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CROSS REFERENCE
SEARCH ROOM

Nov. 30, 1965 R. W. MOORE 3,220,147
VIBRATORY FINISHING
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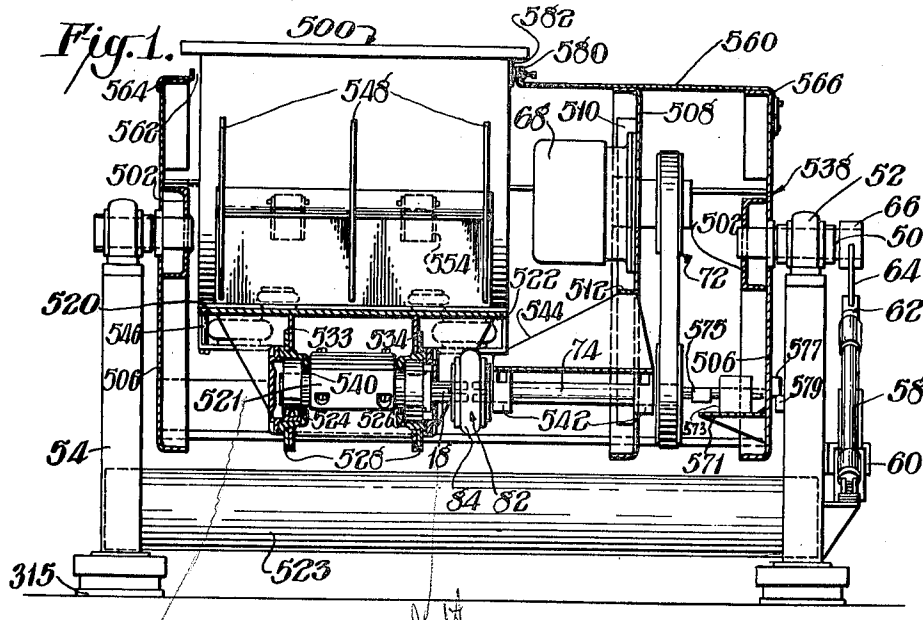
13/67

Fig. 1.



eccentric weight

Fig. 2.

