United States Patent

Anderson et al.

[15] **3,707,058**

[45] **Dec. 26, 1972**

[54] **VIBRATORY FINISHING APPARATUS**

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[22] Filed: **Feb. 3, 1971**

[21] Appl. No.: **112,257**

[52] **U.S. Cl.** **51/163**

[51] **Int. Cl.** **B24b 31/06**

[58] **Field of Search** ..51/163, 164, 314, 316; 241/66, 241/67

[56] **References Cited**

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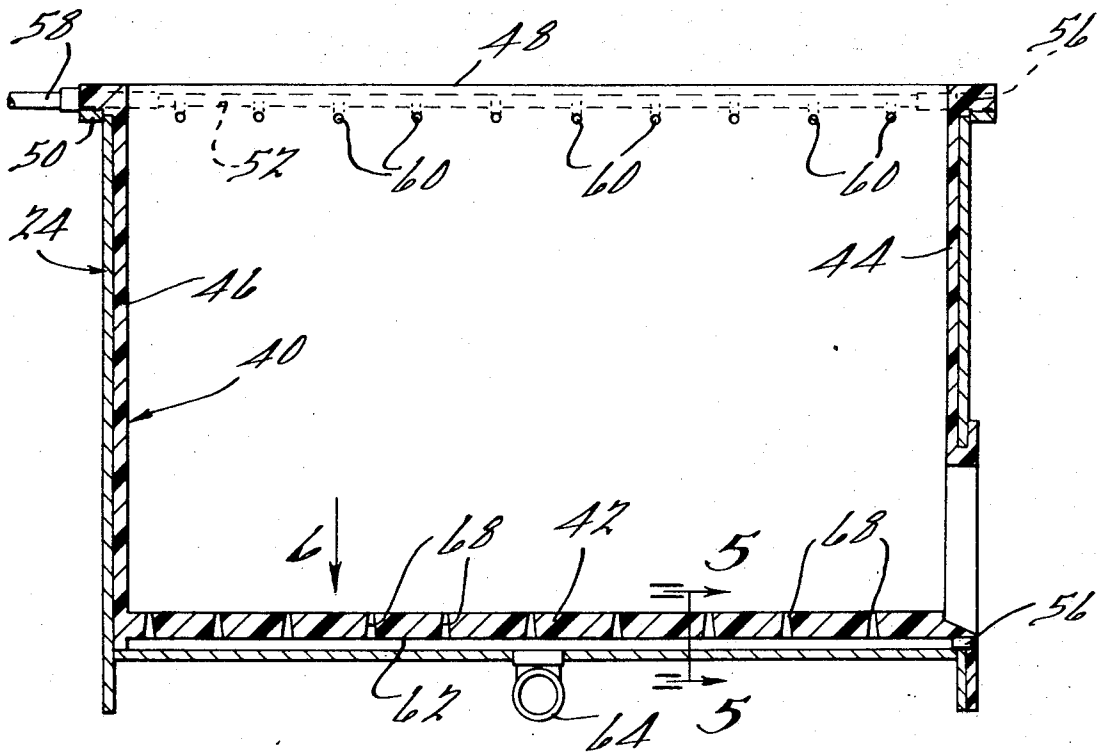
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[57] **ABSTRACT**

A molded liner for the tub of a vibratory finishing machine, the liner having fluid passage means formed interiorly thereof for spraying or discharging fluid into the tub during a finishing operation, and for subsequently draining the fluid therefrom.

