STARTING SYSTEM

Air Starting

The engine is rotated for starting by feeding compressed air into the six cylinders of 'A' bank. Compressed air is fed from a reservoir to a junction box mounted on a bracket secured to the blower sandwich piece at the free end of the engine on 'A' side. The junction box contains a fine gauze strainer. One outlet union from the junction box is connected to the air manifold rail which has outlet pipes connecting with the six air start valves. A second outlet from the junction box is connected to the air start distributor. A third outlet is provided on the junction box and is connected to the cold starting aid system. Pipes from the air distributor connect with each operating valve of the air start valves. A manually operated valve controls the flow of air to the distributor. A flexible pipe connected to a union at the drive end of the air manifold rail carries compressed air to the starting accumulator.

Air Start Distributor

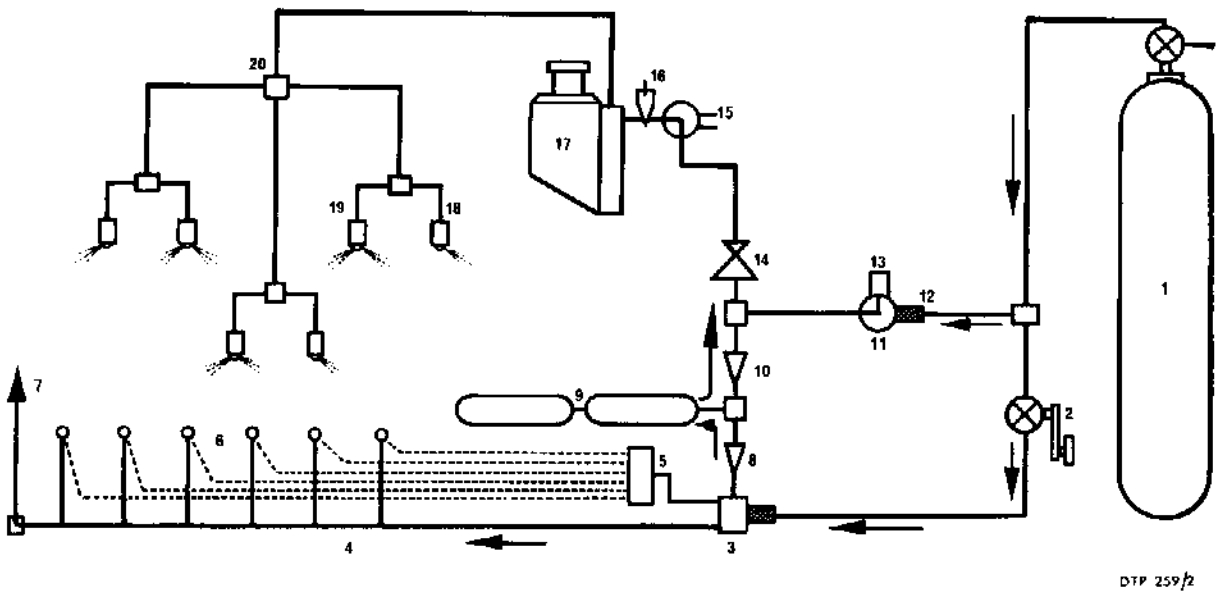
The air start distributor consists of a flat, slotted rotor plate mounted on a spindle supported by ball bearings and housed in a body closed by an end cover. Six outlet unions disposed around the body are connected by flexible pipes with the air start valves. The inlet union of the distributor contains a non-return valve and, an oil drain union containing a spring loaded ball valve is also carried in the end cover.

The distributor is mounted on the free end of 'A' camshaft casing and the spindle is driven through a splined coupling secured to 'A' camshaft. The distributor rotor plate is timed to the engine the arrangement of splines at each end of the spindle permitting timing adjustment to within $\frac{1}{2}^{0}$ to be made.

The dimensions of the slot in the rotor plate permits air to flow to a starting valve for a predetermined number of crankshaft degrees, and before the air is cut off from any one starting valve the leading edge of the slot is just uncovering the port to the starting valve next in firing order. This overlap ensures a smooth turning movement of the crankshafts during starting operations.

