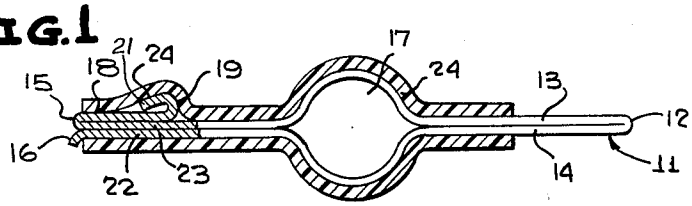
Nov. 24, 1964 T. L. PRICE 3,158,423

SUBMINIATURE ELECTRONIC CONNECTOR

Filed June 11, 1962

FIG. 1



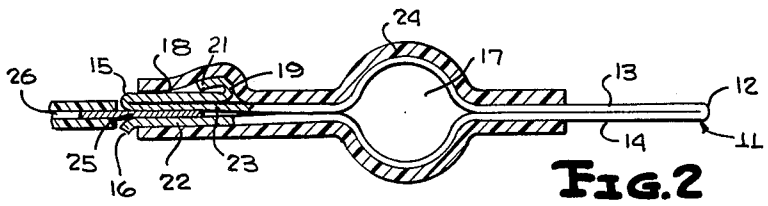


FIG. 2

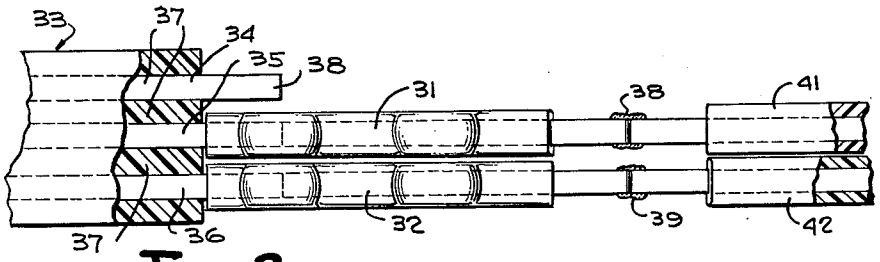


FIG. 3

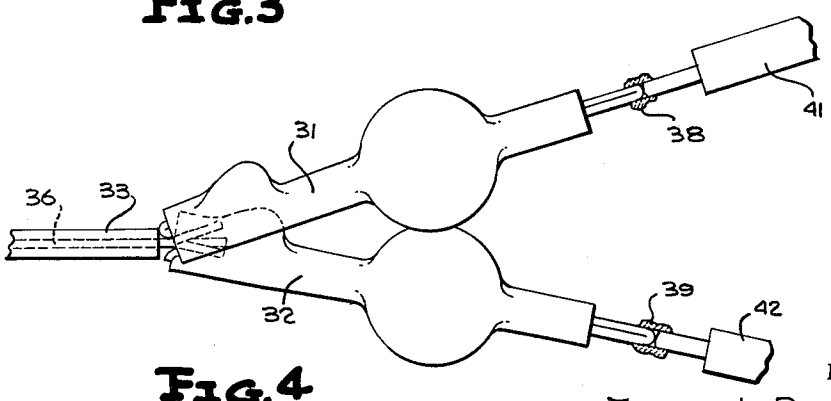


FIG. 4

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SUBMINIATURE ELECTRONIC CONNECTOR

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The present invention relates generally to electrical connectors and more particularly to a sub-miniature electrical connector having a pair of normally contacting, separable fiingers compressed together by an elastic sleeve.

The need presently exists in sub-miniature electrical and electronic circuit applications for a connector adapted for use with taped cables or with junctions located in very close proximity to each other. Such cables frequently include conductors which have width of approxiamtely 0.06 inch and a separation from each other of approximately 0.02 inch. Sub-miniature terminal posts are often positioned in the same intimate manner. Usually in the past, only permanent connections, e.g. soldering or welding, were possible with circuitry of this nature. This is because of the unavailability of appropriate size connectors with sufficient holding forces. The exclusive use of permanent connections in sub-miniature circuitry, particularly in airborne systems, is disadvantageous since repair time and costs are maximized.

The present invention provides a sub-miniature connector in which a pair of separable fingers, having dimensions to receive a male cable jack or terminal plug, have adjacent surfaces normally maintained in contact by the compressive forces of an elastic sleeve, which surrounds the exterior finger surfaces. The sleeve is fabricated of an insulating elastomer material which perferably is an irradiated Teflon. Irradiated Teflon is desirable because of its excellent dielectric properties and its capability of withstanding high equipment operating and installation temperatures.

