CHAPTER 6

TANDEM-ROTOR POWER TRAIN SYSTEM

A typical tandem-rotor power train system consists of an engine transmission for each of the two engines and an engine-combining transmission (Figure 6-1). The system also includes a forward rotary-wing drive transmission (containing a rotary-wing drive shaft [mast]) and an aft rotary-wing drive transmission (containing a rotary-wing drive shaft [mast]). The drive shaft consists of an engine drive shaft assembly between each engine transmission and the engine-combining transmission. This assembly is used by the engine to drive the engine-combining transmission. The drive shaft assembly also consists of a forward synchronizing drive shaft assembly through which the engine-combining transmission drives the forward rotary-wing drive transmission and an aft synchronizing drive shaft assembly through which the engine-combining transmission drives the aft rotary-wing drive transmission.

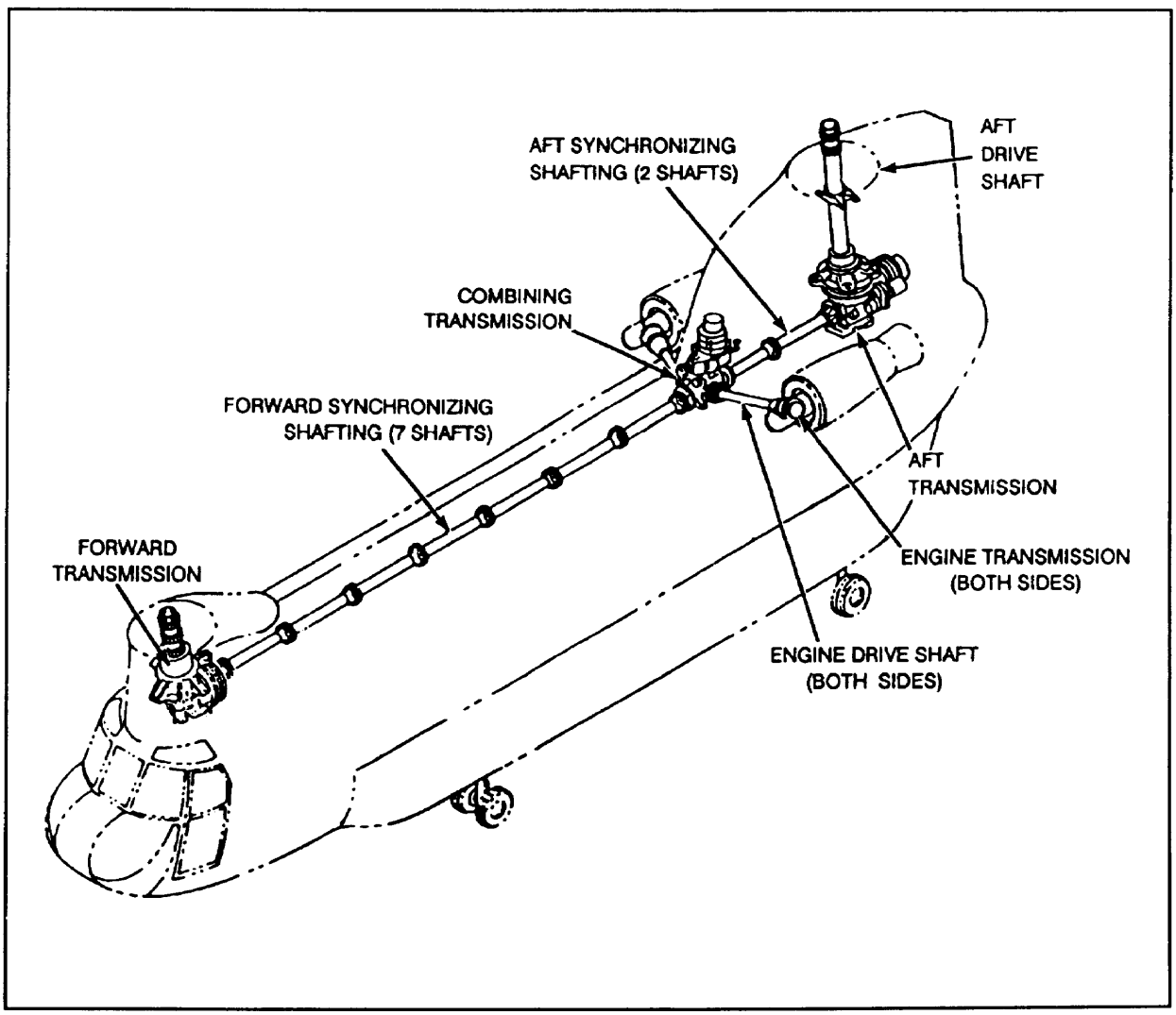

Figure 6-1. Tandem-rotor power train system

ENGINE TRANSMISSION

The two engine transmissions are identical assemblies. Minor rearrangement of transmission external parts provides interchangeability between right- and left-hand engine transmission installations. The transmissions are mounted directly on the engine being driven by the engine output shaft. The transmissions provide angle of drive and RPM reduction in torque. Torque from the engine is transmitted by the engine transmission and engine drive shaft assembly to the engine-combining transmission. Freewheeling is provided in the output shaft of the engine transmissions. This permits the drive system to overrun the engine during failure, a sudden reduction of RPM, or autorotation. (See Figure 6-2.)

