

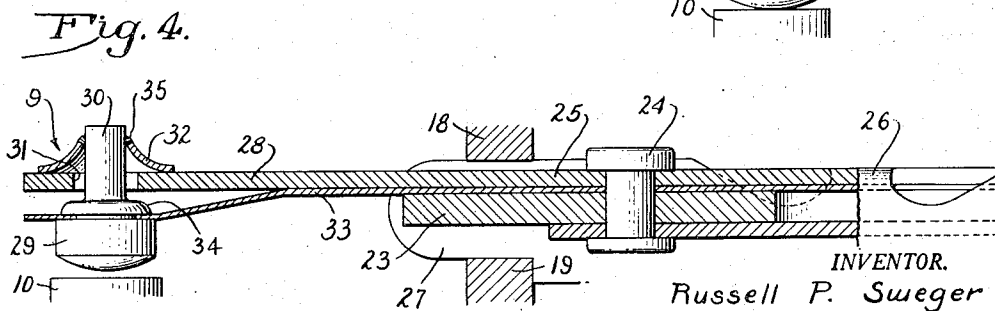
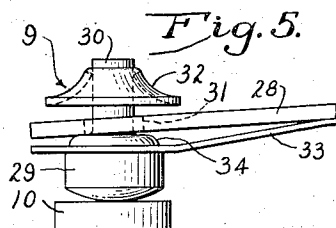
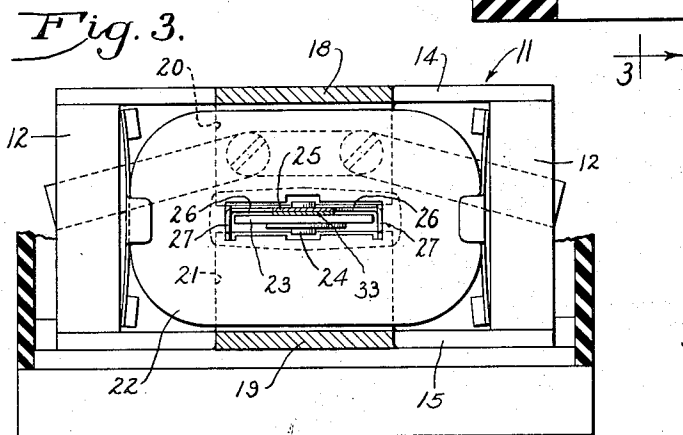
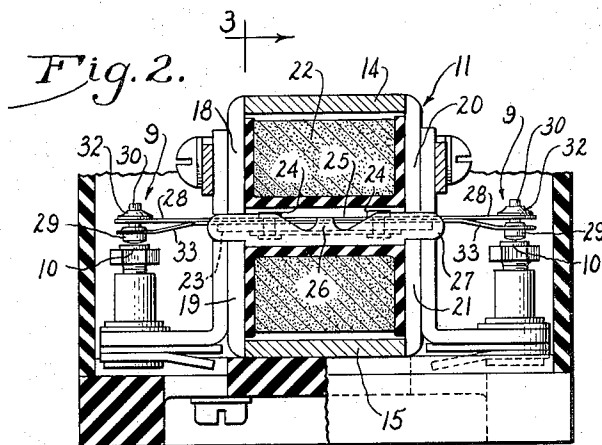
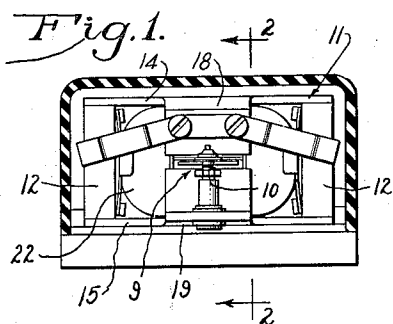
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R. P. SWEGER

2,532,468

MOVABLE CONTACT STRUCTURE

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INVENTOR.
Russell P. Sweger
BY *Carlson, Pitman,
Hubbard & Wolfe*
ATTORNEYS

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MOVABLE CONTACT STRUCTURE

Russell P. Sweger, Rockford, Ill., assignor to Barber-Colman Company, Rockford, Ill., a corporation of Illinois

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1 Claim. (Cl. 200—166)

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The present invention pertains to movable contacts for use in various electrical devices, being especially suited for use in sensitive relays or like precision instruments.

One general object of the invention is to provide a movable contact structure adapted for coaction with a stationary contact in a relay or the like, and which is of such character as not only to minimize the bounce or rebound of the movable contact upon sudden closure, but also to minimize the sensitivity of the contacts to externally applied vibration.

Another object is to provide a novel and improved contact arrangement of the general type indicated which is of such character as to effect a self-cleaning action of the contacts during operation, as well as to effect energy absorption in a manner tending to dampen vibration.

Further objects and advantages of the invention will become apparent as the following description proceeds, taken in connection with the accompanying drawings in which:

Figure 1 is a side elevation of a relay equipped with movable contact structures embodying the present invention, the relay casing being shown in section.

Fig. 2 is an enlarged sectional view taken substantially along the line 2—2 in Fig. 1.

