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S. SCHNEIDER
ELECTRICAL CONNECTOR

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3,058,083

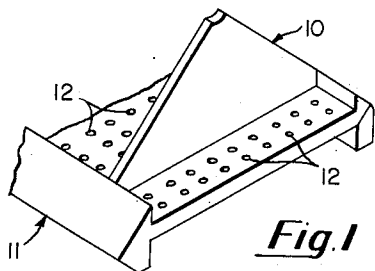


Fig. 1

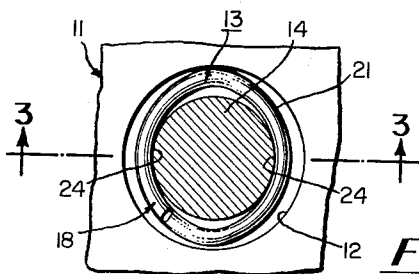


Fig. 2

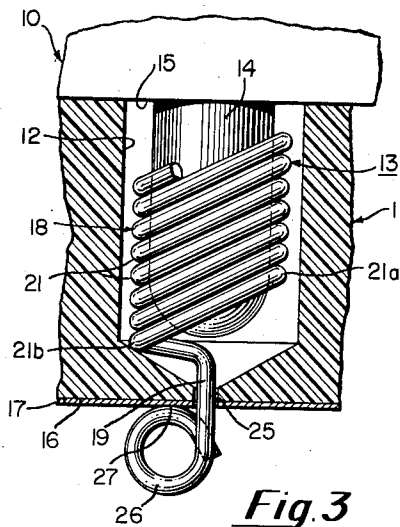


Fig. 3

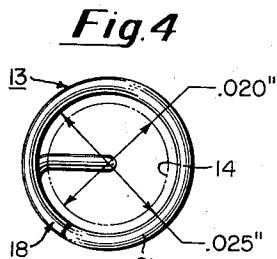


Fig. 4

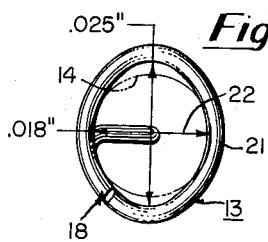


Fig. 6

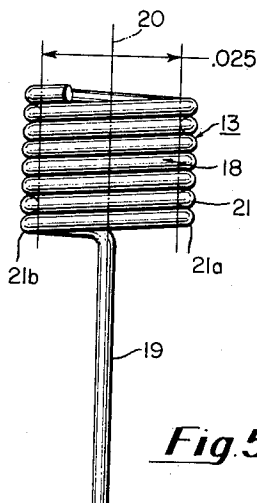


Fig. 5

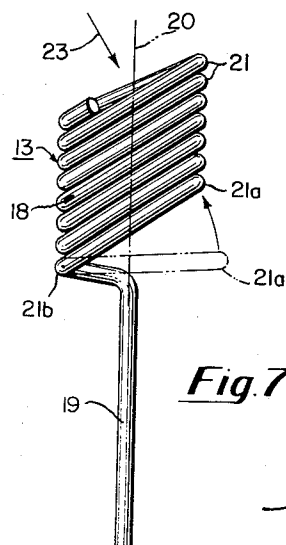


Fig. 7

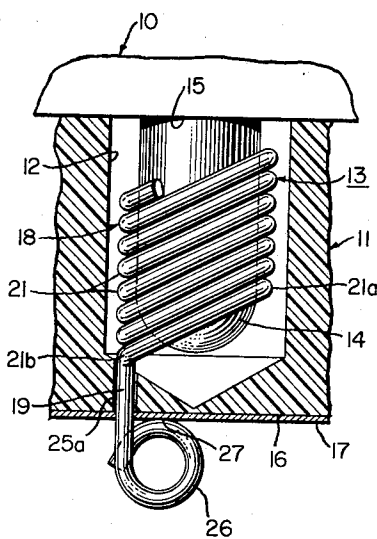


Fig. 8

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ELECTRICAL CONNECTOR

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4 Claims. (Cl. 339-17)

The invention hereinafter described and claimed has to do with separable electrical connectors and more particularly to separable connectors of the socket type primarily useful in interconnecting electrical components or circuitry.

A problem with the use of electrical and electronic assemblies and sub-assemblies is the lack of reliability of the interconnection between components forming the sub-assemblies and even between the sub-assemblies themselves. Many of such interconnections are of the non-separable or permanently connected type and these are fairly reliable. However, we are concerned here with the pressure contact type where electrically conductive interconnections are by pressure of one connector against another. Plug-in connectors are a common example of this type of interconnector and for the most part such connectors usually rely upon only one, but rarely more than two, points of contact for such interconnection. Good overall properties in separable connections are difficult to achieve because of the compromise needed between good contact usually requiring high contact force, and ease of removal better effected with low contact force.

