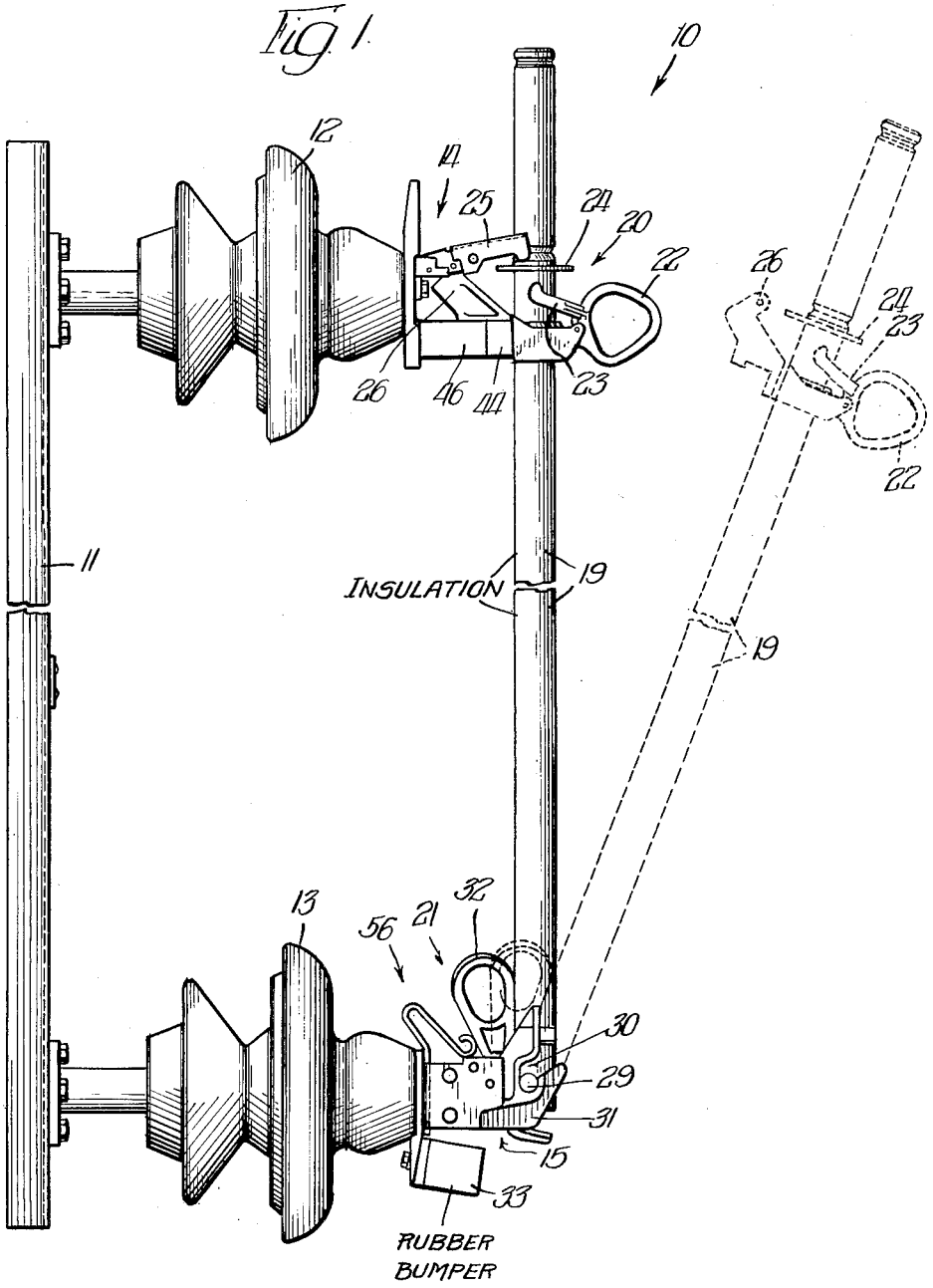
Dec. 11, 1951 S. I. LINDELL 2,578,255

CONTACT CONSTRUCTION FOR CIRCUIT INTERRUPTERS SUCH AS FUSES

Filed Oct. 29, 1948 2 SHEETS—SHEET 1

Fig. 1.



