ENGINES.

SPARK PLUG FOULING. Spark plug fouling may occur during ground operation with the engines idling or during flight if the thrust control levers are allowed to remain in the approximate NO THRUST position even for a relatively short interval. The flat blade angle of the propeller causes a decrease of engine BMEP, which results in incomplete combustion of the fuel-air charge. When idling an engine with the propeller at the low thrust blade angle, frequent run-ups should be made to prevent spark plug fouling.

USE OF PREHEAT CARBURETOR AIR. The engines' float-type carburetors are susceptible to icing even in clear air at nearly closed throttle positions. Carburetor preheat should be used when flying in any conditions conducive to ice formation. When it is necessary to use heat intermittently to remove ice formation, the constant use of heat to prevent icing will improve engine performance in most respects. Under carburetor icing conditions preheat should be used in most instances during takeoff and during approach and landing. The carburetor air temperature indicator on the pilot's instrument panel shows the temperature of the air as it enters the carburetor. Since in this installation air temperature is sensed as air enters the carburetor, the operating range for the carburetor air temperature is higher than in installations where the temperature, known as carburetor mixture temperature, is sensed "downstream" of the carburetor. Table XIV is a summary of recommended temperatures to be used as a guide in setting preheat.

Table XIV. Carburetor Air Temperature (°C)

CONDITION	MIN*	RECOMMENDED OPERATING RANGE	MAX
Icing	+25	+32 to +38	+38
Cold Weather Cruise		+10 to +32	+32
Cold Weather Take-Off (O.A.T. Below 0°C)		+10 to +32	+32
Letdown	+20	+20 to +32	+32

*Use full preheat when the minimum temperature cannot be obtained.

DETONATION. Continuous or frequent detonation will result in damage to an engine; in extreme cases it can result in complete engine failure. A rapid increase in the indicated cylinder head temperature is the pilot's only warning of detonation. Six factors contribute to the tendency of an engine to detonate: (1) excessive manifold pressure, (2) insufficient cooling, (3) lean fuel-air mixtures, (4) excessive carburetor air temperatures, (5) faulty ignition system, and (6) fuel of low octane. If cylinder head temperature rises sharply, possibly indicating detonation, the pilot can (1) reduce power, (2) open the cowl flaps, (3) enrich the fuel-air mixture, and (4) reduce carburetor air temperature. Detonation most frequently occurs when the use of preheat is followed by an increase in the power setting. The temperature of the exhaust manifold, the primary source of carburetor preheat, rises with an increase in power setting, causing a corresponding rise in carburetor air temperature. Whenever the power setting is increased while preheat is being used the carburetor temperature indicator should be checked to insure that carburetor air temperatures stay within operating limits.

POWER CONTROL. The application of thrust control (Beta system) has reversed the fundamental relationships of engine power control. Instead of controlling the power output of the engine directly, as in throttle control of manifold pressure, and governing the propeller blade angle to absorb the power and maintain constant rpm, the Beta system controls the load on the engine through thrust lever control of blade angle and governs the throt-

tle setting to control power output of the engine and maintain constant rpm. In more concise terms, normal operation with the Beta system is a fixed pitch-variable throttle operation as opposed to the more conventional fixed throttle-variable pitch operation. Direct electrical control of the throttle is available for use when the governing action of the system is not required. The throttle override levers are mechanical controls for emergency use only.

NORMAL THROTTLE OPERATION. Each engine throttle is normally controlled electrically, either automatically by operation of the throttle governor or manually by operation of the throttle selector switch.

Automatic control of the engine throttle is engaged by placing the propeller selector switch and the throttle selector switch in the LEVER OPER position. Any engine speed between 1000 and 2250 rpm can then be selected by operation of the rpm control lever. The carburetor actuator, controlled by the throttle governor, maintains a constant engine rpm regardless of the propeller pitch setting. Automatic control of the throttle actuator is used for all normal flight operations except starting or shutting down the engine.

The throttle actuator is manually controlled by placing the throttle selector switch in the momentary OPEN or CLOSE position. The actuator cycles the throttle from open to close in approximately 1-1/2 seconds. Each engine idles at 800 rpm when the propeller is at take-off pitch (+12 degrees) and the throttle actuator is in the full close position. From this setting idling speed varies inversely with the blade angle.

Engine overspeeding, which can occur when control of the throttle actuators is changed from manual to automatic, may be prevented by the following procedure:
a. Place prop selector switch in the center off position.
b. Adjust engine speed for 1000 to 1050 rpm with the throttle selector switch.
c. Set the rpm control lever in full DEC RPM position.
d. Place throttle selector switch in LEVER OPER.
e. Place propeller selector switch in LEVER OPER.

