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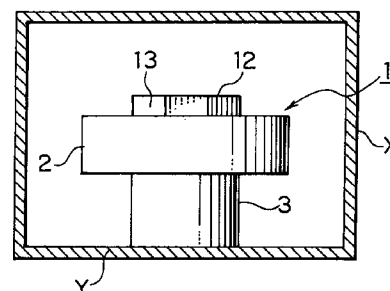
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(54) Dielectric resonator

(57) A dielectric resonator comprises a disk-shaped dielectric resonator body having a through hole at the center, a supporting member for supporting the resonator body, and a screw fixing member for fixing the resonator body on the supporting member, in which the supporting member is made of resin material and is intended to be mounted on a mounting surface, and the resonator body is held between the supporting member and the holding portion of the screw fixing member.

FIG. 2



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a dielectric resonator which may be used as a filter or an oscillator in a high frequency region.

Prior Art

One of conventional dielectric resonators of this type is illustrated in Fig. 1 of the accompanying drawings in which the dielectric resonator A is mounted on a base member B such as a metal casing by an insulating support member C made of alumina or forsterite so as to obtain a desired Q characteristic. The bondings between the dielectric resonator A and the support member C and between the support member C and the base member B are made by means of heat-resisting adhesive layers D and E, respectively. These adhesive layers D and E may be made from a glass grease adhesive or a silica-based inorganic adhesive.

The dielectric resonator A is self-heated with the resonance thereof when being operated. In particular, when the resonator is actuated with higher power, the higher the operation frequency is the larger the heat release value in the resonator.

Therefore, there may occur a heat-accumulation in the resonator so that it has a higher temperature. As a result, there may occur a pull-up in the interface (adhesive layer D) between the dielectric resonator A and the support member C and/or the interface (adhesive layer E) between the support member C and the base member B, or the resonance characteristic is varied by the difference of temperature-linear expansion coefficient between the resonator and the insulating support member C or between the resonator and the base member B. Further, there have been such problems that the coating and drying of the adhesive layers take time and working efficiency is low.

To solve the above problems, it has been proposed that the dielectric resonator and the support are constructed as an integral unit made of a dielectric material (see US Patent No. 5,136,270). However, the dielectric material is expensive and the amount of the dielectric material used is large by one-piece molding in the above configuration, resulting in an expensive dielectric resonator. In addition, since the shape of the resonator becomes complex, it is necessary to use such means as a rubber press machine for molding with the result of troublesome manufacture.

It is therefore an object of the present invention to provide a dielectric resonator in which a dielectric material is used only in a resonator portion without using an adhesive.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a dielectric resonator comprising a disk-shaped dielectric resonator body made of dielectric material and having a through hole at the center; a supporting member of resin material for supporting the dielectric resonator body and including a threaded connection portion to be inserted into the through hole and a leg portion formed continuously with the connection portion and to be mounted on a mounting base, and a screw fixing member having a threaded portion intended to be inserted into the through hole of the dielectric resonator body and engaged with the threaded connection portion of the supporting member and a head portion intended to be abutted on an upper surface of the dielectric resonator body, whereby holding the dielectric resonator body between the supporting member and the screw fixing member.

The connection portion of the supporting member may comprise a female threaded cylinder portion projecting upward from the leg portion, and the threaded portion of the screw fixing member may comprise a male screw portion to be engaged with the female threaded cylinder portion of the supporting member.

Alternatively, the connection portion of the supporting member may comprise a male threaded portion projecting upward from the leg portion, and the threaded portion of the screw fixing member may comprise a female screw portion to be engaged with the male threaded portion of the supporting member.

The supporting member may include a through hole extending along a longitudinal direction through which a mounting screw is inserted for fixing the supporting member on the mounting base.

Also, the supporting member may include a shoulder portion on an upper surface of the leg portion for supporting an under surface of the dielectric resonator body.

Further, the supporting member may be provided with a hole formed continuously with the through hole for inserting a mounting screw and a collar formed between the through hole and the inserting hole, with which a head portion of the mounting screw is contacted. In this arrangement, the supporting member may be fixed on the mounting base by fastening the mounting screw through the inserting hole to the mounting base.

Alternatively, the supporting member may be provided with one or more threaded hole on the under surface thereof, and may be fixed on the mounting base by screwing one or more mounting screw through the mounting base into the respective threaded hole.

Alternatively, the supporting member may be provided with a flange portion having mounting holes and may be fixed on the mounting base by screwing mounting screws through the respective mounting holes into the mounting base.

