

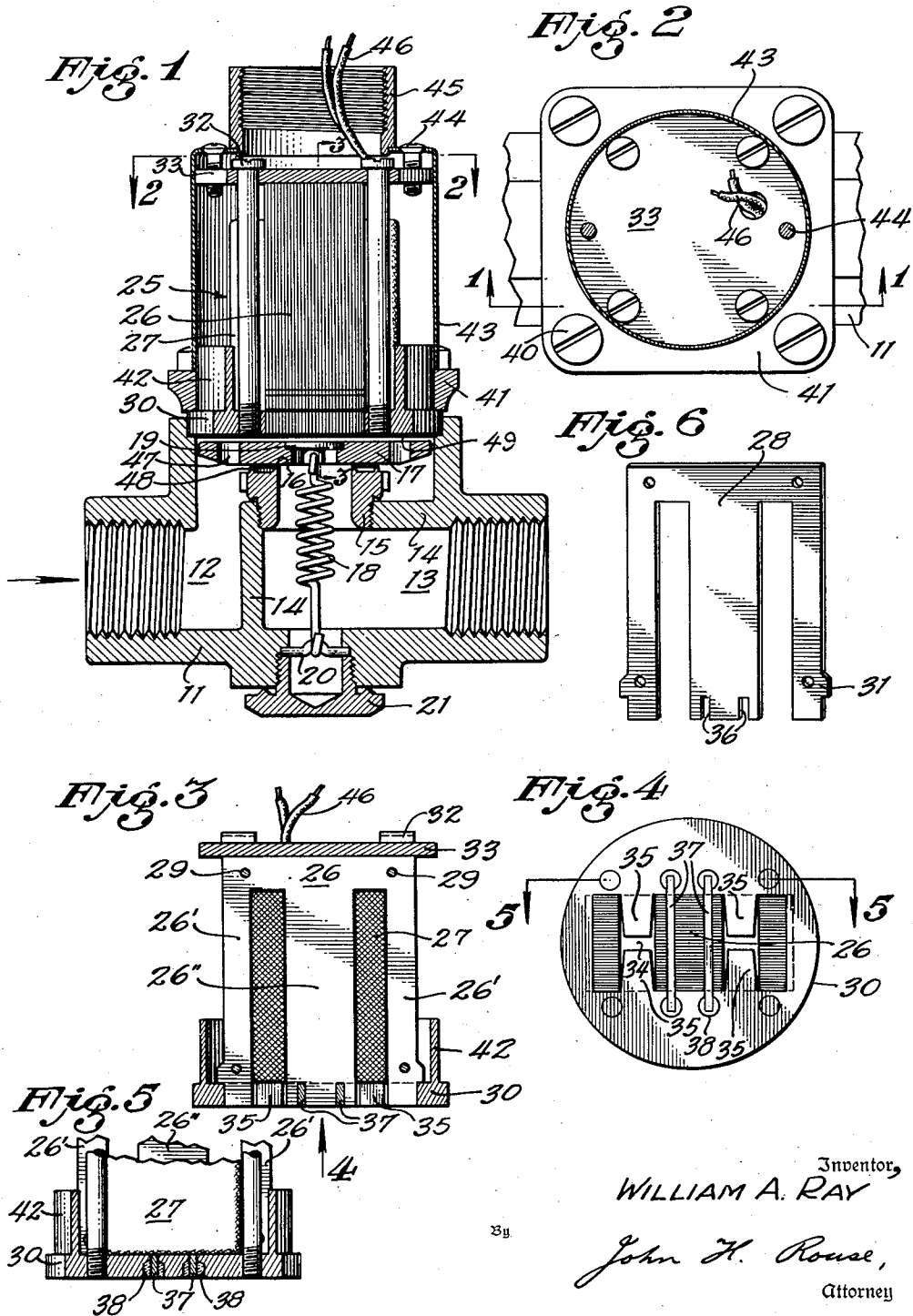
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ELECTROMAGNETICALLY OPERATED VALVE

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ELECTROMAGNETICALLY OPERATED
VALVE

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5 Claims. (Cl. 175-338)

My present invention relates to electromagnetically-operated fluid-control valves, and particularly to those of the type employing a disk-like closure member which is constructed wholly or in part of magnetic material so that it also serves as the movable element, or armature, of the electromagnetic system. It is a main object of this invention to provide an electromagnetically operated valve, of the type indicated, which is particularly adapted for use on alternating current.

Another object of this invention is the provision, in a valve of the type indicated, of an A. C. electromagnetic operator adapted to be mounted on the valve casing so that it presents plane polar faces to the armature; a further provision being the arrangement of a screen, or diaphragm, abutting the pole faces, whereby the electromagnet is shielded from the fluid controlled by the valve.

Another object is the provision, in an electromagnetically operated valve of the character described in the preceding object, of an electromagnet having a generally E-shaped core, the ends of the arms of which form the pole faces of the electromagnet; and of means for removably mounting said core on the casing so that the coil therefor (which encircles the middle arm of the E-shaped core) can readily be changed or replaced.

