

TITLE OF THE INVENTION

IC SOCKET

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a socket used for an IC package having a spherical bump.

2. Prior Art

As shown in Figs. 10 through 13, there is known an IC package of the type in which a number of spherical bumps are formed on a lower surface of an IC package body 1.

Each of the spherical bumps 2 is either semi-spherical as shown in Fig. 10 or spherical as shown in Fig. 11. Any of them is formed of metal having a low melting point such as soldering material. In many cases, there is employed a method of use in which the spherical bumps are directly mounted on a wiring board and welded to a wiring pattern.

As shown in Fig. 13, in a socket for the use of an aging test of the IC package, there is employed a method in which a spring probe 3 held by the socket is moved forwardly and backwardly in a vertical direction relative to the spherical bump 2 to bring a tip of the spring probe 3 into contact with the bump 2 under pressure. As a result, it is unavoidable for this method that the tip of the spring probe 3 is brought into contact with a lower dead point of the spherical bump 2 under pressure.

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However, the following problems are inherent in the above socket. A lower dead point of the spherical bump 2, which is directly welded to the wiring board, is easily damaged by the probe 3, and the tip of the spring probe 3 of the socket tends to slip on the surface of the lower dead point portion of the spherical bump 2 sideways, with the result of poor contacting condition.

In addition, there is another problem in that with a structure having only one contacting spot, it is difficult to realize a reliable contacting condition.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an IC socket which assures reliable contact with an IC package having spherical bumps.

In order to achieve the above object, there is provided an IC socket equipped with a plurality of elastic contact pins which are brought into contact with spherical bumps of an IC package, each of the contact pins having at a foremost end thereof a contacting portion disposed opposite to a lower spherical surface of the spherical bump, the contacting portion having a relief portion which is kept in a non-contacting condition relative to a lower dead point portion in the lower spherical surface of the spherical bump and also a contacting end which is brought into press contact at an area thereof around the relief portion with that area of the

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spherical surface of the spherical bump outwardly adjacent to the lower dead point.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view showing one example of a contacting structure between a spherical bump and an elastic contact pin;

Fig. 2 is a side view showing another example of a contacting structure between a spherical bump and an elastic contact pin;

Fig. 3 is a further example of a contacting structure between a spherical bump and an elastic contact pin, Fig. 3(A) is a perspective view, Fig. 3(B) is a vertical cross-sectional view, and Fig. 3(C) is a transverse cross-sectional view;

Fig. 4 is a perspective view showing a number of elastic contact pins of a socket now in press contact with a number of spherical bumps;

Fig. 5 is a cross-sectional view of the socket;

Fig. 6 is a cross-sectional view of the socket, Fig. 6(A) shows a socket without an IC package loaded thereon, Fig. 6(B) shows a socket with an IC package loaded thereon and in which the contacting condition between a contact pin and a spherical bump is released, and Fig. 6(C) shows a socket with an IC package loaded thereon and in which a contact pin is in contact with a spherical bump;

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Fig. 7 is an enlarged cross-sectional view of a spherical bump and a contact pin, Fig. 7(A) and 7(B) show contact released conditions, respectively;

Fig. 8 is an enlarged cross-sectional view showing contacting conditions of Fig. 7;

Fig. 9 is a bottom view of an IC package showing a part where spherical bumps and contact pins contact;

Fig. 10 is a side view of an IC package;

Fig. 11 is a side view showing another example of an IC package;

Fig. 12 is a plan view of the above IC package; and

Fig. 13 is a side view showing a contacting condition between a spherical bump and a contact pin according to the prior art.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Preferred embodiments of the present invention will be described in detail with reference to Figs. 1 through 9.

In Fig. 1, reference numeral 4 denotes an elastic contact pin held by a socket. This elastic contact pin 4 is formed of a single elongated sheet plate having elasticity. This sheet plate has at a foremost end thereof a contacting portion 5 disposed opposite to a lower spherical surface of a spherical bump 2

This contacting portion is bifurcated generally in a U-shape or V-shape to define a first contacting end 6 and a

second contacting end 7, and a relief portion 8 is defined by a recessed portion formed between the first and second contacting ends 6 and 7. The contacting portion 5 is spaced apart, in a non-contacting condition, at the relief portion 8 from a lower dead point portion of the spherical surface of the spherical bump 2, and are in point-contact at two spots of the distal ends of the first and second contacting ends 6 and 7 on the opposite sides of the relief portion 8 with that area of the spherical bump 2 outwardly adjacent to the lower dead point portion. The first and second contacting ends 6 and 7 are in a symmetrical relation with respect to a lower dead point P of the spherical bump 2 and brought into contact, in an elastically pressed condition, with the spherical surface of the spherical bump 2 at the spots equidistant from the lower dead point P.

To realize this press-contacting condition, the elongated sheet plate portion supporting the contacting portion 5 defines a spring element 9. As shown in Figs. 4 to 6, this spring piece 9 is capable of deflecting in a vertical direction to a line, which connects the first and second contacting ends 6 and 7 together, to accumulate resilient force and brought into press-contact with the spherical bump 2.

The reason why the spring piece 9 must deflect in the vertical direction to the above-mentioned line is as follows.

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If it is designed such that the spring piece 9 is capable of deflecting in the direction of the line which connects the first and second contacting ends 6 and 7 (that is, the direction in the sense of an arrow X of Fig. 1), there is a possibility that either of the first and second contacting ends 6 and 7 moves across and causes a damage to the lower dead point portion of the spherical bump 2. Therefore, in this invention, the spring piece 9 is such designed as to be capable of deflecting in the X direction.

In the example of Fig. 2, the elastic contact pin 4 is moved forwardly and backwardly in a vertical direction to the lower dead point P of the spherical bump 2 in order to realize and release the contacting condition. The contact pin 4 is biased upwardly by a coil spring 10 along the above-mentioned vertical line. By doing this, the first and second contacting ends 6 and 7 are brought into press-contact with two spots of that area of the spherical surface outwardly adjacent to the lower dead point portion of the spherical bump 2, and are kept in a non-contacting condition relative to the lower dead point portion owing to a provision of the relief portion 8.

