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(54) **Socket-type electrical contact.**

(57) A socket-type electrical contact (20) for receiving a cylindrical pin comprises coupling arms (22a,22b,22c) extending between end parts (21a,21b) of the contact (20), and inwardly directed, curved contact surfaces (23a,23c) for engaging the pin.

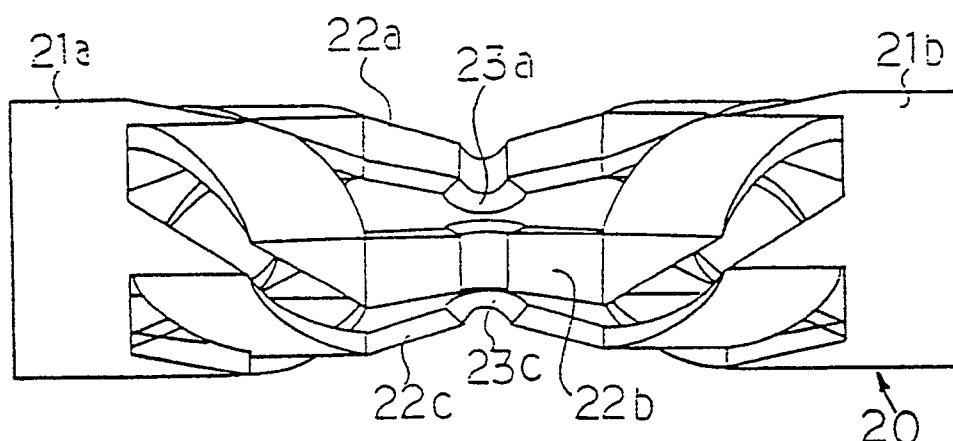


Figure 1A

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SOCKET-TYPE ELECTRICAL CONTACT

The present invention refers to a socket-type electrical contact and in particular, to a socket-type or receptacle-type conductive electrical contact which makes contact with a round conductive pin.

Conductive pins which are square or round when seen in cross-section are well-known. The former are easy to process or manufacture, however, they are square. This means that they have four contact surfaces which must be fixed so that they face the indicated direction relative to a socket-type electrical contact. On the other hand, the round conductive pins are difficult to process and manufacture but are easy to use.

There have been proposals for a variety of socket-type electrical contacts. The most basic socket-type electrical contact is cylindrical and at the same time the center part is made to protrude inwardly thus making electrical contact with the outside surface of the round pin which is inserted inside (please refer to Figure 5). However, this socket-type electrical contact required a comparatively great inserting and extracting force so that insertion and extraction was difficult when it was used with connectors which were equipped with a large number of pins.

Therefore, a great number of tests have been made to reduce the inserting and extracting force between the socket-type electrical contact and the pin. An example of this involved forming a large number of slots on the outside of the cylindrical body which forms the socket-type electrical contact which made it possible to form a contact part at multiple contact points without continuing around the entire circumference of the cylindrical body. As shown in Figure 6, contact parts 12a, 12b, ..., 12n were formed by (a) coupling both the parallel end parts 10a-10b on conductive plate body 1 using coupling pieces 11a, 11b, ..., 11n which act as multiple contact pieces. In processing body 1 to form a cylinder, at the same time the contact parts are bent towards the inside of the cylindrical body so that they protrude. Further, multiple parallel slots 13a, 13b, ... are formed on the conductive plate-shaped body which forms a cylinder. It was first proposed that the contact parts at the center of coupling pieces 15a, 15b, ..., 15n as shown in Figure 6B, between the slots 14 be successively displaced from the end part of plate-shaped body 2 (please refer to Japanese Patent Application 1-294057) by successively displacing the position of parallel slots 14 which are formed on the plate-shaped body 2. As a result, when a socket-type electrical contact is made into a cylinder, the distance from the end part where the pin is inserted to each of the contact parts differs so that the inserting and extracting force of the pin can be reduced to a certain degree. However, when the metallic plate-shaped bodies 1 and 2

which make up the socket were too thin, the strength and the retaining force were insufficient so that they could not withstand being inserted and extracted over and over again. When the individual contact pieces are formed in a straight-line fashion between both base parts 10a and 10b on metal plates 1 and 2, they can no longer impart sufficient elasticity to the contact pieces since it has a biterminal fixed-type structure.

