June 13, 1967 K. M. HAMMELL ETAL 3,325,770

MEANS FOR MAKING ELECTRICAL CONNECTIONS

Filed Dec. 23, 1964

3 Sheets-Sheet 1

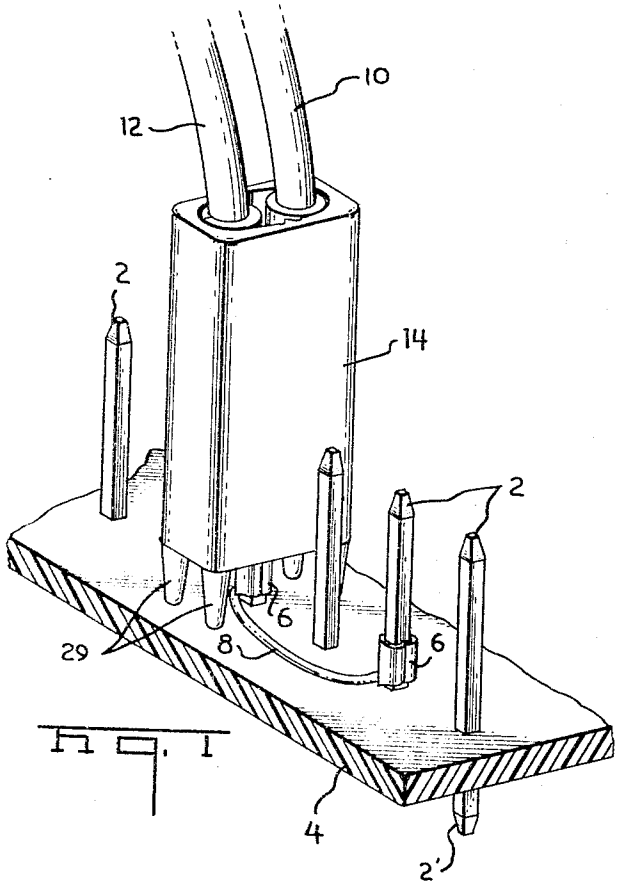


Fig. 1

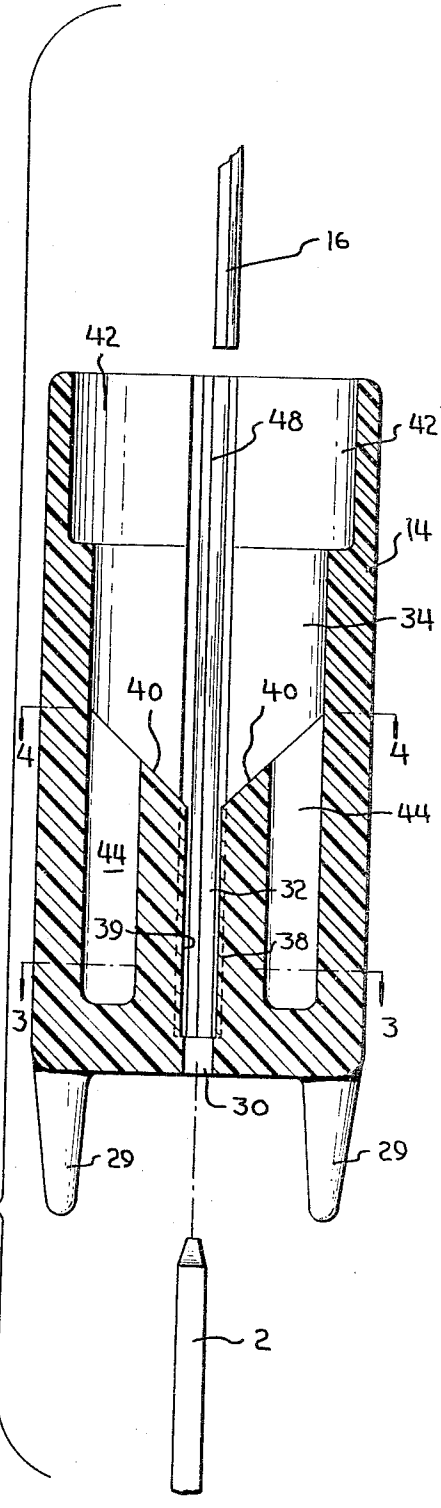


Fig. 2

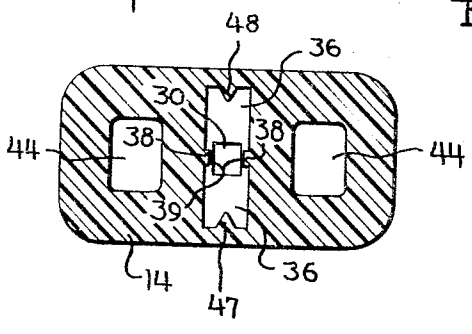


Fig. 3

June 13, 1967 K. M. HAMMELL ETAL 3,325,770

MEANS FOR MAKING ELECTRICAL CONNECTIONS

Filed Dec. 23, 1964 3 Sheets-Sheet 2

