

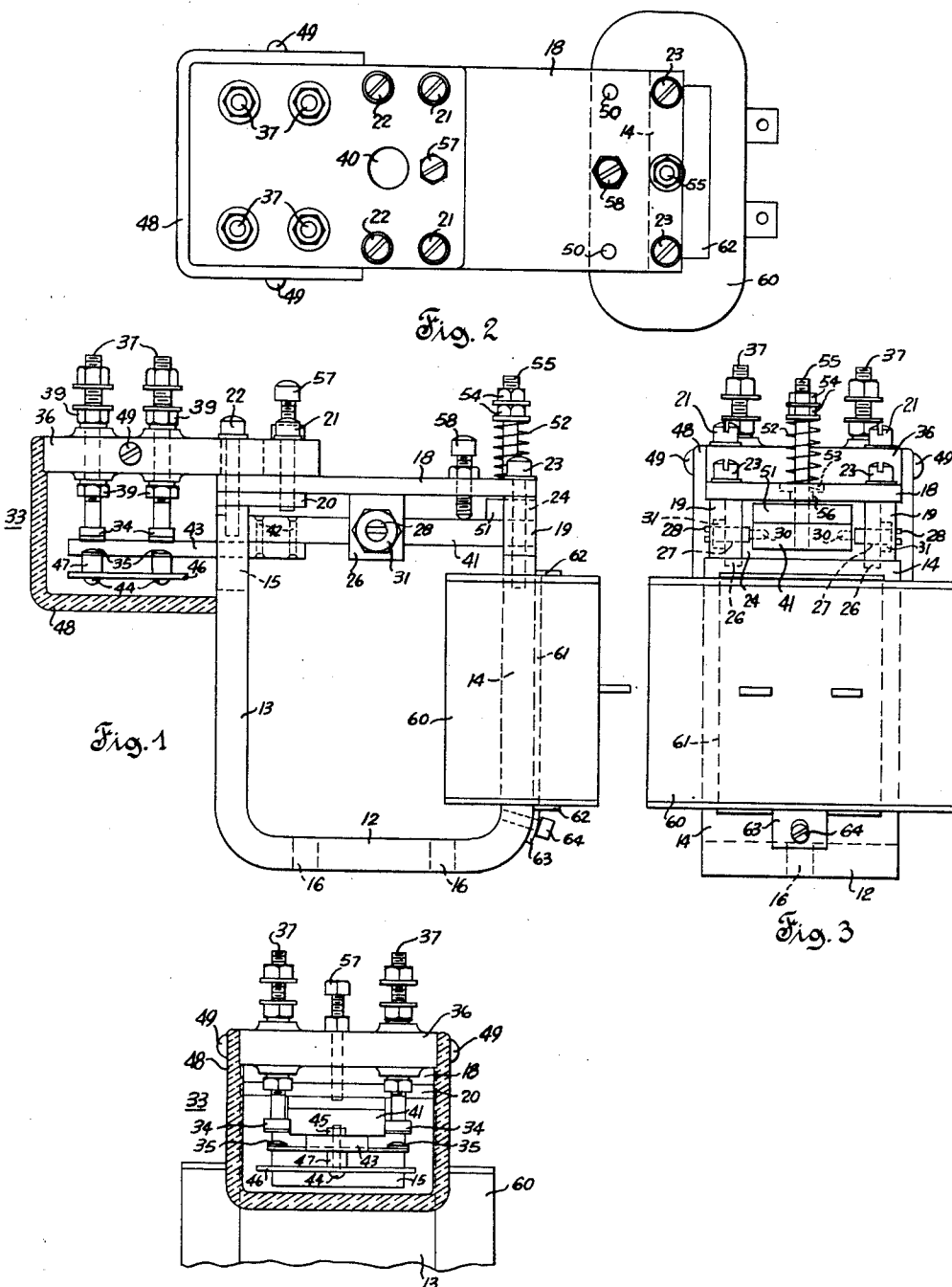
June 26, 1951

J. WUGLER
THROUGH CONDUCTOR RELAY WITH
DETACHABLE ARMATURE ASSEMBLY

2,558,640

Filed June 8, 1948

3 Sheets-Sheet 1



