Feb. 23, 1971 W. TEAGNO ET AL 3,566,344

ELECTRICAL CONNECTOR RECEPTACLES

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Fig. 1.

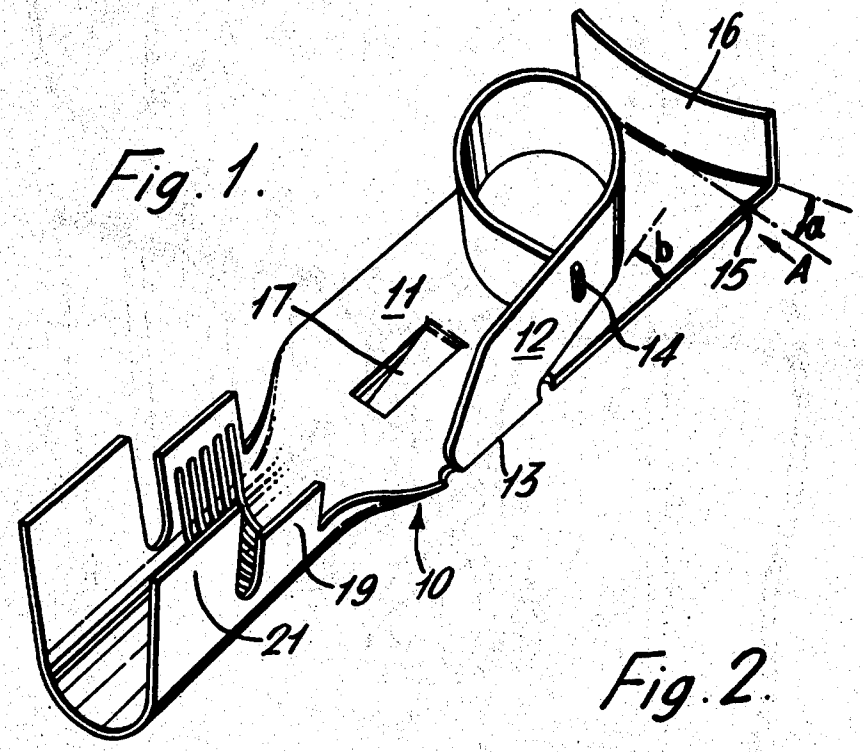
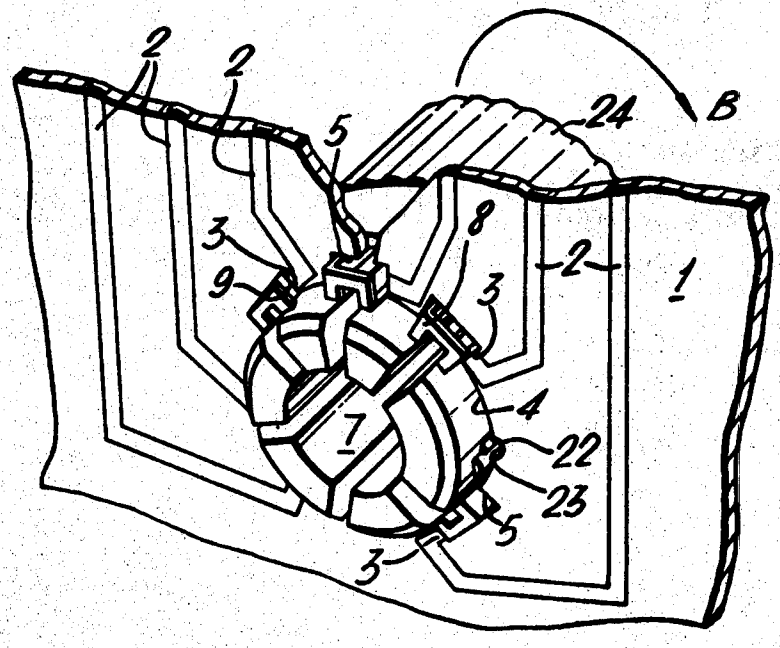


Fig. 2.