The elastic contact pin 4 may be called as a spring probe. In the example shown in Figs. 3(A) through 3(C), the contact pin 4 is brought into press-contact with that area of the spherical surface of the spherical bump 2 outwardly

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adjacent to the lower dead point portion in an annularly contacting condition.

As illustrated, the contacting portion of the foremost end of the elastic contact pin 4 is formed of a sleeve member 11. On end face of this sleeve member 11 is disposed opposite to the lower spherical surface of the spherical bump 2, and a central opening 12 thereof defines the relief portion 8 so that the contacting portion is kept at the central opening 12, in a non-contacting condition relative to the lower dead point portion of the spherical bump 2. An end face 19 of a wall defining a cylindrical hole in the sleeve member 11 defines the contacting end. This contacting end is brought into press-contact with that area of the spherical surface of the spherical bump 2 outwardly adjacent to the lower dead point portion in an annularly contacting condition.

The elastic contact pin 4 of Fig. 3 is brought into press-contact with the spherical bump 2 in the manner as shown in Figs. 1 and 5, as well as elsewhere, or otherwise the contact pin 4 is resiliently held by the coil spring 10 such that the contact pin is moved forwardly and backwardly, vertically to the lower dead point P of the spherical bump 2 in the manner as shown in Fig. 2.

Figs. 4 through 8 show a socket equipped with a means for bringing the elastic contact pin 4 of Fig. 1 into contact



with and away from the spherical bump 2.

A number of contact pins 4 formed of an electrical conductive one-piece elongated sheet plate and extending upwardly are arranged on the socket base 13. The contact pins 4 are pierced into through-holes 15, all the way therethrough, which are formed in a laterally movable operating plate 14 and then the foremost ends of the contact pins 4 thus pierced through the holes 15 are received in through-holes 17 which are formed in a damping plate 16. This damping plate 16 is rigidly integrally formed with the socket base 13, and the above-mentioned operating plate 14 is laterally movably disposed between the socket base 13 and the damping plate 16. The contact pins 4 are loosely inserted into both of the through-holes 15 and 17.

As shown in Fig. 6(A), the contact pin 4 is upstanding. In that condition, when the operating plate 14 is laterally moved in one direction, the inner wall of the through-hole 15 presses the contact pin 4 as shown in Fig. 6(B). As a result, the foremost end of the contact pin 4 is curvedly bent while being supported by the inner wall of the through-hole 17 in the damping plate 16 and moved in a contracting direction within the through-hole 17. As a consequence, the foremost end contacting portion 5 of the contact pin 4 are brought away from the spherical bump 2, thereby realizing the contact-releasing condition as shown in Figs. 7(A) and 7(B).

The IC package body 1 is loaded on the damping plate 16, and a positioning wall 18 formed in the damping plate 16 is disposed between the spherical bump 2 and the damping plate 16 in order to correctly position the bump 2.

As shown in Fig. 6(C), when the operating plate 14 is laterally moved in the other direction by the restoring force of the contact pin 4 or when the operating plate 14 is laterally moved in the other direction to restore the contact pin 4, the contact pin 4 is stretched so that the foremost end portion 5 of the contact pin 4 is brought into press-contact with the spherical bump 2 either at an opening surface of the through-hole 17 in the damping plate 16 or in a slightly projected manner from the through-hole 17 as shown in Figs. 8(A) and 8(B). That is, the contact pin 4 is caused to accumulate resilient force by the spring element 9 deflecting in a perpendicular direction to the line which connects the first and second contacting ends 6 and 7 and brought into press-contact with the spherical bump 2.

The press-contacting is made at an area around the relief portion 8 as already mentioned.

In Fig. 9, those areas S where the contacting portions 5 of the contact pins 4 are in contact with the spherical bumps 2 are indicated by imaginary lines. As seen from the Figure, the contacting ends of the contacting portions 5 are in contact with the spherical surfaces of the bumps 2 on

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circular orbits around the lower dead points P of the bumps 2, respectively.

According to the present invention, since the contact pin can be brought into contact with the spherical bump 2 at a plurality of contacting spots or in annularly contacting conditions in that area of the spherical bump outwardly adjacent to the lower dead point portion around the relief portion, the problem for damaging the lower dead point portion of the spherical bump can be effectively obviated.

In addition, the contacting portion of the contact pin safely catches the area outwardly adjacent to the lower dead point portion of the spherical bump to positively maintain the press-contacting condition, and therefore a reliable contacting condition can be realized.

Furthermore, since the contacting portion of the contact pin is brought into contact with the spherical bump at a plurality of contacting spots or in an annularly contacting condition, the reliable contacting condition is further enhanced.

The present invention is not limited to the above embodiments, but many changes can be made without departing from the scope of the invention.



WHAT IS CLAIMED IS:

1. An IC socket equipped with a plurality of elastic contact pins which are brought into contact with spherical bumps of an IC package, each of said contact pins having at a foremost end thereof a contacting portion disposed opposite to a lower spherical surface of said spherical bump, said contacting portion having a relief portion which is kept in a non-contacting condition relative to a lower dead point portion in the lower spherical surface of said spherical bump and also a contacting end which is brought into press contact at an area thereof around the relief portion with that area of the spherical surface of said spherical bump outwardly adjacent to the lower dead point.

2. An IC socket as claimed in claim 1, in which said contacting portion includes a first contacting end and a second contacting end which are brought into point-contact at opposite sides of the relief portion with that area of the spherical surface of said spherical bump outwardly adjacent to the lower dead point portion, and said contact pin is capable of deflecting in a vertical direction to a line, which connects said first and second contacting ends together, to accumulate resilient force, thereby to realize the contacting condition.

