United States Patent [19]

Cobaugh et al.

[11] **3,803,537**

[45] **Apr. 9, 1974**

[54] **SPRING SOCKET ELECTRICAL CONNECTING DEVICE INTEGRAL WITH A CARRIER STRIP**

[75] Inventors: **Robert F. Cobaugh,** Elizabethtown; **Suel G. Shannon,** Harrisburg, both of Pa.

[73] Assignee: **AMP Incorporated,** Harrisburg, Pa.

[22] Filed: **Mar. 8, 1973**

[21] Appl. No.: **339,475**

[52] **U.S. Cl.** ..... **339/256 R,** 339/276 SF

[51] **Int. Cl.** **H01r 13/12**

[58] **Field of Search** ..... 339/256, 258, 276 SF

[56] **References Cited**

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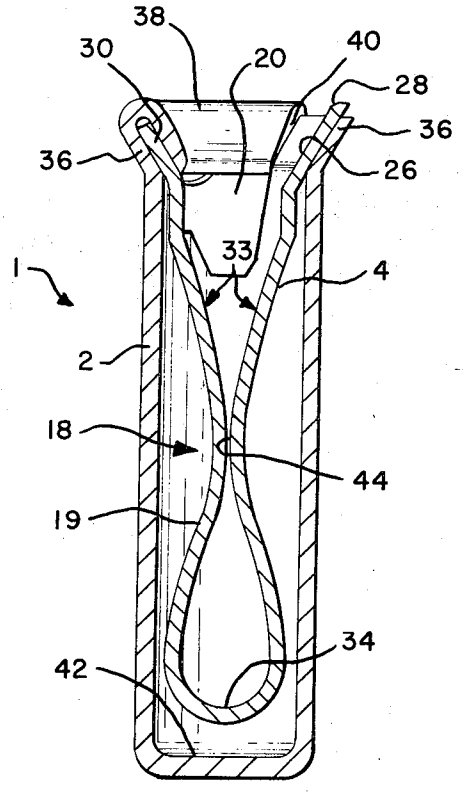
Primary Examiner—Joseph H. McGlynn

Attorney, Agent, or Firm—Gerald K. Kita, Esq.

[57] **ABSTRACT**

An electrically conducting spring receptacle contained within a cup forms a miniature electrically connecting device in the form of a socket receptacle adapted for mounting within a printed circuit board. A particular feature resides in the socket receptacle fabricated in depending relationship from a carrier strip together with a plurality of similar socket receptacles. These socket receptacles are spaced along a carrier strip in correspondence with the spaces between the corresponding apertures provided in the printed circuit board. The socket receptacles are thereby adapted for simultaneous insertion and mounting within corresponding apertures of the printed circuit board prior to severing the carrier strip from the inserted socket receptacle.

