Dec. 5, 1961 B. RAND 3,011,924

CLEANING APPARATUS AND PROCESS

Filed Dec. 30, 1957 2 Sheets-Sheet 1

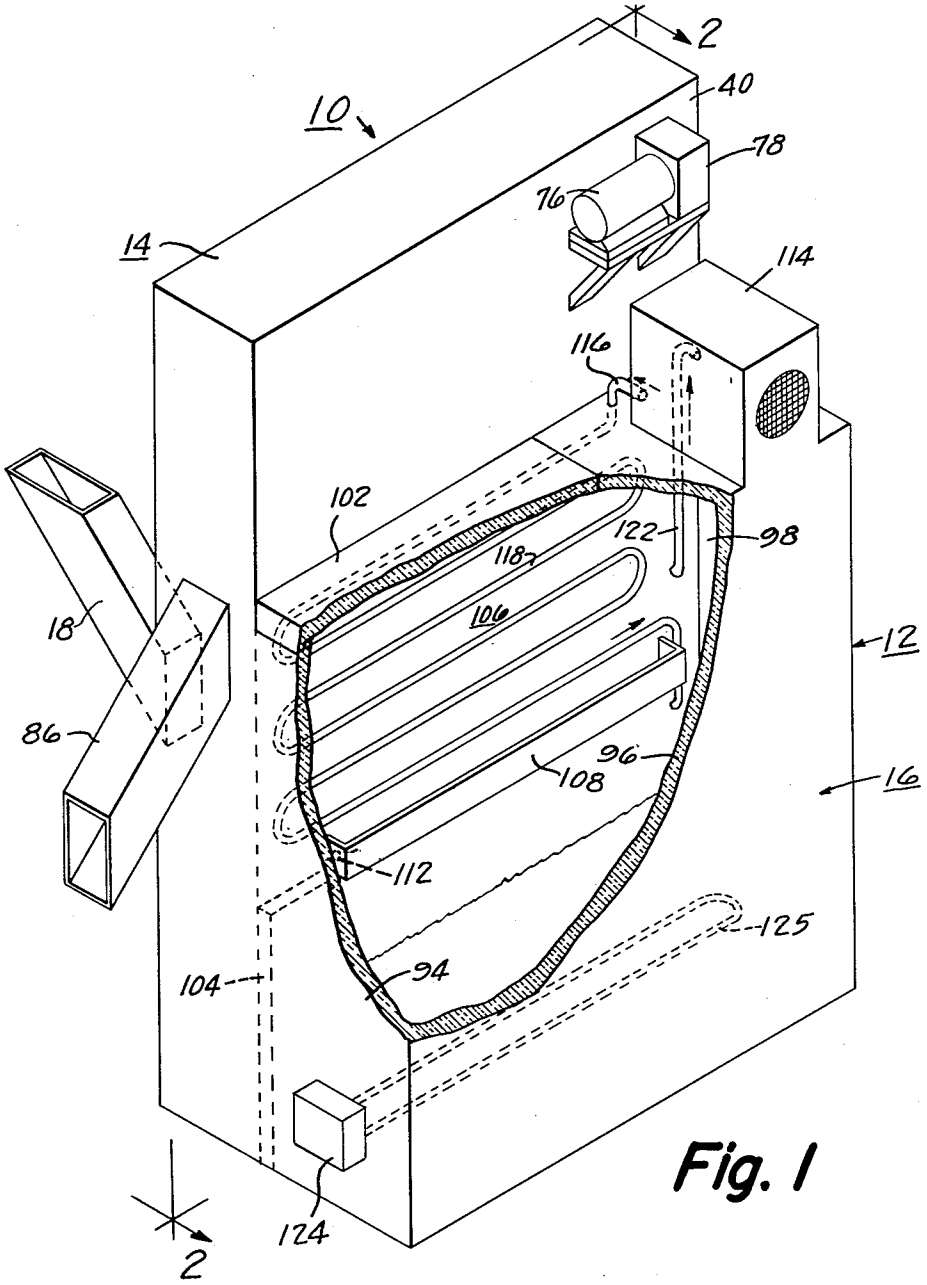


Fig. 1

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Fig. 2

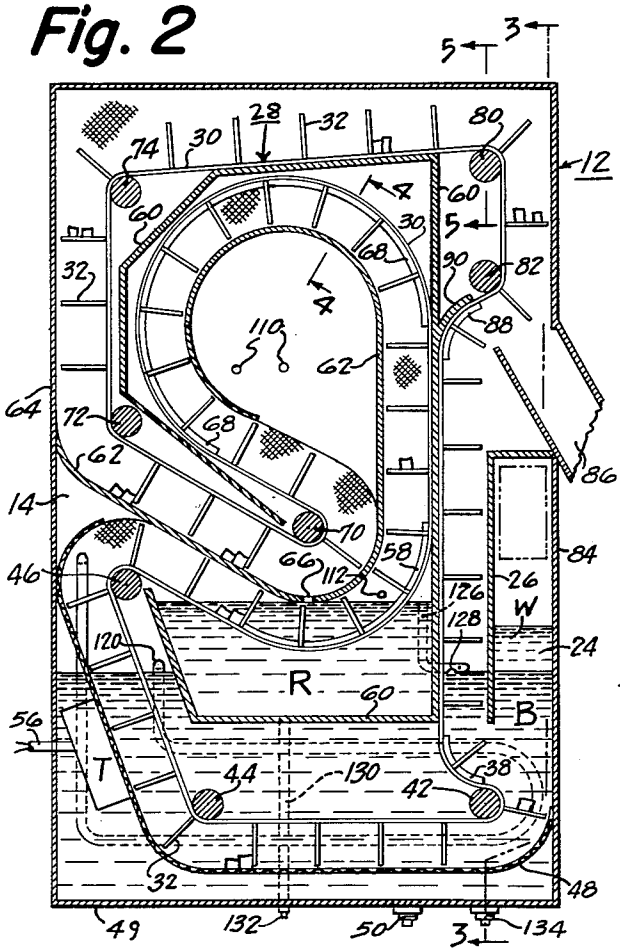
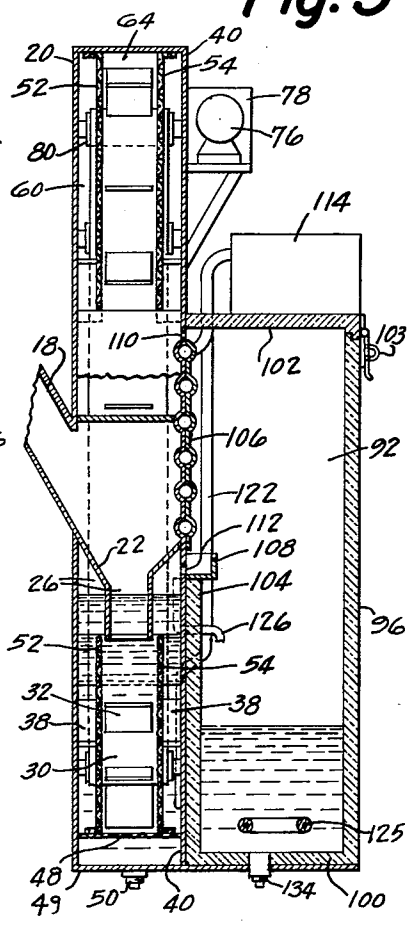


Fig. 3



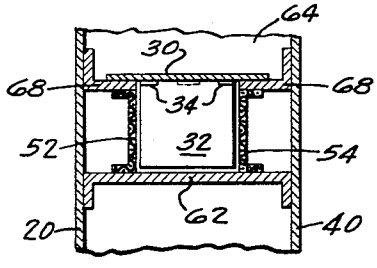


Fig. 4

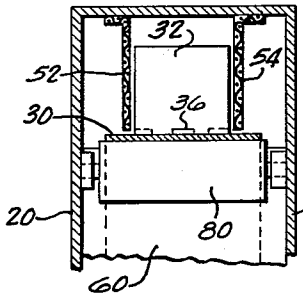


Fig. 5

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3,011,924

CLEANING APPARATUS AND PROCESS

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Filed Dec. 30, 1957, Ser. No. 705,876
13 Claims. (Cl. 134—12)

This invention relates to cleaning apparatus and process, 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 contaminant 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 contaminant adversely affects the machined parts. In particular, if such machined parts are utilized where close tolerances are required, the presence of adhering contaminant constitutes a most serious problem.

This invention has as an object the provision of novel cleaning apparatus.

This invention has as another object the provision of cleaning apparatus which is capable of achieving a high degree of cleaning at a high cleaning rate with small machined parts.

