Aug. 10, 1965 W. R. LEMKE 3,200,225

ARTICULATED RECIPROCATING CONTACT STRUCTURE

Filed June 3, 1963

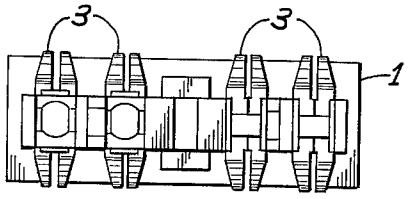

Fig. 1.

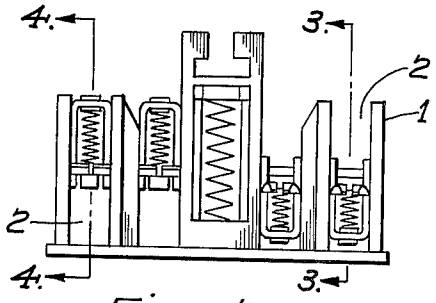

Fig. 2.

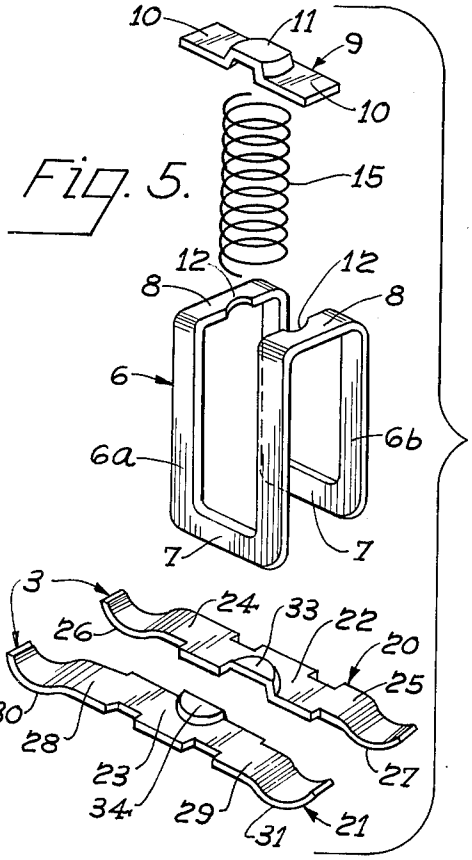

Fig. 5.

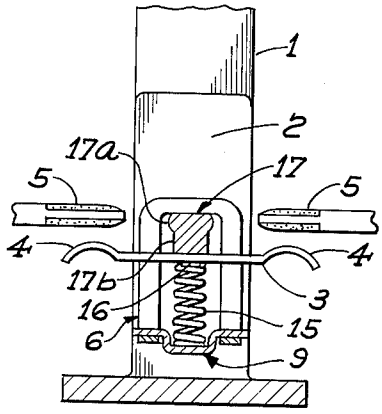

Fig. 3.

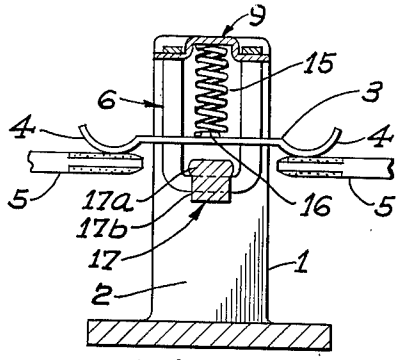

Fig. 4.

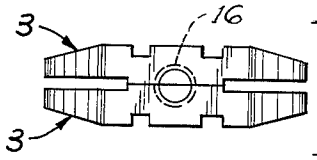

Fig. 6.

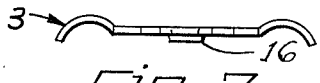

Fig. 7.

Fig. 8.

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ARTICULATED RECIPROCATING CONTACT STRUCTURE

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This invention relates to a contact structure and particularly to a contact structure employing a rigid bridging contact combining the advantages of a bridging contact made of rigid material with the advantages of one made of resilient material. For the purpose of illustration, the invention is illustrated herein as incorporated in the movable contact structure disclosed in the copending application of Erik J. Nielsen and Max Hurter, Serial No. 206,624, filed July 2, 1962, now Patent No. 3,161,644 and entitled Electromagnetic Relay, its use as a stationary contact and in other structures being apparent from the illustrative example.