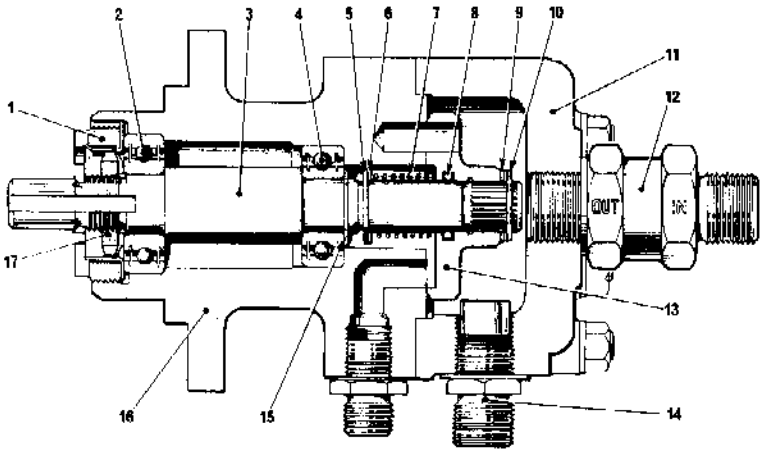
Air Starting Valve

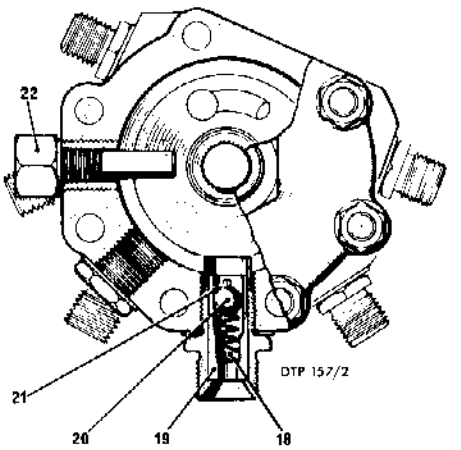
The valve consists of a piston operated, spring-loaded poppet valve mounted in a body. The valve assembly is carried in an adapter screwed into the cylinder liner and sealed by a seating washer. The arrangement of the adapter and sleeve, and the method of securing the air start valve in position are the same as for a fuel injector. The body of the air start valve carries two unions, the main supply union and the valve-operating supply union.



1. Reservoir
2. Starting valve
3. Junction box
4. Air start manifold rail
5. Air start distributor
6. Air start nozzles
7. Pipe to starting accumulator
8. Non-return valve
9. Reservoir air bottles
10. Non-return valve
11. Priming cock, cold starting aid
12. Filter
13. Priming reservoir air bottle
14. Pressure reducing valve
15. Air dump cock
16. Relief valve
17. Cold starting aid capsule unit
18. Nozzle, single hole
19. Nozzle, twin hole
20. Junction block

DIAGRAMMATIC LAYOUT OF AIR START SYSTEM





1. Ring nut
2. Ball bearing
3. Spindle
4. Ball bearing
5. Circlip
6. Washer
7. Spring
8. 'O' ring seal
9. Washer
10. Circlip
11. End cover
12. Non-return valve
13. Timing valve plate
14. Oil drain union
15. Circlip
16. Distributor body
17. Ring nut
18. Spring
19. Inner sleeve
20. Ball
21. Pin
22. Setting pin

AIR START DISTRIBUTOR

System Functioning

When the operating valve is depressed compressed air is admitted simultaneously to the air manifold rail, starting accumulator and air start distributor.

Air entering the distributor passes through the slot in the rotor and to the operating piston of an air start valve. The valve is forced off its seat and air from the air manifold rail is permitted to enter the cylinder to drive the pistons apart and commence the rotation of the engine. As the engine rotates so the rotor plate in the distributor plate rotates uncovering the port to the air start valve of the cylinder next in order of firing sequence. As the port to the original valve is closed, the return spring on the operating piston assisted by air pressure from the air manifold snaps the poppet valve closed. The sequence is repeated until the operating valve is released. When air pressure is admitted to the distributor, the spring loaded ball in the drain union is forced down against a seat formed in the inner sleeve of the drain union thus preventing the escape of air.