EMERGENCY THROTTLE OPERATION. In the event of electrical power or throttle actuator failure, the throttles are controlled manually by operation of the override levers. These levers are normally left in the full closed position and should not be engaged except in an emergency. The override is engaged by raising the levers until the override engages when lever position matches the throttle position. With the override engaged, approximately 40 to 50 pounds pressure must be applied to overcome actuator friction and change the throttle setting. The override is disengaged by pulling a spring-loaded pin at the carburetor while the override lever is bottomed. The disengaging procedure is difficult and hazardous in flight since the pin must be disengaged in the nacelle.

CAUTION

Never operate throttles electrically with the override engaged. The actuators are not designed to carry the load imposed by the override.

PROPELLER OPERATION.

Propeller blade angle is controlled by operation of the thrust lever or the propeller pitch selector switch. Thrust lever control is used when the Beta system is operating. The propeller selector switch and the throttle selector switch must be in the LEVER OPER position for the related thrust lever to be operative. The position of the thrust lever determines the blade angle within the range between plus 29.4 degrees (full FWD position) and minus 6.7 degrees (full REV position). Some degrees of power lag must be anticipated when the Beta system is operative. If thrust levers are advanced to increase manifold pressure, stop the lever when MAP is indicated as 2 inches less than the desired pressure. The manifold pressure increases approximately 2 inches after the thrust lever stops. At take-off engine speed (2250 rpm) advance thrust levers to obtain a manifold pressure of 36 inches Hg. Further advance will cause engine rpm to decrease, since full available throttle is reached before maximum blade angle setting. Full engine take-off power is not obtainable with the Beta control system.

There is no specific hover blade angle when the Beta control system is operating. Any blade angle can be selected to produce the desired hover condition. The maximum allowable rpm (refer to section V) should not be exceeded in the hover condition. A no thrust condition is attainable throughout the entire range of engine speeds.

Blade angle control by momentary operation of the prop pitch selector switch permits the selection of any blade angle between feather (+89.4 degrees) and full reverse (-8.7 degrees). This is the only method for feathering a propeller.

OIL SYSTEM MANAGEMENT.

The flap thermostat in each oil cooling system is set to maintain oil temperature between 71°C (160°F) and 77°C (170°F) when the oil cooler switches are in the AUTO position. If either flap thermostat fails, hold the switch in OPEN or CLOSE long enough to place the oil cooler flap in the position required to maintain oil temperature within the limits marked on the indicator.

FUEL SYSTEM.

NORMAL FEED. Under normal flight conditions fuel is fed from the forward tank to both engines. The forward tank is replenished by automatic transfer as follows:
a. Turn selector switch to tank from which fuel is to be transferred.
b. Turn forward tank refueling valve switch to the open position.
c. Turn emergency feed switch to the closed position.
d. Place transfer pump switch in ON.

The transfer pump control system starts the transfer pump when fuel in the forward tank drops to 600 pounds. Fuel is transferred from the selected tank to the forward tank; when the forward tank holds 900 pounds of fuel, the transfer pump stops until the level again drops to 600 pounds. This automatic replenishment of the forward tank is continuous as long as the transfer pump switch is left at ON. During automatic transfer, the no transfer

pressure warning light does on when the tank from which fuel is being transferred is empty. The selector switch must then be turned to a tank containing fuel.

FUEL TRANSFER. (See figure 7-1.) Fuel can be transferred from any tank except the forward tank. Automatic transfer into the forward tank is described as part of the normal feed condition. Fuel is transferred into the aft or slip tank by the following procedure:

a. Select tank from which to draw fuel.
b. Transfer Pump Switch ON
c. Emergency Feed Switch Open

CAUTION

The fuel being transferred is also supplying the engines. Check engine fuel pressure gages after switching to emergency feed.

d. Open refueling valve to tank receiving fuel.
e. Close refueling valve when tank is full or transfer is completed.

