Sept. 6, 1932. R. HOFGAARD 1,876,295

UNPOLARIZED ELECTROMAGNETIC RELAY

Filed April 5, 1927

Fig. 1.

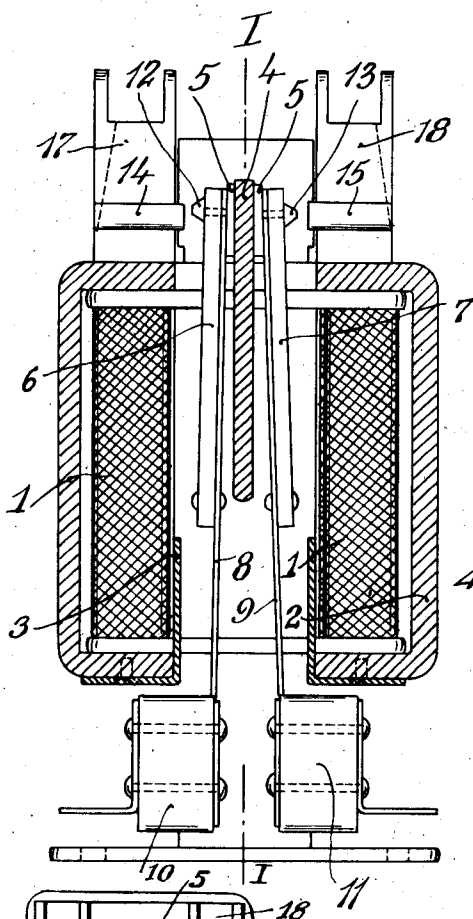
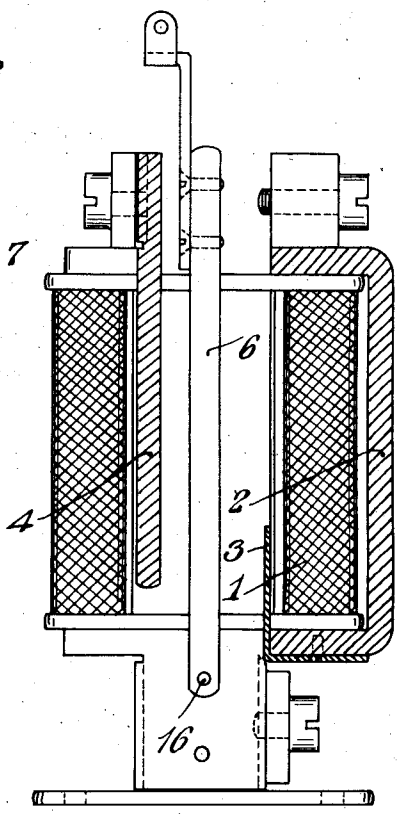


Fig. 2.



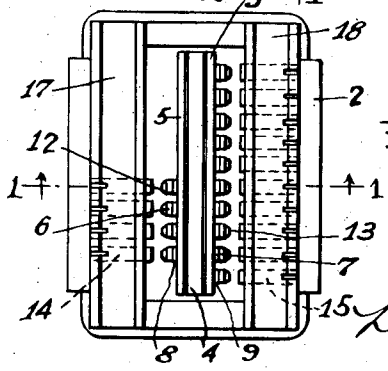


Fig. 3.

INVENTOR
Rolf Hofgaard
by
Langner, Parry, Card & Langner Attys.

Patented Sept. 6, 1932 1,876,295

UNITED STATES PATENT OFFICE

ROLF HOFGAARD, OF STABEKK, NEAR OSLO, NORWAY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO HOFGAARD-REMINGTON CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

UNPOLARIZED ELECTROMAGNETIC RELAY

Application filed April 5, 1927, Serial No. 181,223, and in Germany February 4, 1927.

The present invention has for its object an unpolarized electromagnetic relay, and the purpose of the invention is to provide a relay of the kind specified which operates with the utmost possible speed and utilizes in the best possible manner the forces at disposal for actuating the movable part or parts of the relay.

In order to obtain the highest possible operative speed, the relay is so built as to possess the least possible self-induction and accordingly the least possible amount of electromagnetic inertia.

Hereby is obtained at the same time the advantage that the interruption sparks produced by cutting out the relay are reduced as far as possible.

Secondly the relay is so constructed as to provide paths with the least possible magnetic resistance for the power lines produced by means of the current through the relay coil.

This is obtained by mounting the armature or armatures of the relay inside a relay coil which on the outside is covered by iron in such a manner that the enclosing iron together with the armature or armatures forms as far as possible an uninterrupted path for the magnetic power lines. If so desired, a small stationary core may also be located in the relay coil.

