United States Patent

[11] 3,623,706

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[21] Appl. No. **48,114**
[22] Filed **June 22, 1970**
[45] Patented **Nov. 30, 1971**
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[54] **VIBRATORY APPARATUS**
9 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **259/29,** 51/163, 241/79.1, 259/72
[51] **Int. Cl.** **B01f 11/00**
[50] **Field of Search** 259/29, 35, 12, 17, 2, 1, 72, 75, 13, 54, 55, 59; 51/163; 241/79.1

[56] **References Cited**
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ABSTRACT: An open-top tub or container is supported by springs to effect orbital movement of a load of parts and media within the container. An endless belt conveyor has a lower run positioned adjacent the open top of the container, and a permanent magnet is disposed within the conveyor to attract parts upwardly from the treating media for transport by the conveyor to a discharge station. A pivotal frame supports the conveyor and magnet for movement as a unit between a parts-removing position adjacent the container and an upper retracted position, and wheels support the conveyor and magnet for horizontal movement as a unit to provide for removing parts from a plurality of containers. An optional directing member is also supported by the frame for corresponding movement between an upper retracted position and a lowered position within the media to assure that the parts orbit upwardly within the container and into the field of the magnet.

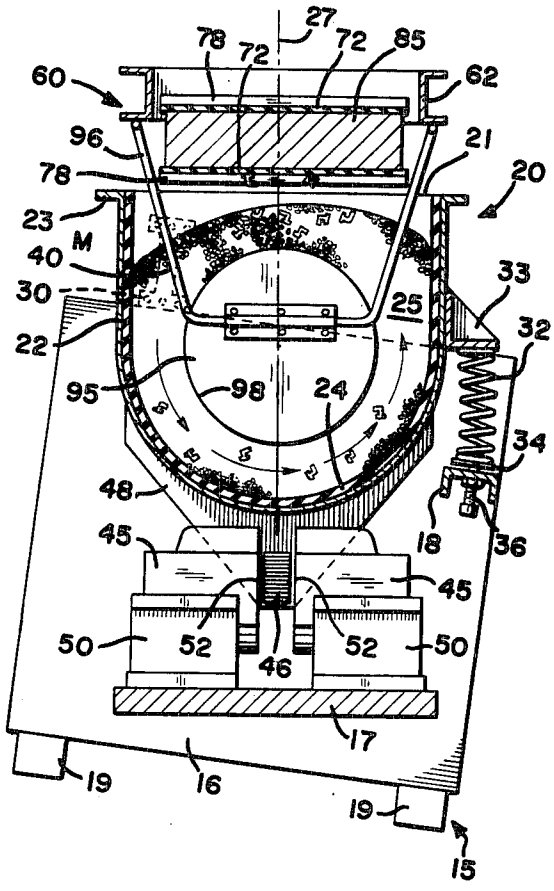


FIG-1

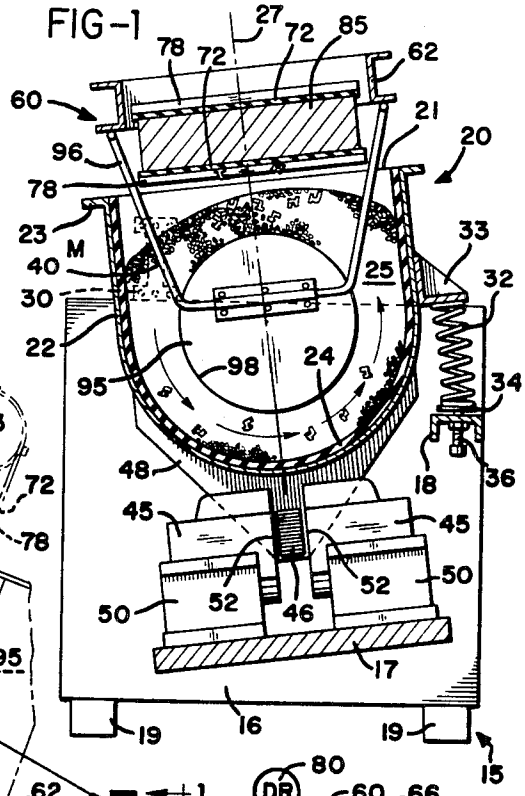


FIG-2

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VIBRATORY APPARATUS

BACKGROUND OF THE INVENTION

The invention relates to a vibratory machine or apparatus and preferably a machine as disclosed in Isaacson et al. U.S. Pat. No. 3,173,664 wherein an open-top container is cantileveredly supported by a set of spring beams for oscillatory movement on an effective axis offset laterally from a vertical plane extending through the center of the container. As shown in the above patent, after a load of parts has been treated within the media in the container, the parts are discharged from the container by pivoting the entire assembly of the container and the electromagnetic drive means for oscillating the container. If the media is larger than the parts, the media may be retained within the container with the aid of a screen having openings of sufficient size to permit passage of the parts but not the media. If the media is smaller than the parts, which is most common, the complete load of parts and media are usually dumped onto a vibratory screen which separates the parts from the media.

