Sept. 20, 1966 W. J. ENGEL 3,274,532

CONNECTOR FOR PRINTED WIRE BOARD

Original Filed Feb. 18, 1959

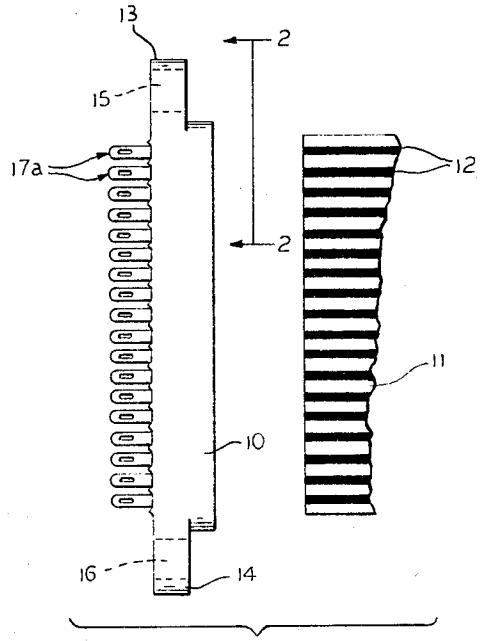

FIG.1

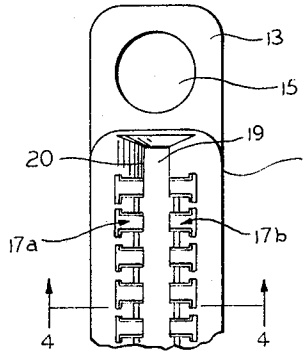

FIG.2

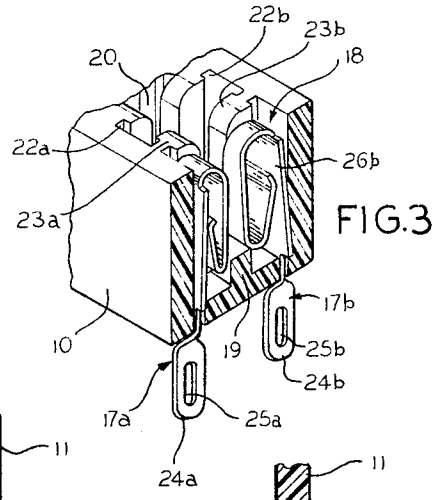

FIG.3

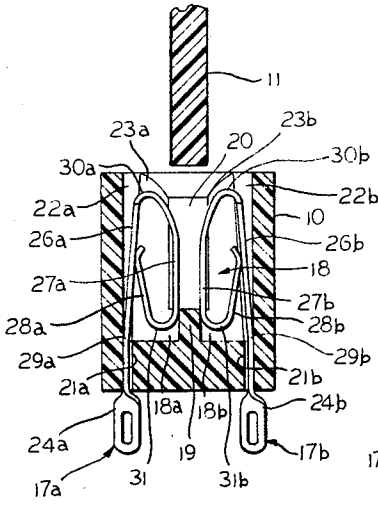

FIG.4

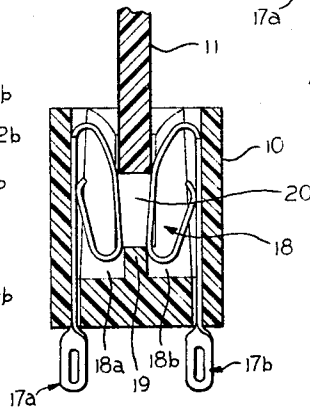

FIG.5

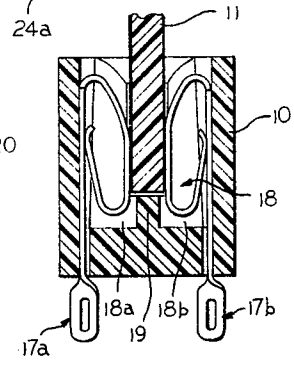

FIG.6

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CONNECTOR FOR PRINTED WIRE BOARD

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2 Claims. (Cl. 339—176)

This application is a continuation of my now abandoned application Serial No. 794,013, filed February 18, 1959.