16 Claims, 6 Drawing Figures

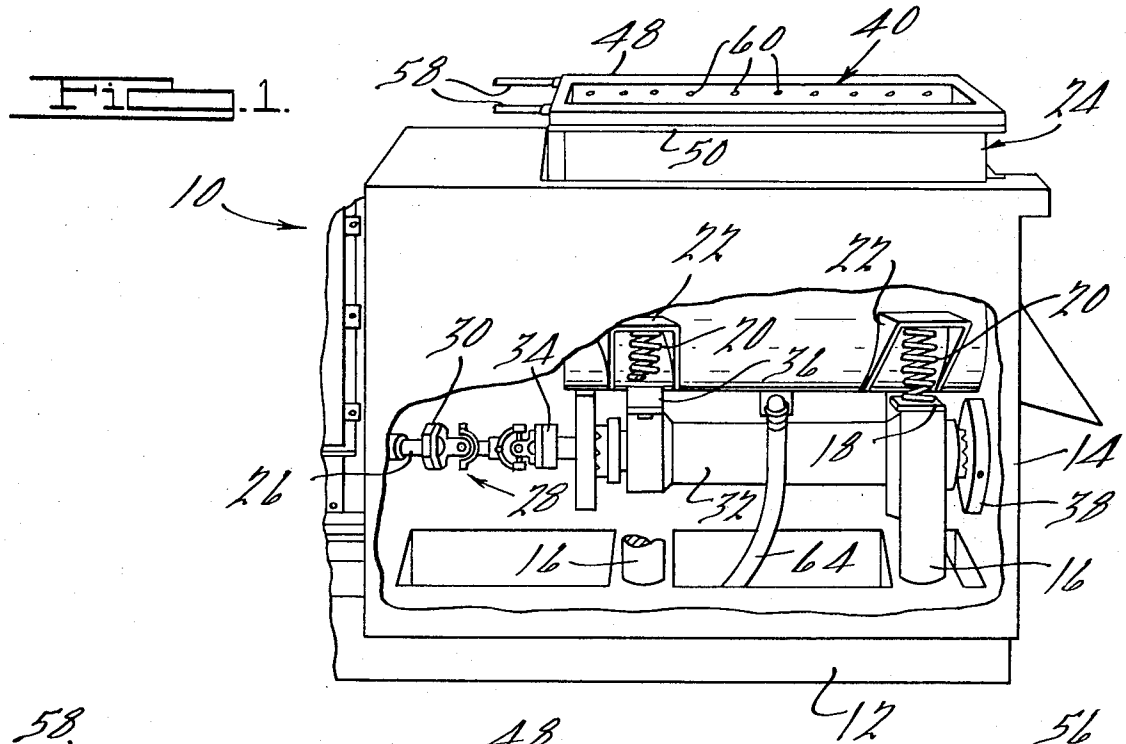


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SHEET 1 OF 2

FIG. 1.



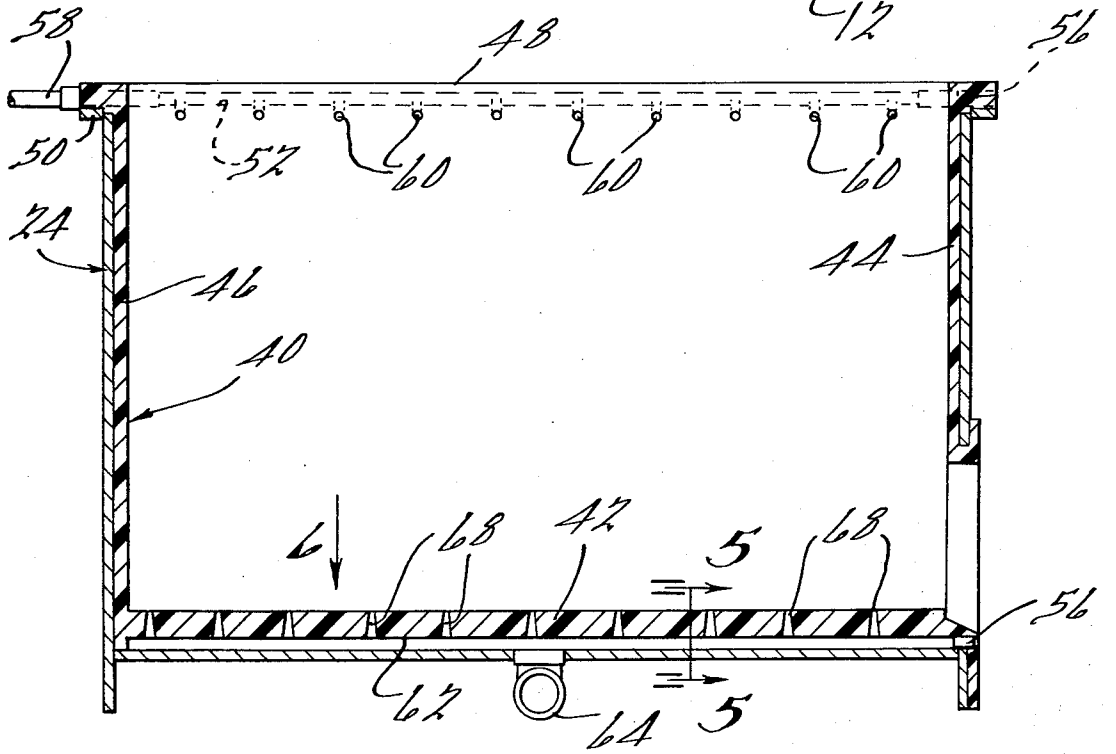


FIG. 2.

