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Electromagnetic vibrator apparatus with adjustable elastic reaction.

Electromagnetic vibrator apparatus, comprising a base (1) capable of being connected to an object to be set in vibration, an electromagnetic armature (3) integral with the base (1) and an electromagnet (4) facing the armature, and connected to the base by an elastic means (6), in which the elastic means connecting the base to the electromagnet is of constant stiffness, while between the electromagnet (4) and the base (1) there is interposed at least one adjusting unit (12), comprising elastic means (14) with adjustable prestress.

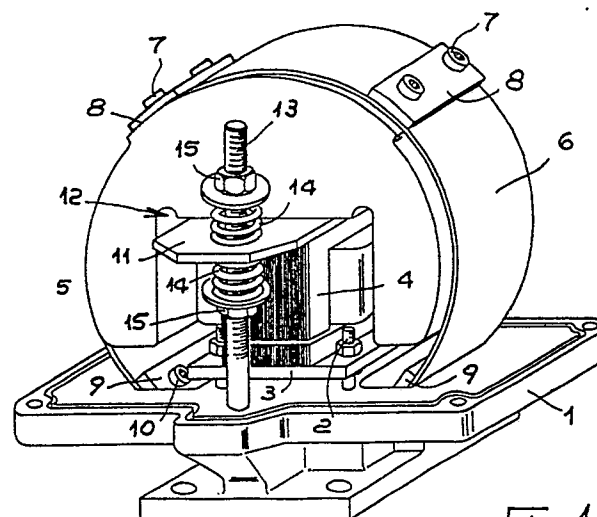


Fig. 1

ELECTROMAGNETIC VIBRATOR APPARATUS WITH ADJUSTABLE ELASTIC REACTION

The subject of the present invention is an electromagnetic vibrator apparatus with elastic reaction which can be continuously adjusted, even during operation.

For achieving the conveying of granular materials, in powder or similar form, for example in the case of vibrating feeders, screens, shaker devices and extraction devices from silos and the like, use is frequently made, in many industrial applications, of vibration motions induced in the containing structure for said materials.

For this purpose, such structures for containing the materials are equipped with devices adapted for setting them in vibration with the desired frequency and amplitude.

Among such devices are often found the electromagnetic vibrators, in which the vibration is generated by attracting an armature by means of an electromagnet, in opposition to an elastic means, actuating the electromagnet with a suitable excitation frequency. In particular, one convenient form of embodiment of such vibration devices provides that the electromagnet, connected to the armature by an interposed elastic element, shall be supplied with a pulsed voltage, produced by partly rectifying the alternating voltage of the mains.

In this way the excitation frequency of the electromagnet, which causes the vibration of the system, is the mains frequency and is therefore constant.

For the purpose of obtaining the best yield from the vibrator, it is necessary for the vibratory characteristics of the complex composed of the vibrator apparatus and of the structure connected to it to be such as to possess a natural frequency of vibration close to resonance with the imposed frequency but not coincident with it, so as to have induced vibrations of sufficient amplitude, while nevertheless keeping said amplitude under control.

For this purpose, the excitation frequency of the electromagnet of the vibrator apparatus being constant, and the characteristics of the structure set in vibration, especially its mass, being determined by the requirements in use, it is necessary to act on the mechanical characteristics of the vibrator apparatus and thereby tune it to the assembly to which it is fitted.

As is known, leaving out of consideration the damping effects, the vibratory behaviour of a body is determined by its mass and by its elastic constant; therefore, in order to tune the vibrator apparatus to the structure which is to be set in vibration, it is possible to select for it a particular value of elastic reaction.

Vibrator apparatuses are known, which are

equipped with elastic reaction means constituted of a leaf spring packet, secured to the armature and to the electromagnet; in such devices, the tuning to the characteristics of the structure to be set in vibration can be achieved by varying the number of leaf springs forming the packet, by adding or removing one leaf of the median number of leaves provided; alternatively, it is possible to vary the distance between the supports of the ends of the leaves.