In the above arrangement, the assembly work is

easy because the dielectric resonator body is fixed on the supporting member only by screwing of the screw fixing piece and the supporting member.

By the fact that the dielectric resonator body and the supporting member are mechanically connected together without using an adhesive, even if the resonator body is self-heated with the resonance thereof, it does not peel off and separate because there is not adhesive layer between the resonator body and the supporting member.

Further, since only the plate-shaped resonator body is made of dielectric material, it is possible to reduce production costs. In addition, by provision of the supporting member of resin material, it can be formed easily by common molding means.

When the screw fastening means is used for fixing the supporting member on the mounting base as described above, as not only the dielectric resonator body and the supporting member but also the supporting member and the mounting base are mechanically connected together without using an adhesive, even if the resonator body is self-heated with the resonance thereof, it does not peel off by separation between the leg portion of the supporting member and the mounting base. In the arrangement that the inserting hole for the mounting screw is formed in the supporting member, the wider exposed area may be obtained and thus a heat radiation effect may be high. Further, by using the mounting screw(s) the connection strength is improved.

The present invention will now be described by way of example with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view schematically showing a conventional dielectric resonator;

Fig. 2 is a side view schematically showing a dielectric resonator according to a first embodiment of the present invention device which is fixed on a base member of a metal casing;

Fig. 3 is a longitudinal section showing the dielectric resonator of Fig. 2;

Fig. 4 is a separated perspective view showing the dielectric resonator of Fig. 2;

Fig. 5 is a longitudinal section showing a dielectric resonator according to a second embodiment of the present invention;

Fig. 6 is a separated perspective view showing the dielectric resonator of Fig. 5;

Fig. 7 is a longitudinal section showing a dielectric resonator according to a third embodiment of the present invention; and

Fig. 8 is a longitudinal section showing a modified embodiment in which other fixing means is applied to the dielectric resonator.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 2 illustrates a dielectric resonator according to the first embodiment of the present invention which is fixed to a mounting portion Y of a base member of a metal casing or the like X.

As shown in Figs. 3 and 4, the dielectric resonator 1 comprises a disk-shaped dielectric resonator body 2 having a large diameter and a supporting member 3 having a circular cross section of a smaller diameter. The dielectric resonator body 2 is formed of a dielectric material such as TiO_2 or BaO-TiO_2 by press molding and is sintered. At the center of the dielectric resonator body 2 is provided a through hole 4 which extends along the longitudinal axis of the dielectric resonator body 2. The outer shape of the dielectric resonator body 2 may be circular or square. The dielectric resonator body 2 is fixed to the supporting member 3 the under surface of which is formed as a fixing surface which is fixed to the top surface or mounting surface of the mounting portion Y of the metal casing X.

The supporting member 3 is molded of a resin material such as a fluororesin and has a cylindrical leg portion 5 having a larger outer diameter than the inner diameter of the through hole 4. A female threaded cylinder portion 6 projects upward from the intermediate region of the top surface of the leg portion 5 as a connection portion. The supporting member 3 is provided with a longitudinal hole 7 extending along the center axis thereof and an outer shoulder 8 on the boundary between the leg portion 5 and the cylinder portion 6. This longitudinal hole 7 comprises a threaded hole portion 7a provided on the the inside of the female threaded cylinder portion 6 and provided with a female thread 9, and a hole portion 7b provided on the inside of the leg portion 5 and having an inner diameter smaller than that of the threaded hole portion 7a. The outer diameter of the female threaded cylinder portion 6 is smaller than the inner diameter of the through hole 4 of the dielectric resonator body 2. Further, the threaded hole 7 has a bottom provided with a hole 10 through which a fixing screw 11 is inserted for fixing the supporting member 3 on the the mounting portion Y of the metal casing X. A head of the fixing screw 11 is engaged with the shoulder portion of the bottom around the hole 10.

A screw fixing member 12 is screwed into the female threaded cylinder portion 6 from above. This screw fixing member 12 is of a hollow bolt structure and comprises a holding portion 13 which is a hexagonal head portion, a through hole 14 extending in a longitudinal direction at the center and a male screw portion 15 which is intended to be inserted into the female threaded cylinder portion 6 and mated with the female screw 9. The through hole 14 is designed to have substantially the same inner diameter as that of the hole portion 7b. This screw fixing member 12 may be made of a metal material besides a synthetic resin material.

