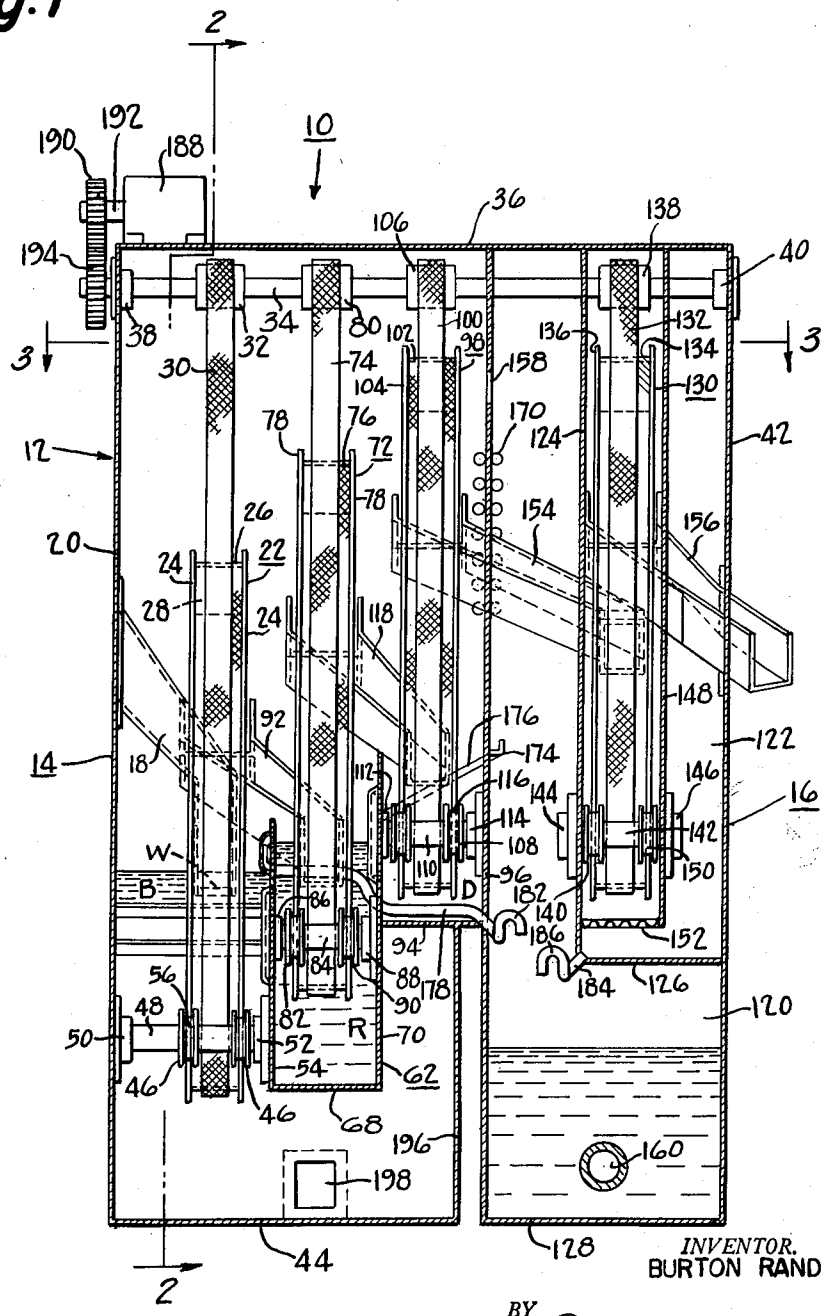
Dec. 5, 1961 B. RAND 3,011,500

CLEANING APPARATUS

Filed July 15, 1959 3 Sheets-Sheet 1

Fig. 1



INVENTOR.
BURTON RAND

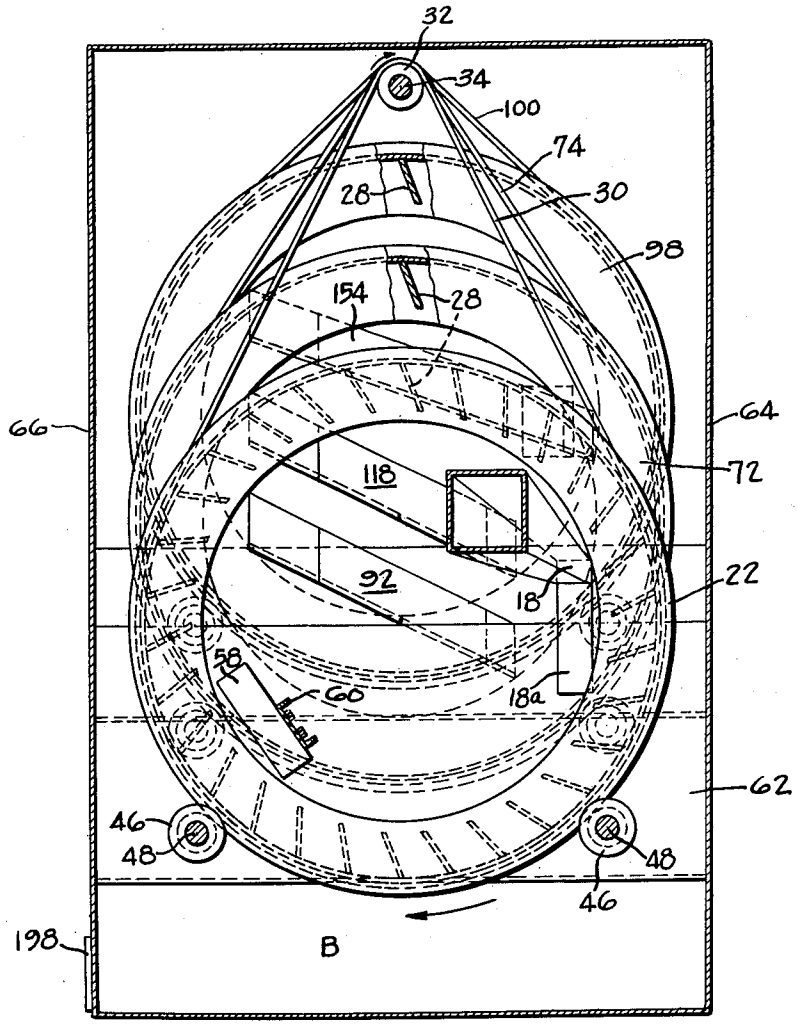
BY Arthur H. Seidel
ATTORNEY

Dec. 5, 1961 B. RAND 3,011,500

CLEANING APPARATUS

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Fig. 2



INVENTOR.
BURTON RAND

BY Arthur H. Seidel

ATTORNEY

Dec. 5, 1961 B. RAND 3,011,500

CLEANING APPARATUS

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Fig. 3

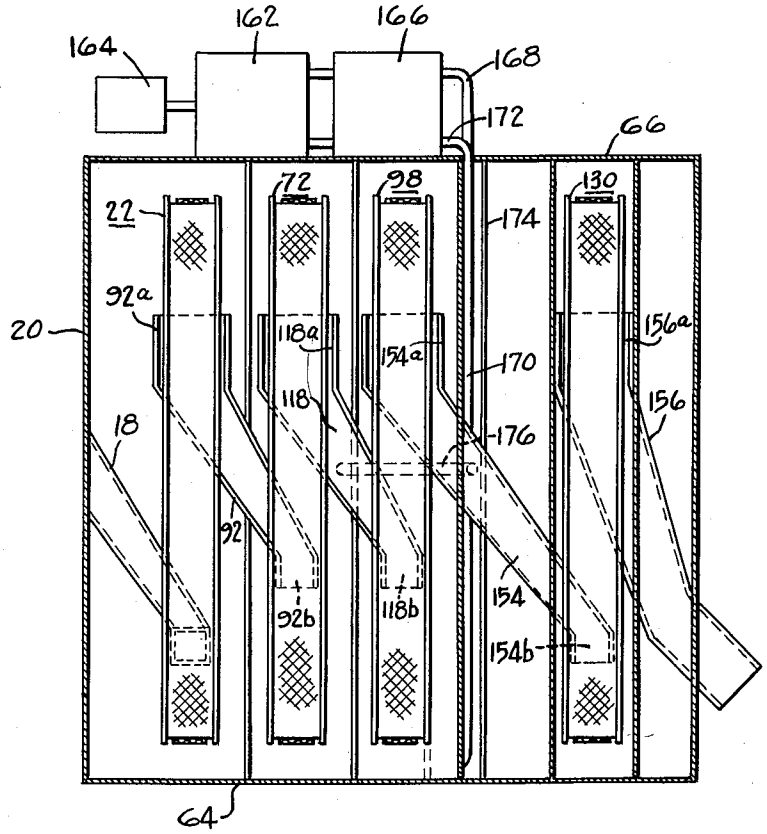
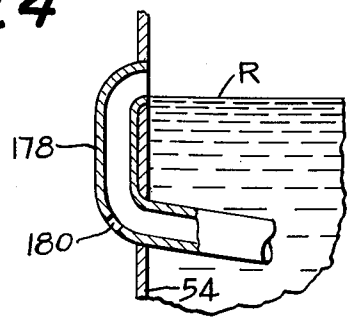


Fig. 4



INVENTOR.
BURTON RAND

BY Arthur H. Seidel

ATTORNEY

United States Patent Office 3,011,500 Patented Dec. 5, 1961

3,011,500

CLEANING APPARATUS

Burton Rand, Bala Cynwyd, Pa., assignor to Autosonics Inc., Philadelphia, Pa., a corporation of Pennsylvania

Filed July 15, 1959, Ser. No. 827,321
16 Claims. (Cl. 134—69)

The present invention relates to cleaning apparatus, and more particularly to cleaning apparatus for removing grease and hydrocarbon deposits plus associated dirt or soil from machine parts by treatment with solvents such as chlorinated hydrocarbons, such as trichlorethylene or the like.

The satisfactory and rapid cleaning of small machined parts, as for example small machined parts which have been buffed, lapped, ground, or the like presents a most difficult problem. Experience has shown that notwithstanding repeated submergence in solvents effected by conventional cleaning equipment, an appreciable amount of contaminate in the nature of adhering dirt or the like remains with the machined parts, particularly in the hollows of interstices thereof. This, of course, is most undesirable, since the presence of contaminate adversely affects the machined parts. In particular, if such machined parts are utilized where close tolerances are required, the presence of adhering contaminate constitutes a most serious problem.

Heretofore, such small machined parts have been generally cleaned by a batch process. That is, the machined parts are discharged from the processing machine into a container. When the container is filled, it is manually carried to a centrally located cleaning machine. This batch method of cleaning small machined parts not only requires additional handling of the machined parts, but is also time consuming. Therefore, it would be most desirable to have a cleaning apparatus which would receive the machined parts directly from the processing machine, and will continuously clean the machined parts.

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 cleaning apparatus which is capable of achieving a high degree of cleaning at a high cleaning rate with small machined parts.

