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CLEANING APPARATUS

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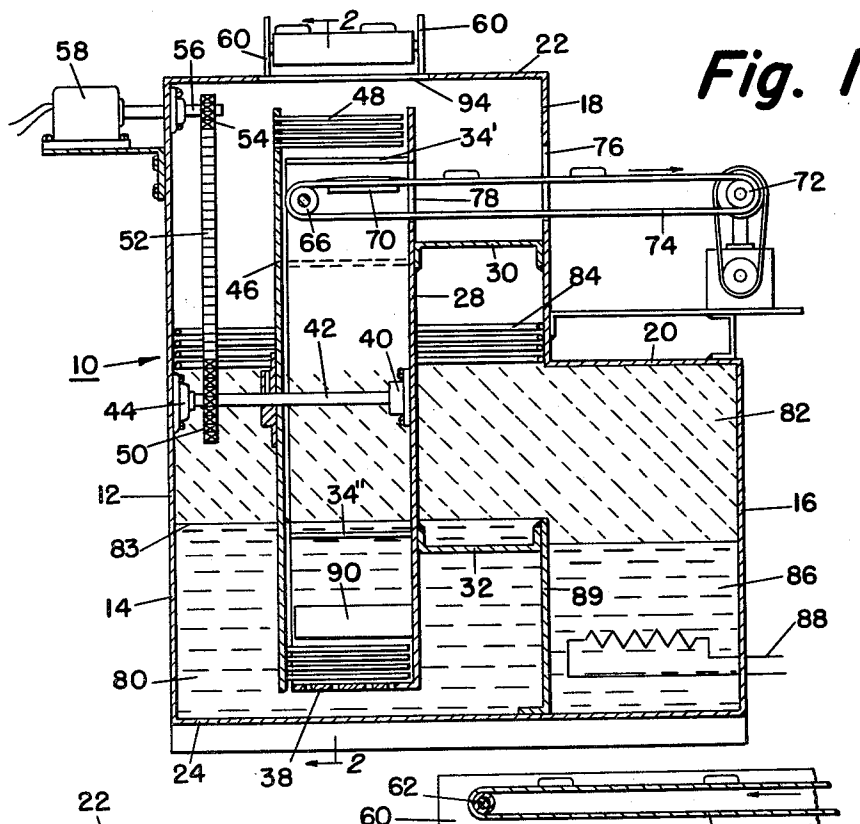


Fig. 1

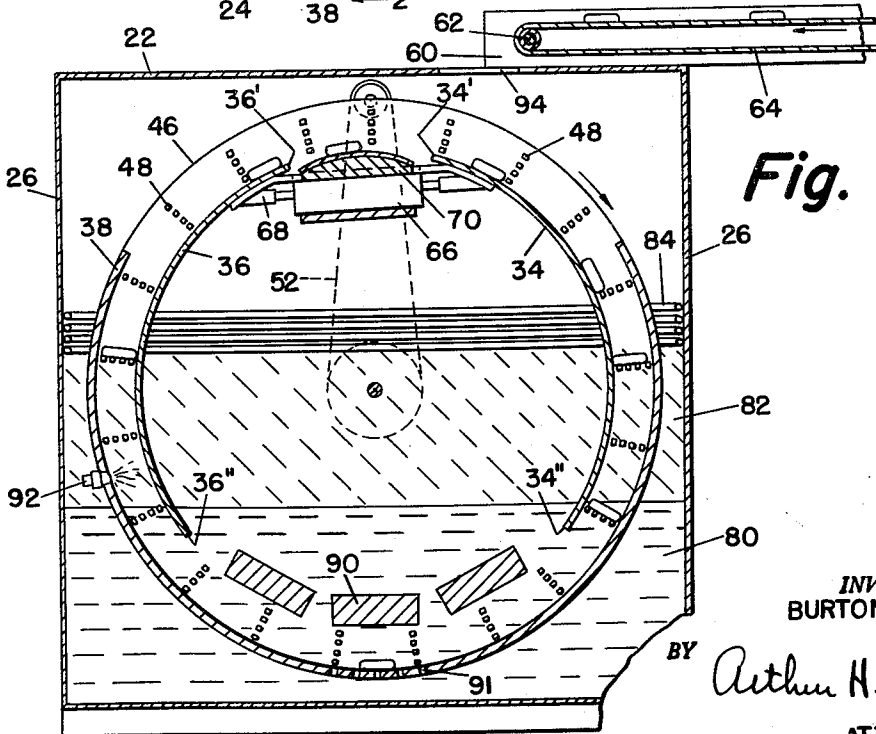


Fig. 2

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CLEANING APPARATUS

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

The satisfactory and rapid cleaning of small machined parts, such as machined parts which have been buffed, ground or the like presents a most difficult problem. Experience has shown that notwithstanding repeated submerges in solvents effected by conventional cleaning equipment, an appreciable amount of contaminate in the nature of adhering dirt or the like remains on the machined parts, particularly in the hollows of interstices thereof. The presence of adhering contaminate presents a serious problem where the machined parts are utilized in a structure designed to have close tolerances.

