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(54) Improvement in the base of a washing machine with shock and vibration damping capabilities

(57) Base structure for home appliances, in particular clothes and similar washing machines, which, although made as a single piece in an integral construction, has the peculiarity of being able to disengage those among its portions which are most heavily stressed dynamically from the remaining portions of the base which complete the structure and the casing of the washing machine and carry it statically.

This is obtained by simply sectioning some of the sides or portions of said portions from the rest of the base, in such a manner that said base portions become elastic with respect to the rest of the base, and anchoring the shock-absorber struts therein.

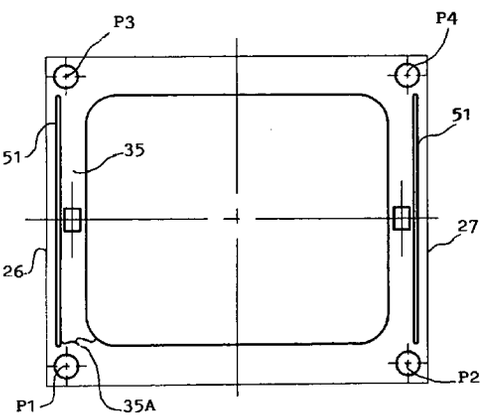

FIG. 3

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Description

The invention relates to a household appliance, in particular a household clothes washing machine, provided with a base structure that is particularly improved so as to be capable of acting as a damping element to deaden the vibrations generated by the operation of the moving machine parts arranged thereabove.

For mere reasons of greater simplicity, reference is made to a front-loading type of washing machine in the following description. It will however be appreciated that the invention equally applies to any kind of household or similar appliance containing moving parts that may generate troublesome or even hazardous vibrations that are generally transmitted to the base portion thereof.

One of the main problems faced by engineers in connection with the design of current-type home appliances, and in particular with clothes washing machines, is commonly known to be connected with the methods and means used in order to effectively damp both the vibrations and oscillations induced by such moving parts as the washing unit of the machine, and transmitted to the base portion thereof, and the vibrations trasmitted by the latter to the floor.

Such appliances are characterized in that they use separate base structures that complete the structure of the outer casing of the same appliances and are joined to said outer casing by means of screws, rivets, welded joints (in the case of metal-on-metal combinations), or even by the coupling of shapes and the use of threaded fasteners. Such appliances are usually made to include an outer casing made up by either a single or more pieces, a base structure and a single-piece or composite upper structure. In particular, a washing unit provided with vibration-damping masses is mounted elastically, ie. in a damped, sprung manner, in the interior of the casing of front-loading clothes washing machines.

In the majority of the cases, the damping means are secured to the base structure by means of at least a pair of appropriate shock-absorber struts based on generally known principles and any of the various existing technical solutions, such as for instance devices with semi-hermetic piston, friction-type shock absorbers or the like, which are attached directly to the base structure of the machine, being it more convenient or even more cost-effective for said washing unit to be actually suspended by means of 2, 3 or 4 springs attached with their top end portion to the upper portion of the outer casing.

Solutions are also known which make use of an outer casing in a single-piece construction, said outer casing consisting practically of a mantle with its upper and lower peripheral edges folded over themselves several times in order to create an inherently stronger, more rigid structure.

All such solutions share the peculiarity of having a structure that can be differentiated in the form, thicknesses, size and, as far as the present invention is more directly concerned, they also share a double circumstance in that the damping elements:

a) are applied, at the opposite end with respect to the point at which they are attached to the washing unit, to respective anchoring means secured to the base of the machine, and

b) also the various parts and walls making up the outer casing of the appliance are attached to or are resting on the same base structure of the machine.

It therefore ensues that such a base structures actually turn into an element that directly, albeit not rigidly, connects the washing unit to the outer casing, so that they have a major drawback in that they are unable to absorb with the due evenness all of the vibrations at the different frequencies that are transmitted by the washing unit to the structure through shock-absorbers or spring-type feet, at all of the rotational speeds that can be reached by the washing machines currently on the market when spin-extracting.

