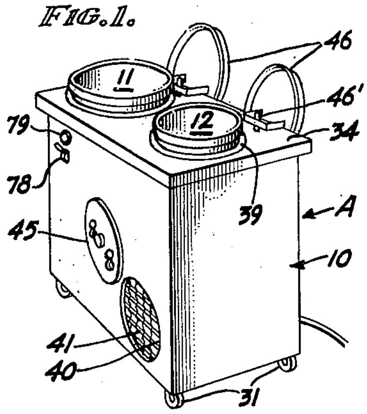
PORTABLE TWO BATH SOLVENT VAPOR PARTS CLEANER

Filed June 6, 1963

FIG. 1.



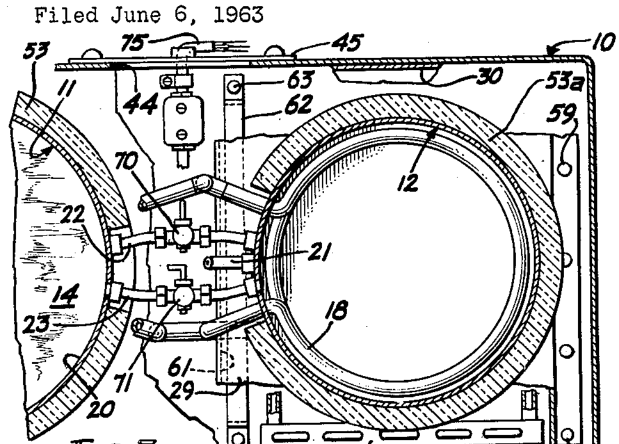
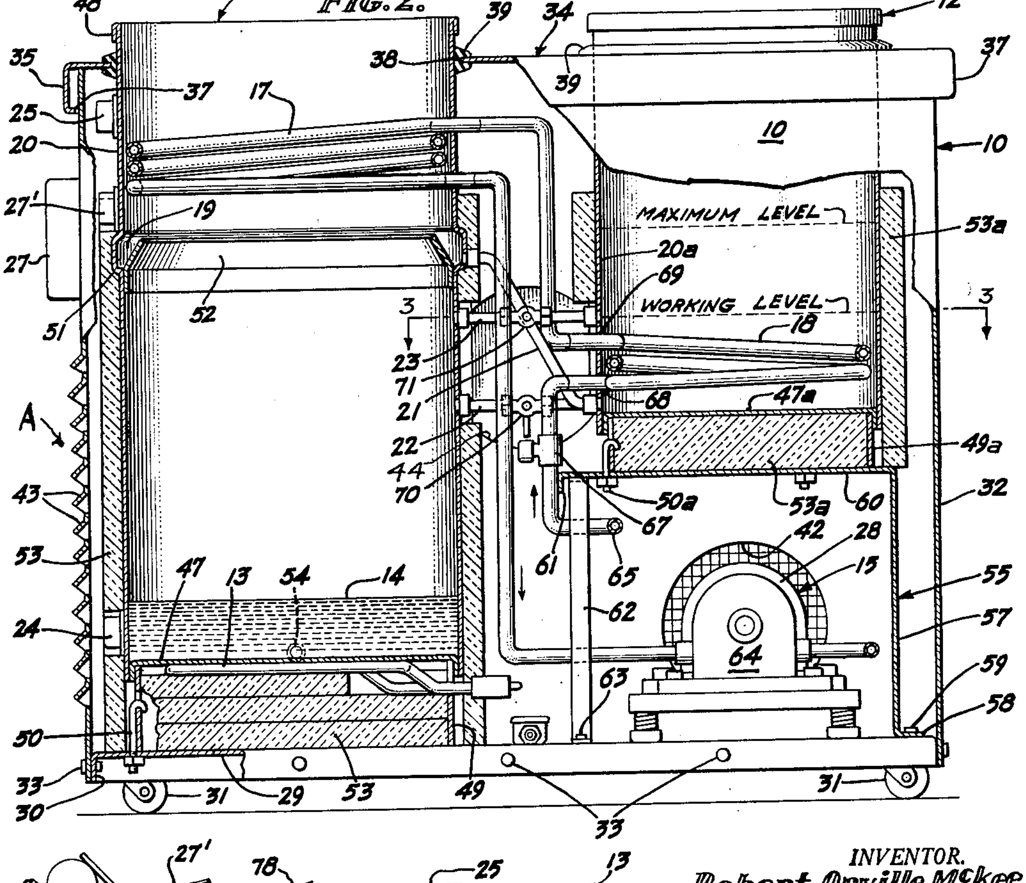


FIG. 3.

