Sept. 4, 1928. 1,682,749

R. M. GILSON

ELECTRICAL RELAY

Filed Jan. 8, 1923 2 Sheets-Sheet 1

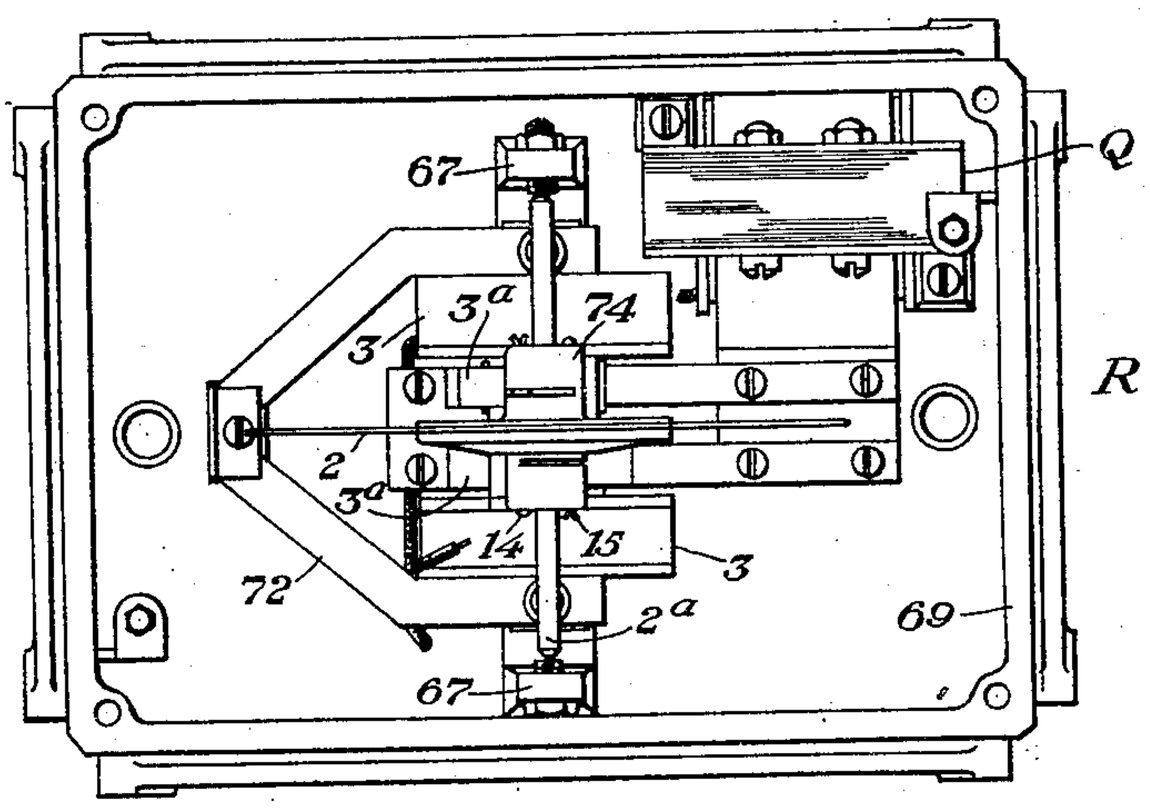

Fig. 2.

