Nov. 9, 1926. 1,606,571

R. A. HEISING

RELAY

Filed Nov. 7, 1925

Fig. 1.

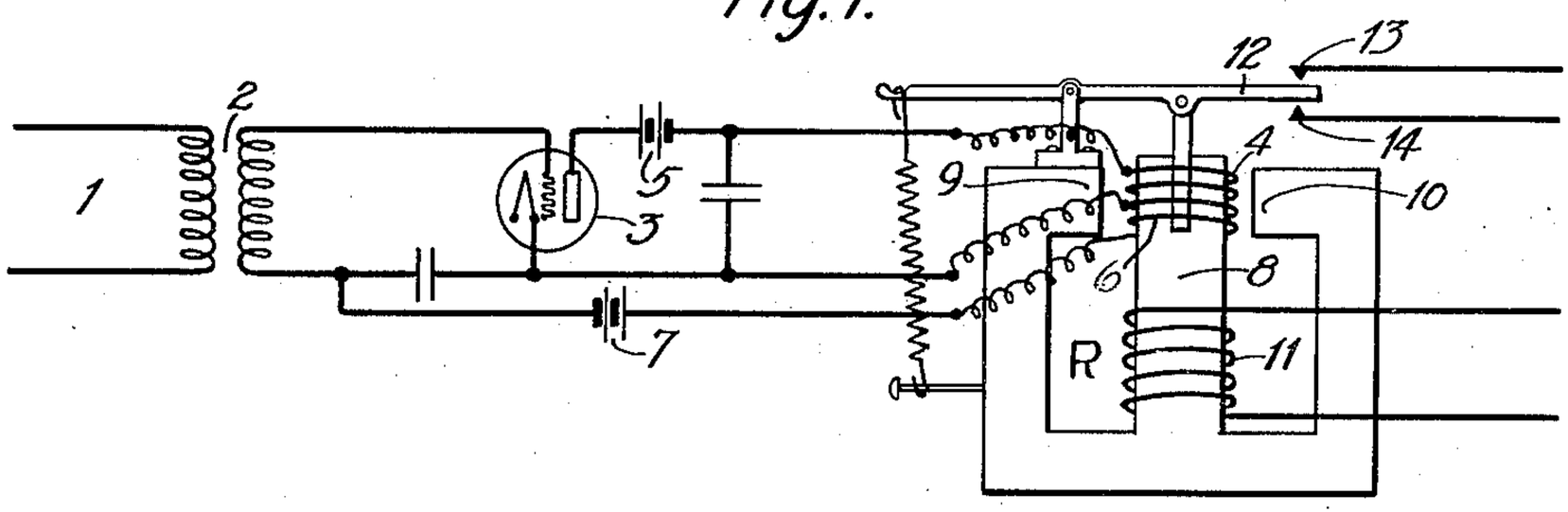


Fig. 2.

