June 9, 1942. H. G. BLOSSER 2,285,890

STATIONARY CONTACT

Filed Nov. 16, 1939 6 Sheets-Sheet 1

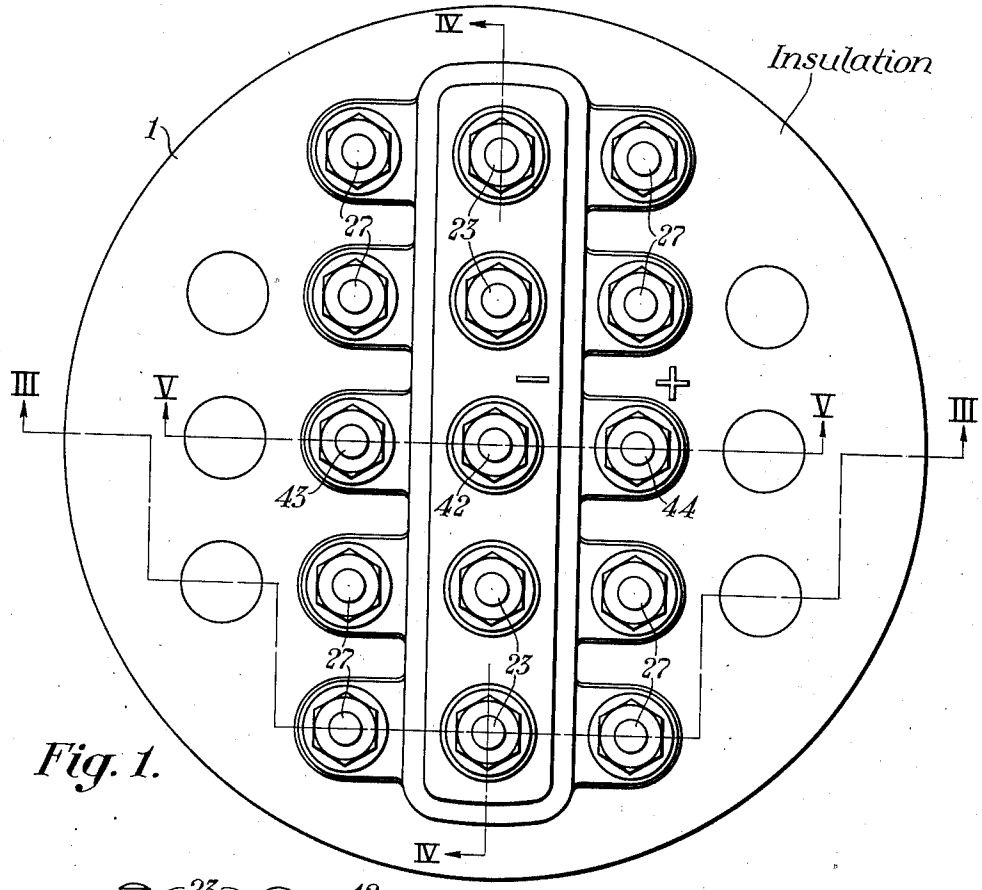

Fig. 1.

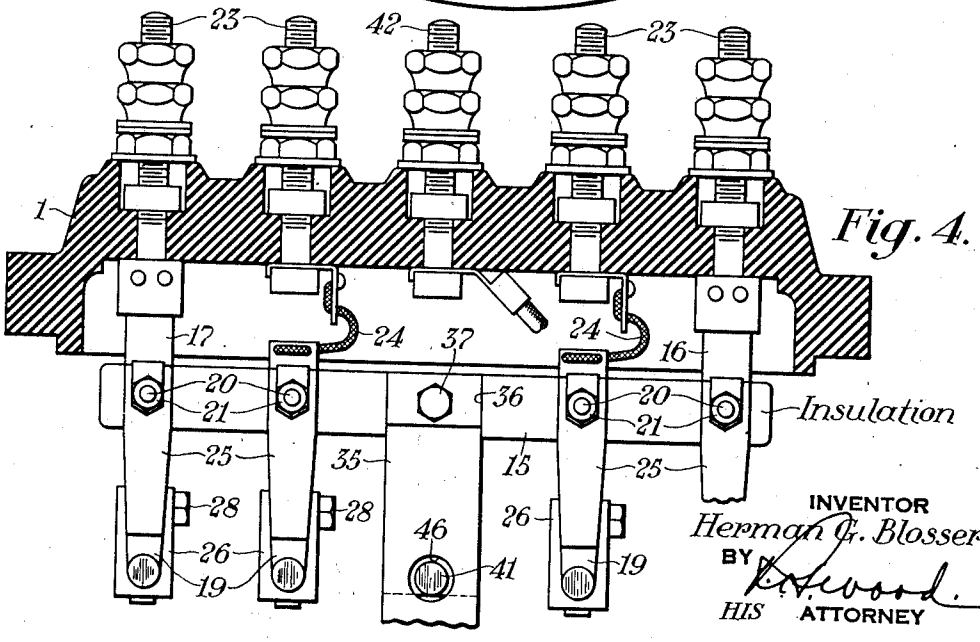

Fig. 4.

