CHAPTER 8

POWERTRAIN

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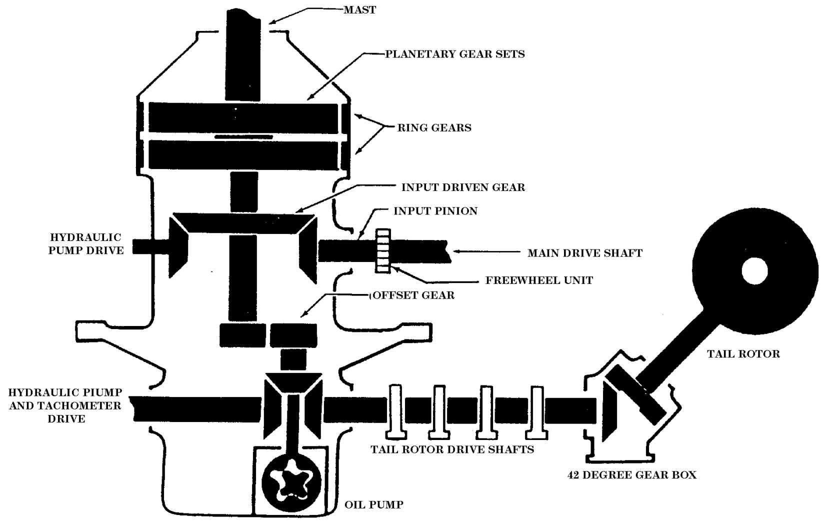
ILLUSTRATIONS

POWERTRAIN



INTRODUCTION

The powertrain of the Bell 212 distributes engine power to drive the helicopter's main and tail rotor systems and numerous required subsystems. The powertrain includes the main drive shaft, main transmission, main rotor mast, and tail rotor drive system. The tail rotor drive system includes six sections of tail rotor drive shafting, the intermediate or 42° gearbox, the tail rotor or 90° gearbox, and the tail rotor mast. Subsystems include the two hydraulic pumps, the main rotor tachometer, and the rotor brake.

GENERAL

Engine power is transmitted from the combining gearbox to the main transmission by the main drive shaft. Splined couplings at each end of the main drive shaft provide positive, self-aligning connection. The main transmission reduces the powerplant/main drive shaft rpm through ring and planetary gear systems to drive the main rotor mast and main rotor. The transmission, through additional gearing, drives the tail rotor drive system, No. 1 and No. 2 hydraulic pumps, NR tachometer generator, main transmission oil pump and provides connection for the rotor brake system.

The tail rotor drive system utilizes five sections of drive shafting, mounted between hanger bearings, to drive the intermediate gearbox. The intermediate gearbox, with a self-contained lubrication system, changes the direction of drive 42° and drives a sixth section of drive shafting to power the tail rotor gearbox. The tail rotor gearbox, with its self-contained lubrication system, reduces tail rotor drive rpm, changes the direction of drive 90°, and drives the tail rotor mast and tail rotor. The tail rotor gearbox also mounts and houses the tail rotor pitch-change mechanism.

Specific information on the rotor systems is discussed in Chapter 9, "Main Rotor," and Chapter 10, "Tail Rotor." The rotor brake

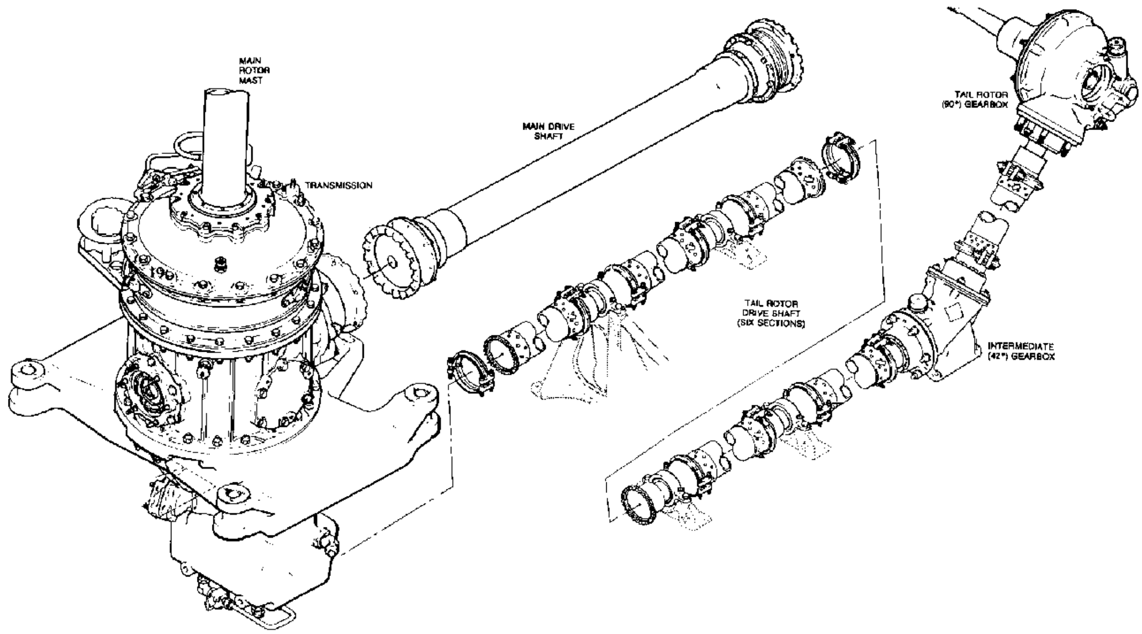


Figure 8-1 Powertrain Components

system is discussed in Chapter 17, "Hydraulic Power Systems." (Figure 8-1) shows the powertrain system, and Figure 8-2 illustrates the system schematically.

MAIN DRIVE SHAFT

The main drive shaft (Figure 8-3) connects the powerplant's combining gearbox to the main transmission. It consists of a pre-balanced tubular steel shaft with grease-packed curvic-splined couplings at each end.

The floating-spline design of the couplings allows the shaft to operate at very high rpm and provide a positive yet universal connection between components. It also provides correction for any misalignment between the combining gearbox and the transmission that might occur due to dynamic forces acting on the transmission during flight.

The shaft is constructed of tubular steel with splined connectors welded at each end. Prior to assembly the shaft is dynamically balanced by grinding the flanges of the connectors.

Each curvic-splined coupling consists of a grease-seal boot, an inner coupling, an outer coupling, and associated hardware. Springs in each coupling provide self-centering of the shaft within the couplings.

