C. P. FREY.

ELECTRO VALVE MECHANISM.

APPLICATION FILED MAY 8, 1920.

1,384,443.

Patented July 12, 1921.

2 SHEETS—SHEET 1.

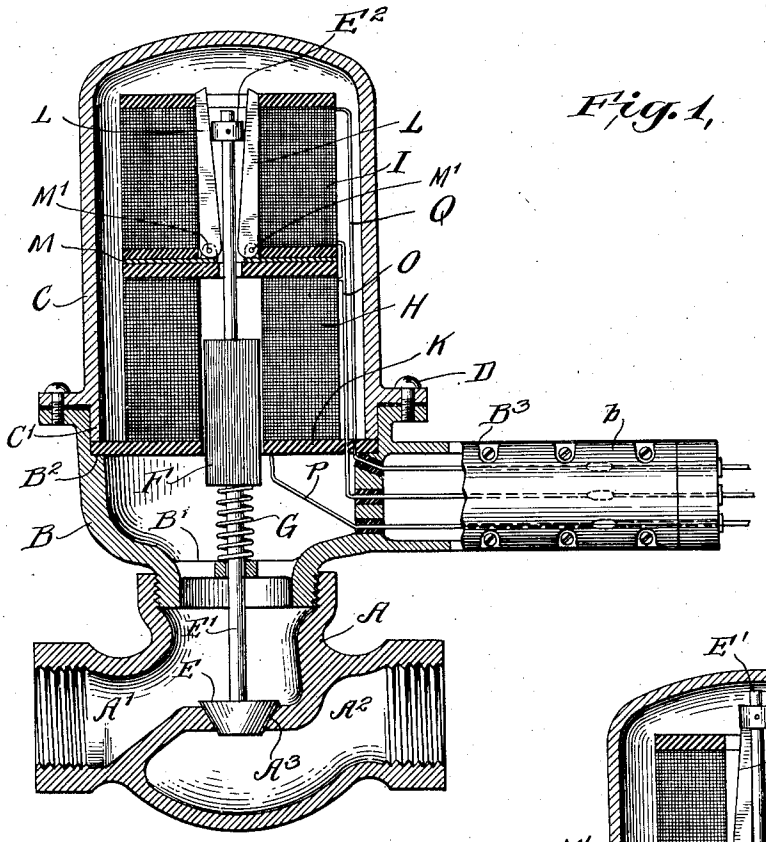

Fig. 1.

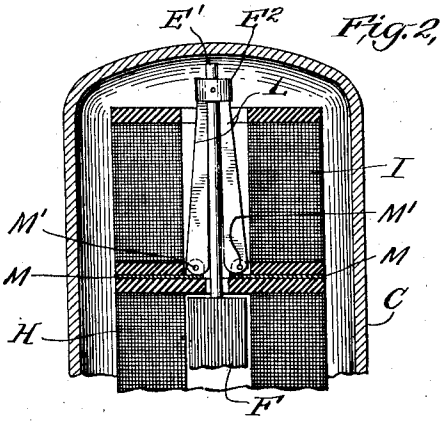

Fig. 2.

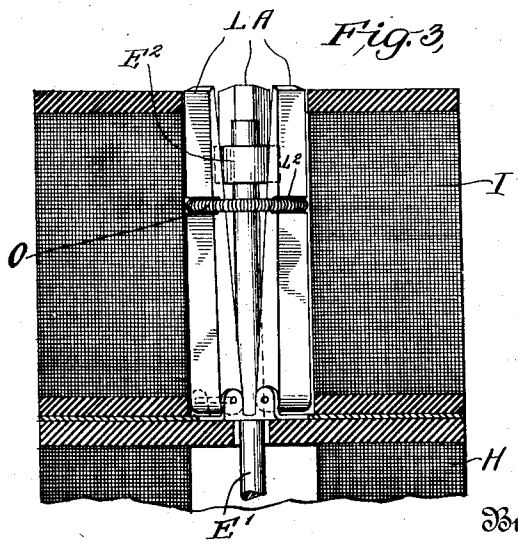

Fig. 3.

