Jan. 27, 1931. H. K. KOUYOUMJIAN 1,790,271

MAGNET AND RELAY

Filed May 21, 1929

Fig. 1.

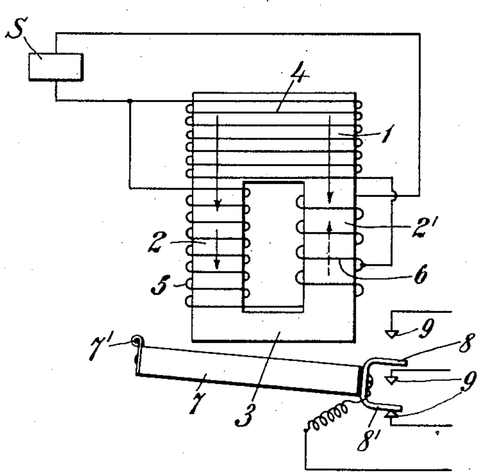


Fig. 2.

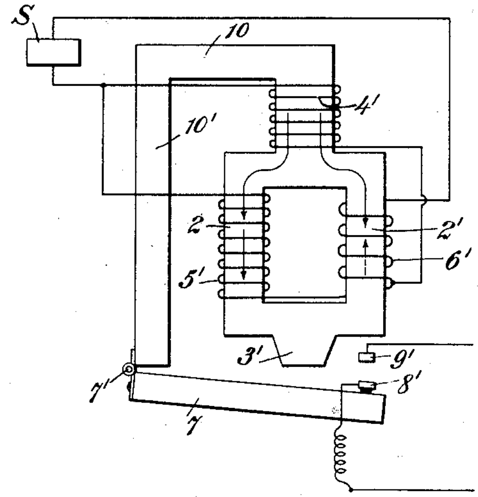


Fig. 3.

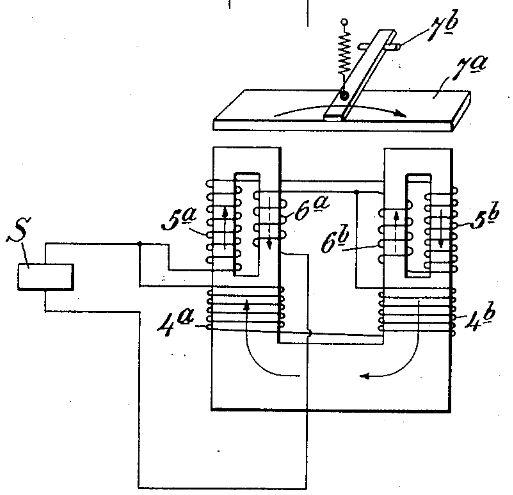
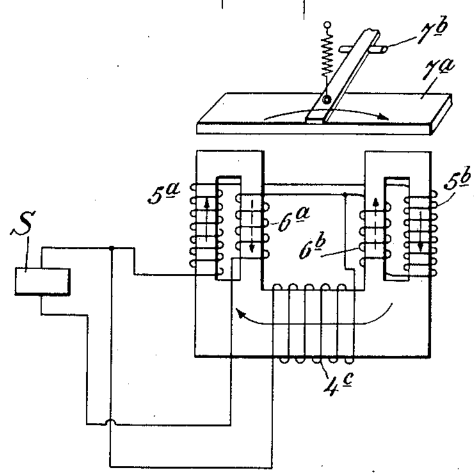


Fig. 4.



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UNITED STATES PATENT OFFICE

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MAGNET AND RELAY

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This invention relates to magnets and relays particularly adapted for exerting a substantially constant magnetic influence on the movable part of the magnet, regardless of commercial variations in the supply voltage, or such undesirable changes in voltage as may be due to the character of the apparatus. The invention is also adapted to control the magnetic influence upon the movable part of the magnet, if desired, in such a manner that instead of maintaining the magnetic influence substantially constant, the same may be caused to strengthen upon decrease in supply voltage, or otherwise serve to fulfill any required conditions in control of the effective flux of the magnet upon variations in the supply of current thereto.

There are many cases in the various uses and applications of magnets and relays where difficulties arise which result in undesired, or unexpected, action of the magnet, or relay, due to changes which cannot easily be controlled. For example, if a magnet is supposed to act only upon absence of exciting current, or interruption of the exciting current, it will often be found that the relay has acted when not intended, due to increased drop in the line wires, increased resistance, abnormal drop in the voltage of the source, such as occurs when a battery approaches the discharged condition, and various other conditions may result in the action of the magnet when not desired.

