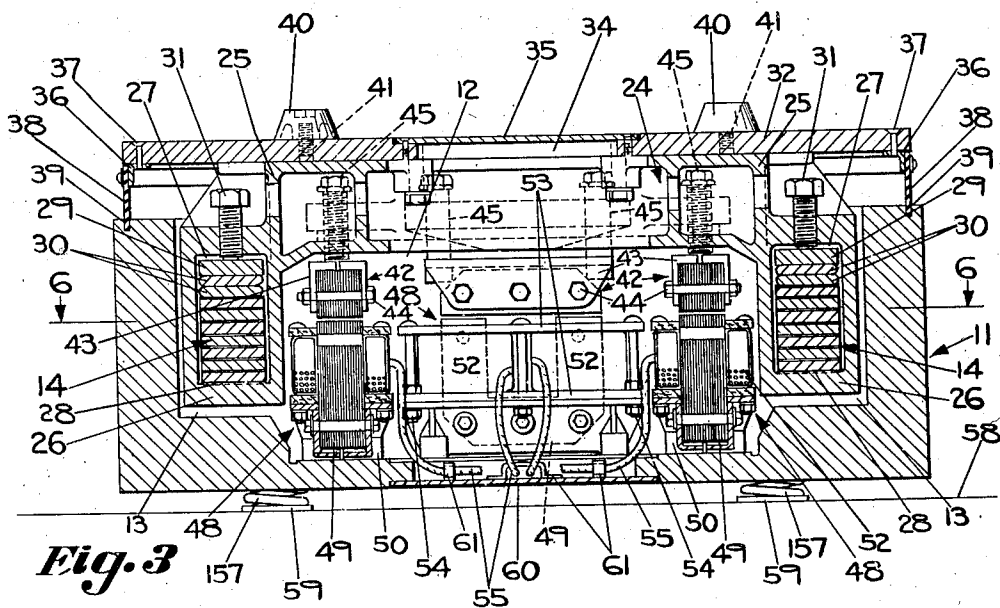
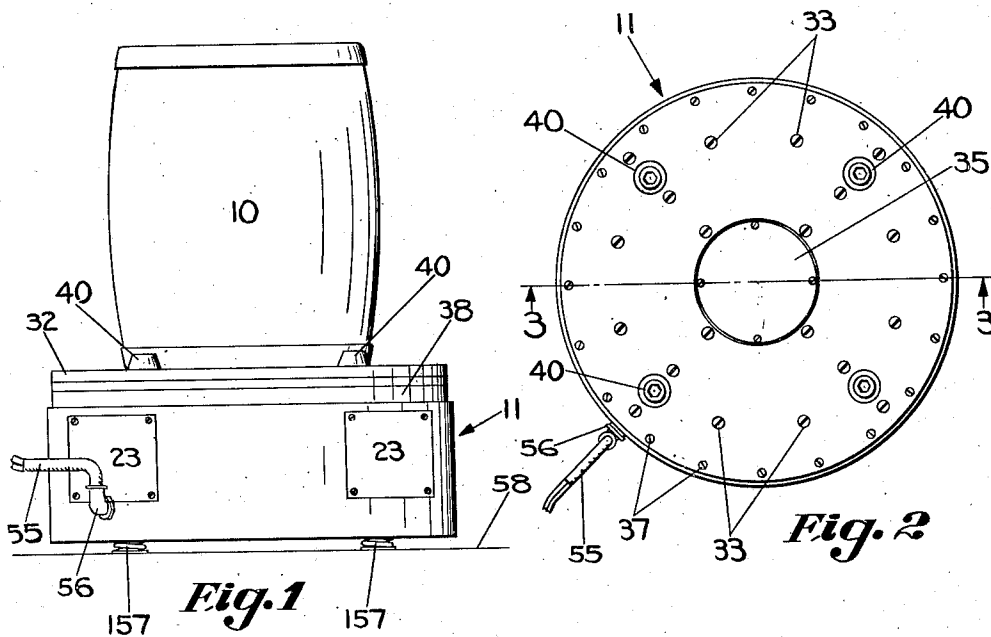


Dec. 17, 1940.