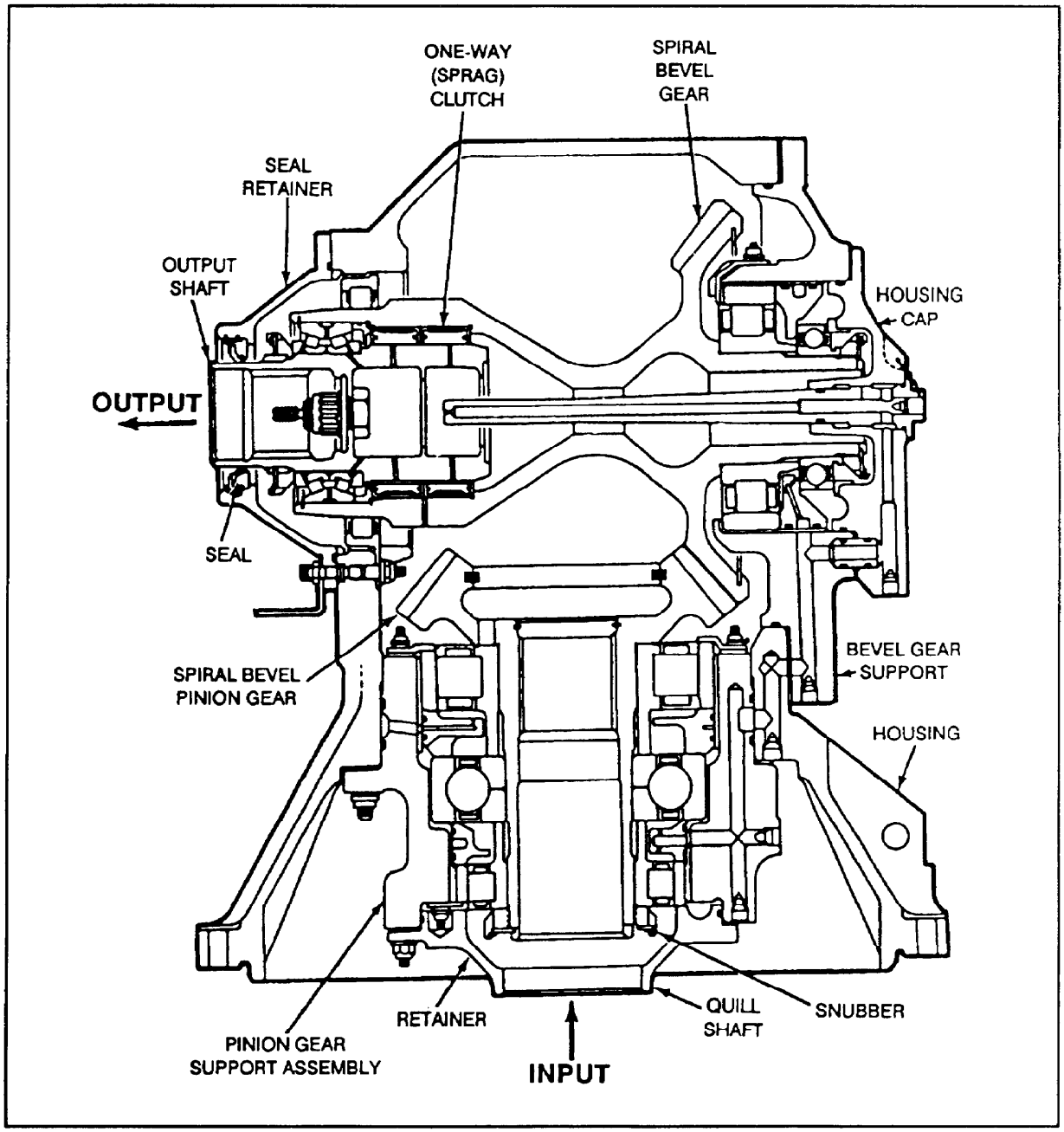

Figure 6-2. Sectional view of engine transmission

Oil System Components

For each engine transmission there is a complete and separate oil system (Figure 6-3). The oil system is made up of the transmission sump, transmission lubrication jets, check valve, electrical chip detector, oil temperature transmitter (bulb), oil pump, oil pressure transmitter (transducer), filter and relief valve assembly, oil tank, and oil cooler. Although the oil systems of the engine transmission and engine-combining transmission are not interconnected, oil pressure and circulation for both types of transmissions are provided from a six-element oil pump mounted onto and driven by the engine-combining transmission.

the left-hand engine transmission, and one section for the engine-combining transmission. The oil filter and relief valve assembly for each of the engine transmissions and engine-combining transmission are mounted on the aft side of the oil tank. The oil cooler for the engine transmissions is mounted on top of the combining transmission. It receives cooling air from the fan assembly mounted on top of the combining transmission.

Oil Circulation

Oil is circulated in each transmission lubrication system by two separate elements of the six-element lubrication pump in the combining transmission. Oil