As disclosed in the above identified copending application, a bridging contact for an electromagnetic relay is provided and is mounted in a suitable support which is movable in opposite directions along a predetermined operating path to open and closed contact positions by means of an electromagnet. The contact is mounted on the support in a manner such that it can be rotated 180° about an axis extending transversely of the contact and normal to the path of movement of the support for disposing the contact selectively in two positions. In one position the contact can function as a normally open contact and in the other position as a normally closed contact.

Heretofore in relays, bridging contacts of sheet metal have been used. Such a prior contact has a midportion, by which it is supported in a movable support and end portions extending outwardly therefrom for cooperation with stationary contacts, respectively, at opposite sides of the support. In order to assure effective contact of the end portions, the contact is sometimes made of spring metal and bifurcated partway from the midportion outwardly to the ends so that two end portions are provided at each end in the form of two resilient contact fingers spaced apart from each other edgewise. Thus four separate contact surfaces are provided on a single bridging contact. Consequently, if either contact finger at either end should fail to engage or function properly, the one adjacent to it could flex and function independently, thus greatly reducing the possibility of malfunctioning of the contact as a whole. For example, should one of the two fingers be bent out of normal position slightly, it, or the one adjacent to it, would flex and self-adjust for contact so that both contact surfaces at the same end would make and break contact. This assures alternate paths for current between the contacts which are bridged by a single bridging contact. Usually both fingers at each end make proper contact and provide wiping engagement for cleaning the contact surfaces of the bridging contact and of the complementary stationary contacts.

In the above copending application, the bridging contact is a rigid strip of metal having only one contact surface at each end, but it can rock in its support about an axis extending parallel to the plane of the contact and transversely of the length of the contact at its midportion. However, it is desirable to provide bridging contact of rigid metal having a plurality of contact fingers at each end while eliminating the necessity for resiliency and while, at the same time, providing for limited movement of the fingers independently of each other along the path in which the contact moves for making and breaking contact.

For this purpose, the contact structure of the present invention is provided.

In the present disclosure, the contact is disclosed as mounted in the same general manner as in the above entitled copending application, so as to retain the benefits thereof while at the same time, assuring alternate paths for the current through the bridging contact and proper contact and wiping action without the necessity for a contact of resilient metal.

In accordance with the present invention, the contact bridge comprises a plurality of rigid metal bridging contact elements and are arranged side by side on a support so as to be movable together as a unit relative to the support and with the support along a predetermined path in opposite directions, for making and breaking contact, respectively. Concurrently with their movement, as a unit, along their path, they are rockable relative to each other about axes which extend transversely of the path and also transversely of their lengths. The elements are resiliently constrained to this movement by a spring common to the elements. The adjacent end portions of adjacent elements are spaced apart edgewise of the elements from each other so as to provide separate contact fingers. The members are resiliently urged relative to the support by a spring, in a direction for making contact, against a fulcrum on the support. The spring yieldably holds them in normal parallel relation to each other while permitting them to rock resiliently relative to each other about the fulcrum.

Specific objects and advantages of the invention will become apparent from the following description wherein reference is made to the drawings, in which:

FIG. 1 is a top plan view of a contact support and bridging contact mounted therein, and embodying the present invention;

FIG. 2 is a front elevation of the structure illustrated in FIG. 1;

FIGS. 3 and 4 are enlarged vertical cross sectional views, respectively, taken on the lines 3—3 and 4—4, respectively, of each of FIGS. 1 and 2;

FIG. 5 is an exploded perspective view showing the bridging contact and mounting elements therefor which may be used in the present invention;

FIG. 6 is a top plan view of the contact bridge of the present invention; and

FIGS. 7 and 8 are a front elevation and a right end elevation, respectively of the contact bridge illustrated in FIG. 6.

