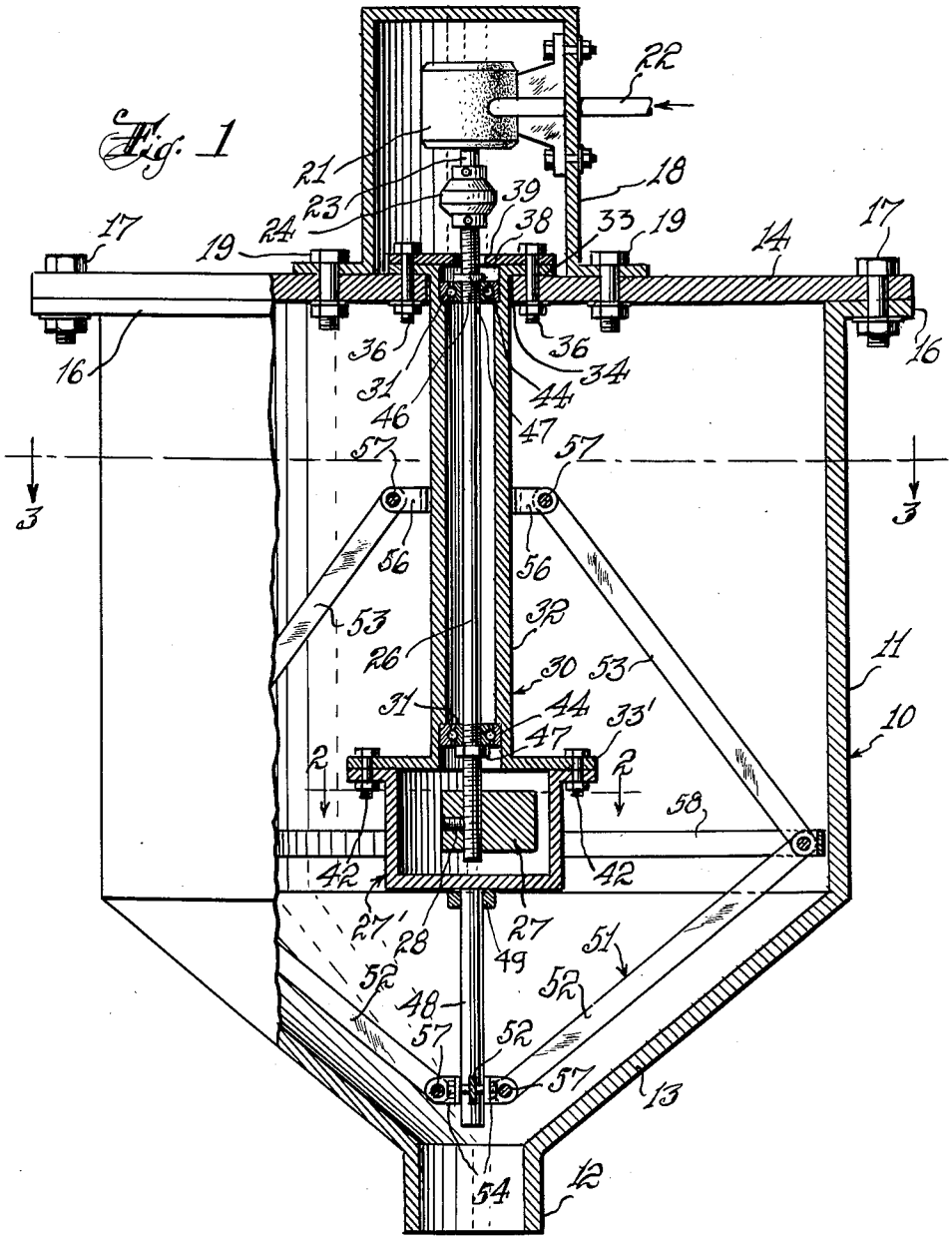
Feb. 26, 1963 E. A. WAHL 3,079,050

DISPENSER FOR STORAGE HOPPERS

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Fig. 1



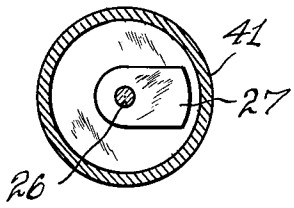
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DISPENSER FOR STORAGE HOPPERS

