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3,376,790

PISTON VIBRATOR

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FIG. 1

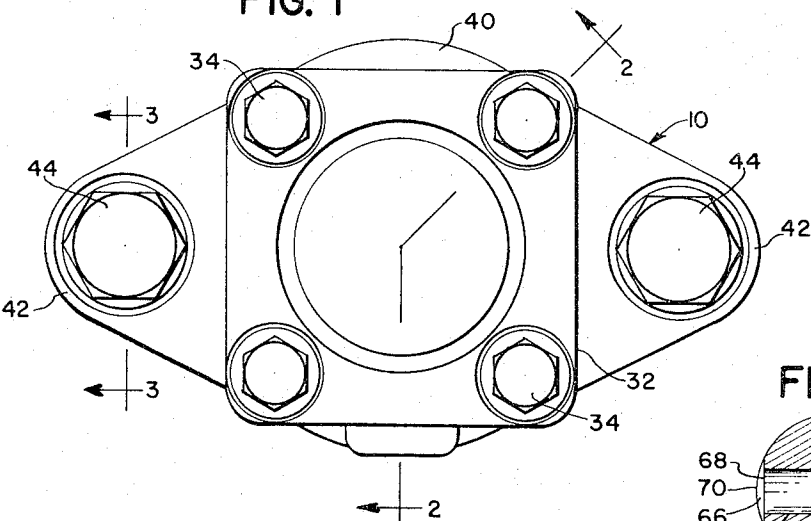


FIG. 5

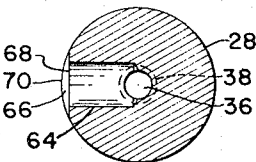


FIG. 2

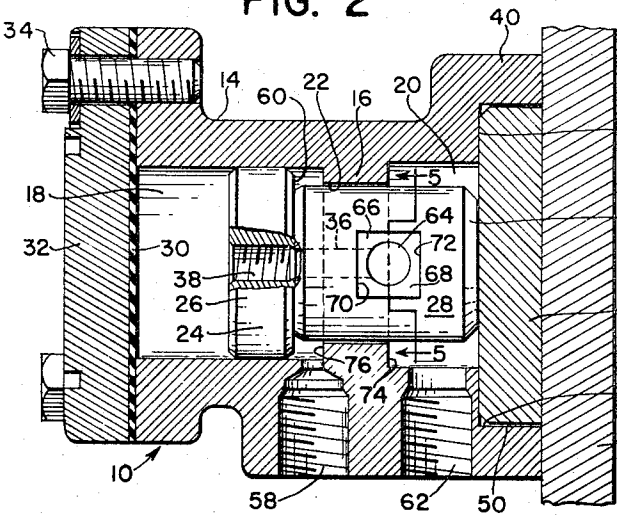


FIG. 6

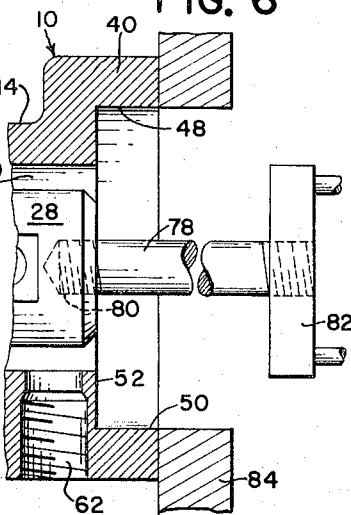
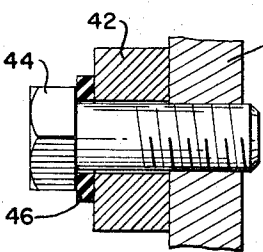


FIG. 3

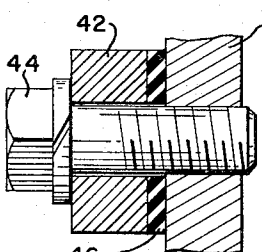


FIG. 4

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PISTON VIBRATOR

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ABSTRACT OF THE DISCLOSURE

A single-acting, fluid-pressure-operated vibrator having a cylinder divided by a centrally apertured radial wall into inlet and exhaust chambers and in which a piston reciprocates by changes in porting among the chambers and piston passages to create axial vibrations either by striking of an anvil by the exhaust-chamber end of the piston or by adjusting piston reciprocation so that the piston is fluid-cushioned at both ends of its strokes.