Therefore, it is an object of the present invention to provide a socket-type electrical contact which has sufficient pin retaining strength and whose pin inserting and extracting force is sufficiently low and which is suitable for a multi-terminal connector.

It is yet another object of the present invention to provide a socket-type electrical contact which (1) is equipped with multiple contact pieces at different angular positions on the cylindrical body and (2) which has low inserting and extracting force which makes possible secure and reliable electrical connection with the pin by placing multiple contact parts at the angular positions which have been selected.

According to the invention, a socket-type electrical contact having coupling arms attached to and extending between end parts is provided. Inwardly directed contact surfaces for engaging a pin inserted into the contact are located on the arms or on beams attached to the arms or to the end parts.

For a better understanding of the present invention reference will now be made by way of example to the accompanying drawings, in which :

FIGURE 1A is a side view of a socket-type electrical contact made in accordance with an embodiment of the present invention ;

FIGURE 1B is an end view of the contact ;

FIGURE 1C is a plan view of the stamped contact prior to being formed ;

FIGURES 2A,B, 3A,B and 4A,B,C are plan views of preformed, stamped contacts of other embodiments of the present invention ;

FIGURE 5 is a perspective view of a pin received in an idealized electrical contact ; and

FIGURES 6A,B are plan views of preformed, stamped contacts of prior art contacts.

As shown in Figure 1A, socket-type electrical contact 20 is equipped with end parts (or base parts) 21a-21b which have been processed to form a cylindrical shape with identical radii. This contact 20 is equipped with multiple coupling/contact arms 22 which couple both ends parts 21a-21b. In this specific example, there are five coupling/contact arms (hereafter simply referred to as contact pieces) 22a through 22e which couple both end parts 21a-21b. Each of the contact arms 22a-22e are inclined from both end parts into the cylindrically-shaped body, in other words, in the center shaft direction. At the same

time, the center part is curved inside to form an arc with a comparatively small radius to form contact surfaces 23a-23e. These contact surfaces 23a-23e are connected electrically with the outside surface of the round pin (indicated by broken line P in Figure 1B which is inserted in this socket-type electrical contact from a single direction (for example, from the left).

The socket-type electrical contact 20 is formed by bending conductive metal plate-shaped body 24 of a single piece of copper or copper alloy which has been blanked, as is indicated in Figure 1C. As can be seen from the same figure, metal plate-shaped body 24 is joined at the position which corresponds to both parallel end parts 21a-21b and is equipped with five non-linear U-shaped contact arms 22a-22e which are basically identical. The joined parts of the contact arms 22 with the base parts 21a-21b and the contact surfaces 23 are separated from one another by distance L as indicated in Figure 1C. As a result, each of the contact arms 22 has cantilever-type characteristics which correspond to this distance L despite the fact that both ends are of the stabilized type. Therefore, the contact surfaces 23a-23e and the pin make contact due to sufficient elasticity with sufficiently low inserting and extracting force. When this metal plate-shaped body is bent and shaped to form a cylinder, a slight gap 25 is formed as is indicated in Figure 1B.

The individual contact arms on socket-type electrical contact 20 by no means need to be exactly shaped like the letter "U" as is indicated in the example in Figure 1C. As long as the pair of parallel end parts are joined by multiple non-linear contact pieces, they may be shaped like the letter "C" or the letter "V" stood on end, as is shown in Figures 2A and 2B. Needless to say, two, three or more or any number of contact arms may be selected.

Next, we shall describe the second socket-type electrical contact in the present invention by referring to Figures 3A and 3B. The second socket-type electrical contact 30,30' seeks to reinforce the elasticity by using each of the contact arms as a complete cantilever and to further reduce the inserting and extracting force of the force.

