

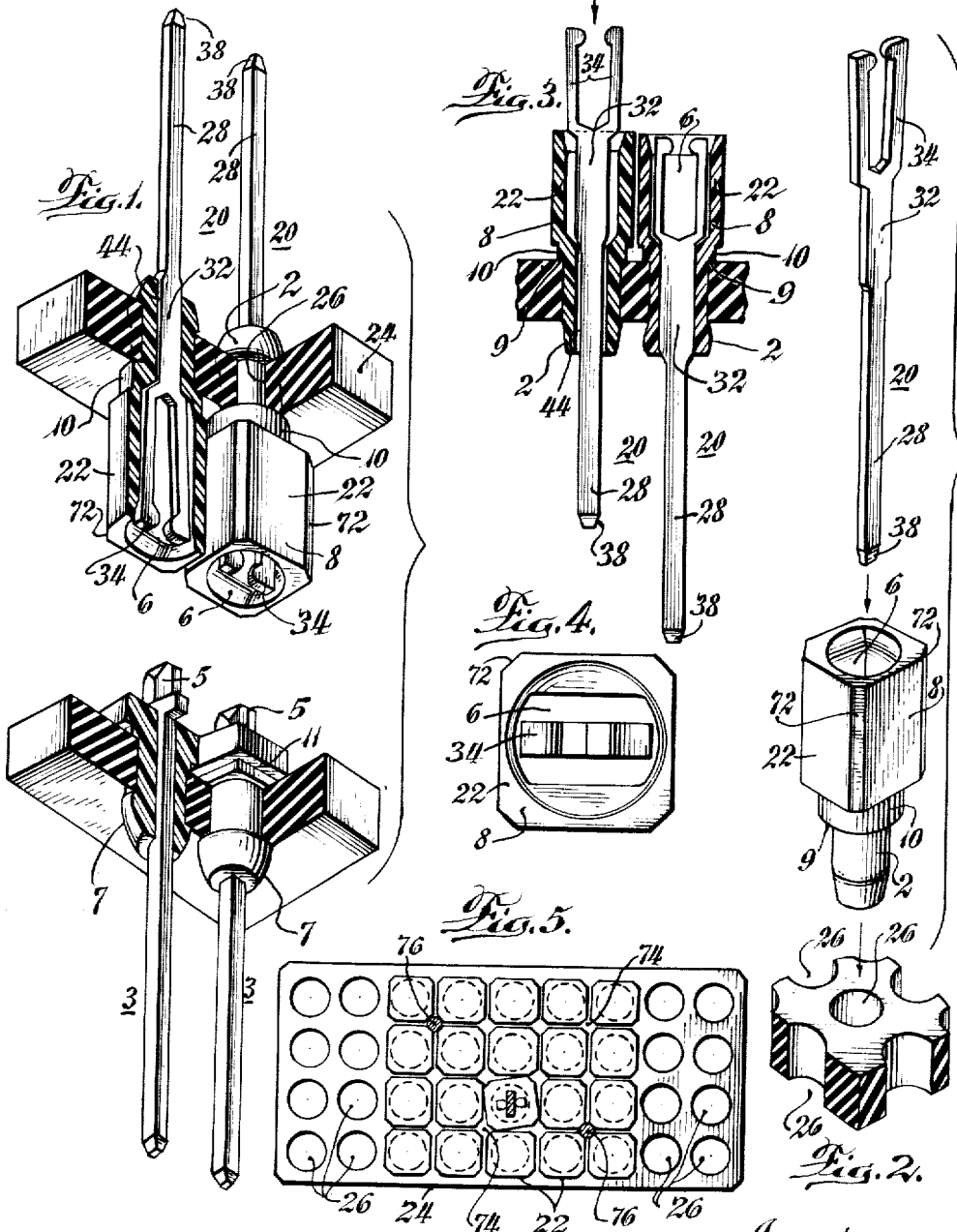
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SELF-ORIENTATING TERMINAL CONNECTORS

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SELF-ORIENTATING TERMINAL CONNECTORS
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This invention relates in general to electrical terminal connectors for insertion in terminal base boards utilized in the electrical and electronics industry.