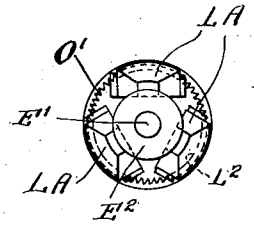

Fig. 4.

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2 SHEETS—SHEET 2.

Fig. 5,

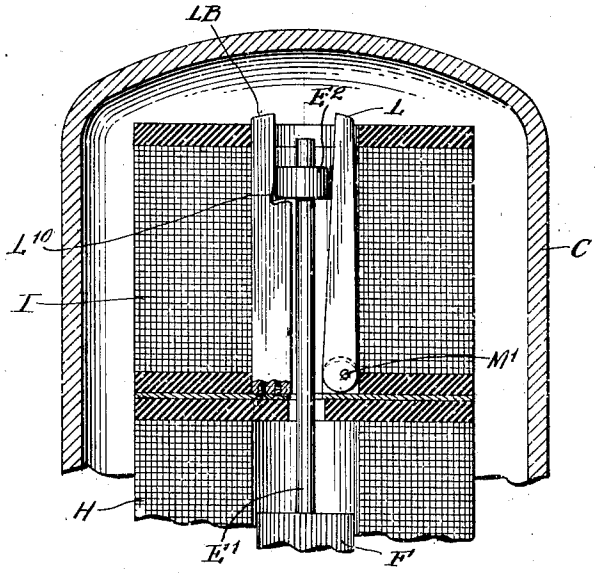


Fig. 6,

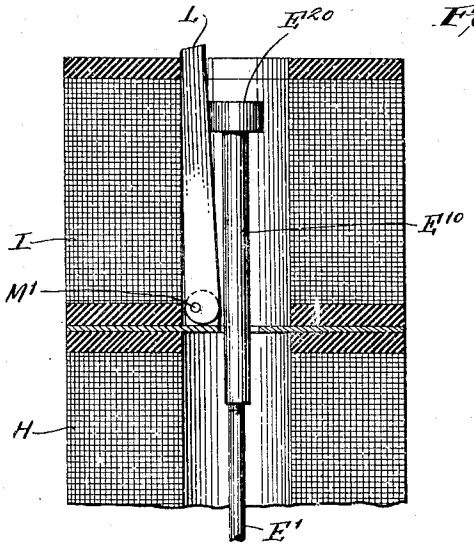
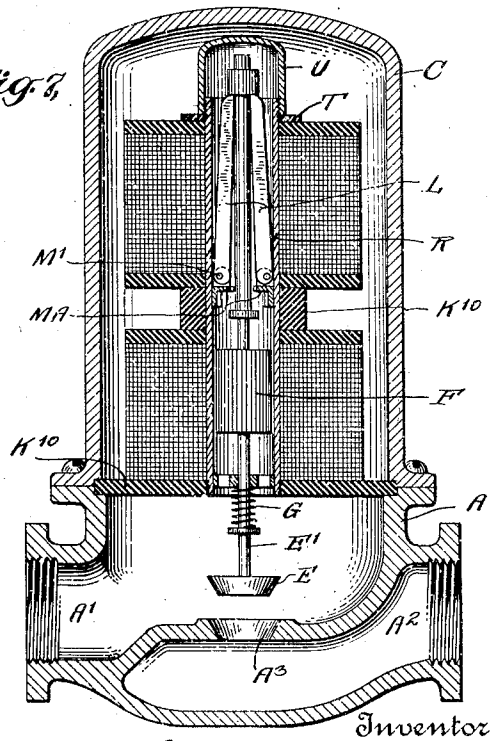


Fig. 7,



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UNITED STATES PATENT OFFICE.

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ELECTRO VALVE MECHANISM.

1,384,443. Specification of Letters Patent. Patented July 12, 1921.

Application filed May 8, 1920. Serial No. 379,709.

To all whom it may concern:

Be it known that I, CHARLES P. FREY, citizen of the United States, and resident of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Electro Valve Mechanism, of which the following is a specification.

