Oct. 18, 1932. J. ERICKSON 1,883,773

ELECTROMAGNETIC RELAY

Filed May 18, 1931

Fig. 5

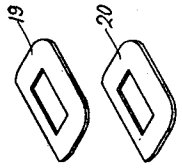


Fig. 4

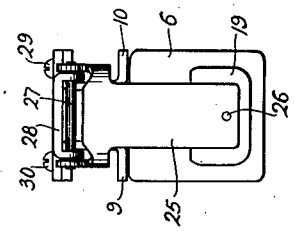


Fig. 3

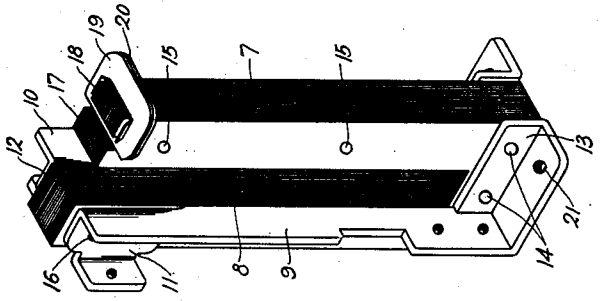


Fig. 2

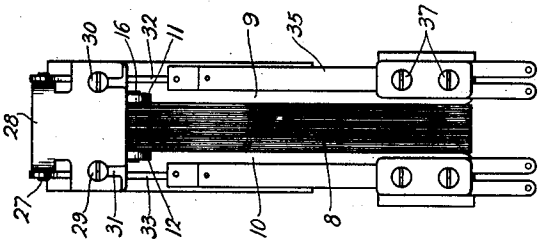
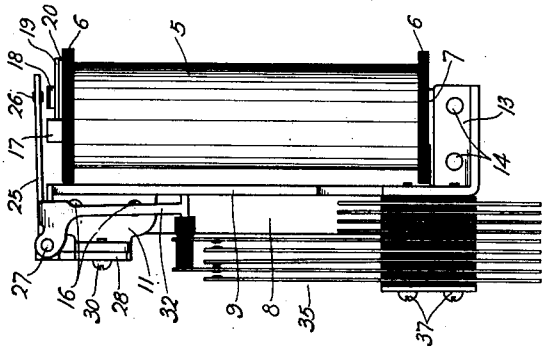


Fig 1



Inventor
John Erickson

Atty.

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UNITED STATES PATENT OFFICE

JOHN ERICKSON, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO ASSOCIATED ELECTRIC LABORATORIES, INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE

ELECTROMAGNETIC RELAY

Application filed May 18, 1931. Serial No. 538,058.

This invention relates in general to electromagnetic relays, but more particularly to relays which are operated by alternating current, and the principal object of the invention is to design a new and improved alternating current relay which will be extremely sensitive and efficient in operation, will control a larger number of contact springs with better contact pressure between the springs, and be simple in construction and economical to manufacture.

In alternating current relays, when the relay winding is energized the armature has a tendency to chatter or hum due to the current in the coil passing through zero potential value. This may effect the contact springs controlled by the armature and result in undesired operations. To avoid this chattering of the armature, various means have been devised to provide a secondary or holding flux in the magnetic circuit of the relay which is out of phase with the primary or main flux of the relay so as to maintain the armature in its attracted position at the time that the main flux ceases to flow due to the cycles of alternating current being at zero potential. This is commonly known as "pole shading" and one method of accomplishing this is to provide a copper ring or short-circuited winding on the armature end of the core.

It is an object of the invention to design a relay having new and improved means for providing a displacement of the main flux flowing through the relay, and in accordance with this object a particular feature of the invention resides in providing a novel shading coil which in general takes the form of a short-circuited winding or ring of electric current conducting material enclosing a portion of a pole face or core of the relay.

A particular feature of the invention resides in providing a plurality of washers made of copper which perform the function of introducing a displacement of the main flux flowing through the core of the relay, and depending upon the number of washers assembled together the amount of this displacement of the flux may be adjustable.

Another feature of the invention is directed to a novel mounting plate and its arrangement for supporting the contact spring sets, the armature, and the relay as a unit.

