Jan. 3, 1933. B. WALKER ET AL 1,892,917

MAGNETIC VALVE

Filed May 31, 1930

Fig. 1.

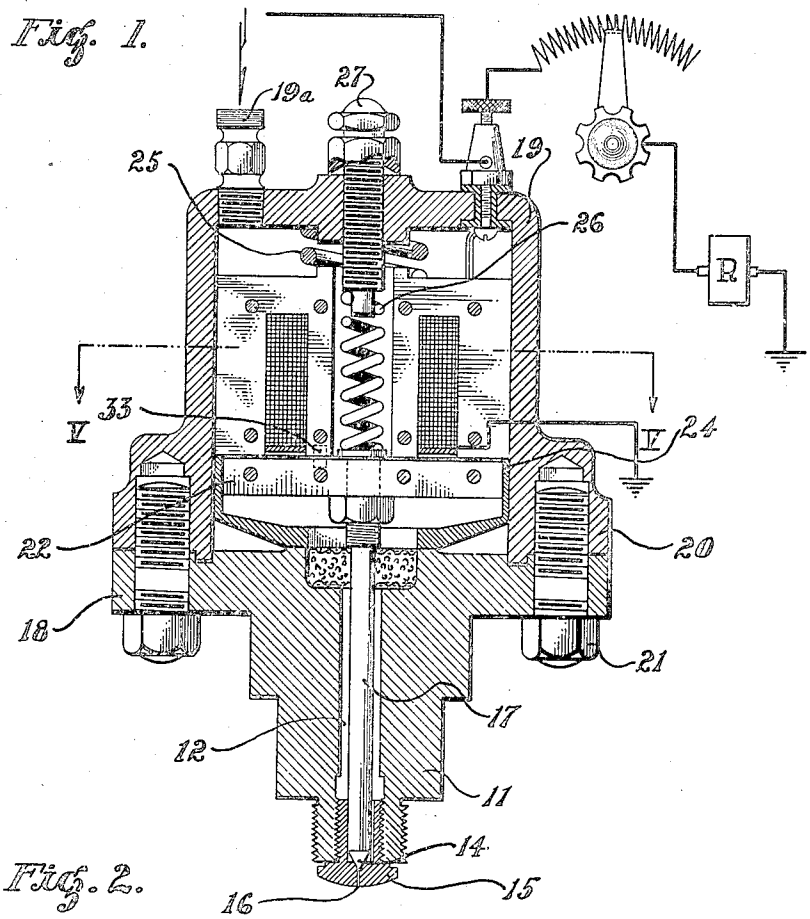
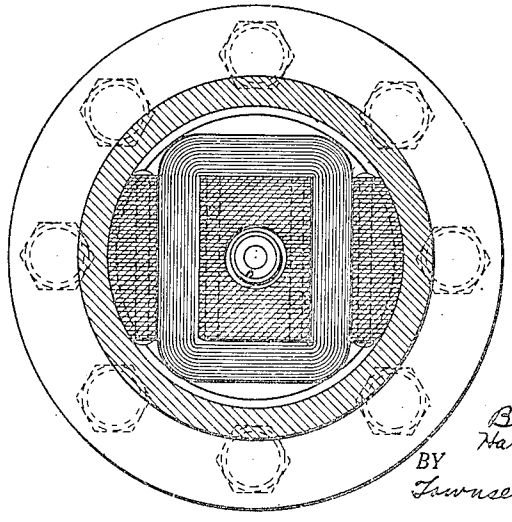


Fig. 2.



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Patented Jan. 3, 1933

1,892,917

UNITED STATES PATENT OFFICE

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MAGNETIC VALVE

Application filed May 31, 1930. Serial No. 458,739.

This invention relates to internal combustion engines of the type operating on the Diesel cycle and particularly pertains to an electrically operated and controlled fuel valve for engines of this type.

It is the principal object of the present invention to provide a generally improved magnetically operated fuel valve exceedingly sensitive to rapid changes of current, which enables it to operate efficiently with great rapidity on a minimum of energy and with negligible energy losses and wherein the dissipation of the stored energy existing upon the discontinuance of the electromotive force is controlled so that it may be dissipated at a desired rate to vary the open period of the valve subsequent to the discontinuing of the electromotive force thereto.

In carrying this object into practice in order to render the valve sensitive to rapid changes of current we so construct the magnetic structure that the eddy currents are rendered negligible. To control the period that the valve remains open after it has been opened by energizing the magnetic structure, we control the dissipation of the energy which exists in the magnetic field subsequent to the discontinuing of the electromotive force to the circuit by the interposition of a variable resistance into the circuit. By varying this resistance we change the rate at which the existing energy in the magnetic field is dissipated and therefore vary the time limit which the valve remains open subsequent to the discontinuing of the electromotive force to the circuit.

