May 2, 1944.

J. W. LIVINGSTON

2,347,834

ELECTRICAL SWITCH

Filed Nov. 11, 1942

2 Sheets-Sheet 1

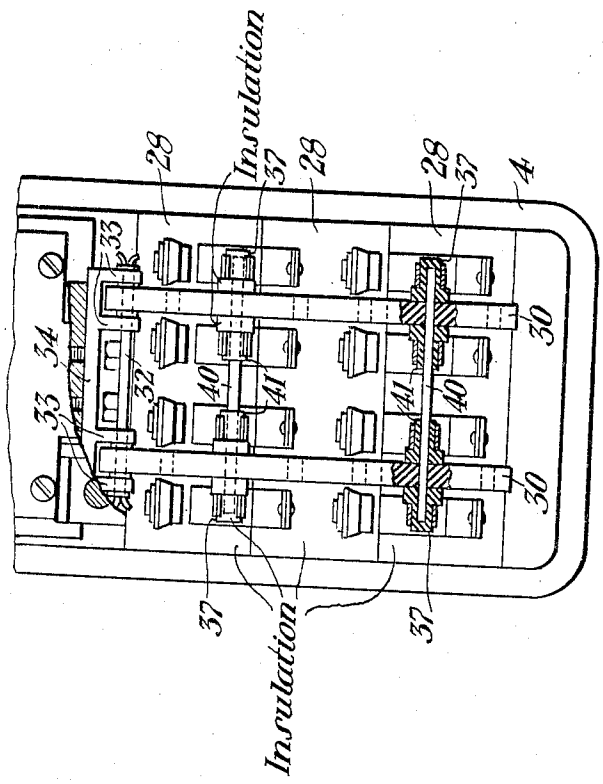


Fig. 4.