It is still another object of the present invention to provide a light, easily transportable cleaning apparatus for small machined parts of high efficiency, and yet of relatively low cost to manufacture.

It is a further object of the present invention to provide a cleaning apparatus for small machined parts which can receive the machined parts directly from a processing machine, and will continuously clean the machined parts.

Other objects will appear hereinafter.

For the purpose of illustrating the invention there is 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.

Referring to the drawings wherein like reference characters refer to like parts:

FIGURE 1 is a sectional view, partly in elevation, of the cleaning apparatus of the present invention.

FIGURE 2 is a sectional view taken along line 2—2 of FIGURE 1.

FIGURE 3 is a sectional view taken along line 3—3 of FIGURE 1.

FIGURE 4 is a sectional view of the overflow tube of the cleaning apparatus of the present invention.

The cleaning apparatus of the present invention is generally designated as **10**. Cleaning apparatus **10** comprises an upright housing **12** which includes a cleaning section **14**, and a solvent distillation section **16**.

Referring initially to the cleaning section **14**, the inlet **18** for the cleaning section **14** comprises a chute into which the machined parts having adhering contaminate are fed, such machined parts descending through such inlet **18** by gravity.

The inlet chute **18** passes through the wall **20** of housing **12**. Within the cleaning section **14**, the inlet chute **18** extends downwardly and angularly away from the wall **20** to a point within and adjacent to the inner periphery of the conveyor wheel **22**. The end portion **18***a* of the inlet chute **18** extends substantially vertically downwardly through the main bath of chlorinated hydrocarbon (designated B) to the inner periphery of the conveyor wheel **22**. A layer of water (designated W) is superposed above the portion of the main bath B within the end portion **18***a* of the inlet chute **18**. The layer of water W provides a water seal and reduces the loss of volatile chlorinated hydrocarbon from the main bath B.

The conveyor wheel **22** comprises a pair of flat, annular side walls **24** connected together in spaced, parallel relation by a cylindrical outer wall **26**. The outer diameter of the cylindrical outer wall **26** is slightly less than the outer diameters of the side walls **24** so that the outer wall **26** is spaced radially inwardly from the outer edges of the side walls **24**. A plurality of circumferentially spaced baffles **28** are secured between the side walls **24** within the outer wall **26** (see FIGURE 2). Baffles **28** extend inwardly from the outer wall **26** at an angle to the radius of the conveyor wheel **22** in the direction of the direction of rotation of the conveyor wheel **22**. Thus, upon rotation of the conveyor wheel **22**, as the baffles **28** reach the outlet end of the inlet chute **18**, the baffles **28** are at an angle to catch the machined parts dropping from the chute **18** and direct the machined parts outwardly to the outer wall **26**. The outer wall **26** is preferably formed of wire mesh. The side walls **24** may be also formed of wire mesh or of sheet metal.

Conveyor wheel **22** is supported in an upright position for rotation about a horizontal axis by an endless belt **30** which extends around the outer surface of the outer wall **26** between the side walls **24**. Endless belt **30** extends upwardly from the conveyor wheel **22**, and passes over a pulley **32** mounted on a shaft **34**. Shaft **34** extends across the housing **12** adjacent the top wall **36** of the housing **12**, and is rotatably supported in bearings **38** and **40** mounted on the walls **20** and **42** respectively of the housing **12**. Thus, the conveyor wheel **22** is supported from the shaft **34** by the endless belt **30**. Endless belt **30** is of a length so that slightly less than one-half of the conveyor wheel **22** is immersed in the main bath B. The main bath B extends down to the basal floor **44** of the cleaning section **14** of housing **12**, the entire bottom of the cleaning section **14** being occupied by the bath B for maximum solvent inventory.

The conveyor wheel **22** is seated on two pairs of guide rollers **46**. Each pair of guide rollers **46** is mounted on a shaft **48**. Each shaft **48** is rotatably supported in bearings **50** and **52** which are mounted on the wall **20** and wall **54** respectively. Each of the rollers **46** has an annular groove **56** in its outer pheripheral edge of a side wall **24** of the conveyor wheel **22** is guided. Thus, the rollers **46** guide the conveyor wheel **22** during the rotation of the conveyor wheel **22**, and prevent axial movement of the conveyor wheel **22**.

As shown in FIGURE 2, means for introducing vibration of ultrasonic frequency, designated **58**, is disposed within the main bath B and adjacent the conveyor wheel **22**. The vibration inducing means **58** is mounted on a channel bracket **60** which is secured between the wall **20** and the wall **54**. Such means **58** may comprise piezo-

ceramic transducers of conventional construction. For example, such piezoceramic transducers may be molded or otherwise fashioned from ceramic material, such as barium titanate or the like, having piezoelectric properties. Such piezoelectric transducers are preferably provided with silver coatings in the form of electrodes. As illustrative of suitable piezoceramic transducers may be mentioned transducers of the type disclosed in Kearney Patent 2,802,476, issued August 13, 1957. However, it is to be understood that in place of the piezoceramic transducers above-mentioned, other means for generating or inducing high frequency ultrasonic vibrations with the bath, whose construction is well known to those skilled in the art, may be used for the means designated **58**.