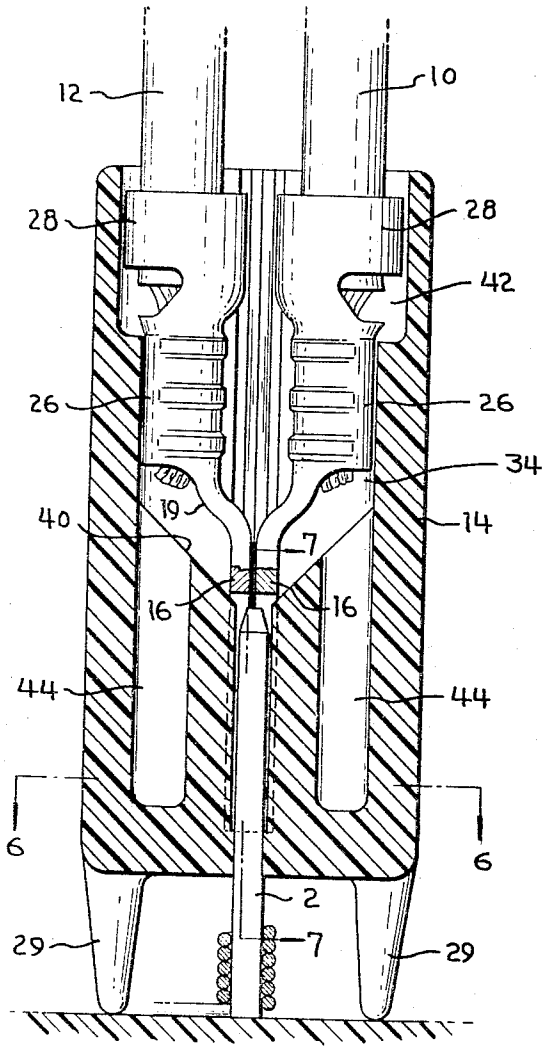


Fig. 5

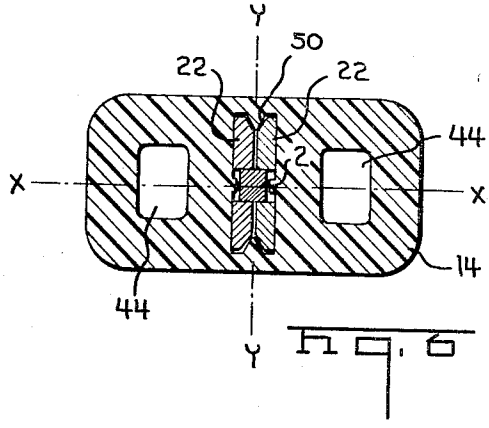


Fig. 6

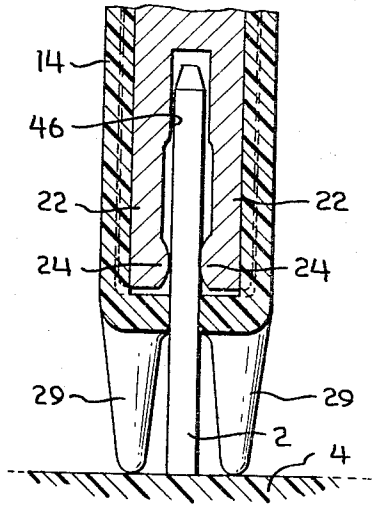


Fig. 7

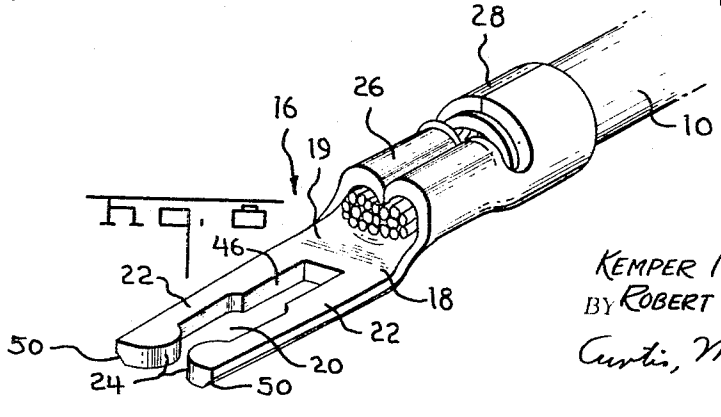


Fig. 8

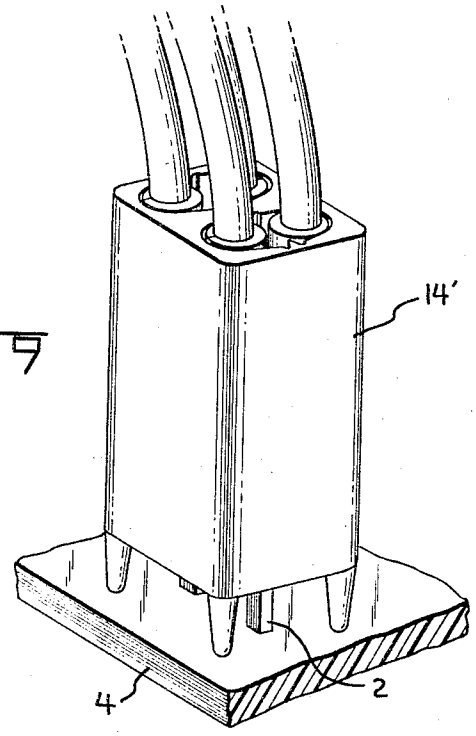
INVENTORS
KEMPER MARTEL HAMMELL
BY ROBERT FRANKLIN COBAUGH
Curtis, Morris & Safford

June 13, 1967 K. M. HAMMELL ETAL 3,325,770

MEANS FOR MAKING ELECTRICAL CONNECTIONS