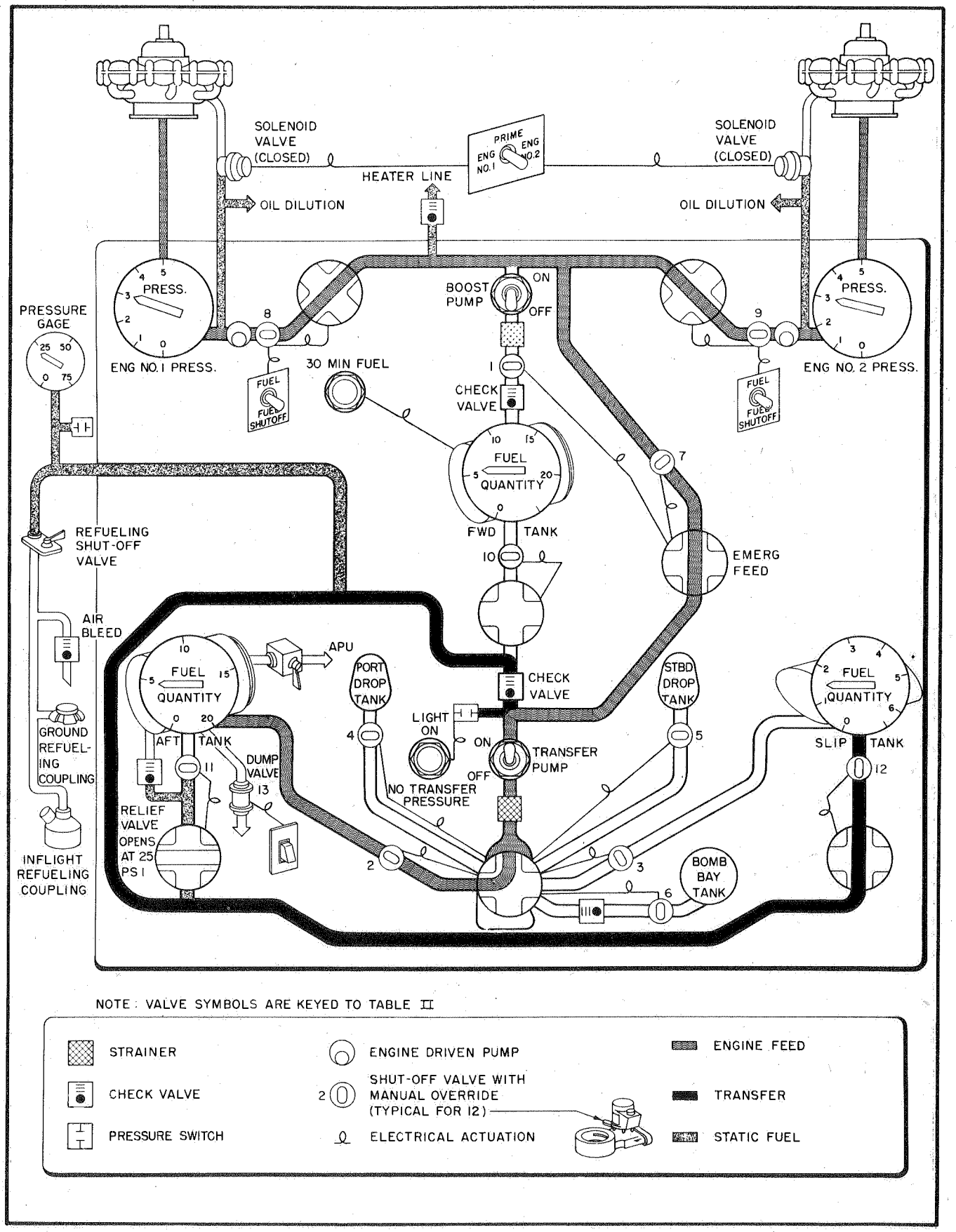

Figure 7-1. Fuel Flow Diagram - Transfer

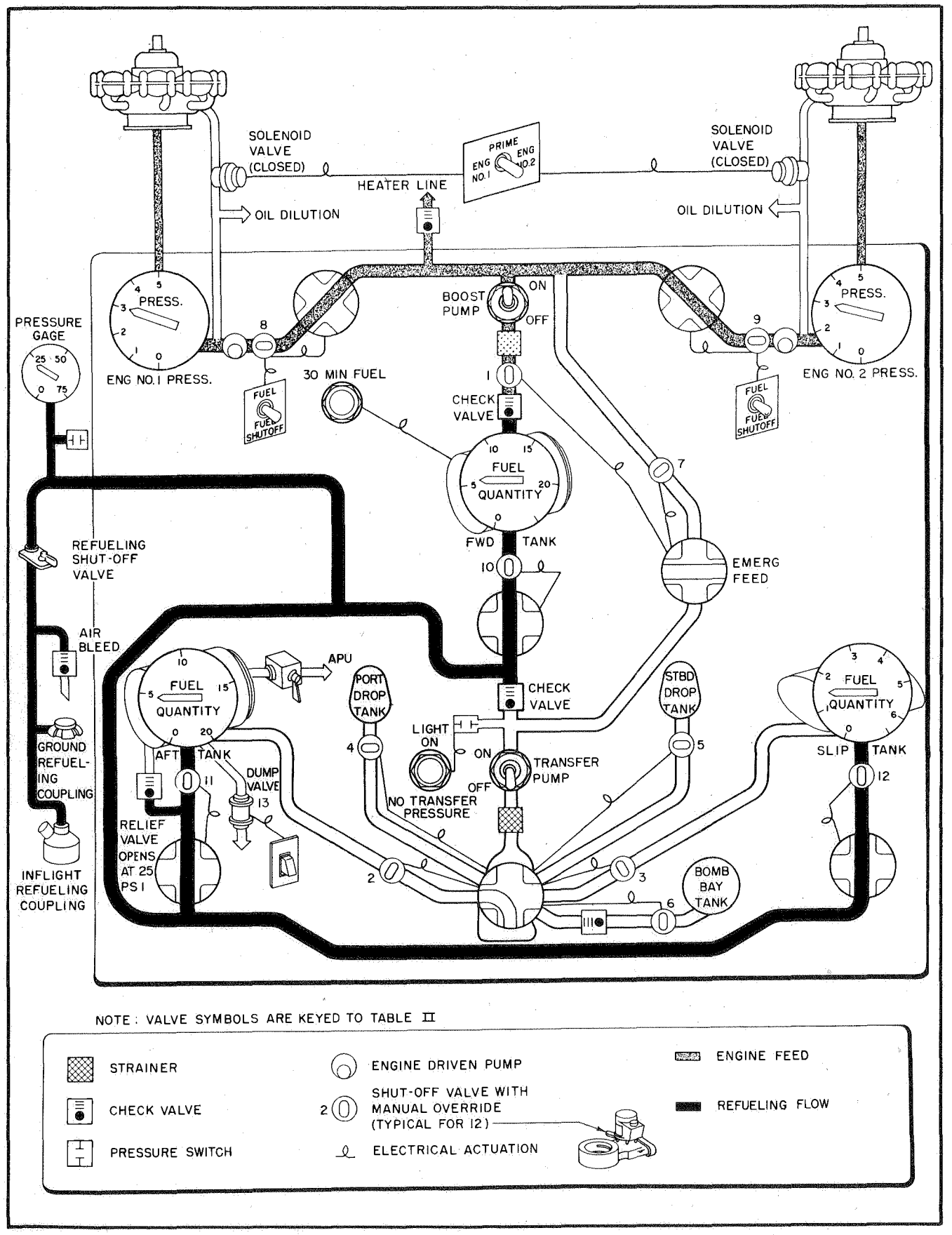

Figure 7-2. Fuel Flow Diagram - Refueling

f. Emergency Feed Switch — Closed

NOTE

Normal engine feed from forward tank is resumed when emergency feed is shut off.

USE OF FUEL BOOSTER PUMP. The booster pump should be operated during take-off and landing and when an engine is started. Booster pressure should also be used whenever an engine-driven pump is not maintaining the steady feed pressure required for safe flight.

BOMB BAY TANK. When the bomb bay tank is installed, the bomb bay door should be open approximately 1-1/2 inches to provide adequate ventilation of the bomb bay. Since intermediate positions of the bomb bay doors cannot be maintained when the electrical control system is energized, the bomb bay control circuit breaker on the d-c circuit breaker panel must be opened. The doors are then opened manually.

WARNING

Bomb bay doors should be full open if the instrument inverter is operated during ground operation.

RELEASE OF JETTISONABLE FUEL TANKS. The procedures for jettisoning the drop tanks and bomb bay tanks are discussed with the armament system in section IV.

IN-FLIGHT REFUELING.

PREPARATION. Engine fuel feed and tank refueling flow are shown in figure 7-2. Flight refueling requires the coordinated effort of the flight crew. Directly concerned in the operation are the pilot, a refueling officer, and the winch operator. The pilot plans the operation and briefs the refueling officer, who supervises the stern crew during refueling. The pilot must consider the heaviness condition of the airship before and after refueling and the wind velocity over the deck of the refueling vessel to determine the necessary airspeed and the trim and power changes required to maintain constant altitude. Figure A-5 can be used to select the angle of attack and power settings required for various conditions of heaviness. Before refueling, the pilot must take note of the operating limitations established in section V for flight refueling operations. He should plan fuel distribution so that trim can be maintained. During refueling the pilot controls the flow of fuel into the tanks, dumps ballast to maintain a satisfactory condition of heaviness, and controls the airship so as to maintain level flight and a fixed position relative to the surface vessel. Power changes, as slight and as smoothly applied as possible, should be made only when necessary.

The winch operator controls the winch operation with the winch remote control handle, aligns and secures the refueling hose in the coupling, and operates the refueling line manual shut-off valve. The hoisting drum brake should be set at 2800 pounds. Both the refueling officer and winch operator should wear headsets with boom microphones. The refueling officer's headset is plugged into the winch operator's ICS terminal. The winch operator's headset is plugged into the refueling ICS terminal beside the flight refueling doors. The winch operator should wear a safety harness with the harness line secured to car structure in the stern compartment.