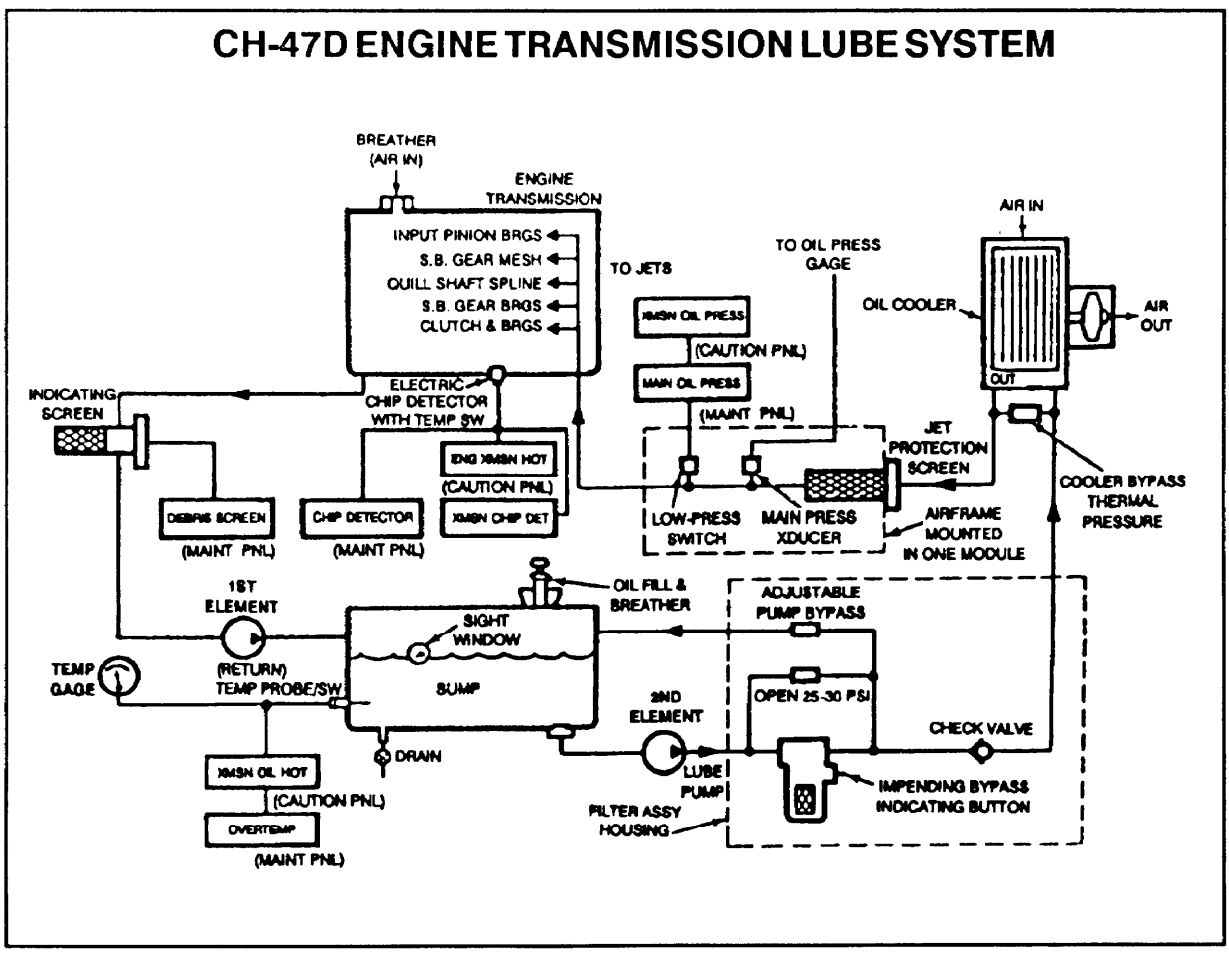

Figure 6-3. Engine transmission oil system

The engine-combining transmission is a three-section tank that is mounted onto and above the engine-combining transmission: one section for the right-hand engine transmission, one section for

flows from the oil tank through the pressure pump, through the filter and relief valve assembly, through the oil coder, and through the check valve. Then the oil flows into the transmission where it is sprayed on

the gears and bearings by various jets. Oil is scavenged from the sump by the scavenge section of the oil pump and returned to the oil tank.

ENGINE-COMBINING TRANSMISSION

The combining transmission is a central collection and distribution point for the drive system. The combining transmission is mounted in the lower forward section of the pylon. Torque from the engine transmission is transmitted by the combining transmission and the forward and aft synchronizing drive shafts to the forward and aft rotary-wing drive transmission. Speed reduction is also attained within the combining transmission. The output shaft drives the lubricated pump. The three-section oil tank (one section each for the combining transmission and each engine transmission) forms the uppermost portion of the combining transmission.

Oil System Components

The combining transmission oil system is a complete and separate oil system. The system includes the oil sump, oil temperature transmitter (bulb), oil pump, oil pressure transmitter (transducer), filter and relief valve, bypass valve, transmission lubricating jets, check valve, magnetic chip detector, oil tank, and oil coolers.

> **NOTE:** The reservoir for the oil system is the center section of the three-section oil tank on the combining transmission. The three-section oil cooler and fan assembly is mounted on the top section of the transmission.

Oil Circulation

Oil is circulated by two separate elements: one pressure element and one scavenge element of the six-element oil pump in the combining transmission (Figures 6-4 and 6-5). Oil is routed from the oil tank through the filter and bypass valve and through an external line to the oil cooler. The oil is then routed by an external line through a check valve to the transmission. In the transmission oil is distributed through internal passages and jets and is sprayed on bearings and gears. Oil is scavenged from the sump through internal passages by the scavenge clement of the oil pump. The pump then pumps the oil to the tank. A sight level gage is installed on the forward end of the oil tank.

FORWARD ROTARY-WING DRIVE TRANSMISSION

Torque is delivered to the forward rotary-wing drive transmission by the forward synchronizing drive shaft from the combining transmission (Figure 6-6). The forward rotary-wing transmission then changes the direction of torque from a horizontal plane to a vertical plane. This reduces the input shaft speed. The forward rotary-wing transmission transmits the torque through the rotary-wing drive shaft (mast) to the rotor head.

Oil System Component

The oil system serving the forward rotary-wing drive transmission is a complete, separate system. It is a wet-sump system, which includes the oil temperature transmitter (bulb), screens, oil pressure pump, oil pressure transmitter (transducer), relief valve, pressure filter, magnetic chip detector, oil cooler, and No. 1 flight control pump.

Oil Circulation

Oil from the sump flows through the screen to the inlet of the pressure pump. The pump pressurizes the system and pumps oil through the filter and cooler and then back to the transmission. Drilled and cored passages in the transmission distribute the oil to lubricators and oil jets. The lubricators and jets spray the oil into the transmission bearings and onto the rotating gears.

