Oct. 6, 1931. M. D. MOORE 1,826,630

FUEL CONTROL FOR INTERNAL COMBUSTION ENGINES

Filed Aug. 17, 1929

Fig. 1.

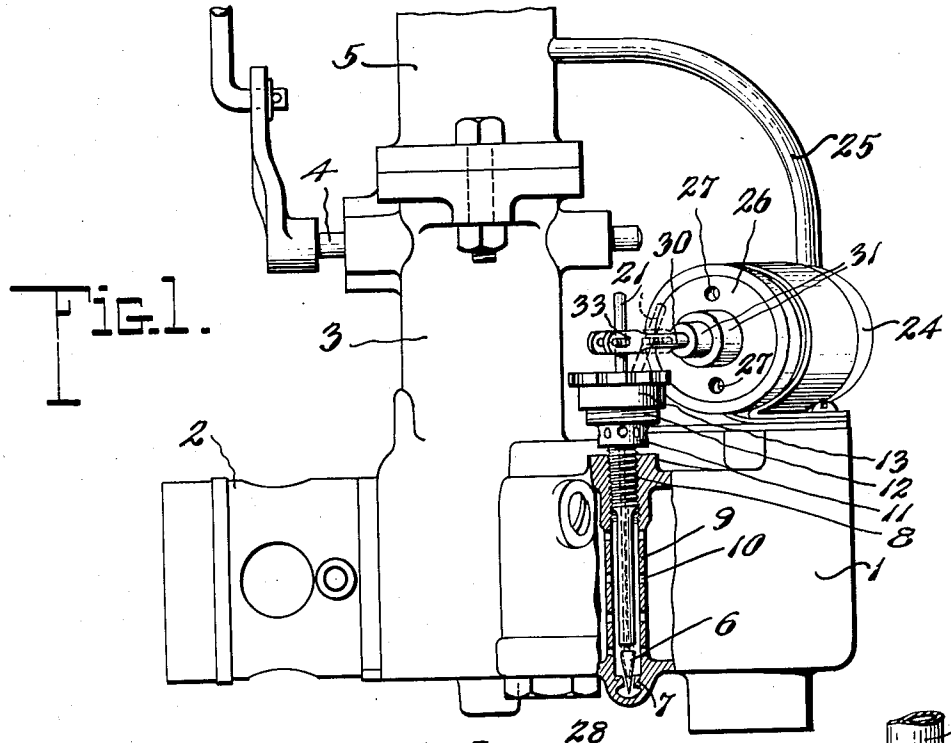


Fig. 2.

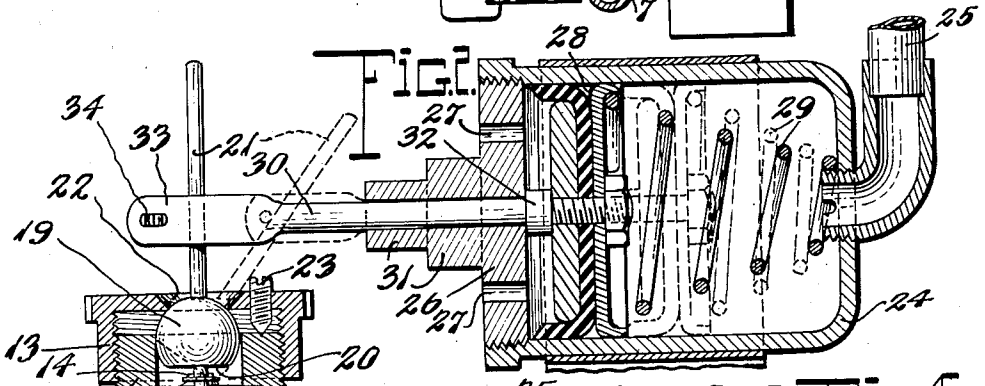


Fig. 3.