The usual spring type connectors wherein a terminal pin is inserted or plugged axially into the spring whereby the coils of the spring are forced to expand and grip the pin circumferentially, can provide adequate contact pressure but the area of contact is so extensive as to cause the spring to act like a "Chinese finger" when an attempt is made to withdraw the pin from the spring to separate the connection—i.e., the harder the pull to separate them the tighter the spring tends to hold on to the pin. Such separating attempts often result in the destruction of the spring connector.

Therefore, it is an important object of the present invention to provide a separable electrical connector overcoming the above-mentioned difficulties by a construction capable of effecting interconnection of electrically conductive terminal elements with a high degree of reliability.

Another important object of the invention is to provide a spring type separable connector readily adapted for manufacture in micro-miniature size for use in miniaturized circuit assemblies.

More specifically it is an object of the present invention to provide an inexpensive spring type separable electrical connector providing multiple contact points of low area and high contact force providing for easy insertion and withdrawal of associated pin connectors, and a connector which is characterized by its ease of assembly with associated apparatus.

In accordance with the above objects and first briefly described, the invention comprises a socket type coiled wire spring connector for use with a pin type terminal connector and wherein the coil is so formed as to have a major transverse dimension through the axis of the coil greater than the diameter of the mating pin connector and a minor transverse dimension through the axis of the coil less than the diameter of said pin connector, whereby upon insertion of the pin connector into the spring connector the coils of the spring are urged into multiple point contact with the pin connector on opposite sides thereof across the minor transverse dimension and with maximum force. The spring coil terminates in an extension by

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which it is easily attached to the socket base or other associated apparatus.

In the accompanying drawings illustrating the preferred embodiment of the invention:

FIG. 1 is a general perspective view of a miniaturized electronic module of triangular shape plugged into a printed circuit panel containing a plurality of transverse rows of spring connectors in accordance with the present invention, the connectors being positioned in apertures formed in the upper surface of the panel thus to form the socket connector;

FIG. 2 is a fragmentary plan view of one of the apertures shown on the panel of FIG. 1, and showing a pin type connector plugged into a spring connector in accordance with the present invention;

FIG. 3 is a sectional view taken on the line 3—3 of FIG. 2 but showing both connectors in elevation;

FIG. 4 is a plan view of a coiled spring connector in accordance with the present invention but in a condition intermediate to its finished form;

FIG. 5 is an elevational view of the spring shown in FIG. 4;

FIG. 6 is a plan view of a spring type connector in accordance with the present invention and showing its elliptical shape;

FIG. 7 is a side elevational view of the connector as shown in FIG. 6; and

FIG. 8 is a view similar to FIG. 3, but showing a modified form of the connector.

Now more specifically with reference to the details of the drawings and first to FIG. 1, there is shown an electronic miniaturized electrical module 10 mounted on a printed circuit panel 11. The construction shown in this figure is in accordance with the invention described and claimed in the copending application of Edgar O. Sprude, Serial No. 860,602, filed December 18, 1959, entitled "Modularized Electrical Network Assembly" and assigned to the assignee of the present invention.

According to the Sprude application, the panel 11 is provided on its upper surface, as seen in FIG. 1, with transverse rows of apertures or recesses 12 each of which, as seen in FIGS. 2 and 3, is provided with a socket type separable electrical connector 13 for receiving terminal pin connectors 14 projecting from the lower edge 15 of the module 10, normally, but not necessarily, having a pin connector for each of the apertures 12 in a row. The lower surface 16 of the panel 11 is provided with printed circuitry 17 in accordance with a predetermined pattern to establish the desired circuits.

In accordance with the present invention, each of the connectors 13 within the apertures 12 comprises a coiled wire spring portion 18 including a plurality of convolutions, and an axial portion or extension 19. The coiled portion 18 is formed by wrapping wire around a circular mandril or rod in the manner usually used for forming a coil spring, as seen in FIGS. 4 and 5, and in a manner resulting in the inner diameter of the loops or convolutions of the coil being greater than the diameter of the pin connector 14.