More particularly, the invention relates to improved self-locking terminal connectors adaptable for high speed insertion in terminal base boards and the like by automatic machines.

It is an object of the present invention to provide an improved terminal connector which can be used in terminal base boards and the like.

Another object of the invention is to provide an improved self-locking terminal connector which is particularly adapted for insertion by high speed automatic machinery.

A further object of the invention is to provide a terminal connector that is readily and inexpensively manufactured.

A further object of the invention is to provide a terminal connector that is adapted to be mounted on a terminal base board or the like such that the connector is unable to be twisted when an electrical connection is made to the connector.

It is a further object of the invention to provide a new electrical arrangement comprising electrical connectors and a terminal base board.

It is another object of the invention to provide an improved self-locking terminal connector and terminal base board arrangement wherein the configuration of the terminal connector and the terminal base board cooperate so as to properly align the terminal connector in the terminal base board.

It is another object of the invention to provide an improved terminal connector, terminal base board arrangement adapted to be readily mated with a complementary terminal connector, terminal base board arrangement.

The above and other objects are realized in accordance with the present invention by providing a new and improved terminal connector adapted to be mounted in a terminal base board or the like. The connector comprises a terminal pin to which electrical leads may be attached and a cooperating sleeve in which the terminal pin is inserted. A predetermined plurality of terminal connectors are assembled in a terminal base board and the configuration of the sleeves of the terminal connectors and the spacing of the terminal connectors in the base board cooperate to provide a self-aligning feature for the terminal connectors, and also cooperate to prevent rotation of the sleeve in the terminal base board. In another aspect of the present invention, there is provided in the base board means which coact with the sleeves to facilitate alignment of mating terminal connector, base board arrangements.

The invention, both as to its organization and method of operation, taken with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawings in which:

FIGURE 1 is a partially cut-away perspective view illustrating a plurality of mating terminal connectors embodying the features of the present invention assembled in their respective terminal base boards;

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FIGURE 2 is an exploded view of a female terminal connector illustrated in FIGURE 1;

FIGURE 3 illustrates sequential steps in the assembly of the female terminal connector illustrated in FIGURE 1 on a terminal base board;

FIGURE 4 is a plan view of a terminal connector containing the invention;

FIGURE 5 is a plan view of a terminal connector, terminal base board arrangement embodying the features of the invention.

Referring now to the drawings, there is illustrated therein a female and male terminal connector embodying the features of the present invention. Considering first the female connector, it comprises a female terminal pin which is generally designated by the reference numeral 20. The female terminal pin 20 is intended for insertion in a pin receiving member comprising a sleeve or bushing 22. The terminal pin 20 and the sleeve 22 are permanently set in a terminal base board 24 in any one of a plurality of apertures 26 provided therein, preferably of uniform size.

The female terminal pin 20 comprises starting from one end a wire wrap shank 28, a gripping shank 32, and a female type connector head 34. The female terminal pin 20 may be formed by stamping or the like from any relatively hard metallic substance having good electrical conducting characteristics, for example, half-hard brass so that the sections of the pin are of uniform thicknesses.

The wire wrap shank 28 has a rectangular or square cross-section with relatively sharp corners about which wiring leads (not shown) are tightly wrapped to form a permanent electrical connection between the leads and the terminal pin 20. One end of the wire wrap shank 28 may be beveled as shown at 38 to facilitate handling of the pins by automatic machinery (not shown).

A gripping shank 32 is formed immediately adjacent the wire wrap shank 28 and is intended to be gripped within the sleeve 22 after final assembly.

The female type connector head 34 having a pair of integral tines is formed above the gripping shank 32 as clearly viewed in FIGURE 2 and is of substantially greater width than the gripping shank 32.