For convenience in description and comparison with the above identified application, the invention is herein disclosed as embodied in the movable contact of the relay, its incorporation in a stationary contact, where desired, being apparent from the illustrative example.

The relay is shown as provided with a body having stationary contacts therein against which a bridging contact is to be moved upon operation of the relay. The movable contact generally is carried by a movable contact support which is operative electromagnetically for moving the movable contact either into or out of engagement with the complementary stationary contacts, depending upon whether the contacts are to be normally open or normally closed.

The movable bridging contact of the present invention is carried in a support 1 in the form of a movable contact carrier which is mounted for movement in any suitable conventional manner along a predetermined path in opposite directions so as to move the bridging contact to open and closed positions. The support has a passage 2 therethrough, the passage being open at its opposite ends. A bridging contact 3 extends through the passage and has contact surfaces 4 at its ends and disposed outwardly

beyond the ends of the passage for cooperation with complementary stationary contacts **5**. The contacts **5** and movable support may be supported by a housing portion of the relay, if desired.

If the bridging contact is to be one which can be set so as to be used as a normally open or normally closed contact, selectively, the support **1** may include, as part of the support, an auxiliary supporting frame member **6** in the form of a double yoke having one forward upright U-shaped portion **6***a* and one rearward inverted U-shaped portion **6***b*, these portions being aligned forwardly and rearwardly of the yoke. The portions **6***a* and **6***b* are connected to each other at the open ends of the U's by forwardly and rearwardly extending members **8**. The members **8** are adapted to bear against one face of a spring rest **9** which has lateral portions **10** which are juxtaposed against the under face of the members **8**. The rest **9** is provided with a concavo-convex boss **11** which is received between members **8** and engages notches **12** therein for preventing displacement of the member **10** edgewise.

A compression spring **15** is disposed with one end in the concavity of the boss **11**. The other end engages a boss **16** on the bridging contact **3** and is centered thereby. The spring **15**, being compressed between the member **9** and the bridging contact **3**, urges the contact in a direction relative to the support **1** toward contact making positions. The double yoke is disposed in the opening or passage **2** wherein is a cross bar **17** having a top portion **17***a* and a depending lug portion **17***b* which, when the bottom portions **7** of the double yoke engages the under face of the cross bar, so that the contact is in normally closed position, is disposed between the bottom portions **7**. When the double yoke is rotated 180° about the cross bar from this position so that the contact is in normally open position, the bottom portions **7** engage the upper face of the top portion **17***a*, and the portion **17***b* is disposed between the portions **6***a* and **6***b*.

The purpose of this different engagement of the contact relative to the cross bar **17** is for compensating for certain distances and movements of the contact and support when the contact operates as a normally closed contact and as a normally open contact, as fully explained in the above copending application.

As mentioned heretofore, it is desirable that the bridging contact be made of stiff metal and non-resilient for some purposes, yet it is desirable that the contact portions be at least two in number at each end of the contact and that these portions be movable relative to each other in the contact making and breaking directions, so that all of the four contact portions can self-adjust independently in making contact with complementary stationary contacts.

For this purpose, the bridging contact **3** is composed of two separate elements **20** and **21**, respectively, each of which is separate and unconnected from the other along a dividing line and extending endwise of the contact midway between the lateral limits of the contact. The two elements **20** and **21** each is formed of a separate piece of rigid sheet material. The elements have central portions **22** and **23**, respectively, so arranged that, when the members are placed side by side in edgewise parallel and generally coplanar relation to each other, the adjacent or inner edges of the portions **22** and **23** engage each other throughout their lengths. Outwardly endwise beyond the central portion **22**, the member **20** has finger portions **24** and **25**, the outer ends of which are contact surfaces **26** and **27**, respectively. Correspondingly, the element **21** has fingers **28** and **29** extending outwardly from its central portion **23**, with contact surface portions **30** and **31** at their outer ends, respectively.