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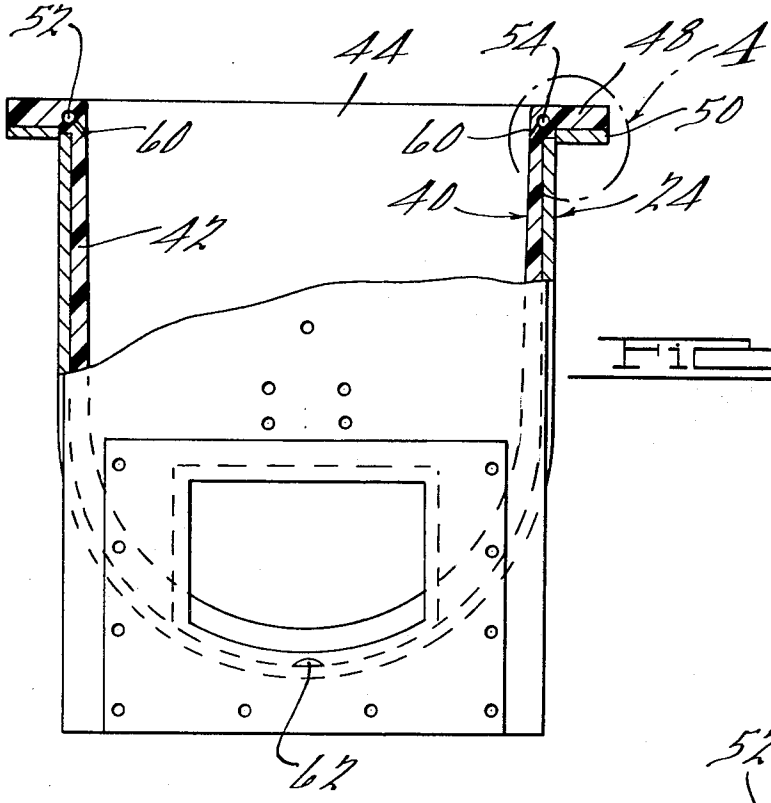


Fig. 3.

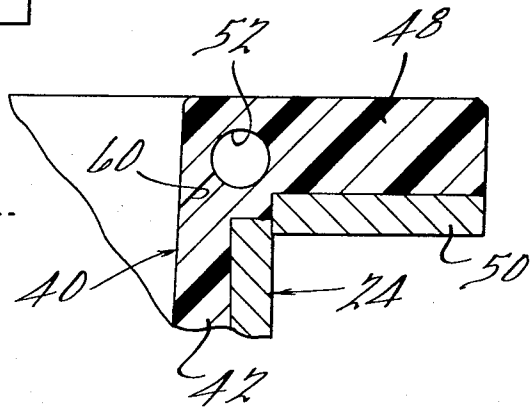


Fig. 4.

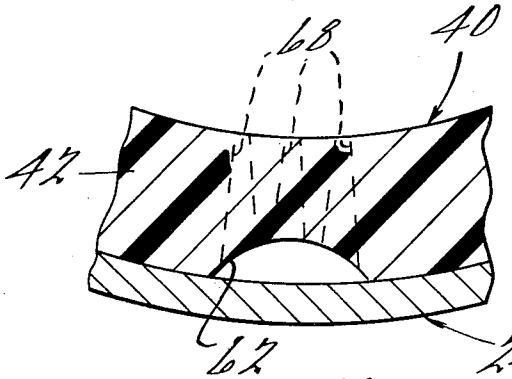


Fig. 5.

