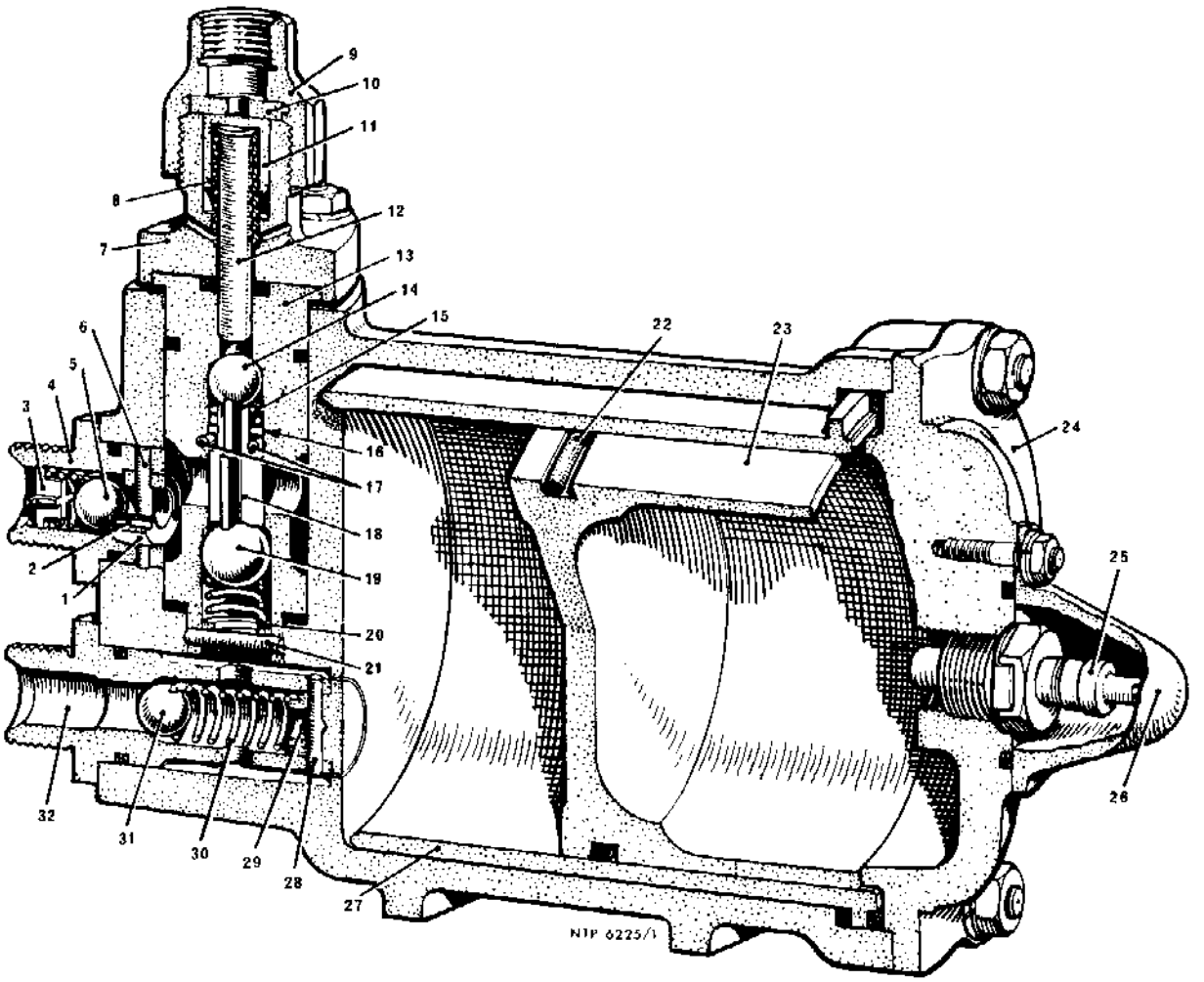


1. Delivery valve seat
2. Bleed hole
3. Valve stop
4. Delivery valve body
5. Delivery valve ball
6. Retaining peg
7. Release plunger housing
8. Release plunger spring
9. Adapter nut
10. Orifice plate
11. Release plunger
12. Push rod
13. Release valve body
14. Sealing ball
15. Sealing ball spring
16. Washer
17. Retaining pegs
18. Spacer
19. Release valve ball
20. Release valve spring
21. Retaining peg
22. Piston sealing ring
23. Piston
24. End cover
25. Air release valve
26. Valve cover
27. Sleeve
28. Retaining peg
29. Priming valve end cap
30. Spring
31. Priming valve ball
32. Priming valve body

STARTING ACCUMULATOR

HYDRAULIC CONTROL UNIT

shuttle valve. Movement of the shuttle valve uncovers ports in the valve sleeve, through which a flow of oil from a gear-type pump is directed to the appropriate friction clutch through one of the outlet unions.