Filed Dec. 23, 1964 3 Sheets-Sheet 3

Fig. 3



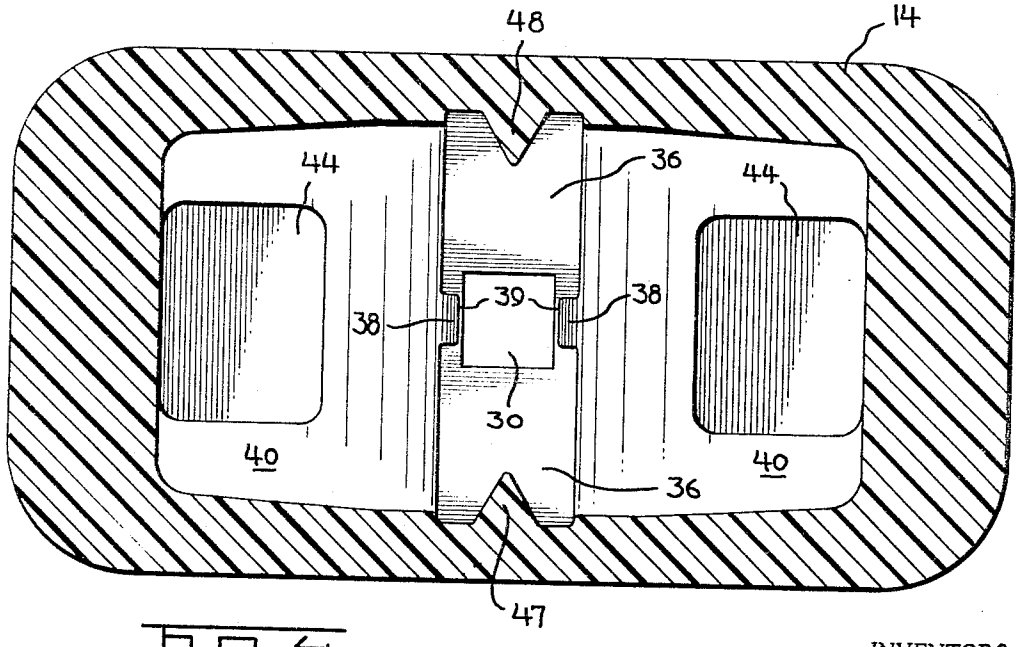


Fig. 4

INVENTORS
KEMPER MARTEL HAMMELL
BY ROBERT FRANKLIN COBAUGH
Curtis, Morris & Safford

United States Patent Office 3,325,770 Patented June 13, 1967

3,325,770

MEANS FOR MAKING ELECTRICAL CONNECTIONS

Kemper Martel Hammell, Harrisburg, and Robert Franklin Cobaugh, Hershey, Pa., assignors to AMP Incorporated, Harrisburg, Pa.

