



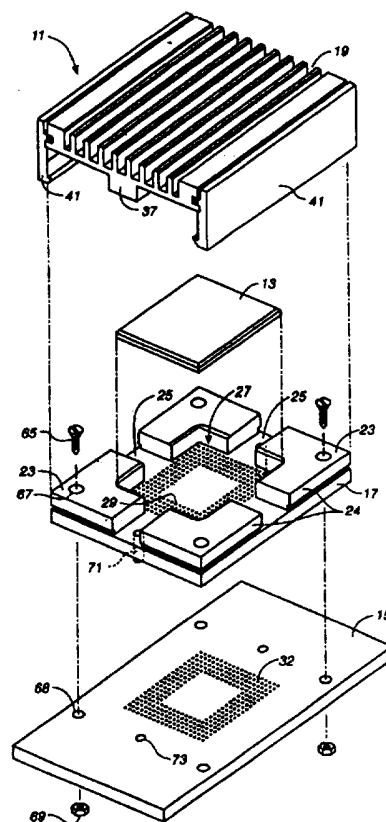
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| <p>(21) International Application Number: PCT/US96/16018 (22) International Filing Date: 4 October 1996 (04.10.96) (30) Priority Data: 08/538,956 4 October 1995 (04.10.95) US (71) Applicant: OZ TECHNOLOGIES, INC. [US/US]; 3387 Investment Boulevard, Hayward, CA 94545 (US). (72) Inventor: BARABI, Nasser; 4067 Happy Valley Road, Lafayette, CA 94549 (US). (74) Agent: BEESON, Donald, L.; Suite 2360, One Kaiser Plaza, Oakland, CA 94612 (US).</p> | | <p>(81) Designated States: European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p> |

(54) Title: TEST SOCKET FOR LEADLESS IC DEVICE

(57) Abstract

A test socket (11) for an IC device (13) has relatively thin contact interface wall (20) having an array of double-ended pogo pins (29). The double-ended pogo pins (29) provide resilient spring-loaded contacts for the I/O contacts (30) of an IC device (13) held in the socket as well as for the circuit contacts (32) of a PC board (15) to which the socket is mounted.



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TITLE OF THE INVENTION

Test Socket for Leadless IC Device

TECHNICAL FIELD

5 The present invention generally relates to the surface mounting of integrated circuit (IC) devices to a printed circuit (PC) board, and more particularly to test sockets for the test and burn-in of IC devices. The invention is particularly suited to the testing of leadless IC chips, but is not limited to such applications.

BACKGROUND ART

10 The increased capabilities of IC chips have led to increased input/output (I/O) densities and alternative techniques for mounting IC chips to printed circuit (PC) boards involving leadless IC chips. For example, ball grid array (BGA) mounting techniques have been developed to replace pin grid array (PGA) mounting approaches in order to
15 achieve more densely packed contacts and smaller contact dimensions (in the order of 25 mils.). To facilitate the testing and burn-in of leadless IC devices, special test sockets have been devised to hold these devices and to temporarily connect them to a PC test board. Test sockets for leadless IC devices most commonly employ stamped or formed metal contact pins for achieving electrical interconnection between the I/O
20 contacts of the IC device being tested and the PC test board circuits. Such socket designs have a relatively high profile and relatively high capacitance and inductance making them undesirable for high speed applications. They also require soldering of the socket pins to the PC board and do not operate efficiently with IC devices having noncompliant I/O contacts. Sockets having elastomeric contactors which do not require
25 soldering have also been devised. These test sockets utilize flexible wire filaments which extend in a perpendicular relation to the contact points. Such wire filaments are generally not reliable and will not hold up with repetitive use. In addition, they are not likely to withstand the thermal shock while testing an IC device.

 Still another known IC test socket design is a test socket having high profile,

spring-loaded pins, called "pogo pins." Heretofore, the use of pogo pins in test sockets have been limited to relatively long, single-ended pogo pins wherein one end of each pogo pin is a fixed end soldered to the PC board and the other end is spring-loaded. Again, the relatively high profile of such test sockets make them unsuitable for high speed test applications. Also, since the fixed ends of the pogo pins are soldered to the PC board, such sockets are relatively difficult to remove.