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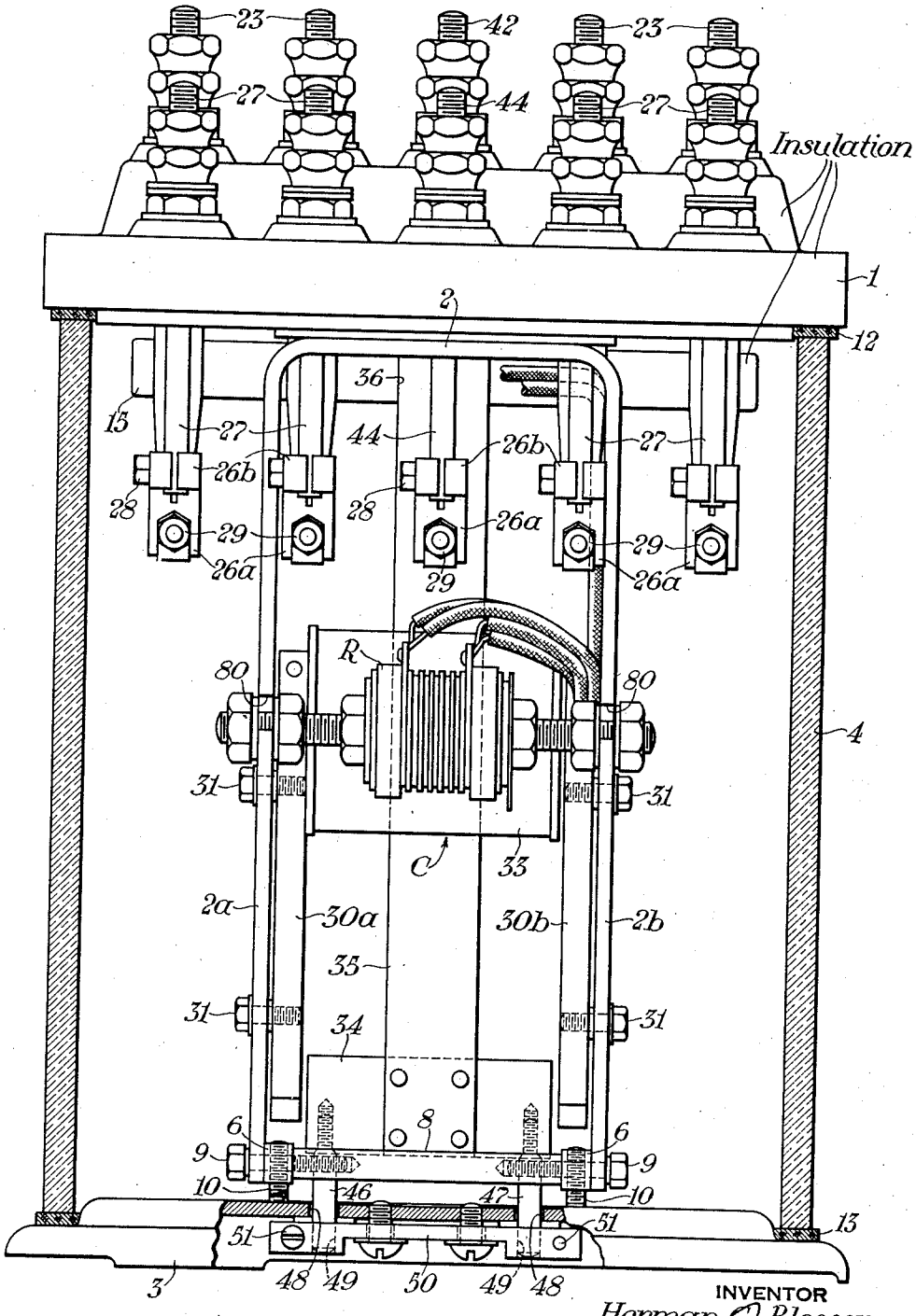

Fig. 2.

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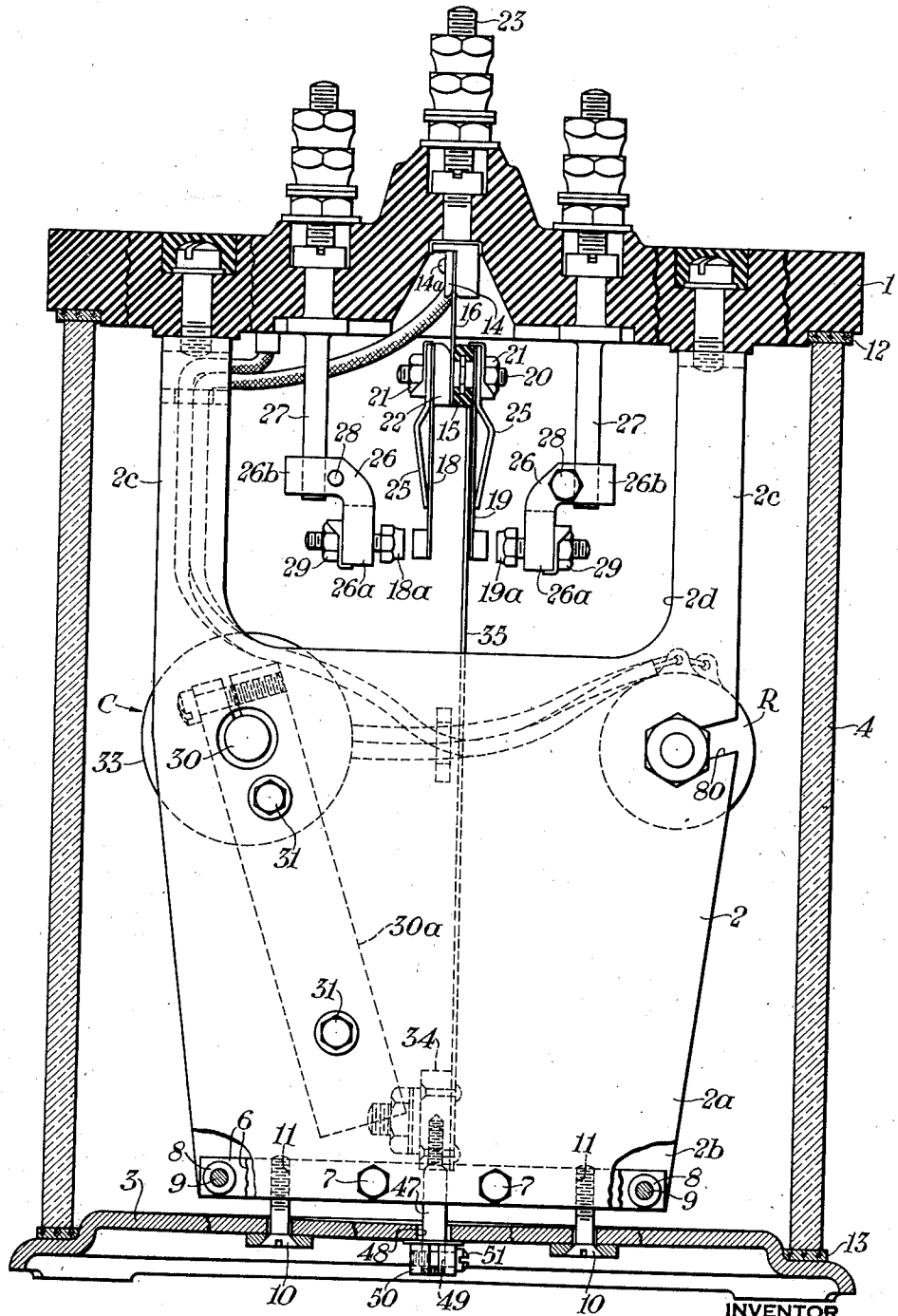

