March 15, 1966 R. W. MOORE 3,239,968

VIBRATORY FINISHING

Original Filed Feb. 13, 1964 2 Sheets-Sheet 1

Fig. 1.

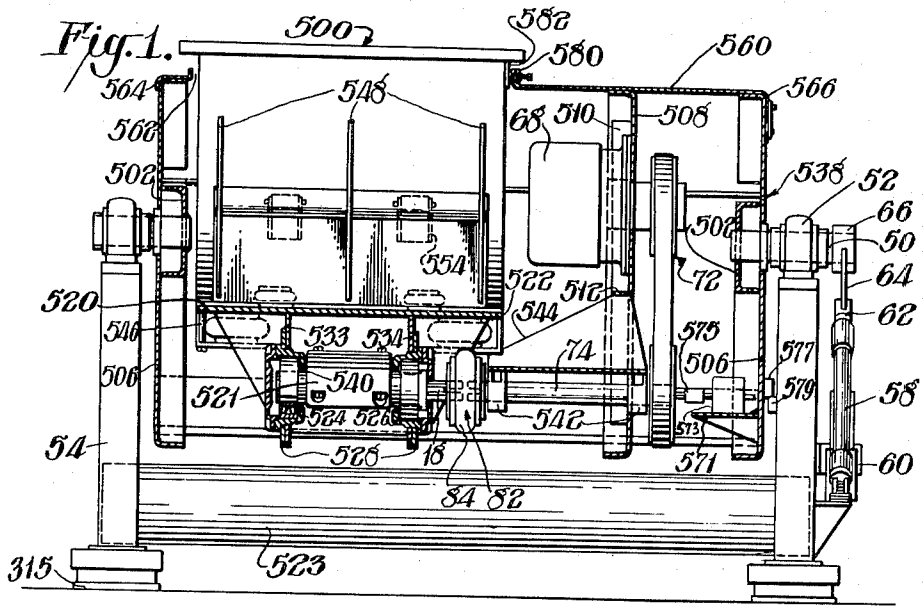


Fig. 2.

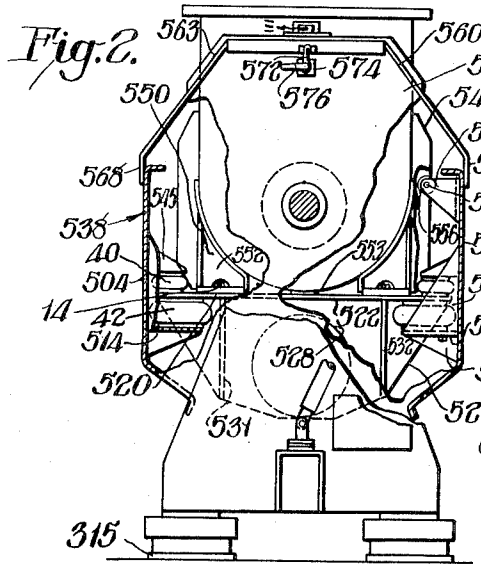
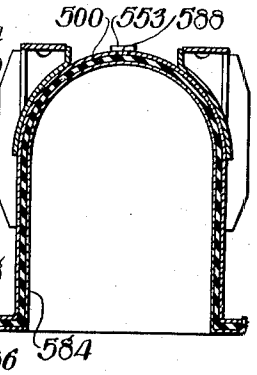


Fig. 5



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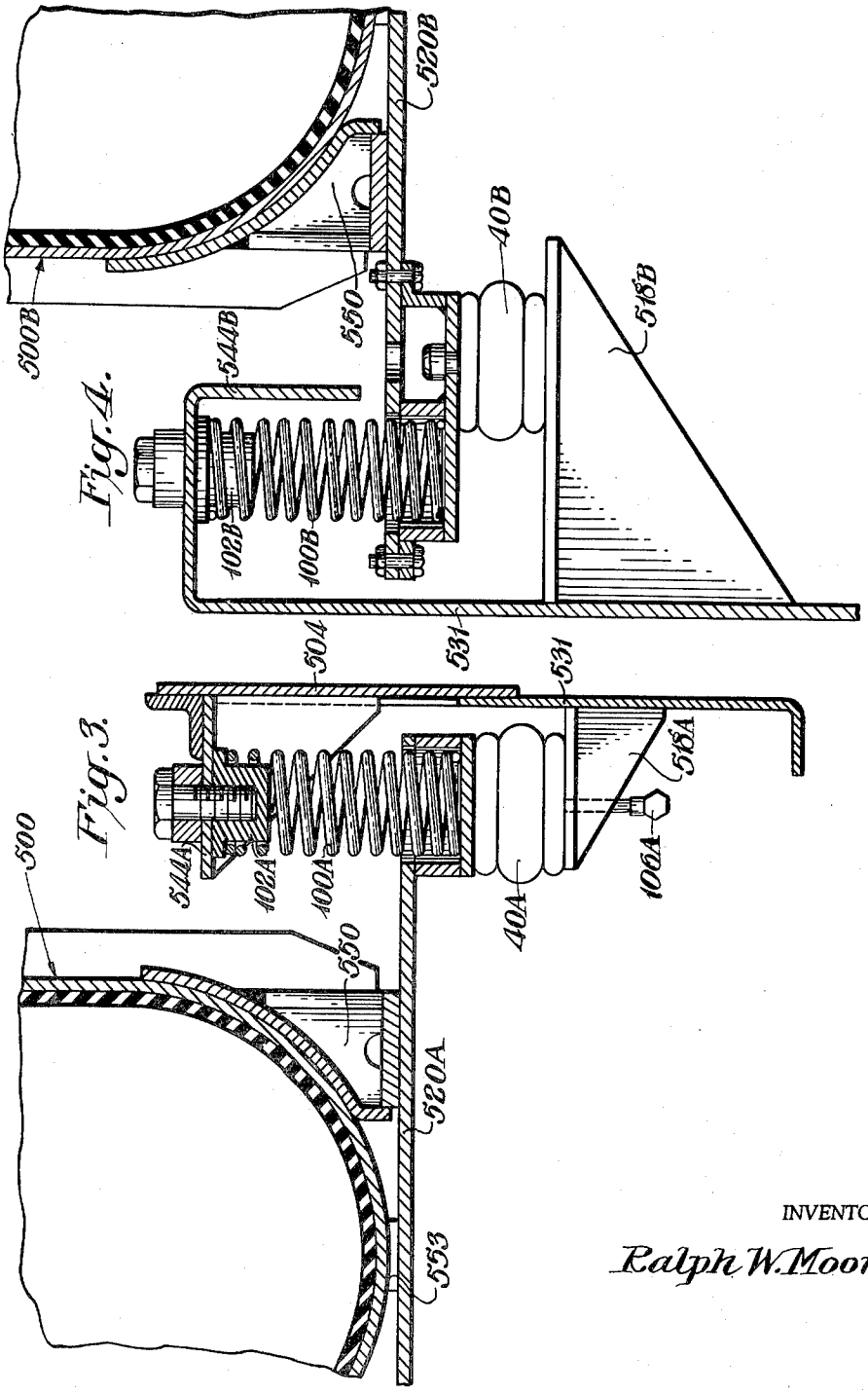

