June 10, 1969 M. ISAACSON 3,448,747

DUAL CONTAINER WORK PROCESSING DEVICE

Filed Feb. 15, 1968 Sheet 1 of 4

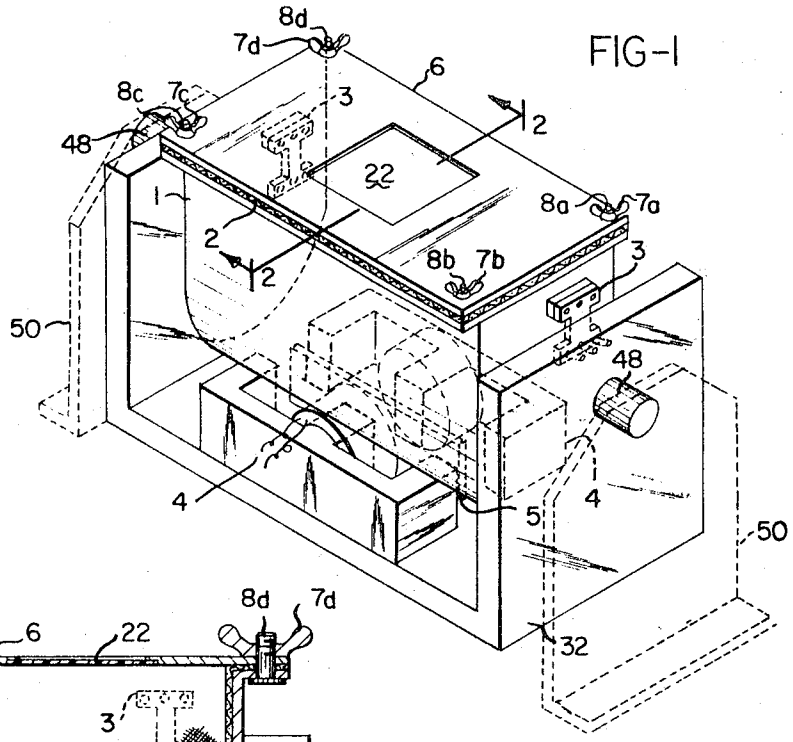


FIG-1

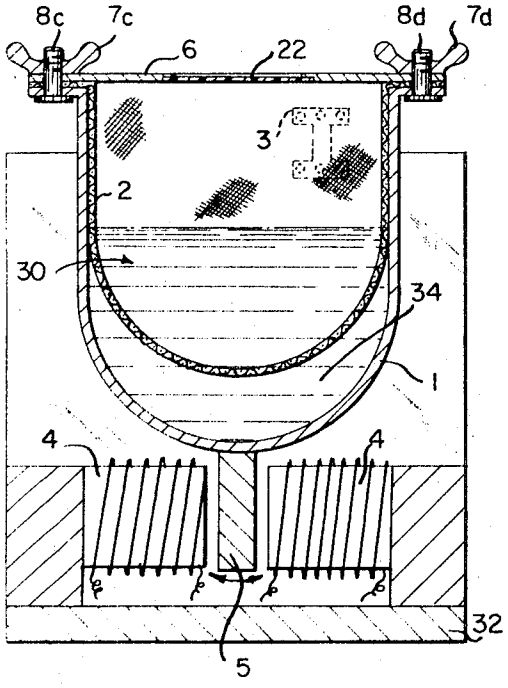


FIG-2

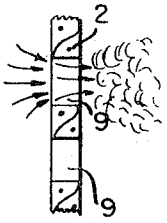


FIG-3

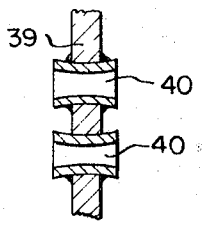


