Sept. 5, 1967 S. T DEAKIN 3,340,491

ELECTRICAL SOCKET CONNECTORS AND OTHER ELECTRICAL CONTACT DEVICES

Filed April 17, 1964 2 Sheets-Sheet 1

FIG. 1

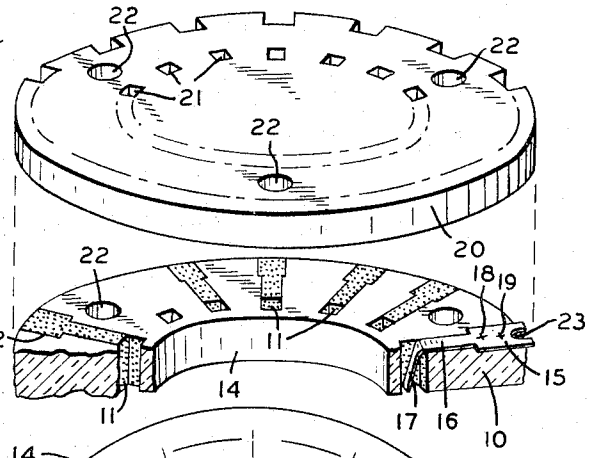


FIG. 2

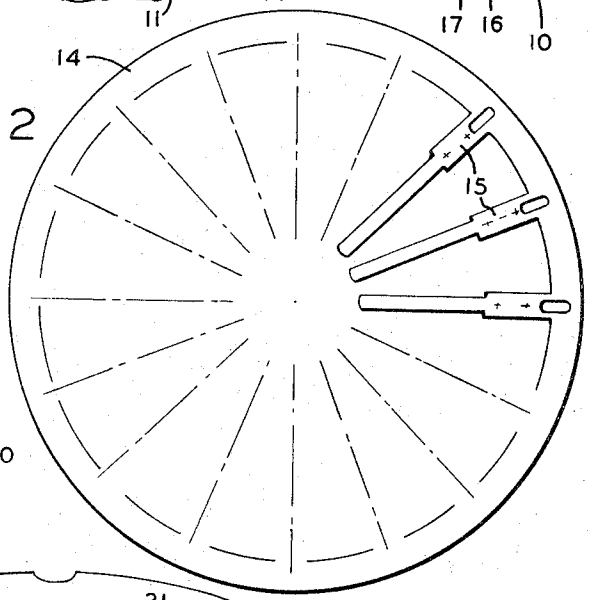
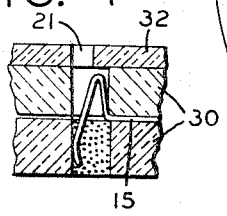


FIG. 4



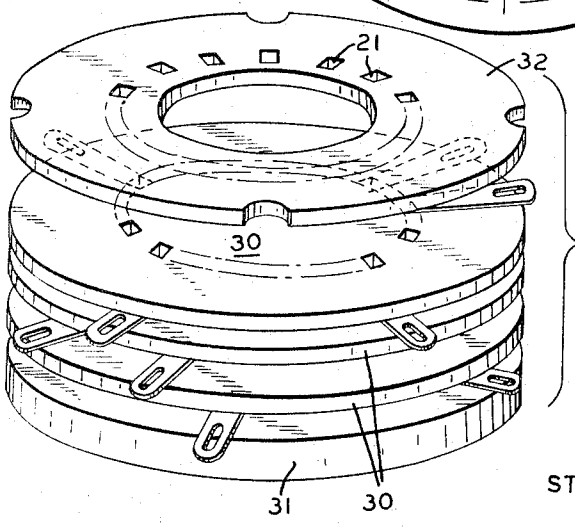


FIG. 3

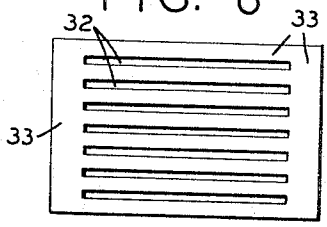
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FIG. 6



