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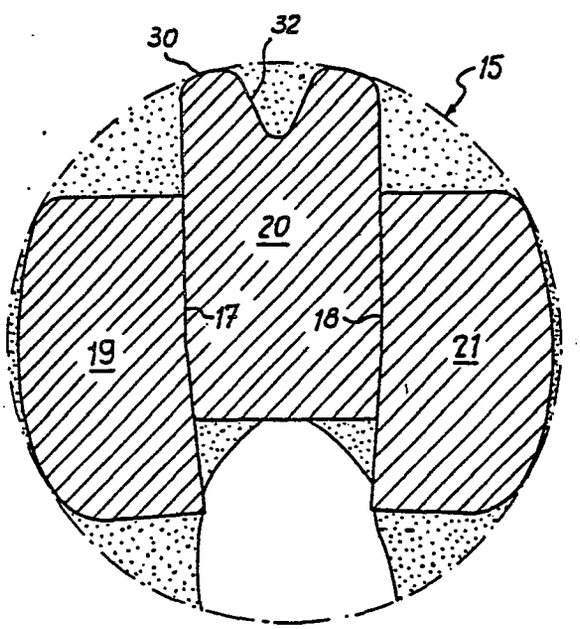
(54) Electric contact pin for use in printed circuit boards.

(57) The contact pin is characterized in that the three resilient legs are symmetrically displaced upon insertion of the pin (10) in a hole (15) of a printed circuit in such a manner that the outer legs (19,21) are bended towards one another so as to obtain a V-shaped configuration while the inner leg (20) acts like a wedge and is clinged between the two outer legs.

FIG. 15



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Electric contact pin for use in printed circuit boards.

This invention relates to electrical terminal pins to be mounted through apertures of a base of a printed circuit board and which project from each side of the base board to serve as electrical terminal elements on which connectors may be plugged or to which wire leads may be wrapped (wire-wrap).

In order to reduce damage upon insertion of said pins into the plated-through apertures of circuit boards several kinds of press fit pins have already been proposed.

The mounting section of said pins is adapted to be resiliently deformed upon insertion such as shown for example in U.S. patent 3.783.433 issued on January 1st,1974.

It is also known to split the mounting section following its longitudinal axis so as to create two legs which are bent outwardly and which are resiliently deformed when inserted into an aperture.

It has been observed that in this case the insertion and retention force of the pin is only acting on two contact points. Also the direct electrical contact is created in those two contact points through

which the forces applied on the pin are transmitted to the surrounding material of the plated-through aperture.

The contact surfaces being very small, the local stresses applied to said surrounding material are high and may adversely affect said material at those contact points. In addition, a split two-legged pin of that kind, when inserted,normally takes an unsymmetrical cross-sectional shape which causes the pin to be twisted and possibly misaligned.

Pins also have been manufactured having three resilient legs such as described in U.S. patent 4.066.326 issued January 3,1978.

Although the legs present in this case a symmetrical configuration upon insertion of the pin in a hole of a printed board, only three contact points are obtained and the legs do not act on each other in order to obtain a permanent reaction force.

The purpose of the present invention is to develop an improved contact pin in which the amount of mechanical and electrical contact points is increased and in which the resilient legs are acting on each other in order to obtain a permanent reaction force upon insertion of the pin in a hole of a substrate.

Another purpose of the present invention is also to provide an improved contact pin which diminishes the stresses between each contact point and the inner wall of the hole in a printed circuit so as to obtain less damage corresponding to equal insertion forces.

Still another purpose of the invention is to provide a contact pin which is soldered in a printed circuit with or without addition of tin.

According to the invention the contact pin is provided with a central part adapted for resilient mounting of the pin into a hole of a printed circuit, said central part having three resilient legs which are symmetrically displaced, upon insertion of the pin in a hole, in such a manner that the outer legs are bended towards one another so as to obtain a V-shaped configuration while the inner leg acts like a wedge and is clinged between the two outer legs.

Preferably the cross section of the outer legs is cut out so as to be less thick than the central leg to improve the bending towards each other while the extremities of the three legs remain connected with the body of the pin.

According to an alternative configuration, one extremity of the inner leg is cut-away from the pinbody.

In order to still improve electrical and mechanical properties of the contact points, it is proposed that the outer edges or surfaces of the resilient legs, which realize the contact with the inner wall of the hole in the printed circuit, are provided with a controlled wave-shape configuration which creates a cold welding effect between the conductive tinlayers of the pin and the hole.