FIG. 2.



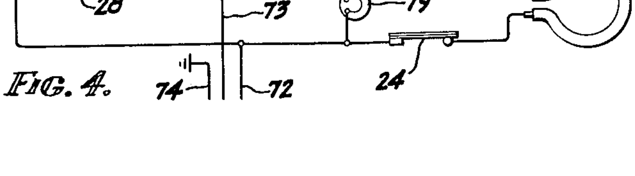


FIG. 4.

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PORTABLE TWO BATH SOLVENT VAPOR PARTS CLEANER

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The present invention relates to parts cleaning, and pertains more particularly to a mechanism for cleaning grease, metal chips, and other foreign matter from accurately machined small parts, including such parts having blind holes therein.

In recent years there has been a substantial increase in the number of shops and manufacturing plants, particularly smaller plants, producing accurately machined and highly finished parts and components for the many highly sophisticated mechanisms which have been developed during that time.

In cleaning large parts, such as many of those used in the automotive and airplane industries, the use of ordinary de-greasing mechanisms and methods is usually satisfactory. In using such ordinary de-greasing mechanisms, articles to be cleaned are lowered into the vapor zone of a tank having a quantity of boiling, heavy-vapor-type solvent in the bottom thereof, and having a cold water coil around its upper end to chill the vapor below its vapor point and thus prevent the escape of the vapor from the tank. The parts, when thus lowered into the vapor zone, chill and condense the vapor thereon, and this condensed solvent cascades down along the parts, cleaning them of grease and oil deposits thereon.

In the case of small parts, the amount of condensate formed thereon by such ordinary degreasing procedure is slight, due to their small surface area. Also, due to their small size, they rapidly heat up to vapor temperature, whereupon the condensation stops. When such parts have blind holes therein, the difficulty of cleaning becomes even more acute. Therefore, ordinary degreasing mechanisms have not been satisfactory for the cleaning and degreasing of small parts. Other procedures have been employed for the cleaning of such small parts, including immersion of the parts in a solvent bath having an ultrasonic vibrator immersed therein. While such supersonic baths are quite effective, even they frequently fail to clean out blind holes in the parts being cleaned.

The present invention provides a portable cleaner for effectively cleaning grease and metal chips from small, highly machined parts.

Another object of the invention is to provide a portable, two-bath cleaner, one of the baths being of a boiling solvent, with a vapor zone thereabove, the other bath being chilled, and being constantly replenished by distilled vapors from the first bath, means being provided to maintain a constant working level of condensate in the chilled tank.

Another object of the invention is to provide an improved, two tank, portable, solvent cleaning mechanism comprising a heated, solvent vaporizing tank, and a shorter, chilled tank, means being provided for transferring vapor condensate from the heated tank into the chilled tank, means also being provided for controlling the depth of liquid solvent in the chilled tank.

These, and other objects and advantages of the invention, will be apparent from the following description and the accompanying drawings wherein:

FIG. 1 is a small scale, perspective view of a two-bath, portable, parts cleaning mechanism embodying the invention.

FIG. 2 is an enlarged, vertical, longitudinal sectional view through the mechanism shown in FIG. 1, portions being shown in elevation.

FIG. 3 is a fragmentary, sectional view taken along line 3—3 of FIG. 2.

FIG. 4 is a circuit diagram of the mechanism shown in FIGS. 1–3.

Briefly, the illustrated form A of the invention comprises a caster mounted enclosure 10 having a heated tank 11, and a shorter, chilled tank 12 mounted therein, both of the tanks being insulated.