My present invention consists in an improved valve mechanism comprising a valve member proper, a lock adapted to engage the valve member and hold it in the open position when the valve member is moved into the open position, and electromagnetic means which may be actuated at will to open the valve if closed, and if open, to release the lock and permit the valve to close. The general object of the invention is to provide a simple and effective mechanism of the character specified having electromagnetic means adapted to be actuated by energizing currents of relatively small magnitude and, therefore, suitable for use as a fuel control valve in a heating or furnace system in which the valve is automatically opened and closed as required to maintain predetermined temperature conditions by an electrical pyrometer or analogous temperature indicator of a sensitive and delicate character.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and the advantages possessed by it reference may be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

Of the drawings:—

Figure 1 is a sectional elevation of one form of valve mechanism;

Fig. 2 is a similarly taken view of a portion of the apparatus with the part shown in different relative positions;

Fig. 3 is a view taken similarly to Fig. 2 showing a slightly modified construction;

Fig. 4 is a plan view of the valve locking mechanism employed in Fig. 3; and

Figs. 5, 6 and 7 are views taken similarly to Fig. 2, each illustrating a different modification.

In the drawings, and referring first to the construction shown in Fig. 1, A represents a valve body of conventional form provided with inlet and outlet chambers A′ and A^2 respectively. A^3 is a valve seated port connecting these chambers. Flow through the port A^3 is controlled by a valve member E, the actuating mechanism for which is located within a chamber formed by a tubular casing part B connected to the valve body A and in open communication with the inlet chamber A′, and a second casing part C which is detachably connected at one end to the casing part B as by means of screws D and is closed at its opposite end. The stem E′ of the valve E projects into the chamber formed by the casing parts B and C and carries an armature F, of soft iron which may be laminated, and above the latter a collar E^2. The armature F projects into the end of a solenoid coil H. A second solenoid coaxial with the coil H is located at the end of the latter remote from the valve seat A^3. As shown the two coils H and I are each in the form of a hollow cylinder and are provided with insulating heads, respectively. In practice the coils H and I will ordinarily be combined in a single mechanical structure, and as shown this structure is anchored in place by clamping the outer edge of the lower head of the coil H, between an annular seat B^2 formed in the inner wall of the casing part B and the end of a cylindrical flange C′ provided for the purpose on the casing part C. Mounted within the coil I are latches L of soft iron, each pivotally supported at its end adjacent the valve seat, the pivotal support being formed, as shown, by pivot pins M′ passing through the ends of the latch members L and through ears formed on an annular metallic member M, clamped between the electromagnet heads H^2 and I′.

As shown the latch members L are of approximately the same length as the coil I and in the closed position of the valve member E, the collar E^2 is between the latch members and holds their free ends apart. When the valve member E is in its open position the collar E^2 is beyond the free ends of the latches L and the latter are free to swing in against the valve stem E′ as shown in Fig. 2.

The valve member E must be loaded, as by a spring or the action of gravity, so that

it will move automatically from its open to its closed position when free to do so. In the particular form of valve mechanism shown, the valve stem E′ is vertically disposed with the valve E at its lower end, and tends to move under its own weight from its open to its closed position. Advantageously the weight of the valve and the pressure acting on the upper side of the valve is partially, but not entirely counterbalanced by a spring G, which surrounds the valve stem E′, and is interposed between the lower end of the armature F and a spider portion B′ of the valve casing part B. With this arrangement, when the coil H is energized the armature F is sucked up into the coil, thus lifting the valve E out of its seat. The energization of the coil H carries the collar E^2 secured to the upper end of the valve stem above the upper ends of the latch members L. The latter, in the form shown in Figs. 1 and 2, are so mounted that when the collar E is moved above their upper ends they are moved by gravity from the position occupied by them in Fig. 1, into the position shown in Fig. 2. When the magnet H is subsequently deënergized, the upper ends of the latches L engage the under side of the collar E^2 and thus lock the valve in its open position. When, thereafter, it is desired to close the valve, the coil I is energized. This similarly magnetizes the latches L, and their free ends being of the same polarity, repel one another, thereby spreading the latches L apart. This releases the collar E^2 and thereby permits the valve E to close.

