Dec. 13, 1927

D. D. MILLER

1,652,491

ELECTROMAGNETIC RELAY

Filed March 31, 1926

Fig. 1.

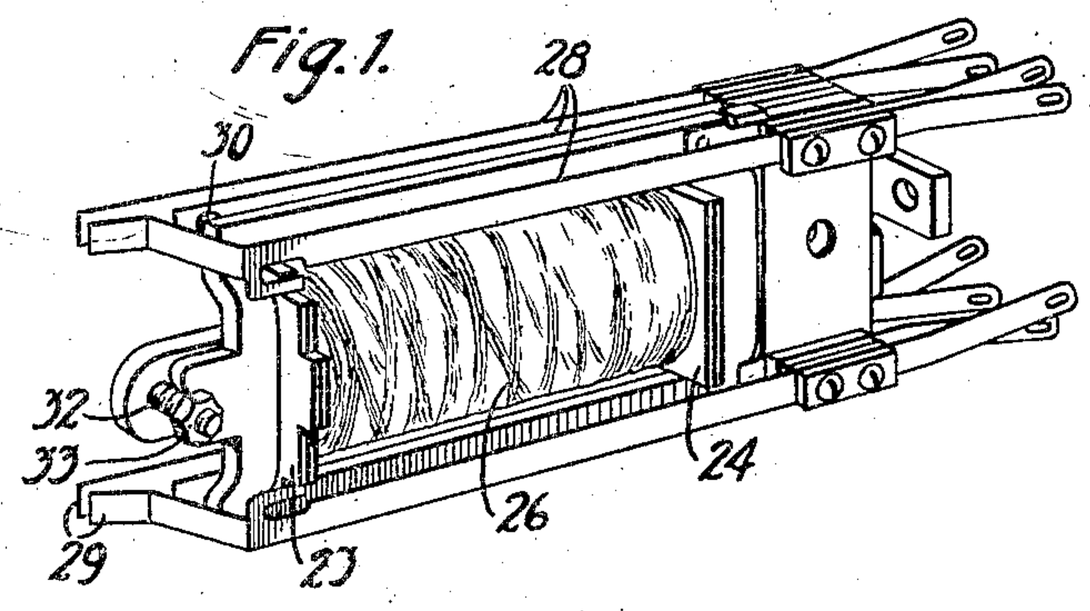


Fig. 2.

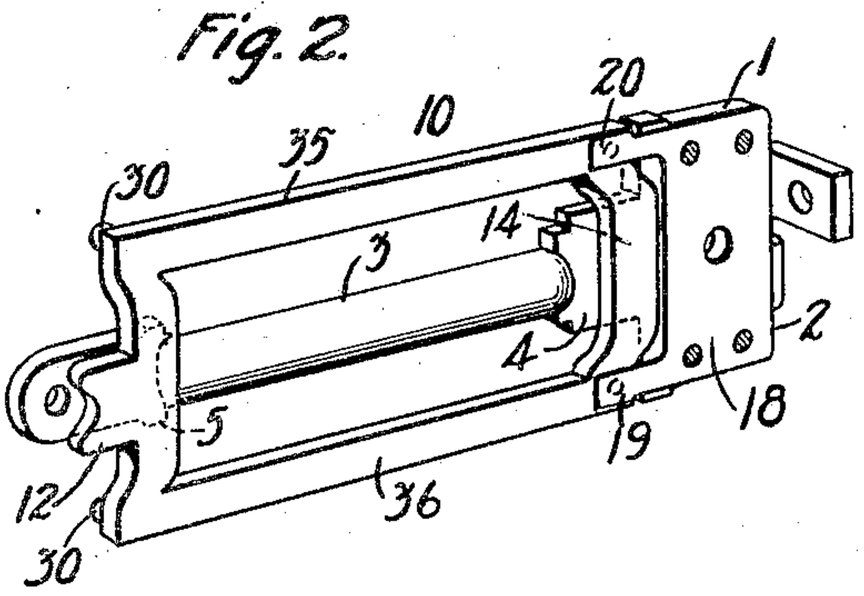


Fig. 3.