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Fig. 2



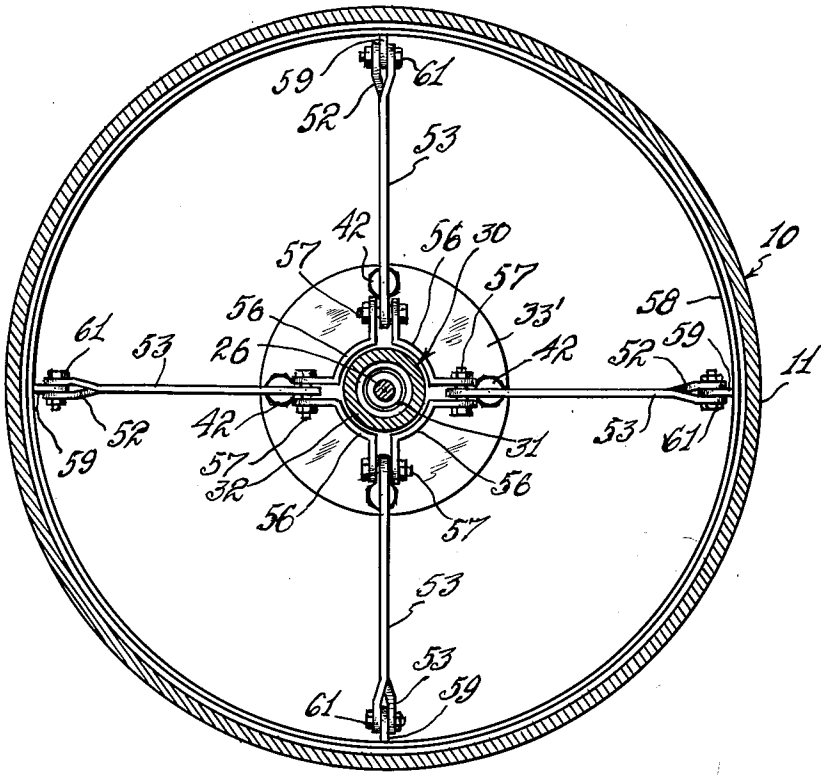


Fig. 3

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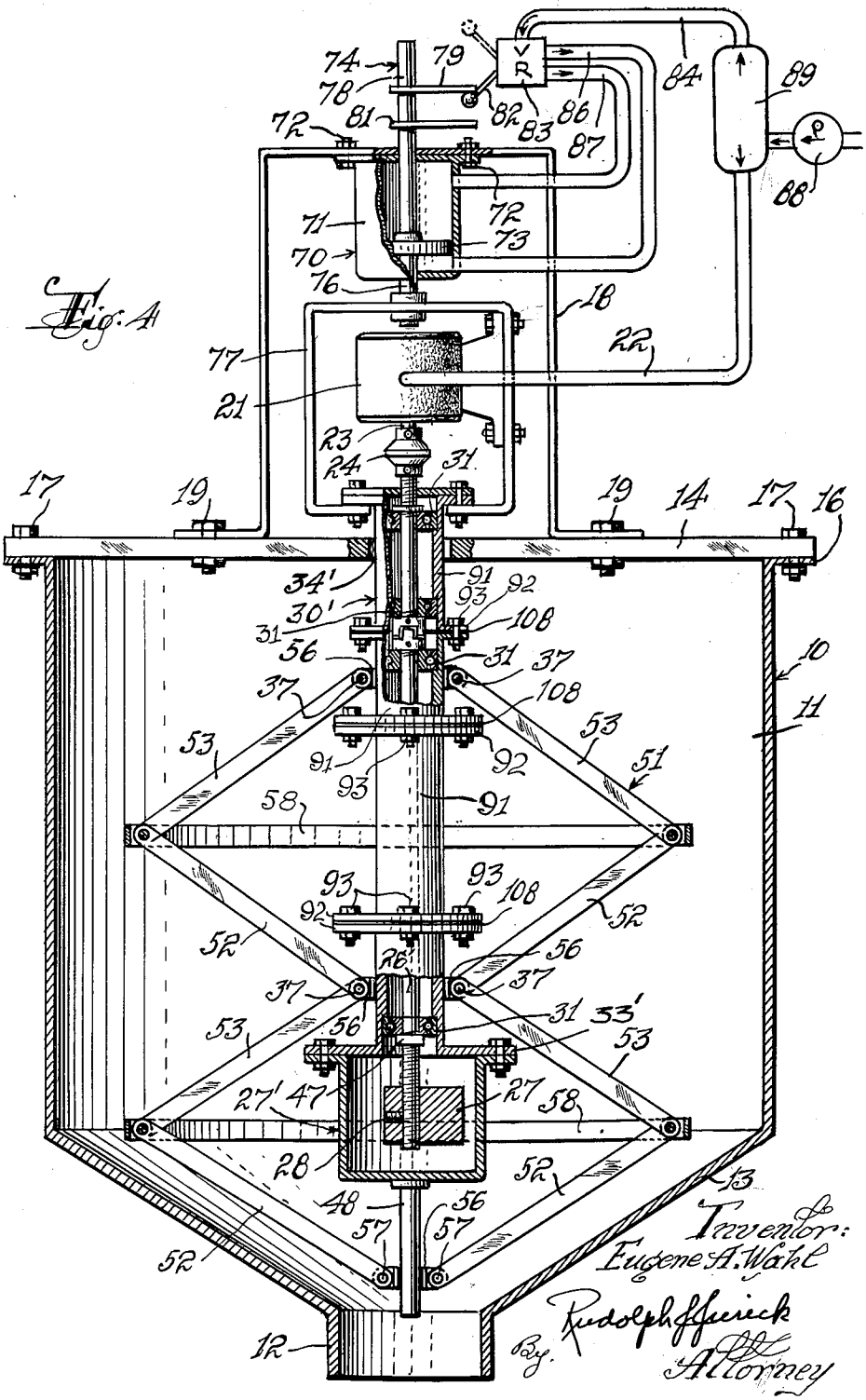


Fig. 4

