D. D. MILLER.

ELECTROMAGNETIC DEVICE.

APPLICATION FILED MAR. 4, 1915.

1,240,471. Patented Sept. 18, 1917.

Fig. 1.

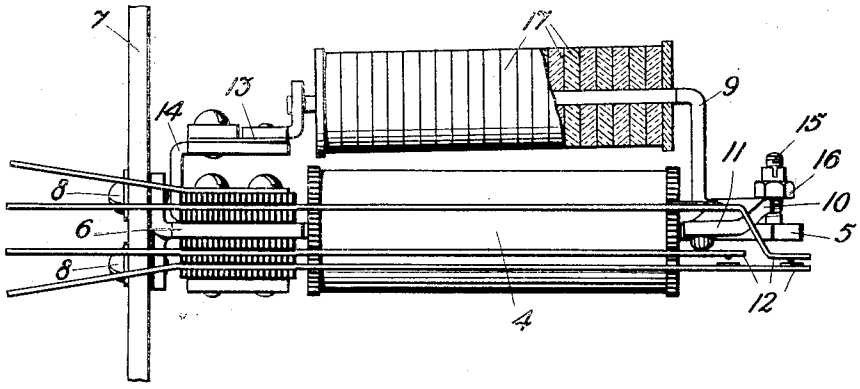


Fig. 2.

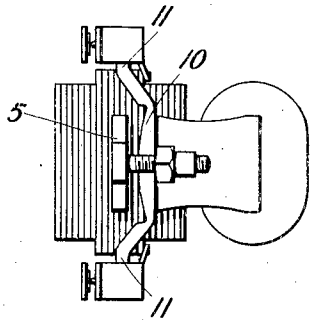
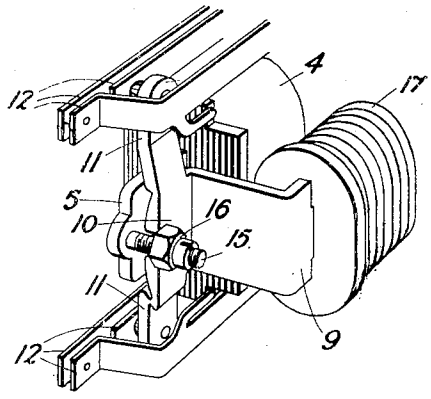


Fig. 3.



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UNITED STATES PATENT OFFICE.

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ELECTROMAGNETIC DEVICE.

1,240,471. Specification of Letters Patent. Patented Sept. 18, 1917.

Application filed March 4, 1915. Serial No. 12,204.

To all whom it may concern:

Be it known that I, DANIEL D. MILLER, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Electromagnetic Devices, of which the following is a full, clear, concise, and exact description.

The invention relates to electromagnetic devices and more particularly to electromagnetic relays.

The object of this invention is the production of a relay which will be slow both in responding and in releasing.

In accordance with one feature of this invention, the armature of a relay is provided with an encircling closed circuit coil in which a current is induced from current flow in the energizing winding, the flow of current in the closed coil opposing that in the energizing winding, whereby the pulling up of the armature is delayed when the energizing winding is brought into circuit with a source of current.

In accordance with another feature of this invention, the armature pole face is convexed so as to concentrate the flux, whereupon, when the flow of current through the energizing winding is interrupted, the convex pole face and the closed circuit coil coöperate to delay the falling off of the armature.

Other features of this invention relate to combinations of parts and details of construction as will hereinafter appear.

This invention is illustrative in the accompanying drawing, in which—

Figure 1 is a plan view, partly in section, of an electromagnet embodying this invention;

Fig. 2 is an end elevation of the electromagnetic device shown in Fig. 1; and

Fig. 3 is a view in perspective of the electromagnetic device shown in Figs. 1 and 2.

As shown in the drawing, the electromagnetic device embodying this invention comprises an electromagnet 4, the core of which has a forward extension 5 forming a pole piece and a rearward extension 6 forming a second pole piece. The end of extension 6 may be bifurcated, and the legs thereof bent at right angles, as shown in Fig. 1, and secured to a suitable mounting strip 7 by means of screws 8, 8. It will be noted that the core of the electromagnet 4 forms a support for the entire structure of the electromagnetic device. A U-shaped mounting lug 14, suitably secured to the extension 6, supports a U-shaped armature 9 hinged to the lug 14 by means of a flat spring 13 of magnetic material. The free end of the armature 9 is provided with a convex pole face 10 positioned in operative relation to the pole piece 5 of the core, and with projecting lugs 11, 11 which control the movement of contact springs 12, 12 mounted upon the extension 6, but insulated therefrom and from one another. A screw 15 secured to the end of pole piece 5 passes through an opening provided in the free end of armature 9 and is engaged by a locking nut 16, by means of which the distance between the pole piece 5 and the convex pole face 10 may be adjusted. The adjustment of the tension of the middle spring 12 of each set is such that these springs normally hold the free end of the armature 9 against the locking nut 16.

On the armature and linking with the magnetic flux therethrough is carried an encircling closed circuit secondary coil shown in the form of a plurality of annular disks 17, 17 conductively united. The magnetomotive force of the closed secondary coil, due to the induction from the flow of current through the energizing winding of the electromagnet upon connection being established with a source of current, is opposed to the magnetomotive force of the energizing winding and delays the building up of the flux thereby delaying the responding of the armature to the energization of the electromagnet.