C. J. JOHNSON
VIBRATING APPARATUS
Filed July 17, 1937

2,225,537

3 Sheets-Sheet 1



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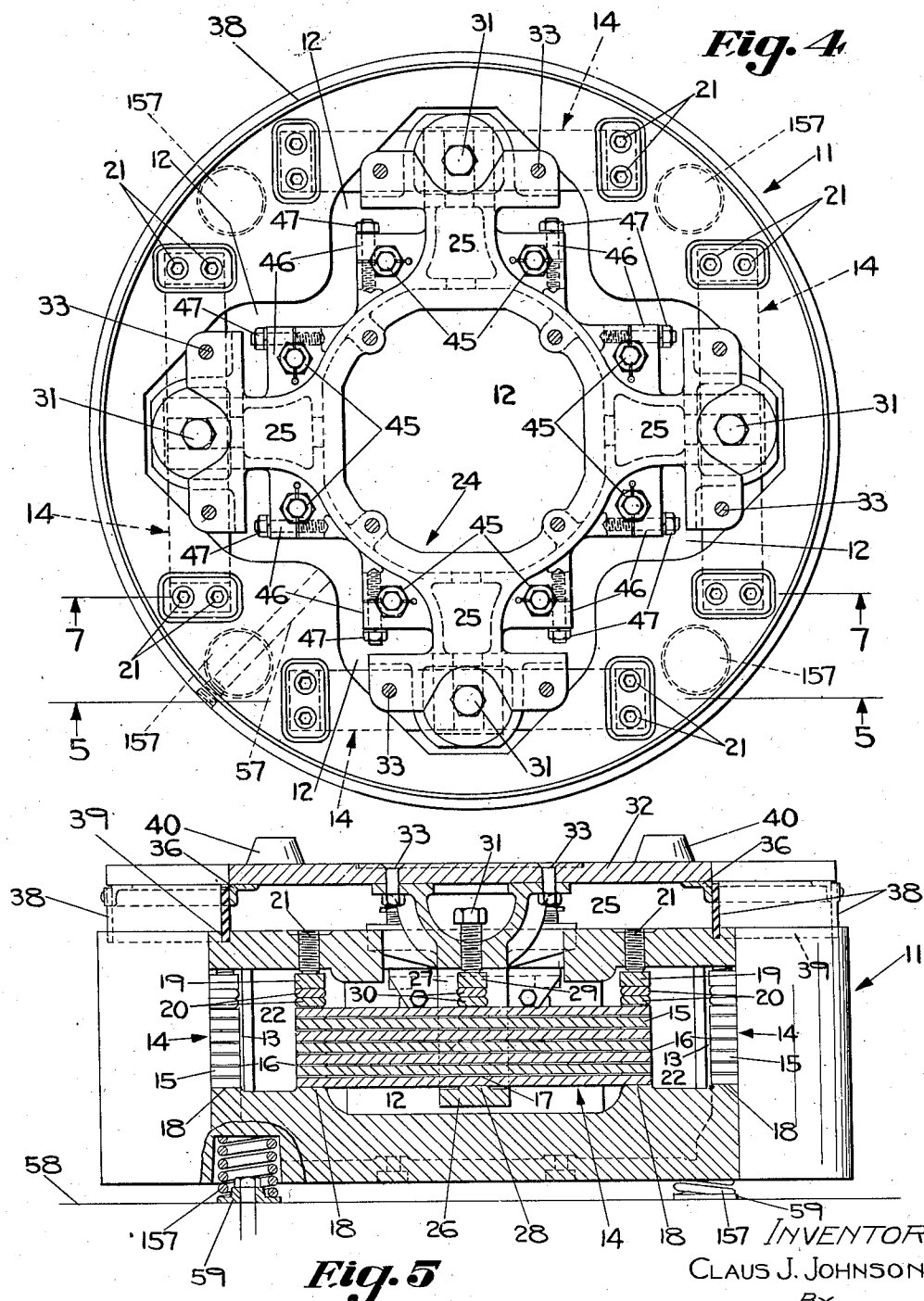
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VIBRATING APPARATUS