In one actual embodiment of the invention for use in a miniaturized modular network assembly, the pins 14 have a diameter of .020". The coiled portion 18 of the connector 13 is wrapped about a mandril of the same diameter, but when removed from the mandril the coils spring back to a larger dimension in the neighborhood of .025" substantially as shown in FIG. 4. In this condition the diameter of the coiled portion is uniform throughout its length about the axis 20, as seen in FIG. 5. By suitable means, not shown, the coils or loops 21 of the spring are then simultaneously rotated about axes perpendicular to the axis 20 and relative thereto to a new

"set" condition (FIGS. 6 and 7). Such rotation may easily be accomplished by holding the coils along one side—the left, as seen in FIG. 7—and urging the other side—the right, in FIG. 7—upwardly, as shown by the broken and full line showing of loop 21a in FIG. 7, thus to decrease the angularity of the planes of the loops relative to the axis 20 to a degree decreasing the transverse dimension 22, of the aperture through the coil, see FIG. 6, to a dimension something less than the diameter of the pin 13 (.020"). It will be understood, of course, that the diameter of the individual loops is not materially changed from its original dimension, and that when looking in the direction of the arrow 23, at the top of FIG. 7, each loop will appear as a circle rather than an ellipse. However, when looking directly down upon the coils along the axis 20, as seen in FIG. 6, in the direction in which the pin 14 will be inserted, it will be seen that the coiled structure is now of elliptical shape and that each loop 21 has peaked portions at the ends of the major axis of the ellipse.

When a pin 14 is inserted axially in the coiled portion 18 of the connector, the individual loops of the spring 20 are rotated by the pin toward their original condition (FIGS. 4 and 5) sufficiently to accommodate the pin therebetween (FIG. 2) and will grip the pin at points on opposite sides thereof, as indicated at 24, with sufficient pressure to insure good electrical contact of the connector with the pin and at a plurality of points corresponding to the number of loop points 24 in contact with the pin. It will also be understood that as the pin 14 is inserted in the coiled portion 18 of the connector, the points 24 will be in wiping contact, thus to assure good electrical conductivity between the pin 14 and the connector 13. With a wire of .006" dia. and the dimensions mentioned above, a contact pressure up to 4 oz. is obtainable.

Insertion and withdrawal of the pin from the coil 18 is relatively easy because of the low area of contact therebetween at points 24 and because the convolutions of the coil have not been stressed or stretched by insertion of the pin. The only pressure is exerted by the desire of the convolutions of the coil to return to their set condition shown in FIGS. 6 and 7.

Now with reference to FIG. 3, it will be seen that the axial extension 19 of the connector projects through a small axially positioned hole 25 through the bottom wall of the aperture 12 and is formed with a loop 26 turned into engagement with the printed circuitry 17 on the underside of the panel 11. The loop is formed by a suitable tool after the extension 19 is passed through the aperture 22, which will be while the extension is in the shape shown in FIG. 7. Preferably the connector 13, as seen in FIG. 7, is inserted into the aperture 12 until the left side 21b of the lowermost coil 21a contacts the bottom of the aperture after which the extension 19—now extending straight through small aperture 25—is formed into the loop 26 so that the distance between its inner edge 27 and the lowermost portion 21b of the lower loop 21a is less than the distance between the outer surface of the printed circuit 17 and where the bottom edge 21b of the loop 21a is in contact with the bottom of aperture 12, whereby a spring force urges the loop 26 at point 27 into tight contact with the printed circuit 17.

From the above description it will be understood that this novel connector construction lends itself well to dip soldering techniques whereby, if desired, the loop 27 may be soldered into contact with the printed wiring 17 and, furthermore, the loop 26 provides means for connecting a test probe to test the circuitry within the module 10 after it is plugged into the panel 11.

It will be realized, of course, that the connector may take other forms within the scope of the invention, one such form being illustrated in FIG. 8 where the extension 19 is tangent to the coils of the connector and extends through a small hole 25a through the panel 11 offset

from the axis of the aperture 12 rather than axially as shown in FIG. 3, illustrating the preferred form.

It will be understood too that the angularity of the coils of the connector to the axis 20, as shown in FIG. 7, may be varied in accordance with the diameter of the pin 14, which is to be inserted in the connector. It will also be understood that by the use of a suitable mandril or other tool that the coils of the connector may be wound originally in the desired angular relationship one with another, as seen in FIGS. 6 and 7, thus eliminating the necessity of rotating the coils as described above.