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DISPENSER FOR STORAGE HOPPERS

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Fig. 6

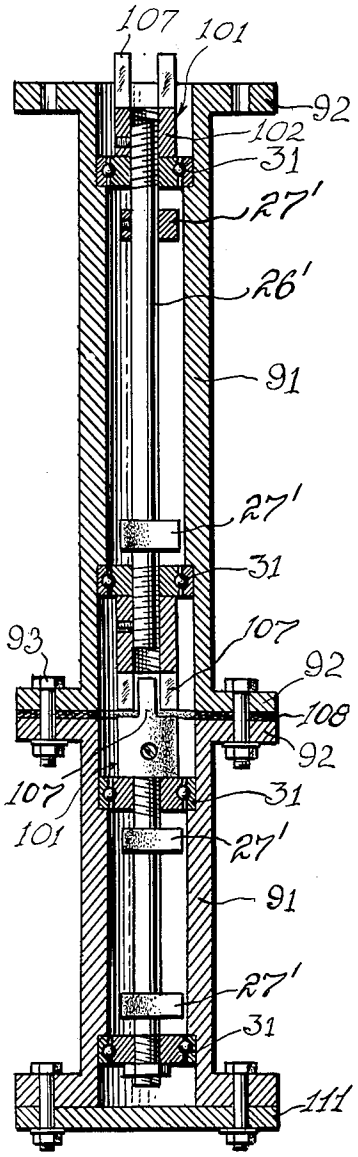
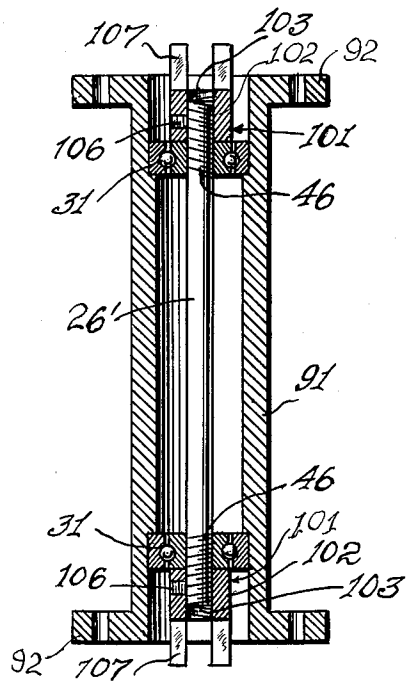