7 Claims, 5 Drawing Figures



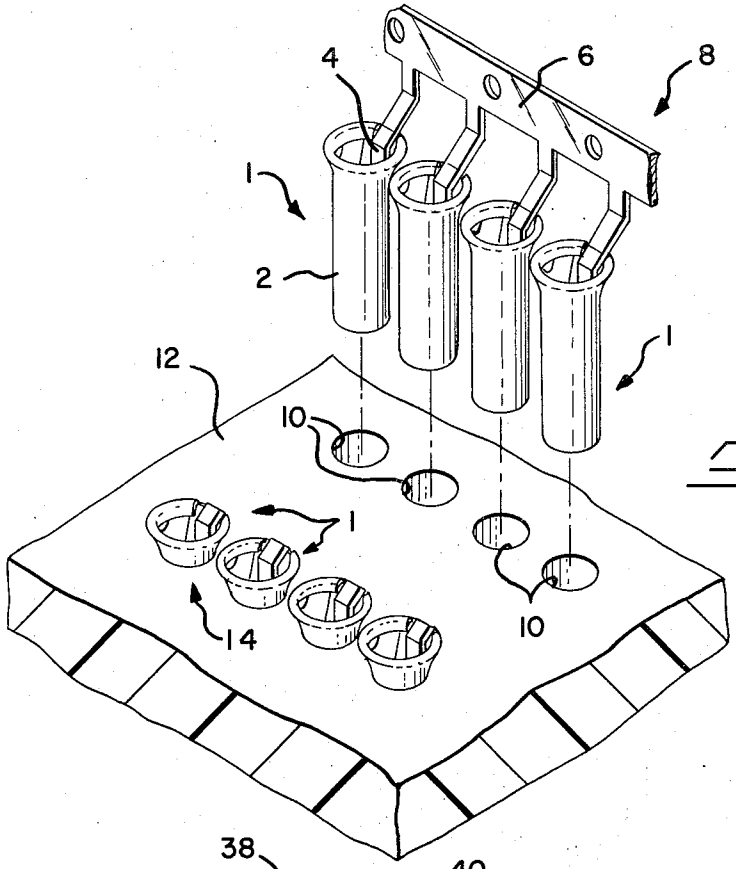


Fig. 1

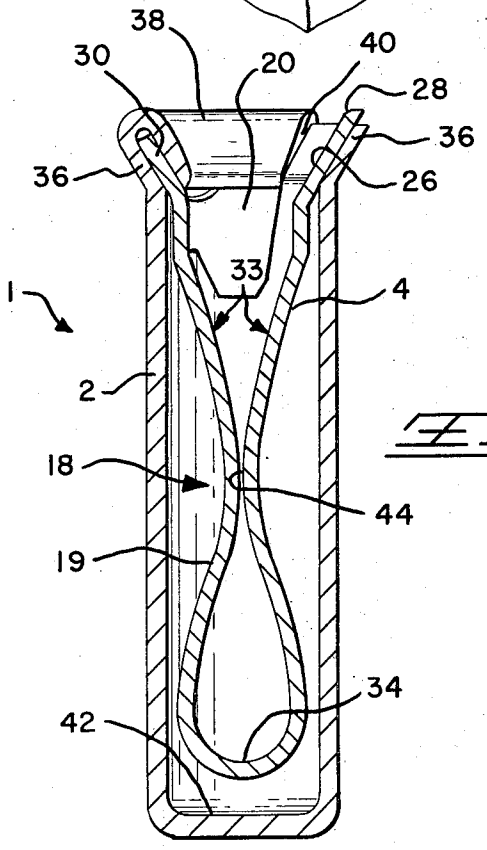


Fig. 2

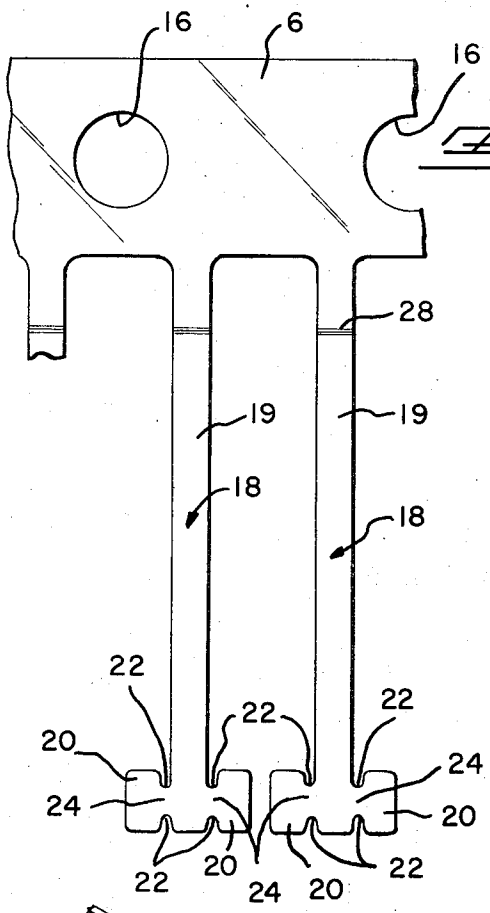


Fig. 3

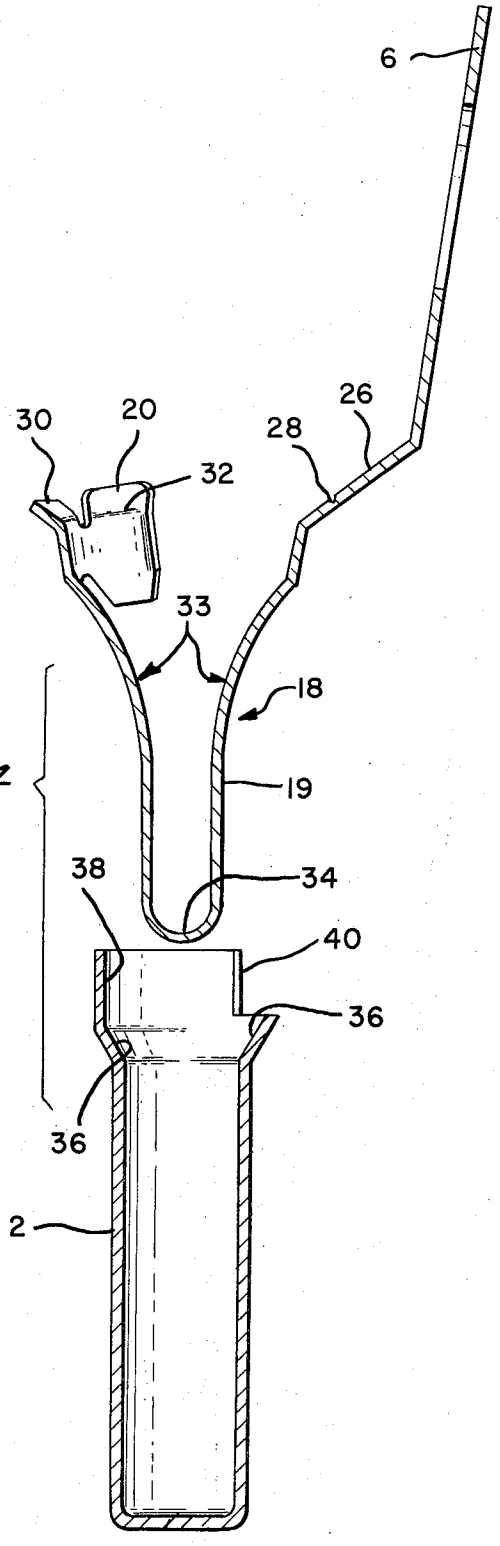


Fig. 4

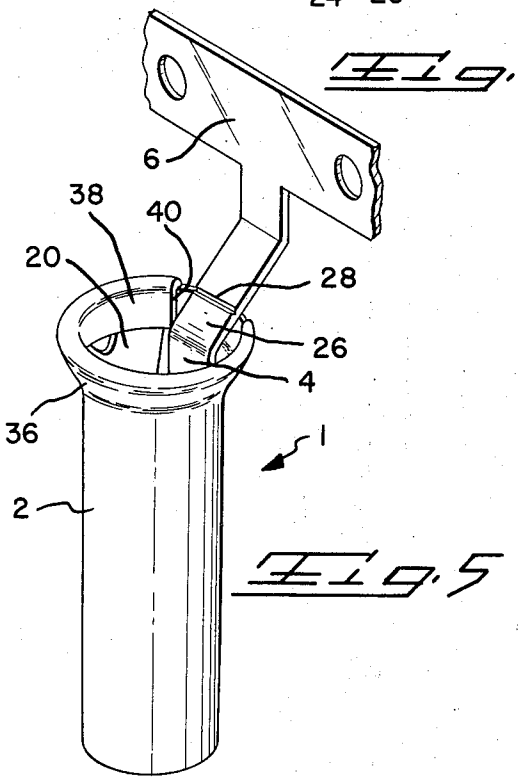


Fig. 5

SPRING SOCKET ELECTRICAL CONNECTING DEVICE INTEGRAL WITH A CARRIER STRIP

The present invention generally relates to socket type receptacles for receiving and making electrical contact with corresponding male electrical terminals. Each socket according to the present invention is in the form of an arcuate conducting spring element generally folded back on itself to provide a resilient receptacle for receiving and gripping onto a male electrical terminal inserted into the receptacle. Each spring element is received within a metallic cup; the cup being joined to the corresponding spring element by a lip of the cup rolled over into gripping relationship on an end of the corresponding spring element. The other end of each spring element protrudes outwardly from the cup in an outwardly flaring or otherwise inclined relationship in correspondence generally with the outwardly flared lip configuration of the corresponding cup. The protruding end portion of the spring is integral with a carrier strip and is provided with a scored portion which is frangible to separate the assembled cup and spring element from the carrier strip. A plurality of similar assemblies of cups and spring elements may be similarly connected to a common carrier strip and spaced along the strip to correspond with spaces between apertures provided in a printed circuit board. Such a procedure allows simultaneous insertion of a plurality of sockets into corresponding apertures. Subsequentially the carrier strip is frangibly separated from the sockets, leaving the sockets assembled in the apertures. Such procedure allows simultaneous rather than individual insertion