United States Patent

[11] **3,572,641**

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[54] **ROTARY VIBRATOR WITH ADJUSTABLE WEIGHT MEANS**
4 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **259/1,** 74/61, 74/87
[51] **Int. Cl.** **B06b 1/16**
[50] **Field of Search** ..... 259/1, (Digest), 42; 74/61, 87

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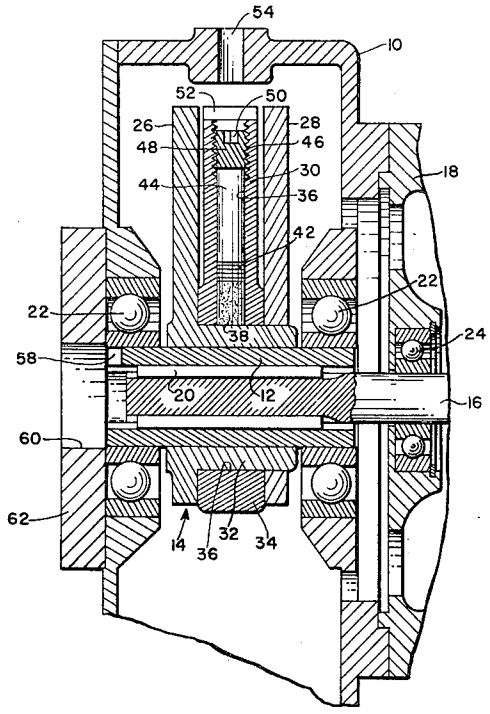
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Primary Examiner—James Kee Chi
Attorney—Harold M. Knoth

ABSTRACT: A rotary vibrator of the eccentric weight type has its weight means comprised of at least two separate parts that are relatively angularly positionable selectively about the shaft axis so as to enable selection of the amount of unbalance and thus to achieve variation in the vibratory forces, all without requiring dismantling and reassembly of the machine.