Fig. 5



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3,079,050
DISPENSER FOR STORAGE HOPPERS

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4 Claims. (Cl. 222—334)

This invention relates to a device for use with a bin or hopper for maintaining the flow of material therefrom, and more particularly to a novel dispenser device adapted to be secured to the hopper, and which extends therewithin, which activator device is vibrated and thereby applies vibratory motion directly to the material in the hopper or bin.

A common problem encountered in the handling of powdered, granular, pulverized, or the like material, is the feeding of such material from overhead supply or storage bins or hoppers since the material being handled often sticks and bridges within the hopper. Conventional means for inducing flow of material from such hoppers includes external vibrating devices, internal pulsating air pads lining the walls of the hopper, mechanically driven rotating agitators, and the like. Rotating agitators are generally impractical on hoppers of large size because of the difficulty of agitating large masses of powdered material. Also, while vibration of the hopper serves to prevent sticking and bridging of many materials, it has been found that with some material, a small amount of vibration may not be sufficient to prevent such sticking and bridging and with externally applied vibration, the structural mass and rigidity of the storage bin limits the amount of vibration that can be transmitted through the bin walls, and into and throughout the material contained within the bin.

The present invention overcomes the above shortcomings of such prior art arrangements by means of a vibrating device which extends into the hopper and which applies a high amplitude vibratory motion directly to the material therewithin rather than to the material through the hopper walls, for example. Since the activator applies the vibratory motion directly to the material, the device is equally as effective on heavy steel plate or concrete storage bins, as on light gauge steel hoppers. Further, the novel activator of my invention is adaptable to any hopper size, from a few cubic feet, to thousands of cubic feet—and to any hopper shape from round to rectangular, with steep or flat bottoms.

If desired, or necessary, a relatively slow translatory motion may be imparted to the above-described rapidly vibrating activator, and in one of the illustrated embodiments of the invention described hereinbelow, the relatively slow movement of the vibrating device is in a vertical direction, the device being slowly reciprocated with an up and down motion. As will be apparent, the rapid vibratory motion of the device may be combined with other forms of translatory motion such as a slow rotary motion, for example. The combined rapid vibratory motion of the activator and slow translatory motion thereof is especially useful for low density, fibrous materials, such as cotton linters, and the like, which materials have poor vibration transmission properties. By translating the activator, vibration is carried more readily to other regions of the bin.

In the illustrated embodiments of the invention, vibration of the device is effected by rotation of a vertical shaft extending through the device, which shaft has secured thereto one or more weights having a center of mass displaced from the axis of the shaft whereby rotation of the shaft produces transverse vibration of the device. As will be apparent, other means may be employed to impart vibratory motion to the device. Hence, in the embodiment of my invention employing an activator which is both vibrated and slowly moved, a large number of combinations of means simultaneously producing the vibrational and translational movement may be employed in accordance with my invention.