The adjustment in one case is therefore discontinuous in nature, it being possible for the elastic constant to be varied by a finite number, achieving an approximate tuning, and furthermore in both cases it is necessary, in order to carry out the adjustment, to effect an at least partial dismantling and reassembly of the apparatus, or indeed to carry out complete operations, which can only be effected by specialized personnel, requiring appreciable time.

The requirement therefore arises to have available a vibrator apparatus which can be adjusted in its elastic characteristics rapidly and continuously, without complex operations of dismantling and reassembly, and while it is in operation.

The leaf spring structure of the known vibrators, moreover, is bulky and expensive, it being necessary to provide a large number of elastic strips secured to one another in order to form a packet of adequate stiffness, with considerable expense and assembly times; a further requirement therefore arises, to have available a vibrator apparatus of simple construction and reduced expense, both in respect of machining operations and its assembly.

These results are achieved by the present invention, which provides an electromagnetic vibrator apparatus, comprising a base capable of being connected to an object to be set in vibration, an electromagnetic armature integral with the base and an electromagnet facing the armature and connected to the base by an elastic means, in which the elastic means connecting the base to the electromagnet has constant stiffness, at least one adjusting unit being interposed between the electromagnet and the base, this adjusting unit comprising elastic means with adjustable prestress.

The elastic means of constant stiffness interposed between the electromagnet and the base is constituted of at least one elastic strip of suitable thickness, having a curvature extending through an arc of at least 180°.

In particular, the elastic means of constant stiffness is constituted of a strip curved to a part of a cylindrical surface extending through an arc greater

than 180°, secured at its ends to the base, and carrying the electromagnet secured in an intermediate position.

In an alternative, the elastic means of constant stiffness is constituted of a pair of strips curved to a portion of a cylindrical surface and extending through an arc of approximately 180°, each being secured at one end to the base and at the other end to the electromagnet, on opposite sides of same.

The adjusting unit comprises a pair of helical springs aligned and secured by means comprising screws to a rod integral with the base, between which springs there is interposed a plate slidable on the rod and integral with the electromagnet, the screw means for securing the springs on the rod being adjustable in position, thereby varying the initial deformation imparted to the springs themselves.

With advantage, two adjusting units are present, disposed symmetrically on opposite sides of the electromagnet.

The screw means for securing the springs on the rod are directly accessible, for the adjustment of the prestress of the springs, while the apparatus is in operation.

Further details can be obtained from the following description, with reference to the attached drawings, in which there are shown:

in Figure 1, a vibrator apparatus according to this invention, in perspective view;

in Figure 2, the vibrator apparatus of Figure 1 in lateral view;

in Figure 3, a vibrator apparatus according to this invention in an alternative form of embodiment, in front view;

in Figure 4, the vibrator apparatus of Figure 3 in lateral view.

As Figures 1 and 2 show, a vibrator apparatus according to this invention comprises a base 1, to which there is secured, by means of the screws 2, an armature 3, opposite which is an electromagnet 4, which is connected to a heavy body 5, also termed reaction mass, in turn attached to the base 1 by means of an elastic element, composed of a metal strip 6, shaped to an arc.

The reaction mass 5 is secured to the arc-shaped strip 6 by screws 7 and associated small plates 8, while the small plates 9 and the screws 10 secure the arc-shaped strip 6 to the base 1.

From the reaction mass 5 there project laterally the plates 11, which connect the mass 5 to an adjusting unit 12, comprising a pair of threaded rods 13 securely fixed at one end to the base 1, symmetrically on opposite sides of the mass 5, and secured to the plates 11 through the interposition of helical springs 14, prestressed by means of nuts 15 engaged on the rods 13 and advantageously

equipped with locking devices.

The base 1 enables the vibrator apparatus to be fitted to the machine or to the element of a machine which is to be set in vibration.

