May 28, 1957 W. HOPPE 2,794,158

ELECTROMAGNETIC DEVICE

Filed Nov. 13, 1952

Fig. 1

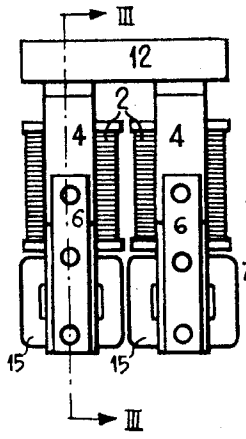


Fig. 2

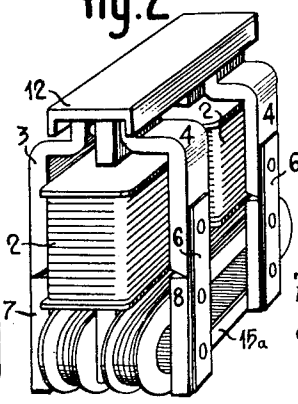


Fig. 3

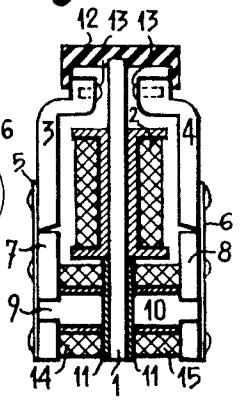


Fig. 4

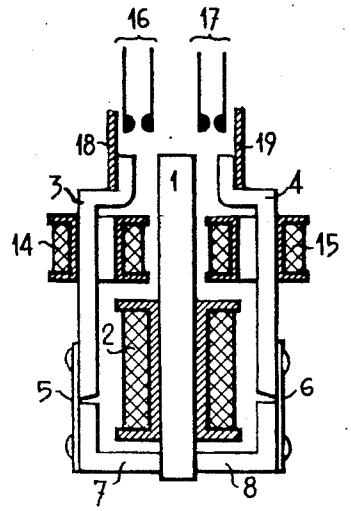
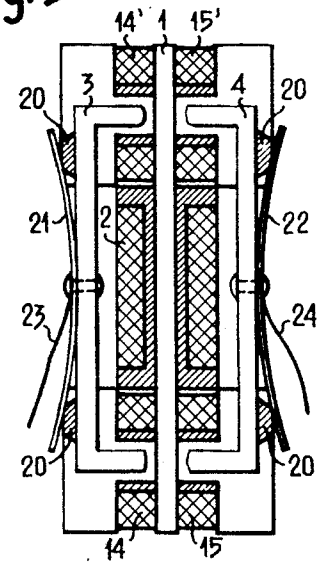


Fig. 5



INVENTOR
WALTER HOPPE
BY Fritz G. Hochwald
AGENT

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ELECTROMAGNETIC DEVICE

Walter Hoppe, Yverdon, Switzerland, assignor to El-Re-Ma S. A. per lo sfruttamento di brevetti, Lugano, Switzerland, a company of Switzerland

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8 Claims. (Cl. 317—189)

The present invention relates to electromagnetic devices, and particularly to electromagnetic devices comprising a relay.

A principal object of the present invention is to provide an electromagnetic device which is adapted to totalize impulses.

It is another object of the present invention to provide an electromagnetic device which can totalize impulses in calculating machines and telephonic installations.

It is a further object of the present invention to provide an electromagnetic device adapted to assume three positions.

It is still another object of the present invention to provide an electromagnetic device which allows a considerable reduction of the number of elements to be used in installations of the kind described.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a side elevation of an embodiment of an electromagnetic device according to the present invention;

Fig. 2 is a perspective view of a second embodiment;

Fig. 3 is a cross section taken along the line III—III of Fig. 1;

Fig. 4 is a similar cross section of a third embodiment of the invention; and

Fig. 5 is a similar cross section of a fourth embodiment of the invention.

Referring now to the drawings and first to Figs. 1 and 3 showing a device comprising two relays, each of the two relays includes a core **1** which traverses a main winding **2** forming part of the relay. The two relays are arranged side by side so that the longitudinal axes of their main windings **2** are located in the same plane. Each relay comprises two movable armatures **3** and **4** which are attached, respectively, by means of resilient members such as leaf springs **5** and **6** to pieces **7** and **8** consisting of magnetic material so as to form part of the magnetic circuit of the relay. The pieces **7** and **8** are rigidly connected to, or form one piece with, parts **9** and **10**, respectively, which consist of magnetic material and are separated from the core **1** by an electric and magnetic insulation **11**. In the rest position of the relays which is shown in the drawings, the movable armatures of each relay abut with one end thereof against an insulating piece **12** which is preferably U-shaped. All the armatures **3** are disposed substantially parallel to one another and with their main parts in a plane substantially parallel to that containing the axes of the main windings **2**. The same applies to the armatures **4**. Each relay is designed in such a manner that if one of its armatures is attracted, a direct electrical contact is established between the core **1** of the relay, which is silvered,

and the end of the armature which carries a contact piece **13** consisting of silver.