This invention has as yet another object the provision of light, easily transportable cleaning apparatus for small machine parts of high efficiency, and yet of relatively low cost to manufacture.

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 perspective view of the cleaning apparatus of the present invention, with parts being broken away to reveal the structure thereof.

FIGURE 2 is a section taken on line 2—2 of FIGURE 1.

FIGURE 3 is a section taken on line 3—3 of FIGURE 2.

FIGURE 4 is a section taken on line 4—4 of FIGURE 2.

FIGURE 5 is a section taken on line 5—5 of FIGURE 2.

The cleaning apparatus of the present invention is designated generally 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 contaminant are fed, such machine parts descending through such inlet **18** by gravity.

The inlet **18** passes through the wall **20** of housing **12**. Within the cleaning section **14** and behind the wall **20**, the inlet **18** is flared into a funnel **22** which discharges into the water seal chamber **24**. The water seal chamber **24** is formed by the housing **12** and the back plate **26**. Within the water seal chamber **24** there is a layer of water (W in FIGURE 2) superposed over the main bath of chlorinated hydrocarbon (designated B in FIGURE 2). The layer of water W provides a water seal and reduces the loss of volatile chlorinated hydrocarbon from the main bath B.

Below the water seal chamber **24** is the conveyor belt **28**. The conveyor belt **28** comprises a web **30** of sheet metal onto which is welded the perpendicular flap **32**. This is best accomplished by providing flap **32** with a pair of tongues **34** extending outwardly at one side and a tongue **36** extending outwardly at the other side, and welding the tongues **34** and **36** to the surface of the web **30**. The conveyor belt **28** passes beneath the water seal chamber **24** because it is directed to such position within the bath by virtue of the curved guides **38** which are secured to the walls **20** and **40**. Such curved guides, as curved guides **38**, are required whenever the web **30** is passed through a turn in direction which cannot be effected solely by virtue of rollers. From curved guides **38** the web **30** passes over idler roller **42** which is carried on trunnions by the walls **20** and **40**. While the roller **42** is illustrated as an idler roller, it is to be understood that the web **30** may include apertures for mating with sprocket teeth or the like, and that positive driving of the web **30** may be effected. From idler roller **42** the endless web **30** passes over idler roller **44** and thence over idler roller **46**. Between the idler roller **42** and the idler roller **44** the web **30** is downwardly directed, so that the flaps **32** depend from the web **30**. A perforated curved floor **48** formed of sheet metal or wire mesh is secured intermediate walls **20** and **40**. The bath B extends down to the basal floor **49**, the entire bottom of cleaning apparatus **10** being occupied by the bath B for maximum solvent inventory. As used hereinafter, solvent inventory is to be interpreted as meaning the amount of cleaning solvent within the apparatus **10**. The spacing of the curved floor **48** from the web **30** is such that a clearance is provided intermediate the ends of the flaps **32** and the juxtaposed surface of the floor **48**, but such clearance is less than any dimension of the machined parts which are being cleaned in cleaning apparatus **10**. As a result, machined parts which are being cleaned are pushed along the uppermost surface of the floor **48** by the flaps **32** which depend from the web **30**. The floor **49** is provided with an outlet plug **50** through which the bath may be drained from the cleaning apparatus **10**.

As seen particularly in FIGURE 3, lateral retention of the parts being cleaned is achieved by the use of wire mesh screens **52** and **54** on either side of the flaps **32**. Such wire mesh screens not only permit the machined parts undergoing cleaning to be engaged by the liquid comprising the bath, but also function as guides preventing the dislodgement of the machined parts being cleaned from the flaps **32** carried by the web **30**. The wire mesh screens **52** and **54** are disposed on either side of the flaps **32** along the length of web **30**.

Beneath the floor **48** and intermediate the idler rollers **44** and **46** is disposed the means for inducing vibration of ultrasonic frequency designated **56**. Such means **56**

may comprise piezoceramic transducers designated T 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 within the bath, whose construction is well known to those skilled in the art, may be used for the means designated **56**.

From idler roller **46** the web **30** angularly changes its direction so that the flaps **32** are disposed above the web **30**. The web **30** passes under the curved guides **58**, which like curved guides **38** are carried by the walls **20** and **40**.