A heating unit 13 is mounted beneath the tank 11 to boil heavy-vapor-type liquid solvent 14 contained therein, while a refrigerating unit 15 is mounted in the space beneath the tank 12 to chill a pair of coils 17 and 18, mounted within the tanks 11 and 12, respectively.

An annular trough 19 in the heated tank 11 collects solvent condensate flowing down on the tank wall 20, and a drain tube 21 allows this condensate to gravitate from the trough 19 into the lower portion of the chilled tank 12.

A lower transverse line 22 communicates the bottom of the shorter, chilled tank 12 with the heated tank 11, while an upper, transverse, overflow line 23 provides a constant working depth of solvent in the chilled tank 12, and returns clean solvent to the heated tank 11.

Thermostatic safety limit switches 24 and 25, referred to later herein, are connected in series with the heating unit 13, while an adjustable thermostatic switch 27, set to close slightly above ambient room temperature, is connected in series with the drive motor 28 of the refrigerating unit 15.

In using the parts cleaning mechanism A in accordance with the present invention, with both transverse lines 22 and 23 closed off, a sufficient qaantity of liquid solvent is poured into the shorter tank 12 to fill it sufficiently to just overflow the trough 19 in the heated tank 11. The upper transverse line 23 is then opened to allow solvent above the level of this line to drain off into the heated tank 11.

The heater 13 is then energized to boil the solvent contained in the heated tank 11, which becomes filled with the hot, heavy, solvent vapor. The vapor heats the thermostatic switch 27, which thereupon closes and energizes the refrigerating unit 15 to chill the coils 17 and 18 and the solvent contained in the shorter tank 12.

Articles to be cleaned are first immersed in the boiling solvent 14 until heated. They are then withdrawn and are immersed in the chilled solvent contained in the tank 12. When chilled, the parts are withdrawn from the tank 12 and are lowered into the vapor zone of the heated tank 11 until dry.

Referring to the drawings in greater detail, the cabinet type enclosure 10 comprises a sheet metal base 29, of suitable strength and stiffness, having down-turned side flanges 30, and supported on casters 31. A rectangular enclosure wall 32 is fitted around the base 29, and is secured thereto by bolts 33.

A top plate 34 is mounted on the upper edges of the wall 32, and extends laterally therebeyond. It is formed with a down-turned marginal portion 35 (FIG. 2) and inwardly bent lower flange 37 to form a bulge or blister completely surrounding the upper end of the enclosure. A primary purpose of this bulge or blister is to prevent a side of the machine from being positioned so close to a building wall or other object as to prevent a flow of cooling air to and from the refrigerating unit 15 contained therein. It also adds considerably to the structural strength of the enclosure. Openings 38 are provided in the top plate 34 to receive the tanks 11 and 12 therein, and sealing gaskets 39, of neoprene or other suitable material, are fitted onto the edges of these openings seal the tanks to the top plate 34, and to absorb vibration at these points.

An air opening 40 is provided in the front wall of the enclosure 10 to admit cooling air to the condenser coil

41 of the refrigerating unit 15, and a similar opening 42 (FIG. 2) is provided in the opposite wall to allow such cooling air to exit from the enclosure. Louvers 43 are also provided in an end wall of the enclosure to insure adequate venting at all times. Access openings 44 are provided, one in each of the front and rear walls of the enclosure, to permit access to valves which control the flow of solvent through the transverse lines 22 and 23. Removable cover plates 45 are provided, one for each of the access openings 44.

The tanks 11 and 12 are of conventional construction, and are provided with conventional covers 46, which may be hung upon pegs 46′ when the mechanism A is in use. The heated tank 11 has a flanged bottom 47 (FIG. 2) which is sealed to the lower marginal portion of the cylindrical tank wall 20. A reverse flange 48 is formed around the upper edge of the tank wall 20. The tank 11 is supported upon a rolled cylinder 49 of steel strip material which is secured to the tank bottom 47, and is anchored to the enclosure base plate 29 by conventional hook bolts 50.

To form the condensate collecting trough 19, an annular, outward bulge 51 is provided, as by rolling, in the tank wall 20, and an annular flange 52 is sealed to the inner face of the tank wall just below this bulge.

