July 30, 1929. E. W. JONES ET AL 1,722,799

VALVE MECHANISM

Original Filed June 18, 1921

Fig. 1.

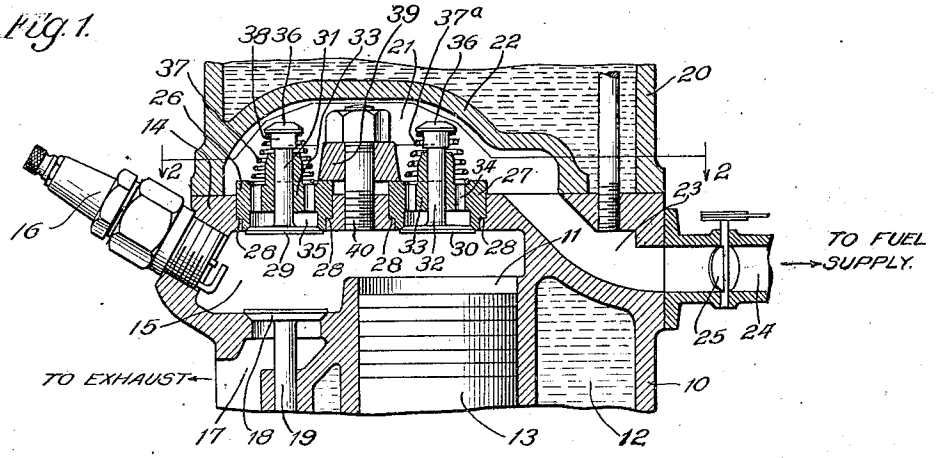


Fig. 2.

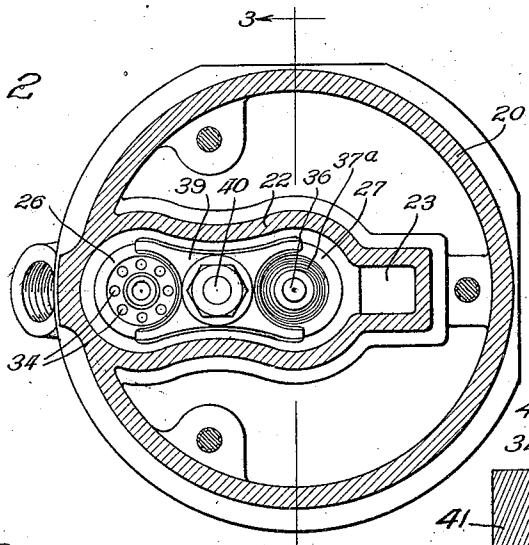


Fig. 3.

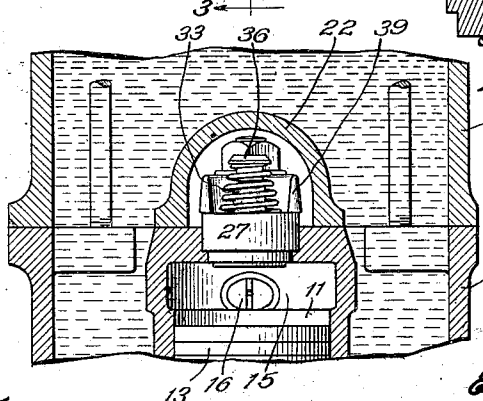
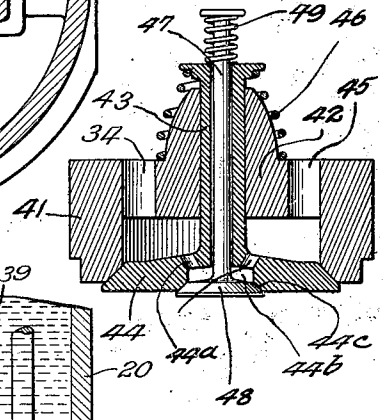


Fig. 4.



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UNITED STATES PATENT OFFICE.

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VALVE MECHANISM.

Application filed June 18, 1921, Serial No. 478,666. Renewed December 6, 1928.