The main object of the present invention is to overcome undesired operation of the magnet, or relay, under various conditions, such as above referred to, and also to insure that when the movable element of the device is in its attracted or unattracted position, it will dependably remain there. Another object is to insure good contact of the parts controlled by the movable element of the magnet when in any position, and not be subject to varying pressures, or force, such as to cause variable pressures between contacts, uncertainty or hesitancy in operation, chattering and the like. Another object is to accomplish the desired results by a simple form of apparatus which may be conveniently and economically manufactured, and a form of structure that will be durable and reliable in long continued use and one which avoids the use of movable parts in securing the desired results. Another object is to provide a form of construction which is applicable for use with alternating or direct current as the exciting energy. Other objects and advantages will be understood from the following description and accompanying drawings.

Fig. 1 is a diagram illustrating one embodiment of the invention; and Figs. 2, 3 and 4 are similar diagrams of modified forms.

Referring to Fig. 1, the iron or steel core, which should, of course, be laminated when used for alternating currents, is shown as having a main portion 1 from which extends two legs 2, 2′ connected at their ends by a cross-piece 3, although the latter may sometimes be omitted. A main exciting winding 4 envelops the portion 1 of the core, and upon the leg 2 is another exciting winding 5 which is cumulative in its action with reference to the winding 4. On the leg 2′ is another exciting winding 6, but the direction of the turns thereon is such as to tend to set up a magnetic flux in opposition to that of the main winding 4.

Ordinarily, the number of turns in the winding 6 will be less than that in the winding 5, but it will, of course, be understood that the number of turns, proportions of the parts and relationship between the parts will be designed such as to suit particular requirements.

The movable element 7 of the magnet is shown pivoted at 7′ and carrying insulated contactors 8, 8′ adapted to engage the fixed contacts 9 in one position or the other. Obviously, the movable element or armature of the magnet and the contacts engaged thereby may be made in any way desired to secure the particular purposes of control.

In Fig. 1, the long arrows indicate an assumed direction of the magnetic flux due to the main winding 4, the short full line arrow the direction of flux due to the winding 5, and the short dotted line arrow the direction of flux tending to be set up by the winding 6. The source of energy is indicated at S, and this may be of any character and of either direct or alternating current. The cumulative winding 5 is connected across the line in series with the winding 6, although in some cases these coils may be connected in multiple with each other. The main winding 4 is connected across the line through a portion of the winding 6, but it may be connected directly across the line, or to include all or a portion of the winding 6 in series. When alternating current is used, it is desirable to connect this main winding in series with at least a portion of the winding 6, so as to reduce the watt-less current and improve the controlling effect.

Assuming that the direction of the current in the windings at the moment considered to be such as indicated by the arrows in Fig. 1, the action which occurs to give a substantially constant effective flux and a substantially constant force exerted by the magnet, will be understood from the following.

First, assume that the supply voltage to which the windings of the magnet is subjected, to increase somewhat above the normal amount. Ordinarily, this would cause the pull, or attractive force, of the magnet to increase. With this invention, however, an increase in the supply voltage and current in the windings tends to cause an increase in flux due to the increased current in the winding 4, and also in the cumulative winding 5, but the core of the winding 5, under normal conditions, is worked at or just below the knee of the saturation, or permeability, curve. Thus, the increase of flux in the leg 2 is not in proportion to the increase in current, because the magnetization is on, or above, the knee of the saturation curve. The effect on leg 2′, however, is quite different, because the flux density in this leg is made such that it is worked below the knee of the saturation curve, or on the so-called straight portion. Increase of current in the winding 6 thus increases the opposing magneto-motive force and tends to decrease the flux in the leg 2′. This offsets, or cancels, the effect of the attempted increase in flux due to the windings 4 and 5 in the magnet. The parts, may, of course, be proportioned such that the result, upon increase in supply voltage, is to have no effect upon the resultant flux which is effective in holding or attracting the movable element of the magnet. Evidently, the windings and parts can be so proportioned that an increase in supply voltage would give an actual decrease in the attractive or pulling effect of the magnet, or an increased pull, if desired.

Similarly, when the supply voltage drops below the normal amount, the decreased current in the windings 4 and 5 tends to correspondingly decrease the attractive power of the magnet, but the decreased current in winding 6 causes a decrease in its opposing magneto-motive force and as the leg 2′ is worked below the knee of the curve, it permits the flux in this leg to increase to such an extent that it offsets the decreased effect of the windings 4 and 5, resulting in no substantial change in the attractive power of the magnet. Obviously, depending upon the relative number of turns and proportions of the parts, the attractive power of the magnet could, if desired, be made to increase with a decrease of supply voltage, or to decrease; ordinarily, of course, the invention will have its greatest utility in cases where it is desired that the attractive power of the magnet remains unchanged, regardless of variations in the supply voltage of a character which should not affect the operation of the magnet, or relay. Of course, if the magnet, or relay, is to be operated when the exciting current attains a certain predetermined amount, or drops to a certain predetermined amount, the magnet will be designed to operate upon the occurrence of such changes and will, of course, prevent any operation, or substantial change in condition, unless such predetermined limits are reached.