Except for its length, and the trough 19 therein, the heated tank 11 is generally similar to the shorter chilled tank 12. Corresponding parts of the latter tank are, therefore, designated by the same reference numerals as those of the heated tank 11 with the suffix *"a"* added thereto. Suitable insulation 53, such as glass fiber batt, is provided beneath and around both tanks.

The heating unit 13 is illustrated as a conventional, enclosed or rod type electrically energized heating coil, and is mounted beneath the bottom of the heated tank 11 to boil solvent 14 contained therein. A conventional drain outlet 54 is provided in the bottom of the heated tank 11 to permit draining off oil and sludge when cleaning this tank.

The lower most thermostatic safety limit switch 24 is adjusted to open at a temperature slightly above the boiling point of the solvent employed, for example, at a temperature of 300 degrees F. This switch may be applied externally to the lower end portion of the tank wall 20, and is connected in series with the heating unit 13. In the event that the solvent in the heated tank 11 should become completely depleted, leaving the tank either empty, or containing only oil washed from parts cleaned therein; since the boiling point of such oil is above the limit point of the switch 24, the latter will open and thereby break the circuit to the heater. This avoids damage which otherwise might occur if the oil residue were permitted to be burned or baked onto the tank bottom.

The adjustable thermostatic switch 27, connected in series wtih the motor 28 (FIG. 2) of the refrigerating unit 15, has the sensing unit 27′ thereof applied externally to the tank wall 20 just below the refrigerating coil 17. This switch 27 preferably has an adjustable closing range of between 70 degrees F. and 120 degrees F., and should be set by the user to close at a temperature about ten degrees above the highest ambient room temperature to be expected.

After the heating unit 13 has been energized, and the solvent 14 in the heated tank 11 is boiling, hot vapor, rising from the boiling solvent, heats the tank wall 20 and causes the switch 27 to close, thereby closing a circuit through the motor 28 of the refrigerating unit.

The thermostatic switch 25 is applied to the tank wall 20 above the refrigerating coil 17, and is set to open at a temperature well above the maximum ambient room temperature to be expected, for example, at a temperature of approximately 130 degrees F. In the event of a failure of the refrigerating unit while the mechanism A is in operation, the coil 17 will not be chilled and the heated solvent vapor will rise in the tank 11 above the level

of the coil 17, heating the wall 20 and causing the switch 25 to open the circuit through the heating unit 13.

Since the thermostatic switches employed are all of well known types, readily available by purchase on the open market, and since the details thereof form no part of the present invention, such details are not illustrated or described herein.

A platform 55 for supporting the tank 12 is of sheet steel, and comprises a flat, upright portion 57 having an outwardly bent flange 58 at its lower end secured by bolts 59 to the base plate 29. A transversely extending top portion 60 supports the tank 12, and is stiffened by a downwardly bent end flange 61. An inverted, U-shaped, metal strip 62, secured by bolts 63 to the base plate 29, supports the other end of the transverse top portion 60 from the upright portion 57.

The refrigerating unit 15, which is conventional, comprises the usual electric drive motor 28 (FIG. 2) rotary compressor 64, and condenser 41. From the condenser 41 a tube 65 leads to an expander 67, which, with the compressor 64, divides the heat dissipating, high pressure side of the system from the cold, low pressure side thereof. The points 68 and 69 at which the tubing of the expander coil 18 enters and leaves the chilled tank 12 are sealed to the tank. Since the coils 17 and 18, and the piping connecting them to the refrigerating unit 15 are conventional, it is unnecessary to describe them in greater detail herein.

The transverse lines 22 and 23 are of suitable metal tubing, and are provided with conventional shut-off valves 70 and 71, respectively. The sloping drain line 21 for transferring condensate from the trough 19 into the chilled tank 12 communicates at its upper end with the interior of the trough 19, while its lower end opens into the chilled tank 12 near its bottom. Preferably, the trough 19 is at a height, relative to the chilled tank 12, that, with both valves 70 and 71 closed, a desired quantity of solvent to operate both tanks, when contained in the chilled tank 12 alone, will just overflow the trough 19 via a reverse or upward flow through the drain pipe 21.