The web **30** passes from the main bath designated B which is disposed appreciably below the idler roller **46** to the rinse bath designated R which is carried intermediate the walls **20** and **40** on the divider member **60**. The divider member **60** is formed from sheet metal and extends from a point adjacent idler roller **46** to a point generally on the same line as the lowermost edge of back plate **26** and then upwardly and then angularly away from back plate **26** forming a vapor-tight barrier. As seen particularly in FIGURE 2 the divider member **60** forms a trough spaced above the larger trough formed by the floor **49**. The trough formed by the divider member **60** 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 second divider member **62** formed of sheet metal is secured intermediate the walls **20** and **40**, such second divider member **62** forming a vapor-tight barrier and extending from the housing wall **64** to within the enclosure formed by the upper portion of the divider member **60**. The lowest portion of the second divider member **62** above the divider member **60** is provided with a drainage aperture **66**, which opens into the rinse bath R.

The endless web **30** passes from the rinse bath R and is supported by the inside surface of divider member **60** for a vertical distance. The web **30** parts company with the divider member **60** when it reaches curved guides **68**. The curved guides **68** are carried on the walls **20** and **40** and are disposed intermediate the divider member **60** and the second divider member **62**. Such curved guides **68** comprise an arc forming the major portion of a circle and sinuously deflect the web **30**. From its engagement with curved guides **68** the web **30** passes over idler roller **70**.

It will be seen from an examination of FIGURE 2 that the flaps **32** serve as dividers with the machine parts being cleaned being carried on the web **30** when the web **30** is passing through the rinse bath R. When the web **30** leaves the rinse bath R the machine parts are carried on the flaps **32**. Then as the web **30** travels over the curved guides **68** the machine parts are pushed along the uppermost surface of second divider member **62**. After the web **30** leaves curved guides **68** the machine parts are carried on the web, **30**, and after the web **30** passes over idler roller **70** the machine parts are carried on the uppermost surface of second divider member **62**. From idler roller **70** the web **30** passes to idler roller **72**, and thence vertically to the driver roller **74**. Between the idler roller **72** and the driver roller **74** the cleaned machine parts are carried on the flaps **32**, the free ends of the flaps **32** being spaced a short distance from the inside surface of the housing wall **64**.

The driver roller **74** is journaled by trunnions intermediate the walls **20** and **40** and is driven by motor **76** and gear reducers **78** which reduce the speed of rotation of the spindle of motor **76** to the speed assumed by driver roller **74**. The driver roller **74** may be surfaced with a high friction type material which secures engagement between such roller **74** and the juxtaposed surface of the web **30**, or alternatively, the driver roller **74** may comprise sprockets mating with apertures in the web **30**.

From driver roller **74** the web **30** passes along the uppermost surface of divider member **60** to the idler roller **80**. Between the driver roller **74** and the idler roller **80** the cleaned machine parts are carried on the uppermost surface of web **30**.

The web passes vertically downwardly from idler roller **80** to idler roller **82**, with the cleaned machine parts being carried on the flaps **32**. The free ends of the flaps **32** intermediate the idler rollers **80** and **82** are spaced a short distance from the inside surface of the housing wall **84**.

The outlet **86** for cleaning apparatus **10** extends through the housing wall **84**, with the mouth of such outlet **86** extending into the housing **12** of cleaning apparatus **10** to a point approximately beneath the idler roller **82**.

From idler roller **82** the web **30** veers inwardly intermediate the curved guides **88** and the projection **90** which extends from the divider member **60**. The curved guides **88** resemble the curved guides **38**, **58**, and **68** which have already been described. Thus, the curved guides **88** are secured to the inside surfaces of the walls **20** and **40** and project inwardly providing a support for the web **30**.

The drastic inward veering of the web **30** above the mouth of the outlet **86** results in the dislodgement of the cleaned machine parts which fall off of the flaps **32** as they round the idler roller **82**, and into the mouth of outlet **86**. A storage bin, or conveyor belt, or other means may be provided beneath outlet **86** to receive machine parts discharged from such outlet **86**.

From curved guides **88** the web **30** extends vertically downwardly along the divider member **60**. At a spaced distance from curved guides **88** the web **30** passes adjacent the back plate **26** and thence into the main bath B. After passing over the curved guides **38**, the conveyor belt **28** receives machine parts which have entered cleaning apparatus **10** through inlet **18**, funnel **22**, and water seal chamber **24**.