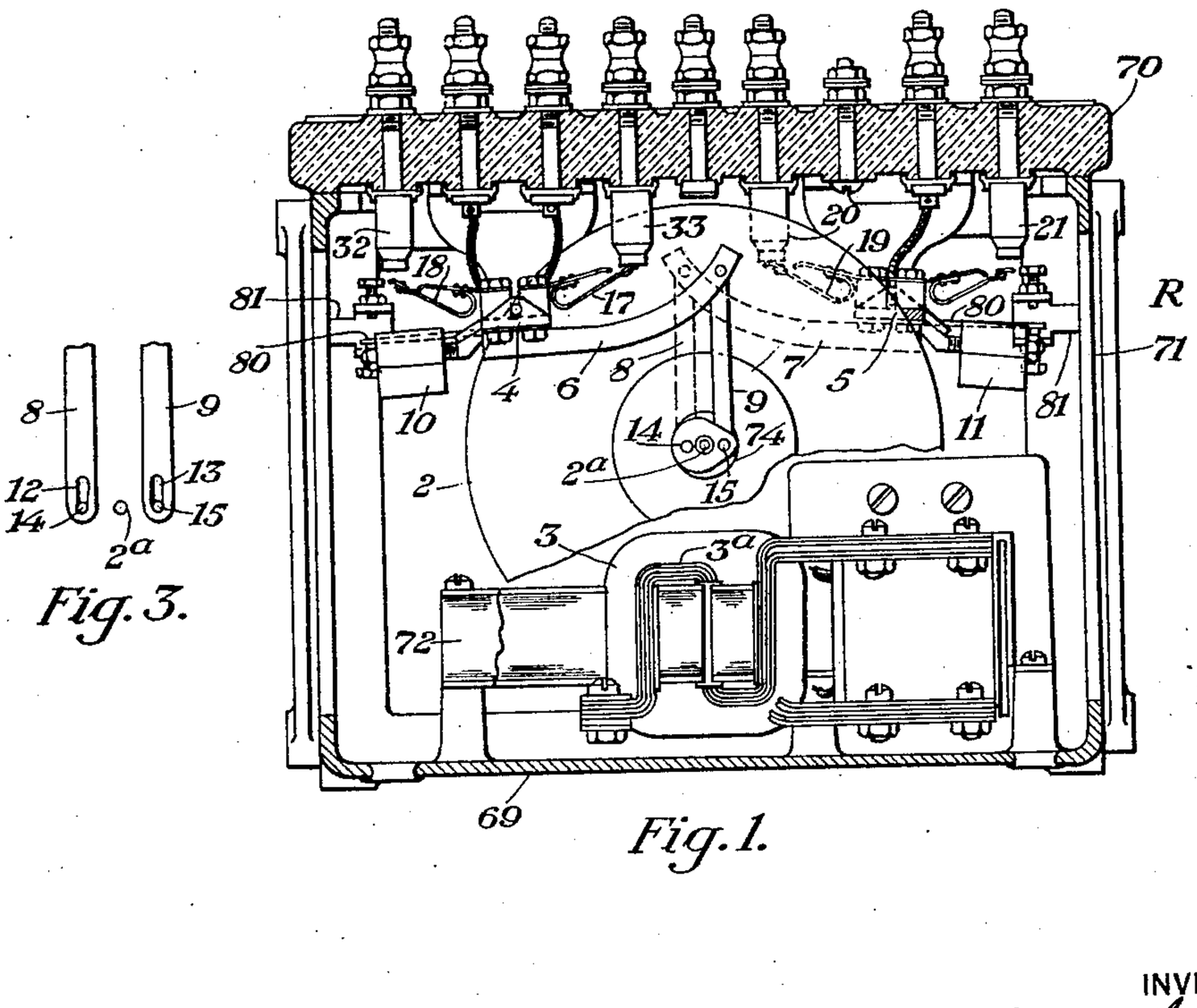

Fig. 1.

Fig. 3.

INVENTOR:
R. M. Gilson,
BY A. L. Vencill
His ATTORNEY

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Fig. 4.