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3 Sheets-Sheet 2



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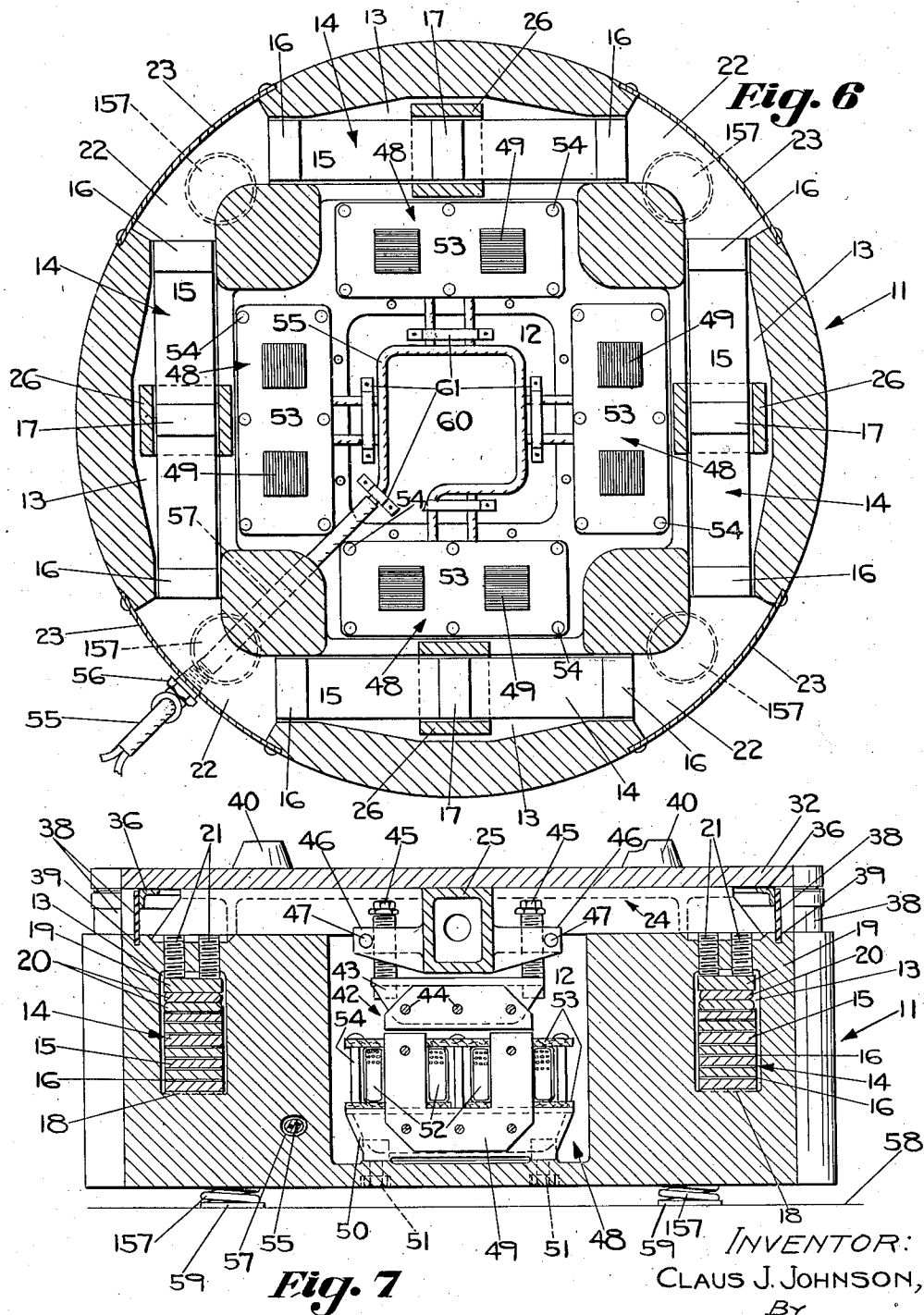
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VIBRATING APPARATUS