The connector is preferably fabricated from a single, elongated, metal strip folded in the center. The two ends are joined together to form the fingers, one of the ends being folded over to form a compressive spring for the adjacent finger surfaces. To maintain the sleeve and strip in a fixed longitudinal position, a bulge is formed between the ends of the fingers and the folded center portion of the strip. The folded finger also aids in keeping the sleeve and strip correctly positioned. To establish permanent connections between external circuitry, such as leads, cables, and wiring boards, the folded part of the strip extends beyond the end of the sleeve so that welded or soldered joints may be established.

It is an object of the present invention to provide a new and improved sub-miniature connector.

Another object of the present invention is to provide a new and improved sub-miniature connector capable of high density packing.

An additional object of the present invention is to provide a new and improved sub-miniature connector in which: short circuiting between adjacent leads is obviated; high temperatures during installation or operation are not deterimental; any length or type of miniature conductor or circuit may be permanently connected to one of its terminals without special preparations; the holding forces to a male connecting member are greater than in previous connectors of comparable size.

Another object of the present invention is to provide a new and improved sub-miniature connector that enables the equipment with which it is coupled to be easily and completely repaired.

Still an additional object of the present invention is to provide a new and improved sub-miniature connector

which is capable of being mass produced by automatic machinery or of being farbircated on short notice without special tools.

A further object of the present invention is to provide a sub-miniature connector having a pair of contact fingers with adjacent, normally engaging surfaces and an elastomer sleeve compressing the fingers towards each other.

The above and still further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description of one specific embodiment thereof, especially when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a cross section of a preferred embodiment of the switch of the present invention when it is not connected to a male prong;

FIGURE 2 is a cross section of the switch of FIGURE 1 when it is connected to a male prong;

FIGURE 3 is a top view illustrating the manner in which a number of the switches shown in FIGURE 1 are connected to a multi-lead sub-miniature taped cable; and

FIGURE 4 is a side view of the assembly of FIGURE 3.

Reference is now made to FIGURE 1 of the drawings, a side sectional view of the connector, which shows an elongated, flat strip **11** of electrically conductive material, such as aluminum. The center portion **12** of strip **11** is folded so that the interior surfaces of central segments **13** and **14** contact as do the segments **22** and **23**. Segments **13** and **14** are resistance spot welded together to prevent their separation during assembly of the connector and bonding of external circuitry thereto. Centrally disposed between folded portion **12** and ends **15** and **16**, a bulb **17**, in the form of a cylindrical bulb, is formed by turning each of the segments **13** and **14**.

The ends **22** and **23** are compressed together to form mating contact fingers by the spring formed by folding the portion **18** of strip **11** beyond end point **15** over twice, at points **15** and **19**. Thereby, the very end point **21** of strip **11** and curve **19** bear against interior segnment **22** to maintain it in contact with segnment **23**. The end point **16** is bent away from point **15** to permit facile insertion of a male jack between the fingers formed by strip portions **22** and **23**.

A cylindrical sleeve **24** fabricated of a shrinkable, elastic material covers segments **18**, **22** and **23** and bulb **17** of strip **11**. Sleeve **24** is shrunk over the metal strip and maintained in a fixed longitudinal position relative thereto by bulb **17** and the raised strip segment between fold **19** and end **21**. Sleeve **24** exerts compressive forces on segments **22** and **23** so that considerable holding forces are exerted on male jack **25**, FIGURE 2, when it is inserted between fingers **22** and **23**.

The central portion **12** of strip **11** extends beyond the end of sleeve **24** so that a permanent connection can be made by soldering or welding a lead, wiring board, etc., to the connector at segment **13** or **14**.

Sleeve **24** is preferably fabricated from irradiated Teflon because this material, in addition to having the necessary elastomer characteristics to achieve the compressive forces against segments **22** and **23**, has excellent dielectric properties so that high density packing of the connectors is attainable. Also, irradiated Teflon is capable of withstanding, without longitudinal shinkage or change in its insulation properties, the high temperatures to which the connector is subjected during use and bonding of the external component to segment **13** or **14**.

From FIGURE 2, it is noted that the male connector **25** extending from insulated lead **26** protrudes between separable fingers **22** and **23**. While the spring formed by segment **18** and folded end **21** bearing against fingers **22** and **23**, aids to a certain extent in holding plug **25** in place, the primary compressive forces for securing the fingers against the plug are derived from sleeve **24**. By

utilizing sleeve **24** both as an insulator and a force exerting member, great packing density and considerable holding forces are obtained.