Our invention relates to valve mechanisms and it has especial relation to such mechanisms which are employed in connection with internal combustion engines.

More particularly our invention relates to valves governing the supply of fuel to the cylinder of an internal combustion engine and has for its object to provide a device wherein the valve is operated entirely by the difference of pressures on its outer and inner faces, or, in other words, by the pressure difference between the outside and inside of the engine cylinder. In this connection we make use of the different pressures which usually occur in the inlet manifold of an engine by reason of the varying amounts of fuel which are supplied thereto when the load carried by the engine increases or decreases, a valve in the fuel supply pipe being employed to govern said fuel supply in accordance with the load carried.

A further object of our invention is to so arrange a plurality of valves, operating in the above manner, in combination with the ignition points of a spark plug, that the air drawn through said valves, and especially through that valve which is operated continuously during the running of the engine, operates to scavenge or clean the locality immediately adjacent to the ignition points. To that end we so form a cylinder and the space adjacent thereto that an ignition pocket or space, into which the ignition points of the spark plug project, is established, this pocket being, of course, in direct communication with the cylinder. In this structure the ignition pocket is always filled with live gas just prior to the spark whereby extremely rapid propagation of the flame is obtained and a highly satisfactory explosion results.

The use of a plurality of valves insures the maximum inlet area together with a very short stroke by each valve piston. A small amount of energy is needed, therefore, in contra-distinction to that required were it necessary to overcome the inertia of one large valve, giving an equal valve opening. The net result of the desirable factors enumerated and obtained with a plurality of valves, is high speed operation and rapid functioning with substantially no vibration, noise or other difficulties usually attendant upon such operation. It is our experience that a speed of 3600 R. P. M. can easily be obtained with the structure hereinafter to be described.

The inlet manifold extends directly over the aforesaid pocket and cylinder and the valves themselves are mounted in the wall between said manifold and the cylinder and pocket, one valve being mounted directly over the pocket whereas the positioning of the other one is arranged as we shall hereinafter describe.

The above positioning of the plurality of valves which we find it desirable at times to employ, is contributory to another advantage which is secured by the use of my improved valve mechanism. That is, it is possible to employ any desired number of valves and to so associate restraining springs of different strengths with the pistons thereof that said valves open at different pressure differences whereby they successively come into operation in an entirely automatic manner as said pressure difference increases, or as above indicated, as the load on the engine, of which said valve mechanism is a part, increases.

In the hereinafter described embodiment of our invention, we have illustrated the mechanism as embodying two valves only but it is obvious from the foregoing statement that any number over two may be used and the spring strengths so adjusted that the desired results are obtained.

For a better understanding of our invention, reference may be had to the accompanying drawings, in which:

Fig. 1 is an elevational, sectional view of only so much of an internal combusion engine as is necessary for a clear understanding of the operation of a device embodying our improved valve mechanism;

Fig. 2 is a plan sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is an elevational, sectional view taken on the line 3—3 of Fig. 2; and

Fig. 4 is an elevational, sectional view of a modified form of valve structure embodying our invention.

While the valve mechanism, which we shall hereinafter describe and claim is of such character and so operated that it may be utilized in any prime mover of the above described type, we have herein illustrated the

same as employed in connection with an engine of the type illustrated in a co-pending application of ours, filed June 18, 1921, Serial No. 478,665, and assigned to the Sunbeam Electric Manufacturing Company and reference may be had to said application if a more detailed discussion of said engine is desired.

In the present instance, we show a portion of a casting 10 which is formed to provide a cylinder 11 surrounded by a cooling chamber space 12, a piston 13 being shown as reciprocating in the said cylinder portion 11. An upper wall or top of the casting 10 closes the cylinder 11 and a pocket 15 which is formed in the casting 10 transversely to the left of, and in communication with, the cylinder portion 11. A spark plug 16, or other ignition device, is disposed in the side wall of the casting whereby the ignition points thereon project into the pocket portion 15.

An exhaust manifold 17 leads from the pocket portion 15 and the cylinder 11, and is adapted to be placed in communication with the same by the operation of an exhaust valve 18 which is reciprocated by a valve rod 19.