During the refueling procedure all crew members are alerted and all non-essential electrical and electronic equipment is shut down. No smoking is permitted. The car should be sealed off as tightly as possible and the blower secured. If fumes are present the car may be ventilated after the refueling is completed. The heater blower should not be used in ridding the car of explosive fumes.

FLIGHT REFUELING PROCEDURE.

PILOT	REFUELING OFFICER	WINCH OPERATOR
1. Level off to maintain constant position relative to surface vessel.		
		2. Open refueling doors (safety bar secured across door opening). 3. Lower hoisting cable to surface vessel.
	4. Notify pilot when refueling hose is attached to cable.	
		5. Operate winch to haul up hose.
6. Make trim adjustment to compensate for weight of hose. Dump approximately 300 pounds of ballast as hose is hauled up.		
		7. Inch hose into reception coupling.
	8. Make certain hose nozzle is correctly seated in coupling.	
		9. Place control handle on flight refueling hydraulic panel in ENGAGE and actuate hand pump until indicator shows 850 psi. Minimum pressure of 750 psi must be maintained while hose is clamped in coupling.

PILOT	REFUELING OFFICER	WINCH OPERATOR
		10. Inch out cable approximately two inches. Pawl should not be engaged on hoist drum. 11. Plug circuit leads hoisted with hose into phone jack.
	12. Check wind speed over deck of surface craft and inform pilot.	
13. Adjust power setting to maintain fixed position relative to surface vessel.		
		14. Close flight refueling doors and refueling line manual shut-off valve.
15. Close tank refueling switches.		
	16. Inform surface vessel that testing for line pressure is to begin. Place refueling switch in PUMP. Pressure as shown on refueling pressure indicator should rise to 32 psi. Inform pilot of maximum pressure. Then evacuate line.	
17. Place boost pump switch ON. 18. Open forward tank refueling valve.		
	19. Notify surface craft that refueling operation is to begin. Then place refueling switch on PUMP.	
		20. Stand by with portable fire extinguisher.
21. Watch forward tank quantity indicator and discharge ballast at approximately the same rate that fuel is taken aboard. 22. When forward tank is full, repeat steps 18 and 21 for the slip and aft tanks in that order. The aft tank is filled last so that sufficient space is available to take the discharge of the aft tank relief valve in the event of refueling pressure surges.		
	23. Watch refueling pressure gage and place refueling switch in EVAC if pressure exceeds 32 psi.	
24. When tanks are filled close tank refueling valve and order refueling officer to stop the refueling operation.		
	25. Place refueling switch in EVAC. Inform surface craft that refueling is completed.	
		26. Close manual shut-off valve; open refueling doors. 27. Inch up slack in hoist cable. 28. Disconnect control circuit from phone jack. 29. Place control handle on flight refueling hydraulic panel in RELEASE. 30. Operate winch to lower hose to surface vessel.
	31. Notify pilot when hose is disconnected.	
		32. Reel in winch cable.
33. Trim airship.		

CONSTANT SPEED DRIVE SYSTEM.

The pressure in the gas cylinder on the winch reservoir panel must be checked before each flight. The cylinder must be replaced when the pressure indicated is less than 150 psi. Before the engines are started, the gas cylinder shut-off valve is opened to pressurize the reservoir and insure an adequate supply of fluid to the constant speed drive unit and the hydraulic pumps. Cavitation of the pumps, caused by an inadequate fluid supply, will damage the pumps. Cavitation of the pumps is also caused by operating the engines at high rpm with the drive unit vented. If the engines must be run with the drive unit vented or the reservoir depressurized, engine rpm should be kept as low as possible to prolong pump life. If a pump is run until it fails, the pump drive shaft shears when the pump seizes. Engine operation is not affected by hydraulic pump failure but electrical power generation is greatly reduced. Procedure for resetting the constant speed drive is given in section III. The gas cylinder shut-off valve is closed and the winch reservoir depressurized after the engines are stopped.

ELECTRICAL SYSTEMS MANAGEMENT.

GENERAL. The a-c generator, the instrument inverter, and the main d-c generator normally supply the entire electrical system during flight. Since both the main d-c and the a-c generator are driven by the constant speed drive, normal operation of the electrical systems is dependent upon proper functioning of the drive unit. Under normal load conditions, the generators are driven at a constant speed; however, a large increase in electrical load at low speed requires an increase in engine rpm. Figure 5-3 covers the maximum electrical loads at various engine speeds during single and dual engine operation.

