

March 30, 1937.

H. N. WAGAR

2,075,488

ELECTROMAGNETIC SWITCHING DEVICE

Filed Jan. 31, 1934

2 Sheets-Sheet 1

FIG. 1

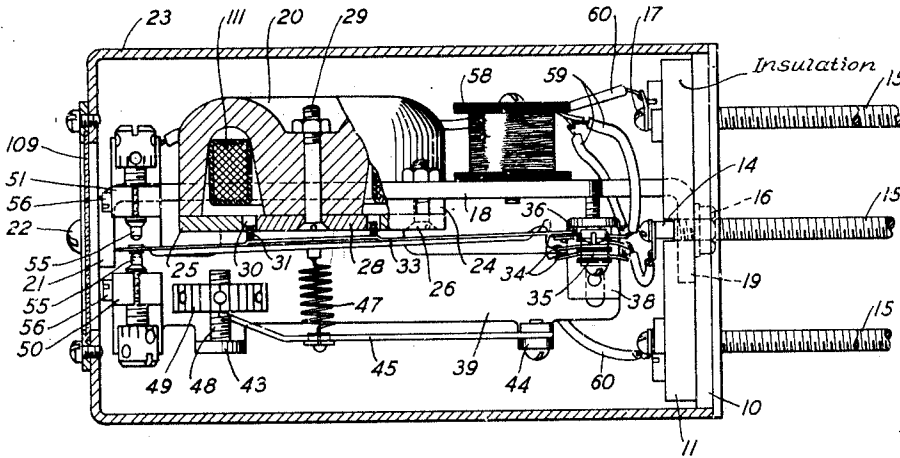
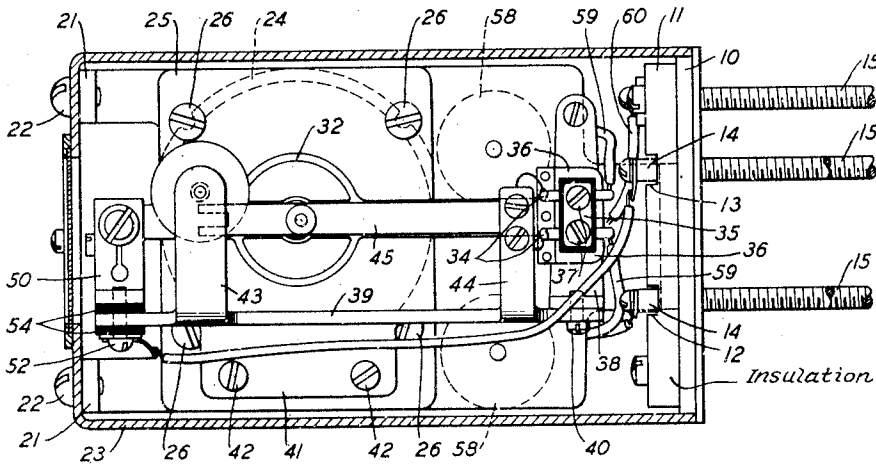


FIG. 2



INVENTOR
H. N. WAGAR
BY *E. W. Adams*
ATTORNEY

March 30, 1937.

