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Georgopulos

[11] **3,760,328**

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[54] **TELEPHONE TYPE ELECTRICAL CONNECTORS**

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[73] Assignee: **GTE Automatic Electric Laboratories Incorporated,** Northlake, Ill.

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[52] **U.S. Cl.** ..... **339/18 R,** 317/101, 339/17 E, 339/198

[51] **Int. Cl.** **H01r 9/08,** H01r 13/50, H01r 29/00

[58] **Field of Search** ..... 339/17 R, 17 C, 17 CF, 339/17 L, 17 M, 17 N, 18 R, 18 C, 18 P, 19, 75 M, 65, 66, 176 M, 176 MP, 276 A, 191, 192, 195, 150 T, 151, 198

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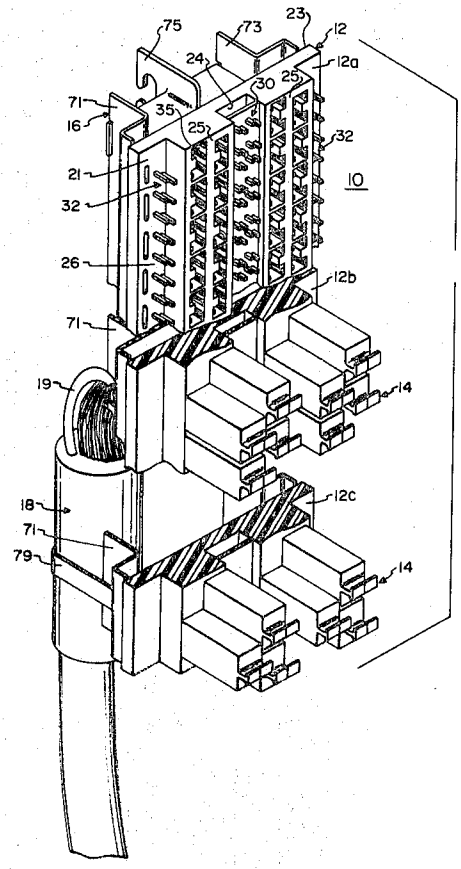
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Primary Examiner—Marvin A. Champion
Assistant Examiner—Terrell P. Lewis
Attorney—K. Mullerheim et al.

[57] **ABSTRACT**

An electrical connector body for use with a main distributing frame of a telephone central office including a generally elongated flat rectangular panel having front face and rear surfaces, a plurality of socket type apertures in the panel face in which to mount pluggable circuit protector modules, a first set of pin terminals extending at once both outwardly from and axially along a central portion of the panel face, and a second set of pin terminals extending at once both outwardly from and axially along the two opposite longitudinal edge portions of the panel face. The socket type apertures are disposed intermediately of the central first set of pin terminals and both longitudinal edge second set of pin terminals, respectively. The apertures are geometrically arranged with respect to each other and with respect to the first and second sets of pin terminals, so as to provide a readily ascertainable geometrical pattern of association between selected ones of the first and second sets of pin terminals and a selected aperture. Further, the first and second sets of pin terminals are continuous in their respective length dimensions to extend into the associated apertures to provide terminal means within the apertures whereby the protector modules are connectible to said first and second sets of pin terminals.