It is obvious, of course, that instead of having but two latches L, as shown in Fig. 1, three or more latches may be employed as is shown in the modification shown in Figs. 3 and 4 wherein there are three latch members LA symmetrically disposed about the valve stem E′. Instead of relying upon gravity action to move the latch members toward the valve stem other means may be employed. For example, a spring belt O′ may be placed about the latch members which may be notched at L^2 to receive the belt O′, as shown in Figs. 3 and 4.

It is possible also to employ but a single movable latch member. For example, as shown in Fig. 5, a single pivoted latch member L is associated with a stationary soft iron bar LB longitudinally disposed in the coil I at the opposite side of the valve stem E′ from the latch L. As shown the bar LB extends into close proximity to the stem E′ except at its upper portion where it is cut away at L^{10} to clear the collar E^2. A single latch member L may be employed also, as shown in Fig. 6, where the upper portion of the valve stem itself is made of suitable magnetic material. In Fig. 6, the major portion of the valve stem may advantageously be made of brass, but the portion E^{10} located within the coil I is formed of soft iron, as is the collar like portion E^{20} at its upper end. When the coil I of either construction shown in Figs. 5 and 6 is energized, the corresponding latch L and the part LB or E^{10} are similarly magnetized and repel one another, and thus cause the latch L to move out from under the collar E^2 or E^{20}. These forms possess in common with those illustrated in Figs. 1–4, the advantage of a simple construction which may be positively actuated by an electrical energizing current of relatively small magnitude.

By arranging the valve actuating mechanism in a chamber at all times in free communication with one of the two valve chambers A′ and A, as shown in Fig. 1, I avoid the necessity of any stuffing box to prevent leakage along the valve stem and avoid the frictional resistance to the opening and closing movements of the valve offered by such a stuffing box.

Advantageously, as shown, the two coils H and I have one common terminal lead O, and this lead together with the second lead P of the coil H, and the second lead Q of the coil I pass through insulated and fluid tight apertures in the body of the casing part B into a condulet extension B^3 thereof having a removable cover *b*, as shown, and in which these leads may, at the time the valve is installed, be soldered or otherwise properly connected to the controlling circuit conductors extending through the outer end wall of the chamber B^3. The insulation on the windings of the coils H and I, and on the leads should be of suitable character to withstand the action of the fluid passing through the valve.

The armature F is preferably so arranged, as shown, as to insure an effective lifting action when the coil H is energized. Arranged as shown, but a momentary energization of the coil H is required to open the valve, but a prolonged energization or successive energizations of the coil do not interfere with the maintenance of the valve in its open position until the releasing coil I is energized. The coil I may be energized by direct or alternating current since the effect of either is to spread the latches L apart. The tapering of the latches shown is desirable since with the larger lower ends a better magnetic action is had and the lower ends can extend close to the valve stem without interfering with the movements of the latter. In the modification illustrated in Fig. 7 the coils H and I are connected by a tube R axially disposed in the coils and serving as a tie between a base support K^{10} into which the lower end of the tube R is threaded, and a washer T engaging the upper end of the coil I and clamped in place by a cap member V threaded on the upper

end of the tube R. The washer T may advantageously be made of insulating material while the support K^{10} is advantageously a disk of non magnetic metal secured at its periphery to the valve body. The latches L in Fig. 7 are pivoted between ears carried by an annular member MA secured in the tube R. With the arrangement shown in Fig. 7, the valve stem E′ and parts carried by it, work loosely in the tube R and stuffing box friction is avoided as in the construction first described, while the coils H and I are protected from contact with the fluid flowing through the valve.

It will be obvious, of course, that the electromagnetic mechanism disclosed herein may be employed in valve mechanisms otherwise differing greatly in form and intended use from that specifically disclosed herein, and I do not wish the claims hereinafter made to be restricted to the particular form of apparatus disclosed more than is made necessary by their terms and the prior state of the art.