This invention relates to a connector structure, and more particularly to a female connector or socket usefully exemplified in the environment of an edge connector for a conductor-equipped panel such as a printed wire board.

In a connector socket of the type herein considered, the connector comprises a block or casting having a spring contact mounted therein, and such spring contact is adapted to frictionally grip and thereby establish an electrical connection with a prong or male component inserted thereinto. It will be apparent that in order to effect such resilient engagement between the spring contact and male element, the spring contact must be compressed by insertion of the male element. If the connector has but one spring contact, the resistive force exerted thereby on a male element inserted into the connector is not sufficiently severe that it creates a problem of consequence. However, if the connector comprises a plurality of contacts oriented in a row so that each such contact resists the insertion of a single male element into the connector, the cumulative forces make initial insertion of the male element quite difficult. This is the situation with an edge connector for a printed wire board, for such a board is equipped with a plurality of conductors adapted to be respectively connected to individual circuit conductors through the intermediate agency of the connector. Thus, the connector is provided with a spring contact for each of the conductors provided by the board; and when an edge portion of the board is inserted into the connector, the cumulative forces of the individual spring contacts resist such insertion.

This difficulty cannot be overcome by making the individual spring forces weak, for then the retention forces applied by the individual spring contacts to a fully inserted board would not be large enough to properly and adequately anchor the connector to the board and to establish a good electrical connection between the individual spring contacts and the respective conductors provided by the board. In view of this, an object of the present invention is to provide a connector structure that satisfies the necessary requirement of a relatively high retention force exerted upon an inserted conductor-equipped board by the spring contacts, but which at the same time provides a relatively small resistive force to the initial insertion of the conductor-equipped board.

Another object of the invention is in the provision of a connector structure equipped with a spring contact adapted to establish an electrical connection with a male element inserted into the connector, and in which successively effective forces are applied by the contact to the board—the first such force being relatively weak and being applied to the board during initial insertion thereof, and the second such force being of greater magnitude and being applied to the board subsequent to the initial insertion thereof.

Still another object is that of providing a connector comprising a connector block having a cavity therein and a spring contact positioned within the cavity and adapted to be connected to a circuit conductor and to establish an electrical contact with a male element inserted into the block, and in which the contact has two spaced points

of flexure therealong—the first being associated with a relatively long lever arm whereby a relatively small force applied by a male element to the contact during initial insertion of the element into the block is effective to deflect the contact, and the second being associated with a lever arm of reduced length whereby the frictional force developed between the contact and male element subsequent to initial insertion thereof is significantly increased.

Yet another object is in the provision of a connector structure of the type described in which the connector comprises a plurality of such spring contacts oriented in longitudinal alignment along the connector block and in spaced apart relation, and in which the individual cavities for such contacts are interconnected by a longitudinally extending channel providing a mouth or opening along one side thereof into which a male element in the form of a conductor-equipped board is inserted.

A further object is to provide an edge connector for a printed wire board, wherein a pair of contacts are mounted in cavities and have spring legs that are biased toward each other or in the direction of the longitudinally extending channel, and in which the contacts comprising each pair thereof are structurally similar and function in the same manner to afford a relatively weak force that resists initial insertion of the conductor-equipped board, and subsequently affords a larger force that frictionally grips the board to retain the same in position within the connector.

Yet a further object is the provision of a connector structure of the character described, in which each of the contacts has a tail that extends from the connector block for connection with a circuit conductor, and which has also an elongated spring leg extending from the bottom of the contact cavity to adjacent the open mouth of the board-receiving channel at the top of the cavity, and is then turned upon itself to form a contact segment that extends downwardly into the cavity and is thereafter turned upwardly to define a leaf spring segment interposed between the spring leg and contact segments so as to bear against the spring leg and thereby resist deflection of the contact segment; the spring leg being bent inwardly adjacent the bottom of the cavity to define a first point of flexure at which the spring leg is readily deflected laterally by a printed wire panel upon initial insertion thereof into the channel, the arcuate connection of the spring leg and contact segment defining a second point of flexure at which the contact segment is deflected laterally upon further insertion of such printed wire board into the channel—such lateral deflection of the contact segment being also resisted by the action of the leaf spring segment. Additional objects and advantages of the invention will become apparent as the specification develops.