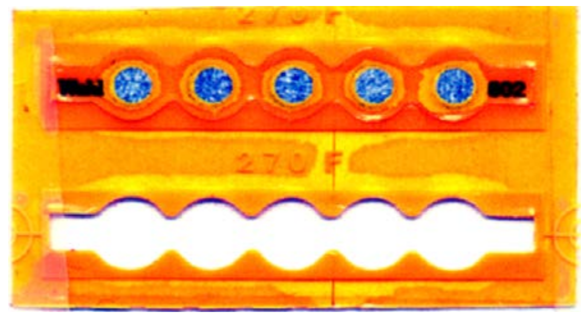
Each outer coupling face is paint striped to provide visual indication of coupling overheating. Since overheating of the coupling can result in complete failure of the coupling and sudden loss of power to the transmission, the main drive shaft and couplings should be carefully checked for signs of overheating or loss of grease during the exterior inspection.

The following is provided for information only. The main point is if any dots are missing, partially black or black the pilot must consider the aircraft unserviceable and seek maintenance action.

The Dot strips are now required by bulletin in place of the painting heat strips. The red or yellow strips are used in combinations of color and amounts for different components. For example the Main drive shaft uses 4 Strips, 2 Yellow and 2 Red (Red, Yellow, Red, Yellow) at (12-3-6-9) o'clock positions.

The Red Strip turns to Black dots at 370°F.

The Yellow Strip dots turn Black at 270°F



Maintenance uses a matrix of different combinations of situations to determine maintenance actions.

TEMP-PLATE CONDITIONS AND CORRECTIVE ACTION

One Yellow Temp-Plate	Other Yellow Temp-Plate	One red Temp-Plate	OTHER RED Temp-Plate	Probable Cause	SEE Note
Good	Black	Good	Good	Defect/Instl.	1
Black	Black	Good	Good	Elevated Temp.	2
Good	Good	Black	Good	Defect/Instl.	1
Good	Good	Black	Black	Defect/Instl.	4
Black	Black	B lack	Black	Over temp	3
Part Black	Good	Good	Good	Chem. Contamination	1
Part Black	Part Black	Good	Good	Chem. Contamination	1
Good	Good	Part Black	Good	Chem. Contamination	1
Good	Good	Part Black	Part Black	Chem. Contamination	4
Missing	Good	Good	Good	Defect/Instl.	1
Missing	Missing	Good	Good	Possible Elevated Temperature	2
Good	Good	Missing	Good	Defect/Instl.	1
Good	Good	Missing	Missing	Defect/Instl.	4
Missing	Missing	Missing	Missing	Possible Over temp	3

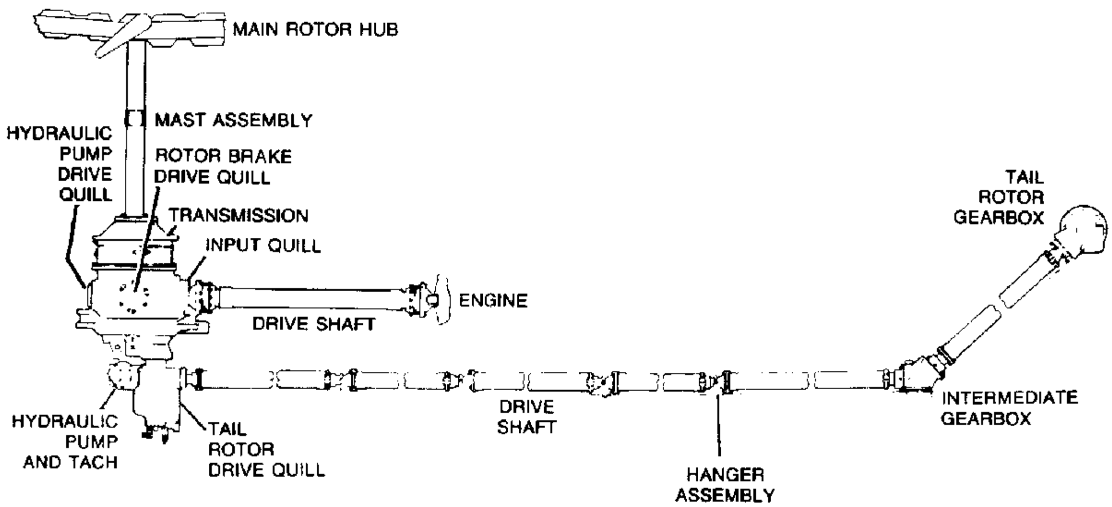


Figure 8-2 Powertrain

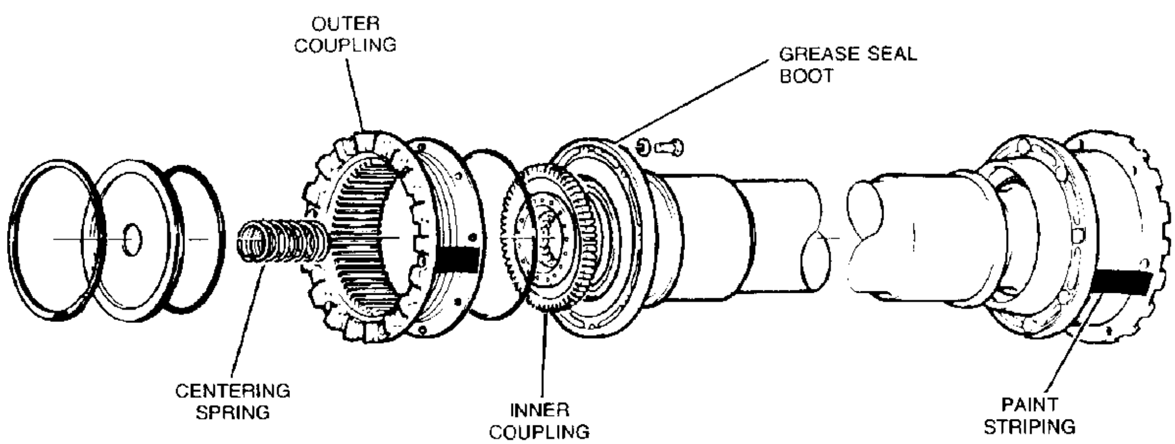


Figure 8-3 Main Drive Shaft

MAIN TRANSMISSION

GENERAL

The main transmission (Figure 8-4), mounted on the transmission pylon of the airframe, changes the angle of drive and reduces the rpm of the powerplant drive to power the rotor mast and main rotor. It also powers the tail rotor drive system, its own lubrication system, and both hydraulic systems and provides for operation of the rotor brake.