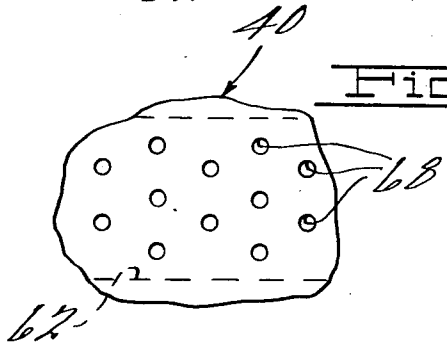


Fig. 6.

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VIBRATORY FINISHING APPARATUS

BACKGROUND OF THE INVENTION

The present invention is generally directed toward vibratory finishing apparatus of the type wherein workpieces are immersed in an abrasive media and by the relative movement between the workpieces and the abrasive media, the exposed surfaces of the workpieces are finished. It is frequently the practice in such finishing apparatus or machines to provide some type of means for introducing or spraying a cleaning fluid, liquid or other substance onto the workpieces being finished, as well as onto the abrasive media, in order to clean the workpieces and media during a finishing operation or otherwise aid processing, such as in acid descaling. Such liquid applying means in the past has consisted of an overhead spray header which was disposed above the open upper end of the finishing tub or container and was either bolted directly to the tub or to the support structure therefor. Additionally, such machines have been provided with some type of drain means in or adjacent the lower end of the finishing tub in order to provide for the disposal of the cleaning fluid. Such drain means has, in the past, consisted of one or more bolt-on drain headers secured to the inner surface of the tub or liner thereof.

The aforedescribed apparatus for applying cleaning fluids to the workpieces and abrasive media have been the subject of considerable objectionable criticism, primarily from the standpoint that the equipment heretofore known and used has been expensive to manufacture and difficult and time consuming to install. Additionally, considerable criticism has arisen from the fact that the spray header arrangements heretofore known and used have substantially interfered with the loading and unloading of the machine tub, while the bolt-on drain headers have been objectionable from the standpoint of preventing satisfactory sealing and efficient operation thereof.

The present invention is intended to overcome the aforementioned difficulties and objectionable features of prior known vibratory finishing apparatus through the provision of a novel tub liner which is intended to be mounted directly within the finishing tub. The tub liner of the present invention, together with functioning in the traditional manner of affording quiet operation and long operational life for the tub per se, has been designed so as to have fluid passage means formed integrally or interiorly thereof, which fluid passage means is adapted to enable the aforementioned cleaning fluid to be introduced directly into the finishing tub and be drained therefrom without in any way interfering with the loading and unloading of the tub and without in any way inhibiting efficient draining or disposal of the cleaning fluid after application thereof. The tub liner of the present invention affords a substantial cost savings over heretofore known designs which have traditionally required extensive use of pipes, mounting brackets and the like. Additionally, the present invention allows a tight cover to be applied to the tub during processing and, of course, offers many aesthetic advantages over analogous bolt-on apparatus heretofore used. Further, the present invention provides for selfcleaning that the spray ports will be cleaned upon vibration of the tub, a feature not present in prior machines wherein the fluid applying apparatus did not vibrate with the tub.

SUMMARY OF THE INVENTION

This invention relates generally to vibratory cleaning apparatus, and more particularly, to a new and improved tub liner for use in such apparatus.

It is accordingly a general object of the present invention to provide a new and improved vibratory finishing machine.

It is a more particular object of the present invention to provide a new and improved liner for use in the workpiece and abrasive media containing tub of vibratory finishing machines.

It is still a more particular object of the present invention to provide a new and improved tub liner of the aforedescribed type which is formed with integral, interior passage means for applying and disposing of cleaning fluids during a workpiece finishing operation, whereby to obviate the need for bolt-on spray and drain header arrangements heretofore known and used.

It is another object of the present invention to provide a new and improved tub liner of the above described type which provides for convenient cleaning and universality of application.

It is still another object of the present invention to provide a new and improved tub liner which is economical to manufacture, easy to assemble and which will have a long and effective operational life.

Other objects, features and advantages of the present invention will become apparent from the subsequent description and the appended claims, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevated perspective view, partially broken away, of a vibratory finishing machine embodying the principles of the present invention.

FIG. **2** is a side elevational view of the tub liner of the present invention which is incorporated in the machine shown in FIG. **1**.

FIG. **3** is an end elevational view of the tub liner illustrated in FIG. **2**.