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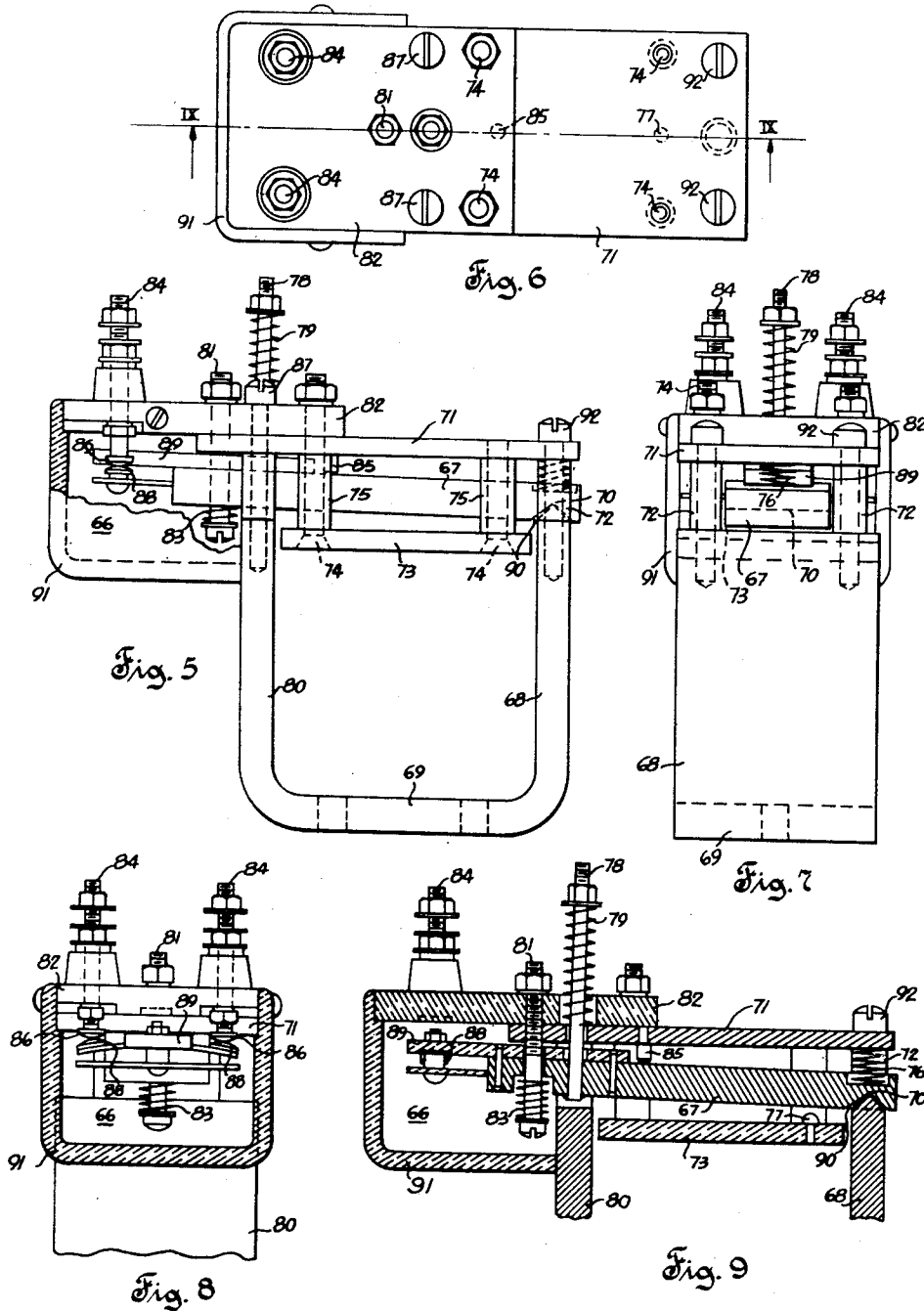
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3 Sheets-Sheet 3