Fig. 3.

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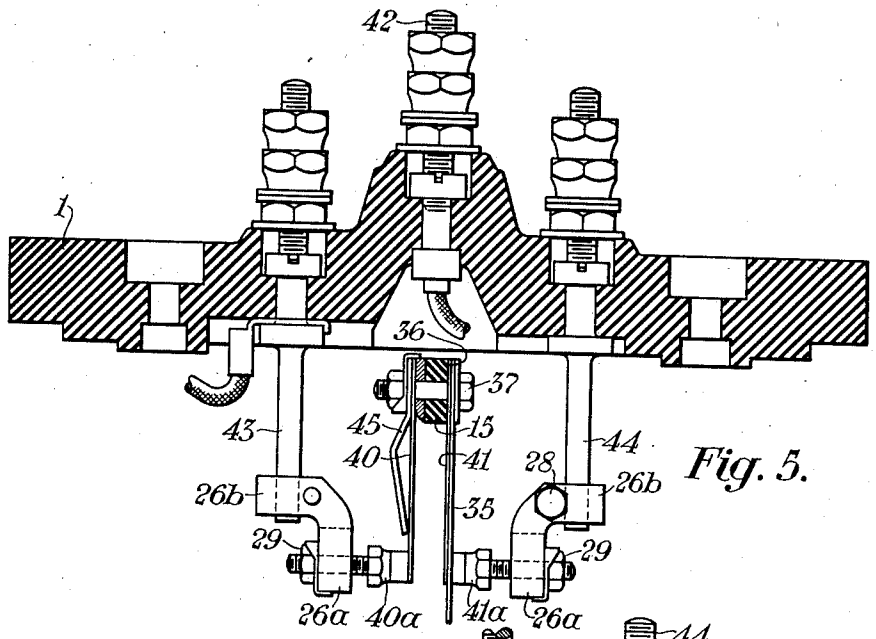

Fig. 5.

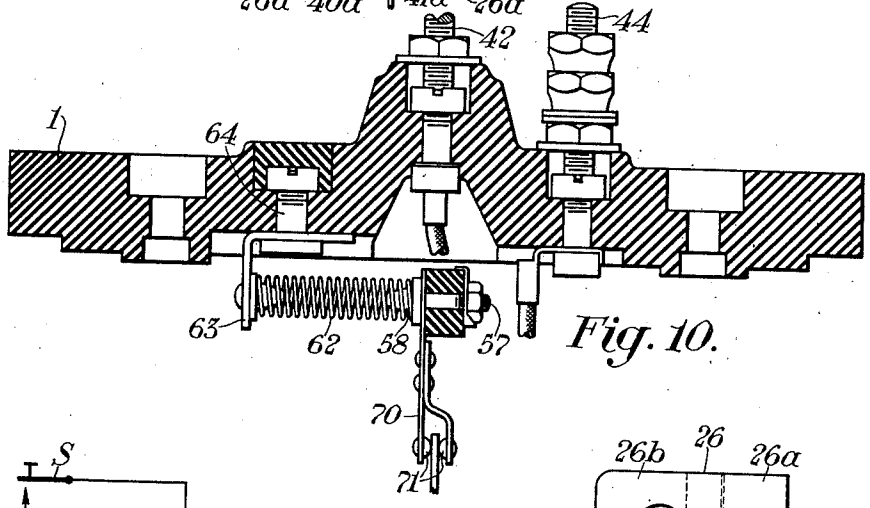

Fig. 10.

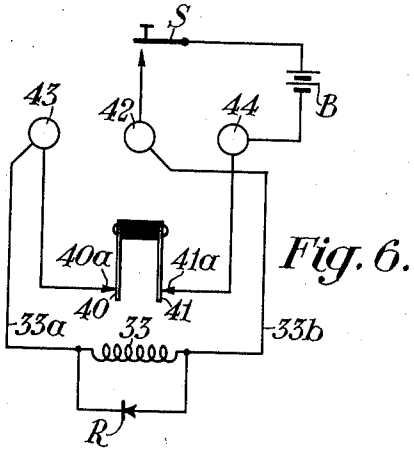

Fig. 6.

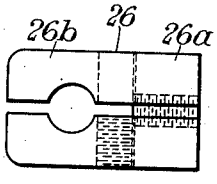

Fig. 7.