The present invention overcomes the disadvantages of conventional test sockets for leadless IC devices by providing a low profile test socket suitable for high frequency test applications which will provide efficient and solderless contacts for both the PC board and the IC devices being tested.

DISCLOSURE OF THE INVENTION

Briefly, the present invention provides for an improved IC socket for surface mounting an IC device having a predetermined array of I/O contacts to a circuit board having a corresponding array of circuit contacts using an array of miniature, double-ended pogo pins which provide an array of resilient contacts for both the circuit contacts of the PC board and the I/O contacts of the IC device. More specifically, the IC socket has a body portion which includes a contact interface wall having opposed and substantially parallel mounting surfaces, one of the mounting surfaces of the interface wall is an interior mounting surface for receiving an IC device and the other of the mounting surfaces being an exterior surface for mounting the body portion of the socket to the circuit board. A plurality of substantially parallel conductor pins in the form of double-ended pogo pins extend through and are held by the contact interface wall in an array that corresponds to the predetermined array of the I/O contacts of the IC device (as well as to the corresponding circuit contacts of the circuit board). The conductor pins, which have contact ends that project beyond the mounting surfaces of the contact interface wall, provide a conductive path between these mounting surfaces. By using double-ended pogo pins, both contact ends of the pins will be resiliently depressible to provide spring-loaded contacts for both the IC device held in the socket

and the circuit board to which the socket is mounted. Means for releasably holding an IC device against the interior mounting surface of the contact interface wall of the socket's body portion is provided such that the I/O contacts of the IC device remain in contact with the ends of the conductor pins at all times.

5 It is noted that the invention's substantially parallel conductor pin provide a conductor pin footprint that is the same on both sides of the socket. Thus, the socket receives an IC device having the same contact footprint as the contact footprint on the PC board to which it is mounted. This permits the IC device to be soldered directly to the PC board after the test socket, which is not soldered to the PC board, is removed.

10 Therefore, it can be seen that a primary object of the present invention is to provide an IC test socket suitable for high frequency applications and which provides efficient electrical contacts to both the I/O contacts of an IC device and the circuit contacts of a PC board. Another object of the invention is to provide a durable test socket that can withstand the thermal shock encountered in test and burn-in applications, and that can further withstand the repeated insertions and extractions of IC devices into and from the test socket. It is still another object of the invention to provide a test socket for an IC device having the same I/O contact footprint as the footprint of the circuit contacts (also called "pads") of the PC board to which it is mounted. Yet other objects of the invention will be apparent from the following specification and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of an IC test socket in accordance with the invention as it would be mounted to a PC board.

25 FIG. 2 is an exploded side elevational view of the test socket shown in FIG. 1 with the base portion of the socket secured to the PC board.

FIG. 2A is a side elevational view of the test socket and PC board shown in FIG. 2 fully assembled.

FIG. 3 is an enlarged, fragmentary view in cross-section of the interface wall

of the test socket body motion illustrated in FIG. 1 showing double-ended pogo pins held in the interface wall. FIG. 3A is an enlarged, fragmentary view in cross-section of the contact interface wall of the test socket's body portion showing the contact ends of the double-ended pogo pins depressed by the contacts of an IC device and the contacts of a PC board to which the test socket is mounted.

FIG. 4 is an enlarged view of one of the double-ended pogo pins illustrated in FIG. 3.

FIG. 4A shows the pogo pin of FIG. 4 with the contact ends of the pogo pin depressed.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring now to the drawings, FIGS. 1, 2 and 2A illustrates a test socket 11 for surface mounting IC chip 13 to PC board 15. The test socket includes body portion 17 and a latch cover 19 which serves as a means for releaseably holding IC chip 13 in the socket's body portion. Referring to FIG. 3, it can be seen that the body portion is formed to provide a relatively thin contact interface wall 20 having opposed and substantially parallel mounting surfaces. One of the mounting surfaces is the interior mounting surface 21 which receives IC chip 13, while the other mounting surface of the contact interface wall is an exterior mounting surface 22 against which the IC test socket is mounted to PC board 15. The body portion of the test socket further includes shoulder portions 23 which form an elevated perimeter 24 having a latch cover alignment slots 25. Perimeter 24 further defines an interior region 27 sized to capture and hold IC chip 13 such that its I/O contacts 30 (see FIG. 3) are precisely aligned with the array of parallel conductor pins 29 held in the body's contact interface wall.