The electromagnet 4 is supplied with a pulsating voltage at constant frequency, of adjustable strength; when the electromagnet is energized, it attracts the armature 3, bending the strip 6 which, when the voltage pulse ceases, again brings back the electromagnet, and the mass 5 securely fixed to it, to the initial distance from the armature.

This movement, repeated at the frequency of the excitation pulses, therefore causes a vibration which is transmitted to the object to which the vibrator apparatus is fitted, thereby keeping it in the desired vibrational state.

For the purpose of tuning the assembly so that it shall possess a natural frequency of vibration close to that of resonance with the excitation frequency, but not equal to it, according to criteria which are in themselves known in the art, in relation to the magnitude of the mass of the object to be set in vibration under its effective operating conditions, the adjusting unit 12 is adjusted by varying the prestress value of the springs 14, by means of the nuts 15.

This in fact modifies the elastic characteristics of the vibrator apparatus and therefore those of the entire assembly set in vibration, constituted of the vibrator apparatus and of the object to which it is fitted; such elastic characteristics, as is known, participate in the determining of the amplitude of the vibration of the assembly, in response to a given excitation force, and the adjustment of these characteristics therefore enables the greatest efficiency of the vibrator apparatus to be achieved.

The desired adjustment, carried out by an appropriate tightening of the nuts 15, is particularly easy and can be effected even while the vibrator apparatus is fitted and is in operation, and it can be carried out by the users, without requiring specialized personnel and by directly controlling the correctness of the adjustment carried out.

The use of a curved elastic strip, furthermore, enables a high elastic characteristic to be achieved by the use of one single strip, simple and economical to construct and to install, as compared with the flat leaf springs previously used.

In Figures 3 and 4 there is illustrated an alternative form of embodiment, in which the corresponding parts bear the same numerical references as already used; in this embodiment it is arranged that the elastic strip carrying the reaction mass and the electromagnet shall be formed in two parts, 6a and 6b, each curved through an arc of 180° and with their plane ends parallel.

This enables a lower overall height of the apparatus to be achieved, compared with an analo-

gous apparatus with the strip in a single piece, and associated with a slightly greater breadth, and above all it does not require a large portion of the surface of the reaction mass 5 to be machined to enable it to be coupled to the strip, nor the oblique seating surfaces of the ends of the strip 6 in the base 1 to be machined.

According to the form of embodiment of Figure 3, in fact, it is sufficient for the upper surface of the mass 5 and the central part of the base 1 to be machined flat, in a much simpler and less expensive manner.

Also, in the case where the pulsed excitation which generates the vibration is imparted to the electromagnet in a different manner from that described above, the adjustment of the elastic constant of the system, achieved by means of the adjusting units 12, enables the desired tuning, in relation to the total mass to be set in vibration, to be obtained in an especially easy manner.

The adjusting units 12 may also be fitted to a vibrator apparatus of different construction, for example of the conventional type with a packet of flat leaf springs, thus giving to them also the possibility of achieving an easy adjustment of the elastic characteristics of the complex.

Numerous variants may be introduced, without thereby departing from the scope of the invention in its general characteristics.

Claims

1. Electromagnetic vibrator apparatus, comprising a base (1) capable of being connected to an object to be set in vibration, an electromagnetic armature (3) integral with the base (1) and an electromagnet (4) facing the armature (3), and connected to the base (1) by an elastic means (6), characterized by the fact that the elastic means (6) connecting the base (1) to the electromagnet (4) is of constant stiffness, at least one adjusting unit (12) being interposed between the electromagnet (4) and the base (1), this adjusting unit (12) comprising elastic means (14) with adjustable prestress.

2. Electromagnetic vibrator apparatus according to Claim 1, characterized by the fact that the elastic means (6) of constant stiffness interposed between the electromagnet (4) and the base (1) is constituted of at least one elastic strip of suitable thickness, having a curvature extending through an arc of at least 180°.