In particular, said base structures share a common limitation in that they are single-piace structures in a construction that is almost invariably integral, which, since they have to ensure the required rigidity and stability of the appliance, possess but a minimum extent of the flexibility that, if available to a greater extent, would enable them to double as vibration-damping elements.

The result of such a compromise is the use of oversized structures which are anyway not able to stop the stresses being transmitted in the form of more or less manifest vibrations and/or oscillations of the outer casing at both the low/high spin-extraction speeds and the intermediate operational speeds of the machine.

It is particularly on these machines provided with variable spin-extraction speed, capable of being adjusted in either a continuous or a step-like manner by the user, that clear problems of vibrations and noise of the outer casing arise, especially when the same casing is equipped with rear castors or in the presence of unbalanced, reduced or compacted washloads, even if quite sophisticated damping means are used. Now, it is fully apparent that this is particularly unacceptable in the case of appliances for built-in installation, ie. intended for installation within appropriate niches, compartments or cabinet sections.

As a matter of fact, the oscillations of the respective casings, albeit modest, are in this case quite likely to cause the same to knock or bump against the inner walls of said niches or cabinet compartments, with damages or unacceptable consequences both in terms of noise and for the resistance, ie. withstanding capability of the structures that are in this way caused to vibrate.

It would therefore be desirable, and it is actually a purpose of the present invention, to provide a household appliance equipped with a base structure which is able to bring about a significant improvement in the vibration damping characteristics without this implying

any major modification either in the product design itself or in the product manufacturing process, as well as without any need arising for particularly sophisticated, expensive, oversized vibration damping means to be introduced in the structure.

According to the present invention, this aim is reached in a base structure for household appliances, in particular clothes washing machines, which, although made as a single piece in an integral construction, has the peculiarity of being able to disengage those among its parts which are most heavily stressed dynamically from the remaining parts of the base which complete the structure thereof and the casing of the washing machine and carry it statically.

This is obtained by providing portions that are connected with the rest of the structure of base through only a limited portions of the respective perimeter, as well as arranging the points of anchorage of the damping means, ie. the shock-absorber struts, on said portions.

These portions can also be obtained by simply sectioning some of the sides or portions of said portions from the rest of the base, in such a manner that said portions become elastic with respect to the rest of the base.

The invention will be more readily and clearly understood from the description which is given below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figures 1 and 2 are a front elevational view of a symbolized constructive schema of a traditional-type clothes washing machine and a top plan view of the support base of the same clothes washing machine illustrated in Fig. 1, respectively;

- Figures 3, 4 and 5 are a top plan view of three different embodiments, respectively, of a support base according to the present invention;

- Figure 6is an enlarged view of a section of the anchoring point of a shock-absorber strut to the base.

The invention is subtantially based on following considerations: since vibrations are in turn transmitted by the washing unit of the machine to the suspension springs and the shock absorbers, by the shock absorbers to the base of the machine, and by the base of the machine to the casing or surrounding cabinet, all it takes in order to interrupt this chain effect is to eliminate or at least weaken a link of the same chain, so as for instance to prevent said effects from overlapping.

To this aim, the present invention defines a base structure with differentiated elasticity and structural characteristics, ie. having a greater rigidity in the peripheral border portion of said base structure, while it provides for that portion of the structure being subject to absorb the oscillations induced by the washing unit/damping means, ie. suspension springs and shock absorbers, system to be rendered appropriately elastic and disengaged from the rest of the structure.

In practice, if the afore mentioned analogy with a chain with a plurality of links is further used, the invention teaches to weaken the link which in this case corresponds to the base, in the sense that the latter is converted from a rigid link that directly transmits the vibrational stresses it receives, into a ring provided with a certain extent of elasticity so as to be able to damp said vibrational stresses and transmit them in a very attenuated form.