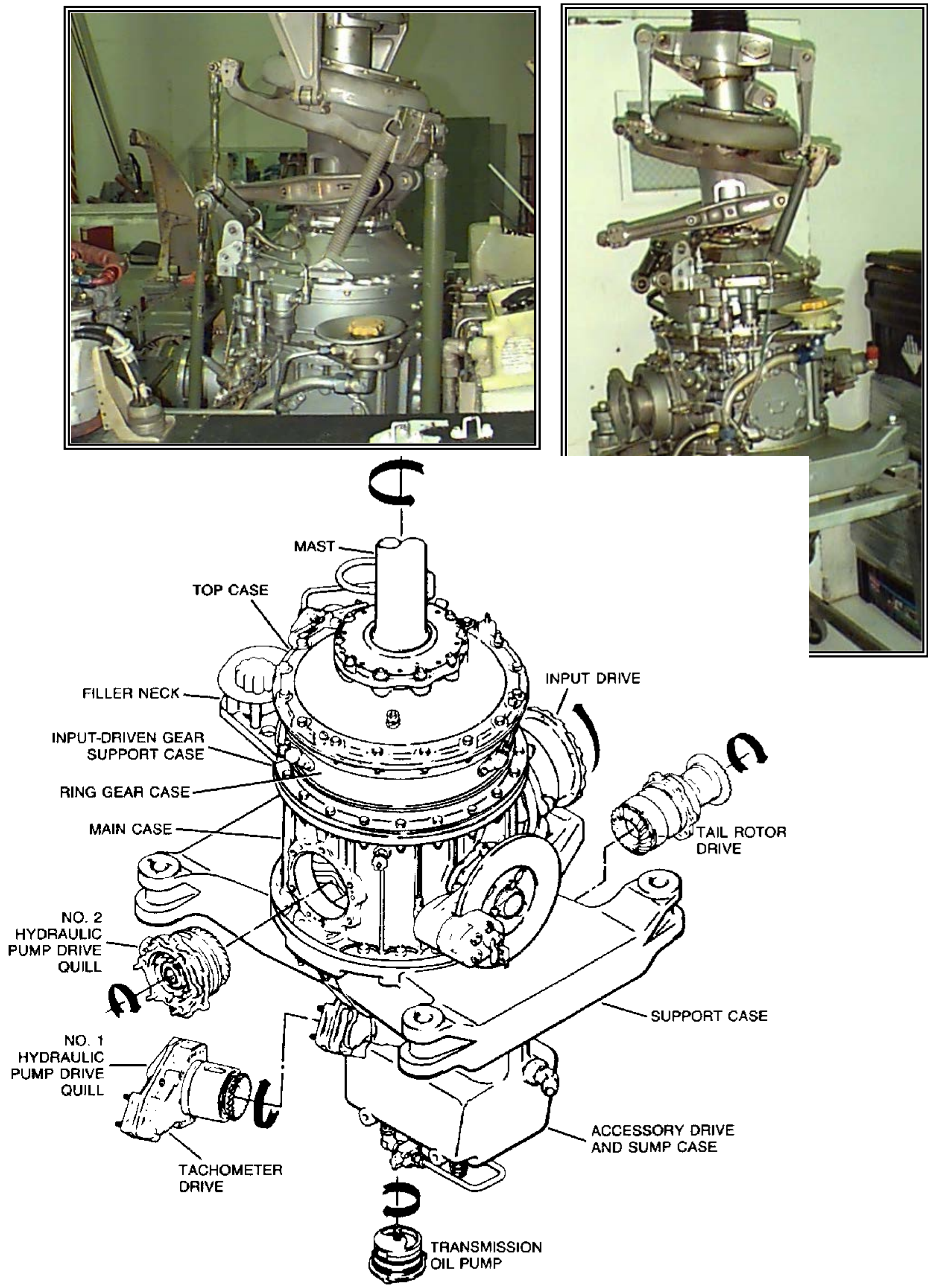


Figure 8-4 Main Transmission

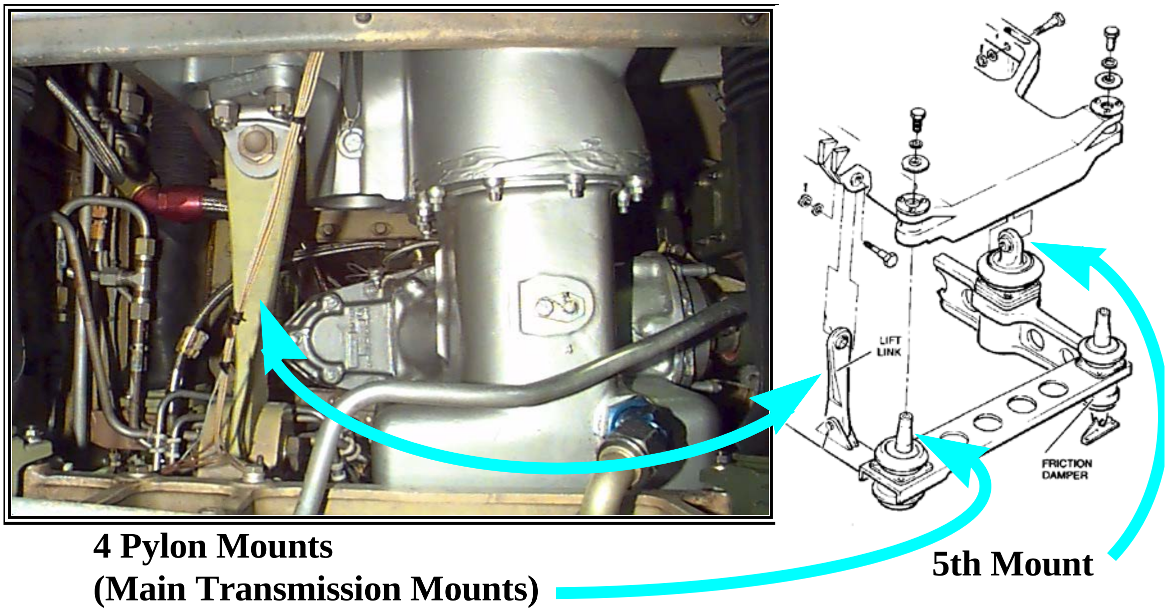


Figure 8-5 Transmission Mounting

TRANSMISSION MOUNTING

The transmission is connected to the airframe by three different devices (Figure 8-5). The main attachment, the lift-link, is a forged steel connector incorporating self-aligning bearings at each end. The lift-link connects directly between the airframe and the transmission case and is designed to absorb all airframe/rotor loads. Four elastomeric vibration isolator mounts position the transmission properly on the pylon and isolate rotor/transmission vibrations from the airframe. A fifth mount is bolted to the center of a support fitting which is bolted to the airframe structure.