An embodiment of the invention is illustrated in the accompanying drawing, in which—

FIGURE 1 is a side view in elevation of an edge connector structure embodying the invention, and shown in association with a fragmentary portion of a printed wire board prior to the insertion thereof into the connector;

FIGURE 2 is an enlarged, broken vertical sectional view taken along the line 2—2 of FIGURE 1;

FIGURE 3 is a further enlarged, broken perspective view of a portion of the connector structure, and may be considered as being taken generally along the line 4—4 of FIGURE 2;

FIGURE 4 is a further enlarged, transverse sectional view taken along the line 4—4 of FIGURE 2, and showing the position of the contacts prior to the insertion of a printed wire board into the connector;

FIGURE 5 is a transverse sectional view identical to that of FIGURE 4, but showing the position of the con-

tacts at the time of initial insertion of a printed wire board into the connector; and

FIGURE 6 is a transverse sectional view identical to FIGURE 4, but showing the contact after a printed wire board has been completely inserted into the connector.

In the drawing, the inventive concept is illustrated in a structural exemplification thereof as an edge connector for a conductor-equipped panel such as a printed wire board. The connector is designated with the numeral **10**, and such a conductor-equipped panel with the numeral **11**. The panel or board **11** may be fabricated by any of the well known techniques, and is seen to comprise a plurality of conductors **12** extending along at least one side thereof in spaced apart, parallel relation. The connector **10** comprises a connector block which may be a casting, and is formed of any of the suitable and well known insulating materials as, for example, one of the plastics having such properties. Preferably, the connector **10** is equipped at the ends thereof with ears **13** and **14** which are, respectively, apertured as shown at **15** and **16**, so as to pass rivets therethrough to permit the connector to be rigidly mounted on a supporting structure where such mounting is desired. Mounted in the casting or contact block are a plurality of contacts oriented in spaced apart, longitudinal alignment along the casting. By referring to FIGURES 3 through 6, it will be seen that each contact comprises a pair of contact elements; and for purposes of differentiation, these elements are denoted, respectively, with the numerals **17***a* and **17***b*.

Each pair of contact elements **17***a* and **17***b* is mounted within a cavity **18**. The cavities **18** extend transversely across the connector casting, and are oriented in spaced apart, longitudinal alignment. As is most evident in FIGURES 4 through 6, each cavity **18** comprises two sections **18***a* and **18***b* that respectively correspond to the contact elements **17***a* and **17***b*. The cavity sections **18***a* and **18***b* may be thought of as being defined along opposite sides of a medially positioned, longitudinally extending divider or stop **19** that limits insertion of a printed wire board **11** into the connector casting, as shown in FIGURE 6, and forms the bottom wall of a channel **20** that extends longitudinally of the connector casting and interconnects all of the cavities **18**. The channel **20** is thus closed along the bottom thereof and also at its respective ends, but is open along one side to form a mouth into which the conductor-equipped panel **11** is inserted.

Each cavity **18** is closed at the bottom thereof except for slots **21***a* and **21***b* which, respectively, communicate with the cavity sections **18***a* and **18***b*. The slots **21***a* and **21***b* are in respective alignment with generally T-shaped recesses or vertically oriented channels **22***a* and **22***b* that taper inwardly from the bottom closure of the cavity toward the top thereof, as shown in FIGURES 4 through 6. The T-shaped recesses are defined by inwardly extending ribs **23***a* and **23***b* positioned intermediate adjacent cavities **18**.