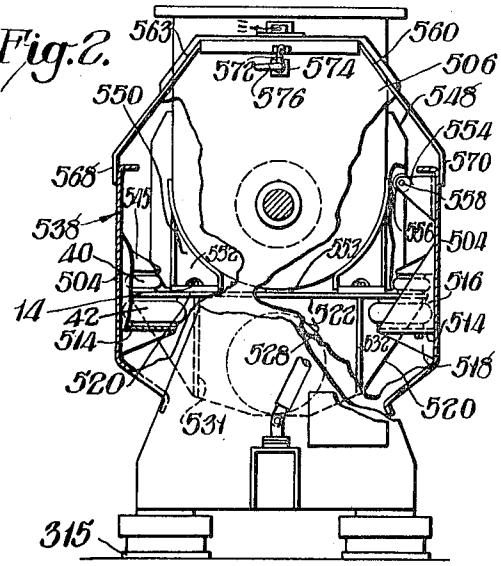


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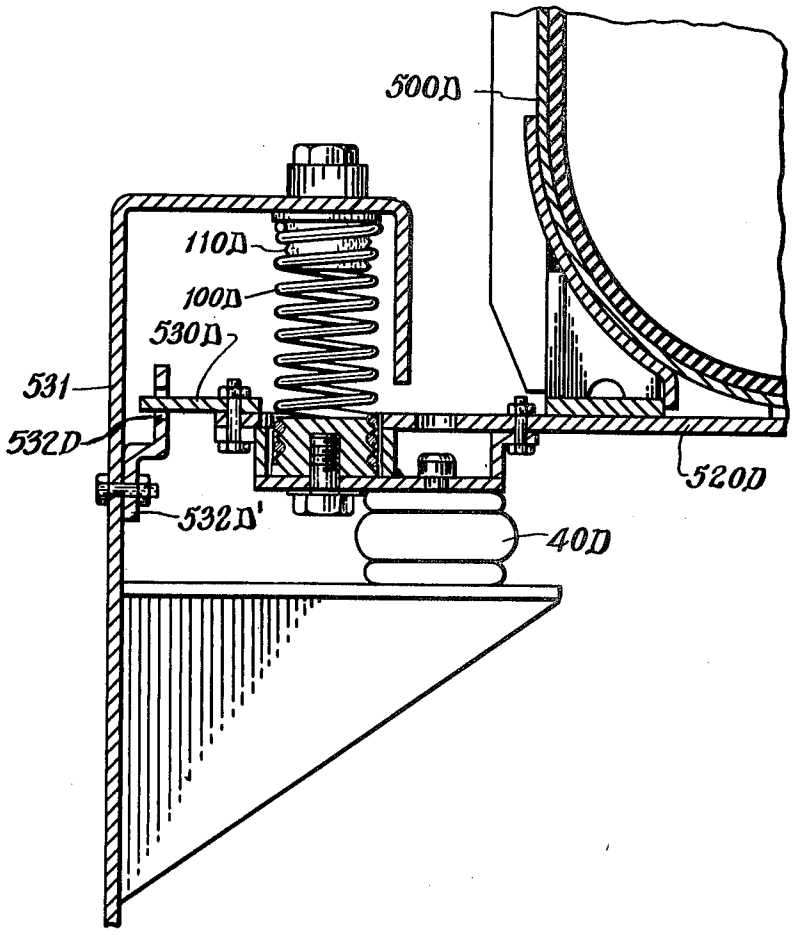
Fig. 3



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3,220,147

VIBRATORY FINISHING

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Original application Feb. 13, 1964, Ser. No. 344,763, now Patent No. 3,163,967, dated Jan. 5, 1965. Divided and this application Oct. 2, 1964, Ser. No. 401,003
4 Claims. (Cl. 51—163)

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This application is a divisional application of copending application Serial No. 344,763, filed February 13, 1964, now U.S. Patent No. 3,163,967 granted January 5, 1965; which in turn is a continuation-in-part of application Serial No. 168,146, filed January 23, 1962, now U.S. Patent No. 3,163,966 granted January 5, 1965; which in turn is also a continuation-in-part of application Serial No. 4,908, filed January 27, 1960, now U.S. Patent No. 3,063,207 granted November 13, 1962. This application is also a continuation-in-part of the aforementioned copending application Serial No. 168,146, filed January 23, 1962, now U.S. Patent No. 3,163,966 granted January 5, 1965.

This invention relates to vibratory finishing, more particularly the type of vibratory or gyratory finishing suitable for treatment of work pieces of metal or the like for the purpose of deburring, descaling, cleaning, polishing, burnishing, rounding corners and edges, etc.

The use of vibration or gyration for the above purpose has been known for some time. However, machines built for these purposes have been relatively complicated and cumbersome as well as somewhat awkward to use when adapted for variable loading.

Among the objects of the present invention is the provision of novel equipment and techniques for the above type of finishing that simplifies the handling of widely varying loads and reduces the cost of such treatment.

The above as well as additional objects of the present invention will be more clearly understood from the following description of several of its exemplifications, reference being made to the accompanying drawings wherein:

FIG. 1 is a front view partially in section of an apparatus representative of the present invention;

FIG. 2 is a side view partially in section of the apparatus of FIG. 1; and

FIG. 3 is a detail, on an enlarged scale and partially in section of a further support arrangement for a vibratory apparatus.

According to the present invention the vibratory finishing apparatus has a work container resiliently supported on a framework and connected for gyratory movement. A bar is secured to the container and extends into an oversized aperture means held by the framework to indicate the location of the container with respect to the framework and to give an audible indication of misadjustment.

In an advantageous form of this invention, a drive mechanism is secured to the framework in a fixed position and a generally horizontally extending flexible drive coupling connects the drive mechanism to the container for gyrating it.