Referring now to the above listed Figures, an embodiment of the invention is described in the following with reference to a base having a modular structure of composite materials.

The clothes washing machine that is illustrated schematically in Figure 1 is provided with two side walls 1, 2, a washing unit comprising a wash tub 3 and all other usual operational parts (not shown here), two springs 4, 5 to which said wash tub 3 is suspended so that the weight thereof is transferred on to the upper lateral edges 6, 7, respectively, of said side walls 1, 2, two traditional-type shock absorbers 8, 9 that are applied on one respective side 10, 11 thereof to the lower portion of said wash tub and, on the other side 12, 13 thereof, to the support base 14.

Figure 2 illustrate a traditional-type base, wherein the sides 12, 13 of the respective lower shock absorbers are applied on torespective points of anchorage 15, 16 situated on said support base 14.

Referring now to Figures 3, 4, 5, it can be noticed that said points of anchorage 15, 16 of the respective shock-absorber struts to said base 14 are situated on particular portions 35, 36, 28 of said base, said portions sharing the peculiarity of being connected to the rest of the structure of the base 14 through only a limited portion 35A, 36A, 28A, respectively, of the perimeter circumscribing them, while the rest of said perimeter is suspended.

This common peculiarity makes said portions moderately elastic with respect to the rest of the base, since the flexural strength of said limited portions 35A, 36A, 28A of the perimeter thereof depends on and decreases due to not only the shorter connection, and therefore working, and therefore resistance length of said limited portions, but also the geometry, ie. shape of the same portions, as anyone skilled in the art is well aware of, and as this will become more apparent from the following examples.

Actually, said limited portion of the perimeter may in turn be constituted by several tracts, such as this is illustrated in Figures 3, 4 and 5 which show a base 14 in which said portions 35, 36, 28 are connected with the rest of the base through two respective pairs of distinct tracts 35A, 36A, 28A on which the respective anchoring points for the shock-absorber struts 15, 16, 17 are applied.

It is advantageous for said portions to be given an

elongated and preferably rectilinear shape, so as to ensure the desired flexibility, and for said limited perimeter portion 35A, 36A, 28A provided for connection to the rest of the base to be situated on the two smaller, obviously opposite sides of the respective portions. This in fact contributes to an increased strength of said portions without affecting elasticity to any significant extent.

Furthermore, in order to make the most out of the elasticity and, at the same time, robustness properties of said portions, it has been found appropriate for the anchoring points 15, 16, 17 to be situated in the central zone of the respective portions.

Considering additionally the particular shape and symmetry of a clothes washing machine, it has been found particularly appropriate for also said elongated portions to be situated symmetrically along the side edges 26, 27 of the same base 14, as this is for instance shown in Figs. 3, 4 and 5.

The illustrated configuration, however, is not exhaustive of the wide range of improvements that can be made on bases of the afore described kind. In particular, if the possibility is given to also introduce or use cantilever-type portions as shown in Figure 5, where the portion 40 is joined on a single side 41 thereof with the rest of the base, or in Figure 4, where the cantilever-type portion 42 is substantially provided in the inner surface 43 of the same base when the latter also includes said surface that closes the appliance on its bottom, it is in all such cases advantageous for the elastic deviation of said cantilever portions to be exploited by positioning on them the anchoring points 44 for other component parts that are usually supported by the base; and it may be still more advantageous for said anchoring points 44 to be situated in the most distant zones with respect to said sides 41 connecting the respective portions to the base, since in this case said anchoring points are connected to a still lesser extent to the structure of the base and, therefore, are less stressed, so that the component parts arranged thereon are less subject to shocks and vibrations.

Such cantilever portions can also be joined to the base through more than a single side, while it is of course within the ability of those skilled in the art to conceive such other forms and shapes of said portions as to more appropriately comply with the architecture and the requirements of each single machine.

Some constructional suggestions and indications are given below concerning two preferred embodiments of a clothes washing machine according to the present invention.