The sleeves or bushings 22 illustrated in the drawings are comprised of a securing portion 2 of a circular cross section, an intermediate expansion accommodating portion 10 of a circular cross sectional area larger than the cross sectional area of the securing portion 2, and an aligning head portion 8 illustrated as, but not limited to, a rectangular or square cross section. A shoulder 9 is formed between the securing portion 2 and the intermediate portion 10. The securing portion 2, the intermediate expansion accommodating portion 10, and the aligning head portion 8 of the sleeve 22 are provided with an axial aperture or bore. The sleeve 22 is formed of a material somewhat softer than the terminal pin 20 as, for example, copper or nylon. The securing portion 2 and the intermediate expansion accommodating portion 10 of sleeve 22 have formed therein a circular axial aperture 44 to coact with the gripping shank 32 of the associated terminal pin 20. The maximum transverse dimension of the aperture 44 is smaller than the width of the gripping shank 32 of the terminal pin 20. It must be small enough so that a substantial interference fit is provided causing the securing portion 2 of sleeve 22 to expand considerably when the gripping shank 32 is driven into the securing portion 2 of sleeve 22.

In order to permit the ready insertion of the securing portion 2 of the sleeve 22 in the aperture 26, the outside dimensions of the securing portion 2 of sleeve 22 are arranged to be slightly less than the corresponding dimensions of the circular aperture 26. However, the fit is close enough so that the securing portion 2 of the sleeve por-

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tion 22 will become wedged in the aperture 26 when the securing portion 2 is expanded slightly. The outside dimensions of the intermediate expansion accommodating portion 10 are larger than the corresponding dimensions of the aperture 26 and limit the depth of insertion of the sleeve 22 into the aperture 26 as will be more fully explained hereinafter. The aligning head portion 8 of the sleeve 22 has formed therein an axial aperture 6 which is substantially rectangular in configuration throughout except at the upper portion of the aperture 6 where the rectangular configuration transcends into a circular opening as clearly illustrated in the drawings. The maximum transverse direction of the aperture 6 in the aligning head portion 8 is slightly greater than the maximum width of the female connector head 34.

The assembly sequence is illustrated in FIGURES 2 and 3. In operation the sleeve 22 is inserted into the terminal base board 24 by placing the securing portion 2 of the sleeve 22 into a corresponding aperture 26. As has been previously stated, the dimensions of the aperture 26 are slightly larger than the corresponding outside dimension of the securing portion 2 of sleeve 22. Therefore, the securing portion 2 of the sleeve portion 22 fits readily into the terminal board 24. Inasmuch as the outside dimensions of the intermediate expansion accommodating portion 10 of sleeve 22 are larger than the corresponding dimensions of aperture 26, the sleeve 22 is inserted into the aperture 26 until the shoulder 9 of the portion 10 rests upon the upper surface of the terminal board 24 as viewed in FIGURE 3.

The terminal pin 20 is then inserted into the sleeve 22. Specifically, the wire wrap shank 28 is inserted into the aperture 6 down through the axial passage 44 until the shoulder portion 32 of the terminal pin 20 lies adjacent the upper portion of the axial passage 44 of sleeve 22 as seen in FIGURE 3. The maximum transverse dimension of the gripping shank portion 32 of the terminal pin 20 is larger than the corresponding dimension of the axial passage 44 and, therefore, the gripping shank portion 32 will not enter the axial passage 44 without the application of force.