It is also common to discharge the load of parts and media from the container through an opening within one end wall of the container so that the parts and media flow onto a vibratory screen which separates the parts from the media. However, when the parts are smaller in one dimension than the treating media and are larger in another dimension, a vibratory screen is not particularly effective for separating the parts from the media. On the other hand, when the parts are larger than the treating media in every dimension, and separation can be performed with a vibratory screen, substantial time is required for the separating operation. Moreover, as the size of the part approaches the size of the treating media, the time required for separation with a vibratory screen is increased.

SUMMARY OF THE INVENTION

The present invention is directed to vibratory apparatus which incorporates an improved means for removing treated ferrous parts from a media within the vibratory container without removing the media from the container. The apparatus provides for removal of the parts from the media with the aid of a magnet and a conveyor which extends adjacent the path of the moving parts and media within the container.

In accordance with a preferred embodiment of the invention, the vibratory container is supported by a plurality of a spring beams for oscillatory movement on an effective pivot axis offset laterally from a vertical plane of the container. The container has an open top, and an endless conveyor belt is positioned so that its bottom run is directed over the open top of the container. A permanent magnet is positioned within the conveyor directly behind the lower run of the belt and functions to attract ferrous parts from the media within the container and to retain the parts on the lower run of the conveyor which extends outwardly to a discharge station.

A chute is positioned to direct the parts which are released from the lower run of the conveyor, and the conveyor and magnet are supported by a frame which pivots between an upwardly extending retracted position during loading and treating of the parts and a generally horizontal parts-removing position. For removing some treated parts, a cylindrical drum is positioned within the container to assure that the parts orbit in a path adjacent the top of the container. The drum is supported by the pivotal frame so that the drum is retracted from the container during the treating of the parts and is lowered into the container only when it is desired to remove the parts.

Other features and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical section of vibratory apparatus constructed in accordance with the invention and taken generally on the line 1—1 of FIG. 2; and

FIG. 2 is a side-elevational view of the vibratory apparatus and illustrating the retracted and operative positions of the means for removing treated parts from the apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The vibratory apparatus shown in the drawing includes a base frame 15 having parallel spaced vertical end walls 16 rigidly connected by a cross plate 17 and a channel member 18. The frame 15 is mounted on resilient shock-absorbing feet 19 located at the corners of the frame. A troughlike tub or container 20 is positioned between the end walls 16 of the frame 15 and includes parallel spaced vertical end walls 21 rigidly connected by an intermediate wall 22 having a U-shaped cross-sectional configuration. The container has an outwardly projecting peripheral flange 23, and the walls 21 and 22 are covered with a durable plastic lining 24 having ribs defining a corrugated inner surface.

The lined container walls 21 and 22 define an open top chamber 25 having a rectangular horizontal configuration and a U-shaped vertical configuration. The chamber 25 is adapted to receive a work load, for example, a media M of ceramic chips or other abrasive materials and a suspended batch of ferrous parts P which are to be surface-finished such as by a deburring, polishing or descaling operation. The container 20 is positioned so that a longitudinal plane 27 extending through the center of the chamber 35, is slightly inclined from a vertical plane.

The container 20 is supported on one side of the center plane 27 by a pair of I-shaped end spring beams 30 which connect the end walls 21 of the container to the end walls 16 of the frame 15. On the opposite side of the center plane 27, the container 20 is supported by a plurality of longitudinal spaced coil compression springs 32 which extend between the frame channel 18 and a longitudinally extending angle bracket 33 secured to the adjacent side of the intermediate wall 22 of the container. The lower end of each coil spring 32 seats on a fitting 34 supported by the upper end of a screw 36 which can be adjusted to vary the upward force exerted by the spring on the container 20.

The spring beams 30 establish an effective pivot axis 40 for the container 20 and cooperate with the springs 32 to provide the container 20 with a predetermined resonant frequency of oscillation. This resonant frequency is in the neighborhood of and generally above 3,600 cycles per second when the apparatus is to be operated from a 60-cycle power supply. After the load is placed within the container 20, the coil springs 32 are adjusted so that the resonant frequency of the system including the container, load, spring beams and coil springs, is substantially 3,600 cycles per second.