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ELECTRICAL CONNECTOR RECEPTACLES

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Fig. 3.

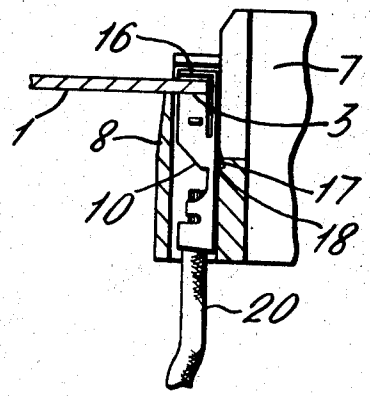
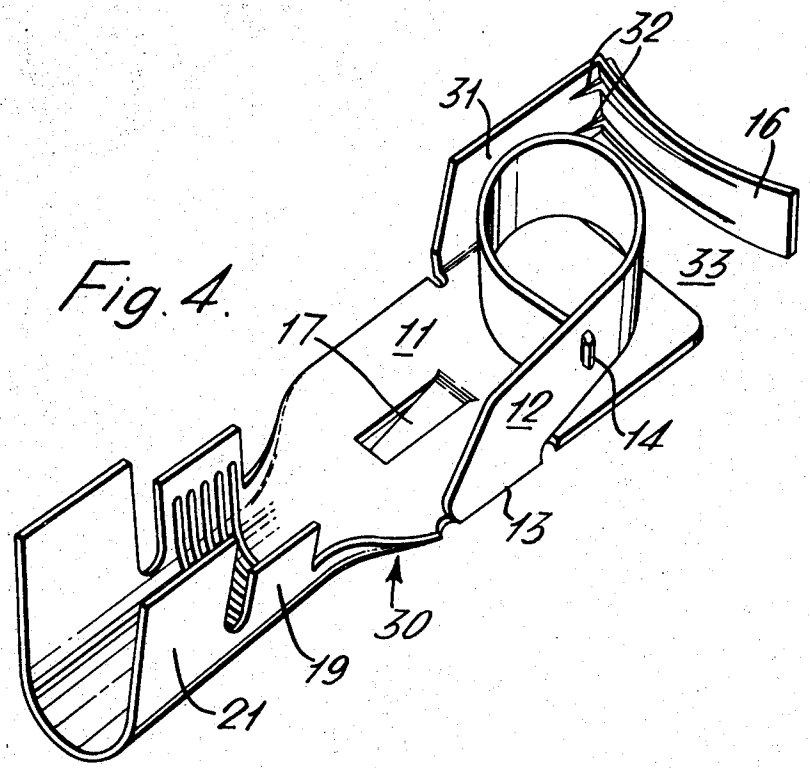


Fig. 4.



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ELECTRICAL CONNECTOR RECEPTACLES