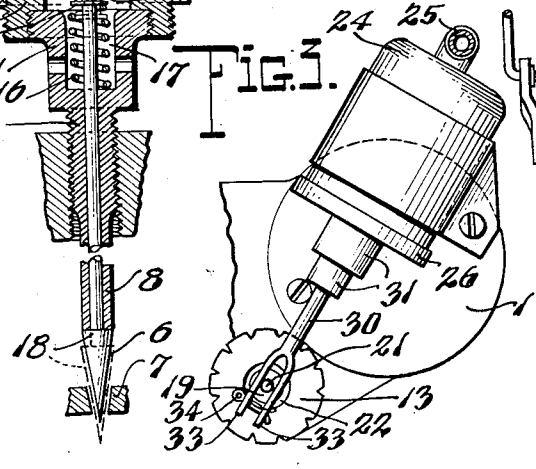
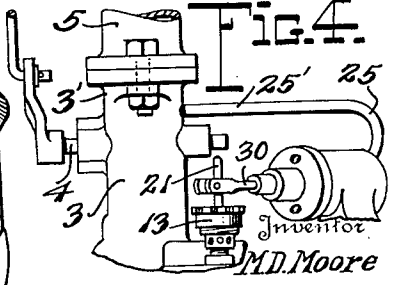


Fig. 4.



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FUEL CONTROL FOR INTERNAL COMBUSTION ENGINES

Application filed August 17, 1929. Serial No. 386,724.

This invention relates to improvements in apparatus for supplying carburetted fuel to internal combustion engines, and has as its essential object the automatic variation in the character of such fuel proportioned to the requirements of the engine incident to load conditions.

When an internal combustion engine is operating under a light load, the vacuum in the intake manifold will be proportionally more nearly perfect or "stronger" incident to the necessary more nearly closed condition of the throttle or butterfly valve; but when the throttle is opened further to allow a more free passage the supplying of gas to the manifold reduces the degree of vacuum proportionally, and this variation is taken advantage of by the present invention to control the character and nature or condition of the fuel supplied to afford assurance that the cylinders will receive just the best conditioned and proportioned fuel charges according to the work being done by the pistons under any set of conditions.

Further detailed objects will in part be stated and in part become apparent hereinafter, and in the accomplishing of these objects the invention comprises certain novel constructions, combinations, and arrangements of parts as will hereinafter be more specifically pointed out and subsequently recited in the appended claims.

In the accompanying drawings,—

Figure 1 is a view in side elevation of a carburetor embodying the features of the present invention, a fragment of the intake manifold being shown, and parts being broken away and seen in section for disclosing interior construction.

Figure 2 is a vertical, central section through fragmentary portions of parts seen in Figure 1, illustrating details of the present invention.

Figure 3 is a fragmentary plan view of parts of the carburetor seen in Figure 1, the vacuum tube being seen in cross sections.

Figure 4 is a view similar to Figure 1, parts being broken away, and the parts being seen on a reduced scale, the figure illustrating a slightly modified arrangement of the vacuum tube to enable the structure to be supplied as a carburetor unit.

Referring to the drawings by numerals, 1 indicates any conventional form of fuel cup of any commercial or well known carburetor, which is supplied with air through the intake tube 2, and which discharges through the venturi 3 past the throttle 4 to the intake manifold 5 of the internal combustion engine, not illustrated. The usual carburetor control needle 6 has its customary seat 7 arranged to control the inflow of gasoline or other hydrocarbon, or other appropriate liquid fuel. The needle 6 extends upward through a tubular housing 8 which is threaded into an appropriate portion of the carburetor wall, the housing extending down through the usual intake tube 9, apertured at 10, for the ready inflow of fuel to cup 1 as it passes the valve seat 7. Naturally, in all carburetors the liquid level in the cup 1 will vary according to the rate of consumption relative to the rate of inflow past the seat 7, and it is important, therefore, to keep the needle 6 at that location with respect to seat 7 such as to maintain the liquid level at highest efficiency for working conditions of the engine. By the present invention, the relation of the needle 6 to the seat 7 will vary constantly with variations in working conditions of the engine to assure maximum efficiency incident to a constant maintenance of the exactly required liquid level for the particular conditions of work of the engine at any given time.