One form which the invention may assume is exemplified in the following description and illustrated by way of example in the accompanying drawing, in which:

Fig. 1 is a central vertical section through a valve structure embodying the preferred form of our invention.

Fig. 2 is a plan section through the same taken on line V—V of Fig. 1.

Referring more particularly to the accompanying drawing, 10 generally indicates a magnetic valve structure which in this instance is illustrated as an injection valve for engines operating on the Diesel cycle. It is to be understood, however, that the invention can be embodied in valves of any character.

The valve structure here illustrated comprises a cylindrical valve body 11 having a central axial valve chamber 12 formed longitudinally therethrough and terminating at its lower end in a valve seat 14 in a nozzle element 15. This nozzle element 15 is formed with an orifice 16 which is controlled by a valve member 17 reciprocably disposed in the valve chamber 12 of the valve body, and which cooperates with the valve seat 14 in controlling the discharge of fuel through the orifice 16.

The upper end of the valve body 11 is formed with a disk 18 concentric with respect to the valve 17 and the chamber 12. Arranged on the valve body 11 is a cylindrical housing 19 having a flange 20 at its lower end complementary to the disk 18. The housing 19 is secured to the disk 18 through the medium of studs 21.

The upper end of the valve member 17 projects upwardly into the housing 19 and is connected with a laminated armature 22 of the magnetic structure which we provide for operating the valve. The magnet of the magnetic structure is likewise laminated as illustrated. Vertical dowels 33 are provided to prevent relative rotation between the magnet and the armature as illustrated in Figs. 1 and 2.

The magnet is vertically reciprocable in the housing 19 and is interposed between a spring 25 and a cylindrical support 24. The annular wall of the latter slidably engages the inner periphery of the housing 19. The bottom of this cylindrical supporting member 24 is frusto-conical and extends downwardly and abuts against the upper surface of the valve body 11 substantially at the center of the latter. The spring 25 maintains the magnet in engagement with the supporting member. The supporting member and the magnet are therefore movable relative to the housing. The reason for this is that we have found in actual practice that under varying conditions of fuel pressure within the housing, the latter distorts and as it is essential to maintain the magnet and its ar-

mature in definite relation to the valve seat, the permitting of relative movement between the housing and the magnet and its supporting structure compensates for this distortion of the housing and the disk 18 and enables the maintenance of the proper cooperative positions between the valve and the valve seat.

Inasmuch as the center of the valve body remains rigid and is not distorted, abutment of the supporting member 24 at the center of the housing will enable the valve and its magnetic structure to remain stationary during any distortion of the housing 19 and the flange 18 of the valve body.

It will be noticed that the laminated armature 22 is disposed within the cylindrical supporting member 24 and is reciprocable therein, a sliding fit being provided between the inner periphery of the member 24 and the armature so that the former will act substantially as a guide for the latter.

In order to maintain the valve seated when the magnet is de-energized, we provide a spring 26 which is interposed between an adjusting screw 27 threaded in the upper end of the housing and the armature 22. This spring tends to yieldingly maintain the valve seated. The tension of the spring can, of course, be regulated by adjusting the position of the adjusting screw 27 so that the influence of the spring on the valve can be adjusted to suit conditions.

The housing 19 is fitted with a conduit connection 19*a* in order that fuel under pressure may be delivered to the interior of the housing. This fuel is intended to pass through the valve chamber 12 and discharge from the orifice 16 when the valve 17 is opened.

We have found it desirable to filter the fuel delivered to the housing before it passes into the valve chamber 12. In order to accomplish this the upper end of the valve chamber 12 is counterbored and filtering medium is inserted therein. In the present instance we have illustrated this filtering medium as spaced layers of reticulated material between which is a layer of felt or other preferable filtering material. We have found this very advantageous in preventing foreign matter from passing through the valve chamber 12 and clogging the orifice 16.

We have also provided in connection with the present valve a controlling medium for controlling the time the valve remains open after the electromotive force to the circuit of the magnetic structure has been discontinued. This medium comprises a variable resistance 30 interposed in the circuit of the magnetic structure as illustrated in Fig. 1.