Each part **9** and **10** of each relay traverses an auxiliary biasing or polarizing winding **14** or **15**, respectively. The auxiliary windings **14** are connected in series so that their polarizing effects on both armatures **3** are equal. The same applies to the windings **15**.

The electromagnetic device described hereinabove is capable of operation in different manners, and its operation is as follows:

The number of turns of the polarizing windings of each relay as well as the thickness of the insulation **11**, which has the effect of decreasing the remanence of the magnetic circuit, can be chosen in such a manner that when the armatures of a relay are attracted in consequence of the excitation of its main winding **2**, the excitation of the windings **14** or **15** is sufficient for maintaining the corresponding armature in attracted position, whereas the excitation of an auxiliary winding **14** or **15** is by itself not sufficient to cause the attraction of said armature. Each armature of a relay is thus not able to move into its rest position unless the main winding of the relay and the auxiliary winding acting upon this armature are de-energized.

Each polarizing or auxiliary winding may also be so dimensioned that if the field produced by it is directed in opposite direction to the magnetic field of the main winding, the resultant field is too weak for causing an attraction of an armature. In this case, the two groups of auxiliary windings can be so arranged that the action of the auxiliary windings of one group opposes, and the action of the auxiliary windings of the other group aids the action of the main winding. Thus, by changing the direction of the exciting current in the main winding of a relay, one obtains selectively the attraction of one or the other of the armatures.

The device shown in Figs. 1 and 3 comprises two relays, each with two armatures; however, it should be understood that the device could comprise, if desired, a different number of relays and that it could especially comprise one relay only.

For certain applications of the device, it is advantageous to provide different exciting characteristics for the windings of a group of armatures. It is obvious that the polarizing windings of a group may be connected in parallel instead of in series.

The device shown in Fig. 2 comprises two relays and is quite similar to that shown in Figs. 1 and 3. The part **10'** corresponding to the two parts **10** shown in Figs. 1 and 3 traverses an auxiliary or polarizing winding **15***a*, which has an elongated shape and is common to both armatures **4**. The same applies to the part (not shown) corresponding to the parts **9** shown in Figs. 1 and 3. A cross section of the embodiment shown in Fig. 2 would be exactly the same as that shown in Fig. 3.

Referring now to Fig. 4, the auxiliary windings or polarizing windings **14**, **15** are arranged on the movable armatures **3** and **4**, the bobbins of the auxiliary windings **14**, **15** having a neutral aperture of sufficient size for the armatures **3**, **4** to move from the rest position into the attracted position and vice versa. The armatures **3** and **4** cooperate with contact springs **16** and **17**, respectively, through intermediate insulating pieces **18** and **19**. In this embodiment of the invention, the remanence is maintained below a certain value by the gap which is provided between the armatures **3** and **4** and the core **1** in the attracted position of the armatures. It should be noted that in this embodiment of the invention the electrical contact could also be obtained between the armature and the core in the manner indicated in Fig. 3, a gap being provided in this case in the magnetic circuit for diminishing the remanence thereof. The relay could also

comprise two cores insulated electrically from each other so that each armature would close an independent electric circuit.

Referring now to Fig. 5, the relay comprises two armatures 3, 4 which are substantially U-shaped. The armatures 3 and 4 are intended to come into electrical contact with the core 1 at the ends thereof which are for this purpose covered by a layer consisting of a material being a good conductor of electricity and being non-magnetic for keeping the remanence below a certain limit.

Each armature 3, 4 is kept in abutment with abutment pieces 20 by a leaf spring 21 or 22, respectively. Current is fed to each armature by a flexible conductor 23 or 24, respectively. Each end of the armatures 3 and 4 traverses an auxiliary or polarizing winding 14, 14', 15, 15'. The efficiency of the polarizing or auxiliary windings is high, since they are located so as to enclose the gaps separating the armatures 3 and 4 from the core 1 so that the magnetic dispersion is weak.