TRANSMISSION OPERATION

Main drive shaft torque is transmitted through an input drive quill at the rear of the transmission case to the input pinion gear (Figure 8-6). The pinion gear drives the input-driven gear, which in turn drives the rotor mast through two stages of planetary gears. This sequence results in an approximate 20 to 1 reduction in rpm. The input-driven gear also drives the No. 2 hydraulic pump and the rotor brake disk.

A gear assembly, powered by a splined sleeve from the input-driven gear, drives an offset gear, which in turn drives a geared shaft that drives two pinion gear shafts. One shaft drives the No. 1 hydraulic pump and the main rotor tachometer generator, and the other drives the tail rotor drive system. The offset gear shaft also drives the main transmission lubrication pump at the bottom (sump) of the transmission case.

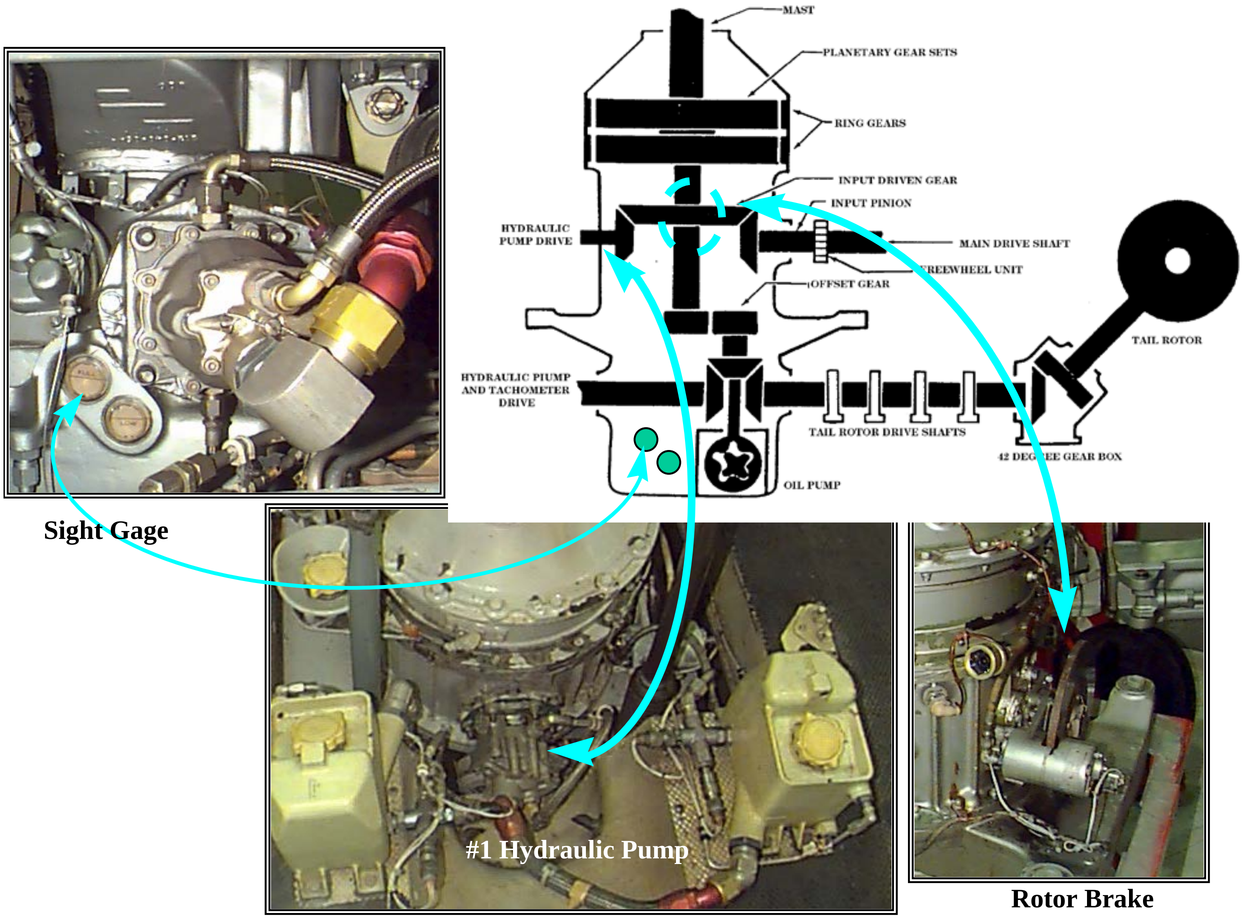


Figure 8-6 Main Transmission Operation

TRANSMISSION LUBRICATION SYSTEM

General

The main transmission incorporates its own self-contained lubrication system (Figure 8-7) which operates any time the main rotor is turning. Components of the system include wet-sump storage with sight gauge, a pressure pump, a thermostatically controlled oil cooler, internal and external filters, a pressure manifold with spray nozzles, pressure and temperature sensors, chip detectors, and associated plumbing.

