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CLEANING APPARATUS

Filed March 20, 1962 2 Sheets-Sheet 1

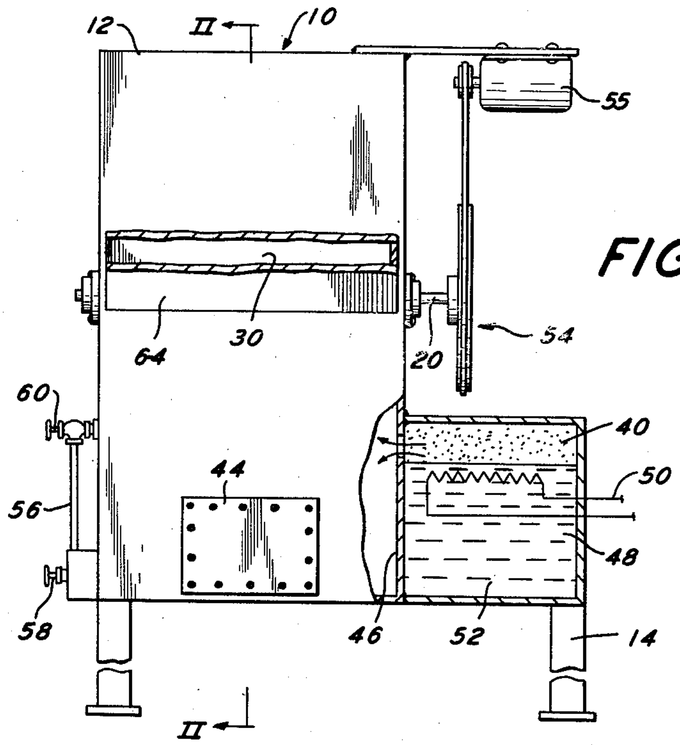

FIG.1

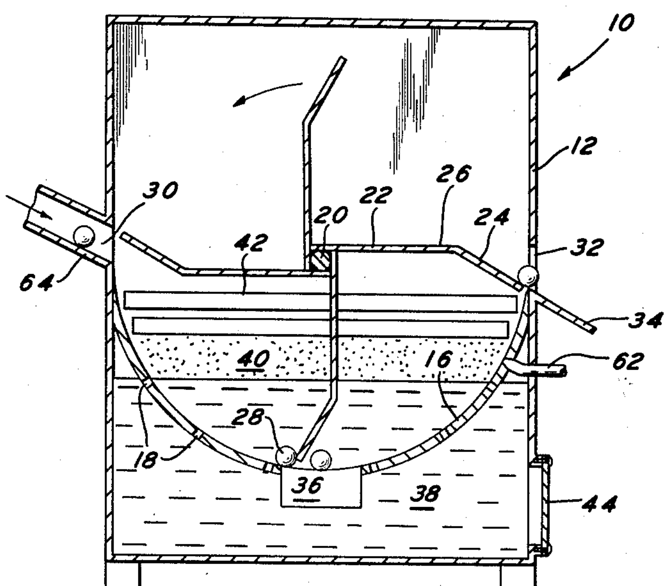

FIG.2

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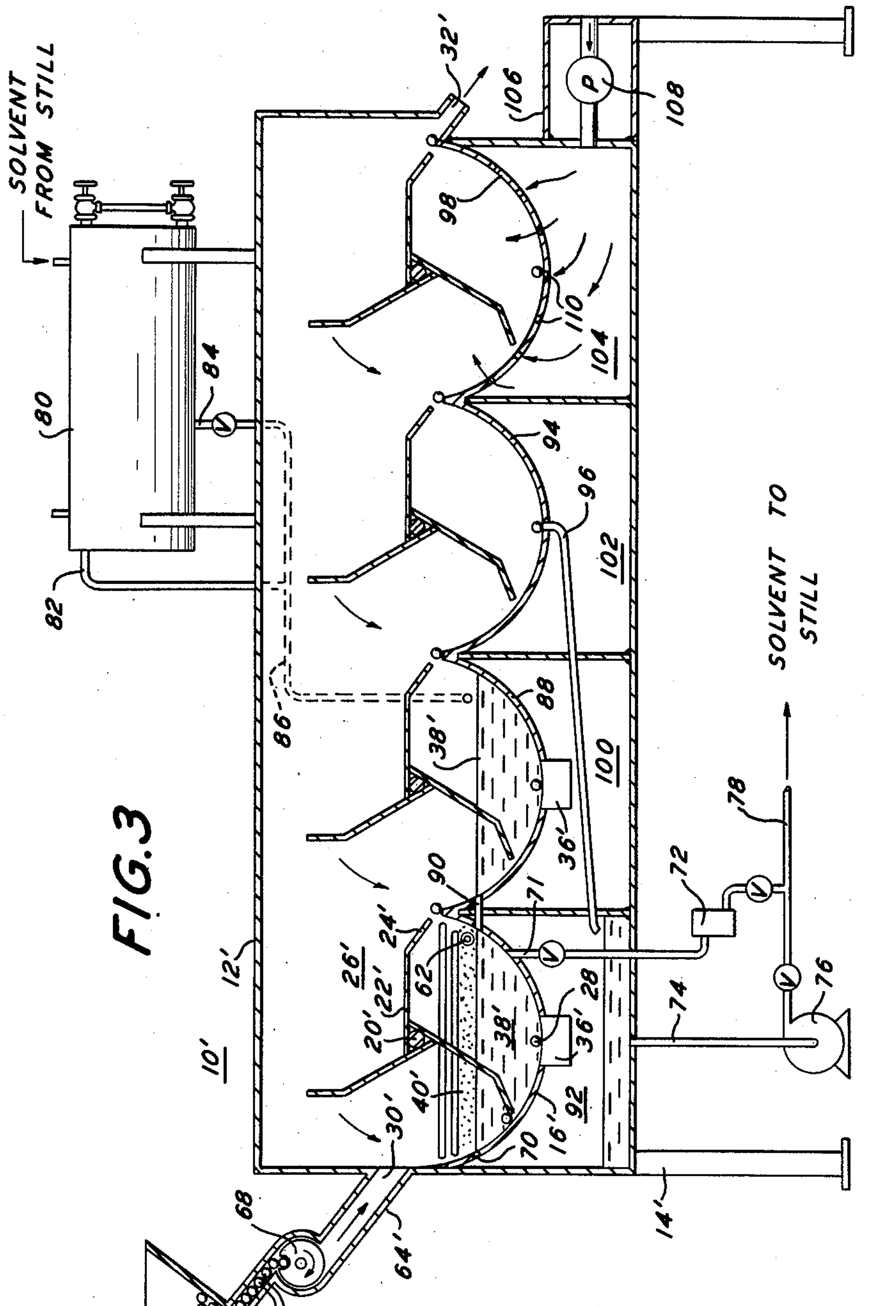

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CLEANING APPARATUS

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In general, this invention relates to cleaning apparatus, and more particularly, to cleaning apparatus for removing grease and hydrocarbon deposits plus dirt from machined parts such as bearings by treatment with solvents such as chlorinated hydrocarbons, trichloroethylene, etc.

The satisfactory and rapid cleaning of small machined parts such as bearings, presents a most difficult problem. Experience has shown that notwithstanding repeated submerges in solvents affected by conventional cleaning equipment, an apprecibale amount of contaminate in the nature of adhering dirt or the like remains on the machine parts. In addition, in the case of a ball bearing cleaning, it is a serious problem in the bearing industry to avoid impingement of the balls on themselves. Thus, if the balls are not placed carefully into the cleaning apparatus and removed smoothly therefrom, flat spots will occur due to impingement of one ball on another and therefore rejections of the cleaned ball bearings due to the flat spots will be present.

Apparatus utilized heretofore has included an ultrasonic transducer for effecting cleaning of the machined parts by generating cavitation of the solvent. Cavitation is essentially a gas-filled cavity or bubble which is generated in a liquid by the passage of an intense sound wave through the liquid. The present invention comprehends the generation of cavitation solely in the area of the solvent where the machined parts are passing through the solvent as compared to cavitating the entire body of solvent in the cleaning apparatus. It should be noted that the cavitation effect concentrates at certain levels called power nodes wherein the most effective cleaning is obtained. By utilizing a paddle wheel type pusher in a semi-cylindrical tub member, the arcuate path of the parts to be cleaned assures that the parts pass through the power nodes. It is the general object of the present invention to avoid and overcome the difficulties of and exceptions to the prior art by the provision of a new and better cleaning apparatus.