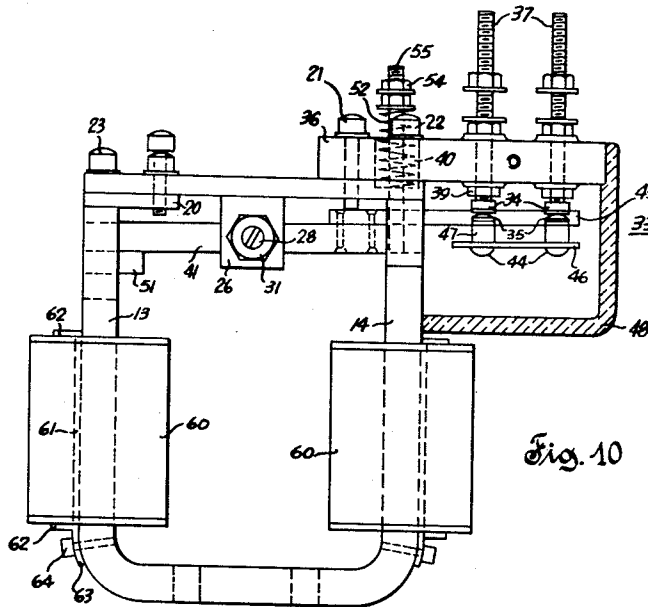


Fig. 10

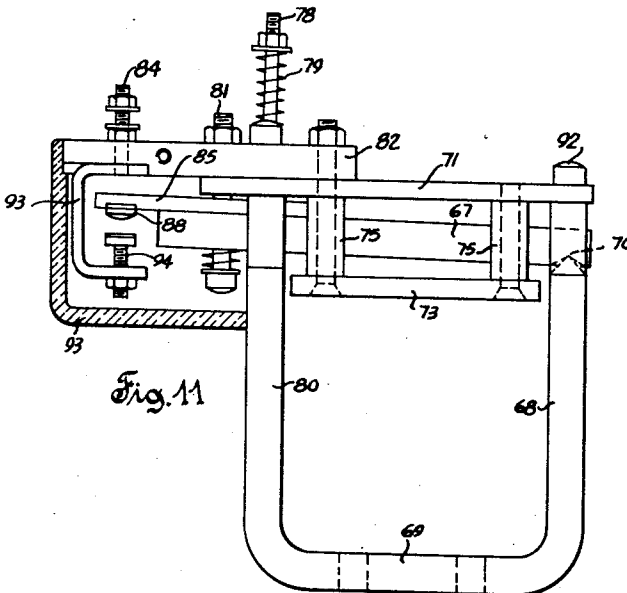


Fig. 11

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UNITED STATES PATENT OFFICE

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THROUGH CONDUCTOR RELAY WITH
DETACHABLE ARMATURE ASSEMBLY

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This invention relates in general to improve-
ments in relays, and more particularly to through
conductor current relays.

Through conductor type relays are mounted
so that a bus bar or cable passes through its mag-
netic core. For mounting the relay it is generally
necessary to remove the frame and the armature
from the core. In doing so the adjustments of
the relay which determine its operating charac-
teristics are disturbed, requiring the relay to be
readjusted or adjusted only after it is installed.

It is therefore advantageous to use a through
conductor type relay which can be disassembled
for mounting the relay without disturbing any
of its operating adjustments. A preferred em-
bodiment of such a relay comprises a balanced
armature supported on a frame which is remov-
ably mounted on a U-shaped core. Another pre-
ferred embodiment is a relay comprising an ar-
mature pivoted on a leg of the core and supported
on the frame when the frame is removed from
the core.

It is therefore an object of the invention to
provide a through conductor type relay that can
be readily mounted on a cable or bus bar.

Another object is to provide a through con-
ductor type relay which may be disassembled in
two parts for mounting on the cable or bus bar.

Another object is to provide a through con-
ductor type relay which may be disassembled for
mounting on the conductor without disturbing
the adjustment of the armature.