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3. An IC socket as claimed in claim 3, in which said contacting portion is moved forwardly and backwardly in a direction generally vertical to the lower dead point portion of said spherical bump, thereby to realize the contacting condition.

4. An IC socket substantially as hereinbefore described with reference to any one of Figs. 1 - 12 of the accompanying drawings.

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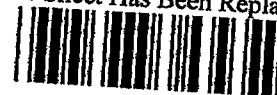


FIG. 1

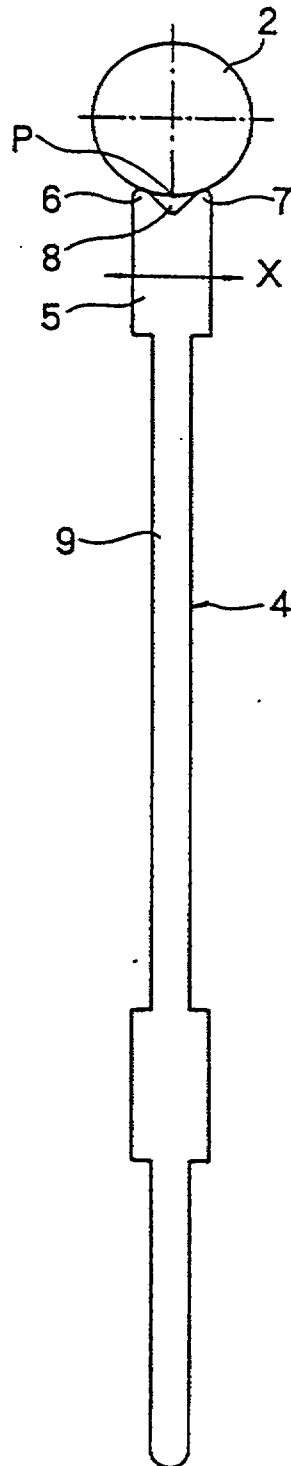


FIG. 2

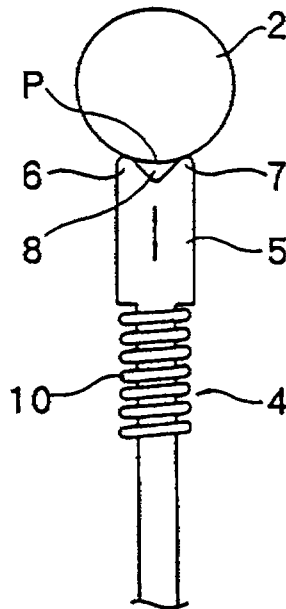


FIG. 3(A)

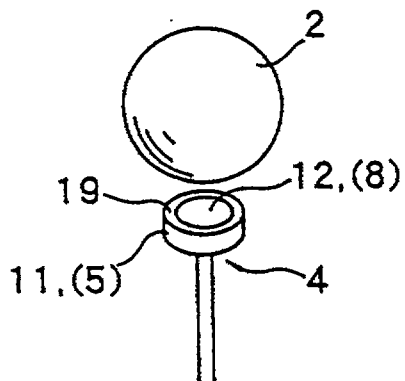


FIG. 3(B)

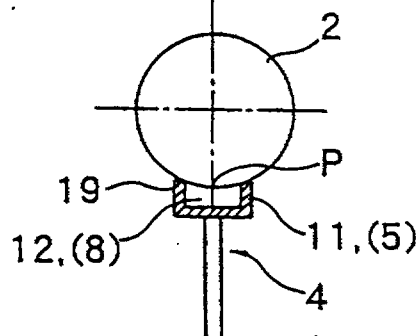
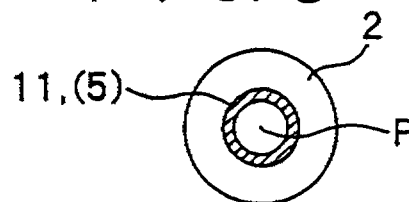


FIG. 3(c)



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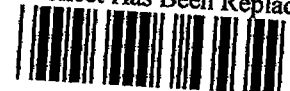


