Feb. 13, 1940. W. T. TABB 2,190,575

VALVE FOR FUEL PUMPS OF INTERNAL COMBUSTION ENGINES

Filed Feb. 20, 1937

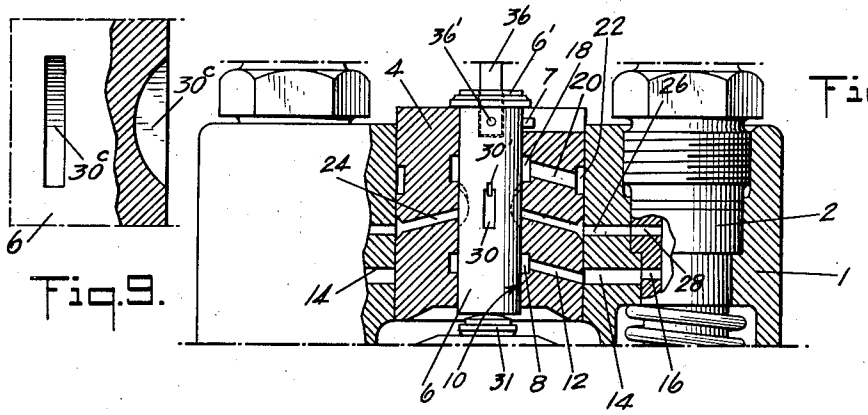


Fig. 1.

Fig. 9.

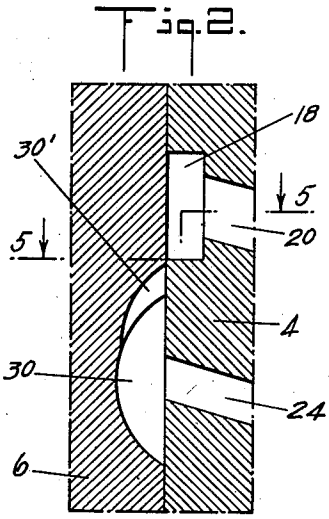


Fig. 2.

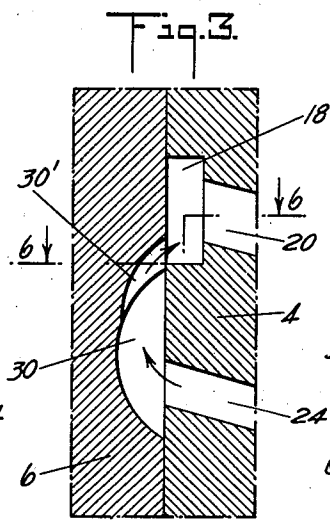


Fig. 3.

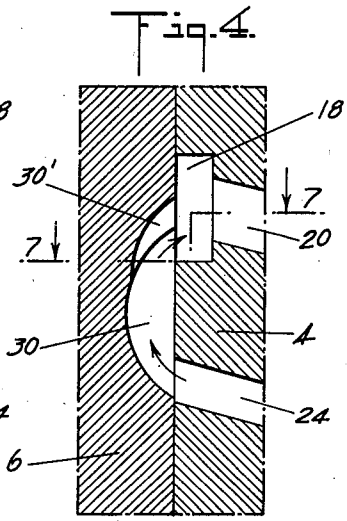


Fig. 4.

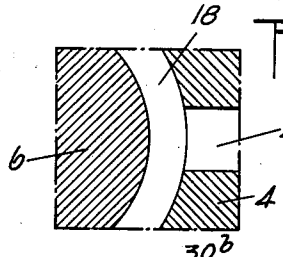


Fig. 5.

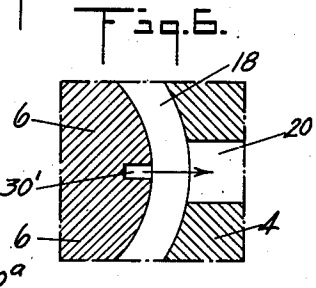


Fig. 6.

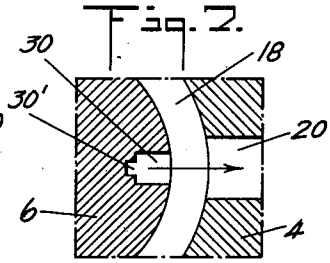


Fig. 7.

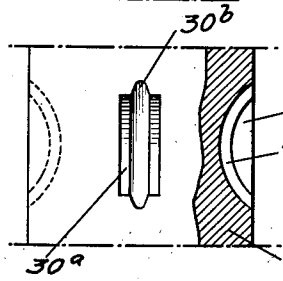


Fig. 8.