The invention will now be described by way of example and with reference to the accompanying drawings in which :

- figure 1 : shows a serie of pins inserted in a multi-layer printed circuit board ;

- figure 2 : shows a pin according to the invention ;
- figure 3 : is a cross-sectional view following the line AA in figure 2 ;
- figure 4 : is a lateral view from the pin according to figure 2 ;
- figure 5 : similar view as figure 4 showing in addition the wave-shape configuration in the contactlegs ;
- figure 6 : is a cross-sectional similar to figure 3 but after insertion of the pin in a printed circuit ;
- figure 7 : shows a pin such as in figure 2, but according to a alternative embodiment, in which the inner leg is cut away at one of his extrmity ;
- figure 8 : shows a lateral view of the pin shown in figure 7 ;
- figure 9 : is similar to figure 8 and shows in addition the wave-shape configuration in the contact legs ;
- figure 10 : is an axial section of the pin according to figure 2 after insertion in a printed circuit ;
- figure 11 : is similar to figure 10, but with legs having a wave-shape configuration ;
- figure 12 : shows an axial section of the pin according to figure 7 after insertion in a printed circuit ;
- figure 13 : similar to figure 12 but with legs having a wave-shape configuration.

As shown in figures 1 and 2, the electrical contact pin generally designated 10 consists of two outer sections 11, 12 for the connection of electrical components and a central or mounting section 13 adapted for securing the pin 10 into an aperture 15 of a printed circuit board 14. One of the ends of said central section 13 has an enlarged cross-sectional area thus forming a shoulder 16.

In the central section 13, the pin 10 has two through cuts 17, 18 extending parallel to one another and parallel to the longitudinal axis of the pin thus forming three resilient leg portions 19, 20 and 21. As shown, preferably, both outer legs 19 and 21 are bent in the same direction while the inner leg 20 is bent in opposite direction thus giving a cross-section such as shown in figure 3, said cross-section being made along the line AA in figure 2.

These bendings are carried out in the plane of the through cuts 17, 18 while the extremities of the legs 19, 20 and 21 remain connected with the pin-body 10.

As shown in figure 3, both outer legs 19 and 21 are made slightly smaller than the central leg 20 to facilitate their bending towards one another and to take a V-shaped configuration upon insertion into the hole 14 (figure 6).

This figure 6 shows clearly how six areas of contacts are obtained between the pin 10 and hole wall 15.

According to another embodiment shown in figures 7, 8 and 9, the central leg portion 20 has one end thereof cut away from the pinbody 10. By providing such an ajustment one accommodate specific application conditions in which the strenghts on the contact areas are still to be lowered or when the contact pin 10 is intended to be soldered in the aperture 14.

In order to still improve mechanical and electrical properties of the contact pin according to the two proposed embodiments, the outer edges or surfaces of the resilient legs, which realize the contact with the inner wall of the hole in the printed circuit, may be provided with a controlled wave-shape configuration 22 such as shown in figures 5, 9, 11 and 13.

During insertion of the pin in a printed circuit tin material is piled up in the waves 22 and new tin material which is oxidized comes into contact with the printed circuit.

The piled up tin material will create after a while a so called "cold welding" in the wave-shape configuration which will increase extraction force.

Although several tests already confirmed the qualities and advantages of the pin mentioned hereabove, it has also been noticed that side-effects may occur in particular applications in which the mounting area of the pin into a printed circuit board is not covered with precious metal layer (Au, Pd, Ni...) but only with a tin-lead plating.

The insertion of such a pin with tin-lead plating into a plated through hole gives bird to the formation of a burr or peeling of the outer layer in such a way that said peel extends from the hole over a more or less great distance and may give rise to non desired contacts.

According to the thickness of the tin-lead plating said pin is used in two particular embodiments. In a first embodiment the mounting portion of the pin is covered with a thick tin-lead (5 to 10μ) ; in this case, the contact pins provided in a printed circuit board are soldered by addition of heat, with or without applying extra solder f.i. a solderring. Because of the large contact-area between the pin and the hole, tin-lead material is peeled of during insertion and only the solder material on the free side walls of the pin and inner walls of the hole may reflow together during solder-process. In a second embodiment the thickness of the pin-lead layer on the mounting portion of the pins is less important (1 to 3μ) so to obtain a dry connection with the holes in a printed circuit-board. The burrs or peels produced during the insertion operation are smaller in this case than in the previous one, but they could be separated from the pin when shivering the panel and this could give rise to undesired short-circuitings.