Figures 3A and 3B show stamped, pre-formed socket-type electrical contacts 30,30' respective of other embodiments of the invention. First, in Figure 3A, metal plate-shaped body 30 is equipped with a pair of parallel end parts 31a-31b and they are joined by multiple coupling arms 32a, 32b, ..., 32n. In addition, contact beams 33a, 33b, ..., 33n are formed between the adjoining coupling pieces from one side of coupling arm 32 — for example from the insertion side of the pin. This metal plate-shaped body 30 is shaped to form a cylinder just as in Figure 1. Each of the coupling arms 32 may basically be coplanar with end parts 31, however, contact beam 33 is inclined inside as it faces the free side and the contact surface 34 is bent to form a spoon shape so that it makes contact

with the outside surface of the pin (not shown). The contact 30' in Figure 3B is basically the same as the one in Figure 3A. However, the coupling arm 32' between the pair of parallel end parts 31a'-32b' and the contact beams 33' are completely separated. This means that each of the contact beams 33' is used as a cantilever and extends from one of the end parts — for example, from side 31a' toward the other side 31b' — between the adjoining coupling arms 32' and contact surface 34' is formed near the free end.

We shall use Figures 4A, 4B and 4C to illustrate the third socket-type electrical contact in the present invention. This third socket-type electrical contact 40,40',40'' is equipped with multiple contact beams and is designed to achieve low inserting and extracting force as well as a secure and reliable electrical connection with the pin.

Figure 4A is a view of one embodiment of a suitable example of the socket-type electrical contact, i.e., the metal plate-shaped body 40 which is used to manufacture it. This plate-shaped body 40 is equipped with two straight coupling arms 42a and 42b between both parallel end parts 41a-41b. They are equipped with a pair of cantilevered contact beams 43 and 44 (which are parallel to coupling arm 42) on both sides of the center parts of this coupling arm 42, are separated from coupling arm 42 and face respectively end parts 41a-41b. Contact surfaces 45 and 46 are formed near both free ends of contact beams 43 and 44. The metal plate-shaped body 40 is shaped to form a cylinder and a socket-type electrical contact (not shown) is obtained which makes contact at eight locations on the four split positions on the outside of the pin by making the contact surfaces 45 and 46 of contact beams 43 and 44 protrude inwards. The free end of the contact beams 43 and 44, in particular, the free end of the side on which the pin is inserted should be bent sufficiently outwards so that no collision or fracture takes place when the pin is inserted.

Figure 4B shows a metal plate-shaped body 40'. Contact beam 43' is formed only on one side of each of the coupling arms 42'. The rest of the structure is basically the same.

Figure 4C shows metal plate-shaped body 40''. It is configured so that contact beams 43'' and 44'' are separate from the coupling arm 42'' and is configured to form a cantilever which extends from both end parts 41a''-41b'' towards the other side. The free end parts of the contact beams 43'' and 44'' are made to protrude inward and so that two contact surfaces 45'' and 46'' are formed.

The third socket-type electrical contacts (not shown) which makes use of these metal plate-shaped bodies 40, 40' and 40'' is bidirectional and provides the same low inserting and extracting force and the same reliable electrical contact no matter from what side the pin is inserted.

We have just described three types of socket-

type electrical contacts of the present invention. Nevertheless, the present invention is by no means limited to these practical examples and we would like to emphasize the fact that they may undergo a variety of changes and deformations without deviating from the basic outline of the invention. For example the number of coupling arms and contact beams may be selected at will. The inserting and extracting force may be further reduced by displacing (staggering) the positions of each of the contact surfaces successively, position by position, in the shaft direction position of the cylindrical body. It may be configured so that the contact beam 33' indicated in Figure 3B extends from the opposite side of coupling arm 31.

When the third socket-type electrical contact point in the present invention is used, the coupling arms 22, 22' and 22'' in Figure 1C or in Figures 2A and B may be shaped to form the letter "W" or in a zigzag and the contact surfaces may be formed at multiple bent points.

As can be seen from the above explanation, the socket-type electrical contacts described above are all equipped with multiple cantilever-type contact arms. Therefore, the contact surfaces have outstanding elasticity and as a result the inserting and extracting force with the pin can be significantly reduced so that it is suitable for use in a connector when a large number of electrical contact pins must be inserted or extracted simultaneously.