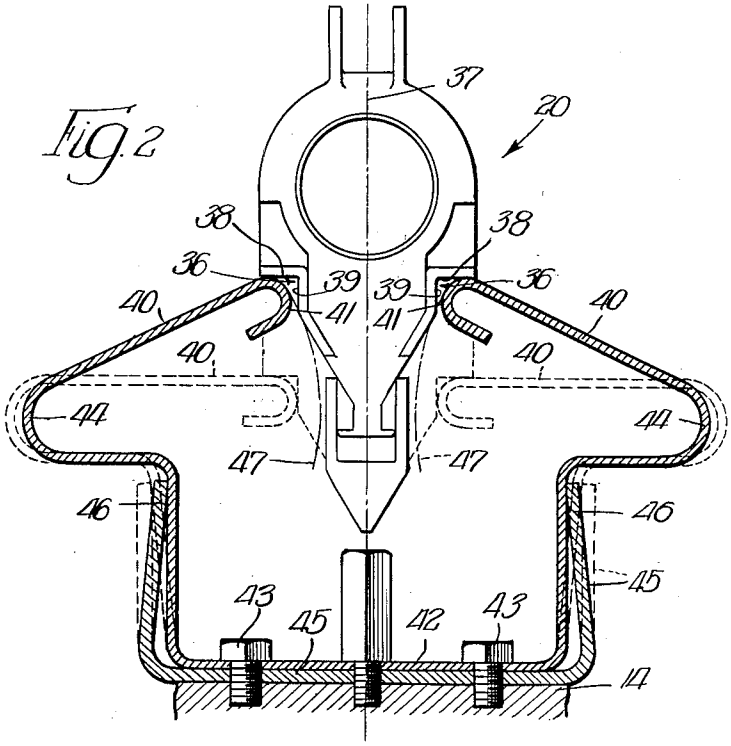
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CONTACT CONSTRUCTION FOR CIRCUIT INTERRUPTERS SUCH AS FUSES

Filed Oct. 29, 1948 2 SHEETS—SHEET 2

Fig. 2



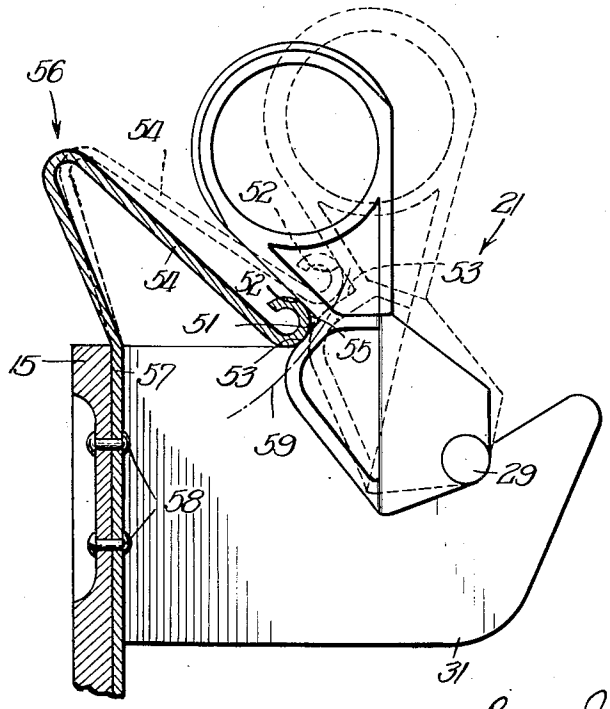


Fig. 3.

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UNITED STATES PATENT OFFICE

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CONTACT CONSTRUCTION FOR CIRCUIT INTERRUPTERS SUCH AS FUSES

Sigurd I. Lindell, Chicago, Ill., assignor to S & C Electric Company, Chicago, Ill., a corporation of Delaware

Application October 29, 1948, Serial No. 57,346

11 Claims. (Cl. 200—114)

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This invention relates, generally, to the construction and operation of electrical contacts, and it has particular relation to contacts for circuit interrupters such as fuses. The present invention constitutes an improvement over the construction shown in copending application Serial No. 663,833, filed April 22, 1946, and assigned to the assignee of this application, now Patent No. 2,484,839, issued October 18, 1949.

Among the objects of this invention are: To provide a simple, efficient and inexpensive contact construction for interconnecting the terminals of a fuse tube and the corresponding line terminals in a circuit in which the normal current flow may be of the order of several hundred amperes and, under certain overload or fault conditions, the current flow may reach several thousand amperes; to arrange the separable contact surfaces so that they engage with a wiping action and are capable of disengaging with a rolling or rocking action and without a wiping action; to accomplish these actions by employing a concave contact surface and a cooperating flexible contact finger having a convex contact surface; to form the concave contact surface by employing a pair of contact surfaces lying in planes which intersect at right angles and the convex contact surface by a cylindrically shaped end of the contact finger; and to employ a pair of the concave contact surfaces on opposite sides of the plane of relative movement of the contact supports and a cooperating pair of contact fingers for one set of contacts and a single concave contact surface normal to said plane and a cooperating contact finger for the other set of contacts.

Other objects of this invention will, in part, be obvious and in part appear hereinafter.

This invention is disclosed in the embodiment thereof shown in the accompanying drawings and it comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of this invention, reference can be had to the following detailed description, taken together with the accompanying drawings, in which:

Figure 1 is a view, in side elevation, of a dropout fuse construction in which the present invention is incorporated;

Figure 2 is a view, partly in top plan and partly

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in section, showing the construction of the upper fuse tube contact and the cooperating contact fingers on the upper stationary line terminal; and

Figure 3 is a view, partly in side elevation and partly in section, showing the details of construction of the lower fuse tube contact and the cooperating contact finger carried by the associated lower line terminal.