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,225,537

VIBRATING APPARATUS

Claus J. Johnson, Columbus, Ohio, assignor to The
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Application July 17, 1937, Serial No. 154,185

4 Claims. (Cl. 172—126)

This invention relates to a device for packing materials and more particularly to a device for packing granular materials in receptacles or containers of large size and weight by imparting vibratory motion to the container during the filling thereof and is particularly adapted for the packing of such materials as chemicals, paint pigments or any other relatively small granular material.

10 An object of the invention is to provide an improved vibratory packing device which is capable of packing very heavy weights of material into containers while at the same time maintaining the overall height and diameter of the packing device
15 at a minimum.

Another object of the invention is to provide a highly efficient container packing device which will pack very heavy weights of materials into containers and will require a minimum consumption
20 of power.

Still another object of the invention is to provide a device of the above mentioned type in which the entire operating mechanism is totally enclosed and thereby fully protected.

25 Still another object of the invention is to provide a packing device capable of handling large weight materials in which the natural period of vibration of the vibratory elements are brought substantially but not exactly into resonance with
30 the operating frequency thereof, thereby providing for a minimum consumption of power consistent with controlled vibration.

Still another object of the invention is to provide a very powerful vibratory packing device in
35 which the natural period of vibration of the vibratory element is independent of the weight of the container and material therein which is being packed.

Another object of the invention is to provide a compact but powerful vibratory motor.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the accompanying drawings,

45 Fig. 1 is an elevational view of the device comprising my invention, showing a barrel in position to have the material therein packed;

Fig. 2 is a plan view of the device of Fig. 1, with the barrel removed;

50 Fig. 3 is a sectional elevational view taken on the line 3—3 of Fig. 2 looking in the direction of the arrows;

Fig. 4 is a plan view of the device, with the cover or supporting plate removed;

55 Fig. 5 is a sectional elevational view taken on

the line 5—5 of Fig. 4 looking in the direction of the arrows;

Fig. 6 is a sectional plan view taken on the line 6—6 of Fig. 3 looking in the direction of the arrows; and

Fig. 7 is a sectional elevational view taken on the line 7—7 of Fig. 4 looking in the direction of the arrows.

The packing device comprising my invention is designed to vibrate containers such as a container
10 or barrel 10 at a very high frequency and to effect a very thorough compacting of the material in said barrel or container. The device is particularly designed to accommodate containers of considerable weight, which may have a weight as
15 high as one thousand pounds, including the material to be packed therein, which containers may be vibrated with an appreciable amplitude of vibration, which, for example, may be as much
20 as three-eighths of an inch.

Referring to the accompanying drawings, it will be seen that said packing device comprises a main frame 11 preferably formed as an iron or steel casting which is generally of cup shape. As best seen by reference to Figs. 4, 5, 6 and 7 of the
25 drawings the main frame 11 has a centrally disposed recess or cavity 12 adapted to receive and contain operating mechanism as hereinafter described in complete detail. Said main frame 11 is also provided with four horizontally extending
30 passageways 13, Figs. 6 and 7, which extend at right angles to each other and through which extend four sets of leaf springs 14. That is, the four sets of leaf springs 14 are symmetrically
35 spaced around the main frame 11. Each set of leaf springs comprises a plurality of stacked steel leaves or bars 15, each very stiff and strong and which are spaced-apart at their ends by spacers
16 and at their centers by spacers 17. The ends
40 of the leaves 15 of each set of leaf springs 14 are clamped rigidly in a passageway 13 between upwardly extending bosses 18, 18 and top clamp
45 plates 19, 19 and filler plates 20, 20. The filler plates 20, 20 preferably have all their corners rounded to prevent the presentation of any sharp
corner to a vibrating bar or leaf 15. The top clamp plates 19, 19 may be forced downwardly to clamp the leaves 15 by virtue of clamp screws
21, 21 threaded in the top portion of the main frame 11. The clamp screws 21, 21 preferably
50 have wrench receiving recesses to provide for their adjustment. It is thus evident that the four sets of leaf springs 14 have their ends rigidly clamped to the main frame 11 and are spaced around the periphery thereof so that there are two opposite
55