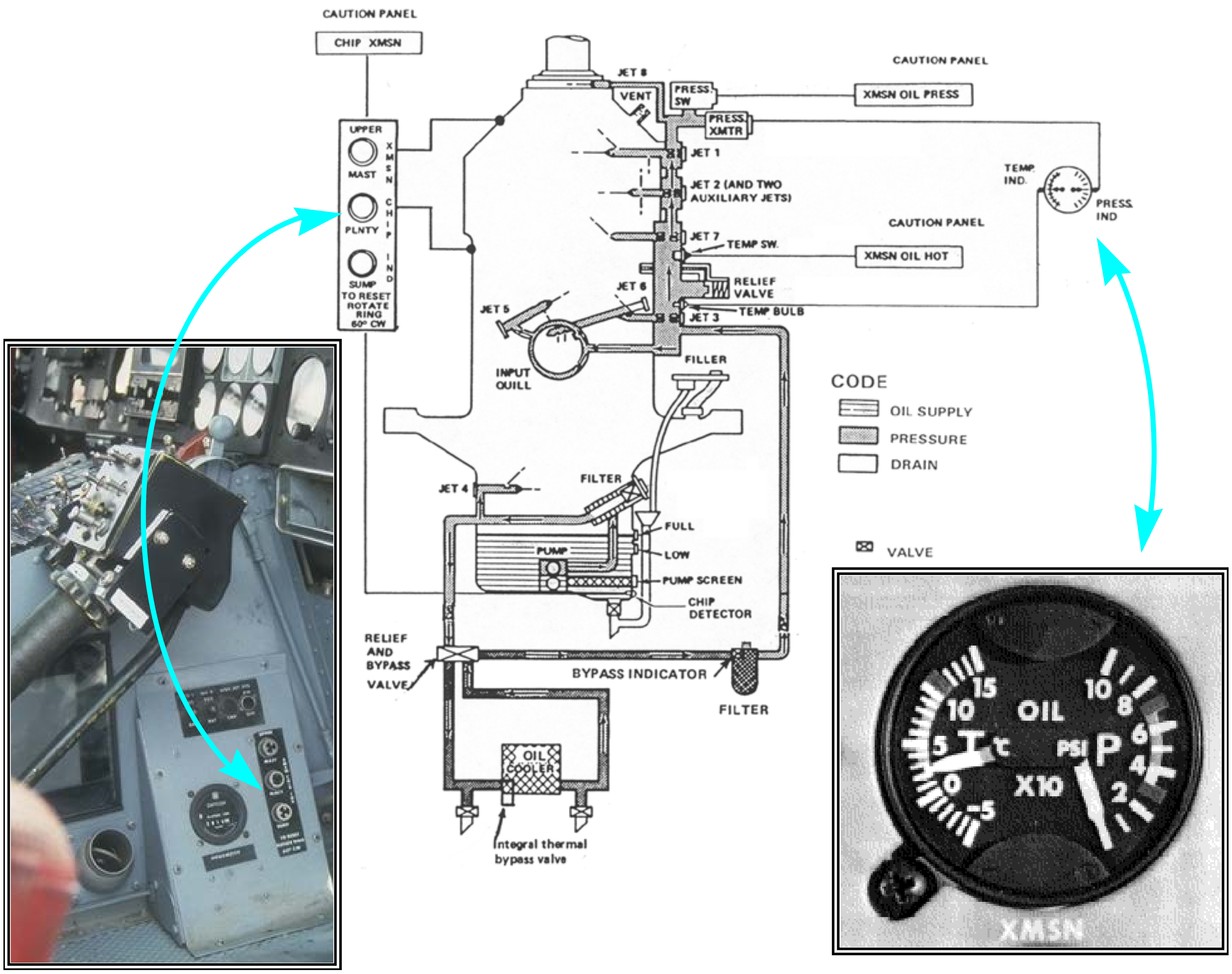


Figure 8-7 Transmission Oil System

Operation

Lubricating oil, stored in the bottom case of the transmission, is drawn through a filtering screen and is pressurized by the pump as the rotor begins to turn. A sight gauge (Figure 8-8), located on the right side of the case, can be viewed through a window in the right side of the transmission pylon housing in the passenger cabin. The transmission oil level should only be checked cold and when the rotors are not turning.

Pressurized oil is directed through an internal filter and out through external piping. A small portion of the oil is used to lubricate the tail rotor drive quill bearing. The remaining oil moves on to the thermal relief and bypass valve. If the oil is cold, the thermal bypass valve directs the oil straight to the external oil filter, bypassing the oil cooler. If the oil is hot, it is directed to the oil cooler where a thermostatic valve regulates cooling of the oil. After cooling, the oil is routed to the external filter.

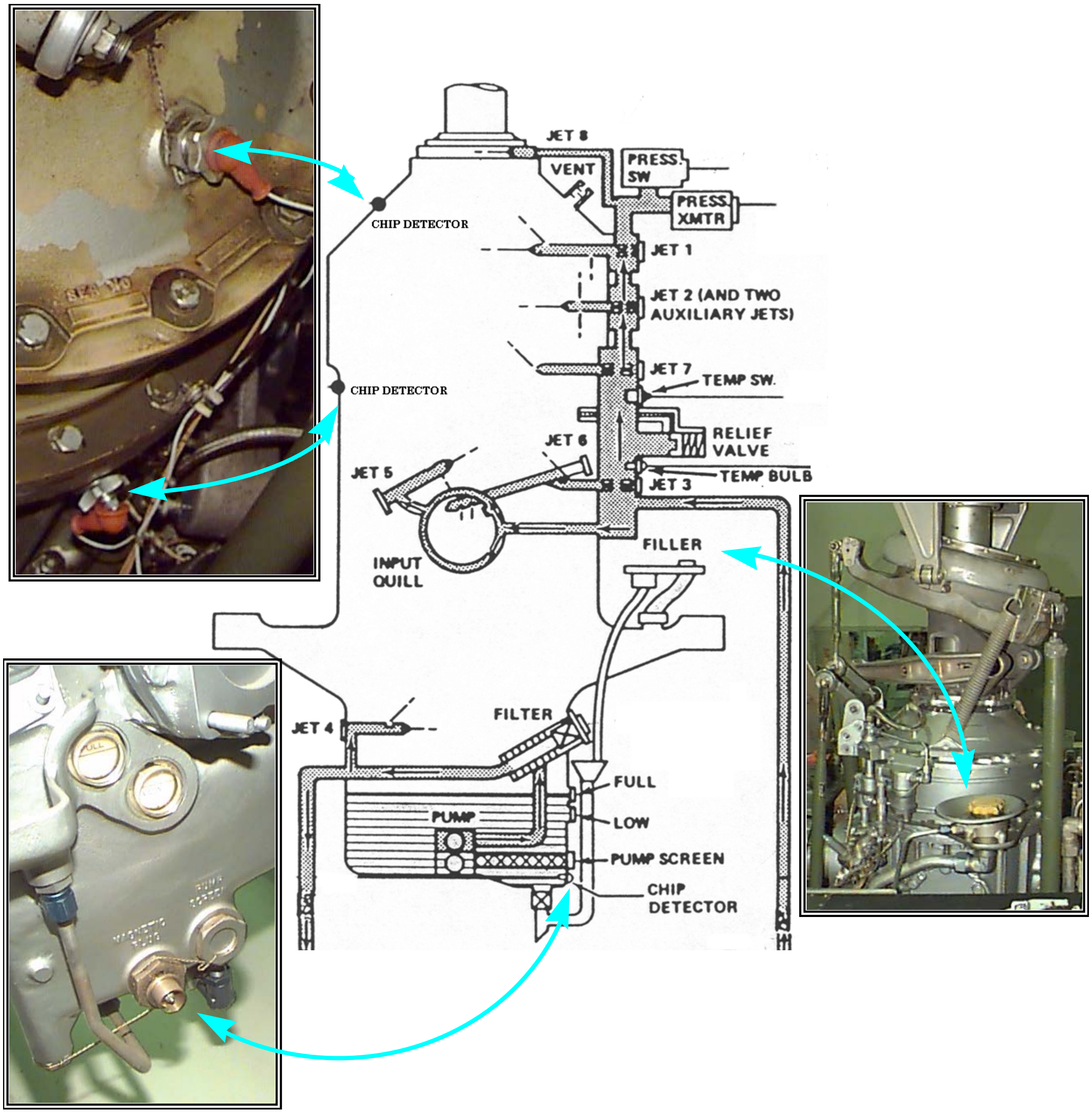


Figure 8-8 Main Transmission Oil System Components

The external filter cleans the pressurized oil and directs it to an external lubrication system manifold. The external filter incorporates a "pop-up" red indicator that activates if the external filter becomes clogged and indicates that the oil is bypassing the filter. The bypass indicator of the filter should be checked daily during the exterior inspection.