As the drive unit is loaded the hydraulic pressure increases until the red-line limit is exceeded as the overload point is reached. This overload may be a combination of electrical load and winch hydraulic load, but the effect is the loss of electrical power generation regardless of what causes the drive to be overloaded. Use the hydraulic pressure indicator to gage the load on the constant speed drive unit and increase engine rpm whenever the pressure approaches the red-line limit. Anticipate the addition of large loads and increase engine rpm in advance to insure that electrical generation will continue.

LOSS OF MAIN D-C GENERATOR. If the main d-c generator or constant speed drive fails, the two standby generators must be switched on to supply the main and essential d-c busses. Connected in parallel the two 50-ampere standby generators are rated at 90 amperes, 30 percent of the maximum electrical load carried by the main d-c generator. The two 24-volt batteries have a combined life of 48 ampere hours (see figure 7-3).

The load on the electrical system must be held to a minimum when operating on the standby generators or the batteries. The monitor busses are automatically disconnected from the electrical system when the main d-c generator is disconnected. These busses are energized from the standby generators or the batteries by placing the monitor override switch in OVERRIDE.

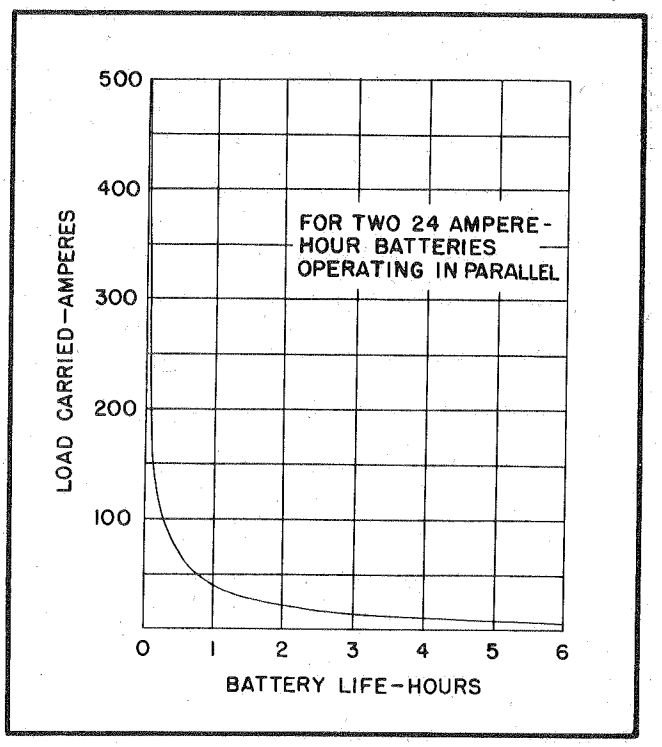

Figure 7-3. Battery Life Chart

Serious overloading will result unless every non-essential circuit breaker on the monitor busses is manually opened before the monitor is overridden.

INSTRUMENT INVERTER FAILURE. The instrument inverter can be operated when the d-c essential bus is energized. If the inverter fails or the d-c essential bus is not energized, phase A power from the a-c generator is connected to the instrument bus by placing the inverter switch in STANDBY.

RESETTING A-C GENERATOR. When the generator off light comes on to signal a generator fault trip, the a-c generator reset switch should be held in RESET momentarily. If the light is not extinguished and the ammeters do not indicate a generator load the main a-c power circuit breakers should be checked immediately. The main circuit breakers that have tripped should be reset and the generator reset switch again placed in RESET momentarily to restore generator operation.

SURFACE CONTROL SYSTEM.

GENERAL. The surface controls may be separated or shifted to manual operation at any time without regard to booster engagement or automatic pilot operation. The simultaneous operation of the boosters and the automatic pilot is prevented by an interlock circuit. Automatic pilot control of the rudder alone is not practical since manual operation of the elevator is required with the boosters off. The advantages of partial control by the automatic pilot are offset by the extra effort required to operate the elevator. The automatic pilot should be used on both elevator and rudder or the booster system should be engaged and the pilot and copilot alternate at the controls.

Normally the surface controls are moved by the electrical boost system and spring tabs. The pilot has very little control "feel" while this boost system is operating. The initial tendency to overcontrol will disappear as the pilot develops a lighter touch on the controls. Caution should be used in determining longitudinal trim of the airship. More attention should be given to control column position than to the force required to hold the column in position or to move it.

If the boosters fail, emergency (manual) control utilizes spring tabs on all control surfaces to allow the pilot to fly the ship without exceeding the following control loads:

Maximum pilot effort required to hold maximum deflection: Rudder - 75 pounds
Elevator - 80 pounds
Maximum pilot effort required to return control to neutral: Rudder - 68 pounds
Elevator - 35 pounds

ENGAGING BOOSTER SYSTEM.