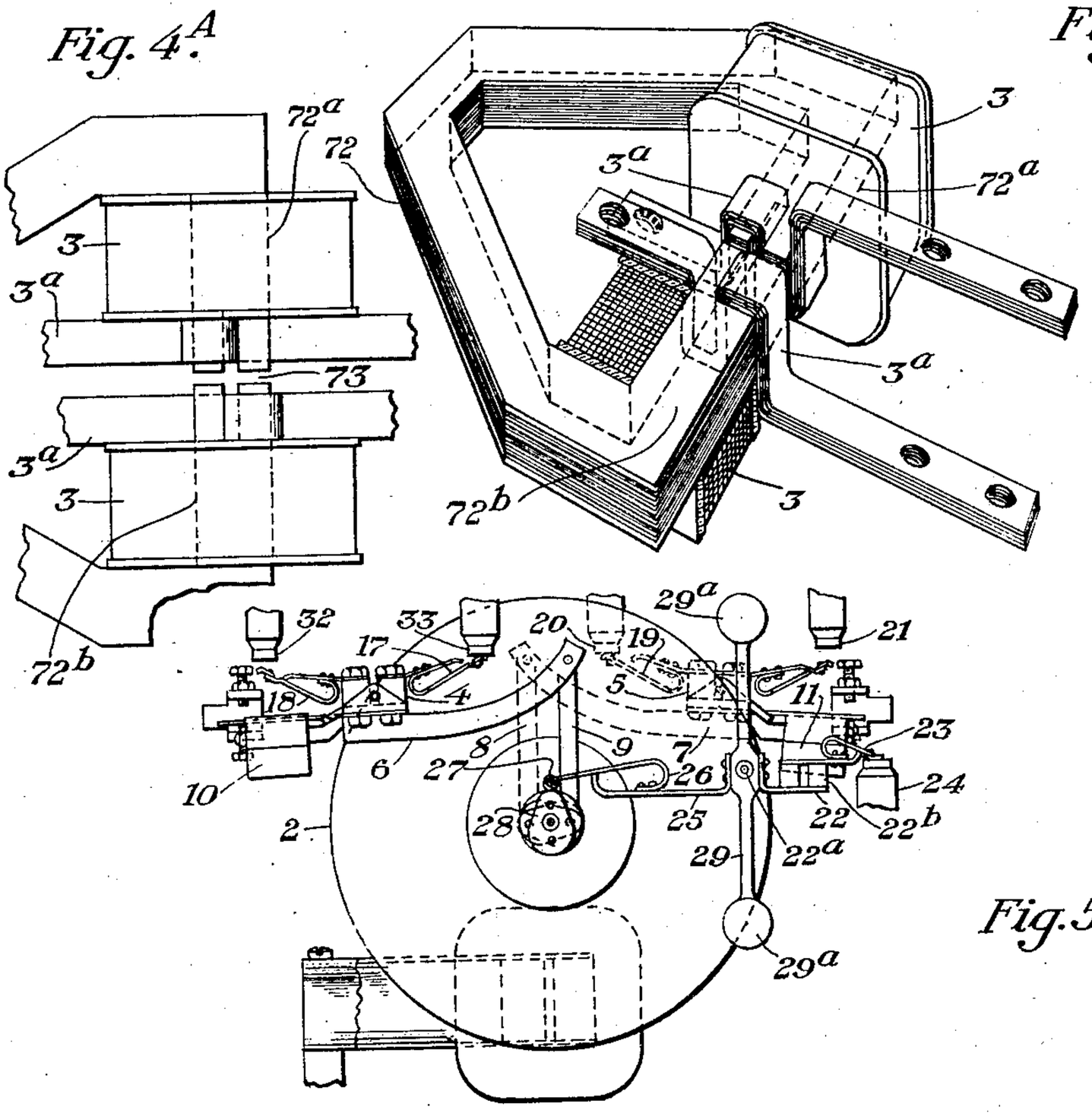

Fig. 4A

Fig. 5.

