Feb. 23, 1971 D. B. POWELL 3,566,335

SELF-ALIGNING MULTIPLE ELECTRICAL CONNECTOR

Filed Sept. 18, 1968 3 Sheets-Sheet 1

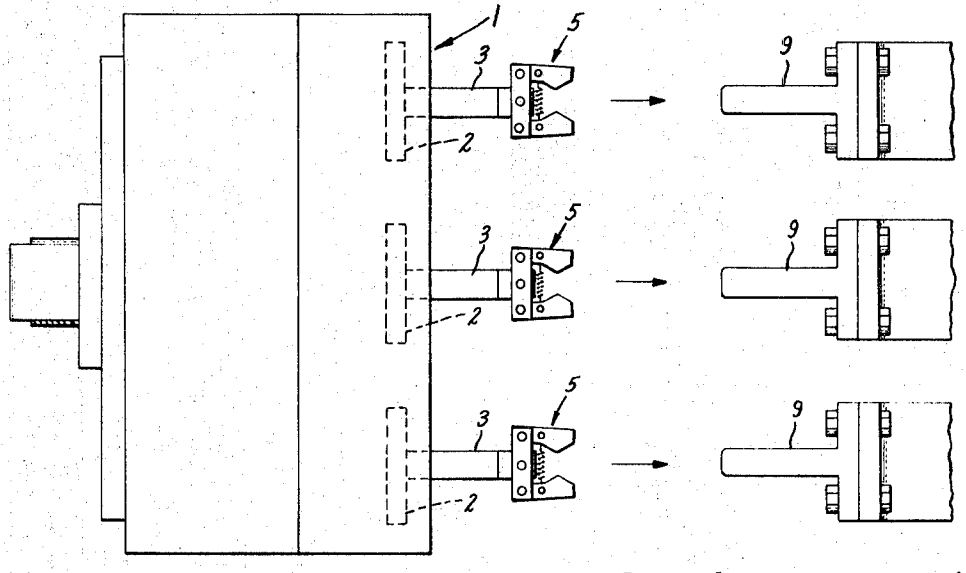


FIG. 1

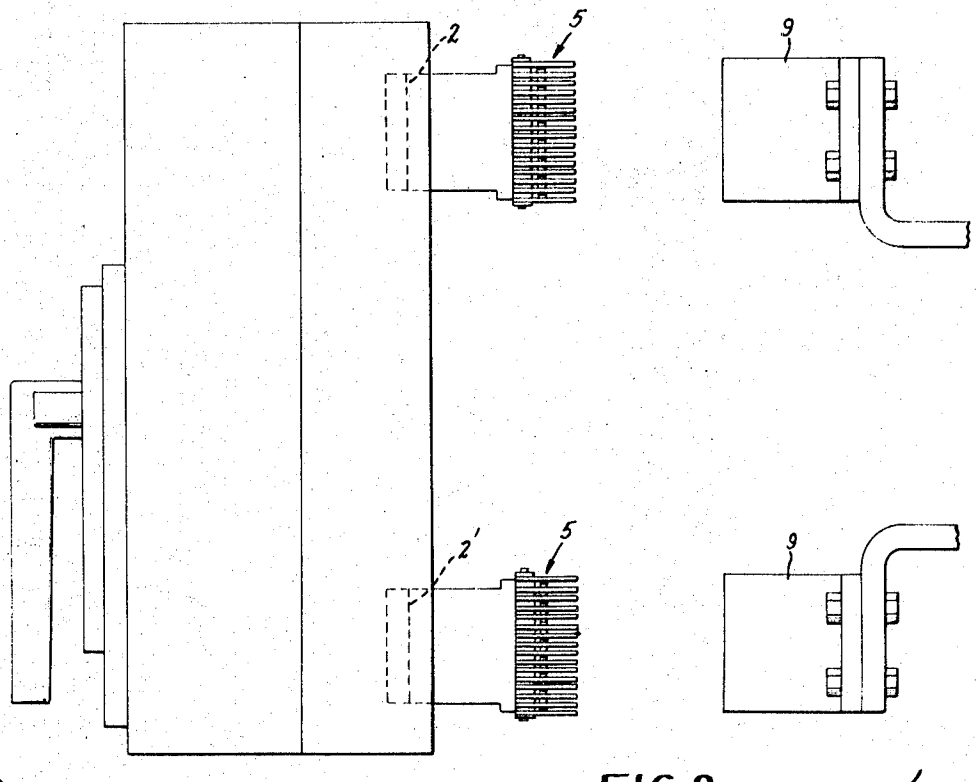


FIG. 2

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SELF-ALIGNING MULTIPLE ELECTRICAL CONNECTOR

