Dec. 8, 1970 W. R. EVANS 3,545,080

METHOD OF MAKING RESILIENT PINS

Filed May 16, 1967 4 Sheets-Sheet 1

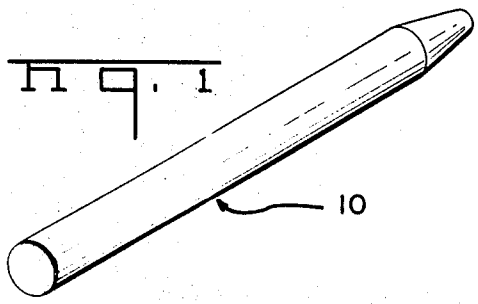

Fig. 1

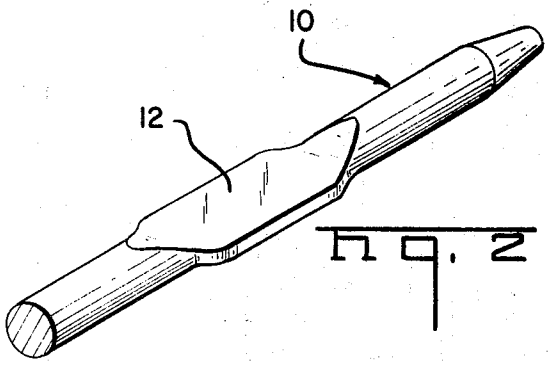

Fig. 2

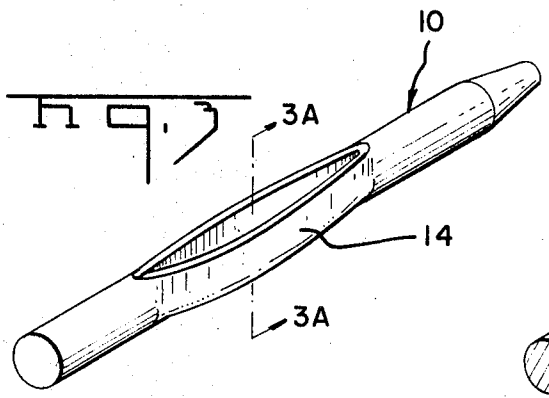

Fig. 3