Filed Dec. 23, 1964, Ser. No. 420,666
14 Claims. (Cl. 339—176)

This invention relates to disengageable electrical connectors for connecting conductors to terminal posts on a panelboard.

An object of the invention is to provide an improved electrical single or multiple disconnect for connecting conductors to square or rectangular-sectioned terminal posts on a panelboard or mounting means. A further object is to provide a connecting device for connecting relatively large conductors to relatively small terminal posts which are mounted on a panelboard. A still further object is to provide a connector for connecting at least two external conductors to a relatively small terminal post where only a relatively short length of the post is available for making electrical connections with the external conductors. An additional object is to provide a housing of dielectric material which is cooperable with a terminal post and with fork-type terminals in the housing so as to provide axial stability in two planes and stability against rotation of the housing on the post. A still further object is to provide a connecting device which is particularly intended for usage where the spacing between terminal posts and terminal panels are limited.

These and other objects of the invention are achieved in a preferred embodiment comprising a housing having axial openings extending into the housing from both ends. The lower end of the opening in the housing comprises a square or rectangular post entrance portion, two opposite sides of which extend into a terminal-receiving portion in a manner such that these two opposite sides provide a constricted section bearing on an extended length of post. The widths of the post-bearing areas are somewhat smaller than the width of the post so as not to interfere with mating of the terminal and the post. The widths of the post-bearing areas may be substantially equal to the distance between the contact areas of the forked terminals so as to provide a centering guide for a terminal inserted into a housing prior to the housing being placed on a post. The post entrance portion has a cross-section equal to or slightly smaller than the cross-section of the terminal post to provide a frictional sliding fit when the housing is telescoped onto the post. This frictional fit stabilizes the housing rotationally and in cooperation with the above-mentioned two opposite sides in at least one plane axially. The contact-receiving portion is provided with guide surfaces in the form of downwardly and centrally sloping guide planes leading into a lower centrally constricted section for each terminal. The constricted section for each terminal is provided by V-shaped ribs extending centrally downwardly from the upper opening. The dual function of these ribs will be presented later. Cavities on each side of the constriction extending downwardly from the upper end of the opening are provided to obtain uniform wall sections throughout the molding to reduce curing time and to increase dimensional accuracy. The upper contact-receiving portion is enlarged having a cross-section sufficient to admit the crimped insulation and wire portions of the electrical conductor which are to be connected to the post. The housing is preferably used in conjunction with fork-type spring contacts which are crimped onto the ends of the conductors. In the case of relatively large conductors, it is desirable that the thickness of the spring contact be

substantially greater than half the thickness of the mating post in order to provide adequate wire retaining strength in the wire barrel of the contact and adequate contact force in the forked contact region. Thus, the provisions in the cavities of the housing provide operating clearance for such contacts.

The spring contacts comprise a forked section having a slot extending axially inwardly from their ends; the width of this slot near the ends between the contact areas being substantially equal to one-half the thickness of the terminal post and the width of the slot near the juncture of the tines being slightly larger than the post thickness so that two or more such contacts can be moved axially onto the post in straddling relationship thereto, each providing substantial contact force with its two contact surfaces against said post. The arrangement is such that the two fork-type terminals on the ends of the conductors can be moved into the housing and into the terminal-receiving portion thereof so that they will straddle the post with the opposed edges of the slot at the contact area bearing against the exposed sides of the post to establish the electrical connection.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there are shown and described illustrative embodiments of the invention; it is to be understood, however, that these embodiments are not intended to be exhaustive nor limiting of the invention but are given for purposes of illustration and principles thereof and the manner of applying them in practical use so that they may modify them in various forms, each as may be best suited to the conditions of a particular use.

In the drawings:

FIGURE 1 is a fragmentary perspective view showing a portion of a panelboard having terminal posts extending therefrom and having an electrical connecting device in accordance with the invention mounted on one of the terminal posts;

FIGURE 2 is a cross-sectional view showing a connector housing in accordance with the invention in alignment with the terminal post and with a fork-type terminal which is to be connected to the terminal post;

FIGURE 3 is a view taken along lines 3—3 of FIGURE 2;

FIGURE 4 is a view taken along lines 4—4 of FIGURE 2;

FIGURE 5 is a view similar to FIGURE 2 but showing the connector housing mounted on the terminal post with the fork-type terminals sectioned at the upper ends of their slots and disposed in the housing and electrically connected to the post;

FIGURES 6 and 7 are views taken along lines 5—5 and 6—6 of FIGURE 4;

FIGURE 8 is a perspective view of a contact terminal on the end of a conductor of the type used for connecting the conductors to the terminal; and

FIGURE 9 shows an alternative embodiment of a connecting device in accordance with the invention.

