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(54) ENGINE VALVE OPERATING SYSTEM

(71) We, LUCAS INDUSTRIES LIMITED a British Company of Great King Street, Birmingham, B19 2XF do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to an operating system for a valve of an internal combustion engine, and has for its object to provide such a system in a simple and convenient form.

According to the invention an operating system for a valve of an internal combustion engine comprises a piston housed within a cylinder, said piston being operatively associated with the stem of the valve, a source of liquid under pressure, a first control valve through which liquid under pressure can flow from said source to one end of said cylinder when the first control valve is opened thereby to cause displacement of said piston to open said valve, a second control valve operable when said first control valve is closed to allow liquid to escape from said one end of the cylinder thereby to allow said valve to close, a further piston housed within a further cylinder for controlling the operation of a further engine valve which is required to be opened and closed at a different time to the first mentioned valve, the system including a further first control valve for controlling the admission of liquid to said further cylinder, the escape of liquid from the further cylinder being controlled by said second control valve, the system including a pair of non-return valves interposed between said one ends of the cylinders and said second control valve respectively.

According to a further feature of the invention said valves of the engine are spring biased to the closed position.

According to a further feature of the

invention said valves of the engine are biased by subsidiary pistons respectively to the closed position, said subsidiary pistons being exposed to liquid pressure, the force exerted by said subsidiary pistons being less than the force developed by said first mentioned pistons when the respective first control valves are operated.

According to a further feature of the invention said control valves are electrically operated.

Two examples of engine valve operating systems in accordance with the invention will now be described with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic view of a system for spring loaded valves and

Figure 2 is a similar view for positively closed valves.

With reference to Figure 1, four engine valves are indicated at 10, 11, 12 and 13 and are biased by respective springs to the closed position. The valves are in the particular example exhaust valves and the engine is of the kind in which one valve is opened and closed before it is necessary to open another valve.

Operatively associated with the stems of the valves are pistons 14, 15, 16 and 17 respectively, these being housed within respective cylinders.

The system also includes a source of liquid under pressure and the source communicates with a gallery 19. Interconnecting the ends of the cylinders remote from the valves are branch passages each of which includes an electromagnetically operable first control valve, these being referenced 20, 21, 22 and 23. A drain gallery 24 is also provided and this is connected to the aforesaid ends of the cylinders by way of non-return valves referenced 25, 26, 27 and 28 which close to prevent flow of liquid into the respective cylinder from the drain gallery. Moreover, a second control valve 29 is

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provided operable to allow the escape of liquid from the drain gallery. The second control valve is also electromagnetically operated.

5 In operation, if it is required to open engine valve 10, the first control valve 20 is opened to admit liquid under pressure to the cylinder accomodating the piston 14. During this time control valve 29 is closed. The liquid pressure acting on the piston 14 opens valve 10 against the action of its spring. In order to premit the engine valve to be closed, valve 20 is closed and valve 29 opened. The liquid under pressure is displaced from the cylinder by means of the action of the valve spring which moves the piston, and the escaping liquid flows by way of the non-return valve 25 and the control valve 29 to drain. It will be appreciated that when the first control valve 20 is operated the drain gallery is pressurized by way of the valve 25 however, the valves 21, 22 and 23 remain closed thereby preventing operation of the other engine valves.

25 It will be understood that because a single control valve 29 is provided only one engine valve can be opened and closed at a time. When the next engine valve is to be operated the control valve 29 must be closed.

30 In Figure 2 there is shown an extension of the system shown in Figure 1 in which alternative means is provided to bias the engine valves to the closed position. The system of Figure 2 includes an additional gallery 30 which is connected to the outlet of the source 18. Moreover, the engine valves are connected to subsidiary pistons 31, 32, 33 and 34 conveniently by Tee head and slot connections. Furthermore, the subsidiary pistons are of smaller diameter than the pistons 14, 15, 16 and 17 and are engaged thereby.

35 The additional gallery 30 communicates with the ends of the subsidiary pistons adjacent the valve stems so that a constant face is developed acting to close the engine valves. This force is however overcome when liquid pressure is applied to the respective pistons 14, 15, 16, or 17.

40 The control valves 20, 21, 22 and 23 together with the valve 29 as has been stated, are electromagnetically operated valves which conveniently are supplied with electric current when it is required to open the valve although it will be appreciated that they can be arranged so that when energised, the valves are closed.

45 The control of electric current to the valves is effected by a control system conveniently an electronic control system, which is supplied with a signal or signals indicative of the position of the crankshaft of the engine. The control system can adjust the valve timing in accordance with the speed and power demanded of the engine provid-

ing no two engine valves operated by the control system are required to be open at the same time.

70 Conveniently the valves are operated by actuators which include a field structure and an armature structure, the field structure being of annular form with helically disposed ribs on its face presented to the armature structure, the field structure also including windings which can be energised so that adjacent turns of the ribs are of opposite magnetic polarity. The armature structure includes further helical ribs which are disposed in the grooves defined by the ribs on the field structure whereby when the windings are energised relative axial movement of the field and armature structures will take place to operate the control valve connected thereto.