An additional feature of the invention resides in the means for holding together the laminations of the magnetic structure of the relay and at the same time securely supporting the armature and spring mounting plates to the structure.

The above objects and features and others will be apparent from the following detailed description, which, together with the sheet of drawings, illustrates a preferred embodiment of the invention.

In the accompanying drawing, Fig. 1 illustrates in elevation a relay embodying the invention; Fig. 2 is a rear view of the relay taken from the left-hand side of Fig. 1; Fig. 3 is a perspective view showing only the laminated core and the mounting plates, the other parts of the relay being removed; Fig. 4 is a top view of the relay; while Fig. 5 shows a perspective of a pair of pole shaders or short-circuiting copper rings.

Referring to the drawing, the relay comprises the coil or winding 5 wound between a pair of insulated spool-heads 6 on each end, as seen in Fig. 1. A preferred method of holding the winding of the coil is to provide an insulated or bakelite spool with which the spool-heads 6 may be formed integral. A square-shaped opening is provided in the center of the spool in order that it may be slid over the core of the relay. The bakelite spool with the coil 5 thereby constitutes a separate unit which may be easily slid onto the core and therefore made up separate.

The magnetic structure of the relay comprises a U-shaped magnetic member having a pair of legs 7 and 8 joined together at one end. This magnetic member is preferably

constructed of silicon iron and consists of a plurality of thin pieces of laminations bound together to form a unitary structure. The coil 5 wound upon the spool 6, is placed over the leg 7 of the magnetic member and in this way it serves as a core for the coil.

A pair of substantially Z-shaped non-magnetic supporting plates 9 and 10 are mounted on each side of the leg 8 of the magnetic member. The mounting plate 9 has a turned over extension 11 for supporting one end of the armature while at the bottom of the plate 9 a turned over portion 13 serves as a means for supporting the complete relay on a suitable base. The plate 10 also has a turned up ear portion 12 for supporting the armature, and at the bottom a similar portion such as 13 on plate 9 for supporting the relay. The plates 9 and 10 are secured to the legs 7 and 8 at the bottom of the coil by means of a pair of rivets 14 extending from each of the extensions 13 directly through the laminated pieces of the core to the opposite side where they are riveted together. At the opposite top end of each of the plates 9 and 10 a pair of rivets 16 are provided which extend from extension 11 of the plate 9 through the laminations of the leg 8 to the projection 12 where they are riveted together. Additional rivets 15 on the leg 7 of the magnetic member are provided in order to secure the laminations together on the leg 7. With the foregoing structure it is seen that the laminations and the plates 9 and 10 are secured together by the rivets 14 on the bottom side of the U-shaped magnetic member, and at the top by the rivets 16 to form a solid unitary structure.

The leg 7 of the core is provided at its end with a pair of projections or pole-pieces 17 and 18 separated by a slot so that one or more copper rings 19 and 20 may be placed on the leg 7 surrounding this projection 18. In order to securely hold the copper rings 19 and 20 onto the leg 7, the last two laminations on each side of the leg 7 are bent over on the top of the ring 19. This prevents dislodgment of the rings and at the same time securely holds the coil 5 onto the leg 7. The copper rings 19 and 20 then lie directly upon the top edge of the insulated spool-heads 6.

The armature 25 is provided at its end with a brass residual pin 26 which strikes against the end of pole-piece 18 to prevent sticking of the armature 26 on the core when the coil is deenergized. The armature 25 is pivoted by pin 27 to the supporting member 28 which in turn is secured by screws 29 and 30 in the extensions 11 and 12 of the supporting plates 9 and 10. The screws 29 and 30, when loosened permit the supporting member 28 to slide up or down in the slots 31 and thereby adjust the armature stroke with respect to the ends of the pole pieces 17 and 18. The armature 25 is provided on each side with contact controlling arms 32 and 33 formed integral therewith. These arms are T-shaped at their ends and one end is provided with an insulated bushing for bearing against the contact spring sets 35 when operating them, while the other end serves as a back stop and limits the normal position of the armature. The contact spring sets 35 in addition to suitable soldering tags for coil 5 are secured by screws 37 threaded into the sides of mounting plates 9 and 10. In order to support the relay as a unit on a suitable mounting plate, the screw holes 21 on the plates 9 and 10 are provided.