Further referring to FIGS. 1, 2 and 2A, the socket's latch cover 19 has a cover plate 31 which can suitably be fabricated of aluminum and which can serve as a heat sink for the IC chip. The cover plate includes lateral edge portions 33 and upwardly extending heat fins 35 distributed along the top of the cover plate between the cover plate's two lateral edges. Alignment posts 37, which are shaped to mate with the

alignment slots 25 of the socket's body portion 17, are provided to permit the gross alignment of the latch cover over the socket body portion. An additional pressure plate 39 is also provided on the bottom of the cover plate and is centrally located to permit it to bear against the top of IC chip 13 when the socket is assembled. In applications where the latch cover is to act as a heat sink, the pressure plate 39 is metal, and suitably integral to cover plate 31, to conduct heat away from the IC chip. In applications where the latch cover is not intended to act as a heat sink, pressure plate 39 can suitably be a plastic material such as Ultern™ 1000. Similarly, the alignment ports 37 can be fabricated of a metal or plastic material, depending on the application.

Latch cover 19 is releaseably held to the body portion of the socket by means of opposed latch handles 41 pivotally mounted to lateral edges 33 of cover plate 31. The latch handles are spring-loaded by means of compression springs 43 and has a cammed locking ridge 45 which snaps into locking groove 47 on the perimeter of the socket's body portion as shown in FIG. 2A when the latch cover is placed down over the body portion.

FIGS. 3, 3A, 4 and 4A illustrate in greater detail the contact interface wall 20 of the socket body portion and the conductor pins held thereby. Conductor pins 29 are held in the contact interface wall 20 in an array of straight and parallel pins that corresponds to the footprint of both the array of I/O contacts 30 on the bottom of IC chip 13 and the circuit contacts or "pads" 32 of PC board 15 to which the IC chip is to be surface mounted. Referring to FIG. 4, it can be seen that each of the straight conductor pins is in the form of a double ended pogo pin having oppositely extending contact ends 51, 52 which are depressible within pin casing 53 against internal compression spring 55 which exerts a restoring force against the enlarged base ends 57, 58 of each of the contact ends.

Body portion 17 of the socket is fabricated from an insulator material, suitably a plastic material, the composition of which will depend on the application. For high temperature applications, a material such as Vespel™ can be used, while for low temperature applications, a material such as Ultern™ can be employed. To permit

insertion and retention of the conductor pins in the contact interface wall of the body portion, the body portion can suitably be provided with a separate bottom cover plate 61 which fits onto the bottom of the body portion 17 after the conductor pins have been inserted into predrilled holes in the interface wall. Enlarged collar portions 63 on the outside diameter of the conductor pin casing 53 will fit into a counterboard portion of the pin holes and will fix the pins in the wall when bottom cover plate 61 is installed. Bottom cover plate 61 can be secured to the body portion by mechanical means, such as screws, or a suitable adhesive, or both.

To use the test socket of the invention, the socket's body portion 17 is first secured to PC board 15 by means of any suitable attachment means such as attachment screws 65 which extend through aligned attachment screw openings 67, 68 in, respectively, the socket's body portion and the PC board. Attachment nuts thread onto the attachment screw 65 from the back side of the PC board. Locator pins 71 and corresponding locator holes 73 are provided to precisely locate the socket body 17 over the PC board circuit contacts 32.

The operation of the double-ended pogo pin type conductor pins is best illustrated in reference to FIG. 3. In FIG. 3, the bottom contact ends 51 of conductor pins 29 contact and are depressed slightly when the contact ends meet the circuit contacts 32 of PC board 15 when the socket's body portion is mounted to the PC board as above described. Similarly, as the IC chip 13 is pressed against the top of the interface wall 20 by means of pressure plate 39 of the socket's latch cover 19, the I/O contacts on the bottom of the IC chip are pressed against the upper contact ends 51 of conductor pins 29 to slightly depress these ends. Because both contact ends of the conductor pins are resiliently depressible, they will exert a spring-like force against the contacts of the IC chip and circuit board and will account for any lack of coplanarity in these contact points. Such contacts can be made with minimal insertion force, that is, only that force required to slightly depress the contact ends of the conductor pins. It is noted that the tips 75 of the contact ends of the conductor pins have a recessed V-shape shape to increase the area of the conductor pin that actually comes into contact

with the ball-shaped contact points of the PC board. which are well suited to provide good electrical contact with the ball-shaped contacts of the IC device and the surface pad contacts of the PC board.

