Feb. 9, 1932. F. H. HIBBARD 1,844,121

ELECTROMAGNETIC SWITCHING DEVICE

Filed Aug. 14, 1929

FIG. 1

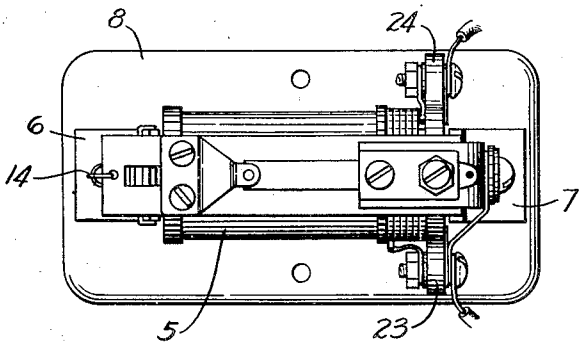


FIG. 2

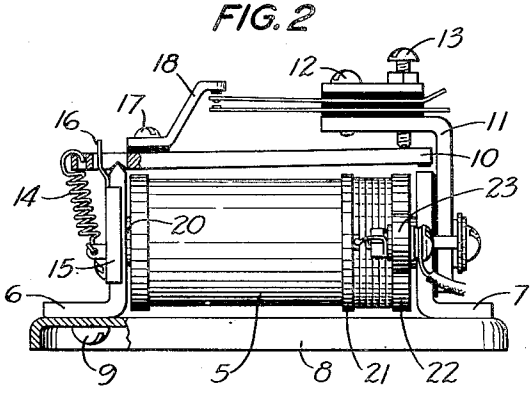


FIG. 3

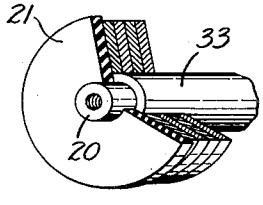


FIG. 4

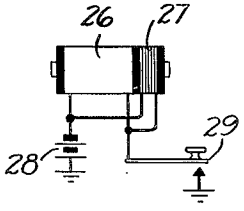
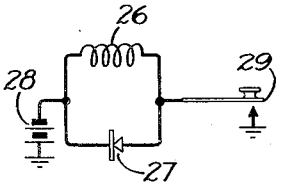


FIG. 5



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UNITED STATES PATENT OFFICE

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ELECTROMAGNETIC SWITCHING DEVICE

Application filed August 14, 1929. Serial No. 385,865.

This invention relates to electromagnetic devices and more particularly to electromagnetic relays of the slow acting type.

In electrical systems generally, and telephone systems particularly, the relay plays an important role, and in view of the time limit of operation and release under which it is called upon invariably, to function, great care must be exercised in its design, both electrical and mechanical. Slow acting relays constitute a particular type of relay which, by virtue of its design, delays the actuation or release of its armature until a certain predetermined interval of time has elapsed after the energizing current is applied or discontinued, as the case may be.

The customary method of obtaining slow acting relays is to design the relay so that the lag between a change in the operating current and the corresponding change in the strength of the core flux is comparatively large. In other words, the relay must be designed so that the core flux and the operating current have a large time phase. Many expedients have been resorted to in accomplishing this, the most common being the use of a secondary or short circuited winding which in some instances assumes the form of a copper slug located at one end of the relay core. Another type of slow acting relay employs a unidirectional current conducting device such as a copper oxide rectifier connected in shunt to the relay winding. Such an arrangement is disclosed in Patent No. 1,742,367, issued January 7, 1930, to L. L. Nettleton et al.

Some circuit conditions require that a relay be delayed in effectively actuating or releasing its armature until a very appreciable period of time has elapsed since the initial application of current to its energizing winding, or the interruption thereof. In such cases wherein an emphasized time lag is required, the above-mentioned types of slow acting relays would not serve satisfactorily.

It is the object of this invention to emphasize the slow acting characteristics of electromagnetic devices of the slow acting type.

This object is attained in accordance with a feature of the invention by connecting a "dry rectifier" in shunt to the electromagnet winding and mounting the discs which constitute the rectifier, on the electromagnet core in such a manner as to utilize the copper slug action of the rectifier copper discs. In this manner applicant has combined the shunt valve action of the rectifier with the copper slug action of the rectifier disc in a unitary structure and has perfected a relay whose slow acting characteristics are materially emphasized.

The invention will be readily understood from the following detailed description made with reference to the accompanying drawings in which Fig. 1 is a plan view of an electromagnetic device embodying the feature of this invention; Fig. 2 is a side elevation of the device shown in Fig. 1; Fig. 3 is a perspective view, part in section, showing the relation of the rectifier discs to the electromagnet core; Figs. 4 and 5 are schematic circuit representations.

Applicant does not intend to limit himself to the particular mechanical construction chosen for the disclosure of his invention, as it is obvious the rectifier discs may be associated with practically any type of relay.