Another casting 20 is bolted to the casting 10 in such manner that an intake manifold 21 is formed by the top of the casting 14 and a cap-like portion 22 of the casting 20, it being observed that a supply passage 23 is formed in the casting 10 and communicates with said manifold. We have diagrammatically indicated a supply pipe 24 for feeding fuel to the intake passage 23 and the manifold 21 and have, moreover, shown a valve 25 of the butterfly type as positioned in said supply line whereby the supply of fuel passing therethrough and, consequently, the pressure thereof in the manifold 21 is governed by the opening and closing of said valve. The opening and closing of the valve 25 is governed in accordance with the load imposed upon the engine but it is possible to govern the fuel supply in accordance with other functions of the apparatus if desired.

Valve cages 26 and 27 are disposed in the wall 14 and are prevented from moving downwardly by shoulders 28 formed in openings in said wall. Puppet valves 29 and 30, to which are attached valve rods 31 and 32 respectively, cooperate with the cages 26 and 27 respectively, said valves being chamfered to prevent their upward movement whereby they can open in a downward direction only. The stems 31 and 32 reciprocate in central guide portions 33 which are integral with the cages 26 and 27. Ports 34 comprise a plurality of openings disposed around the guide members 33, said ports projecting through the cages from the outside thereof into chambers 35 whereby substantially the entire inner faces of the valve pistons are subjected to the fluid pressure in the intake manifold.

Caps 36 are secured to the tops of the valve rods 31 and 32 and between said caps and the outer portions of the cages springs 37 and 37ª are positioned, the latter restraining the downward movement of the valve pistons.

These springs are of different strengths, the one cooperating with the piston 29 being lighter than that one associated with the piston 30. Because of this difference in spring restraining power, the left hand valve piston 29 may be moved downwardly more easily than the piston 30. The left hand valve, or that one positioned over the pocket 15, may be designated the "normal duty" valve. This valve functions continually while the engine is running by reason of the strength of the spring associated therewith and consequently a stream of incoming fluid is passing substantially continuously through the aforesaid pocket and sweeping over and through the ignition chamber and around the ignition points therein. The other or "heavy duty" valve is positioned directly over the cylinder whereby the fluid fed therethrough passes directly into said cylinder.

Because of the particular positioning of the above described elements and also because of the sweeping of the gas through the ignition pocket, the mixture in the combustion chamber is quite homogeneous. If any dead gas remains in the space above the pistons it is forced down on top of the pistons by the inrushing gas, the latter filling the space above the pistons with a homogeneous mixture of live gas through which an extremely rapid flame propagation is obtained after the said flame is initiated in the ignition chamber. As a matter of fact, the dead gas which is forced down on top of the pistons and there compressed is, in one way, advantageous since such gas is quite an efficient heat insulating medium and, at the same time, limits the flame propagation, whereby said pistons are protected.

From the above statement it is apparent that through the utilization of two or more valves of the above described type, streams of fuel may be directed to various points in an engine cylinder at various points on the load curve of said engine, said streams as well as the intensity thereof being governed entirely by the load on said engine.

An enlarged shoulder portion 38 is formed on the rods 31 and 32 whereby the downward motion of said valve rods and pistons is limited by the upper end of the central guide member 33. A retaining member 39 has a yoke at each end thereof surrounding the valve springs and guides and, at the same time, bearing against the upper portions of the valve cages. This yoked member is secured to the wall 14 by a bolt 40 through the central portion thereof whereby the cages themselves are firmly retained in position, as shown.

Having described one embodiment of our invention the operation thereof is as follows, it being assumed that when the engine is not running the difference in pressure between the outside and inside of the cylinder is equal to substantially zero and, as above described, that the spring which restrains the downward movement of the valve positioned directly over the ignition pocket is of such strength that the same opens to admit fuel wherever an appreciable difference in pressure exists between the fluid in the inlet manifold and that within the cylinder itself. The other valve, having a restraining spring of greater strength, is not opened until a greater pressure difference exists.