It is another object of the present invention to provide a novel cleaning apparatus capable of achieving a high degree of cleaning of small machined parts such as bearings.

It is another object of the present invention to provide a new and better cleaning apparatus in which the objects to be cleaned are fed smoothly into the cleaning apparatus and discharged smoothly therefrom.

Still further objects and the entire scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood however, that the detailed description while indicating preferred embodiments of the invention, is given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

The apparatus of this invention will become more readily apparent by reference to the attached drawings in which:

FIGURE 1 is a side partially sectionalized view of one embodiment of the present invention.

FIGURE 2 is a sectional view of the apparatus shown in FIGURE 1 taken along lines II—II.

FIGURE 3 is a sectionalized end view of a second embodiment of the present invention.

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In FIGURES 1 and 2 there is shown a compact single unit type ball bearing cleaning apparatus utilizing the principles of the present invention. The cleaning apparatus 10 has a housing 12 supported by legs 14. Within the housing 12 is a semi-cylindrical tub 16 having perforations 18 therein. Paddles 26 mounted for movement about axis 20 of the semi-cylindrical tub 16 are made of straight sections 22 and angular sections 24. It will be noted that the angular section 24 is so called because it is at an angle to the radial distance between the tip of the paddle 26 and the axis of rotation 20. The paddles 26 are driven through a belt means 54 by a motor 55. Ball bearings or other machined parts to be cleaned are fed through the feed opening 30 in the housing 12 and are removed through discharge opening 32 in the housing 12.

The angle of the angular portion 24 is preferably made to mate with the angle of the feed chute 64 at the opening 30 and the angle of the discharge chute 34 at the discharge opening 32. In this manner, ball bearings entering the cleaning apparatus 10 are fed smoothly by the vanes till they reach the bottom of the tub where they will lie until the succeeding blade pushes them smoothly upward and outward through the discharge opening 32.

An immersion chamber 38 is provided within the lower portion of the housing 12. The immersion chamber 38 contains a cleaning solvent such as trichloroethylene or the like. The immersion chamber 38 includes the bottom portion of the housing 12 and the bottom portion of the tub 16, which two portions are in fluid communication by reason of the perforations 18 in the tub 16. A vapor zone 40 is maintained above the cleaning liquid in the immersion chamber 38. The upper limit of the vapor zone 40 is determined by the cooling coils 42 which extend along the inner periphery of side walls of the housing 12 at a level just below the feed and discharge openings 30 and 32.

A sump 52 is provided within the housing 12 and a heating coil 50 is positioned within the sump 52. The heat from the heating coil 50 vaporizes the solvent within the sump 52 so as to maintain the vapor zone 40. The solvent within the sump 52 is maintained separate from the solvent within the immersion chamber 38 by an upright wall 46. An ultrasonic transducer 36 is placed at the bottom of the tub 16 so as to radiate upwardly and generate cavitation only in that portion of the solvent through which the machined parts will pass. It will be noted that the perforations 18 in the wall of the tub 16 are provided so that contaminate can settle into the bottom of the housing 12 rather than on the wall of the tub 16.

The outer arcuate wall of the tub 16 is provided with holes in the vapor zone 40 through which extend nozzles 62, of which only one is shown. Each nozzle 62 is connected to a pump (not shown) which in turn is connected to a trough (not shown) located below the cooling coils 42. The nozzles 62 direct a stream of clean distillate at the bearings after they have emerged from the solvent in the immersion chamber 38.

A clean out opening 44 is provided to periodically clean out the sediment at the bottom of the housing 12 after cleaning operations. A fill valve 60 and a drain valve 58 are provided for periodic or continuous change of the cleaning liquid and a gauge glass 56 is also used to determine the level of the liquid in the cleaning apparatus 10.