FIGURE 1 shows a portion of a panelboard 4 having a multiplicity of terminal posts 2 mounted therein in accordance with a coordinate grid system. In the embodiment shown, the posts extend through board 4 to the opposite side thereof as shown at 2' so that individual modules containing circuit components may be mounted on the underside of board 4 and the necessary electrical connections between the modules can be made by means of projecting portions 2 of the posts by any suitable wiring method. In FIGURE 1, a relatively small conductor 8, which is matched to the size of post 2, provides electrical

connection between the terminal posts as shown by means of clip-type connections **6** which are described more fully in the copending application of Robert F. Cobaugh, Ser. No. 171,074, filed Feb. 5, 1962, now U.S. Patent No. 3,239,918. Alternatively, connections may be provided between the posts in the region adjacent to the panel by conductors similar to **8** by means of welded or wrap-type connections.

The disclosed embodiment of the present invention is particularly intended for usage under circumstances where one or two further conductors **10, 12** are to be disengageably connected to a post **2** and/or where size limitations as regard the post or the conductors renders the employment of additional clip-type or wrap-type connections impractical. Thus, in FIGURE 1, it will be apparent that conductors **10, 12** may be substantially larger than conductor **8** and could not conveniently be connected to a terminal post by means of a clip-type, wrap-type, or weld connection. This does not preclude the advantageous use of smaller conductors **10, 12** being disengageably connected to small posts as this is also contained within the invention. With small conductors only, the crimpable wire and insulation supporting barrels of the forked terminals are preferably proportional to the cross-section of wire, the thickness of the forked end of the terminal is preferably identical to those used on larger conductors.

The disclosed embodiment of the invention comprises an insulating housing **14** into which fork-type contact terminals **16** (FIGURE 8) are adapted to be inserted. Each terminal **16** is crimped onto a conductor **10**, by means of a pair of crimped connections **26, 28**, the terminal being secured to the strands of the wire by crimp **26** and to the insulating sheath on the wire by means of crimp **28**. The fork-type terminals comprise an elongated flat tab **18** having a slot **20** extending axially inwardly from its end to define a pair of parallel tines **22**. The inner portion of slot **20** is relatively narrow as shown at **46**, the width of the slot being only slightly greater than the width of the post in this narrow portion. Inwardly-directed contacts **24** are provided on the opposed edges of tines **22** adjacent the ends thereof and they are spaced relatively close together so that a high pressure electrical contact will be established between the contact terminals and the post when the terminals are moved into stradding relationship and spread by the posts in the manner described below. As can be discerned, tab **18** is offset with respect to connections **26, 28** by transition section **19**.

Insulating housing **14** has legs or supports **29** extending from its underside so that it can be moved telescopically onto a single terminal post and will be supported above the surface of board **4** at a position such that it will not interfere with, or otherwise affect, clip-type connection **6** which is provided adjacent to the base of the post. Housing **14** has an opening **30, 32, 34** extending centrally therethrough which is adapted to receive the upper portion of a terminal post **2** and a pair of contact terminals **16**. Portion **30** of the opening which is adjacent to the lower end of the housing constitutes an entrance section and has a cross-sectional configuration closely conforming to and providing a sliding frictional fit with the cross-section of post **2** so that the housing will be stabilized against rotation on the post when the parts are in their assembled relationship. Contact-receiving portion **32** of the opening which is directly above entrance portion **30** has an hourglass configuration (see FIGURE 3) having a centrally constricted section **38** and a pair of laterally extending cavities **36**. The width of the constricted section (i.e., the distance between sides **39, 39**) is substantially equal to the corresponding width of post **2** so that the opposed surfaces of this portion of the opening may bear against opposite sides of the post while the remaining sides will face outwardly and into cavities **36**. The length of the constricted section in the plane at the forked connectors is materially less than the thickness of the post so that the contacts will bear on the post, as shown in FIGURES 3 and 6, and

not on the cavity walls. The width of each cavity is substantially equal to and slightly greater than twice the thickness of forked portion **18** of an individual terminal so that two terminals in back-to-back relationship can be accommodated in the cavities as shown in FIGURES 5 and 6. The cross-sectional length of the cavities, normal to the width, is substantially equal to, and slightly greater than the overall width of tines **22** when they are spread apart by the post.