To this end, the upstanding portion of casing or tube 8 is provided with a head or enlargement 11 to the upper end of which is threaded or otherwise detachably secured an enlarging bushing 12, which bushing in turn is engaged by a threaded cap 13. Obviously, other detachable securing means than threads may be employed for cap 13, as preferred. The shank of needle 6 extends through the head 11 and into the space surrounded by bushing 12, and the upper end portion of said shank is preferably provided with an appropriate stop, such as cross cotter key 14 and washer 15, and between said stop and an appropriate part of head 11 is

arranged a spring 16. The spring 16 is tensioned to stress the needle 6 upward or away from its seat 7. Spring 16 is preferably coiled and to accommodate the spring while providing a sufficient length thereof for sensitive responsiveness, the head 11 is preferably provided with a recess 17 of appropriate depth extending along the shank of needle 6, and the spring 16 rests on the base of said recess. The needle 6 is shouldered at 18 to abut against the lower end of the housing or tube 8 for limiting the possible extent of upward movement or movement away from seat 7. The tube or housing 8 being threaded into place is adapted to be adjusted toward the seat 7 to that extent causing the liquid level in the carburetor to be correct for engine starting conditions with the needle 6 at its greatest elevation. But for the presence of this invention, the needle 6 would remain at such greatest elevation and variations in the work of the engine would not be responded to by proportional variations in fuel feed. The present invention, however, provides for rendering the feeding of fuel responsive and variable with respect to variations in engine working conditions. To this end, a needle actuator is provided which is itself responsive to working conditions of the engine and consists essentially of a cam 19 and means influenced by varying degrees of vacuum in the intake manifold 5 for actuating cam 19 as required for effective control of the flow past the valve seat 7. The cam 19 is, of course, capable of substantial variation according to the particular carburetor to which attached, but consists preferably and essentially of a globular body having a flat face 20 disposed to rest in engagement with the upper end of the shank of needle 6 when the needle 6 is in its highest position or position most remote from its seat 7. It will be obvious, of course, that the flat face 20 being substantially located to have its center point contacting with the upper end of the shank of needle 6 will cause depression of the needle whenever the globular part is rotated about a fixed axis, since any movement on an established axis must cause some part of the bulk of the cam 19 to move to a position lower than the plane of the flat face 20 when that face is horizontal. An operating rod 21 is fixed to and upstands from the upper portion of the cam 19, and extends through an appropriate aperture 22 formed preferably centrally through the cap 13. The cap 13 is located to rest against a globular portion of cam 19 so that the said cam may be oscillated with its globular surface moving across edge portions of cap 13 produced by aperture 22. A set screw or other appropriate adjusting means 23 is preferably threaded through the cap 13 into contact with the bushing 12 to enable nicety of adjustment and limitation of cap 13 with respect to the bushing. It will be seen that by backing off the set screw 23 and screwing down on cap 13 relative to bushing 12, the cam 19 may be lowered bodily to that effective location desired with respect to the shank of needle 6, and may even be lowered to a position depressing the needle below its present upward limit, but ordinarily such depression will be avoided and the adjustment provided is utilized to accommodate the cam 19 without interfering with the at-rest or uppermost position of needle 6. It will be observed also that the bushing 12 is proportioned to surround the cam 19 and contact with globular surfaces thereof so as to prevent bodily shifting of the cam while allowing the cam to oscillate about a fixed axis.