FIG. 4

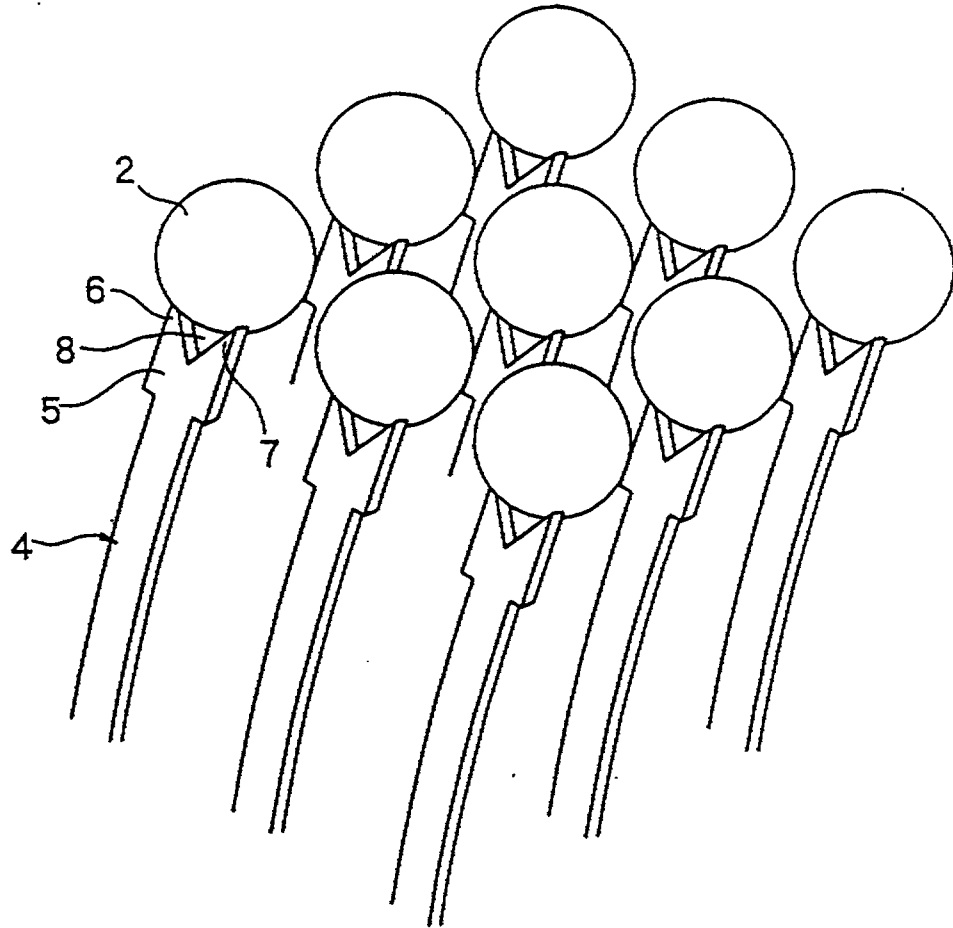


FIG. 5

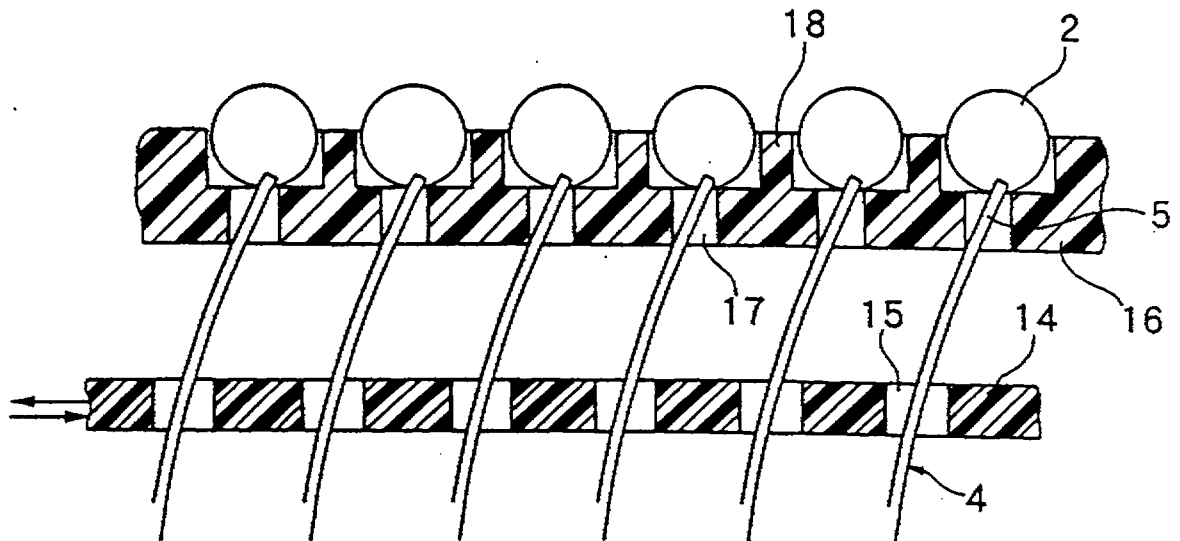


FIG. 6(A)

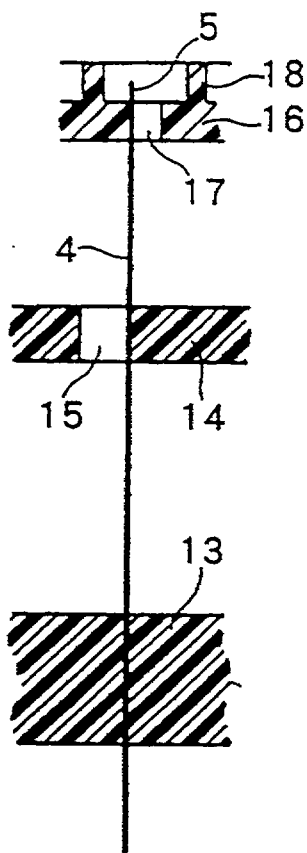


FIG. 6 (B)

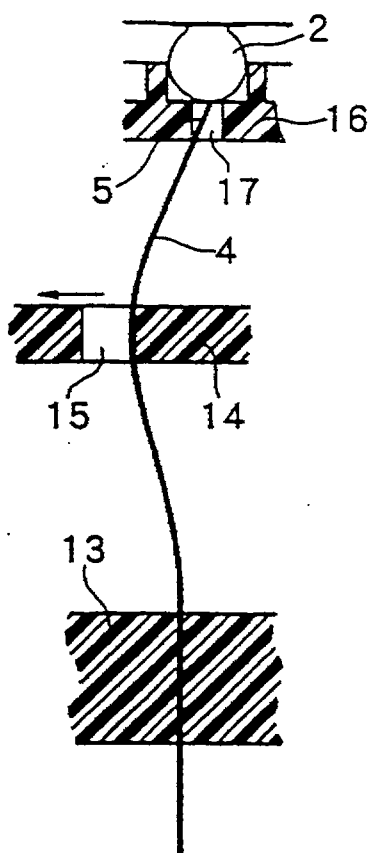


FIG. 6 (C)

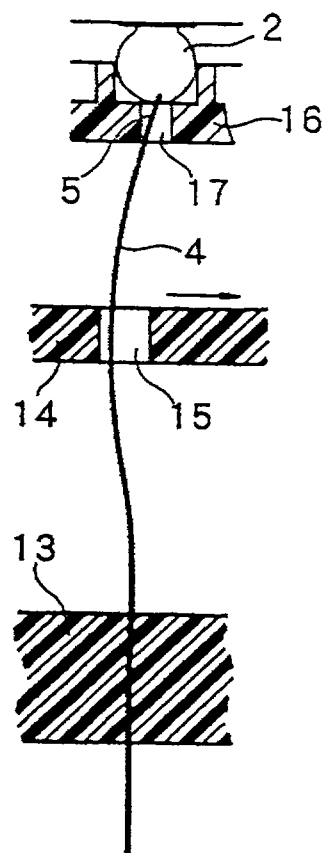


FIG. 7 (A)