In a first embodiment, which is illustrated in Figure 3, the conceived structure is formed in the following manner:

- the outer peripheral rim preserves the rigidity characteristics and is provided with all fastening means needed for attachment to the outer casing of the machine.

Two side portions 35, which maintain a connection with the remaining outer rim along two opposite tracts, are made integrally therewith, whereas the remaining part of said portions is separated from the corresponding portions of the lateral structure. On said side portions there are provided the fastening means for the attachment of the shock-absorber struts or damping and/or suspension means of the washing unit, whereas on the inner portions there are provided appendices adapted to accomodate functional parts of the machine, such as pumps, electrical component parts, pipings, discharge manifolds and the like, said appendices being obviously isolated from said two portions subject to dynamic stresses.

In this manner, such a part of the structure may be given a differentiated rigidity profile and can be caused to oscillate without such vibrations being transmitted to the remaining structure.

In a second embodiment, as illustrated in Figure 4, the invention consists in making the whole base, and therefore also the above cited portions, integrally in a single-piece construction. The advantage of such a solution derives from the fact that any possible manufacturing problem and complexity in connection with the forming of the component part is eliminated. Furthermore, in both above described embodiments the interstices 51, 52 that separate said portions from the rest of the base structure are simply cut or sawn or anyway produced with a simple and inexpensive mechanical sectioning operation.

Given the purpose which the present invention is aiming at, it is of course most appropriate for the tracts connecting said portions to the respective base structure, however they may also be formed and connected thereto, to be located as near as possible to the support elements P1, P2, P3, P4, on which said base is resting on the floor, so that vibrations are enabled to be discharged as directly as possible from the washing unit to those portions of the base that are more rigidly associated with said feet, or support elements, thereby preventing them as much as possible from involving those other portions of the same base that would on the contrary transmit their vibrations on to the outer casing of the machine.

This practically translates into a greater capacity of absorbing the vibrations that are generated during spin-extraction cycles, in particular even in the case of remarkably unbalanced washloads, and therefore into a greater quietness of the machine during the operation thereof, practically without any noticeable oscillation of the outer casing of the same machine.

This has enabled a simple, cost-effective clothes washing machine to be provided, and the feasibility and advantages thereof to be demonstrated experimentally, which is effective in absorbing the vibrations generated by the washing unit, starting as early as the washload distribution phase preceding actual spin-extraction through to high-speed spin-extraction operation at 1600 rpm, with the possibility for the machine to keep spin-

extracting further on at any speed whatsoever, without any occurrence of resonances that might be trasmitted to the other elements and parts of the structure of the machine.

Although the invention has been described on the example of preferred embodiments thereof and using a generally known terminology, it shall not be intended as being limited by these, since it will be appreciated that anyone skilled in the art may be able to use the teachings of this invention to devise any number of variants and modifications thereto. The appended claims shall therefore be intended as to include all such obvious modifications that are readily apparent to those skilled in the art and clearly fall within the scope of the present invention.

Claims

1. Clothes washing machine, particularly of the household type, comprising an outer casing, a washing unit including a wash tub (3), a cylindrically shaped perforated drum mounted in said tub and capable of rotating therein during washing and spin-extraction, a plurality of suspension means (4, 5) suspending said washing unit to said outer casing, a support base (14) supporting the outer casing of said machine, a plurality of vibration damping means attached to said washing unit on one side and to appropriate anchoring points situated on said base on the other side, **characterized in that** said base (14) includes portions (35, 36, 28) that are connected to the rest of the base structure only through a limited portion (35A, 36A, 28A) of their respective perimeter, and that said anchoring points (15, 16, 17) of said vibration damping means are arranged on said portions (35, 36, 28).

2. Clothes washing machine according to claim 1, **characterized in that** at least one of said portions supports a single respective one of said anchoring points.

3. Clothes washing machine according to any of the preceding claims, **characterized in that** said limited portion of the perimeter of the respective base portion includes several distinct tracts (35A, 36A, 28A) connecting said portion to the rest of the base.