15 Claims, 7 Drawing Figures



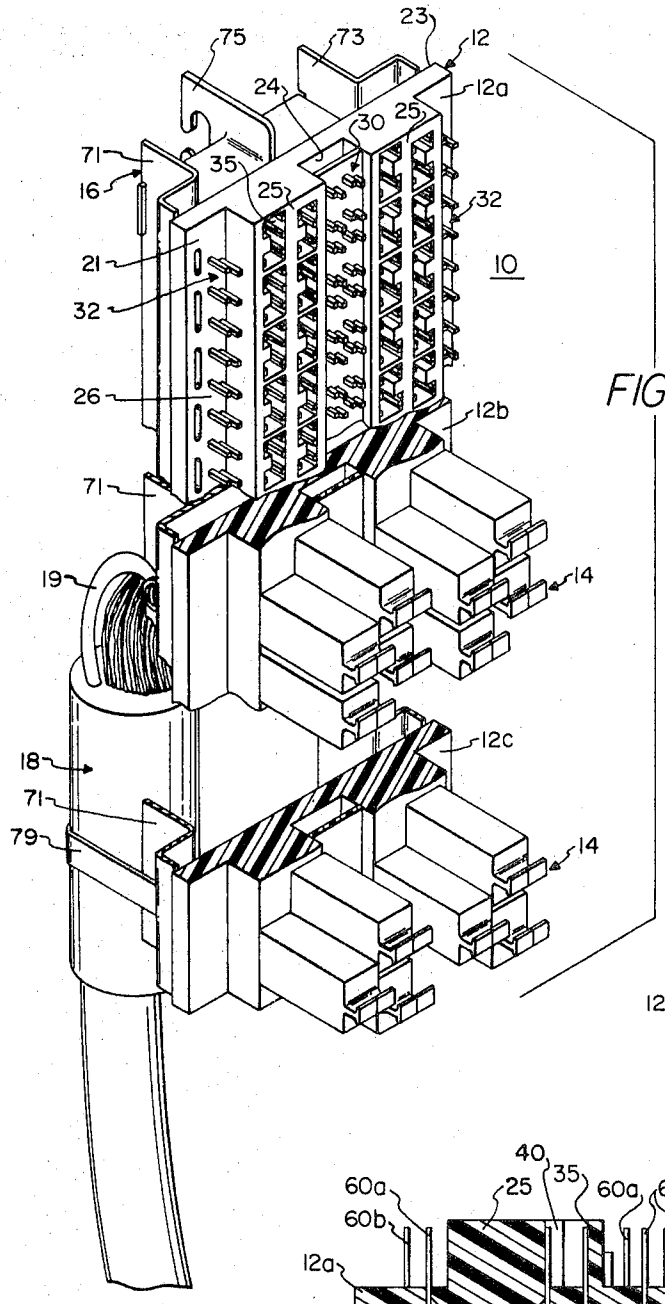


FIG. 1

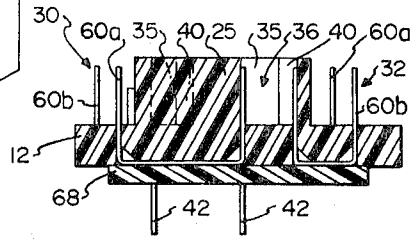


FIG. 7

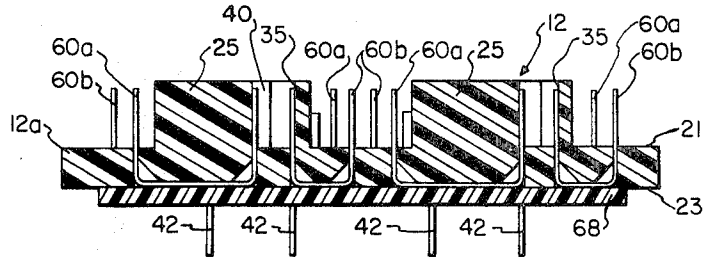


FIG. 6

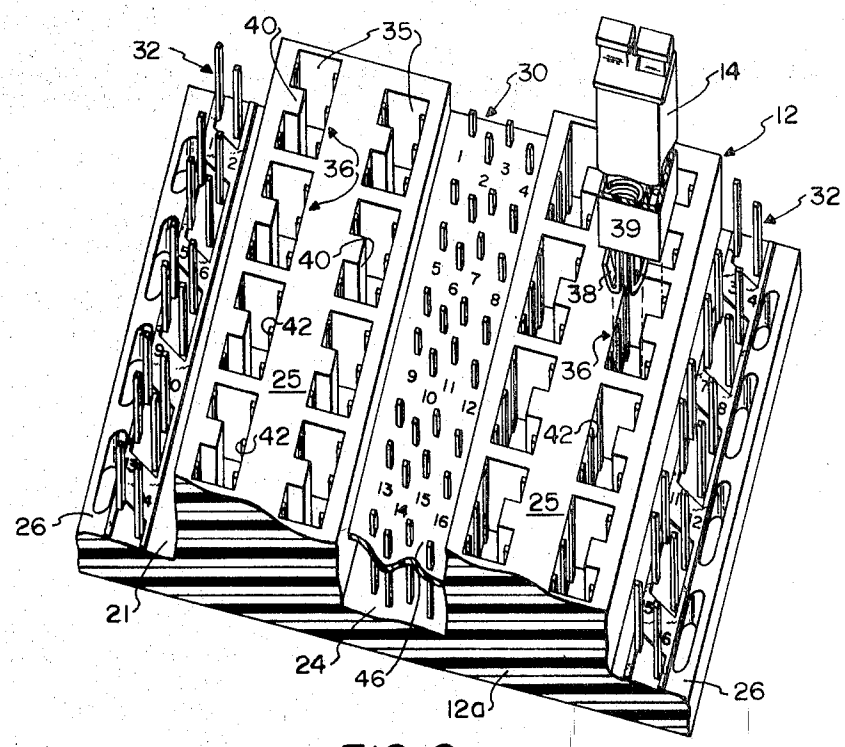

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120
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FIG. 2