Fig. 3A

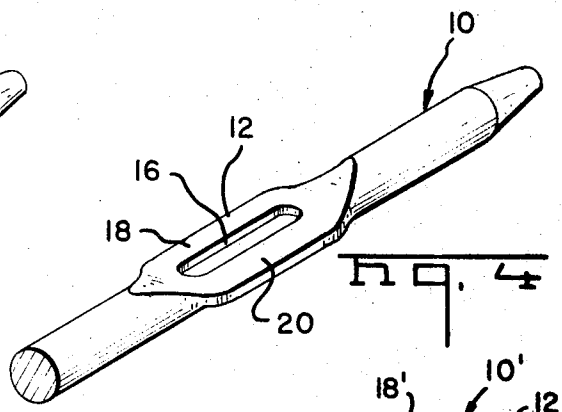

Fig. 4

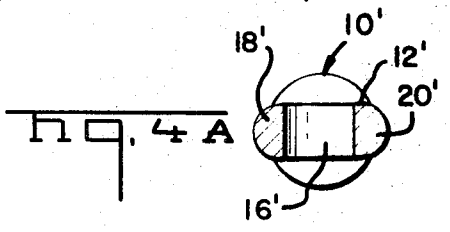

Fig. 4A

Fig. 5

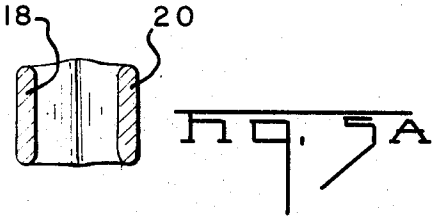

Fig. 5A

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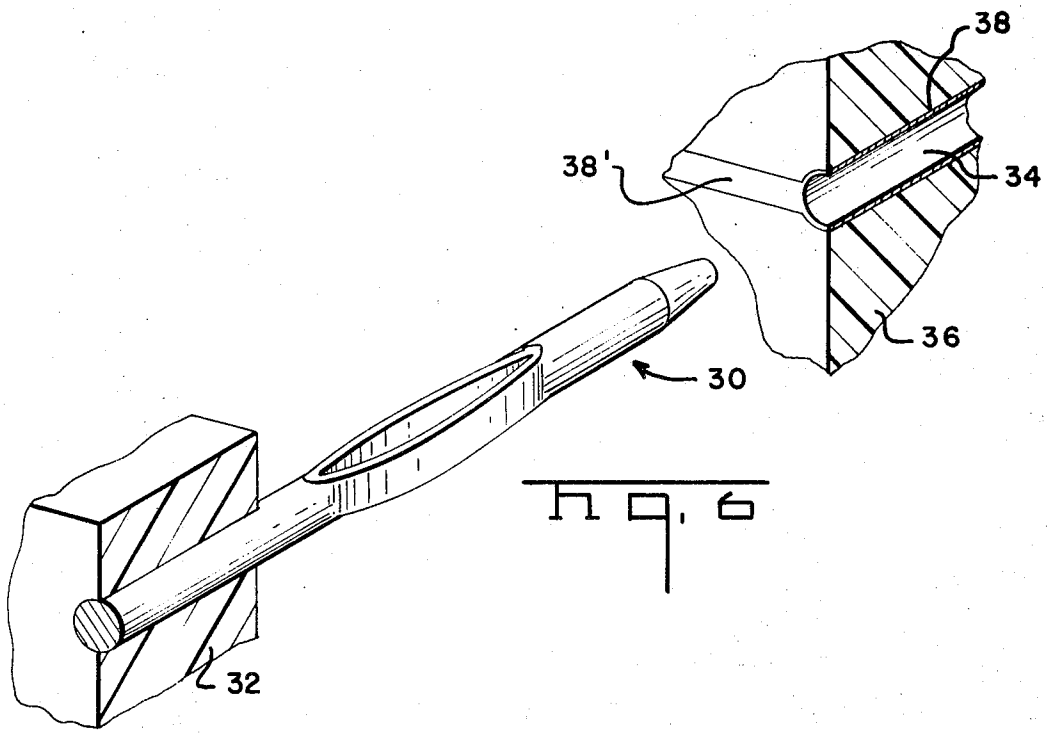