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2 Sheets-Sheet 1

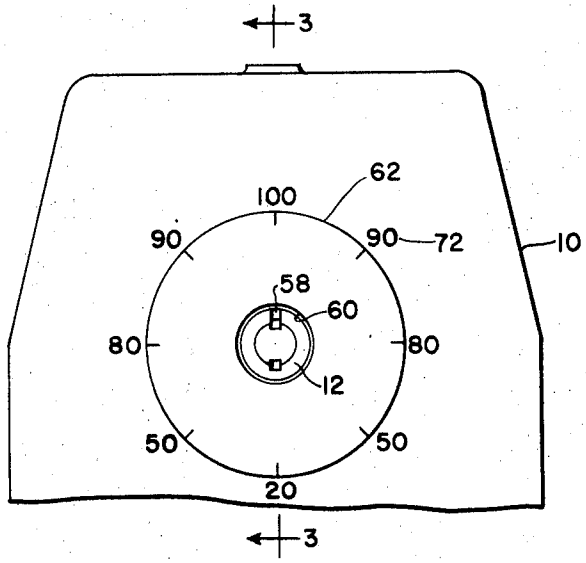


FIG. 1

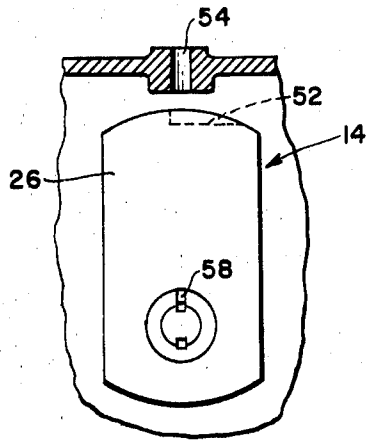


FIG. 2

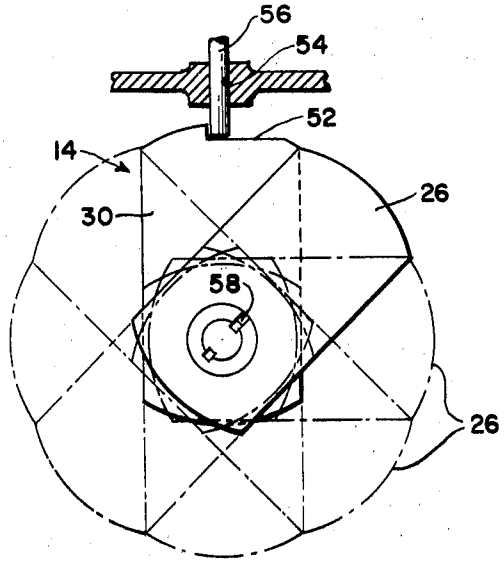


FIG. 3

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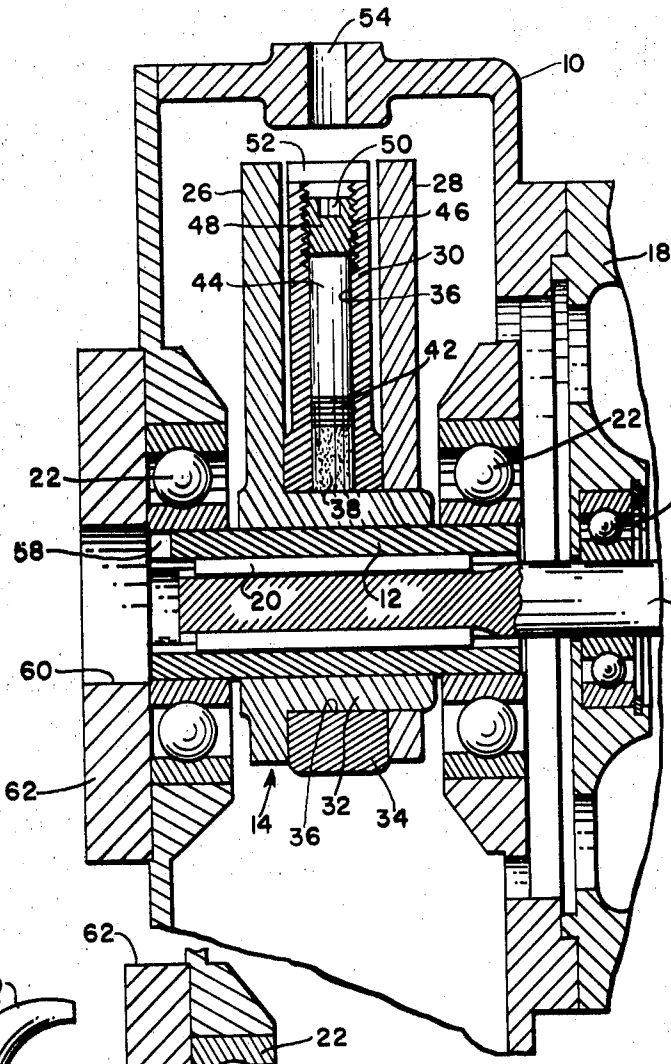