Background of the invention

Vibrators of the general class referred to are well known as useful tools in the field of materials-handling; e.g., for inducing the flow, settling etc. of granular, semi-fluid materials etc. as in hoppers, bins, railway cars, concrete forms and the like.

A typical device of this character, depends upon pressure differential between the opposite sides or faces of the enlarged head of the piston in the inlet chamber and further upon the interchange of piston passages between these chambers as the piston passages are alternately exposed to these chambers at opposite sides of the divider wall as the piston reciprocates. Normally, the cylinder is closed at both ends, one closure completing the inlet chamber and the opposite closure being rigidly secured over the exhaust chamber to provide an anvil against which the reduced or rod portion of the piston impacts.

One disadvantage in prior devices stems from the rigid mounting of the anvil because the shocks of the impacts are transmitted to the cylinder and shorten the life of the device. A serious disadvantage also flows from the relative criticality of the piston passages which require accurate drilling if the device is to operate efficiently and start easily. On many occasions the piston will stick because of entry of a foreign substance and it becomes necessary to remove the vibrator from its mount and to disassemble it in order to free the piston. Further, a rigidly mounted anvil minimizes the flexibility of the device because it is impossible to add extensions and the like to the piston, or even to use optional pistons. Another defect in prior devices is that they have no provision for resilient mounting to objects to be vibrated and hence they have relatively short lives because of concentrated destructive forces.

Summary of the invention

The present invention overcomes the foregoing and other disadvantages by significant improvements in porting, mounting, arrangement of anvil, removability of piston and increased flexibility of function. As to porting, critical drilling operations are eliminated by resort to a simple machine operation, such as milling, grinding, etc., whereby a recess or slot is cut into the cylindrical surface of the piston to provide sharp, clean-cut porting edges cooperative with opposite faces of the divider wall and the inlet and exhaust chambers. The anvil is disposed in a floating relation to the cylinder so as to isolate shock forces from piston-anvil impacts. Further, the device is additionally isolated from shock forces by means of improved resilient mountings. The anvil is removable to expose or open the end of the exhaust chamber so that axial extensions may be added to the piston or different-

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length pistons etc. may be employed. Removability of the anvil is further exploited by the use of anvils of different axial thicknesses, whereby to vary the intensity of the impact force. Additional features will appear as the disclosure develops.

Brief description of the drawing

FIGURE 1 is an end view of the device;
FIGURE 2 is a section on the line 2-2 of FIGURE 1;
FIGURE 3 is a fragmentary section on the line 3-3 of FIGURE 2, showing one form of resilient mounting;
FIGURE 4 is a similar section, showing another resilient mounting;
FIGURE 5 is a section on the line 5-5 of FIGURE 2; and
FIGURE 6 is a fragmentary section showing a piston extension.

Description of preferred embodiments

The vibrator as a whole bears the numeral 10 and is shown in association with a representative object 12 to which vibrations are to be imparted for any known purpose. The vibrator comprises a metal cylinder 14 having intermediate its ends an integral radial wall 16 that divides the cylinder 14 into inlet and exhaust chambers 18 and 20 respectively. This wall has a central circular bore or opening 22, and a piston 24 is reciprocable in the cylinder, having an enlarged head portion 26 in the inlet chamber 18 and an integral reduced or rod portion 28 extending slidably through the wall opening 22 and into the exhaust chamber 20.

The left hand end of the inlet chamber 18 is closed by a gasket 30 and cap member 32 that is removably secured to the cylinder by cap screws 34. The piston head 26 has an axial blind passage 36 opening to the inlet chamber 18 at the head 26, at which portion the passage is preferably tapped at 38 to provide means into which a suitable tool (not shown) may be threaded to facilitate axial removal of the piston when the end cap 32 and gasket 30 are removed, as in instances when the piston becomes stuck because of entry of foreign matter, etc. Such removal can be accomplished without removing the vibrator 10 from the object 12.

The end of the cylinder 14 toward the object 12 has an integral enlarged portion 40 which includes a pair of apertured mounting lugs 42 through which cap screws 44 are passed and threaded into the object 12. Resilient mounting of the vibrator may be achieved in several ways, as by interposing rubber washers etc., as at 46 between the cap screws 44 and lugs 42 (FIGURE 3) or between the lugs 42 and the object 12. If desired, the washers may be used at both sides of the lugs. Other resilient means may be employed to free the vibrator from excessive shock forces occurring during operation.