5 Conductor pins 29 while be miniature conductor pins capable of providing a low profile contact between PC board and the IC chip. The conductor pins can suitably have an overall length, including the contact ends, of approximately 0.220 inches, a casing outside diameter of approximately 0.025 inches, and a contact end diameter of approximately 0.0120 inches. Preferably the overall length of the conductor pins will be less than approximately 0.250 inches. The length of the conductor pin casing 53 can
10 suitably have a dimension of approximately 0.160 inches with the overall thickness of the contact interface wall 20 being slightly larger than this dimension. Such dimensions will be consistent with a low profile contact suitable for high frequency test applications.

15 Therefore, it can be seen that the present invention provides a test socket for efficiently surface mounting a leadless IC chip to a circuit board involving solderless connections and small insertion forces. At the same time, the test socket of the invention has a relatively low profile and is suitable for use in high frequency test and burn-in applications. The test socket of the invention also provides a uniform contact footprint from one side of the socket to the other which permits the socket to be
20 removed and the IC device soldered directly to the PC board. While the invention has been described in considerable detail in the foregoing specification, it is understood that it is not intended that the invention be limited to such detail, except as necessitated by the following claims.

CLAIMS:

1 1. An IC socket for surface mounting an IC device having a predetermined
2 array of I/O contacts to a circuit board having a corresponding array of circuit contacts,
3 said IC socket comprising

4 a body portion which includes a contact interface wall having opposed and
5 substantially parallel mounting surfaces, one of said mounting surfaces being an interior
6 mounting surface for receiving an IC device and the other of said mounting surfaces
7 being an exterior mounting surface for mounting the body portion to a circuit board,

8 a plurality of conductor pins extending through and held by said contact interface
9 wall in a array corresponding to a predetermined array of I/O contacts of an IC device,
10 said conductor pins having contact ends projecting beyond the mounting surfaces of said
11 contact interface wall to provide a conductive path therebetween, and each of the
12 contact ends of said conductor pins being resiliently depressible to provide spring
13 loaded contacts for both the I/O contacts of an IC device and the circuit contacts of a
14 circuit board contacted thereby, and

15 means for releaseably holding an IC device against the interior mounting surface
16 of the contact interface wall of said body portion such that the I/O contacts of the IC
17 device remain in contact with the contact ends of the conductor pins projecting from
18 said interior mounting surface.

1 2. The IC socket of claim 1 wherein the thickness of said contact interface wall

2 and the length of said conductor pins are relatively small to provide a low profile
3 interface between the IC device and the circuit board.

1 3. The IC socket of claim 2 wherein the length of said conductor pins is less
2 than approximately .250 inches.

1 4. The IC socket of claim 1 wherein said conductor pins are straight
2 conductor pins held in parallel relation in said contact interface wall to provide an array
3 of conductor pins that has the same footprint at each of said interior and exterior
4 mounting surfaces.

1 5. An IC socket for surface mounting an IC device having a predetermined
2 array of I/O contacts to a circuit board having a corresponding array of circuit contacts,
3 said IC socket comprising

4 a body portion which includes a relatively thin contact interface wall having
5 opposed and substantially parallel mounting surfaces, one of said mounting surfaces
6 being an interior mounting surface for receiving an IC device and the other of said
7 mounting surfaces being an exterior mounting surface for mounting the body portion
8 to a circuit board,

9 a plurality of straight, parallel and relatively short conductor pins extending
10 through and held by said contact interface wall in a array corresponding to a
11 predetermined array of I/O contacts of an IC device, said conductor pins having contact

12 ends projecting beyond the mounting surfaces of said contact interface wall to provide
13 a conductive path therebetween, and each of the contact ends of said conductor pins
14 being resiliently depressible to provide spring loaded contacts for both the I/O contacts
15 of an IC device and the circuit contacts of a circuit board contacted thereby, and
16 means for releaseably holding an IC device against the interior mounting surface
17 of the contact interface wall of said body portion such that the I/O contacts of the IC
18 device remain in contact with the contact ends of the conductor pins projecting from
19 said interior mounting surface.