Apparatus utilized heretofore has included an ultrasonic transducer for effecting cleaning of the machined parts by generating cavitation in the solvent. As used heretofore, the machined parts have been transported through the cleaning apparatus in wire mesh type baskets or the like and the ultrasonic transducer has been positioned below the baskets. I have found that the cleaning effect can be greatly enhanced by localizing the cavitation generated by the ultrasonic transducer. In addition, I have found that the size of the transducer can be reduced and the parts can be cleaned more efficiently by mounting the transducer above the parts to be cleaned. In this manner, the contaminate which is removed from the machined parts cannot settle onto the transducer, but instead will settle on the bottom wall of the cleaning apparatus. In addition, the baskets used heretofore interrupt the cavitation when they are positioned intermediate the machined parts and the transducer. The interruption of the cavitation by the baskets reduces the efficiency of the ultrasonic cleaning effect of the cavitation.

Cavitation is essentially a gas-filled cavity or bubble which is generated in a liquid by the passage of an intense sound wave through a liquid. The present invention comprehends the generation of cavitation solely in that 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.

The present invention not only provides satisfactory and rapid cleaning of small machine parts such as bolts, ball bearings, etc., but also is more compact and efficient than in-line production apparatus used heretofore.

It is an object of the present invention to provide a novel cleaning apparatus.

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

It is another object of the present invention to provide a novel cleaning apparatus wherein machined parts are subjected to cavitation generated by a transducer mounted above the machined parts.

It is still another object of the present invention to provide a novel cleaning apparatus wherein the machined parts are mechanically delivered to the cleaning apparatus, mechanically passed through the cleaning apparatus, and mechanically carried away from the cleaning apparatus completely automatically.

Other objects will appear hereinafter.

For the purpose of illustrating the invention there is

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shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a longitudinal sectional view of the cleaning apparatus of the present invention.

FIGURE 2 is a transverse sectional view taken along the lines 2-2 in FIGURE 1.

Referring to the drawing in detail, wherein like numerals indicate like elements, there is shown in FIGURE 1 a cleaning apparatus designated generally as 10.

The cleaning apparatus 10 comprises a generally rectangular housing 12. The housing 12 comprises a rear wall 14, a front wall section 16, a front wall section 18 connected to the front wall section 16 by a shelf 20, a top wall 22, a bottom wall 24, and side walls 26.

A generally upright plate 28 is fixed within the housing 12 by brackets 30 and 32. An inner arcuate wall 34 and an inner arcuate wall 36 are fixedly mounted on the plate 28. The inner arcuate wall 34 is provided with an upper end 34' and a lower end 34''. The inner arcuate wall 36 is provided with an upper end 36' spaced from the upper end 34' and a lower end 36'' which is spaced from the lower end 34''.

The inner arcuate walls 34 and 36 each extend through an arc of approximately 120 degrees. An outer arcuate wall 38 extending through an arc of substantially 240 degrees is concentrically mounted on the plate 28 around a major portion of the inner arcuate walls 34 and 36. Thus, it will be seen that the inner arcuate walls 34 and 36 are spaced radially inwardly from the outer arcuate wall 38 and that the walls 34, 36, and 38 along with the plate 28 are fixed relative to the housing 12.

A bearing 40 is fixedly mounted on the inner surface of the plate 28. A shaft 42 is rotatably mounted between the bearing 40 and a bearing 44 on the inner surface of the rear wall 14. A circular movable plate 46 is keyed to the shaft 42 intermediate the ends of the shaft 42. The movable plate 46 is parallel to the plate 28 and is provided adjacent its periphery with a plurality of spaced rows of pusher vanes 48. The rows of pusher vanes 48 have a length slightly less than the distance between the inner arcuate walls 34 and 36 and the outer arcuate wall 38.

As seen more clearly in FIGURE 1, a driven sprocket 50 is fixedly secured to the shaft 42. A flexible belt or chain 52 extends around the driven sprocket 50 and a driving sprocket 54. The driving sprocket 54 is fixedly secured to a shaft 56 extending from the motor 58. The motor 58 is conveniently mounted on the rear wall 14. The chain 52 and sprocket 50 do not require lubrication.

A pair of spaced parallel plates 60 are fixedly secured in any convenient manner to the top wall 22 of the housing 12. A roller 62 extends between the plates 60. A flexible belt 64 extends around the roller 62. The belt 64 extends around a driving roller (not shown) which causes the belt 64 to move and thereby convey machined parts to the cleaning apparatus 10.