sets of leaf springs 14 carried by said main frame 11.

To provide for the ready insertion and removal of the leaf springs 14, openings 22 are provided in the periphery of the main frame 11, which openings 22 are preferably closed by removable cover plates 23. It is to be noted that access to adjacent ends of two sets of leaf springs 14 is provided by each opening 22.

Supported by the centers of the four sets of leaf springs 14 is a spider or main support 24 preferably in the form of a casting having four legs 25, one associated with each of the four sets of leaf springs 14. Each of the legs 25 is provided with a downwardly extending yoke 26 (see Fig. 3) which is formed integral therewith, each yoke 26 having an opening 27 therein through which a set of leaf springs 14 is threaded. Each yoke 26 is positioned adjacent the center of a set of leaf springs 14 and is clamped rigidly thereto by virtue of a boss 28 at the bottom of the opening 27 and a clamp plate 29 at the top thereof which clamps the centers of the leaves 15 against the spacers 17 through the intermediary of rounded corner filler plates 30, the clamp plate 29 receiving its clamping action by virtue of a set screw 31.

It is thus to be seen that the spider or main support 24 is mounted upon two diametrically opposite sides to the centers of the four sets of leaf springs 14. Said spider or main support 24 is, therefore, mounted in a balanced relation by four very heavy sets of leaf springs, as a consequence of which it may support a relatively heavy weight without appreciable deflection, yet, as hereinafter described in full detail, due to the cumulative effect of electro-magnetic forces, the four sets of leaf springs 14 may be deflected at their centers at a high speed of vibration, thereby to impart high speed vibratory motion of appreciable amplitude to the spider or main support 24 and to anything which is rigidly attached thereto.

Positioned above and rigidly attached to said spider or main support 24 is a support and cover plate 32 which is removably attached by nuts and bolts 33. The cover plate 32 is provided with a central opening 34 which in turn is closed by a removable plate 35. The opening 34 provides access to the interior recess or cavity 12 of the main frame 11 and thus provides access to the hereinafter described electro-magnetic motor mechanism. Adjacent its bottom peripheral edge the plate 32 carries a circumferential angle member 36 which is removably attached thereto by screws 37, to the vertical flange of which angle member 36 is removably attached a rubber apron 38, the lower edge of which fits into a circumferential groove 39 in the top portion of the main frame 11.

It is thus to be seen that a complete enclosure is provided by the main casting 11, the support and cover plate 32 and the apron 38, thus completely housing and protecting all the operating mechanism therein contained while providing for relative vibratory motion between the support and cover plate 32 and the main frame 11. The support and cover plate 32 also carries a plurality of centering and retaining lugs 40 having rigidly attached threaded shafts 41 which are screw-threaded into said plate 32, the tops of the lugs having wrench receiving recesses to provide for their insertion and removal. As clearly illustrated in Fig. 1 of the drawings, the lugs 40 are effective to center the container or barrel 10

and to maintain it on said plate 32 while receiving the vibratory motion to pack the material contained therein.