Considering the pin which is subject matter of the patent cited hereabove, the formation of peeling

could be important at the large contact area between the outer side of the central leg and the inside of the hole (see fig.6).

The purpose of the present embodiment is to prevent formation of said peeling and besides still to improve the solder connection between the layers of the pin and the hole of a printed circuit board.

Further details and properties will be explained in the following description of an embodiment according to the invention and in which reference is made to the enclosed drawings in which :

Figure 14 : is a cross-sectional view of a pin taken in the mounting section of the pin in a hole of a printed circuit board.

Figure 15 : is an enlarged reproduction of the same section after insertion into a hole and after a reflow solder process of the tin-lead plating of the pin and the hole.

On the figure 14 is illustrated the enlarged central portion of the contact pin 10.
As already mentioned in the main application, this central portion is cut twice in 17 and 18 over a certain distance of its lenght in order to create three resiliently displacable legs 19, 20 and 21.

According to the invention, the outer side 30 of the central leg 20 is provided with a lengthwise and centrally disposed depression or groove 32.

During the manufacturing of the pin said depression 32 in the outer side 30 of the pin causes a slight waving of the side walls, the strenght of which is increased by local compression of material in the waved outer side 30 of central leg 20.

Preferably the side walls of the central leg 20 are conically shaped in 36 towards the inner side 34, this to still improve the wedge like action of

central leg 20 between the two outer legs 19, 21.

Through several tests the optimum ratio has also been established between the width M of the central leg 20 and the width B of the outer legs 19, 21. The value of this ratio $\frac{M}{B}$ should be mainly situated between 1,05 and 1,2 and should preferable reach 1,13 with material thickness D of $\pm$ 0,63 mm and an overall width of the mounting section of $\pm$ 1,05 mm.

By respecting said ratio's one obtains a self-centering action of the pinbody into the hole of a printed circuit board.

It has also been established that the rounded outer edges R2 should have a more important radius than the rounded edges R1 disposed at the inner side of the outer legs.

On figure 15 it is clearly shown which kind of contact-area is created after reflow of the tin-lead layers of pin and holde whereby a remarkable electrical connection is obtained through the complete filling of the groove 32 and all of the edges between the legs 19, 20 and 21 with tin-lead alloy.

Claims

1. An electric contact pin for printed circuits, provided with a central portion adapted to resiliently secure the pin in a hole of the printed circuit, in which said central portion has two longitudinal through cuts to form three resilient legs, the outer legs of which are bended in one direction in the plane of the cut, while the inner leg is bended in opposite direction, characterized in that the three resilient legs are symmetrically displaced upon insertion of the pin (10) in a hole (15) of a printed circuit in such a manner that the outer legs (19, 21) are bended towards one another so as to obtain a V-shaped configuration while the inner leg (20) acts like a wedge and is clinged between the two outer legs.

2. An electric contact pin according to claim 1, characterized in that the through cuts (17, 18) are realized so to obtain outer legs (19, 21) which are less thick than the central leg (20) to improve the bending towards one another upon insertion of the pin (10) in a hole (15) of a printed circuit.

3. An electric contact pin according to claims 1 and 2, characterized in that the three resilient legs (19, 20, 21) remain connected to the pinbody (10) with their extremities.

4. An electric contact pin according to claims 1 to 3, characterized in that one extremity of the inner leg (20) is cut away from the pinbody (10).

5. An electric contact pin according to claims 1 to 4, characterized in that the outer edges or surfaces of

the resilient legs, which realize the contact areas with the inner side of a hole (15) in a printed circuit, are provided with a wave-shape configuration (22) so as to obtain a "cold welding" between the tinlayers from pin and hole.

6. An electrical contact pin according to claim 1, characterized in that the outer side (30) of the central leg is provided with a lengthwise and centrally disposed depression or groove (32).