AFT ROTARY-WING DRIVE TRANSMISSION

Torque is delivered to the aft rotary-wing drive transmission by the aft synchronizing drive shaft from the combining transmission. The direction of torque changes from a horizontal plane to a vertical plane, and the aft rotary-wing transmission reduces input shaft speed (Figure 6-7). The aft rotary-wing transmission transmits the torque through the rotary-wing drive shaft (mast) to the rotor head. In addition to the reduction gearing, there are two accessory drive gears. One, driven by the input shaft, drives the transmission oil-cooling fan shaft and an oil scavenge pump. A second accessory gear drives the accessory gear section. The accessory gear section consists of gearing for driving the lubrication pump, one flight-control hydraulic pump, two AC generators, and a utility hydraulic pump. A one-way-drive clutch is united into one body in the accessory gear drive shaft for the accessory gear section. This type of clutch permits the accessory gears to overrun the

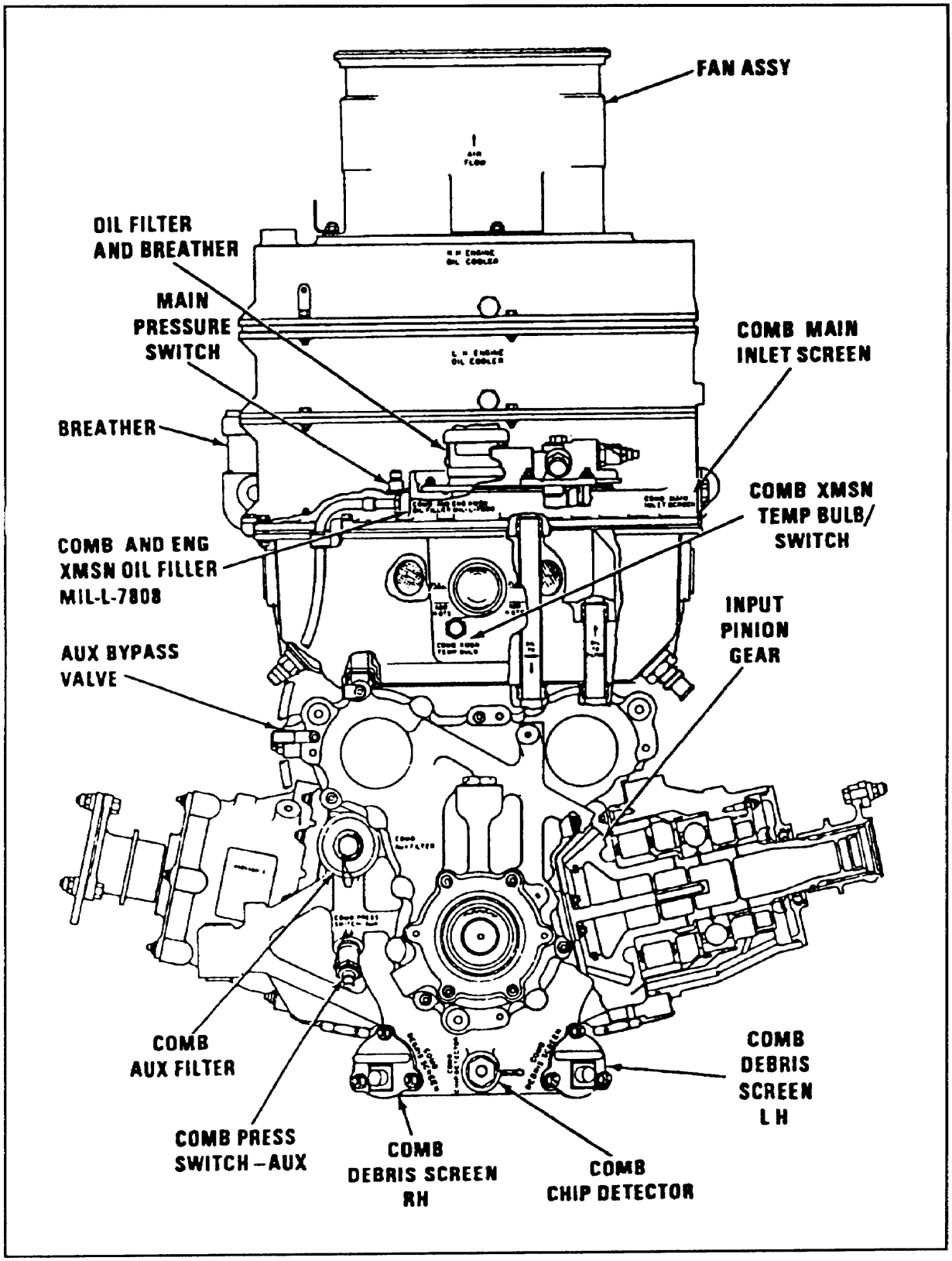

Figure 6-4. Combining transmission – sectional view

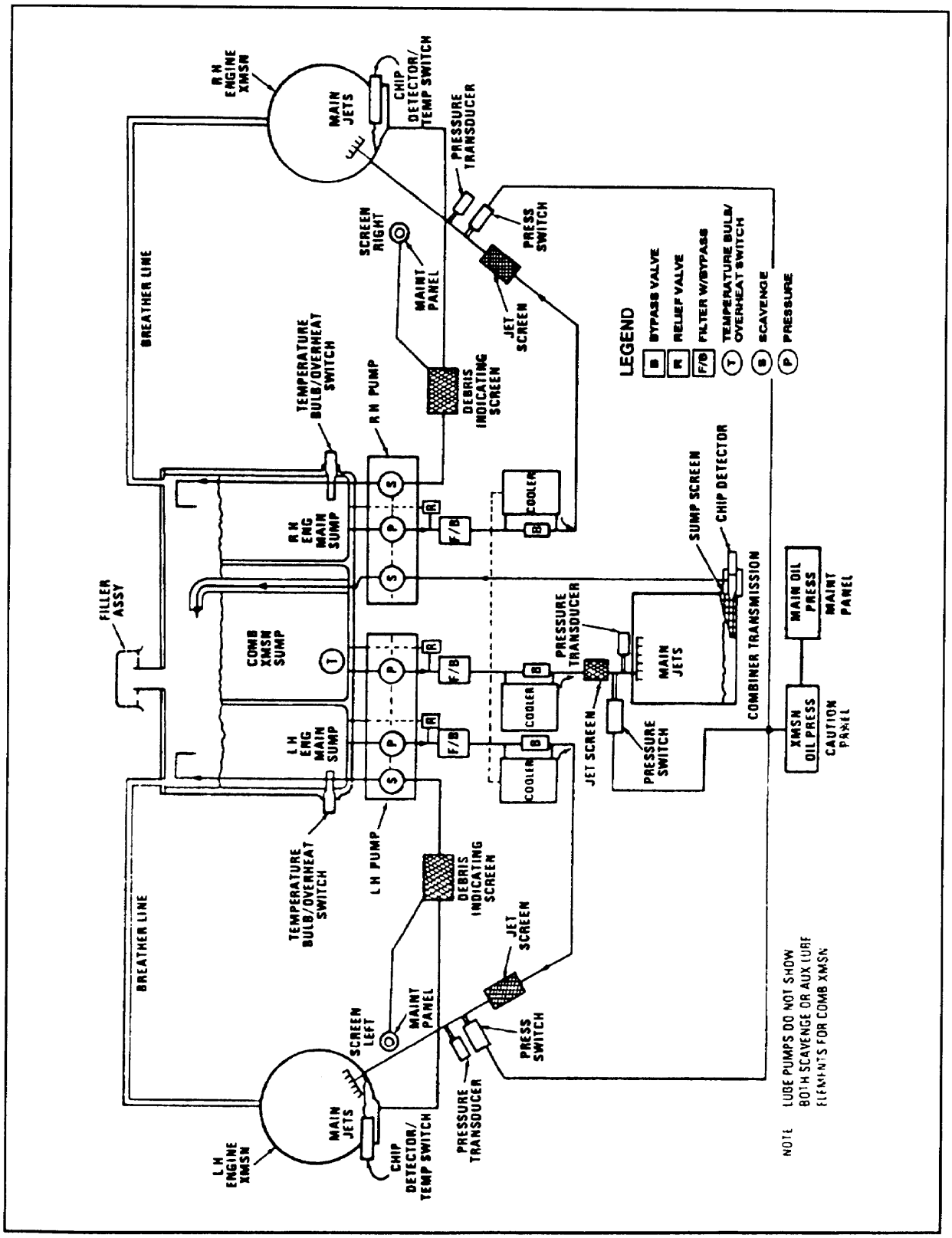

Figure 6-5. Combining transmission oil system – schematic diagram

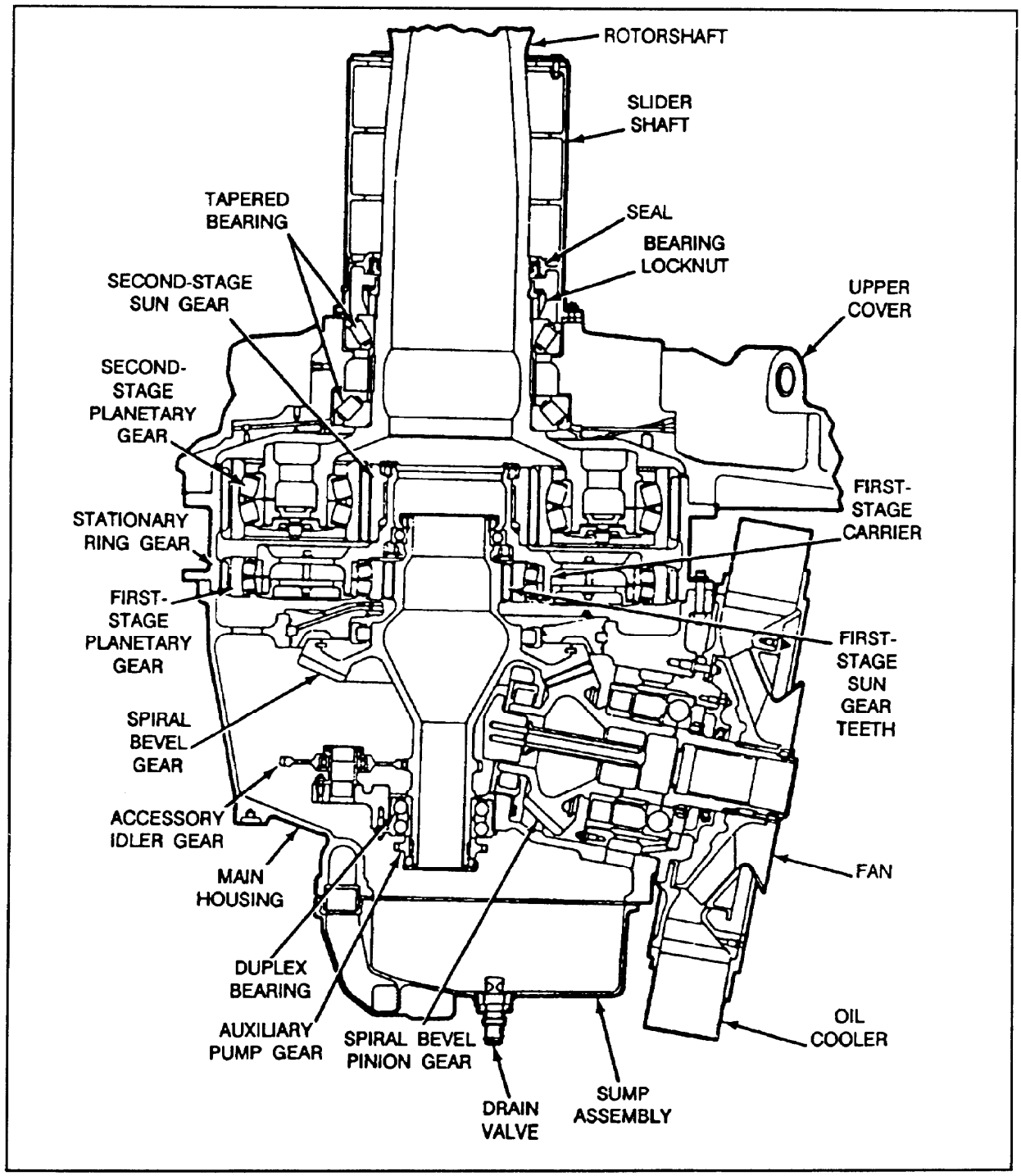

Figure 6-6. Sectional view of forward transmission

transmission gears when the accessory gears are being driven by the hydraulic motor. In normal operation the accessory gears are driven by the bevel gear in the transmission through the clutch.

