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ELECTROMAGNETIC VALVE

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FIG. 1

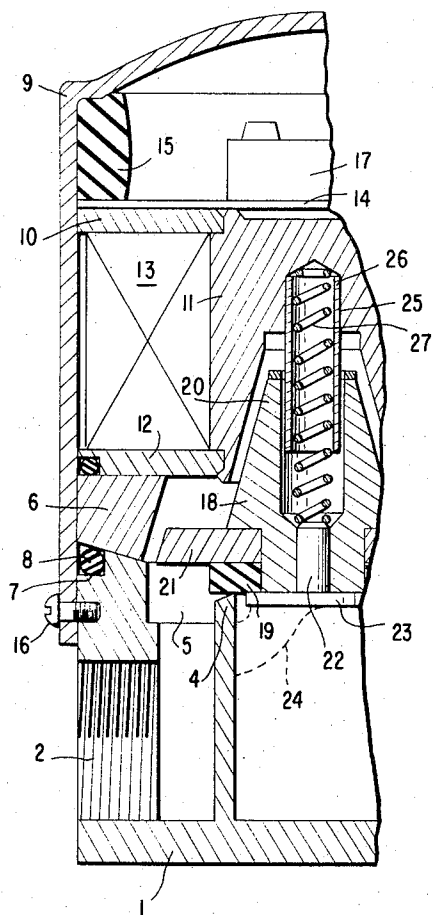
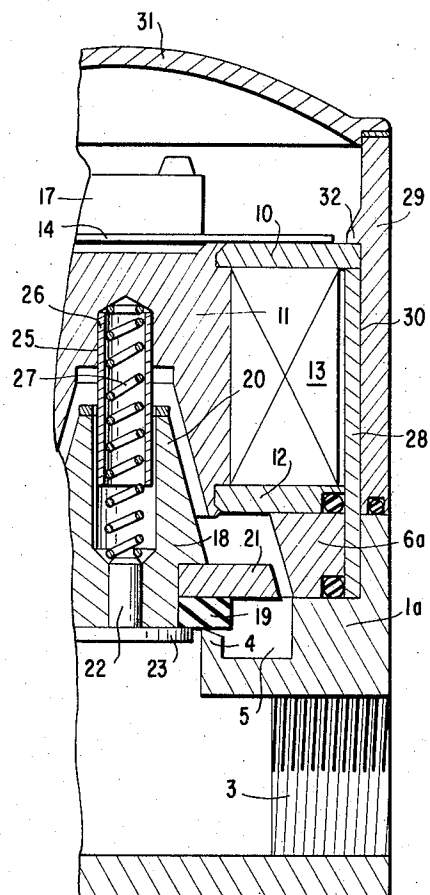


FIG. 2



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ELECTROMAGNETIC VALVE

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The present invention relates to an electromagnetically operated valve which is provided with a fixed pot-shaped magnetic element, the central and outer wall parts of which form magnetic poles, and with a movable armature of an inverted T-shaped cross section, the central arm of which projects into the pot-shaped element.

It is an object of the present invention to provide a magnetic valve of the above-mentioned type which may be produced very easily and at a low cost and is very reliable in operation. Another object of the invention is to provide such a magnetic valve which may be employed especially as a gas valve and is equally reliable for controlling a flow of gas under a low pressure and under relatively high pressures.

These objects are attained according to the invention by providing at least two air gaps within the magnetic circuit and by providing the two magnetic pole surfaces of the armature underneath the pole surfaces of the fixed element of the magnet, as seen in the actuation of the valve, so that when the armature is pulled up, the distance between both air gaps is reduced and the magnetic force attracting the armature is therefore considerably increased.

The present invention further provides that the opposite pole surfaces of the magnet are made of a conical shape. This has the advantage that, when the armature is pulled up, the width of the air gaps is reduced and the armature will thereby also be accurately centered within the fixed element of the magnet.

The central arm of the T-shaped armature may also be made of a short length and the central magnetic pole of the fixed magnetic element may be downwardly extended. In an extreme case it is also possible to provide the armature merely in the form of a flat disk and to make the fixed magnet of a double U-shaped cross section. In such a case, it is, however, necessary to provide additional centering means for insuring that the movement of the armature will occur centrally to the fixed element of the magnet.

Another feature of the invention which is contained in a very preferred embodiment thereof consists in providing the core of the fixed magnetic element with a central conical recess into which the central arm of the armature projects which forms a frustum. The rim of the fixed magnetic element may project inwardly and form a magnetic shunt ring, and the conical pole surface which is provided on this rim or ring may be made of a considerably greater width than the associated opposite pole surface which is provided on the armature disk from which the frustum projects.