Referring now particularly to Figure 1 of the drawings, it will be observed that the reference character 10 designates, generally, a dropout fuse of the general character disclosed in copending application Serial No. 663,834, filed April 22, 1946, and assigned to the assignee of this application. Since the instant application is not concerned with the particular details of the dropout fuse mechanism, a description thereof will be omitted herein. It will be understood that the contact construction here disclosed can be employed with other types of circuit interrupters and other types of dropout fuses. Also these contact constructions can be employed with non-dropout fuses, switches, etc.

The dropout fuse 10 includes a channel base 11 which carries upper and lower pin type insulators 12 and 13. The insulators 12 and 13 at their outer ends carry upper and lower line terminals which are indicated, generally, at 14 and 15. It will be understood that other arrangements can be employed for holding the line terminals 14 and 15 in insulated spaced relation.

In order to interconnect the line terminals 14 and 15 a fuse tube 19 is provided. As indicated above the details of construction of the fuse tubes of this general type are set forth in application Serial No. 663,834. For present purposes it is pointed out that the fuse tube 19 has an upper fuse tube terminal, that is indicated generally at 20, and a lower fuse tube terminal, that is indicated generally at 21. These terminals 20 and 21 can be detached from the fuse tube 19 for reuse with another fuse tube after operation of the fuse on which the fuse tube terminals originally are installed.

An eye 22 is pivoted on the upper fuse tube terminal 20 and it carries a pair of arms 23 which are arranged to engage the underside of a movable flange 24 for lifting a latch 25 which cooperates with a hook portion 26 on the upper fuse tube terminal 20 for latching the fuse tube 19 in the upright circuit closed position shown by the full lines of Figure 1. It will be understood that the flange 24 is released for upward movement automatically upon operation of the fuse 19 to disengage the latch 25 from the hook

portion 26. The eye 22 and arms 23 are provided for manually releasing the fuse tube 19 from the latch 25. In addition the eye 22 is provided to permit the swinging of the fuse tube 19 to the closed position when the prong of a switch stick is inserted therein.

The lower fuse tube terminal 21 is provided with trunnions 29 which extend from opposite sides and are arranged to pass through slots 30 in the forwardly extending ears 31 of the lower fuse tube terminal 19. The trunnions 29 serve to hinge the fuse tube 19 for rocking or dropout movement relative to the lower fuse tube terminal 19. An eye 32 is formed integrally with the lower fuse tube terminal 21 for receiving a prong of a switch stick to permit the placing of the fuse tube 19 in place by first inserting the trunnions 29 through the slots 30 for positioning on the lower fuse tube terminal 21. A rubber bumper 33 is located on the underside of the lower fuse tube terminal 21 and is arranged to be engaged by the fuse tube 19 when it swings downwardly to take up the shock incident to such movement. The dropout fuse mechanism thus far described is typical of circuit interrupting apparatus with which the contact construction of the present invention can be employed. As indicated hereinbefore, such circuit interrupting apparatus is disclosed herein for illustrative purposes only. The contact constructions to which the present invention is particularly directed will be described now.

Referring particularly to Figure 2 of the drawings, it will be observed that concave contact surfaces 36 are provided on the upper fuse tube terminal 20 on opposite sides of a plane which is indicated by a broken line 37. The plane 37 extends longitudinally of the fuse tube 19 and is employed as a reference plane not only for Figure 2 but also for Figure 3 as will be apparent hereinafter. Each concave contact surface 36 is made up of a pair of contact surfaces 38 and 39. The contact surfaces 38 are termed herein control contact surfaces and contact surfaces 39 are termed main contact surfaces. While both contact surfaces 38 and 39 are provided by conducting material of the upper fuse tube terminal 20, it will be understood that the control contact surfaces 38 may be formed in insulating material since they are not required to conduct current. It will be observed that the contact surfaces 38 are located in a plane which is perpendicular to the plane indicated by the broken line 37, while the contact surfaces 39 are located in planes which are parallel to the plane 37. Thus the concave contact surface 36 constitutes a reentrant angular contact surface which is made up by the contact surfaces 38 and 39 that intersect at an angle, in this case at an angle of 90°.

Contact fingers 40 are provided on opposite sides of the plane 37 for engaging the concave contact surfaces 36. At the end of each contact finger 40 there is a convex contact surface 41 which preferably is formed on a radius so as provide a cylindrical contact surface whose longitudinal axis in parallel to the plane 37.

It will be observed that the contact fingers 40 constitute the ends of a generally U-shaped contact member that is formed of good conducting resilient material such as beryllium copper. The contact fingers 40 are biased inwardly toward the plane 37 as will be apparent hereinafter. The generally U-shaped contact member 42 may be secured to the upper line terminal 14 by suitable bolts 43. The contact fingers 40 are located at the outer ends of reverse bends 44 in the branches of the generally U-shaped contact member 42.

