

[54] **PANEL MOUNTED ELECTRICAL
TERMINAL**

[72] Inventor: **Frank Irvin Douglass**, Mechanic-
sburg, Pa.
[73] Assignee: **AMP Incorporated**, Harrisburg, Pa.
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Related U.S. Application Data

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1968, abandoned.
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[51] Int. Cl. **H01r 9/08**
[58] Field of Search **339/220, 218, 256, 258, 262,**
339/276, 217

[56] **References Cited**

UNITED STATES PATENTS

3,237,149	2/1966	West.....	339/256
3,541,496	11/1970	Castellani	339/220 R
3,091,838	6/1963	Hild et al.	29/155.55
2,533,987	12/1950	Bahr	173/361

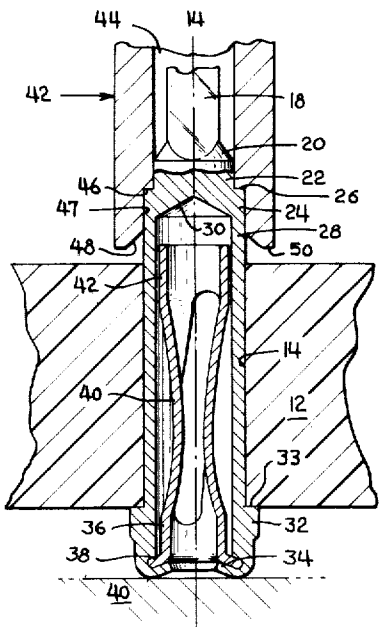
1,656,856 1/1928 Gagnon.....339/220 T

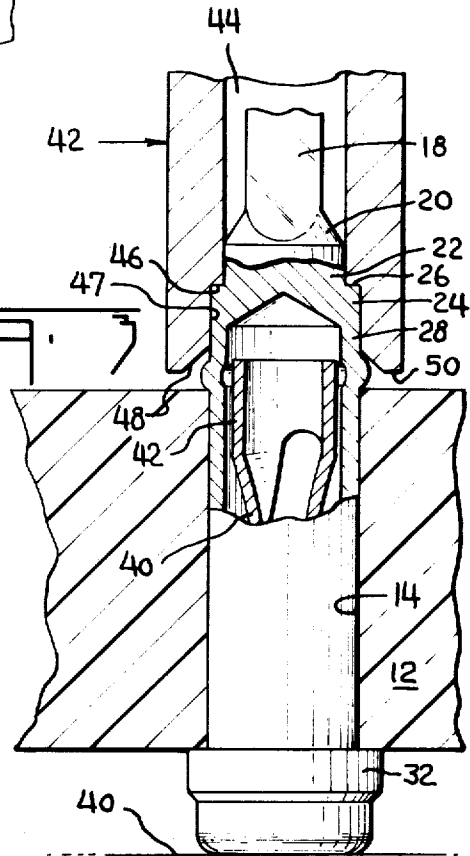
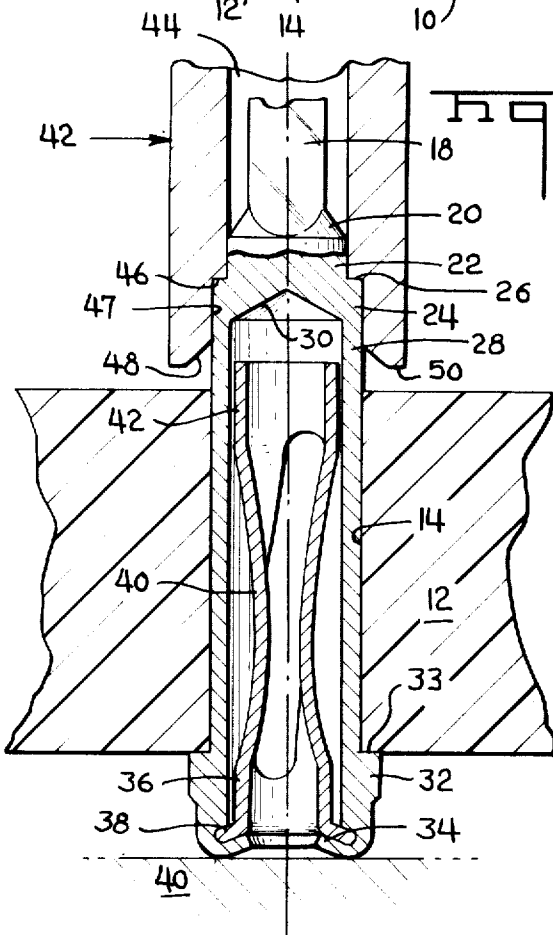
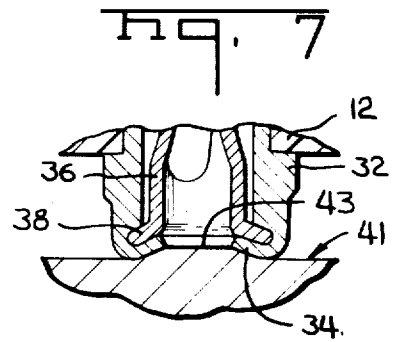
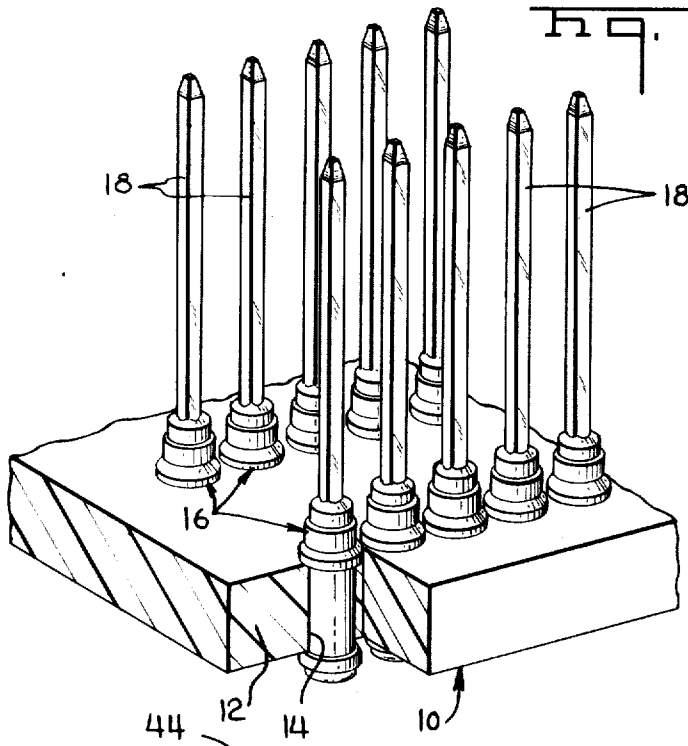
Primary Examiner—Marvin A. Champion
Assistant Examiner—Robert A. Hafer
Attorney—Curtis, Morris and Safford, Marshall M.
Holcombe, William J. Keating, Frederick W. Raring,
John R. Hopkins, William Hintze, Adrian J. La Rue,
Jay L. Seitchik, Gerald K. Kita, John R. Flanagan and
Allan B. Osborne