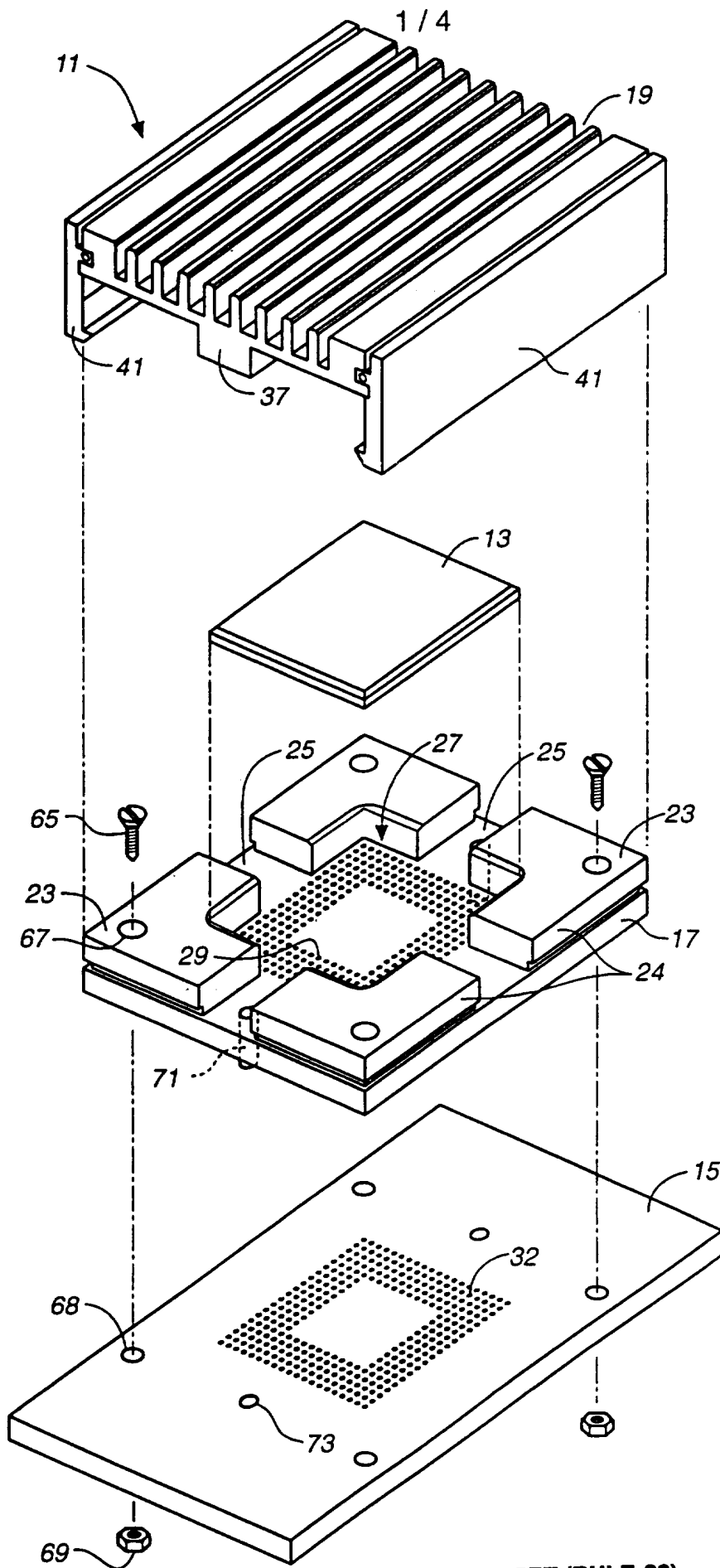


FIG. 1