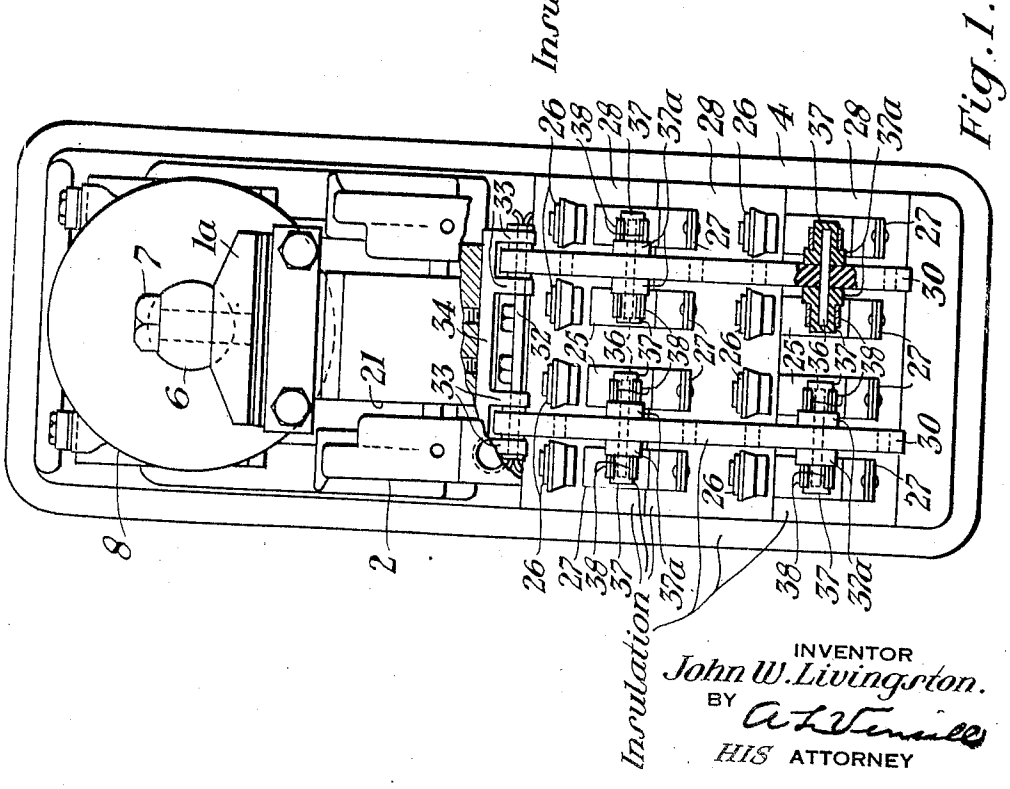


Fig. 1.

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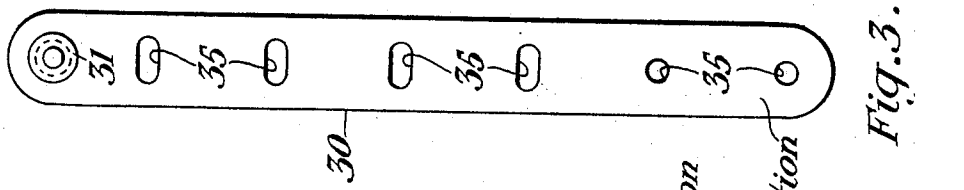


Fig. 3.