[57] **ABSTRACT**

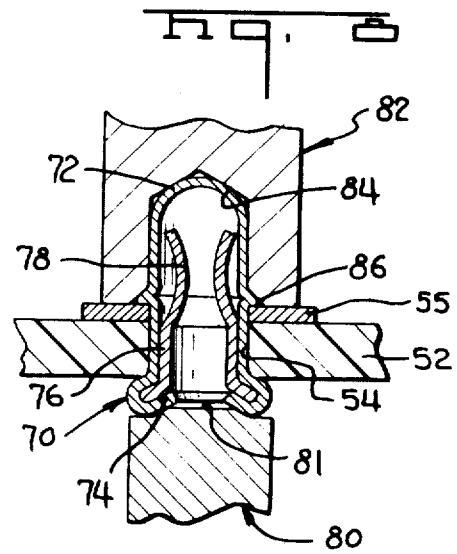
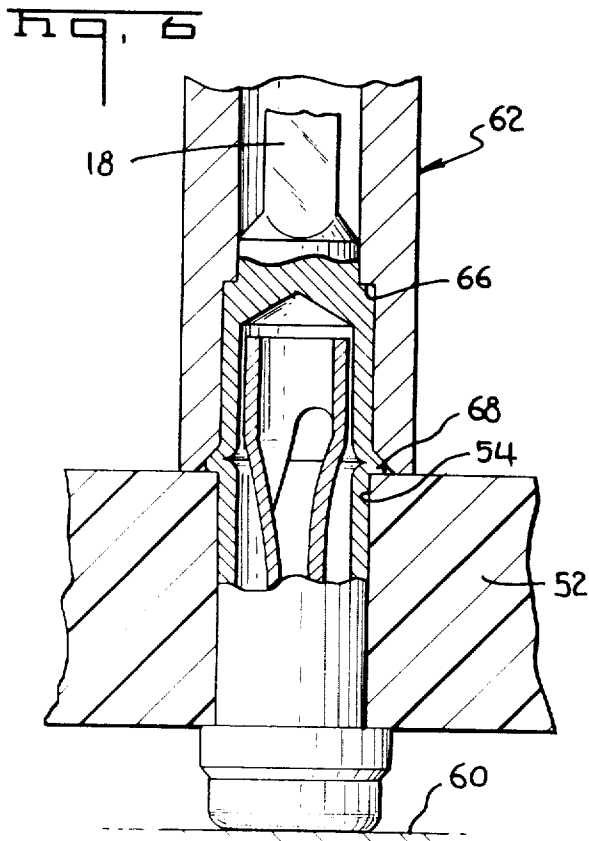
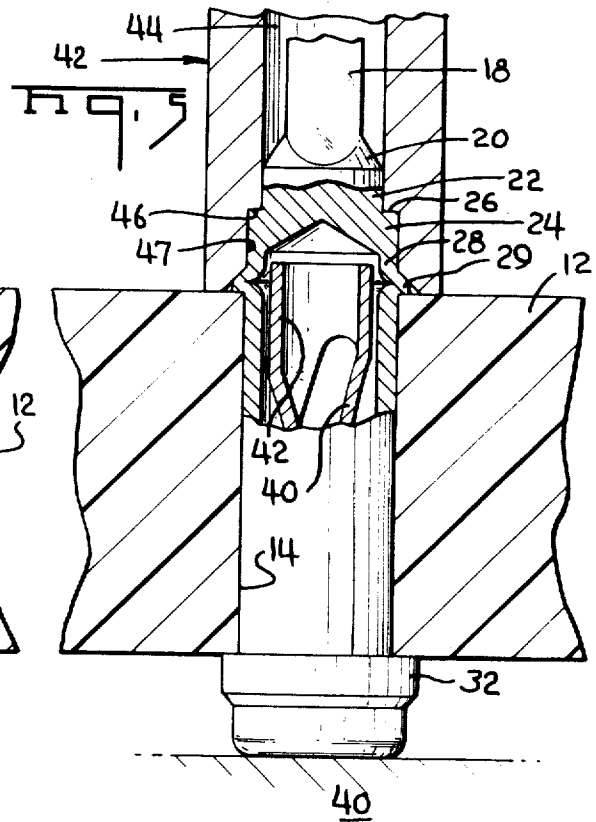
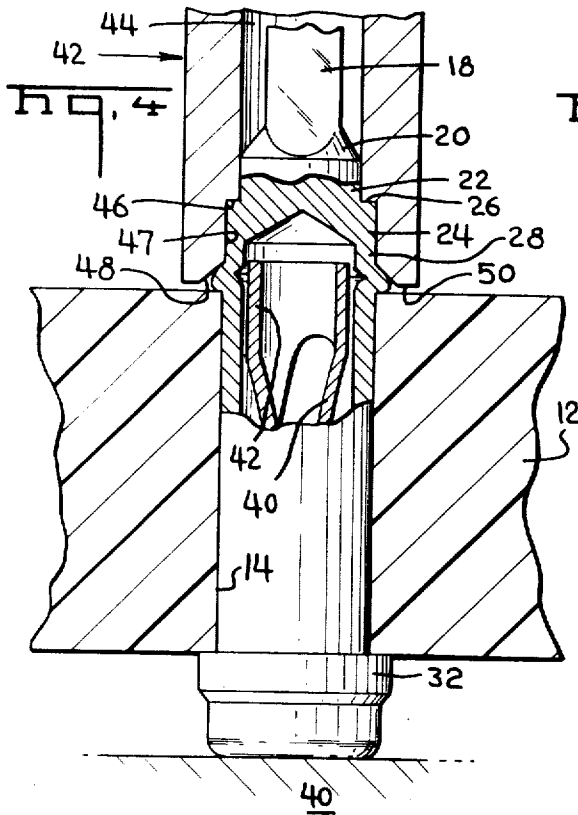
A method and article for mounting electrical contacts in a panel is disclosed which features a headed metal tubular element carrying a spring contact adapted to be inserted in an aperture of a panel. The tubular portion of the element is dimensioned to be symmetrically compressed longitudinally by tooling to develop an outward annular bulge capable of locking the element tightly into panels of different thicknesses. Bulging of the contact element is controlled to permit large numbers of contacts to be mounted in a plastic panel without causing panel growth and incident misalignment of elements. The tubular element is of a configuration to assure adequate deformation without damage to a preassembled spring contact carried therewithin.