The relay which applicant has elected to disclose, comprises essentially an electromagnet 5 horizontally disposed intermediate a pair of angular pole pieces 6 and 7 which are secured to a support or mounting base 8 by means of screws such as 9, entering from the underside thereof. The upper end of the pole piece 6 is provided with a knife edge adapted to register with a groove formed in an armature 10 so as to afford a pivotal mounting for said armature. The free end of armature 10, when attracted by the energization of the electromagnet 5, strikes the end of the pole piece 7. Mounted adjacent the pole piece 7, but insulated therefrom, is an angular mounting member 11. The upper or horizontal portion of member 11 supports the springs which control an external circuit and which are insulatively mounted on the member 11 by means of screws 12 and 13, the latter also serving as a means for adjust-

ing the air gap between the end of the pole piece 7 and the armature 10, and as a back stop for the armature. A helical spring 14 is attached to the fixed end of armature 10, the tension of which is adjustable by moving vertically the fastening piece 15 to which its other end in anchored. This spring functions both as a retractile spring and as a holding spring to firmly seat the armature 10 on its supporting knife edge. The fastening piece 15 is provided at its upper end with a tongue portion 16 adapted to extend through an aperture in the armature 10, thus preventing the sidewise dislocation of the armature from its pivotal mounting. Insulatively mounted on the armature 10 by means of a screw 17 is a rigid member 18 which moves with the armature to cause the closure of the external circuit contacts.

A portion of one end of the core provides a mounting for the discs of a copper oxide rectifier. The discs which are alternately copper and lead may be mounted on the core in any suitable manner. Applicant has selected to disclose an insulating collar 33 tightly fitted to the core with the discs mounted thereon and interposed between the separator 21 and the spool head 22 which are also tight fitting on the core.

The spool head 22 is provided with binding posts 23 and 24 by means of which the necessary electrical connections are made. The electromagnet winding terminals and rectifier taps are brought out to the binding posts 23 and 24, to which leads from an external source of power may be secured.

Referring now to the circuit schematics shown in Figs. 4 and 5, the winding 26 of the electromagnet is connected in series with a power source 28 and a key 29 and is shunted by the rectifier 27. The rectifier, as indicated in Fig. 5 is so poled as to offer a high resistance to the flow of current from battery 28.

To actuate the relay, the winding 26 is connected to the battery supply 28 and the circuit controlling key 29 actuated to its closed position. Under this condition current will traverse the winding 26 of the electromagnet, but will not pass through the rectifier shunt circuit, the rectifier being so poled as to oppose the flow of current in this direction. The electromagnet becomes energized and pulls up its armature.

Due to the presence of the copper discs on the core of the relay the actuation of the armature lags behind the operating current in the relay winding. It is believed unnecessary to enter into a detailed description of the action which takes place at this time as the theory of the short circuit copper turn or slug is well known and has already been referred to in a general way in this application. The relay is slow operating.

The emphasized slow acting characteristic of the relay is realized only when the shunt valve effect of the rectifier is experienced and in this case, when the operating circuit for the relay is opened upon the restoration to normal of key 29.

When key 29 is restored the current in the operating winding 26 changes in value from its maximum to zero. This change of current in the winding 26 sets up an E. M. F. of self induction in the winding which produces a current, the direction of which opposes that of the decaying current in the relay winding. As the rectifier 27 is poled so as to permit the passage of this current through it, it, in effect, short circuits the winding of the relay. The passage of this current through the winding 26 sets up a flux which tends to maintain the armature of the relay actuated.

This shunt valve action which delays the release of the armature is augmented by the copper slug action of the rectifier copper discs. The decaying current in the winding 26 induces an E. M. F. in the short circuited copper discs in the same manner as does the initial building up of the current, only in an opposite direction, the effect being to delay the release of the relay armature.

It is now evident that with the combined effects of the rectifier and copper slug, the delay of the relay in releasing its armature is materially increased and the slow releasing characteristic emphasized. By interchanging the rectifier connections the emphasized sluggish characteristic would be experienced on the operation of the relay, and upon its release, the copper slug effect only, would act to delay the release of the armature.

From the foregoing description it is apparent that applicant has combined in a unitary structure the shunt valve action of a rectifier and the sluggish characteristic of a short circuited copper slug and has so adapted it to a relay structure as to obtain an emphasized slow acting characteristic.

What is claimed is:

1. In combination, an electromagnetic device having a core and a rectifier mounted directly on said core.

2. In combination, an electromagnetic device having a core and a rectifier including a copper disc mounted directly on said core.

3. In combination, an electromagnetic device having a core and a rectifier comprising alternate copper and lead discs mounted directly on said core.

4. In combination, an electromagnetic device having a core, a rectifier mounted directly on the core of said electromagnetic device and terminal means incorporated in the structure of said device for permitting the connection of said rectifier in shunt with the winding of said electromagnetic device.

5. In combination, an electromagnetic device having a core, an operating winding

mounted on said core, a source of current for said winding, and a unidirectional current conducting device mounted on said core in such a manner as to increase the time lag between the current in said operating winding and the core flux set up thereby.

6. In a slow acting relay, the combination of a core, an operating winding mounted on said core and a rectifier connected in shunt with said operating winding to impart a slow acting characteristic to said relay and mounted on said core to emphasize the slow acting characteristic.

In witness whereof I hereunto subscribe my name this 12th day of August, 1929.

FRANK H. HIBBARD.