3. Electromagnetic vibrator apparatus according to Claim 2, characterized by the fact that the elastic means (6) of constant stiffness is constituted of a strip curved to a portion of a substantially cylindrical surface, extending through an arc exceeding 180°, and secured at its ends to the base

and carrying the electromagnet secured in an intermediate position.

4. Electromagnetic vibrator apparatus according to Claim 2, characterized by the fact that the elastic means (6) of constant stiffness is constituted of a pair of strips curved to a portion of cylindrical surface extending through an arc of approximately 180°, each secured at one end to the base and at the other end to the electromagnet, on opposite sides of same.

5. Electromagnetic vibrator apparatus according to Claim 1, characterized by the fact that the adjusting unit (12) comprises a pair of helical springs (14) aligned and secured by means comprising screws (15) to a rod (13) rigidly secured to the base (1), between which springs (14) there is interposed a plate (11) slidable on the rod and integral with the electromagnet, the screw means (15) for securing the springs (14) on the rod (13) being adjustable in position, thereby varying the initial deformation imparted to said springs (14).

6. Electromagnetic vibrator apparatus according to Claim 5, characterized by the fact that two adjusting units (12) are provided, symmetrically disposed on opposite sides of the electromagnet (4).

7. Electromagnetic vibrator apparatus according to Claim 5, characterized by the fact that the screw means (15) for securing the springs (14) on the rod (13) are directly accessible for the adjustment of the prestress of said springs (14), while the apparatus is in operation.