4 Claims, 8 Drawing Figures





INVENTOR.
FRANK IRVIN DOUGLASS
BY *John R. Higgins*



INVENTOR
FRANK IRVIN DOUGLASS
BY
John R. Hopkins

PANEL MOUNTED ELECTRICAL TERMINAL

This application is a continuation of prior copending application, Ser. No. 756,809, filed Sept. 3, 1968, now abandoned.

BACKGROUND OF THE INVENTION

The need for precision placement of electrical contacts arises in many instances. In connection matrices wherein a relatively large number of terminal posts are secured in a panel in an array adapted for wiring by automatic machinery each terminal must be placed within a given close tolerance of a center referenced to the overall dimension of the panel. In other instances terminal matrices are interconnected by multiple connectors carrying an array of contact springs in a plastic housing on fixed centers which require a rather exact placement of panel-carried terminals mated therewith. In still another example, a matrix of terminal receptacles mounted in a panel are engaged by the multiple leads of circuit modules, each having a number such as fourteen or sixteen individual terminals which must be plugged into the terminal receptacles. Misalignment of receptacles results in considerable hand labor, and possible damage to the assembled elements.

A constant problem faced in the foregoing applications is one of a phenomena termed "panel growth." This phenomena is caused by the incremental build-up of stresses in a panel due to wedging terminals through panel apertures. Panel growth may result in a panel becoming warped or cracking or fracturing, or in perhaps a greater problem resulting in misalignment of terminals. For example, in a panel having an array of one hundred terminals in a line across a given dimension, specified to be on, for example, 0.100 of an inch centers, the individual stresses created by wedge-fitting terminals into the panel will cause a gradual off-centering of terminals as more and more terminals in a given line are inserted. This may occur even though the apertures are drilled in a precise center-to-center spacing.