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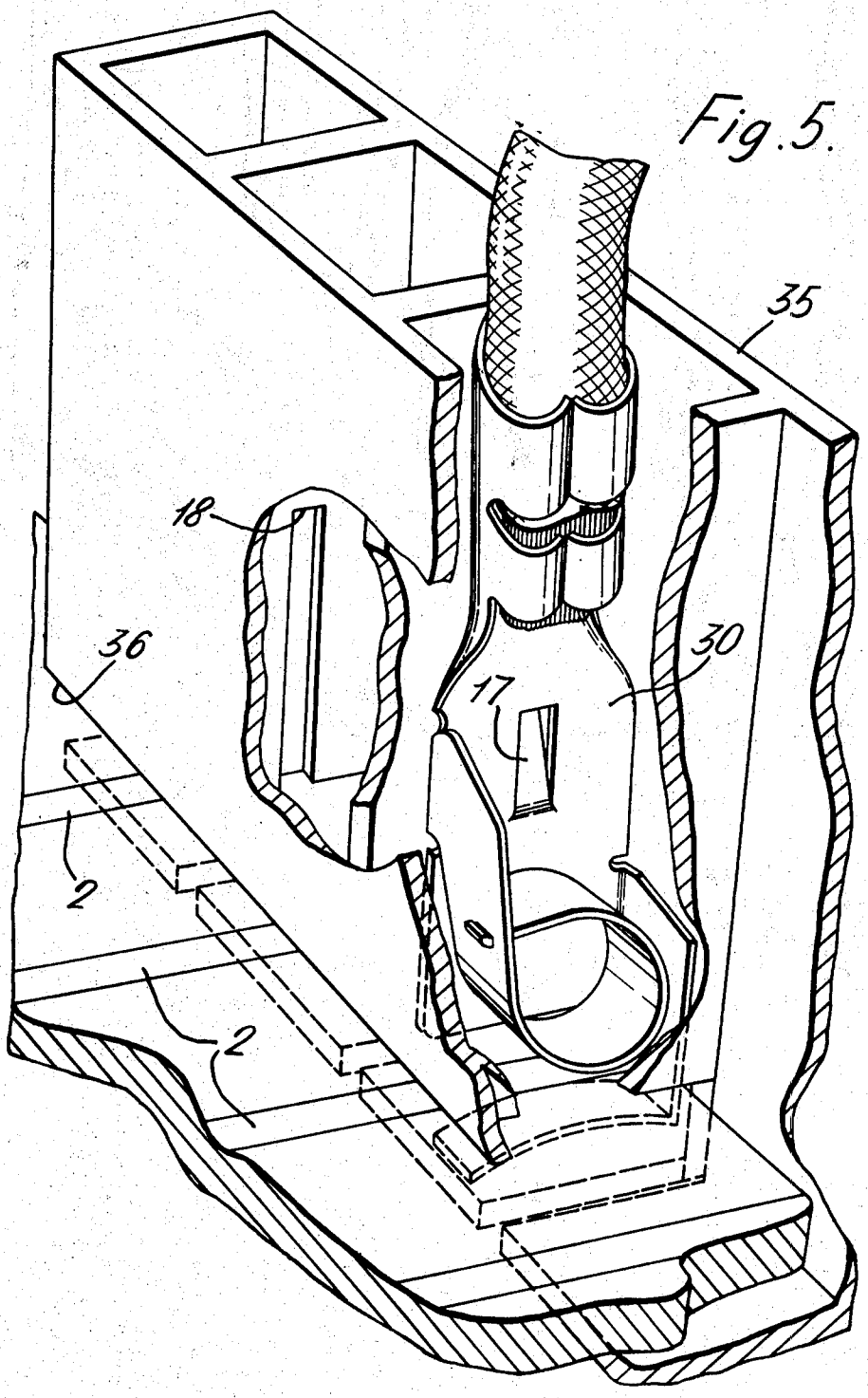
Fig. 5.



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ELECTRICAL CONNECTOR RECEPTACLES

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Fig. 6.