In the form shown in Fig. 2, the form of the magnet is such as to give a return magnetic path through the part 10 extending from the upper part of the magnet and the part 10′ extending to the armature 7, as distinguished from a return air path of the form shown in Fig. 1. The upper portion of the core within the main winding 4′ in Fig. 2 is made smaller than that in Fig. 1, which has the advantage of economy in the size and cost of the main winding 4′. Also, the cross-piece at the lower ends of the legs 2, 2′ is formed with a projecting portion 3′ which tends to localize the path of the flux between the core and the movable element of the magnet and to give a more uniform effect. The main parts of Fig. 2 are numbered corresponding to similar parts of Fig. 1; and as the controlling action is similar to that already described, it need not be repeated.

Fig. 3 illustrates the invention embodied in a two-pole magnet wherein each of the poles is provided with a main winding 4*a* and 4*b*, a cumulative winding 5*a* and 5*b*, and an opposing winding 6*a* and 6*b*, respectively. The armature 7*a* carries the flux between the poles and is adapted to be pivoted at 7*b* on any suitable support and may be caused to give any desired control to parts connected therewith. The general path of the flux is indicated by the long arrows, the direction of the flux due to the cumulative windings 5*a* and 5*b* is indicated by the short full line arrows, and the direction of the flux tending to be set up the windings 6*a* and 6*b* is indicated by the dotted line arrows. The main exciting windings 4*a* and 4*b* are shown connected in series with each other and in series with one of the opposing windings 6*c* across the line; but the main windings may be connected in parallel with each other and connected directly across the line, or through any portion of the windings 6*a* and 6*b*. The operation is similar to that described with reference to Fig. 1, the regulating action occurring in each of the two portions, each of which comprise the two legs of Fig. 1. In some cases, sufficiently good results might be obtained by applying cumulative and opposing windings to one portion only of the double-pole magnet, but in that case the regulation will not be as close as that which may be secured by the form shown in Fig. 3.

Fig. 4 shows a form similar to that of Fig. 3, except that the core of the magnet is considerably shortened and the two main windings 4*a* and 4*b* of Fig. 3 are merged into a single winding 4*c* applied to the portion of the core extending directly between the two-pole portions.

In some cases, the main exciting winding may be superimposed over the cumulative and opposing windings, although in that case the results, if close regulation be desired, will not be so satisfactory as when the main exciting winding or windings are located on other portions of the core. It will be understood that various modifications may be made in the form and construction of the magnet, or relay, to suit particular requirements, without departing from the scope of the invention; and that the forms indicated and the explanations thereof are for general guidance in incorporating the invention in magnets of other forms which may be desirable for special purposes and for securing desired controlling effects.

I claim:

1. A magnet having a core with at least two legs, a main exciting winding on the core, a cumulatively acting winding on one leg and an opposing winding on another leg.

2. A magnet having a core with a main portion and at least two legs extending therefrom towards the movable element of the magnet, a main exciting winding on the main portion, a cumulatively acting winding on one of the legs, and an opposing winding on another of the legs.

3. A magnet having a core comprising two legs joined together at their ends, a main exciting winding on the core, and an opposing winding on one of the legs.

4. A magnet having a core comprising two legs joined together at their ends, a main exciting winding on the core, a cumulatively acting winding on one of the legs, and an opposing winding on the other of said legs.

5. A magnet having a core, an armature, said core having two branch portions for conducting the flux of the core in parallel paths to the armature, a main winding on the core, and a winding on one of said branch portions opposing the main winding.

6. A magnet having a core, an armature, said core having two branch portions for conducting the flux of the core in parallel paths to the armature, a main winding on the core, a cumulatively acting winding on one of said branch portions, and an opposing winding on another of said branch portions.

7. A magnet having a core, a movable element, said core having two branch portions for conducting the flux of the core in parallel paths to said element, a main winding on the core, a cumulatively acting winding on one of said branch portions, and an opposing winding on another of said branch portions, said portions being adjacent to each other and to the movable element of the magnet.

8. A magnet having a core forming two poles, an armature, said two poles being in proximity to the armature and at least one of said poles having two branch portions for conducting the flux of the core in parallel paths to the armature, a main winding on the core, and an opposing winding on one of said branch portions.

9. A magnet having a core forming two poles, an armature, said two poles being in proximity to the armature and at least one of said poles having two branch portions for conducting the flux of the core in parallel paths to the armature, a main winding on the core, a cumulatively acting winding on one of said branch portions, and an opposing winding on another of said branch portions.

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