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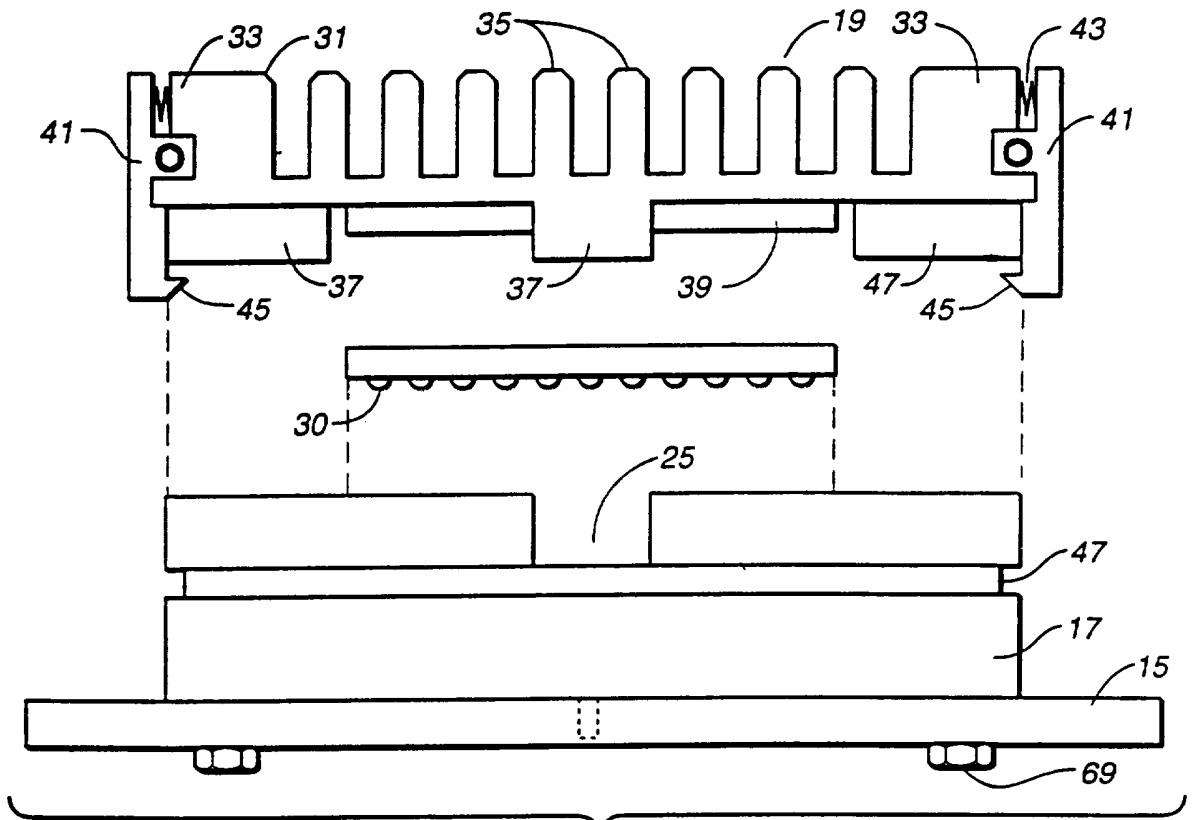