H. N. WAGAR

2,075,488

ELECTROMAGNETIC SWITCHING DEVICE

Filed Jan. 31, 1934

2 Sheets-Sheet 2

FIG. 4

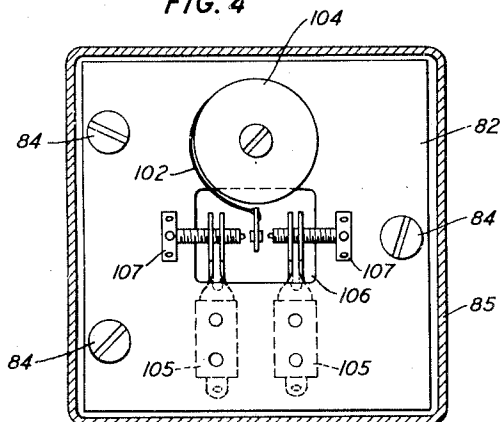


FIG. 5

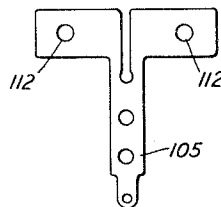


FIG. 6

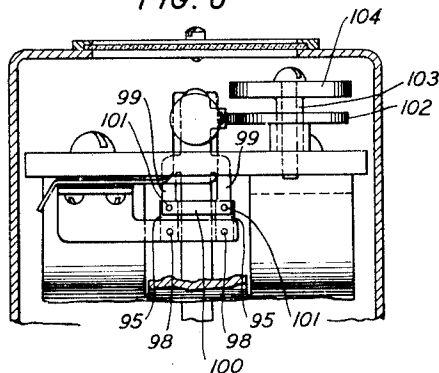
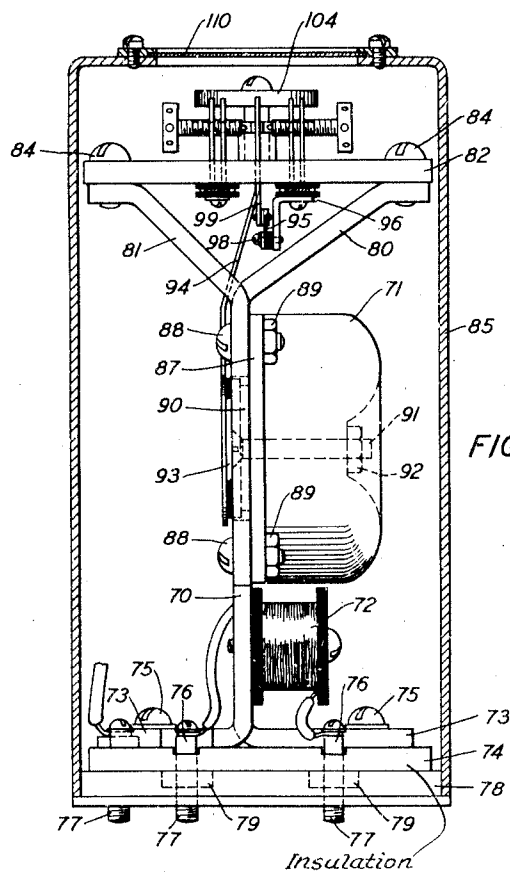


FIG. 3



INVENTOR
H.N. WAGAR
BY *W. A. Adam*
ATTORNEY

UNITED STATES PATENT OFFICE

2,075,488

ELECTROMAGNETIC SWITCHING DEVICE

Harold N. Wagar, New York, N. Y., assignor to
Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application January 31, 1934, Serial No. 709,053

9 Claims. (Cl. 200—110)

This invention relates to electromagnetic switching devices and particularly to electromagnetic relays of the type generally known as voltmeter or current relays.

One of the chief uses of voltmeter or voltage regulating relays, particularly in the telephone plant is in power systems to provide alarms or perform other circuit functions when the voltage or current under control falls outside predetermined limits.

The accurate control of a voltage or current supply by a switching device of this character depends, to a major degree, upon the sensitivity of the relay, its freedom from external interference such as is caused by extraneous magnetic fields, variations in temperature and humidity conditions, etc., its ability to provide a maximum build-up of contact pressure per unit change in current through the operating winding as well as a maximum build-up of pressure at the contact per unit change of voltage across the relay system, and its freedom from contact chatter.

It is the object of this invention to provide a simple, compact and inexpensive device for indicating the rise and fall of voltage or current in an electric circuit, which embodies the desirable characteristics set forth above.

This object is attained in accordance with a feature of the invention by the provision of an electromagnetic switching device having a self-shielding magnetic circuit which is made possible by a specially shaped permanent magnet having a plurality of concentric poles which form an annular air gap in which a pivotless moving coil, composed of edge-wound copper or aluminum tape is adapted to function.

Another feature of the invention which greatly enhances the efficiency of the relay, resides in a reed type mounting for a semi-rigid arm which supports the moving coil in position in the circular air gap effected by the permanent magnet poles. This feature results in a radical departure from the usual design of voltage regulating relays and obviates the necessity for pivot supports for the moving coil which, heretofore, constituted a source of considerable trouble in relays of this type.

Another feature of the invention is embodied in a locking device for the adjustable contact posts whereby a predetermined adjustment of the contact posts is insured and rigidly maintained.

