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A. W. HANNA

3,081,528

METHOD OF MANUFACTURING FEMALE ELECTRICAL SOCKETS

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Fig. 1

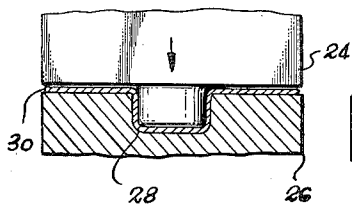


Fig. 2

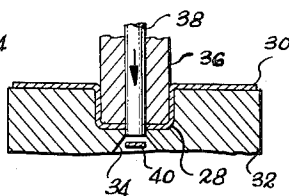


Fig. 3

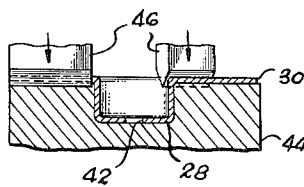


Fig. 5

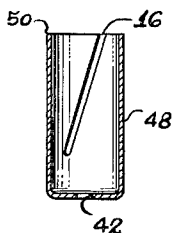


Fig. 6

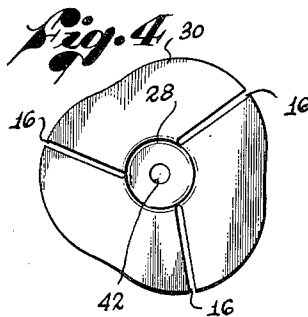
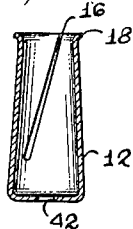


Fig. 7

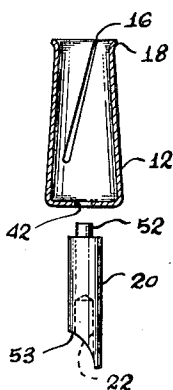


Fig. 8

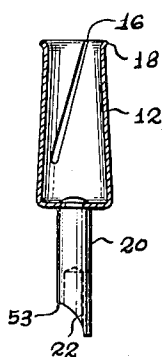


Fig. 9

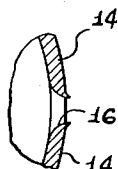
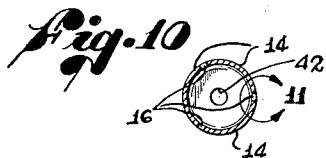
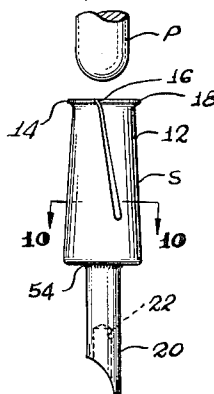


Fig. 11

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METHOD OF MANUFACTURING FEMALE ELECTRICAL SOCKETS

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The present invention relates to electrical connectors and more particularly to a female electrical connector and a method of manufacturing the same.

As electrical systems progressively become more complex, an increased number of electrical connectors are employed to interconnect component circuits. Of course, the greater the number of connectors used, the more important it becomes to provide a process by which connectors may be economically manufactured. Furthermore, when a large number of electrical connectors are used in a system, the reliability of the connectors becomes increasingly important.

It has previously been proposed to form a disengageable electrical connection by providing mating male and female electrical connectors. The female connector, i.e., socket, in such an electrical connection, normally exerts a spring force against the male connector, i.e., plug, to thereby provide improved electrical contact. One manner of effecting such a positive form of engagement is to provide longitudinal flex slots in the socket and taper the walls of the socket toward the plug-receiving opening by partly closing the flex slots. When the plug is inserted in a socket of this type, the slotted sections of the socket are deformed outwardly (widening the slots), thereby causing a spring force to be exerted against the plug. In manufacturing sockets of the above-described type, it has become somewhat common practice to machine the plug-receiving socket or receptacle and to thereafter cut the flex slots. Of course, various other manufacturing techniques also have been employed whereby the slots are cut after the socket is formed. As a result of these methods of manufacture, a substantial effort is required to properly face the interior surfaces of the socket and particularly those surfaces which lie adjacent to the slots. That is, during the process step of cutting the slots in the socket, rough and sharp edges are formed on the interior walls of the socket; these edges must be removed to prevent the plug from being scarred, and fail to make proper electrical contact. Of course, the manufacturing operation of surfacing the interior of the socket is expensive and complex.