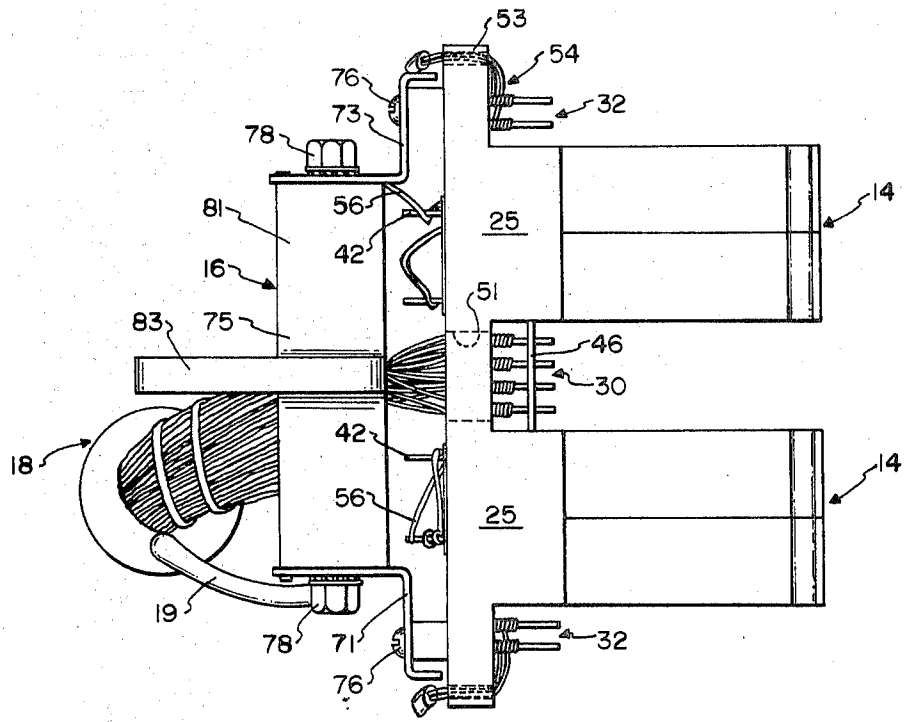

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FIG. 3

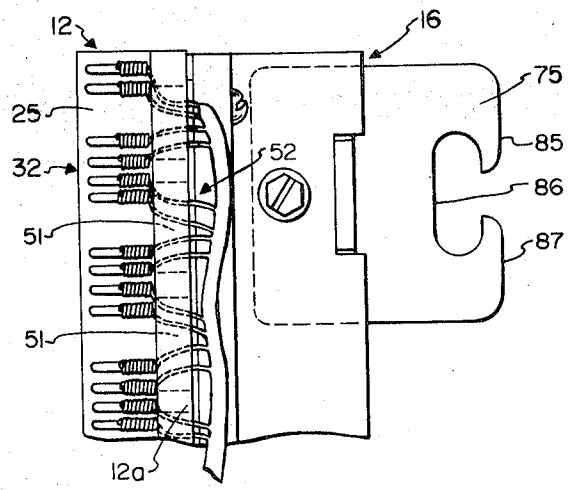

12
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12a

FIG. 4

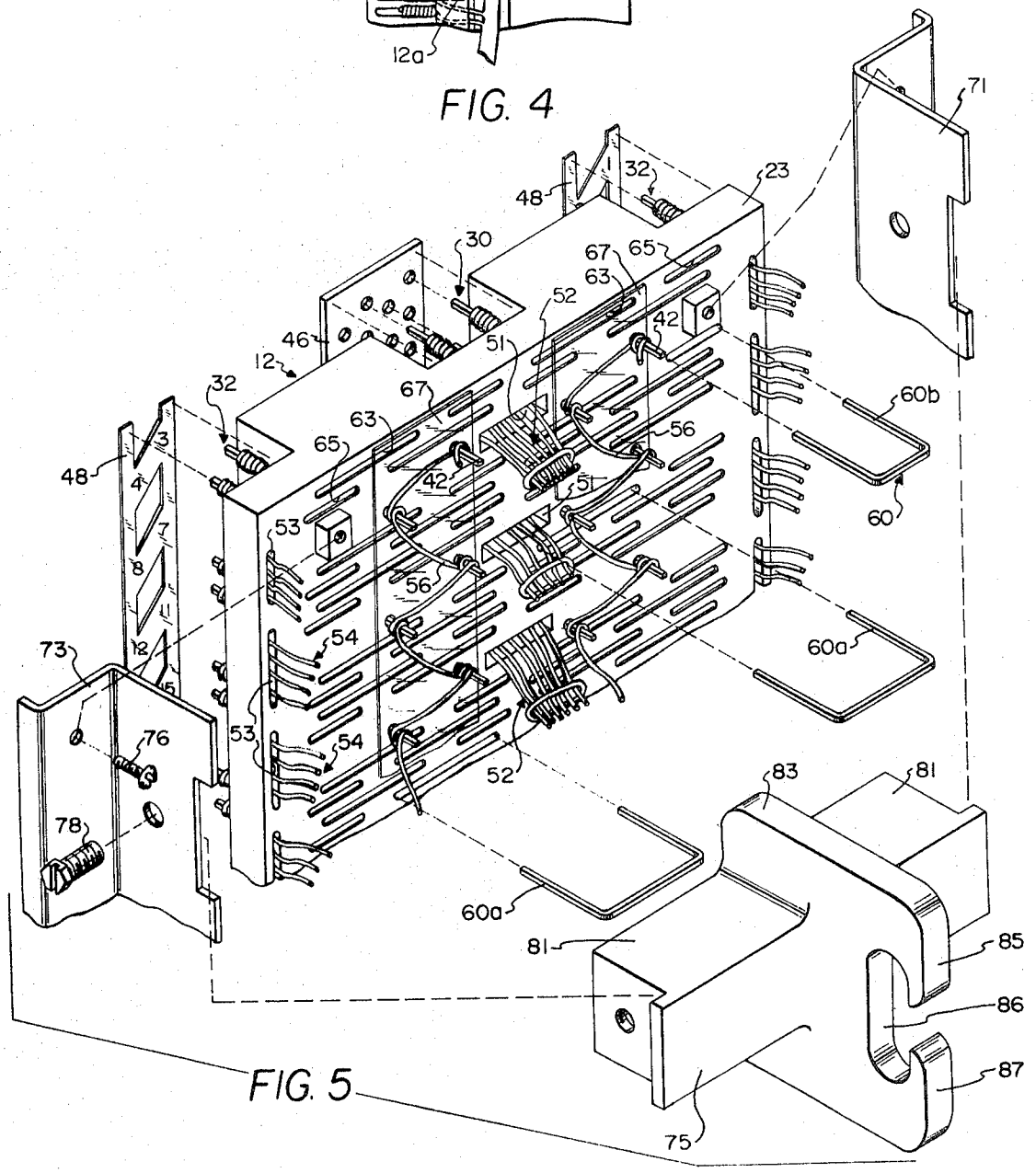

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FIG. 5

TELEPHONE TYPE ELECTRICAL CONNECTORS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to electrical connectors, and more particularly, relates to main frame connectors useful to provide line protection for critical telephone central office switching equipment.

2. Description of the Prior Art

In a central office forming part of a telephone transmission network, blocks of connector assemblies serve as the electrical interface between incoming feeder cables from the exchange area and the central office switching equipment. Each connector assembly typically consist of an elongated connector body, mounting brackets therefor, a feeder cable with attendant wiring, and multiple protector units or modules mountable on the connector body. Each protector module is connectible to a subscriber line pair of talk and ring circuits and serves to protect the critical central office switching equipment against undesirable electrical transients and surge conditions. In serving as protectors, these plug-in modules constitute switches for disconnecting the incoming and outgoing line pairs when the modules are partially removed to a so-called detent position from their electrical engagements within their associated pin sockets.

The elongated connector body comprises a generally wide flat panel to be mounted on the main distributing frame with its elongated dimension positioned vertically with respect to the main frame. Commonly, the feeder cables and other supply cables are fed to the connector panels from the bottom and rear positions of the main frames, and the attendant wiring leads for both incoming and outgoing line pairs including ground paths are connected preferably by wire wrapped solderless type connections to suitable pin terminals made available from the rear of the connector body. Often, selected ones of the pin terminals are continued through the panel thickness to provide multiple test fields on the front surface of the connector body.

An electrical connector assembly of the same general class as the present invention is the subject of the U.S. Pat. No. 3,518,611, patented June 30, 1970, and assigned to Bell Telephone Laboratories, Incorporated, wherein it can be seen that the front surface of the elongated connector body is generally reserved for connecting protector modules thereto and providing fields of test points for both incoming subscriber line pairs and outgoing central office line pairs. The rear surface of the connector body is generally reserved for connecting the attendant wiring leads to multiple pin terminals including the incoming and outgoing arrays of pin terminals. The pluggable protector modules are connectible in electrical series between the incoming and outgoing arrays of pin terminals as through being insertedly engaged by pin-grip type terminals.

The pin-grip terminals are accessible from the rear of the elongated panel and are connected to the incoming and outgoing arrays of pin terminals by means of wire wrapped connections, thus requiring a wiring scheme having multiple wire wrapped connections. For example, when considering only the two line transmission path through a single protector module, four wire wrapped connections are necessary to connect to the incoming and outgoing wiring leads, eight additional wire wrapped connections are necessary to interconnect the incoming and outgoing pin terminals with the intermediately disposed protector module, and at least one further wire wrapped connection is used to connect the ground terminal or the protector module to a common ground lead. Even though these multiple wire wrapped connections are usually effected with automatic wiring machines in order to reduce the manufacturing cost of the connector body, further economy can be realized through the elimination of some of these wire wrapped connections. It is hereby proposed to present an improved structure for the connector body and the pin terminals whereby all eight of the intermediately disposed wire wrapped connections are eliminated.

In a common practice of arranging the front surface or face of the connector body as shown in the above-referenced U.S. Pat. No. 3,518,611 and used for other main frame connectors, a plurality of electrical test points are provided for both incoming subscriber line pairs and outgoing central office line pairs. The incoming and outgoing test points comprise first and second test fields which are normally grouped in different areas of the face of the panel in order to reduce the likelihood of confusion therebetween. Often a different structural configuration is utilized for the test pins of the two test fields in order to quickly distinguish therebetween during testing procedures. For a test conductor, it is important to be able to readily distinguish between the different test fields as by locating the test fields in different and spaced apart areas of the panel face, and also to distinguish between the test points within a given test field as by arranging the test points in a predetermined repeating geometrical pattern. Also, it is important to provide an overall layout having a predetermined repeating geometrical pattern for associating selected ones of the test points in one test field with selected ones of the test points in another test field and with a selected protector module serving the telephone lines accessible through those particular test points.