In addition to the foregoing problem, many applications call for connections which may be readily disconnected and replaced, which practice leads to the use of spring contact members associated with panel mounted terminals. A frequent configuration finds a panel carrying on one side an array of terminal posts which may be interwired by automatic machinery or by hand through a variety of techniques with such posts connected to contact springs mounted in receptacles in the panel accessible from the other side. A number of prior art terminal structures have been devised for this type of application which are either quite complex in terms of number of parts or assembly steps required or functionally limited in terms of providing a stable interconnection which can be repeatedly made and broken without deterioration of contact interface. In applications wherein the terminal dimensions are very small, as on the order of ten or twenty thousandths of an inch in cross-section, the use of elements which must be hand assembled in a panel becomes so impractical as to preclude any use in matrix type terminal applications.

SUMMARY OF THE INVENTION

The present invention relates to a method and article for mounting electrical contacts in panels.

It is an object of the invention to provide a method of mounting very small electrical contacts in the form of

terminals, receptacles and the like, which is simple and inexpensive in terms of elements employed and steps required. It is another object to provide a method, article and tooling which facilitates mounting of arrays of relatively large numbers of electrical contacts in panel structures of different thicknesses without causing panel growth. It is a further object to provide an electrical contact article which facilitates a mounting in a panel which is sufficient to withstand both torque and axial stresses incident to various termination techniques presently being employed. It is still a further object to provide an electrical contact spring receptacle of a configuration permitting deformation for mounting in panels of different thicknesses in preassembled form.

The foregoing objects are attained by the invention through an electrical terminal and contact structure including a headed metal tubular element carrying a contact spring therewithin which is preassembled in terms of being mechanically and electrically connected thereto. The walls of the element and the exterior configuration are arranged so that the element may be compressed in a longitudinal sense to be plastically deformed presenting an outwardly directed annular bulge of the wall material locking the element within a panel by engagement of opposing surfaces of the panel. In accordance with the method of the invention and the structure of the article, the annular bulge occurs essentially outward of the panel aperture to prevent loading of the panel material in a radial sense causing panel growth. The method of the invention contemplates control of the dimensions of the element and application tooling to assure the plastic deformation but at the same time precluding interference with the contact spring disposed within the element. In one embodiment the contact article includes a terminal post extended from the tubular portion. In another embodiment the invention contemplates a socket adapted to be interconnected to a panel by such techniques as flow soldering or the like.

Referring now to the drawings:

FIG. 1 is a perspective view in partial section of a portion of a panel, considerably enlarged from actual size;

FIG. 2 is a sectional view showing one of the contacts of FIG. 1, further enlarged, with a compressing tool disposed thereon just prior to deformation of the contact;

FIG. 3 is a view similar to that of FIG. 2, but at a point after the application of compressive forces and initial deformation of the contact;

FIG. 4 is a view similar to FIG. 3, showing deformation of a contact in an intermediate stage;

FIG. 5 is a view similar to FIG. 4 showing deformation of a contact in a final stage, just prior to removal of the compressing tool;

FIG. 6 is a view of the final stage of deformation of a contact in use with a panel of lesser thickness than that shown in FIGS. 2-5;

FIG. 7 is a sectional view of the head end of a contact in conjunction with a support plate of an alternative configuration; and

FIG. 8 is a sectional view showing an alternative contact construction in the final stage of compression by a compressing tool.

Referring now to FIG. 1, a portion of a terminal matrix 10 is shown to include a panel 12 containing a series of apertures such as 14, each having an electrical contact 16 fitted thereto and locked to the panel. The panel 12 is typically of a plastic sheet material such as is used to make printed circuit boards. Each contact includes a terminal post 18 supported to extend upwardly from a surface of the panel with the various posts 18 disposed in a parallel line or row relationship. The posts 18 serve to provide terminations for the contacts which may be made in any number of ways, including the well-known techniques of wrapping wires thereabout and forcing wires into engagement through the use of clips or the like applied over a post, or through engagement with multiple connectors carried in a common block, commonly mounted on a given row or line. Each of the contacts 16 is made to extend through the panel 12 and each includes in an illustrative embodiment a contact spring as shown in FIG. 2, adapted to receive a lead or conductive strip or member inserted therein. Typically, a number of leads extended from a given component module may be inserted in portions of two rows of contacts.