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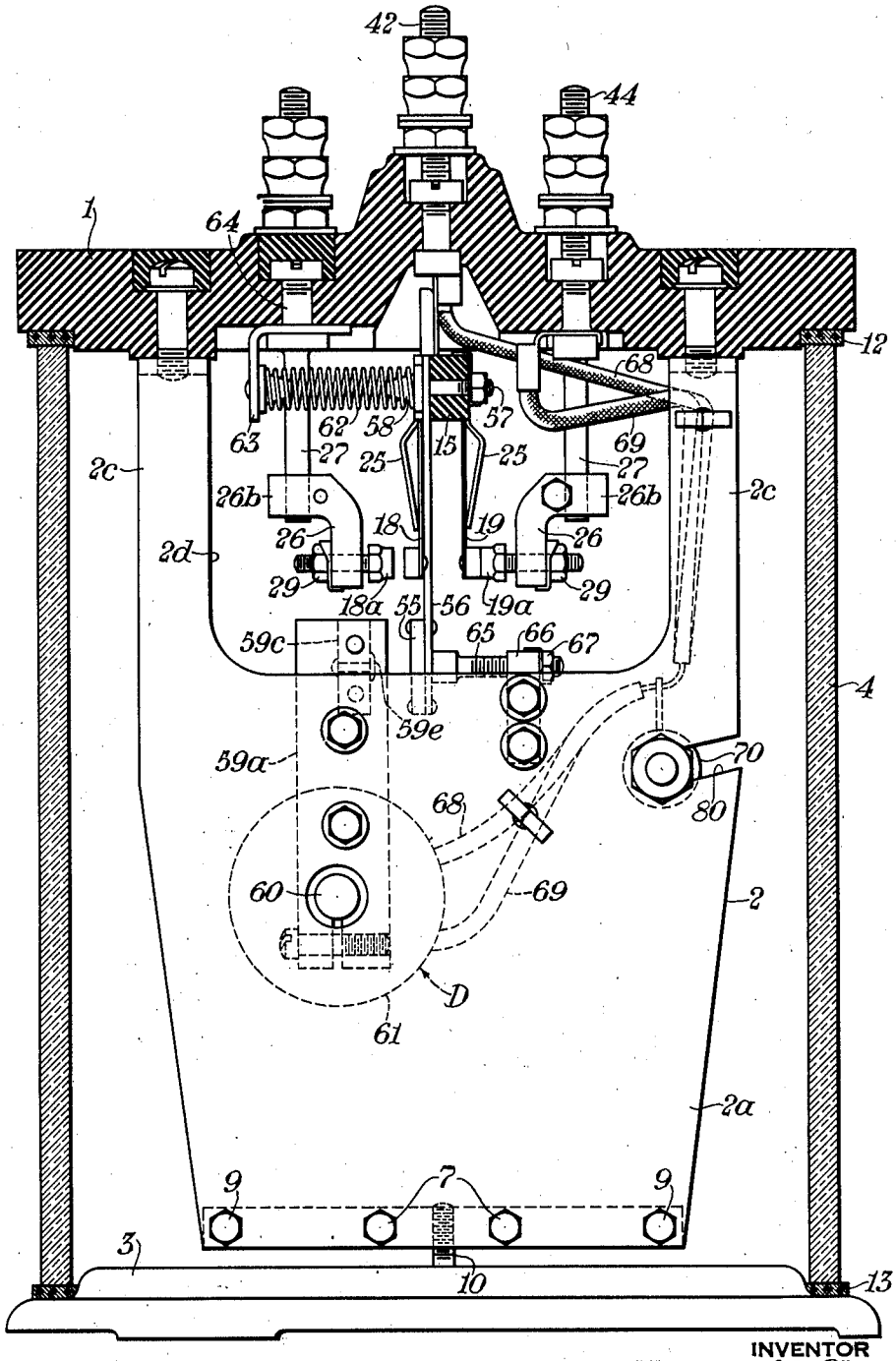

Fig. 8.

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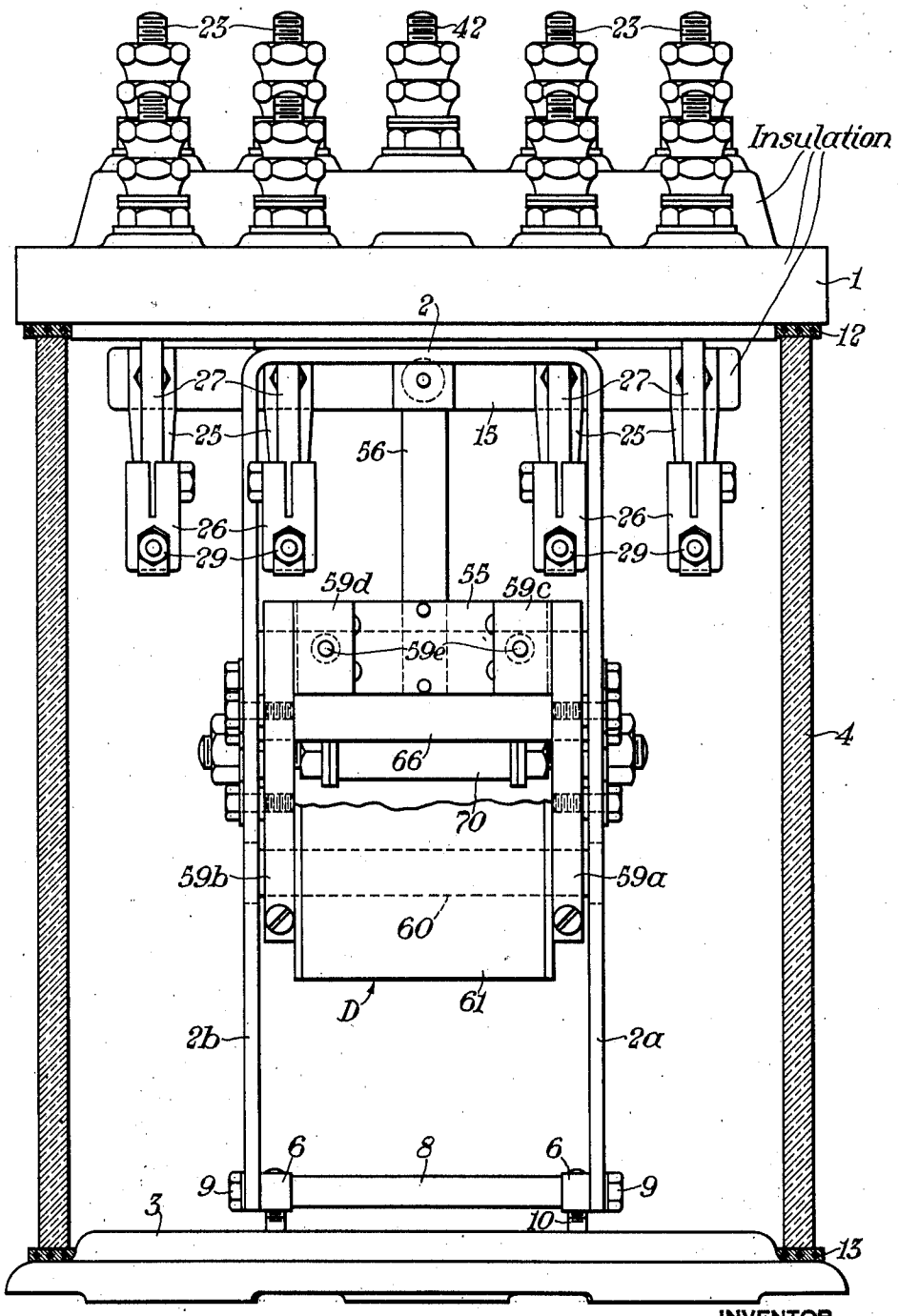