Fig. 3 is a sectional view taken substantially along the line 3—3 in Fig. 2.

Fig. 4 is an enlarged longitudinal sectional view of one of the movable contact structures included in the relay, and embodying the present invention, together with a fragmentary showing of the associated elements of the relay.

Fig. 5 is a stop motion view illustrating the contact of Fig. 4 in its closed position.

Referring more particularly to the drawings, the invention has been exemplified as embodied in a polarized relay equipped with movable contact structures embodying the present invention. Two such movable contact structures, each designated generally as 9 (see Fig. 2), are included in this particular relay. They coact with corresponding stationary contacts 10 to open and close associated circuits (not shown) which they control. The relay shown is simply an example of one of the various forms of sensitive relays or the like in which movable contact structures of the present invention find utility, the relay as a whole being the invention of Clark V. Bullen and Carl J. Anderson and being covered by their copending application Serial No. 487,244, filed May 17, 1943, now Patent No. 2,443,784, granted June 22, 1948. It will be understood therefore that there is no

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intention to limit the present invention to such an installation nor to details inessential to practice of the invention, even though a preferred embodiment is described and shown in some detail.

On the contrary, the intention is to cover all uses, modifications, alterations and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

By way of preliminary, the construction of the relay as a whole will be briefly outlined and thereafter the movable contact structures 9, embodying the present invention, considered more in detail. In the particular relay shown, the stator, designated generally as 11, comprises a pair of block-shaped permanent magnets 12 made of Alnico or other material having a high degree of magnetic retentivity. The magnets are spanned by upper and lower bridges 14, 15 which are fixed to the magnets. Inturned from the opposite side edges of each of the bridges 14, 15 are integral ears constituting pairs of opposed pole pieces 18, 19 and 20, 21. The air gaps between the ends of the respective pairs of pole pieces are aligned with each other on the transverse center line of the stator structure. The pole pieces are permanently magnetized by the magnets 12. The upper pole pieces 18, 20 may, for example, be north poles and the lower pole pieces south poles. Encircling the transverse center line of the stator 11 passing through the air gaps between the two pairs of pole pieces is an actuating winding 22. If an armature, such as the armature 23, is positioned to extend axially through such winding, energization of the latter will tend to rock the armature about its center. Flow of current through the winding in one direction will cause the armature to rock in one direction, while flow of current in the opposite direction will correspondingly cause the armature to rock in an opposite direction. Contacts may thus be controllably opened or closed in accordance with the direction of current flow through the actuating winding.

In the present instance the armature 23 consists of a thin platelike wafer of soft iron or other suitable ferromagnetic material. It is generally rectangular in form, being dimensioned to extend into the air gaps between both of the opposed pairs of pole pieces 18, 19 and 20, 21 (see Fig. 2). Secured to the upper face of this armature 23 by rivets 24 is a sheet metal stamping 25 having torsionally flexible lateral projections 26 terminating in integral side members or bars 27 which are clamped between the opposed ends of the pairs of pole pieces to support the armature

in operating position. The torsional flexibility of the projections 26 permits the armature 23 to rock about its transverse center line through a few degrees of arc in the manner outlined generally above, and the torsionally stressed projections 26 also serve as restoring springs for returning the armature to its mid position shown.

Polarized relays of the general style described above are high precision instruments, their sensitivity having proved adequate to enable them in some instances to replace even electronic relays. The requirements of such an instrument are, however, extremely exacting and minute aberrations of operation, which could be tolerated in an ordinary electromagnetic contactor or switch, assume considerable importance. One such factor, and with which the present invention deals, is bounce or rebound of the contacts upon closure. Any such bouncing or rebounding causes the contact closure to be intermittent, thereby interfering with accurate operation. The present invention aims to provide a contact structure which will minimize any such bounce or rebound. Moreover, the arrangement is such as to minimize inadvertent contact closure or other undesirable contact operation upon the imposition of externally applied vibration, thereby increasing the fidelity of operation of the instrument in airplane installations or like environment where vibration is likely to take place.

In the exemplary construction shown each movable contact structure 9 includes a supporting arm 28, fashioned in this instance as axially aligned integral extensions on the sheet metal stamping 25 and projecting outward in cantilever fashion. These arms 28 mounted for broadwise swing move toward and from the respective stationary contacts 10 as the armature 23 is rocked about its central transverse axis by the action of the operating winding 22 heretofore described.

Also included in each of the illustrated movable contact structures 9 are contacts or contact points 29, here shown (see Fig. 4) as being cylindrical in shape and having active or outer end faces which are slightly convex. Rigid with each contact 29 and projecting from its rear face is a stud 30. These studs pass freely through apertures 31 in the supporting arms 28. The contacts 29 are thus floatingly mounted with respect to the arm 28 eliminating any possibility of frictional contact therebetween. Washers 32 are secured to each of the studs 30, being located on the sides of the arms 28 opposite the contacts 29. These washers serve as abutments for holding the stud captive and limiting the bodily movement of the contact and stud subassemblies 29, 30 transversely of the supporting arms 28.