Some difficulty has heretofore been encountered in providing a means for associating the separated test fields with each other and with the respective protector modules while simultaneously providing a means for distinguishing between the individual arrays of electrical test points and protector modules as these objects are somewhat opposed to each other. That is to say the object of providing separation between test fields and between test fields and protector modules is somewhat opposed to the object of providing for an association therebetween. In the present invention, both objects are sought through repeating down the vertical face of the connector body a particular matrix comprised of a plurality of horizontal rows of associated pin terminals and socket apertures defining first and second sets of equally spaced rows, the second set thereof being interpositioned with respect to the first set of rows in a non-interferring pattern.

It is also to be noted that existing connector bodies sometimes employ a different pin structure for one test field from that structure used in another test field. The reason is to enhance the aesthetic distinction between the two test fields and thereby to facilitate testing procedures. However, the present structure utilizes the same type of simple and inexpensive pin terminal for both incoming and outgoing test fields, but yet minimizes the likelihood of confusion therebetween be-

cause of the particular matrix mentioned above. Further, the incoming and outgoing line pin terminals do not protrude outwardly from the rear surface of the connector body but only from the front surface thereof. Thus, the front extending pin terminals serve a dual function of accommodating wire wrapped connections and providing electrical test points. Effecting wire wrapped connections from the front of the connector body is largely made acceptable by the elimination of the several wire wrapped connections as described hereinbefore.

Another disadvantage with the connector structure presented in the above-referenced U.S. Pat. No. 3,518,611 relates to the extremely close packing of the protector modules. While this may upon first instance appear to be a space saving scheme, it does tend to detract from the accurate identification of an interiorly positioned module as being associated with a given transmission path when attempting to disconnect the central office side of the path by removing the protector module to its detent position. The protector module placement on the present improved connector body utilizes the available face area and yet permits fast and accurate identification, increased likelihood of grasping the correct module once identification is made, and an increased peripheral area in which to firmly grasp the protector module.

Further, an improved configuration for the socket type apertures is provided which will permit a keyed base portion of a protector module to be inserted therein as opposed to receiving only projecting prong type terminals on the module. This mounting scheme provides a firmer mounting of the modules upon the connector body, especially if the type protector modules used are those which require the entire module to be partially withdrawn from the socket in order to achieve a detent position such as the type protector modules disclosed in the U.S. Pat. No. 3,518,611. A common configuration of pin terminal like that of the incoming and outgoing pin terminals is used interiorly of the socket apertures to connect with exterior terminals of the protector modules. The present structure is also improved in that these interiorly positioned pin terminals are merely extensions of associated ones of the incoming and outgoing line pin terminals, thus eliminating the need for extending additional wire wrapped type pin terminals rearwardly of the panel and for providing additional wire wrapped connections to link the line pin terminals with such rearwardly extending interior pin terminals.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an improved connector body for routing a standard number of telephone transmission line pairs, which connector body utilizes unique pin terminals permitting a reduced number of wire wrapped connections for interconnecting the line pairs and also permitting the use of a standard configuration for all pin terminals.

It is another object of the invention to provide a more judicious choice for the placement of the various pin terminals and protector modules onto the connector body whereby the placement is in accordance with a readily ascertainable repeating geometrical pattern in order to facilitate rapid and accurate identification of and distinction between associated ones of the pin terminals, protector modules and electrical test points.

It is still another object to provide a connector body having an improved mounting provision for the electrical protector modules in the form of socket type apertures.

It is a further object of the invention to provide that the incoming and outgoing pin terminals and those pin terminals positioned interiorly to the socket apertures are merely opposite end portions of elongated wire forms which optionally serve as either a pair of incoming to interior pin terminals or a pair of interior to outgoing pin terminals.

Still another object of the invention is to provide a mounting bracket for the connector body that will permit the same to be mounted in a vertical position on the main frame without regard to which end portion of the connector body is in the uppermost position.

An electrical connector body on which to mount pluggable electrical protector modules used with a distributing frame of a telephone central office includes an elongated generally flat rectangular panel. A front surface of the panel is provided with a plurality of socket type apertures in which to mount the protector modules, a first set of pin terminals extending from a central portion thereof, and a second set of pin terminals extending from the two opposite longitudinal edge portions thereof. The apertures are disposed generally intermediately of selected pairs of said first and second sets of pin terminals, respectively, each aperture contains two pairs of interior pin terminals which comprise opposite end portions of elongated wire forms used to provide the first and second sets pin terminals. The first and second sets of pin terminals are connectible to multiple line pairs of incoming subscriber and outgoing central office telephone transmission lines, respectively. The panel includes increased thickness dimensions intermediately of said first and second sets of pin terminals to comprise a pair of raised bosses on said panel having said apertures disposed therein, the increased thickness dimension being at least equal to the length of said interior pin terminals for providing that said interior pin terminals terminate within said apertures. A separate grounding pin terminal is provided within each of the socket type apertures for providing means for grounding said pluggable electrical protector modules. Finally, the selected pairs of pin terminals from the first and second sets of pin terminals and their associated apertures comprise multiple associated first and second sets of pin terminals and apertures, the first multiple set being equally spaced from each other and the second multiple set being equally spaced from each other and being offset from the first multiple set in a non-interfering pattern.

Other objects and advantages of the invention will no doubt occur to those skilled in the art as the invention is described in connection with the accompanying drawing in which:

THE DRAWING

FIG. 1 is a frontal perspective view of an electrical connector assembly of the present invention showing an elongated connector body, mounting bracket, electrical feeder cable and multiple protector modules mounted on the connector body, the assembly being twice discontinued to reduce its elongated dimension;

FIG. 2 is a slightly enlarged frontal perspective view of the connector body of FIG. 1 taken at a different angle and omitting the other parts except for a single removed protector module;

FIG. 3 is a slightly enlarged end plan view of the connector assembly of FIG. 1;

FIG. 4 is a slightly enlarged side plan view of an upper portion of the connector assembly of FIG. 1;

FIG. 5 is a rear exploded perspective view of the upper portion of connector assembly of FIG. 4 and showing two different sizes of U-shaped wire forms used to provide the various pin terminals of the connector body; and

FIG. 6 is a cross-sectional view of an alternative embodiment of the connector body of FIG. 1 omitting other parts and showing a retaining plate.