Referring now to the drawings, FIGS. 1 and 2 show a vibratory treatment apparatus having a generally trough-shaped container **500** held on a table **520** as by means of bolts **14** through the table top sheet **522**. Feet **550** secured as by welding to the underside of the container provide convenient flat surfaces at their lower portions for engagement against the table top **522**. The table is vibrated by means of a shaft **18** having an eccentric weight **521** secured thereto and journalled between bearings **524** and **526** rigidly attached to the table as by means of the plates **533** and **534** welded to the underside of the table.

Skirts **531** and **532** depending from the side edge of the table and also fastened to the table by welding, help to greatly increase the rigidity of the connection to the vibrating drive. The eccentric weight can be replaceably attached to shaft **18** as by bolts so that different weights can be used for modifying the magnitude of vibration.

The air cushion support is shown as provided by upper and lower flanges **518** and **544** secured against the inner surfaces of the sheets **504** and carrying horizontally extending shelves **514** that are received between the flanges of suporting sheets **504** that encircle the table. Sheet **522** of the table is joined to the flange **518** below it by an air cushion **42**, and is also similarly joined by an air cushion **40** to the flange above it.

FIGS. 1 and 2 employ a tilt framework **538** made of a pair of traverse channel beams secured to and connected by side sheets **504**. These side sheets have flanged longitudinal edges for added stiffness and are also bent inwardly near their lower portion to further increase their rigidity and protect the interior somewhat against splashing from the floor. The outer faces of the beams **502** are covered by end panels **506** which extend over the entire space between the end sheets and also rise to a height well above them. The margins of the end panels are also flanged for strength. A similar intermediate panel **508** is secured between the side sheets and is reinforced as by welded-on angles **510** and a bar **512** to support the driving motor **68** and jackshaft **74**.

To each side sheet is secured a pair of shelves **514** on which are mounted the lower air cushion supports for the work container. The shelves extend short distances longitudinally of the apparatus and then terminate in vertically disposed flanges **516**, **518**. The flanges **516** at the outer ends of the shelves extend upwardly while the flanges **518** at the adjacent ends of the shelves extend downwardly. All flanges as well as the bodies of the shelves are welded to the side sheets **504**.

Upon the lower air cushions the work table **520** rests. The top of the table is a flat sheet **522** and it is rigidified by a grid of reinforcing plates **531**, **532**, **533** and **534** welded to its lower surface. Plates **533**, **534** extend transversely and have central passageways in which are received the bearings **524**, **526** of the vibrator shaft. Around these passageways strengthening rings **528** can be secured. The bearings are preferably encased as shown with leak-tight covers sealed against the vibrator shaft with wiper-type seals as at **540**. The bearings are also supplied with lubricant as by a conduit connected to a convenient reservoir which can be observed readily to make sure a lubricant supply is available and also that lubricant is being consumed. A check of the bearing temperatures is also desirable and this can be provided by a thermocouple also connected to a convenient measurement location.

The jackshaft **74** is secured by bearings **542** fastened to the underside of a channel-shaped mounting plate **544** welded to the intermediate panel **508** and projecting through a suitable passageway in that panel. Where upper air cushion supports are used for the table they can be appreciably smaller than the lower air cushion and can be secured to the top of the table offset from the lower cushions in a longitudinal direction such that the upper cushions are closer to each other than the lower cushions, as shown in FIG. 1. Removable brackets **545** can be bolted to the side sheets **504** to hold down the upper cushions and permit them to be readily removed, as for example when the table **520** is to be replaced. For shipping purposes bolts **546** can be fitted through holes in the air cushion shelves **514** and threaded into the table, with spacers slipped between the shelves and the table to clamp the table against movement. Two such bolt clamps

on diagonal corners of the table are adequate for this purpose.

The work container of FIGS. 1 and 2 has strengthening ribs **548** welded to its external side surfaces and also has its feet **550** strengthened by gusset plates **552** welded over the open ends of the feet, preferably in the plane of the ribs **548**. A further set of aligning bosses **553** can be formed along the longitudinal center of the container bottom, and they can be provided with aligning pin openings that match up with aligning openings in the table top.