At the same time as the engine commences to turn, air pressure felt on the release plunger of the starting accumulator, trips the release ball valve and fuel under pressure from the accumulator is passed to the governor to move the 'racks' to the 'full fuel' position.

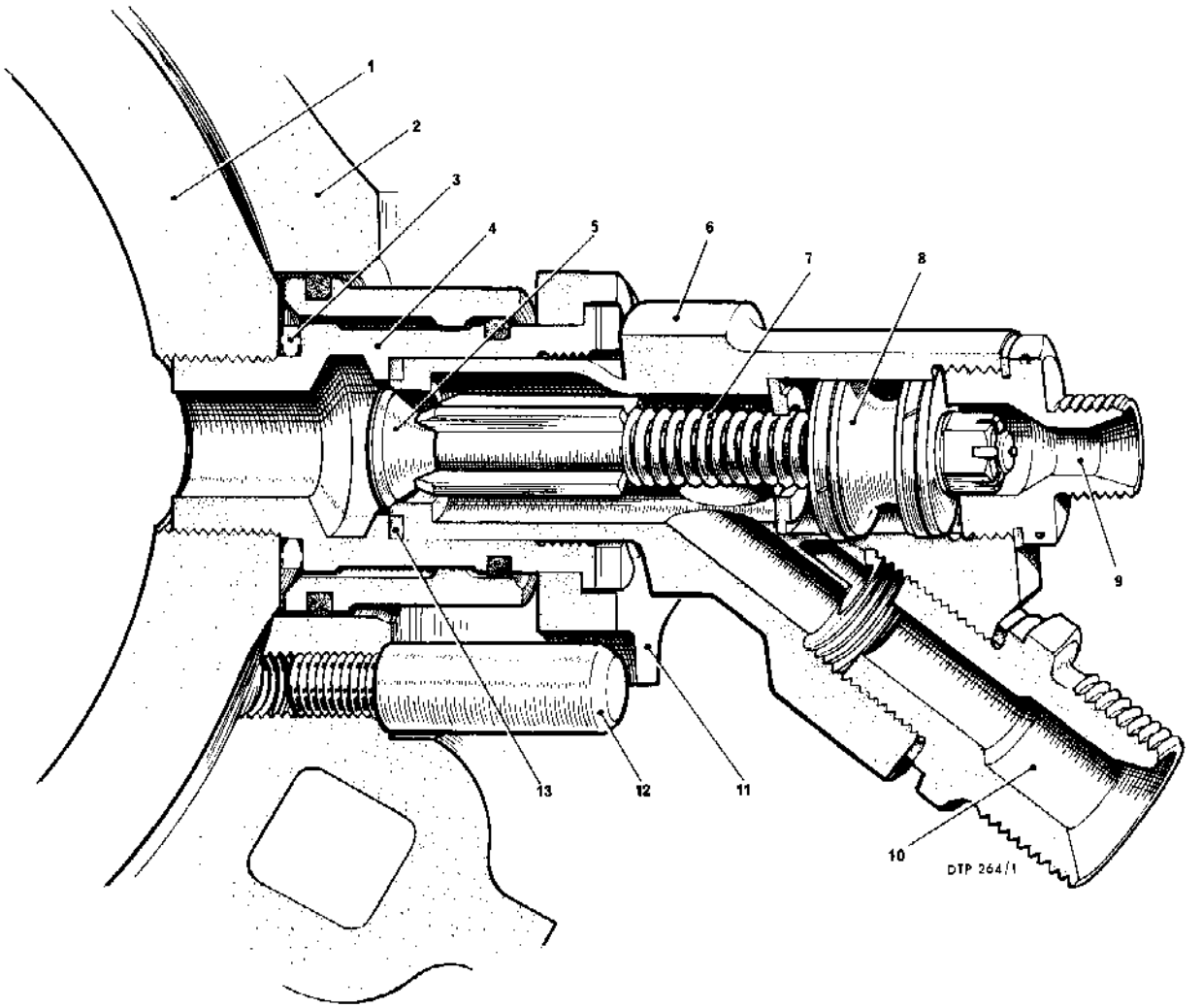
Under normal circumstances the engine should start approximately 4-5 seconds after depressing the operating valve. Should the engine fail to start after approximately 10 seconds of admitting air, the operating valve should be released and an investigation into the failure to start should be made.