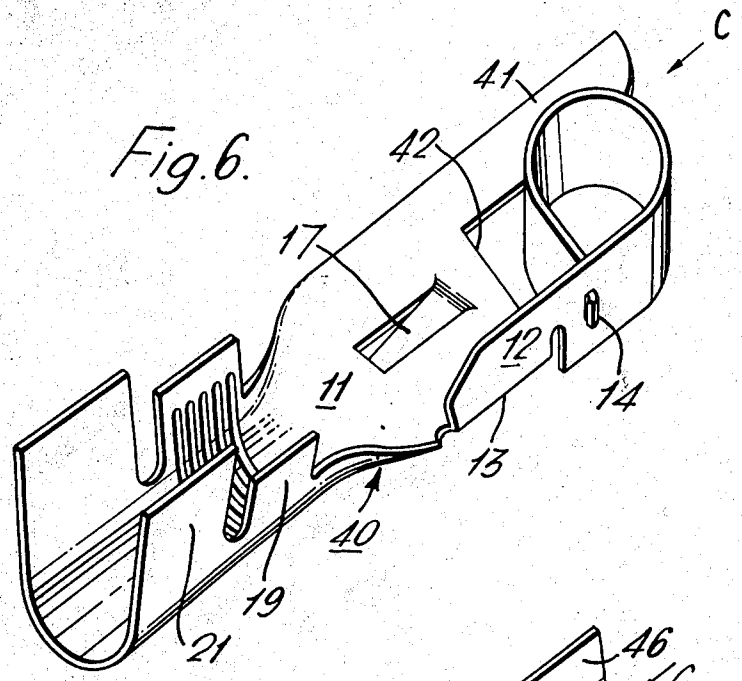
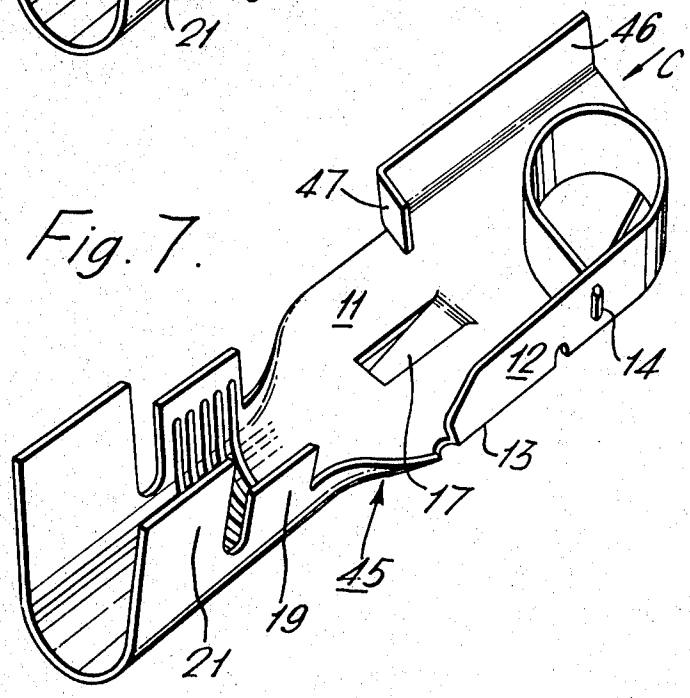


Fig. 7.



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ELECTRICAL CONNECTOR RECEPTACLES

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Fig. 8.

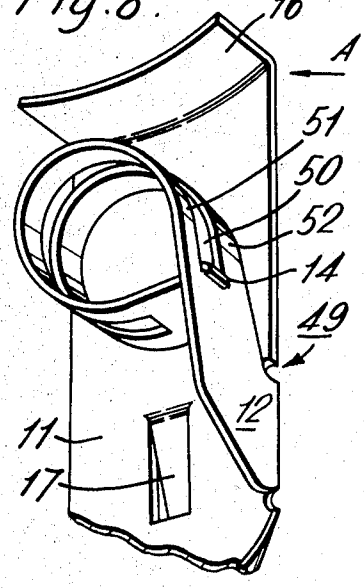


Fig. 9.

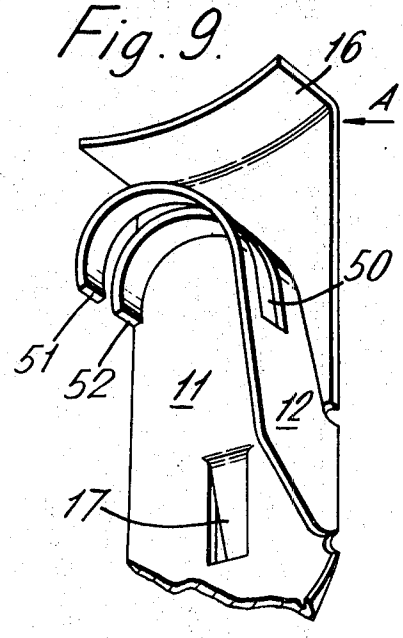


Fig. 10.