FIG. 4

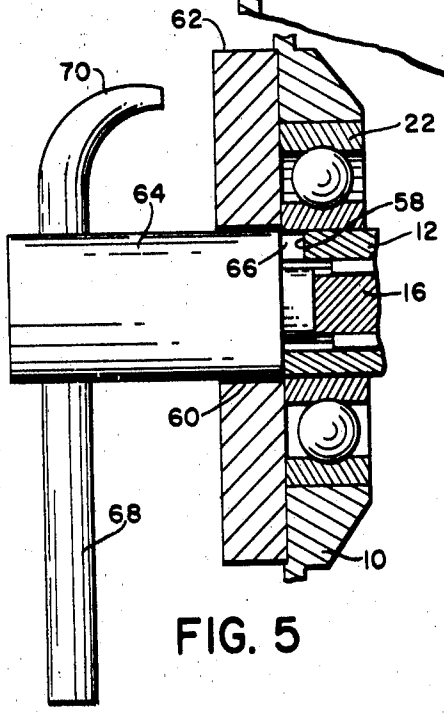


FIG. 5

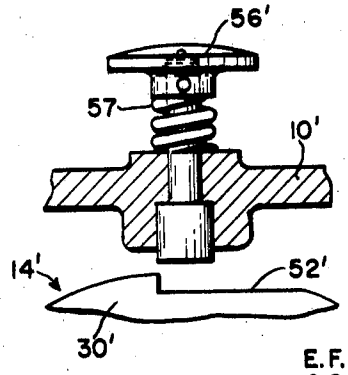


FIG. 6

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ROTARY VIBRATOR WITH ADJUSTABLE WEIGHT MEANS

BACKGROUND OF THE INVENTION

The use of vibrators in the field of materials handling and for other purposes is well known. A typical rotary vibrator consists of a support or casing that may be clamped to an object to be vibrated, a rotary shaft and a weight eccentric to and rotatable with the shaft for creating the vibratory forces. Normally the size of the weight is selected on the basis of the task to be performed, and this presents several disadvantages. A large weight requires a comparably high capacity driving source, especially when one considers the starting torque required to start the shaft and weight from a dead stop. Further, if the size of the task to be performed becomes greater or less, it is necessary to change to another vibrator or to dismantle and reassemble the one in use so as to obtain the correct weight size. This also affects the driving motor. Other factors entering into the need for easy selection of weight masses grow out of the type of mounting of the vibrator as a whole; that is, if the object on which it is mounted is fairly rigid, elliptical orbit is relatively small or even nil, but if the mount includes, for example, a long resilient member, elliptical orbit increases. Moreover, changes in forces may become desirable during vibration of one object, as where forces at the beginning are required to be different from later forces.

SUMMARY OF THE INVENTION

The present invention provides significant improvements in known vibrators because the weight means is divided so that one part thereof may be adjusted angularly relative to the other, thus yielding selective and retainable variations in unbalance of the weight means as a whole. This may be accomplished without dismantling the vibrator, because means are provided for temporarily holding one weight element while adjusting the other, the elements being mounted to the shaft in such manner that they both rotate normally with the shaft but, when one weight element is held, the other may be forcibly turned, and the adjustment will be maintained during further normal rotation of the shaft and weight means. To augment the feature of selective adjustment, one weight element may be temporarily held, as by locking it to the vibrator support or casing while the other is turned by a tool provided for that purpose. Still further, the casing may be provided with indicia, visible externally, so that the person making the adjustment knows precisely the amount of unbalance he is selecting. The mounting of the separate weight parts or elements utilizes a force fit for one element and a frictional fit for the other, together with means for varying the force on the frictional means, construction of the weight element so that the mounting means is contained therewithin and utilization of a weight structure in which one element comprises a pair of parts spaced axially apart on the shaft and the other element is disposed between the parts, thus providing a compact construction.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary elevation showing the external appearance of a typical vibrator embodying one form of the invention;

FIG. 2 is a sectional view showing the weight means at full unbalance;

FIG. 3 is a similar view, but shows how one weight element may be temporarily held while unbalance adjustments are made, the dotted lines showing several representative positions of the other weight element;

FIG. 4 is an enlarged section on the line 3–3 of FIG. 1;

FIG. 5 is a fragmentary section showing the addition of a rotating tool to the structure of FIG. 4; and

FIG. 6 is a fragmentary sectional view showing a modified form of means for temporarily locking the one weight element to the casing or support.

DESCRIPTION OF PREFERRED EMBODIMENTS

The vibrator selected here for purposes of illustration typically includes a support or casing **10**, a rotary shaft **12** and weight means **14**. Not shown are means by which the casing may be secured to an object to be vibrated. Such means are well known and need no elaboration here. Examples occur in the U.S. Pat. Nos. 3,134,564 and 3,237,896 to Peterson. These mountings serve, in effect, to make the vibrator a temporary part of the object to be vibrated.

The shaft **12** may be tubular and keyed to and driven by a power shaft **16** of a conventional power source **18**, which may be an air or electric motor. A pair of driving keys are shown at **20**. The shaft **12** is suitably journaled in the casing **10** by bearings **22**, and a coaxial bearing **24** carries the motor shaft **16**. For the moment, the weight means may be regarded as carried by the shaft for rotation therewith and its mass is of course eccentric to the shaft axis so that rotation creates vibratory forces because of the unbalance. In the attitude of the weight means as shown in full lines in the drawing, the unbalance is substantially 100 percent, because the total basic mass lies on one radius extended from the shaft axis.