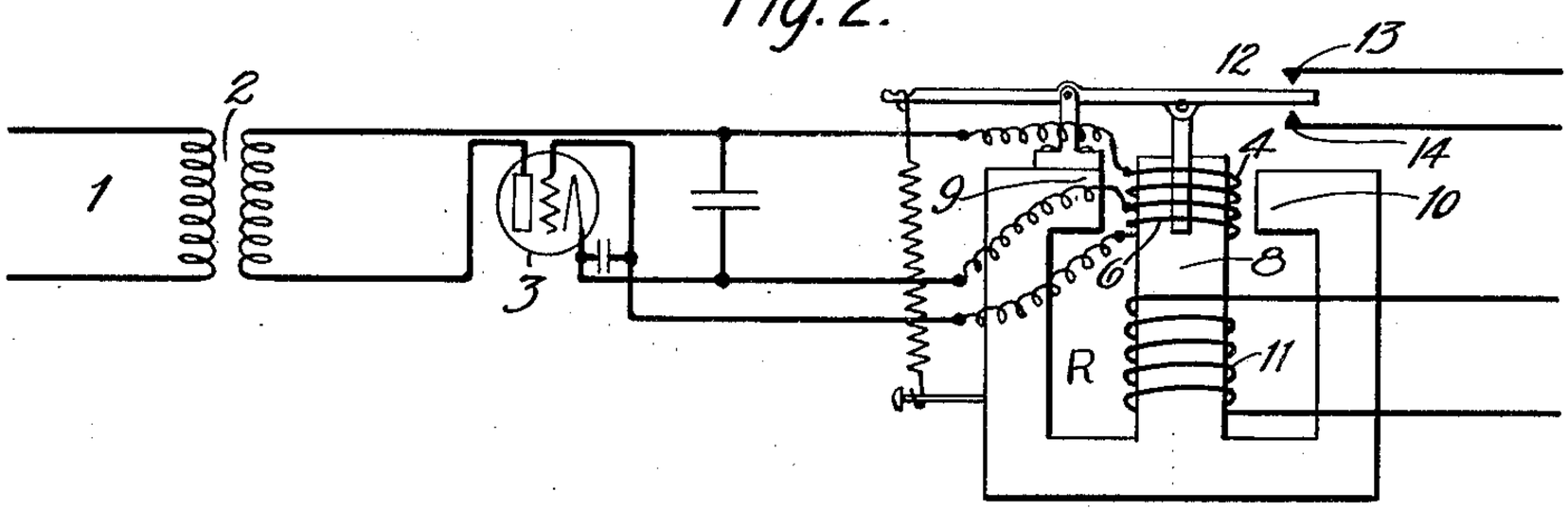
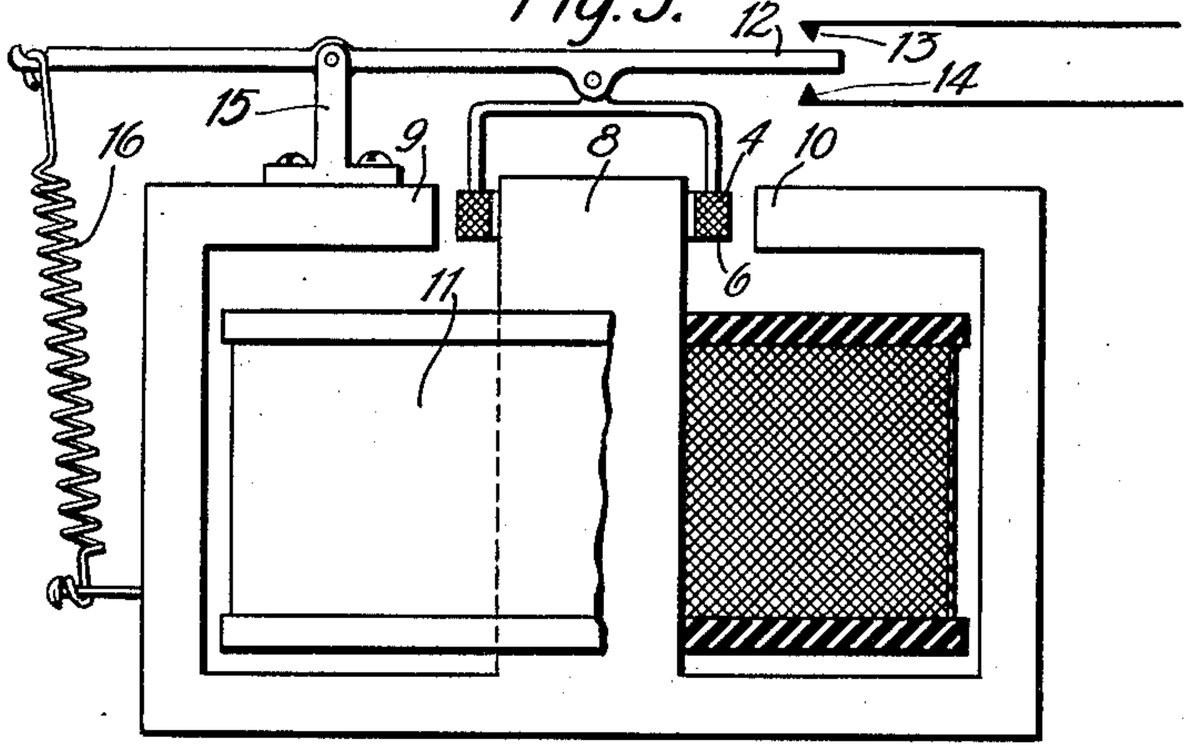


Fig. 3.