A pair of V-shaped ribs **48** are provided on opposite sides of conductor-receiving portion **34** and contact-receiving portion **32** of the opening in the housing. These ribs extend centrally downwardly in the opening and conform to chamfers **50** on the lower edges of tines **22** of terminals **16** and function to polarize and locate the terminals in a proper and sequential manner during insertion in a manner described below.

Upper portion **34** of the opening has a cross-section sufficiently large to admit a pair of terminals disposed with their fork portions in back-to-back relationship and with their crimped portions **26, 28** disposed in parallel relationship with each other. In this respect, it will be noted that upper section **42** of the cavity of the upper end of the housing is slightly enlarged in order to admit insulation crimps **28** of the terminals. The transition portion between contact-receiving portion **32** of the opening and conductor-receiving portion **34** comprises inclined surfaces **40** which slope from opposite sides of the housing downwardly towards cavities **36** for the purpose of guiding the ends of tines **22** of the contacts into the cavities and into straddling relationship with the exposed sides of the post as explained below.

The inner ends of surfaces **40**, which form the sides of cavities **36**, are slightly smaller in length than the sides of these cavities and constricted sections **38**, as illustrated in FIGURE 4, and this occurs at the transition between the tab and wire barrel to frictionally retain the terminals in the housing without restricting action of the tines.

In normal point-to-point connection use, housing **14** is first mounted on a post **2** to which it is desired to connect external conductors **10, 12**. A terminal **16** is then positioned above a desired cavity **42**, as shown in FIGURE 2, in alignment with the post and with its tine portions in general alignment with cavities **36**. The terminal is then pushed downwardly against guide surfaces **40** which guide its forked ends toward the post and cavities **36**, in engagement with sections **38** and into straddling relationship to the post. If required, a second terminal in like manner, may then be positioned in or removed from cavity **42**. In the finished connection, the terminals will be in back-to-back relationship with their crimp portions **26, 28** facing in opposite directions. It is not essential that the precise sequence described above be followed; for example, the terminals can be inserted into the housing together, back-to-back, when complete wiring harnesses are made up and it is convenient to do so. Many times, however, only a single connector will be required in a housing.

In the case of the particular embodiment of the invention, the terminals can be inserted into the housing only in the intended manner. That is to say, inclined surfaces **40** will function to guide the ends of tines **20** towards the post if the terminal is reasonably aligned with cavities **36**, as above. Ribs **48** in cooperation with chamfered edges **50** insure that the conductor-retaining crimps **26** and **28** will be properly positioned in their respective cavities so that either terminal can be connected or disconnected independent of the other. In other words, with reasonable initial alignment, it is difficult to insert the terminals in any orientation other than that shown in FIGURES 5 and 6. Sections **38** serve a dual function, as self-centering means to enable the forked ends to be properly centered with respect to post **2** and as bearing areas for bearing against post **2**.

Although terminal post **2** has a small cross-section relative to the size of housing **14** and the size of fork-type ter-

minals 16, the housing is stabilized against unintentional movement in all directions by the manner in which the housing, cooperating with a terminal or terminals, is fitted onto the post. As previously noted, the housing is stabilized against rotation on the post by constricted entrance portion 30 of the opening since this entrance portion conforms to the cross-section of the post and has a close fit therewith. The housing is stabilized against rocking motion in the plane X—X of FIGURE 6 by surfaces 39 of the terminal-receiving portions of the opening in the housing. These surfaces 39 extend along and bear against the post for a substantial portion of its length, as best shown in FIGURE 5, so that rocking of the housing to the left or right in FIGURE 5 is effectively prevented. Finally, rocking of the housing in the plane Y—Y of FIGURE 6 is prevented by the relationship of fork-type terminals 16 to post 2 and their relationship to housing 14. The stability of the housing in the Y—Y plane of FIGURE 6 depends upon the close fit of the terminals in cavities 36 and the fact that the upper end of the post extends into narrow sections 46 of the slots in the terminals. By virtue of the close fit of the terminals in cavities 36, the terminals are permitted only very limited movement within the cavity as is best shown in FIGURE 6. By virtue of the fact that the post extends into narrow portions 46 of slots 20 of the terminals, very little relative movement of the terminals with respect to the post is permitted.

The stability of the housing in the Y—Y plane can also be explained by assuming that a force will be applied to the housing from the right or left in FIGURE 7. Such a force would ordinarily tend to rock the housing in the plane of the drawing of FIGURE 7. However, such a force when applied to the housing would actually cause only very limited rocking motion for the reason that this force would be transmitted to terminals 16 (by virtue of the close fit of these terminals in cavities 36) and thence to post 2 by virtue of the relatively close fit of the post in upper narrow portion 46 of slot 20. It should be noted that tines 20 of the terminals are highly resistant to flexure in their own planes in the load-bearing areas (within slot portion 46) because of the fact that the force is transmitted to the relatively rigid upper ends of the tines near the upper end of slot 20. This fact is of importance in maintaining the electrical contact between contacts 24 of the terminal and the sides of the post when a force is applied to the housing from one side thereof, as viewed in FIGURE 7.