The contact elements are provided, respectively, with elongated tails **24***a* and **24***b* which extend through the slots **21***a* and **21***b* and outwardly from the bottom wall of the connector casting. The elongated tails are adapted to be connected with circuit conductors, such as wire leads, and for such purpose may be provided with apertures **25***a* and **25***b* extending therethrough. In order to prevent the contact elements from being withdrawn from the cavity **18**, the tails of the contacts may be twisted slightly as shown in FIGURES 3 through 6, or the tails may be provided with protuberances adjacent the bottom wall of the casting, or with other means similar thereto which automatically prevents withdrawal of the contact elements from the cavity after positioning of the contact elements therein. Preferably, however, the contact tails are twisted, for in this manner they can be tightly constrained within the cavity so as to prevent vertical movement during insertion and withdrawal of a printed wire panel **11**. The contacts are provided with elongated spring legs **26***a* and **26***b*, respectively, that define continuations of the elongated tails, and these spring legs extend upwardly from the bottom of the cavity **18** to adjacent the top thereof at the open mouth of the channel **20**. As seen in FIGURE 3, the spring legs are slightly wider than the contact tails so that they abut the bottom wall of the cavity, and thus limit downward movement of the contacts therein beyond the positions shown in the drawing. Further, the longitudinal edges of the enlarged spring legs **26***a* and **26***b* ride within the T-shaped recesses or channels **22***a* and **22***b*. Consequently, the limits of the channels **22***a* and **22***b* define lateral limits for deflection of the spring legs both inwardly toward the longtiudinally extending channel **20** and outwardly therefrom.

The spring legs are turned inwardly and downwardly to provide contact segments **27***a* and **27***b*, respectively, that extend generally along the sides of the longitudinally extending channel **20** in substantially spaced apart, parallel relation. However, the contact segments diverge upwardly and outwardly adjacent the open mouth of the channel **20** to facilitate the insertion of the printed wire panel **11**. Inward movement of the contact segments **27***a* and **27***b* toward each other is limited at the lower ends thereof by abutment with the respective sides of the stop member **19**. The contact segments are turned upwardly and outwardly at the lower ends thereof to form leaf spring segments **28***a* and **28***b* which respectively abut the spring leg portions **26***a* and **26***b*.

It will be noted that the respective spring leg segments **26***a* and **26***b* are bent inwardly adjacent the bottom wall of the cavity **18**, and thus are biased inwardly in the direction of or toward the longitudinally extending channel **20**. The points at which the spring leg segments are bent inwardly define first points of flexure **29***a* and **29***b*. As shown in FIGURE 5, the spring leg segments **26***a* and **26***b* deflect outwardly about the respective points of flexure **29***a* and **29***b* upon initial insertion of the board **11** into the channel **20**. Relatively little force is required to effect such outward deflection of the segments **26***a* and **26***b* for the force that accomplishes the deflection is applied to the spring legs adjacent the upper ends thereof or in the vicinity of the open mouth of the channel **20**, and is laterally or transversely directed. Consequently, such force is exerted at the points of flexure **29***a* and **29***b* through a relatively long lever arm—namely, the length of the respective spring leg segments **26***a* and **26***b*. Thus, the force exerted by the contact elements in resisting insertion of the board **11** is readily overcome by a small force applied to the board **11**, for such small force is exerted at the first points of flexure through the relatively long lever arm.

The arcuate connections of the contact segments and spring leg segments of the contact elements define a second point of flexure, and these are respectively denoted with the numerals **30***a* and **30***b*. The contact segments **27***a* and **27***b* deflect laterally at the second points of flexure **30***a* and **30***b* after a printed wire board **11** has been initially inserted into the longitudinally extending channel **20**, as shown in FIGURE 5, and is thereafter moved toward the fully inserted position illustrated in FIGURE 6. The force necessarily applied to the board **11** to effect lateral deflection of the contact segments **27***a* and **27***b* about the respective points of flexure **30***a* and **30***b* is greater than the force heretofore described in connection with the initial insertion of the board, for the lever arm through which such second or greater force must act is substantially smaller than the lever arm through which the first force acts. That is to say, the force necessarily applied in a lateral or transverse direction to the contact segments **27***a* and **27***b* to effect deflection thereof about the points of flexure **30***a* and **30***b* is applied to the contact legs at the point of engagement thereof with the board **11**, as shown in FIGURE 5, and the distance between such point of engagement and the sec-

ond point of flexure is the vertically projected length of the inclined portions of the contact segments **27***a* and **27***b*, and such length is substantially less than half of the length of the spring segments **26***a* and **26***b*.