Another object is the provision of a diaphragm, of the type referred to in the second-preceding paragraph, which is constructed of normally non-magnetic metal, a portion of the diaphragm adjacent a pole face of the magnet being selectively heat-treated so that that portion is rendered substantially magnetic.

Another object is the provision of an electromagnet, especially adapted for the operation of a valve of the character described, in which a novel shading coil arrangement is incorporated.

Other objects and advantages of the invention will be found in the description, the drawing, and the appended claims; and for complete understanding of the invention reference may be had to the following detailed description and accompanying drawing, wherein,

Figure 1 is a sectional view of an electromagnetically operated valve embodying my invention, the main upper portion of the device being viewed generally along the line 1-1 of Fig. 2;

Figure 2 is a fragmentary transverse section taken along the line 2-2 of Fig. 1;

Figure 3 is a section through the electromag-

netic unit 25 of the device shown in Fig. 1, taken generally along the line 3-3 of Fig. 1;

Figure 4 is a bottom elevation of the electromagnetic unit shown in Fig. 3;

5 Figure 5 is a fragmentary section of the electromagnetic unit taken along the line 5-5 of Fig. 4; and

Figure 6 is a view, in perspective, of a single lamination of the electromagnet core 26.

10 In the drawing, the numeral 11 indicates a casing having an inlet 12 and an outlet 13 separated by a partition 14. This partition is apertured to threadedly receive a hollow member 15 which provides at its upper end an annular knife-edged valve seat 16. Cooperable with the seat 16 is a thin disk-shaped closure member 17, of magnetic material, which is normally held in tight engagement with the seat by the force of a contractile spring 18. The upper end of this spring is attached to the reduced lower end of a plug 19 pressed in a shouldered central opening through the closure member 17, and the lower end of the spring is hooked to a pin 20 received in an opening through the bottom wall of the casing 11 and held in engagement with a shoulder, formed by the reduced upper end of that opening, by a hollow plug 21.

25 The closure member 17 is freely guided at its periphery in an opening through the top wall of the casing; and mounted on a shoulder formed by an outer enlargement of that opening is an electromagnet, generally indicated at 25, comprising a laminated core 26 and an energizing coil 27. Since the closure member 17 is of magnetic material, it also serves as the electromagnet armature. The electromagnet is better seen in Figs. 3, 4 and 5, the core 26 being shown built up of a plurality of E-shaped laminations 28, a single example of which is shown in Fig. 6, and held together by the usual rivets 29. For mounting the core, a base, or mounting plate, 30 is provided, the base being of non-magnetic material, such as brass, and apertured to receive the end portions of the core arms. The outer arms 30 of the core laminations are provided toward their lower ends with projecting lugs 31 which engage the upper surface of the base 30 and thus limit the extension of the core therethrough, the bottom surfaces of the core arms terminating in the plane of the underside of the base. The coil 27 encircles the middle arm 26' of the core 26, and the core and coil assembly is secured to the base 30 by a plurality of elongated screws 32 which extend through a plate 33, on the top of the core, and are threaded into the base. By this

arrangement, it will be seen that the coil 27 can readily be replaced when burnt out, or changed for one adapted for use on a different voltage. The material of the base 30 between the middle and outer arms of the core is cut away at 34 so as to break the otherwise short-circuiting turn formed around these arms by the base. The unremoved portions 35 of the base, between the middle and outer arms of the core, are tapered away from the arms to prevent the possibility of induced currents flowing in the material of the base around the arms and "jumping" the gap 34 by conduction through the central laminations of the core. The extreme lower end portion of the middle arm 26'' is provided with a pair of slots 36 to receive copper bars 37 which extend across the opening provided in the base for that arm. These bars have a depth equal to the thickness of the base and are secured at their ends by brazing; shallow openings 38 in the bottom surface of the base facilitating this operation. The bars 37, together with the material of the base between the ends of the bars, constitute a shading coil encircling the portion of the middle arm of the core between the bars. This shading coil serves to maintain the magnetic flux in that portion when the main flux in the electromagnetic circuit is zero, which contributes to vibrationless operation.

As was mentioned hereinabove, the electromagnet 25 is mounted in an opening through the top wall of the valve casing, the marginal portion of the base 30 resting on a shoulder formed by an outer enlargement of that opening. The electromagnet is securely held in position by screws extending through a ring 41 and threaded in the casing, the underside of the ring cooperating with the upper marginal portion of the base. Extending from the upper surface of the base near its outer edge, is a skirt 42 which serves to position the lower end of a housing 43 which encompasses the upper portion of the electromagnet and is secured thereto by screws 44, threaded into the top plate 33. The housing 43 carries at its upper end a threaded nipple 45 for connection to a wiring conduit and through which the coil leads 46 extend.