Fig. 6

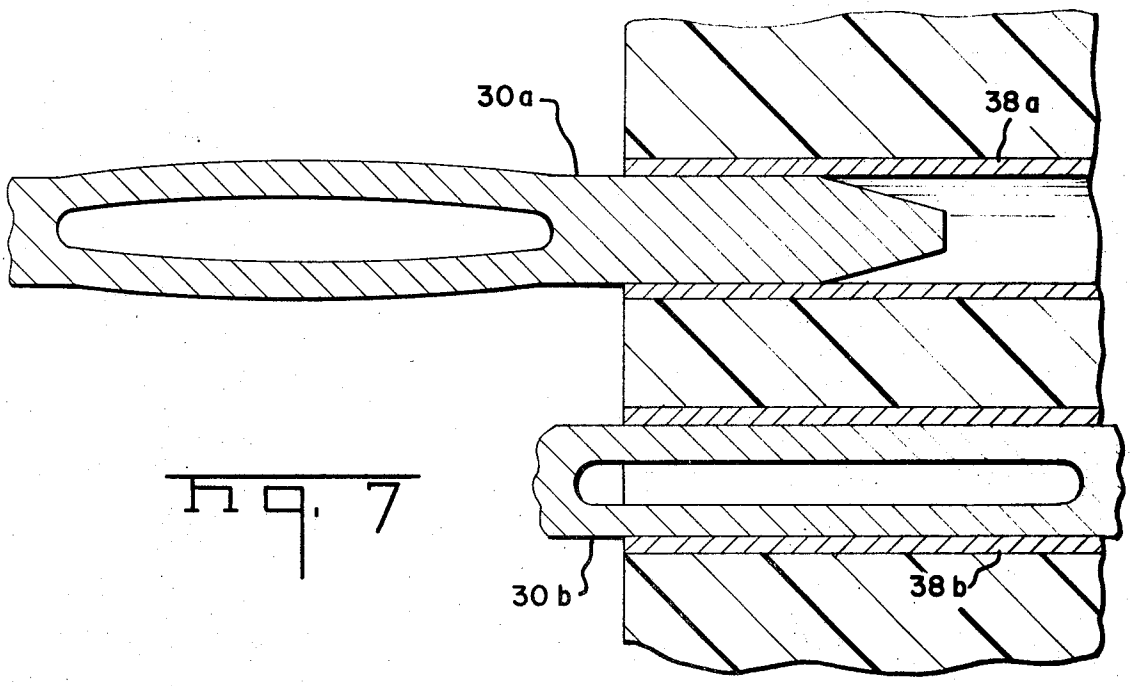

Fig. 7

METHOD OF MAKING RESILIENT PINS

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FIG. 8

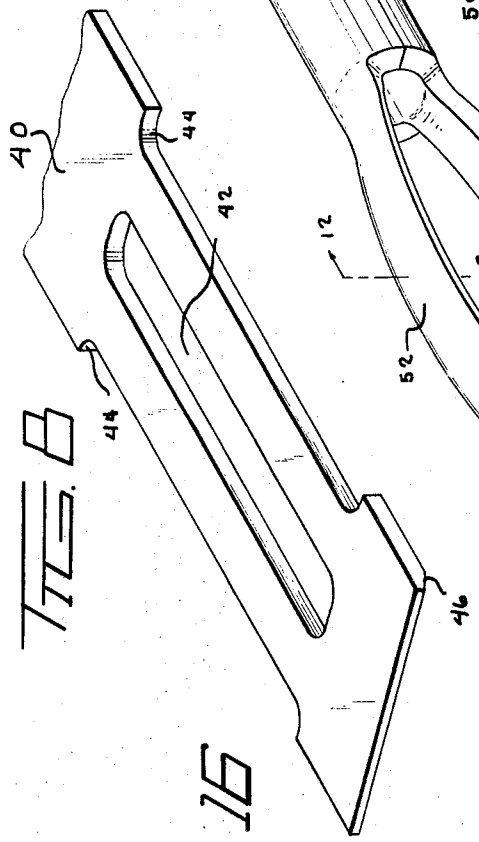


FIG. 9

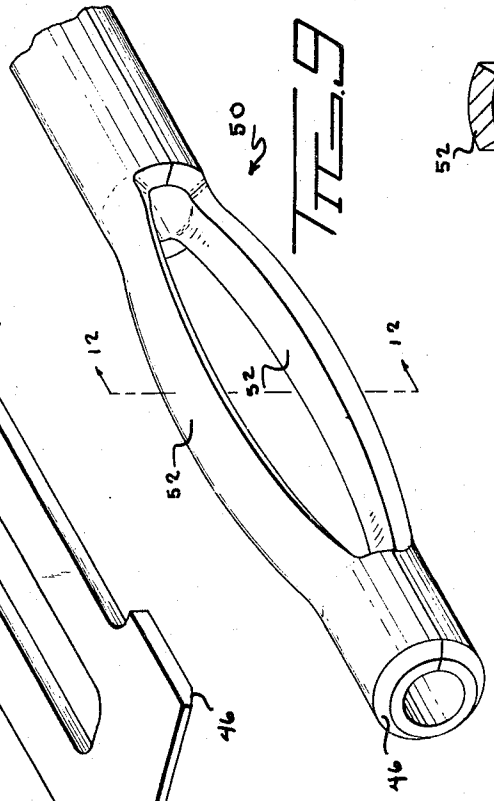


FIG. 10

