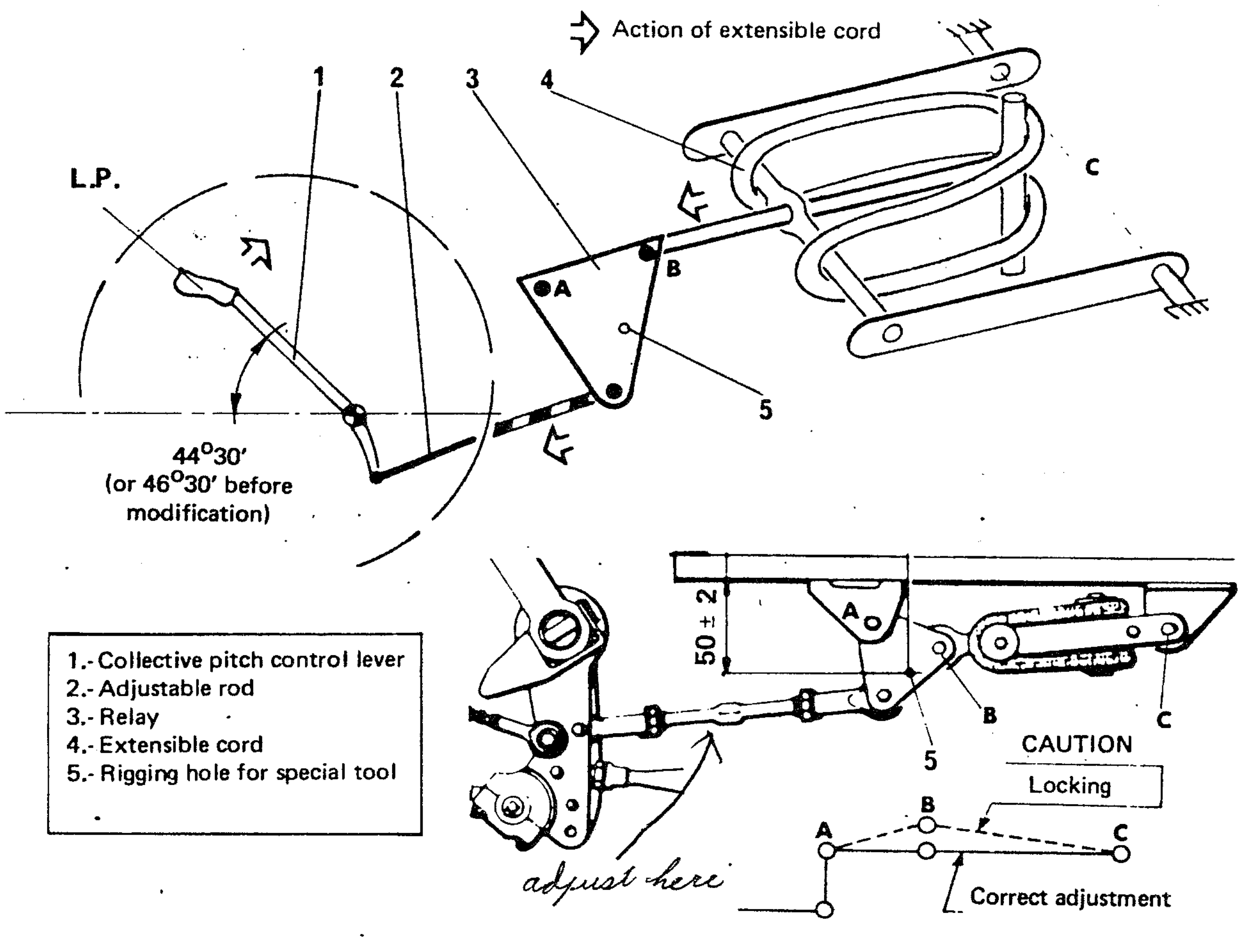
C.- ASSOCIATED ADJUSTMENTS :

These include all the adjustments that do not directly concern the control linkage. They are :

- adjustment of the collective pitch compensator
- adjustment of the parallelism of the co-pilot's stick laterally
- adjustment of the collective pitch transmitter.

1 - ADJUSTMENT OF THE COLLECTIVE PITCH COMPENSATOR - THEORY (Figure 9)

The compensating extensible cord (4) pulls the collective pitch stick (1) towards the high pitch setting, compensating for the aerodynamic load on the blades which tends to push the stick towards the low pitch setting. Thus, in case of breakdown of the servo, the pitch lever is balanced.
The adjustment of this device consists essentially in obtaining maximum tension of the extensible cord when the lever is set at low pitch by alignment of the three pivot points A, B and C.