FIG. 2

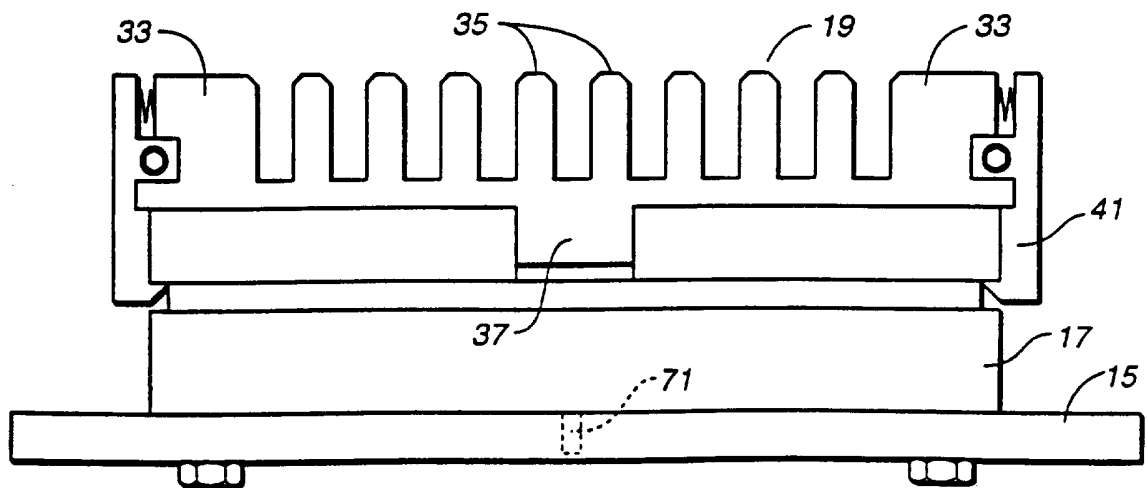


FIG. 2A

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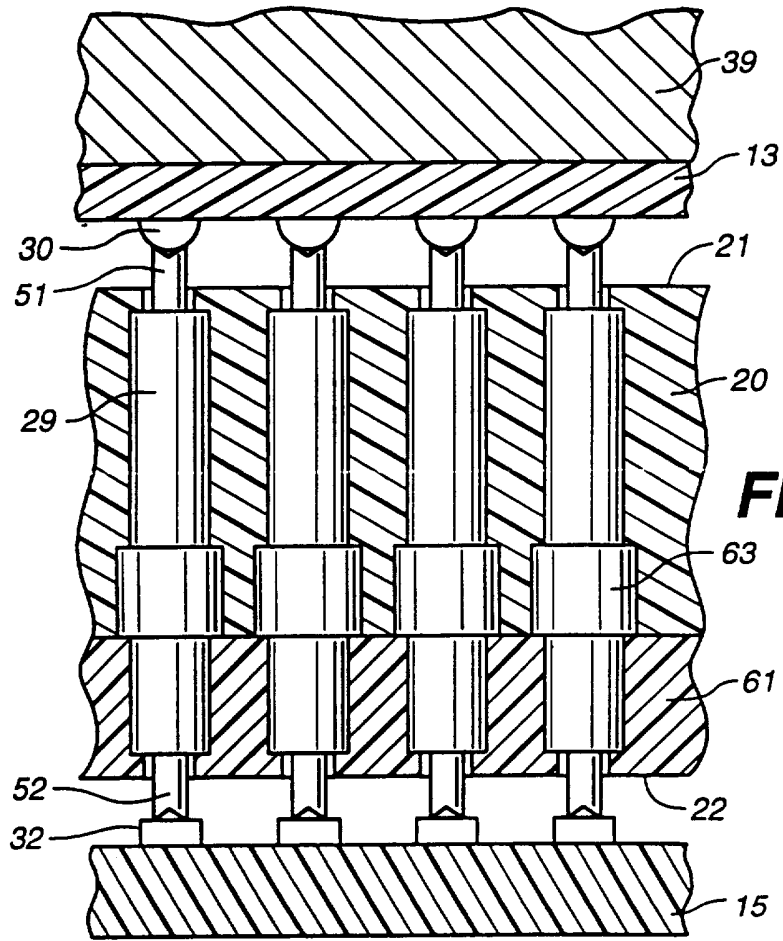