Next, an inserting tool (not shown) is positioned between the tines of the female head portion 34 of the terminal pin 20. The terminal base board 24 and the sleeve 22 are held in place and against relative movement while the inserting tool is driven downwardly against the terminal pin 20 causing the gripping shank portion 32 to enter the axial passage 44 until the head 34 is in the proper position, as seen in FIGURE 3. Inasmuch as there is a substantial interference fit or force fit between the gripping shank 32 of the terminal pin 20 and the axial passage 44, both the expansion accommodating portion 10 and the securing portion 2 of sleeve 22 are spread a considerable amount so that securing portion 2 forcibly grips the surrounding edge portions of the terminal base board 24 and flares outwardly above and below the board 24. After this last operation has been performed, the female pin 20 and the sleeve 22 combination form a complete terminal connector. The sleeve is permanently secured in the terminal base board 24 and an excellent contact is provided between the pin 20 and the sleeve 22 and between the sleeve 22 and the terminal base board 24 because of the substantial pressure caused by the insertion of the gripping shank 32 and the consequent expansion of the securing portion 2 of the sleeve 22.

The male terminal pin, seen generally at 3, is quite similar to the female terminal pin 20 with the exception of the female connector head 34 being replaced by a substantially rectangular male head or prong 5. The male terminal pin sleeve 7 is similar to sleeve 22 with the exception that the male prong 5 is exposed and not surrounded by the sleeve 22 as is the female head portion 34 and the aligning head portion 11, corresponding to the aligning head portion 8 of sleeve 22, is of a substantially

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lesser height than the corresponding aligning head portion 8 of the sleeve 22 as seen in FIGURE 1.

The assembly sleeve sequence of the male terminal connector is substantially identical to the assembly sequence of the female terminal connector with the exception that the inserting tool (not shown) butts against the top portion of the male prong 5. When the male or female terminal connectors are mounted on their corresponding terminal base boards and pressed into engagement, the male prong 5 moves between the tines of the female head 34 and the male prong 5 is of such a dimension that the tines of the female connector head 34 are spread slightly and exert a force on the male prong 5 resulting in a tight fit. It will be understood that the operation to be performed in seating and securing the male and female pins in the sleeves in the terminal base boards can be readily performed by automatic machines.

As will be explained hereinafter and specifically with reference to FIGURE 5, apertures are provided in a terminal board to receive terminal connectors and the physical proportions of the terminal connectors and the spacing of the apertures in the terminal board combine to align and guide adjacent terminal connectors as they are inserted into the terminal board. Also the spacing of the apertures and the physical proportions of the terminal connectors combine to prevent the twisting of the terminal connectors in the terminal board when an electrical connection is made to the terminal connector. Also means are provided in the terminal board to facilitate the alignment of mating terminal connector, terminal base board arrangements.

Specifically, FIGURE 5 illustrates a terminal board 24 having a plurality of mounting holes or mounting apertures 26 regularly spaced in a predetermined orientation in the terminal base board 24. The apertures 26 are in the illustrative embodiment of the invention circular in cross-section. A plurality of terminal connectors including the terminal pin 20 and the sleeve 22 are diagrammatically illustrated in FIGURE 5 and assembled in the terminal base board 24. The spacing of the apertures 26 in the terminal board 24 and the outside perimeter of the square or rectangular aligning head portions 8 of the sleeves 22 are so arranged that the walls of the rectangular or square aligning head portions 8 of the terminal sleeves 22 are almost contiguous with one another. In other words, the aligning head portions of adjacent terminal connectors are substantially complementary.

All four corners of the rectangular or square aligning head portions 8 of the terminal sleeves 22 are beveled as at 72. The beveling of each rectangular portion 8 of each terminal sleeve 22 provides a space 74 between adjacent terminal sleeves 22 through which a terminal base board aligning pin 76 can be extended. The aligning pins 76 are anchored to one of the terminal base boards 24 of a mating terminal connector, terminal base board arrangement and apertures are provided in the terminal base board of the other mating terminal connector, terminal base board arrangement so as to provide an aligning feature to facilitate the mating of complementary terminal connector, terminal base board arrangements.

Another important feature of the present invention lies in the formation of the rectangular aligning head portions 8 and the close spacing of the terminal connectors in the terminal board 24. The very tight spacing of the terminal sleeves in the terminal base board aids in aligning the terminal sleeves and consequently the terminal connectors in the terminal base board.