FIGURE 8 shows an alternative embodiment of the invention comprising a housing 14' having a pair of openings extending therethrough which is adapted to be mounted on a pair of adjacent terminal posts of the panelboard. The openings in the housing of FIGURE 8 may be in all respects similar to the opening in housing 14 and the relationship of the housing to the posts and the relationship of the terminals to the housing and post would be as described above. One advantage of the type of housing shown in FIGURE 8 is that in the event of the application of a torque to the housing, the two posts extending into the housing would provide added stability and prevent twisting of the housing with respect to the board. Obviously, a housing in accordance with the invention could be made with many desired numbers of post-receiving openings therein.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the particular embodiments of the invention, which are shown and described herein, are intended as merely illustrative and not as restrictive of the invention.

What is claimed is:

1. An electrical connecting system comprising a panelboard having terminal posts mounted on and extending therefrom, an insulating housing mountable on at least one of said terminal posts, said housing having an opening extending therethrough, said post extendable into said opening at one side of said housing, said opening having constricted-portion means conforming to said post and engageable with opposite sides of said post whereby said housing is stabilized on said post thereby in one direction, conductor means having contact terminal means on end means thereof, said terminal means being extendable into said opening on another side opposite to said one side and being disengageably connectable to other opposite sides of said post in said opening to stabilize said housing on said post in another direction.

2. An electrical connecting system comprising mounting means having terminal posts extending therefrom, an insulating housing mounted on at least one of said terminal posts, said housing having an opening extending therethrough and said post extending into said opening at one side of said housing, said opening having constricted portions engaging opposite sides of said post whereby said housing is partially stabilized on said post thereby, at least one conductor having a fork-type contact terminal on its end, said contact terminal extending into said opening on the side opposite to said one side and being in straddling relationship to and being electrically engaged with other opposite sides of said post, the straddling relationship between said fork-type contact terminal and said post cooperating with said housing thereby effecting its complete stabilization on said post.

3. A system as set forth in claim 2 wherein said housing is mounted on said post above a surface of said panelboard, and including a second conductor connected to said post between said surface and said housing.

4. A system as set forth in claim 2 wherein said constricted portions serve as self-centering means to enable the forked-type contact terminal to be properly centered with respect to said post.

5. An electrical connecting system comprising an insulated body member having terminal posts extending therefrom, an insulating housing having an opening extending therethrough from one side of said housing to the opposite side thereof, one of said posts extending into and at least partially through said opening, said opening having constricted portions conforming to the cross-section of said post, whereby said housing is stabilized in at least one axial plane on said post, said housing having cavities extending parallel to said opening, said cavities extending into said housing from the side opposite to the side thereof which is adjacent to the base of said post, a conductor having a fork-type contact terminal on its end, said terminal extending into said opposite side with one leg thereof in each of said cavities, said terminal straddling and being in electrical contact with said post, said fork-type contact terminal cooperating with said post near its top to effect axial stabilization for both contact terminal and said housing in a second axial plane normal to said axial plane.

6. An electrical connecting system comprising a panelboard or other electrical connection device having terminal posts extending therefrom, at least one post having an insulating housing mounted thereon above said panelboard, said housing having legs to position a lower end of said housing a substantial distance above said panelboard and providing electrical contact access to said post between said housing and panelboard, said housing having cavities therein on two opposite sides of said one post, at least one conductor entering a top of said housing and having a spring contact terminal on its end, said terminal comprising a pair of spaced-apart tines, the spacing of said tines being substantially less than the thickness of said post, one of said tines being disposed in each of said cavities with said terminal in straddling relationship to and in electrical contact with said post, means within said housing and above said cavities to guide said tines into said cavities.

7. A system according to claim 6 wherein polarizing means are in said cavities and on said terminal to polarize and locate said terminal so that space is provided for another conductor having a spring contact terminal on its end.