COLD STARTING AID

As an aid to engine starting, a combustion promoting fluid mixed with air is sprayed into the air intake system through nozzles, one located in each air inlet manifold of the cylinder blocks and one in each blower volute outlet elbow. The fluid is contained in sealed capsules which are placed in the chamber of the capsule unit of the system.

Description

The system consists of two reservoir air bottles, a pressure reducing valve, priming cock and reservoir unit, a capsule unit, a relief valve and a dump cock. The components of the system are interconnected as required by flexible pipes, and two non-return valves are positioned in the system to control the flow of pressure air. The outlet from the capsule unit is connected to the nozzles by a system of rigid pipes and tee-pieces. The nozzles located in the air inlet manifolds have a single jet; the nozzles in the blower, volute elbows have twin jets. The nozzles must be assembled to the engine with the arrows marked on the nozzle body position as shown in the inset circles of the illustration of the cold starting aid system.



1. Cylinder liner
2. Cylinder block
3. Adaptor seal ring
4. Adaptor
5. Poppet valve
6. Body
7. Return spring
8. Piston
9. Valve-operating supply union
10. Main air supply union
11. Locating collar
12. Locating peg
13. Copper seal washer

AIR START VALVE AND ADAPTOR ARRANGEMENT

Reducing Valve

The pressure reducing valve, mounted on a bracket attached to the blower volute casing, receives a pressure air at a nominal 450 lb/in^2 (31.64 kg/cm^2) which, in passing through the valve, is reduced to a nominal 40 lb/in^2 (2.81 kg/cm^2).

The unit consists of a body having inlet and outlet unions. The pressure reducing mechanism is of the standard diaphragm-operated type. The diaphragm is spring loaded against the incoming air pressure and, in moving controls the position of a needle valve in a calibrated orifice. Air passing through the orifice is reduced in pressure and is passed through a drilling in the body to the outlet union. A spring loaded non-return ball valve is positioned in the base of the unit and closes the orifice when the incoming air pressure is cut off. Adjustment is provided at the top of the unit and comprises a lock nut and adjuster which sets the loading of the spring on the diaphragm.