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UNITED STATES PATENT OFFICE

2,190,575

VALVE FOR FUEL PUMPS OF INTERNAL COMBUSTION ENGINES

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Application February 20, 1937, Serial No. 126,893

8 Claims. (Cl. 251—76)

This invention relates to means for controlling the supply of fuel to internal combustion engines and more particularly to a valve for controlling the volume of fuel supplied to the engine cylinders by a fuel pump and it is an object of this invention to provide a valve of the type described arranged to control individually the volume of fuel supplied to each of a plurality of engine cylinders. It is also an object of this invention to provide a valve of the type described arranged to control the supply of fuel to the engine cylinders by venting fuel under pressure from the pump cylinders during the pumping stroke and it is also an object of this invention to provide a valve of the type described arranged to stop the operation of the engine by venting fuel from the pump cylinders. It is a further object of this invention to provide a valve of the type described having an improved arrangement of ports whereby exact control of very small volumes of fuel is secured and which insures uniformity of control of the volume of fuel supplied to each of a plurality of engine cylinders. It is a further object of this invention to provide a valve of the type described which permits of ready manufacture under usual production methods at reasonable cost.

In the drawings:

Fig. 1 is a partial vertical sectional view of a fuel pump having a valve constructed in accordance with this invention, the valve being shown in elevation;

Figs. 2, 3 and 4 are fragmentary vertical sections of the valve and valve bushing of Fig. 1; Fig. 2 showing the relation of a valve port to cooperating ports and passages of the valve bushing when the engine is not operating or is operating under full load; Fig. 3 showing the relation during operation of the engine under partial load; and Fig. 4 showing the relation when the valve is positioned to stop the engine;

Figs. 5, 6 and 7 are fragmentary horizontal sections of the valve and bushing of Fig. 1, taken as on lines 5—5 of Fig. 2; 6—6 of Fig. 3, and 7—7 of Fig. 4, respectively; and

Figs. 8 and 9 are views, partly in elevation and partly in section of valves having ports of modified construction.

In the drawing the invention is shown in connection with a fuel pump comprising a casing 1 having a plurality of pump plunger bores fitted with bushings 2 and arranged in a circle about a bore having a valve bushing 4 which serves as a seat for a cylindrical valve 6. A pin 7 prevents rotation of the valve 6 in the bushing 4. Pump plungers (not shown) are reciprocated in the bushings 2 by a cam revolving about the axis of the valve bushing. Ports and passages (not shown) for the passage of fuel from a fuel supply are connected to an annular chamber 14 in the valve casing 1 which is connected by ports 16 to the bores of the plunger bushings 2. An annular groove 18 in the valve bushing 4 is connected by a passage to an annular groove or passage 22 which is connected by a passage (not shown) to a reservoir for receiving fuel or to the source of fuel supply. Ports 24 in the valve bushing 4 are connected by passages 26 in the casing 1 to ports 28 in the pump plunger bushings 2 which extend to the plunger bores of the bushings 2. The valve 6, which is fitted in the bore of the valve bushing 4 for reciprocation therein either manually or in accordance with the action of a centrifugal governor (not shown) upon the valve through the stem 31 in opposition to a spring (not shown) acting upon the head 6' of the valve, is provided with a plurality of ports 30 symmetrically disposed about the cylindrical valve 6 and positioned to cooperate with the groove 18 and ports 24 in the valve bushing in the control of the supply of fuel to the engine cylinders. The bushing 4 is also provided with an annular groove 8 connected by a port 12 to the chamber 14.

The ports 30 are formed as slots milled into the valve, before the valve is hardened, by a cutter of the type used for milling slots for Woodruff keys. At the end of the ports 30 adjacent the head 6' of the valve the ports 30 are provided with extensions 30' formed as narrower slots of less depth than the ports 30 by a similar cutter. The ports 30, 30' and 24 and the annular groove or passage 18, are so positioned relatively to each other that the ports 30, 30' are in constant communication with the ports 24 so that slight inaccuracies in the locations of the ports 24 are immaterial and do not affect the operation of the valve.