A leaf spring is fixedly clamped between the armature 23 and overlying sheet metal stamping 25 (see Fig. 4) and presents end or finger portions 33. The body portions of these fingers 33 adjacent the armature extend outwardly toward the end of the supporting arms 28 and are positioned to lie flatly against the lower side of the arms. The fingers 33 are bent outwardly from the arms closely adjacent the contacts 29 defining offset outer end portions which constitute only a relatively small fraction of the entire length of the springs as measured from the axis of swing to the respective contacts. The offset end portions thus have a very limited radius of swinging movement toward and away from the arm. These end portions are secured to the contact and stud subassemblies 29, 30 urging the latter away from the supporting arms 28. For the

latter purpose the fingers 33 are apertured to receive the studs 30 and the latter are rolled over, as indicated at 34, to fix such portion of the spring fingers to the contacts 29.

In assembling the movable contact structures 9 illustrated, the contact and stud subassemblies 29, 30 are secured to the spring fingers 33 and positioned in reference to the supporting arms 28 with the washers 32 slidably embracing the studs 30. The spring fingers 33 are placed in a suitable heat treating fixture which serves to flex them downwardly in the form shown and thus preload them with the desired initial tension. The washers 32 are pressed on the studs 30 until the required pressure is obtained and then soldered to the studs 30 as indicated at 35.

Should the contact 29 be fixed directly to the arm 28, rather than mounted on a supplemental preloaded spring finger 33 as shown, the contact will bounce on closure even without extraneous vibration unless the voltage of the operating winding 22 is raised so gradually that there is very little kinetic energy in the moving contact. Such bounce will take place no matter what the stiffness of the arm 28 may be. In contrast, with the construction disclosed, the arm 28 can vibrate with reference to the contact 29 so that the spring 33 can and does hold the contact closed even while the arm 28 vibrates to some extent. During actual operation of the disclosed relay, and assuming a flow of current in the winding 22 in a direction to rock the armature 23 counterclockwise as viewed in Fig. 4, the arm 28 may be in any position between those shown in Figs. 4 and 5, depending upon the degree of energization of the winding. When the spring 33 is flexed only slightly, the contact will open under effects of externally applied vibration if the arm 28 moves far enough to lift contact 29 off of contact 10. This condition permits vibratory contact through a much smaller range of operating coil magnetomotive force than when the contact 29 is mounted directly on the arm 28. In other words there is a wide range of position for the arm 28 in which the preloaded spring 33 holds the contact 29 firmly against the contact 10 and irrespective of whether the arm 28 is itself vibrating.

When the armature 23 is rocked back to its central position shown in Fig. 2 the contact 29 is pulled away from the stationary contact 10, the various parts assuming again the position shown in Fig. 4. In such condition the spring finger 33 still remains stressed, urging the contact 29 downward, so that the contact 29 and finger 33 do not have any tendency to flutter or vibrate independently of the arm 28 and thus cause inadvertent closure of the contacts when they are supposed to be open.

It will be understood that the same type of operation takes place for the identical righthand contact structure 9 when the armature is rocked in a direction to close it.

From the foregoing it will be perceived that when the contacts 29, 10 are closed with more force than necessary to overcome the initial tension on the spring fingers 33, the armature 23 is permitted to vibrate slightly without causing the contacts to reopen. Thus vibration of the armature can take place without having the contacts 29 separate from their companion stationary contacts 10. On the other hand, the initial tensioning of the relatively weak spring fingers 33 prevents independent vibration of the same when the contacts are open. In addition, the described arrangement, with the relatively short

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outer end portions of the spring fingers offset outwardly from the arms, causes the movable contacts to swing bodily away from the axis of swing of the arms since the radius about which the outer end portions of the springs deflect is only about one quarter that of the entire arm and spring assembly. This relative movement provides a wiping action of the contacts 29 with reference to the stationary contacts 10. This is beneficial not only in cleaning the contacts but also in absorbing energy in a manner tending to dampen vibrations of the armature 23 since the kinetic energy which contributes to chattering and bounce is absorbed by the frictional sliding of the contacts.

I claim as my invention:

In a movable contact structure for a sensitive relay having an armature movable through only a few degrees of arc, the combination comprising an elongated supporting arm fashioned from sheet material and mounted on said armature in freely projecting position for broadwise swinging movement, said arm having an aperture in its free end portion, a contact having a stud on its rear side dimensioned to project freely through said aperture, a cooperating fixed contact, a resilient spring finger having a body portion and an end portion mounted on said arm, said end

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portion engaging said contact to urge the same outwardly with respect to the aperture, a collar member on said stud embracing the rearwardly projecting portion thereof and positioned to span said aperture and hold said stud captive thereon, the body portion of said resilient spring finger being positioned to lie flatly alongside said arm with the end portion thereof bent outwardly therefrom at a point closely adjacent the contact to provide a short radius of swing therefor so that appreciable wiping movement occurs between said contacts even under very limited swinging movement of the armature, said collar member being so positioned on said stud as to retain the end portion of said spring preloaded against movement in the inward direction.

RUSSELL P. SWEGER.

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The following references are of record in the file of this patent:

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