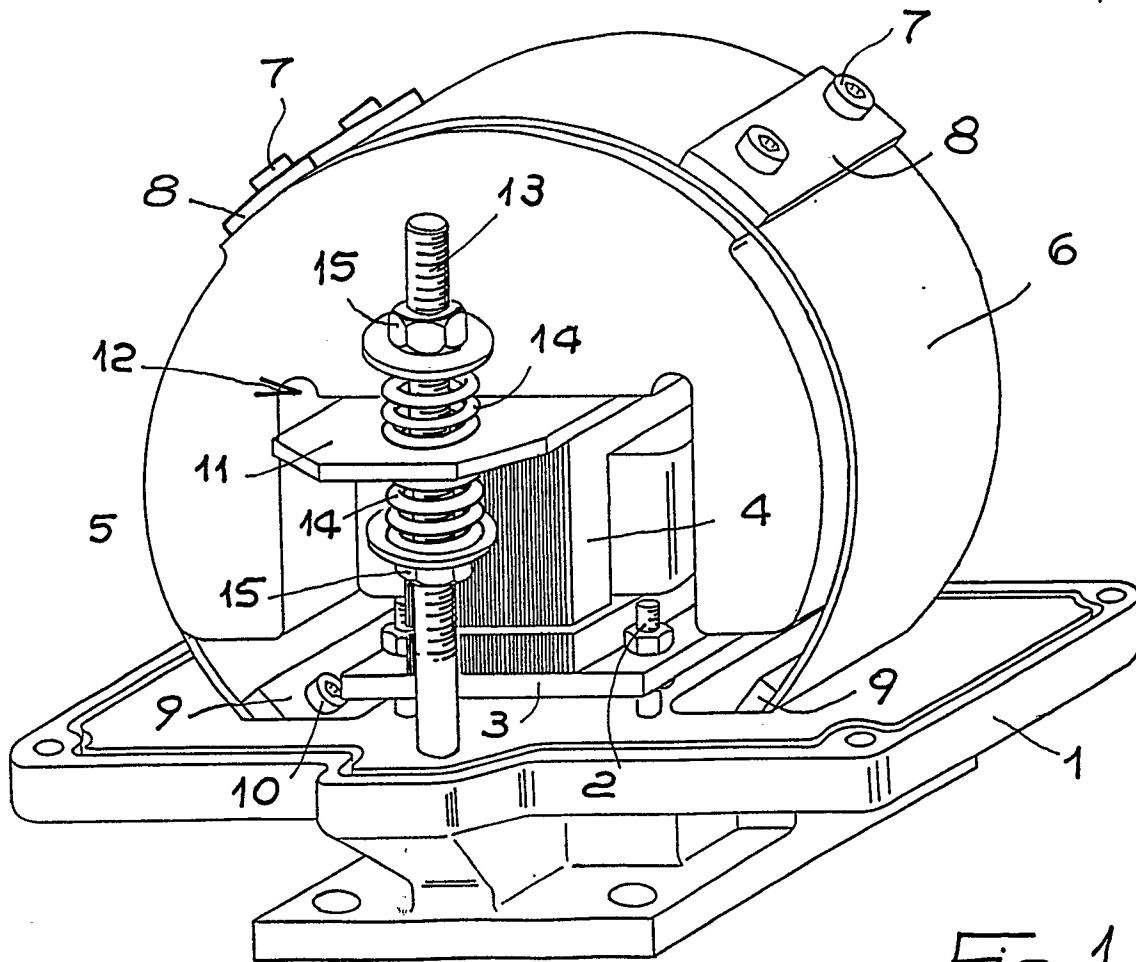


Fig. 1

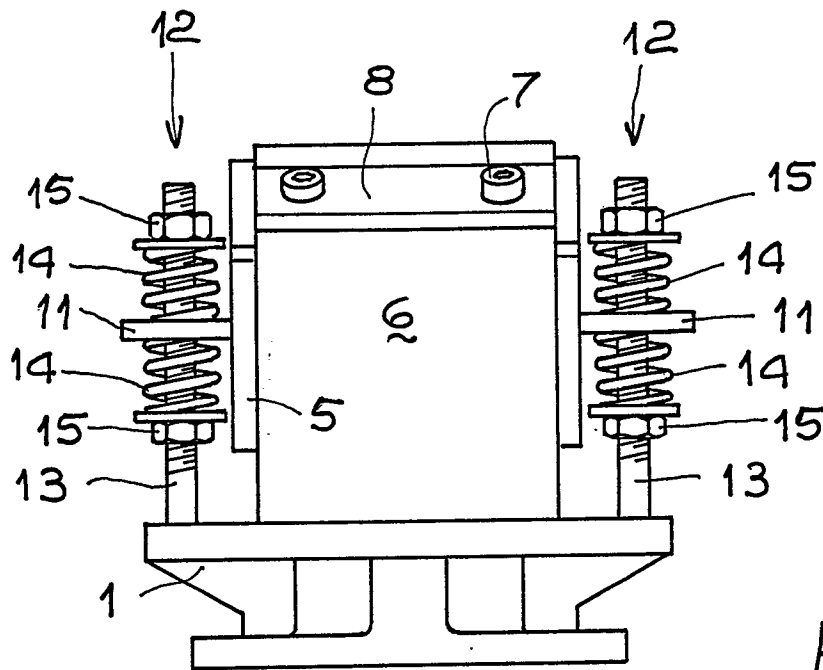


Fig. 2