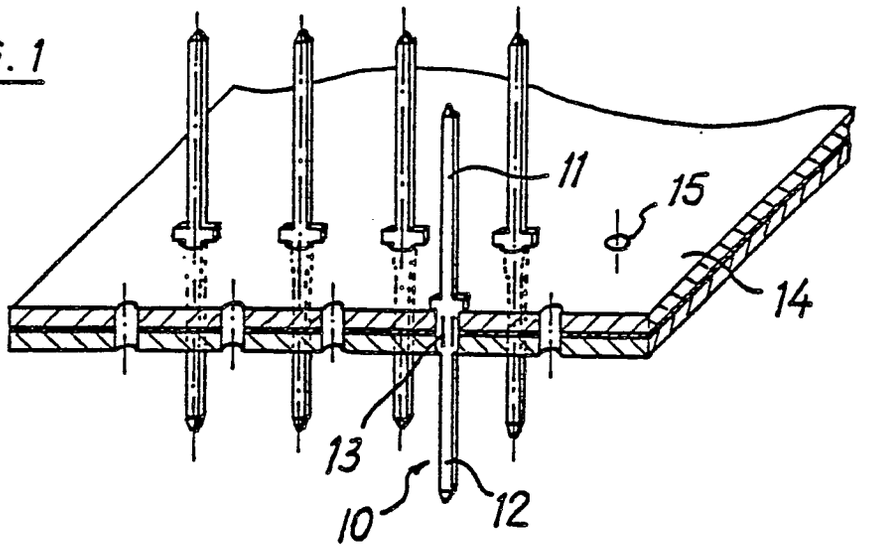
7. Electrical contact pin according to claim 1, characterized in that the ratio between the width (M) of the central leg (20) and the width (B) of the outer legs (19, 21) is mainly situated between 1,05 and 1,2.

8. Electrical contact pin according to claim 7, characterized in that the ratio between the widths (M/B) of the legs equals 1,13 with a material thickness (D) of $\pm$ 0,63 mm.

9. Electrical contact pin according to claim 1, characterized in that the side walls of the central leg (20) are conically shaped (36) toward the inner side (34), to still improve the wedge like action of the central leg (20).

10. Electrical contact pin according to claim 1, characterized in that the rounded outer edges (R2) of the legs (19, 21) have a more important radius than the rounded inner edges (R1) of said legs (19, 21).