A vacuum cylinder 24 is provided and may be located at any appropriate point, a convenient place being the top of cup 1. Communicating with one end of cylinder 24 is the vacuum tube 25 which extends to the intake manifold 5 or to a corresponding part of the carburetor structure, as illustrated in Figure 4 and hereinafter referred to. For facility of assemblage, the tube 25 is preferably provided with a threaded connection or other detachable anchorage to the cylinder 24, and the opposite end of the cylinder 24 from that penetrated by tube 25 is provided with a preferably detachable cylinder head 26 apertured at 27, 27, to permit intake and exhaust of air. A piston head 28 of any appropriate construction is arranged within cylinder 24 and is stressed toward the head 26 by a spring 29 of sufficient low resistance to allow the piston head 28 to be moved toward the vacuum intake end of cylinder 24 under the influence of the partial vacuum of intake manifold 5. Of course, spring 29 will be tensioned to return the piston with the relaxing of the vacuum. A piston rod 30 is fixed to the piston head 28, and extends through the cylinder head 26. A guiding boss 31 preferably outstands from cylinder head 26 to elongate the bearing of the rod 30 through head 26 and thus largely eliminate wear. A stop collar 32 is fixed to piston rod 30 within cylinder 24 to limit the return movement of the piston head 28 under the action of spring 29.

Piston rod 30 is appropriately connected or located to act upon the operating rod 21 of cam 19, and the connection of course is susceptible of a very wide range of variation within the spirit and purpose of the present invention. A simple and effective arrangement consists in bifurcating the free end portion of the rod 30 to provide furcations or prongs 33, 33, arranged to extend at opposite sides of the rod 21 and connected at their outer ends by an appropriate cotter or other connecting means 34. The prongs 33 are of sufficient length to provide an elongated slot-like passageway as seen in Fig-

ure 3 in which the rod 21 is accommodated and the length of which enables the piston rod 30 to have some play without varying the location of cam 29 while the parts are adapted, when under maximum actuation, to move to the maximum caming capacity of cam 19, as clearly indicated by the dotted line position seen in Figure 2. It will be observed in this connection that the furcations or prongs 33 are preferably widened somewhat beyond the diameter of rod 30 so that when moving to the dotted line position of Figure 2 the said prongs serve as a stop for the rod 30 limiting the rearward stroke of piston 28 just as stop 32 limits the forward stroke thereof. Thus there is no possibility of such movement of cam 19 as to jam the needle 6 upon its seat or otherwise create an inoperative condition.

The structure as illustrated in Figures 1 to 3 is shown as applied to a standard carburetor already in use, and the invention may be applied to subsequently produced carburetors in the same way, but in order to provide for a complete carburetor unit including the present invention, it is preferable to arrange the structure as seen in Figure 4 in which the same identical parts are employed and the same reference numerals and description will apply, except that the cylinder 24 is preferably formed integral with the other parts of the carburetor and the pipe 25 has an extension 25′ which enters an elongation 3′ of the venturi 3 above the throttle 4, whereby the carburetor as a unit may be applied to and detached from the intake manifold 5 without requiring any special connection to said intake manifold.

The operation will be readily understood from the foregoing, and consists essentially in the actuation of the rod 21 responsively to variations in vacuum conditions in the intake manifold. This is, of course, true whether the connection of pipe 25 be directly to the manifold or just below the manifold as seen in Figure 4. Thus, when the vacuum is strongest in manifold 5, piston 28 will be moved to the dotted line position of Figure 2, and the cam 19 will thereby depress needle 6 to its lowermost position as seen in dotted lines in Figure 2. This, of course, is the condition when the throttle 4 is most nearly closed. With the opening of the throttle and the consequent drop in vacuum, the piston 28 is proportionally released and moves under the stress of spring 29 toward the full line position of Figure 2, which proportionally allows the needle 6 to rise from its seat 7, and thus allows increased inflow with the increased demand incident to the greater opening of the throttle. The upward movement of the needle 6 will continue to maximum engine demand as the throttle approaches and reaches maximum open position, and converse action will occur with the closing of the throttle.

What is claimed is:

1. In fuel control apparatus for internal combustion engines, the combination, with a carburetor having a fuel supply control needle, of a cam cooperating with the needle, and means actuated by variations of vacuum acting upon the carburetor for variably shifting said cam for proportionally shifting said needle, the cam resting directly against the end of the needle and actuating the needle by relative movement of the caming face against the engaged end of the needle.