To supply power for the periodic deflection of the sets of leaf springs 14 and as a consequence to provide for the vibration of the support or cover plate 32, I provide within the opening or excavation 12 of the main frame 11, four continuous circuit, or non-make-and-break type, electro-magnetic type of vibratory motors which include the leaf springs 14 as an integral part thereof. In addition to said leaf springs 14, each of said motors comprises a vibratory armature 42 preferably built up of laminated magnetic steel carried by an appropriate frame 43 by transversely extending bolts 44, which frame 43 is adjustably supported at opposite ends by adjusting screws 45, 45 threaded through wings 46, 46 (see Figs. 4 and 7) extending laterally from the legs 25 of the spider or main support 24. The wings 46 are split, as illustrated in Fig. 4 of the drawings, and are provided with clamping screws 47 whereby said adjusting screws 45 may be clamped in any position of adjustment. It is thus obvious that each of the armatures 42 may be adjusted to any desired position and clamped rigidly in said position with respect to the spider or main support 24, there being an armature 42 positioned laterally of and adjacent each set of leaf springs 14. Positioned below each of the armatures 42 is a field structure 48 comprising a U-shaped core 49 built up of laminated magnetic steel and clamped rigidly to a frame 50 which is rigidly bolted to the bottom of the main casting 11 by bolts 51. Each of the legs of the core 49 carries an energizing coil 52 held rigidly in place between insulated boards 53, 53 by tie bolts 54.

An appropriate electrical cable 55 is attached to the main casting 11 by a fitting 56 (see Fig. 1) and extends through an appropriate bore 57 (see Figs. 6 and 7) to the recess or cavity 12 in said main casting 11, thus providing for connection to all of the field coils 52. It may be stated that the field coils 52 may be connected in various ways, depending upon the voltage available, since each coil is preferably wound for a fixed voltage, such as 110 volts. In certain instances they will be connected all in parallel, in other instances in parallel in groups of two, and still others in parallel in groups of four, and in still others all in series.

It will be evident that when an undulating, alternating or pulsating current is supplied to the windings 52, an electro-magnetic force will be set up and each of the cores 49 will attract each of the armatures 42. The armatures will all be attracted simultaneously and in synchronism and when attracted will deflect simultaneously the four sets of leaf springs 14 at their centers downwardly.

Due to the alternating character of this electro-magnetic force the armatures will be effectively released during each alternation of the current, as a consequence of which the energy stored up in the deflected leaf springs 14 will be released to move the armatures 42 away from the cores 49. In other words, the electro-magnetic impulses will be effective to move the spider or main support 24, and with it the cover plate or support 32, downwardly, and the resulting energy stored up in the sets of leaf springs 14 will be effective to move said elements upwardly. As a consequence, upon the energization of the coils 52 from an undulating, alternating or pulsating

current source, the support or cover plate 32 will be vibrated. In practice I prefer to energize said coils 52 either from a source of commercial available alternating current of twenty-five, thirty, fifty or sixty cycles per second, or to energize said coils 52 from mixed current as taught by the patent to James A. Flint, No. 1,846,326, granted February 23, 1932, or from rectified alternating current.

Where the coils 52 are energized from alternating current, the frequency of vibration of the support or cover plate 32 will be twice the frequency of the alternating current source. For example, there will be one hundred and twenty vibrations per second if the available alternating current has a frequency of sixty cycles per second. This is particularly desirable because of the complete elimination of auxiliary apparatus and can be used with the smaller size barrel packers. With the larger size barrel packers, however, it is preferred to use the mixed current and in this instance the frequency of vibration of the support or cover plate 32 is the same as the frequency of the source of current. I also contemplate the use of rectifiers to provide pulsating current from alternating current in a well known manner, in which case the frequency of vibration of the support or cover plate 32 will be the same as the frequency of the source.