Oil System Components

The oil system serving the aft rotary-wing drive transmission is a complete, separate system (Figure 6-8). It is a wet-sump system which includes

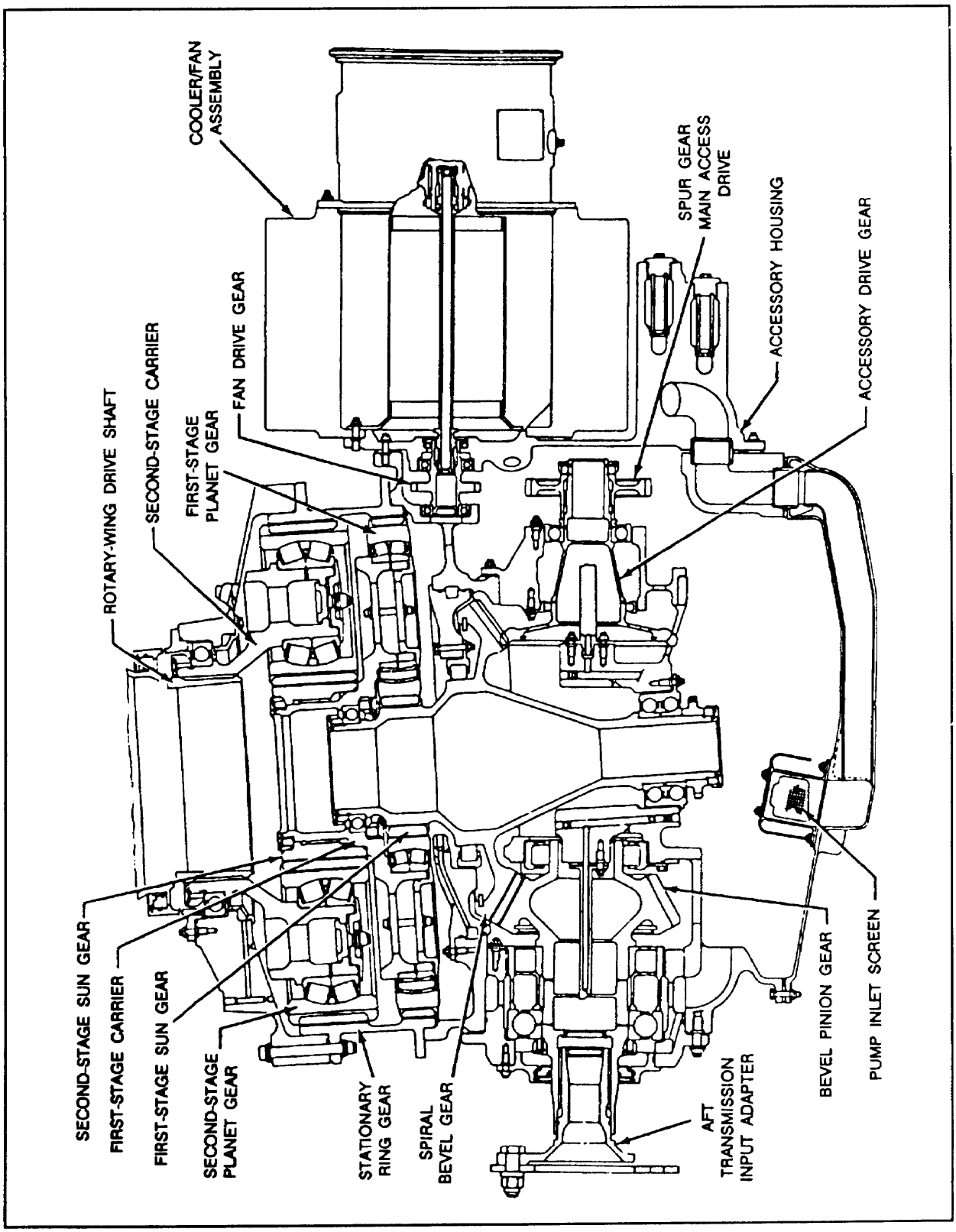

Figure 6-7. Sectional view of aft transmission

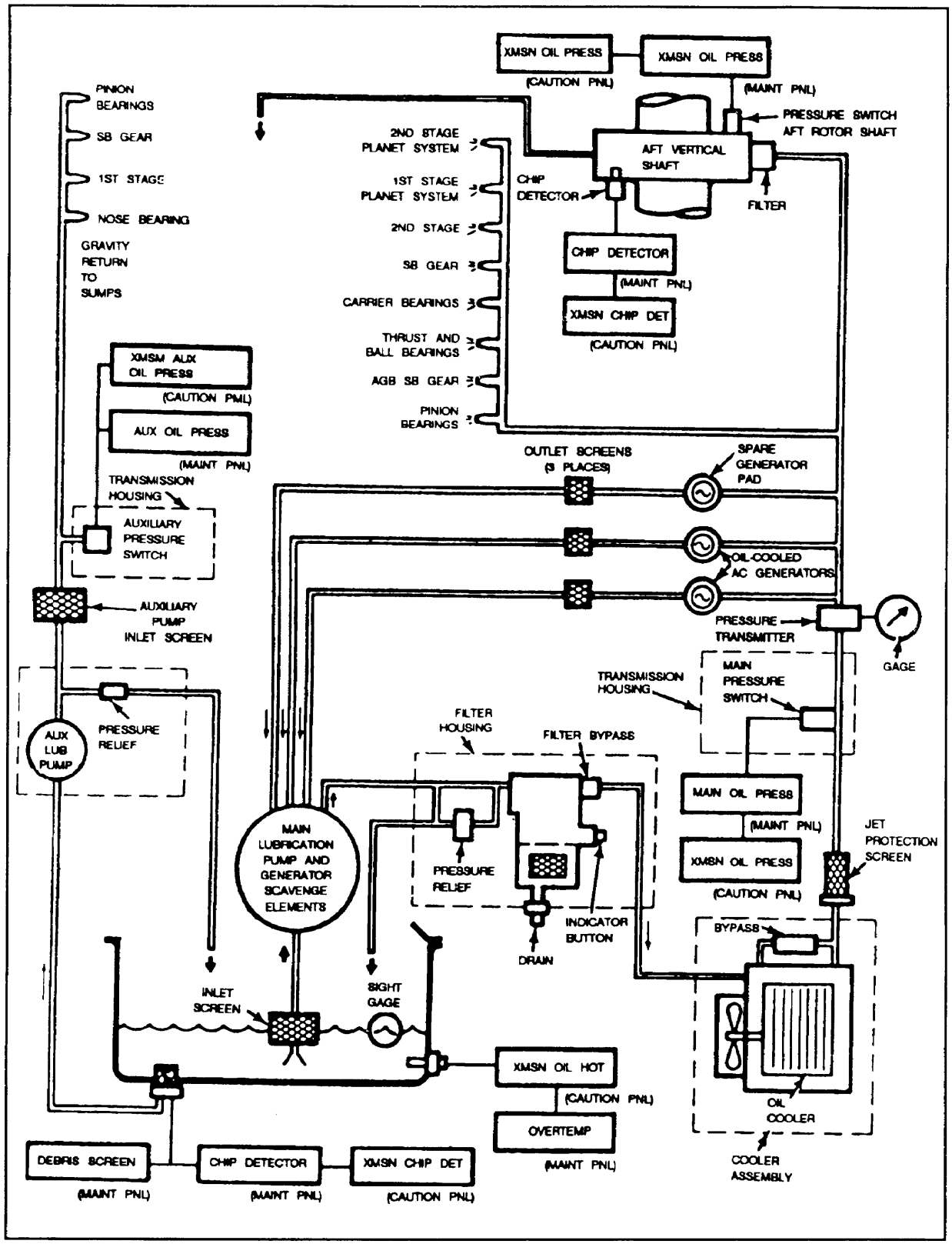

Figure 6-8. Aft transmission oil system – schematic diagram

the temperature transmitter (bulb), magnetic chip detector, screens, drain valve, oil level sight gage, oil pressure pump, oil pressure transmitter (transducer), relief valve, pressure filter, and oil cooler.

> **NOTE:** The sump is the lower circular casting of the transmission. The fan drive shaft drives an oil scavenger pump in the fan drive housing. The pump returns scavenge oil which collects in the forward part of the transmission when the aircraft is in a nose-down attitude.

Oil Circulation

Oil is drawn from the sump, through the screen to the inlet of the pressure pump. The pump pressurizes the system and pumps the oil through the filter and cooler and back to the transmission. Oil is supplied through external piping to the aft rotary-wing drive shaft (mast) thrust bearing. Drilled and cored passages in the transmission unit distribute oil to lubricators and jets. The lubricators and jets spray oil into the transmission bearings and onto the rotating gears. A scavenge pump in the fan drive housing is driven by the fan drive shaft. The pump returns scavrnged oil which collects in the forward part of the transmission when the aircraft is in a nose-down attitude.

DRIVE SHAFTS

The purpose of drive shafting is to transmit torque from the engines to the transmissions and rotors. It also transmits torque to the fan assembly.

Engine Drive Shaft

There are two engine drive shaft assemblies in each tandem-rotor power train system (Figure 6-9). The purpose of the engine drive shift assembly is to transmit torque from each of the engine transmissions to the combining transmission. The shaft is a hollow, dynamically balanced tube. Each shaft is connected to the combining transmission and engine transmission by an adapter and plate assemblies, one on each end of the shaft. The adapter and plate assemblies provide flexibility in the shaft assembly.

Forward Synchronizing Drive Shaft

The purpose of the forward synchronizing drive shaft is to transmit torque from the engine-combining transmission. It also keeps the forward and aft