FIG-4

INVENTOR.
MAX ISAACSON

BY Milton E. Gilbert

ATTORNEY

DUAL CONTAINER WORK PROCESSING DEVICE

Filed Feb. 15, 1968 Sheet 2 of 4

FIG-5

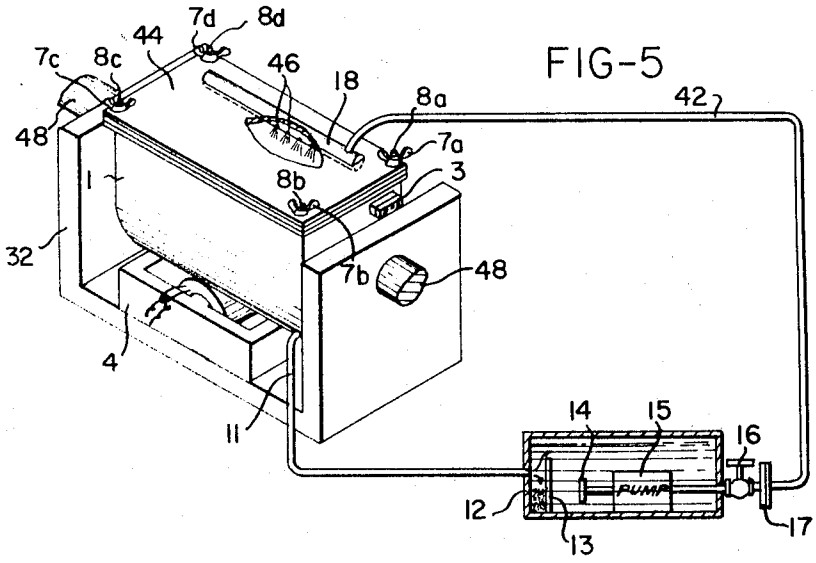


FIG-6

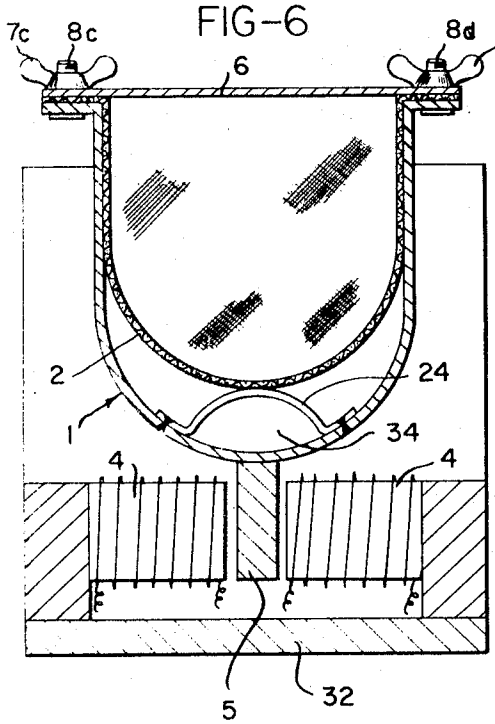
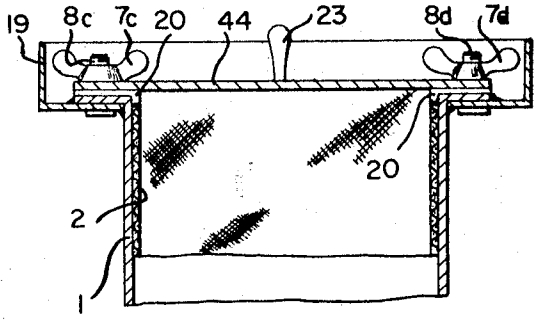