FIG. 1



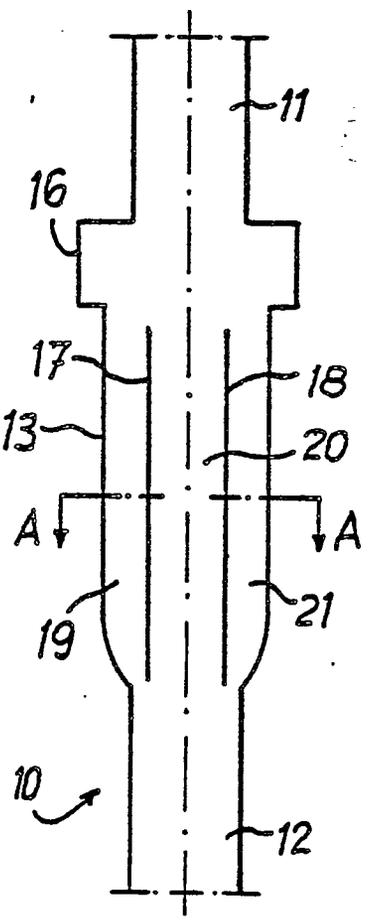


FIG. 2

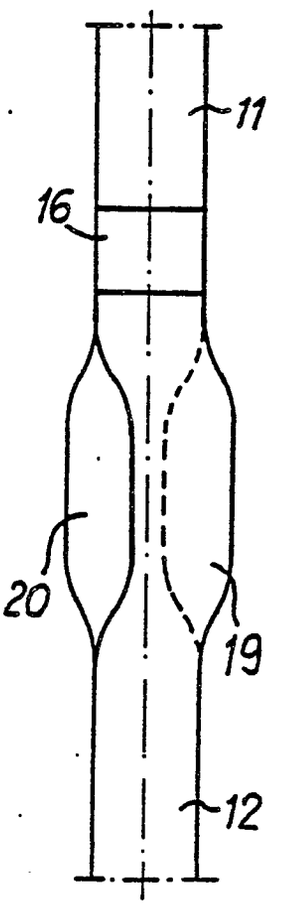


FIG. 4

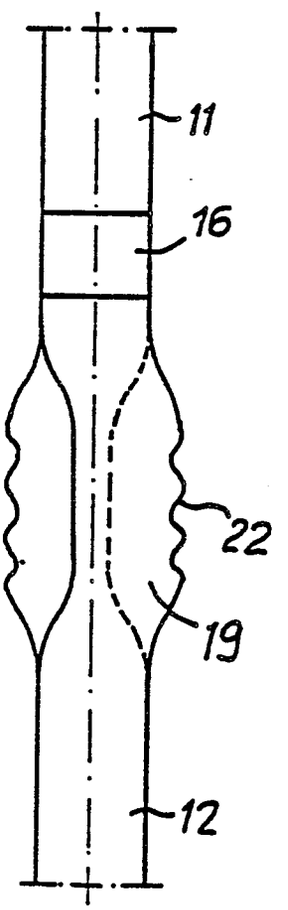


FIG. 5

FIG. 3

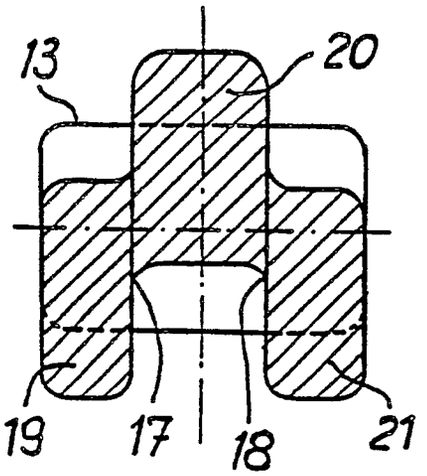
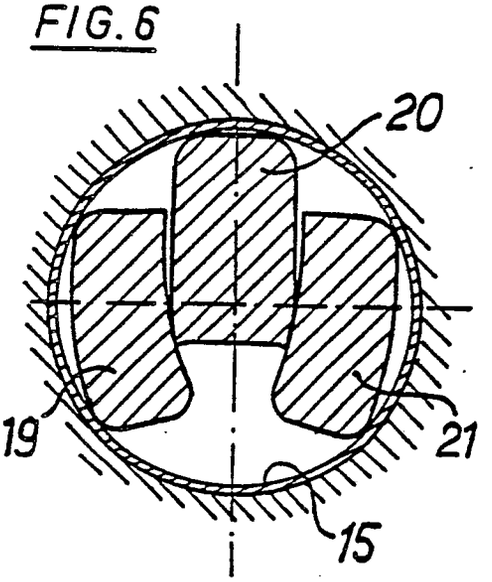