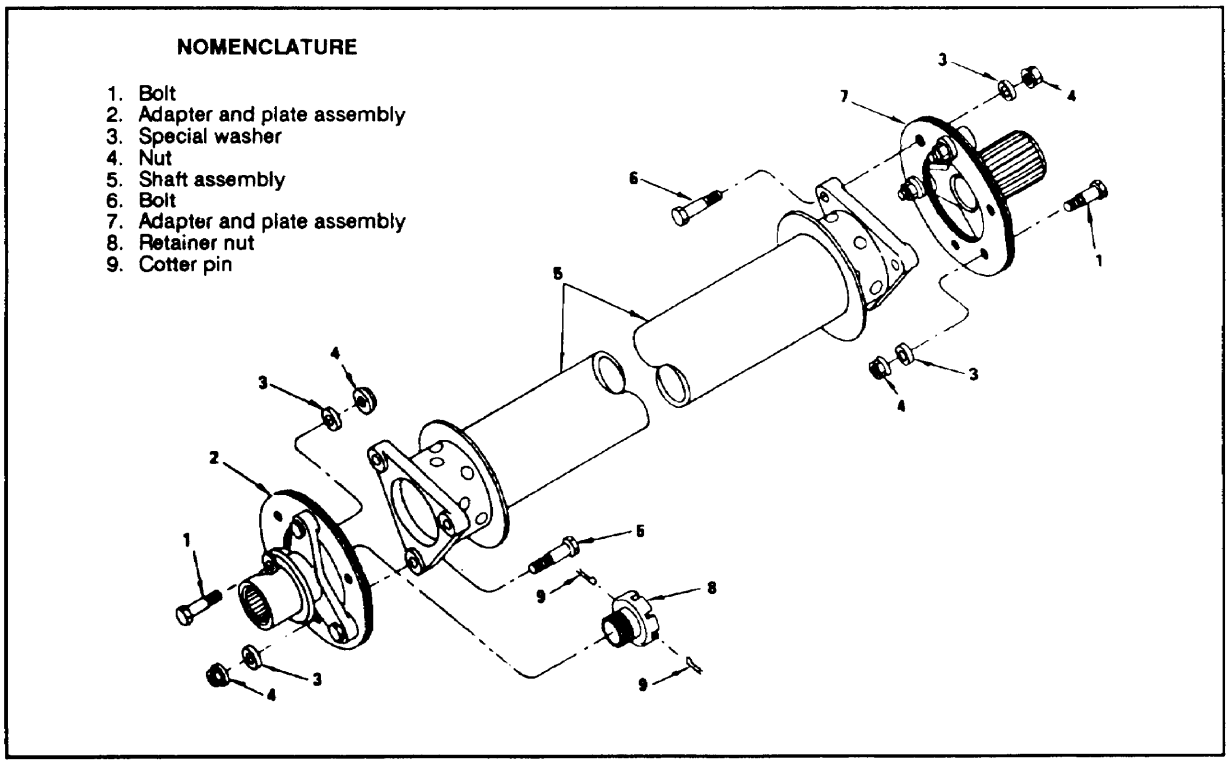

Figure 6-9. Engine drive shaft assembly

rotors mechanically connected and in phase with each other. The shafting assembly consists of a series of shafts, each of which is a hollow, dynamically balanced tube. Each shaft is interconnected to the other, to the combining transmission on the aft end, and to the forward rotary-wing drive transmission on the forward end by an adapter and plate assembly. The shaft is mounted and supported by bearings and support assemblies which contain shock mounts.

Synchronizing Drive Shaft

The purpose of the aft synchronizing drive shaft is to transmit torque from the engine-combining transmission to the aft rotary-wing drive transmission (Figure 6-10). The aft synchronizing drive shaft is similar to and supported in the same manner as the forward synchronizing drive shaft assembly. The only difference is that the aft synchronizing shaft assembly contains fewer shaft units and fewer supports.

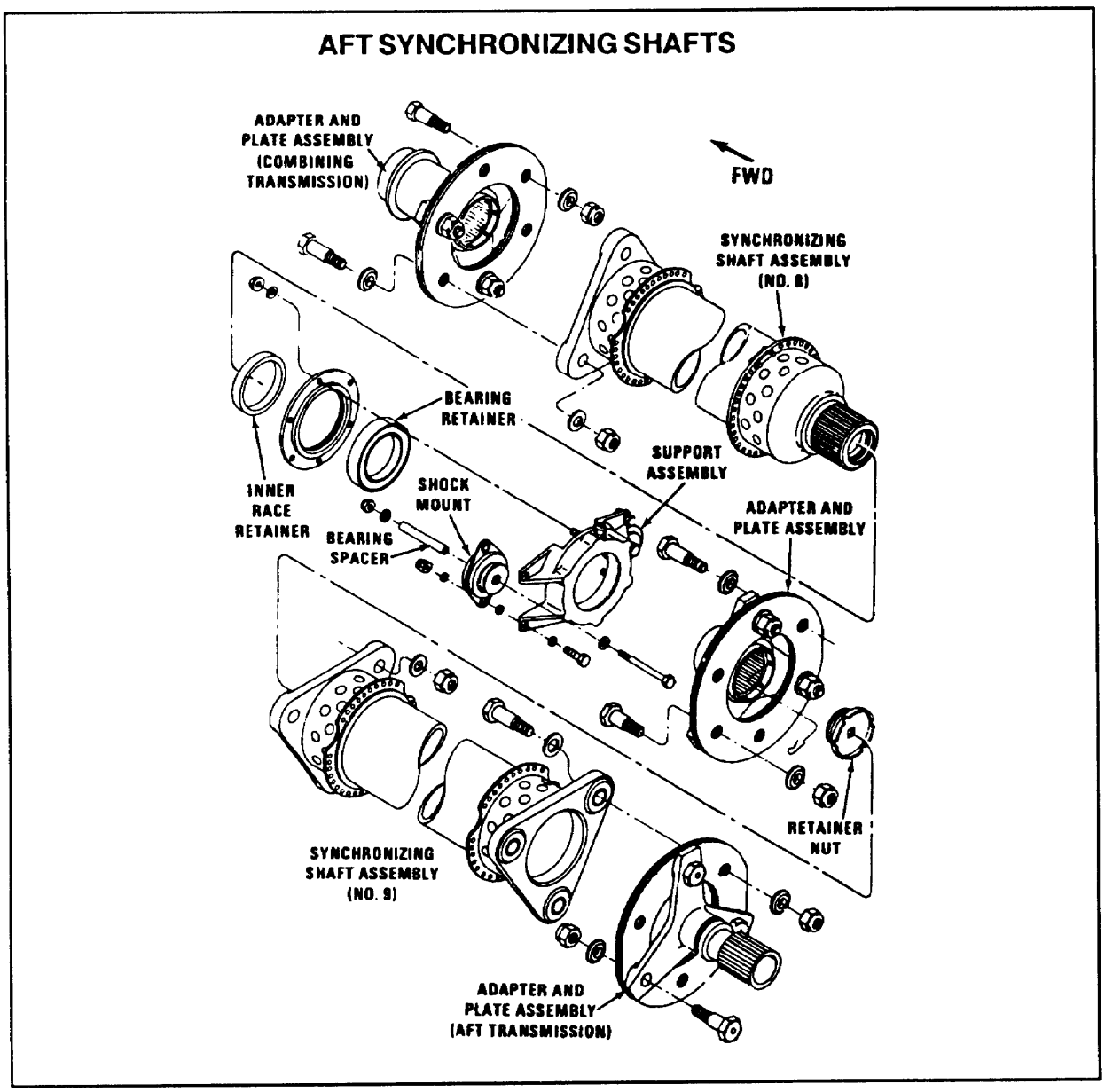

Figure 6-10. Synchronizing drive shaft