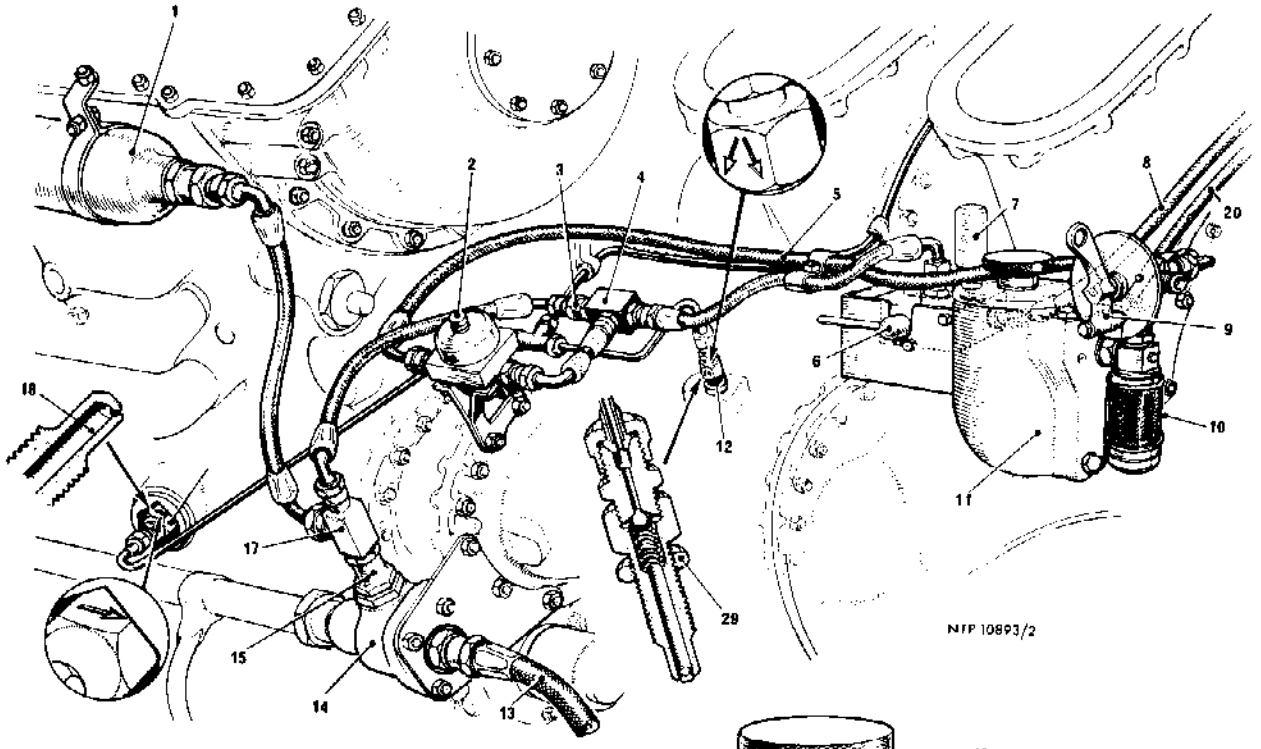
Priming Cock

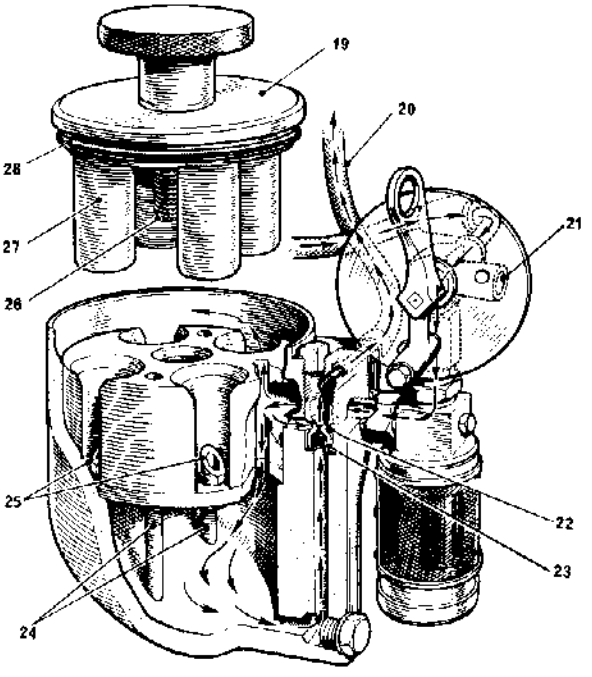
The unit, mounted on a bracket secured to the blower casing, comprises a body having inlet and outlet unions, a reservoir bottle and a manually operated two-position cock.

When turned to the "Normal" position, the cock opens a port to permit compressed air, direct from the main air supply source, to flow to the reservoir bottle. A wire-wound edge-type filter is positioned in the inlet union. When turned from "Normal" to "Prime", the inlet port is closed and the quantity of air contained in the reservoir bottle is released to the system and is sufficient to fill the pipes between the capsule chamber and the nozzles with a mixture of air and fluid.