Claims

1. A conductive plate-shaped member (24) for forming a socket-type electrical contact for receiving an electrical pin wherein said plate-shaped member includes parallel end parts (21a, 21b) and contact arms (22) attached to the end parts and extending therebetween, characterised in that said contact arms (22) are non-linear and have contact surfaces (23) whereby the forming of the plate-shaped member into a cylinder positions the center parts of the contact arms and the contact surfaces (23) thereon inside the cylinder thereby forming a contact area.
2. A conductive plate-shaped member (30, 40, 40') for forming a socket-type electrical contact for receiving an electrical pin wherein said plate-shaped member includes parallel end parts (32a, 42a, 42b, 42') and coupling arms (32, 42, 42') attached to the end parts and extending therebetween, characterised in that contact beams (33, 43, 44) are attached to said coupling arms and have contact surfaces (34, 45, 46) whereby the forming of the plate-shaped member into a cylinder positions the contact beams and the contact surfaces thereon inside the cylinder thereby form-

ing cantilever contact beams.

3. A conductive plate-shaped member (30', 40'') for forming a socket-type electrical contact for receiving an electrical pin wherein said plate-shaped member includes parallel end parts (31a', 31b, 41a'', 41b'') attached to the end parts and extending therebetween, characterised in that contact beams (33', 43'', 44'') are attached to one or both of said end parts and have contact surfaces (34') whereby the forming of the plate-shaped member into a cylinder positions the contact beams and the contact surfaces thereon inside the cylinder thereby forming cantilever contact beams.