The enlarged end 40 of the cylinder 14 has an internal, annular, coaxial recess 48 that includes a circumferential surface 50 and an annular radial shoulder 52 forming a junction between the surface 50 and the proximate end of the exhaust chamber 20. This recess 48 relatively loosely receives an anvil 54, here circular to fit the recess in such manner that the anvil may have limited axial movement relative to the cylinder 14. Also as shown here, the axial dimension or thickness of the anvil is such that its radial face away from the exhaust chamber 20 or toward the object 12 abuts the object.

The terminal end of the piston portion 28 forms a striker 56 that strikes successive blows against the anvil as the piston reciprocates. The forces of these blows or impacts are of course transmitted to the object 12.

Since the anvil 54 is easily removable from the recess 48 when the vibrator 10 is dismounted from the object, it may be replaced by other anvils of different thicknesses,

thus enabling the user to vary the length of the piston stroke and thus the magnitude of the impact forces. As will be brought out later, variation in piston stroke may also be achieved by regulating inlet pressure at the fluid pressure inlet 58 that leads to the inlet chamber 18 between the cylinder radial wall 16 and the near side of the piston head 26 to act on what may be termed an annular lift area 60 on the piston head. The fluid pressure medium is preferably compressed air fed to the inlet port 58 and leaving the exhaust chamber 20 via an exhaust port 62.

The novel piston passage means provided according to the invention includes the axial piston passage 36 previously described, a radial connecting passage 64 and a recess 66 transversely intersecting the cylindrical surface of the piston portion 28 and providing preferably a flat bottom or face 68, at which the radial piston passage 64 opens, and a pair of sharp, clean-cut porting edges 70 and 72 that are axially spaced apart a distance substantially equal to the thickness of the cylinder divider wall 16. The recess may be easily cut into the piston surface by any suitable machining operation, preferably by milling or grinding. As shown here, the flat recess bottom 68 lies in a plane parallel to the piston axis and including a chord of the cylindrical surface of the piston portion 28. Significant advantages of the recess 66 over a pair of spaced holes are that the recess may be easily and accurately formed, it provides the sharp accurate porting edges 70 and 72, and is far less costly than drilling two holes because such drilling operations are relatively critical and must be carefully set up and constantly checked for tolerances etc. Drilling the single hole for the radial passage 64 is not a critical operation because the valving function of the piston is taken care of by the porting edges 70 and 72.

The piston 24 is shown at impact position in which the porting edge 72 is at its maximum position beyond the proximate face 74 of the wall 16, thus exhausting the inlet chamber 18 at the left side of the piston head 26 via 36-64-66. The inlet porting edge 70 lies between the wall faces 74 and 76 and is thus cut off from the inlet pressure port 58. However, inlet pressure is still applied to the piston lift area 60, causing the piston to move to the left or away from the anvil 54. Ultimately the inlet porting edge 70 moves to the left of the wall face 74 and pressure fills the inlet chamber 18 via 66-64-36, acting on the large piston head area to drive the piston to the right or on its impact stroke. It will be clear of course that, during the leftward or return stroke of the piston 24, as the porting edge 70 moves to the left of the wall 16 to complete the passage 66-64-36 to the inlet chamber 18, the other porting edge 72 will move to the left of the wall face 74 and will thus be cut off from the exhaust chamber 20 so that no pressure escapes in that direction.

As the piston reciprocates on alternate impact and return strokes, the porting edges 70 and 72 are alternately exposed and cut off by their respective wall faces 76 and 74, creating a valve action that keeps the piston going so long as pressure is applied at the inlet 58. As is well known in the art, regulation of the pressure at the inlet enables the user to vary the speed and stroke of the piston and thus the frequency and magnitude of the impacts. As is also known in the art, the inlet chamber 18 between the piston head 26 and cylinder end cap 32 is never completely void of air during operation and there is thus created an air cushion against which the piston rebounds; i.e., the piston head 26 does not strike the end cap gasket 30. The piston may also be regulated so that it falls short of striking the anvil 54 and thus may be caused to "flutter" back and forth in the cylinder 14.

This characteristic, plus the removability of the anvil 54, enables the exploitation of the vibrator 10 for other uses, a representative one of which is shown in FIGURE 6, where, with the anvil removed, the exposed end of the piston 24 is fitted with an extension, such as a coaxial rod 78 threaded into a tapped bore 80 in the pis-

ton and carrying any suitable device 82 as for mixing granular material (not shown). The vibrator 10 may be mounted on the material container 84 in one of the fashions previously described.