It is obvious that when the source of electromotive force to the magnetic structure is discontinued there will exist an amount of stored energy in the magnetic structure influencing the operation of the valve and tending to maintain the same open. This stored energy can be maintained a constant per cycle and it is apparent that by controlling the dissipation of this energy that a control will be exercised over the valve varying the open period of the valve after the source of electromotive force has been discontinued. Through this medium the time the valve is opened can be varied and consequently variation in metering effected.

It is manifest that for any given setting of the resistance 30 the valve will, regardless of engine speed, remain open for a constant period of time per cycle in addition to the period of time it is opened prior to the discontinuing of the electromotive force to the magnet.

By changing the setting of the resistance 30, the rate of dissipation of the stored energy can be varied so as to increase or decrease the time of opening of the valve subsequent to the discontinuing of the electromotive force to the magnet.

We may find it desirable to render the resistance ineffective during the establishment of the current and in order that the resistance illustrated will have no effect on the establishment of the current we have interposed a rectifier between the resistance and the ground. Thus, the resistance will only be effective in dissipating the stored energy in the magnetic field after the electromotive force thereto is discontinued.

In operation of the device, it is constructed and assembled substantially as illustrated and described and if it is in the form of an injection valve as illustrated it is assembled on the cylinder in communication with the combustion chamber and electrically connected with a control circuit for operation. When the voltage is impressed on the valve, magnetic flux increases until the magnetic attraction exceeds the forces tending to seat the valve and the armature will then be influenced so that the valve will be unseated.

Should the housing distort through pressure variations therein, the manner in which the magnetic structure is mounted in the housing will compensate for such distortion and enable the proper relative positions between the magnetic structure, the valve and the valve seat to be maintained so that the valve will operate efficiently under varying conditions.

To adjust the time period which the valve remains open after the electromotive force to the circuit has been discontinued, the variable resistance 30 may be adjusted. This, as previously described, will vary the rate at which the energy stored in the magnetic structure will be dissipated after the discontinuing of the electromotive force to the circuit and consequently vary the length of time which the valve will remain open.

From the foregoing it is obvious that we

have provided an improved magnetic valve structure which will operate efficiently under varying conditions and which will be sensitive to rapid changes in current and wherein the time which the valve remains open subsequent to the discontinuing of the electromotive force to the circuit may be controlled either for metering or throttling purposes.

While we have shown the preferred form of our invention, it is to be understood that various changes may be made in its construction by those skilled in the art without departing from the spirit of the invention as defined in the appended claims.

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

1. In a fuel injection valve including a housing, an electro-magnetic structure mounted within the housing and including a magnet and an armature, supporting means supporting said magnet in the housing and preventing distortion of the housing from changing the relative positions of the magnet and armature.

2. An electro-magnetic fuel injection valve for Diesel engines including a housing, a valve member operatively mounted in the housing and controlling the discharge of fuel therefrom and having an armature mounted thereon, an electro-magnet reciprocably mounted in the housing and operatively associated with the said armature, supporting means for said magnet preventing distortion of the housing from changing the relative positions of the magnet and said armature.

3. An electro-magnetic valve including a housing, a valve member operatively associated with the housing and having an armature thereon, an electro-magnet reciprocably mounted in the housing and operatively associated with the valve armature for operating the valve, means for compensating for distortion of the housing.

4. An electro-magnetic valve including a housing, a magnetic structure including a magnet and armature, a valve reciprocably mounted in the housing and connected with the armature, means for yieldingly maintaining the magnet of the magnetic structure in a definite position relative to the valve seat.

5. A magnetic valve structure including a valve and an electrically influenced medium for operating the same, an electrical circuit for operating said medium, and an adjustable reactance associated with said circuit for controlling the dissipation of energy existing subsequent to the discontinuance of the electromotive force to said circuit.

6. A magnetic valve structure including a valve and an electrically influenced medium for operating the same, an electrical circuit for operating said medium, and an adjustable reactance associated with said circuit for controlling the dissipation of energy existing subsequent to the discontinuance of the electromotive force, and means for rendering said resistance ineffective during the energizing period.

7. A magnetic valve structure including a valve, an electro-magnetic structure for operating a valve, an electrical circuit for energizing and deenergizing said magnetic structure, an adjustable resistance associated with said circuit for controlling the dissipation of energy existing subsequent to the discontinuance of the electromotive force to said circuit, and means for rendering said resistance ineffective during the energizing period.

8. An electro-magnetic valve comprising a fluid tight housing, a magnetic structure including a magnet and armature disposed entirely within the housing, a valve member reciprocably mounted in the housing and connected with the armature, and means for yieldingly maintaining the magnet of the magnetic structure in a definite position relative to the valve seat of the housing.

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