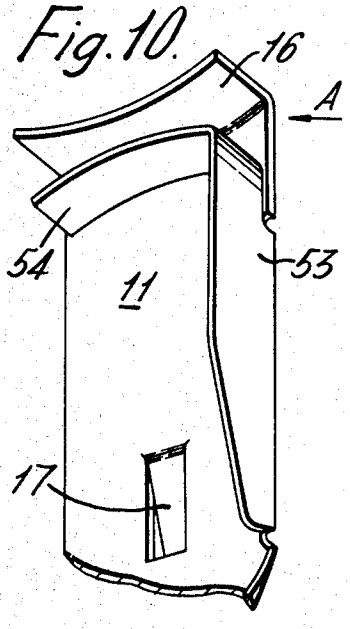
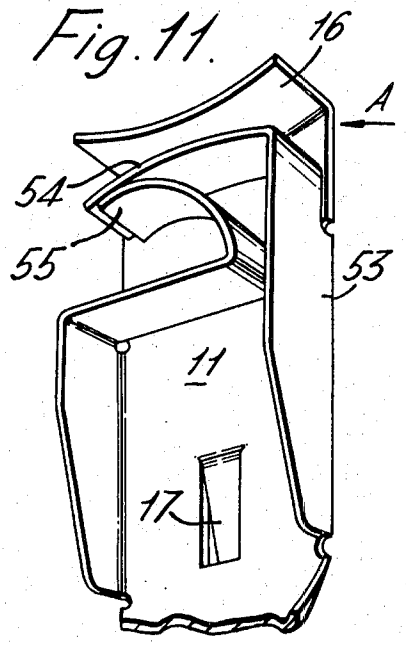


Fig. 11.



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3,566,344

ELECTRICAL CONNECTOR RECEPTACLES

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Claims priority, application Italy, May 15, 1967, 16,114/67
Int. Cl. H01r 13/12
U.S. Cl. 339—258 9 Claims

ABSTRACT OF THE DISCLOSURE

An electrical connector for engaging with the edge of a printed circuit board, tab or the like is made from one sheet of metal by bending up a spring portion which is at right angles to the plane of the connector and is curved in the direction of insertion of the board. A support part of the connector is also formed from the one piece of sheet metal and engages the nonconductive surface of the board.

This invention relates to an electrical connector receptacle adapted to receive and retain a mating electrical contact.

The mating electrical contact is primarily designed to be a conductive electrical surface on the face of a support board, such as a printed circuit board. However the invention is not limited in its application or use to such mating contacts and can effectively be used with tab or plug inserts of correctly dimensioned proportions.

In many applications a mating contact has to be connected to and disconnected from an electrical connector receptacle a great many times during the life of the apparatus of which it forms a part. It is therefore essential that no damage is done to the receptacle during either a connect or disconnect operation which would impair its properties, and it is also essential that these operations can be performed quickly and easily. However, one of the problems of any readily disconnectable receptacle is that if the mating contact is too easily withdrawable the contact pressures and general efficacy of the electrical contact formed are not high. Furthermore, if the receptacle is used in a situation which is subject to vibration there is a grave risk that the mating contact may be shaken out of engagement with the receptacle.

In order to overcome such problems connector receptacles have been proposed in which the two ends of a piece of sheet metal have been bent and bowed towards each other with their extreme ends flared outwards to ease entrance of a mating contact between them. Other receptacles have been formed by using two or more contact spring portions located in a block. Such prior proposals suffer from the disadvantage that good contact pressure cannot be achieved without providing indents in the surface of the sheet metal which scratch the surface of a mating contact or which, if the indents are omitted, are insufficient to withstand vibration. Multi-part contact springs located in a block are relatively difficult and expensive to produce.