FIG. **4** is an enlarged fragmentary view of the structure illustrated within the circle **4** of FIG. **3**.

FIG. **5** is an enlarged fragmentary cross-sectional view taken substantially along the line **5—5** of FIG. **2**, and

FIG. **6** is an enlarged fragmentary view of a portion of a tub liner structure shown in FIG. **2**, as viewed in the direction of the arrow **6** therein.

DETAILED DESCRIPTION OF THE INVENTION

Referring now in detail to the drawings, a workpiece finishing apparatus, generally designated by the numeral **10** and embodying the principles of the present invention, is shown generally as comprising a base or support structure **12** having a generally rectangular tub encasement **14** fixed thereto and supported thereon. The apparatus **10** comprises a set of four, generally rectangularly oriented upstanding posts or columns **16** which are disposed within the encasement **14** and are secured at their lower ends to the base **12**. Each of the posts **16** has a plate **18** fixed to its upper end to which the lower end of one of four helical compression springs **20** are secured. The upper ends of the springs **20** are each disposed in and fixed to a respective one of four inverted generally U-shaped channel members **22**,

each of which members 22 is welded or otherwise suitably secured to an open upper ended tub 24, with the result that the tub 24 is resiliently supported upon the posts 16 and base 12 for universal movement.

The apparatus 10 comprises a suitable electrical energized drive motor (not shown) which is suitably mounted within or adjacent the encasement 14 and has a drive shaft 26 which is drivingly connected to a universal joint mechanism 28 via coupling 30. The opposite end of the mechanism 28 is connected to a vibrator shaft 32 via a second coupling 34, as illustrated in FIG. 1. Generally speaking, the shaft 32 is constructed and designed so as to impart generally rapid orbital movement to the tub 24 via suitable intermediary brackets 36 which are interposed between the shaft 32 and the tub 24. Such orbital movement is achieved by constructing the vibrator shaft 32 so as to have an offset or eccentric section constituting a major portion of the mass thereof. Eccentric rotary movement of said section of the shaft 32 is transferred to the brackets 36 and hence to the tub 24, causing it to move in an orbital (or any other suitable) path. The compression springs 20 afford smooth and quiet orbital travel of the tub 24, and means in the form of a suitable counterweight or the like 38 provided on the shaft 32 may be incorporated for varying the amplitude of orbital travel of the tub 24. A detailed description of a highly satisfactory construction and mode of operation of the vibrator shaft 32 will be found in U.S. Pat. No. 3,371,449, issued Mar. 5, 1968, which is incorporated by reference herein.

The tub 24 is generally U-shaped in cross-section and adapted to have an abrasive media (not shown) dispersed therein; a suitable workpiece holding fixture (also not shown) may, if desired, be provided interiorly of the tub 24 for supporting workpieces during a finishing operation. The workpieces may or may not be relatively movably supported interiorly of the tub 24, depending upon the particular finishing operation to be performed. Conventionally, a liquid compound or substance is sprayed into the tub 24 to maintain the workpieces and abrasive media cleansed throughout the finishing operation, or otherwise assist in the finishing process, as is well known in the art.

In accordance with the principles of the present invention, the tub 24 is provided with a tub liner, generally designated by the numeral 40. The liner 40 is preferably of a molded or cast construction and is preferably, although not necessarily, fabricated of molded or cast urethane. Various alternative materials, of course, may be utilized instead of urethane, such as neoprene, polyvinylchloride (pvc), or any other suitable natural or synthetic resinous material having the requisite structural integrity. Generally speaking, the tub liner 40 is intended to insure a long life for the tub 24 and provided for quiet operation for the workpiece finishing apparatus 10. As best seen in FIGS. 2 and 3, the liner 40 is of a generally U-shaped configuration in transverse cross section and is adapted to be fixedly nestingly secured interiorly of the tub 24. The liner 40 comprises a continuous U-shaped side wall 42 and a pair of spaced parallel end walls 44 and 46 which are formed integrally of the opposite ends of the side wall 42. The liner 40 is formed with an outwardly projecting, generally horizontally disposed rim section 48 around the upper end thereof, which section 48 extends outwardly above a generally outwardly disposed flange portion 50 of the tub 24. It will be appreciated, of course, that the tub liner 40 of the present invention may assume various alternative shapes or configurations, such as cylindrical, rectangular, etc., without departing from the scope of the present invention.