Fig. 9.

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Patented June 9, 1942

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UNITED STATES PATENT OFFICE

2,285,890

STATIONARY CONTACT

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Application November 16, 1939, Serial No. 304,811

3 Claims. (Cl. 200—166)

My invention relates to electrical relays, and particularly to electrical relays which are suitable for use in railway signaling systems employing for the control of signaling devices direct current which is periodically interrupted or coded at different frequencies in accordance with traffic conditions.

In signaling systems of the type referred to at least three different types of relays are employed, namely, code transmitters for periodically interrupting the direct current at the desired frequency, code following relays which respond to coded current of one polarity only, and neutral relays which respond to the presence or absence of direct current whether it is coded or uncoded.

One object of my present invention is to provide a relay of such construction that it can be converted into any one of the three types above described by making certain relatively minor changes.

Another object of my invention is to provide a relay construction which is simple, rugged and can be manufactured at a minimum cost.

Other objects and characteristic features of my invention will become apparent as the description proceeds.

In the accompanying drawings, Fig. 1 is a top plan view showing one form of relay embodying my invention. Fig. 2 is a side elevational view of the relay shown in Fig. 1, certain of the case parts being broken away or sectioned to better illustrate the construction of the remaining parts. Figs. 3, 4 and 5 are detail sectional views taken substantially on the lines III—III, IV—IV, and V—V, respectively, of Fig. 1. Fig. 6 is a wiring diagram for the relay shown in Fig. 1. Fig. 7 is a detail view of one of the brackets 26 forming part of the relay illustrated in the preceding views. Fig. 8 is a view similar to Fig. 3 showing a modification of the relay illustrated in Figs. 1, 2 and 3. Fig. 9 is a left-hand side view of the relay shown in Fig. 8 with certain of the parts broken away or removed to better illustrate the remaining parts. Fig. 10 is a detail sectional view showing a further modification of the relay illustrated in Figs. 1, 2 and 3.

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

Referring first to Figs. 1, 2 and 3, the relay in the form here shown comprises a suitable case, consisting of a top plate 1 of insulated material secured to the upper end of a non-magnetic frame 2, a metal base plate 3 secured to the lower end of the frame 2, and a transparent glass cylinder 4 clamped between the top plate 1 and the base plate 3. The main or upper part of the frame 2 is formed from a single piece of material bent generally into an inverted U-shape, and comprises two vertically disposed plate portions 2a and 2b of substantially trapezoidal form terminating at their upper ends in spaced parallel arms 2c which form openings 2d through which certain portions of the contact mechanism of the relay can be viewed for inspection. A horizontal bar 6 is secured to the lower end of each plate portion 2a and 2b by means of studs 7, and extending between the bars 6 at their opposite ends are spacing rods 8 held in place by studs 9. These latter studs extend through clearance holes in the plate portions 2a and 2b and the bar 6, and are screwed into tapped holes formed in the ends of the spacing rods, as will readily be apparent from an inspection of the drawings. The base plate 3 is secured to the frame 2 by means of screws 10 screwed into tapped holes 11 provided in the bars 6. It will be seen, therefore, that the frame provides a rigid support for the various case parts. A gasket 12 of cork or other suitable material is interposed between the top plate 1 and the upper end of the cylinder 4, and a similar gasket 13 is interposed between the bottom plate and the lower end of the cylinder, thereby sealing the case against the entry of dirt or other foreign substances.