Upon the first down stroke of the piston the above appreciable difference will exist, it being assumed that whatever governing means is employed to open and close the supply line valve is functioning to admit a predetermined amount of fuel, and the light-spring or normal duty valve opens. The fuel, therefore, passes first into the ignition pocket and thence into the cylinder. At the proper time, the fuel is ignited by the spark passing between the spark plug points and, upon the next suction stroke of the piston, the incoming fuel sweeps through the ignition pocket and around the ignition points and contributes to the above-discussed advantages. As the load upon the engine increases the amount of fuel supplied to the inlet manifold likewise increases and when a predetermined pressure is reached therein, the valve to the right, or what we have hereinbefore described as the heavy duty valve, opens, first to a small extent and finally upon extreme loads to the limit set by the contact between the collar 36 and the top of the guide 33. In other words, as the pressure difference between the outside and inside of the cylinder becomes greater, the valves successively come into operation, it being understood that while we have only illustrated two valves in the hereinbefore described embodiment of our invention it is entirely possible, and may at times be found desirable, to have a number of these valves provided with springs of different strengths whereby they will successively come into operation at the desired pressure differences.

In Fig. 4, we have illustrated a modified form of valve mechanism embodying our invention. In this particular structure the two valves are combined into one structure whereby a device which, under some circumstances, may be preferable to that heretofore discussed is obtained.

A valve cage 41 is analogous to that described in connection with the previous embodiment of our invention, the same having a centrally located guide portion 42 through which a stem 43 of a valve member 44 passes and in which the same slides. Ports 45 are arranged circumferentially around the portion 42 and a spring 46 opposes the downward movement of the valve member 44.

In the present embodiment of our invention, however, the member 44 is provided with a series of ports 44^a which are arranged around the stem 43 and which open into a space 44^b having a lower chamfered surface 44^c. The stem 43 is hollow and a stem 47 carrying a piston or port controlling member 48 passes therethrough and slides therein. It will be observed that the member 48 is held in closed position by a spring 49 interposed between the top of the stem 43 and the top of the stem 47 and that said member 48 is normally restrained in such position that the ports 44^a are closed. Further, it should be noted that the spring 49 is, as heretofore described, of a less strength than the spring 46.

The operation of the combined concentric valve structure just described, is analogous to the operation of the mechanism when two separate structures are utilized. Under light load conditions the member 48 moves downwardly while the member 44 remains tightly closed. Fuel then passes through the ports 45 and through the ports 44^a into the cylinder. When, however, the pressure difference increases, as the load increases, the member 44 moves downwardly against the restraint of the spring 46 and an additional amount of fuel is admitted by reason of the larger area of the openings 45, the fuel now passing into the cylinder around the valve 44.

From the above description it will be seen that we have provided valves and governing mechanism for an internal combustion engine whereby the former are responsive in an entirely automatic manner to the load upon the engine, without the intervention of a complicated valve governing system comprising rods, cams and otherwise. Moreover, by the particular positioning of such valves, we have ensured the continual cleaning of the ignition chamber and the spark plug points therein whereby the difficulties usually attendant upon the use of such devices are substantially eliminated. Furthermore, the dead gas is shoved away from the pocket whereby the latter can be filled with a live, homogeneous mixture through which a rapid flame propagation takes places.

Again, we believe that the idea of having a valve of such construction that it automatically opens at the proper time by reason of the pressure difference, above discussed, is entirely novel. The provision of such a valve ensures a smooth steady operation of the engine because it inherently follows the piston positions in the same manner as if a positive connection existed therebetween.

While we have described but two embodiments of our invention it will be understood, as above pointed out, that we do not wish to limit ourselves to the form described and we desire, therefore, that our invention be broad-

ly interpreted and limited only by the scope of the appended claim and by the showing of the prior art.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

In an internal combustion engine, a cylinder having a piston therein, valves governing the admission of fluid to said cylinder, and means comprising a light spring on one valve and a comparatively heavy spring on another valve whereby they may pass fluid in one direction only, the light spring or normal-duty valve being operative at all times and the heavy spring of heavy-duty valve being operative only on increased loads.

In witness whereof we have hereunto subscribed our names.

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