FIG. 6



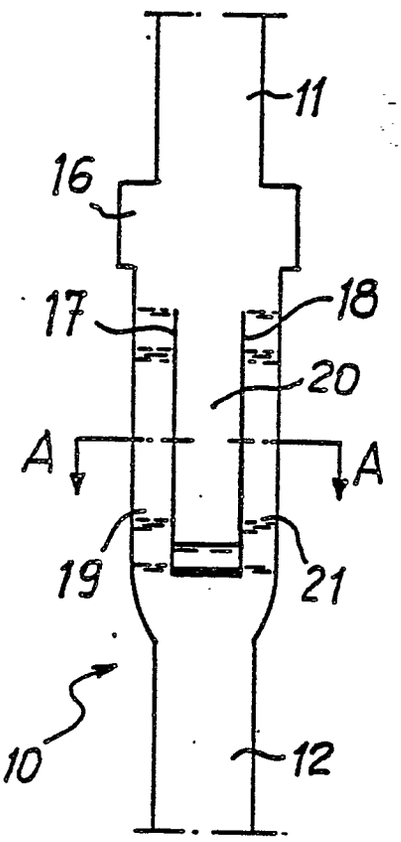


FIG. 7

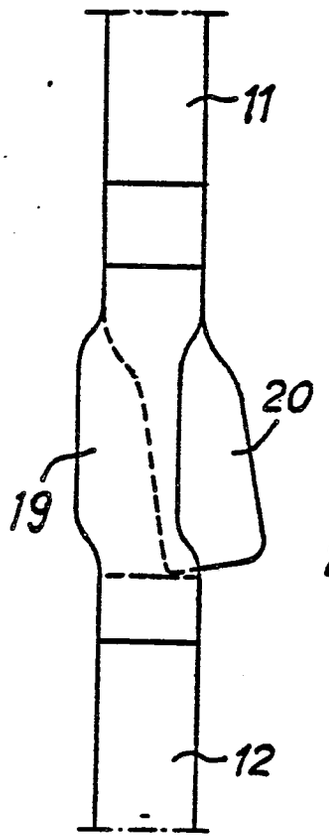


FIG. 8

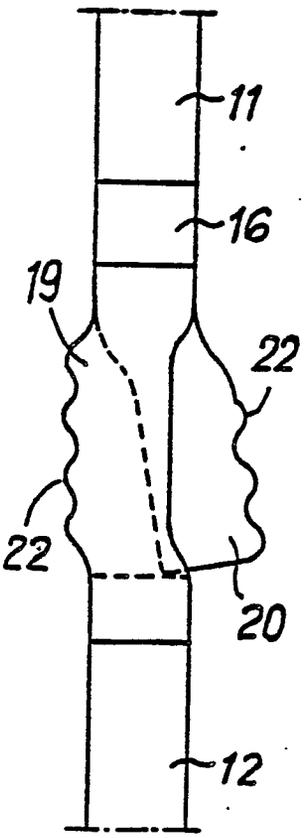


FIG. 9

FIG.10

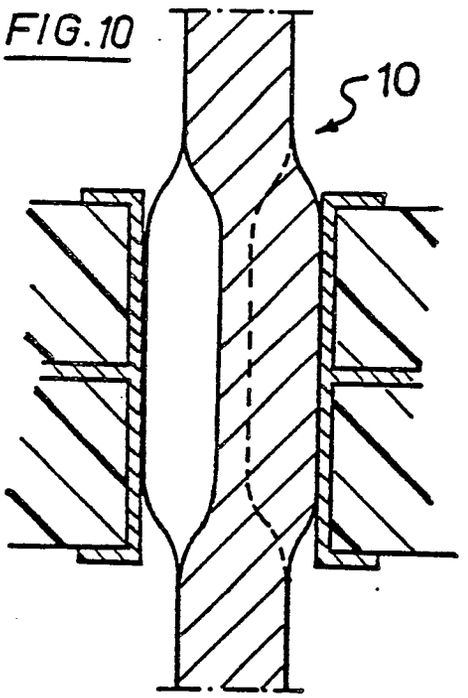


FIG.11

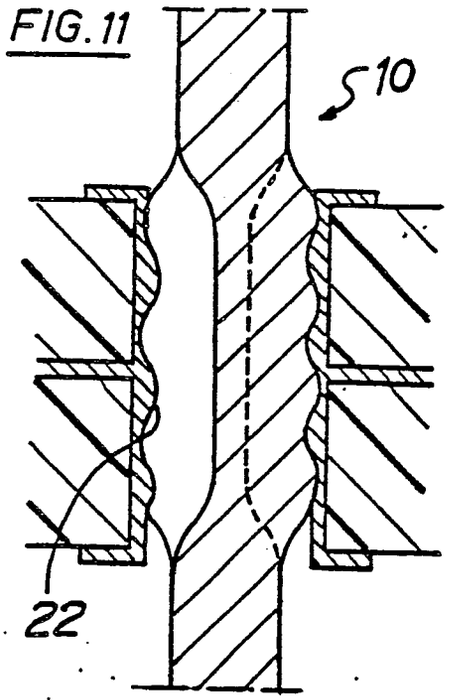


FIG.12

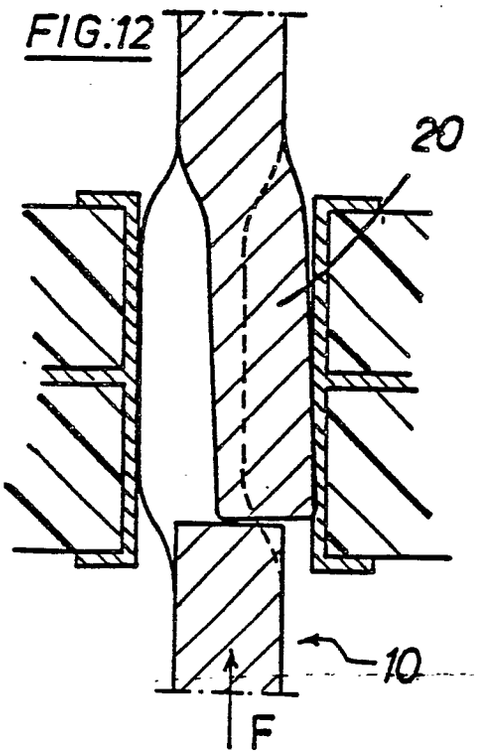


FIG.13

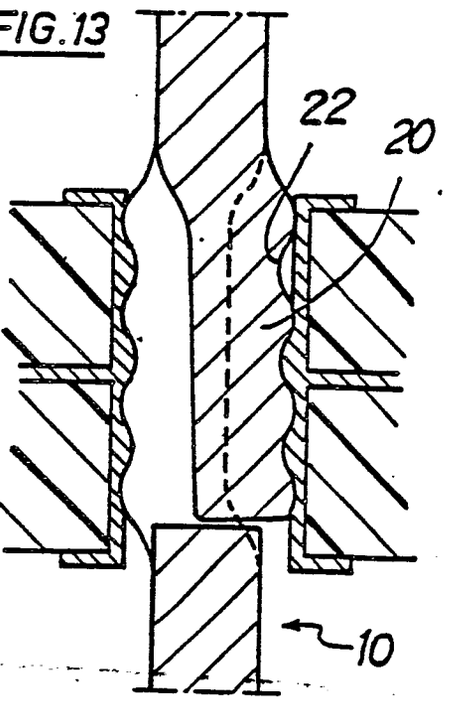