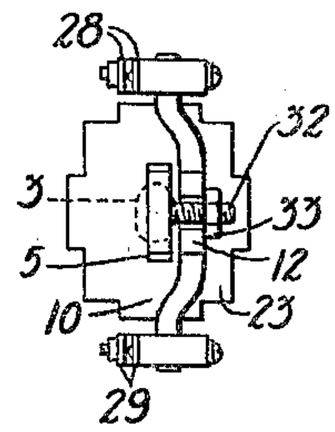
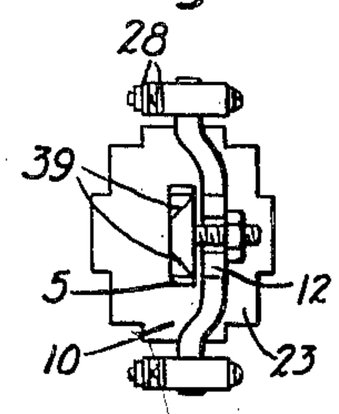


Fig. 4.



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by J. E. Roberts Atty.

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UNITED STATES PATENT OFFICE.

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ELECTROMAGNETIC RELAY.

Application filed March 31, 1926. Serial No. 98,652.

This invention relates to electromagnetic relays, and more particularly to improvements in the construction of so called flat-type relays.

The construction of flat-type relays is in general along the lines of the relay disclosed in Patent No. 1,121,897, issued December 22, 1914 to E. B. Craft. The Craft relay is provided with a core of a flat substantially T-shaped piece of magnetic material, on the long shank of which the magnetizing coil is wound. The shorter shanks of this core serve as supports for a U-shaped armature of magnetic material, the backwardly extending arms of which are secured to these shanks by means of a highly flexible spring, while the yoke portion of this U-shaped armature is adapted to extend over the free end of the long shank of the core. In this manner the armature and the shorter shanks of the core serve as return paths for the magnetic flux through the core portion.

It is an object of this invention to improve the electrical operating characteristics of relays of this general type by a construction tending to decrease the magnetic reluctance and the magnetic leakage at the portions of the armature and core where they cooperate magnetically. That is, it is an object of this invention to provide a mechanical structure whereby the reluctance of the path for the magnetic lines of force through the armature and core and the intervening air gap is greatly reduced and whereby the leakage incidental to the passage of these magnetic lines of force from one part to another is also reduced.

To attain this and other objects of the invention there is provided in accordance with one feature thereof in place of the usual U-shaped armature for flat type relays, an armature having a rectangular shape of such comparative areas and cross sections across the portions where the armature cooperates magnetically with the core that the magnetic reluctance is materially reduced and yet the standard commercial shape of the relay is maintained.

Another feature is the provision of a construction in accordance with this invention of flat type relays whereby the portion of the air gap between the core and armature, at the points nearest to the portions of the core and armature that it is intended should cooperate magnetically, and that are of necessity ineffective during the operation of the relay due to relative position of the core to the armature in flat type relays, is so constructed that the amount of leakage across this air gap is reduced.

Referring now to the drawing: Fig. 1 illustrates in perspective a complete flat type relay embodying this invention; Fig. 2 illustrates in perspective the shape, relative size and relation of the armature and core of the relay shown in Fig. 1 and constructed in accordance with this invention; Fig. 3 is a front view of the relay shown in Figs. 1 and 2 illustrating the relative shape and size of the magnetically operating position of the core and armature while Fig. 4 is a front view of a similar relay showing how the magnetically cooperating portions of the core and armature may be modified in regard to their shape.

In the drawing the core piece 1 is shown as a substantially T-shaped punching of magnetic material comprising a cross piece 2, a shank 3, of a circular axial or other suitable cross section, and flat enlarged ends or pole pieces 4 and 5. The armature 10 is a rectangularly shaped flat punching of magnetic material having an enlarged pole piece 12 cooperating with the pole piece 5 and at its opposite end, a correspondingly enlarged cross piece 14 cooperating with pole piece 4. The cross piece 2 serves as a mounting plate for the various piles of contact springs 28 and 29 to be controlled by the armature 10 and for mounting the relay itself to suitable supports. The armature 10 is also secured to the cross piece 2 by means of a resilient sheet steel plate 18 riveted to cross piece 2 and having projections 19 and 20 riveted to the armature and acting as a hinge between the armature and the core. The spool heads 23 and 24 are mounted on the enlarged portions 5 and 4, respectively, and the winding 26 is carried on the core portion 3 between these two spool heads. The two piles of contact springs 28 and 29 are mounted as shown on opposite sides of the coil 26 and are arranged to be controlled and operated by the movements of the armature through the medium of insulating studs, such as 30. The adjustment of the air gap between the pole piece 12 of the armature and the pole piece 5 is regulated by means of a screw 32 secured to the pole piece 5 and the nut 33 thereon which bears against the pole piece 12.