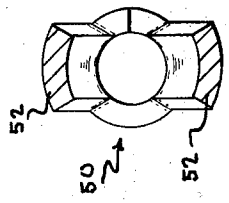


FIG. 15

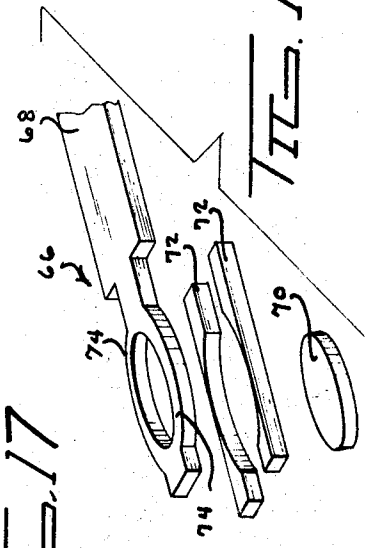


FIG. 16

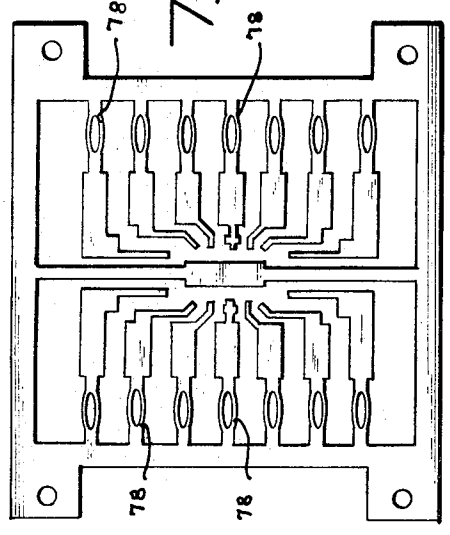
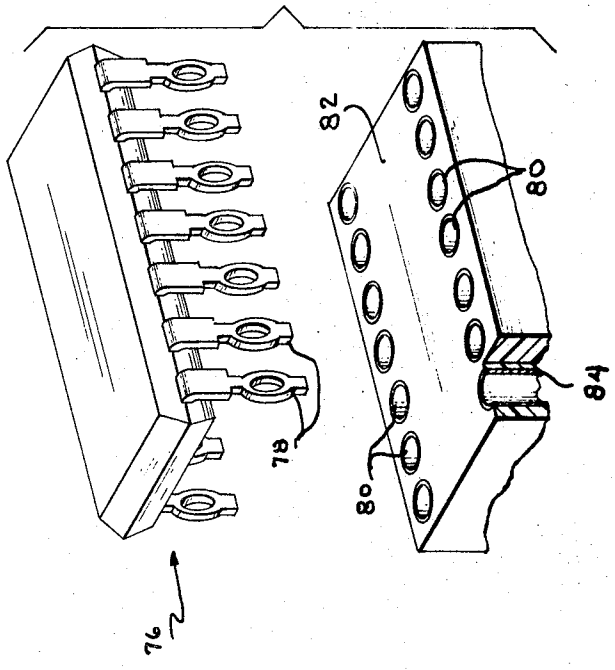


FIG. 17



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METHOD OF MAKING RESILIENT PINS