An object of this invention is the provision of an improved bridge breaker for a hopper for preventing bridging of the material in the hopper during the flow thereof from the hopper.

An object of this invention is the provision of a vibratory activator which extends into the material within a hopper for application of vibratory motion directly to the material rather than through the hopper walls.

An object of this invention is the provision of a novel activator arrangement for use in a hopper, which arrangement combines a rapid vibratory motion with a slower translatory motion to insure the flow of material from the hopper.

An object of this invention is the provision of an activator ararngement for use in a supply hopper and comprising an elongated shaft extending generally vertically into the hopper, first means axially reciprocating the shaft and second means simultaneously vibrating the shaft.

An object of this invention is the provision of an activator comprising an elongated sectionalized columnar member for use in a supply hopper which is easily assembled and which may be easily lengthened or shortened, as desired or necessary.

These and other objects and advantages will become apparent from the following description when taken with the accompanying drawings. It will be understood that the drawings are for purposes of illustration, and are not to be construed as defining the scope or limits of the invention, reference being had for the latter purpose to the appended claims.

In the drawings wherein like reference characters denote like parts in the several views;

FIGURE 1 is a side elevational view of an activator arrangement mounted on a hopper, which arrangement embodies my invention, portions of the drawing being shown broken away for clarity;

FIGURE 2 is an enlarged transverse sectional view taken on line 2—2 of FIGURE 1;

FIGURE 3 is a transverse sectional view taken on line 3—3 of FIGURE 1;

FIGURE 4 is a side elevational view, with parts broken away, of an activator having a combined vibratory and translatory motion in accordance with my invention;

FIGURE 5 is an enlarged longitudinal sectional view of one section of the vibratory tube shown in FIGURE 4; and

FIGURE 6 is a longitudinal sectional view of a modified form of vibratory tube embodying my invention.

The activator arrangement contemplated by this invention is of general utility in dry material storage, or supply, hoppers from which material is intended to flow. The arrangement includes an elongated vertical tube which extends generally axially of the hopper axis within the hopper. A framework which may include generally

radially extending arm members is secured to the tube, with the outer free ends of the arms terminating a spaced distance from the hopper wall. Means are included for vibrating the tube and attached framework in the hopper whereby maintenance of a flow of material from the hopper is insured, the arrangement directly imparting a vibratory motion to the material in the hopper.

Reference is first made to FIGURE 1, of the drawings, wherein there is shown a hopper **10** having the novel activator, or bridge breaking device, of my invention supported thereon. The hopper, which may be of any shape or size, is shown comprising a cylindrical-shaped top portion **11** and smaller diameter cylindrical-shaped lower discharge end **12** interconnected by an intermediate cone-shaped portion **13**. A supporting beam **14**, or the like, extends across the intake opening, or upper end, of the hopper and is secured to the hopper flange **16** as by threaded fastening means **17**.

An inverted U-shaped bracket **18** is secured by bolts **19** to the upper face of the supporting beam **14**, and a motor **21** is mounted on the bracket **18**, which motor may be an electric motor, a fluid operated motor, or any other suitable type. For purposes of illustration, a fluid operated motor is shown having an inlet tube **22** adapted for connection to any suitable source of fluid pressure not shown. The rotatable motor shaft **23** is connected by a flexible coupling means **24** to a drive shaft **26** having a weight **27** secured adjacent the lower end of the shaft by means of a set screw **28**. The center of mass of the weight **27** is displaced from the shaft axis (as seen in FIGURE 2) whereby rotation of the shaft by the motor **21** produces transverse vibration of the shaft. Vibration of the shaft is transmitted to a vertical column, designated generally **30**, which column extends into the hopper in direct contact with the material in the hopper. The weight **27** comprises a portion of a gyrator, designated **27'**, in FIGURE 1.