of sockets within printed circuit board apertures, resulting in a substantial savings of assembly time. The sockets when connected to a common carrier strip may be reeled or otherwise stored in strip form with the sockets being predictably oriented in their stored condition thereby eliminating the need for inspecting and orienting each individual socket prior to insertion within a corresponding aperture of a printed circuit board. Heretofore it has been the practice to provide plurality of sockets which are randomly oriented and stored in appropriate containers. Often during shipment and handling the random individual sockets abraded and collided with one another and became damaged. The random individual sockets were difficult to handle during their assembly due to their miniature size. Damaged receptacles were inserted only with extreme difficulty within printed circuit board apertures, and even when once inserted would sometimes fall out. Such difficulties greatly increased the expenditure of time required for assembling the sockets within the apertures of the printed circuit board. According to the present invention, all such problems associated with storage and orientation of the sockets for proper insertion within a printed circuit board are eliminated by fabricating the sockets in depending relationship from a common carrier strip. In addition each spring contact element contained within a cup portion of a socket is of non-complicated configuration enabling the spring elements to be stamped out with a minimum number of die strokes, thus facilitating relatively cheap stamping and forming costs. In addition the non-complicated configurations of the spring contact elements allow for ease and miniaturization thereof and close spacing of a plurality of such contact elements along a common carrier strip. As another feature of the invention, the