In accordance with the present invention, the tub liner 40 is formed with an integral spray header arrangement by which the aforedescribed liquid cleansing or other compound may be sprayed or otherwise delivered into the interior of the liner 40 for purposes of cleaning the abrasive media and workpieces being finished thereby during a finishing operation. More particularly, the aforesaid spray header is provided by a pair of longitudinally extending bores or fluid passageways 52 and 54 are formed within the upper opposite ends of the side wall 42, as best seen in FIG. 2. The passageways 52, 54 preferably extend the entire length of the liner 40 and are suitably closed at one end thereof by means of suitable removable closure plugs 56 or the like. The opposite ends of the passageways 52, 54 are communicable with suitable fluid conduit means, generally designated by the numeral 58, which are in turn communicable with a source of the aforementioned liquid compound which is communicated to the passageways 52, 54 via the conduit means 58. As best illustrated in FIG. 2, the fluid passageways 52, 54 are communicable with the interior of the liner 40 by means of plurality of longitudinally spaced discharge ports, generally designated 60, which are formed in the inner surface of the side wall 42 and thereby communicate the passageways 52, 54 with the interior of the liner 40. The ports 60 are preferably inclined downwardly toward the inner ends thereof, whereby to direct the cleaning fluid interiorly of the liner 40, as will be apparent. It will thus be seen that when a liquid cleaning or other compound is supplied to the passageways 52, 54, said compound will flow longitudinally of the passageways 54, 52 and be discharged via the ports 60 along the entire length of each side of the side wall 42, whereby the liquid will be sprayed on to and over the workpieces and abrasive media contained within the tub 24.

It may be noted that suitable fluid discharge nozzles (not shown) may be pressed or threaded into the liner 40 at each of the discharge ports 60 for providing optimum uniform flow control of the liquid as it is sprayed into the liner 40. Alternatively, of course, the discharge ports 60 may be formed with such precision as to provide the desired uniform flow control without the need for the aforesaid nozzles, as will be appreciated by those skilled in the art. It will also be appreciated that while it is desirable from a convenience standpoint to introduce the cleansing compound into the passageways 52, 54 from one end thereof, as a highly satisfactory alternative, both ends of the passageways 52, 54 could be suitably plugged or blocked and the cleaning liquid could be introduced therein by suitable cross bores or the like communicable with some intermediate portion of each of the passageways 52, 54. Also, it may be noted that the location of the passageways 54, 52 may be varied within the liner 40 commensurate with a particular workpiece finishing operation. For example, the passageways 52, 54, and

hence the discharge ports **60**, may be located closer to the bottom or lower end of the liner **40** if a particular finishing operation so required or if a particular cleansing compound so dictated. Of course, the specific orientation of the discharge ports **60** may also be varied, as well as the number thereof, depending upon the particular type of finishing operation being performed.

Further in accordance with the present invention, the tub liner **40**, together with having the aforedescribed spray header for introducing cleaning liquids into the interior of the liner **40**, is provided with a drain header arrangement for selectively removing or draining the aforesaid liquid from the interior of the liner **40**. More particularly and as best seen in FIGS. **2–5**, the liner **40** is formed with a generally hemispherical cross section recessed area or drain passageway **62** which extends longitudinally along the entire length of the liner **40** on the under side of the lowermost portion of the U-shaped side wall **42**. By virtue of the fact that the liner **40** is preferably contiguously engaged with the inner periphery of the tub **24**, the lower side of the drain passageway **62** is defined in part by the confronting portion of the inner periphery of the tub **24**, as best seen in FIG. **5**. It will be appreciated, of course, that the passageway **62** could be formed entirely interiorly of the liner **40**, where conditions so require. The passageway **62** is intended to be communicable with a suitable drain conduit **64** which is in turn communicable with a discharge drain or may, if desired, be communicable with the source of cleaning liquid whereby said liquid may be recirculated. The conduit **64** may be communicable with either end of the passageway **62** via suitable fluid fitting means, with the opposite end of said passageway **62** being suitably closed or plugged, for example, by the closure plug means **56**, as described in connection with the passageways **52**, **54**. Alternatively and as shown herein, both ends of the passageway **62** may be suitably closed or plugged, with the conduit **64** being communicable with the passageway **62** via a suitable fluid fitting secured to the under side of the tub **24** at a position intermediate the opposite ends thereof as best seen in FIGS. **1** and **2**.