A contact carrying rocker 15 of suitable insulating material is suspended from the top plate 1 for swinging movement between two extreme positions by means of two flexible strips 16 and 17 (see Figs. 3 and 4), and this rocker is provided with a plurality of flexible contact fingers 18 and 19, each of which cooperates with a fixed contact member 18a or 19a to close a contact 18—18a or 19—19a according as the rocker is swung to one or the other of its extreme positions. The contact fingers 18 and 19 are disposed in pairs and are secured to the opposite sides of the rocker within suitable vertical grooves which maintain the fingers in the desired vertical positions, by means of studs 20 moulded into the rocker and provided at each end with a nut 21. The two studs 20 which secure the two end pairs of fingers 18 and 19 to the rocker also serve to secure the lower ends of the strips 16 and 17 to the rocker, and disposed between each strip 16 or 17 and the adjacent finger 18 is a spacing block 22 of such thickness that the lower ends of the strips 16 and 17 are disposed substantially at the center of the rocker. A terminal post 23 is mounted in the top plate directly above each pair of fingers 18 and 19 and the upper ends of the strips 16 and 17 are secured to the heads of the two outer terminal posts 23 by means of rivets 14a and clamping blocks 14. It will be seen, therefore, that the strips 16 and 17 not only serve to support the rocker, but also serve to electrically connect the two outer pairs of fingers with the associated terminal posts. The remaining two pairs of fingers are electrically connected with the vertically aligned terminal posts 23 by means of flexible connectors 24. The positions

of the flexible fingers when the fingers are out of engagement with the associated fixed contact member are determined by stops 25 which are clamped against the outer faces of the fingers by means of the associated studs 20, and which are so adjusted by bending them that the fingers will break the contacts in the desired positions in response to swinging movement of the contact carrying rocker 15.

When the relay is in operation, the rocker is oscillated between its two extreme positions at a relatively rapid rate, and in order to prevent breakage of the strips 16 and 17 due to the resultant flexing of the strips, the lower edges of the clamping blocks 14 on the sides next to the strips and the opposite lower edges of the heads of the associated terminal posts 23 are rounded as shown in the drawings in such manner that any flexing of the strips which occurs adjacent these parts will be in the form of a gradual curve. Furthermore, the upper edges of the spacing blocks 22 on the sides next to the strips and the opposite edges of the tops of the slots in the rocker are likewise rounded to prevent sharp bends in the strips adjacent these parts.

The fixed contact members 18*a* and 18*b* are all alike, and each comprises a low resistance contact button welded to or formed on one end of an adjusting screw. Each adjusting screw is screwed through the depending vertical leg 26*a* of an angle bracket 26, the horizontal leg 26*b* of which is formed with a split portion which receives the circular lower end of an associated terminal post 27 with sufficient clearance to enable the bracket to be moved freely along the post in an axial direction, and also to be rotated to any desired angular position relative to the post. A clamping screw 28 is associated with the split portion of each angle bracket and is effective when tightened to clamp the bracket in any position to which it is moved on the associated terminal post. To facilitate turning the adjusting screw, the head of the screw is made polygonal in shape for the reception of a wrench or other suitable tool, and in order to lock the screw in its adjusted position a lock nut 29 is provided on the outer end of the screw. With this arrangement, it will be seen that the low resistance contact buttons of the fixed contact members can be adjusted relative to the contact buttons which are provided on the flexible contact fingers in all directions, thereby readily enabling any desired contact adjustment to be made.

The relay also comprises a suitable motor device for moving the rocker 15 between its two extreme positions to alternately operate the contacts 18—18*a* and 19—19*a*. This motor device may assume any one of three different forms depending upon the use to which the relay is to be put. When the relay is to be used as a code transmitter this motor device consists of an electromagnet C having pole pieces 30*a* and 30*b* secured by means of studs 31 to the plate portions 2*a* and 2*b* of the frame 2 in parallel spaced relation and connected together at one end by a core 32 surrounded by a winding 33. The free ends of the pole pieces cooperate with an armature 34 which is attached to the lower end of a metallic flat spring 35, the upper end of which is secured to the center of the rocker 15 within a vertical groove 36 by means of a bolt 37, as best seen in Figs. 4 and 5. The armature 34 together with the spring 35 serve as a pendulum to bias the rocker 15 to its central position in which it is shown in the drawings and in which the contacts 18—18*a* and 19—19*a* are all open, and the parts are so proportioned that when the armature occupies the position to which it is biased by gravity, it will be disposed outside of the field set up between the pole pieces 30*a* and 30*b*. The length of the armature is such that it is free to swing between the pole pieces, and it will be seen therefore that energization of the winding 33 will tend to pull the armature between the pole pieces, and hence will swing the rocker 15 in a clockwise direction, as viewed in Fig. 3.

The supply of energy to the winding 33 is controlled by two driving contacts comprising two contact fingers 40 and 41 (see Fig. 5) which cooperate with fixed contact members 40*a* and 41*a*, respectively. The fingers 40 and 41 are secured to the opposite sides of the rocker 15 by means of the bolt 37 which secures the spring 35 to the rocker. This bolt also serves to electrically connect the two fingers 40 and 41 together. The fixed contact members 40*a* and 41*a* are similar to the previously described fixed contact members 18*a* and 19*a* and are adjustably mounted in adjustable brackets 26 secured to terminal posts 43 and 44 mounted in the top plate 1 in the same manner that the fixed contact members 18*a* and 19*a* are adjustably mounted in adjustable brackets 26 secured to the terminal posts 27. A stop 45 is associated with the finger 40 to position it when it is out of engagement with the associated fixed contact member 40*a*, but no stop is provided for the finger 41 since the spring 35 performs this function. In order to permit the low resistance contact buttons on the finger 41 to engage the fixed contact member 41*a*, a hole 46 (see Fig. 4) is formed in the spring 35, which hole receives the contact button with considerable clearance. The fixed contact members are so adjusted that when the rocker occupies its normal position to which it is biased by the pendulum-armature 34, both contacts 40—40*a* and 41—41*a* will be closed, but that when the armature moves a small distance in a clockwise direction, as viewed in Figs. 3 and 5, the contact 41—41*a* will open, and that when the armature moves a small distance in the opposite direction the contact 40—40*a* will open.