Nesting with the U-shaped contact member 42 is a generally U-shaped relatively stiff reenforcing spring member 45 which may be formed of beryllium copper. As shown in Figure 2 the ends 46 of the reenforcing member 45 engage the outer surface of the U-shaped contact member 42 immediately below the reverse bend 44. This construction serves to increase the contact pressure which is applied by the convex contact surfaces 41 to the concave contact surfaces 36, particularly to the main contact surfaces 39, when the fuse tube 19 is swung to the circuit closed position shown by the broken lines in Figure 1.

The arrangement of the concave contact surfaces 36 and the convex contact surfaces 41, as described hereinbefore, is such as to effect engagement therebetween with a turning or wiping action and to permit disengagement with a rolling or rocking action against the main contact surfaces 39. It will be observed that, when the contact fingers 40 are unstressed, as when the upper fuse tube terminal 20 has not been moved to the closed position, this position being shown by the full lines in Figure 2, the contact surfaces 41 are spaced sufficiently far apart so as to permit the main contact surfaces 39 to enter freely therebetween. It will be noted also that substantial clearance is provided between the contact surfaces 41 and the main contact surfaces 39. This construction reduces to a minimum the resistance developed between these surfaces to the closing and opening movement of the terminal 20. The outermost portions of the cylindrical contact surfaces 41 first engage the control contact surfaces 38 which are in a plane at right angles to the plane 37. Since this engagement is betwen a cylinder and a plane, the actual engagement takes place along a line. As the fuse tube 19 continues to be moved toward the closed position, the contact surfaces 38 move forwardly toward the base of the U-shaped contact member 42. Since the contact fingers 40 extend inwardly toward each other, they tend to rock about the reverse bends 44 and in so doing each cylindrical contact surface 41 slides and wipes along the adjacent control contact surface 38. The inner ends of the contact fingers 40 move inwardly into engagement with main contact surfaces 39 and tend to move along arcuate paths which are indicated by the broken lines 47. However, they are prevented from following these paths as soon as the cylindrical contact surfaces 41 engage the main contact surfaces 39. The continued inward movement of the upper fuse tube terminal 20 carries with it the contact surfaces 41 at the outer ends of the contact fingers 40 and they continue to move with a turning and wiping action against the contact surfaces 38 and 39. As indicated by the broken lines in Figure 2 the contact fingers 40 in the fully closed position extend in a plane which is substantially perpendicular to the plane 37. The reverse bend portions 44 have moved outwardly as indicated. In this position the ends 46 of the reenforcing member 45 are effective to increase the biasing force which is available in the U-shaped contact member 42 itself in increasing the contact pressure between the contact surfaces 38 and 39 and the convex or cylindrical contact surfaces 41 at the ends of the contact fingers 40.

This contact construction is such that a rel-

atively great force is exerted against each of the concave contact surfaces 36. This force is the resultant of two components. One component is relatively great and reacts against the main contact surface 39 on opposite sides of the plane 37. This insures good electrical contact and at the same time these components are balanced and do not act to urge the terminal 20 outwardly. The length of the moment arm about the axis provided by the reverse bend 44 for the component exerted against the main contact surface 39 diminishes as this component increases while the terminal 20 is moved toward the closed or latched position. The other component acts against the control contact surface 38 and is relatively small. Thus the latch 25 is not required to restrain a relatively great force acting to bias the terminal 20 outwardly. The operation of this contact construction is similar to a toggle action but cannot go over center.

Now, when the latch 25 is released, the fuse tube 19 is moved outwardly by the forces acting on the control surfaces 38 toward the position shown by the broken lines in Figure 1. When this movement takes place, the convex contact surfaces 41 at the ends of the contact fingers 40 are capable of rolling out of engagement with the convex contact surfaces 36 if relatively high friction, such as occurs when the surfaces become corroded or under sleet or ice conditions, is present rather than to slide out of engagement therewith since they are now freed from the restraint previously applied through the contact surfaces 38. This action in the opening movement of the fuse tube 19 is advantageous since there is the possibility that some corrosion or other friction causing condition, as indicated, may have taken place between the convex contact surfaces 41 and the concave contact surfaces 36. Because of the clearance between the main contact surfaces 39 and the inner ends of the contact fingers 40, the latter may disengage the former while still engaging the control contact surfaces 38. A minimum of force is required to move the fuse tube 19 away from the closed position when the outer ends of the contact fingers 40 disengage with a rolling or rocking action. On the other hand it is desirable to have them engage with a wiping action in order to remove any oxides or other insulating films which might be present on the contact surfaces 39 and which would increase the contact resistance. The contact construction for interconnecting the lower line terminal 15 with the lower fuse tube terminal 21 is generally similar to that employed for interconnecting the upper line terminal 14 and the upper fuse tube terminal 20. There are certain differences in the construction since the fuse tube 19 is hinged on the lower line terminal 15 although the action is essentially the same. However, it will be understood that the same construction, if desired, can be used for interconnecting the lower line terminal 21 as is employed for interconnecting the upper line terminal 14 and the upper fuse tube terminal 20.

