

VIBRATOR DEVICE

The present invention relates to a vibrator device and particularly, but not exclusively, to an electro-massager.

In known vibrator devices, a drive motor rotates a crank-shaft connected to an output shaft of the motor and thereby rocks a vibrating plate attached to an end of the crank-shaft. Such vibrator devices include the vibrating plate and a counter-weight for compensating for the reaction against rocking by the vibrating plate; for example, such a vibrator device is disclosed in published Japanese Utility Model Application No. Sho-51-21592.

The known vibrator devices, however, still have a problem. When the vibrating plate is rocked, undesirable shaking occurs in the direction of the crank-shaft. For example, when a vibrator device is used on the floor, the vertical movement of the vibrating plate makes the vibrator device bounce and thus creates a noise.

According to the present invention there is provided a vibrator device comprising:

a vibratory plate;

a crank-shaft connected to the vibratory plate such that the vibratory plate vibrates when the crank-shaft rotates;

a motor for rotating the crank-shaft; and

a counter-weight for compensating for the reaction against the vibration of the vibratory means; wherein

the vibratory plate and the counter-weight are arranged such that the centres of gravity of the vibratory plate and the counter-weight are in a centre of gravity plane that is perpendicular to the crank shaft, and which, in use of the device, is horizontal.

The driving point of the vibratory plate may also

be disposed on the same plane described above. It is further preferable that part of the vibratory plate is inclined towards the motor, so that the centre of gravity of the vibratory plate shifts towards the motor.

5 A protrusion or protrusions may be provided on the ridge at the end of the inclined portion of the vibratory plate.

In the vibrator device thus constructed, the vibratory plate rocks corresponding to the rotation of the crank-shaft driven by the motor. The counter-weight connected to the crank-shaft is balanced with a force applied vertically on the crank-shaft due to rocking of the vibrating plate; namely the counter-weight compensates for the reaction in the rocking direction.

10 The centre of gravity of the counter-weight and that of the vibratory plate are disposed on the same plane perpendicular to the crank-shaft. When forces of the vibratory plate and of the counter-weight are vertically applied onto the crank-shaft, the respective points of action for the forces are placed on the same plane.

15 Accordingly no force is applied to shake the vibratory plate in the direction of the crank-shaft. In the vibrator device of the invention, the vibratory plate is thus rocked stably and noiselessly without making the entire vibrator device bounce.

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When the driving point of the vibratory plate is disposed on the same plane described above, no distortion due to the inertia force of the vibratory plate occurs and the vibratory plate is thus much more stably rocked. When part of the vibratory plate is inclined towards the motor, the centre of gravity of the vibratory plate shifts to the motor and the vibratory plate is thereby well balanced. A protrusion or protrusions provided on the ridge on the vibratory plate can be used to fit and massage a lesion like the plantar arch of a foot effectively.

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An embodiment of the invention will now be described, by way of an example, with reference to the accompanying drawings, in which:-

5 Figure 1 is a cross-sectional view of a vibrator device embodying the present invention;

Figure 2 is a perspective view of the vibrator device of Figure 1;

Figure 3 is a perspective exploded view of the vibrating mechanism of the vibrator device;

10 Figure 4 is an enlarged cross-sectional view illustrating the vibrating mechanism of the vibrator device;

Figure 5 is a view showing positions of the vibrating plate and the counter-weight seen from a direction parallel to the output shaft; and

Figure 6 is a view showing positions of the vibrating plate and the counter-weight seen from a direction perpendicular to the output shaft.

The vibrator device has a rectangular casing 1
20 consisting of a body portion 1a and a cover portion 1b and has a handle or hand grip 2 integrally formed thereon. A vibratory plate 3 formed of a synthetic resin is provided in such a position that the centre of gravity 3a is located on a horizontal centre of gravity plane "A" disposed between the vibratory plate 3 and the casing 1 as shown in Figure 4. In the embodiment, the vibratory plate 3 has an inclined portion 3c on one end so as to shift the centre of gravity 3a to the plane "A". Another method may be used to position the centre
25 of gravity 3a on the plane "A". For example, the vibratory plate 3 may have an inclined portion on two opposite ends or a detachable weight may be attached to the vibratory plate 3. The plane "A" is perpendicular to a vertical crank shaft 28 as explained below. The
30 outer surface 6 of the vibratory plate 3 has a plurality of semi-spherical projections 4. Large protrusions 8 are formed on the ridge 3b at the end of the inclined

portion 3c.

Resilient columns 10, e.g. formed of rubber, connect the vibratory plate 3 with the casing body portion 1a. One end of each resilient column 10 is
 5 fixed to the vibratory plate 3 and the other end fixed to the casing body portion 1a, thus allowing the vibratory plate 3 to rock stably. In the embodiment, a resilient column 10 is provided at each corner of the vibratory plate 3.