Clutch Pump

A figure-of-eight recess, machined in the pump housing and closed on one side by the face of the hydraulic control unit, houses the gears of the clutch pump. The clutch pump is driven by a quill-shaft connected to a gear in the train driven by 'BC' crankshaft gear. Oil is admitted to the pump inlet from 'BC' crankcase main pressure gallery through a flexible pipe. Oil from the pump is passed through a cored passage in communication with the clutch-operating shuttle valve and a pressure relief valve which returns oil to the pump inlet chamber when the engine is running in neutral or, running in gear after the clutch has filled.

Running in Neutral

With the engine control lever set at neutral, the piston valve rests at the centre of the rising slope of the cam and the ducts leading to both ends of the shuttle valve is held centrally by the spring and oil does not flow to the clutch.

When the shuttle valve is held centrally, there is no escape for the oil passed by the clutch pump and the pressure builds up until the relief valve opens and relieves the pressure to the pump inlet chamber.

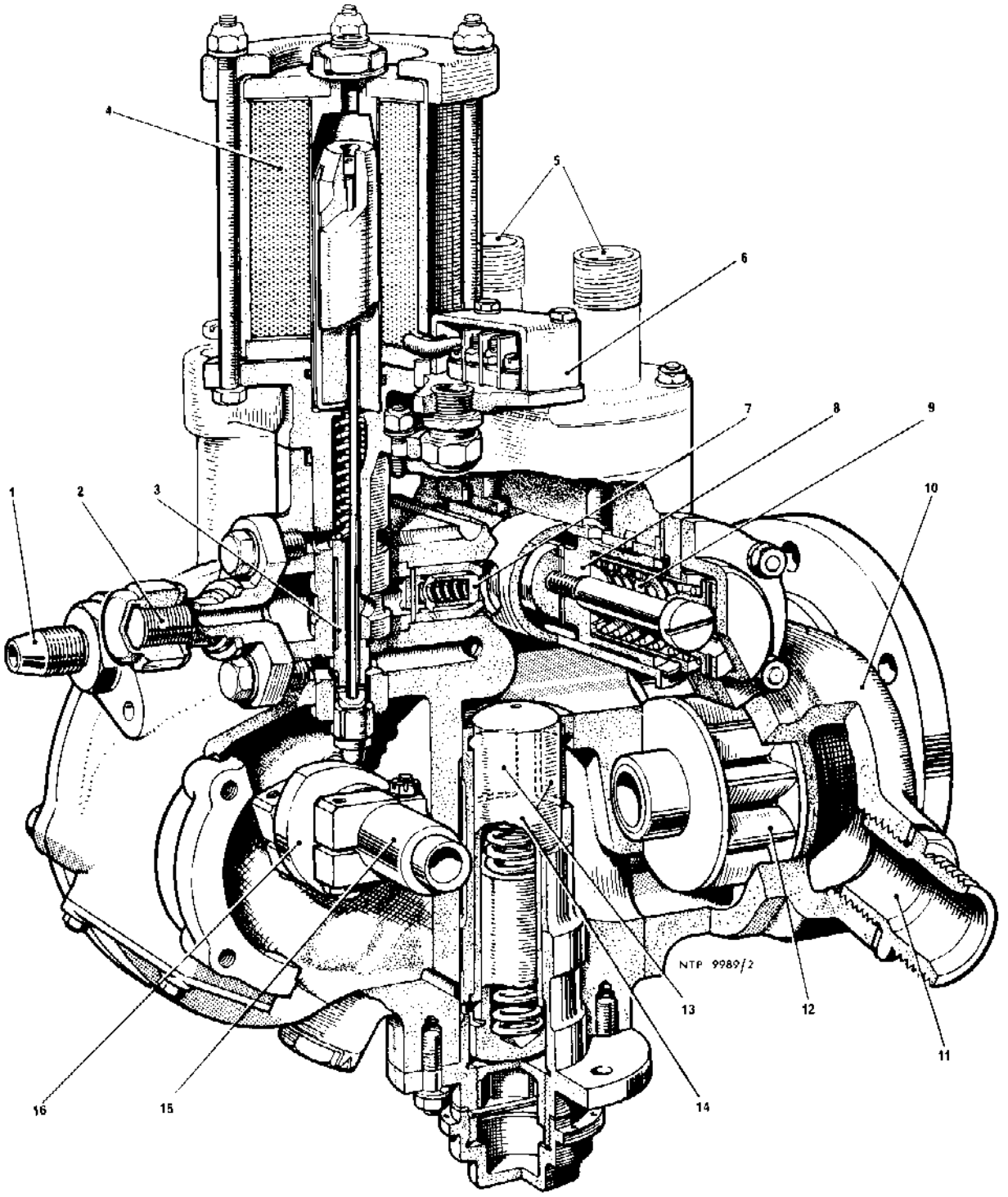
Clutch Selection