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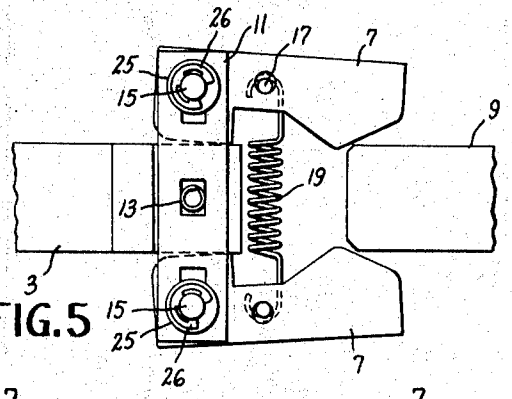


FIG. 5

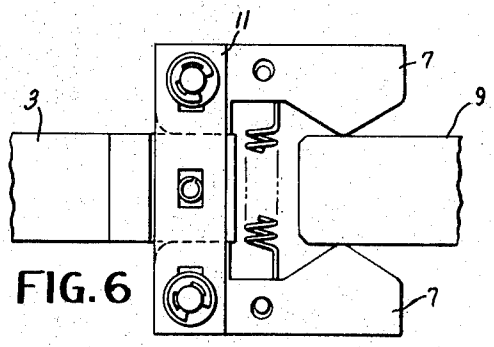


FIG. 6

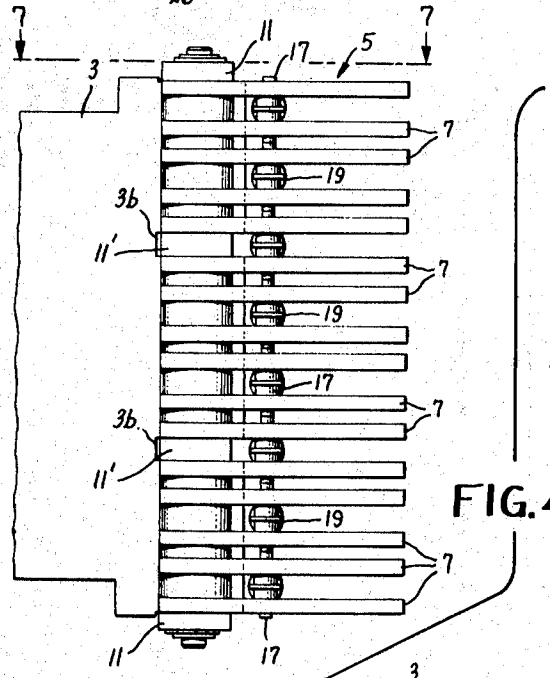
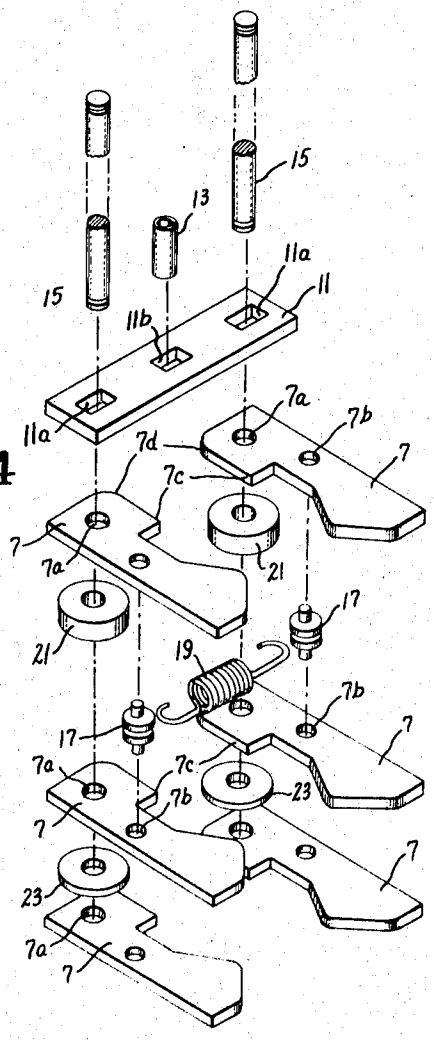