Referring now to the wiring diagram illustrated in Fig. 6, it will be seen that the one terminal of the winding 33 is connected by a wire 33*a* with the terminal post 43, and the other terminal is connected by a wire 33*b* with the terminal post 42. A source of electromotive force here shown as a battery B is connected with the terminal posts 42 and 44 through a switch S. It follows, therefore, that when the switch S is closed winding 33 will be supplied with current provided contacts 40—40*a* and 41—41*a* are then both closed, but that the supply of current to the winding 33 will be interrupted when either contact 40—40*a* or contact 41—41*a* becomes opened. In order to prevent excessive arcing of the contacts 40—40*a* and 41—41*a*, a rectifier R is connected in multiple with the winding 33. This rectifier is supported at its ends in slots 60 provided in the plate portions 2*a* and 2*b* of the frame 2 as shown in Figs. 2 and 3.

As shown in the drawing, the switch S is open so that the winding 33 is deenergized. Rocker 15 therefore occupies its normal position to which it is biased by the pendulum-armature 34, and under these conditions the contacts 18—18*a* and 19—19*a* are all open, but the control contacts 40—40*a* and 41—41*a* are both closed. I will now assume that switch S becomes closed. Since con-

tacts 40—40a and 41—41a are both closed, current from battery B is supplied to winding 33, and flux lines are therefore set up in the air gap between the pole pieces 30a and 30b. These flux lines thread the armature 34, and as will be readily understood, exert a force on the armature which rotates it and hence the rocker 15 in a clockwise direction as viewed in Fig. 3. The contact 41—41a is so adjusted that when the armature has swung to the position in which it is between the lower ends of the pole pieces 30a and 30b, this contact will open and will deenergize winding 33. The armature 34, however, will continue to swing in the direction it was previously moving until the kinetic energy which the rotating parts have acquired is expended in stressing the contact fingers 18 and in bending the spring 35 which supports the armature. When this happens, the energy stored in the contact fingers and the spring 35, and in armature 34 due to its elevated position will reverse the direction of rotation of the rocker 15, so that it will now rotate in a counterclockwise direction. During this latter rotation contact 41—41a will again become closed. Due, however, to the inductance of winding 33, the field between the pole pieces 30a and 30b will build up slowly, and since the rocker is now rotating in a counter-clockwise direction, as viewed in Fig. 3, by the time the field has built up between the pole pieces to its normal value the pendulum armature 34 will have swung to the position where the electromagnet will have little effect on the armature. As soon as the armature moves a small distance to the right of its normal position as viewed in Fig. 3, contact 40—40a will open and will deenergize winding 33. It will be seen therefore that winding 33 will be deenergized as soon as the armature moves a small distance to either side of its neutral or gravity biased position. When the rocker reaches its extreme counter-clockwise position as viewed in Fig. 3, the energy stored in the contact fingers 19a, the spring 35 and the pendulum 34 will cause the rocker 15 to again rotate in a clockwise direction. As soon as the rocker reaches the position in which contact 40—40a closes, electromagnet C will again become energized and will again cause a force to be exerted on the pendulum-armature 34 tending to accelerate it. The parts are so proportioned that the energy supplied to the rocker 15 during this clockwise rotation is greater than that expended in overcoming friction and other losses during the clockwise rotation of the rocker and the previous counter-clockwise rotation together with that expended in overcoming the opposing force of the magnetic pull on the armature during the previous counter-clockwise rotation, so that the rocker starts to oscillate at a period which depends upon the thickness, stiffness and length of the spring in combination with the mass of the pendulum-armature. These parts can be varied to provide any desired code speed within the limits of the apparatus.

It will be apparent that when the rocker 15 is oscillated the contacts 18—18a and 19—19a will be alternately opened and closed at the frequency of oscillation of the rocker. These contacts may be used for coding purposes or to control any desired circuits.

It should be pointed out that the double break arrangement provided for the energizing circuit for the winding 33 by the contacts 40—40a and 41—41a reduces energy requirements to a minimum and tends to keep the energy in the energizing winding 33 fairly constant for wide variations of applied voltage, and in consequence thereof tends to keep a constant code speed for voltage ranges such as may be expected in battery circuits.

It should also be pointed out that the motion of the rocker 15 permitted by the flexure of the contact fingers after the contacts become closed causes the pressure on the contacts to continue to increase until the pendulum-armature reaches the end of its stroke. This assures ample contact pressure with a minimum amount of energy in the operating winding.

It should be pointed out that the use of a spring in place of a rigid member for attaching the pendulum-armature 34 to the rocker 15 eliminates shocks to the parts when the contacts on one side or the other of the rocker become closed and also permits of wider amplitudes for the pendulum-armature. These wider amplitudes in turn, permit lower stresses in the contact fingers, which increases the life of the fingers and also permits more uniform code speed stability to be obtained with changing voltage conditions such as are liable to be encountered in operation.

As will be apparent from an inspection of the drawing, the pendulum-armature 34 possesses considerable mass, and unless some means are provided to prevent it from swinging during handling of the relay, damage is likely to result to the strips 16 and 17 which support the rocker 15, to the contacts, or to other parts of the relay. In accordance with my present invention, I prevent the armature from swinging by means of two screws 46 and 47, the upper ends of which are screwed into tapped holes in the armature 34 to positions in which shoulders formed on the screws engage the bottom of the armature. The lower ends of the screws 46 and 47 extend downwardly through clearance holes 48 in the bottom plate 3 and into holes 49 formed between split portions of a bracket 50. The bracket 50 is secured to the underside of the bottom plate 3, and the lower ends of the screws are clamped between the split portions of the bracket by means of clamping screws 51 which draw the split portions together and cause them to securely grip the lower ends of the screws 46 and 47. When the screws are thus gripped, they are prevented from moving in all directions, and it wil be seen, therefore, that the pendulum-armature 34 and rocker 15 will then be securely held in their normal positions in which they are shown in the drawing.