4. Clothes washing machine according to claim 3, **characterized in that** said base portions have an elongated shape (35, 36) and said limited portion (35A, 36A) of the respective perimeter thereof connecting them to the rest of the base is substantially provided on the two smaller opposite sides of said portions.

5. Clothes washing machine according to claim 4, **characterized in that** the anchoring point for said vibration damping means on the respective base portion is situated in the central zone of the respective elongated portion.

6. Clothes washing machine according to claim 4 or 5, **characterized in that** there are two of such elongated portions, which are arranged in a substantially symmetrical manner along the two side edges (26, 27) of the base.

7. Clothes washing machine according to any of the preceding claims, **characterized in that** said base and said portions are made integrally as a single-piece construction.

8. Clothes washing machine according to any of the preceding claims, **characterized in that** said limited portions of the perimeter of said base portions are arranged as close as possible to the support means (P1, P2, P3, P4) on which said base rests on the floor.

9. Clothes washing machine according to any of the preceding claims, **characterized in that** said portions (35, 36, 28) are obtained by sectioning said base along the tracts of the corresponding perimeter other than said limited-length tracts connecting said portions to the rest of the base, said sectioning originating respective interstices (51, 52).

10. Clothes washing machine according to any of the preceding claims, **characterized in that** said base includes portions (41) which are cantilevered with respect to the rest of the structure of the base and on which anchoring points (44) are provided for operational or functional parts of the machine.

11. Clothes washing machine according to claim 10, **characterized in that** said anchoring points (44) are arranged on the respective portion in the zone thereof which is more distant from the side (41) on which said respective portion (41) is connected to the rest of the base.