Movement of the control lever causes the piston valve to rise up or down the slope of the cam, thus admitting pressure oil to one side or the other of the shuttle valve. The valve moves rapidly and uncovers one of the outlet ports admitting pressure oil to the selected clutch. Reduction of pressure caused by the flow of oil to the clutch permits the relief valve to close, but as soon as the clutch plates move and a volume of oil sufficient to fill the clutch has been passed, the relief valve opens.

When the control is returned to neutral, the piston valve moves back to the centre of the slope on the cam and the shuttle valve moves to the central position. At the same time, the accumulation of operating oil, displaced by the shuttle valve as it changes direction is exhausted through the hollow piston valve.

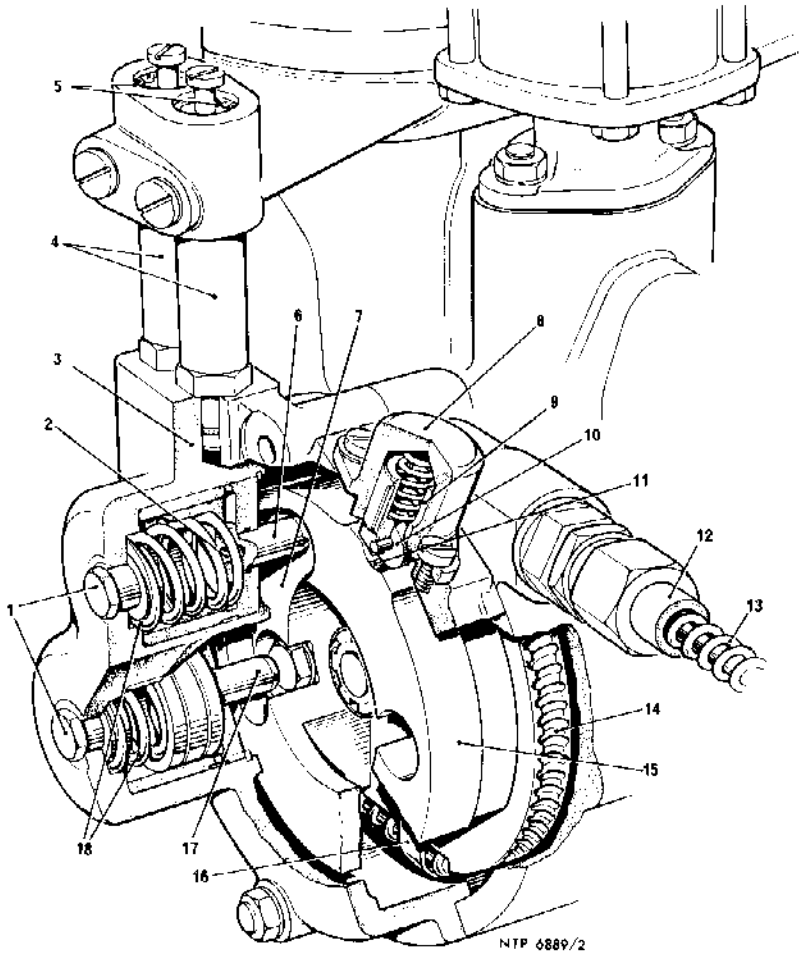
Hydraulic Gate

The hydraulic gate restricts the movement of the controls so that the engine speed cannot be increased above idling until the clutch is engaged in either ahead or astern gear.



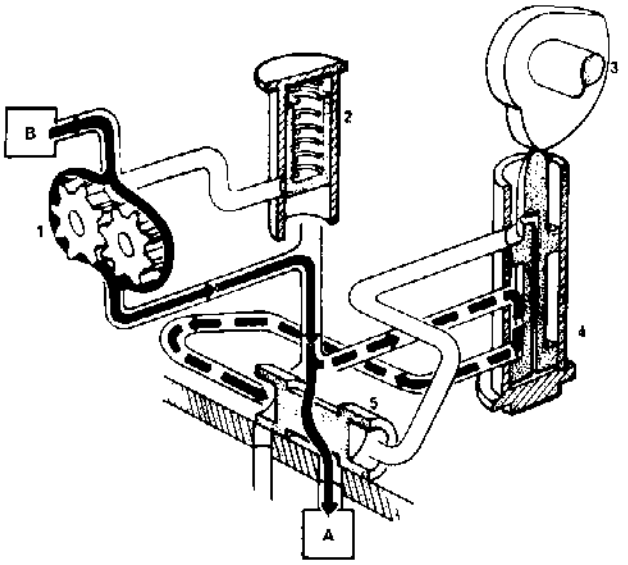
1. Control cable entry
2. Oil pressure transmitter connection
3. Piston valve
4. Clutch delay solenoid
5. Oil outlet unions to clutch
6. Terminal box
7. Non-return valve
8. Shuttle valve
9. Spring
10. Pump housing
11. Oil inlet union
12. Clutch pump
13. Relief valve ports
14. Relief valve
15. Camshaft
16. Clutch selection cam