On the drawing two forms of the invention are illustrated diagrammatically by means of axial sectional views which for purposes of clarity are shown approximately twice the size of the actual device.

Fig. 1 is an axial section through an unpolarized electromagnetic relay on line 1—1 of Fig. 3 in accordance with the invention and provided with two armatures or two rows of armatures for the purpose of making contacts.

Fig. 2 illustrates an axial section through another form of the invention, having one single armature or one single row of armatures being adapted to perform a mechanical movement.

Fig. 3 illustrates the relay of Fig. 1 in plan view.

According to the form illustrated in Figs. 1 and 3, 1 is a coil which is wound in the ordinary manner from insulated wire and the axis of which is indicated by the line I—I.

Externally said coil is covered by means of soft iron 2, and this covering or screening iron is continued part of the way from the bottom upwards inside the coil as indicated at 3.

In the centre of the coil there is located a small stationary core 4 made of soft iron which is provided near its upper part and outside the coil with insulated bosses or discs 5. On both sides of this core there are mounted armatures 6, 7 which normally rest with their upper ends against the bosses 5. The armatures 6, 7 are made of iron and are fastened to platesprings 8, 9, mounted on insulated blocks 10, 11 outside the bottom of the coil.

The armatures 6, 7 and core 4 together with the stationary shell or external covering 2 and the extensions 3 of the shell form a substantially continuous magnetic path which offers relatively small resistance to the magnetic flux. This path through the core 4 is interrupted only a sufficient space to permit of the interposition and required movement of the armatures 6 and 7. The distance between the extensions 3 and armatures 6 and 7 may be quite short but must be long enough to prevent the flow of current from the armatures 6, 7, to the extensions in cases where a plurality of movable contact armatures are now used on the same side of the magnet.

The relay here specified is intended for contact-making, and the lines to be closed pass through the springs 8, 9 to contact-pieces 12, 13, mounted on the upper free ends of the armatures and co-operating with stationary contacts 14, 15 which are suitably supported in respective insulators such as the blocks or strips 17 and 18.

Where a plurality of respective armatures 6 and 7 are employed, the strips 17 and 18 will support correspondingly respective series of contacts 14 and 15. Each of the contacts 14, 15 is adapted to be attached to its

respective line, as will be well understood by those skilled in this art.

Coil 1 may have a large extension in a direction vertically on the plan of the drawing, and a large number each of mutually independent armatures 6, 7 may be located respectively side by side in the coil, as shown in Fig. 3.

When the current is closed through coil 1 there is induced a resultant magnetic flux which finds an easy path of flow through the soft iron core 4 and armatures 6, 7, the extensions 3 and the shells 2. This flux induces a like polarity in the core and armatures causing the armatures to move away from the core, the maximum repulsive force occurring when the armatures are at rest and closest to the core, thus quickly overcoming the inertia of rest of the armatures. This flux induces in the upper ends of the shells 2 a polarity of unlike sign with respect to the armatures attracting the armatures outwardly. This attraction increases as the armatures approach the shells and is greatest when the contacts 12, 13 carried by the armatures engage the stationary contacts 14, 15. By using a core 4, the distances over which the forces of repulsion act are only half as long as they would be in the absence of the core in which case these forces would act solely between the armatures.

The construction therefore provides a quick operating magnet, the greatest force of repulsion due to the core 4 and like polarized armatures occurring when the inertia of rest of the armatures has to be overcome, and the force of attraction due to the shell 2 and armatures increasing as the armatures move toward the shell and the force of repulsion due to the core 4 decreases, the result being that there is a continual acceleration of movement of the armatures from the first until contact is made with the stationary contacts. This acceleration due to attraction increases as the armatures approach the shell 2 due to the fact that the magnetic flux flows more easily through the armatures and shell and extensions 3 as the gaps are shortened.

It is obvious also that the movable armatures would in the absence of the core repulse each other and that this repulsion operates in the same manner and for the same purpose as the repulsion from core 4.

As shown in Fig. 1, the armatures 6, 7 when in their outward position are spaced a slight distance from the shell 2 to prevent the current in the armatures from flowing through the shells into other armatures conducting different currents as is usually the case where a plurality of armatures are used on the same side of the relay.

According to the form of the invention illustrated on Fig. 2 there is only a single armature 6 or a single row of armatures inside the coil, and the core 4 is located between this armature or row of armatures and one side of the coil.