The shaft **26** is mounted in ball bearings **31** which, in turn, are mounted within a tubular member **32** having radially flanged ends **33** and **33'**. The tube **32** (comprising a portion of the vibrated column **30**), extends through an aperture **34** in the supporting beam **14**, which aperture may be suitably shaped to permit the insertion of the flanged tube therethrough. Fastening means **36** secure the upper flanged end **33** of the tube **32** to the supporting beam **14**. A cap **38** having an aperture **39**, through which the shaft **26** extends, closes the upper end of the tube **32** and prevents the entrance of dust, dirt and material being hoppered from entering the tube **32**. A generally cylindrically-shaped gyrator housing **41** is secured by bolts **42** to the lower end of the tube **32**, which housing encloses the weight **27** and closes the lower end of the tube.

It will be noted that the tube **32** is provided with enlarged inner diameter ends whereby seats **44** for the outer races of the ball bearings **31** are formed. Further, the ends of the shaft **26** are threaded as at **46** whereby nuts **47** may be threaded thereto for thrust loading the ball bearings **31** against the radial shoulders **44** formed in the tube.

A rod **48** is secured, as by welding **49**, to the bottom of the gyrator housing **41** for the support of a vibrated framework designated **51**. As seen in FIGURES 1 and 3, the framework **51** comprises a plurality of upwardly and downwardly inclined arms **52** and **53** secured to the rod **48** and tube **32**, respectively, by suitable four-piece brackets or clamps **54** and **56**, respectively, and fastening means **57**. An annular ring **58**, having short, inwardly directed supporting stubs **59**, is supported by the arms **52**, **53** adjacent the ends thereof, with bolts **61** securing the arm ends and stubs together. The annular rings **58** is spaced from the inside walls of the hopper **10** to avoid contact with the hopper walls during vibration of the device. The configuration and exact location of the vibrated framework **51** is dependent upon the size and shape of the hopper and the manner in which the material flows from the hopper. Thus, the framework is designed and constructed to fit within any bin of any configuration, and is located in the bin where the material tends to bridge. It will be apparent, then, that the proper location of the vibrated frame may best be determined experimentally during the feeding of material through the hopper.

Since the framework **51**, including the annular ring **58**, is secured to the tube **32** and rod **48**, which are vibrated upon rotation of the shaft **26** by the motor **21**, it will be apparent that the said framework is vibrated with a rotary vibratory motion of high amplitude along with the vibrating tube and rod. With this novel arrangement, the vibrations are applied directly to the material within the bin, rather than through the hopper walls.

Most materials may be fed out of the hopper, or bin, by the use of the above-described vibrating activator. Some materials, such as cotton linters, which are fibrous and of a low density, are particularly difficult to feed from storage bins and may bridge in such bins despite the use of the novel vibratory activator, above-described. In accordance with my invention, a relatively slow translatory movement may be imparted to the vibrating device; the simultaneous vibration and translation of the device insuring the flow of material from the hopper. Reference is now made to FIGURE 4, of the drawings, wherein there is shown a bin activator which is simultaneously vibrated and reciprocated in accordance with my invention. Referring to FIGURE 4, the inverted, U-shaped bracket **18**, which is secured to the supporting beam **14** at the top of the hopper **10**, supports a reciprocating fluid motor **70**, which includes a cylinder **71**; the cylinder **71** being secured by threaded fastening devices **72** to the upper horizontal end of the bracket **18**. A piston **73** is located in the cylinder **71** and is provided with a piston rod **74**, which extends from both faces of the piston through holes in opposite ends of the cylinder. Suitable packing, not shown, provides a seal between the movable piston rod and cylinder to prevent fluid leakage therebetween. The lower extension of the piston, designated **76**, supports a rectangular-shaped bracket member **77**, while the upper end **78** of the piston rod has secured thereto a pair of spaced arms, designated **79** and **81**, for actuation of the control arm **82** of a reversing valve **83**; the valve control arm **82** being shown in full lines in the lowermost position thereof, and in broken lines in the uppermost position. It will be apparent that the upper arm **79**, on the piston rod **74**, functions to actuate the valve control arm in a downward direction, while the arm **81** actuates the control arm **82** in an upward direction upon upward movement of the piston **73** in the cylinder **71**.