Interposed between the underside of the base 30 and the valve casing, is a thin metallic diaphragm 49 which serves both to protect the electromagnet from the fluid controlled by the valve and also as a magnetic "separator." This diaphragm, which is preferably not more than 0.005 inch in thickness, may be of non-magnetic metal such as bronze. Such a diaphragm effectively prevents the possibility of magnetic sticking (due to residual magnetism) of the armature 17 to the core when the electromagnet is deenergized. However, under some conditions I prefer to employ for the construction of the diaphragm 49 a metal which, while normally non-magnetic, can be selectively heat-treated so that the particular portions so treated become magnetic. A suitable material for that purpose is the variety of stainless steel known as "18-8," and containing 18% of chromium and 8% of nickel. When a diaphragm of such material is employed, it is preferred to treat only the central portion thereof which abuts the middle arm of the core so that that portion becomes appreciably magnetic. The shaded portion of the middle arm then becomes more effective in its influence upon the armature, which tends toward more uniform holding of the same.

So as to prevent a dash-pot effect when the armature-closure-member 17 is attracted upon

energization of the electromagnet, a plurality of openings 47 are provided toward its periphery. Extending from the upper surface of the valve port member 15, concentrically of its seat 16, is a "guard-ring" 48 which, being positioned slightly below but closely adjacent the plane of the seat 16, serves to minimize uneven wear of that seat by limiting the degree of tilt that the closure member can assume in its engagement therewith. This feature is fully described and claimed in my copending application, Serial No. 418,707, filed November 12, 1941.

While I have herein shown and described, by way of illustration, a specific embodiment of my invention, I wish it to be understood that modifications may be made without departing from the spirit of the invention, and that I intend therefore to be limited only by the scope of the appended claims.

I claim as my invention:

1. In an electromagnetic operator: an E-shaped core, the surfaces at the ends of the arms of which form spaced-apart pole faces located in a plane; a mounting plate for said core and constructed of non-magnetic material, said plate having apertures therein for receiving the outer end portions of said core arms; a coil winding encircling the inner portion of the middle arm of said core and retained in position by said plate; said plate including means forming a shading coil encircling a portion of the cross-sectional area of the middle arm of the core and cooperating with a slot formed in the end surface thereof; and a disk-like armature positioned closely adjacent the outer surface of said plate and in a plane parallel to that of said pole faces for attraction theretoward when said coil winding is energized.

2. In an electromagnetic operator: an E-shaped core, the surfaces at the ends of the arms of which form spaced-apart pole faces located in a plane; a mounting plate for said core and constructed of non-magnetic material, said plate having plane parallel opposite surfaces and apertures extending between said surfaces for receiving the outer end portions of said core arms; means integral with said core and forming surfaces engageable with the inner surface of said plate for so limiting the projection through said apertures of the arms of the core that the plane of said pole faces substantially coincides with the plane of the outer surface of the plate; a coil winding encircling the inner portion of the middle arm of said core and retained in position by said plate; and a disk-like armature positioned closely adjacent and parallel to said outer surface of the plate for attraction toward said pole faces when said coil winding is energized.

3. In an electromagnetic operator: an E-shaped core, the surfaces at the ends of the arms of which form spaced-apart pole faces located in a plane; a mounting plate for said core and constructed of non-magnetic material, said plate having plane parallel opposite surfaces and apertures extending between said surfaces for receiving the outer end portions of said core arms; means so limiting the projection through said apertures of the arms of the core that the plane of said pole faces coincides substantially with the plane of the outer surface of the plate; said plate including means forming a shading coil encircling a medial portion of the middle arm of the core and cooperating with slots formed in the end surface thereof; a coil winding encircling the inner portion of the middle arm of the core and retained in position by said plate; and a disk-like armature positioned

closely adjacent and parallel to said outer surface of the plate for attraction toward said pole faces when said coil winding is energized.

4. In an electromagnetic operator: an E-shaped core, the surfaces at the ends of the arms of which form spaced-apart pole faces located in a plane; a mounting plate for said core and constructed of non-magnetic material, said plate having plane parallel opposite surfaces and apertures extending between said surfaces for receiving the outer end portions of said core arms; means so limiting the projection through said apertures of the arms of the core that the plane of said pole faces coincides with the plane of the outer surface of the plate; a flat diaphragm of normally non-magnetic material secured to the outer surface of the plate and covering said apertures, the portions of said diaphragm abutting said pole faces being selectively treated so as to render them substantially magnetic; a coil winding encircling the inner portion of the middle arm of the core and

retained thereon by said plate; and a disk-like armature positioned closely adjacent and parallel to said diaphragm for attraction toward said pole faces when said coil winding is energized.

5. In an electromagnetic operator: an E-shaped core, the surfaces at the ends of the arms of which form spaced-apart pole faces substantially in a plane; a mounting plate for said core and constructed of non-magnetic material, said plate having apertures therein for receiving the outer end portions of said core arms; a coil winding encircling the inner portion of the middle arm of said core and retained in position by said plate; said plate including, and forming part of, means forming a shading coil encircling a portion of the cross-sectional area of at least one of the core arms and cooperating with a slot formed in the end surface thereof; and an armature positioned adjacent said pole faces for attraction thereto-ward when said coil winding is energized.

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