While the port 30 and its extension 30' have been shown as formed by cutting with two cutters of different widths these ports may be formed by a single cutter shaped to give a port 30^a and a restricted extension 30^b at one operation, as shown in Fig. 8. In this connection there is a restricted extension 30^b at each end of the port 30^a but this is immaterial as the ports 30^a are constantly fully opened to the passages 24 as shown in Figs. 2 to 4 inclusive. The shape of the port 30^b, as shown in Fig. 8 is illustrative only, it being understood that the shape of the

restricted extension of the port may be varied, as desired, by changing the shape of the cutting or grinding tool or, as shown in Fig. 9, the slots 30c may be formed by a single cutter shaped to give a slot having a rectangular shape on the face of the valve 6.

With the engine at rest the centrifugal governor permits return of the valve 6 to the position shown in Fig. 2 in which the ports 30' do not register with the groove 18 and flow of fuel through the ports 30, 30' is prevented. With the engine in operation the valve 6 is raised to a position in which the extension grooves 30' register with the groove 18, as shown in Fig. 3, and flow of fuel through the ports 30, 30' is permitted, the extent to which the ports 30' are opened to the groove 18 being governed by the action of the centrifugal governor. Under ordinary operating conditions the valve 6 is not shifted sufficiently to register the grooves 30 directly with the annular groove 18 but where the motor is operated beyond the governed speed, as in descending a hill, the valve may be shifted to register the ports 30 with the groove 18.

In the drawing the ports and passages are shown arranged for controlling the supply of fuel to the engine cylinders by venting more or less fuel from the pump cylinders during each pumping stroke thereof. The fuel supplied to the annular chamber 14 from a source of fuel supply under a suitable low pressure when the engine is in the operation passes through ports 16 to the bores of the pump bushings 2 upon retraction of the pump plungers. Upon operation of a pump plunger the port 16 is closed by the plunger and the fuel is forced under pressure to the engine cylinder connected thereto. At the same time some of the fuel is forced from the bore of the pump bushing 2 through port 28 in the pump bushing 2, port 26 in the casing 1 and port 24 in the valve bushing 4 to a port 30, 30' in the valve 6. Extensions 30' of the ports 30 are, at this time, in register to some extent with the annular groove 18, as shown in Fig. 3, so that some fuel is vented through the groove 18, passage 20 and groove 22 to a discharge reservoir or back to the source of supply, the amount of fuel vented being dependent upon the extent to which the extension 30' of the port 30 registers with the groove 18. Any leakage of the fuel under high pressure along the valve 6 will pass either through groove 18, port 20 and groove 22 to the discharge reservoir or through groove 8 and port 12 to the source of supply and leakage to the ends of the valve 6 is prevented.

To stop the engine, manually operated means are provided which are arranged to act upon a valve stem 36 attached to the valve 6 by a pin 36' so as to shift the valve 6 to a position in which the ports 30 register with the annular groove 18, as shown in Fig. 4. In this position of the valve 6 the amount of fuel vented from the pump cylinders is sufficient to prevent the pump placing the fuel under sufficient pressure to open the usual discharge valves in the passages leading to the engine cylinders and the engine is stopped. The ports 30a, 30b of Fig. 8 will operate in identical manner with the ports 30, 30' of Fig. 1 while the ports 30c will be operated to make but a restricted connection with the groove 18 during the normal operation of the engine and will be shifted to make a more extensive connection therewith to stop the engine. Both ports 30a, 30b and 30c are at all times fully opened to the ports 24.

Forming the ports in the valve 6 in the manner described permits of readily maintaining the ports uniformly positioned and of uniform size, the length being determined by the depth of the slot cut and the cutter being held in the same position longitudinally of the valve for the cutting of all the ports of a valve. If desired, the ports may be milled in the valve 6 or may be formed by grinding after the valve has been hardened. Throughout this operation the upper edges of the extensions 30' and 30b and the edges of the ports 30, 30a and 30c can be maintained true. Forming the groove 18 as an annular groove permits of maintaining the edges thereof true and uniformly positioned so that the relations of the ports in the valve 6 to the groove 18 are uniform and adjustment of the valve 6 provides uniform control of the venting of the fuel from the pump cylinders and, consequently, uniform control of the supply of fuel to the engine cylinders.

While the various ports and passages have been shown arranged to control the supply of fuel to the engine cylinders by controlling the venting of fuel from the pump it is to be understood that such showing is illustrative only as the ports and passages may be arranged to control the supply of fuel to the engine cylinders in other ways. While the valve 6 has been shown and described as movable longitudinally it is to be understood that a valve 6 having ports arranged as in Fig. 9 is adapted for use with mechanism which causes the valve to have a rotating movement in order to cooperate with the ports and passages of the valve bushing or seat as shown in my co-pending application, Serial No. 66,711, filed March 2, 1936, and of which application this application is in part a continuation.