While it is not essential to the operation of the device comprising my invention, great economy in the consumption of power is realized by providing a tuned or resonant relation between the natural period of vibration of the vibratory system comprising the support or cover plate 32 and the spider or main support 24 and all elements which are rigidly attached to either of them, and the operating frequency of the device. In other words, great economy is realized by bringing the mechanical vibratory system into approximate resonance with the frequency of vibration thereof. I have found, however, that exact resonance of the above-mentioned type is not desired because then the device is entirely too load-responsive. In other words, when exact resonance is realized the amplitude of vibration tends to decrease as the load in the container or barrel is increased, and when the current supplied the device is a maximum, as for example where the control rheostat I propose to use is substantially completely cut out, there may be a tendency for the armature to strike the core 49 and thus damage the equipment. I therefore propose to make the natural period of vibration of the above-mentioned vibratory structure only slightly different from the operating frequency. For example, if the operating frequency is sixty cycles per second, I propose to set the natural period of vibration at a value between fifty-five and fifty-nine cycles per second or between sixty-one and sixty-five cycles per second. This may be done by proper calculation of the number, length or thickness of the heavy, strong leaves 15, and small variations may be made by adjusting the clamping action of the clamp screws 21 or set screws 31.

It may additionally be pointed out that with the device comprising my invention, the amount and weight of material in the container or barrel 10 has substantially no effect upon the natural period of vibration of the vibratory structure. This is believed to be due to the fact that the device vibrates at a very high frequency and consequently the load represented by the barrel 10 and any material therein is a "live" load. That is, it does not continuously rest on the plate 32

or ride up and down therewith but is effectively suspended in air by the repeated high frequency impulses or blows which it receives from the plate 32. This appears to be explained by the fact that the plate 32 has a downward movement which is greater than the downward movement of the container 10, as a consequence of which the container 10 does not ride down with the plate 32.

It is to be particularly noted that the overall height of the device is relatively very small, particularly in view of the great weight it can vibrate. This is due largely to the fact that the electro-magnetic elements of each of the four vibratory motors, or the four units of the quadruple motor, are formed by placing the sets of leaf springs 14 of said motors or units and the cooperating armatures 42 and field structures laterally of each other, with the common spider or main support 24 rigidly connecting said armatures 42 with the centers of said leaf springs 14.

As above mentioned, it is also to be noted that the electro-magnetic mechanism of the motors or units is completely enclosed within the recess or cavity 12 of the cup-shaped main frame 11, thereby affording complete protection thereof from the elements.

The sets of leaf springs 14 are also completely protected by the main frame 11 yet the leaves 15 of said leaf springs 14 are readily removable for inspection and renewal.

It is also to be noted that the frequency of vibration of the device has a predetermined relation to the frequency of the available source, and is always a multiple of it, it being understood that the multiple may be one (1) or any integer.

In order to prevent the transfer of any vibratory motion in the main frame 11 to the floor or foundation upon which the device is supported, said main frame 11 is preferably supported upon four coil springs 57 which may be centered on the floor 58 by centering plates 59.

In the operation of the device comprising my invention, the container or barrel 10 is placed above the support or cover plate 32, as illustrated in Fig. 1 of the drawings. The device is then placed in operation by closing an appropriate switch leading thereto, and the amplitude of vibration is adjusted by an appropriate control rheostat or other equivalent device. With the barrel 10 in vibration, material is fed to it which is to be packed, a typical example of which is a chemical salt. The alternating, undulating or pulsating current flowing through the coils 52 of the four electro-magnetic motors will provide periodic deflection of the leaf springs 14 at their centers and the periodic release of said leaf springs. The deflection of said leaf springs under the influence of the electro-magnetic impulses will be vertically downward, and when released said leaf springs will move vertically upward at their centers. As a consequence there will be a vertical vibratory motion imparted to the spider or main support 24 and to the support or cover plate 32, in synchronism with electro-magnetic impulses which will be either equal to or twice the frequency of the available source of alternating current as previously pointed out. This high frequency vibration of the support or cover plate 32 will effect a very thorough packing of the material in the container or barrel 10.