The container 20 is oscillated by power-operated means including a pair of electromagnets 45 arranged in opposing relation on opposite sides of a barlike armature 46. The ends of the armature are rigidly connected to parallel spaced plates 48 which are secured to the intermediate wall 22 of the container 20. Each magnet 45 is mounted on a bracket 50 which is slidably supported by the cross plate 17 and is laterally adjustable by a set of screws (not shown). Each magnet 45 is adjusted before the container is loaded to form a predetermined uniform gap 52 between the armature 46 and each of the electromagnets 45 according to the desired amplitude of oscillation. When the load is placed within the container 20, the armature 46 moves closer to the magnet 45 on the left. (FIG. 1). The adjustment of the coil springs 45, as mentioned above is effective to return the armature to a position centered between the magnets. As a result of the offcenter effective pivot axis 40, it is apparent that the amplitude of vibration or oscillation of the container 20 is greater on the right side (FIG. 1) of the center plane 27 than on the left side.

In accordance with the present invention, a conveyor assembly 60 is positioned above the container 20 and includes a rectangular frame 62 formed of channel members. The frame 62 is supported on one end by a cross-shaft 64 which is

mounted within bearings secured to a frame 65 having an h-shaped side configuration. The shaft 64 provides for pivoting the frame between a generally horizontal position and an upwardly extending retracted position as shown by the dotted lines in FIG. 2. A pair of rods 66 are mounted on the opposite end of the frame 62 and seat within corresponding hook-shaped brackets 67 which are mounted on an upright pedestal or frame 68. As shown in FIG. 1, the frame 62 is inclined slightly so that it is perpendicular to the center plane 27 of the container 20.

A conveyor 70 includes an endless flexible belt 72 which is directed around a pair of end rollers 73 mounted on corresponding cross-shafts 74 rotatably supported by bearings secured to the underneath side of the frame 62. The frame 62 and the rollers 73 are positioned so that the lower run of the belt 72 extends longitudinally of the container 20 and directly over the open top of the chamber 25. A series of longitudinally spaced cross bars 78 are secured to the belt 72, and the outermost shaft 74 is connected to a drive 80 (shown schematically) which is mounted on the top side of the frame 62.

A rectangular permanent magnet 85 is positioned within the conveyor belt 72 and is supported on opposite sides by brackets (not shown) secured to the frame 62. As shown in FIG. 2, the magnet 85 extends the full length of the conveyor chamber 25 and projects from the left end of the container 20 to the corresponding belt support roller 73. A chute 86 is positioned below the left belt support roller 73 (FIG. 2) and is supported by brackets (not shown) which are secured to the pivotal frame 62. Thus the assembly of the chute 86, the conveyor 70 and the permanent magnet 85 is movable as a unit with the frame 62 between the horizontal position where the conveyor belt 72 overlies the container chamber 25 and the upwardly extending retracted position as shown by the dotted lines in FIG. 2. A power-operated winch 88 is mounted on the upper end of the h-frame 65 and is effective to retract and extend a cable 89 which is secured to the frame 62 for raising and lowering the conveyor, magnet and chute assembly.

As shown in FIGS. 1 and 2, a cylindrical drum 95 is adapted to be positioned within the container chamber 25 after treating relatively heavy parts. The drum is supported on each end by a bracket 96 consisting of a formed cylindrical rod having its upper ends secured to the frame 62. The drum 95 has an outer curved surface 98 which is effective to assure that the load of media M and parts P is directed in an orbital path as shown by the arrows in FIG. 1. As a result, the parts P will move in a path which will bring all of the parts to the top of the container chamber 25 and within the field of attraction of the permanent magnet 85.

When the apparatus is being used to treat a load of parts P and media M which has been placed within the container chamber 25, the assembly of the conveyor 70, the permanent magnet 85 and the drum 95 is retained in its retracted position by the cable 89 extending to the power winch 88. After the parts P have been treated, the winch 88 is energized so that the assembly is lowered to its horizontally extending position where the lower run of the conveyor belt 72 is positioned adjacent the open top of the container chamber 25. Lowering of the conveyor 70 is also effective to lower the drum 95 into the load of parts and media within the chamber 25 until the drum arrives at the position shown in FIG. 1.