DETAILED DESCRIPTION

FIG. 1 shows a connector block assembly 10 of the type commonly mounted in vertical arrays upon main distributing frames of telephone central offices and referred to as main frame connectors. The connector assembly 10 includes a connector body 12 in the form of an elongated generally flat rectangular panel, a plurality of electrical protector modules 14 to be mounted on the panel for providing protection for critical switching equipment against undesirable electrical transients and surge conditions, mounting bracket apparatus 16 for attaching the connector panel 12 to the main frame and a feeder cable 18 for routing telephone line pairs to and from the connector panel 12. Cable 18 is provided with a ground lead 19 connected to the mounting bracket 16. The present invention relates more particularly to the connector body 12, and the remaining parts of the assembly 10 will only be very briefly mentioned.

The connector body 12 is normally constructed of some suitable dielectric material and can accommodate up to one hundred protector modules 14. The feeder cable 18 is shown approaching the connector panel 12 from the bottom and rear positions as viewed in FIG. 1 due to the practice of routing the many cables associated with a main frame from the bottom and rear positions with respect to the plurality of connector assemblies. The connector panel 12 has front and rear surfaces 21 and 23 and is shown in FIG. 1 as three separate panel sections 12*a*, 12*b* and 12*c* representative of discontinued segments of a single continuous elongated panel. Now, in accordance with the invention, the connector panel 12 is configured on its front surface 21 to present a central region 24 and two opposite longitudinal edge regions 26 disposed in a common plane and a pair of raised bosses 25 disposed intermediately thereof. The raised bosses 25 can be integrally formed merely by increasing the thickness dimension of the panel 12 during molding of the panel or they can be provided as separate block-like structures to be mounted on the common plane of the front surface 21.

The connector panel 12 is provided with a plurality of pin terminals comprising a first set of pin terminals 30 located in the central region 24, which pin terminals are of the straight solderless type and which extend at once both outwardly from and axially of the central region 24. A further plurality of these same type pin terminals comprising a second set of pin terminals 32 are provided on the front surface 21 generally in the two longitudinal edge regions 26, which terminals 32 extend at once both outwardly from and axially of the two edge regions 26. A selected plurality of socket type apertures 35 opening from the front surface 21 are disposed in the raised bosses 25 in which to mount a corresponding plurality of the protector modules 14 in a plug-in connection, the apertures 35 comprising two separate sets of apertures, a set being disposed in each of the bosses 25; alternatively, the apertures 35 can be considered as a single set having two spaced-apart groupings.

The apertures 35 contain interiorly positioned pin terminals 36 of the solderless type which extend generally from the bottoms of the apertures toward the front openings thereof. The pin terminals 36 are preferably terminated before extending beyond the apertures 35. Some of the pin terminals can be made shorter in length than others so as to provide for the ability to disconnect selected ones of these terminals from electrical contact with the protector modules 14 in order to attain a detent or electrical disconnect position for the protector modules 14 by the common method of partially withdrawing the modules from the receiving apertures. The interior pin terminals 36 are shown in the drawing to be substantially equal for the reason that the type protector module used with the connector body 10 is provided with a detent actuator which does not depend upon deactuating movement of the protector modules with respect to the pin terminals 36 through partial withdrawal from the apertures 35. FIG. 2 shows a typical protector module 14' removed from its receiving aperture 35 in order to demonstrate briefly the manner of its reception and electrical connection within the aperture 35.

The housing of the protector module 14' has a generally rectangular cross-section and the apertures 35 are therefore given a generally rectangular cross-section; however, it is apparent that other shapes could as well be provided. The protector module 14' is provided with the normal exterior electrical terminal arrangement whereby two pairs of such exterior terminals are provided, only one pair being shown at 38. The two pairs of exterior terminals 38 are used to connect a line pair of incoming subscriber lines to a line pair of outgoing central office lines, respectively, through the protection devices within the protector module 14'. The configuration of the exterior terminals 38 are generally spring-like to provide good electrical contact with the fixed configuration of the interior pin terminals 36. Electrical isolation is provided between the exterior terminals 38 by a compartmentalized structure of dividing walls 39 extending from the base portion of the protector module 14'. The apertures 35 are provided with shoulder members or portions 40, respectively, which extend into the inner spacial confines of the apertures, these shoulder portions providing guide means for determining the reception of the protector module 14' within the aperture 35 only when oriented in a selected manner for comprising a keyed insertion of the modules within the apertures. Obviously, such shoulder members could as well be provided on the modules 14 and a cooperating groove (not shown) provided in the wall portions of the bosses 25 which define the apertures 35.

The interior pin terminals 36 are therefore seen to comprise two pairs of pin terminals corresponding to the incoming subscriber line pairs and the outgoing central office line pairs. Further, a ground pin terminal 42 is provided in each of the apertures 36 for providing

a means for grounding either or both of the talk and ring circuits which comprise a line pair of transmission lines. Now considering the particular arrangement of the plurality of apertures 35 and the first and second sets of pin terminals 30 and 32 for the connector body 10, it can be seen that the arrangement is generally symmetrical with respect to the elongated axis of the panel 12. The particular arrangement of the apertures 35 and pin terminals 30 and 32 is chosen to provide a readily ascertainable geometric visual pattern which is repetitive down the vertical face 21 of the panel 12 and which is more easily aesthetically recognized by virtue of the aforementioned symmetry with respect to the central axis of the panel 12. Existing connector bodies such as connector body 12 have employed correlated arrangements of front mounted parts comprising a geometric visual aid but it is believed that the particular geometric arrangement of the present connector body 12 comprises an improved and novel connector body.

The geometrical arrangement of the connector body 12 is most clearly shown in FIG. 2 wherein it can be seen that selected pairs of pin terminals from the first and second sets of pin terminals 30 and 32 are disposed in physical association with selected ones of the apertures 35. Each pair of pin terminals from the first and second sets of pin terminals 30 and 32 which service a talk and ring line pair are spaced-apart axially along the front surface 21 in the central region 24 and the edge regions 26 of the panel 12, respectively. The apertures 35 which are associated with the selected pairs of pin terminals from the first and second sets of pin terminals 30 and 32 are disposed intermediately of the selected pairs generally in transverse alignment with each other across the front surface 21. Predetermined ones of such selected pairs of pin terminals 30 and 32 and selected apertures 35 comprise multiple associated sets of pin terminals 30 and 32 and apertures 35, which multiple associated sets are generally equally spaced from each other down the vertical face 21 of the panel 12 and extend laterally across the face 21 of the panel 12 to comprise a first matrix of equally spaced horizontal rows of associated sets of pin terminals and apertures. Predetermined others of the multiple associated sets are generally equally spaced from each other down the face 21 of the panel 12 and extend laterally across the face 21 to comprise a second matrix of equally spaced horizontal rows of associated sets of pin terminals and apertures. The predetermined others of the multiple associated sets are offset both longitudinally and transversely from the predetermined ones of the multiple associated sets of pin terminals and apertures, i.e., the first matrix, in an interspersed non-interfering pattern.