The fingers are so shaped that when the central portions are in engagement with each other at their adjacent inner edges, the adjacent inner edges of the fingers **24** and **28** are spaced apart laterally of the contact, as also are the inner adajcent edges of the fingers **25** and **29**. Thus, when the two elements **20** and **21** are assembled in parallel substantially coplanar relation, the end portions of each are spaced apart laterally from each other so that the resultant bridging contact provides two contact portions at each end aligned with each other transversely of the two elements, as in the case of a solid contact having bifurcated end portions.

In order to mount the elements **20** and **21** in the support **1**, the elements are provided at the inner margin of their central portion with boss portions **33** and **34**, respectively. These boss portions preferably are such that when the two elements are positioned with their adjacent edges and central portions in contact with each other, the boss portions form the common boss **16** which is received in the end of the spring **15** which bears on the contact **3**.

The elements **20** and **21** have notches, such as indicated generally at their outer margins, which may engage the portions **6***a* and **6***b* in the frame member **6** for guiding the contact elements as they are moved relative to the support in the passage **2** toward and away from the cross bar **17**. The common boss **16**, formed of the portions **33** and **34**, is adapted to be snugly received in the lower end of the spring **15** so that the elements not only are urged as a unit toward the cross bar, but are resiliently held thereagainst so that they can rock independently of each other about the face **17***a* thereof as a fulcrum.

As mentioned, these two elements are separate from each other. Hence each can rock in a path parallel to a plane extending endwise of the passage **2** normal to the plane of the elements. The two elements can rock independently of each other about migratory axes which are parallel to each other and extend transversely of the opening and transversely of the path of movement of the contacts in the support, these axes being the upper surface and edges of the upper portion **17***a* of the cross bar **17**.

The spring **15** yieldably urges the elements to remain in parallel edge to edge relation to each other in a row. At the same time, it permits them to move relative to the support in the seating direction and to rock independently of each other to assure a proper contact of the bridging contact as a whole. Further, each element is urged by the spring **15** to an unrocked position wherein the elements are substantially coplanar and parallel to each other.

Thus, in effect, two spaced contact surfaces are provided at each end of the bridging contact, and are made self-adjusting independently of each other as was done heretofore only by making the contact of resilient metal.

As used herein, the term "resilient contacts" defines a contact structure wherein the material which supports the contact surfaces usually has a relatively thin cross section so it flexes as the contact engages a cooperating contact to obtain a contact wiping action as the cooperating contacts move to circuit opening and closing positions. When the resilient contacts are formed with bifurcated ends on which the contact surfaces are disposed, alternate paths are provided for current. Therefore, in the event a particle of dust or other foreign matter prevents engagement of one of the contacts of a pair of resilient bifurcated contacts, the material supporting the contact surfaces flexes, so contact engagement is made by the contact surface on the other of the pair of bifurcated contacts. One inherent deficiency of a resilient contact structure arrangement is that the limits of the flexural strength of the resilient contacts material limit the contact pressure which resilient contacts are able to exert.

The term "rigid contacts," as used herein, defines a structure wherein the parts of the contacts which support the contact engaging surfaces have little, if any, flexing action under the forces which may be impressed thereon as the contacts are moved to a circuit closing position. Thus in the contact arrangement according to the present invention, the limited independent movement of the pair of elements provides alternate current paths in the same manner as is accomplished by a resilient contact structure, in event one of the elements is prevented from moving to

a circuit closing position because of dust or other foreign matter, and, while the contact arrangement according to the present invention does not provide the degree of wiping action achieved by a resilient contact arrangement, it permits higher pressures between cooperating contacts in the circuit closing position, and, as the metal supporting the contacts has a greater cross section, the structure provides a greater heat dissipation and a corresponding increased current conducting capacity which more than offsets any advantages achieved by a contact wiping action. Furthermore, crystallization of the metal due to repeated flexure is eliminated.

It is apparent, therefore, that the beneficial action such as provided by a resilient contact formed of a single metal part having bifurcated ends on which contact surfaces are disposed is obtained by using separate rigid elements for the contact, yet the additional advantages of using rigid metal are retained.