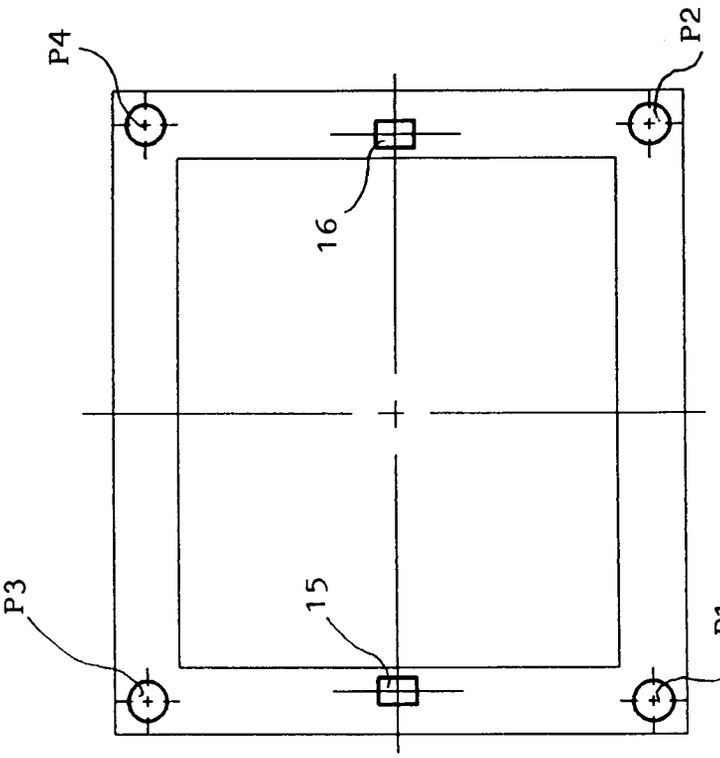

FIG.2

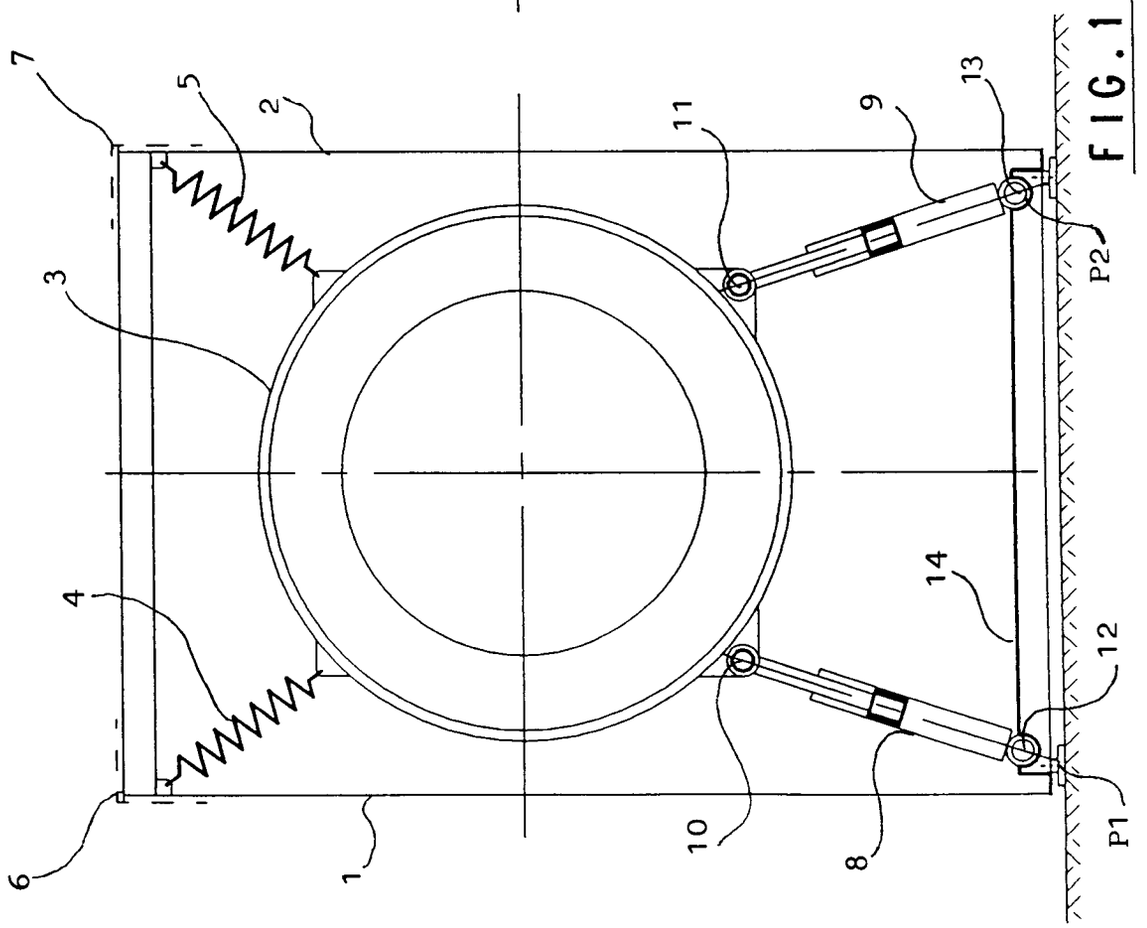

FIG.1

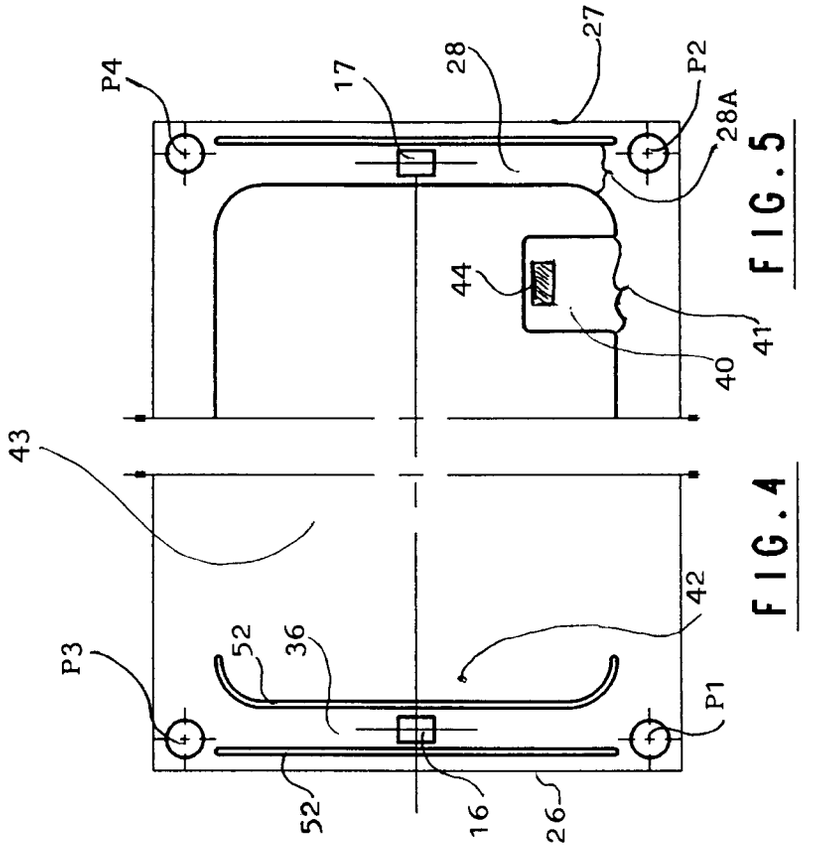