FIG. 2 shows a number sequence applied to the selected pairs of pin terminals 30 and 32 so that the axially extended pair of pin terminals from the first set of pin terminals 30 which are marked as 1 are quickly identified with the axially extended pair of pin terminals from the second set 32 which are also marked as 1. The associated aperture is disposed therebetween in alignment with the pin terminal pairs 1—1. Pin terminal pairs 5—5 are then seen to be equally spaced axially from terminal pairs 1—1, 9—9 and 13—13 and so on. Likewise, on the right-hand side of the connector body 12 as viewed in FIG. 2, the pin terminal pairs 3—3, 7—7, 11—11 and 15—15 with their respective aligned apertures 35 are shown to be repetitive of the aforementioned pin terminal pairs and aligned apertures. These, therefore, comprise the predetermined ones of the multiple associated sets of pin terminals 30 and 32 and apertures 35. Briefly, the even numbered pin terminal pairs with their respective aligned apertures 35 comprise the predetermined others of the multiple associated sets of pin terminals 30 and 32 and apertures 35. This staggered interspersed offsetting arrangement of selected pairs of pin terminals 30 and 32 and selected apertures 35 from the first and second matrices provide ample peripheral area surrounding each of the pin terminals of the first and second terminal sets 30 and 32 within which to effect a wire wrapped connection to a given wire lead and also surrounding each aperture 35 for facilitating the insertion and removal of a pluggable protector module 14. While the numbering sequence shown in the drawing serves as an illustrative aid in describing the geometric visual pattern, it may or may not be provided on the actual connector body 12. If wished to be provided, overlay stencils 46 for the central region 24 and 48 for the edge regions 26 could be provided with the number sequence imprinted thereon as desired, see FIG. 5.

The first set of pin terminals 30 in the central region 24 of the panel 12 are selected to be connected to the multiple wire leads of the incoming subscriber line pairs while the outgoing central office line pairs are to be connected to the second set of pin terminals 32. As shown in FIGS. 3–5, these wire leads are preferably attached by means of wire wrapped solderless type connections which facilitate the use of automatic wire wrapping machines. The axial length of the pin terminals 30 and 32 are of sufficient length to permit the base portion thereof near the front surface 21 of the connector body 12 to receive the wire wrapped connection while the outer end portions of the pin terminals 30 and 32 remain free for attaching test leads and jumper wires used in testing and/or servicing the connector assemblies 10. Accordingly, the first and second sets of pin terminals 30 and 32 also comprise first and second electrical test fields wherein each pin terminal thereof provides a potential electrical test point. In the central region 24 of the panel 12, the stencil 46 is further used as a divider between the test field and the wire wrapped lead connections to isolate the test field at generally the outer ends of the pin terminals 30. Obviously, similar stencils could be used in lieu of or in addition to the stencils 48 with the second set of pin terminals 32.

As best shown in FIG. 5, the connector body 12 is provided with a plurality of central slots 51 spaced longitudinally along the central region 24 and extending through the panel thickness for receiving an inserted plurality of incoming line pairs of wire leads 52 to be connected to the pin terminals 30. The slots 51 provide a convenient means of routing or distributing the incoming wire leads from the feeder cable 18 in the rear of the panel 12 to the front surface 21 of the panel 12. Additionally, each edge region 26 of the panel is provided with a fanning strip having multiple apertures 53 through which outgoing wire leads 54 are routed from the front-mounted pin terminals 32 to the rear of the panel 12. Also shown in FIG. 5, the ground pin terminals 42 extend rearwardly of the connector body 12 from the apertures 35, respectively, to present two spaced-apart zigzag patterns of extending terminal end portions which are conveniently interconnected with common ground wire leads 56, respectively.

According to the present invention, a plurality of elongated wire forms 60 are provided in generally a U-shaped configuration so that the opposite end portions thereof which define the leg sections of the U-shaped wire forms 60 are utilized to comprise the first and second sets of pin terminals 30 and 32 as well as the interior pin terminals 36 within the apertures 35. By virtue of the elongated wire forms 60 the selected pairs of pin terminals of the first and second sets of pin terminals 30 and 32 are extended into their selected apertures 35 to provide the interior pin terminals 36, and thus obviate the need to provide multiple wire leads to interconnect the pin terminals 30 and 32 with the pin terminals 36. It can now be appreciated that the extreme dense packing of multiple interconnecting rear-mounted wire leads of existing connector assemblies has been replaced through the use of the elongated wire forms 60, leaving only the incoming and outgoing wire leads 52 and 54 extending to the connector body 12.

The previously described geometric placement pattern of the multiple pin terminals and apertures with respect to each other on the connector body 12 further facilitates the use of only two sizes of elongated wire forms 60. Two sizes of wire forms are as shown in FIG. 5 at 60*a* and 60*b* wherein the wire forms 60*a* and 60*b* have the same size leg sections but the wire form 60*a* includes a greater length in the bight section of the U-configuration. As shown in the drawing, there are two multiple associated sets of pin terminals 30 and 32 and apertures 35 in each horizontal row of both the first and second matrices of such multiple associated sets, namely, in the first matrix, there are the two associated sets of pin terminal pairs 1—1 and 3—3 in the first row and terminal pairs 5—5 and 7—7 in the second horizontal row; in the second matrix, there are the two associated sets of pin terminal pairs 2—2 and 4—4, and terminal pairs 6—6 and 8—8 in the top two rows. In each row of the first and second matrices, the aperture of one of the two associated sets is alternately positioned more nearly adjacent the selected pair of pin terminals of the second and first sets of pin terminals 32 and 30, respectively. The aperture of the other associated set in each row of the first and second matrices is alternately positioned more nearly adjacent the selected pair of pin terminals of the first and second sets of pin terminals 30 and 32, respectively. The resulting geometric pattern permits the selected pairs of pin terminals which are utilized with the one associated set in each horizontal row of the first and second matrices to be comprised of alternately the longer and shorter wire forms 60*a* and 60*b* for the selected pairs of terminals 30 and 32, respectively. Also, the selected pairs of pin terminals of the first and second sets of pin terminals 30 and 32 which are used with the other of the two associated sets in each horizontal row of the first and second matrices are comprised alternately of the shorter and longer lengths wire forms 60*b* and 60*a*, respectively.