In accordance with one aspect of the invention, panel 12 might contain a large number of contacts 16; panels forty inches long having posts on 0.100 of an inch centers not being unknown in the art. For those termination techniques wherein the terminal posts 18 are interwired by automatic tooling, the center-to-center spacing of the post is quite critical. The longitudinal disposition of the post is also critical, but this may be fairly easily corrected if the post is on a proper center. If the post is not on the proper center, however, bending the post will only result in a longitudinal misalignment. As previously mentioned, post misalignment can occur, due to growth of the board 12 in turn caused by the incremental build-up of stresses created by contacts being wedge-fitted into board apertures. In accordance with the present invention, the contacts 16 are mounted within the apertures 14 of the panel 12 without appreciably loading the material of the panel. FIGS. 2-5 depict the method of the invention in the process of achieving a deformation of the contact which avoids panel growth. Before turning to a detailed description of this method, reference will be made to FIG. 2 and to the details of the contact illustrated thereby.

The contact 16 is comprised of two pieces; an outer metal element including an upper post portion integrally joined to a lower tubular portion, and a metal contact spring 36 fitted therewithin. The post portion 18 is flared outwardly as at 20 into a solid region of metal 22 of cylindrical outer configuration, as shown in FIGS. 1 and 2, which then joins the tubular portion which is of a larger diameter through a step forming a radial surface 26 extending around the periphery of the element. The tubular portion shown as 28 includes an interior bore 30 extending therealong and opening opposite to the post portion in a head portion 32, which includes a radial surface 33. The head portion 32 includes a flange 34, shown in FIG. 2 as being folded over and deformed inwardly to clinch the contact spring 36 and hold such against displacement relative to the tubular portion. Clinching 36 also provides a stable electrical contact between 36 and the tubular portion and

thus the post portion of the contact. The contact spring 36 may be of any suitable configuration, but is preferably made in the manner shown to accommodate pins or leads of different diameters inserted therein. In the embodiment shown in FIG. 2, the contact 36 has inwardly bowed spring arms 40 which define on the inner surfaces thereof contact points for engagement with a pin or lead inserted within the spring. The arms 40 are joined to a tubular portion 42 which ties the ends of the springs together to stabilize and strengthen the contact spring. The contact spring 36 is made to be a little shorter in length than the length of bore 30 for reasons which will be appreciated from the description to follow.

In accordance with the invention, as illustrated in FIGS. 2-5, the contact 16 is made to have an outer diameter in the tubular portion approximately equal to the diameter of the aperture or hole 14 which is drilled, punched or otherwise formed in panel 12. The contact is fitted into such hole in the position shown in FIG. 2, with the radial surface 33 abutting one of the major surfaces of the panel to limit movement of the contact in an axial sense in one direction relative to the panel. The contact in such position is then caught between a fixed surface 40, which may be considered as part of the tooling and a tool head shown as 42. The tool head 42 includes an interior bore 44 of a diameter and length to receive the post 18 of the contact, extended freely therewithin. The bore 44 is of a diameter to receive in a sliding fit that portion shown as 22 of the contact and thus to support the contact in a radial sense in such region. Toward the lower end of bore 44 is a radial surface 46 which is dimensioned to bear against surface 26 of the contact. Adjacent surface 46 is a further bore 47 which is of a diameter to receive in a sliding fit portion 24 of the contact and to support the contact in such region against deformation. Adjacent bore 47 is a flared or beveled portion 48 which serves as a relief to permit outward deformation of the contact in the region of 28. The tool 42 ends in a flat surface 50 on the lower portion thereof. In accordance with the invention concept, the tool 42 is driven axially against the contact with the flange portion 46 bearing against surface 26 to an extent to cause the contact to buckle and bulge outwardly as shown by numeral 29 in FIG. 3. At this time the tool bore 47 prevents plastic deformation of the contact in the region of the contact engaged by the surface of bore 47 and the relief defined by the flared portion 48 permits an outward bulge of the contact at 29. I have discovered that the board aperture surface, even when defined by a plastic material, tends to restrict bulging of the contact elsewhere along the length of the contact. As can be observed from FIGS. 2 and 3, the contact is solidly formed in the region above the zone of outward bulge of deformation and above the point of application of deforming forces. The contact is also dimensioned relative to the tooling so that the forces applied to the tooling effect an outward and not inward bulge of the material of the contact.