As pressurized oil enters the manifold, a portion of it goes directly to lubricate the main drive shaft input bearing. A pressure relief valve located at the entrance to the manifold is maintenance-adjusted to provide proper oil pressure for the lubrication system.

Numerous oil jets take pressurized oil from the mainfold and supply lubricating oil to various bearings and gears within the transmission. The jets spray oil throughout the internal geartrain, and used oil drains down to the sump for reuse.

An oil temperature sensor provides transmission oil temperature gauge indications (Figure 8-9). An oil temperature switch causes illumination of the XMSN OIL TEMP warning light if oil temperature exceeds limits. Both of these devices are located near the entrance of the manifold.

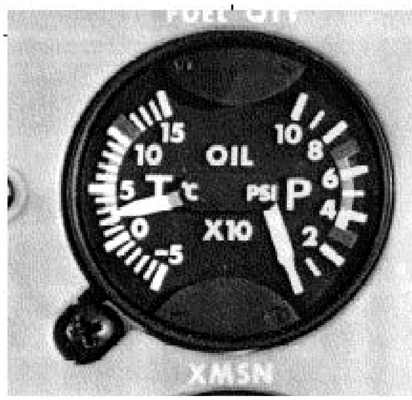


Figure 8-9 Transmission Oil Pressure/Temperature

An oil pressure sensor provides transmission oil pressure gauge indications. An oil pressure switch causes the XMSN OIL PRESS warning light to illuminate if pressure falls below limits. Both of these devices are located at the end of the manifold.

CHIP DETECTOR SYSTEM

General

The main transmission is protected by a chip detector system that detects and advises the pilot that there are metal particles or chips in the transmission lubricating oil.

The system includes three chip detector plugs (one located in the lower case sump, one just below the planetary gears, and one just below the upper main rotor mast bearings), a CHIP XMSN caution panel light and a remote indicator on the hourmeter panel. System operation requires 28-VDC electrical power.

Some older model 212's may still have just one chip detector plug (located in the lower case sump), and therefore have no remote indicator on the hour-meter panel.

Figure 8-10 Transmission Chip Detector Remote Indicator

Operation

In the event that metal chips should occur in the transmission, the chips are carried to one of the detectors by the lubricating oil. When metal contacts a detector, it completes an electrical circuit to ground and the CHIP XMSN caution light illuminates.

Since there are three detectors in the system, the pilot must check the remote transmission chip indicators on the hourmeter panel to determine which detector has activated. The remote detectors are labeled "UPPER MAST," "PLNTY," and "SUMP."

TAIL ROTOR DRIVE SYSTEM

GENERAL

The tail rotor drive system (Figure 8-11) consists of six drive shaft sections, four hanger bearings, the intermediate gearbox, and the tail rotor gearbox.

The tail rotor is driven by the main transmission through six sections of drive shafting mounted between the transmission, the hanger bearings, and the two gearboxes. Flexible couplings at each hanger bearing and gearbox compensate for tailboom flexing due to dynamic loads.

DRIVE SHAFT SECTIONS

There are five sections of tubular aluminum drive shafts of equal length and one short section. Each section has a coupling adapter riveted to each end, and the sections are dynamically balanced by bonding-on weights during manufacture. All five of the longer sections are interchangeable. (Figure 8-14)

HANGER BEARINGS

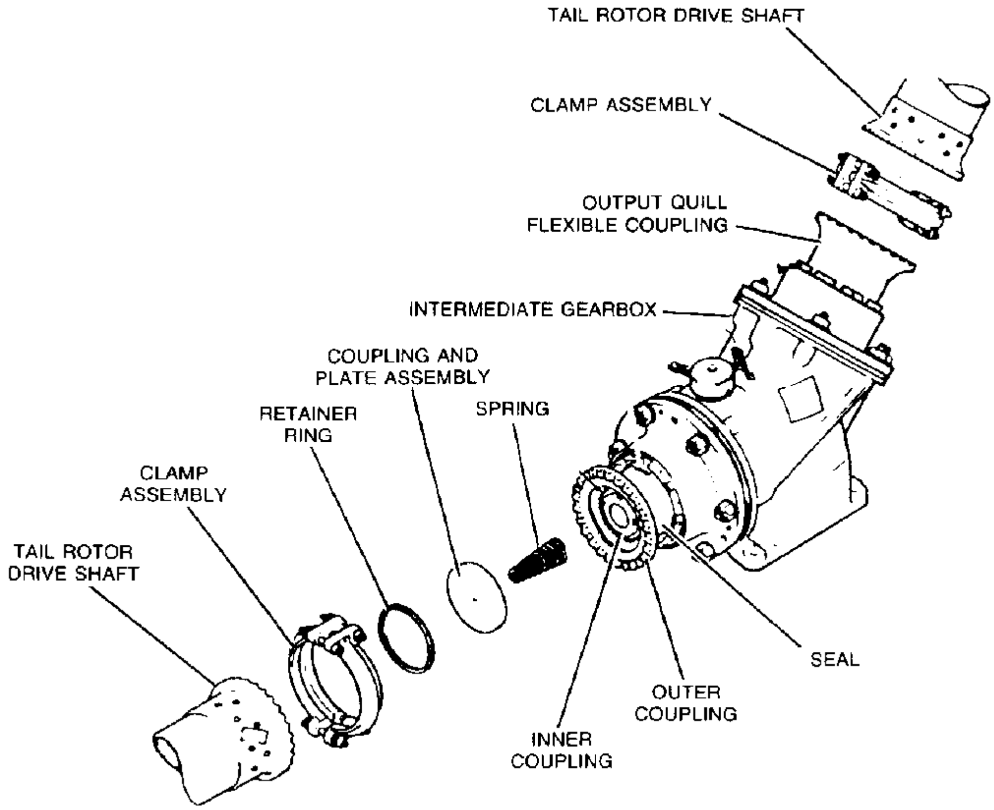
Greaseable bearings are mounted on hanger brackets of various heights located on top of the engine deck and tailboom to provide a straight-through drive. Each bearing incorporates a grease-packed curvic-splined coupling on the forward side to provide for shaft self-alignment. Both the bearings and their splined couplings are paint striped to provide visual indication of overheating.