Another object is to provide a through con-
ductor type relay with a coil which may be slidably
mounted on a leg of the core and readily removed
when the frame is removed from the core.

Another object is to provide a through con-
ductor type relay which may be mounted in any
position.

Another object is to provide a through con-
ductor type relay which is substantially shock-
proof in operation.

Other objects and advantages will be apparent
from a consideration of the following description
taken in connection with the accompanying
drawing in which:

Fig. 1 is a view in side elevation of a balanced
armature through conductor type relay showing
a coil mounted thereon and a normally open
contact assembly;

Fig. 2 is a plan view of the relay shown in
Fig. 1;

Fig. 3 is a right end view of the relay shown
in Fig. 1;

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Fig. 4 is a partial left end view of the relay
shown in Fig. 1;

Fig. 5 is a view in side elevation of another
through conductor type relay having a clapper
type armature and a normally closed contact
assembly;

Fig. 6 is a plan view of the relay shown in
Fig. 5;

Fig. 7 is a right end view of the relay shown
in Fig. 5;

Fig. 8 is a partial left end view of the relay
shown in Fig. 5 with the cover broken away;

Fig. 9 is a cross sectional view taken along
the line IX—IX of Fig. 6;

Fig. 10 is a view of the relay shown in Fig. 1
modified by addition of a coil thereon and by re-
arrangement of the contact assembly to provide
normally closed contacts; and

Fig. 11 is a view of the relay shown in Fig. 5
modified by rearrangement of the contact assem-
bly to provide normally open contacts.

Referring more particularly to the drawings by
characters of reference, the preferred embodiment
of relay illustrated in Figs. 1 to 4, inclusive, com-
prises a U-shaped magnetic core 12 having two
legs 13, 14. Leg 14 is shorter than the other
and has a flat end forming a pole plate for one
end of the relay armature. The longer leg 13 is
provided with a rectangular slot giving a U-
shaped appearance to the end of the leg. The
bottom of the core is provided with a pair of
drilled and tapped holes 16 for fastening the
core in any suitable known manner. The core
may be made with any required depth for mount-
ing on bus bars of different predetermined sizes.

A frame of nonmagnetic material, such as
brass, is mounted on the core. The frame com-
prises a plate 18 and a pair of spacers 19 integral
with the plate for supporting the frame on the
shorter leg 14 of the core. A pole plate or bridge
20 of magnetic material is seated on the leg 13
and bridges its slot to define an opening 15.
This bridge 20 is fastened to the plate 18 by
screws 21. Screws 23 and screws 22 which pass
through the bridge, fasten the frame to the legs
of the core. Leg 14, plate 18, and spacers 19
define an opening 24 similar to opening 15.

Pivot supports 26 are united to the plate 18
to form a part of the frame. The supports are
located substantially midway of the two core
legs, and each has a drilled and tapped hole
27 for receiving a threaded pivot member 28.

Each pivot member 28, besides the threaded
portion, has a smaller cylindrical portion 30,
forming a pivot with a rounded or ball point

end. The pivot member is locked to the support by a lock nut 31. The pivots 30 project into openings drilled in opposite sides of the armature 41 of the relay for pivotally supporting the armature.

The armature extends across the legs of the core through the openings 15, 24, for free movement in the openings longitudinally of the legs.

A contact assembly generally designated 33 comprises two pairs of fixed contacts 34 supported on the frame, and two pairs of movable contacts 35 supported on the armature. A block 36 of any suitable known insulating material is fastened to the frame by screws 21, 22. The block 36 is provided with four threaded studs 37 for connecting leads thereto and for supporting two pairs of fixed contacts 34. Each stud 37 is locked in position by lock nuts 39. The lower end of each stud defines a fixed contact 34, and is silver tipped to form a good contact surface. Each stud 37 may also be tapped for receiving a head screw, the head of which defines a fixed contact.