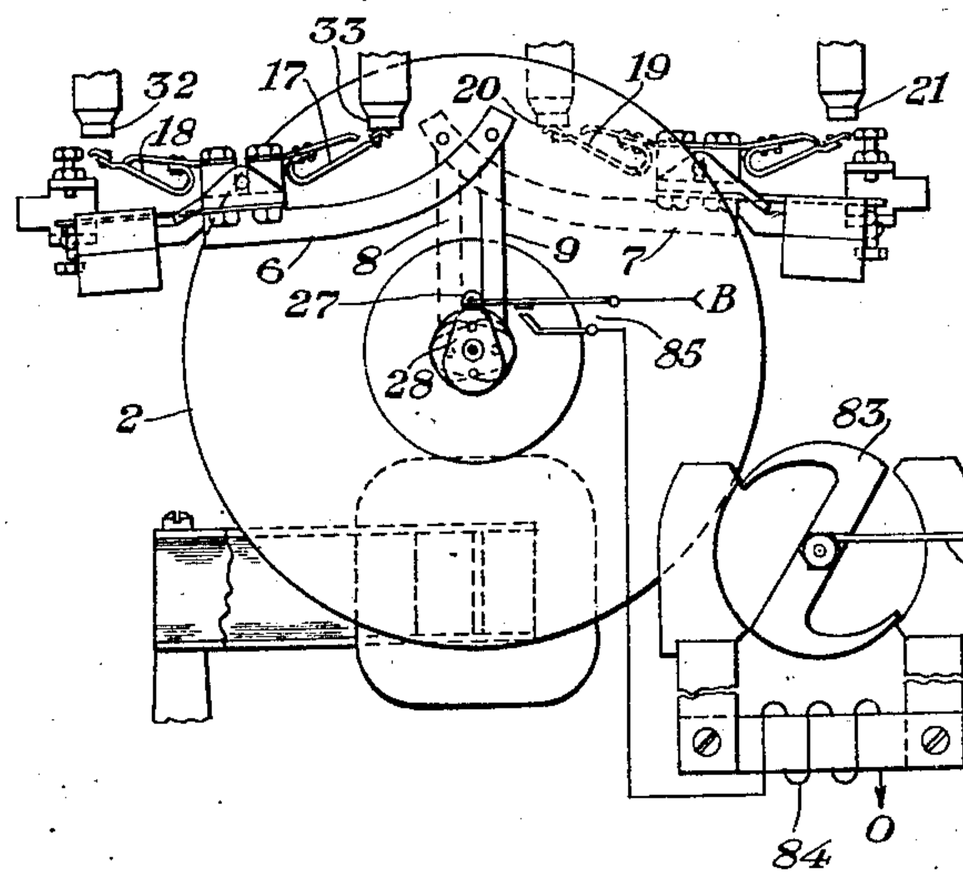

Fig. 6.

INVENTOR:
R. M. Gilson,
BY A. L. Kenneill
His ATTORNEY

Patented Sept. 4, 1928. 1,682,749

UNITED STATES PATENT OFFICE.

ROBERT M. GILSON, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

ELECTRICAL RELAY.

Application filed January 8, 1923. Serial No 611,275.

My invention relates to electrical relays.

I will describe certain forms of relays embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a view showing in vertical section one form of relay embodying my invention, and Fig. 2 is a top plan view, with top plate removed, of the relay shown in Fig. 1. Fig. 3 is a view showing a detail of the relay shown in Figs. 1 and 2. Fig. 4 is a perspective view of the magnetic core and the windings thereon of the relay shown in Figs. 1 and 2. Fig. 4^a is a top plan view of a portion of the magnetic core and windings shown in Fig. 4. Figs. 5 and 6 are views showing modifications of the relay shown in Figs. 1 and 2 and also embodying my invention.

Similar reference characters refer to similar parts in each of the several views.

Referring first to Figs. 1, 2, 3, 4 and 4^a, the relay, which is designated as a whole by the reference character R, comprises a base plate 69 and a top plate 70 spaced apart by glass sides 71. Mounted on suitable supports on the base plate 69 is a substantially U-shaped core 72 of magnetizable material, such as soft iron, having confronting pole-pieces 72^a and 72^b with an air gap 73 between them. This core is provided with a winding comprising two coils 3, 3 surrounding the two pole-pieces, respectively, and usually connected in series when the relay is in use, and this winding I will term the "track" winding of the relay. It will be noted that when alternating current is supplied to this winding an alternating flux is created in the core 72 which at any given instant flows in the same direction across all parts of the air gap 73. The core is also provided with a second winding having two sections 3^a, 3^a, each comprising a plurality of superposed bars of copper or other similar material. These two sections 3^a, 3^a are mounted on the core on opposite sides of the air gap and are usually connected in series when the relay is in service, each section being substantially S-shaped as best shown in Figs. 1 and 4. The upper bar of the S rests against one vertical side of the core, the lower bar rests against the other vertical side of the core, and the middle bar of the S passes vertically through the middle of the core. The two sections 3^a, 3^a are reversed in relative positions as best shown in Fig. 4. When alternating current is supplied to winding 3^a, which I will term the "local" winding of the relay, it will be clear that at any given instant magnetic flux will flow across air gap 73 in one direction between the right hand sections of pole-pieces 72^a and 72^b, and in the other direction between the left-hand sections of these pole faces. The result of this is that when alternating currents of the same frequency but displaced in phase are supplied to windings 3 and 3^a, a shifting magnetic flux will pass through air gap 73, and the direction of travel of this flux will be reversed when the polarity of the current in one winding is reversed with respect to the polarity of the current in the other.