Now it is well known that upon interruption of the flow of current in an electromagnet the magnetomotive force thereof will be reduced to practically zero almost instantaneously, and an armature associated with the electromagnet will release immediately. However, if a closed secondary coil is associated with said electromagnet, a magnetomotive force will be induced in the closed secondary coil upon the interruption of the flow of current in the primary coil. This induced magnetomotive force of the closed secondary coil will be in the same direction as that of the primary coil. This magnetomotive force of the closed secondary

coil builds up very rapidly and then decreases very rapidly for a certain period of time, after which there is a gradual decrease until this magnetomotive force is dissipated. In the ordinary electromagnetic device during this first mentioned period, the density of the lines of force is sufficient to hold the armature in attracted position, but during the period of gradual decrease the armature is in its unattracted position. In accordance with the present invention, the pole face of the armature is made convex, whereby the lines of force are concentrated and for a portion of the period of gradual decrease the density of the concentrated lines of force is sufficient to maintain the armature in attracted position. By the utilization of this invention, the interval of time between the interruption of the flow of current in the energizing winding and the releasing of the armature may be as much as three-quarters (¾) of a second. It will be readily apparent that a time interval of such magnitude is of utmost importance where such a device is to be used in association with other apparatus in circuits which must be maintained closed for approximately this length of time, in order that such apparatus may have time to perform the necessary functions.

By employing the present invention, it will be noted that the armature of an electromagnetic device may be rendered both slow-responding and slow-releasing by means external to the electromagnet proper, thereby retaining all the space around the core for the energizing winding and effecting a large saving in the amount of copper required for the winding. Since the means for rendering the armature slow-responding and slow-releasing are associated with the armature only, the electromagnet may be used in an ordinary electromagnetic device by merely changing the armature. Likewise an electromagnetic device embodying this invention is readily assembled and may be readily dismantled for the purpose of repairs.

While the closed secondary coil has been herein described as copper disks encircling the armature, it is apparent that it may consist of a single encircling sleeve or bare copper wire wound thereon, and such are to be understood as coming within the scope of this invention.

What is claimed is:

1. In an electromagnetic device, an electromagnet, an armature therefor, and a short circuited secondary coil encircling and linking with the flux in said armature for cooperating with said electromagnet to control the movement of said armature.

2. In an electromagnetic device, an electromagnet, an armature therefor adapted to move in a direction transverse to the axis of the electromagnet, and a plurality of copper disks carried by and linking with the flux in said armature to render it slow-responding and slow-releasing.

3. In an electromagnetic device, a magnetic circuit comprising a core and an armature, a pole piece for said core, a convex pole piece for said armature adapted to have substantially line contact with the pole piece for said core, a primary energizing winding on the core, a closed secondary coil linking with all the flux in the magnetic circuit, said closed secondary coil coöperating with said pole pieces to render the armature slow-releasing.

4. In an electromagnetic device, an electromagnet, an armature therefor having a convex pole face, a pole face on the electromagnet adapted to have substantially line contact with the convex pole face of the armature, and a closed secondary coil carried by and linking with the flux in said armature and coöperating with said contacting pole faces to render said armature slow-releasing.

5. In an electromagnetic device, an electromagnet, an armature therefor having a convex pole piece, a pole piece for said electromagnet adapted to have substantially line contact with the convex pole piece of the armature, and a closed coil of non-magnetic material carried by and linking with the flux in said armature for coöperating with said contacting pole pieces to render said armature slow-releasing.

6. In an electromagnetic device, an electromagnet, an armature therefor, and a plurality of copper disks carried by and linking with the flux in said armature, coöperating pole pieces for said electromagnet and said armature adapted to have substantially line contact with each other, one of said pole pieces being convex for coöperating with said copper disks to render said armature slow-releasing.

7. In an electromagnetic device, an electromagnet having a core with extending pole pieces, an armature mounted on one pole piece and having the free end thereof positioned adjacent the other pole piece in operative relation thereto, a convex pole piece on the free end of said armature adapted to have substantially line contact with the opposing pole piece on said core, and a plurality of copper disks carried by and encircling said armature for coöperating with said opposing pole pieces to render said armature slow-releasing.

8. In an electromagnetic device, a magnetic circuit comprising a core and an armature, opposing pole pieces on said armature and said core adapted to contact over a comparatively small area of their surfaces, a primary energizing winding for the core, a closed secondary coil linking with all the

flux in the magnetic circuit, said closed secondary coil coöperating with said opposing pole pieces to render the armature slow-releasing.

9. In an electromagnetic device, an electromagnet, a pole piece therefor, an armature for said electromagnet having a pole piece adapted to have contact with the pole piece of the electromagnet over a comparatively small area thereof, and a closed secondary coil carried by and linking with the flux in said armature and coöperating with said contacting pole pieces to render said armature slow-releasing.

10. In an electromagnetic device, an electromagnet, a core and an armature therefor, opposing pole pieces for said core and said armature adapted to have contact over a comparatively small area thereof, and a closed secondary coil carried by and linking with the flux in said armature and coöperating with said contacting pole pieces to render said armature slow-releasing.

In witness whereof, I hereunto subscribe my name this 2nd day of March A. D., 1915.

DANIEL D. MILLER.

Witnesses:
E. EDLER,
K. L. STAHL.