In a preferred practice for mounting the wire forms 60*a* and 60*b* upon the panel 12, the panel 12 is provided with a plurality of wire form openings 63 and 65, FIG. 6, of correspondingly longer and shorter dimensions for receiving the wire forms 60*a* and 60*b*, respectively, from the rear of the panel 12. It is apparent that the wire form openings 63 and 65 receive the opposite leg sections of the wire forms 60*a* and 60*b* to permit the extension of the wire forms from the first and second sets of pin terminals 30 and 32 to the interior pin terminals 36 within the apertures 35. The wire form openings 63 and 65 optionally can be slightly recessed within the rear surface 23 of the panel 12 in order to receive the bight sections of the inserted wire forms 60*a* and 60*b*, respectively. In order to protect against inadvertent grounding of the ground wire lead 56 to the exposed bight sections of the wire forms 60*a* and 60*b*, an insulating strip 67 can be provided therebetween, FIG. 5. Alternatively, the wire forms 60*a* and 60*b* can be held within the openings 63 and 65 by means of a force fitted reception of the wire forms into the openings, or the wire forms can be accommodated loosely within the openings and be retained therein by the retaining plate 68, FIG. 6, which plate is attachable to the rear surface 23 of the panel 12. When the retaining plate 68 is utilized, the insulating strips 67 are not required.

FIG. 7 shows a cross-section of another alternative embodiment of the connector body 12 similar to FIG. 6 in respect to the use of the retaining plate 68 and the loosely fitted wire forms 60*a* and 60*b*. However, the connector body 12 has been modified to include only a single raised boss 25 disposed intermediately of first and second sets of pin terminals 30 and 32. The first and second sets of pin terminals 30 and 32 serve the incoming subscriber line pairs and the outgoing central office line pairs, respectively, but are now disposed axially along the opposite longitudinal edge regions of the modified panel 12. The U-shaped wire forms 60*a* and 60*b* are again used to provide the first and second sets of pin terminals 30 and 32 as well as the interior pin terminals 36. The geometrical pattern of the selected pairs of pin terminals 30 and 32 and their selected apertures 35 is identical with that shown on one-half of the panel 12 of FIG. 2. It is apparent therefore that two such modified panels could be arranged in longitudinal adjacent positions to comprise the preferred embodiment of panel 12 of FIGS. 1 and 2.

The mounting bracket apparatus 16 for attaching the connector assembly to the main frame comprises two angular side brackets 71 and 73 of mirror-image reverse configuration extending longitudinally of the edge regions 26 of the panel 12 and a pair of identical cross-tie brackets positioned near the longitudinal extreme end portions of the panel 12, an upper cross-tie bracket shown in the drawing at 75. Briefly, the configuration of the side brackets 71 and 73 is self-explanatory from the drawing and many different configurations equally suitable can be substituted for the side brackets 71 and 73. The side brackets 71 and 73 are attachable to the panel 12 and the cross-tie brackets to the side brackets by means of standard fastening devies such as with the screws 76 and bolts 78, respectively, shown in FIG. 3. The configuration of the cross-tie brackets, such as bracket 75, is especially provided, however, so that the panel 12 can be mounted on the main frame without regard to which end of the panel is in the uppermost vertical position, and thereafter the cable 18 can be attached as by the use of the cable bracket 79 of FIG. 1.

The cross-tie brackets include a generally transversely oriented member 81 and a longitudinally oriented member 83 in which two spaced jaw-like protrusions 85 and 87 define an open cavity 86. The shape of the protrusions 85 and 87 and the open cavity 86 permit the connector body 12 to be conveniently attached to horizontally extending structures of the main frame

as by hooking the jaw protrusions thereon, or to be conveniently attached to vertically extending structures of the main frame as by receiving fastening devices through the cavity **86.**

It is to be understood that while the present invention has been shown and described with reference to the preferred embodiments thereof, the invention is not limited to the precise forms set forth, and that various modifications and changes may be made therein without departing from the spirit and scope of the present invention.

What is claimed is:

1. An electrical connector body on which to mount pluggable electrical protector modules used with a main distributing frame of a telephone central office comprising: an elongated flat rectangular panel having front and rear surfaces, a plurality of socket type apertures opening from the front surface of said panel, a plurality of elongated wire forms positioned on said panel with at least two pairs of said wire forms used in connection with each socket type aperture, the opposite end portions of each wire form of the respective pairs of wire forms being positioned with respect to its associated aperture to provide a first end portion extending outwardly from said front surface and a second end portion positioned interiorly of said associated aperture, and said two pairs of wire forms for each socket type aperture being provided to complete an electrical conductive current path between at least a pair of incoming subscriber line pairs and a pair of outgoing central office line pairs when said electrical protector module is inserted into said socket type aperture.

2. An electrical connector body as claimed in claim **1** wherein one pair of each of said two pairs of wire forms which are used in connection with each socket type aperture has the first end portions thereof positioned axially along a central region of said panel while the other pair of said two pairs of wire forms has the first end portions thereof positioned axially along a selected one of the opposite edge regions of said panel, each of said apertures is disposed intermediately of the first end portions of said two pairs of said wire forms, and the plurality of first end portions of said wire forms which are positioned in the central region of said panel comprise a first set of pin terminals and the plurality of first end portions of said wire forms which are positioned in the opposite edge regions of said panel comprise a second set of pin terminals.

3. An electrical connector body as claimed in claim **2** wherein said first and second sets of pin terminals are connectible to multiple line pairs of incoming subscriber and outgoing central office telephone transmission lines, respectively, and said first and second sets of pin terminals comprise electrical test points for first and second test fields, respectively, whereby electrical test connections to both incoming and outgoing line pairs are provided.

4. An electrical connector body as claimed in claim **2** wherein said elongated wire forms having said first and second end portions are generally U-shaped configured wire forms with the leg sections thereof comprising said first and second end portions, and said panel includes increased thickness dimensions intermediately of said first and second sets of pin terminals to comprise a pair of raised bosses on said panel with said apertures disposed in said bosses, the increased thickness dimension of said panel being at least equal to the extension of said leg sections of said wire forms for providing that said second end portions terminate within said apertures.