spring contact elements are frangibly connected to the common carrier strip such that when the cups are assembled over the corresponding spring contact elements to form a plurality of sockets, the spring contact elements alone will frangibly connect the resulting sockets in serial depending relationships from the carrier strip to allow the sockets to be reeled out or otherwise stored in strip form along the carrier strip.

Accordingly it is an object of the present invention to provide a socket in a form of a metallic cup having therein a receptacle in the form of a spring contact element, the socket being capable of miniaturization and connected frangibly to a carrier strip.

Another object of the present invention is to provide an electrical connector in the form of a socket capable of miniaturization and connected in depending relationship from a carrier strip.

Another object of the present invention is to provide a socket type electrical connector capable of miniaturization, wherein the connector includes a cup portion containing a resilient electrically conducting spring contact element connected integrally with a carrier strip, further wherein the contact element includes a portion projecting from the cup portion and frangibly attached to a carrier strip from which depends a plurality of like connectors.

Another object of the present invention is to provide a connector in the form of a socket having a cup portion containing a spring contact element defining a receptacle within the cup portion, and wherein the cup portion includes a lip portion rolled over into crimping relationship on the spring element to define a funnel entry into said receptacle, and further wherein the contact element includes a portion projecting from the cup portion to define a funnel surface to facilitate funneling a male contact internally of said socket and said receptacle, the projecting portion of the contact element further being integrally attached to a carrier strip.