FIG. 3

FIG. 4



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SELF-ALIGNING MULTIPLE ELECTRICAL CONNECTOR

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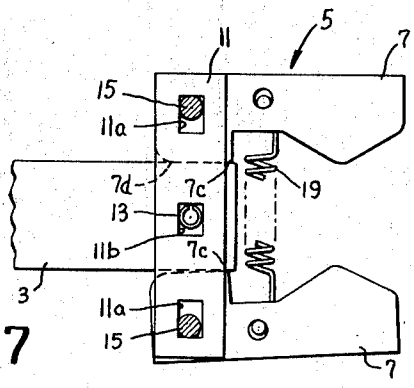


FIG. 7

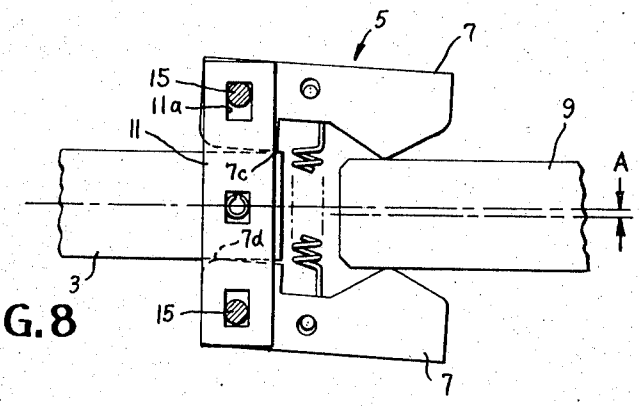


FIG. 8

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SELF-ALIGNING MULTIPLE ELECTRICAL CONNECTOR

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U.S. Cl. 339—64 10 Claims

ABSTRACT OF THE DISCLOSURE

A self-aligning multiple contact electrical connector of the plug-in type comprising a conductive support member and at least one pair of opposed elongated contact members having a rocking type contact engagement with the support member adjacent one end, the other ends of said contact members projecting outwardly away from the support member. A tension spring interconnects the contact members of each pair at an intermediate point outwardly of their points of rocking engagement with the support. A tie plate interconnects the contact members of each pair at a point inwardly of their points of making engagement with the support member. The tie plate is slidable transversely of the support whereby the outer ends of each pair of contact members can shift transversely to accommodate slight misalignment between the connector and a conductive member onto which it is being plugged.

BACKGROUND OF THE INVENTION

(1) Field of the invention

My invention relates to electric power connection devices of the plug-in type, and more particularly to electrical connectors used in apparatus which establishes a predetermined path of movement of the plug and receptacle with respect to each other.