As a result of the substantial attractional force produced by the permanent magnet 85, the parts P are pulled from the media M within the upper portion of the chamber 25 and are held against the lower run of the moving conveyor belt 72. As the parts are carried past the left end of the magnet 85 (FIG. 2) by the conveyor belt 72, the parts drop from the belt onto the chute 86 which directs the parts into a suitable receiving bin (not shown). With some very small parts, it is helpful to direct jets of air against the conveyor belt 72 at a location directly above the chute 86 to assure that the parts are released from the conveyor belt. Referring to FIG. 1, as a result of the orbital movement of the load of parts and media around the surface of the drum 95 within the chamber 25, all of the parts P will flow or orbit with the media to the upper portion of the container chamber 25 so that the parts are attracted to the conveyor belt 72 by the magnet 85. As shown in FIG. 2, a set caster sacter wheels 100 support the frame 65 so that the conveyor 70 and the magnet 85 may be moved horizontally as a unit to provide for removing parts from a plurality of vibratory containers 20.

From the drawing and the above description, it is apparent that vibratory apparatus constructed in accordance with the present invention provides desirable features and advantages. For example, the conveyor 70 and the magnet 85 cooperate to remove the treated parts from the media in the container chamber 25 as the parts orbit to the upper portion of the chamber. The conveyor and magnet also cooperate to deliver the parts to the discharge station adjacent the chute 86. While most parts will flow upwardly into the filed of the magnet 85 as a result of the normal orbital movement of the parts and media within the container 20, it is desirable with some heavier parts to position a directing member having a curved outer surface, such as the drum 95, within the center of the container chamber 25 to assure that the parts will move to the surface of the load within the chamber 25.

Another important feature of the invention is provided by the support of the conveyor 70 and the magnet 85 so that they are movable between operative positions for removing parts from the container 20 and retracted positions during loading of parts into the container and also during treatment of the parts. As shown in FIG. 2, when the conveyor 70 and magnet 85 are retracted upwardly, the chute 86 moves to a position where it effectively shields the magnet 85 from the ferrous parts being treated within the container 20. It is also apparent that the conveyor 70 and the magnet 85 provide for treating minute parts which may be smaller in at least one dimension than the treating media.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Vibratory apparatus comprising a frame, a container defining a chamber adapted to receive a load of media and parts to be vibrated, spring means mounted on said frame and supporting said container for vibration, power-operated means cooperating with said spring means for vibrating said container with sufficient force to effect orbital movement of the load in a path which causes movement of the parts toward the upper surface of the load, conveyor means positioned adjacent said chamber and extending to a discharge station, magnetic means associated with said conveyor means and adapted to attract parts from the media within said chamber to said conveyor means, and means for releasing parts at said discharge station from the attraction of said magnetic means.

2. Vibratory apparatus as defined in claim 1 wherein said container has an open top, said spring means and said power-operated means cooperate to effect vibration of said container at a greater amplitude on one side of the center of said container than on the other side to aid the orbital movement of the load, and said conveyor means and said magnetic means extend across said open top of said container.

3. Vibratory apparatus as defined in claim 1 including directing means disposed within said chamber to assure orbital movement of the parts upwardly within said chamber and within the field of said magnetic means.

4. Vibratory apparatus as defined in claim 3 including means connecting said directing means within said chamber to said conveyor means, and means supporting the assembly of said conveyor means, said magnetic means and said directing means for movement between a parts-removing position and an upwardly retracted position.

5. Vibratory apparatus as defined in claim 1 wherein said conveyor means includes an endless belt, a set of rollers sup-

porting said belt, and said belt has a lower run extending adjacent an open top of said container.

6. Vibratory apparatus as defined in claim 1 wherein said magnetic means comprise a permanent magnet positioned adjacent the path of said belt.

7. Vibratory apparatus as defined in claim 1 including means for moving said conveyor means and said magnetic means between a parts-removing position adjacent said chamber and a retracted position spaced from said chamber.

8. Vibratory apparatus as defined in claim 1 including means supporting said conveyor means and said magnetic means for generally horizontal movement as a unit to provide for removing the parts from a plurality of said vibratory containers with one said unit.

9. Vibratory apparatus comprising a frame, a container defining an open top chamber adapted to receive a load of media and parts to be vibrated, a plurality of spring beams mounted on said frame and supporting said container for oscillatory movement on a predetermined effective axis offset laterally in relation to a generally vertical plane extending through the center of said container, said spring beams being effective to provide said container and the load therein with a resonant frequency corresponding generally to a predetermined frequency, power operated means for oscillating said container at substantially said predetermined frequency to cause orbital movement of the load within said chamber, an endless conveyor belt, roller means supporting said belt within a lower run positioned adjacent said open top of said chamber and extending to a discharge station, a permanent magnet positioned within said conveyor and adapted to attract parts from the media within said chamber to said lower run of said conveyor, means for releasing parts at said discharge station from said belt, and means supporting the assembly of said conveyor belt and said magnet for movement between said position adjacent said chamber and a retracted position spaced from said container.

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