A U-shaped trough **62** is secured between the walls **64** and **66** of the housing **12**. The trough **62** extends parallel to the conveyor wheel **22**, and is positioned between the conveyor wheel **22** and the solvent distillation section **16** of the housing **12**. The trough **62** comprises a floor **68**, which is spaced above the floor **44** of the cleaning section **14** of the housing **12**, the upright wall **54**, and upright wall **70**. The upright walls **54** and **70** of the trough **62** extend vertically above the level of the main bath B, and the upright wall **70** is higher than the upright wall **54**. The trough **62** contains the rinse bath R which comprises the identical chlorinated hydrocarbon solvent used in the main bath B. However, the chlorinated hydrocarbon solvent within rinse bath R is appreciably cleaner than the chlorinated hydrocarbon solvent which forms the main bath B.

A conveyor wheel **72** is supported within the trough **62** for rotation about a horizontal axis by an endless belt **74**. Conveyor wheel **72** is identical in construction to the conveyor wheel **22**. Endless belt **74** extends around the outer surface of the outer wall **76** of the conveyor wheel **72** between the side walls **78** of the conveyor wheel **72**. Endless belt **74** extends upwardly from the conveyor wheel **72**, and extends around a pulley **80** mounted on the shaft **34**. Thus, the conveyor wheel **72** is supported from the shaft **34** by the endless belt **74** for rotation simultaneously with the conveyor wheel **22**. Endless belt **74** is of a length so that less than half of the conveyor wheel **72** is emersed in the rinse bath R. Since, as shown in FIGURE 1, the liquid level of the rinse bath R is higher than the liquid level of the main bath B, the axis of rotation of the conveyor wheel **72** is vertically higher than the axis of rotation of the conveyor wheel **22**.

Conveyor wheel **72** is seated on two pairs of guide rollers **82**. Each pair of the guide rollers **82** are mounted on a shaft **84**. Each of the shafts **84** is rotatably supported in bearings **86** and **88** which are mounted on the walls **54** and **70** respectively of the trough **62**. Each of the rollers **82** has an annular groove **90** in its outer periphery in which the outer peripheral edge of a side wall **78** of the conveyor wheel **72** is guided. Thus, the guide rollers **82** guide the conveyor wheel **72** during the rotation of the conveyor wheel **72**, and prevent axial movement of the conveyor wheel **72**.

A transfer chute **92** extends downwardly from the inner periphery of the conveyor wheel **22** to the inner periphery of the conveyor wheel **72** to transfer the cleaned machined parts from the conveyor wheel **22** to the conveyor wheel **72**. The inlet end **92***a* of the transfer chute **92** is positioned adjacent the inner periphery of the conveyor wheel **22** at a point substantially diametrically opposite to the outlet end of the inlet chute **18**. Thus, as shown in FIGURE 2, upon the rotation of the conveyor wheel **22**, as the baffles **28** of the conveyor wheel **22** reach the inlet end **92***a* of the transfer chute **92**, the baffles **28** are angled downwardly to permit the machined parts to fall from the conveyor wheel **22** onto the transfer chute **92**. The outlet end **92***b* of the transfer chute **92** is positioned adjacent the inner periphery of the conveyor wheel **72** at a point corresponding to the position of the outlet end of the inlet chute **18** with respect to the conveyor wheel **22**. Thus, upon the rotation of the conveyor wheel **72**, as the baffles, not shown, of the conveyor wheel **72** reach the outlet end **92***b* of the transfer chute **92**, the baffles of the conveyor wheel **72** are angled upwardly to catch the machined parts descending the transfer chute **92**, and guide the machined parts to the outer wall **76** of the conveyor wheel **72**.

A floor **94** extends horizontally between the walls **64** and **66** of the housing **12**, and between the wall **70** of the trough **62** and the wall **96**. Floor **94** is spaced vertically above the floor **68** of the trough **62**. The trough formed by the wall **70**, floor **94**, and wall **96** forms a drying chamber, designated as D.

A conveyor wheel **98** is supported in the drying chamber D for rotation about a horizontal axis by an endless belt **100**. Conveyor wheel **98** is of a construction identical to the conveyor wheels **22** and **72**. Endless belt **100** extends around the outer surface of the outer wall **102** of the conveyor wheel **98** between the side walls **104** of the conveyor wheel **98**. The endless belt **100** extends upwardly from the conveyor wheel **98**, and extends around a pulley **106** mounted on the shaft **34**. Thus, the conveyor wheel **98** is supported from the shaft **34** by the endless belt **100** for rotation simultaneously with the conveyor wheels **22** and **72**. The axis of rotation of the conveyor wheel **98** is vertically higher than the axis of rotation of the conveyor wheel **72**.

Conveyor wheel **98** is seated on two pairs of guide rollers **108**. Each pair of the guide rollers **108** is mounted on a shaft **110**. Each of the shafts **110** is rotatably supported in bearings **112** and **114** which are mounted on the walls **70** and **96** respectively. Each of the guide rollers **108** has an annular groove **116** in its outer periphery in which the outer peripheral edge of a side wall **104** of the conveyor wheel **98** is guided. Thus, the guide rollers **108** guide the conveyor wheel **98** during the rotation of the conveyor wheel **98**, and prevent axial movement of the conveyor wheel **98**.

A transfer chute **118** extends downwardly from the inner periphery of the conveyor wheel **72** to the inner periphery of the conveyor wheel **98**. The inlet end **118***a* of the transfer chute **118** is positoned adjacent the inner periphery of the conveyor wheel **72** at a point diametrically opposite to the outlet end **92***b* of the transfer chute **92**. Thus, the inlet end **118***a* of the transfer chute **118** is in a position to receive the machined parts discharged from the conveyor wheel **72**. The outlet end **118***b* of the transfer chute **118** is positioned adjacent the inner periphery of the conveyor wheel **98** at a point corresponding to the position of the outlet end of inlet chute **118** with respect to the conveyor wheel **22**. Thus, the outlet end **118***b* of the transfer chute **118** is in a position to discharge the machined parts descending through the transfer chute **118** onto the baffles, not shown, of the conveyor wheel **98**.