The operation of the cleaning apparatus 10 shown in FIGURES 1 and 2 is as follows:

Ball bearings or machined parts having adhering contaminate are fed down the feed chute 64 through the opening 30 so that they will slide easily onto the angular portion 24 of the pusher vane 26. This type of contact will prevent the occurrence of flat spots on the bearings due to abrupt contact between them. The machined parts to be cleaned are moved along the surface of the tub 16 by the pusher vane 26. As the pusher vane 26 moves the machined parts through the vapor zone 40, the machined parts, due to gravity, tumble so that they are moved through the solvent in the immersion chamber 38 on the inner surface of the tub 16 by the pusher vane 26. As the machined parts are moved through the vapor zone 40 they are degreased. As the machined parts pass through the solvent in the immersion chamber 38 they are subjected to the cavitation generated by the ultrasonic transducer 36. At the lowermost point of the tub 16, the machined parts are out of the control of the vane 26 for a short period of time. The ultrasonic transducer 36 is mounted directly below the machined parts when they pass out of the control of the pusher vane 26. At this point, the machined parts are directly subjected to the cavitation generated by the transducer 36. The spacing between the pusher vanes 26 prevents any structure from interrupting the cavitation. Any contaminate removed from the machined parts will settle on to the inner surface of the tub 16 and pass through the perforations 18 into the bottom of the housing 12. Thereafter, the settlement will not be in a position to interfere with the cavitation generated by the ultrasonic transducer 36.

While still subjected to the cavitation generated by the transducer 36, the machined parts are moved by the succeeding pusher vane 26 along the inner surface of the tub 16 out of the cavitation zone and through the vapor zone 40 on the right hand side of the apparatus shown in FIGURE 2. As the machined parts pass through the vapor zone 40, they are subjected to a stream of clean distillate by the nozzles 62. The stream of distillate from the nozzles 62 rinses the machined parts. As the machined parts pass through the vapor zone 40, the temperature of the parts is increased so that the parts may dry more readily.

When the pusher vane 26 mates with the discharge opening 32 the bearings will roll smoothly down the discharge chute 34 with little or no physical contact between the parts.

It should be noted that the cavitation effect concentrates at certain levels called power nodes wherein the most effective cleaning is obtained. The arcuate path of the parts to be cleaned assumes that the parts pass through the power nodes.

FIGURE 3 is a more sophisticated embodiment of the invention shown in FIGURES 1 and 2. In FIGURE 3, four modules somewhat similar to the type shown in FIGURES 1 and 2 are utilized to more effectively clean ball bearings or machined parts. In FIGURE 3, cleaning apparatus 10' has a first module on the left side of FIGURE 3 which includes a tub 16', pusher vanes 26', cooling coils, vapor zone 40' and nozzles 62' which perform the same functions described with reference to FIGURES 1 and 2. The immersion chamber 38', however, is confined to the lower arcuate portion of the tub 16' as the perforations 18 of FIGURE 2 have been omitted. An overflow hole 70 is made in the tub 16' to prevent the solvent level in the tub 16' from exceeding the limit set by the hole 70. Any overflow liquid will fall to a chamber 92 in the bottom of the housing 12. The vapor zone 40' is maintained in the same manner as was described with reference to FIGURES 1 and 2.

Bearings are fed through a feed hopper 66 to a rotary feed member 68 having a U-shaped longitudinal notch therein for receiving a row of bearings and being capable of rotatably feeding them through the chute 64 as a single line. After completing the washing cycle in the tub 16', the bearings are discharged into a rinse tub arrangement 88 similar to the tub 16'. The semi-cylindrical tubs 88 and 16' are connected through an orifice 90 so that the immersion chamber 38' includes the bottoms of both of the above mentioned tubs. A drain pipe 74 at the bottom of housing 92 into which the overflow from

the tub 16' falls, carries the overflow fluid through a valve to a pump 76. The pump 76 is capable of delivering this fluid through a pipe 78 to a still. A second drain pipe 70 is connected through an opening in the tub 16' to drain continuously the dirty cleaning fluid in the tank 16' through a valve to a filter 72 whence it is cleaned. Clean fluid from the filter 72 is fed through another valve to the line 78 and thence to a still. In this still, the cleaning fluid is again decontaminated for reuse in the cleaning apparatus. Cleaning fluid from the still (not shown) is fed to a solvent surge tank 80 having an overflow pipe 82 and a drain pipe and valve arrangement 84 and fed through a pipe 56 to the immersion chamber 38' in the rinse tub 88. Thus, a continuous draining of the cleaning fluid in the wash tank 16' is compensated for by the return into the rinse tank 88 of the decontaminated cleaning fluid.