The solvent distillation section **16** comprises the vapor generator chamber **92**.

The vapor generator chamber **92** is formed intermediate the walls **94**, **96**, and **98**, and the floor **100**. The ceiling **102** for vapor generator chamber **92** may be removed therefrom, and may be secured in position by means of clasps **103** which extend intermediate the ceiling **102** and the wall **96**.

The walls **94**, **96**, and **98**, and the floor **100** and the ceiling **102** are preferably formed from materials which serve as non-conductors for heat. Thus, they may be formed of sheet metal coated with insulation materials, or may be formed of other suitable non-conductors for heat. Since ceiling **102** is separate from the remainder of the vapor generator chamber **92**, access may be had to the interior of vapor generator chamber **92** for cleaning by removing ceiling **102**.

The remaining wall of vapor generator chamber **92** includes the wall **104**, preferably formed of a non-conductor for heat, which extends upwardly for about half the height of vapor generator chamber **92**. The remainder of this wall of vapor generator chamber **92** comprises a sheet metal wall **106** which extends intermediate the ceiling **102** and the condensate trough **108** which is carried on the uppermost surface of wall **104**. A plurality of pressure relief ports **110** extend intermediate the vapor generator chamber **92** and the cleaning section **14** through the walls **40** and **106**, specifically such pressure relief ports **110** connecting the uppermost portion of vapor generator chamber **92** and the drying chamber formed in

the uppermost portion of cleaning section **14**, such drying chamber being isolated by the barrier-forming second divider member **62**.

The condensate trough is tilted, its end adjacent the wall **94** of vapor generator chamber **92** being lower than its end adjacent the wall **98** of vapor generator chamber **92**. At its lower end adjacent its floor, the condensate trough is provided with a passageway **112** which extends from the condensate trough **108** into the cleaning section **14**, and specifically to a point within the rinse bath R contained in the rinse sump formed by the lower portion of divider member **60**.

Refrigeration means **114** comprising a standard coolant gas compressor is disposed on top of solvent distillation section **16**. A wide variety of refrigeration means **114** may be utilized including those which deliver an 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 refrigeration means **114** is passed therefrom through duct **116** into the coil **118** which is formed intermediate the wall **40** and the wall **106**. The coil **118** serves to cool the wall **106**, whereby such wall **106** serves as a condenser onto which volatilized liquid may be condensed. Furthermore, the wall **40** is cooled, which serves to cool the drying chamber portion of the cleaning apparatus **10** above the divider member **60**.

From the walls **40** and **106**, the coil **118** extends as the duct **120** into the bath B within the cleaning section **14**. The duct **120** serves to cool the bath B whereby flashing of the chlorinated hydrocarbon solvent is prevented.

The duct **120** re-enters the vapor generator chamber **92** by passing through the walls **40** and **106**. This portion of the duct **120** designated **122** extends vertically upwardly within the vapor generator chamber **92** and thence into the refrigeration means **114**.

Heater means **124** is provided at the bottom of solvent distillation section **16**, such heater means comprising conventional means for disseminating heat including the coil **125** which extends from the wall **94** into the vapor generator chamber **92** and serves to heat the liquid inventory of vapor generator chamber **92**.

The level of liquid within the rinse bath R in the rinse sump formed by the bottom portion of divider member **60** is controlled by overflow pipe **126**, which also controls the height of the bath B. Thus, overflow pipe **126** extends through the divider member **60** and then through the walls **40** and **104**, discharging into the vapor generator chamber **92**. The portion of overflow pipe **126** intermediate the divider member **60** and the walls **40** and **104** includes the aperture **128** by which the level of the bath B is controlled.

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

Machine parts bearing an adhering contaminant are introduced into the cleaning apparatus **10** through inlet **18** and funnel **22** descending onto the conveyor belt **28** adjacent the idler roller **42**. During the descent from the funnel **22** the machine parts pass through the water seal W, on top of the bath B of chlorinated hydrocarbon solvent, and which water seal serves to prevent the volatilization of chlorinated hydrocarbon solvent from the bath B.

The machine parts are urged along the floor **48** by the flaps **32** of the conveyor belt **28**. The motion of the machine parts through the bath B effects cleaning of the machine parts. The bath B is maintained cool to prevent flashing and volatilization by the coolant passing through the duct **120** which is in heat-exchange with the bath B.