75 Such actuators are described in the Specification of British Patent 1504873.

#### WHAT WE CLAIM IS:-

1. An operating system for a valve of an internal combustion engine comprising a piston housed within a cylinder, said piston being operatively associated with the stem of the valve, a source of liquid under pressure, a first control valve through which liquid under pressure can flow from said source to one end of said cylinder, when the first control valve is opened thereby to cause displacement of said piston to open said valve, a second control valve operable when said first control is closed to allow liquid to escape from said one end of the cylinder thereby to allow said valve to close, a further piston housed within a further cylinder for controlling the operation of a further engine valve which is required to be opened and closed at a different time to the first mentioned valve, the system including a further first control valve for controlling the admission of liquid to said further cylinder, the escape of liquid from the further cylinder being controlled by said second control valve, the system including a pair of non-return valves interposed between said one ends of the cylinders and said second control valve respectively.

100 2. A system according to claim 1 in which said valves of the engine are spring biased to the closed position.

105 3. A system according to claim 1 in which said valves of the engine are biased by subsidiary pistons respectively to the closed position, said subsidiary pistons being exposed to liquid pressure, the force exerted by said subsidiary pistons being less than the force developed by the first mentioned pistons when the respective first control valves are operated.

120 4. A system according to claim 3 in which said subsidiary pistons are smaller in area than the first mentioned pistons.

125 5. A system according to any one of the 130

preceding claims in which said control valves are electrically operated, an electronic control system being provided to operate the control valves in the correct order.

5 6. An operating system for a valve of an internal combustion engine substantially as hereinbefore described with reference to Figures 1 of the drawings.

10 7. An operating system for a valve of an internal combustion engine substantially as hereinbefore described with reference to Figure 2 of the drawings.

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COMPLETE SPECIFICATION

2 SHEETS

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Sheet 1

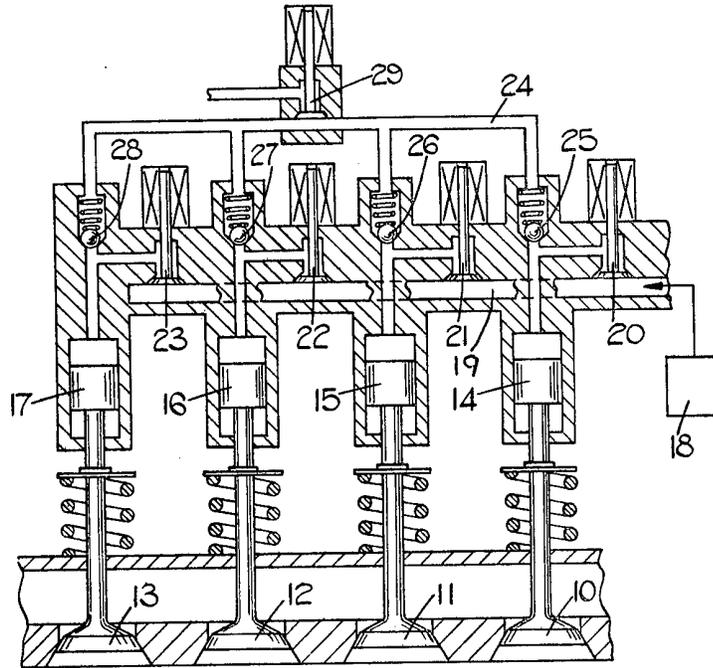


FIG. 1.

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COMPLETE SPECIFICATION

2 SHEETS

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Sheet 2

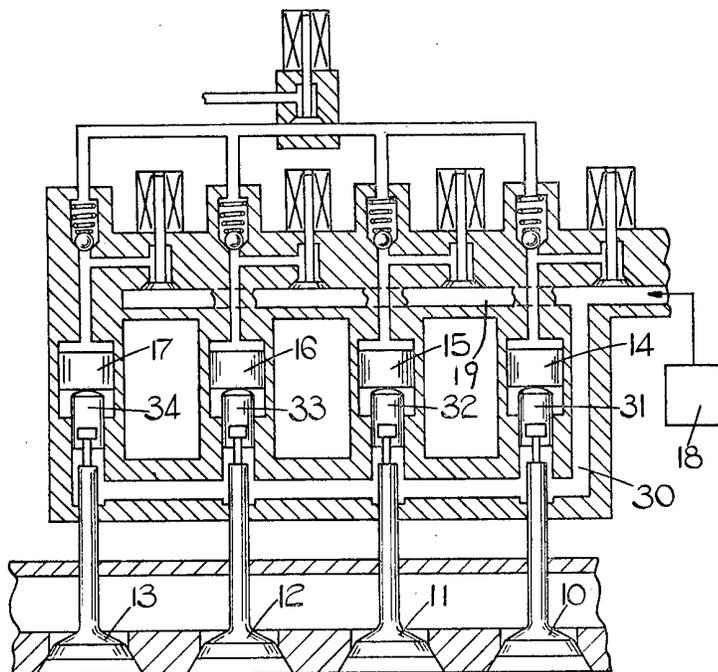


FIG.2.