Additionally, however, lateral deflection of the contact segments **27***a* and **27***b* is further resisted by the leaf spring segments **28***a* and **28***b* which must flex inwardly about the third points of flexure **31***a* and **31***b* defined by the arcuate connection of the contact segments with the leaf spring segments. The point of force application to effect the deflection of the leaf spring segments may be substantially the same as the point of application of the force which deflects the contact segments **27***a* and **27***b* about the respective second points of flexure **30***a* and **30***b*, as shown in the specific embodiment illustrated in the drawing, or may be some subsequent point engaged by the board **11** as it moves along the contact segments **27***a* and **27***b* toward complete insertion of the board into the channel **20**. In either event, the force causing deflection of the leaf spring segments acts through a relatively short lever arm; and further, whatever the lever arms may be, a double force resists movement of the board **11** from the partially inserted position thereof shown in FIGURE 5 toward the completely inserted position thereof illustrated in FIGURE 6. Hence, the resistance to flexure at both the points **30***a*–**30***b* and **31***a*–**31***b* must be overcome by the force applied to the board.

Thus, the connector structure illustrated and described provides the two desirable attributes discussed hereinbefore—namely, that of affording a relatively low resistance to initial insertion of a printed wire board **11**, and that of providing a relatively high retention force to the board after initial insertion thereof and when the board is completely inserted as shown in FIGURE 6. Therefore, the board **11** is easily inserted into the connector for once insertion has been initiated, the greater forces then applied to the board upon deflection of the contact segments **27***a* and **27***b* are easily overcome, for when these greater forces are applied, the board **11** is properly aligned in the channel **20** and is also properly aligned and slidably engages the contacts. Further, because of the relatively large secondary forces applied to the board, and particularly the conductors **12** thereof, by the various contact elements **17***a* and **17***b*, an excellent electrical connection is established between the contact elements and conductors.

While in the foregoing specification an embodiment of the invention has been described in considerable detail for purposes of making a complete disclosure thereof, it will be apparent to those skilled in the art that numerous changes may be made in those details without departing from the spirit and principles of the invention.

I claim:

1. In combination with a connector body part having a longitudinally extending channel and a transversely oriented contact receiving cavity intersecting said channel, said cavity having a bottom wall and opposed end walls and an opening extending upwardly into said cavity through the bottom wall adjacent each end wall thereof, a pair of contact members mounted within said cavity adjacent each end wall in spaced, opposed relationship to one another and adapted to receive a longitudinally oriented male member in frictionally gripped relationship therebetween with at least one of said contact members adapted to be electrically coupled with said male

member, each of said contact members including a spring leg portion juxtaposed to each end wall of the cavity and extending through said opening and terminating in a free end outside the cavity thereof, each of said spring leg portions being inclined slightly upwardly and inwardly from a point adjacent the bottom wall of said cavity and forming a first flexure zone thereat, each of said spring leg portions at the outside free end thereof being adapted to be connected to an electrical conductor, a contact portion having an upper portion and a lower portion secured at one end to the other end of each of said spring leg portions with the upper portion of each contact portion extending inwardly and downwardly in the direction of one another, the point of jointure of each of said upper portions to each spring leg portion forming a second flexure zone thereat, the lower portion of each contact portion extending downwardly from said upper portion in generally spaced parallel relationship to the spring leg portion and to each other for a distance sufficient to form a passageway between the lower portion of each contact portion having a substantial contacting surface which will frictionally engage a male member when inserted into the passageway, the width between said lower portions being normally less than the width of the male member to be inserted therein, a leaf spring portion integrally joined at one end to the free end of each of said lower portions of said contact portions and extending upwardly and inwardly from the lower portion of each contact portion in the direction of its corresponding leg portion, each of said first flexure points normally biasing each spring leg and its contact portion in the direction away from the juxtaposed cavity end wall with each of said first flexure points being relatively pliant as a result of the length of each leg portion so as to be overcome by a relatively small force applied against each contact portion upon initial insertion of the male member into said channel to move each of said leg portions and contact portions inwardly in the direction of the respective end walls of the cavity; said second flexure zone of each contact member being relatively stiff as a result of the shortness of the upper contact portion of each contact portion and the formed passageway between the lower portions and the leaf spring portion so as to be overcome only by a greater force applied against such contact portion by said male member subsequent to the initial insertion thereof into said cavity by the relatively small force.

2. In combination with a connector body in accordance with claim **1**, in which the leaf spring portion of each contact member has a terminal point adjacent its free end and abutting its respective spring leg portion.

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