It should be noted that one could also build electromagnetic devices according to the present invention which include several relays, such as those shown in Figs. 4 or 5, in which at least one group of movable armatures including an armature of each relay could be polarized by means of a common polarizing or auxiliary winding analogous to the winding 15*a* shown in Fig. 2. Each armature of these electromagnetic devices could also traverse an exciting winding associated only with the armature. These electromagnetic devices comprising a plurality of relays offer the same possibilities of operation as those which have been described hereinabove with reference to Figs. 1 and 3. Obviously, electromagnetic devices according to the invention could comprise, if desired, relays with at least two cores which are insulated from each other, and a plurality of movable armatures.

It will be understood that each of the elements described hereinabove, or two or more together, may also find a useful application in other kinds of electromagnetic devices differing from the kinds described hereinabove.

While I have illustrated and described the invention as embodied in an electromagnetic device, I do not intend to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

I claim:

1. An electromagnetic relay device comprising a main winding, a plurality of elongated magnetizable members positioned in end-to-end relationship and forming two substantially closed flux paths each having an air gap, said members including a core common to both of said flux paths and traversing said main winding, said members further including two mechanically independent armatures each included in a respective one of said paths and displaceable between an unoperated position, in which the associated air gap is relatively large, and an operated position, in which the associated air gap is relatively small, restoring means tending to maintain said armatures in said unoperated positions, said main winding being arranged to produce a flux insufficient to displace either of said armatures from its unoperated to its operated position, and biasing means for generating in each of said flux paths a magnetomotive force insufficient to move the respective armature to its operated position in a de-energized condition of said main winding but strong enough to maintain said respective armature operated following a displacement thereof in response to simultaneous and aiding energization of said respective biasing means and of said main winding, said biasing means including a pair of auxiliary windings each surrounding one of said members, other than said core, in a respective one of said flux paths, each of said auxiliary windings being arranged to selectively produce fluxes of opposite polarity, whereby energization of said main winding will result in the operation and holding of any armature associated with a flux path in which the main winding and the biasing winding fluxes are in aiding relationship.

2. A relay device according to claim 1, wherein said main winding is arranged to produce a flux insufficient to operate either of said armatures when energized in bucking relation to the respective auxiliary winding, said auxiliary windings being arranged to produce mutually opposite fluxes in said core whereby energization of said main winding by a current of either polarity will result in the operation of a respective one of said armatures only.

3. A relay device according to claim 1, wherein said members include a pair of connecting elements between said core and respective ones of said armatures, said auxiliary windings surrounding said connecting elements.

4. A relay device according to claim 1, wherein said auxiliary windings surround said armatures with sufficient clearance to enable movement thereof between said operated and unoperated positions.

5. A relay device according to claim 1, wherein each of said armatures is provided with a displaceable main portion and an extremity adjacent said associated air gap extending substantially transversely to said main portion, said auxiliary windings surrounding said extremities and said air gaps.

6. A relay device according to claim 1, further including means in each of said flux paths for increasing the magnetic reluctance thereof.

7. In an electromagnetic device, in combination, at least two relays each comprising a main winding, as well as a plurality of elongated magnetizable members positioned in end-to-end relationship and forming two substantially closed flux paths each having an air gap, said members including a core common to both of said flux paths and traversing said main winding, said members further including two mechanically independent armatures each included in a respective one of said paths and displaceable between an unoperated position, in which the associated air gap is relatively large, and an operated position, in which the associated air gap is relatively small, each of said relays further comprising restoring means tending to maintain said armatures in said unoperated positions each of said main windings being arranged to produce a flux insufficient to displace either of said associated armatures from its unoperated to its operated position; one armature of each of said relays forming part of a first group of armatures, the other armature of each of said relays forming part of a second group of armatures; first biasing means for generating in the flux paths associated with said first group of armatures simultaneous magnetomotive forces insufficient to move said first group of armatures to their operated positions in a de-energized condition of the respective main windings but strong enough to maintain the armatures of said first group operated following a displacement thereof in response to simultaneous and aiding energization of said first biasing means and of said respective main windings; and second biasing means for generating simultaneous magnetomotive forces of like character in the flux paths associated with said second group of armatures; each of said biasing means including auxiliary winding means surrounding one of said members in each of the respective flux paths, each of said auxiliary windings means being arranged to selectively produce fluxes of opposite polarity, whereby energization of said main windings will result in the operation and holding of any armature associated with a flux path in which the main winding and the biasing means fluxes are in aiding relationship.

8. The combination according to claim 7, wherein each of said auxiliary winding means comprises a single biasing winding common to all of said relays.

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