It is an object of the present invention to provide an improved form of electrical receptacle which is cheap and easy to produce as an integral unit and which provides good spring contact pressures so as to be able to withstand location in vibrating environments. It is also an object to provide a receptacle with which a mating contact is repeatedly able to be engaged and disengaged without damage to either contact or receptacle.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken

in conjunction with the drawings in which there are shown and described illustrative embodiments of the invention; it is to be understood, however, that these embodiments are not intended to be exhaustive nor limiting of the invention but are given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

According to the present invention there is provided an electrical receptacle adapted to receive and retain a mating electrical contact comprising a curved spring contact part and a support part spaced from the spring contact part, the mating electrical contact being arranged to be inserted in the space between the two contact parts, in which the receptacle includes a base portion of sheet metal from which the spring part is integrally formed, the spring part being bent at right angles to the plane of the base portion and being curved in the direction of insertion of the mating contact, and in that the support part is also integral with the base portion and the base portion has means for connecting an electrical conductor to the receptacle.

In order that the invention may be readily understood different embodiments of an electrical connector receptacle in accordance with the invention will now be described with reference to the accompanying drawings.

In the drawings:

FIG. 1 shows a perspective view of a first form of contact;

FIG. 2 shows a switch housing and printed circuit board arrangement employing the receptacle of FIG. 1;

FIG. 3 shows a detail of a receptacle of FIG. 1 in part of the housing of FIG. 2;

FIG. 4 shows a second form of receptacle in a perspective view;

FIG. 5 shows in a perspective view the receptacle of FIG. 4 in broken section in a housing and engaging a printed circuit board; and

FIGS. 6 to 11 each show a separate further form of receptacle in perspective view.

Referring now to FIGS. 1 to 3, the receptacle is used here in a switch arrangement for making contact with a printed circuit board **1**. The board **1** has a number of conductive paths **2** on one surface. These paths each terminate in a separate land **3** and these lands **3** are spaced around an aperture **4** in the board **1**. At the area of the lands **3**, the aperture **4** has further recesses **5** into the board. The various recesses **5** are at different angles so that a polarizing effect can be given for an insert into the aperture **4**. A rotary member **7** comprising a housing of insulating material and carrying around its outer periphery a plurality of receptacle housings **8** is fitted into the aperture **4** with the receptacle housings **8** in the recesses **5**. The housings **8** are of a generally rectangular form and have one open side **9** facing the land **3** associated with each recess **5**.

As is shown best in FIG. 3, each receptacle housing **8** includes an electrical contact receptacle **10** of the kind as shown in more detail in FIG. 1. The receptacle **10** is formed from a single piece of sheet metal and comprises a base portion **11** from one side of which a spring contact part **12** is formed. The part **12** is of strip form and is fixed to base portion **11** at one end **13** and has its free end bent round to form an enclosed loop as shown. A tab **14** carried at this free end engages in a slot in the strip to retain the loop. The part **12** is bent up at right angles to the plane of the base portion **11** and the edge of part **12** lies on the base portion **11**. The part **12** is bent across the portion **11** at an angle *b* inclined from a front edge **15** of the receptacle.

The top end of the receptacle is bent upwards at right angles to the base portion **11** to form a support part **16**. This part **16** is curved to form an angle *a* with the direction of entry of a mating contact with the receptacle. This direction of entry is indicated by the arrow A. A locking lance **17** is pressed out of the base portion **11** to lock with a shoulder **18** in the receptacle housing **8** to retain the receptacle in the housing. The bottom end of the base portion has a crimping ferrule **19** adapted to be crimped onto the wires of a conductor **20** and an insulation-supporting ferrule **21** adapted to be crimped around the insulation of conductor **20**.

As is shown in FIG. 2, the housing **7** is provided with a locking and locating spigot **22** which engages on initial insertion in a further recess **23** in the board **1** at the edge of the aperture **4** and then passes beyond the board to permit rotation. The spigot and recess enable the housing to be accurately located before being locked to the board. The housing **7** is attached to a knob **24** by which it can be manually rotated in the direction of arrow B to make contact between the receptacles and the conductors on the board **1**.