Other objects and advantages of the present invention will become apparent upon perusal of the following detailed description taken in conjunction with the drawings, wherein:

FIG. 1 is an enlarged fragmentary perspective of a preferred embodiment of a present invention and illustrating a plurality of sockets capable of miniaturization in depending relationship from a common carrier strip and adapted for simultaneous insertion within a corresponding plurality of apertures provided in a printed circuit board; and further illustrating a plurality of similar sockets assembled to the circuit board with the carrier strip then removed;

FIG. 2 is an enlarged elevation in section illustrating the details of a preferred embodiment of the socket according to the present invention;

FIG. 3 is an enlarged fragmentary plan of exemplary spring contact elements in integral depending relationship from a common carrier strip illustrating the simplicity of details thereof;

FIG. 4 is an enlarged elevation in section illustrating the formed configuration of an exemplary spring contact element and a metallic cup portion into which the contact element is assembled, with the contact element being illustrated in its formed configuration; and

FIG. 5 is an enlarged fragmentary perspective of a socket according to the present invention in depending

relationship from a carrier strip and further illustrating the details thereof.

With more particular reference to the drawings, there is generally shown at **1** in FIGS. **1** and **5** a socket according to the present invention. The socket includes a metallic cup portion to containing therein, as particularly shown in FIGS. **1, 2** and **5,** a metallic spring contact element integrally joined to a carrier strip **6.** As shown more particularly in FIG. **1,** a plurality of similar sockets **1** are joined to a common carrier strip as indicated generally at numeral **8.** The plurality of sockets are spaced in depending relationship from the carrier strip in correspondence with the spacing between a corresponding plurality of apertures **10** provided in a printed circuit board **12.** For example, a selected plurality of sockets **1** may be selected for insertion within the corresponding plurality of apertures **10,** requiring severing off an appropriate length of the carrier strip **6** from the remaining portion of the carrier strip in order to select the desired plurality of sockets **1** for insertion within the corresponding plurality of apertures. The sockets then may be inserted in any well-known manner into the corresponding plurality of apertures while still attached to the carrier strip **6.** In this manner the carrier strip **6** serves to align and position or otherwise orient the sockets **1** properly for simultaneous insertion into the apertures **10.** Such a procedure substantially eliminates the expenditure of time and labor required for separate orientation and insertion of individual sockets. Accordingly the ability to insert a plurality of sockets simultaneously while attached to carrier strips allows the assembly of sockets to a printed circuit board more economically and with greater accuracy of alignment than heretofore attained. In addition, since the sockets are attached to a carrier strip, storage is accomplished by reeling or otherwise storing the sockets in strip form. This allows the sockets to be removed from storage in serial fashion merely by unreeling the carrier strip or by selecting appropriate lengths of the carrier strip to feed or otherwise dispense a plurality of sockets. Heretofore, individual sockets were stored in loose piece form within a container. The sockets had no particular orientation in the container and were often damaged either by abrasion or crushing upon one another. It was heretofore often difficult to inspect the sockets for damage due to the sockets being of miniaturized form. For example, the sockets are designed to be placed in apertures of about 0.050 inches in diameter. Accordingly, damaged sockets were often individually assembled to printed circuit boards, with the result that upon a closer inspection such sockets had to be removed and replaced with undamaged ones. In the present invention, the possibility of socket damage is greatly allieviated by enabling storage in strip or reel form. Since assembly of plurality of sockets simultaneously, saves great expenditures of time, both the initial insertion and even replacement of sockets found to be damaged can be accomplished more economically than before. With reference to FIG. **1,** there is illustrated generally at **14** a plurality of sockets assembled within apertures of a printed circuit board. As shown, the sockets may be connected to a circuit board in any well known fashion. For example the sockets may be force fitted within the corresponding apertures to complete the assembly. In the alternative, the sockets may be soldered in place by wave soldering or even hand soldering techniques which are well known in the prior art. Whenever assembly technique is selected, after the sockets are completely assembled to the printed circuit board, the carrier strips may then be removed leaving the individual sockets without any carrier strip desirably assembled to the printed circuit board **12.** While the sockets are being inserted and permanently attached to the printed circuit board **12,** the carrier strip **6** may be retained in attachment thereto to maintain the sockets in proper alignment during all steps of the assembling operation. In such manner, the carrier strip is not removed until the sockets are all in proper alignment and are securely fastened to the printed circuit board **12.** The details which enable the carrier strip to be removed from the individual sockets will be described hereinafter in detail.