Filed May 16, 1967 4 Sheets-Sheet 4

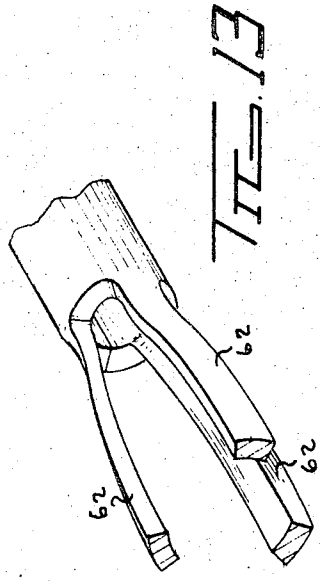

FIG. 13

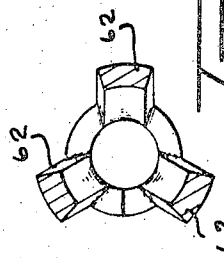

FIG. 14

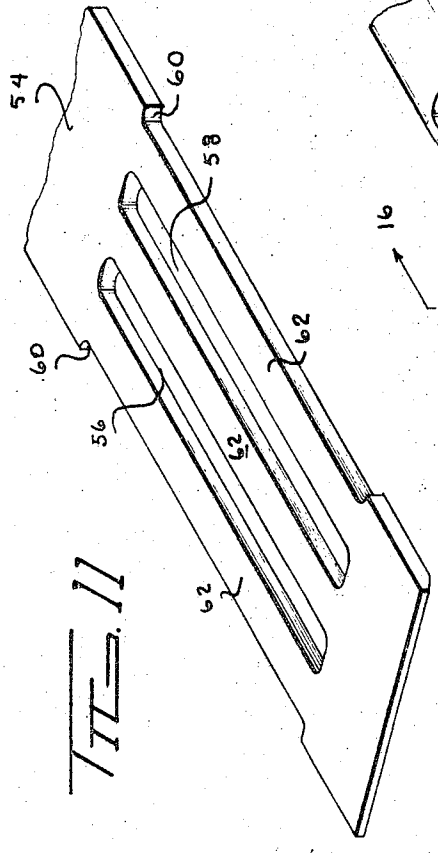

FIG. 11

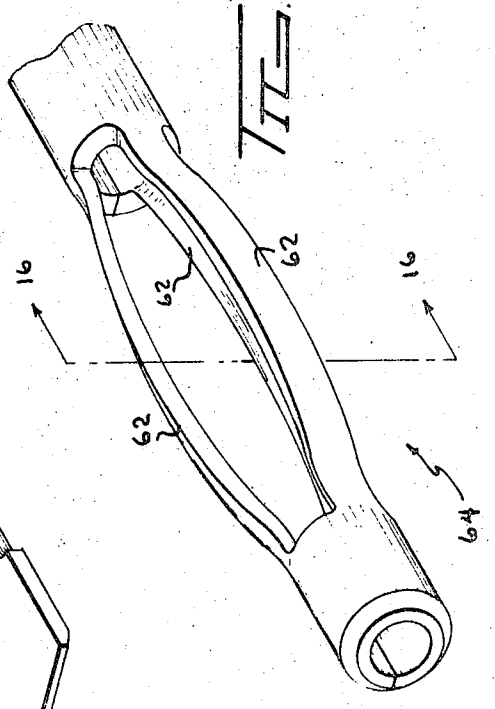

FIG. 12

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Patented Dec. 8, 1970

3,545,080

METHOD OF MAKING RESILIENT PINS

William Robert Evans, Hershey, Pa., assignor to AMP Incorporated, Harrisburg, Pa.

Continuation-in-part of application Ser. No. 612,125, Jan. 27, 1967. This application May 16, 1967, Ser. No. 642,639

Int. Cl. H02g 15/00

U.S. Cl. 29—629 1 Claim

ABSTRACT OF THE DISCLOSURE

A length of bar stock is flattened and reformed to produce a section having spring characteristics whereby the bar is capable of resiliently mating with a nonresilient article. Alternatively, a length of flat stock is stamped or etched to produce resilient members, the flat stock being rolled or left flat depending on a particular use.

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my earlier filed copending U.S. application Ser. No. 612,125, filed Jan. 27, 1967, now abandoned.

BACKGROUND OF THE INVENTION

Field of the invention

Male contact posts for mechanically or electrically mating with a female receptacle.

Description of the prior art

Prior art posts are generally rectangular or circular in cross-section and are solid, non-resilient members. The posts mate with resilient sockets or eyelets.

SUMMARY OF THE INVENTION

The invention provides a method of producing a pin having resilient properties. The basic advantage of such a pin is that it can mate with a stiff socket or eyelet. For example a pin could make electrical connection with a printed circuit board by simply drilling a hole in the board and plating the hole. The electrical contact would be provided by the resilience of the pin so no special socket or the like is required on the board. Also, the pin can be produced with no scrap and a natural "lead-in" is formed for ease in mating.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the length of bar stock;

FIG. 2 is a perspective view showing the bar of FIG. 1 subsequent to a forming operation;

FIG. 3 is a perspective view showing the bar of FIG. 2 after a subsequent forming operation;

FIG. 3A is a cross-sectional view taken along the line 3A—3A of FIG. 3;

FIG. 4 is a perspective view showing an alternative method of production;

FIG. 4A is a cross-sectional view of a pin similar to that shown in FIG. 4;

FIG. 5 is a perspective view showing the pin of FIG. 4 after a subsequent forming operation;

FIG. 5A is a cross-sectional view taken along the line 5A—5A of FIG. 5;

FIG. 6 is a view partly in section showing a typical application of a pin made according to the present invention;

FIG. 7 is a cross-sectional view showing the mating action between a socket and the pin of the instant invention;