FIG.5

FIG.4

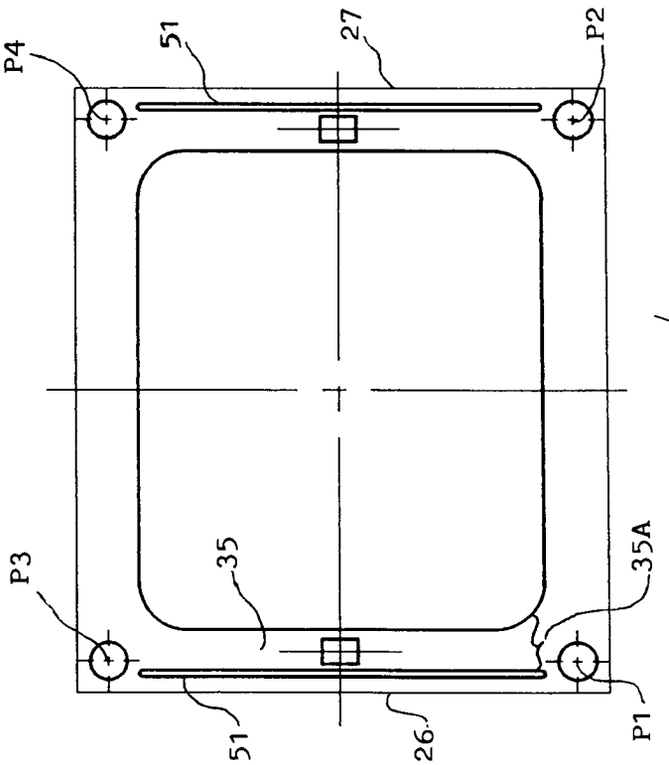

FIG.3

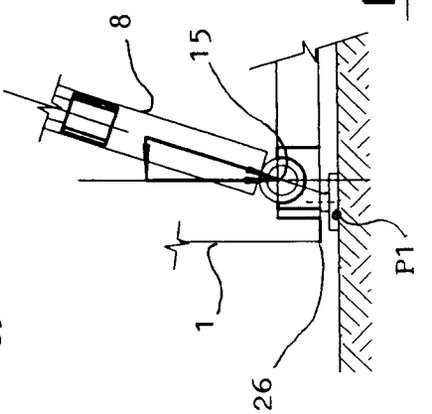

FIG.6