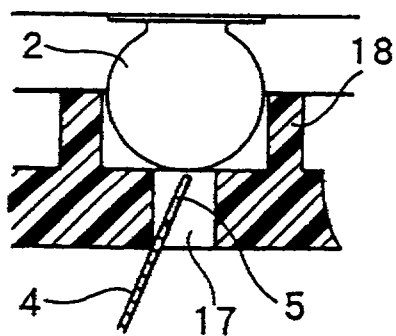


FIG. 7 (B)

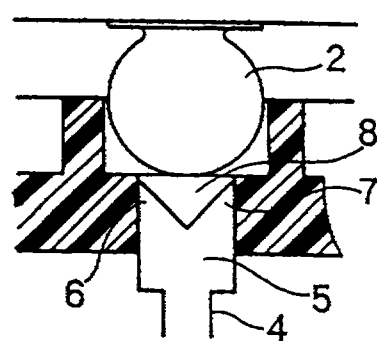


FIG. 8 (A)

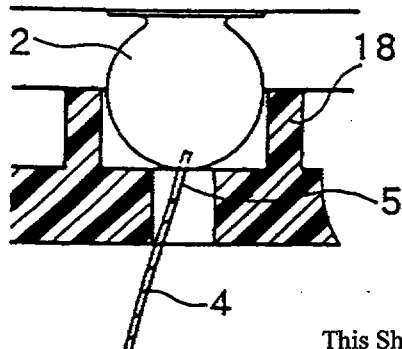
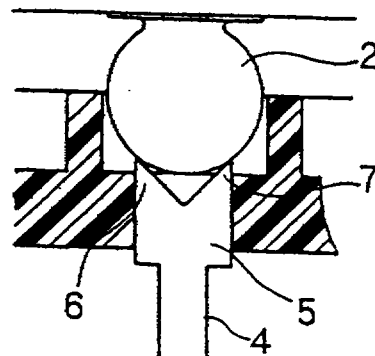


FIG. 8 (B)



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FIG. 9

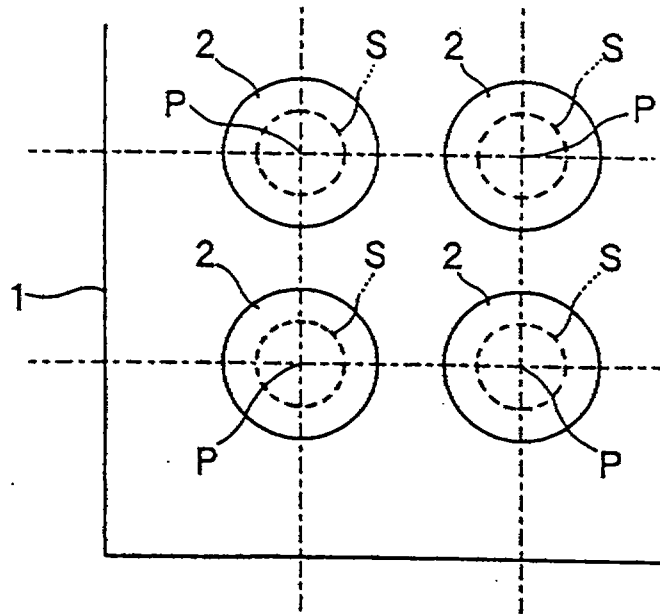


FIG. 10

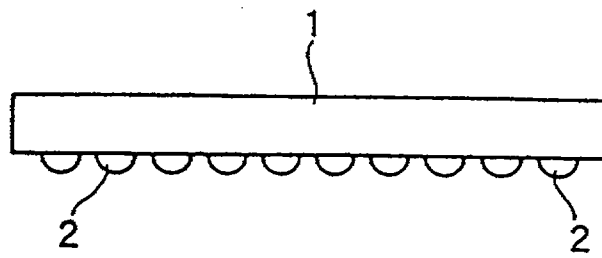


FIG. 11

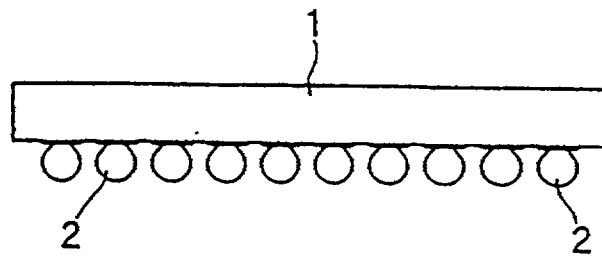
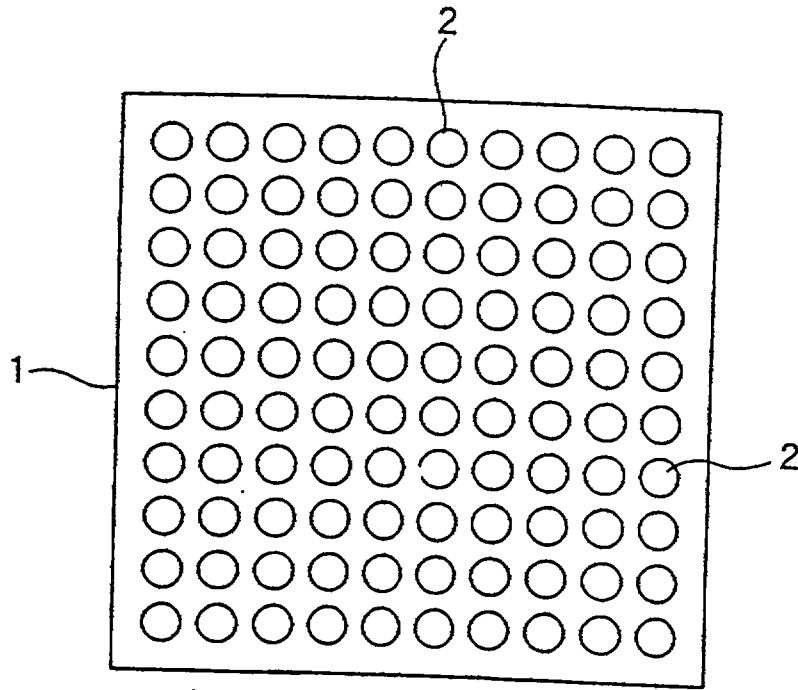
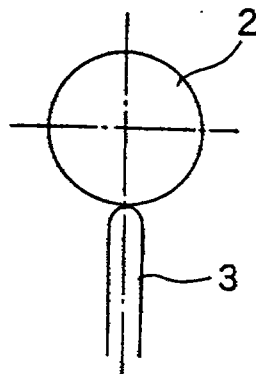