A shaft 2^a is mounted to oscillate in suitable bearings carried by posts 67 which project upwardly from the base plate 69, and fixed to this shaft is an operating member 2 of non-magnetic electro-conductive material such as aluminum in the form of a vane or disk. This member passes through the air gap 73 in core 72, and so is subjected to the shifting magnetic field created by alternating currents in the windings on this core. It follows, of course, that when both windings 3 and 3^a are energized, an electro-magnetic torque will be exerted on member 2 in one direction or the other depending on the relative polarity of the currents in these windings.

It will be observed that with this arrangement the number of turns in the S-shaped winding 3^a is very small compared with the number of turns in winding 3. If, therefore, the two windings are to produce a comparable number of ampere-turns, the current through winding 3^a must be correspondingly great. In practice the current actually required in this winding is of the magnitude of several hundred amperes. As shown in the drawing the immediate source of this current is the secondary winding of a special transformer Q which is placed as close as possible to the winding 3^a in order to reduce losses in connections and in this instance is mounted within the relay case 69. The secondary of this transformer comprises a sin-

gle turn and the primary winding is supplied with alternating signaling current by any suitable means.

Located above the vane 2 are two contact carrying rocker arms 4 and 5, pivotally mounted in brackets suspended from the top plate 70 of the relay. Attached to rocker arm 4 is a horizontal bar 6 the free end of which is pivotally connected with a vertically disposed link 9. Similarly, attached to rocker arm 5 is a horizontal bar 7 the free end of which is pivotally attached to link 8. The lower ends of the links 8 and 9 are provided with slots 12 and 13, respectively, (see Fig. 3) and projecting into these slots are two pins 14 and 15 respectively, which pins are movable with the member 2 and are located on opposite sides of the axis of the member. As here shown, these pins pass through a slotted block 74 which is attached to the member 2 and the shaft 2^a.

Rocker arm 4 controls a set of contacts of which only two are shown in the drawing. One of these contacts comprises a spring 18 attached to the rocker arm 4 and cooperating with a fixed contact block 32, and this I will call the normal contact. The other contact comprises a spring 17 attached to the rocker arm and co-operating with a fixed contact block 33; this I will term one of the middle or back contacts. The rocker arm 5 likewise controls a set of contacts of which only two are shown in the drawing. These contacts comprise a spring 19 attached to the rocker arm and co-operating with a fixed contact block 20 or a fixed block 21 depending upon the position of the rocker arm. Contact 19—21 I will term a reverse contact, and contact 19—20 I will term one of the middle or back contacts of the relay. It is understood that each rocker arm may be provided with a plurality of contacts similar to those shown in Fig. 1, and in Fig. 7 where a plurality of such contacts are shown, the exponents "a", "b" and "c" are used to designate the several contacts of each set.

The two rocker arms 4 and 5 are provided with counterweights 10 and 11 respectively which bias these arms to such positions that the middle or back contacts 17—33 and 19—20 are closed.

Each rocker arm 4 and 5 also carries a bar 80 which co-acts with adjustable front and back stop screws in a fixed block 81, whereby the swinging motion of the arm is restricted to the desired limits.

The operation of the relay shown in Fig. 1, as thus far described, is as follows: When one or both of the stator windings 3, 3^a are de-energized, there is, of course, no electromagnetic torque on the movable member 2, and this member is then held in the position in which it is shown by the action of the counterweights 10 and 11 on the rocker arms 4 and 5. The back contacts 17—33 and 19—20 are then closed, whereas both the normal and reverse contacts are open. I will now assume that both stator windings 3 and 3^a become energized by currents of such relative polarity that a torque is exerted on member 2 in clockwise direction as viewed in Fig. 1. When the member moves in that direction pin 15 drives link 9 downwardly, whereas pin 14 moves freely upwardly in the slot 12 in link 8. The downward movement of link 9 causes the counterweight 11 to rise and also swings the rocker arm 4 in clockwise direction, thereby opening the back contact 17—33 and closing the normal contact 18—32. The member 2 continues its movement until the force exerted by the normal contact plus the torque due to counterweight 10 is equal to the electromagnetic torque exerted on the member. It will be observed that during such operation of the member 2 the contacts controlled by the rocker arm 5 are not affected. As soon as one or both of the stator windings become de-energized, the member 2 will be restored to its biased or initial position by the action of counterweight 10.

