

essential bus. Circuit protection is provided by the CAUTION LIGHTS, RH FUEL BOOST PUMP and LH FUEL BOOST PUMP circuit breakers. On helicopters prior to Serial No. 69-15292 a FUEL TANK SUMP PUMP circuit breaker is used instead of RH and LH BOOST PUMP circuit breakers.

2-27. Auxiliary Fuel System.

Complete provisions have been made for installing an auxiliary fuel equipment kit in the helicopter cargo passenger compartment. Two crashworthy bladder type tanks can be installed on the aft bulkhead and transmission support structure. This allows the helicopter to be serviced with an additional 300 U.S. gallons of fuel (table 2-1).

a. *Internal Fuel Transfer Switches.* Two switches marked INT AUX FUEL LEFT/RIGHT are mounted in the ENGINE control panel (fig 2-6). Placing the switches to the forward position energizes the auxiliary fuel system. Fuel is transferred to the main fuel cells. An overfill limit switch is installed in the main fuel tank to prevent the auxiliary fuel pumps from overfilling the main fuel cells. Power is supplied by the dc essential bus and protected by the FUEL TRANS PUMP circuit breaker.

b. *Auxiliary Fuel Low Caution Light.* An AUX FUEL LOW caution light is provided to indicate when the auxiliary fuel tanks are empty. The light will illuminate only when the fuel transfer switches are in the forward position, and the auxiliary tanks are empty. The circuit receives power from the 28 Vdc essential bus and is protected by the CAUTION LIGHTS circuit breaker.

SECTION V. FLIGHT CONTROL SYSTEM

2-28. Description. The flight control system is a hydraulic assisted positive mechanical type, actuated by conventional helicopter controls. Complete controls are provided for both pilot and copilot. The system includes a cyclic system, collective control system, tail rotor system, force trim system, synchronized elevator, and a stabilizer bar.

2-29. Cyclic Control System The system is operated by the cyclic stick movement (fig 2-5). Moving the stick in any direction will produce a corresponding movement of the helicopter which is a result of a change in the plane of rotation of the main rotor. The pilot cyclic contains the cargo release switch, radio ICS switch, armament fire control switch, hoist switch and force trim switch. Desired operating friction can be induced into the control stick by hand tightening the friction adjuster

a. *Synchronized Elevator.* The synchronized elevator (fig 2-1) is located on the tailboom. It is connected by control tubes and mechanical linkage to the fore and aft cyclic system. Fore and aft movement of the cyclic control stick will produce a change in the synchronized elevator attitude. This improves controllability within the cg range.

b. *Stabilizer Bar.* The stabilizer bar is mounted on the main rotor hub trunnion assembly in a parallel plane, above and at 90 degrees to the main rotor blades. The gyroscopic and inertial effect of the stabilizer bar will produce a damping force in the rotor rotating control system and thus the rotor. When an angular displacement of the helicopter/mast occurs the bar tends to remain in its trim plane. The rate at which the bar rotational

plane tends to return to a position perpendicular to the mast is controlled by the hydraulic dampers. By adjusting the dampers, positive dynamic stability can be achieved, and still allow the pilot complete responsive control of the helicopter.

2-30. Collective Control System. The collective pitch control lever controls vertical flight (fig 2-5). When the lever is in full down position, the main rotor is at minimum pitch. When the lever is in the full up position, the main rotor is at maximum pitch. The amount of lever movement determines the angle of attack and lift developed by the main rotor, and results in ascent or descent of the helicopter. Desired operating friction can be induced into the control lever by hand-tightening the friction adjuster (fig 2-5). A grip-type throttle and a switch box assembly are located on the upper end of the collective pitch control lever. The pilot switch box contains the starter switch, governor rpm switch, engine idle stop release switch, and landing light/search light switches. A collective lever down lock is located on the floor below the collective lever. The copilot collective lever contains only the grip-type throttle, governor rpm switch, and starter switch when installed. The collective pitch control system has built-in breakaway (friction) force to move the stick up from the neutral (center of travel) position of eight to ten pounds with hydraulic boost ON.

2-31. Tail Rotor Control System. The system is operated by pilot/copilot anti-torque pedals (fig 2-5). Pushing a pedal will change the pitch of the tail rotor blades resulting in directional control. Pedal adjusters are provided to adjust the pedal distance for individual comfort. A force trim system is connected to the directional controls.

2-32. Force Trim System. Force centering devices are incorporated in the cyclic controls and directional pedal controls. These devices are installed between the cyclic stick and the hydraulic servo cylinders, and between the anti-torque pedals and the hydraulic servo cylinder. The devices furnish a force gradient or "feel" to the cyclic

control stick and anti-torque pedals. A FORCE TRIM ON/OFF switch is installed on the miscellaneous control panel to turn the system on or off (Fig 2-6). These forces can be reduced to zero by pressing and holding the force trim push-button switch on the cyclic stick grip or moving the force trim switch to OFF.