HYDRAULIC CONTROL UNIT

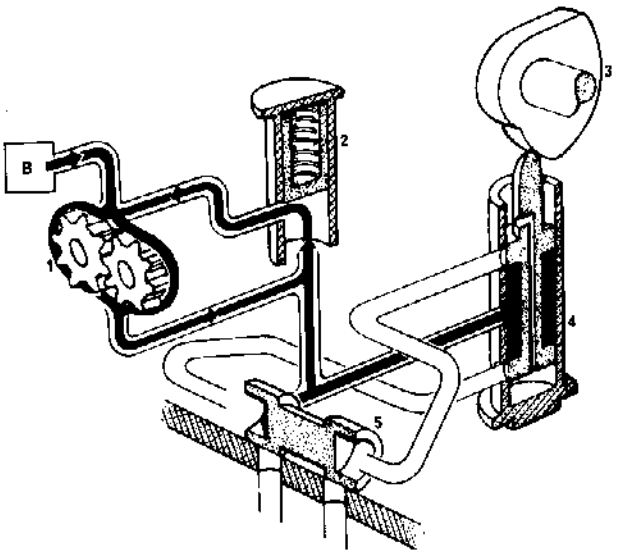


1. Plugs
2. Threaded hole for jacking screw when plunger manually operated
3. Cable wheel cover
4. Restrictor tubes
5. Circlips
6. Ahead plunger
7. Crescent-shaped groove
8. Detent plunger housing
9. Detent plunger
10. Detent plunger roller
11. Notch in lock ring
12. Control cable conduit
13. Control cable
14. Cable wheel
15. Lock ring
16. Cable clamp
17. Astern plunger
18. Plunger springs

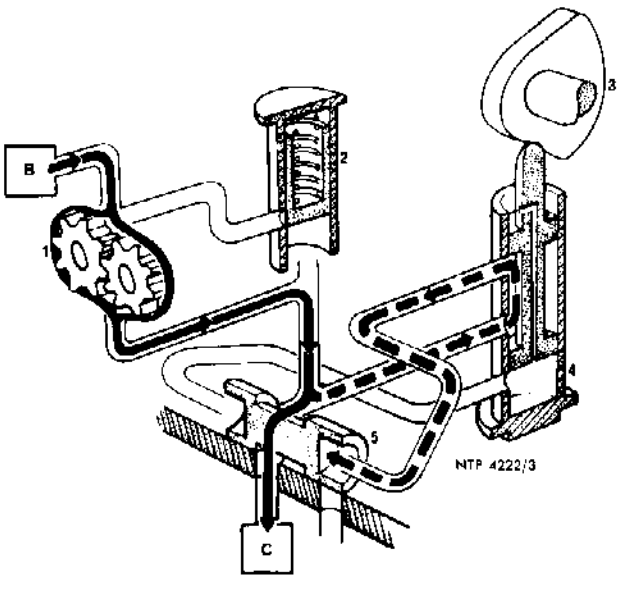
HYDRAULIC GATE



AHEAD ROTATION



RUNNING IN NEUTRAL



ASTERN ROTATION

1. Clutch pump
2. Relief valve
3. Clutch selection cam
4. Clutch selecting piston valve
5. Shuttle valve

A. Outlet to astern clutch
B. Oil inlet to control unit
C. Outlet to ahead clutch

CONTROL UNIT FUNCTIONING

The hydraulic gate comprises a lock ring bolted to the hydraulic control unit cable wheel, and two spring-loaded hydraulic plungers located in the cable wheel cover. The plungers, one for ahead gear and one for astern gear are operated by clutch oil pressure. With the controls in the neutral position the clutch is disengaged, the engine speed reduced to idling, and the plungers are extended by the load of the springs. In this condition the available control movement, which is limited to the extent of the groove, is sufficient to permit selection of ahead gear or astern gear but insuffucuent to increase the engine speed above idling. As the clutch oil pressure increases when either ahead or astern gear is selected the appropriate plunger is retracted by the oil pressure and the cable wheel becomes free to turn.