As the machine parts pass over the means for inducing vibrations of ultrasonic frequency **56**, such parts are subjected to ultrasonic cleaning, which facilitates in the removal of adhering contaminant which is disposed within interstices, and voids within the machine parts.

After being ultrasonically cleaned, the machine parts are impelled out of the bath B, and over the idler roller **46**, and into the rinse bath R maintained within the rinse sump formed in the lower portion of divider member **60**. The divider member **60** forms a barrier separating the rinse bath R from the main bath B. 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 machine parts may be effected within the rinse bath R. The tortuous path assumed by the conveyor belt **28** assures tumbling of the machine parts, facilitating their cleaning in both the main bath B and the rinse bath R, and also the drainage of solvent and contaminant from the machine parts, and drying of the machine parts.

From the rinse sump containing the rise bath R the machine parts are conveyed on the conveyor belt **28** upwardly into the drying chamber formed above the rinse sump and separated therefrom and from the bath B by the divider member **60** and the second divider member **62**, such divider members **60** and **62** serving as barriers preventing the machine parts carried by the conveyor belt **28** from coming into contact with the chlorinated hydrocarbon solvent. The drying chamber above the rinse sump is maintained cool by heat-exchange with the cooled wall **40**. This prevents loss of the chlorinated hydrocarbon solvent to the atmosphere, and also serves as an added protection against the possibility of vaporization of the solvent through the water seal W. Any chlorinated hydrocarbon solvent which is carried over from the rinse bath R is returned to the rinse bath R through drainage aperture **66**. In the illustrated embodiment the drainage aperture **66** is shown on second divider member **62** beneath the web **30** of conveyor belt **28**. In such case the drainage aperture may be covered by wire mesh in order to prevent jamming of machine parts therein. However, it is feasible to position the drainage aperture **66** to one side of the second divider member **62** in order that such drainage aperture would not interfere with machine parts being conveyed along the second divider member **62** by the flaps **32** of conveyor belt **28**.

The labyrinthian construction of the upper portion of cleaning section **14**, utilized as a drying chamber, permits the optimum use to be made of the available space within the drying chamber. Moreover, this construction permits the length of travel through the drying chamber to be extended so that facile drying of the cleaned machine parts may be accomplished.

Within the vapor generator chamber **92** chlorinated hydrocarbon solvent is distilled off from the bottom of the chamber by heater **125**. The vaporized chlorinated hydrocarbon condenses on the wall **106** of vapor generator chamber **92**, and the condensate is collected in the condensate trough **108**. The collected condensate which flows downwardly by gravity in the condensate trough **108** leaves such trough as cooled liquid through passageway **112**. From passageway **112** the condensate enters the rinse bath R within the rinse sump in the bottom portion of divider member **60**. The level of chlorinated hydrocarbon solvent within the rinse bath R is maintained at a constant height by the duct **126**. Thus, overflow from rinse bath R leaves through the duct **126** into the vapor generator chamber **92**. Chlorinated hydrocarbon solvent within the main bath B passes into the duct **126** through the opening **128**, and from the duct **126** into the vapor generator chamber **92**.

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 outlet plug **50**. If desired, it may also be drained from the rinse bath R through the drain pipe **130** and

plug 132. The solvent inventory may be drained from the vapor generator chamber 92 through the plug 134.

The heretofore-indicated mode of construction renders the cleaning apparatus 10 of the present invention readily available for major repairs and overhauling. Thus, the cleaning apparatus 10 may be built in such manner that it is possible to remove the entire wall 20. In this embodiment the curved guides and divider members may be bolted into position, and the wall 20 removed by unscrewing the bolts. This construction will permit rapid and facile access to the entire cleaning section 14. Since the ceiling 102 of vapor generator chamber 92 may be removed, rapid and facile access to the vapor generator chamber 92 is possible.

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 machine parts including a cleaning section and a solvent distillation section, a party wall intermediate said cleaning section and said solvent distillation section, cooling means disposed within said party wall for cooling both said cleaning section and said solvent distillation section, means at the base of said solvent distillation section for volatilizing solvent, a condensate trough carred on said party wall within said solvent distillation section and spaced above the floor of said solvent distillation section for capturing condensed solvent from said party wall, and a passageway extending from said condensate trough to said cleaning section.