FIG. 12*FIG. 13**PRIOR ART*

ABSTRACT

IC SOCKET

An IC socket equipped with a plurality of elastic contact pins which are brought into contact with spherical bumps of an IC package, each of the contact pins having at a foremost end thereof a contacting portion disposed opposite to a lower spherical surface of the spherical bump, the contacting portion having a relief portion which is kept in a non-contacting condition relative to a lower dead point portion in the lower spherical surface of the spherical bump and also a contacting end which is brought into press contact at an area thereof around the relief portion with that area of the spherical surface of the spherical bump outwardly adjacent to the lower dead point.

FIG. 1.

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FIG. 2

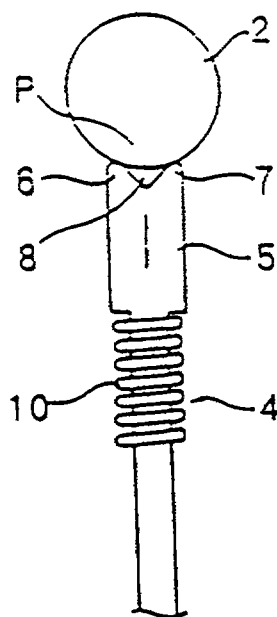


FIG. 3 A

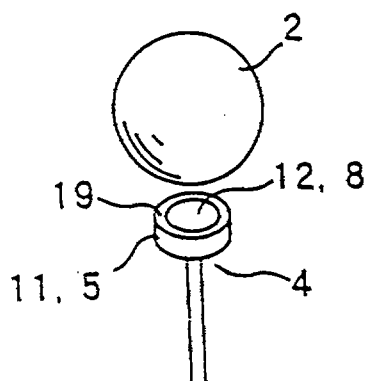


FIG. 3 B

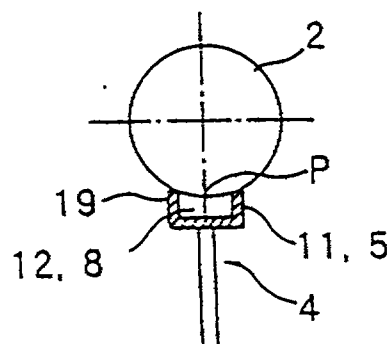


FIG. 3 c

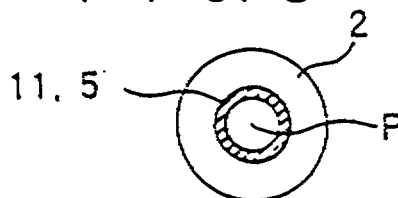


FIG. 6 A

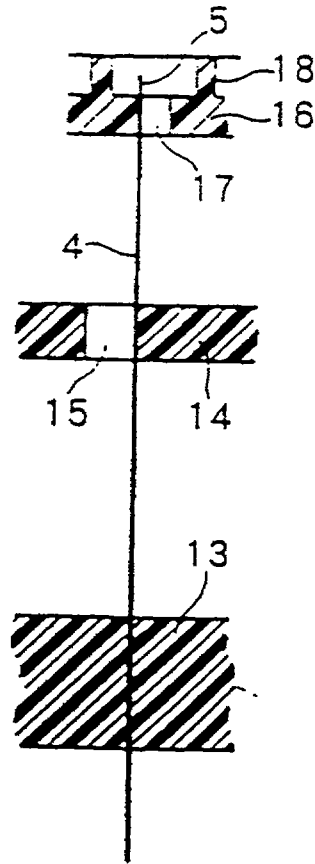


FIG. 6 B

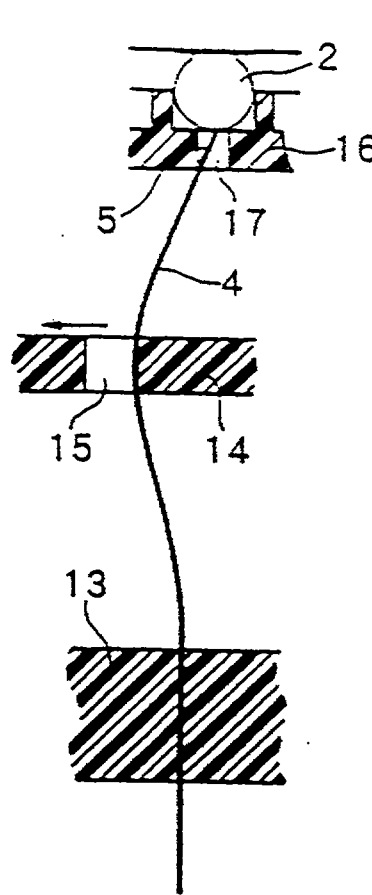


FIG. 6 C

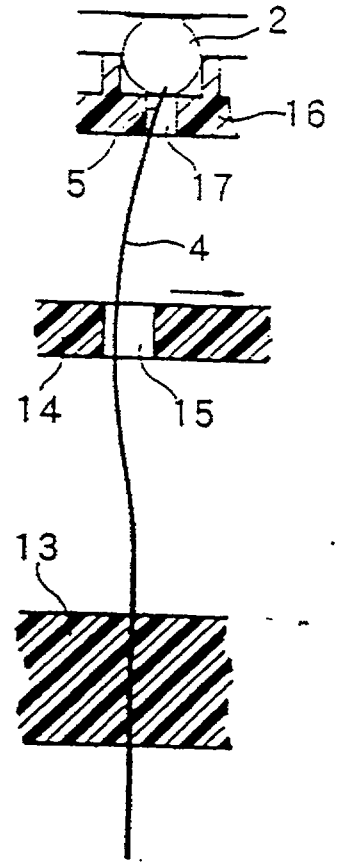


FIG. 7 A

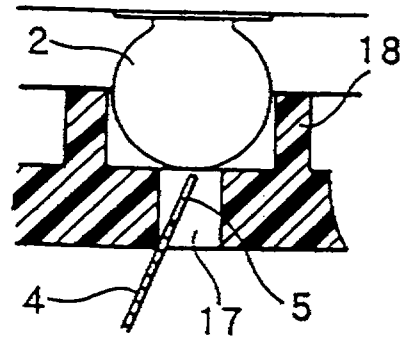


FIG. 7 B

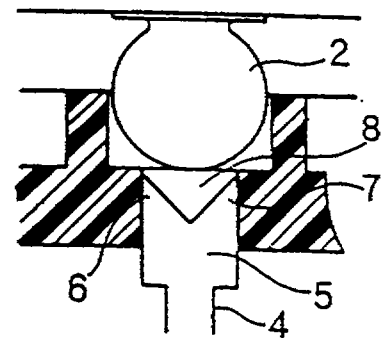


FIG. 8 A

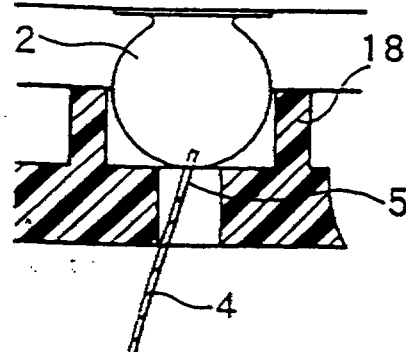
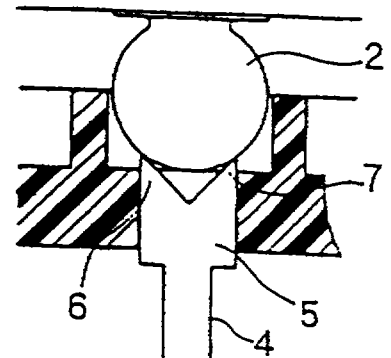


FIG. 8 B



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However, the following problems are inherent in the above socket. A lower dead point of the spherical bump 2, which is directly welded to the wiring board, is easily damaged by the probe 3, and the tip of the spring probe 3 of the socket tends to slip on the surface of the lower dead point portion of the spherical bump 2 sideways, with the result of poor contacting condition.

In addition, there is another problem in that with a structure having only one contacting spot, it is difficult to realize a reliable contacting condition.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an IC socket which assures reliable contact with an IC package having spherical bumps.

The invention provides the combination of an IC socket equipped with a plurality of elastic contact pins and an IC package provided with spherical or part-spherical bumps to be contacted by said pins, each of said contact pins being in the form of a single elongate metallic sheet plate having at a foremost end thereof a contacting portion disposed opposite to a lower surface of a respective bump, said contacting portion comprising a first contacting end portion and a second contacting end portion which are disposed symmetrically relative to and substantially equidistant from the lowermost point of the lower surface of the respective bump so as to be capable of being brought into resilient contact with said lower surface of the respective bump only at two points thereon equidistant from said lowermost point of said lower surface of the bump.