Fastened to armature 41 as by rivets 42, a support arm 43 of suitable insulating material, extends under the block 36. The support arm 43 carries a pair of resilient bridge contacts 35 each fastened by a screw 44 and nut 45 so that each pair of bridge contacts 35 aligns with a pair of the fixed contacts 34. Each of the resilient bridge contacts comprises a pair of contacts conductively connected together by a resilient bridge member fastened to the arm 43. A shield 46 may be provided for the bridge contacts and may be supported by the support arm 43 and fastened thereto by screws 44 provided with collars 47 between the bridge contact and the shield.

A transparent protecting cover 48 is provided for the contact assembly and is fastened to the block 36 by screws 49.

A nonmagnetic bar 51 is attached to one end of the armature to balance the armature with the movable contacts supported at the other end thereof. The armature being balanced in all positions, the relay is shockproof in operation.

A spring 52 is seated in a recess 53 of plate 18, and the spring is mounted on a threaded stud 55 which is united with the armature 41. The spring is held under compression between nuts 54 and the plate 18 for biasing armature 41 to the unattracted position shown. The stud 55 extends through bar 51 and plate 18. A hole 56 in plate 18 permits free movement of stud 55 therein due to pivoting of the armature.

The magnetic circuit of the relay comprises two air gaps, one between armature 41 and the end of leg 14, and the other between the armature and bridge 20 seated on leg 13. When the armature is in the biased position shown away from the core, the air gaps are relatively large and are called pick up air gaps; when the armature is attracted, the air gaps are relatively small and are called the drop out air gaps.

The flux in the air gaps at each end of the armature cooperate to give a torque tending to pivot the armature in the same direction.

Also mounted in the frame are air gap adjusting screws 57, 58. Screw 58 is located in plate 18 for contacting the armature near the short leg to provide a pick up air gap adjustment. Screw 57 is located in plate 18, extending through block 36, plate 18, and pole plate 20 for contacting the armature near the longer leg to provide a drop out air gap adjustment.

The relay may be provided with a coil 60

mounted on a leg of the core for either independent operation of the relay or differential operation with the through conductor. The coil is constructed with an opening for fitting the leg of the core. A clamp 61 extending through the opening in the coil has bent up portions 62 for retaining the coil therebetween. Another portion 63 of the clamp 61 provides a hole for receiving a screw 64 to bind the clamp to the leg of the core. The clamp is also held to the core by the coil which it retains from longitudinal movement on the core leg.

To assemble the relay, pole plate 20 and the fixed contact assembly comprising block 36 are mounted on the frame and fastened thereto by screws 21, 22. The bridge contacts are mounted on the arm support which is permanently attached to the armature. The armature mounted stud 55 is inserted into the hole 56 of the plate 18 and the armature is supported on the frame by the pivots 30 which are inserted into the openings in the opposite sides of the armature. The pivots are pressed finger-tight against the armature by turning the pivot members 28 in the supports 26. When the side play of the armature is taken up, the pivot members are locked by tightening lock nuts 31. Bias spring 52 is inserted in recess 53 over the threaded stud 55. The spring is compressed by screwing lock nuts 54 on the stud. The set screws 57, 58, also provided with lock nuts, are screwed into the plate. The cover 48 is mounted on block 36 to protect the contact assembly.

The coil 60 may be mounted on a leg of the core with the clamp previously inserted in the coil. The coil and clamp 61 are slidably moved into position on the leg and the screw 64 inserted to hold the coil in place.

The frame then is mounted on the core with the bridge 20 seated on leg 13 and the spacers 19 seated on leg 14.

To properly adjust the relay, it may be test mounted and its core excited by predetermined values of magnetomotive force by a conductor passing through the core or by a coil mounted on a core leg. Although the relay may be mounted in any position, for precise adjustment it is best to test mount it in the same position it will assume in an installation in which it is to be used.

When the armature is in the unattracted position, the pick up air gap is adjusted by screw 58 so that the armature is attracted by a predetermined value of magnetomotive force for a given bias force on the armature due to spring 52. For a given pick up air gap and magnetomotive force, the bias of spring 52 is decreased until the armature is attracted to the core.