The height, as viewed in the drawings, of the aligning head portions 8 of the terminal sleeves 22 is arranged to be greater than the combined height, as viewed in the drawings, of the securing portions 2 and the intermediate expansion accommodating portions 10 of the terminal sleeves 22. Thus, as each additional terminal

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sleeve 22 is inserted the aligning head portions of terminal sleeves 22 already inserted in the terminal board and adjacent to the terminal sleeve being inserted guide and align the securing portion 2 of the terminal sleeve being inserted into the aperture provided therefor in the terminal board before the securing portion 2 thereof actually enters the aperture provided therefor in the terminal board. This feature aids greatly in the insertion and subsequent securing of terminal connectors to the terminal base boards.

Another aligning feature of the invention is provided by the tight spacing of the terminal sleeves in the terminal base board and the formation of the aligning head portions 8 of the terminal sleeves 22. As can be seen in FIGURE 5, the terminal sleeves 22 can only be rotated a small distance before the terminal sleeve 22 intersects the face of an adjacent terminal sleeve 22 and therefore the terminal sleeve 22 can only possibly vary from a predetermined orientation by a comparatively small amount, comprising the tolerance of angular orientation.

The intermediate expansion accommodating portion 10 performs the function of allowing the portion of the sleeve above the base board 24 to expand without causing interference between adjacent terminal sleeves 22 and specifically between adjacent aligning head portions 8. Inasmuch as the intermediate expansion accommodating portion 10 is smaller than the aligning head portion 8, expansion of the intermediate expansion accommodating portion 10 may occur without effecting the aligning head portion 8. If the intermediate expansion accommodating portion 10 was not provided, then there would be a danger that adjacent terminal connectors including terminal sleeves 22 would interfere with one another, thus, preventing close tolerance placement of the terminal connectors in the terminal board 24.

The accuracy of the positioning of each terminal connector in a board 24 is intended, of course, to be solely a function of the accuracy of positioning of its receiving aperture. In other words, each connector is individually precision mounted in the terminal board. As first demonstrated in U.S. Patent No. 2,995,617, entitled "Self Locking Terminal," issued August 8, 1961, and assigned to the same assignees as the present invention, it is an important feature of self locking terminal connectors to permit very close tolerance placement of the terminals without tolerance build-up therebetween.

The fact that the accommodating portion 10 is smaller than the head portion 8 and consequently defines an undercut at their juncture is additionally significant. The terminal sleeves 22 are normally molded in a chain having severable strips connecting them together between the adjoining accommodating portions 10. This permits the strips to be severed from the sleeves during the insertion operation without any remnant thereof protruding beyond the sides of head portion 8. It is a significant consideration since any such protrusion might put pressure on an adjoining terminal and throw both terminals out of precision alignment. Such an interference can result in tolerance build-ups in a series of terminal connectors mounted in the terminal board 24.

It should be apparent that the securing portion 2 and the intermediate expansion accommodating portion 10 of the terminal sleeve need not be circular in cross-section and could be of another configuration, and also that the aligning head portion 10 may be of any polygonal configuration. However, the configurations shown are preferred.

Another important feature of the present invention is provided by the formation of the rectangular aligning head 8 and the close spacing of the terminal connectors in the terminal board 24. It has been found in practice that when a lead wire is wrapped very tightly around the wire wrapped shanks 28, a strong rotational force is exerted on the terminal pin tending to rotate the terminal pin in

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the sleeve and the terminal pin and sleeve in the terminal base board itself. Many terminal connectors have not been able to resist this rotational force and disastrous results have occurred such as the terminal connector being removed from the board or reorientated. The improper orientation of the terminal connectors in the terminal boards will cause great difficulty in the proper mating of complementary male and female terminal connectors. Also, any lost terminals may disturb the entire system.