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UNITED STATES PATENT OFFICE.

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RELAY.

Application filed November 7, 1925. Serial No. 67,528.

This invention relates to relays and more particularly to a high speed sensitive relay.

In connection with certain apparatus, such as a signal strength recorder, it is necessary to use a relay adapted to operate in response to current values not greater than 1 microampere. A relay suitable for this purpose comprises a magnetized core provided with a gap in which a movable coil is supported by its armature, the current to be measured being supplied to the movable coil. However, when such a relay is associated with a space discharge device there is produced in the movable coil a counter-electromotive force of sufficient magnitude to materially impede the operation of the relay, unless a high resistance is inserted in series with the space discharge device. The use of such a resistance is objectionable as the sensitivity of the relay is thereby reduced and consequently a larger current is necessary to operate it.

It is an object of this invention to provide a high speed sensitive relay.

Another object is to provide a relay which will operate at high speed in response to the small current strengths available in the anode circuit of a space discharge device.

These objects, and others which will be apparent as the nature of the invention is disclosed, are accomplished by employing a movable coil relay of the type described above having one coil connected in the plate circuit of a space discharge device and a second soil included in the grid circuit of the device. The back electromotive force, induced in the first coil by its movement in the magnetic field of the relay, is neutralized by the control action of the electromotive force produced in the second coil upon the grid of the device.

Although the novel features which are believed to be characteristic of this invention will be pointed out with particularity in the claims appended hereto, the invention itself, as to its objects and advantages, the manner of its organization and the method of its operation will be better understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof, in which:

Fig. 1 illustrates diagrammatically one embodiment of this invention.

Fig. 2 illustrates a different embodiment thereof; and

Fig. 3 is an elevation, partly in section, of one design of relay which may be used in the systems shown in Figs. 1 and 2.

Referring to the system illustrated in Fig. 1, currents, in response to which it is desired to operate a relay, are received from line 1 and impressed by means of transformer 2 upon the input circuit of space discharge device 3. The anode circuit of device 3 includes the movable coil 4 of the relay and a space current source 5. A source 7 supplies to the control electrode or grid of the device 3 a polarizing potential of such value that normally no current flows through the coil 4. A second movable coil 6, mechanically united to coil 4, is included, in series with grid polarizing source 7, in the input circuit of space discharge device 3.

Coils 4 and 6 are secured to the armature or bar 12.

The relay R comprises a core having a central member 8 and laterally projecting poles 9 and 10 spaced from the central member 8 to provide a gap. Current is supplied from a source (not shown) to a coil 11 wound on the central member 8 to magnetize the core, whereby a magnetic field is produced across the gap.

Current transmitted over the line 1 and impressed upon the input circuit of device 3 will cause current to flow through its output circuit, and coil 4 will be energized to produce a magnetic field. This field cooperates with that produced between the member 8 and poles 9 and 10 to move coils 4 and 6 relatively to the member 8. The movement of coils 4 and 6 actuates the armature or bar 12 in such manner that contacts 13 and 14 are alternately closed depending upon the position of the coils.

In the operation of this system, when the current impressed upon detector 3 from line 1 is less than a predetermined amount, coils 4 and 6 and associated bar 12 will be in such position that contact 13 will be closed. As the current impressed upon the device increases, coil 4 is displaced downwardly on core 8, in the magnetic field between pole pieces 9 and 10. As this movement takes place, a counter-electromotive force is produced in the coil, which tends to oppose

further increase in current. This counter-electromotive force is compensated for, however, by means of the potential induced in coil 6 by the downward movement thereof in connection with coil 4.

Coil 6 is so connected in the circuit that the grid of space discharge device 3 will tend to become more positive in response to downward displacement, thereby allowing more current to flow in the anode circuit.