2. Cleaning apparatus for degreasing machine parts including a cleaning section and a solvent distillation section, a party wall intermediate said cleaning section and said solvent distillation section, cooling means disposed within said party wall for cooling both said cleaning section and said solvent distillation section, a bath sump disposed at the bottom of said cleaning section, a barrier above said bath sump, a rinse sump disposed in said cleaning section above said barrier, means at the base of said solvent distillation section for volatilizing solvent, a condensate trough carried on said party wall within said solvent distillation section and spaced above the floor of said solvent distillation section for capturing condensed solvent from said party wall, and a passageway extending from said condensate trough to said rinse sump.

3. Cleaning apparatus for degreasing machine 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 barrier above said bath sump, a rinse sump disposed in said cleaning section above said barrier, a second barrier disposed in said cleaning section above said rinse sump, a drying chamber disposed in said cleaning section above said second barrier, an outlet from said drying chamber for the machined parts adapted to be cleaned, an inlet into said bath sump for the machined parts adapted to be cleaned, an endless conveyor for transferring the machine parts within said cleaning section through said bath sump, rinse sump, and drying chamber, means at the base of said solvent distillation section for volatilizing solvent, means within said solvent distillation secton for condensing solvent, and a passageway through said party wall joining said last-mentioned means and said cleaning section.

4. Cleaning apparatus in accordance with claim 3 in which the bath sump includes means for inducing vibrations of ultrasonic frequency spaced from said endless conveyor.

5. Cleaning apparatus in accordance with claim 3 in which the inlet into said bath sump enters into a chamber having a downwardly extending baffle, and in which the endless conveyor passes into the bath sump from the opposite side of said baffle from said inlet, and in which said endless conveyor moves beneath said baffle into a position below said inlet.

6. Cleaning apparatus in accordance with claim 3 in which said second barrier includes an aperture through which solvent may be drained from said drying chamber into said rinse sump, and said rinse sump includes an overflow pipe which extends from said rinse sump through the party wall into said solvent distillation section.

7. Cleaning apparatus in accordance with claim 6 in which said overflow pipe passes downwardly from said rinse sump into said bath sump and includes 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 sump.

8. Cleaning apparatus for degreasing machine 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 barrier above said bath sump, a rinse sump disposed in said cleaning section above said barrier, a second barrier disposed in said cleaning section above said rinse sump, a drying chamber in said cleaning section above said second barrier, an outlet from said drying chamber for the machined parts adapted to be cleaned, an inlet into said bath sump for the machined parts adapted to be cleaned, an endless conveyor for transferring the machine parts within said cleaning section through said bath sump, rinse sump, and drying chamber, cooling means disposed within said party wall for cooling both said cleaning section and said solvent distillation section, means at the base of said solvent distillation section for volatilizing solvent, a condensate trough carried on said party wall within said solvent distillation section and spaced above the floor of said solvent distillation section for capturing condensed solvent from said party wall, and a passageway extending from said condensation trough to said rinse sump.

9. Cleaning apparatus in accordance with claim 8 in which the bath sump includes means for inducing vibrations of ultrasonic frequency spaced from said endless conveyor.

10. Cleaning apparatus in accordance with claim 8 in which the inlet into said bath sump enters into a chamber having a downwardly extending baffle, and in which the endless conveyor passes into the bath sump from the opposite side of said baffle from said inlet, and in which said endless conveyor moves beneath said baffle into a position below said inlet.

11. Cleaning apparatus in accordance with claim 8 in which said second barrier includes an aperture through which solvent may be drained from said drying chamber into said rinse sump, and said rinse sump includes an overflow pipe which extends from said rinse sump through the party wall into said solvent distillation section.

12. Cleaning apparatus in accordance with claim 11 in which said overflow pipe passes downwardly from said rinse sump into said bath sump and includes 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 sump.

13. A process for degreasing machine parts which comprises moving said machine parts through a solvent bath, withdrawing said machine parts from said solvent bath and transferring said machine parts to a rinse bath, transferring said machine parts from said rinse bath to a drying zone in which solvent from the rinse bath is drained from the machine parts, volatilizing solvent from said rinse bath in a separate zone, condensing said volatilized solvent by contact with a cooled surface, adding said condensed solvent to said rinse bath, maintaining said rinse bath and solvent bath at a temperature below ambient tempera-

tures, and withdrawing solvent from said rinse bath to said solvent bath and to said separate zone where the solvent is volatilized for said rinse bath.

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