The outer wall of the fixed pot-shaped element of the magnet may be formed by the magnet housing. Such a magnet may be very easily assembled by placing the inwardly projecting rim of the fixed element of the magnet directly upon the valve body, by holding the different parts of the fixed element together by means of a compressed elastic ring, and by then securing the magnet housing to the valve body, for example, by screws.

If the electromagnetic valve according to the invention should be noncorrosive at the outside, the outer wall of the fixed pot-shaped element of the magnet may be provided in the form of a tubular casing, the lower end of

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which is inserted into a cylindrical recess in the upper end of the valve body so as to be accurately centered, while the upper part of this casing is enclosed by a housing of noncorrosive material. The housing may also be provided with an inner flange or projection for holding the different parts of the fixed element of the magnet together.

The various features and advantages of the present invention will become more clearly apparent from the following detailed description thereof which is to be read with reference to the accompanying drawing in which:

FIGURE 1 shows one half of a valve according to the invention which is provided within a housing which is not fully noncorrosive; while

FIGURE 2 shows one half of a valve according to the invention which is mounted within a housing which consists of a noncorrosive and nonmagnetic material.

The electromagnetic valve according to the invention as illustrated in FIGURE 1 comprises a valve body 1 which is preferably made of aluminum and has a valve inlet 2 and a valve outlet 3 which, when the valve is open, communicate with each other through the opening of the valve seat 4. This valve seat 4 is surrounded by an inlet chamber 5 which may, for example, be cut into the valve body 1 from the upper side. The valve body 1 carries the lower magnetic shunt ring 6, the lower conical surface of which engages upon the corresponding upper conical surface of the valve body and is thus properly centered relative thereto. An outer annular groove 7 around the upper conical surface of the valve body contains a sealing ring 8. The fixed element of the magnet consists of the lower magnetic shunt ring 6, the magnet housing 9, the upper magnetic shunt ring 10, and the magnet core 11 and has a pot-shaped form with an inwardly projecting rim. This fixed element of the magnet is energized by an annular coil 13 which rests on a brass ring 12 and may, if properly insulated, be mounted directly on the magnet core 11.

The upper shunt ring 10 carries an insulating disk 14 which is separated from the upper wall or cover of the magnet housing by a ring 15 of elastic material. When the magnet housing 9 is screwed together with the valve body 1 by means of several screws 16 which are peripherally spaced from each other, the elastic ring 15 will be compressed, whereby the fixed parts of the magnet will be firmly held together and the magnet housing will be tightly closed toward the outside. The insulating disk 14 supports a coil terminal 17 from which the electric connecting cable leads to the outside through an airtight cable inlet, not shown. In order to prevent any humming of the valve which could easily occur if it is operated with alternating current, the valve according to the invention is preferably operated with direct current.

The armature 18 of the magnet has substantially an inverted T-shape and serves as the support of the valve ring 19 which consists of a well-sealing elastic material. Armature 18 consists of the central bar 20 of the inverted T which has the shape of a frustum, of an armature disk 21 which forms the cross bar of the inverted T and has a conical outer edge, and of a bolt 22 with a flat head 23 which secures the valve ring 19 to the armature. The pole surface on the shunt ring 6 has a considerably greater width than the opposite pole surface on the armature disk 21. The bolt head 23 may also be provided with at least one slidable guide number 24 for maintaining the armature in the proper position in the event that the pull of the magnet is too eccentric.

The magnet core 11 is provided with a conical recess of a shape in accordance with that of the frustum 20, and the bottom of this conical recess has a cylindrical blind hole 25 into which one end of a brass bushing 26 is pressed. The outer part of bushing 26 serves as a guide for the armature 18, and at the inside this bushing contains a return spring 27 which acts at one end upon the

bottom of a blind hole in the frustum 20 and at the other end upon the magnet core 11 so that, when the magnet is not energized, the armature 18 together with its valve ring 19 will be pressed firmly upon the valve seat 4 and the latter will thus always be closed tightly.

The magnetic circuit which is formed by the fixed magnet parts 11, 10, 9, and 6 and the armature parts 21 and 20 is interrupted by air gaps between the parts 20 and 11 and the parts 6 and 21. The particular design and construction of the parts of the magnetic circuit as provided in accordance with the invention is intended for the purpose of reducing the width of the two air gaps when the armature is pulled up and of thus considerably increasing the power of the magnetic valve. The new magnetic valve will therefore operate properly even though the flow of the fluid to be controlled has a relatively high pressure.