Functioning

When the engine is running and the control lever is at NEUTRAL, the governor speed control cam sets the engine speed at idling, and the hydraulic control unit is in the 'Neutral' position. When the control lever is moved in the AHEAD or ASTERN direction, the movement is arrested by the hydraulic gate until the selected clutch is engaged and the oil pressure withdraws the appropriate plunger enabling an increased engine speed to be selected.

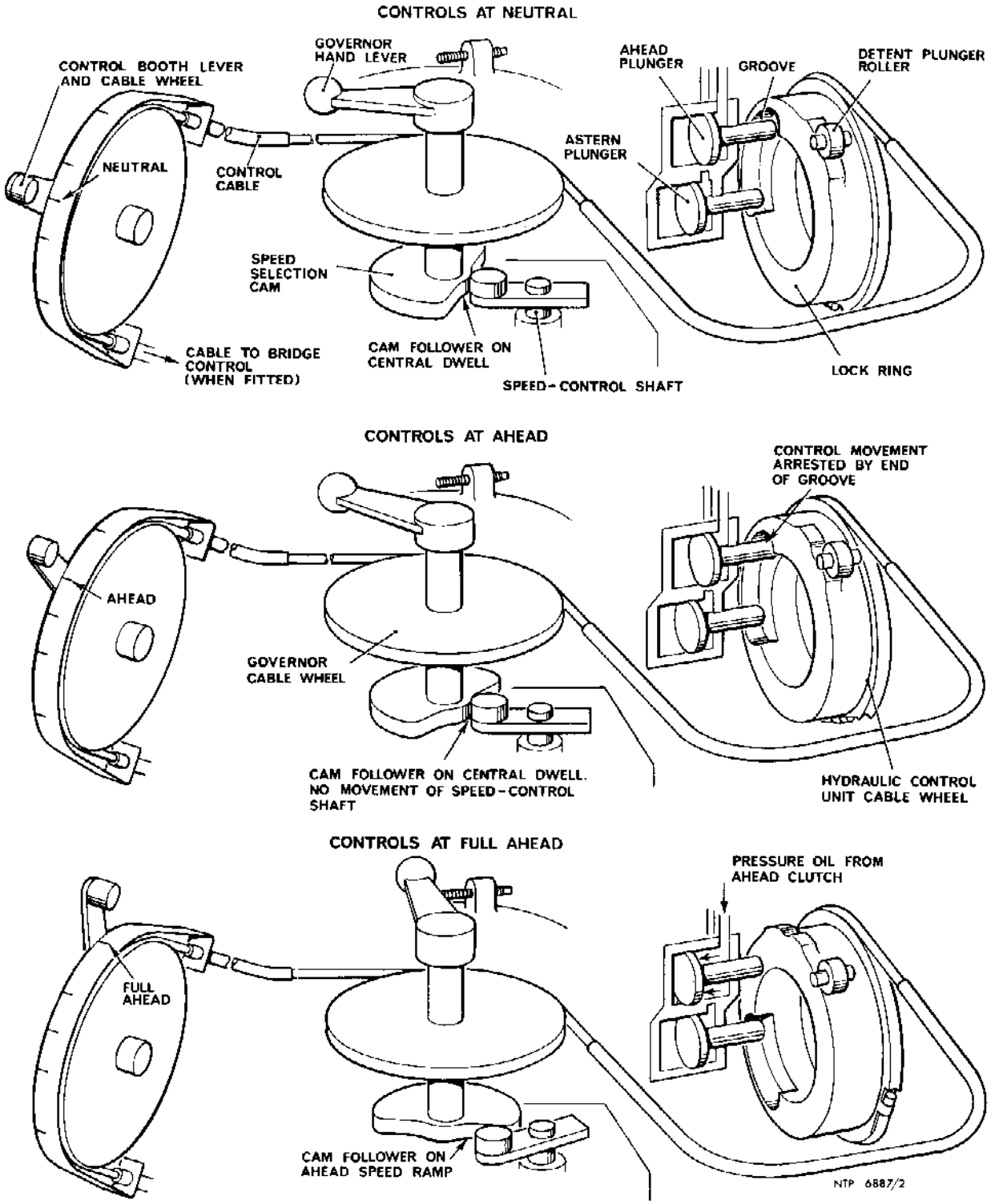
GEAR CHANGE DELAY

When a boat is travelling at high speed and the control lever is moved to NEUTRAL or ASTERN, the delay device operates to retain 'Ahead' gear until the speed of the boat is reduced sufficiently to permit a safe gear change.