As shown in FIG. 4, the tooling is further driven to cause a further collapse and outward annular bulging of the material of the contact and to shape the outward bulging by the engagement of the material of the outer wall of the contact with the surface 48. As this occurs the forces tending to deform the contact are applied to

a broader area of material. FIG. 5 shows the tooling in a position with the lower surface 50 bottoming against the surface of the panel 12 and with the material of the contact bulged and deformed outwardly and down against the upper surface of the panel. Care must be taken not to overdrive the tooling so as to shear the walls of the tubular portion 28 at 29.

As can be discerned from FIG. 5, the length of the contact spring 36, relative to the length of the bore 30 in the contact is made to accommodate shortening of the contact due to the outward bulging and deformation thereof.

The contact as shown in FIG. 5 and also as shown in FIG. 1 is effectively locked against any axial displacement relative to the panel or aperture 14 thereof between the flange surface 33 of the head of the contact and the bulged portion 29. Somewhat surprisingly, the locking action achieved through the deformation indicated in FIG. 5 has been found to also resist torque loads applied to the contact through the application of wires spirally wrapped around the post portion 18 and placed under tension. As previously mentioned, deformation of the contact indicated in FIG. 5 has been found to result in an inappreciable stressing of the panel material, notwithstanding the fact that the panels of use are typically of an insulating plastic material.

FIG. 6 shows the contact 16 heretofore described being applied to a panel shown as 52, which is substantially thinner than 12. In accordance with the invention, the contact is caught between a surface 60 which is part of the tool and a tool head 62 similar to the tool head 42 previously described, but with a radial surface 66 spaced further away from the interiorly beveled relief shown as 68 and corresponding surfaces of the previously mentioned tool. As shown in FIG. 6, the application of compressive forces by the tooling results in an outward bulge and deformation of the wall of the contact to lock the contact into the panel. This deformation is approximately the same in extent as in the previously mentioned embodiment, only displaced downwardly to accommodate the thinner panel.

FIG. 7 shows an alternative embodiment of a part of the tooling corresponding to fixed surfaces 40 and 60 previously described. In the embodiment of FIG. 7 the lower or fixed surface of the tooling shown as 41 is made to include a raised portion shown as 43, which has a configuration to fit within the head of the contact and increase the bearing area therewith. The tooling of FIG. 7 has been found to stabilize the compressing operation to prevent cocking of the contact and to further minimize the change of damaging the contact and in particular the mounting of the contact spring therein. One of the more critical steps of the method of the invention is to assure that the deforming force is applied evenly or symmetrically to the contact. The embodiment of FIG. 7 also helps in this respect.

FIG. 8 shows an alternative embodiment of contact 70 in the process of being mounted in a thin panel 52 apertured as at 54 and made to include a conductive path shown as 55, which may typically be a foil or the like, as used on printed circuit boards. The contact 70 is comprised of a thin walled metal shell having a rounded end as at 72 closing the shell at one end. At the other end the shell material is deformed inwardly as at 74 to trap and connect a contact spring 76

therewithin. The contact spring includes a plurality of spring arms 78 extended down within the shell. The tooling shown in FIG. 8 includes an element 80 having a raised and beveled portion 81 to partially enter contact 70 and a tool head 82 similar in function to the tool heads previously described. The tool head 82 includes a bore of a length to receive the end portion of the shell of the contact ending in a relieved beveled surface 86. It has been found that by making the bottom of the bore of the tool head to include a relieved surface like 84 (formed for example by an included angle of approximately 120°) a contact having a rounded end can be longitudinally compressed to effect the bulging shown in FIG. 8. It is felt that the shape of the surface 84 better assures the application of forces causing a compression of the contact in the manner indicated in FIG. 8.