To assemble the dielectric resonator body 2 in the above arrangement, the female threaded cylinder portion 6 of the supporting member 3 is inserted into and engaged with the through hole 4. Then, the male screw portion 15 of the screw fixing member 12 is inserted into the threaded hole 7 of the female threaded cylinder portion 6 and turned to be engaged with the female screw 9. In this way, the dielectric resonator body 2 is fixed to the supporting member 3 by tightening the portion around the through hole 4 between the shoulder 8 or the top surface of the leg portion 5 of the supporting member 3 and the under surface of the holding portion 13 of the screw fixing member 12. The supporting member 3 is then fixed to the mounting portion Y. This fixing is carried out by inserting the mounting screw 11 through the through hole 14 of the screw fixing member 12 and the longitudinal hole 7, bring the screw head thereof into contact with the stop surface, inserting a male screw portion of the mounting screw 11 into the bottom hole 10, extending it from a through hole Z of the mounting portion Y and fastening it with a nut 16.

In the illustrated arrangement, after the dielectric resonator body 2, the supporting member 3 and the screw fixing member 12 are assembled together, the mounting screw 11 can be screwed through the through hole 13 formed in the screw fixing member 12.

Referring to Figs. 5 and 6, there is illustrated another embodiment of the present invention in which the components corresponding to those in the arrangement shown in Figs. 2, 3 and 4, are given the same reference symbols and their descriptions are omitted.

As shown in Figs. 5 and 6, a dielectric resonator 1 comprises a dielectric resonator body 2 and a supporting member 3A which is provided with a through hole 7 and a stage or shoulder 20 at the outside for receiving the dielectric resonator body 2. The female threaded cylinder portion 6 of the supporting member 3A is extended along the through hole 7 so that the female threaded cylinder portion 6 has the same inner diameter as that of leg portion 5. Also, blind screw holes 21 are provided in the under surface of the supporting member 3A.

Further, in this embodiment a screw fixing member 12A of a solid bolt structure is used. The screw fixing member 12A is to be screwed into the female threaded cylinder portion 6 of the supporting member 3A. When being assembled in this embodiment, the supporting member 3A is first fixed to the mounting portion Y of the metal casing X. This fixing is carried out by tightly mating mounting screws 22 with the blind screw holes 21 through the through holes Z of the mounting portion Y from outside. Then the dielectric resonator body 2 is disposed on the shoulder 20 by inserting the female threaded cylinder portion 6 of the supporting member 3A into the through hole 4, and the male screw portion 15 of the screw fixing member 12A is inserted into the female screw 9 of the female threaded cylinder portion 6 from above the dielectric resonator body 2 and turned to be mated with the female screw 9. Thereby, the dielectric resonator body 2 is fixed on the the supporting

member 3A by retaining the portion of the dielectric resonator body 2 around the through hole 4 between the shoulder 20 of the supporting member 3A and the under surface of the holding portion 13 of the screw fixing member 12A.

In each of the above embodiments, it is appreciated that the female threaded cylinder portion 6 is provided on the supporting member 3 or 3A as a connection portion and the male screw portion 15 is provided on the screw fixing member 12 or 12A.

Fig. 7 illustrates a further embodiment of the present invention in which a supporting member 3B is provided with a top surface 30 for receiving the dielectric resonator body 2 and a male screw portion 31 which may be projected from the top surface 30 of the supporting member 3B to form a connection portion. A screw fixing member 12B comprises a head portion 32 and a female threaded cylinder 33 which longitudinally extends from the under surface of the head portion 32 and is intended to be mated with the male screw portion 31 on the supporting member 3B.

Fig. 8 illustrates a modified embodiment of the present invention in which a supporting member 3C includes a flange portion 40 formed at a lower portion thereof. The flange portion 40 is provided with a plurality of mounting holes 41 at equal intervals. The mounting holes 41 may be through holes or groove holes which are open sideways to allow mounting screws 42 to be mounted from the side thereof. The mounting screws 42 are inserted into the mounting holes 41 to be screwed into the screw holes Z' formed in the mounting portion Y of the metal casing X. Alternatively, the mounting screw 42, as described above, may inserted into the through hole formed in the mounting portion Y and mated with a nut, not shown, at an inserted end thereof to be fixed to the mounting portion Y.

The dielectric resonator according to the present invention may be incorporated into a strip line device or the like. In this case, the dielectric resonator may be fixed on the surface of a dielectric substrate serving as a mounting surface by means of the above-described fixing means.