Generally, connectors of the type described above provide good electrical contact and enable rapid disengagement; however, such connectors have, in the past, met with certain difficulties. The primary difficulty in using connectors of the type described above results from thin films of dirt, grease, or other insulating material which become coated upon the male connector or plug and prevent complete electrical contact between the members. As a result, care must be continually taken to assure that the plug of the electrical connecting means is clean.

The present invention, in general, provides an improved method of manufacturing a female connector, i.e., socket, which has flex slots positioned therein. The manufacturing process utilizes a drawing operation in combination with a slot-cutting operation whereby the socket is formed with an interior surface that is essentially free of burrs and sharp edges which would mar the mating plug. Furthermore, the present invention provides an improved form of a female electrical socket, having flex slots positioned therein in such a manner as to provide a scraping action upon a mating male connector to thereby maintain the male connector free of insulating films.

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A major object of the present invention is to provide an improved method of manufacturing a female electrical connector.

Another object of the present invention is to provide an improved and novel socket member of an electrical connector means.

Another object of the present invention is to provide a female electrical connector which incorporates means for automatically cleaning a mating male connector as the connectors are engaged and disengaged.

A further object of the present invention is to provide a method of manufacturing a female electrical connector in a more economical manner.

A further object of the present invention is to provide an improved and simplified method of manufacture for making female electrical connectors, which incorporate flex slots.

A still further object of the present invention is to provide a method of manufacturing a female electrical connector which does not necessitate the provision of expensive machinery.

These and other objects and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the appended drawings wherein:

FIGURE 1 is a vertical sectional view of the apparatus illustrating a first step in the process of the present invention;

FIGURE 2 is a vertical sectional view illustrating a second step in the process of the present invention;

FIGURE 3 is a vertical sectional view illustrating a third step in the process of the present invention;

FIGURE 4 is a plan view of a partially-completed connector, shown after the step illustrated in FIGURE 3 has been performed;

FIGURE 5 is a vertical sectional view of a partially-completed connector shown after a fourth step in the process of the present invention has been performed;

FIGURE 6 is a vertical sectional view of a partially-completed connector, shown after a fifth step in the process of the present invention has been performed;

FIGURE 7 is a vertical sectional view of a partially-completed connector, illustrating a sixth step in the process of the present invention;

FIGURE 8 is a vertical sectional view of a partially-completed connector shown after a seventh step in the process of the present invention has been performed;

FIGURE 9 is a perspective view of a female connector constructed in accordance with the principles of the present invention;

FIG. 10 is a horizontal sectional view taken along the line 10—10 of FIGURE 9; and

FIGURE 11 is an enlarged sectional view taken along the line 11—11 of FIGURE 10.

Referring to FIGURE 9 of the drawings, there is shown a socket S which illustrates the process of the present invention. Of course, sockets of other structure may be manufactured in accordance with the present invention; however, the socket S incorporates certain improvements which has a generally-cylindrical tapered cavity to receive a plug P and thereby provide an electrical connection. The socket S includes a generally-cylindrical tapered member 12, one end of which is closed, the other end being open to receive the plug P. The cylindrical member 12 is divided into tines 14 by slots 16 which are transverse to the axis of rotation of the cylinder member 12 and do not extend the full length of the member 12. The cylindrical member 12 is tapered toward the open end thereof and incorporates a lip 18 which is outwardly turned from the open end to guide the entry of the plug P. The closed end of the cylinder member 12 has a conductor-connecting lug 20 af-

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fixed thereto, which includes a bore 22 for receiving an electrical conductor (not shown). The lug 20 is terminated in a section which is transverse to the bore 22, to provide an enlarged opening into the bore 22, and facilitate the insertion of an electrical conductor.