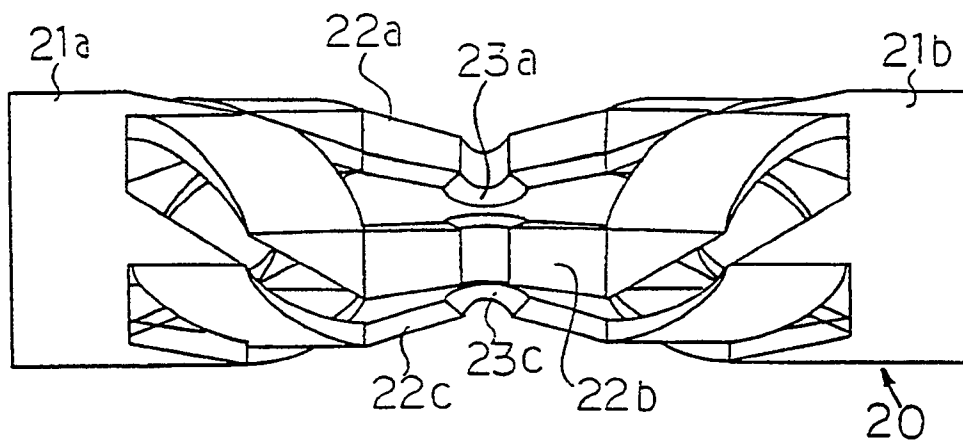


Figure 1A

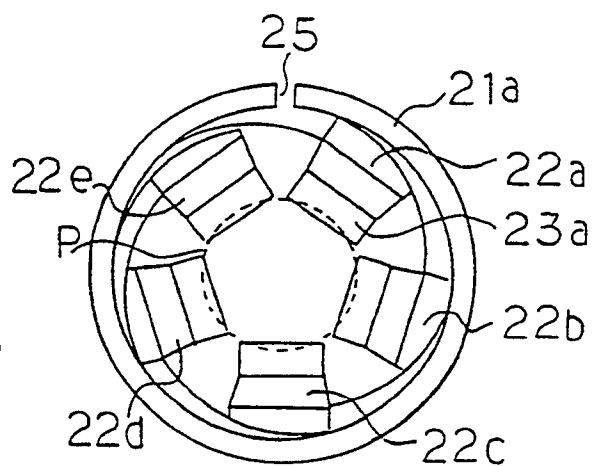


Figure 1B

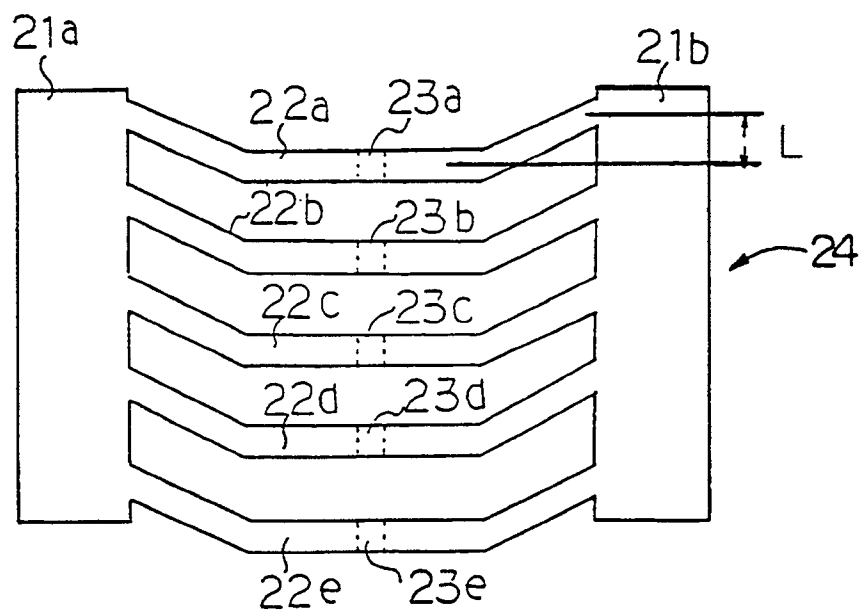


Figure 1C

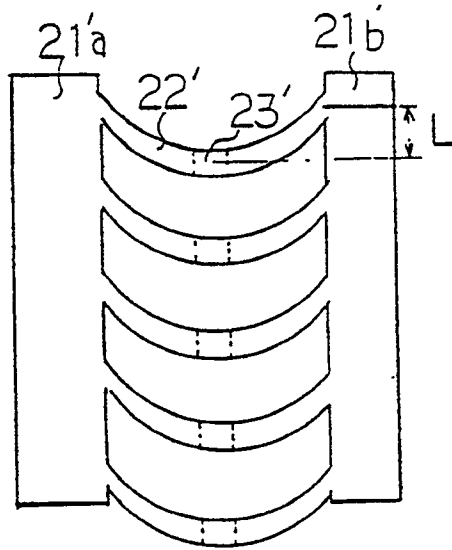