I will now assume that the relative polarities of the currents of the stator windings 3 and 3^a are such as to swing member 2 in counter-clockwise direction. Pin 14 then drives link 8 downwardly whereas pin 15 moves freely upwardly in the slot 13. The downward movement of link 8 raises counterweight 11 from its stop and swings the rocker arm 5 in counter-clockwise direction, thereby opening the back contact 19—20 and closing the reverse contact 19—21. During this operation of the member 2 the contacts controlled by rocker arm 4 are not affected. When torque is removed from the member 2, this member is restored to its biased position by the action of the counterweight 11.

Referring now to Fig. 5, the relay shown herein is the same as that shown in Figs. 1 to 4, with the addition of an auxiliary contact 23—24 comprising a fixed contact member 24 and a contact spring 23 mounted on insulating studs 22^b fixed to a member 22. Member 22 is attached to an arm 29 which is pivotally mounted at point 22^a, and also attached to the arm 29 is a bar 25 carrying a spring 26 the free end of which is provided with a roller 27. Roller 27 co-operates with a cam 28 fixed to the shaft on which the movable member 2 is mounted. Arm 29 carries two weights 29^a, 29^a, so that this arm together with the weights constitutes an inertia device for causing retarded operation of contacts 23—24. When the movable member 2 is in its biased or middle position, the roller 27 is raised by the cam 28 and under this condition the auxiliary contact 23—24 is closed. When the movable member 2 is swung in either direction from its biased position, roller 27 is released by the cam 28, where-

upon the auxiliary contact swings to the open position due to the weight of bar 25. I will now assume that the member 2 makes a continuous movement from one extreme position to the other. During such movement the roller 27 is raised momentarily by the cam 28, but owing to the effect of the inertia device 29—29[a] the auxiliary contact 23—24 does not close, so that the only effect of raising the roller 27 is to bend the spring 26. It will be seen, therefore, that when member 2 is in its biased position contact 23—24 is closed, when the member 2 moves to either extreme position this contact opens, and this contact does not close during continuous movement of the member 2 from either extreme position to the other.

It will be observed that when the member 2 swings in either direction from its biased position, the only force tending to oppose movement of the member is the force exerted by counterweight 10 or 11, and so it follows that the relay requires no more operating energy than if the auxiliary contact 23—24 were not provided.

Referring now to Fig. 6, the relay shown in this view is the same as that shown in Fig. 5 except for a modified structure for controlling the auxiliary contact 23—24. In Fig. 6 the movable spring member 23 of this contact is attached to an arm 22 which in turn is fixed to a Z-shaped armature 83 operating in a magnetizable core 82. The core 82 is provided with a winding 84 which is included in a circuit with a suitable source of current the terminals of which are designated B and O in the drawing. This circuit is controlled by a contact 85 governed by the cam 28 and roller 27 in such manner that the contact is open when the member 2 is in its middle or biased position, and closed when this member swings to either extreme position.

The Z-armature 83 and arm 22 are biased to such position that contact 23—24 is closed, but when winding 84 is energized the armature 83 swings to such position that this contact is open. Owing to the sluggish action of armature 83, however, the operation is such that when contact 85 opens momentarily during a continuous movement of member 2 from either extreme position to the other, a complete movement of armature 83 will not occur and so contact 23—24 will not close.

It should be pointed out that the relay shown in Fig. 6 requires no more operating energy from the track circuit than if contact 23—24 were not provided. A certain amount of additional energy is, of course, required for the operation of the Z-armature, but this energy may be supplied from a local source and does not increase the power drawn from the track circuit.