(2) Description of the prior art

It is common practice to mount heavy plug-in type electrical apparatus on slides to permit easy insertion and withdrawal from a panel mounting. The slide mounting establishes a predetermined path of movement of the apparatus, which is commonly supported on a chassis or frame. Various means have been utilized to electrically connect the slide mounted chassis to stationary contacts by plug-in action. In accordance with one prior art type of construction directed to that problem, where appreciable current loads are involved, pairs of bridging contact members or jaws are carrried by a conductive support member. The jaws are spring biased toward each other. The male part of the connector enters between the spring biased jaws and the electric current path is through the male part of the connector, the jaws, and the conductive support member. Contact force is provided by the spring biasing the jaws together. If there is misalignment of the male part of the connector and the jaws, however, one of the jaws may not contact the male part at all.

OBJECTS OF THE INVENTION

It is an object of the invention to provide a bridging contact member type of plug-in electrical connector which provides good contact of the elements even when there is slight misalignment of the plug and receptacle portions.

Another object of the invention is to provide a connector of the type described which can be used in groups to provide electrical connections between stationary contacts and a movable chassis having a fixed predetermined path with respect to the stationary contacts, where misalignment is most troublesome because of accumulation of "tolerance" variations.

Another object of the invention is to provide freedom

of lateral motion between the connector assembly portion and the conductive support member with minimum stress of the connector attachment means.

SUMMARY OF THE INVENTION

In accordance with the invention in one form, an electrical connector is provided that comprises a conductive support member with an arm slidably mounted transversely on the conductive support member, the arm having opposed jaws pivotally mounted on it. The transverse movement and pivotal jaw movement permitted by this structure compensates for any possible misalignment.

In accordance with another aspect of the invention, longitudinal forces on the receptacle jaws as they engage the plug are transmitted to the slidable arm and then to a shoulder of the conductive support member. This arrangement reduces the stress exerted on the fastening means employed between the arm and the support member. Additionally, the force is transmitted without limiting the required motion for proper contact despite misalignment of the plug and receptacle.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a circuit breaker employing three connector assemblies constructed in accordance with the invention, and the corresponding mating male or plug connectors;

FIG. 2 is a side elevation view of the circuit breaker shown in FIG. 1;

FIG. 3 is a side elevation view of the connector assembly of FIG. 2;

FIG. 4 is an exploded perspective view of a portion of one of the connector assemblies of FIG. 1;

FIG. 5 is a top view of one of the connector assemblies of FIG. 1, on enlarged scale, and showing a male or plug connector just prior to engagement;

FIG. 6 is a view similar to FIG. 5 but showing the plug connector in engaged condition;

FIG. 7 is a sectional view of the connector assembly of the invention taken on the plane indicated by the line 7—7 of FIG. 3; and

FIG. 8 is a view similar to FIG. 7, but showing the relation of the parts after engagement of a misaligned plug connector.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2, the invention is shown as utilized with a circuit breaker **1** having three line terminals **2**, and three load terminals **2'**. Each terminal **2** and **2'** has attached thereto a connector assembly **5**, having pairs of opposed jaws adapted to engage male contact members or plugs **9**. The plugs **9** are generally rectangular in cross-section and elongated. The plugs are rigidly mounted so that no significant movement is possible with respect to the jaw connector assemblies. The circuit breaker **1** is mounted on slides or other mounting means, not shown, which predetermine its permitted path of movement with respect to the plugs **9**. The permitted path of movement would ordinarily be rectilinear in nature.