Reference is now made to FIGURES 3 and 4 of the drawings which are illustrations of a top and a side view, respectively, of the manner in which a pair of connectors **31** and **32** of the present invention are connected to a multi-lead taped cable **33**. Cable **33** includes three elongated, flat metal leads **34–36** which have a width of approximately 0.06 inch. A suitable plastic insulation **37** separates leads **34–36** by approximately 0.02 inch. The insulation **37** is embossed about leads **34–36** so that it extends over and between them.

Extending from insulation **37**, is a jack, such as exposed male plug **38**, which is integral with lead **34**. The jacks extending from leads **35** and **36** are held in place by the contact fingers of connectors **31** and **32**, respectively.

The ends of connectors **31** and **32** remote from cable **33** are bonded by welding or soldering joints **38** and **39** to insulated leads **41** and **42**, respectively. To provide maximum packing density connectors **31** and **32** are folded at different angles relative to cable **33**, thereby obviating the possibility of short circuits between any exposed segments of leads **41** and **42**.

In use, it is merely necessary to insert the fingers of connector **31**, after lead **41** has been bonded thereto, to the jack extending from lead **35**. To repair a component attached to lead **41**, connector **31** is merely withdrawn from its jack, thereby reducing the time and expense for maintenance. After the repair has been completed, the connector is easily reinserted on the jack.

The connector of the present invention can be manufactured on a large scale by automatic machinery or it can be fabricated with generally available components and tools because of its simplicity and minimum number of parts.

While I have described and illustrated one specific embodiment of my invention, it will be clear that variations of the details of construction which are specifically illustrated and described may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims.

I claim:

1. A sub-miniature female connector that is at will connected to and removed from a flat male jack having a thickness on the order of 0.06" comprising a pair of flat mating fingers having mutually adjacent surfaces, at least one of said surfaces being electrically conductive, means for normally compressing said surfaces together, said means for compressing including a cylindrical elastic sleeve surrounding said fingers and contacting said fingers at all of their exterior surfaces, said fingers being separable by distances only on the order of 0.06 inch for entry of the male jack between said adjacent surfaces and being urged by said sleeve into holding contact with the flat surfaces of the jack, one of said fingers having an outwardly extending bulge thereon, said sleeve fitting tightly around said bulge for maintaining said fingers and said sleeve in a predetermined, fixed, longitudinal position.

2. A sub-miniature female connector that is at will connected to and removed from a flat male jack having a thickness on the order of 0.06" comprising a pair of flat mating fingers having mutually adjacent surfaces, at least one of said surfaces being electrically conductive, means for normally compressing said surfaces together, said means for compressing including a cylindrical elastic insulating sleeve surrounding said fingers and contacting said fingers at all of their exterior surfaces, said fingers being separable by distances only on the order of 0.06 inch for entry of the male jack between said adjacent surfaces and being urged by said sleeve into holding contact with the flat surfaces of the jack, one of said fingers having an outwardly extending bulge thereon, said sleeve fitting tightly around said bulge for maintaining said fingers and said sleeve in a predetermined, fixed, longitudinal position.

3. A sub-miniature female connector that is at will connected to and removed from a flat male jack having a thickness on the order of 0.06" comprising a pair of flat mating fingers having mutually adjacent surfaces, at least one of said surfaces being electrically conductive, means for normally compressing said surfaces together, said means for compressing including a cylindrical elastic insulating sleeve surrounding said fingers and contacting said fingers at all of their exterior surfaces, said fingers being separable by distances only on the order of 0.06 inch for entry of the male jack between said adjacent surfaces and being urged by said sleeve into holding contact with the flat surfaces of the jacks, one of said fingers having an outwardly extending bulge thereon, said sleeve fitting tightly around said bulge for maintaining said fingers and said sleeve in a predetermined, fixed, longitudinal position relative to each other, and a metal lead extending beyond said sleeve for permanently connecting said electrically conductive finger to external circuitry, said lead being integral with said finger.

4. A sub-miniature connector comprising a strip of electrically conductive material, said strip being folded at its center so that a surface of one of its ends normally contacts a surface of the other of its ends, said one end being folded to form a compression spring for urging the surfaces together, an elastic dielectric sleeve contacting said strip and further compressing said surfaces together, said ends being separable for entry of a male connector therebetween, a bulge in said strip between its center fold and its ends, said sleeve being drawn over said bulge and thereby being maintained in a fixed longitudinal position relative to said strip, the center folded portion of said strip extending beyond said sleeve.

5. The connector of claim 4 wherein said sleeve is irradiated Teflon.

6. The connector of claim 4 wherein said strips are separable at said ends only on the order of 0.06 inch.

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JOSEPH D. SEERS, *Primary Examiner.*