5. An electrical connector body on which to mount pluggable electrical protector modules used with main distributing frames of telephone central offices, comprising: an elongated substantially flat rectangular panel having front and rear surfaces, a first set of electrical pin terminals extending outwardly from the front surface of said panel in substantially a central region of the width of said panel, said first set of pin terminals extending axially along the elongated dimension of said panel, a second set of electrical pin terminals extending outwardly from the front surface of said panel in substantially the edge regions of said panel, said second set of pin terminals extending axially along the elongated dimension of said panel, and two separate sets of socket type apertures opening from the front surface of said panel, said apertures having interior pin terminals and being disposed intermediately of said centrally positioned first set of pin terminals and each edge regionally positioned second set of pin terminals, respectively, said two sets of apertures extending axially along the elongated dimension of said panel substantially the same distance as said first and second sets of pin terminals.

6. An electrical connector body as claimed in claim **5** wherein at least selected pairs of pin terminals of said first set and selected pairs of pin terminals of said second set are extended into selected ones of said socket type apertures which are disposed intermediately of said pairs of first and second set pin terminals to provide said interior pin terminals in the form of two pairs of said interior pin terminals within each of said apertures.

7. An electrical connector body as claimed in claim **6** wherein said socket type apertures are provided with separate ground pin terminals, respectively, for providing means for grounding said pluggable electrical protector modules.

8. An electrical connector body as claimed in claim **6** wherein said selected pairs of pin terminals from said first and second sets of pin terminals and said selected ones of said apertures are disposed generally in transverse alignment with each other across said panel to provide multiple associated sets of pin terminals and apertures, predetermined ones of said multiple associated sets of pin terminals and apertures being equally spaced from each other longitudinally of said panel and predetermined others of said multiple associated sets of pin terminals and apertures being equally spaced from each other longitudinally of said panel and further being offset longitudinally and transversely of said panel with respect to said predeterminaed ones of said multiple associated sets of pin terminals and apertures for facilitating the aesthetic association of said multiple sets with particular pluggable protector modules and further facilitating the insertion and removal of said protector modules from said connecotor body.

9. An electrical connector body as claimed in claim **8** wherein said extended pin terminals of said first and second sets of pin terminals comprise elongated generally U-shaped wire forms having one of a longer and a shorter length in the bight sections thereof, said predetermined ones and said predetermined others of said multiple associated sets of pin terminals and apertures comprise first and second interspersed matrices of

equally spaced horizontal rows of said associated sets having at least two associated sets of pin terminals and transversely aligned apertures in each row thereof, the aperture of one associated set of pin terminals and apertures in each horizontal row of said first and second matrices being alternately positioned more nearly adjacent the selected pair of pin terminals of said second and first sets of pin terminals, respectively, and the aperture of the other associated set in each horizontal row of said first and second matrices being positioned more nearly adjacent the selected pair of pin terminals of said first and second sets of pin terminals, respectively, said selected pairs of pin terminals of said first and second sets of pin terminals which are used with said one associated set in each horizontal row of said first and second matrices are comprised alternately of longer and shorter wire forms and then shorter and longer wire forms, respectively, and said selected pairs of pin terminals of said first and second sets of pin terminals which are used with said other associated set in each horizontal row of said first and second matrices are comprised alternately of shorter and longer and then longer and shorter wire forms, respectively.

10. A method for assembling the connector body of claim **9** wherein said longer and shorter elongated wire forms are positioned on said panel from the rear surface of said panel and the wiring leads for the incoming and outgoing line pairs are connected to said first and second sets of pin terminals, respectively, from the front surface of said panel.

11. An electrical connector body as claimed in claim **6** wherein said selected pairs of pin terminals from said first and second sets of pin terminals are connectible to multiple line pairs of incoming subscriber and outgoing central office telephone transmission lines, respectively, and said selected pairs from said first and second sets of pin terminals comprise electrical test points for first and second test fields, respectively, whereby electrical test connections to both incoming and out-going line pairs are provided.

12. An electrical connector body as claimed in claim **6** wherein each of said apertures includes one of a shoulder member and a groove for cooperating with the other of a shoulder member and a groove provided on said pluggable protector modules to to permit the keyed insertion of said protector modules into said apertures.

13. An electrical connector body on which to mount pluggable modules comprising: an elongated substantially flat rectangular panel having front and rear surfaces, first and second sets of pin terminals spaced apart on said panel and extending at once both outwardly from and axially along the front surface of said panel, respectively, a set of apertures opening from the front surface of said panel, each aperture being disposed intermediately of a selected pair of said first set of pin terminals and a selected pair of said second set of pin terminals which are generally oppositely disposed from said selected pair of said first set of pin terminals for providing an associated set of pin terminals and apertures, at least two pairs of interior pin terminals within each of said apertures for engaging with said pluggable modules, predetermined ones of said associated sets of pin terminals and apertures equally spaced from each other axially along said panel and predetermined others of said associated sets of pin terminals and apertures equally spaced from each other axially along said panel, said predetermined others being offset at once both longitudinally and transversely of said panel with respect to said predetermined ones of said associated sets of pin terminals and apertures for facilitating the aesthetic association of said associated sets with particular pluggable modules and further facilitating the insertion and removal of said modules from said connector body.

14. An electrical connector body as claimed in claim **13** wherein said first and second sets of said pin terminals of said predetermined ones and said predetermined others of said associated sets of pin terminals are extended into said intermediately disposed apertures, respectively, to provide said two pairs of interior pin terminals in each of said apertures.

15. An electrical connector body as claimed in claim **14** wherein said extended pin terminals of said first and second sets of pin terminals comprise elongated generally U-shaped wire forms having one of a longer and a shorter length in the bight sections thereof, the apertures of said predetermined ones of said associated sets being selectively more closely spaced to one of said first and second sets of pin terminals and the apertures of said predetermined others of said associated sets being selectively more closely spaced to the other of said first and second sets of pin terminals, said selected pairs of pin terminals of said first and second sets of pin terminals which are used with said predetermined ones of said associated sets are comprised of said longer and shorter wire forms, respectively, and said selected pairs of pin terminals of said first and second sets of pin terminals which are used with said predetermined others of said associated sets are comprised of said shorter and longer wire forms, respectively.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,760,328 Dated 9-18-73

Inventor(s) THOMAS GEORGOPULUS

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 11, line 38, after "pair" add -of each-

Column 12, line 54, "predeterminaed" should be -predetermined-

Column 13, line 3, "transversely" should be -traversely-

Column 13, line 45, after "modules" delete "to"

Signed and sealed this 25th day of December 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

FORM PO-1050 (10-69)

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