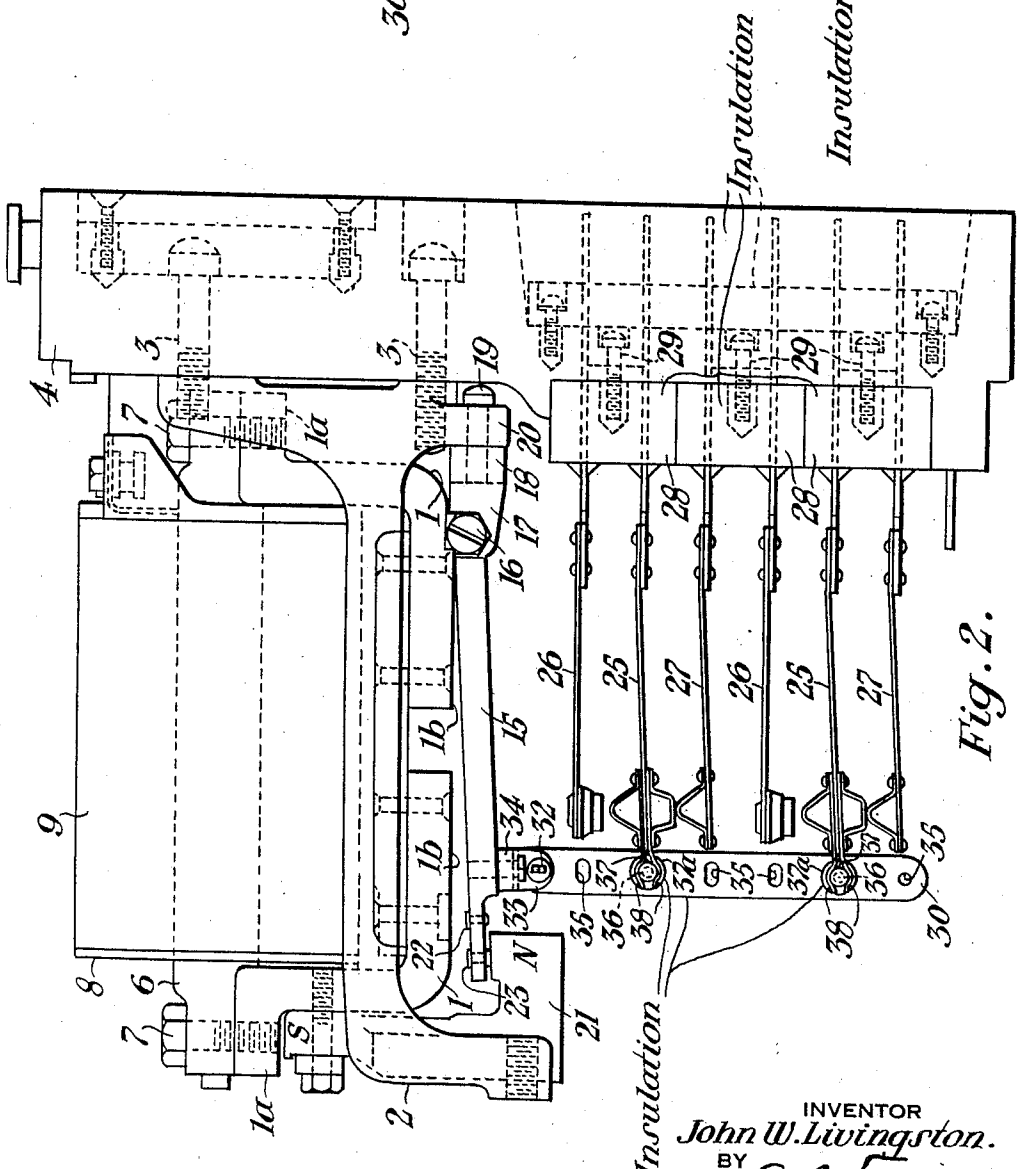


Fig. 2.

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Patented May 2, 1944

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UNITED STATES PATENT OFFICE

2,347,834

ELECTRICAL SWITCH

John W. Livingston, Milwaukee, Wis., assignor to The Union Switch and Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application November 11, 1942, Serial No. 465,218

5 Claims. (Cl. 200—1)

My invention relates to electrical relays, and particularly to multicontact relays in which the contacts are arranged in replaceable groups, and in which the movable contact fingers of each group are connected with the relay armature through the medium of an associated operating member of insulating material pivotally attached to the armature.

One object of my invention is to provide improved means for operatively connecting the movable contact fingers with the associated operating member, which means is easy to assemble and requires a minimum amount of adjustment.

Another object of my invention is to cheapen the cost of manufacture of relays of the type described and claimed in Letters Patent of the United States No. 2,198,704, granted to Branko Lazich, on April 30, 1940.

These objects are attained by arranging the contacts in spaced vertical rows below the relay armature, and by providing the free end of each movable contact finger with a bifurcated end which aligns laterally with the corresponding end of the finger in the next adjacent row. An insulating operating member is provided for each pair of vertical rows and this member extends upwardly between the fingers of the associated rows and is pivotally attached at its upper end to the relay armature. Provided in each operating member in alignment with the bifurcations in the fingers is a hole or slot through which a transverse pin extends with a minimum amount of clearance. These pins in the preferred form of my invention are made just long enough to extend between the bifurcations on the fingers on each side of the operating member, and each pin is provided at each end with a removable insulating cylinder which fits between the bifurcations on the associated finger with sufficient friction to cause it to be gripped by the bifurcations. The cylinders are positioned lengthwise within the bifurcations by integral annular flanges disposed between the fingers and the operating member, and the pins are positioned lengthwise by constructing the cylinders so that the holes in the cylinders which receive the pins are closed at their outer ends.

In an alternative form of my invention each pin is made long enough to extend through more than one operating member, and as many cylinders are provided on each rod as there are laterally aligned fingers. The holes in the two end cylinders are closed at their outer ends to position the rods lengthwise, but the holes in the remaining cylinders extend all of the way through the cylinders.

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

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

In the accompanying drawings, Fig. 1 is a front elevational view showing one form of relay embodying my invention. Fig. 2 is a right-hand side view of the relay shown in Fig. 1. Fig. 3 is an enlarged detail side view of one of the operating members 30 forming part of the relay shown in Figs. 1 and 2. Fig. 4 is a fragmentary view similar to Fig. 1 showing a modification of the relay illustrated in Figs. 1 and 2.