The solvent distillation section **16** of the housing **12** comprises a vapor generator chamber **120**, and a second drying chamber **122**.

The second drying chamber **122** is formed intermediate the walls **42** and **124**, the floor **126**, and the top wall **36** of the housing **12**. The wall **124** of the drying chamber **122** is spaced from the wall **96** of the solvent distillation section **16**, and the floor **126** of the drying chamber **122** is spaced above the basal floor **128** of the solvent distillation section **16**. A conveyor wheel **130** is supported within the second drying chamber **122** for rotation about a horizontal axis by an endless belt **132**. Conveyor wheel **130** is of a construction identical to the conveyor wheels **22**, **72**, and **98**. Endless belt **132** extends around the outer surface of the outer wall **134** of the conveyor wheel **130** between the side walls **136** of the conveyor wheel **130**. Endless belt **132** extends upwardly from the conveyor wheel **130**, and extends around a pulley **138** mounted on the shaft **34**. Thus, the conveyor wheel **130** is supported from the shaft **34** by the end-

less belt **132** for rotation simultaneously with the conveyor wheels **22**, **72**, and **98**.

The conveyor wheel **130** is seated on two pairs of guide rollers **140**. Each pair of the guide rollers **140** is mounted on a shaft **142**. Each of the shafts **142** is rotatably supported in bearings **144** and **146** which are mounted on the wall **124** and a wall **148** respectively. Each of the guide rollers **140** has an annular groove **150** in its outer periphery in which the outer peripheral edge of a side wall **136** of the conveyor wheel **130** is guided. Thus, the guide rollers **140** guide the conveyor wheel **130** during the rotation of the conveyor wheel **130**, and prevent axial movement of the conveyor wheel **130**. A wire mesh screen **152** is secured between the wall **124** and the wall **148** beneath the conveyor wheel **130**.

A transfer chute **154** extends downwardly from the inner periphery of the conveyor wheel **98** through the vapor generator chamber **120** to the inner periphery of the conveyor wheel **130**. The inlet end **154***a* of the transfer chute **154** is positioned adjacent the inner periphery of the conveyor wheel **98** diametrically opposite the outlet end **118***b* of the transfer chute **118**. Thus, the inlet end **154***a* of the transfer chute **154** is positioned to receive the machined parts discharged from the conveyor wheel **98**. The outlet end **154***b* of the transfer chute **154** is positioned adjacent the inner periphery of the conveyor wheel **130** at a point corresponding to the position of the outlet end of the inlet chute **18** with respect to the conveyor wheel **22**. Thus, the outlet end **154***b* of the transfer chute **154** is positioned to discharge the machined parts descending through the transfer chute **154** onto the baffles, not shown, of the conveyor wheel **130**.

An outlet chute **156** for the cleaning apparatus **10** extends downwardly from the inner periphery of the conveyor wheel **130** through the wall **148** and wall **42** of the housing **12**. The inlet end **156***a* of the outlet chute **156** is positioned adjacent the inner periphery of the conveyor wheel **130** diametrically opposite the outlet end **154***b* of the transfer chute **154**. Thus, the inlet end **156***a* of the outlet chute **156** is positioned to receive the machined parts discharged from the conveyor wheel **130**.

The vapor generator chamber **120** is formed intermediate the walls **96**, **124**, and **42**, the floors **128** and **126**, and the top wall **36** of the housing **12**. A pressure relief port **158** extends intermediate the vapor generating chamber **120** and the cleaning section **14** through the upper portion of the wall **96**. Heater means **160** is provided at the bottom of the vapor generator chamber **120**. Such heater means **160** comprises conventional means for disseminating heat, and serves to heat the liquid inventory of the vapor generator chamber **120**.

Refrigeration means comprising a standard coolant gas compressor **162**, a motor **164** for operating the compressor **162**, and an evaporator **166** is mounted on the wall **66** of the casing **12**. A wide variety of refrigeration means may be utilized including those which deliver aqueous brine coolant, and those which deliver coolant gases. Alternatively, cold tap water may be used for refrigeration draining to a sewer.

The refrigerant fluid from the evaporator **166** is passed therefrom through duct **168** into the coil **170** which extends along opposite sides of the wall **96**. The coil **170** serves to cool the wall **96**, whereby such wall **96** serves as a condenser onto which volatized liquid may be condensed. In addition, the cool wall **96** serves to cool the drying chamber portion of the cleaning apparatus **10** which is adjacent the wall **96**. The return end of the coil **170** is connected to the condenser **162** through a duct **172**.

A condensate collecting trough **174** extends along the side of the wall **96** within the vapor generator chamber **120** beneath the cooling coil **170**. The condensate collecting trough **174** is tilted to provide a low point. A duct **176** extends downwardly from the low point of the condensate collecting trough **174** across the drying chamber D, through the wall **70** of the rinse trough **62**, and into the rinse bath R.