10 A motor 12 housed in the casing 1 rocks the vibratory plate 3. The vibrating mechanism of the embodiment, arranged between the motor 12 and the vibratory plate 3, will now be described in relation to Figures 3 and 4.

15 A main or output shaft 14 of the motor 12 is supported by a bearing 16, and a male screw-thread 18 is provided on one end of the output shaft 14.

A counter-weight 24 for compensating for reaction against rocking of the vibratory plate 3 is provided on
 20 an edge of a fan 22 for cooling the motor 12. A through hole 26 is formed on the hub portion of the fan 22.

The crank-shaft 28 has a cylindrical body 30 and a flange 32 formed on one end of the body 30. A boss 34 which fits into the hole 26 in the fan 22 projects from
 25 the other side of the flange 32. A screw-threaded hole 36 is provided in the boss 34 in such a position that the axis thereof is displaced a certain amount from the axis of the body 30.

A crank bearing 38 is mounted on the centre of the
 30 vibratory plate 3 by an attachment 42. The crank bearing 38 is placed in such a way that the axis of the crank bearing 38 is displaced a certain amount from the axis of the bearing 16 and also the centre of the ball race 40 of the bearing 38 is disposed on the plane A.
 35 Though the centre 38a of the crank bearing 38 coincides with the centre of gravity 3a of the vibratory plate 3

in the embodiment, another configuration may be used.

The vibrating mechanism shown in Figure 3 is assembled as follows. First the output shaft 14 is inserted in the bearing 16 and then into a sleeve 20. The boss 34 is fitted into the through hole 26 of the fan 22, and the male screw-thread 18 of the output shaft 14 is engaged in the screw-threaded hole 36 of the crank-shaft 28. The fan 22 is thus pinched between the sleeve 20 and the crank-shaft 28. The body 30 of the crank-shaft 28 is then fitted into the crank bearing 38.

Figure 5 shows positions of the respective centres of gravity 3a and 24a of the vibratory plate 3 and of the counter-weight 24 seen from a direction parallel to the centre line 14c of the output shaft 14. A straight line "B" passing through the centres of gravity 3a and 24a of the vibratory plate 3 and of the counter-weight 24 intersects the centre line 14c of the output shaft 14. The counter-weight 24 is disposed in such a position that the intersection 14a is placed between the two centres of gravity 3a and 24a.

Figure 6 shows positions of the respective centres of gravity 3a and 24a of the vibratory plate 3 and of the counter-weight 24 seen from a direction perpendicular to the output shaft 14. The positions and shapes of the counter-weight 24 and of the fan 22 are determined in such a way that the centres of gravity 3a and 24a of the vibratory plate and of the counter-weight 24 are disposed on the same plane "A" perpendicular to the crank-shaft 28.

Though the fan 22 is fixed to the crank-shaft 28 by fitting the boss 34 of the crank-shaft 28 into the through hole 26 of the fan 22 in the above embodiment, fixation of the fan 22 may be accomplished in any other method. For example, the fan 22 may be fitted into a notch formed on the top of the crank-shaft 28. The male screw-thread 18 is mounted on the output shaft 14 in the

above embodiment but may be mounted on the crank-shaft 28.

The operation of the vibratory device of the embodiment will now be described.

5 When a switch 50 is moved to the "on" position to energise the motor 12, the crank-shaft 28 is driven through the output shaft 14 of the motor 12 to rotate around the centre of the screw-threaded hole 36. The body 30 of the crank-shaft 28 then starts rocking and
10 rotating around the axis of the screw hole 36. Since the vibratory plate 3 is supported by the resilient columns 10 and the rotation component of the body 30 is absorbed by the crank bearing 38 holding the body 30 therein, the body 30 transmits only the rocking
15 component to the vibratory plate 3. The body 30 hence starts rocking the vibratory plate 3.

As shown in Figures 5 and 6, a force $3F$ due to rocking of the vibratory plate 3 and a force $24F$ due to the counter-weight 24 are applied in the reverse
20 directions on the output shaft 14; that is, the forces $3F$ and $24F$ work to compensate for each other. The counter-weight 24 accordingly compensates for reaction against rocking of the vibratory plate 3. The
25 respective centres of gravity $3a$ and $24a$ of the vibratory plate 3 and of the counter-weight 24 are disposed on the same plane A perpendicular to the output shaft 14. In rocking of the vibratory plate 3, the
30 point of action for the force $3F$ due to the vibratory plate 3 thus coincides with that for the force $24F$ due to the counter-weight 24. When the centre of gravity of the counter-weight 24 is placed at the position $24b$ like a conventional vibrating device, the point of action for the force $3F$ does not coincide with that for a force $24H$ and an undesirable shake occurs in the direction of the
35 output shaft 14. In the vibrating device of the embodiment, however, since a force causing a shake in

the direction of the output shaft 14 is not generated, the vibratory plate 3 is stably rocked. The inclined portion 3c is formed on the vibratory plate 3 to lower the centre of gravity 3a to the motor 12. The vibrator device is thus well balanced and gives stable vibration without bouncing itself.