ADJUSTMENT : Adjusting positions :

- Collective pitch control lever (1) in low pitch position
- Compensator relay (3) in the maximum traction position for the extensible cord (this position is determined by a special tool which establishes a distance of 50 ± 2 mm between the rigging hole of the tool (5) and the cabin floor, and aligns the three points ABC preventing disalignment of point B upwards which would cause the geometrical locking of the assembly). In this configuration, adjust and connect the adjustable rod (2).

Figure 9

6.30.3.- MAIN ROTOR CONTROL RIGGING (contd.)

C.- ASSOCIATED ADJUSTMENTS (contd.)

2 - LATERAL ADJUSTMENT OF PARALLELISM OF CO-PILOT'S CYCLIC STICK

It is only necessary to adjust the length of the lateral synchronizer rod to obtain a parallelism for the cyclic sticks of ± 1° approx.

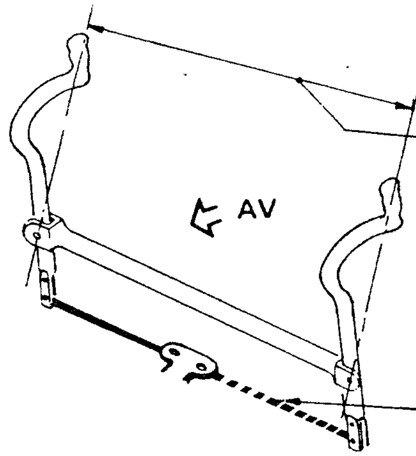


Figure 10
Adjustment of parallelism of cyclic sticks

3 - ADJUSTMENT OF COLLECTIVE PITCH TRANSMITTER (Figure 11A)

THEORY : The collective pitch reading is furnished by the transmitter (2) - indicator (3) assembly which is of the potentiometer type.

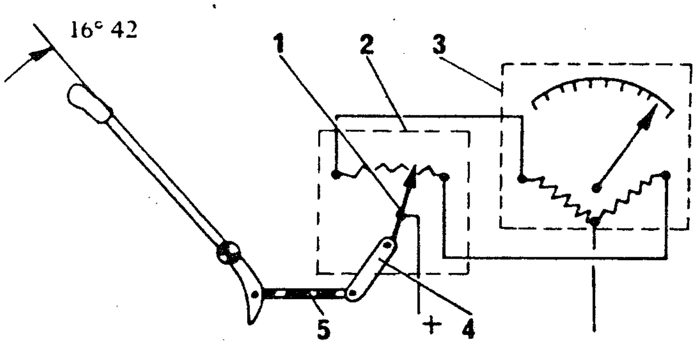
The adjustment consists in bringing to agreement :

- *the collective pitch values measured on the blade sleeves and*
- *the collective pitch values read on the indicator*

SETTING - Adjustment positions :

- Collective pitch lever in the position giving a collective pitch of 16°42 at the blade sleeves.
- **Rod (5) set to length 94.5 mm ± 1 and connected to the transmitter arm (4).**

In this configuration rotate the pick-off (1) to bring indicator needle to graduation 1 ; then tighten the arm (4) on the transmitter shaft.



To check the transmitter adjustment, place the collective pitch control lever in the basic positions and check for correct readings on the indicator.

PITCH	INDICATOR
12°40 →	0.65
14°24 →	0.80
16°42 →	1.

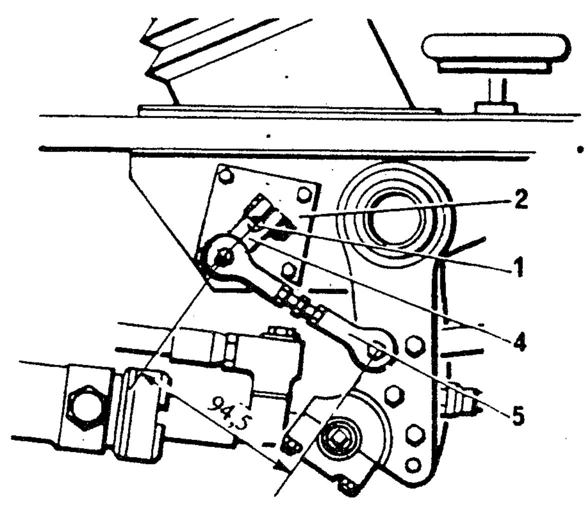


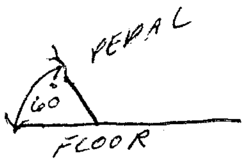
Figure 11
Adjustment of collective pitch transmitter

① neutral pedals
② set 88 MM
③ adjust rod to fit.
④ drum out all the way then in 15.7 MM (102 MM)

6.30.4.- TAIL ROTOR CONTROL RIGGING

A.- CONTROL LINKAGE RIGGING

1 - ADJUSTMENT TO OBTAIN CONCORDANCE BETWEEN THE BASIC CONTROL POSITION AND THE BASIC CONTROL BODY POSITION (Figure 12).