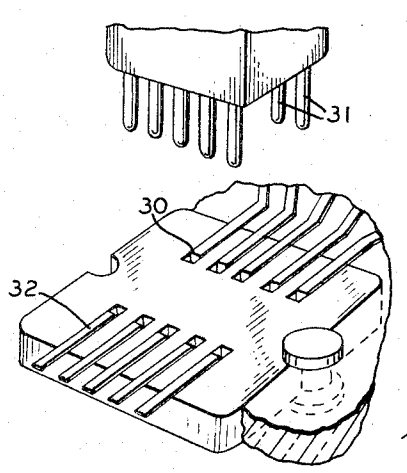


FIG. 5

FIG. 8

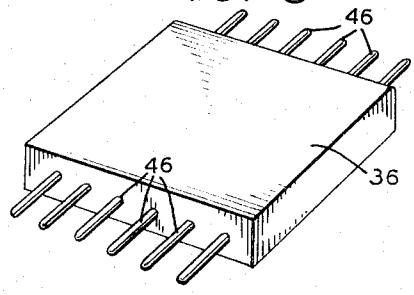


FIG. 7

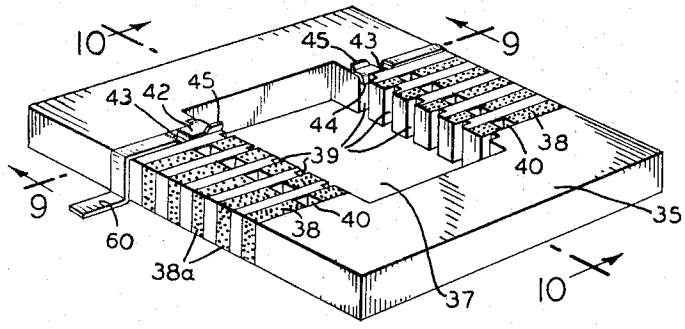


FIG. 11

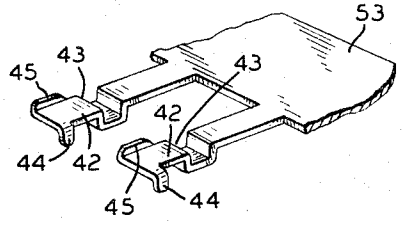


FIG. 9

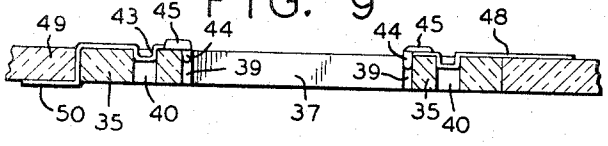
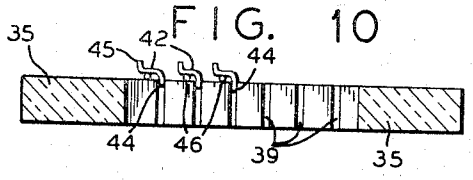


FIG. 10



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United States Patent Office 3,340,491 Patented Sept. 5, 1967

3,340,491

ELECTRICAL SOCKET CONNECTORS AND OTHER ELECTRICAL CONTACT DEVICES

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Filed Apr. 17, 1964, Ser. No. 360,703
Claims priority, application Great Britain, Apr. 18, 1963, 15,400/63
5 Claims. (Cl. 339—17)

The invention relates to electrical socket connectors, plug, switches and other electrical contact devices of the kind having a body (e.g. of plate or disc form) of insulating material carrying at least one electric contact which, in use, makes pressure or sliding engagement with a co-operating contact. The invention is particularly, but not exclusively, concerned with electrical socket connectors of the kind having a support body or plate of insulating material, a plurality of sockets in the support body for receiving the pins or wires of a transistor, valve or other electrical plug, each socket having means for making an electrical connection with the pin or wire. The invention is especially applicable to such devices of small size. The invention also relates to a method of making such devices.