A driven roller 66 is rotatably mounted on a shaft 68 which extends between the fixed inner arcuate walls 34 and 36. A crown-shaped plate 70 is fixedly secured intermediate the fixed inner arcuate walls 34 and 36. A driving roller 72 is rotatably supported in any convenient manner and is rotated by a conventional motor means. A flexible belt 74 extends around the rollers 66 and 72, whereby rotation of the driving roller 72 causes the belt 74 to convey cleaned machined parts away from the cleaning apparatus 10. These parts are above the vapor zone and therefore do not require a separate lubrication system.

The roller 66 and the crown-shaped plate 70 are posi-

tioned intermediate the free upper ends 34' and 36' so that the belt 74 is crown-shaped at the point where the pusher vanes 48 move the clean machined parts thereon for conveyance away from the cleaning apparatus 10. The belt 74 is caused to assume a crown-shape between the ends 34' and 36' so that the clean machined parts will be positioned at the middle area of the belt 74 before the machined parts move out of the influence of the rotating pusher vanes 48. In order to attain this result, the speed of belt 74 must be correlated with the speed of the vanes 48.

The front wall section 18 is provided with an opening 76 and the fixed plate 28 is provided with an opening 78 through which the belt 74 extends. The openings 76 and 78 are of sufficient size so as not to interfere with the clean machined parts being conveyed on the belt 74.

An immersion chamber 80 is provided within the lower portion of the housing 12. The immersion chamber 80 contains a cleaning solvent such as trichlorethylene or the like. A vapor zone 82 is maintained above the cleaning solvent in the immersion chamber 80. The interface between the vapor zone 82 and the solvent in the immersion chamber 80 is designated as 83. The upper limit of the vapor zone 82 is determined by the cooling coils 84 which extend around the inner periphery of the housing 12 at the level of the shelf 20.

A sump 86 is provided within the housing 12 and a heating coil 88 is positioned within the sump 86. The heat from the heating coil 88 vaporizes the solvent within the sump 86 so as to maintain the vapor zone 82. The solvent within the sump 86 is maintained separate from the solvent within the immersion chamber 80 by an upright wall 89.

A plurality of ultrasonic transducers 90 extend from the inner surface of the plate 28 and are positioned between the ends 34' and 36' of the inner arcuate walls 34 and 36 respectively. The transducers 90 radiate downwardly toward the inner surface of the outer wall 33 so as to generate cavitation only in that portion of the solvent through which the machined parts will pass. It will be noted that the lower portion of the outer arcuate wall 33 is provided with a plurality of small holes or slots 91 so that contaminant may settle onto the bottom wall 24 of the housing 12.

The outer arcuate wall 33 is provided with a hole in the vapor zone 82 through which extends a nozzle 92. The nozzle 92 is connected to a pump (not shown) which in turn is connected to a trough (not shown) located below the cooling coils 84. The nozzle 92 directs a stream of clean distillate at the machined parts after they have emerged from the solvent in the immersion chamber 80. The nozzle 92 is positioned so as not to interfere with the machined parts being pushed along the inner surface of the wall 33. If desired, the nozzle 92 may be in wall 36.

The operation of the cleaning apparatus 10 of the present invention is as follows:

Machined parts bearing an adhering contaminant are positioned on the belt 64. The movement of the belt 64 causes the machined parts to fall off the belt 64 through the aperture 94 in the top wall 22 onto the outer surface of the inner arcuate wall 34. The machined parts to be cleaned are moved along the outer surface of the inner arcuate wall 34 by the pusher vanes 48. As the pusher vanes 48 move the machined parts through the vapor zone 82, the machined parts, due to gravity, tumble so that they are moved through the solvent in the immersion chamber 80 on the inner surface of the outer arcuate wall 33 by the pusher vanes 48. As the machined parts move through the vapor zone 82, they are degreased. As the machined parts pass through the solvent in the immersion chamber 80 on the inner surface of the outer arcuate wall 33, they are subjected to the cavitation generated by the ultrasonic transducers 90. At the lowermost point of the wall 33, the machined parts

are out of the control of the vanes 48 for a short period of time. The ultrasonic transducers 90 are mounted directly above and adjacent the machined parts when they pass out of the control of the pusher vanes 48. At this point, the machined parts are directly subjected to the cavitation generated by the transducers 90. The spacing between the pusher vanes 48 prevents any structure from interrupting the cavitation. Any contaminant removed from the machined parts will settle onto the inner surface of the outer arcuate wall 33 and pass through the holes or slots 91. Thereafter, the sediment will not be in a position to interfere with the cavitation generated by the ultrasonic transducers 90.