Having thus described my invention, I claim:

1. A bridging contact comprising a support having passage extending therethrough which is open at both ends, a plurality of separate contact bridge elements extending through the passage in side by side relation in a row which extends transversely of the passage, said elements being movable in the passage bodily in opposite directions along a predetermined path which is transverse to the length of the passage and to said row, fulcrum means carried by the support in said passage, said elements each being engaged between its ends with the fulcrum means for rocking in opposite directions relative to each other and to the support independently of each other about the fulcrum means, each in a rocking path parallel to a plane which extends endwise of the passage and parallel to said predetermined path, each element having contact portions at its opposite ends, respectively, all of said contact portions facing in one direction endwise of said predetermined path, a spring in the passage common to all of the elements and operatively interposed between the support and the elements and resiliently urging all of the elements in said one direction along said predetermined path and into engagement with the fulcrum means and yieldably holding them against the fulcrum means, in relatively rocked positions in their rocking paths wherein the elements are parallel to each other.

2. The structure according to claim 1 wherein each element is an elongated strip of material, the elements are arranged in said row in edge to edge relation, said spring has passage means at one end, and each element has a boss portion which protrudes from one face thereof toward the spring and is disposed within the passage means of the spring.

3. The structure according to claim 2 wherein the fulcrum is rigid with the support.

4. The structure according to claim 2 wherein the edge to edge relation is an abutting relation at the midportions of the elements, the contact portions at the same ends of the elements are spaced apart from each other edgewise of the elements, and said boss portions, when the elements are in said edge to edge parallel relation, provide a common boss, and said opening means of said spring comprise a single opening at the portion of the spring adjacent the elements, and the common boss is received in said opening.

5. The structure according to claim 4 wherein the elements are two in number, each element has notches in its outer edge, guides are carried by the support and are engaged in guiding relation with the notches for constraining the elements, while they are in said edge to edge relation parallel to each other, from movement endwise of the passage out of the passage, the boss portion of each element is at its inner edge, said boss portions protrude in a direction along said path toward the spring, and said spring is a coil compression spring and the common boss is received within the end of the spring adjacent the elements.

6. A bridging contact comprising an upright support having a horizontal passage extending therethrough which is open at both ends, a pair of separate unconnected sheet metal contact bridge elements each extending through the passage endwise, said elements being in edge to edge parallel relation and extending horizontally edgewise transversely of the passage, said elements being movable as a unit in the passage in an upright path, a fulcrum on the support in, and extending horizontally transversely of, said passage beneath the elements, an upright compression coil spring in said passage and in operative engagement at its upper end with the support and, at its lower end engaging the elements and resiliently urging the elements downwardly against the fulcrum, each of said elements having at its midportion a protrusion extending toward the spring, said protrusions, when the elements are in said parallel relation, forming a common boss which is received in the lower end of the spring, said midportions being movable relative to each other, each of the elements being rockable, against the resistance of the spring independently of the other about said fulcrum in an upright path, and both of said elements being resiliently urged to unrocked parallel relation against said fulcrum by the spring.

7. The structure according to claim 6 wherein the face of the fulcrum exposed to the elements is planar and of substantial width endwise of the passage and cooperates with said spring to hold the elements in said parallel relation.

8. A bridging contact comprising an elongated strip of metal having a longitudinal midportion and contact portions at the ends, respectively, with contact surfaces at one face of the strip, said strip having an inner edge at its longitudinal midportion arranged to be engaged with a corresponding inner edge of the midportion of a duplicate strip, when two duplicate strips are placed in edgewise abutting parallel relation to each other, said strip having a boss portion extending from one face of its midportion in a direction away from that face of the strip on which the contact surfaces of the contact portions face, and which boss portion extends edgewise of the strip from said inner edge partway toward the opposite edge and which, if the midportions of two duplicate strips are disposed with their inner edges in said edge to edge abutting parallel relation, form a common boss adapted for reception within the end of a coil spring, the end portions of the strip, outwardly endwise beyond the longitudinal midportion, having their inner edges offset edgewise of the strip relative to the inner edge of the midportion toward the opposite edge of the strip so that, if said midportions of duplicate strips are disposed with their inner edges in abutting relation to each other, the end portions of said strip will be spaced edgewise of the strip from the corresponding end portions of the duplicate strip.

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