It is an object of the invention to provide various improvements in devices of the above kind and in the manufacture thereof.

The invention provides an electrical contact device of the above kind in which the contact is provided by a metallic coating on the body.

The device may have a separately constructed resilient contact secured to the body and opposed to the coated contact to receive and grip between them a separating contact. Preferably the resilient contact is welded or soldered to a metallic coating on the body which may be a part, or an extension, of the coated contact.

When the invention is applied to a socket connector, the body may be of glass with a socket or sockets etched therein and coated with metal to provide socket contact surfaces.

The invention also provides the method of making an electrical socket connector which comprises the steps of exposing to light selected portions of a body of photo-sensitive glass to render the body more readily soluble by etching acid in the region where a socket is required, etching the body to form the socket and coating with metal the internal surface of the socket and an area of the external surface of the body extending from the mouth of the socket.

The photo-sensitive glass used is preferably of the kind in which the etching rate of exposed portions is greater than the etching rate of unexposed portions or vice versa and it may be of the kind sold by the Corning Glass Works under the trade name "Fotoform." After the sockets have been formed, the glass may be converted to its ceramic form. The exposure may be effected through a negative, or a positive, of the desired socket pattern.

The invention further provides the method of making a multi-socket electrical socket connector which comprises the steps of exposing to light selected portions of a body of photo-sensitive glass to render the body more readily soluble by etching acid in the regions where sockets are required, etching the body to form the sockets, forming on the body metallic coatings lining the sockets and extending from the sockets individually over portions of the external surface of the body, welding or soldering to the coatings on the external surface of the body a sheet metal unit shaped to comprise a multiplicity of resilient contacts, one for each socket, joined together by narrow ties, inserting portions of the contacts into the sockets and cutting the ties to separate the contacts.

The metal coating may be applied by the techniques used in the art of decorating ceramic wares (e.g. china ware) and it may be applied to the whole surface of the body and the unwanted areas removed by etching or it may be applied (e.g. by a silk screen printing operation) to the wanted areas only. To coat internal (i.e. socket faces) bores, a metallic paste may be carried into the bores on pins and surplus removed by suction. The paste is heated after application as practiced in the art aforesaid.

The method may, in addition, include the steps of inserting a spring contact strip into the sockets, said strip having an extension projecting from the socket and overlying the metallic coating on the external surface of the glass body and securing the extension to the coating.

The contact strips or the contact unit may be produced by etching from sheet metal.

Thus the spring contacts may be constructed by a method which comprises first forming a unit by etching a sheet of metal to provide a blank in the form of a continuous ring which internally is conveniently, but not necessarily, larger than the support plate, and a number of arms extending inwardly (like spokes) from the ring, bending the ends of the arms downwardly to form spring legs, placing the blank on the support with the legs entering into the sockets, attaching the bases of the arms to the support, and cutting away the ring leaving the individual springs held in position by the attachments of their arms to the support.

The spring contact strips may be arranged both themselves to make electrical connection with the wires or pins of a plug inserted into the sockets and to urge these wires or pins into electrical contact with the metallic linings of the sockets.

The connector may comprise a stack of such support plates each arranged as described above and each having the same number and arrangement of sockets, there being several through sockets in the stack each of which is provided by corresponding sockets in the several support plates, one of which corresponding sockets is internally coated has a spring and a metal strip extending to the periphery of the support plate, the socket so provided being in different plates for the different through sockets, whereby some pins or wires of an electrical plug connect with one support plate of the stack and some with another support plate of the stack. This arrangement enables the ends of the metal strips to be spaced apart axially of the stack as well as around the periphery of the support plates.