Although I have herein shown and described only a few forms of relays embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. A relay comprising two rocker arms each biased to one position, an operating member pivotally mounted to swing in opposite directions from a middle position, two links operatively connected with said two rocker arms respectively and each provided with a slot, two pins moving with said operating member and projecting into said two slots respectively and so arranged that when the member moves in either direction from its middle position one pin or the other pulls its associated link to move the associated rocker arm in opposition to its biasing force while the remaining pin slides idly in the slot of its associated link, and contacts controlled by said rocker arms.

2. A relay comprising two rocker arms each biased to one position, an operating member mounted to move in opposite directions from a middle position, means interposed between said member and said arms for moving one arm in opposition to its bias when the member moves in one direction from its middle position and for moving the other arm in opposition to its bias when the member moves in the other direction from its middle position, and two contacts controlled by each rocker arm one of which contacts is closed when the arm is in its biased position and the other of which contacts is closed when the arm is moved in opposition to its bias.

3. A relay comprising an operating member biased to a middle position and movable in opposite directions therefrom to two extreme positions, two sets of contacts each set including a normally closed and a normally open contact, means operating when said member moves to one extreme position to open the normally closed contact and close the normally open contact of one set, means operating when said member moves to the other extreme position to open the normally closed contact and close the normally open contact of the other set, an auxiliary contact open when said member occupies either extreme position and closed when said member occupies its biased position, and means for preventing momentary closure of said auxiliary contact during continuous movement of said member from one extreme position to the other.

4. A relay comprising a core of magnetizable material having confronting pole-faces, a winding on said core for inducing magnetic flux in one direction throughout the entire core, a second winding on said core for inducing magnetic flux in one direction in a portion of the core and in the opposite direc-

tion in another portion of the core, an operating member of non-magnetizable electro-conductive material mounted to move between said pole-faces, and a contact controlled by said operating member.

5. A relay comprising a core of magnetizable material having confronting pole-faces, an operating member of non-magnetizable electro-conductive material mounted to move in the air gap between said pole-faces, means for creating an alternating magnetic flux which at any given instant flows in the same direction from all parts of one pole-face to all parts of the other pole-face, means for creating a second alternating magnetic flux which at any given instant flows in one direction from a portion of one pole-face to the confronting portion of the other pole-face and in the opposite direction from the remainder of the first pole-face to the remainder of the second pole-face, and a contact controlled by said operating member.

6. A relay comprising a core of magnetizable material having confronting pole-faces, an operating member of non-magnetizable electro-conductive material mounted to move in the air gap between said pole-faces, means for creating an alternating magnetic flux which at any given instant flows in the same direction from all parts of one pole-face to all parts of the other pole-face, a winding comprising two substantially S-shaped members connected in series and located on said core on opposite sides of said air gap in such manner that the two members are reversed in positions, and a contact controlled by said operating member.

7. A relay comprising two rocker arms each biased to one positon, an operating member mounted to move in opposite directions from a middle position, means interposed between said member and said arms for moving one arm in opposition to its bias when the member moves in one direction from its middle position and for moving the other arm in opposition to its bias when the member moves in the other direction from its middle posi-tion, contacts controlled by said rocker arms, an auxiliary contact open when said member occupies either extreme position and closed when said member is at rest in its middle position, and inertia means for preventing said auxiliary contact from closing during continuous movement of said operating member through its middle position.

8. A relay comprising two rocker arms each biased to one position, an operating member mounted to move in opposite directions from a middle position, means interposed between said member and said arms for moving one arm in opposition to its bias when the member moves in one direction from its middle position and for moving the other arm in opposition to its bias when the member moves in the other direction from its middle position, contacts controlled by said rocker arms, an auxiliary contact biased to the closed position, an electromagnet, a Z-armature controlled by said electromagnet and operating to open said auxiliary contact when said electromagnet is energized, and means for energizing said electromagnet when said operating member moves away from its middle position, the operation of said Z-armature being sufficiently sluggish to prevent said auxiliary contact from closing during a continuous movement of said operating member through its middle position.