As was also above pointed out, due to the close setting of the natural period of vibration of the vibratory structure and the operating frequency which is equal or twice the frequency of the avail-

able source of alternating current, very appreciable economy in the consumption of power is realized while at the same time providing for the proper control of the device so that it will not hammer or strike when there is a light load on it and so that the vibrations will not be damped out or appreciably reduced in amplitude as the load increases. In other words, by this correlation of the mechanical and electrical elements, great economy is realized without a sacrifice of control, and the amplitude of vibration and consequently the packing action upon the material in the barrel 10 will be substantially the same whether the barrel is nearly empty or nearly full or in any intermediate condition.

It is to be noted that the positioning of the four sets of heavy leaf springs 14 distributes the static load thereon caused by container 10 and its contents, which would tend to deflect or bend them downwardly beyond their neutral positions, and, in fact, said four heavy leaf springs 14 have such strength that they resist the mentioned tendency to deflect, even under a heavy load, to such a great degree that no appreciable deflection thereof due to such static load, even when very heavy, is perceptible.

However, by the application of high frequency electro-magnetic impulses, particularly when applied substantially in synchronism with the natural period of vibration of the mass to be vibrated including the mechanism mounted on the heavy leaf springs 14, vibrations of appreciable amplitude are built up at the centers of said leaf springs 14 which cause them to be deflected substantially equally on opposite sides of their horizontal or normal positions, yet do not allow the striking of the armatures 42 and cores 49. As a consequence of the above described vibratory movement a minimum amount of electric power is required, consistent with proper control.

It is furthermore again to be pointed out that the entire operating mechanism is totally enclosed and thus fully protected from the elements. It should additionally be pointed out that access to the opening or excavation 12 in the main frame 11 whereby access may be had to repair the motors including the armature or field structure, is not only afforded by the removable plate 35 but also is afforded from the bottom of the casting 11 by a bottom removable plate 60 removably held in place by appropriate screws. The plate 60 is also provided with brackets 61 which clamp the feeders of the cable 55 to said plate 60.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and I therefore wish not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of my invention, what I desire to secure by Letters Patent of the United States is:

1. In a vibratory motor, the combination with a main frame, of a vibratory frame, a plurality of groups of stacked spring leaves comprising not less than three groups, means attaching said frames to each group of spring leaves, and electro-magnetic means for vibrating said vibratory frame including separate field structures and armatures for each group of stacked spring leaves spaced laterally and inwardly thereof.

2. In an electric vibratory motor, the combination with a main frame, of a vibratory frame, a plurality of bars attached to said main frame and vibratory frame and mounting the latter for vibration relative to the former, said bars forming said attachment at a plurality of spaced apart stations and being attached to one of said frames at both ends and to the other at their centers, a plurality of separate armatures and electric field structures at least equal to the number of stations, said armatures being rigidly attached to said vibratory frame and being under the influence of said field structures, said armatures and field structures being positioned laterally of said bars thereby providing a powerful motor of restricted height.

3. In an electric vibratory motor, the combination with a main frame, of a supplementary frame to be vibrated, a plurality of groups of stacked spring bars, each group being attached at opposite ends to one of said frames and at their centers to the other whereby said supplementary frame is supported from said main frame for vibratory movement, electro-magnetic means, one for each group of stacked spring bars, each including an armature and a field structure one of which is attached to said main frame and the other to said supplementary frame, said electro-magnetic means being positioned laterally of said groups of spring bars, whereby a powerful motor of restricted height is produced.

4. In an electric vibratory motor, the combination with a main frame, of a supplementary frame to be vibrated, a plurality of groups of stacked spring bars, each group being attached at opposite ends to one of said frames and at their centers to the other whereby said supplementary frame is supported from said main frame for vibratory movement, electro-magnetic means, including an armature and a field structure one of which is attached to said main frame and the other to said supplementary frame, said electro-magnetic means being positioned laterally of said groups of spring bars, whereby a powerful motor of restricted height is produced.

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