It will be seen that with the foregoing construction of relay, when the winding of coil 5 is energized by a suitable source of alternating current, a magnetic flux is generated for operating the armature 25 which extends over a path including the laminated core legs 7 and 8, armature 25, and the pole-pieces 17 and 18 at the end of leg 7. This constitutes the main flux which flows through the relay at each cycle of the alternating current. This main flux will induce a current flow into the copper rings 19 and 20 which lags or is displaced in phase relatively to the main flow of current and each time that the main current is at zero potential value the current in the copper rings 19 and 20 will cause a holding flux to follow a path extending from pole-piece 17 through armature 25, back over pole-piece 18 and across the end of leg 7 to pole-piece 17 again. This holding flux is of sufficient strength to maintain the armature 25 in its attracted position between each cycle of the alternating current. It is therefore seen that at zero current value through the coil the holding flux generated due to the current induced in the copper rings 19 and 20 holds the armature against the two pole-pieces 17 and 18 of the core 7 to maintain it in a stable position, and prevent it from fluttering in synchronism with the cycles of alternating current, so that the contact springs 35 will remain operated as long as the alternating current is connected to the coil 5.

When the relay is required to be operated in a circuit which provides a source of alternating current of a low frequency a condition exists in which it is difficult to maintain the armature in an attracted position during the interval that the current is passing through zero potential value. This occurs due to the fact that as the current builds up in the coil 5 in the first half of its cycle the armature is not immediately attracted but only when the flux is strong enough to pull it down upon the pole-pieces 17 and 18. Similarly in this half cycle as the flux decays, the armature will retract before the flux has fully ceased to flow and before the current is at zero potential value. It is therefore seen that before the opposite cycle of current creates a flux in the opposite direction an ap-

preciable time interval exists during which the armature will not remain operated at the low frequencies. To provide for this an additional number of copper washers or rings 19 and 20 are placed on the pole-piece 18 in order to create a greater holding flux out of phase with the main flux through the relay and maintain the armature attracted and stable between each cycle of the alternating current.

In instances where the relay is to be operated by alternating current of high frequencies a lesser number of copper washers 19 and 20 are required because the interval between each cycle of alternating current during which the armature is held attracted is not as long as on low frequencies. For all ordinary purposes on frequencies such as used in the telephone art a pair of copper washers is all that is required.

It is desired in certain instances that a greater number of spring combinations such as 35 be operated by the armature from that shown. When this occurs it will be appreciated that upon operation of the contact spring sets 35 considerable tension will be stored in the armature springs so that when subsequently the current through coil 5 passes through zero potential value it will require considerable force to maintain the armature in its attracted position. In order to induce a greater flow of flux in the holding magnetic circuit for holding the armature attracted in this instance, additional copper rings or washers, such as 19 and 20 may be piled up on the pole-piece 18 in order to create a larger amount of flux from the main flux flowing through the magnetic circuit. Similarly when a smaller set of spring combinations are used on the relay a less number of copper rings may be provided. This provides a convenient method of adjusting the lag in the armature when desired.

Due to the fact that the magnetic circuit is completed over the laminated U-shaped member which is made of silicon iron, a very efficient magnetic circuit is provided that is free of any retarding eddy currents, provides an efficient path for the flux to flow and also be powerful enough to operate the armature 25 to control a large number of contact spring sets.

While only one embodiment of the invention has been shown and described, it is not desired to be limited to the exact arrangement shown and described but also those modifications that may fall within the spirit and scope of the invention.

What is claimed is:

1. In an alternating current relay, a magnetic structure comprising a U-shaped member having a winding on one of the legs, a non-magnetic supporting member on each side of the other of said legs, means on one end of said supporting members for supporting the armature of the relay in operative relation to the end of said first leg, means on the other end of said supporting members for mounting the relay as a unit, means on each of said suporting members for mounting a set of contact springs controlled by the armature, and means on said supporting members for adjusting the movement of the armature against the first leg of the relay.