These and other features, not specifically identified, will be readily understood from the follow-

ing description made with reference to the accompanying drawings in which:

Fig. 1 is a side elevation, partially in section, of a relay embodying certain features of this invention;

Fig. 2 is a bottom plan view of the relay shown in Fig. 1;

Fig. 3 is a side elevation of a modification of the relay shown in Fig. 1;

Fig. 4 is a front end view of the relay shown in Fig. 3 showing the armature tensioning spring and the contact post locking mechanism,

Fig. 5 is a plan view of one of the contact post locking members before given its final form; and

Fig. 6 is a bottom plan view of the front end of the relay shown in Fig. 3.

Referring to Figs. 1 and 2, a metallic base plate 10 has secured thereto by screws, or by any other suitable means, an insulating block 11 which is slotted in various locations as at 12 and 13, to provide recesses into which the shouldered portions 14 of terminal posts 15 fit. The metal base plate is provided with a series of circular apertures, one for each terminal post 15, into which nuts 16 are adapted to fit after being made up on the terminal posts 15. By means of the nuts 16 the terminal posts are rigidly secured to the insulating block 11. The shouldered ends of the terminal posts 15 act as terminals to which the coil leads of the relay are secured in any well known manner, such as by tabs and screws generally indicated by the numeral 17 in Fig. 1.

A brass mounting plate 18 is provided at one end with a flange or right angle extension 19 which is centrally located on the metallic plate 10 and secured thereto by means of screws. The plate 18 is generally rectangular in shape having a circular cut-out near its forward end which allows the permanent magnet 20 to be mounted on the plate as will be described presently. The forward end of the plate 18 terminates in two downwardly extending flanges 21 which are tapped to accommodate screws 22 by which a cover 23 for the relay is held in position.

The permanent magnet 20 is of cobalt steel and is substantially shell-shaped having a substantially circular flange 24 which rests on the edge of the circular cut-out in the plate 18 and is clamped thereto by means of the magnetic plate 25, the plate 25 being held in position by means of four screws 26. The magnet is so formed as to present concentric poles, the outer pole being substantially annular and the inner pole circular. A circular magnetic piece 28 is secured to the central pole by means of a screw bolt 29. The

substantially annular piece 25 and the circular piece 28 serve as pole-pieces for the permanent magnet poles.

The relationship of the circular pole-piece 28 and the pole-piece 25 is such that an annular air gap 30 is effected in which a circular moving coil 31 is adapted to function. The moving coil 31 is composed of edge-wound copper or aluminum tape and is supported by a circular frame 32 which constitutes an integral part of the arm or armature 33. The leads of the moving coil are glued or otherwise fastened to the underside of the armature 33 and carried back to the terminals 34 which constitute a part of the spring pile-up generally indicated by the numeral 35.

The pile-up 35 comprises the terminals 34, insulating separators, a reed type hinge 36 and screws 37 which secure the pile-up to a bracket 38 which, in turn, is secured to a spider-like bracket 39 by screws 40. The bracket 39 is provided with a laterally extending integral portion or flange 41 which is secured to the magnetic member 25 by screws 42.

The bracket 39 is also provided with two extensions 43 and 44 which extend over the arm or armature 33, the latter extension having clamped thereto a flexible arm 45 which it carries in superposed relation to the armature and in substantial alignment therewith. At a point immediately above the center of the coil 32, the flexible arm has secured thereto, by soldering or in any other suitable manner, one end of a coil spring 47, the other end of the spring being secured to armature 33 at a point corresponding to the central axis of the coil 32. The other portion 43 of bracket 39 carries a screw 48 upon which an adjusting disc 49 may be made up. The free end of flexible arm 45 is offset and bifurcated and is normally tensioned against the surface of disc 49 as clearly shown in Fig. 1. By manipulating the disc 49 on the screw 48 the tension of spring 47, and consequently of the arm or armature 33 may be adjusted.

At its forward end the spider-like bracket 39 supports the L-shaped contact posts 50 and 51 by means of screws 52 (only one such screw being discernible in the drawings) and is insulated therefrom by means of insulating pads 54. Each contact post carries an adjustable screw type contact 55 and is provided with a central slit, which together with a screw 56 constitutes a locking means for the contacts. To adjust the contacts 55, the screws 56 are loosened which permits the two sections of the split posts 50 to spread, relieving the pressure on the screw contacts; the screw contacts are then adjusted and the screws 56 made up causing the screw contacts to be held securely in their adjusted positions.