FIG. 8 is a perspective view of a length of flat stock used in a further embodiment of the invention;

FIG. 9 is a perspective view of a pin formed from the stock of FIG. 8;

FIG. 10 is a cross-sectional view taken along the line 12—12 of FIG. 9;

FIG. 11 is a perspective view of a length of flat stock used in another embodiment of the invention;

FIG. 12 is a perspective view of a pin formed from the stock of FIG. 11;

FIG. 13 is a perspective view partly broken away showing details of the pin of FIG. 12;

FIG. 14 is a cross-sectional view taken along the line 16—16 of FIG. 12;

FIG. 15 is an exploded perspective view showing a further form of pin being produced from flat stock;

FIG. 16 is a plan view of an etched circuit embodying the present invention; and

FIG. 17 is an exploded perspective view showing the present invention applied to an integrated circuit module.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The 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 where 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 purpose 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.

A pin according to the present invention is produced from a length of bar stock such as shown in FIG. 1 and indicated at **10**. The bar may be of rectangular, circular or other cross-sectional configuration. For ease of illustration a bar of circular cross-section has been shown, such bar being of generally uniform cross-sectional area throughout the major portion of its length.

The pin **10** is normally formed of a metallic material which is electrically conductive and of any suitable length and cross-sectional area. The first step in the production of the pin is to substantially flatten a section of the pin as indicated at **12**. The flattened section **12** may then be formed into a generally U-shaped section as shown in FIGS. 3 and 3A whereby a section **14** is produced which is capable of resilient flexing action. The periphery of section **14** is greater than that of the remainder of pin **10** and therefore the pin can mate with an eyelet or socket just slightly larger than the non-resilient portion of the pin.

An alternative method of producing the pin is shown in FIG. 4 wherein the flattened portion **12** is provided with a blanked out slot **16**. The pin shown in FIG. 4 may then be formed by turning the strips **18** and **20** at substantially right angles to the plane of the flattened portion **12** into a position as shown in FIGS. 5 and 5A. The strips **18** and **20** may be given a generally arcuate configuration during the forming operation. The spring section **22** thus produced in the pin has considerably more resiliency than the section **14** formed in the pin of FIG. 3 since the strips **18** and **20** are substantially free for resilient movement toward and away from each other. The forming operations performed on the pin may be accomplished by conventional forming tools and may be accomplished in either the hot or cold material state.

FIG. 4A illustrates a pin in its final form which is quite similar to the pin of FIG. 4. The flattened section **12'** is not flattened to the extent of section **12** (FIG. 4) leaving strips **18'** and **20'** capable of flexing motion

through the slot **16'**. The degree to which the section **12'** is flattened depends on the amount of resiliency required and on the desired external dimension of the section since an extremely flattened section would have low resiliency and a large external dimension and vice versa. The section can, of course, be adjusted to size by manipulating the strips **18'** and **20'**.

The pins of the present invention have general utility in mechanical and electrical applications. One application of the pins is shown in FIG. 6 wherein the pin **30** is mounted in a housing member **32** and cooperates with an aperture **34** formed in a printed circuit board or the like **36**. The aperture **34** is plated at **38** with an electrically conductive material, which plating extends as shown at **38'** to additional circuitry on the printed circuit board. The actual mating action can be seen in FIG. 7 wherein a pair of pine **30***a* and **30***b* are shown in relation to a pair of sockets **38***a* and **38***b*. Pin **30***a* is just entering socket **38***a* while pin **30***b* is seated within the socket **38***b* and the resilient section of the pin has been compressed by the socket. The resilient pin section will maintain the pin in position and will also provide for an excellent electrical connection between the pin and socket.

The various pins described above and shown in FIGS. 3, 4, and 5 illustrate the present invention as applied to round wire or bar stock. However the present invention is not limited to stock having a circular cross-section but rather the principle of a resilient pin, that is a pin having a spring section, may be applied to flat stock as well as round. The following description teaches various methods of producing a resilient pin from flat stock.