2. In an electromagnetic relay, a U-shaped laminated magnetic structure having a winding on one leg, a non-magnetic supporting plate on each side of the other leg of the magnetic structure, means on opposite ends of said supporting plate for securing the supporting plates and the laminations of the magnetic structure together, means on one end of said supporting plates for securing the armature of the relay in operative relation to the other leg of the magnetic structure, means on the other end of said supporting plates for mounting said relay, means between the ends of said supporting plates for mounting a set of contact springs controlled by the armature, and means on said supporting plates for adjusting the movement of said armature against the winding leg of the magnetic structure.

3. In an alternating current relay, a U-shaped magnetic structure having a winding on one leg, separate non-magnetic supporting plates on each side of the other leg, means on one end of said supporting plates for connecting them together across the leg of the magnetic structure to form a support for the armature of the relay so that it will be in operative relation with the end of the other leg, means on each of the ends of said supporting plates for securing them to the magnetic structure, and means between the ends of each of the supporting plates for mounting a set of contact springs controlled by the armature.

4. In an alternating current relay, a U-shaped magnetic structure having a winding on one leg, a pair of non-magnetic supporting plates on opposite sides of the other leg, means on one end of said supporting plates for mounting the armature of the relay so that it is in operative relation with the other leg of the structure, non-magnetic washers on the winding leg arranged to provide a magnetic flux displayed in phase relatively to the main flux in the magnetic structure for maintaining the armature attracted to prevent chattering thereof when the current through the winding passes through zero potential, and means on said non-magnetic supporting plates for mounting said relay as a unit and for securing sets of contact springs thereon controlled by the armature.

5. In a relay having a U-shaped magnetic structure, a winding on one leg thereof, a pair of non-magnetic supporting plates on

opposite sides of the other leg of said magnetic structure, projections formed on one end of said non-magnetic plates to form a support for the armature of the relay, said projections connected together and bridging the magnetic leg of the structure to form an adjustable support for varying the movement of the armature against the other leg of the structure, means on the other end of said non-magnetic supporting plates for securing said relay to a mounting plate as a unit, means intermediate the ends of the supporting plate for mounting sets of contact springs controlled by the armature, and means on each end of said supporting plates for securing them to said magnetic structure.

6. An electromagnetic device having an armature and a magnetic structure comprising two legs, an energizing winding on one leg, a mounting member on the other leg, means on one end of said mounting member for supporting the armature in operative relation to said first leg, means on the opposite end of said mounting member for supporting the device as a unit, and means on said mounting member for adjusting the movement of the armature against the first leg of the relay.

7. In an electromagnetic device having an armature, a magnetic structure having a pair of legs, an energizing winding on one leg, mounting plates on each side of the other of said legs, means for connecting said plates together across said other leg to form a pivot for the armature and so that it extends opposite the end of said first leg, shading coils on said first leg opposite said armature, and means on said mounting plates for supporting said device as a unit.

8. In an electromagnetic device, a magnetic structure comprising a pair of legs joined together at one end, an energizing winding on one of said legs, an armature on the other of said legs and extending in operative relation to the first leg, supporting plates on said other leg arranged to pivot said armature and support said device as a unit, shading coils on said first leg opposite the moving end of said armature, and means for holding said shading coils and the energizing winding together on said first leg.

9. In an electromagnetic device having an armature and a magnetic structure comprising two legs, an energizing winding on one of said legs, means for supporting the armature on the other of said legs in operative relation to said first leg, shading coils on said first leg, and means on said first leg for clamping said shading coils and energizing winding together on the leg.

10. In an electromagnetic device having an armature, a magnetic structure having two legs joined together on one end, an energizing winding on one leg, a pair of supporting plates on opposite sides of the other leg, projections on one end of said supporting plates forming a support for the armature and connected together across said leg, means on said armature support for adjusting the movement of the armature against the winding leg, means on the other end of said supporting plates for supporting said device as a unit, and a plurality of shading coils supported around the end of the winding leg opposite said armature and on top of said winding.

In witness whereof, I hereunto subscribe my name this 14th day of May, A. D. 1931.

JOHN ERICKSON.