2. In fuel control apparatus for internal combustion engines, the combination, with a carburetor having a fuel supply control needle of a cam cooperating with the needle and mounted both to shift angularly and be adjusted bodily, means actuated by variations of vacuum acting upon the carburetor for variably shifting said cam angularly for proportionally shifting said needle, and and means for bodily adjusting the cam with respect to the needle.

3. In fuel control apparatus for internal combustion engines, the combination, with a carburetor having a fuel supply control needle, of a cam cooperating with the needle, means actuated by variations of vacuum acting upon the carburetor for variably shifting said cam for proportionally shifting said needle, the cam being located to function by direct contact with the needle and the cam having a globular body and a flat face, the flat surface being located to engage the needle, and means for limiting the globular body against bodily movement.

4. In fuel control apparatus for internal combustion engines, the combination, with a carburetor having a fuel supply control needle, of a parti-globular cam having a flat portion presented toward said need and located with respect thereto for engaging and actuating the needle when the cam is oscillated, and a housing engaging the globular portion of the cam and preventing bodily movement thereof.

5. In fuel control apparatus for internal combustion engines, the combination, with a carburetor having a fuel supply control needle, of a parti-globular cam having a flat portion presented toward said needle and located with respect thereto for engaging and actuating the needle when the cam is oscillated, a housing engaging the globular portion of the cam and preventing bodily movement thereof, and means for bodily adjusting the cam with respect to the needle.

6. In fuel control apparatus for internal combustion engines, the combination, with a carburetor having a fuel supply control needle, of a parti-globular cam having a flat portion presented toward said needle and

located with respect thereto for engaging and actuating the needle when the cam is oscillated, a housing engaging the globular portion of the cam and preventing bodily movement thereof, and means for bodily adjusting an engaging portion of the housing for adjusting said cam with respect to said needle.

7. In fuel control apparatus for internal combustion engines, the combination, with a carburetor having a fuel supply control needle, of a parti-globular cam having a flat portion presented toward said needle and located with respect thereto for engaging and actuating the needle when the cam is oscillated, a housing engaging the globular portion of the cam and preventing bodily movement thereof, and a rod extending from said cam through said housing for oscillating the cam when the rod is swung.

8. In fuel control apparatus for internal combustion engines, the combination, with a carburetor having a fuel supply control needle, of a parti-globular cam having a flat portion presented toward said needle and located with respect thereto for engaging and actuating the needle when the cam is oscillated, a housing engaging the globular portion of the cam and preventing bodily movement thereof, and vacuum responsive means for oscillating said cam.

9. In fuel control apparatus for internal combustion engines, the combination, with a carburetor having a fuel supply control needle, of a parti-globular cam having a flat portion presented toward said needle and located with respect thereto for engaging and actuating the needle when the cam is oscillated, a housing engaging the globular portion of the cam and preventing bodily movement thereof, a rod engaging said cam for facilitating oscillation thereof, and a piston responsive to vacuum variations loosely engaging said rod for actuating the same.

10. In fuel control apparatus for internal combustion engines, the combination, with a carburetor having a fuel supply control needle, of a cam cooperating with the needle and mounted both to shift angularly and be adjusted bodily, the bodily adjustment being independent of the capacity for angular shifting, means actuated by variations of vacuum acting upon the carburetor for variably shifting the cam angularly for proportionally shifting said needle, and means for bodily adjusting the cam with respect to the needle.

11. In fuel control apparatus for internal combustion engines, the combination, with a carburetor having a fuel supply control needle, of a cam cooperating with the needle and engaging the end thereof for actuating the needle, the engaged end of the needle being shaped to reduce the area of its contact with the camming surface for refining the nicety of the camming action, and the cam having a globular body and a flat face with the surface of the flat face contacting with the needle.

In testimony whereof I affix my signature.

MARCUS D. MOORE.