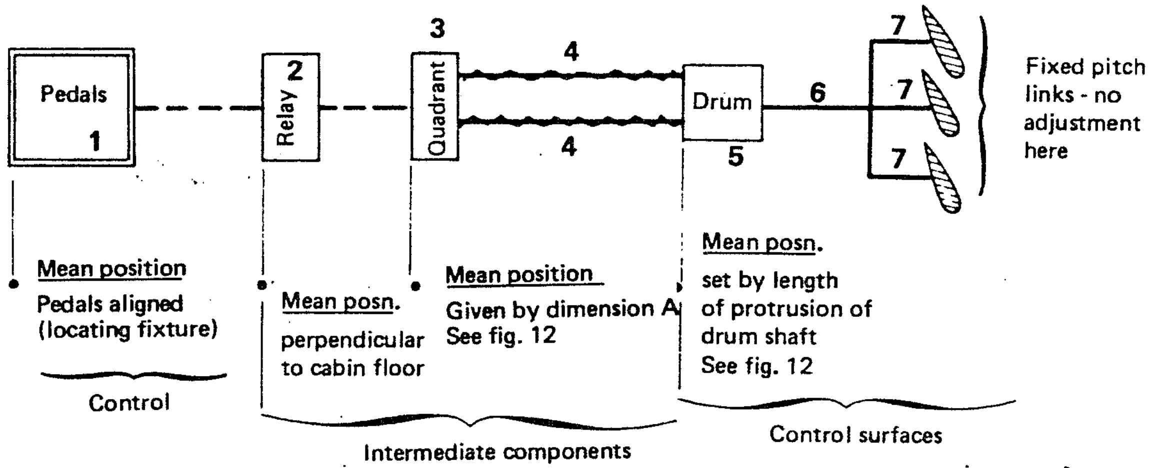


THEORY - When the pedals (1) are in the mean position, the tail rotor control spider (6) should be in the mean position and the blades should be at mean incidence ; the position of the blades and of the control spider is determined by the position of the drum , the pitch rods (7) being fixed.

ADJUSTMENT : To adjust the control linkage it is necessary to : 5

- disconnect the adjustable link rods ——— and the cable turnbuckles
- set the control, control surface and intermediate components in the mean positions defined below.
- adjust the length of the adjustable rods and to connect these to the components
- align the cables and adjust their tension (5 $^{+1}_{-0}$ daN)