As described above, the dielectric resonator according to the present invention comprises a disk-shaped resonator body made of a dielectric material and having a through hole formed at the center, a supporting member made of a resin material having a connection portion to be inserted into the through hole and a leg portion formed continuously with the connection portion and to be mounted on a mounting surface, the connection portion of the supporting member comprising a female threaded cylinder or a male screw portion projecting upward from the leg portion, and a screw fixing member having a male screw portion or a female threaded cylinder to be mated with the female threaded cylinder or the male screw portion inserted into the through hole from above and a holding portion to be contacted to the top surface of the resonator body, the screw fixing member being fixed in the connection por-

tion in the through hole and the dielectric resonator body being fixed to the support such that it is held by the leg portion and the holding portion.

Therefore, the present invention has the following advantages or effects.

a) Since the dielectric resonator body and the supporting member are mechanically connected together without using an adhesive, even if the resonator body is self-heated with the resonance thereof, the dielectric resonator body is not separated by thermal distortion.

b) Since only the disk-shaped dielectric resonator body is made of a dielectric material, the amount of the dielectric material used is small, resulting in low production costs.

c) Since the dielectric resonator body has a simple configuration, molding can be carried out without any difficulty. On the other hand, since the supporting member is made of a resin material, it can be easily formed by common molding means and hence, can be manufactured easily.

d) Since the dielectric resonator body and the supporting member can be connected simply by screwing the screw fixing member into the supporting member, the assembly work is easy.

e) When the supporting member is fixed to the mounting surface of the base member by a mounting screw(s), the connection strength is improved and the dielectric resonator body can be prevented from being separated from the mounting surface by thermal distortion or the like and the assembly step is easy because an adhesive is not used for the connection.

Claims

1. A dielectric resonator for a filter or an oscillator in a high frequency region including a disk-shaped dielectric resonator body made of dielectric material having a through hole at the center and intended to be mounted on a mounting base, characterized in that a supporting member (3, 3A, 3B, 3C) of resin material is provided for supporting the dielectric resonator body (2) and comprises a threaded connection portion (6) to be inserted into the through hole (4) and a leg portion (5) formed continuously with the connection portion (6) and to be mounted on the mounting base (X), and a screw fixing member (12, 12A, 12B) is provided for fixing the dielectric resonator body (2) on the supporting member (3, 3A, 3B, 3C) and comprises a threaded portion (15) intended to be inserted into the through hole (4) of the dielectric resonator body (2) and engaged with the threaded connection portion (6) of the supporting member (3, 3A, 3B, 3C) and a head portion (13) intended to be abutted on an upper surface of the dielectric resonator body (2), whereby holding the dielectric resonator body (2) between the support-

ing member (3, 3A, 3B, 3C) and the screw fixing member (12, 12A, 12B).

2. A dielectric resonator as claimed in claim 1, characterized in that the connection portion of the supporting member (3, 3A) comprises a female threaded cylinder portion (6) projecting upward from the leg portion (5), and the threaded portion of the screw fixing member (12, 12A) comprises a male screw portion (15) to be engaged with the female threaded cylinder portion (6) of the the supporting member (3, 3A).

3. A dielectric resonator as claimed in claim 1, characterized in that the connection portion of the supporting member (3B) comprises a male threaded portion (31) projecting upward from the leg portion, and the threaded portion of the screw fixing member (12B) comprises a female screw portion (33) to be engaged with the male threaded portion (31) of the the supporting member (3B).

4. A dielectric resonator as claimed in any one of claims 1 to 3, characterized in that the supporting member (3, 3A) is provided with a through hole (7) extending along a longitudinal direction through which a mounting screw (11) is inserted for fixing the supporting member (3, 3A) on the mounting base (X).

5. A dielectric resonator as claimed in any one of claims 1 to 3, characterized in that the supporting member (3, 3A, 3B) is provided with a shoulder portion (8, 20, 30) on an upper surface of the leg portion (5) for supporting an under surface of the dielectric resonator body (2).

6. A dielectric resonator as claimed in any one of claims 1 to 3, characterized in that the supporting member (3, 3A) is provided with a hole (10) formed continuously with the through hole (7) for inserting a mounting screw (11) and a caller formed between the through hole (7) and the inserting hole (10), with which a head portion of the mounting screw (11) is contacted, and is fixed on the mounting base (X) by fastening the mounting screw (11) through the inserting hole (10) to the mounting base (X).