8. An electrical connector for connecting a pair of conductors to a terminal post, said post having conductor means connected thereto at its base, said connector comprising an insulating housing having an opening extending therethrough from one end thereof to the opposite end, said opening comprising an entrance portion and a terminal-receiving portion, said entrance portion having a cross-section conforming to the cross-section of said post, said terminal-receiving portion adapted to receive said pair of conductors and having a constricted section when viewed in cross-section for gripping opposite sides of said post, fork-type spring terminals at the ends of said conductors, said terminal-receiving portion having cavities on each side of said constricted section whereby upon insertion of said fork-type terminals into said terminal-receiving portion, said terminals straddle said post with opposed edges of tines of said terminals bearing against other opposite sides of said post.

9. A disengageable electrical connector for connecting at least one conductor to a terminal post, said conductor having a fork-type contact terminal on its end and having a slot extending inwardly from its end, said disengageable connector comprising an insulating housing having an opening extending therethrough from one end to the opposite end, said opening having an entrance portion adjacent to said one end, said entrance portion conforming in cross-section to the cross-section of said post, a terminal-receiving portion adjacent to said entrance portion, said terminal-receiving portion of said opening extending laterally in said housing and being of generally hour-glass cross-section with the central constricted section thereof having a width conforming substantially to the width of said post and with cavities on each side of said constricted portion, said terminal-receiving portion of said opening merging with a conductor-receiving portion opening into said opposite end whereby upon insertion of said fork-type terminals into said opening with the slot of each terminal straddling said post in said terminal-receiving portion, the edges of said terminal on opposite sides of said slot are electrically contacted with said post.

10. A disengageable electrical connector according to claim 9 wherein guide surface means is disposed between said terminal-receiving portion and said conductor-receiving portion to guide said terminal into said terminal-receiving portion.

11. A disengageable electrical connector according to claim 10 wherein the length of said guide surface means at the entrance to said terminal-receiving portion is less than the entrance thereto to frictionally retain said fork-type terminal in said terminal-receiving portion before said housing is inserted onto said post.

12. An electrical connector for connecting conductor means to a terminal post comprising an insulating housing, an opening extending through said housing from one side thereof to the other side, said opening having an entrance portion on said one side which conforms closely to the cross-section of said post whereby said housing can be moved onto said post, said opening having a terminal-receiving portion immediately adjacent to said entrance portion, said terminal-receiving portion being

dimensioned to grip said post on two opposite sides and having enlarged cavities on each of the two remaining sides whereby two sides of a post in said housing are exposed, and an enlarged cavity adjacent to said terminal-receiving portion for reception of a crimped connection between said conductor means and said terminal means, said terminal means including forked-contact section means insertable into said terminal-receiving portion and into straddling relationship to said post so that said terminal means is electrically connected to said post, said housing being stabilized on said post by said entrance portion and by said terminal means.

13. An electrical connector for connecting two conductors to a terminal post, said conductors having fork-type terminals on their ends comprising a pair of spaced-apart coplanar tines, said connector comprising an insulating housing having an axial opening extending therethrough from one end to the opposite end, said opening comprising successively an entrance portion, a terminal-receiving portion, and a conductor-receiving portion, said entrance portion having a cross-section conforming to the cross-section of said post whereby said housing is partially stabilized on said post by said entrance portion, said terminal-receiving portion being of generally hour-glass cross-section and having a centrally constricted section of a width substantially equal to the width of said post for engagement therewith and with cavities on each side of said constricted portion, said conductor-receiving portion being generally open and having a cross-section sufficient to receive both of said conductors whereby positioning said housing on said terminal post with said one end adjacent to the base of said post and upon inserting said terminals into said opening, said tines are moved into said cavities of said terminal-receiving portion and into straddling relationship with said post with the opposed edges of said tines disposed against opposite sides of said post.

14. An electrical connection between a terminal post and a conductor having a fork-type terminal on its end, said terminal being in axial alignment with and straddling relationship to said post with tines of said terminal extending along opposite sides of said post, the distance between opposed sides of said tines at the inner ends thereof being substantially equal to the width of said post and the distance between opposed sides of said tines at the outer end portions thereof being substantially greater than the width of said post, said tines having inwardly-directed contacts on their outer ends, the distance between said contacts being less than the width of said post whereby said tines are sprung apart by said post and said contacts resiliently bear against said opposite sides and said terminal is stabilized on said post against rocking motion in its own plane by said opposed sides of said inner ends of said tines.

References Cited

UNITED STATES PATENTS

2,685,074	7/1954	Lazzery	339—221
3,086,074	4/1963	Just et al.	339—221 X
3,136,591	6/1964	Just et al.	339—176 X
3,209,311	9/1965	Kukla	339—276 X

MARVIN A. CHAMPION, *Primary Examiner.*

W. DONALD MILLER, EDWARD C. ALLEN, *Examiners.*