The interior of the liner **40** is communicable with the drain passageway **62** by means of a plurality of longitudinally extending spaced rows of drain ports, generally designated **68** (see FIG. **6**), which are formed in the liner **40** and extend downwardly between the interior thereof and the passageway **62**. It will thus be seen that as the cleaning liquid or substance falls to the lower end of the liner **40**, said liquid will be drained through the ports **68** into the passageway **62**, through which said liquid will pass to the drain conduit **64** for proper disposal thereof. In accordance with a preferred embodiment of the present invention, the drain ports **68** are of generally tapered configuration, as seen in FIG. **5**, with the result that the lower ends thereof are slightly larger than the upper ends thereof, in order to prevent, or at least minimize, undesirable plugging of the drain ports **68** with solid particles present within the tub **24** during a finishing operation. Of course, the ports **68** may be of generally uniform cross section or of virtually any other shape when and where desired.

The drain passageway **62** preferably has a generally curved or arcuate upper surface, whereby said passageway **62** is of an arch shape in transverse section. While this construction provides for optimum support of the tub load, various alternative configurations will be found to be highly satisfactory. Additionally, the aforesaid arch shape, by being designed so as to be of a relatively shallow, wide shape, conserves lining material and optimizes fluid flow.

It may be noted that the location of the drain passageway **62** need not be located at the lowest point of the liner **40**, since the passageway **62** and associated drain ports **68** may be located along either side of the side wall **42** a short distance from the bottom, whereby to control liquid level during processing. Of course, suitable valve means (not shown) may be utilized also for controlling discharge rates. Additionally, while only a single drain passageway **62** has been illustrated herein, the liner **40** may be provided with two or more parallel passageways **62**, each having a plurality of drain ports **68** connecting with the interior of the liner **40**, as will be appreciated by those skilled in the art.

It may be noted that for certain processing operations, it may be desirable to reverse the functions of the drain and spray headers, whereby cleaning or other fluid will be introduced into the interior of the liner **40** through the plurality of drain ports **68** and be removed or discharged from the interior thereof through the plurality of ports **60**. In such an operation, the entire liner **40** would be filled with the cleaning or other fluid, with such fluid being continually (or intermittently) pumped or otherwise supplied to the lower end of the liner **40**, and be drained or discharged from the upper end thereof, as will be appreciated by those skilled in the art.

It will be seen from the foregoing, that the present invention provides a novel tub liner for use in vibratory finishing machines which offers a substantial cost savings over similar arrangements heretofore known and used involving the use of conventional pipes, support brackets and the like. One particularly important feature of the present invention resides in the fact that the present invention eliminates the problem of the pipe header, which has heretofore been located above the tub lining and as such interferred with loading and unloading of the tub. Additionally, the liner of the present invention allows a tight cover to be applied to the tub during a vibratory finishing operation. Another important feature of the present invention resides in the aesthetic appearance of the tub liner, as compared to the prior known devices utilizing bolt-on spray and drain headers. Still another feature of the present invention resides in the fact that during operation of the finishing apparatus, vibration of the tub maintains the spray and drain ports clean, a feature not shown in earlier known devices wherein the headers did not move or vibrate with the tub. Additionally, the "cast-in" drain obviates a number of problems in connection with bolted-on drain plates which were expensive to manufacture, difficult to seal, and occasionally interfered with workpieces during finishing thereof. Such prior known drain plates were also objectionable because drainage was occasionally restricted by the geometry of the drain plate itself. Yet another feature of the present invention resides in the fact that the arrangement of the longitudinal passageways **52**, **54** and **62** permits convenient cleaning thereof, since one or

both plugged ends may be conveniently opened to permit the use of a rod, brush or the like for purposes of removing accummulated comtaminants, with the result that the tub liner of the present invention will be economical to manufacture, easy to assemble, convenient to maintain and will have a long effective operation life.

While it will be apparent that the preferred embodiment illustrated herein is well calculated to fulfill the objects above stated, it will be appreciated that the present invention is susceptible to modification, variation and change without departing from the scope of the invention.