The reversing valve **83**, which may be of any suitable construction, has connected thereto a supply, or inlet, line **84** and a pair of outlet lines **86** and **87**. A suitable source of fluid pressure, comprising a pump **88** and reservoir **89**, for example, is connected to the inlet line **84** to the valve, while the output lines **86** and **87** are connected to opposite ends of the fluid cylinder **71**. In the lowermost position of the valve control arm **82**, as shown in solid lines, the reversing valve **83** provides a fluid connection between the inlet line **84** and the line **86** to the lower end of the cylinder **71** while venting the line **87** to the atmosphere. Conversely, in the uppermost broken line position of the actuating arm **82**, the inlet line **84** communicates with the line **87** to the upper end of the cylinder **71** while venting the line **86** to the atmosphere. Thus, it will be understood that, in operation, the piston **73**, with the piston rod **74** and attached bracket **77**, reciprocate in a vertical direction, which reciprocation provides a translational movement to the vibrated column designated, generally, **30'**, and the attached framework **51**. The column **30'**, which is a modification of the vibrated column **30** of FIGURE 1, extends through a clearance hole **34'** in the supporting beam **14** and comprises a plurality of tubular members,

or sections, 91 having radially flanged ends 92 which are secured together by fastening means 93. By making the columns in sections, the overall length of the column comprises a selected multiple of the individual section length, and columns of various lengths, to fit the bin or hopper size, may be made up by use of the desired number of sections 91. In FIGURE 4, four sections 91 are shown comprising the column 30'. As in the embodiment of the agitator shown in FIGURE 1, the column 30' is vibrated by means of the eccentric weight 27 of the gyrator 27' secured to the lower end of the shaft 26, which shaft is coupled by the flexible coupling 24 to the motor shaft 23 of the motor 21. In FIGURE 4, the motor 21 is secured to the supporting bracket 77 which, in turn, is secured to the lower extension 76 of the reciprocating piston rod 74. The inlet line 22 to the motor 21 from the reservoir 89 includes a flexible section therein allowing for reciprocating motion of the motor.

In the operation of the device of FIGURE 4, the column 30' and attached framework 51 are vibrated by means of the gyrator 27', and are simultaneously reciprocated by the fluid motor 70. The motor piston 73 is moved very slowly in either direction under control of the reversing valve 83. The pressure to the motor 70 is regulated so that the up and down motion of the piston occurs relatively slowly at, say, one (1) foot per minute, for example, when the hopper 10 is substantially full of material. It is preferred that the rate of descent of the vibrating structure be governed by the gravity settling of the structure into the bed of material within the hopper, under the influence of vibration. The structure will settle readily into the material, since it is vibrated by the gyrator 27'. Thus, it will be understood that it is not particularly intended to have the motor 70 push the column 30' and attached framework 51 into the bed of material, although this may occur to some small degree in practice.

Similarly, when retracting the vibrated column 30' and framework 41 upwardly, the reciprocating motor does not forcibly withdraw the structure against the weight of material in the hopper, but is intended, primarily, to lift the weight of the structure itself, while vibration of the structure serves to displace the material in front of the structure as it is moved upwardly to clear the way therefor. It will be understood, then, that relatively little force is required to reciprocate the vibrating structure. During the downward stroke, the same fluid pressure to the motor 70 would be applied as is required for the upward stroke. The air pressure required for the upward stroke would be essentially that required to overcome the weight of the structure being moved, plus some slight amount of friction between the structure and surrounding material, which friction is greatly reduced by having the structure vibrating.