When the armature is in the attracted position, the drop out air gaps are adjusted by screw 57 until the armature returns to the biased position shown for another predetermined value of magnetomotive force.

In connection with the adjustment of the pick up and drop out air gap set screws, the threaded studs 37 are adjusted so that the fixed contacts and movable contacts are separated when the relay is not energized and make good contact when the relay is energized.

The relay, when thus properly adjusted, is ready to be mounted on a cable or bus bar. The screws 22, 23 are removed, freeing the U-shaped core 12 from the frame. The armature 41 remains supported on the frame and none of the adjustments is disturbed. The U-shaped core 12

is then suitably mounted on the cable or bus bar with the cable or bus bar intermediate the legs of the core. The frame is again mounted on the core and the screws 22, 23 replaced.

The relay may also be provided with a contact assembly comprising normally closed contacts as shown in Fig. 10. The plate 13 is provided with holes 50 for receiving screws 21 for then mounting the block 36 on the other end of the frame. Block 36 is provided with a hole 40 for receiving stud 55 and spring 52. Studs 37 in block 36 are screwed so fixed contacts 34 are brought near to block 36. Arm 43 supporting the bridge contacts 35 is mounted on the upper side of armature 41 at the end adjacent leg 14. The bar 51 is mounted on the underside of the armature at the end adjacent leg 13. The relay is adjusted as before except that the contacts are closed when adjusting the pick up air gap, and the contacts are open when adjusting the drop out air gap of the relay.

The relay illustrated in Figs. 5 to 9, inclusive, comprises an armature 67 pivoted on a leg 68 of a U-shaped core 69. The leg 68 is beveled to form a knife edge fulcrum 70, and the armature has a notch 90 cooperating with the fulcrum for pivotally supporting the armature on the core leg.

The nonmagnetic frame comprises a plate 71, spacers 72, and an armature guard 73. The armature guard 73 is fastened to the plate 71 by screws 74, and the guard is spaced from the plate by collars 75 through which the screws 74 extend.

The frame is mounted on the legs of the core and fastened thereto by screws 87 and 92. The armature is biased against the fulcrum by a spring 76 seated in both the armature and the plate 71 and positioned between them above the fulcrum.

Stud 78 is mounted on the armature 67 and extends freely through plate 71 and insulating block 82. Over stud 78, spring 79 is mounted and seated in plate 71. A stud 81 extending through block 82 is mounted in plate 71 and extends freely through the armature 67. Over stud 81 bias spring 83 is mounted and positioned in a recess in armature 67. Spring 79 biases the armature away from leg 80 toward its unattracted position against a stop 85 integral with plate 71. Stop 85 determines the pick up air gap of the relay. Spring 83 is mounted on the stud 81 with free play thereon when the armature is in the unattracted position. Spring 83 cooperates with spring 79 to bias the armature away from leg 80 when the armature approaches the attracted position.

When the frame is removed from the core, the armature 67 is supported thereon. Bias spring 76 then forces one end of the armature against a rivet 77 in the guard 73, and spring 79 pulls the other end of the armature against stop 85.

Relay 66 is shown having a pair of normally closed contacts and a pair of threaded studs 84 for connecting lead wires. Fixed contacts 86 and studs 84 are supported in block 82 which is mounted on the frame. Guard retaining screws 74 also fasten the block 82 to plate 71. The block 82 is also bound to plate 71 by a pair of screws 87 which with screws 92 attach the frame to the core.

Bridge contacts 88 comprising the movable contacts of the contact assembly are supported on an arm 89 extending from and attached to the armature. The contact assembly is also provided with a transparent cover 91.

As in the case of the embodiment illustrated in Figs. 1 to 4, inclusive, the relay may be mounted

in any position and may be test mounted and operated for adjusting the drop out and pick up characteristics of the relay. In the unattracted position of the armature it remains biased away from core leg 80 by spring 79 which determines the pick up of the armature. Spring 79 is adjusted so that a predetermined value of magnetomotive force will cause the armature to move toward core leg 80, taking up the free play of spring 83 on its stud. Further attraction of the armature compresses spring 83 as well as continued compression of spring 79. Spring 83 requires greater force to compress it than spring 79. The springs 79 and 83 are chosen with force characteristics which cooperate to bias the armature closely to the characteristic of the magnetic attractive force acting on the armature as the air gap decreases when the armature moves toward core leg 80.