The undersurface of the mounting plate 18 carries resistance coils 58, two of which are shown in the drawings which are electrically associated with the moving coil 31 by way of the terminals 34 and leads 59, the other sides of the resistance coils being brought out to two of the terminals 15 by way of the leads 60. The resistances may be connected in series or in parallel with the moving coil depending on circuit conditions and are usually wound with wire having a substantially zero resistance-temperature coefficient.

To completely protect the relay, the cover 23 is provided which is slipped over the relay and

secured to end portions 21 of the mounting plate 18 by means of screws 22.

The relay structure just described, due to the special shape of the permanent magnet is inherently self-shielding and is free from external interference caused by extraneous magnetic fields, and the particular shape of the moving coil lends itself to a construction in which undesirable pivot bearings are eliminated through the mounting of the moving coil on an armature or arm which is supported by a flexible reed.

In the modified form of relay shown in Figs. 3, 4 and 6, the mounting bracket 70 is of magnetic material and is so designed as to provide a central portion of suitable dimensions to accommodate the cobalt steel magnet 71 and the resistance units 72. The rear of the plate 70 terminates in two right angle extensions 73 which are clamped to the insulating block 74 by means of screws 75. The insulating block 74, as in the relay structure previously described, is provided with recesses which accommodate the shouldered ends 76 of the terminals 77, the terminals passing through circular apertures in the metal base plate 78 and held firmly in position by nuts 79 which, when made up on the terminals engage the underside of the insulating block 74. The screws 75 are of sufficient lengths to engage tapped holes in the base plate 78. The front end of the plate 70 terminates in a central upwardly projecting arm 80 and two downwardly projecting arms 81 located on either side of the arm 80. These arms make three point engagement with the mounting plate 82 and are secured thereto at these points by screws 84. The cover 85 may be held in position in any suitable manner.

The permanent magnet 71 is provided with a substantially semi-circular flange on two sides thereof, but one flange 87 being visible in the drawings, which rest on the surface of plate 70 and are secured thereto by screws 88 and their associated nuts 89.

The main body portion of plate 70 is provided with a centrally located circular aperture, the aperture being slightly greater in diameter than the diameter of the central core, thereby effecting an annular air gap. A circular piece of magnetic material 90 is positioned over the surface of the central core and held in contiguous relation therewith by means of screw 91 and nut 92. This element constitutes one pole of the magnet 71, the other pole which is circular is effected by the plate 70.

In the annular air gap just referred to, a moving coil 93 is adapted to function and is supported by the flexible armature or arm 94 which is mounted on the relay structure through the agency of a reed type hinge 95.

The reed type hinge 95 is made up of two parts as clearly illustrated in Fig. 3, which are insulatively mounted on an L-shaped bracket 96 which in turn, is insulatively mounted on the plate member 82. The rear ends of the hinge pieces 95 are secured to the bracket 96 by means of screws 98, the other ends extending forward to support the arm 94 as will appear presently.

The arm 94 is made up of a flat contact-bearing surface at one end, a circular support for the moving coil 93 at the other end, the two ends being integrally joined by an inclined section, the contact bearing surface and the circular support being in two different parallel planes. Substantially at the point where the inclined portion of arm 94 leaves the contact bearing surface,

two L-shaped projections 99 are provided which are located in the same plane as the contact-bearing surface of the arm 94. These projections extend back and are secured to the front ends of the hinge pieces 95 as clearly shown in Figs. 3 and 4, there being provided a clamp 100 which is tapped to receive the screws 101 by virtue of which the hinge and armature or arm are securely joined together. The construction just described affords an increased ratio of the lever arm of the coil to the lever arm of the contacts. This results in an increased contact pressure over the construction shown in Figs. 1 and 2.

One end of a spiral spring 102 is secured to the end of the contact-bearing portion of arm 94, the other end being made fast to a shaft 103 which may be rotated by means of a disc 104 associated therewith. The tension on the arm 94 may be regulated by manipulating the disc 104 to wind up or unwind the spring 102. The shaft 103 is mounted on the plate 82 in any suitable manner.