The stroke of the movement, which is governed by the spacing of the switch actuating arms 79 and 81 on the piston rod section 78, may be of any desired length of, say, from between several inches to several feet. The arms 79 and 81 are preferably movably secured to the piston rod section 78 for adjustment of the stroke. The activator may be applied to any size hopper of, say, from one foot diameter by one foot high to fifty feet diameter by 100 feet high, but is particularly adapted for use on large hoppers which cannot employ mechanically rotated agitators, since the power requirement thereof would be prohibitive in a practical sense.

Reference is now made to FIGURE 5, of the drawings, wherein there is shown a longitudinal cross-sectional view of an intermediate section 91 of the longitudinal vibrated column 30'. It will be noted that each section 91 is provided with its own drive shaft section 26' and coupling means 101, each coupling means comprising a hub portion 102 having a threaded bore 103. The coupling means engage the threaded ends 46 of the shaft section 25' and thrust load the bearings 31 against the shoulders 44 formed within the tubular section 91. Set screws 106 secure the coupling means to the shaft section. The coupling means, which may be of conventional design, may comprise axially extending spaced finger portions 107 formed on the hub 102, which fingers interdigitally couple with fingers formed in identical coupling means on the adjoining section to be joined thereto. A rubber spider (not shown) separates the fingers. It will be apparent that as the flanged portions 93 of the sections 91 are secured together, the drive shaft sections 26' are automatically coupled together by the coupling means 101. Such sectionalization of the central column 30' not only facilitates placement of the bearings with the column, but also provides some flexibility as to the length of the column. As shown in FIGURE 4, gaskets 108 are used between the flanges 93.

A further embodiment of the vibrating column, which eliminates the need for the gyrator 27', is shown in FIGURE 6. Referring to FIGURE 6, the column shown therein is similar to that shown in FIGURE 4 with the addition, however, of eccentric weights 27' which are secured to the individual drive shaft sections 26' adjacent the bearings 31, which weights provide the necessary vibration to the structure when rotated. The lower end of the column is shown closed by a plate 111; the need for a gyrator thereat being eliminated in the illustrated embodiment. Such a column may be utilized in either the vibratory arrangement of FIGURE 1, or the simultaneously vibrated and reciprocated arrangement of FIGURE 4, for example. Obviously, any desired framework or baffle arrangement may be secured to the columns shown in FIGURE 6, as is desired or necessary.

Having now described this invention in detail, in accordance with the requirements of the patent statutes, various modifications and changes will suggest themselves to those skilled in this art, and it is intended that such changes and modifications shall fall within the spirit and scope of the invention as recited in the following claims.

I claim:

1. A dispenser for a storage hopper of the type having vertical side walls and a conical bottom terminating in a discharge opening, said dispenser comprising:

(*a*) a hollow column having a drive shaft extending therethrough,

(*b*) a weight eccentrically secured to the drive shaft,

(*c*) means carried by the hopper top and suspending the column coaxially within the hopper,

(*d*) a rod member extending axially from the lower end of the column, said rod member extending below the plane defining the base of the conical hopper bottom and having an end proximate to the hopper discharge opening,

(*e*) a motor coupled to said drive shaft for rotation thereof,

(*f*) a ring member spaced from the inner surface of the hopper vertical side walls,

(*g*) a plurality of rigid, upwardly-inclined arms secured to the ring member and to the said column, and

(*h*) a plurality of rigid, downwardly-inclined arms secured to the ring member and to the said rod member proximate to the hopper discharge opening.

2. The invention as recited in claim 1, wherein the said column is slidably suspended within the hopper and including means imparting a reciprocating, axial movement to the column simultaneously during rotation of the said shaft.

3. The invention as recited in claim 1, including a cylindrical chamber having an internal diameter exceeding that of the column, said chamber being secured to the lower end of the column and to the upper end of the said rod member, and wherein the said weight is disposed within the cylindrical chamber.

4. The invention as recited in claim 3, wherein the said column is slidably suspended within the hopper and including means imparting a reciprocating, axial move-

ment to the column simultaneously during rotation of the said shaft.

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