Having now described my invention what I claim as new, and desire to secure by Letters Patent, is:

1. A valve mechanism comprising in combination a reciprocating valve member having a valve closing tendency, means for moving said valve member into its open position, an electromagnet coil, means tending to retain the valve member in its open position comprising a pair of relatively movable parts of magnetic material longitudinally disposed in said coil and tending to move into position in which they hold the valve open when said coil is deënergized, and adapted to be separated by magnetic repulsion when said second coil is energized, and said parts are thereby similarly magnetized.

2. A valve mechanism comprising in combination a reciprocating valve member carrying an armature and having a valve closing tendency, an electromagnet coil adapted when energized to exert a pull on said armature and thereby open the valve, a second electromagnet coil, and means tending to retain the valve member in its open position comprising a pair of relatively movable parts of magnetic material longitudinally disposed in said second coil and tending to move into position in which they hold the valve open when said second coil is deënergized, and adapted to be separated by magnetic repulsion when said second coil is energized and said parts are thereby similarly magnetized.

3. In a valve mechanism, the combination with a reciprocating valve member, of locking mechanism therefor comprising a hollow electromagnet coil and relatively movable locking parts of magnetic material longitudinally disposed within said coil and adapted to move toward one another when the coil is not energized, but being separated from one another by magnetic repulsion when the coil is energized and said parts are thereby magnetized.

4. In a valve mechanism, the combination with a reciprocating valve element, of an electromagnetic coil surrounding said element, latch members of magnetic material longitudinally disposed within said coil and tending to move toward one another into engagement with said member when said coil is not energized and being magnetized and separated from one another by magnetic repulsion when the coil is energized.

5. A valve mechanism comprising in combination a reciprocating valve member having a valve closing tendency and provided with a valve stem, a pair of electromagnet coils placed end to end and surrounding said valve stem, an armature carried by said valve stem in coöperative relation with one of said coils whereby, when the latter is energized, the valve member will be moved into an open position, means for releasably latching the valve member in its open position comprising relatively movable members of magnetic material longitudinally disposed in the other coil and adapted to move into position in which the valve member is held in its open position when said second coil is deënergized but being separated from one another by magnetic repulsion to permit the valve to close when said second coil is energized and said parts are thereby similarly magnetized.

6. A valve mechanism comprising in combination a reciprocating valve member having valve closing tendency and provided with a valve stem, a pair of electromagnet coils placed end to end and surrounding said valve stem, an armature carried by said valve stem in coöperative relation with one of said coils whereby, when the latter is energized, the valve member will be moved into an open position, latch members of magnetic material longitudinally disposed in the other coil and adapted to move into position in which they engage said stem and hold the valve member in its open position when said second coil is deënergized but being separated from one another by magnetic repulsion to permit said valve member to close when said second coil is energized and said parts are thereby similarly magnetized.

7. A valve mechanism comprising in combination a reciprocating valve member having a valve closing tendency and provided with a valve stem, a pair of electromagnet coils placed end to end and surrounding said valve stem, an armature carried by said stem in coöperative relation with one of said coils whereby, when the latter is energized, the valve member will be moved into an open position, means for releasably latching the valve member in its open position compris-

ing a latch member located within said second coil and tending to move into the position in which it engages the valve stem and holds the valve open when said second coil is deënergized, but moved by the energization of said second coil into position to permit the valve member to close.

8. An electromagnetic valve mechanism comprising in combination a valve casing having inlet and outlet chambers connected by a valve seated port and a reciprocating valve member controlling and tending to close said port and provided with a valve stem, a pair of electromagnet coils placed end to end and surrounding but not filled by said valve stem, an armature carried by said stem in coöperative relation with one of said coils whereby, when the latter is energized, the valve member will be moved into an open position, means for releasably latching the valve member in its open position comprising a latch member located within said second coil and tending to move into the position in which it engages the valve stem and holds the valve open when said second coil is deënergized but actuated by the energization of said second coil to permit the valve member to close the parts being so relatively arranged that the interiors of said coils are in free communication with one of said chambers.

Signed at Philadelphia, in the county of Philadelphia and State of Pennsylvania, this fourth day of May, A. D. 1920.

CHARLES P. FREY.