Some specific examples of electrical socket connectors according to the invention and a modifications thereto will now be described with reference to the accompanying diagrammatic drawings in which:

FIGURE 1 is an exploded perspective view of the first connector showing how the connector is constructed,

FIGURE 2 is a plan view of the blank from which the spring contact strips are made,

FIGURE 3 is a perspective view of a second connector with the cover plate removed,

FIGURE 4 is a section through a modified connector,

FIGURE 5 is a perspective view showing another form of socket connector with its associated plug,

FIGURE 6 shows a contact unit from which the resilient contacts of FIGURE 5 are produced,

FIGURE 7 shows, in perspective, a further form of connector,

FIGURE 8 shows the form of plug to be used with the connector of FIGURE 7,

FIGURE 9 is a cross-section, on the line **9—9**, through the connector of FIGURE 7 in position in a panel,

FIGURE 10 is a cross-section on the line **10—10** in FIGURE 7, and

FIGURE 11 shows a portion of the contact unit used in the construction of the connector of FIGURE 7.

As can be seen from FIGURE 1 the first embodiment of an electrical socket connector comprises an annular support plate or body **10** providing a ring of sockets **11**. The support plate **10** is made from photo-sensitive sheet or plate glass which is sold under the trade name "Fotoform." The sockets **11** are made by masking the photo-sensitive glass with a negative of the desired socket pattern, and exposing the masked glass to ultra-violet light. The portions of the glass which have not been exposed are very much more readily etched than the exposed portions (the solubility ratio of unexposed to exposed portions in hydrofluoric acid is about 15:1) and when the negative has been removed the selectively exposed glass is immersed in hydrofluoric acid to etch away the exposed glass to form the sockets. The glass is then converted to its ceramic form.

The next stage in the manufacture is to produce metal coatings on selected areas of the support plate **10**, these areas being the insides of the sockets and strips **12** extending from the individual sockets to the edge of the plate. The metal (e.g. copper) is applied as a paste and subsequently sintered, as in the decoration of ceramic wares. The paste is carried into the sockets on pins, any surplus being removed by vacuum and is applied either as strips **12** using a silk screen printing technique or over the whole area of the plate, the metal between the strips subsequently being removed by photo-etching.

The next stage is to produce the blank shown in FIGURE 2 from a sheet of rhodium plated beryllium copper or beryllium nickel. This is done by etching from sheet material using a photo-sensitive resin resist and a master negative. If desired the inner ends of the arms may be connected to a central ring, subsequently removed.

The blank shown in FIGURE 2 comprises an annular ring **14** with arms **15** extending inwardly from the ring **14**. Each arm **15** has to be bent to the shape shown in FIGURE 1 with a portion **16** to overlie the metal strip **12** and a spring arm **17** bent downwardly from the portion **16** to lie inside the socket **11**.

The step of bending the spring arm **17** downwardly can be accomplished by means of a two part mould, one part of which is placed on one side of the blank of FIGURE 2 and the other part of which is placed on the other side of the blank. When the two parts of the mould are pushed together the arm **15** is bent to the desired shape.

The shaped blank is placed over the support plate with the bent arms **17** entering into the socket and each arm **15** is welded at **18** and **19** to its corresponding metal strip **12**. The outer ring **14** is then cut off to leave each arm **15** as an individual unit held in position on the support plate.

As shown in FIGURE 1 a cover plate **20** may be placed on the finished support plate **10** and the cover plate will have sockets **21** corresponding to the sockets **11** so that the pins or wires of an electrical plug can be pushed through sockets **21** into the sockets **11**. The spring arms **17** hold the wires or pins in contact with the metal coatings on the insides of the sockets **11** and in addition themselves make contact with the wires or pins.

The cover plate **20** may be formed by etching in a similar way to the support plate **10** and the cover plate and the support **10** may be held together by means of pins or rivets passing through holes **22** etched in the support plate and the cover plate.

In use of the connector the support plate **10** is placed inside a mating socket forming part of a printed circuit support or the like, and the strips **12** are welded or soldered to corresponding connections in the circuit. For this purpose there are notches **23** formed in the edges of the arms **15** so that connection can be made to the strips **12** directly.