Pilot Switch (Autopilot Pedestal Controller)	OFF
Elevator Columns and Rudder Wheels	Approximately neutral position
Manual Surface Control Handle	Down
Boost Master Switch	ON
Booster Engage Switches	ENGAGE

DISENGAGING BOOSTER SYSTEM. The elevator and rudder servos can be disengaged separately by placing the booster engage switches on DISENGAGE. An electrical interlock automatically trips both engage switches when the boost master switch is placed in the OFF position.

SEPARATING SURFACE CONTROLS.

Elevator Columns and Rudder Wheels	Approximately neutral position
Separate Surface Control Handle	Up

RESTORING DUAL SURFACE CONTROL

Elevator Columns and Rudder Wheels	Approximately neutral position
Separate Surface Control Handle	Down

ENGAGING MANUAL SURFACE CONTROL. The manual surface control handle is pulled up to engage emergency operating ratios for operation of the surface controls. The elevator shift occurs immediately; however, the rudder wheel shift does not occur until the wheel reaches the position required to effect the same degree of rudder displacement in the emergency range. Rudder wheel displacement in the normal range from neutral to hard over is 86 degrees and in the emergency range, 203 degrees. The shift into emergency range can be made with the controls in any position, but the shift from emergency to normal should not be made with the controls hard over.

ENGAGING AUTOPILOT. The procedure for engaging the autopilot is discussed in section IV.

USE OF GUST LOCK. The gust lock should be locked when the airship is moored or on the mast, except as necessary to operate the controls.

BALLAST SYSTEM.

GENERAL. The ballast system provides a variable and jettisonable load and is used to control the trim and heaviness condition of the airship. As fuel is used, water ballast can be picked up to compensate for the weight of the fuel consumed, thus keeping the airship heaviness near equilibrium. A gravity flow between the two ballast tanks equalizes the water level in the tanks when the airship is in trim and the tank shut-off valves are open with the main fill valve closed.

IN-FLIGHT REBALLASTING.

PREPARATION. In-flight reballasting requires the coordinated effort of several crew members; the pilot, the winch operator, and a reballasting officer. The pilot is responsible for the planning and execution of the reballasting operation. Before reballasting he determines the heaviness condition of the airship and the anticipated heaviness after reballasting. The reballasting officer directs the operation from the utility and stern compartments and keeps the pilot informed about the progress of the reballasting. The winch operator operates the winch, the reballasting pump, and the tank and main fill valves. Intercommunication is of prime importance during the reballasting operation. The winch operator uses the refueling station ICS terminal, and the reballasting officer uses the utility compartment terminal. The winch operator should wear a safety harness with the safety line secured to car structure. The pilot can determine angle of attack and the power setting required for various heaviness conditions from figure A-5.

REBALLASTING PROCEDURE.

PILOT	REBALLASTING OFFICER	WINCH OPERATOR
		1. Check out winch (refer to section IV).
		2. Lower hoist cable, with sandbag attached, approximately 10 feet.
		3. Open refueling doors, secure safety bar, and pull sandbag into car.

PILOT	REBALLASTING OFFICER	WINCH OPERATOR
		4. Uncouple sandbag and attach ballast bag to push-pull coupler.
	5. Make certain lock nut on coupler is secure; loose nut can result in loss of coupler and bag.	
		6. Ease bag and cable overboard.
	7. Notify pilot that winch operator is ready to lower bag.	
	If airship is heavy:	
8. Trim airship to attitude of approximately 11 degrees nose-up while holding full up elevator at zero ground speed.		
		9. Reel out 300 feet of cable.
	10. Notify pilot of bag position.	
11. Head into wind and reduce airspeed. Allow airship to settle slowly and bag to settle into water.		
	12. Notify pilot when bag is full.	
13. Apply thrust gradually.		14. Simultaneously with step 13, rapidly reel in hoist cable until bag clears water.
15. If bag drags across water, slow airship until winch operator lifts bag clear of the water.		
	If airship is light:	
8. Trim to an attitude of five degrees nose-up holding full up elevator at zero ground speed.		
		9. Reel out 100 feet of cable with bag attached.
10. Fly airship down to altitude of 150 feet, using minimum airspeed. 11. Apply reverse thrust and notify winch operator.		
		12. Quickly lower bag into the water.
	13. Notify pilot when bag is full.	
		14. Reel in hoist cable.
15. Simultaneously with step 14 apply forward thrust.		
		16. If bag swings during hoisting slow or stop winch to reduce pendulum effect of load. Stabilize winch cable with gloved hand.
	17. Notify pilot when ballast bag is hoisted to refueling doors.	
18. Adjust trim and power as necessary.		
		19. Place in-flight reballasting hose in ballast bag. 20. Open aft or forward tank valves (as instructed by pilot) and place reballasting pump switch ON.
	21. Observe ballast indicators and notify winch operator and pilot when sufficient ballast is aboard.	
		22. Close valves when operation is complete and place ballast pump switch OFF. Never operate pump dry as carbon vanes may seize. Cut off pump before water in bag is depleted.