In using the electrical connector incorporating the socket S and the plug P, the plug P is placed within the lip 18 and urged into the cylindrical member 12. The small end of the cylindrical member 12 has an internal diameter which is less than the external diameter of the plug P; therefore, the tines 14, forming the cylinder 12, are stressed outwardly by the insertion of the plug P. The stressed tines 14 exert forces against the plug P and provide a firm contact between the plug P and the socket S to normally effect good electrical contact. However, in the event that a film of insulating material is coated upon the plug P, a uniform and complete electrical connection may not exist between the plug P and the socket S. In certain electrical systems, and particularly in systems utilizing high-frequency signals, complete and uniform connection between the annular exterior surface of the plug P and the annular internal surface of the socket S is extremely desirable.

As previously stated, the slots 16 in the cylindrical member 12 are transverse to the axis of rotation. That is, the slots 16 are of a greater length than the depth in the cylindrical member 12 penetrated by the slots. As a result, when plug P is inserted in the socket S, a substantial portion of the annular surface of the plug P passes under the slots 16 and the plug P is scraped by the edges of the tines 14 which lie adjacent to the slots 16, thereby cleaning the plug P by removing small particles or insulating films coated on the plug P.

It may, therefore, be seen that by forming the slots 16 in the cylindrical member 12 in the manner described above, proper electrical connection between the plug P and the socket S is more certainly assured with the result of considerably decreased maintenance requirements for the electrical system incorporating this means of connection.

An inventive process of forming the female socket of the present invention will now be considered. Referring to FIGURE 1, there is shown a male die 24 engaged with a female die 26 to produce a cup 28 in a sheet 30 of metal. The sheet 30 may comprise various metals including beryllium-copper or other metals having good electrical-conducting characteristics and which may be drawn.

After the cup 28 has been drawn in the sheet 30, the cup is placed in a die 32 (FIGURE 2) which has a bore 34 positioned immediately below a center section of the bottom of the cup 28. A die stamp 36 then enters the cup 28 mating with the die 32 to support the cup 28, while a punch 38 (coaxially mounted in the die stamp 36) passes into the bore 34 to punch a piece 40 from the cup 28. The piece 40 may, of course, be of various shapes.

The sheet 30 containing the cup 28 with the piece 40 thereof removed, to form a hole 42, is now placed in a die 44 (FIGURE 3). The sheet 30 is next pierced by punches 46 to form the slots 16 as shown in FIGURE 4. The slots 16 are angularly spaced from one another and extend outwardly from the cup 28 to the edge of the sheet 30. As illustrated, the slots are arranged on a bias or are offset from alignment with the central axis of the cup. It is to be noted, that the punches 46 are arranged to form the slots 16 so that when the sheet 30 is drawn to extend the depth of the cup 28, the slots 16 will be formed transverse to the axis of the cup.

The sheet 30, as shown in FIGURE 4, is next placed in a die similar to that shown in FIGURE 1, with a considerably deeper cup, and drawn into the cylindrical form 48 shown in FIGURE 5. The material extending beyond the upper end 50 of the form 48 is removed. It

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is to be noted that as the form 48 is drawn, the punch-receiving side, i.e. upper surface, of the sheet 30 is formed on the interior of the form 48.

The form 48 is next shaped into the cylindrical member 12, as shown in FIGURE 6, with the curved lip 18 and slight taper toward the open end effected by partial closure of the slots 16 near the open end of the member 12. This forming operation may be performed by dies or other metal-forming operations in accordance with well-known techniques. The cylindrical member 12 is now ready to receive the lug 20. The lug 20 (FIGURE 7) comprises a shank containing a bore 22 and having a coaxial extension 52 thereon. The extension 52 on the lug 20 is positioned through the mating hole 42 and riveted to the cylindrical member 12 as shown in FIGURE 8. By riveting these members together, a rigid mechanical structure is provided. The electrical connection between the cylindrical member 12 and the lug 20 is then assured by placing solder 54 between these members.

In forming a female socket in accordance with the above-described process, the internal surfaces of the tines 14 which lie adjacent to the slots 16 contain no burrs or rough edges, due to the manner in which the punching operation illustrated in FIGURE 3 is performed. That is, because the punching operation is performed by urging punches or cutters into the surface which later forms the interior of the socket, a form as shown in FIGURE 11 results. Therefore, the metal adjacent the slots 16 is outwardly turned with the result that there is no necessity for these surfaces to be polished or filed to provide a smooth surface and prevent the plug P from being scarred.