As shown more clearly in Figure 3 of the drawings, the lower fuse tube terminal 21 is provided with a concave contact surface 51 which is normal to the plane 37 represented by the broken line in Figure 2 and referred to above. In other words the concave contact surface 51 extends at right angles to the longitudinal axis of the fuse tube 19. The concave contact surface 51 is formed by contact surfaces 52 and 53 which

are located in planes that intersect at right angles to each other and thus provide a reentrant contact surface. Here the surface 52 is the control contact surface while the surface 53 is the main contact surface. The surface 52 may, if desired, be provided by insulation although it is shown as being provided by the lower fuse tube terminal 21.

A contact finger 54, having a convex contact surface 55 which is cylindrical in form, at its outer end, is employed for engaging the concave contact surface 51 with a wiping action and is capable of disengaging it with a rolling or rocking action in the same manner that the cylindrical contact surfaces 41 of the contact fingers 40 engage and disengage the concave surfaces 39 as described above.

It will be observed that the contact finger 54 constitutes one branch of an L-shaped contact member 56 which may be formed of beryllium copper and may have its other branch 57 secured, as by rivets 58, to the lower line terminal 15 at the base thereof between the forwardly extending ears 31. If desired, a reenforcing member similar to the member 45 may be employed for cooperating with the contact finger 54.

As the lower fuse tube terminal 21 is swung toward the closed position from the position thereof shown by the broken lines in Figure 3, the contact finger 54 is swung from its broken line position to the position thereof shown by the full lines. The outermost part of the cylindrical contact surface 55 tends to follow the arcuate path indicated by the broken line 59 but is prevented from doing this and is moved further back by engagement with the contact surfaces 52 and 53. As the lower fuse tube terminal 21 is moved toward the closed position, the cylindrical contact surface 55 first engages the control contact surface 52. This is shown by the broken line illustration of these mutually engaging parts. Then, as the lower fuse tube terminal 21 is moved further toward the closed position, the cylindrical contact surface 55 wipes and slides along the control contact surface 52 until it engages the main contact surface 53. Thereafter, the wiping engagement with the contact surfaces 52 and 53 continues along lines since a cylindrical surface is in engagement with two plane surfaces. In the final closed position the cylindrical contact surface 55 has line contact with the contact surfaces 52 and 53 and, because of the inherent biasing force exerted by the L-shaped contact member 56, the contact engagement takes place under relatively heavy contact pressure. The relatively great force exerted against the concave contact surface 51 is made up of two components as described above for the surfaces 36. The component acting on the control contact surface 52 is relatively small and tends to rock the terminal 21 outwardly about the trunnions 29. The other component acting on the main contact surface 53 is relatively great. However, since it is directed generally toward the trunnions 29, it exerts substantially no force tending to swing the terminal 21 outwardly.

Now, when the fuse tube 19 swings toward the open position and the lower fuse tube terminal 21 swings therewith away from the closed position, the cylindrical contact surface 55 is capable of rolling or rocking out of engagement with the contact surfaces 52 and 53 or more generally the concave contact surface 51 when friction, such as may be caused by corrosion and ice or sleet

conditions, is present. As a result there is a minimum of binding action which might take place if a wiping or sliding disengagement of these contact surfaces were required.

If desired, the contact construction employed in conjunction with the lower fuse tube terminal 21 can be substituted for that shown for use with the upper fuse tube terminal 20. In such case the arrangement would be such that the main contact pressure would act generally along the longitudinal axis of the fuse tube 19.

It will be apparent now that the contact constructions disclosed herein possess several advantages. A relatively high contact pressure exists between each of the main contact surfaces 39 and the cooperating convex contact surfaces 41 of the contact fingers 40 and also between the main contact surface 53 and the convex contact surface 55. Yet because of the directions in which these pressures or forces act and their negligible moment arms, they exert little, if any, force on the fuse tube terminals 20 and 21 to oppose the closing movement of the fuse tube 19 and to be restrained by the latch 25. This is of particular importance when the fuse tube 19 is relatively long. In some instances, the distance between the centers of the line terminals 14 and 15 may be of the order of from three to five feet. The cantilever load on the fuse tube likely to cause warping and bending is reduced to a minimum while the desired high contact pressure is obtained. This construction of contacts, even for the longer fuse tubes, permits their manipulation with the usual switch stick.

Since clearance is provided between the main contact surfaces 39 and 53 until just prior to and just after high pressure engagement therewith and disengagement therefrom by the convex contact surfaces 41 and 55, there is no friction drag during either the closing or opening movement of the fuse tube 19.

The control pressure with the main contact surfaces 39 and 53 is independent of the spacing between the line terminals 14 and 15 within limits. This is due to the arrangement of the contact fingers 40 acting at right angles to the longitudinal axis of the fuse tube 19.

As indicated, the convex contact surfaces 41 and 55 disengage with a rolling action in the presence of high friction forces. While they are shown as being cylindrical for line contact engagement with the surfaces 38 and 39 and 52 and 53, it will be understood point contact engagement can be employed where provision is made for the same mechanical action.

While the control contact surfaces 38 and 52 are provided on electrical conductors, i. e. the terminals 20 and 21, these surfaces need not be formed on conducting material. All that is required is that surfaces be provided for controlling the movement of the outer ends of the contact fingers 40 and 54 into and out of engagement with the main contact surfaces 39 and 53.