When the current is closed through coil 1, armature 6 is moved toward the side of the coil which is covered by iron 2. As the armature 6 shown in this figure does not carry current, it is obvious that it may rest against the shell 2 in its closed position if desired. Preferably its movement is limited by an adjusting screw as shown. Armature 6 is pivoted at 16 and its free end may be connected in some way or other with the mechanical device to be actuated.

I claim:

1. In an electromagnetic relay, a solenoid, two rows of independent moveable armatures mounted inside said solenoid to be operated by the energization thereof, a stationary core between said two rows of armatures, and a body of iron covering said solenoid externally and providing in combination with the armatures inside of said solenoid a path of small resistance for the magnetic flux.

2. In an electromagnetic relay, the combination of a solenoid, a substantially continuous magnetic conductor providing a low resistance path for magnetic flux and comprising a relatively stationary core within said solenoid, a relatively stationary member exteriorly of said solenoid and a movable armature between said core and said stationary member, said armature positioned within said solenoid between said core and said exterior member and movable laterally between said core and said exterior member and forming substantially throughout its entire length a part of an electrical circuit, and means for preventing said armature from electrically contacting with said core and exterior member.

3. In an electromagnetic relay, a plurality of armatures each forming the movable element of a contact device, a solenoid surrounding said armatures and adapted to operate the same substantially simultaneously, and interior and exterior stationary means which together with said armature provide a substantially continuous magnetic path.

4. In an electromagnetic relay, a plurality of armatures each forming the movable element of a contact device, a solenoid substantially rectangular in cross-section surrounding said armatures and adapted to operate the same substantially simultaneously, and interior and exterior stationary means which together with said armature provide a substantially continuous magnetic path, said armatures being arranged in a row lying in a plane parallel to the longest dimension of the solenoid within said solenoid.

5. In an electromagnetic relay, a solenoid, a stationary core of magnetically permeable material within said solenoid, a body of mag-

netically permeable material substantially surrounding the exterior of said solenoid, and a row of independent movable armatures within said solenoid between said core and said solenoid and adapted to be substantially simultaneously operated by the energization of said solenoid, said core, said body and said armatures providing in combination a path of small resistance of magnetic flux for said solenoid.

6. In an electromagnetic relay, a solenoid, a stationary core of magnetically permeable material within said solenoid, a body of magnetically permeable material positioned externally of said solenoid and at least as extensive in vertical area as the vertical area of said core, and a row of independent movable armatures within said solenoid between said core and said solenoid and adapted to be substantially simultaneously operated by the energization of said solenoid, said core, said body and said armatures providing in combination a path of small resistance of magnetic flux of said solenoid.

7. In an electromagnetic relay, the combination of a solenoid, a low resistance path for magnetic flux comprising a relatively stationary core within said solenoid, a relatively stationary member exteriorly of said solenoid and a movable armature between said core and said stationary member, said armature positioned within said solenoid between said core and said exterior member and movable laterally therebetween.

8. In an electromagnetic relay, the combination of a solenoid of substantially rectangular cross-section, soft iron U-shaped plates applied exteriorly to the long sides of the solenoid with their legs extending toward the medial plane of the solenoid to constitute poles of the magnet, extensions on one pair of ends extending upwardly along the inside face of said sides of the solenoid, pairs of oppositely moving armatures arranged back to back in a plane transverse of said long sides and spaced at their lower ends by short gaps from said extensions, and means supporting said armatures for pivotal movement.

9. In an electromagnetic relay, the combination with a solenoid and a movable armature movably mounted for transverse movement within the solenoid and having one end extending beyond the solenoid and its other end terminating within the solenoid, of a soft iron cover for the outer face of the side of the solenoid opposite the armature comprising an inward extension cooperable with said armature when the solenoid is energized and another extension on said cover extending on the inner face of the same side of said solenoid with its end in close proximity to the end of the armature within the solenoid to provide for a substantially closed path for the magnetic flux through the armature and cover when the solenoid is energized.

10. In an electromagnetic relay, a solenoid, an armature contact pivotally mounted to operate in a transverse plane within the solenoid, a soft iron cover for said solenoid provided with a portion extending inwardly over the end of the solenoid to cooperate with said armature when the solenoid is energized, and a contact supported on and insulated from said portion and located to prevent contact between said armature and portion as the armature is attracted by said portion.

11. In an electromagnetic relay, a solenoid, a plurality of contact armatures pivotally mounted to move in parallel planes within the solenoid, a soft iron cover for said solenoid provided with an extension to cooperate with said armatures, stationary contacts with which said armatures contact to complete circuits, and means for supporting said stationary contacts out of electrical connection with said cover and in position to prevent contact between said armatures and cover.