We claim:

1. In a vibratory workpiece finishing apparatus, a container adapted to receive workpieces to be processed, means for supporting said container and for causing movement of said workpieces disposed therein, a liner disposed interiorly of said container and comprising a bottom wall section and upstanding side wall sections covering substantially the entire inner surface of said container and defining a finishing chamber therewith, an elongated fluid passageway formed interiorly of one of said wall sections and communicable with fluid conduit means located exteriorly of said container, and a plurality of spaced apart flow ports formed in said one wall section and each extending between said passageway and the interior of said chamber for communicating fluid between said chamber and said passageway.

2. The invention as set forth in claim 1 wherein said fluid passage means comprises a longitudinal extending passage formed in said side wall section of said liner, and wherein said plurality of ports are generally horizontally aligned and spaced longitudinally along said liner.

3. The invention as set forth in claim 1 wherein said passage is formed in said bottom section of said liner and wherein said plurality of ports comprise a drain header for said container.

4. The invention as set forth in claim 2 wherein said passage and said plurality of ports comprise a spray header for said container.

5. The invention as set forth in claim 1 wherein said fluid passage comprises a longitudinally extending fluid passage formed in said bottom wall section of sail liner and wherein said plurality of ports communicate the inner surface of said bottom section with said longitudinally extending fluid passage.

6. The invention as set forth in claim 1 wherein said liner comprises a pair of laterally spaced upstanding side wall sections and wherein each of said side wall sections is formed with a longitudinally extending fluid passage and a plurality of discharge ports communicating said passages with the interior of said chamber.

7. The invention as set forth in claim 1 wherein said liner is of a molded one-piece construction.

8. The invention as set forth in claim 7 wherein said fluid passage means extends longitudinally of said liner between the opposite ends thereof, and which includes closure plug means closing at least one end of fluid passage means.

9. The invention as set forth in claim 7 wherein said liner is of a generally U-shaped configuration and comprises a continuous U-shaped side wall section and longitudinally spaced end wall sections, which includes first fluid passage means for communicating fluid into said container and second fluid passage means for communicating fluid out of said container.

10. The invention as set forth in claim 9 wherein said second fluid passage means is disposed in said continuous side wall section adjacent the lowermost portion thereof and comprises a drain header.

11. The invention as set forth in claim 9 wherein said fluid passage means comprises a pair of longitudinally extending fluid passages formed adjacent the upper opposite ends of said continuous side wall section.

12. The invention as set forth in claim 9 wherein said second fluid passage means is disposed in said continuous side wall section adjacent the lowermost portion thereof and comprises a drain header, and wherein said first fluid passage means comprise a pair of longitudinally extending fluid passages formed adjacent the upper opposite ends of said continuous side wall section, and which further includes a plurality of ports communicating said first and second passages with the interior of said container.

13. The invention as set forth in claim 12 wherein said fluid passage comprising said drain header is of a generally arch configuration in transverse section.

14. The invention as set forth in claim 15 which includes a plurality of generally tapered drain ports communicating the interior of said container with said arch-shaped fluid passage.

15. The invention as set forth in claim 14 which includes removable closure means on at least one longitudinal end of one of said fluid passages to permit insertion of a cleaning element from said one end thereof.

16. A one-piece molded liner adapted to be operatively mounted within a finishing vessel of a vibratory finishing machine, said liner comprising upstanding side wall sections terminating at their lower ends in a bottom wall section, a first longitudinally extending flow passage formed directly in said bottom wall section of said liner and communicable with a drain outlet located exteriorly of said vessel, a first plurality of longitudinally spaced flow ports communicable at their lower ends with said passage and at their upper ends with the interior of said liner, second and third longitudinally extending passages formed in opposed side wall sections adjacent the upper end of said liner, and a second plurality of flow ports extending between said second and third passages and the interior of said liner for providing a spray header for directing fluid onto workpieces being finished in said vessel.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,707,058 Dated December 26, 1972

Inventor(s) Gordon H. Anderson and Raymond C. Ahlstrom

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 18, after "54" insert --which--. Column 7, line 47 (Claim 5), "sail" should be --said--. Column 8, line 33 (Claim 14), "claim 15" should be --claim 13--.

Signed and sealed this 29th day of May 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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