Figure 2A

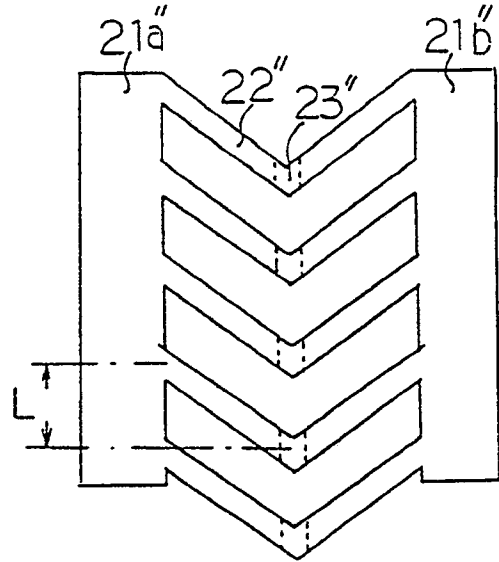


Figure 2B

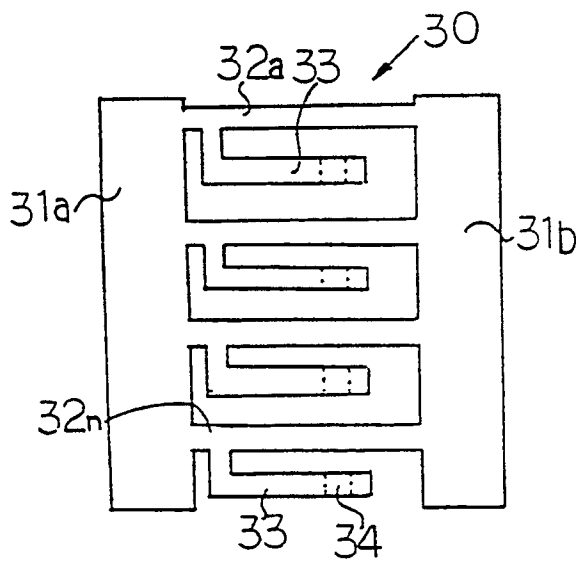


Figure 3A

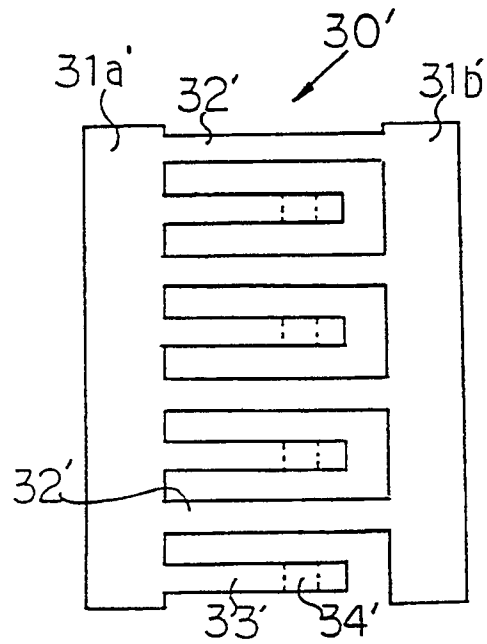


Figure 3B

Figure 4A