In use the receptacles **10** are secured to respective conductors **20** and are inserted in the receptacle housings **8** from the bottom (FIG. 3) so that the lances **17** lock on shoulders **18** with the front edge **15** of the receptacles facing the open side of the housings **8** and the support part **16** at the top of the housings. The housing **7** is then inserted in the aperture **4** with the spigot **22** correctly locating the housings **8** with respect to the various lands **3** and conductors **2**. When this position is reached, the knob **24** is rotated in the direction of the arrow B which has the relative effect of moving the lands **3** and the board **1** in the direction of arrow A (FIG. 1). As the board reaches the receptacles, the back of the board, i.e. the part not carrying the conductive paths **2**, rides along the support path **16** until the leading edge of the board contacts the spring part **12**. Since the gap between parts **12** and **16** is slightly less than the thickness of the board, spring part **12** bends in the direction of arrow A increasing angle B until the gap is sufficient to admit the board. When the board moves into the gap, the land **3** moves over contact part **12**, and, due to the spring nature of this part, the board is pressed against the support part **16** and a wiping action between parts **12** and **3** takes place to ensure good electrical contact. Rotary movement stops when the edge of the board abuts the side of the housing **8** opposite the open side.

The board and receptacles are now held in good electrical contact and due to the spring action will withstand a large amount of vibration without becoming dislodged. No barbs or indentations are required to break the surface of the lands **3** to obtain good contact since the wiping and spring action does this. The thin conductive layer forming the lands **3** is thus not damaged and is able to be used after disconnection for other connections.

The disconnection can easily be made by rotating the knob **24** and thus housing **7** in the direction opposite to arrow B. When this happens the relative movement in FIG. 1 is withdrawal of the board in the direction opposite to that indicated by arrow A. At first the withdrawal will be resisted by the spring being pulled harder into engagement with the board **1**, but as the withdrawal force increases the spring part will bow, particularly between end part **13** and the tab **14** to increase the gap and permit withdrawal.

A second embodiment of a receptacle is shown in FIGS. 4 and 5 to which reference is now made. Similar parts in these and other figures to parts previously described with reference to FIGS. 1 to 3 have been given the same reference numerals. Receptacle **30** is modified over receptacle **10** in that the support part **16** is not attached to the top end of base portion **11** but to an extension **31** at the rear side of the base portion **11**. This extension **31** is bent over to form support part **16** and two ribs **32** are

pressed in it to make reinforcing struts. The extension **31** is at right angles to the base portion **11** and forms an end stop for the printed circuit board **1**. This receptacle is able, since there is a gap **33** between the top end of base portion **1** and support part **16**, to be slipped over the edge of a board **1** at any position along its edge and is not just limited to corner connections as in the previous embodiment.

Such an application is shown in FIG. 5 where a connector housing **35** is illustrated having one receptacle connector **30** in position. The housing is able to accept other receptacles in line for connection to different conductive paths **2**. The housing **35** has an opening **36** along its lower edge so that the edge of the board can fit into it and into the gap **33** of the receptacle **30** until it abuts the end stop **31**. When insertion occurs the conductive paths **2** will be wiped and contacted by the spring **12** in a similar manner to that described with respect to receptacle **10** previously. In all these embodiments it will be seen that the housing is merely an insulator and is not critical in its tolerances so that it can be easily produced with wide tolerances without affecting the quality of electrical contact achieved.

In a third embodiment of receptacle **40**, shown in FIG. 6 to which reference is now made, the support part is constituted by a part **41** of the base portion **11**. The spring part **12** extends through the plane of the base portion **11** so that when a mating contact, such as a printed circuit board, is pushed in the direction of the arrow C it contacts the spring part **12** on one side and the support part **41** on the other. The top end **42** of the base portion **11** acts as an end stop for the mating contact. The wiping action is the same as in the previous embodiments although a different part of the spring part **12** is used for wiping and contact than in the other two embodiments. This type of receptacle is useful where an "end-on" contact is to be made.