The level of liquid within the rinse bath R in the rinse trough **62** is controlled by an overflow pipe **178**, which also controls the pipe of the main bath B. As shown in FIGURES 1 and 4, the inlet end of the overflow pipe **178** extends through the wall **54** of the rinse trough **62** at the level of the liquid of the rinse bath R. The overflow pipe **178** extends downwardly along the outer side of the wall **54** to the level of the liquid of the main bath B. At the point of the level of the liquid of the main bath B, the overflow pipe **178** has an aperture **180** therethrough by which the level of the main bath B is controlled. The overflow pipe **178** then extends back through the wall **54**, and downwardly across the rinse trough **62**, across the bottom of the drying chamber D, and through the wall **96** into the vapor generator chamber **120**. The outlet end of the overflow pipe **178**, which is within the vapor generator chamber **120**, is provided with a U-shaped trap **182** to prevent the vapors within the vapor generator chamber **120** from passing up through the overflow pipe **178**.

A drain pipe **184** extends downwardly from the bottom of the second drying chamber **122** into the vapor generator chamber **120**. Drain pipe **184** is provided with a U-shaped trap **186** to prevent the vapors in the vapor generator chamber **120** from passing through the drain pipe **184** into the drying chamber **122**. A similar drain pipe, not shown, is provided from the bottom of the drying chamber D into the vapor generator chamber **120**.

The shaft **34** is driven by an electric motor **188** mounted on the top wall **36** of the housing **12**. A gear **190** mounted on the motor shaft **192**, meshes with a gear **194** mounted on the shaft **34** to drivingly connect the motor **188** to the shaft **34**.

The cleaning section **14** of the housing **12** includes a vertical wall **196** extending between the floor **44** and the floor **94** of the drying chamber D. The wall **196** is spaced from the wall **96**, and forms one wall of the reservoir for the main bath B. The air space between the wall **196** and the wall **96** thermally insulates the main bath B from the vapor generator chamber **120** whereby flashing of the chlorinated hydrocarbon solvent is prevented.

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

The electric motor **188** is turned on to rotate the shaft **34**, and thereby rotate the conveyor wheels **22**, **72**, **98**, and **130**. Machined parts bearing an adhering contaminant are introduced into the cleaning apparatus **10** through the inlet chute **18**. The machined parts descend the inlet chute **18** to the conveyor wheel **22**. During the descent the machined parts pass through the water seal W, which is the water level on top of the main bath B of chlorinated hydrocarbon solvent within the inlet chute **18**, and which water seal serves to prevent the volatilization of the chlorinated hydrocarbon solvent from the main bath B. As used hereinafter, the term solvent inventory should be interpreted as meaning the quantity of chlorinated hydrocarbon solvent within the main bath B.

The machined parts are fed from the inlet chute **18** onto the baffles **28** of the rotating conveyor wheel **22**. Since the baffles **28** are inclined downwardly when they are adjacent the outlet end of the inlet chute **18**, the baffles **28** guide the machined parts to the outer wall **26** of the conveyor wheel **22**. The machined parts are then carried by the conveyor wheel **22** through the main bath B. Since at least the outer wall **26** of the conveyor wheel **22** is formed of wire mesh, the liquid of the main bath B fills the chambers of the conveyor wheel **22** between the baffles **28** so that the machined parts are completely immersed in the main bath B.

As the machined parts are carried by the conveyor wheel **22** past the means for inducing vibrations of ultrasonic frequency **58**, such parts are subjected to ultrasonic cleaning and the conveyor wheel **22** and its belt **30** are

likewise kept free of sludge and carbon. This facilitates in the removal of adhering contaminant which is disposed within interstices, and voids within the machined parts. The conveyor arrangement shown in the drawings effects cleaning and draining of blind holes on the rotation of the conveyor wheel 22.

After being ultrasonically cleaned, the machined parts are carried by the conveyor wheel 22 out of the main bath B to the inlet end 92*a* of the transfer chute 92. When the baffles 28 of the conveyor wheel 22 reach a position above the inlet end 92*a* of the transfer chute 92, the baffles 28 are angled downwardly away from the outer wall 26 of the conveyor wheel 22 so that the machined parts fall from the conveyor wheel 22 onto the inlet end 92*a* of the transfer chute 92. The machined parts then descend the transfer chute 92 to the conveyor wheel 72.

The machined parts are fed from the transfer chute 92 into the conveyor wheel 72 in the same manner as the machined parts were fed from the inlet chute 18 into the conveyor wheel 22. The conveyor wheel 72 carries the machined parts through the rinse bath R. The rinse bath R comprises chlorinated hydrocarbon solvent which is considerably cleaner than the solvent inventory of the main bath B so that rinsing of the cleaned parts is effected within the rinse bath R. The conveyor wheel 72 carries the machined parts from the rinse bath R to the inlet end 118*a* of the transfer chute 118 where the machined parts are transferred from the conveyor wheel 72 to the transfer chute 118.

The machined parts descend the transfer chute 118 to the conveyor wheel 98 where the machined parts are fed into the conveyor wheel 98. Conveyor wheel 98 carries the machined parts through the drying chamber D where the solvent is drained and evaporated from the machined parts. The solvent drained from the machined parts in the conveyor wheel 98 passes through the wire mesh outer wall 102 of the conveyor wheel 98, and is collected on the floor 94 of the drying chamber D. The solvent collected on the floor 94 of the drying chamber D passes from the drying chamber into the vapor generator chamber 120 through the drain pipe, not shown.

After passing through the drying chamber D, the machined parts are transferred from the conveyor wheel 98 to the transfer chute 154. The machined parts descend the transfer chute 154 to the conveyor wheel 130. The conveyor wheel 130 carries the machined parts through the second drying chamber 122 to obtain a complete drying of the machined parts. Any solvent which may drain from the machined parts in the conveyor wheel 130 passes through the wire mesh outer wall 134 of the conveyor wheel 130, and is collected on the floor 126 of the second drying chamber 122. The solvent collected on the floor 126 is drained from the second drying chamber 122 to the vapor generator chamber 120 through the drain pipe 184.