Referring now particularly to the function of a relay of this type constructed in accordance with this invention, it should be noted that the armature forms a continuous path for the magnetic lines of force from one air gap to the other; that the portions 12 and 5 and 14 and 4 are of comparatively elongated surface areas at the points where they cooperate magnetically and that these parts at these points are correspondingly reduced in a transverse direction to maintain the surface areas approximately the same as in the present flat type relays. Therefore, while the width of the air gap between these parts is less than in standard relays of this type, it is spread out or lengthened in a longitudinal direction to maintain the same surface area. Consequently the magnetic reluctance of these air gaps to the magnetic lines of force seeking to pass between the armature and core at these points is approximately the same and may in fact, depending on the relative dimensions adopted, be considerably reduced. In other words, if the shanks 35 and 36 and 3 have been designed for a certain number of magnetic lines of force, the width across the air gaps and the area of the air gaps between 14 and 4 may be such that this air gap will offer considerably less reluctance to the magnetic lines of force than has been possible in present designs of relays of this type. It is evident that due to the fact that the shanks 35 and 36 have to occupy the same transverse plane as the pole piece 5 and that the standard outside dimensions ought to be maintained this construction is preferable to wider pole pieces heretofore employed.

This construction also enables the armature and core to be so shaped that a considerable reduction in the so called inefficient or ineffective air gaps is produced. In other words due to the narrower and longer pole piece 5 and armature cross piece 12 the portion of the armature on either side of the portion 12 may be so shaped that they slant sharply away from the pole piece 5 and yet permit the shanks 35 and 36 to be bent to occupy the same plane as the core as clearly indicated in Fig. 3. By this construction the magnetic lines of force tending to pass between the armature and core at these points are therefore correspondingly reduced and the greater portion of the magnetic lines of force will, consequently be directed to pass through the so called effective air gap, that is, they must pass between the core and armature at a point where they will perform the most work. Thus it will be seen that the leakage of magnetic lines of force, that is, lines of force that do not participate in the work of attracting the armature to the core, is comparatively negligible and the general efficiency of the relay is therefore enhanced. Fig. 4 shows another application of this principle to further reduce the number of the ineffective lines of force passing between the core and armature. That is, the pole piece 5 is cut away at a steep angle at 39 so that the area for the passage of magnetic lines of force between the pole piece 5 and portion 12 will be sharply defined.

What is claimed is:

1. An electromagnet comprising a core, a winding therefor, and a flat rectangularly shaped armature cooperatively associated with said core, the long sides of the armature being located in substantially the same plane as the core and each of the short sides of the armature being so bent as to straddle the corresponding end of the core to form an effective air-gap and so bent that the ineffective air-gap incident to this construction is lengthened to a maximum.

2. An electromagnet comprising a core having flat ends and a middle portion, an energizing winding for said core on the middle portion thereof, a flat rectangularly shaped armature cooperatively associated with said core having its long sides located in substantially the same plane as the middle portion of the core and having its short sides straddling respectively the flat ends of the core, one short side hinged to a corresponding flat end of the core the other portion of the core and the corresponding short side of the armature magnetically cooperating with each other, said last mentioned short side of the armature being so shaped that the reluctance of the effective air-gap between these cooperating parts is small as compared with the reluctance of the ineffective air-gap incident to this construction.

3. An electromagnet comprising a core having flat ends and an intermediate portion, an energizing winding for said core on the intermediate portion thereof, a flat rectangularly shaped armature cooperatively associated with said core so that one short side of the armature operates magnetically with one flat end of the core, the armature being otherwise so shaped that the long sides thereof are located in substantially the same plane as the flat ends of the core, the surface area of the magnetically cooperating parts being of a rectangular shape and so defined or arranged in relation to the other portions of the armature and core that the majority of the magnetic lines of force will be directed to pass between these two rectangular surfaces and confined sharply to the area thereof.

4. A flat type relay wherein the armature provides two parallel paths in the magnetic circuit and wherein the armature face corresponding to the core face is formed of a cross member bent about the core pole piece characterized by the provision of a similar cross member for the armature at the rear

thereof whereby the magnetic circuit is completed through an air gap between the side face of said rear cross member and the rear face of said core piece, and a forward extension of the armature face corresponding in general outline to said core face whereby the effective armature face area is enlarged so that the air-gap reluctance is reduced, the points at which said armature cross member is bent about said core pole piece being nearer to the ends of said cross member than the center thereof, whereby the reluctance of the air-gap between the sides of said core pole piece and said armature is increased.

In witness whereof, I hereunto subscribe my name this 29 day of March A. D., 1926.

DANIEL D. MILLER.