Any desirable lesion of the body is massaged by rocking of the vibratory plate 3. The surface 6 of the vibratory plate 3 perfectly fits a curved lesion such as a foot or the back because of the inclined portion 3c and the numerous projections 4 and the protrusions 8 appropriately stimulate the lesion. Since the protrusions 8 are provided on the ridge 3b at the end of the inclined portion 3c, the vibratory plate 3 fits and massages a lesion like the plantar arch of a foot effectively.

In the vibrator device described above, a leg 52 is further provided for adjusting the height of the vibrating device as shown in Figure 2. The leg 52 may be detachable or may be held in the bottom of the casing body portion 1a when not in use.

In the vibrator device of the embodiment, the driving point of a force for rocking the vibratory plate 3 coincides with the centre 38a of the crank bearing 38 on the plane A as shown in Figure 4. A force applied on the ball race 40 due to rocking of the vibratory plate 3 then acts on the plane "A"; therefore no distortion due to the inertia force of the vibratory plate 3 occurs. The vibratory plate 3 is accordingly much more stably rocked and the ball race 40 has better durability.

Though only one counter-weight is used in the embodiment, a plurality of counter-weights may be applied. The plurality of counter-weights are disposed in such a way that the resultant of the counter-weights becomes equal to the force 24F shown in Figures 5 and 6.

In the vibrator device of the invention described

above, the centre of gravity of the vibratory plate, which is rocked by rotation of the crank shaft, and that of the counter-weight, which compensates for reaction against the rocking, are disposed on the same plane perpendicular to the crank-shaft. Accordingly no force is applied to shake the vibratory plate in the direction of the crank-shaft. The vibratory plate is thus rocked stably and noiselessly without making the whole body bounce.

When the driving point of the vibratory plate is disposed on the same plane, no distortion due to the inertia force of the vibratory plate occurs and the vibratory plate is thus much more stably rocked. When part of the vibratory plate is inclined towards the motor, the centre of gravity of the vibratory plate shifts towards the motor and the vibratory plate is thereby well balanced and is further stably rocked.

A protrusion or protrusions provided on the ridge at the end of the inclined portion of the vibratory plate fit and massage a lesion like the plantar arch of a foot effectively.

CLAIMS

1. A vibrator device comprising:
a vibratory plate;
5 a crank-shaft connected to the vibratory plate such that the vibratory plate vibrates when the crank-shaft rotates;
a motor for rotating the crank-shaft; and
a counter-weight for compensating for the reaction
10 against the vibration of the vibratory means; wherein
the vibratory plate and the counter-weight are arranged such that the centres of gravity of the vibratory plate and the counter-weight are in a centre of gravity plane that is perpendicular to the crank
15 shaft, and which, in use of the device, is horizontal.
2. A vibrator device as claimed in claim 1, in which a driving point at which the crank-shaft connects to the vibratory plate is also disposed in the centre of
20 gravity plane.
3. A vibrator device as claimed in claim 1 or claim 2, in which a part of the vibratory plate is inclined towards the motor.
- 25 4. A vibrator device as claimed in claim 3, in which one or more protrusions are provided on a ridge where the vibratory plate is inclined towards the motor.
- 30 5. A vibrator device as claimed in any preceding claim, in which an axis of an output shaft of the motor is parallel to and different from the axis of the crank-shaft.



6. A vibrator device as claimed in any preceding claim, further comprising a fan interposed between the output shaft and the crank-shaft.

5 7. A vibrator device as claimed in claim 6, in which the counter-weight is mounted on the fan.

8. A vibrator device as claimed in claim 7, in which the axis of the crank-shaft intersects the fan on a side
10 of the axis of the main shaft opposite to the side of the fan on which the counter-weight is mounted.

9. A vibrator device comprising:
a motor having a main shaft;
15 a fan mounted on the main shaft;
a crank-shaft mounted on the fan such that an axis of the crank-shaft is parallel to and displaced from an axis of the main shaft;
a vibratory plate mounted on the crank-shaft such
20 that the vibratory plate vibrates when the crank-shaft rotates; and

a counter-weight mounted on the fan on a side of the fan opposite to the side of the fan on which the main shaft of the motor is mounted; wherein
25 the vibratory plate and the counter-weight are arranged such that the centres of gravity of the vibratory plate and the counter-weight are in a centre of gravity plane that is perpendicular to the crank-shaft, and which, in use of the device, is horizontal.

30 10. A vibrator device as claimed in claim 9, in which a driving point at which the crank-shaft connects to the vibratory plate is also disposed in the centre of gravity plane.



11. A vibrator device as claimed in claim 9 or claim 10, in which a part of the vibratory plate is inclined towards the motor.
- 5 12. A vibrator device as claimed in claim 11, in which one or more protrusions are provided on a ridge where the vibratory plate is inclined towards the motor.
- 10 13. A vibrator device substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.
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