The delay device consists of a solenoid-operated link rod which holds the hydraulic control unit piston valve in the 'Ahead' position when the solenoid is energised. The solenoid is controlled by a micro switch which is operated by the lever on the 'C' fuel injection pumps control shaft.

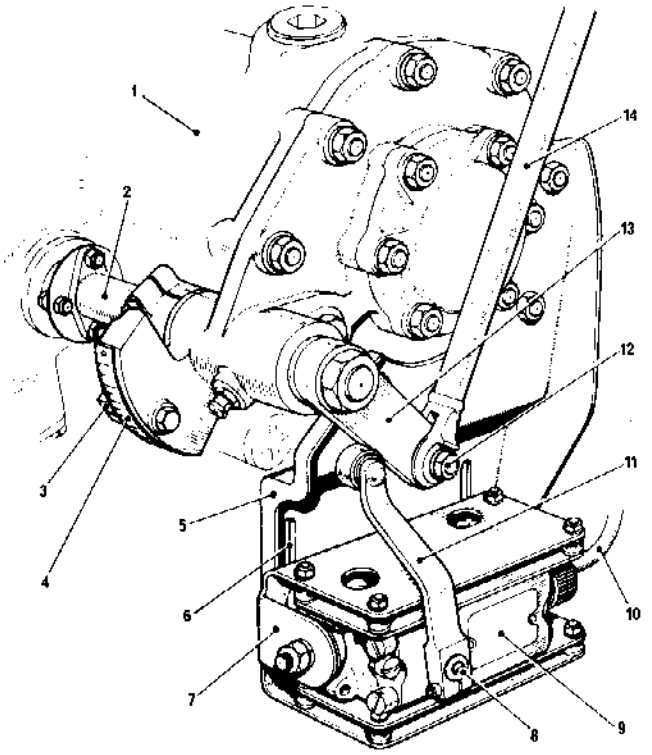
Operation

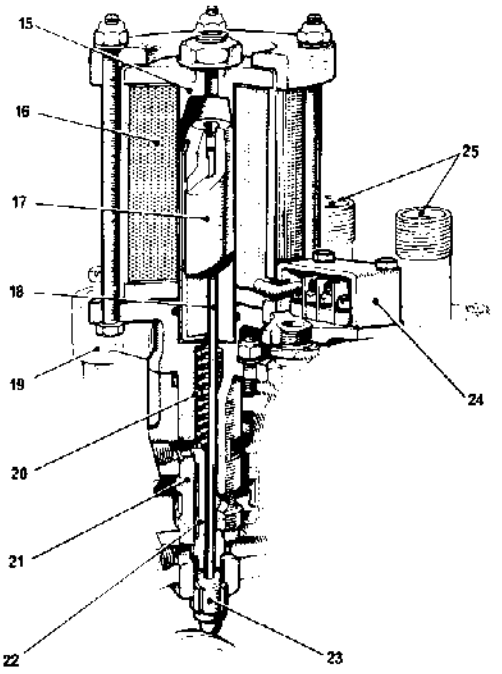
When a boat is travelling at high speed and the control lever is moved through NEUTRAL to ASTERN, the governor speed selection is reduced to slow running, but the trailing propellor turns the engine at a speed higher than idling speed. The governor reacts to this condition by moving the injection pumps control shafts below the idling setting. At a predetermined position, the micro switch closes and the solenoid operates to lock the piston valve in the 'Ahead' position. As the boat speed falls, the trailing effect of the propellor is reduced and, as the engine speed falls, the governor progressively increases the fuel pumpscontrol shaft setting towards the idling position. The micro switch opens at a predetermined position and the solenoid is de-energised, allowing the piston valve to operate normally.



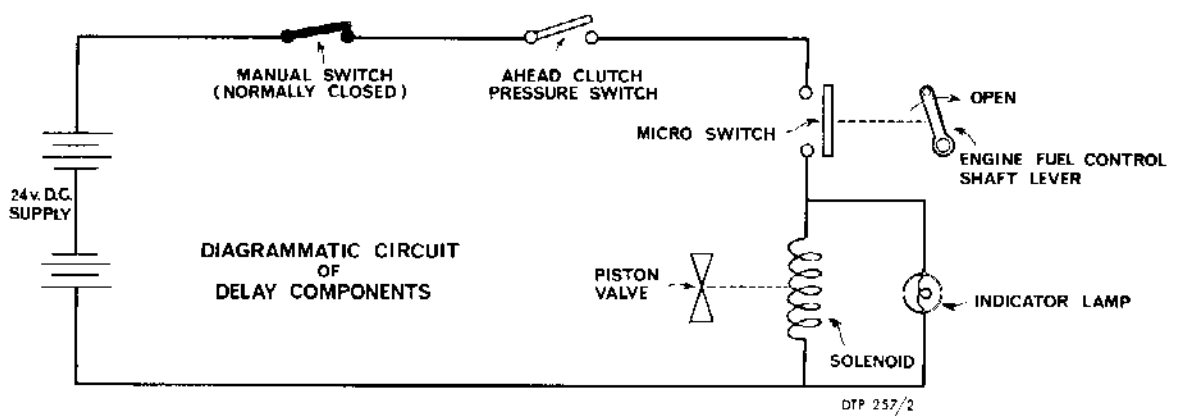
ASTERN SELECTION SIMILAR BUT IN OPPOSITE DIRECTION WITH ASTERN PLUNGER WITHDRAWN