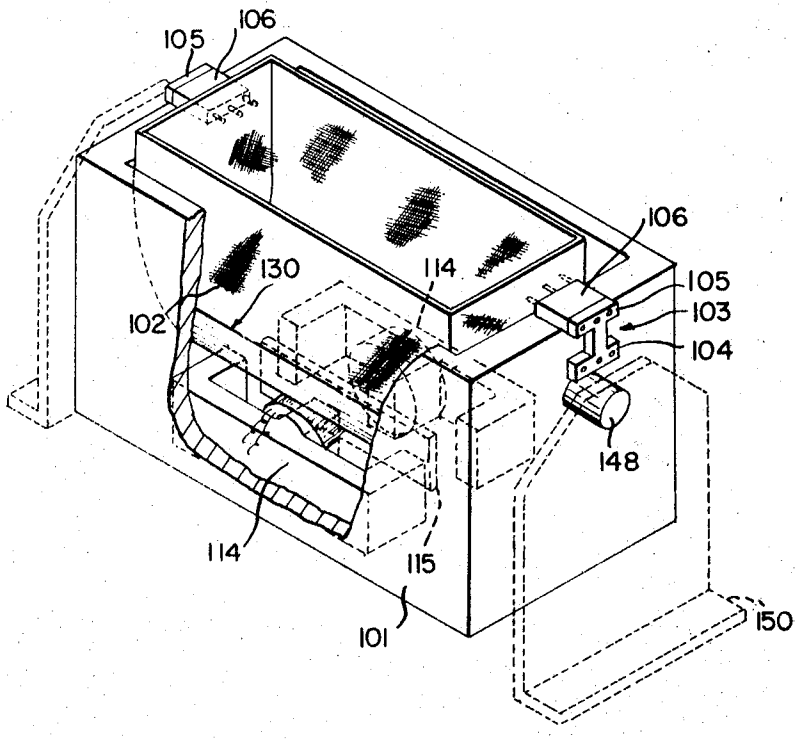
FIG-7



INVENTOR.
MAX ISAACSON
BY Walter E. Gilbert
ATTORNEY

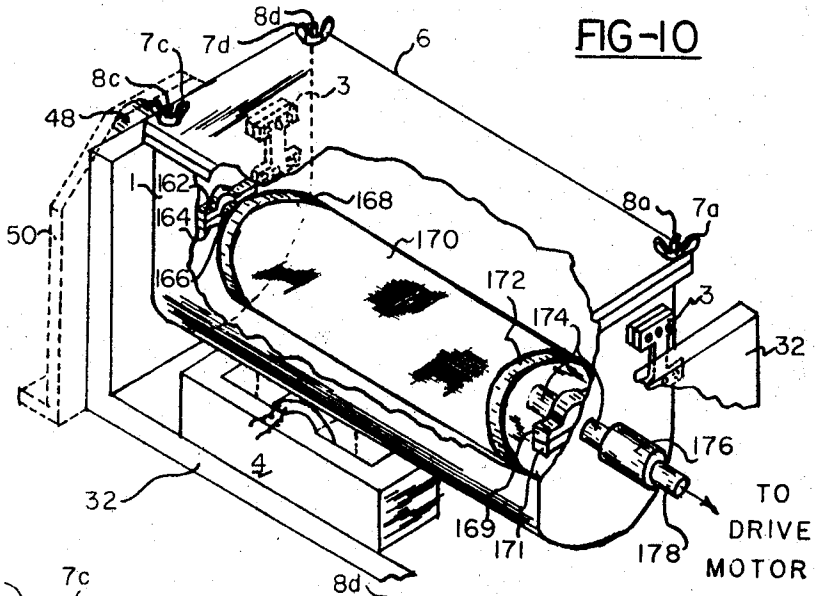
DUAL CONTAINER WORK PROCESSING DEVICE

FIG-8



INVENTOR.
MAX ISAACSON
BY Milton E. Gilbert
ATTORNEY

FIG-10



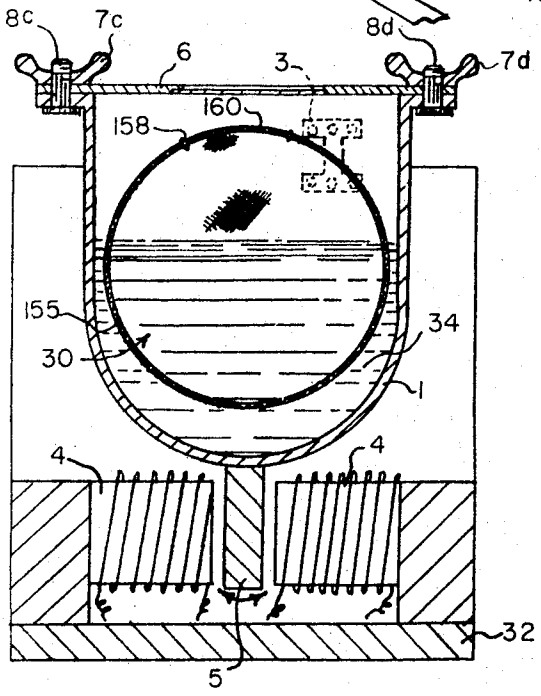


FIG-9

INVENTOR.
MAX ISAACSON
BY
attorney

United States Patent Office 3,448,747 Patented June 10, 1969

3,448,747

DUAL CONTAINER WORK PROCESSING DEVICE

Max Isaacson, 410 W. Nottingham Road,
Dayton, Ohio 45405

Filed Feb. 15, 1968, Ser. No. 705,703
Int. Cl. B08b 3/06, 3/02, 3/04
U.S. Cl. 134—120 7 Claims

ABSTRACT OF THE DISCLOSURE

A work processing device in which an outer tank contains a liquid and is mounted so as to impart orbital motion to a load of parts to be treated within the tub, upon linear oscillatory impulses being applied to the tub, and in which a perforated container is mounted to be immersed within the liquid and to have the linear oscillatory impulses applied thereto, the container being bodily displaced through said liquid. The liquid is then forced in a jet flow through the perforations of the container.