What is claimed is:

1. In a socket-type connector for effecting separable electrical connection with a terminal pin, wherein a terminal board of dielectric material is provided with a recess in one surface, a hole of smaller dimension than said recess extending through said board from the bottom of said recess to the other surface of said board, and an electrical conductor bonded to said other surface: a coiled wire electrically conductive spring connector positioned within said recess with one open end exposed to said one surface for the axial insertion therein of the terminal pin, said spring connector comprising, a plurality of helical loops of the same diameter arranged along a common axis with the axis of each loop angularly related to said common axis to an extent whereby the loops cooperate to form an elliptical structure around said common axis with a minor inside dimension across the common axis of said ellipse less than the diameter of said terminal pin and a major inside dimension across said common axis of said ellipse greater than the diameter of said terminal pin, whereby said terminal pin when axially inserted into said spring connector will contact the helical loops only at points spaced across the minor inside dimension, and a terminal end extending from the other end of said spring connector in one direction through said hole and in another direction into contact with said electrical conductor at a point removed from said hole, in such manner as to resiliently secure said spring connector against the bottom of said recess and so position it that said common axis will be substantially normal to said terminal board.

2. In a socket type connector for effecting separable electrical connection with a terminal pin, wherein a terminal board of dielectric material is provided with a recess in one surface, a hole of smaller dimension than said recess extending through said board from the bottom of said recess to the other surface of said board, and a printed circuit conductor on said other surface: a coiled wire electrically conductive spring connector positioned within said recess with one open end exposed to said one surface for the axial insertion therein of the terminal pin, said spring connector comprising, a plurality of helical loops of the same diameter arranged along a common axis with the axis of each loop angularly related to said common axis to an extent whereby the loops cooperate to form an elliptical structure around said common axis with a minor inside dimension across the common axis of said ellipse less than the diameter of said terminal pin and a major inside dimension across said common axis of said ellipse greater than the diameter of said terminal pin, whereby said terminal pin when axially inserted within said spring connector through said open end will contact the helical loops only at points spaced across the minor inside dimension, and a portion extending from the other end of said spring connector through said hole and terminating in a resilient loop pressing against said printed circuit conductor and said printed circuit conductor in turn pressing against said other surface thus resiliently urging said spring connector into said recess against its bottom wall, and securing said spring connector to said terminal board in such manner that said common axis will be substantially normal to said terminal board.

3. A socket type separable electrical connector comprising: a printed circuit panel having wiring printed on

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at least one surface thereof and a circular recess in the opposite surface; and a coiled wire spring connector coaxially positioned within said recess, each of the coils of said spring connector being formed by peaks progressively spaced around and substantially equally spaced from the axis of said spring connector, and portions interconnecting said peaks, the latter interconnecting portions having mid-portions cooperating to form an axial aperture through said spring connector with a minimum transverse dimension through said axis less than the diameter of a pin connector to be received therein, whereby said pin connector when inserted axially within said spring connector may be in point contact with the mid-portions of said interconnecting portions; said circular recess in said panel having its axis normal to the panel surfaces, a diameter slightly larger than the major transverse dimension through the axis of said spring connector, and an aperture extending through its bottom wall to the said one surface with the diameter of said aperture less than the diameter of the recess and less than the major transverse dimension through the axis of said spring connector; said spring connector also having a portion extending through the aperture in the bottom wall of said recess and terminating in a spring loop in contact with said printed wiring in a manner biasing the bottom of said spring connector tightly against the bottom wall within said recess thus to lock said spring connector to said panel in electrically conductive relation with said printed wiring.

4. In a socket type separable electrical connector wherein a printed circuit panel has wiring printed on at least one surface thereof and a circular recess in the opposite surface: a coiled wire spring connector substantially coaxially positioned within said recess, each of the coils of said spring connector being formed by peaks progressively spaced around and substantially equally spaced from the axis of said spring connector, and portions interconnecting said peaks, the latter interconnecting portions having mid-portions cooperating to form an axial aper-

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ture through said spring connector with a minimum transverse dimension through said axis less than the diameter of a pin connector to be received therein, whereby said pin connector when inserted axially within said spring connector will be in point contact with the mid-portions of said interconnecting portions; said circular recess in said panel having a diameter slightly larger than the major transverse dimension through the axis of said spring connector, and an aperture extending through its bottom wall to the said one surface with the diameter of said aperture less than the diameter of the recess and less than the major transverse dimension through the axis of said spring connector; said spring connector also having an end portion extending through the aperture in the bottom wall of said recess and terminating in a spring loop in contact with said printed wiring in a manner biasing the bottom of said spring connector tightly against the bottom wall of said recess thus to lock said spring connector to said panel in electrically conductive relation with said printed wiring.

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