The electromagnetic valve according to the modification of the invention as illustrated in FIGURE 2 differs from the valve according to FIGURE 1 primarily by the fact that in place of a magnet housing 9, as shown in FIGURE 1, it is provided with a magnetic tubular casing 28 which is enclosed by a housing 29 of a noncorrosive material, for example, aluminum. Although the magnet housing 9 according to FIGURE 1 could also be made of noncorrosive magnetic steel, such a structure would be much more expensive than that as illustrated in FIGURE 2.

The lower magnetic shunt ring 6a according to FIGURE 2 is mounted together with the lower end of the inner casing 28 in a cylindrical recess 30 in the upper end of the valve body 1a. This has the advantage that these parts are properly centered in a very simple manner relative to the magnet core and the armature. Housing 29 is closed at its upper end by a cover 31 which may likewise consist of aluminum. The different parts of this structure are held together in the proper relation to each other by an inner flange 32 on the housing 29 and are secured to each other by means of screws, not shown.

The fixed parts 11, 10, 28, and 6a of the magnet according to FIGURE 2 may also be integrally connected to each other and be made in the form of a single pressed piece of magnetizable material, and the coil which is separately made may then be slipped over the magnet core 11.

Although my invention has been illustrated and described with reference to the preferred embodiment thereof, I wish to have it understood that it is in no way limited to the details of such embodiment but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed my invention, what I claim is:

1. An electromagnetic valve comprising a fixed substantially pot-shaped magnetizable element, a field coil for energizing said element, and a movable armature of a substantially T-shaped cross section having a disk-shaped member and a central member projecting from said disk-shaped member and movable into the open side of said pot-shaped element when said fixed element is energized, the outer surfaces of said central and disk-shaped members together forming pole surfaces of one magnetic pole, and the central part and the rim of said fixed element together forming pole surfaces of the other magnetic pole, each of said pole surfaces being conically-shaped and disposed in an opposed, substantially parallel relationship with a pole surface of the opposite pole, said conically-shaped opposed pole surfaces defining therebetween at least two air gaps, whereby the size of said air

gaps will be reduced when said fixed element is energized and said armature is attracted thereby.

2. An electromagnetic valve as defined in claim 1, wherein one of said air gaps is offset with respect to the other of said air gaps at right angles to the direction of movement of said armature.

3. An electromagnetic valve as defined in claim 1, in which the central member of said armature has a short length, said central part of said fixed element projecting downwardly and forming a magnetic pole.

4. An electromagnetic valve as defined in claim 1, in which said fixed magnetizable element has a central magnet core projecting from its bottom, said magnet core having a conical recess, said central member of said armature having a frustum shape and normally projecting centrally into said conical recess but spaced from the surface thereof by one of said air gaps.

5. An electromagnetic valve as defined in claim 1, in which the rim of said fixed pot-shaped element projects inwardly and forms a magnetic shunt ring, the inner annular surface of said shunt ring and the outer peripheral surface of said disk-shaped member being coaxial and having a substantially corresponding conical shape and forming two of said pole surfaces spaced from each other by one of said air gaps, the pole surface of said shunt ring having a considerably greater width than the pole surface of said disk-shaped member.

6. An electromagnetic valve as defined in claim 1, in which the outer peripheral wall of said fixed element forms a part of the magnet housing.

7. An electromagnetic valve as defined in claim 5, further comprising a valve body having an inlet and an outlet, a valve seat within said valve body intermediate said inlet and outlet, a valve ring mounted on said disk-shaped member for opening and closing said valve seat, said shunt ring engaging upon said valve body, the outer peripheral wall of said fixed element forming a part of the magnet housing, a compressed resilient ring within said housing for holding the different parts of said fixed element together, and means for securing said magnet housing to said valve body.

8. An electromagnetic valve as defined in claim 5, further comprising a valve body having an inlet and an outlet, a valve seat within said valve body intermediate said inlet and outlet, a valve ring mounted on said disk-shaped member for opening and closing said valve seat, said shunt ring engaging upon said valve body, said valve body having a cylindrical recess in its upper side, the outer peripheral wall of said pot-shaped element forming a tubular member having one end mounted in said recess, and a housing of a noncorrosive material surrounding the remainder of said tubular member, and means for securing said housing to said valve body.

9. An electromagnetic valve as defined in claim 8, further comprising a flangelike projection on the inner wall of said housing for holding the different parts of said fixed element together.

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