The details of the individual sockets **1** will be described in detail by reference to FIGS. **2** through **5.** As shown in FIG. **3,** the carrier strip **6** shown greatly enlarged includes a plurality of apertures **16** which are serially spaced therealong to allow for transport of the carrier strip serially along a plurality of die stations as is well known in the prior art. A plurality of elongated spring contact elements **18** generally of rectangular form **19** are die stamped along one side margin of the carrier strip in relatively closely spaced adjacent relationship. Since the contact elements **18** are of simple elongated form **19,** they are fabricated easily in closely adjacent spaced relationship and with a minimum number of die stations required. Each spring contact element includes a pair of laterally spaced ears **20** which are also of generally non-complex rectangular configuration with rounded corners joined integrally with the corresponding elongated portion **19** in corresponding contact elements by narrow neck portions **24** extending medially from each ear portion **20** and defined by a pair of opposed, rounded configuration notches **22** generally separating each ear portion from the elongated portion **18** of a corresponding contact element. As shown in FIG. **4,** the contact elements **3** may then be formed into generally receptacle shapes. Most particularly, with reference to FIG. **4,** an exemplary contact element is shown in sections together with its carrier strip **6.** The elongated portion **19** of each contact element is doubled back on itself to form a reversely curved configuration with one end of the elongated portion **19** being creased rather sharply and bent into a stem portion **26** inclined at an obtuse angle with respect to the carrier strip **6.** The stem portion **26** is immediately adjacent to a scored line or recess **28** which may be formed in the spring contact element during stamping. Such a portion **28** provides a weakened location to allow frangible separation of the carrier strip **6** from the individual spring contact element **18.** With reference to FIG. **4,** the other end of the elongated portion **19** of each spring contact element **18** is bent or formed outwardly in inclined outwardly flaring relationship as shown generally at **30.** The ear portions **20,** only one of which is shown in detail in the figure, also are folded generally along a line **32** into outwardly flared configuration similar to the end **30.** Also as shown the ear portions **20** are generally formed into a partially arcuate shape. This allows for conformity with the arcuate periphery of a cup portion **2** into which a corresponding spring element **18** is inserted as will be explained hereinafter in detail. Initially as shown in FIG. **4,** each spring element **18** is formed into a generally flaring relationship allowing the contact elements

to be plated with tin or gold or other plating with a high conductivity. If the contact element **18** were formed into a more tightly closed configuration eveness of plating would be difficult to achieve.

Yet with reference to FIG. **4**, each contact element **18** formed to its configuration as shown in the figure includes an arcuate U-shaped bight portion **34** facilitating insertion of the contact element **18** within the corresponding cup portion **2**. More particularly, the cup portion **2** as shown in FIG. **4** is of generally elongated cylindrical configuration having an open end defined by an outwardly flared lip portion **36** defining a funnel entry integral with one end of the cup portion **2**. The funnel entry thus funnels the arcuate portion **34** of the corresponding contact into alignment with the end of the cup for proper insertion of the entire contact element **18** within the cup portion **2**. Since the arcuate portion **34** of a corresponding contact element **18** is unbroken and smoothly curved, such insertion can be accomplished without substantial resistance or friction resisting insertion. It is also illustrated in FIG. **4** that each cup portion includes a generally cylindrical extended flange portion **38** integral with and forming a part of the outwardly flared lip portion **36**. Such flange portion **38** is relieved by a notch portion **40** also more particularly shown in FIGS. **2** and **5**.