INTERMEDIATE GEARBOX

The 42° intermediate (Figure 8-11) gearbox is mounted on top of the tailboom at the base of the vertical fin. Its sole purpose is to change the angle of tail rotor drive. The gearbox case serves as an oil reservoir for the splash lubrication system and includes a vented filler cap. The couplings on the input and output bearings of the gearbox are paint-striped for visual indication of bearing or coupling overheating. The case has an oil level sight gauge and a chip detector plug on the right side. The oil level should be checked when cold with the system static and on a level surface. The chip detector, if activated, illuminates a CHIP 42/90 BOX caution light. Both chip detectors must be visibly checked to determine which has activated.

TAIL ROTOR GEARBOX

The 90° tail rotor gearbox (Figure 8-13) is mounted on top of the vertical fin and provides for a reduction of rpm, a change in the angle of drive, and mounting for the tail rotor and tail rotor pitch change mechanism. The gearbox case serves as an oil reservoir for the splash lubrication system and includes a vented filler cap. The case has an oil level sight gauge and a chip detector plug on the left side. The oil level should be checked when cold with the system static and on a level surface. The chip detector, if activated, illuminates a CHIP 42/90 BOX caution light. Both chip detectors must be visibly checked to determine which has activated. The coupling on the drive shaft input bearing of the gearbox is paint-striped for visual indication of bearing or coupling overheating.



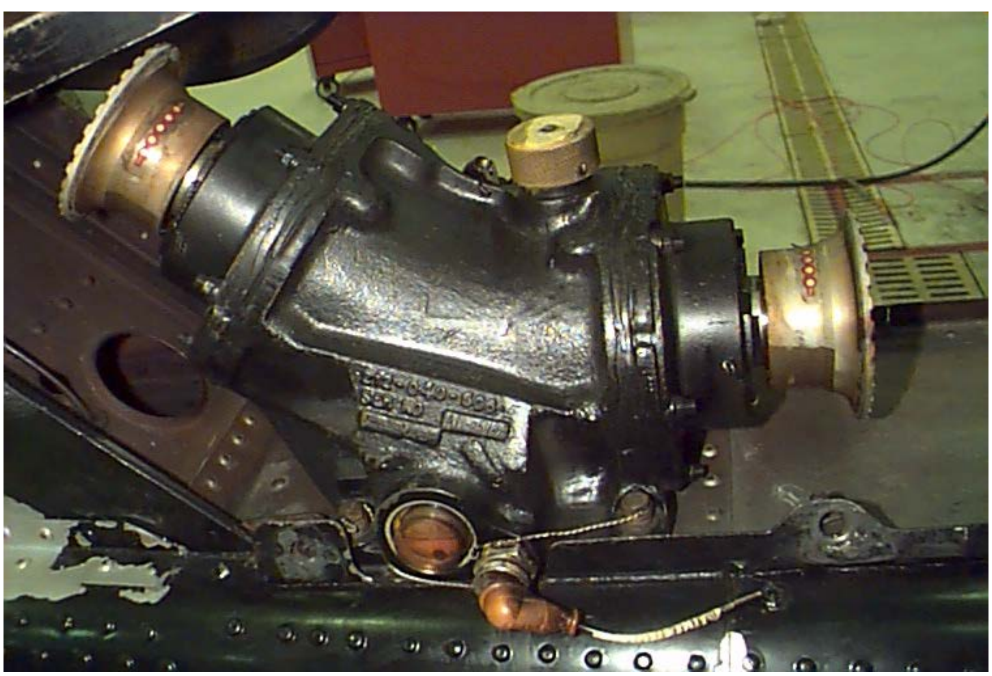
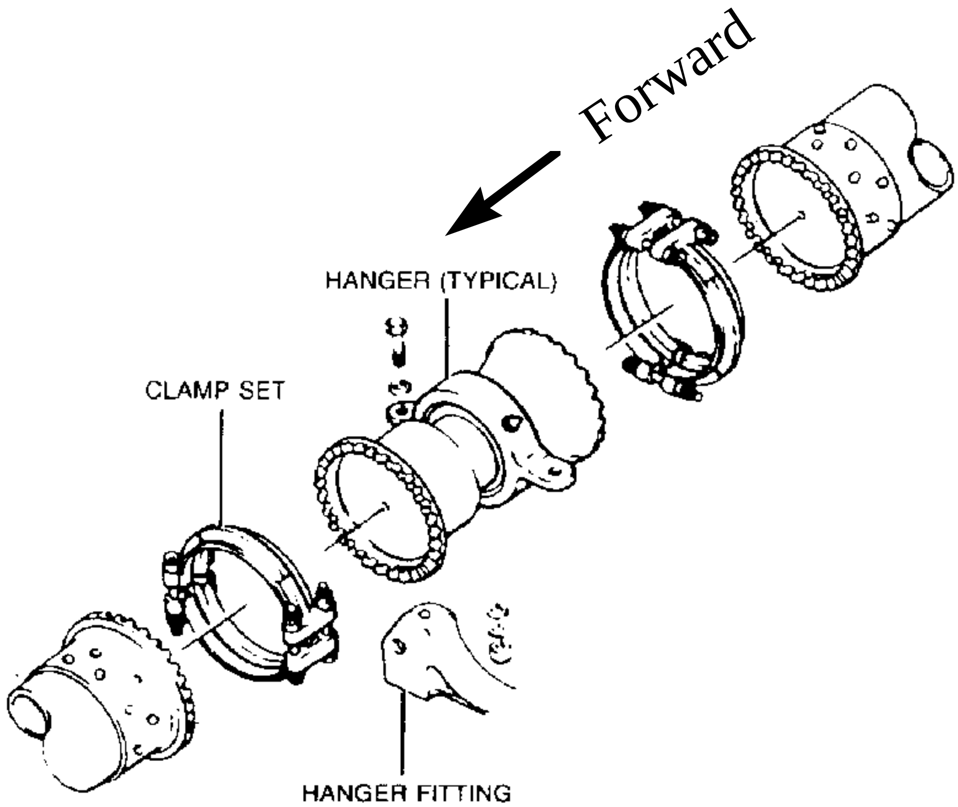