This invention relates to a device for removing dirt, grease and other contaminants from parts and assemblies used in industrial production.

One of the devices in use at the present time employs a magnetostrictive transducer to apply ultrasonic vibrations at frequencies of about 20,000 cycles per second to a liquid solvent contained in a tub. Also in this tub and usually contained in a wire basket are the parts to be cleaned. The ultrasonic vibrations cause an intense cavitational field in the liquid solvent; the "bursting" bubbles force the dirt off the parts to be cleaned. Neither the tub nor the wire basket containing the parts participate in the cleaning action but serve merely as containers for the liquid and for the parts respectively.

However, experience has shown that ultrasonic cleaning fails to remove large particles of dirt and grease, and is also ineffective when the parts to be cleaned are assemblies of components which may shield the critical areas to be cleaned. Furthermore, if these assemblies include components with small amounts of free play like the balls in the race of a ball bearing, then the high-frequency cavitational field will produce such high vibratory accelerations of the balls in the race that the balls will develop flat spots and the races will also be damaged.

It is one object of this invention to provide a simple and practical device for cleaning parts which is capable of removing large as well as small particles of dirt or contaminant.

A further object of this invention is to provide a cleaning apparatus capable of removing dirt particles without damaging the parts to be cleaned.

A still further object of the invention is to provide apparatus for cleaning parts having internal portions shielded from ready access to the cleaning fluid.

A still further object of the invention is to provide an apparatus for cleaning industrial parts wherein the parts are caused to follow an orbital path during the cleaning action.

These and other objects of this invention will become more readily apparent upon a reading of the following specification and upon reference to the accompanying drawings, in which:

FIG. 1 is a perspective view showing one embodiment of the cleaning apparatus of the invention,

FIG. 2 is a side view in cross section taken along line 2—2 of FIG. 1,

FIG. 3 is a cross-sectional view of a screen element showing the motion of the cleaning fluid therethrough,

FIG. 4 is a cross-sectional view, similar to FIG. 3 showing an alternate embodiment of the screen element,

FIG. 5 is a view showing a further embodiment of the invention with the addition of a recirculating system for screening the liquid,

FIG. 6 is a cross-sectional view similar to FIG. 2 showing an additional means for transmitting vibrations from the tub to the screen,

FIG. 7 is a partial cross-sectional view showing means for preventing splashing of cleaning liquid from the tub,

FIG. 8 is a perspective view showing further embodiments of my invention,

FIG. 9 is a side view similar to FIG. 2 but of a further embodiment of the invention, and

FIG. 10 is a perspective view, partially in section, of a still further embodiment of the invention.

The cleaning apparatus of the invention employs a vibratory tank into which a perforated container is placed. The parts to be cleaned are held within the perforated container and cleaning fluid is admitted to the tank. The perforated container is so constructed and arranged with respect to the tank that vibratory and turbulent motions of the liquid are created which serve to effectively remove all dirt particles, regardless of size.

In the embodiment of the invention as shown in FIGS. 1 and 2 there is provided a tank **1** of generally rectangular configuration, containing a cleaning liquid **30** and a screen **2** into which the parts to be cleaned are placed. The tank is flexibly supported within a frame **32** by springs **3, 3**. As shown in FIGS. 1 and 2, the springs **3, 3** are offset from the plane of symmetry; however the springs may be located symmetrically with respect to the tank **1** and screen **2**. The tank is caused to vibrate by an electromagnetic means including electromagnets **4, 4** which act upon the armature **5** which is welded or otherwise affixed to the tank **1**. A cover **6** is placed over the tank and screen and as shown in FIG. 1 is held in place by a series of wing nuts *7a*, *7b*, *7c* and *7d*, on respective studs *8a*, *8b*, *8c* and *8d*. The electromagnets may be alternately energized by suitable electrical impulses such as alternate rectified half-wave pulses. The tank **1** and the screen **2** are caused to vibrate by such means, thus setting in motion a vibratory and turbulent flow of the cleaning liquid **30**. The cover **6** may be provided with a transparent plate **22** to permit observation of the cleaning process if desired. While the frame **32** constitutes the primary support for the tank **1** it may be provided with trunnions **48, 48** for pivotally supporting the frame **32** (as indicated by dotted lines in FIG. 1) in a stand **50**.