In applying the screws 46 and 47 the clamping screws 51 are first loosened, and the screws 46 and 47 are then inserted upwardly through the split portions of the bracket 50 and the holes in the base plate 3 and are screwed into the holes in the pendulum-armature by means of a screw driver which is inserted into a saw kerf provided in the lower ends of the screws. The clamping screws 51 are then tightened. When it becomes desirable to place the relay in service, the clamping screws 51 are first loosened and the screws 46 and 47 are then removed, after which suitable plugs are inserted in the holes in the clamping plate 50 and clamped in place by means of the clamping screws 51 to prevent the entry of foreign substances through the holes in the clamping plate.

One advantage of holding means embodying my invention is that it provides a simple and effec-

tive method for protecting the relay parts during shipment.

Referring now to Figs. 8 and 9, I have here shown the relay constructed in the manner necessary to permit it to be used as a neutral direct current relay. As here illustrated, the driving contacts 40—40*a* and 41—41*a* have been removed and the pendulum-armature 34 and its associated flexible supporting spring 35 have been replaced by an armature 55 which is secured to the rocker 15 by means of a rigid strip 56. The strip 56 is considerably shorter than the strip 35, and is secured to the rocker at its upper end by means of a bolt 57 having a conical head 58. Further, as here illustrated, the electromagnet C has been replaced by an electromagnet D comprising a pair of pole pieces 59*a* and 59*b* secured to the opposite ends of a magnetizable core 60 which is surrounded by a winding 61. The pole pieces 59*a* and 59*b* are also secured to the plate portions 2*a* and 2*b* of the frame 2 in vertical positions, and are provided at their upper ends with magnetizable block 59*c* and 59*d* toward which the armature is adapted to move when the electromagnet becomes energized. The length of the armature is such that it is free to swing between the pole pieces toward the blocks 59*c* and 59*d*, and in order to prevent the armature from actually touching the blocks, non-magnetizable stop pins 59*e* are provided in the blocks in positions to engage the left-hand face of the armature, as viewed in Fig. 8. The rocker 15 is constantly biased to the position in which the contacts 19—19*a* are closed and the contacts 18—18*a* are open by means of a coil spring 62 one end of which surrounds the head 58 of the bolt 57 and the other end of which engages a spring support 63. The spring support 63 is secured to the top plate 1 by means of a bolt 64 which is mounted in the top plate in the same location as the terminal post 43 in Fig. 1. For the purpose of limiting the movement of the armature in response to the bias of the spring 62, a pair of adjustable stop screws 65 are provided. These screws are adjustably screwed through threaded holes formed in a transverse member 66 secured at its ends to the plate portions 2*a* and 2*b* of the frame 2, and are arranged to be locked in adjusted positions by means of lock nuts 67 screwed onto the outer ends of the screws. The leads 68 and 69 of the winding 61 are connected with the terminal posts 42 and 44 to facilitate making electrical connection with the winding and a resistor 70 is shown shunted across the winding to provide the desired operating characteristics. This resistor is supported between the plate portions 2*a* and 2*b* in the same manner as the rectifier R is supported in Fig. 1. The remaining parts of the relay shown in Figs. 8 and 9 are identical with those shown in Fig. 1.

With the relay constructed in this manner it will be apparent that when the winding 61 is deenergized, the rocker will be held by the spring 62 in the position in which the contacts 19—19*a* are closed and the contacts 18—18*a* are open. When, however, the winding 61 is supplied with current of either polarity, the flux set up between the pole pieces will attract the armature and will thus move the rocker to the position in which the contacts 18—18*a* are closed and the contacts 19—19*a* are open. It should be pointed out that due to the presence of the magnetizable blocks 59*c* and 59*d* and the arrangement of the armature and pole pieces shown, a very fast response of the armature to the energization of the winding is provided. This is particularly desirable when the relay is to pick up on the pulses of coded current. It should also be pointed out that when the relay is operated as a neutral relay, the contacts 19—19*a* correspond to the usual back contacts, while the contacts 18—18*a* correspond to the usual front contacts.

When it is desired to use the relay for a code following relay, the rocker 15 is biased to one of its extreme positions by means of the spring 62 in the same manner as shown in Figs. 8 and 9, and is provided with a bifurcated driving arm 70 in the manner shown in Fig. 10. This arm is secured to the rocker by means of the screw 57, and the bifurcations thereof are provided with confronting rounded buttons 71 between which the upper end of the hinged armature 72 of a motor element is adapted to extend. For example, the armature 72 may be the armature 20 of the motor element described in my prior Patent No. 2,057,605, granted October 13, 1937, for Electrical relays. As will be apparent from an inspection of this patent, the armature 20 will respond to current of one polarity only, and is adapted when the motor element is energized by current of the proper polarity to move toward the left far enough to open the contacts 19—19*a* and close the contacts 18—18*a*.

Although I have herein shown and described only a few forms of electrical relays embodying my invention, it is to be 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. An adjustable contact structure for cooperation with a movable flexible contact finger comprising a terminal post having a cylindrical end, a bracket having one leg mounted on said end in such manner that said bracket can be slid axially along and rotated to different angular positions relative to said terminal post, means for clamping said bracket in an adjusted position relative to said terminal post, and a screw threaded through another leg of said bracket at right angles to said post and provided at one end with a low resistance contact button which is adjustable radially with respect to said post by means of said screw.

2. An adjustable contact structure comprising a supporting post, a contact member, and means adjustable axially along, circumferentially about, and radially with respect to, said post for securing said contact member to said post to permit adjustment of said contact member in all directions with respect to said post.

3. An adjustable contact structure comprising an insulating support, a terminal post mounted on said support and provided with a portion which projects from one side of said support, a bracket carried by said portion and movable axially along and circumferentially about said portion, and a contact member secured to said bracket by means permitting radial movement of said contact member relative to said terminal post, whereby said contact member is adjustable in all directions relative to said terminal post.

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