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

Referring first to Figs. 1, 2 and 3, the relay to which I have shown my invention applied is of the type described and claimed in Letters Patent of the United States No. 2,198,704 referred to hereinbefore, and comprises two magnetizable pole pieces 1 secured as by riveting to a non-magnetizable supporting bracket 2, which supporting bracket, in turn, is fastened by means of screws 3 to a backplate 4 of suitable insulating material that can be readily moulded, such for example, as a phenol condensation product. The pole pieces extend upwardly through slots (not shown) formed in the bracket 2, and are provided at their upper ends with outwardly extending portions 1*a*. A magnetizable backstrap 6 is secured at its ends to the outwardly extending portions 1*a* of the pole pieces 1 by means of screws 7, and mounted on this backstrap is an insulating spool 8 provided with an energizing winding 9. The portions of the pole pieces which are located on the underside of the top plate extend toward each other, and have their lower pole faces 1*b* ground to lie in the same plane.

The relay also comprises a magnetizable armature 15 which is pivotally supported at one end in trunnion screws 16 for swinging movement toward and away from the pole faces 1*b* of the pole pieces 1. The trunnion screws 16, only one of which is visible in the drawings, are supported in outstanding lugs 17 formed on a non-magnetizable bracket 18 secured by means of screws 19 to a depending portion 20 of the bracket 2.

The relay further comprises an L-shaped permanent magnet 21 which is secured at one end to the outer pole piece 1, and the other end of which extends underneath the armature 15 opposite the pole face 1*b* of the outer pole piece 1 in such manner that when the armature 15 is swung away from the pole pieces 1 it will be swung toward the permanent magnet, and vice versa. The armature is prevented from actually touching the pole pieces 1 by means of a core pin 22 of non-magnetizable material riveted to the armature adjacent its forward end in a position to engage the head of one of the rivets which secure the one pole piece 1 to the bracket

2. A core pin 23 similar to the core pin 22 prevents the armature from actually touching the pole face of the permanent magnet 21.

Assuming that the lower end of the permanent magnet 21 is a north magnetic pole and the upper end a south magnetic pole, as indicated by the letters N and S in the drawings, when the winding 9 is deenergized, the armature 15 will drop under the influence of gravity to the position shown, and under these conditions a part of the flux from the permanent magnet will pass lengthwise through the armature and will exert on the armature a torque which assists the pull of gravity in retaining the armature in the position shown. When, however, the winding 9 becomes energized, if it is energized in such direction that the front pole piece 1 becomes a south pole and the rear pole piece 1 becomes a north pole, the permanent magnet and electromagnet fluxes will buck each other, and as the electromagnet flux builds up on the armature, a point will be reached at which the upward pull exerted on the armature by this flux will exceed the downward pull due to the permanent magnet flux and the force of gravity, and when this happens the armature 15 will swing upwardly toward the pole pieces 1 to the position determined by the core pin 22. If the winding 9 is energized in such a direction that the front pole piece 1 becomes a north pole and the rear pole piece 1 becomes a south pole when the armature 15 occupies its deenergized position, the flux due to both the electromagnet and the permanent magnet will then thread the armature 15 in the same direction, and under these conditions the armature 15 will remain in the position shown even though the energization of the winding 15 is increased to many times its normal value.

It should be particularly pointed out that, if the polarity of the permanent magnet 21 be reversed from that shown in the drawings, the armature will operate in a manner similar to that just described except for the fact that the polarity of the current which must be supplied to winding 9 to cause it to pick up will then be reversed.