When the pick up value of the relay is adjusted, the stud 81 supporting spring 83 is turned to increase or decrease the free play of the spring slidably mounted on the stud between the head thereof and the armature. Decreasing the free play increases the bias and brings the drop out characteristic closer to the pick up characteristic. This arrangement permits the drop out to be adjusted very closely to the pick up value.

Removing the four head screws 87 and 92 permits removal of the core from the frame on which the armature remains supported. The core may be mounted in a known suitable manner on a cable or bus bar, and the frame remounted on the core and the head screws replaced without disturbing the adjustment of the armature.

The relay may also be provided with a contact assembly comprising normally open contacts as shown in Fig. 11. For normally open contacts, two U-shaped brackets 93 are mounted on studs 84. Each bracket 93 supports a fixed contact stud 94 aligned below a contact of inverted bridge contacts 88. The brackets 93 conductively connect the fixed contact studs 94 to the studs 84 to which leads are to be connected. The relay is adjusted as before, taking into account that the contacts are open when adjusting the pick up value of the relay, and the contacts are closed when adjusting the drop out value of the relay.

Although the relays herein described are referred to as of the through conductor type, they may be operated by at least one coil mounted on a core leg, or differentially operated by a pair of coils or a coil and a through conductor.

It is claimed and desired to secure by Letters Patent:

1. An electromagnetic relay comprising a U-shaped magnetic core having first and second legs defining a passage for the insertion of a current carrying conductor, said first core leg being provided with a slot, a nonmagnetic frame removably mounted across said core legs to permit insertion of said conductor in said passage, a bridge of magnetic material mounted on said frame across said slot between said frame and said first core leg to define an opening, a pair of pivot members mounted on opposite sides of said frame, an armature having a pair of recesses provided on opposite sides thereof at points substantially equidistant from the ends thereof, said pivot members engaging said recesses whereby said armature is pivotally positioned with one end extending into said slot of said first core leg and the other end disposed adjacent to said second core leg, a stud attached to said other end of said armature and extending freely through said

frame, stop means attached to the end of said stud, a spring fitted over said stud and compressed between said stop means and said frame to bias said armature, adjustable screw means mounted on said frame for adjusting the air gaps between said armature ends and said core legs, a first member of insulating material attached to said one end of said armature and extending through said slot, a resilient bridge member mounted on said insulating member, a first pair of contacts mounted on said resilient bridge member and conductively connected thereby, a second insulating member attached to said frame adjacent to said slot, a second pair of contacts distinct from said screw means mounted on said second insulating member and engageable with said first pair of contacts in response to movement of said armature against the action of said spring, and means for adjusting the distance between said first and said second pair of contacts when said pairs of contacts are disengaged.

27 An electromagnetic relay operable in response to the flow of current through a conductor, said relay comprising a U-shaped magnetic core having first and second legs defining a passage for the insertion of said conductor, said first core leg being longer than said second core leg and having a slot at its end, a nonmagnetic frame removably mounted across said core legs to permit insertion of said conductor in said passage, pivot means mounted on said frame, an elongated armature supported at a point intermediate the ends thereof on said pivot means to form with said core a magnetic circuit in which magnetic flux is produced by said flow of current, one of the

ends of said armature extending into said slot and the other end of said armature extending between said frame and said second core leg, said second core leg forming a pole plate for said other end of said armature and defining therein with an air gap in said magnetic circuit, and a bridge of magnetic material secured to said first core leg across said slot forming a pole plate for said one end of said armature and defining therein with a second air gap in said magnetic circuit, whereby said flux causes said one end of said armature to be attracted toward said bridge and said other end of said armature to be attracted toward said second core leg to cause rotation of said armature about said pivot means.

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