The weight means is made up of a pair of weight elements, one comprising a weight part **26** and a companion weight part **28** and the other comprising a central weight element **30**. The weight part **26** has a tubular hub **32** force fitted to the shaft **12**, and the weight part **28** is bored and force fitted to the hub in axially spaced relation to the mass of the weight part **26** so as to leave a space between the two parts which accommodates the central weight part or element **30**, which has a central or hub portion **34** bored to fit the hub **32**. In this arrangement, and because of the interference fit between the hub **32** and the shaft **12**, the former becomes essentially a part of the shaft and may be broadly regarded as such with reference to the relative adjustability of the two weight elements **26—28** and **30**.

The element **30** is in the form of an arm extending radially of the shaft **12** and has an interior radial or lengthwise bore **36** that forms a recess for housing means for mounting the element **30** to the shaft **12**, here via the hub **32**. This mounting means is basically of such construction as to cause the weight element **30** to turn normally with the shaft but permits forcible angular movement of that element relative to the two-part element **26—30**. In a preferred construction, this mounting means includes an inner or shaft-proximate portion **38** of suitable friction or like material of any type, such as phenolic asbestos material commonly employed as brake lining etc. Superimposed on this portion or material **38** is biasing means **42** of any adequate character, such as a stack of Belleville spring washers, and this stack or biasing means is engaged by a compression rod or member **44**.

The outer or shaft-remote end of the weight element recess or bore **36** opens as an interiorly threaded counterbore **46** which receives a threaded adjusting member **48** having a recessed wrench receiving portion **50**. The member **48** may be a conventional Allen head screw. It will be apparent that the screw may adjust the force on the biasing means **42** by means of the rod **44**, thus adjusting the frictional ability of the means **38**. This means may be, as a variation of the material noted above, of any material that will not gall the hub **32**, because galling would create a tendency of the weight element **30** to affix itself to the hub and thus prevent angular adjustment.

The outer end of the weight element **30** is provided with a notch **52**, and this forms part of the means whereby the two weight elements may be relatively angularly adjusted. The mounting means described above enables the retention of the selected adjustment, because that means has the capacity of retaining the adjusted position of the weight element **30** during normal rotation of the shaft means **12**.

A further part of the adjustment means comprises a part of the support or casing, preferably a top part; although, this does not limit the invention. Such top part may be provided with an aperture **54** through which a suitable tool or the like

56 (FIG. 3) may be temporarily inserted to engage in the notch 52 and thus to temporarily lock the weight element 30 to the casing 10. The outer or motor-remote end of the shaft 12 has a radial-axial notch 58 therein which opens axially through a coaxial opening 60 in a gauge plate 62 affixed to the near face of the casing 10. While the weight element 30 is temporarily locked to the casing 10 as by a tool or rod 56, a second device or tool 64 is coaxially inserted through the plate opening 60 and has a projecting lug 66 which fits the shaft notch 58. This tool has a handle 68 including a pointer 70 for cooperation with externally readable indicia 72 on the plate 62 (FIG. 1).

This indicia is shown here, by way of representation only, as including numerical representations of unbalance in percentages; but it is clear that any other indicia may be used and that these will vary according to the particular weight masses of the elements 26—28 and 30. For example, as shown here, the weight element 30 has a mass that is not totally equal to that of the element 26—28, so that when the two elements are in register the total mass is so related to the shaft axis as to give substantially 100 percent unbalance (disregarding the element portions diametrically opposed to the major portions of the elements), but when angular adjustment is made, the percentage of unbalance per amount of angular adjustment depends initially upon the relative weight masses. It should also be observed that the percentages change similarly in each 180° of adjustment; i.e., they repeat themselves, because it is broadly immaterial whether one element leads or lags the other. Since the indicia may vary according to the relative masses of the weight elements selected, such indicia may be regarded generally as means enabling the user to repeat prior settings; although, it is obvious that the indicia may be calibrated if desired.