This contact construction is less likely to be adversely affected by sleet. One reason for this is that there are no pivot joints with journals which can be frozen. There are merely contact fingers 40 and 54 that flex in the manner described.

Since certain changes can be made in the foregoing construction and different embodiments of the invention can be made without departing from the spirit and scope thereof, it is intended that all matter shown in the accompanying drawings and described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

What is claimed as new is:

1. Separable contact means comprising, in combination, a pair of movable contact supports, guide means cooperating with said supports and fixing the path of relative movement thereof, a contact finger resiliently mounted at its inner end on one of said contact supports so as to have bodily swinging and endwise movement and extending toward the other contact support and having at its outer end a portion providing a transversely extending cylindrical contact surface and a rigid contact member carried by said other contact support and having a concave contact surface located in such position as to have generally line contact engagement with said cylindrical contact surface, said inner end of said contact finger being offset from the path of relative movement between said contact surfaces so that said contact finger can swing bodily toward its contact support and move bodily endwise toward said concave contact surface when said contact supports are moved relatively toward each other and said contact surfaces are engaged and vice versa and said cylindrical contact surface can move bodily transversely of said concave contact surface to engage the same with a wiping action and disengage with a rocking action.

2. Separable contact means comprising, in combination, a pair of relatively movable contact supports, guide means cooperating with said supports and fixing the path of relative movement thereof, a contact finger resiliently mounted at its inner end on one of said contact supports so as to have bodily swinging and endwise movement and extending toward the other contact support and having at its outer end a portion providing a transversely extending cylindrical contact surface, and a rigid contact member carried by said other contact support and having a concave contact surface defined by intersecting flat surfaces extending parallel to said cylindrical contact surface so as to have generally line contact engagement therewith, said inner end of said contact finger being offset from the path of relative movement between said contact surfaces so that when said contact supports are moved relatively toward each other said contact finger can swing bodily toward its contact support as a result of engagement between one of said flat surfaces and said cylindrical contact surface while the latter is spaced from the other flat surface and continued relative movement results in said cylindrical contact surface sliding over said one flat surface and into engagement with said other flat surface.

3. Separable contact means comprising, in combination, a pair of relatively movable contact supports, guide means cooperating with said supports and fixing the path of relative movement thereof, a contact finger resiliently mounted at its inner end on one of said contact supports so as to have bodily swinging and endwise movement and extending toward the other contact support and having at its outer end a portion providing a transversely extending cylindrical contact surface, and a rigid contact member carried by said other contact support and having a concave contact surface defined by intersecting flat surfaces extending parallel to said cylindrical contact surface so as to have generally line contact engagement therewith, one of said flat surfaces being located in a plane perpendicular to said path of relative movement and the other in a plane generally parallel thereto, said inner end

of said contact finger being offset from the path of relative movement between said contact surfaces so that when said contact supports are moved relatively toward each other said contact finger can swing bodily toward its contact support as a result of engagement between one of said flat surfaces and said cylindrical contact surface while the latter is spaced from the other flat surface and continued relative movement results in said cylindrical contact surface sliding over said one flat surface and into engagement with said other flat surface, the endwise biasing action on said contact finger reacting on said other flat surface to maintain temporarily contact engagement therebetween when said contact supports are moved relatively away from each other whereby said cylindrical contact surface disengages said other flat surface with a rocking action.

4. Separable contact means comprising, in combination, a pair of relatively movable contact supports, guide means cooperating with said supports and fixing the path of relative movement thereof, a flexible resilient contact finger mounted at its inner end on one of said contact supports and having a reverse bend intermediate its ends so that its outer end portion is capable of combined swinging and endwise movement, said outer end portion extending toward the other contact support and having at its extreme outer end a portion providing a transversely extending cylindrical contact surface, and a rigid contact member carried by said other contact support and having a concave contact surface defined by intersecting flat surfaces extending parallel to said cylindrical contact surface so as to have generally line contact engagement therewith, one of said flat surfaces being located in a plane perpendicular to said path of relative movement and the other in a plane generally parallel thereto, said reverse bend of said contact finger being offset from the path of relative movement between said contact surfaces so that when said contact supports are moved relatively toward each other said outer end portion of said contact finger can swing bodily toward its contact support as a result of engagement between one of said flat surfaces and said cylindrical contact surface while the latter is spaced from the other flat surface and continued relative movement results in said cylindrical contact surface sliding over said one flat surface and into engagement with said other flat surface, the endwise biasing action on said outer end portion of said contact finger reacting on said other flat surface to maintain temporarily contact engagement therebetween when said contact supports are moved relatively away from each other whereby said cylindrical contact surface disengages said other flat surface with a rocking action.