In FIG. 8 there is shown a strip of flat stock **40** from which a resilient pin is to be produced. The stock **40** has a central slot **42** and a pair of edge slots **44** formed therein, the edge slots **44** being approximately one-half of the central slot **42**. The slots may be formed in the stock by a stamping operation, by chemical etching or by other convenient methods. The forward portion of the stock is charfered at **46** to provide lead-in for the pin as will be apparent as this description proceeds. The remaining portion of stock **40** is not shown in FIG. **8** but would be connected, in practice, to electrically conductive means according to the particular application made of the resilient pin. In FIG. 9 a pin **50** is shown which has been formed by the flat stock **40** after having been rolled into a cylindrical configuration. The pin is rolled about an axis generally parallel to the major extent of the slots **42** and **44** thereby producing the pair of resilient members **52** on opposite sides of the slot. Preferably the members **52** are bowed outwardly to present a diameter larger than that of the main portion of the pin. The bowing operation may be performed simultaneously with the rolling operation or may be a separate step achieved by a mandrel or the like. The chamfered edge **46** of the pin can thus be seen to provide appropriate lead-in for the pins entry into a mating receptacle.

In FIG. 11 there is shown a blank of flat stock **54** which is similar to the stock **40** shown in FIG. 8. Stock **54** has formed therein two central slots **56** and **58** and two edge slots **60**. By providing two central slots the contact will produce three spring members **62** rather than two as formed in the pin of FIG. 9. In FIG. 12 a pin **64** is shown which represents the formed-up configuration of the flat stock **54**. The pin **64** differs from the pin **50** previously described by the provision of the three spring members **62**. The three spring members permit a greater force to be exerted in a radially outward direction than could be exerted by the two spring members and thus yields a pin which is capable of improved mechanical retention in a socket and improved electrical mating characteristics. The three spring members **62** are disposed at approximately 120° from each other as best seen in

FIGS. 13 and 14 and provide equal distribution of forces between the pin and its mating receptacle.

In FIG. 15 there is shown a pin **66** which has been blanked or stamped from a piece of flat stock **68**. The pin is formed by stamping a generally oval piece **70** from the center of the stock and also stamping a pair of edge portions **72** which surround the oval portion **70** but are slightly spaced therefrom in order to produce the pair of resilient members **74**. The pin **66** needs no subsequent forming operation since the surved spring members **74** will function in their flat condition. This version of the pin, in most instances, will exert lower radial forces as compared to the pins of FIGS. 9 and 12. Pin **66** is primarily useful for mechanical retention and may be soldered or otherwise connected to a mating receptacle in order to complete an electrical connection.

FIG. 16 shows a typical etched circuit for use in an integrated circuit or flat pack such as **76** shown in FIG. 17. The circuitry of FIG. 16 is shown as including the teachings of the present invention in that the outer ends of each circuitry strip is provided with a resilient pin as indicated at **78**. The circuitry of FIG. 18 is secured to an integrated circuit in a manner well known in the art and the pin portions **78** are bent at 90° as seen in FIG. 19 to enable the flat pack to be plugged into appropriate sockets **80** disposed in a printed circuit board or the like **82**. The sockets **80** for receiving the pins **78** may be circular as shown in the figure or may be of rectangular configuration. These sockets in their simplest form may merely be plated through holes consisting of a metallic liner **84** which connects with external circuitry on the board **82**. The pins **78** will be received in the socket and will be pressed inwardly to cause a firm mechanical union between the pin and socket. If desired, the pin may then be soldered to the socket.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only. The actual scope of the invention is intended to be defined in the following claim when viewed in its proper perspective against the prior art.

What is claimed is:

1. A method of producing a resilient pin from a bar of substantially uniform cross-section comprising the steps of forming an intermediate portion of said bar into a substantially flattened condition whereby material is forced beyond the lateral periphery of said bar, forming an elongated slot in said flattened portion only, said slot being formed on and parallel to the axis of said bar, subsequently turning the flattened material on both sides of the slot in opposite directions and into confronting walls in parallel relation and on opposite sides of the bar axis and bowing the opposite walls outwardly beyond the periphery of the bar thereby constituting resilient members integral between the bar ends capable of flexing motion toward and away from each other.

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R. W. CHURCH, Assistant Examiner

U.S. Cl. X.R.

29—630, 190, 193; 339—17, 252; 76—102, 103; 113—119; 24—213, 214; 165—1