The receptacle **45** of FIG. 7 is also useful for "end-on" connections and employs a larger support part **46** than the part **41** of FIG. 6. This part **46** is formed by bending up a section of the base portion **11** at right angles to that portion. A free end **47** is further bent as indicated to give an end stop for the mating contact. The use of a large area support part **46** gives a more stable support than just an edge such as **41**.

FIG. 8 shows a receptacle **49** which is basically the same as that of FIG. 1 except that the spring part **12** is modified by the inclusion of a slit **50** dividing the part into two parallel sections **51**, **52** over the contact area. This has the advantage that a greater area of contact is possible if the mating contact received in the receptacle has an irregular contact surface. FIG. 9 shows a further modification of the receptacle of FIG. 8 where the curvature of the spring part **12** is permanently set and no tab **14** is necessary.

FIGS. 10 and 11 show modified forms of receptacles developed from FIGS. 8 and 9. In FIG. 10 the spring part is shown as having a straight section **53** and a bowed contact section **54**. The contact section **54** having a permanent set in it. In FIG. 11 the receptacle of FIG. 10 is modified by adding a backing part **55** integral with and bent up from the base portion **11**. This backing part **55** lends support to the spring section **54** when it is deflected and ensures good contact pressure. The base portion in each embodiment provides a guide and locating means for a mating electrical contact.

In all the examples illustrated and described a printed circuit board type of mating contact has been considered. Although these receptacles are extremely suitable for use with such boards they are not limited in their use only to them. Particularly, flat tab inserts may be used as mating contacts and even suitably dimensioned rounded plugs.

The receptacles are preferably constructed from a material such as brass or phosphor-bronze which has good

spring characteristics as well as good electrical conductive properties.

The receptacles are easy and cheap to produce from sheet material by stamping and forming methods already known and due to their design are able to hold mating contacts in environments subjected to high vibrations without affecting the contact pressure. Due to the resilient nature of the spring part a mating contact although easy to insert needs a much higher force for extraction than insertion.

In typical practical examples of the receptacle of FIG. 1 the angle *a* was set at about 30° and the angle *b* at about 10°, although these angles are not critical.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the particular embodiments of the invention, which are shown and described herein, are intended as merely illustrative and not as restrictive of the invention.

The invention is claimed in accordance with the following:

1. An electrical connector receptacle adapted to receive and retain a mating electrical contact comprising a base portion of sheet metal, an integral spring part having one end attached to said base portion and extending outwardly from said base portion, the spring part being bent at substantially right angles to the plane of the base portion and having a generally circular configuration thereby being curved in the direction of insertion of the mating contact with the other end of the spring part secured to the spring part, an integral support part extending outwardly from the base portion and spaced opposite said spring part thereby defining a contact-engaging area therebetween for receiving the mating electrical contact in the receptacle.

2. An electrical connector as claimed in claim **1**, including stop means integral with the base portion and positioned at the end of the contact-engaging area to limit the entry of the mating electrical contact into the receptacle.

3. An electrical connector as claimed in claim **1**, wherein the base portion provides a guide and locating means for the mating electrical contact.

4. An electrical connector as claimed in claim **1** wherein the spring part is divided along at least part of its length into a plurality of parallel contact sections.

5. An electrical connector as claimed in claim **1**, wherein the support part is formed as an extension of the base portion and extends in the same plane as the base portion so that the spring part extends through the plane of the base portion.

6. An electrical connector as claimed in claim **5**, wherein the top end of the base portion constitutes stop means for the mating contact.

7. An electrical connector as claimed in claim **1**, wherein a contact part of the spring part extends only along the length of the support part.

8. An electrical connector as claimed in claim **7**, wherein a backing part is arranged to support the contact part.

9. An electrical connector receptacle adapted to receive and mate with a mating electrical contact comprising a base portion of sheet metal, a support part integral with and extending outwardly from said base portion, a spring contact part having a substantially straight portion attached to said base portion and a curved portion forming a continuation of said straight portion, a section of said curved portion disposed opposite said support part defining a contact-engaging area therebetween, and a free end of said curved portion being bent round and secured to said straight portion thereby forming a loop.

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