9. A relay comprisng an operating member biased to a middle position, and movable in opposite directions therefrom to two extreme positions, contacts controlled by said member, an auxiliary contact biased to the closed position, a slow acting electric motor for opening said contact, and means for energizing said motor when said member occupies either extreme position.

10. A relay comprising an operating member biased to a middle position and movable in opposite directions therefrom to two extreme positions, contacts controlled by said member, an auxiliary contact biased to the closed position, an electromagnet, a Z-armature controlled by said electromagnet and operating to open said auxiliary contact when said electromagnet is energized, and means for energizing said electromagnet when said operating member moves away from its middle position, the operation of said Z-armature being sufficiently sluggish to prevent said auxiliary contact from closing during a continuous movement of said operating member through its middle position.

11. A relay comprising an operating member biased to a middle position and movable in opposite directions therefrom to two extreme positions, contacts controlled by said member, a cam operatively connected with said operating member, a follower controlled by said cam, and an auxiliary contact controlled by said follower.

12. A relay comprising a suitable case, a core of magnetizable material having confronting pole faces and mounted in said case, a winding on said core for inducing magnetic flux in one direction throughout the entire core, a second winding on said core for inducing magnetic flux in one direction in a portion of the core, means contained in said case for supplying current to said second winding, an operating member of nonmagnetizable electro-conducting material mounted to move between said pole-faces and a contact controlled by said operating member.

13. A relay comprising a suitable case, a core of magnetizable material having confronting pole-faces and mounted in said case, a winding on said core for inducing magnetic flux in one direction throughout the entire core, a second winding on said core for in-

ducing magnetic flux in one direction in a portion of the core, a transformer contained in said case for supplying alternating current to said second winding, an operating member of non-magnetizable electro-conducting material mounted to move between said pole-faces and a contact controlled by said operating member.

14. A relay comprising a core of magnetizable material having confronting pole-faces, an operating member of non-magnetizable electro-conductive material mounted to move in the air gap between said pole-faces, means for creating an alternating magnetic flux which at any given instant flows in the same direction from all parts of one pole-face to all parts of the other pole-face, means located adjacent said relay for supplying alternating current to said winding and a contact controlled by said operating member.

15. A relay comprising a core of magnetizable material having confronting pole-faces, an operating member of non-magnetizable electro-conductive material mounted to move in the air gap between said pole-faces, means for creating an alternating magnetic flux which at any given instant flows in the same direction from all parts of one pole-face to all parts of the other pole-face, a transformer having a secondary comprising a very few turns for supplying alternating current to said winding, and a contact controlled by said operating member.

16. A relay comprising a core of magnetizable material having confronting pole-faces, an operating member of non-magnetizable electro-conductive material mounted to move in the air gap between said pole-faces, means for creating an alternating magnetic flux which at any given instant flows in the same direction from all parts of one pole-face to all parts of the other pole-face, a transformer located adjacent said relay and having one turn in its secondary for supplying alternating current to said winding, and a contact controlled by said operating member.

17. A relay comprising two rocker arms each biased to one position, an operating member mounted to move in opposite directions from a middle position, means interposed between said member and said arms for moving one arm in opposition to its bias when the member moves in one direction from its middle position and for moving the other arm in opposition to its bias when the member moves in the other direction from its middle position, auxiliary contacts controlled by said rocker arms, an auxiliary contact controlled by said operating member, said auxiliary contact being open when said member is in either extreme position and closed when said member is at rest in its biased position, and means for preventing said auxiliary contact from closing momentarily during continuous movement of the operating member through its middle position.

18. A relay comprising an operating member biased to a middle position and movable in opposite directions therefrom to two extreme positions, contacts controlled by said member, a cam operatively connected with said operating member, a follower controlled by said cam, a circuit controller operated by said follower, and an auxiliary contact controlled by said circuit controller.

19. A relay comprising an operating member biased to a middle position and movable in opposite directions therefrom to two extreme positions, contacts controlled by said member, a cam operatively connected with said operating member, a follower controlled by said cam, a circuit controller operated by said follower, a slow acting electric motor controlled by said circuit controller, and an auxiliary contact controlled by said motor.

In testimony whereof I affix my signature.

ROBERT M. GILSON.