The screen **2** is so shaped as to provide a chamber **34** between the tank **1** and the screen **2** which is normally filled with liquid. As the tank and the screen vibrate about an effective pivot point located near the center of the springs **3, 3**, the liquid entrapped in the chamber **34** between the screen and the tank is forced to flow through the openings in the screen and over the work parts contained within said screen. The relative velocity between the liquid and the work parts contained in the screen is accentuated because when the screen and parts move in one direction, the liquid flows in the opposite direction through the perforations and over the work parts. The velocity of this flow may be further increased if the screen is flexibly mounted with respect to the tank **1** and is so tuned mechanically that under the forced vibrations of the tank **1** the screen **2** moves in phase with and through larger amplitudes than the tank **1**. The additions of fins and vanes to the moving elements in the liquid can also be used to increase the flow rates, turbulence, and cleaning effectiveness. As shown in FIG. 8, a mounting frame **150** supports a tank **101** via the trunnions **148, 148**. A perforated screen element **102** is suspended wtihin tank **101** by means of the springs **103, 103**. Each spring **103** is mounted at its lower end **104** to the outside of the tank **101**, and at its upper end **105** to a spacer element **106**. A

flexible mounting of the screen wtihin the tank may be thus provided.

As further shown in FIG. 8, the screen element **102** may be directly vibrated while the tank **101** remains relatively motionless. In this configuration the cleaning fluid **130** is caused to flow turbulently through the perforations in the screen **102** and over the parts to be cleaned. The means for vibrating the screen may be any motive source which creates vibrations, but preferably is the electromagnets **114, 114**, which are mounted in the bottom of tank **101**, and which coact with an armature or paddle element **115** which is affixed to the bottom of screen **102**. Upon vibratory motion of the screen **102**, the element **115** acts as a paddle to cause additional flow and turbulence of the cleaning fluid **130**.

The flow through the holes in the screen is turbulent and contains considerable jet action which is effective in cleaning the parts. As shown in FIG. 3 an ordinary screen **2** of suitable mesh may be employed having openings **9, 9** for permitting the flow of the liquid to pass through the screen.

FIG. 4 shows an alternate form of screen means in the form of a perforated plate **39** having a series of venturi inserts **40, 40** inserted in the screen to increase the effectiveness of the jet flows.

The liquid used to wash the parts may be of any of several commercially available solvents such as trichloroethane. In order to conserve and purify the liquid a system may be employed such as shown in FIG. 5. A conduit **11** is suitably connected for removing the fluid from the bottom of the tank **1** and for conducting same to a settling tank **12**. The tank **12** contains a baffle plate **13** located adjacent to the influx of liquid and serves to separate the majority of dirt particles from the flow. A further means for purifying this flow is the filter **14** through which the liquid is next strained. The filtered liquid is then pumped by a pump **15** back to the tank **1** via the conduit **42**. A flow adjusting valve **16** and additional filter-cleaner **17** are provided in the flow line for further decontamination and flow adjustment. Other cleaning means such as distillation and/or centrifuging can be used. The cover plate **44** has affixed thereto a spray tube **18** to which the conduit **42** is connected. Openings **46, 46** are provided in the lower portion of tube **18** to return the liquid to tank **1**.

In the embodiment of the invention in which the tank **1** is directly vibrated, it is important that the vibrations of the tank **1** be transmitted to the screen **2** with minimum loss of energy. In FIG. 6 there is shown a positive means in the form of a spring clip **24** for effecting such motion transfer. The clip **24** may be welded to the tank **1** or to the screen **2** (not shown). When screen element **2** is set inside the tank **1** and fastened in place by means of wing nuts **7***a*, **7***b*, **7***c* and **7***d*, the screen is forced against said spring clip **24**. Consequently, when the tank **1** is forced to vibrate, the screen **2** vibrates conjointly with the tank **1**. A series of such clips **24** may be employed, if desired.

In FIG. 7 there is shown a means for preventing the splashing of the liquid out of tank **1**. The tank is provided with a peripheral flange or vertical lip **19** which extends continuously around the periphery of the top of tank **1** and is attached thereto. The screen element **2** has cutouts **20** at several stations around its perimeter. When the liquid contained in tank **1** splashes upwards it may seep out between the tank **1** and the screen. This liquid will be entrapped by the lip **19** and flow back into the tank through the openings **20**. The cover **44** is employed to fasten the screen **2** tightly against the tank **1** and may be provided with a handle **23** to permit the operator to lift it easily off the tank **1**.