FIG. 6 shows a modified means for temporarily locking the intermediate weight element to the casing, and similar numerals, but primed, are used to illustrate the modification. For example the casing 10′ has a bore which carries a detent 56′ normally spring loaded at 57 for disengagement from a notch 52′ in the intermediate weight element 30′ of a weight means 14′. This detent may be depressed and held down to engage the notch 52′ when adjustment is to be effected. A tool such as that at 64 may be used to turn the shaft and other element relative to the temporarily locked element.

The notch 58 in the shaft 12 is so provided as to register with the radial extent of the two-part weight element 26—28, and the pointer 70 on the tool 64 is radially aligned with the tool lug 66. Since the weight element 30 can be engaged by the rod 56 or detent 56′ in only its upper position (as shown here), the pointer 70 will shown on the indicia 72 the relative angular position of the weight element 26—28. For example, the element 30 is lockable only at the "100" position. If the two weights are in radial register, the pointer 70 will point to 100. If not, the pointer will point at some other position to show the amount of angular offset of the weight elements and thus their relative unbalance.

Also to be observed is that with the weight element in register with the opening 54, a suitable wrench may be inserted to adjust the screw 48.

In operation, and assuming that the weight means 14 is set so that both elements are in radial register, the result is maximum (100 percent) unbalance. Should the user desire to make a change, he shuts off the motor 18 and uses the tool 64 to turn the weight means and shaft 12 manually, here in a clockwise direction while inserting the rod 56 (or depressing the detent 56′) until the notch 52 (or 52′) is engaged so as to temporarily lock the weight element 30 against turning (at least in a clockwise direction). He then, by applying manual torque to the inserted tool 64, turns the shaft 12 and its mounted weight element 26—30 in a clockwise direction until he has achieved the desired angular adjustment (change in unbalance as respects the shaft axis). The frictional mounting means, as stated above, will retain the new position so that normal rotation does not change the selected positions of the elements. At any time, the motor may be shut down and new positions obtained. It should be noted that an infinite number of positions may be achieved, irrespective of the indicia 72, since the adjustability is stepless because of the frictional mounting of the weight element 30 on the shaft 12 (hub 32).

We claim:

1. A vibrator comprising a housing, a shaft journaled within the housing and an eccentric-type weight means carried by the shaft within the housing, said housing including wall means radial to the shaft axis and peripheral wall means joined to the radial wall means and surrounding the shaft and weight means so that both said wall means substantially enclose the shaft and weight means, said radial wall means including a first opening therethrough and providing axial access to one end of the shaft and said peripheral wall means including a second opening therethrough providing radially inward access to the weight means, said weight means including a first part connected to the shaft to rotate therewith and having a radial arm extending toward the peripheral wall means and a second part also in the form of a radial arm alongside the first radial arm, friction means cooperative among the shaft and the weight parts for connecting the second weight part for normal rotation with the first weight part and shaft, said friction means being so constructed and arranged as to enable selective forcible movement of the second weight part relative to the first weight part angularly about the shaft axis so as to achieve adjustment in the unbalance of the weight mass, said second opening providing for insertion of an element to arrest rotation of the second weight means part when the vibrator is shut down and the first opening providing for insertion of a second element to engage the shaft for manual turning of same and the first weight means part relative to the arrested second part by forcibly overcoming the friction means whereby to achieve the aforesaid adjustment of the unbalance of the weight mass.

2. The invention defined in claim 1, including a tool comprising the shaft engaging element, said tool having an internal shaft engaging portion and an external radial pointer portion, and indicia on an external portion of said sidewall means cooperative with said pointer to enable reading of the angular relative adjustment of the weight means parts.

3. The invention defined in claim 1, in which the friction means includes a radial adjustable part for varying the friction relationship of the friction means to the shaft and first weight means part, said adjustable part being registrable with the second opening to enable insertion of a tool engageable with said adjustable part.

4. The invention defined in claim 3, in which the second weight means part has a radial bore therein and said friction means includes, in said bore, friction material proximate to the shaft, spring means radially outwardly of and engaging said material, a rod outwardly of and engaging said spring means, and said adjustable part is a single screw threaded into said bore outwardly of and engaging the rod.