Figure 8-11 42° Gear Box



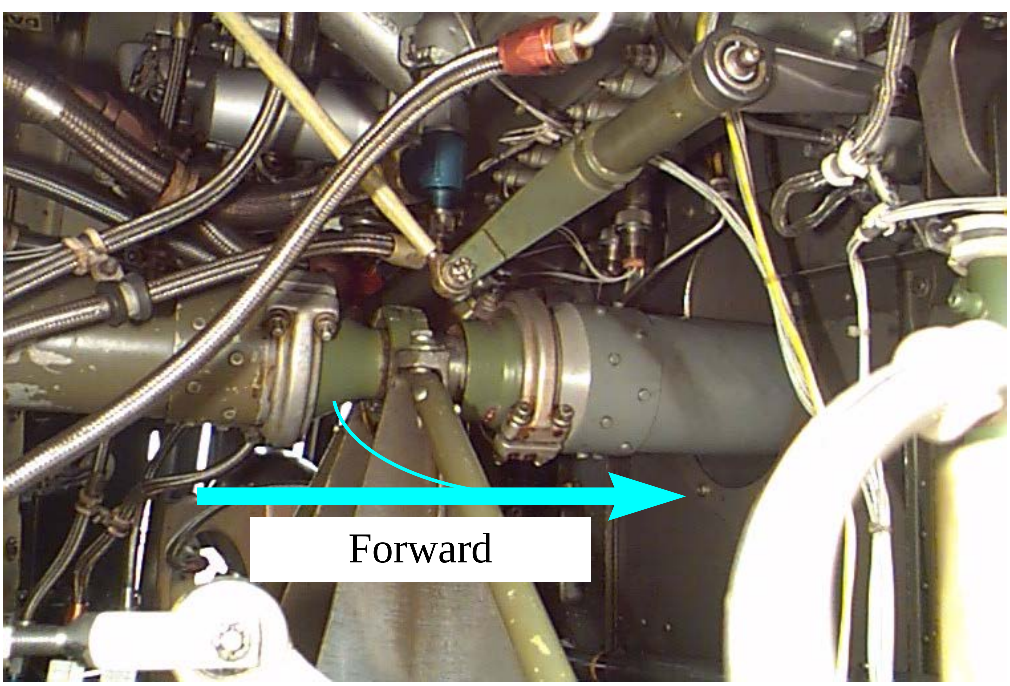
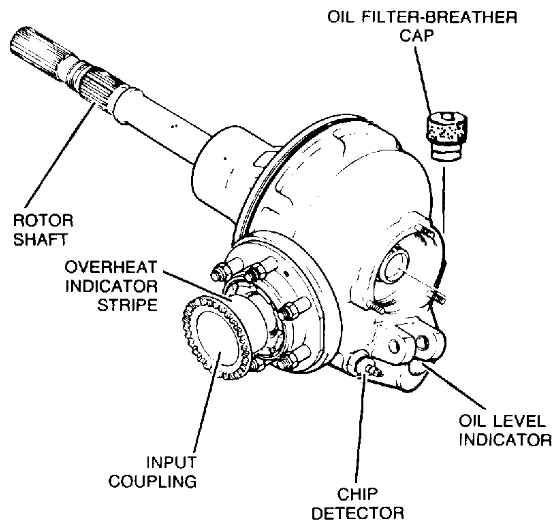


Figure 8-12 Tail Rotor Drive



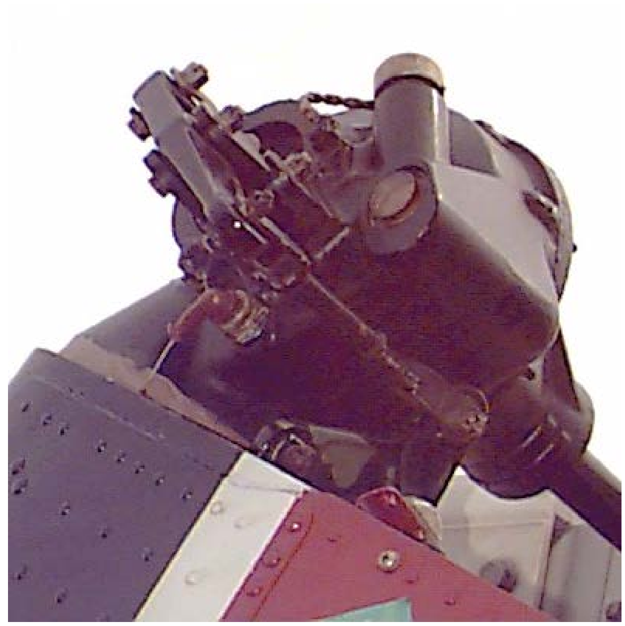


Figure 8-13   90° Gearbox

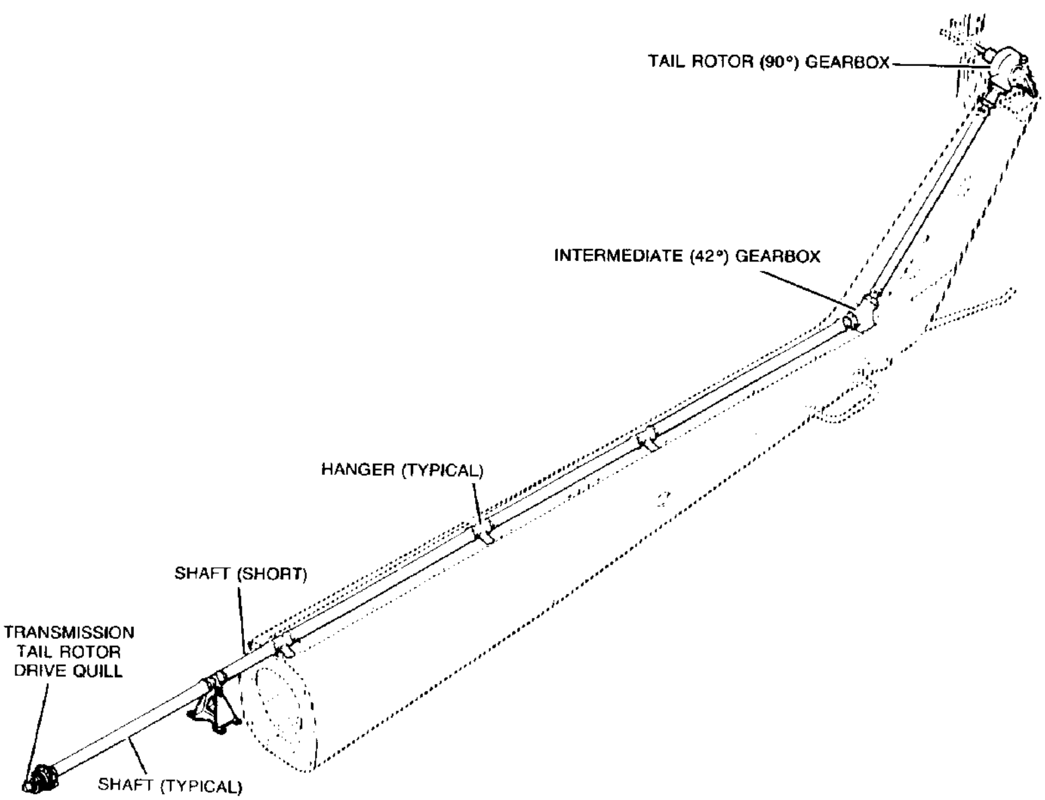


Figure 8-14   Drive Shaft Sections

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