The invention also provides the combination of an IC socket and an IC package provided with spherical or part-spherical bumps, the IC socket comprising a plurality of elastic contact pins to be brought into pressure contact with lower surfaces of respective bumps of the IC package, each contact pin has at its contact end a cylindrical contact portion facing the lower surface of the respective bump such that the contact end can be brought into pressure contact with

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only an annular area of the lower surface of the respective bump around the lowermost point of that lower surface.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view showing one example of a contacting structure between a spherical bump and an elastic contact pin;

Fig. 2 is a side view showing another example of a contacting structure between a spherical bump and an elastic contact pin;

Fig. 3 is a further example of a contacting structure between a spherical bump and an elastic contact pin, Fig. 3(A) is a perspective view, Fig. 3(B) is a vertical cross-sectional view, and Fig. 3(C) is a transverse cross-sectional view;

Fig. 4 is a perspective view showing a number of elastic contact pins of a socket now in press contact with a number of spherical bumps;

Fig. 5 is a cross-sectional view of the socket;

Fig. 6 is a cross-sectional view of the socket, Fig. 6(A) shows a socket without an IC package loaded thereon, Fig. 6(B) shows a socket with an IC package loaded thereon and in which the contacting condition between a contact pin and a spherical bump is released, and Fig. 6(C) shows a socket with an IC package loaded thereon and in which a contact pin is in contact with a spherical bump;

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second contacting end 7, and a recess portion 8 is defined by a recess formed between the first and second contacting ends 6 and 7. The contacting portion 5 is spaced apart, in a non-contacting condition, at the recess portion 8 from a lower dead point portion of the spherical surface of the spherical bump 2, and are in point-contact at two spots of the distal ends of the first and second contacting ends 6 and 7 on the opposite sides of the recess portion 8 with that area of the spherical bump 2 outwardly adjacent to the lower dead point portion. The first and second contacting ends 6 and 7 are in a symmetrical relation with respect to a lower dead point P of the spherical bump 2 and brought into contact, in an elastically pressed condition, with the spherical surface of the spherical bump 2 at the spots equidistant from the lower dead point P.