7. A dielectric resonator as claimed in any one of claims 1 to 3 and 5, characterized in that the under surface of the supporting member (3A, 3B) is provided with one or more threaded hole (21) and is fixed on the mounting base (X) by screwing one or more mounting screw (22) through the mounting base (X) into the respective threaded hole (21).

8. A dielectric resonator as claimed in any one of claims 1 to 3 and 5, characterized in that the supporting member (3C) is provided with a flange por-

tion (40) having mounting holes (41) and is fixed on the mounting base (X) by screwing mounting screws (42) through the respective mounting holes (41) into the mounting base (X).

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FIG. 1
PRIOR ART

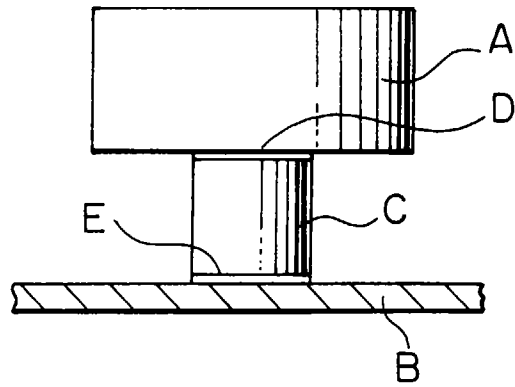


FIG. 2

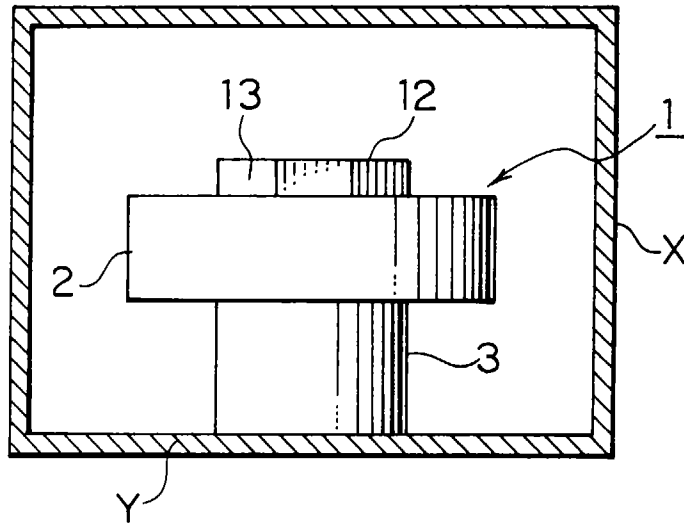


FIG. 3

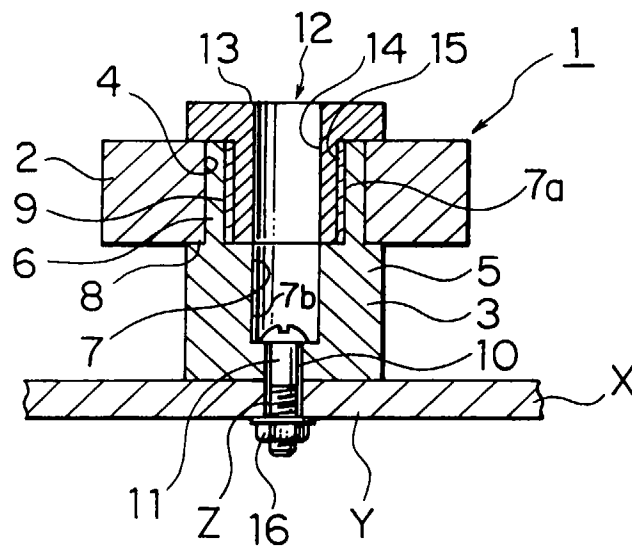


FIG. 4

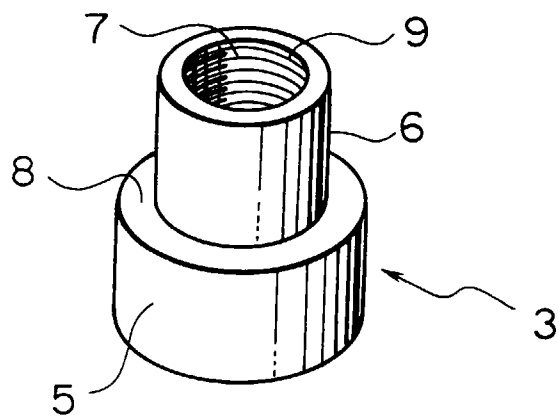
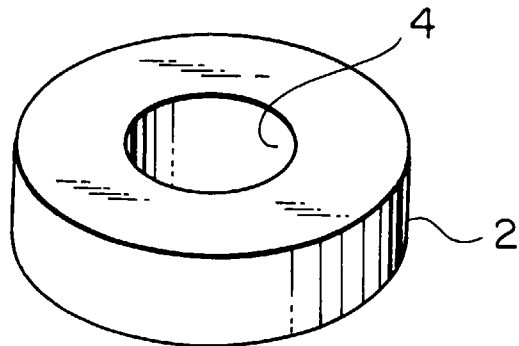
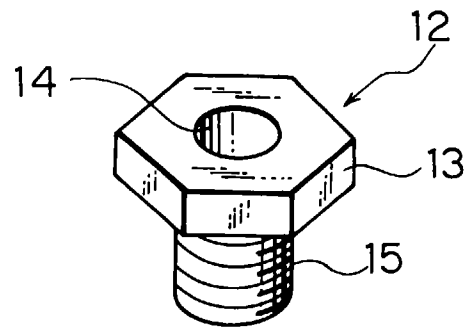


FIG. 5

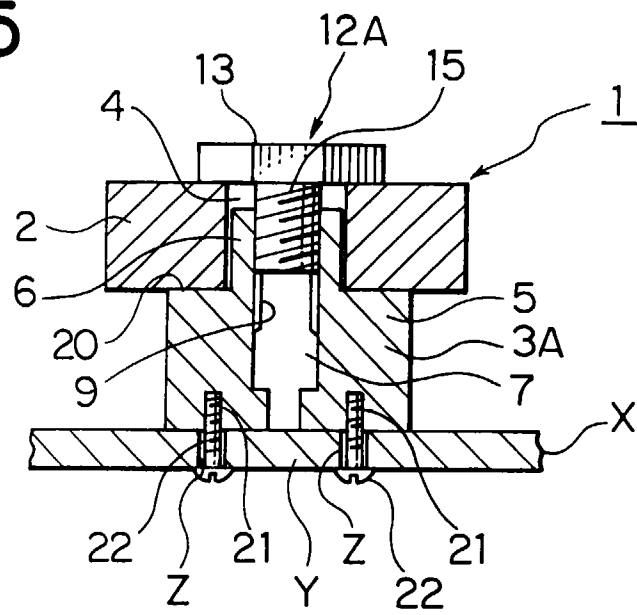


FIG. 7

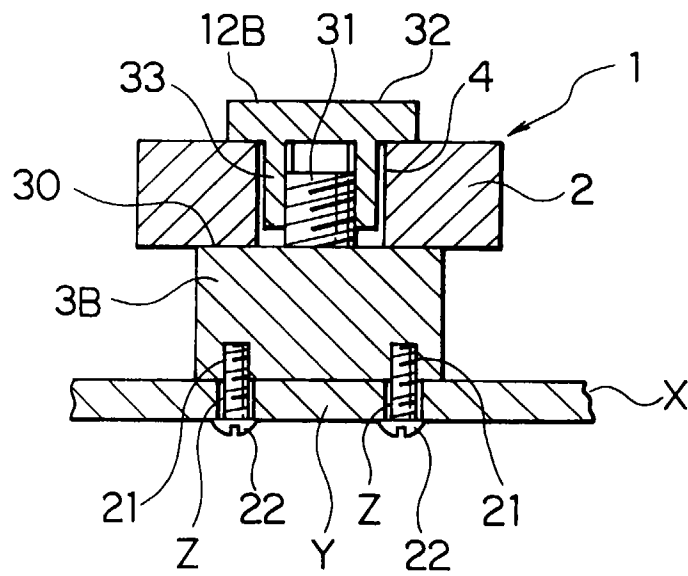


FIG. 8

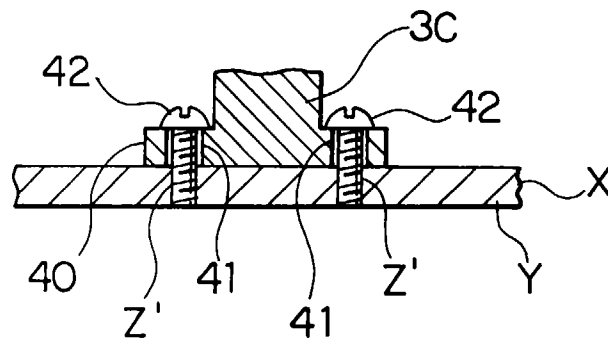


FIG. 6