5. Separable contact means comprising, in combination, a pair of relatively movable contact supports, guide means cooperating with said supports and fixing the path of relative movement thereof, a contact finger formed by a flat strip of resilient conducting material having a reverse bend intermediate its ends and located in said path of relative movement of said contact supports with one branch rigidly mounted on one of them and the other branch being capable of bodily swinging and endwise movement and extending toward the other contact support and having its outer end portion turned backwardly to provide a cylindrical contact surface extending transversely of said path, and a rigid contact

member carried by said other contact support and having a concave contact surface defined by intersecting flat surfaces extending parallel to said cylindrical contact surface so as to have generally line contact engagement therewith, one of said flat surfaces being located in a plane perpendicular to said path of relative movement and the other in a plane generally parallel thereto, said inner end of said contact finger being offset from the path of relative movement between said contact surfaces so that when said contact supports are moved relatively toward each other said contact finger can swing bodily toward its contact support as a result of engagement between one of said flat surfaces and said cylindrical contact surface while the latter is spaced from the other flat surface and continued relative movement results in said cylindrical contact surface sliding over said one one flat surface and into engagement with said other flat surface, the endwise biasing action on said contact finger reacting on said other flat surface to maintain temporarily contact engagement therebetween when said contact supports are moved relatively away from each other whereby said cylindrical contact surface disengages said other flat surface with a rocking action.

6. In a fuse construction, in combination, a pair of stationary terminal members in insulated spaced relation, a fuse tube pivotally mounted near one end for movement toward and away from said terminal members, a pair of terminal members in spaced relation on said fuse tube, and separable contact means for interconnecting the respective pairs of terminal members, the separable contact means at the pivoted end of said fuse tube comprising a contact finger formed by a flat strip of resilient conducting material having a reverse bend intermediate its ends and extending generally along said fuse tube in its closed circuit position with one branch rigidly mounted on the stationary terminal member at the pivoted end of said fuse tube and the other branch being capable of bodily swinging and endwise movement and extending toward the terminal member at the pivoted end of said fuse tube and having its outer end portion turned backwardly to provide a cylindrical contact surface extending transversely of the path of relative movement of said terminal members at the pivot end of said fuse tube, and said terminal member at the pivoted end of said fuse tube having a concave contact surface defined by intersecting flat surfaces extending parallel to said cylindrical contact surface so as to have generally line contact engagement therewith, one of said flat surfaces being located in a plane perpendicular to said path of relative movement and the other in a plane generally parallel thereto, said reverse bend of said contact finger being offset from the path of relative movement of said contact surfaces so that when said fuse tube is swung toward the closed circuit position said outer end portion of said contact finger can swing bodily toward its stationary terminal as a result of engagement between said one of said flat surfaces and said cylindrical contact surface while the latter is spaced from said other flat surface and continued closing movement of said fuse tube results in said cylindrical contact surface sliding over said one flat surface and into engagement with said other flat surface, the endwise biasing action on said outer end portion of said contact finger reacting on said other flat surface to maintain temporarily contact engagement

therebetween when said fuse tube is swung to open circuit position whereby said cylindrical contact surface disengages said other flat surface with a rocking action.

7. Separable contact means comprising, in combination, a pair of relatively movable contact supports, guide means cooperating with said supports and fixing the path of relative movement thereof, a pair of contact fingers resiliently mounted at their inner ends on one of said contact supports so as to have bodily swinging and endwise movement and extending generally toward each other and toward the other contact support and having at their outer ends portions providing transversely extending cylindrical contact surfaces, and a rigid contact member carried by said other contact support and having a pair of concave contact surfaces generally facing the respective cylindrical contact surfaces and located so as to have generally line contact engagement therewith, said inner ends of said contact fingers being offset from the respective paths of relative movement between the respective cylindrical and concave contact surfaces so that each contact finger can swing bodily toward its contact support and move bodily endwise toward the related concave contact surface when said contact supports are moved relatively toward each other and the respective contact surfaces are engaged and vice versa and said cylindrical contact surfaces can move bodily transversely of the respective concave contact surfaces to engage them with a wiping action and disengage them with a rocking action.

8. Separable contact means comprising, in combination, a pair of relatively movable contact supports, guide means cooperating with said supports and fixing the path of relative movement thereof, a pair of contact fingers resiliently mounted at their inner ends on one of said contact supports so as to have bodily swinging and endwise movement and extending generally toward each other and toward the other contact support and having at their outer ends portions providing transversely extending cylindrical contact surfaces, and a rigid contact member carried by said other contact support and having a pair of concave contact surfaces generally facing the respective cylindrical contact surfaces and defined by intersecting flat surfaces extending parallel to the respective cylindrical contact surfaces so as to have generally line contact engagement therewith, said inner ends of said contact fingers being offset from the respective paths of relative movement between said contact surfaces so that when said contact supports are moved relatively toward each other said contact fingers can swing bodily toward their contact support as a result of engagement between one flat surface of each concave contact surface and the respective cylindrical contact surface while the latter is spaced from the respective other flat surface and continued relative movement results in said cylindrical contact surfaces sliding over the respective one flat surfaces and into engagement with the respective other flat surfaces.