PILOT	REBALLASTING OFFICER	WINCH OPERATOR
		23. If water remains in bag, dump same amount from one of the tanks; then pump water from bag into tank.
	24. Notify pilot when reballasting is complete.	
		25. Pull ballast bag aboard; disconnect bag and coupling. 26. Replace sandbag on cable and inch cable with sandbag to refueling coupling. 27. Close refueling doors and stow ballast bag.

SONAR FISH TOWING.

Towing speed, fish depth, airship altitude, and tow cable length are related. Any variation of one affects the others. For a given cable length, higher speed requires lower airship altitude because of smaller cable angles. Higher airship altitude and deeper fish depth are attainable only at lower towing speed. The faired cable must be submerged at least ten feet at all towing speeds. The fish tends to yaw if the fairing breaks water, resulting in greater towing loads and possible damage to the fairing. Excessive depth also results in greater towing loads. The greatest structural loads imposed in towing are produced when the fish bounces on the surface, especially in rough water. The fish should be immersed and withdrawn at near zero ground speeds.

The winch is not normally operated during towing. However, limited operation of the winch is allowable at ground speeds not exceeding 18 to 19 knots. For the towing operation the winch brake should be set to slip at 2500 pounds. The limitations for sonar fish towing are discussed in section V. The following general limitations should be strictly observed:

a. Maximum ground speed should not exceed 43 knots during steady towing.

b. Fish depths should not exceed 55 feet at maximum towing speeds.

c. Maximum towing altitude at maximum speed is 100 feet when fish depth is 55 feet and 1000 feet of cable is reeled out.

d. The winch should not be operated when towing at speeds over 18 to 19 knots.

FISH TOWING PROCEDURE.

PILOT	WINCH OPERATOR
1. Make necessary trim and power adjustments for desired fish depth, towing speed, and airship altitude as determined from towing characteristics chart. 2. Establish communication with winch and sonar operators. 3. Instruct operator to lower fish until faired cable is clear of swivel pulley.	
	4. Check out winch as described in section IV and place winch main switch in ON. 5. Shift engaging control handles to engage towing drum with winch motor. 6. Move towing drum pawl control lever to DISENGAGE. 7. Depress inch-in button momentarily to remove slack from towing cable. 8. Actuate fish clamps switch to OPEN. 9. Reel out winch until faired cable clears swivel pulley. 10. Check that swivel pulley is locked in 180^{o} position. 11. Place swivel pulley switch on TOWING to lower and engage follower pulley. 12. Disengage lock handle. 13. Rotate swivel pulley to 0^{o} trail position. Do not engage lock handle. 14. Report to pilot that fish is ready to be lowered.
15. Reduce ground speed to 19 knots or less. Maintain altitude greater than desired towing altitude to ensure that fish does not enter water during reel-out.	

PILOT

16. Instruct winch operator to reel out required length of cable.

18. Reduce altitude slowly to immerse fish and maintain required towing altitude throughout towing operation. Adjust airspeed as required.

20. Reduce ground speed to 19 knots or less when towing is completed.
21. Increase altitude until fish is clear of water.
22. Instruct winch operator to retrieve fish.

WINCH OPERATOR

17. Reel out required length of cable and then open towing vent valve. Report to pilot.

CAUTION

Towing vent valve must never be closed while fish is in water. It is opened before fish hits water and closed after fish is retrieved.

19. During towing operations while fish is in water:
Keep towing vent valve open.
Keep tongs open.
Keep towing drum pawl disengaged.
Observe reservoir quantity and temperature and helium bottle pressure.
Observe cable angle.
Observe winch for pay-out caused by brake slippage.
Report above checks to pilot.

23. Close towing vent valve and reel in unfaired cable.
24. Rotate swivel pulley to 180° position and engage lock handle.
25. Place swivel pulley switch in STOWED.
26. Reel in faired cable until fish approaches clamps.
27. Reduce speed and inch fish against cradle stops.
28. Place fish clamp switch on CLOSE.
29. Momentarily depress inch-out button to reduce tension on towing cable.
30. Move towing drum pawl control lever to ENGAGE.
31. Place winch main switch in OFF.