FIG. 14

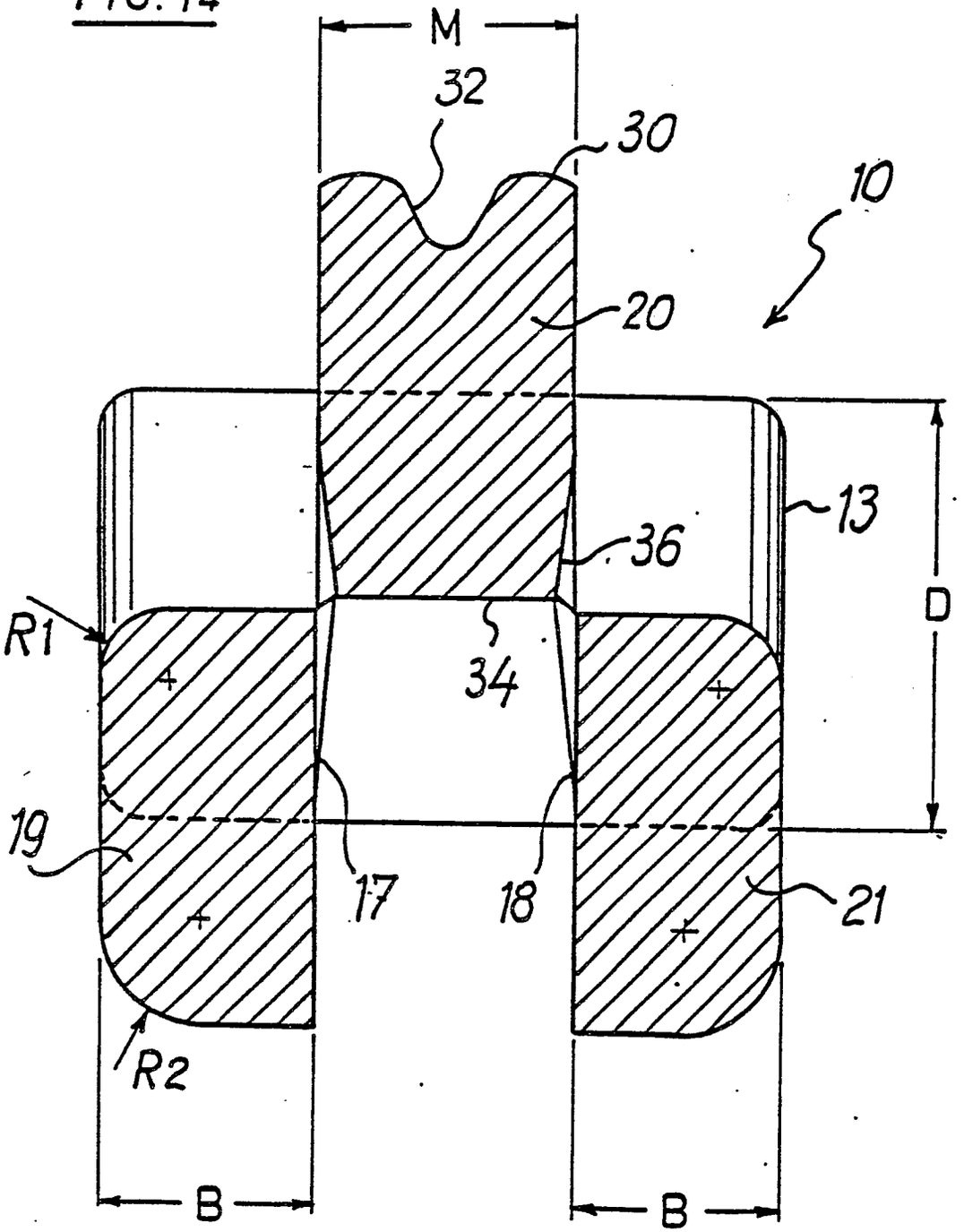
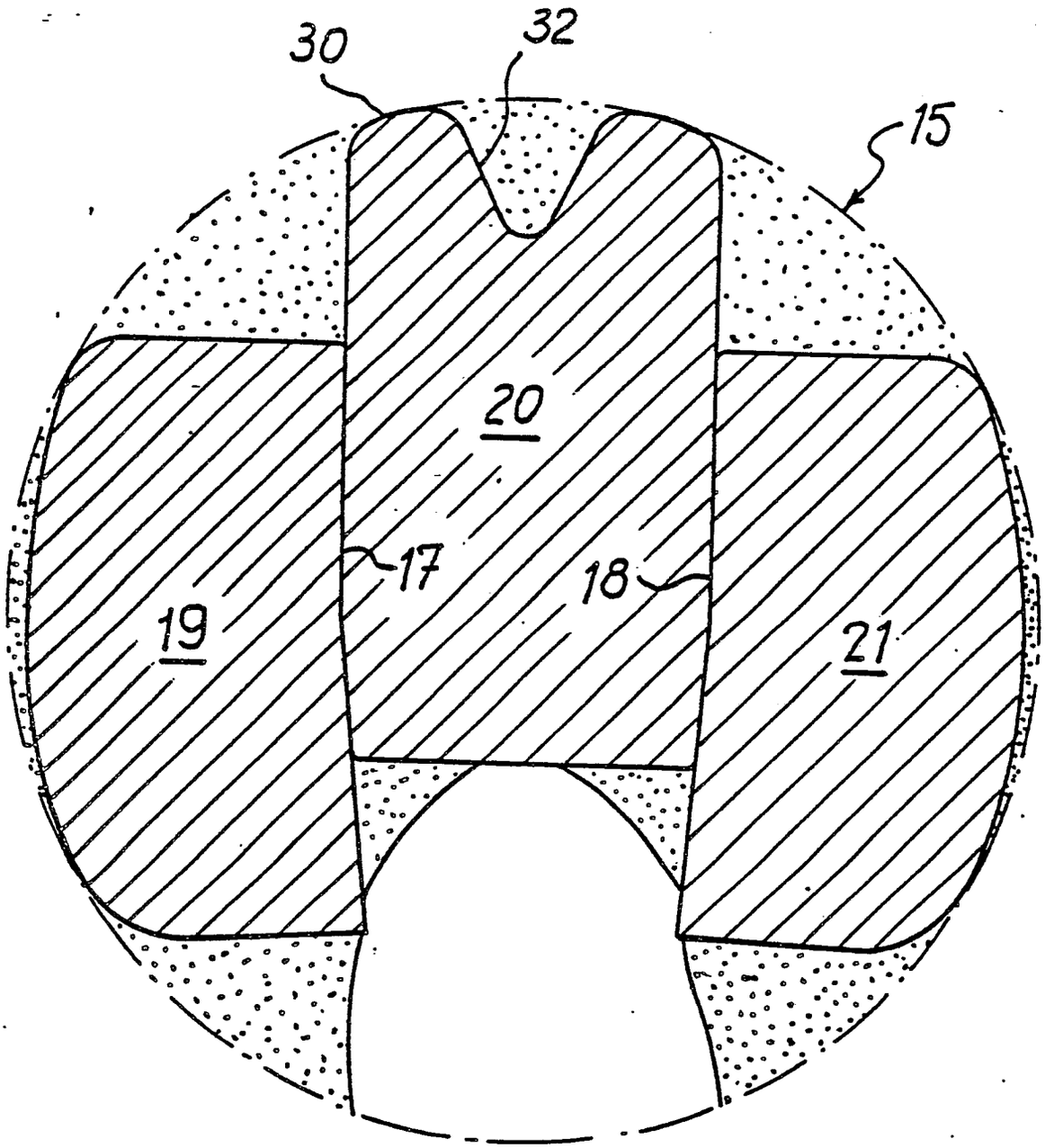


FIG. 15



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EUROPEAN SEARCH REPORT

Application number

EP 83 87 0089

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A,D	FR-A-2 287 827 (DU PONT DE NEMOURS) * Whole document *	1,3	H 01 R 9/09
A	GB-A-1 087 422 (MALCO) * Page 4, lines 68-82 *	1	
A	FR-A-1 268 834 (F.T. PRODUCTS)		
A,D	US-A-3 783 433 (LITTON SYSTEMS)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³) H 01 R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15-12-1983	MOBOUCK G.C.

CATEGORY OF CITED DOCUMENTS

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