The bearings, after the rinse operation is completed in the tub 88, are moved by the pusher arms 26 into the drain tub 94 adjacent the rinse tub. In the drain tub 94 the liquid adhering to the ball bearings or machined parts is allowed to drain through a pipe 96 located at the bottommost portion of the tub 94. This drain pipe 96 is located in the chamber 102 below the tub 94 and is connected through the chamber 100 below the rinse tank 88 to the chamber 92 below the wash tub 16'. Thus, the cleaning fluid from the drain tub 94 is also fed back through the drain pipe 74 and pump 76 to be reused in the washing and rinsing operation. The ball bearings in the drain tub 94 are moved by the pusher arms 26 into the drying tub 98. An air control chamber 106 is adjacent the chamber 104 below the drying tub 98. A pump 108 supplies hot dry air to the chamber 104. This hot dry air is forced through perforations 110 in the drying tub 98 so as to dry the bearings 28. The pusher arm 26 then discharges the ball bearings from the cleaning apparatus 10' through an opening 32.

While few of the best known embodiments of the invention have been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

I claim:

1. A machine for washing bearings and the like comprising a tub member of a semi-cylindrical shape adapted to have a cleaning liquid placed therein, a housing enclosing said tub member, said housing having feeding and discharging means, said tub member having at least one perforation therein, said housing being constructed and arranged to receive liquids discharged thereinto from said perforation, means to continuously maintain a body of liquid in the tub, a plurality of angularly disposed rotatably mounted paddles above said tub member, each paddle having a tip disposed at an angle with respect to the remainder of each paddle and a radius of the tub member, said remainder of each paddle being generally perpendicular to the axis of rotation of said paddle, means maintaining the angular relationship of the paddles and their tips constant, and means for rotating said paddles to facilitate movement of the elements to be cleaned from the feeding to the discharging means, said means rotating said paddles in a direction such that each tip is angled away from the direction of rotation of said paddle.

2. The cleaning apparatus of claim 1 wherein feeding and discharging means are placed on opposite sides of said tub member and at least one of said feeding and discharging means includes a chute placed at substantially a mating angle to the angle of said paddle tips when said paddle tips are abreast one of said feeding and discharging means.

3. The cleaning apparatus of claim 1 wherein the perforation in said tub member is above a certain level so that only fluid above said certain level will flow therefrom into the said housing.

4. The cleaning apparatus of claim 3 wherein liquid changing means is provided for continuously removing all

liquid from said tub member, cleaning the liquid and replacing the old liquid with cleaned liquid in the tub member.

5. A machine in accordance with claim 1 including a second tub member of semi-cylindrical shape juxtaposed to said first tub member in a manner so that elements to be cleaned may pass through the tub members in series, a second set of rotatable paddles for said second tub member, said second set of paddles being identical with said first mentioned plurality of paddles, and means operatively associated with the paddles for said second tub member for rotating the last-mentioned paddles.

6. The machine of claim 5 including interconnection means for interconnecting the fluid in said first and second tub members, and fluid cleaning means adapted to remove dirty fluid from said first tub member, clean said fluid, and return the cleaned fluid to said second tub member.

7. The machine of claim 6 including a third tub member adjacent said second tub member for draining bearings of fluid after said bearings leave said second tub member, and drain means for returning said fluid from said third tub member to said first and second tub members.

8. The cleaning apparatus of claim 6 wherein a fourth tub member is provided for drying said bearings, and hot air pumping means for blowing hot air around said bearings to dry them in said fourth tub member.

9. The cleaning apparatus of claim 6 wherein an ultrasonic transducer is effective on the liquid in at least one of said first and second tub members whereby bearings in said liquid are subject to cavitation generated by said transducer.

10. A machine is accordance with claim 1 including means providing a vapor zone within the tub member above the cleaning liquid adapted to be placed therein, whereby elements to be cleaned pass through the vapor zone prior to and after passing through the liquid.

11. A machine in accordance with claim 1 including an ultrasonic transducer coupled to the tub member at a point approximately equidistant from the longitudinally extending side edges of the tub member, whereby elements to be cleaned in a liquid may be subjected to cavitation generated by the transducer.

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