While still being subjected to the cavitation generated by the transducers 90, the machined parts are moved by the pusher vanes 48 along the inner surface of the outer arcuate wall 33 out of the cavitation zone and through the vapor zone 82 on the lefthand side of FIGURE 2. As the machined parts pass through the vapor zone 82, they are subjected to a stream of clean distillate by the nozzle 92. The stream of distillate from the nozzle 92 rinses the machined parts. As the machined parts pass through the vapor zone 82, the temperature of the parts is increased so that the parts may dry more readily.

As the machined parts pass out of the vapor zone 82, they tumble due to gravity so that they are now being pushed along the outer surface of the inner arcuate wall 36. As the machined parts are moved beyond the upper end 36' of the inner arcuate wall 36, they are deposited on the belt 74. The pusher vanes 48 continue to push the machined parts so that the machined parts are at the middle portion of the belt 74 before the machined parts pass out of the influence of the pusher vanes 48. In order that the pusher vanes may continue to have an influence on the machined parts, the belt 74 is caused to have a crown-shape in the area between the upper ends 34' and 36' by the crown-shaped plate 70. The belt 74 conveys the clean machined parts away from the cleaning apparatus 10 to any desired location. For purposes of illustration, the belt 74 is shown in FIGURE 1 as extending around rollers 66 and 72 which are supported on the housing 12. If desired, the driving roller 72 may be supported at a location spaced from the cleaning apparatus 10.

As the cleaning apparatus 10 is utilized, there is a gradual build-up of contaminant and sediment within the immersion chamber 80 on the bottom wall 24. A drain (not shown) may be provided so that the solvent within the immersion chamber 80 and the sediment may be removed. The cleaning apparatus 10 includes few moving parts so that it is not susceptible to needing any major repairs or overhauling. If desired, one of the side walls 26 may be made removable so as to provide access to the interior of the housing 12.

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 assures that the parts pass through the power nodes.

The present invention prevents delicately machined parts such as ball bearings from impinging against one another since they are separated by the vanes 48. The vanes 48 and the wall 46 may be made of a material which is softer than the ball bearings so as to avoid flat spots which may be caused by the drop from the belt 64.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. In a cleaning apparatus for degreasing machined parts comprising a housing, a pair of spaced arcuate inner walls fixedly mounted within said housing, an outer

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arcuate wall fixedly mounted around said inner walls, a rotary member having pusher vanes which are disposed between the inner and outer walls, means in said housing operatively connected to said member for rotating said member, the lower portion of said inner and outer walls being adapted to be disposed in a degreasing solvent, and at least one ultrasonic transducer adapted to be disposed within the degreasing solvent, said transducer being disposed between spaced ends of said inner walls and radiating downwardly toward the inner surface of said outer wall, whereby said machined parts may be moved between the inner and outer walls through said solvent and be subjected to cavitation generated by said transducer.

2. In a cleaning apparatus in accordance with claim 1 including means within said housing providing a vapor zone above an immersion chamber adapted to contain the degreasing solvent, whereby said machined parts pass through the vapor zone prior to and after passing through the immersion chamber.

3. In a cleaning apparatus in accordance with claim 1 wherein said inner and outer walls are fixed to a first plate which is disposed upright with respect to said vanes.

4. In a cleaning apparatus in accordance with claim 3 wherein said member is a second plate which is disposed spaced from and parallel to said first plate.

5. In a cleaning apparatus in accordance with claim 1 including mechanical means for automatically feeding the machined parts between the inner and outer walls.

6. In a cleaning apparatus in accordance with claim 5 including a second mechanical means for removing clean machined parts from said housing, said second mechanical means including a conveyor belt partially disposed between spaced upper ends of said inner walls.

7. In a cleaning apparatus for degreasing machined parts comprising a housing having a solvent containing immersion chamber therein, a fixed plate within said

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housing extending into said chamber, a pair of spaced arcuate inner walls fixedly mounted on said plate, an outer arcuate wall fixedly mounted on said plate radially outwardly from said inner walls and concentric with respect to said arcuate inner walls, a rotary member having a plurality of spaced rows of pusher vanes, said pusher vanes being disposed between the inner and outer walls, a mechanical means in said housing operatively connected to said member for rotating said member, each of said inner walls having a lower end extending into said chamber, and a transducer mounted on said plate between the lower ends of said inner walls, said transducer radiating downwardly toward the inner surface of said outer wall, whereby machined parts may be moved between said inner and outer walls through solvent in said chamber and be subjected to cavitation generated by said transducer.

8. In a cleaning apparatus in accordance with claim 7 including means within said housing for providing a vapor zone above said chamber.

9. In a cleaning apparatus in accordance with claim 7 including a conveyor belt extending between spaced upper ends of said inner walls, and means within said inner walls for causing that portion of the belt between said spaced upper ends of said inner walls to be crown-shaped.

10. In a cleaning apparatus in accordance with claim 7 including mechanical means for depositing machined parts onto the outer surface of one of said inner walls between adjacent rows of said pusher vanes.

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