In all of the embodiments of the invention one of the two containers **1** or **2** is caused to be oscillated by an electromagnetic means, and the parts contained within the screen element **2** are caused thereby to travel in an orbital path. In order to provide for freer and greater movement of the parts with the screen element it may be desirable to form the latter into a tubular member such as shown at **155** in FIG. 9. In this event the screen would be provided with a portion thereof **160** hinged at **158** and appropriately fastened (not shown) by a releasable latching means. Alternatively the element **155** could be side loaded (not shown).

Should even a more positive flow of parts be desired so as to insure orbital movement of parts (especially desirable where relatively heavy parts are to be cleaned), then a motorized drive may be provided for the screen element such as shown at **170** in FIG. 10. The screen element is provided with end caps **168** and **172**. The end cap **168** may have joined thereto or formed thereon a stub shaft **166** which is journaled into a split bushing **162, 164**. The lower member **164** of this bushing can be suitably affixed to the inside of the tank **1** in any desirable manner, and the element **162** is preferably releasably fastened (not shown) as by nut or bolts to the lower member **164** but is not affixed to the tank **1**. This will enable ready assembly and disassembly of the screen **170**. The cap member **172** is provided with a similar shaft **174**, however this shaft is much longer and passes through the split bushing **171** and **169** and through a suitably sealed opening (not shown) in the opposite tank wall. The split bushing **171, 169** may be similarly arranged as the bushing **162, 162** in that the lower member **171** is affixed to the wall of the tank and the upper member **169** is releasably assembled to the lower member **171** but is not affixed to the tank **1**. The shaft **174** is coupled to the drive shaft **178** of a suitable drive motor through a suitable flexible coupling **176**.

In all of the embodiments of the invention as illustrated in the drawings like reference numbers have been applied to the identical parts where they are used in different species of the invention. Although specific embodiments have been shown and described, it will be readily apparent to those skilled in the art that various modifications and rearrangements of parts may be made without departing from the spirit and scope of the invention as set forth in the appended claims. Thus, for example, the mounting of the shafts **166, 174** with respect to the axis of the screen **170** may coincide therewith, or be eccentric thereto as shown in FIG. 10.

What I claim is:

1. A work processing device, comprising in combination:

an outer imperforate container adapted to contain a liquid medium, a perforated container immersed in said outer container and so mounted and arranged within said outer container as to permit only one degree of freedom of motion of said perforated container and to provide an effectively fixed pivotal axis therefor, said perforated container being employed to contain work to be processed;

and motive power means adapted to impart linear oscillatory impulses to said device and to said liquid at a point remote from the said mounting, whereby said impulses forcibly bodily displace said perforated container through said liquid and said liquid through the perforations of said perforated container through an appreciable amplitude so as to cause jet flow of liquid through the perforations of said perforated container.

2. The work processing device of claim **1** wherein the walls of said two containers are rigidly connected to one another over a substantial area to create a fluid chamber therebetween.

3. The work processing device of claim **2** wherein the containers are so constructed and arranged that said chamber is closed at its upper portion and has its maximum volumetric capacity at its lowermost portion.

4. A work processing device, comprising in combination:

an outer imperforate container adapted to contain a

liquid medium, said outer imperforate container being mounted on a support and arranged as to permit substantially only one degree of freedom of motion thereof and to provide an effectively fixed pivotal axis therefor;

a perforated container mounted and arranged within said outer imperforate container to be immersed within said liquid, said perforated container being employed to contain work to be processed;

motive power means adapted to impart linear oscillatory impulses to said perforated container and liquid at a point on said container remote from its mounting;

said perforated container being so mounted as to move in the direction of application of said impulses and to have said impulses imparted at a point remote from its mounting, said perforated container having its perforations disposed in the said direction of application of said impulses;

spring means associated with said device and so arranged whereby said impulses forcibly displace said perforated container through an appreciable amplitude so that when liquid and work parts are present in the device there will be produced an orbital motion of the parts within the perforated container and jet flow of the liquid through the perforations of said perforated container.

5. The work processing device of claim **4** wherein said perforated container is in the form of an enclosed tube which is arranged substantially coextensive with said imperforate container and is freely movable therein.

6. The work processing device of claim **5** wherein said perforated container is provided with means for positively rotating same during application of said oscillatory motion.

7. The work processing device of claim **4**, including means affixed to said outer container providing a flexible yielding support for the bottom of said perforated container so as to permit relative motion between the two containers while preventing sagging of said perforated container and unwanted local accumulation of work to be processed within the perforated container.

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ROBERT L. BLEUTGE, *Primary Examiner.*

U.S. Cl. X.R.

68—3; 134—148, 153, 159, 163; 259—1