After passing through the second drying chamber 122, the machined parts are transferred from the conveyor wheel 130 onto the outlet chute 156 which carries the machined parts from the cleaning machine 10.

Within the vapor generator chamber 120, chlorinated hydrocarbon solvent is distilled off from the bottom of the chamber by heater 160. The vaporized chlorinated hydrocarbon condenses on the wall 96 which is cooled by the cooling coil 170. The condensate flows down the wall 96 and is collected in the condensate collecting trough 174. The collected condensate leaves the trough 174 as cooled liquid through the duct 176. The duct 176 carries the condensate to the rinse bath R within the trough 62.

The level of the chlorinated hydrocarbon solvent within the rinse bath R is maintained at a constant height by the overflow pipe 178. Thus, overflow from the rinse bath R leaves through the overflow pipe 178 and is carried back into the vapor generator chamber 120. The overflow pipe 178 also maintains the level of the chlorinated hydrocarbon solvent within the main bath B at a constant height. If the level of the solvent of the main bath B drops below the level of the opening 180 in the overflow pipe 178, the overflow from the rinse bath R passing through the overflow pipe 178 flows through the opening 180 to raise the level of the main bath B back to the level of the opening 180. If the level of the main bath B becomes higher than the level of the opening 180, the excess solvent of the main bath B will flow through the opening 180 into the overflow pipe 178, and will be carried back to the vapor generator chamber 120.

Gradually as the cleaning apparatus 10 is utilized, there is a build-up of contaminant within the main bath B, and it will become necessary to close the cleaning apparatus down and drain away the solvent inventory. The solvent may be drained from the main bath B through a door 198.

Since the cleaning apparatus 10 of the present invention is compact, and relatively small in size, the cleaning apparatus 10 can be placed next to a processing machine so that the small machined parts can be discharged from the processing machine directly into the inlet chute 18 of the cleaning apparatus 10. Thus, the cleaning apparatus 10 of the present invention can continuously clean the small machined parts as they are received directly from the processing machine.

This application is a continuation in part of my copending application Serial No. 705,876, filed on December 30, 1957.

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. Cleaning apparatus for degreasing machined parts including a cleaning section and a solvent distillation section, a party wall intermediate said cleaning section and said solvent distillation section, a bath sump disposed at the bottom of said cleaning section, a rinse trough extending across said cleaning section adjacent said bath sump, a drying chamber extending across said cleaning section adjacent said rinse trough, a plurality of annular conveyor wheels supported in parallel relation within said cleaning section for rotation about horizontal axes, one of said conveyor wheels passing through said bath sump, a second of said conveyor wheels passing through said rinse trough, the third of said conveyor wheels passing through said drying chamber, an inlet means for feeding machined parts to said one conveyor wheel, means for transferring the machined parts from said one conveyor wheel to said second conveyor wheel, means for transferring the machined parts from said second conveyor wheel to said third conveyor wheel, means for transferring the machined parts from the third conveyor wheel through said party wall and depositing said machined parts on a support in said distillation section, means for transferring said parts from said support and delivering the parts to an outlet means, a rotatable shaft extending across the top of the cleaning section above the conveyor wheels and parallel to the axes of rotation of the conveyor wheels, and means for individually supporting each of said conveyor wheels from said shaft so that rotation of said shaft simultaneously rotates all of said conveyor wheels.

2. Cleaning apparatus in accordance with claim 1 in which the means individually supporting each of the conveyor wheels from the shaft comprises a separate endless belt extending around a conveyor wheel and said shaft.

3. Cleaning apparatus for degreasing machined parts including a cleaning section and a solvent distillation section, a party wall intermediate said cleaning section and said solvent distillation section, a bath sump disposed at the bottom of said cleaning section, a rinse trough extending across said cleaning section adjacent said bath sump, a drying chamber extending across said cleaning

section adjacent said rinse trough, a plurality of annular conveyor wheels supported in parallel relation within said cleaning section for rotation about horizontal axes, one of said conveyor wheels passing through said bath sump, a second of said conveyor wheels passing through said rinse trough, a third of said conveyor wheels passing through said drying chamber, an inlet means for feeding machined parts to said one conveyor wheel, means for transferring the machined parts from said one conveyor wheel to said second conveyor wheel, means for transferring the machined parts from said second conveyor wheel to said third conveyor wheel, means for transferring the machined parts from the conveyor wheel through said party wall and depositing said machined parts on a support in said distillation section, means for transferring said parts from said support and delivering the parts to an outlet means, each of the conveyor wheels comprises a pair of flat annular side walls in spaced parallel relation, a cylindrical outer wall connected between said side walls adjacent the outer peripheries of said side walls, and a plurality of circumferentially spaced baffles connected between said side walls and extending inwardly from said outer wall.

4. Cleaning apparatus in accordance with claim 3 in which the baffles of each of the conveyor wheels extend inwardly from the outer wall at an angle to the radius of the conveyor wheel in the direction of the direction of rotation of the conveyor wheel.

5. Cleaning apparatus in accordance with claim 4 in which the outer wall of each of the conveyor wheels is formed of wire mesh.

6. Cleaning apparatus in accordance with claim 3 including a rotatable shaft extending across the top of the cleaning section above the conveyor wheels and parallel to the axes of rotation of the conveyor wheels, and a separate endless belt extending around the outer surface of the outer wall of each said conveyor wheels, each of said endless belts extending around said shaft to support said conveyor wheels from said shaft for rotation with said shaft.