As shown more particularly in FIGS. **2**, **4**, and **5**, when the spring contact element **18** is fully inserted within a corresponding cup portion, the arcuate portions **34** will be generally adjacent the bottom **42** of the corresponding cup portion **2**. The elongated portion **19** of each spring contact element **18** will be resiliently compressed by the cylindrical confines of the cup portion to a more closed configuration. More particularly, the spring contact element **18** is of resilient metal. When the relatively open configuration of the contact element **18** as shown in FIG. **4** is inserted within the relatively narrow confines of the cup portion, the configuration changes to a relatively narrow loop configuration as shown in FIG. **2**. Such is accomplished resiliently, however, without permanently deforming or otherwise permanently bending the reversely curved elongated portion **19**. As shown accordingly in FIG. **2**, the elongated portion **19** retains its bight shaped portion **34** and its outwardly flared configuration **33**. Between the portions **33** and **34**, however, the contact element portion **19** forms a reduced waist or throat area **44** rendering the contact element **18** with a generally hour glass shape within the corresponding cup portion **2**. Further as shown in FIGS. **2**, **4** and **5**, with the spring contact element **18** properly located within a corresponding cup portion **2**, the end portion **30** and adjacent integral ear portions **20** will be stopped against and generally overlying against the outwardly flared lip portion **36**. This enables the extended flange portion **38** of a corresponding cup portion to be rolled over into compressed engagement on the end portions **30** and the portions of the ear portion **20** located above the fold line **32**, in order to sandwich such portions between the outwardly flared lip portion **36** and the extended portion **38**, thereby gripping such portions of the spring contact element and retaining them in proper orientation with respect to the cup portion **2**. In so doing, the ear portions **20** conform to the lip portion **38** and the cup portion is permanently joined to the corresponding spring contact element contained therein. The extended portion **38** of the outwardly flared lip portion **36** is therefore provided as a double thickness funnel entry to the cup portion **2**. In addition such funnel entry reinforces the open end of the cup portion by virtue of its double thickness and also provides a funnel entry for the outwardly flared portion **33** of the spring contact element **18**. Thus, the spring contact element **18** is generally of hour glass configuration defining a receptacle designed for receipt of a male electrical terminal which is guided by the funnel entry of the cup portion into the outwardly flared configuration and into the reduced waist area **44** of the contact element **18**. Since the elongated portion **19** of the contact element remains resilient, the reduced area **44** is resiliently widened by insertion of the male terminal therein and thus creates resilient stored spring energy which acts to grip in mechanical and electrical engagement on the male terminal, to complete an electrical connection. Thus when the spring contact element is resiliently formed from a relatively open configuration in FIG. **4** to its relatively closed position within the confines of the cup portion **2**, the elongated portion **19** will be closed upon itself but resiliently storing spring energy therein. The elongated portion **19** thereby as a pre-loaded spring with a resilient stored energy which, upon insertion of the male terminal within a waist area **44** acts in gripping relationship on the terminal at the area **44** to assure a positive gripping force on the male terminal. In addition, the once flared entry of the cup portion **2** which facilitates insertion of the corresponding contact element **18** therein now serves as a funnel entry to facilitate insertion of the male terminal within the confines of the spring contact element **18**. The spring contact element **18** has its own funnel entry **33** serving to funnel the male terminal into proper received in the reduced third area **44** of the contact element **18**. The contact element **18** thus serves as a receptacle type electrical terminal, which in conjunction with the cup portion **2** comprises a socket type electrical connector.