SCHEMATIC LAYOUT OF CONTROLS





1. 'C' camshaft casing
2. Injection pumps control shaft
3. Pointer
4. Scale
5. Micro switch bracket
6. Slotted adjustment holes
7. Cradle
8. Spindle
9. Micro switch
10. Electrical cable
11. Switch lever
12. Control rod bolt
13. Control shaft lever
14. Control rod
15. Plunger stop
16. Solenoid
17. Plunger
18. Link rod
19. Hydraulic control unit
20. Spring
21. Sleeve
22. Piston valve
23. Retaining plug
24. Electrical junction box
25. Clutch oil feed pipes



GEAR CHANGE DELAY

A pressure switch mounted on the hydraulic control unit and in connection with the 'Ahead' clutch pressure duct, is connected in series with the clutch delay micro switch and the solenoid. This ensures that the clutch delay device does not operate when changing from 'Astern' to 'Ahead', or when the engine is being started.

An indicator lamp positioned on the engine control booth console is wired in circuit to indicate operation of clutch delay. The delay circuit can be made inoperative, in the event of failure of any of the component units, by a manually operated switch on the control console.

FUEL RACK POSITION INDICATOR

The fuel injection pumps are interconnected for control purposes by connecting shafts the arrangement of the interconnecting shafts being termed-fuel injection pumps control shafts. This term in common usage is shortened to 'fuel rack' or simply 'rack'.

Secured to the drive-end of each camshaft casing is a scale graduated in degrees from 92° to 150° and, a lever attached to the rack and bearing a register mark, moves adjacent to the graduated scale.

'Rack' Indicator

A transmitter mounted on a bracket at the free end of 'A' camshaft casing, is actuated by a lever secured to the No.1 fuel injection pump control shaft. The transmitter is fundamentally a potentiometer, and is connected into the 24-volt d.c. circuit of the installation. A registering instrument is mounted on the control console in the engine control booth.