In an actual embodiment like that shown in FIGS. 1-7, the contact outer shell was screw-machined out of brass with the post portion thereafter being coined into a 0.025 x 0.025 of an inch square cross-section. The portion numbered 22 of the contact was approximately 0.040 of an inch in diameter with the tubular portion of the contact being approximately 0.050 of an inch in diameter. The tubular portion had a wall thickness of approximately 0.005 of an inch and the tubular portion was approximately 0.165 of an inch in length. The contact was staked into a phenolic board roughly 0.125 or 0.063 of an inch in thickness having apertures on the order of 0.052 of an inch in diameter to provide a slight interference fit when the contact was inserted therein. Tooling of the configuration shown in FIG. 2 or in FIG. 6 was driven to develop a compressive force of approximately 60 to 75 pounds to effect the deformation indicated in FIG. 5. Contacts so staked readily accepted up to 2.5 ounce inch pounds torque without twisting in the panel.

In the examples previously given, one embodiment of the invention has been detailed which includes a post extended from one end of the contact and another embodiment has been detailed which includes the closed end shell having no post thereon. The invention fully contemplates applications wherein the shell may be opened-ended, as for example by changing the shape of the configuration shown in FIGS. 1 and 2 by removing the post and having an aperture extending into the shell. The invention contemplates having exteriorly therefrom contact members of other configurations extending longitudinally of the shell or exteriorly therefrom with or without a spring portion. The invention also contemplates having dielectric or insulating inserts carrying contact posts or other contacts mounted within the shell and inserted therefrom for feed-through or shielded application; the important criteria being that the shell includes a portion shaped relative to the tooling to provide the collapsing action herein described.

Having now disclosed the invention in terms intended to enable a preferred practice thereof, claims are appended which are intended to define what is asserted to be inventive.

I claim:

1. In an electrical contact member adapted for mounting within an aperture provided in a panel, the combination comprising: an elongated post portion and

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a generally tubular portion provided on said contact member, said post being joined to said tubular portion by a generally solid transition region of the contact member said generally tubular portion being adapted for insertion within said aperture provided in said panel, a protruding head portion adjacent one end of said tubular portion defining a first radial surface around the periphery of said tubular portion for engagement on said panel, a substantially non-deformable second radial surface around the periphery of said tubular portion and in spaced relationship from said first radial surface, said tubular portion including a deformable-by-buckling-and-bulging portion which is located between said first and said second radial surfaces and which is adapted for radially outward bulging upon the application of compression forces on said substantially non-deformable second radial surface, said deformable-by-buckling-and-bulging portion of said tubular portion being purposely spaced from said substantially non-deformable second radial surface to allow said radially outward bulging at a location spaced

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from said substantially non-deformable second radial surface.

2. The structure as recited in claim 1, and further including: a substantially non-deformable portion of said tubular portion interposed between said second radial surface and said deformable-by-buckling-and-bulging portion of said tubular portion.

3. The structure as recited in claim 1, wherein, said deformable-by-buckling-and-bulging portion is further collapsible upon the application of deforming forces directly thereon, said deformable-by-buckling-and-bulging portion being engagable on said panel upon the application of said deforming forces directly thereon.

4. The structure as recited in claim 2, wherein, said deformable-by-buckling-and-bulging portion is further collapsible upon the application of deforming forces directly thereon, said deformable-by-buckling-and-bulging portion being engagable on said panel upon the application of said deforming forces directly thereon.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,704,441 Dated November 28, 1972

Inventor(s) FRANK IRVIN DOUGLASS

It is certified that error appears in the above-identified patent
and that said Letters Patent are hereby corrected as shown below:

Claim 1, column 7, lines 10 and 11, delete "tubular
portion" and insert - - - transition region - - - .

Signed and sealed this 10th day of April 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents