

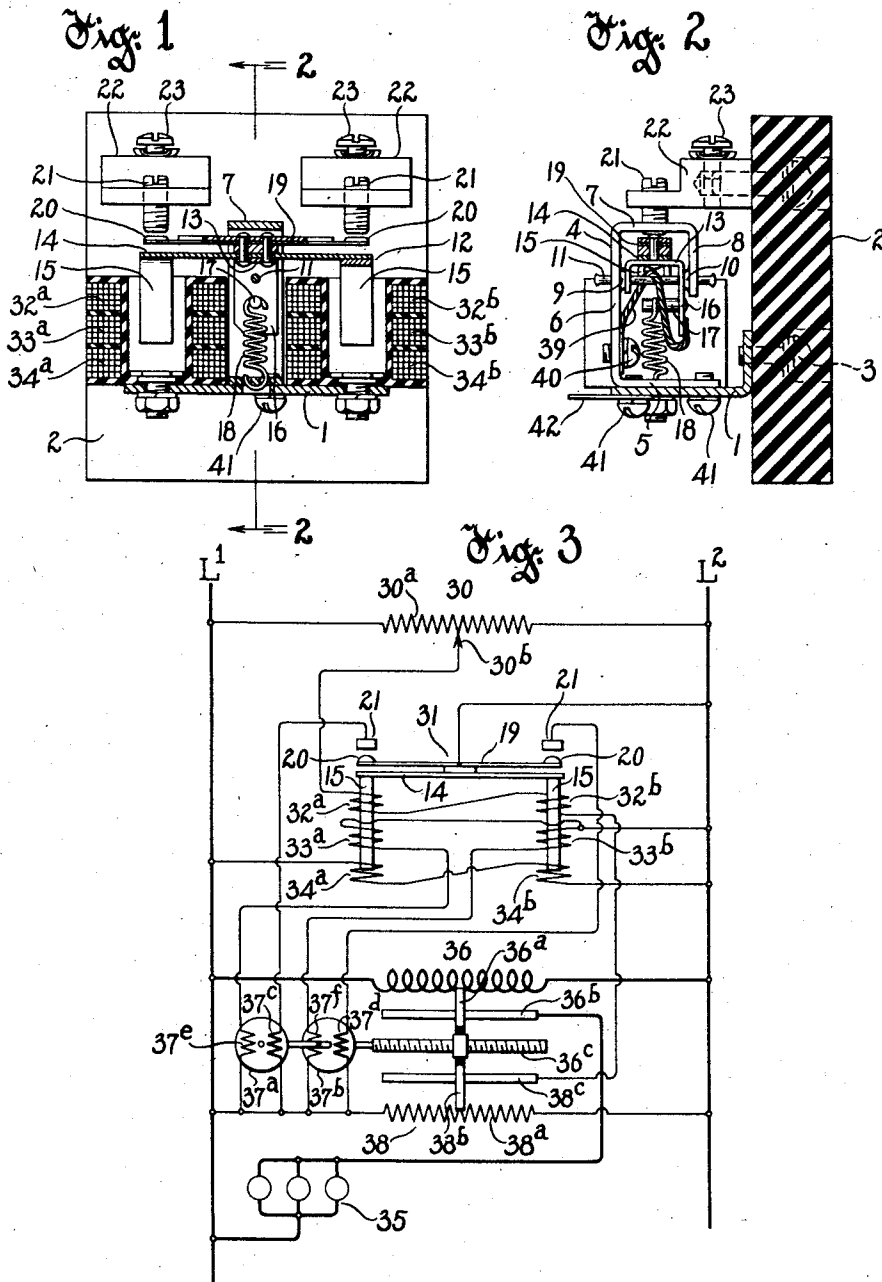
March 24, 1942.

C. T. EVANS

2,277,653

ELECTROMAGNETIC RELAY

Original Filed July 20, 1939



Inventor
Clarence D. Evans
By Frank H. Hubbard
Attorney

UNITED STATES PATENT OFFICE

2,277,653

ELECTROMAGNETIC RELAY

Clarence T. Evans, Wauwatosa, Wis., assignor to
Cutler-Hammer, Inc., Milwaukee, Wis., a cor-
poration of Delaware

Original application July 20, 1939, Serial No.
285,533. Divided and this application May 23,
1940, Serial No. 336,707

4 Claims. (Cl. 172—239)

This invention relates to electromagnetic re-
lays, and, while not limited thereto, the inven-
tion relates more particularly to a polarized re-
lay which upon response controls the circuit of
a translating device.

This application is a division of my copending
application, Ser. No. 285,533, filed July 20, 1939,
for a Voltage regulator.

An object of the invention is to provide a relay
which is very sensitive to variations of the con-
trol current.

Another object is to provide a relay which is
positive in opening and closing its contacts in re-
sponse to such variations of the control current.

Another object is to provide a relay in which a
magnetic force which is a function of the operat-
ing current of the controlled circuit is super-
imposed upon the magnetic force which initiates
the response of the relay.

Other objects and advantages will hereinafter
appear.

The accompanying drawing illustrates an em-
bodiment of the invention as applied to a center-
biased polarized relay.

In the drawing, Figure 1 is a vertical cross sec-
tion of a relay embodying the invention.

Fig. 2 is a vertical transverse cross section of
the relay, on the line 2—2 of Fig. 1.

Fig. 3 is a diagram of connections of a control
system embodying the relay illustrated in Figs. 1
and 2.

Referring to Figs. 1 and 2 the relay comprises a
bracket 1 which is arranged to be supported from
an insulating base 2 by means of screws or other
holding means 3. Attached to the bracket 1 is a
second bracket 4. The bracket 4 is made of strip
metal and comprises a horizontal foot portion 5
by means of which it is fastened to the bracket 1,
a vertical portion 6 bent upwardly at a right
angle to the foot 5, a horizontal top portion 7
which is parallel to the foot 5 and a depending
vertical portion 8 which is in a plane at right
angles to the plane of foot 5 and parallel to the
portion 6. The portions 6 and 8 are provided
with aligned bearings 9 and 10 to receive a hori-
zontal shaft 11 for pivotal support of an arma-
ture 12. The armature 12 comprises a horizontal
lever 14 to which is attached a bearing bracket
13. At each end the lever 14 carries a magnetiz-
able core 15, said cores being preferably of
U-shape as illustrated. Each of the magnet cores
15 is surrounded by three magnetizing coils as
will be explained hereinafter. The lever 14 is
pivotally supported by bracket 13 upon the pivot
shaft 11 and is rotated thereabout in one direc-

tion or the other when the pulls upon the two
cores 15 differ from each other. The bracket 13
is provided with a depending extension 16 which
carries a horizontal pin 17 and a biasing spring
18 is interposed between the same and the foot
portion 5 of bracket 4 so as to bias the armature
12 normally to the central or intermediate posi-
tion thereof illustrated.

Riveted to the central part of the lever 14, but
offset upwardly from the latter, as by means of
an interposed metallic spacer, is a double-ended
contact spring 19 which carries at each end a
contact button 20, which buttons 20 are selective-
ly movable into engagement with adjustable sta-
tionary contacts 21 respectively associated there-
with which are screw-mounted on brackets 22,
the brackets 22 being supported by the insulat-
ing base 2 and each being provided with a ter-
minal 23 for the attachment of a circuit wire
leading thereto for connection of the respective
stationary contacts in the respective circuits.

As shown in Fig. 2 bracket 13 has attached to
its extension 16, as by spot-welding, one end of a
wire or pigtail 39, the other end of which is at-
tached by a screw 40 to the portion 6 of bracket
4. By the means illustrated a good electrical
connection is provided between the contact
spring 19 and bracket 4; the securing screws 41
insuring a good mechanical and electrical con-
nection between brackets 1 and 4, and a solder-
type wiring terminal 42 (Fig. 2) being clamped
in position by one of the screws 41 to provide
for connection of a third wire common to the two
circuits shown diagrammatically in Fig. 3.

It will thus be apparent that if the armature is
rotated in one direction or the other a circuit is
closed between a contact button 20 on spring 19
and one or the other of the stationary con-
tacts 21.

Referring now to Fig. 3 the same illustrates a
power supply system represented by lines L¹ and
L² and a sender potentiometer 30 having a re-
sistance 30^a which is connected between the lines
L¹ and L² and which is provided with an adjust-
able contact brush 30^b. A relay 31 like that just
described is provided with three pairs of magne-
tizing coils 32^a, 32^b, 33^a, 33^b and 34^a, 34^b, respec-
tively, one coil of each pair surrounding one of
the magnet cores 15. The coils 34^a and 34^b are
connected across the lines L¹ and L² in such a
manner that the pulls which they exert upon the
respective cores 15 are equal and tend to rotate
the armature 12 in opposite directions thereby
tending to balance the latter.

The system further includes a group of lamps

35 and a lamp illumination intensity regulator in the form of a rheostat or transformer 36 the winding of which is connected across the lines L¹, L². The lamp regulator 36 is provided with a movable contact brush 36^a which connects different taps of the regulator 36 to the bus bar 38^b. The brush 36^a may be moved to different taps by a screw 36^c which is operable selectively by a pair of motors 37^a and 37^b rotatable in opposite directions respectively. A receiver potentiometer rheostat 38 has a resistance 38^a which is connected across the lines L¹ and L² and which is provided with a sliding contact brush 38^b, which connects the rheostat to the bar 38^c. The brush 38^b is attached to and movable simultaneously with the brush 36^a so that the position of the former always corresponds to the illumination intensity of the lamps 35. The pair of coils 32^a and 32^b on the left and right hand cores respectively of the relay are so connected relatively to each other and to the pair of coils 34^a and 34^b that a current flowing in one direction or the other in the former pair of coils modifies or counteracts the balanced pull of the latter pair of coils upon the cores 15 whereby the armature 12 (see Fig. 1) and consequently the contact spring 19 are rotated or tilted in one direction or the other. The coils 32^a and 32^b are connected in series between the brush 30^b and the contact bar 38^c. Hence if there is a potential difference between the brushes 30^b and 38^b this is impressed upon the coils 32^a and 32^b and the resulting current unbalances the relay so that its armature is rotated in one or the other direction, depending upon whether the lamp intensity and therefore the voltage of potentiometer brush 38^b is higher or lower than the desired intensity, which corresponds to the position of the brush 30^b. The movable contact buttons 20 of the relay are both connected to line L², while one terminal of each of the operating windings 37^c and 37^d, respectively, of the motors 37^a and 37^b is connected to line L¹, and the other terminals of the respective windings are connected to the terminals of the left hand and right hand stationary contacts 21, respectively, of the relay. Hence if the lamp voltage differs from the desired value corresponding to the position of brush 30^b the armature 12 is rotated or tilted, and consequently one or the other of the motors 37^a or 37^b is energized to change the position of the brush 36^a and thus provide the desired lamp brilliancy.

As the system again approaches the balanced condition the current in the coils 32^a and 32^b approaches zero and the torque exerted by the interaction of the coils 34^a, 34^b and 32^a, 32^b heretofore described also approaches zero, thereby decreasing the pressure of the particular relay contact 20 against its associated stationary contact 21, thus tending to produce arcing and chattering at said contacts. This is avoided by associating with each magnet core 15 a third coil 33^a and 33^b, respectively, and connecting these coils in parallel with each other across lines L¹ and L² in series with coils 37^c and 37^d, respectively; the latter coils being wound in inductive relation to the operating windings 37^c and 37^d of the motors 37^a and 37^b, respectively. Thus as soon and as long as either motor is energized an additional torque is exerted upon one or the other core 15 of the relay to increase the pressure of the active contact button 20 against its associated stationary contact 21 to thereby prevent chattering or vibration of the armature and arcing at such contacts. It will be observed that the coils 33^a

and 33^b are permanently connected across the supply lines in series with the respective coils 37^c and 37^d. But the current flowing there-through when both motors are disconnected affects the pull on the respective relay cores 15 equally but in opposite directions and therefore they do not unbalance the relay. Furthermore the pull is very low because the inductance of the circuit is relatively high. If, however, current flows through one of the motor operating windings, a supplemental voltage is induced in the respective coil 37^c or 37^d, which unbalances the pull exerted by the coils 33^a and 33^b and substantially increases one of them which assists in maintaining the relay contacts closed until the current in coils 32^a and 32^b is again substantially zero, at which time the only unbalanced torque remaining is due to the coils 33^a and 33^b, which is insufficient to maintain the relay contacts closed, whereupon they open and disconnect the respective motor and this again establishes equal current flow in the coils 33^a and 33^b.

Furthermore, if it should be desirable to increase the natural sensitivity of the relay, the coils 37^c and 37^d may be connected in the reverse way from that described so that upon energization of the respective motor winding 37^c or 37^d, the unbalanced pull on the relay armature 12 by coils 32^a and 32^b is decreased or counteracted by the tendency of coil 37^c or 37^d (as the case may be) to open or disengage the active pair of relay contacts 20, 21, thus decreasing the range between the closing pull required to be exerted by the coils 32^a and 32^b and the point at which the pull of said coils for effecting closure of one or the other of the sets of contacts 20, 21 is neutralized to permit opening thereof by the balancing elements.

What I claim as new and desire to secure by Letters Patent is:

1. A polarized relay for controlling a pair of circuits comprising, a center pivoted lever, means to bias said lever to a neutral position, contacts for selectively energizing one of a pair of circuits in response to departure of said lever from said neutral position in opposite directions, a magnetizable core attached to each end of said lever, auxiliary windings adapted when energized to produce equal fluxes in said core resulting in balanced torques on said lever, control windings adapted when energized to cause a current flowing therein to increase one and to simultaneously decrease the other of said fluxes by substantially equal amounts, and compound windings respectively connected in a circuit energized by the current flowing in the respective circuit and adapted to cause said current to induce a supplemental flux in the respective core which is a function of the current of said respective circuit.

2. A polarized relay for controlling reversible motor means comprising, a center pivoted lever, means to bias said lever to a neutral position, contacts for reversibly energizing said first mentioned means in response to the departure of said lever from said neutral position, a magnetizable core attached to each end of said lever, auxiliary windings surrounding each core and adapted to induce fluxes in said cores resulting in individual pulls thereon tending to rotate said lever in opposite directions, control windings adapted when energized to cause a current flowing therein to increase the flux in one core and simultaneously decrease the flux in the other core by substantially equal amounts and to reverse said effect upon reversal of the current in said control wind-

ings respectively and compound windings, connected in a circuit energized by the current flowing in said motor means and adapted to cause said current to induce a supplemental flux in said cores which is a function of the current of the motor means.

3. A polarized relay for controlling reversible motor means comprising, a center pivoted lever, means to bias said lever to a neutral position, contacts for reversibly energizing said first mentioned means in response to the departure of said lever from said neutral position, a magnetizable core attached to each end of said lever, an auxiliary coil surrounding each core and adapted when energized to exert equal pulls on said cores tending individually to rotate said lever in opposite directions, a control coil on each core, said control coils when energized increasing and decreasing the pull on their respective cores by equal amounts, said increase and decrease depending upon the magnitude and direction of the current flowing in said control coils, and a compound coil on each core connected in a circuit energized by the current flowing in said motor means and adapted when energized to exert a supplemental pull on the respective core

which is a function of the current of the motor means.

4. A polarized relay for controlling reversible motor means comprising, a center pivoted lever, means to bias said lever to a neutral position, contacts for reversibly energizing said first mentioned means in response to the departure of said lever from said neutral position, a magnetizable core attached to each end of said lever, an auxiliary coil surrounding each core and adapted to induce fluxes therein resulting in individual pulls thereon tending to rotate said lever in opposite directions, a control coil on each core, said control coils when energized increasing and decreasing the flux on their respective cores by equal and opposite amounts, said increase and decrease depending upon the magnitude and direction of the current flowing in said control coils, and a compound coil on each core connected in a circuit energized by the current flowing in said motor means and adapted to cause said current to induce a supplemental flux in the respective core, which is a function of the current of the motor means.

CLARENCE T. EVANS.