To realize this press-contacting condition, the elongated sheet plate portion supporting the contacting portion 5 defines a spring element 9. As shown in Figs. 4 to 6, this spring piece 9 is capable of deflecting in a vertical direction to a line, which connects the first and second contacting ends 6 and 7 together, to accumulate resilient force and brought into press-contact with the spherical bump 2.

The reason why the spring piece 9 must deflect in the vertical direction to the above-mentioned line is as follows.

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If it is designed such that the spring piece 9 is capable of deflecting in the direction of the line which connects the first and second contacting ends 6 and 7 (that is, the direction in the sense of an arrow X of Fig. 1), there is a possibility that either of the first and second contacting ends 6 and 7 moves across and causes a damage to the lower dead point portion of the spherical bump 2. Therefore, in this invention, the spring piece 9 is such designed as not to be capable of deflecting in the X direction.

In the example of Fig. 2, the elastic contact pin 4 is moved forwardly and backwardly in a vertical direction to the lower dead point P of the spherical bump 2 in order to realize and release the contacting condition. The contact pin 4 is biased upwardly by a coil spring 10 along the above-mentioned vertical line. By doing this, the first and second contacting ends 6 and 7 are brought into press-contact with two spots of that area of the spherical surface outwardly adjacent to the lower dead point portion of the spherical bump 2, and are kept in a non-contacting condition relative to the lower dead point portion owing to a provision of the recess portion 8.

The elastic contact pin 4 may be called as a spring probe. In the example shown in Figs. 3(A) through 3(C), the contact pin 4 is brought into press-contact with that area of the spherical surface of the spherical bump 2 outwardly

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adjacent to the lower dead point portion in an annularly contacting condition.

As illustrated, the contacting portion of the foremost end of the elastic contact pin 4 is formed of a sleeve member 11. An end face of this sleeve member 11 is disposed opposite to the lower spherical surface of the spherical bump 2, and a central opening 12 thereof defines the recess portion 8 so that the contacting portion is kept at the central opening 12, in a non-contacting condition relative to the lower dead point portion of the spherical bump 2. An end face 19 of a wall defining a cylindrical hole in the sleeve member 11 defines the contacting end. This contacting end is brought into press-contact with that area of the spherical surface of the spherical bump 2 outwardly adjacent to the lower dead point portion in an annularly contacting condition.

The elastic contact pin 4 of Fig. 3 is brought into press-contact with the spherical bump 2 in the manner as shown in Figs. 1 and 5, as well as elsewhere, or otherwise the contact pin is resiliently held by the coil spring 10 such that the contact pin is moved forwardly and backwardly, vertically to the lower dead point P of the spherical bump 2 in the manner as shown in Fig. 2.

Figs. 4 through 8 show a socket equipped with a means for bringing the elastic contact pin 4 of Fig. 1 into contact

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The IC package body 1 is loaded on the damping plate 16, and a positioning wall 18 formed in the damping plate 16 is disposed between the spherical bump 2 and the damping plate 16 in order to correctly position the bump 2.

As shown in Fig. 6(C), when the operating plate 14 is laterally moved in the other direction by the restoring force of the contact pin 4 or when the operating plate 14 is laterally moved in the other direction to restore the contact pin 4, the contact pin 4 is stretched so that the foremost end portion 5 of the contact pin 4 is brought into press-contact with the spherical bump 2 either at an opening surface of the through-hole 17 in the damping plate 16 or in a slightly projected manner from the through-hole 17 as shown in Figs. 8(A) and 8(B). That is, the contact pin 4 is caused to accumulate resilient force by the spring element 9 deflecting in a perpendicular direction to the line which connects the first and second contacting ends 6 and 7 and brought into press-contact with the spherical bump 2.

The press-contacting is made at an area around the recess portion 8 as already mentioned.

In Fig. 9, those areas S where the contacting portions 5 of the contact pins 4 are in contact with the spherical bumps 2 are indicated by imaginary lines. As seen from the Figure, the contacting ends of the contacting portions 5 are in contact with the spherical surfaces of the bumps 2 on

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CLAIMS

1. The combination of an IC socket equipped with a plurality of elastic contact pins and an IC package provided with spherical or part-spherical bumps to be contacted by said pins, each of said contact pins being in the form of a single elongate metallic sheet plate having at a foremost end thereof a contacting portion disposed opposite to a lower surface of a respective bump, said contacting portion comprising a first contacting end portion and a second contacting end portion which are disposed symmetrically relative to and substantially equidistant from the lowermost point of the lower surface of the respective bump so as to be capable of being brought into resilient contact with said lower surface of the respective bump only at two points thereon equidistant from said lowermost point of said lower surface of the bump.
2. A combination as claimed in Claim 1, in which said contact pin is capable of deflecting in a direction perpendicular to a line which connects said first and second contacting ends together to resiliently bear against the respective bump thereby to realize the contacting condition.
3. The combination of an IC socket and an IC package provided with spherical or part-spherical bumps, the IC socket comprising a plurality of elastic contact pins to be brought into pressure contact with lower surfaces of respective bumps of the IC package, each contact pin has at its contact end a cylindrical contact portion facing the lower surface of the respective bump such that the contact end can be brought into pressure contact with only an annular area of the lower surface of the respective bump around the lowermost point of that lower surface.
4. A combination as claimed in Claim 3, in which said contact portion is moved forwardly and backwardly in a direction generally towards and away from the lower surface of

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the respective bump, thereby to realize the contacting condition.

5. An IC socket substantially as hereinbefore described with reference to any one of Figs. 1 - 9 of the accompanying drawings.