Section VL HYDRAULIC SYSTEM

2-33. Description. The hydraulic system is used to minimize the force required by the pilot to move the cyclic, collective and pedal controls. A hydraulic pump, mounted on and driven by the transmission supplies pressure to the hydraulic servos. The hydraulic servos are connected into the mechanical linkage of the helicopter flight control system. Movement of the controls in any direction causes a valve, in the appropriate system, to open and admit hydraulic pressure which actuates the cylinder, thereby reducing the force-load required for control movement. Irreversible valves are installed on the cyclic and collective hydraulic servo cylinders to prevent main rotor

feedback to the cyclic and collective in the event of hydraulic system malfunction.

2-34. Control Switch. The hydraulic control switch is located on the miscellaneous panel (Fig 2-6). The switch is a two-position toggle type labeled HYD CONTROL ON/OFF. When the switch is in the ON position, pressure is supplied to the servo system. When switch is in the OFF position the solenoid valve is closed and no pressure is supplied to the system. The switch is a fail-safe type. Electrical power is required to turn the switch off.

2-35. Reservoir and Sight Glass. The hydraulic reservoir is a gravity feed type and is located at the right aft edge of the cabin roof (fig 2-10). The reservoir and sight gage are visible for inspection through a plastic window in the transmission fairing.

2-36. Hydraulic Filter. A line filter is installed on helicopters prior to Serial No. 68-16050. This filter has no indicator. Helicopters Serial No. 63-16050 and subsequent, or those modified by MWO have an improved filter system. When the filter is clogged it will give a visual warning by raising a red indicator button. The red button pops out when a set differential pressure across the element is exceeded. Once actuated, the indicator will remain extended until reset manually. When the indicator

is in reset position, it will be hidden from view. An inspection window may be provided to permit ready visual access to the filter indicator. The transparent window is located on forward face of the transmission bulkhead.

2-37. Hydraulic Pressure Caution Light. Low hydraulic system pressure will be indicated by the illumination of HYD PRESSURE segment on the CAUTION panel. Moderate feedback forces will be noticed in the controls when moved.

2-38. Electrical Circuit. Electrical power for hydraulic system control is supplied by the 28 Vdc ESSENTIAL BUS. The circuit is protected by the HYD CONT circuit breaker.

SECTION VII. POWER TRAIN SYSTEM

2-39. Transmission. The transmission is mounted forward of the engine and coupled to the power turbine shaft at the cool end of the engine by the main driveshaft. The transmission is basically a reduction gearbox, used to transmit engine power at a reduced rpm to the rotor system. A freewheeling unit is incorporated in the transmission to provide a quick-disconnect from the engine if a power failure occurs. This permits the main rotor and tail rotor to rotate in order to accomplish a safe auto-rotational landing. The tail rotor drive is on the lower aft section of the transmission. Power is transmitted to the tail rotor through a series of driveshafts and gearboxes. The rotor tachometer generator, hydraulic pump, and main DC generator are mounted on and driven by the transmission. A self-contained pressure off system is incorporated in the transmission. The oil is cooled by an oil cooler and turbine fan. The engine and transmission oil coolers use the same fan. The oil system has a thermal bypass capability, an oil level sight glass, filler cap, and magnetic chip detector are provided. A transmission oil filter is mounted in a pocket in the upper right aft corner of sump case, with inlet and outlet ports through internal passages. The filter incorporates a bypass valve for continued oil flow if screens become clogged. The transmission external oil filter is located in the cargo-sling compartment on right side wall, and is connected into the external oil line. On Helicopters equipped with ODDS, a full flow debris monitor with integral chip detector replaces the integral oil filter. A bypass valve is incorporated, set to open at a set differential pressure to assure oil flow if filter

element should become clogged. A bypass condition will be indicated by extension of a red indicator on the filter head. On Helicopters equipped with ODDS, the external oil filter is rated to 3 microns.

2-40. Gearboxes.

a. Intermediate Gearbox - 42 Degree. The 42 degree gearbox is located at the base of the vertical fin. It provides 42 degree change of direction of the tail rotor driveshaft. The gearbox has a self-contained wet sump oil system. An oil level sight glass, filler cap, vent (fig 2-10) and magnetic chip detector are provided.

b. Tail Rotor Gearbox - 90 Degree. The 90 degree gearbox is located at the top of the vertical fin. It provides a 90 degree change of direction and gear reduction of the tail rotor driveshaft. The gearbox has a self-contained wet sump oil system. An oil level sight glass, vented filler cap (fig 2-10) and magnetic chip detector are provided.

2-41. Driveshafts.

a. Main Driveshaft. The main driveshaft connects the engine output shaft to the transmission input drive quill.

b. Tail Rotor Driveshaft The tail rotor driveshaft consists of six driveshaft and four hanger bearing assemblies. The assemblies and the 42 degree and 90 degree gearboxes connect the transmission tail rotor drive quill to the tail rotor.