The configuration of the sleeve 22 and the close spacing of the terminal connectors in the terminal base board 24 are such as to resist any rotational force. As can be seen in FIGURE 5, any tendency to rotate the sleeves 22 results in the interference of adjacent terminal connectors and specifically the terminal sleeves 22. The terminal connectors including the terminal sleeves 22 can rotate only a very small distance before interference with the next terminal sleeve 22 is encountered. Thus, the rectangular shaped configuration of the aligning head portions 8 of the sleeves 22 and the spacing of the terminal connectors in the terminal board effectively resist any type of rotational force which is applied thereto as when a lead wire is tightly wrapped around a wire wrap shank 28.

According to the present invention, it is possible to use the same terminal pin interchangeably with metallic electrical conducting sleeves or with plastic non-conducting sleeves. In this manner, any conceivable pattern of insulated and non-insulated terminal connectors can be provided and the pattern can be changed at will merely by substituting insulated sleeves for metallic sleeves and vice versa. It is readily apparent that it is highly desirable to utilize boards with uniform size holes particularly from an automation standpoint.

It will be understood, of course, that terminal sleeve combinations of this embodiment may be readily utilized with an insulating board such as a printed circuit board having patterns of conducting material formed on an insulating base.

While the form described herein at present is considered to be preferred, it is understood that various modifications and improvements may be made therein and it is intended to cover in the appended claims all such modifications and improvements as fall within the true spirit and scope of the invention.

What is desired to be claimed and secured by Letters Patent of the United States is:

1. A terminal connector assembly comprising a base board having a plurality of apertures formed therethrough in a precisely and evenly spaced pattern, terminal connectors secured in said apertures in a predetermined tolerance of angular orientation, each of said terminal connectors including a head portion having a polygonal cross sectional shape with dimensions such that head portions of adjacent terminal connectors are substantially complementary, the spacing between the head portions of adjacent terminal connectors being sufficient to prevent engagement between perfectly angularly orientated terminal connectors but not greater than that required to maintain said predetermined tolerance of angular orientation of the terminal connectors.

2. A terminal connector assembly comprising a base board having a plurality of apertures formed therethrough in a precisely and evenly spaced pattern, terminal connectors secured in said apertures in a predetermined angular orientation, each of said terminal connectors having an aligning head portion with a polygonal cross sectional shape and with predetermined physical proportions, said head portions being substantially complementary with the head portions of adjacent terminal connectors to maintain said predetermined angular orientation, the head portions of adjacent terminal connectors being spaced an amount determined solely by the accuracy of spacing of said apertures.

3. A terminal connector assembly comprising a base

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board having a plurality of apertures formed therethrough in a precisely and evenly spaced pattern, terminal connectors secured in said apertures in predetermined angular orientation, each of said terminal connectors including a head portion having a polygonal cross sectional shape with physical proportions such that head portions of adjacent terminal connectors are substantially complementary to maintain said predetermined angular orientation, each of said terminal connectors including an integral securing portion for engagement in one of said apertures, the length of said securing portion being less than the length of said head portion to prevent engagement of the securing portion of a terminal connector with its head portion out of said predetermined angular orientation.

4. A terminal connector assembly comprising a base board having a plurality of apertures formed therethrough in a precisely and evenly spaced pattern, terminal connectors secured in said apertures in predetermined angular orientation, each of said terminal connectors including a head portion having a polygonal cross sectional shape with transverse dimensions such that head portions of adjacent terminal connectors are substantially complementary to maintain said predetermined angular orientation, each of said terminal connectors including an inner contact part and a separable outer sleeve part of material softer than the base board and softer than said contact part, said contact part having means for locking in said

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sleeve part, said sleeve part including said head portion and an integral securing portion for engagement in one of said apertures, said sleeve part also including an integral expansion portion formed between said head portion and said securing portion and having smaller transverse dimensions than said head portion but larger transverse dimension than said securing portion, said expansion portions engaging said base board to axially locate said sleeve part when inserted in said apertures and preventing interference between adjacent terminal connectors when said contact parts are locked in said sleeve parts.

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