The framework can merely be a generally rectangular combination of channels carrying a pair of opposed reinforced sheets to which flanges are welded, which may in turn be pivotally held by stub shafts **50** projected from opposite ends of the framework. Journals **52** carried by piers **54** receive the stub shafts and permit the entire framework, including the table and container, to pivot as for the purpose of unloading work articles from the container. The piers **54** can be directly secured to a floor such as a rigid concrete slab, and can also be tied together by a brace **523**, in the form of a tube. Either or both of the piers can also be used as an anchoring for a tilting mechanism which in the illustrated embodiment is a pneumatic cylinder **58** pivoted directly at its lower end to a bracket **60** held by the piers, and having a movable piston rod **62** connected to jackshaft **50** by a bell crank **64** which can be secured to a collar **66** keyed to the shaft. This tilting can also be hydraulically, mechanically or electrically actuated, if desired.

It is helpful not to rely on the air cushions holding the work container when it is tilted to unloading position. As illustrated in FIGS. 1 and 2, mounting clips **554** are affixed to the side sheets and each has two arms holding a resilient tube **556** so that it is only slightly spaced from the side of the work container and does not interfere with its gyration. Pins **558** extending through the arms support the tubes **556**, and the tubes can be made of rubber, either natural or synthetic, as well as of resilient plastic such as nylon. Two such tubes will adequately support the work container when the tilt frame is tilted. The air cushions permit the tilted container to lean against the supporting tubes without unduly stressing the cushions. At the same time the supporting tubes do not interfere with the simple lifting out of the work container when it is to be replaced.

In order to protect the apparatus against spillage around the top of the container, a cover **560** is fitted over the entire top of the tilt frame. The cover has a cut-out opening **562** through which the work container projects and this opening is shown as smaller than the area covered by the lip of the work container so that the lip overhangs the cover around its entire periphery. Turned-up flange **563** around the entire opening further assures that anything dropping on the cover will not be in a position to run into the interior of the tilt frame. Turned-down margins **564**, **566**, **568**, **570** on the cover fit over the corresponding margins of the tilt frame and the cover can be conveniently secured in a readily removable fashion as by means of a hook **572** pivoted to panel **506** at **574** and provided with an operating handle **576**. With this arrangement the entire equipment can be hosed down very conveniently and thereby kept very clean.

The cover can also be used as a height indicator for the work container. Adjustable pointer **580** can be secured to cover flange **563** for this purpose and can cooperate with a scale **582** fixed to the adjacent side of the work container. For the longest life of the flexible coupling between the jackshaft and the vibrating shaft, these should be aligned as closely as possible and variations in loading of the work container as well as pressure in the cushion supports, will change the vertical position of the vibrating shaft. The indicator will serve as a convenient guide for the purpose of adjusting the height of that shaft so as to match the position of the jackshaft. The adjustment can also be made automatic as by having a combination cushion inflating valve and cushion deflating valve connected to respond to vertical movement between the work container or table, and the cover or other convenient portion of the tilt frame. The height-sensing device can merely be a pair of electrical switches positioned one above and one below the margin of the table in such a manner that upward movement of the table closes the upper switch and downward movement of the table closes the lower switch. The switches can in turn be connected to operate the valves so that upward movement of the table will cause the lower cushions to deflate and downward movement of the table will cause them to inflate. Alternatively the height control can be applied to the upper cushions or to both the upper and lower cushions.

A feature of the construction of FIGS. 1 and 2 is the flat top character of its vibrating table. With such an arrangement the work container can be removed and replaced by any other type of equipment that is desired to be vibrated. Also a perfectly flat top is a simple matter to machine with high accuracy so that one container can be replaced by another without any special fitting required.