FIGURE 3 shows a modified form of connector comprising a stack of four support plates **30**. Each of the support plates **30** is formed in exactly the same way as the support plate **10** in the first embodiment, with the exception that each support plate **30** has only some of its sockets **11** coated internally, with corresponding metal strips **12** and arms **15**. When the pins or wires of a plug are pushed into the connector of FIGURE 3 some of the pins will make connection with the coated sockets in one support plate **30** and others will make contact with coated sockets in another support plate **30**. Thus the ends of the metal strips **12** to be connected to an outside circuit are staggered at different levels in the stack for ease of connection.

The connector shown in FIGURE 3 may be provided with a base **31** without socket holes and a cover plate **32** with holes **21**.

FIGURE 4 shows a modified way in which the spring arms **15** may be bent. This form may be used in a connector (e.g. that of FIGURE 3) where there are two stacked support plates **30** or more such plates as in FIGURE 3.

It is not essential that the sockets be arranged in a ring. They may, for example, be in rows as seen in FIGURE 5 in which the sockets are shown at **30** and the pins of a plug contact are shown at **31**. The contact strips **32** extend to the edge of the support and are originally produced in the form of a grid as seen in FIGURE 6. Before attachment the arms of the grid are divided at the centre and the two parts bent downwardly and after attachment the bars **33** are removed.

FIGURE 7 shows another form of connector adapted to receive a plug of the form shown in FIGURE 8. The connector body **35** shown in FIGURE 7 is of glass as above described and has a central aperture **37** to receive the body **36** of the plug, the aperture being somewhat longer than the plug. Along each of the longer sides of the connector body there is a row of strips **38**, **38***a* of metal coating on the body. The strips **38***a* on one side of the body also extend down the side face. At the inner end of each strip the body has a notch **39** and adjacent the inner end there is a recess or hole **40**. Welded or soldered to each strip there is a resilient contact **42**. These contacts, which are received between the recess **40** and the outside edges of the body, have locating depressions **43** and tags **44** which are secured in the recesses **40** and notches **39** (see FIGURE 9). The side edges of the contacts are bent upwardly near the ends as seen at **45** to provide lead-in ramps for the pins **46** of the plug which, as seen in FIGURE 10, are engaged under the ends of the contacts and between these ends and the underlying strips of metal coating. The ends of the row of contacts on one side of the body project in the plane of the upper surface of the body as seen at **48** in FIGURE 9 and after insertion of the body into a hole in a support panel **49** these ends are soldered to a circuit printed on the top surface of the panel. The ends of the other row of contacts are cranked downwardly, as shown at **50**, to lie against the under surface of the panel and are secured to a circuit printed on this surface. The contacts may be etched from a sheet in a manner analogous to that shown in FIGURE 6 and the connecting ties cut off after attachment. FIGURE 11 shows a portion of the unit after bending of the contacts and before removal of the tie **53**.

The photo-sensitive glass and the photo-sensitive resist have been described as being exposed through negatives and positives and it is to be understood that the terms negatives and positives are intended to include metal masks as well as images on the normal photographic plates, films or other supports.

The invention may be applied to miniature switches in which there will be a support of glass or other moulding material with one or more metallic contacts coated thereon, with or without resilient contacts attached thereto, to receive in sliding or pressure contact, the contacts of a companion switch member.

I claim:

1. An electrical socket connector, plug, switch or other electrical contact device comprising a body of insulating

material carrying at least one electric contact provided by a metallic coating on the body and a separately constructed resilient contact secured to a metallic coating on the body of insulating material, said first named metallic coating and said resilient contact being arranged to make electrical connection with opposite sides of a cooperating contact inserted between them.

2. A device as claimed in claim 1 in which said second named metallic coating is a part of said at least one metallic contact.

3. A device as claimed in claim 1 in which said second named metallic coating is an extension of said at least one metallic contact.

4. An electrical socket connector as claimed in claim 1 in which said body has at least one socket and in which said resilient contact projects into the socket.

5. An electrical socket connector as claimed in claim 1, in which said body is of glass with at least one socket formed therein, said socket being coated on its internal surface with metal to provide said at least one metallic contact.

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