9. Separable contact means comprising, in combination, a pair of relatively movable contact supports, guide means cooperating with said supports and fixing the path of relative movement thereof, a pair of contact fingers resiliently mounted at their inner ends on one of said contact supports so as to have bodily swinging and endwise movement and extending generally toward each other and toward the other contact support and having at their outer ends portions providing transversely extending cylindrical contact surfaces, and a rigid contact member carried by said other contact support and having a pair of concave contact surfaces generally facing the respective cylindrical contact surfaces and defined by intersecting flat surfaces extending parallel to the respective cylindrical contact surfaces so as to have generally line contact engagement therewith, one flat surface of each pair being located in a plane perpendicular to the paths of relative movement between the respective cylindrical and concave contact surfaces and the other flat surface of each pair being located in planes generally parallel to said paths of relative movement, said inner ends of said contact fingers being offset from the respective paths of relative movement between said contact surfaces so that when said contact supports are moved relatively toward each other said contact fingers can swing bodily toward their contact support as a result of engagement between one flat surface of each concave contact surface and the respective cylindrical contact surface while the latter is spaced from the respective other flat surface and continued relative movement results in said cylindrical contact surfaces sliding over the respective one flat surfaces and into engagement with the respective other flat surfaces, the endwise biasing action on said contact fingers reacting on the respective other flat surfaces to maintain temporarily contact engagement therebetween when said contact supports are moved relatively away from each other whereby said cylindrical contact surfaces disengage said other flat surfaces with a rocking action.

10. Separable contact means comprising, in combination, a pair of relatively movable contact supports, guide means cooperating with said supports and fixing the path of relative movement thereof, a pair of flexible resilient contact fingers mounted at their inner ends on one of said contact supports and each having a reverse bend intermediate its ends so that their outer end portions are capable of combined swinging and endwise movement, said outer end portions extending generally toward each other and toward the outer contact support and having at their extreme outer ends portions providing transversely extending cylindrical contact surfaces, and a rigid contact member carried by said other contact support and having a pair of concave contact surfaces generally facing the respective cylindrical contact surfaces and defined by intersecting flat surfaces extending parallel to the respective cylindrical contact surfaces so as to have generally line contact engagement therewith, one flat surface of each pair being located in a plane perpendicular to the paths of relative movement between the respective cylindrical and concave contact surfaces and the other flat surface of each pair being located in planes generally parallel to said paths of relative movement, said inner ends of said contact fingers being offset from the respective paths of relative movement between said contact surfaces so that when said contact supports are moved relatively toward each other said contact fingers can swing bodily toward their contact support as a result of engagement between one flat surface of each concave contact surface and the respective cylindrical contact surface while the latter is spaced from the respective other flat surface and continued relative move-

ment results in said cylindrical contact surfaces sliding over the respective one flat surfaces and into engagement with the respective other flat surfaces, the endwise biasing action on said contact fingers reacting on the respective other flat surfaces to maintain temporarily contact engagement therebetween when said contact supports are moved relatively away from each other whereby said cylindrical contact surfaces disengage said other flat surfaces with a rocking action.

11. In a fuse construction, in combination, a pair of stationary terminal members in insulated spaced relation, a fuse tube pivotally mounted near one end for movement toward and away from said terminal members, a pair of terminal members in spaced relation on said fuse tube, and separable contact means for interconnecting the respective pairs of terminal members, the separable contact means at the outer end of said fuse tube away from its pivoted end comprising a pair of contact fingers formed of resilient flat strip conducting material having a reverse bend intermediate the ends of each finger and extending generally at right angles to said fuse tube in its closed circuit position with one branch of each contact finger rigidly mounted on the stationary terminal member at said outer end of said fuse tube and the other branch of each contact finger being capable of bodily swinging and endwise movement and extending generally toward each other and toward the terminal member at said outer end of said fuse tube and having its outer end portion turned backwardly to provide transversely extending cylindrical contact surfaces, and said terminal member at said outer end of said fuse tube having a pair of concave contact surfaces generally facing the respective cylindrical contact surfaces and defined by intersecting flat surfaces extending parallel to the respective cylindrical contact surfaces so as to have generally line contact engagement therewith, one flat surface of each pair being located in a plane perpendicular to the paths of relative movement between the respective cylindrical and concave contact surfaces and the other flat surface of each pair being located in planes generally parallel to said paths of relative movement, said reverse bend portions of said contact fingers being offset from the respective paths of relative movement between said contact surfaces so that when said fuse tube is swung toward the closed circuit position said outer end portions of said contact fingers can swing bodily toward their stationary terminal as a result of engagement between one flat surface of each concave contact surface and the respective cylindrical contact surface while the latter is spaced from the respective other flat surface and continued closing movement of said fuse tube results in said cylindrical contact surfaces sliding over the respective one flat surfaces and into engagement with the respective other flat surfaces, the endwise biasing action on said contact fingers reacting on the respective other flat surfaces to maintain temporarily contact engagement therebetweeen when said fuse tube is swung to open circuit position whereby said cylindrical contact surfaces disengage said other flat surfaces with a rocking action.

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