12. In an electromagnetic relay, a solenoid, a plurality of contact armatures pivotally mounted to move in parallel planes within the solenoid, a soft iron cover for said solenoid provided with an extension to cooperate with said armatures, stationary contacts with which said armatures contact to complete circuits, means for supporting said stationary contacts out of electrical connection with said cover and in position to prevent contact between said armatures and cover, and means on said supporting means for supporting a cable having leads extending to said stationary contacts.

13. In an electromagnetic relay, the combination of a solenoid, a pair of armatures oppositely movable in the same plane within the solenoid, a soft iron cover for said solenoid provided with extensions cooperating with said armatures, contacts supported on and insulated from said extensions with which said movable armatures are adapted to engage, and means supporting said armatures out of electrical contact with said cover.

14. In an electromagnetic relay, the combination of a solenoid of substantially rectangular form, two rows of movably mounted armatures within said solenoid, the armatures of each row being movable away from those of the other row toward the side walls of the solenoids, soft iron covers for the sides of the solenoid provided with portions positioned to cooperate with said armatures, and a series of contacts for each row of armatures insulated from each other and from said covers.

15. In an electromagnetic relay, the combination of a solenoid, a pair of oppositely moving armatures mounted for movement in the same plane within the solenoid, a single contact on each armature, a single stationary contact for each armature contact, and a pair

of soft iron covers for said solenoid for attracting said armatures.

16. In an electromagnetic relay, the combination of a solenoid, a pair of oppositely moving armatures mounted for movement in the same plane within the solenoid, a single contact on each armature, a single stationary contact for each armature contact, a pair of soft iron covers for said solenoid for attracting said armatures, and a central core located between said armatures and insulated therefrom and adapted to repel said armatures.

17. In an electromagnetic relay, the combination of a solenoid, a soft iron two part cover for said solenoid constituting a pair of like poles of the magnetic relay, a pair of contact armatures within said solenoid arranged back to back and insulated from each other and adapted to be moved outwardly when said solenoid is energized, a pair of fixed contacts for said contact armatures, and means supporting said armatures to prevent electrical contact with any part of said cover and with each other.

18. In an electromagnetic relay, the combination of a solenoid, a core located within the solenoid and extending axially thereof, and an armature mounted for transverse movement in the space between the core and solenoid and normally lying close to the core, one end of the armature and core terminating outside of the solenoid, and the other end inside of the solenoid.

19. In an electromagnetic relay, the combination of a solenoid, a core located within and extending axially of the solenoid with one of its ends terminating within the solenoid, and an armature on each side of the core mounted for movement between the core and solenoid and terminating within the solenoid.

20. In an electromagnetic relay, the combination of a solenoid, a relatively stationary core having one end extending into and terminating within said solenoid, a relatively stationary member of low magnetic resistance located exteriorly of said solenoid, and a movable armature positioned within said solenoid between said core and said exterior member and movable laterally therebetween.

21. In an electromagnetic relay, the combination of a solenoid, a movable armature movably mounted for transverse movement within the solenoid, a soft iron cover on the outer face of the solenoid comprising an inward extension at one end thereof, cooperable with said armature, and an extension on the other end of said cover extending on the inner face of said solenoid and located between said armature and said cover with its free end terminating within the solenoid to provide for a path of low magnetic resistance for the magnetic flux through the armature and cover.

22. In an electromagnetic relay, the combination of a solenoid, a movable armature movably mounted for transverse movement within the solenoid, a soft iron cover on the outer face of the solenoid comprising an inward extension at one end thereof, cooperable with said armature, an extension on the other end of said cover extending on the inner face of said solenoid and located between said armature and said cover with its free end terminating within the solenoid to provide for a path of low magnetic resistance for the magnetic flux through the armature and cover, and a stationary core within said solenoid located between the armature and the wall of the solenoid on the opposite side of the armature with respect to said second mentioned extension and said cover.

23. In an electromagnetic relay, the combination of a solenoid, a pivoted armature within said solenoid for movement transversely thereof, a stationary core terminating within said solenoid and located between one side of said armature and said solenoid, a U-shaped cover for said solenoid located on the opposite side of said armature and provided with inwardly extending portions extending toward said armature, and an extension on one of said portions, located within the solenoid between said armature and cover and terminating within said solenoid.

In testimony whereof I have signed my name to this specification.

ROLF HOFGAARD.