Referring now to FIGS. 3, 4, and 5, each connector assembly **5** includes conductive support member **3**. Conductive support member **3** is a generally rectangular elongated block of metal as best shown in FIG. 4. It is mounted on terminal **2** or **2'** of circuit breaker **1** by suitable means that are not shown. Disposed on opposite sides of elongated conductive support member **3** are jaws **7** arranged in opposed pairs. Portion **7c** of each jaw maintains contact with support **3**. Opposed jaws are biased toward each other by tension springs **19**, there being one spring **19** for each four jaws. Spring **19** is a coil tension spring. Spring **19** extends between two bias pins **17**, each of which is positioned between adjacent contact jaws **7**. Bias pins **17**

are held in place by ends extending into holes 7*b* in jaw 7 respectively. Jaws 7 are held in position with respect to conductive support member 3 by tie-plates or arms 11, 11' and pins 13 and 15. In the embodiment shown in FIG. 3, there are two end tie plates 11 and two intermediate tie plates 11'. The jaws 7 are pivotally connected to tie plates 11 and 11' by pins 15 which pass through elongated holes 11*a* in the tie plates 11, 11' and holes 7*a* in jaws 7. The tie plates are slidably mounted on and connected to support 3 by primary pin 13 passing through elongated hole 11*b* in arms 11 and frictionally held in blind holes 3*c* of conductive support member 3. The tie plates 11 are guided for slidable movement by shoulders 3*a* of conductive support member 3. The arms 11' are guided for slidable movement by slots 3*b* of support 3. Spacers 21 separate the pivoted ends of the group of four contact jaws 7 which are biased by each spring 19. Spacers 23 separate the contact jaws 7 of one group of four from the the contact jaws of the next group.

Referring to FIG. 5, washer 25 and snap-ring 26 are provided to retain each pin 15. The jaws 7 are shown in this figure in the slightly collapsed mode before engagement with the plug 9. FIG. 6 shows the jaws after engagement with an aligned plug 9.

Referring now to FIG. 7, the connector 5 is shown before engagement and with pins 15 sectioned. The lower jaw 7 represents the usual static free condition of the jaws. Bias spring 19 is urging the jaws 7 toward each other. The lower jaw contacts elongated conductive member 3 only at one corner of surface 7*c*. The upper jaw represents a situation where by virtue of friction in the connection at pin 15 the jaw 7 does not move freely and therefore does not pivot about the corresponding corner of the surface 7*c* of jaw 7. The only significant limitation on the opposed jaws 7 moving to a fully closed condition is that pivot pin 15 which engages hole 7*a* of jaw 7 is restrained by the end of elongated slot 11*a*. No movement between jaw 7 and pin 15 is possible since the pin 15 is placed within a round similarly sized hole in jaw 7.

FIG. 8 shows the position of member 3, plug 9 and jaw 7 given a misalignment indicated by A. Member 3 and plug 9 are fixed in place by the constraints of the installation. As plug 9 moves to engage jaws 7 it contacts the sloping entrance ramp portion of the jaws 7. If there is any misalignment a force component at right angles to the direction of relative movement between member 3 and plug 9 will be set up. This force component will act through one jaw 7, one pin 15 and tie plate 11 to cause the tie plate to move slidably within the constraints of shoulder 3*a* of member 3, primary pin 13 and the elongated slot 11*b* of the tie plate itself. The right angle force will be a function of the misalignment which exists between member 3 and plug 9. Ordinarily the sliding movement of plate 11 will precisely align the member 3 and plug 9 and therefore no right angle force component will remain. Deflection of one jaw as the result of the insertion of a misaligned plug instead of sliding movement of plate 11 with respect to conductive support member 3 is ordinarily insignificant because of the tension forces of bias spring 19.

After the sliding movement of plate 11 with respect to conductive support member 3 has occurred the jaws 7 will pivot about surface 7*c* and the total electrical contact area between jaws 7 and conductive support member 3 will increase. The jaws have engaged plug 9 also. In this condition the jaws 7 are purely bridging members between conductive support member 3 and plug 9. Spring 19 biases the jaws 7 against both member 3 and plug 9. Since the jaws 7 are no longer pivoting about a point on conductor 3 which is intermediate the bias spring and pin 15 there is no tendency to force pin 15 to the extremity of slot 11*a* in tie plate 11. Instead pin 15 will come to rest at some intermediate point within the slot 11*a* which is sized lengthwise so that electrical contact

forces between jaws 7 and member 3 and plug 9 will not be inhibited by the constraint of the slot.