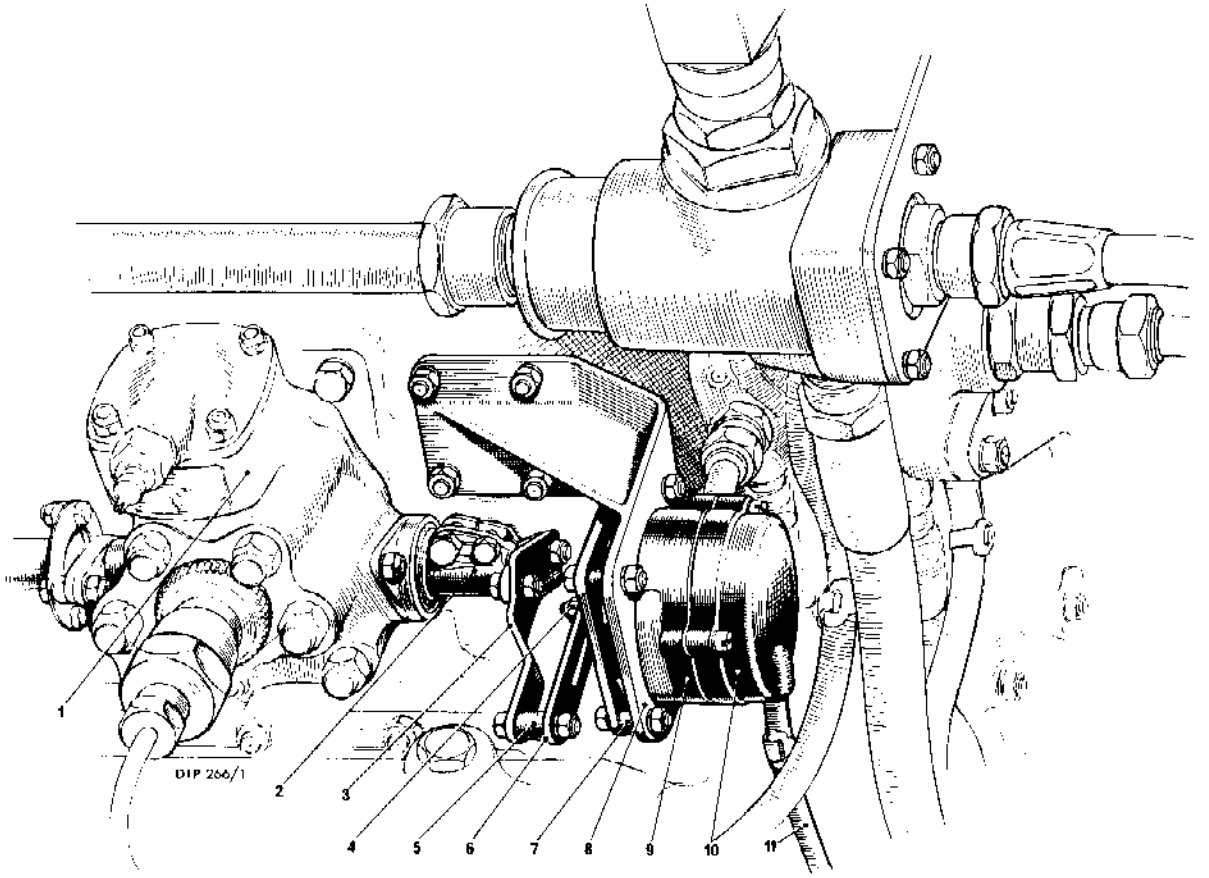
Operation

Movement of the 'rack' is transmitted through the fixed lever to an adjustable lever secured to the transmitter. The resulting movement within the transmitter, translated into an electrical current, is registered on the control booth instrument in 'degrees of rack'.

The figure indicated on the instrument may be used as, an indication of 'rack' reading during the engine starting sequence; as an indication during running of the balance of power between the two engines; and, when used in conjunction with the indicated r.p.m. and against the carpet graph supplied with each engine, shows the power being developed by the engine.

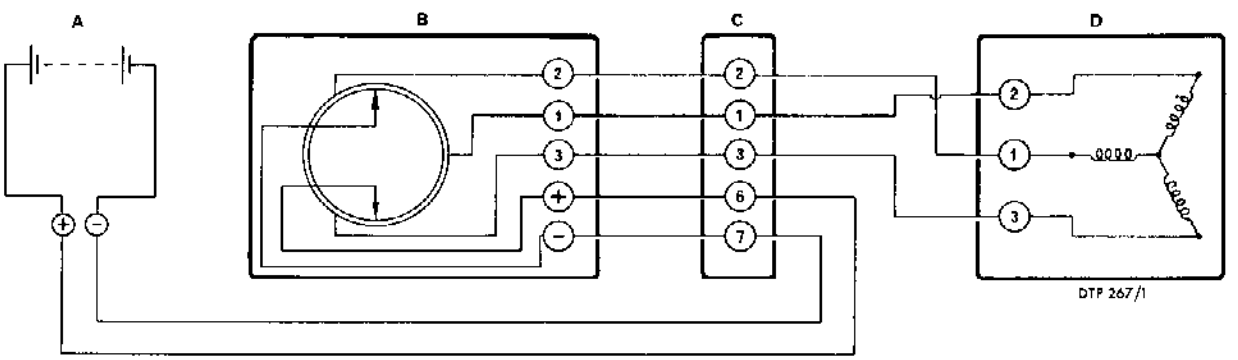
During the engine starting sequence, the governor is required to rotate the 'racks' if necessary, to the "full" position. A registered figure of not less than 129° of 'rack' is required to ensure a successful start.

With the boat underway and both engines running at the same indicated r.p.m., the respective 'rack' readings should be within 1° - 2° of each other. A high 'rack' reading when compared with the other engine and in comparison with readings taken over a period of time could be indicative of a failed injector or fuel injection pump. An abnormally high reading could indicate a damaged or fouled propeller. It should be noted that, during boat manoeuvres when the boat is turning, the 'rack' reading on the engine on the inboard side of the turn will increase during the turn and will return to normal as the rudder.



1. No. 1 fuel injection pump, 'A' bank
2. Injection pump control shaft ('rack')
3. Fixed lever
4. Lock nut
5. Rubber-bonded anti vibration stud
6. Adjustable lever
7. Anti-vibration mounting stud
8. Mounting bracket
9. Transmitter
10. Cover
11. Transmitter cable

FUEL RACK TRANSMITTER



A. 24 volt D.C. supply
B. Transmitted (Item 10 above)
C. Part of engine mounted junction box
D. Indicating instrument in control booth

CIRCUIT DIAGRAM