Features in addition to those described will readily occur to those skilled in the art on the basis of what is disclosed here.

I claim:

1. In a fluid-pressure operated vibrator having a cylinder divided by an intermediate radial wall into inlet and exhaust chambers, said wall having a central circular opening therethrough smaller than the inside diameter of the cylinder and a piston having a head portion slidable in the inlet chamber and a cylindrical reduced portion extending slidably through the opening and into the exhaust chamber, said cylinder having an inlet port leading into the inlet chamber between the wall and the piston head portion, the improvement comprising passage means in the piston including a recess formed in the cylindrical surface of the reduced piston portion and transverse to the length of the piston and having an axial width substantially equal to the axial thickness of the radial wall to provide a pair of axially spaced apart porting edges respectively axially shiftable into and out of the chambers as the piston reciprocates, and said passage means including a first piston passage leading inwardly from the recess to the interior of the piston and a second passage communicating with said first passage and opening through the piston head portion to the inlet chamber.

2. The invention defined in claim 1 in which the recess is a machined slot having a flat bottom lying in a plane parallel to the piston axis and cutting the cylindrical surface of said reduced piston portion.

3. In a fluid-pressure operated vibrator having a cylinder divided by an intermediate radial wall into inlet and exhaust chambers, said wall having a central circular opening therethrough smaller than the inside diameter of the cylinder and a piston having a head portion slidable in the inlet chamber and a cylindrical reduced portion extending slidably through the opening and into the exhaust chamber and terminating as a striker end portion, said cylinder having an inlet port leading into the inlet chamber between the wall and the piston head portion, said piston having passage means therein communicable alternately with the exhaust chamber and with the inlet chamber between the wall and the piston head portion as the piston reciprocates and a passage communicating said passage means with the inlet chamber through said piston head portion, the improvement comprising an open end on the cylinder defining the end of the exhaust chamber remote from said wall, said cylinder having an annularly enlarged portion at said open end beyond the inside diameter of the exhaust chamber and provided with an annular recess including an annular circumferential surface of larger diameter than the exhaust chamber and an annular shoulder facing axially outwardly and forming a junction between said surface and the exhaust chamber, and an anvil having a circular part axially shiftable received in said recess and adapted to be struck by the striker end portion of the piston, said circular part of the anvil being received by said surface and abutting said shoulder.

4. The invention defined in claim 3, in which the striker end of the piston has an axial extension projecting axially beyond said open end of the cylinder when the anvil is removed.

5. In a fluid-pressure operated vibrator having a cylinder divided by an intermediate radial wall into inlet and exhaust chambers, said wall having a central circular opening therethrough smaller than the inside diameter of the cylinder and a piston having a head portion slidable in the inlet chamber and a cylindrical reduced portion extending slidably through the opening and into the exhaust chamber, said cylinder having an inlet port leading into the inlet chamber between the wall and the piston head portion, the improvement comprising a removable

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end closure member secured to the cylinder over the end of the inlet chamber remote from the wall, and the head portion of the piston includes means for receiving a tool by means of which the piston may be axially withdrawn from the cylinder when the closure member is removed.

6. The invention defined in claim 5 in which said means comprises a tapped bore in the piston head portion.

7. In a fluid-pressure operated vibrator having a cylinder divided by an intermediate radial wall into inlet and exhaust chambers, said wall having a central circular opening therethrough smaller than the inside diameter of the cylinder and a piston having a head portion slidable in the inlet chamber and a cylindrical reduced portion extending slidably through the opening and into the exhaust chamber and terminating as a striker end portion, said cylinder having an inlet port leading into the inlet chamber between the wall and the piston head portion, said piston having passage means therein communicable alternately with the exhaust chamber and with the inlet chamber between the wall and the piston head portion as the piston reciprocates and a passage communicating said passage means with the inlet chamber through said piston

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head portion, the improvement comprising an open end on the cylinder defining the end of the exhaust chamber remote from said wall, an anvil member disposed in said open end and adapted to be struck by the striker end portion of the piston, said anvil being mounted for axial movement relative to the cylinder, and means on the cylinder for resiliently mounting said cylinder on an object to be vibrated, with said anvil engageable with such object.

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