The apparatus of FIG. 1 has a vibration frequency measuring device shown as a tachometer generator **573** held on a shelf **571** mounted against the inner surface of panel **506**. This generator has a shaft connected as by a simple coupling such as a short length of rubber or resilient plastic tubing **575**, to a stub shaft extending from the jackshaft pulley. A conductor cable supplies the output of the tachometer generator to a conveniently located meter on which the output is read on an indicator scale. Other systems can also be used for measuring the rotational speed of the vibrating shaft or can even measure the vibration with a series of reeds mounted for free vibration with the individual reeds having natural periods of vibration adjusted to be at graded intervals over the desired operating range. The reed that shows the strongest vibration when the assembly of reeds is mounted anywhere on the apparatus, indicates the frequency at which the apparatus is operating.

The equipment can also be provided with a safeguard against difficulties that could result from an attempt to operate the vibrating drive when the container is tilted toward unloading position. For this purpose FIG. 1 shows a block **577** secured to the outer face of panel **506** and a cooperating switch **579** on the adjacent supporting pier. These two components are so located that when the container is upright in its operating position the block trips the switch **579** closed, thereby establishing an electrical circuit used in energizing the vibrating drive. In all other positions of the container the block is disengaged from the switch so that vibration cannot be carried out.

Driving of shaft **18** to cause gyration of the container can be effected as by means of an electric motor carried by the table, the framework, or any other convenient manner. One highly effective arrangement which reduces the number of components as well as the total mass of the vibratory members is to mount such a motor on the tiling framework. In FIG. 1 such a motor is shown at **68** carried by a panel **508** depending from the framework alongside the table **520**. A drive connection such as a variable ratio pulley combination such as shown in FIG. 10 connects the motor with a jackshaft **74** journalled in bearings **542** held on a shelf **544**. The jackshaft is in turn coupled to the vibrating shaft **18** by means of a flexible drive coupling **82** as shown having an annularly positioned flexible trough-shaped member **84** clamped between drive discs, keyed to shafts **74** and **18**.

FIG. 3 also includes an amplitude-limiting arrangement for the container and table. A bar **530D** fastened to the table or container is arranged to project out through an aperture **532D** in an angled member **532D'** secured to the framework **531** or in a reinforced

section thereof. The aperture **532D** can provide a space all around the bar sufficient to permit the bar to vibrate with the table through the usual range of vibratory amplitudes. Generally a ½ inch clearance is sufficient. This will also minimize the possibility of damage to the air cushions in the event the pressure within them is suddenly released, for example should there be failure of the air pump or inadvertent openings of a vent valve. When this happens the small clearance of opening **532D** will keep the air cushion from complete collapse. The bar **530D** should be made sufficiently strong for the above purpose as by cutting it from a ½ inch thick steel plate. Also to keep the bar from pivoting on its mount it can be fixed in place by more than one bolt. It can, for example, be in the shape of a T with both arms of the T secured by spaced bolts and the leg of the T extending through the aperture **532D**. The position of the bar in the aperture also makes a suitable height indicator for the container. Furthermore it can be so co-related with the alignment of the flexible drive connection where one is used as at **82** in FIG. 1 that a misalignment will cause the rod **530D** to hammer against the margin of aperture **532D** when the work is being vibrated. This gives an audible warning of misalignment, and such a warning is not easily ignored.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An apparatus for subjecting work articles to vibratory finishing treatment, said apparatus having a supporting base, a framework journaled to said base, said supporting framework being mounted on resilient feet, a work container, air cushions mounting said work container on said framework, a drive mechanism secured to said framework in a fixed position, a generally horizontally extending flexible drive coupling connecting said drive mechanism to said container for gyrating said container, an oversized aperture in said framework, a bar disposed in said oversized aperture, and means for reciprocating said bar in said aperture in accordance with the gyratory movement of said container and into contact with the edges of said aperture upon misalignment of said flexible drive coupling with said fixed drive means whereby said contact gives an audible indication of said misalignment.

2. The combination of claim **1** wherein a projecting member is detachably secured to said framework, and said oversized aperture being in said projecting member.

3. The combination of claim **1** wherein the clearance between said bar and said oversized aperture is approximately ½ inch.

4. The combination of claim **1** wherein said air cushions are disposed below said container, said cushions being secured to and under a flat top table, and said container being detachably mounted on said table.

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