Given a still greater misalignment of the parts slot 11*b* in tie plate 11 will not be able to adequately compensate. Given this situation plate 11 moves transversely within the constraint of pin 13 and slot 11*b* in plate 11 as above but in addition upper jaw 7 assumes a position on plug 9 (near the geometric center line of the jaws) and member 3 at surface 7*c* (away from the geometric center line of the jaws). Lower jaw 7 is pushed outward by the plug 9. The contact surface 7*d* of lower jaw 7 bears on member 3. Thus a parallelogram is formed between the surfaces 7*c*, 7*d*, and the contact points of jaws 7 on plug 9 which further compensates for misalignment. The jaws 7 serve as bridging members again until disengagement at which time they will return to the position shown in FIG. 5.

During engagement of the plug 9 and the connector 5 longitudinal forces are exerted. Shoulders 3*a* and slots 3*b* of conductive support member 3 are therefore provided to transmit these longitudinal engagement forces to avoid over-stressing primary pin 13 while at the same time not constraining further the permissible sliding movement of tie plate 11.

While the invention has been shown and described in one particular embodiment, it will be readily apparent that many modifications may readily be made without departing from the spirit and scope of the invention. Thus, for example, while the form of the connector assembly shown includes a plurality of pairs of contact jaws which are electrically common, electrical isolation may be provided between some or all of such pairs to provide a plurality of current-carrying paths that are electrically independent. It is therefore intended by the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electrical connector comprising:
   (a) an elongated support member;
   (b) at least one rigid arm;
   (c) mounting means mounting said rigid arm on said support member, said mounting means providing for sliding movement of said arm in a direction generally at right angles to said support member;
   (d) at least one pair of elongated opposed contact jaws;
   (e) means pivotally mounting a first end of each of said contact jaws on said arm at one end thereof with a second end of each of said contact arms projecting beyond said end portion of said support member;
   (f) means biasing said pair of jaws toward each other; and
   (g) each of said jaws having a surface cooperating with said means pivotally mounting said first end of said jaws to limit movement of said jaws toward each other.

2. An electrical connector as set forth in claim 1 wherein said mounting means mounting said rigid arm comprises a shoulder on said conductive support member.

3. An electrical connector as set forth in claim 1 wherein said means biasing said contact jaws comprises a tension spring.

4. An electrical connector as set forth in claim 1 further including at least one additional pair of said jaws.

5. An electrical connector as set forth in claim 1 further including at least one additional pair of said jaws, an elongated support member for each of said pair of jaws, and holding means for said support members which electrically isolate said pairs of jaws from each other.

6. An electrical connector as set forth in claim 1 wherein said surface is generally planar.

7. An electrical connector as set forth in claim 6 wherein said surface is substantially coplanar with an elongated face of said elongated support member.

8. An electrical connector comprising:
(a) a support member having an end portion;
(b) at least one pair of elongated opposed contact jaws supported on said end portion of said support member, each of said jaws having a pivot end and a projecting end;
(c) means pivotally mounting said pivot end of said jaws on said support member with said projecting portion projecting beyond said end portion of said carrier;
(d) means biasing said opposed contact jaws of each of said pairs toward each other;
(e) stop means comprising a surface on said jaws cooperating with said means pivotally mounting said pivot end of said jaws to limit movement of said jaws;
(f) means mounting said means pivotally mounting said pivot end of said jaws for slidable movement on said support member in a direction generally at right angles to the direction of elongation of said jaws.

9. An electrical connector as set forth in claim 8 wherein said means biasing comprises a tension spring.

10. An electrical connector as set forth in claim 8 said connector also including at least one additional pair of said jaws, a support member for each of said pairs of jaws, and holding means for said support members, said holding means electrically isolating said pairs of jaws from each other.

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U.S. Cl. X.R.
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