Capsule Unit

The capsule unit is mounted adjacent to the priming cock and is secured to the same bracket. The unit consists of a body containing a plate which has four piercers secured to it and has a centrally positioned threaded boss. The plate is located on a step formed in the body and is secured in position by two bolts which pass up into the plate from the base of the unit. The unit cover has a plate scalloped to retain the fluid capsules, and has a centrally positioned screwed thread which engages with the boss on the piercer plate to secure the cover in position. Up to four capsules at a time can be placed in the cover and, the piercers puncture the base of the capsules as the cover is screwed into position on the body. The fluid released when the capsules are punctured, drains to the bottom of the capsule chamber. Drillings in the body walls permit pressurized air to enter the capsule chamber, to be flet on the fluid lying in the bottom of the chamber and to pass to an emulsifying jet. A further drilling connects the base of the capsule chamber with the emulsifying jet. A fine gauze filter is positioned below the emulsifying jet venturi. With the capsule unit cover in position, the capsule chamber is sealed by a synthetic rubber seal ring carried in a groove machined in the cover.





1. Reservoir air bottles
2. Pressure reducing valve
3. Non-return valve
4. Junction block
5. Pipe, reducing valve to dump cock and capsule unit
6. Priming cock
7. Priming air reservoir
8. Pipe, main supply to priming cock
9. Dump cock
10. Pressure relief valve
11. Capsule unit
12. Nozzle, twin hole
13. Pipe, main starting air supply
14. Junction box
15. Non-return valve
16. Three-way connector
17. Nozzle, single hole
18. Nozzle body
19. Capsule unit cover
20. Pipe, outlet to nozzles
21. Dump port
22. Emulsifying jet
23. Filter
24. Piercer plate securing bolts
25. Piercers
26. Cover securing bolt
27. Capsule
28. Cover seal ring
29. Lock nut

COLD STARTING AID SYSTEM

Relief Valve and Dump Cock

A relief valve, set to relieve pressure in excess of a nominal 50 lb/in^2 (3.5 kg/cm^2), is incorporated in the system and is screwed into a tapped hole on the free end face of the capsule chamber. Mounted on top of the relief valve and secured in a three-way connector, is a manually operated two-position cock. The register plate of the cock is stamped with the words "Normal" and "Dump". When turned to the "Dump" position the cock opens the system to atmosphere and permits the escape of pressure air from a port on the side of the cock.

Operation

The starting aid system is activated by the same operating valve and lever as the air start system thus as the engine is rotated for starting, the combustion promoting fluid is injected into the air intake system.

The desired number of capsules are inserted in the capsule chamber cover and the cover screwed into position thus puncturing the capsules and releasing the fluid into the base of the capsule chamber. Operation of the priming cock released the metered quantity of air from the priming unit reservoir bottle, the air being passed through the reducing valve to the capsule unit via the dump cock and relief valve. A non-return valve on the junction block prevents the air from passing back to the reservoir bottles. The priming air enters the capsule chamber and pressurizes the fluid released from the punctured capsules. A drilling in the capsule chamber connects with the mulsifying jet and air in passing through is mixed with the fluids which is forced up the drilling from the base of the chamber. The fluid/air mixture is passed through the outlet union to the system of rigid pipes connecting with the nozzles. The quantity of air contained within the priming reservoir is calculated to be sufficient to prime the pipes and nozzles in readiness for the starting sequence.

Having primed the starting aid system, the air start operating lever is depressed and, at the same time as the engine commences to turn, compressed air from the three-way junction box passes through the non-return valve to the three-way connector. From the connector air is passed to the reservoir bottles and to the junction block through the non-return valve. From the junction block, the air passes to the reducing valve and to the capsule unit through the dump cock and relief valve. The action of the air within the capsule unit is the same as that described above, during the priming sequence, except that with the continued supply of air, the mixture from the emulsifying jet is injected into the blower volutes and air inlet manifolds of the cylinder blocks through the nozzles where it mixes with the air being supplied by the blower and is carried into the cylinders.

When the engine starts and the air start operating lever is released, air from the reservoir bottles continues to pressurize and operate the starting aid system for approximately 40 seconds after the main starting

air supply has ceased. The non-return valve contains the reservoir bottle air supply within the starting aid system.

Should the engine fail to start, the air pressure within the cold starting aid system should immediately be released by moving the dump cock lever on the capsule unit to the "Dump" position. Air will be released from the port on the dump cock.