The contacts of the relay are disposed directly below the armature 15, and as here shown are arranged in four laterally spaced vertical rows. Each vertical row includes two vertically spaced movable contact fingers 25 located between a cooperating front contact finger 26 and a cooperating back contact finger 27. The forward portion of each finger is flexible, and is riveted to a rigid rear portion moulded into an insulating block 28. Each block 28 as shown supports two horizontal rows of four fingers each, and is removably clamped by means of screws 29 against the forward face of the backplate 4, whereby the contacts may be readily removed and replaced with other contacts when desired. The rigid portion of each contact finger is made sufficiently long to extend through an aligned opening in the backplate into a rectangular recess formed in the rear side of the backplate, and constitutes a plug for making contact with a suitable female connector in the manner described in detail in the aforementioned Lazich United States Patent No. 2,198,704.

My present invention relates to improved means which I shall now describe for operatively connecting the movable contact fingers of the relay with the relay armature. In its preferred form these means comprise a plurality of contact operating members 30 of moulded insulating material, one of which is provided for each pair of vertical rows of contact fingers. A bushing 31 is moulded in place in the upper end of each operating member, as shown in Fig. 3, and the two operating members are pivotally suspended from the armature 15 by means of a rod 32 of suitable material such as phosphor bronze, which rod extends through the bushings 31 with some clearance and is mounted in depending lugs 33 formed on a bracket 34 secured to the underside of the armature. One of the lugs 33 is disposed on each side of each bushing, and the parts are so proportioned that the operating members are equally spaced from the two associated vertical rows of contacts by the lugs and bushings. Each operating member is also provided with a plurality of transverse openings 35 spaced apart vertically the same distance as the vertical spacing between the contact fingers, the two lower openings being in the form of round holes and the remaining openings being in the form of slots. A transverse pin 36 extends with a minimum of clearance through the hole or slot disposed at the outer ends of the movable fingers of the two adjacent vertical rows of fingers, and is provided at each end with an insulating cylinder or thimble 37. These thimbles are free to turn on the rods, and are designed to snap in place between bifurcations 38 provided on the ends of the adjacent fingers. The bifurcations are constructed to engage the thimbles with sufficient friction to cause the thimbles to be effectively gripped by the bifurcations. Formed on the end of each thimble and fitting between the operating member and the associated bifurcations is a flange 37a which serves to maintain the operating member equally spaced with respect to the two adjacent rows of fingers and to position the thimble lengthwise in the associated bifurcations. The opening in each thimble into which the rod fits is closed at its outer end, whereby the thimbles also serve to position the rods lengthwise with respect to the operating members.

With the contact operating means constructed in the manner just described, it will be apparent that any movement of the armature 15 will be transmitted through the rod 32 to the operating members 30 and thence through the pins 36 and thimbles 37 to the fingers, whereby the movable fingers 25 will be constrained to move to the positions in which they engage the fixed front fingers 26 or fixed back fingers 27 to close the front contacts 25—26 or the back contacts 25—27 according as the armture 15 is picked up or released. It should be noted that when the armature is picking up or releasing the upper end of each operating member 30 will pivot about the rod 32 and the lower end will pivot about the lower pin 36. This necessitates that the intermediate pin 36 be free to move transversely of the operating member a limited amount, and it is for this reason that the two lower openings in the operating member are in the form of round holes while the remaining openings are in the form of elongated slots. In this connection, it should be noted that while for the contact combination shown the lower pin 36 is shown in the second hole from the bottom in the operating member, for other contact combinations, for example, one in which the relay is provided with all front contacts, the lower pin would be moved to the lower hole, but pins would never

be provided in both lower holes. Moreover, in the event the relay is provided with all front contacts it would then be necessary to provide a pin in the fourth slot 35 from the top.

It will thus be seen that with the contact operating means shown, any desired contact combination may be readily obtained merely by replacing the insulating blocks 23 with other blocks having the desired contact arrangement and then assembling the pins in the proper holes and slots in the operating member.

Another advantage of the contact operating means shown is that the various parts are of such construction that they can be readily moulded or machined to accurate dimensions at a very low most, so that very little, if any, manual adjustment of the contact fingers is required during assembly of the relay to obtain the proper relay operation. It has been found from actual experience that this results in an appreciable savings in the cost of manufacture of the relays.