It may therefore be seen that the present invention provides an improved electrical female connector, or socket, the use of which is accompanied by substantially-reduced maintenance due to a cleaning action exerted upon a mating plug. Furthermore, the present invention provides an improved process of making an electrical socket, which affords considerably economy by the avoidance of a difficult manufacturing operation.

It should be noted that although the particular embodiment and illustrative process of the invention herein shown and described is fully capable of providing the advantages and achieving the objects previously set forth, such embodiment and process are merely illustrative of this invention and, therefore, modifications and changes may be made thereto without departing from the spirit of the invention or the scope of the following claims.

I claim:

1. A process for forming a female electrical socket which comprises the steps of: drawing a cup in the central portion of a sheet of electrically conductive workable metal to leave an annular flange portion at the periphery of said cup; punching a plurality of equally spaced relatively narrow slots in said flange portion from the side thereof which is continuous with the internal surface of said cup toward the side thereof which is continuous with the external surface of said cup, whereby the forming burrs are created only on the last mentioned side of said flange portion, said slots extending from said cup to the periphery of said sheet; and drawing the flange portion of said sheet at the periphery of said cup into a cylindrical form which is a continuation of said cup and which has a plurality of slots similar to said punched slots.

2. A process for forming a female electrical socket which comprises the steps of: drawing a cup in the central portion of a sheet of electrically conductive workable metal to leave an annular flange portion at the periphery of said cup; punching a plurality of equally spaced relatively narrow slots on a bias in said flange portion from the side thereof which is continuous with the internal surface of said cup toward the side thereof which is continuous with the external surface of said cup, whereby the forming burrs are created only on the last mentioned side of said

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flange portion, said slots extending from said cup to the periphery of said sheet; drawing the flange portion of said sheet at the periphery of said cup into a cylindrical form which is a continuation of said cup and which has a plurality of slots similar to said punched slots; and affixing an electrical connection to said cup.

3. A process for forming a female electrical socket which comprises the steps of: drawing a cup in the central portion of a sheet of electrically conductive workable metal to leave an annular flange portion at the periphery of said cup; punching a plurality of equally spaced relatively narrow slots in said flange portion from the side thereof which is continuous with the internal surface of said cup toward the side thereof which is continuous with the external surface of said cup, whereby the forming burrs are created only on the last mentioned side of said flange portion, said slots extending from said cup to the periphery of said sheet; drawing the flange portion of said sheet at the periphery of said cup into a cylindrical form which is a continuation of said cup and which has a plurality of slots similar to said punched slots; and forming an outwardly curved lip at the open end of said cylindrical form.

4. A process for forming a female electrical socket which comprises the steps of: drawing a cup in the central portion of a sheet of electrically conductive workable metal to leave an annular flange portion at the periphery of said cup; punching a plurality of equally spaced relatively narrow slots on a bias in said flange portion from the side thereof which is continuous with the internal surface of said cup toward the side thereof which is continuous with the external surface of the cup, whereby the forming burrs are created only on the last mentioned side of said flange portion, said slots extending from said cup to the periphery of said sheet; drawing the flange portion of said sheet at the periphery of said cup into a cylindrical form which is a continuation of said cup and which has a

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plurality of slots similar to said punched slots; forming an outwardly curved lip on the open end of said cylindrical form; and affixing an electrical connection to said cup.

5. A process for forming a female electrical socket which comprises the steps of: drawing a cup in the central portion of a sheet of electrically conductive workable metal to leave an annular flange portion at the periphery of said cup; punching a plurality of equally spaced relatively narrow slots on a bias in said flange portion from the side thereof which is continuous with the internal surface of said cup toward the side thereof which is continuous with the external surface of said cup, whereby the forming burrs are created only on the last mentioned side of said flange portion, said slots extending from said cup to the periphery of said sheet; punching a hole in the bottom of said cup; drawing the flange portion of said sheet at the periphery of said cup into a cylindrical form which is a continuation of said cup and which has a plurality of slots similar to said punched slots; applying forming pressure inwardly to the walls of said cylindrical form adjacent the open end thereof to close said slots and taper the walls of said cylindrical form; forming an outwardly curved lip at the open end of said cylindrical form; and affixing an electrical connector in said hole.

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