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3,239,968

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. 400,975

1 Claim. (Cl. 51—163)

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;

FIG. 3 is a detail on an enlarged scale and partially in section of a modification of one of the support elements of the apparatus of FIGS. 1 and 2;

FIG. 4 is a view similar to FIG. 3 shown with the support elements in offset position; and

FIG. 5 shows an arrangement for constructing the apparatus of the present invention.

According to the present invention the vibratory finishing apparatus includes a flat topped table resiliently mounted on a support and secured to a gyrating mechanism. A trough-shaped container for the work articles is bolted directly to the table.

In an advantageous form of this invention a resilient lining is secured to and covers the internal surface of the container.

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 supporting 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 transverse 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 farmework. 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 resilient liner for the container can be formed in place as by vulcanizing rubber in situ. FIG. 3 shows such an arrangement in which the work container 500 is held upside-down over an internal mold 584 as by means of bolts 586 passing through openings around the periphery of the mold and threaded into the edge of the container lip. An opening 588 in the bottom of the container is thereby held up and through it can be introduced the vulcanizing mixture in fluid form. Additional openings can also be provided to facilitate the filling. Inasmuch as rubber will vulcanize better to certain surfaces such as brass, the inside surface of the container can be plated with a thin layer of brass. On the other hand, the surface of the mold is preferably coated with a thin layer of a mold release such as silicone oils.

Instead of rubber, plastics such as polyethylene, polyvinylchloride, polyurethanes and epoxy resins, can be used. These can be plasticized or unplasticized. The absence of plasticizer makes the plastics somewhat more abrasion-resistant but on the other hand, the presence of plasticizer makes them somewhat more resilient.

The molding operation can also be carried out with the container in the right-side-up position, in which event no opening is needed in the bottom of the container and the openings can then be merely provided at the top of the internal mold. The internal mold can also be made in detachable sections so as to render it easier to remove when the molding operation is completed. Instead of molding the container lining in place in the container, it can also be separately molded between removable mold shells and then cemented or vulcanized in the container. With such an arrangement the apparatus of the present invention need not have a removable container. Instead, the container can be made integral with the table.

The tilting of the container can be arranged to take place in either direction around the framework pivots 50. In fact, dual tilting can also be provided so that the container can be tilted in one direction as for dumping the work, and in the opposite direction for other purposes such as rinsing the work or the container. The container 500 is shown as provided with an internal liner 104 (FIG. 3) of a resilient material such as natural or synthetic rubber which can be vulcanized in place.

FIGS. 3 and 4 show a useful modification of the supporting elements in which valved air cushions 40A and 40B are employed in supporting position below table 520A and 520B. Coil springs 100A and 100B are mounted in preloading position above the table, and held in place by a nipple 102A and 102B respectively, attached

by a bolt to brackets **545**A and **545**B attached to side sheet **504**. In FIG. 4 is shown a suitable offset arrangement for the coil spring **100**B and air cushion **40**B.

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 claim the invention may be practiced otherwise than as specifically described.

What is claimed is:

An apparatus for subjecting work articles to vibratory finishing treatment, said apparatus having a support, a flat-topped table resiliently mounted on said support, a gyrating mechanism secured to said table for causing it to gyrate, a rigid container for the work articles, said container having a trough shaped bottom that merges into side walls, end walls closing off the ends of said trough-shaped bottom and of said side walls, a resilient lining secured to and covering the internal surface of said container, feet attached to the lower portion of the container's exterior and extending downwardly to define a

planar set of mounting surfaces, said planar mounting surface of said feet extending beyond the lowest portion of said container's exterior, apertures through said mounting surface of said feet, apertures in said table aligned with said feet apertures, and fastening means extending through said aligned apertures for detachably mounting said container to said table with said planar mounting surface contacting said table.

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