On the back of the plate 82 are secured two terminal post supports 105, the front or free ends of which are folded over and extend through the opening 106 in plate 82 forming jaw-like extensions. The folded over portions are pinched closely together and tapped at 112 to receive the contact posts 107. The tendency the jaw-like extensions have to separate serves to maintain the binding posts securely in adjustment.

The front ends of the covers 23 and 85 for the relays just described are provided with an opening over which windows 109 and 110 are secured which enable the relay to be readily observed during operation.

A coil 111, seen only in Fig. 1, is provided for the magnets 20 and 71 and is used only to permanently energize the magnet after the magnetic circuit of the relay has been assembled.

In each of the relay structures disclosed, the combination of the particular type of magnetic circuit shown and the annular coil results in greater efficiency than heretofore obtainable with the usual type of magnetic circuit and moving coil.

What is claimed is:

1. In a circuit controlling device, a magnet comprising a shell having a central pole, an annular pole on said shell forming an annular air gap with said central pole, a ring-shaped ribbon wound coil adapted to function in said air gap, an arm supporting said coil at one end and bearing a contact member near the other end and a reed for mounting said arm, said reed secured to said arm at a point intermediate said coil and said contact member.

2. In a circuit controlling device, a magnet comprising a shell having a central pole, an annular pole on said shell forming an annular air gap with said central pole, a coil movable in said air gap between said poles, a contact arm to which said coil is secured and a reed type mounting for said contact arm, said reed being secured to said contact arm at a point intermediate its ends.

3. In a circuit controlling device, a magnet comprising a shell having a central pole, an annular pole on said shell forming an annular air gap with said central pole, a ribbon wound coil movable in said air gap between said poles, an arm supporting said coil at one end bearing a contact near the other end and means for mounting said arm on said device, said means

including a reed secured to said arm at a point intermediate its ends.

4. In a circuit controlling device, a magnet comprising a shell having a central pole, an annular pole on said shell forming an annular air gap with said central pole, a contact, a coil, an arm supporting said coil and said contact, means for securing said arm to said device, said means including a reed secured to said arm at a point intermediate the contact and coil supported by said arm and means for adjusting said coil supporting arm.

5. In a circuit controlling device, a permanent magnet having concentric poles, an annular air gap effected by said poles, an arm, a contact carried by said arm, a coil carried by said arm and suspended therefrom in said air gap, a reed supporting said arm and having a point of engagement therewith intermediate said coil and said contact, the distance of said coil from said point of engagement of said reed being greater than the distance of said contact from said same point, and means for fixedly associating said reed with said device.

6. In a circuit controlling device, a magnet comprising a shell having a central pole, an annular pole on said shell forming an annular air gap with said central pole, a coil movable in said air gap between said poles, an arm carrying said coil at one end and supporting a contact member at the other end, a projection on said arm extending away from the contact bearing end and towards the coil bearing end and a reed secured to said projection and mounted on said device.

7. In a circuit controlling device, a magnet comprising a shell and a centrally located integral pole, an annular pole on said shell forming an annular air gap with said centrally located pole, a bracket mounted on said device and carrying a reed-type hinge, a coil, an arm to which said coil is secured, and means integrally associated with said arm and located at a point intermediate the ends of said arm and secured to said reed-type hinge for suspending said coil in said air gap.

8. In a circuit controlling device, a magnetic bracket, a magnet comprising a shell and a centrally located pole, said magnet secured to said bracket and said bracket provided with an aperture of slightly greater area than the pole face area of said central pole and so disposed with respect to said central pole as to form an annular air gap therewith, a coil movable in said air gap, an arm supporting said coil, and means including a reed-type hinge secured to said arm at a point intermediate its ends for securing said arm to said device.

9. In a circuit controlling device, a shell-shaped permanent magnet having a central pole, an annular pole on said shell having associated therewith a separable annular pole-piece, a circular pole-piece removably mounted on said central pole by means of a screw passing axially through the body portion of said magnet and situated with respect to said annular pole-piece as to effect an annular air-gap, a ring-shaped ribbon wound coil adapted to function in said air-gap, an arm supporting said coil and a contact mechanism, a reed-type hinge for mounting said arm on said device, a spring having one end thereof secured to said coil-supporting arm and the other end secured to adjustable means for regulating the tension on said arm.

HAROLD N. WAGAR.