I claim—

1. In a device of the class described, a valve member and a relatively movable cooperating member therefor, said members having a common cylindrical surface of contact at which relative motion of said members occurs, one of said members having longitudinally extending slots open to said cylindrical surface and symmetrically disposed on said member, each of said slots continuously cooperating with an edge on said cooperating member common to all of said slots to control the flow of fluid through said slots from corresponding separate sources of fluid under pressure outside said members in all positions of said members permitting flow of fluid.

2. In a device of the class described, relatively movable cooperating valve members having a common cylindrical surface of contact at which relative movement of said members occurs, one of said members having longitudinally extending slots open to said cylindrical surface and symmetrically disposed thereabout and the other of said members having ports for connecting said slots individually to separate high pressure sources and for adjustably connecting said slots to a common low pressure chamber, said slots each changing in width at an intermediate point whereby the rate of change of the controlling area of opening of said slots is suddenly varied at said point during uniform relative movement of said members.

3. In a device of the class described, a casing, a cylindrical valve in said casing having slots extending longitudinally of and spaced peripherally of said valve, said slots being open to the

outer cylindrical surface of said valve and otherwise closed and said casing having a plurality of ports in continual individual open connection with the slots of said valve and an annular recess in said casing having simultaneously opened and varied connection with all the slots of said valve.

4. In a device of the class described, a casing, a cylindrical valve in said casing having a plurality of ports uniformly spaced circumferentially of said valve, each port comprising a groove and an extension of less capacity and gradually reducing in cross-sectional area outwardly at an end of each port and said casing having a plurality of ports in constant individual open communication with the ports of said valve and an annular recess in said casing having simultaneously variable connection with all the port extensions of said valve.

5. Valve means comprising a body member having a bore therein and a valve member slideably movable in said bore, said body member having spaced annular recesses forming low pressure fluid chambers at the surface of sliding contact of said members, said valve member having a plurality of slots open to said contact surface in the region between said chambers and effectively closed to said chambers in the closed position of the valve means but open to one of said chambers in the open position of the valve means, said body member having high pressure fluid ports, one port opening to each of said slots and movement of said valve member serving to control connection of said ports by said slots to one of said low pressure fluid chambers for the escape of fluid thereto.

6. Valve means for controlling simultaneously the pressure within a plurality of fluid conduits by venting said conduits individually to a common chamber, said means comprising a body member having a bore therein and a valve member longitudinally movable in said bore, one of said members having a plurality of recesses at the cylindrical surface of said bore peripherally spaced thereabout, the other of said members having an annular chamber at said cylindrical surface, said recesses being connected to said conduits individually and substantially closed to said annular chamber in the closed position of said valve means, but having a restricted connection to said annular chamber in the open position of said valve means, longitudinal movement of one of said valve members with respect to the other serving to provide an opening of varying area for escape of fluid from each of said conduits by registry of said recesses with said annular chamber, said recesses having the form of slots extending longitudinally of said bore and having portions of different widths, relatively narrow portions of said slots being open to said annular chamber for a predetermined relative movement of said members and relatively wider portions of said slots being opened to said annular chamber upon relative movement of said members in excess of said predetermined movement.

7. Valve means for controlling simultaneously the escape of fluid from a plurality of individual high pressure fluid conduits, said valve means comprising a body member having a bore therein and a valve member slidably movable in said bore, said body member having a plurality of uniformly spaced high pressure ports opening into said bore and an annular recess forming a chamber opening to said bore and said valve mmeber having slots in the surface thereof, each slot being open continuously to one of said high pressure ports in open and closed positions of the valve and all slots opening to said chamber only when the valve is in open position.

8. Valve means for controlling simultaneously the pressure within a plurality of fluid conduits by venting said conduits individually to a common chamber, said valve means comprising a body member having a bore therein and a stem member longitudinally movable in said bore, one of said members having a plurality of recesses uniformly spaced peripherally at the surface of said bore and the other of said members having an annular chamber at said surface, each of said recesses being connected to only one of said conduits and having a restricted connection to said annular chamber in the open position of said valve means and longitudinal movement of one of said members with respect to the other providing a varying opening for venting of fluid from said conduits by registry of said recesses with said annular chamber.

WARNER T. TABB.

CERTIFICATE OF CORRECTION.

Patent No. 2,190,575. February 13, 1940.

WARNER T. TABB.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 49, for the word "connection" read construction; page 2, first column, line 33, strike out "the"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 19th day of March, A. D. 1940.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)