7. Cleaning apparatus in accordance with claim 6 in which each of the conveyor wheels is seated on rotatably supported guide rollers, said guide rollers preventing axial movement of said conveyor wheels.

8. Cleaning apparatus in accordance with claim 3 in which the inlet means for feeding the machined parts to said one conveyor wheel comprises a chute extending downwardly into the cleaning section to the inner periphery of said one conveyor wheel, the means for transferring the machined parts from said one conveyor wheel to the second conveyor wheel comprises a chute extending downwardly from the inner periphery of said one conveyor wheel to the inner periphery of said second conveyor wheel, the means for transferring the machined parts from the second conveyor wheel to the third conveyor wheel comprises a chute extending downwardly from the inner periphery of said second conveyor wheel to the inner periphery of said third conveyor wheel, and the outlet means for transferring the machined parts from the third conveyor wheel comprises a chute extending downwardly out of the cleaning section from the inner periphery of said third conveyor wheel.

9. Cleaning apparatus in accordance with claim 8 in which the lowermost end of the inlet chute and each of the transverse chutes is positioned adjacent the inner periphery of its respective conveyor wheel at a point where the baffles of the conveyor wheels are angled downwardly away from the chutes so that the machined parts descending the chutes are fed onto the baffles, and the uppermost end of each of the transverse chutes and the outlet chute are positioned adjacent the inner periphery of its respective conveyor wheel substantially diametrically opposite to the end of the chaute feeding the machined parts to its respective conveyor wheel.

10. Cleaning apparatus in accordance with claim 1 in which the bath sump includes means for inducing vibrations of ultrasonic frequency spaced from the one conveyor wheel.

11. Cleaning apparatus for degreasing machined parts including a cleaning section and a solvent distillation section, a party wall intermediate said cleaning section and said solvent distillation section, a bath sump disposed at the bottom of said cleaning section, a rinse trough extending across said cleaning section adjacent said bath sump, a drying chamber extending across said cleaning section adjacent said rinse trough, a plurality of annular conveyor wheels supported in parallel relation within said cleaning section for rotation about horizontal axes, one of said conveyor wheels passing through said bath sump, a second of said conveyor wheels passing through said rinse trough, a third of said conveyor wheels passing through said drying chamber, an inlet means for feeding machined parts to said one conveyor wheel, means for transferring the machined parts from said one conveyor wheel to said second conveyor wheel, means for transferring the machined parts from said second conveyor wheel to said third conveyor wheel, means for transferring the machined parts from the conveyor wheel through said party wall and depositing said machined parts on a support in said distillation section, means for transferring said parts from said support and delivering the parts to an outlet means, means at the base of the solvent distillation section for volatilizing solvent, means within the solvent distillation section for condensing solvent, and means for carrying the condensed solvent to the rinse trough.

12. Cleaning apparatus in accordance with claim 11 in which the means for condensing the solvent comprises a cooling coil on the party wall intermediate the cleaning section and the solvent distillation section, and the means for carrying the condensed solvent to the rinse trough comprises a collecting trough extending across said party wall beneath said cooling coil, and a duct extending between said collecting trough and said rinse trough.

13. Cleaning apparatus in accordance with claim 12 in which an overflow pipe extends downwardly from said rinse trough into the bath sump and then to the solvent distillation section, said overflow pipe including an opening within said bath sump whereby the level of liquid in said bath sump is maintained below the level of liquid in said rinse trough.

14. Cleaning apparatus for degreasing machined parts comprising a housing having a cleaning section, a solvent distillation section and a party wall intermediate said cleaning section and said solvent distillation section, a bath sump disposed at the bottom of said cleaning section, a rinse trough extending across said cleaning section adjacent said bath sump, a drying chamber extending across said cleaning section adjacent said rinse trough, three annular conveyor wheels supported in parallel relation within said cleaning section for rotation about horizontal axes, one of said conveyor wheels passing through said bath sump, the second of said conveyor wheels passing through said rinse trough, the third of said conveyor wheels passing through said drying chamber, a vapor generator chamber in said solvent distillation section adjacent said party wall, a second drying chamber in said solvent distillation section spaced from said party wall by said vapor generator chamber, a conveyor wheel rotatably supported in said second drying chamber parallel to said three conveyor wheels, an inlet means for feeding machined parts to the bath sump conveyor wheel, means for transferring the machined parts from said bath sump conveyor wheel to the rinse through conveyor wheel, means for transferring the machined parts from the rinse trough conveyor wheel to the first drying chamber conveyor wheel, means for transferring the machined parts from the first drying chamber conveyor wheel through said party wall and the vapor generator chamber to the second drying chamber conveyor wheel, means at the base of the vapor generator chamber for volatilizing solvent, means within

the vapor generator chamber for condensing solvent, means for carrying the condensed solvent to the rinse trough, and outlet means for transferring the machined parts from the second drying chamber conveyor wheel.

15. Cleaning apparatus in accordance with claim 14 in which each of the conveyor wheels comprises a pair of flat annular side walls in spaced parallel relation, a cylindrical outer wall connected between said said walls adjacent the outer peripheries of said side walls, and a plurality of circumferentially spaced baffles connected between said side walls and extending inwardly from said outer wall.

16. Cleaning apparatus in accordance with claim 15 including a rotatable shaft extending across the top of the housing above the conveyor wheels and parallel to the axes of rotation of the conveyor wheels, and a separate endless belt extending around the outer surface of the outer wall of each of said conveyor wheels, each of said

endless belts extending around said shaft to support said conveyor wheels from said shaft for rotation with said shaft.

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