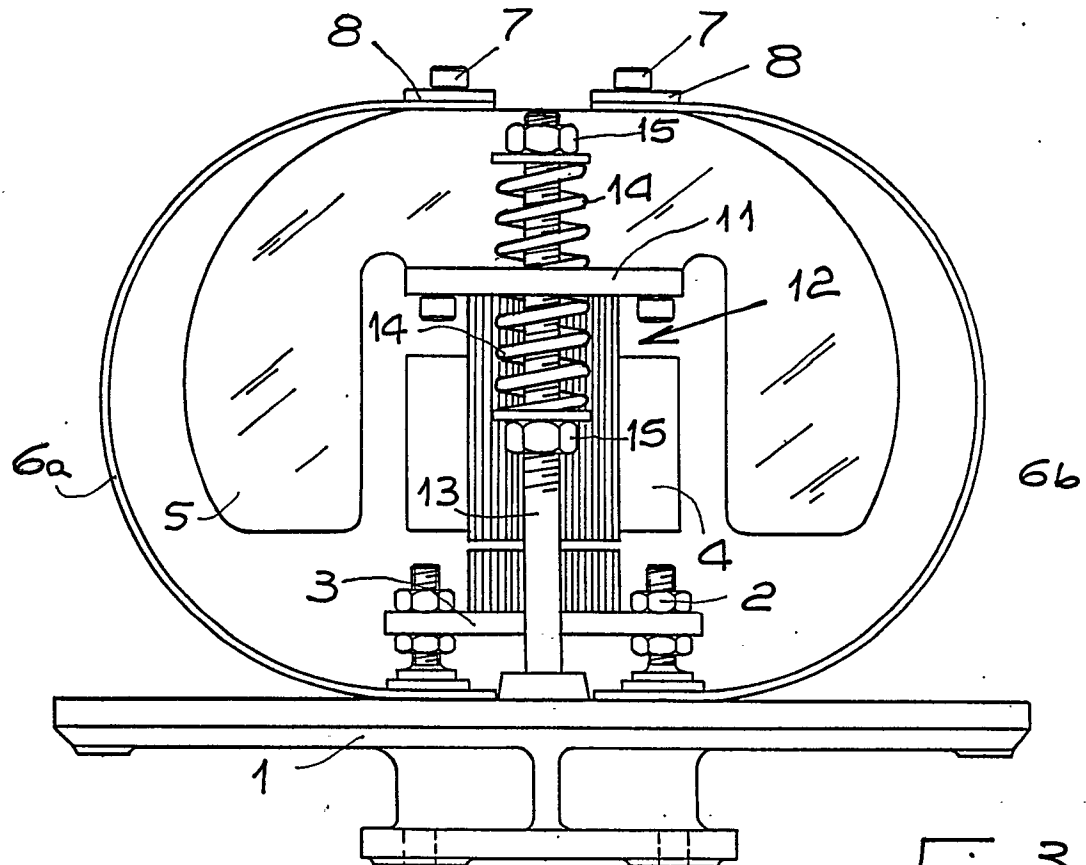


Fig. 3

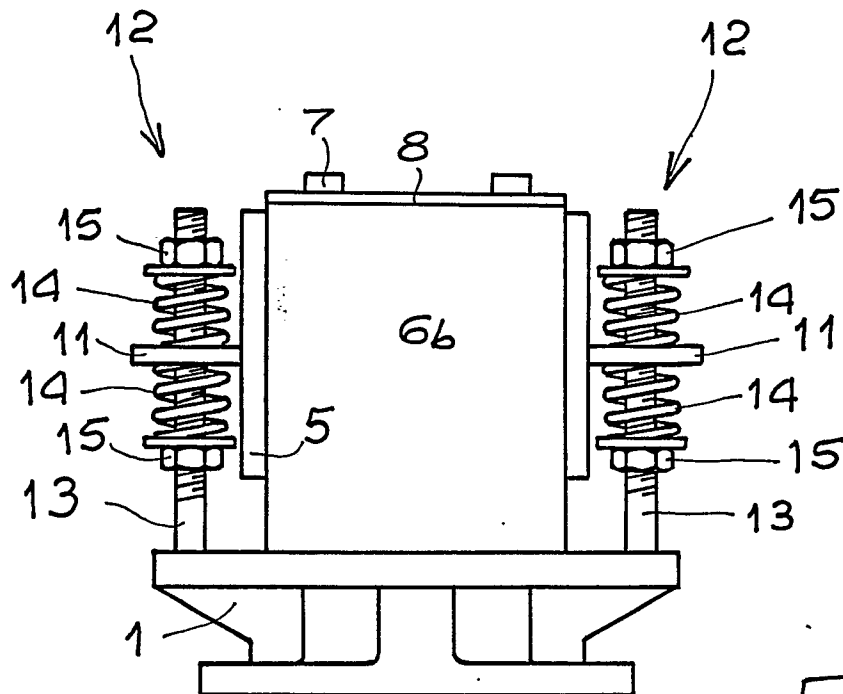


Fig 4