FIG. 3

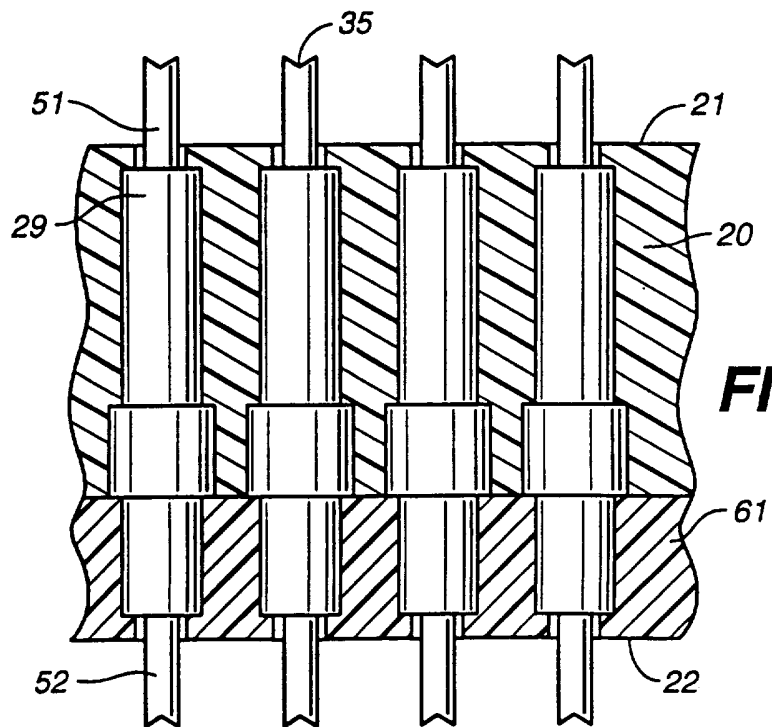


FIG. 3A

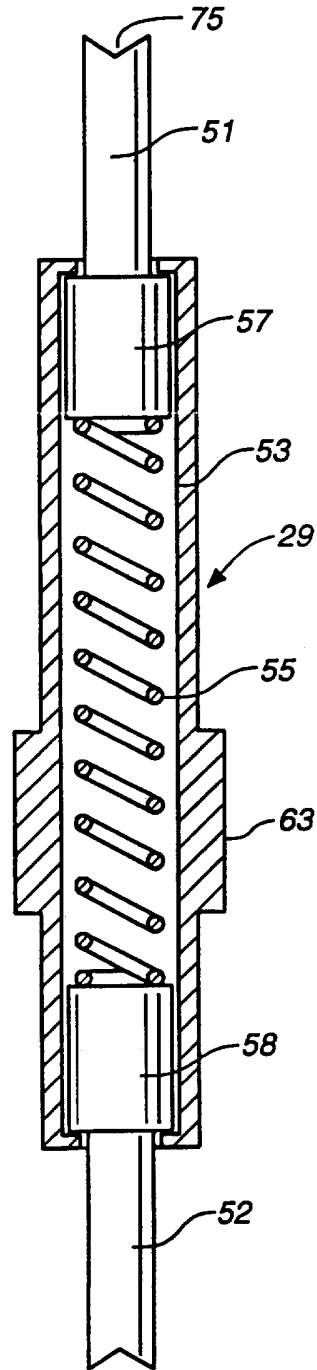


FIG. 4

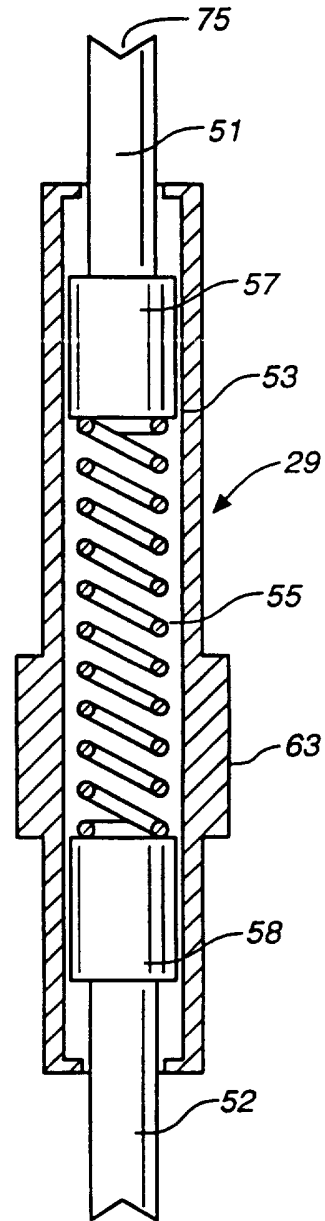


FIG. 4A

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/16018

| A. CLASSIFICATION OF SUBJECT MATTER IPC(6) :HOIR 23/72 US CL :439/66, 71 According to International Patent Classification (IPC) or to both national classification and IPC | | |
|---|--|--|
| B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 439/66, 70, 71 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) | | |
| C. DOCUMENTS CONSIDERED TO BE RELEVANT | | |
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| Y | US, A, 4,443,756 (LIGHTBODY ET AL.) 17 APRIL 1984, SEE FIGURE 3 | 1-5 |
| Y | US, A, 4,508,405 (DAMON ET AL.) 02 APRIL 1985, SEE FIGURES 6, 7 | 1-5 |
| Y | US, A, 5,215,472 (DELPRETE ET AL.) 01 JUNE 1993, SEE FIGURES 1, 3A, 5A | 1-5 |
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