By reference to FIGS. **2** and **5**, it is shown that the stem portion **26** of the corresponding spring contact element **18** protrudes through the notched portion **40** of the extended portions **38** of the third portion **36**. As shown, the stem portion **26** is in inclined relationship with respect to the carrier strip **6**. Also it is of inclined relationship overlying and in correspondence generally with the outwardly flared configuration of the lip portion **36**. The stem portion **26** then serves as a flared funnel surface to facilitate guiding entry of a male terminal within the confines of the receptacle contact **18** and the cup portion **2**. In addition, the scored area **28** of the stem portion **26** is located generally outwardly of the flared configuration funnel entry of the cup portion **2** such that when the carrier strip **6** is severed from the stem portion **26**, the funneling target areas of the outwardly flared lip portions **36** and the funneling inclined surface of the stem **26** will not be removed upon removal of the carrier strip. As a further feature, the relative gaps between the stem portion **26** and the notched portions **40** are sufficiently narrow to prevent any insertion of a male terminal within the gaps. The socket assembly which is shown in FIGS. **2** and **5** is greatly enlarged, thereby the gaps between the stem portion **26** and the notch portion **40** also one greatly exaggerated and in practice not wide enough to allow for insertion of a male terminal in the gaps.

What has been described and illustrated in detail as a preferred embodiment of the present invention. However other embodiments and modifications of the present invention which would be obvious to one having ordinary skill in the art are to be ascertained and intended to be patented in the spirit of scope of the appended claims wherein:

What is claimed is:

1. A miniature spring socket assembly, comprising:

a carrier strip having a plurality of depending electrically conducting spring elements each configured into receptacle configuration which is adapted for receiving a male electrical terminal and for making an electrical connection with the male electrical terminal,

each spring element having a weakened portion thereof adjacent said carrier strip to enable frangible separation of a carrier strip from each spring element,

a cup of electrically conducting material received over each spring element, each said cup having an outer circumference of a dimension suitable for insertion within a corresponding aperture of a printed circuit board, each said cup being joined to a corresponding spring element and thereby being retained in depending relationship from said carrier strip,

a plurality of said cups having corresponding spring elements therein and being spaced along said carrier strip for simultaneous insertion within correspondingly spaced apertures provided in a printed circuit board prior to frangible separation of said carrier strip from said spring elements.

2. The structure as recited in claim **1,** wherein, each said socket includes a lip rolled over into gripping relationship on a corresponding spring element,

each said lips having a notched portion, each spring element extending from the interior of a corresponding socket through the notched portion and into connection with said carrier strip.

3. The structure as recited in claim **1,** wherein each socket includes a lip rolled over in gripping relationship on a corresponding spring element, each said lip having a notch through which such spring element extends for connection with said carrier strip and for depending relationship from said carrier strip.

4. The structure as recited in claim **1,** wherein, each spring element includes ear portions formed into a shape conformed to the inner periphery of a corresponding socket,

each socket having a lip portion thereon joined to the ear portions of a corresponding spring element,

said ear portions of each spring element conforming to the inner periphery of said lip portion upon folding over said lip portion over said ear portions.

5. The structure as recited in claim **4,** wherein each socket includes a notch in the lip portion thereof through which a corresponding spring element extends,

each said spring element having a stem portion inclined toward a said lip portion of a corresponding socket to define an inclined funnel surface to facilitate funneling of a male contact internally of said socket for electrical connection in said receptacle,

a frangible portion of each contact element frangibly connecting a corresponding stem portion to said carrier strip.

6. The structure as recited in claim **1,** and further including:

a lip portion on each cup portion which is rolled over adjacent an open end of each cup portion to define a funnel entry both to said cup portion and to said receptacle.

7. The structure as recited in claim **1,** wherein said receptacle is formed from an elongated spring contact element doubled over on itself to define a relatively wide hour glass configuration externally of said cup portion, said hour glass configuration being retained internally of the confines of said cup portion with said hour glass configuration being resiliently compressed into a relatively narrow hour glass configuration thereby storing spring energy in said contact element and providing resiliently stored energy to be applied at the narrow waist portion of said hour glass configuration for positive gripping relationship on a male terminal inserted internally of said waist portion.

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