As shown in the preceding views, each pin 36 is made just long enough to extend through only one operating member 30 and support two thimbles 37. If desired, each pin may be made long enough to extend through all of the operating members 30 and support as many thimbles as there are lateral rows of contacts, as is the case with the pins 40 shown in Fig. 4. In this event, the two end thimbles on each pin would be identical with those shown in Figs. 1 and 2, but the remaining thimbles designated 41 in Fig. 4 would both be provided with a through opening for the reception of the associated pin 40.

It should be particularly pointed out that while for purposes of illustration I have shown my invention applied to a relay of the type described in United States Patent No. 2,198,704 referred to hereinbefore, it is equally applicable to a form of relay having an operating element which provides a contact operating movement equivalent to that provided by the armature 15.

Although I have herein shown and described only two 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. In a switching device comprising a plurality of contacts arranged side by side in pairs and each comprising cooperating fixed and movable flexible contact fingers, an insulating operating member movable between two positions, means for moving said member, and means for operatively connecting said member with said movable fingers comprising an opening provided in said member for each pair of contacts, a pin extending through each opening, bifurcations provided on the free end of each movable finger, and an insulating thimble disposed on each end of each pin and fitting in the bifurcations on one of said movable fingers.

2. In a switching device having a movable operating element and a plurality of contacts arranged in pairs of spaced rows and each comprising a cooperating fixed and movable flexible contact finger, the combination of an insulating operating member for each pair of rows pivotally attached at one end to said operating element and provided with a plurality of openings, pins disposed in said openings, bifurcations provided on the free end of each movable finger, and insulating thimbles disposed on said pins and each fitting in an associated one of said bifurcations.

3. In a switching device having a movable operating element and a plurality of contacts arranged in pairs of spaced vertical rows, each said contact comprising a cooperating fixed and movable contact finger, a contact operating member of insulating material for each pair of rows of contacts pivotally attached at one end to said operating element and provided with a plurality of transverse openings spaced apart vertically the same distance as the vertical spacing between the contact fingers, a pin extending through each opening, bifurcations provided on the free end of each movable finger, the movable fingers in each two adjacent rows being laterally aligned, and an insulating thimble disposed on each end of each pin and fitting with a snap fit between the bifurcations on an adjacent movable finger.

4. In a switching device having a movable operating element and a plurality of contacts arranged in pairs of spaced vertical rows, each said contact comprising a cooperating fixed and movable contact finger, a contact operating member of insulating material for each pair of rows of contacts pivotally attached at one end to said operating element and provided with a plurality of transverse openings spaced apart vertically the same distance as the vertical spacing between the contact fingers, a pin extending through each opening, bifurcations provided on the free end of each movable finger, the movable fingers in each two adjacent rows being laterally aligned, and an insulating thimble disposed on each end of each pin and fitting with a snap fit into the bifurcations on an adjacent movable finger, each said thimble being provided between the associated bifurcation and the associated operating member with an annular shoulder which positions it lengthwise in the bifurcation.

5. In a switching device having a movable operating element and a plurality of contacts arranged in pairs of spaced vertical rows, each said contact comprising a cooperating fixed and movable contact finger, a contact operating member of insulating material for each pair of rows of contacts pivotally attached at one end to said operating element and provided with a plurality of transverse openings spaced apart vertically the same distance as the vertical spacing between the contact fingers, a pin extending through each opening, bifurcations provided on the free end of each movable finger, the movable fingers in each two adjacent rows being laterally aligned, and an insulating thimble disposed on each end of each pin and fitting with a snap fit into the bifurcations on an adjacent movable finger, each said thimble being provided between the associated bifurcation and the associated operating member with an annular shoulder which positions it lengthwise in the bifurcation, and the opening provided in each said thimble for the reception of the associated pin being closed at its outer end to position said pin lengthwise with respect to said operating member and the associated thimbles.

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