TAIL ROTOR CONTROL RIGGING – BLOCK DIAGRAM



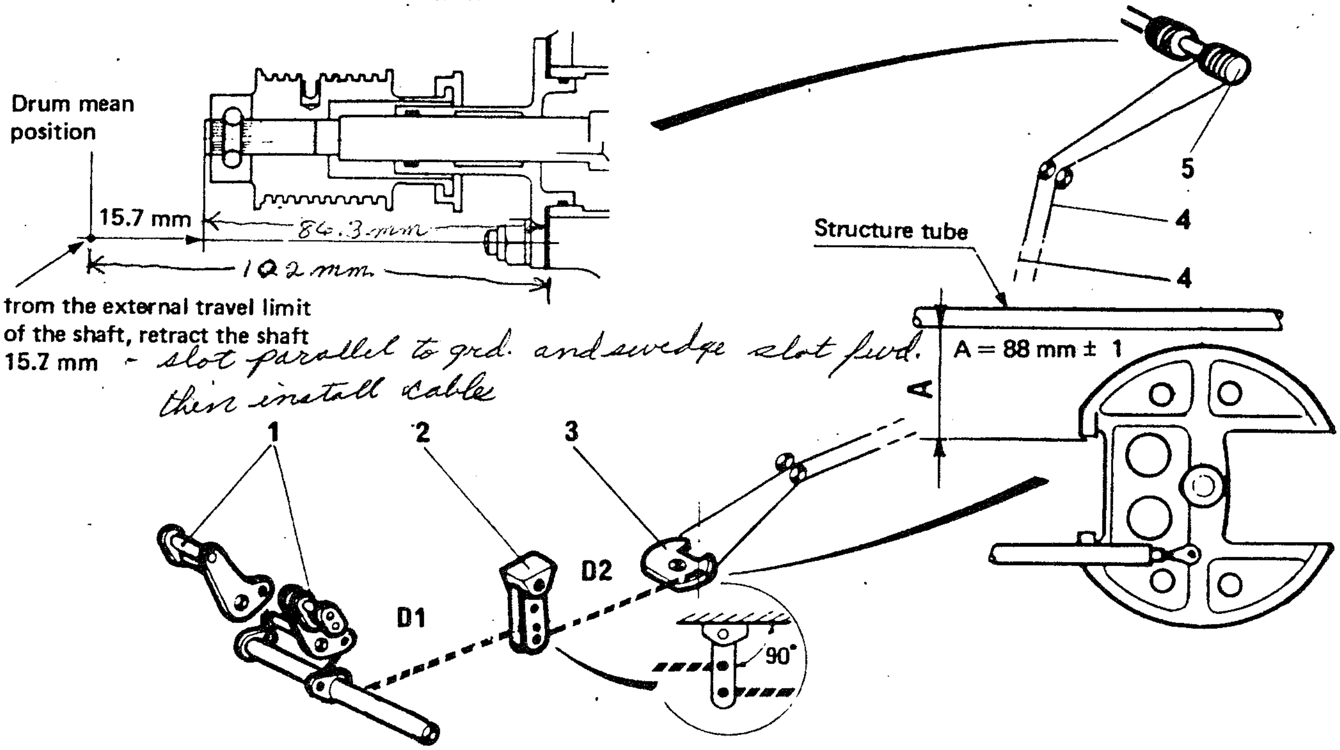


Figure 12
Tail rotor control rigging

6.30.4.- TAIL ROTOR CONTROL RIGGING (Contd.)

2 - ADJUSTMENT OF CONTROL STOPS (Figure 13)

THEORY : So that the tail rotor blades may attain incidence limits, the travel of the pedals should be equal on both sides of mean position. This is obtained by adjustment or replacement of the stops (1).

rate of movement governed by a houdaille valve.

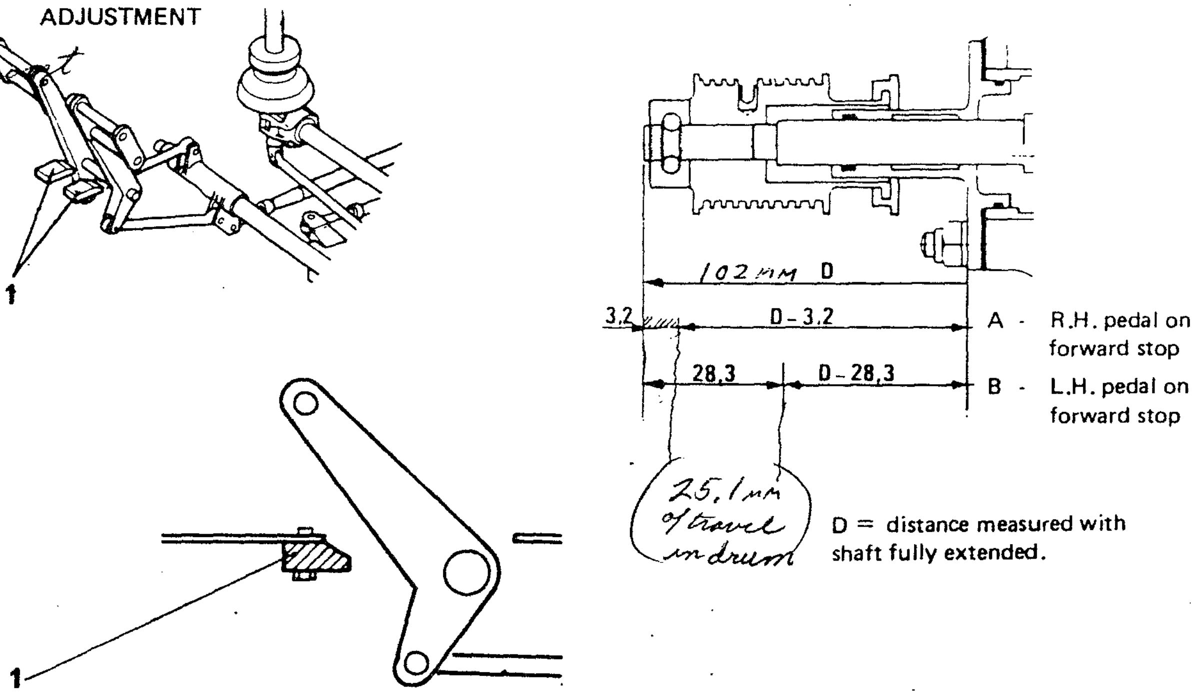


Figure 13
Adjustment of pedal stops

- With the R.H. pedal on the forward stop, adjust or replace the corresponding stop (1) to obtain the correct measurement D - 3.2 at the control drum shaft.
- With the L.H. pedal on the forward stop, obtain the measurement D - 28.3 in the same way.

B.- ASSOCIATED ADJUSTMENT - HYDRAULIC DAMPER

No associated adjustment. The hydraulic damper is driven by a fixed rod. Check only that in maximum movement the damper does not come against internal stops.

(1) 5 ½ total turns sissors drum

(2) inside cable over drum

(3) neutral swedge hole fwd. — parallel to grd.
drum 15.7 MM

(4) right pedal moves drum out.