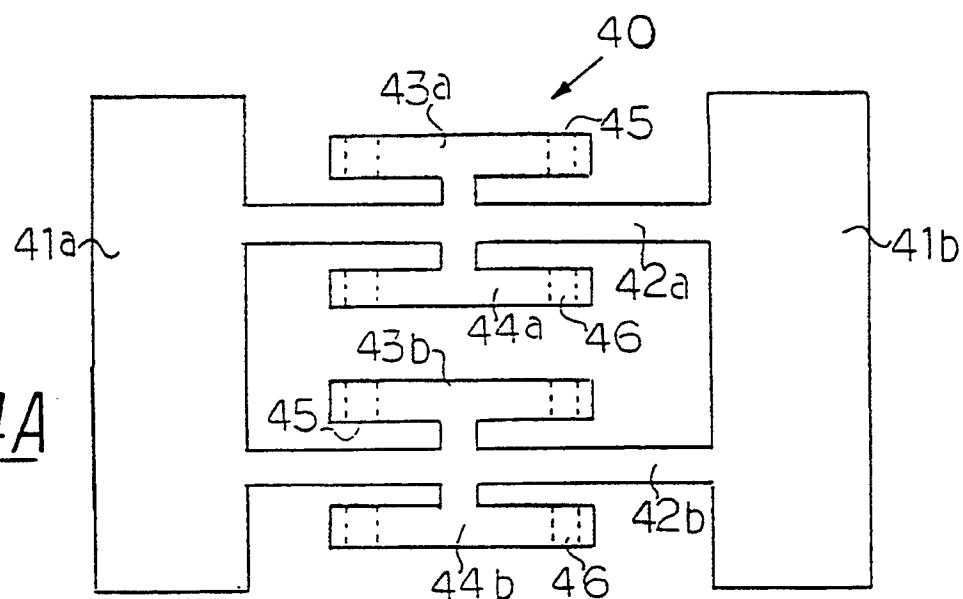


Figure 4B

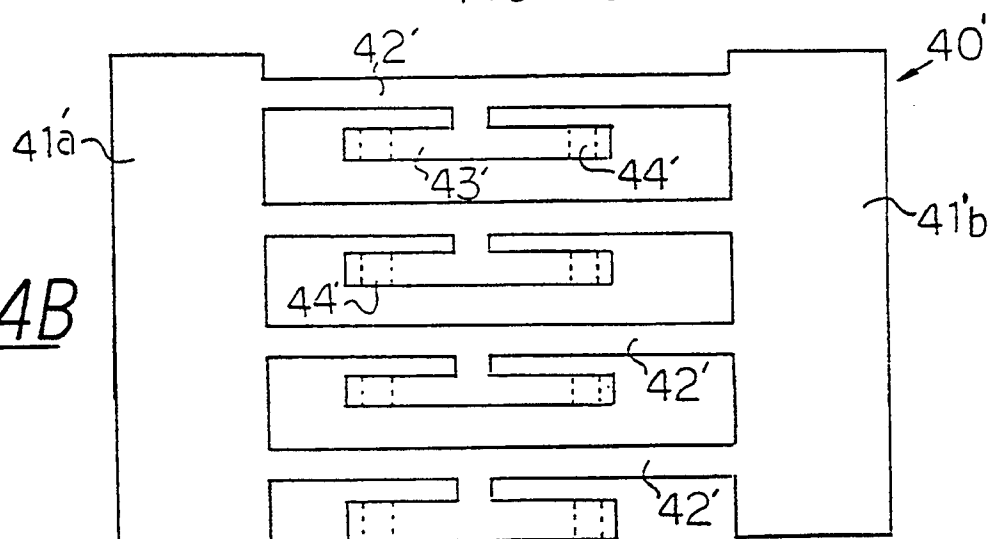
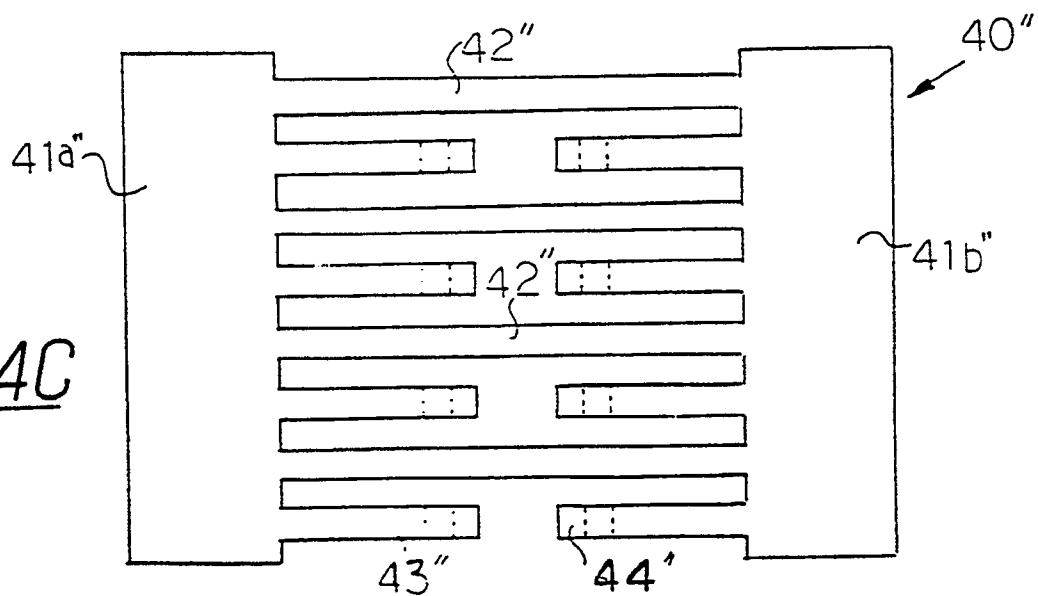


Figure 4C



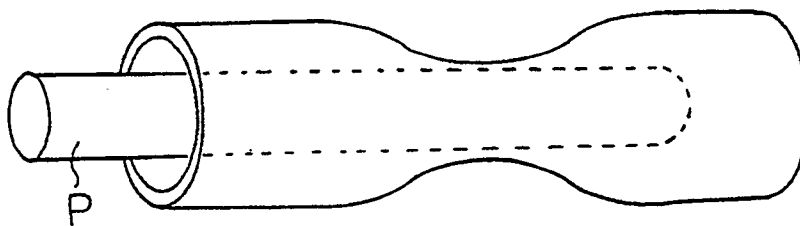


Figure 5