For efficient operation of this system the ratio of turns of coil 4 and coil 6 should be equal to the amplification constant of tube 3. Under such condition the back electromotive force which would be induced in coil 4 by movement in the magnetic field would be compensated for by an equal and opposite electromotive force in the anode circuit of the system, due to the control effect of the electromotive force produced by movement of coil 6.

The various elements of Fig. 2 corresponding to those of Fig. 1 have been given similar reference numerals. Space discharge device 3 of Fig. 2 is adapted to rectify directly in the plate circuit the alternating current impressed from line 1 through transformer 2 upon its input circuit. In this figure no separate space current source is shown, but the rectifying properties of the tube are utilized to supply space current derived from the energy transmitted over the line 1. This method of supplying space current to the discharge device 3 could be used in the arrangement shown in Figure 1. The operation of this system will be entirely similar to that of the system shown in Fig. 1, inasmuch as the back electromotive force induced in coil 4, by movement thereof in the magnetic field, will be compensated for by the grid polarizing electromotive force generated in coil 6 of the relay.

Both contacts 13 and 14 may be used to close circuits to any apparatus which may be used and controlled in response to current values in line 1.

The relay shown more in detail in Fig. 3 comprises a central core 8 associated with pole pieces 9 and 10, forming in connection therewith a small air gap, in which coils 4 and 6 are adapted to move. Core 8 and pole pieces 9 and 10 are energized by coil 11 which consists of a sufficient number of turns to provide the necessary field strength between the pole pieces. Coils 4 and 6 are constructed mechanically as a single member and suspended on rod 12 which is pivoted at support 15 and maintained by means of spring 16 in such position that contacts 13 and 14 are normally open. The downward movement of coils 4 and 6 in the magnetic field will close contact 14 and an upward movement thereof will close contact 13.

By the use of a relay constructed as herein disclosed, it has been found possible to control a signal strength indicating apparatus in such a manner that the instantaneous values of the field strength can be accurately recorded.

Relays previously employed, in which the back electromotive force is not compensated for, were not sufficiently sensitive to enable high speed changes in the field strength to be accurately recorded. By the use of a relay, constructed in accordance with the invention, however, the response to variations in signal strength is greatly facilitated and the utility of the apparatus is substantially increased.

Although this invention has been shown and described as applied to a particular system operating in a particular manner, it is not to be limited thereto but only in accordance with the scope of the invention as defined by the following claims.

What is claimed is:

1. A relay comprising means for producing a magnetic field, coils movable in said field, and means controlled by the movement of one of said coils for compensating the back electromotive force induced in the other of said coils.

2. A relay comprising a core provided with a gap, means for energizing said core to produce a magnetic field in said gap, an armature, a plurality of coils movable in said gap and carried by said armature, means for actuating said coils, and means controlled by one of said coils to neutralize the back electromotive force induced in the other of said coils.

3. In combination with a space discharge device having an anode, cathode and grid or control element, a relay comprising means for producing a magnetic field and a pair of coils movable in said field so connected to the electrodes of said space discharge device that the back electromotive force produced by movement of one of said coils is neutralized by that produced in the other of said coils.

4. In combination with a space discharge device having an anode, cathode and grid, a relay comprising means for producing a magnetic field and a pair of coils movable in said field, one of said coils being connected to the grid and the other of said coils being connected to the anode of said space discharge device in such a manner that the back electromotive force produced in one of said coils by movement thereof in the magnetic field is neutralized by the electromotive force produced in the other of said coils.

5. In a relay system including a space discharge device, means for producing a magnetic field, a pair of coils movable in said field, said coils being connected to the

various electrodes of said space discharge device in such a manner that the electromotive force produced across two electrodes by movement of one of said coils in the magnetic field is compensated for by the potential impressed upon said third electrode in response to the electromotive force produced by movement of the other of said coils, a pair of contacts and means for closing said contacts alternately in response to the movement of said coils.

In witness whereof, I hereunto subscribe my name this 6th day of November A. D., 1925.

RAYMOND A. HEISING.