A suitable electrical circuit for the illustrated form A of the invention is shown in FIG. 4, wherein two line conductors 72 and 73, and a grounded conductor 74, may be the conductor wires of a conventional, three-conductor extension cord 75 (FIG. 3). The conductor 74 is grounded to the enclosure 10, which in turn is electrically bonded to other metal parts of the mechanism A, including the tanks 11 and 12.

The line conductor 72 is connected through the thermostatic limit switch 24 (opens 300 degrees F.), the heating unit 13, the thermostatic limit switch 25, (opens 130 degrees F.) and a conventional "ON"–"OFF" manual control switch 78 to the other line conductor 73. A pilot light 79 is connected in parallel with the heating unit 13, beyond the control switch 78 and ahead of the thermostatic switches 24 and 25, to indicate when the control switch 78 is closed.

The line conductor 73 is also connected through the adjustable thermostatic switch 27 (closes 70 degrees–120 degrees F.) and the motor 28 of the refrigerating unit 15 to the other line conductor 72.

The operation of the illustrated form A of the invention is as follows:

It is assumed that the tanks 11 and 12 are initially empty, the room temperature is approximately 70 degrees F. the thermostatic switch 27 is adjusted to close at a temperature of 80 degrees F., the line conductors 72 and 73 of the extension cord 75 are connected to a suitable source of electricity, and the conductor 74 is grounded.

The tanks 11 and 12 are then charged with heavy-vapor solvent, such as trichlorethylene, perchlorethylene or Freon T.F., by closing the valves 70 and 71 and filling the shorter tank 12 with the selected solvent until the solvent, rising in the drain tube 21, overflows the trough

19. The valve 71 in the upper transverse line 23 is then opened to allow the solvent to drain down to the level of this transverse line 23, which, as stated previously herein, provides a suitable working depth of solvent in both tanks.

The manual control switch 78 is then closed, and, since the limit switch 24, which opens at a temperature of 300 degrees F., and the limit switch 25, which opens at a temperature of 130 degrees F., are both closed at the assumed room temperature, the heating unit 13 is thereby energized as explained in the description of FIG. 4.

The heating unit 13, thus energized, heats to its boiling point the solvent 14 in the tank 11. The hot vapor from the boiling solvent, which is heavier than air, gradually fills the tank 11, and in doing so heats the tank wall 20 until the adjustable thermostatic switch 27 closes at its assumed, adjusted, closing temperature of 80 degrees F. Closing of switch 27 energizes the motor 28 of the refrigerating unit 15, which thereupon promptly chills the expansion coils 17 and 18.

Chilling of the coil 17 in the heated tank 11 provides a cold layer of air in the upper end of this tank which prevents the heated solvent vapor from rising above the level of the bottom of the coil 17, and also causes condensation of solvent on the tank wall 20. This action prevents the uppermost limit switch 25 from attaining its assumed opening temperature of 130 degrees F.

The solvent which is condensed on the tank wall 20 flows downwardly into the trough 19, and thence down the drain tube 21 into the lower end of the chilled tank 11, thereby providing a constant replenishment of clean solvent in the chilled tank 12, while the transverse overflow line 23 returns excess, clean solvent to the heated tank 11, thereby maintaining a desired working depth of solvent in the chilled tank 12.

Should the supply of solvent 14 ever become completely depleted from the heated tank 11, the temperature at the lower end of that tank would rise above the 300 degree F. temperature required to open the limit switch 24. This action would de-energize the heating unit 13, and thereby prevent damage, which might otherwise occur through the baking or burning on the tank bottom of oil or grease washed from parts cleaned in the tank 11.

In using the illustrative mechanism A, parts to be cleaned may be suspended on wires or racks, or placed in wire mesh or perforated metal baskets (not shown) in a manner commonly employed for supporting parts for cleaning in conventional degreasing mechanisms. The parts are first lowered into the tank 11 until they are immersed in the boiling solvent 14. This sets up violent convection currents in the boiling solvent, and tends to thoroughly wash off oil, grease and metal chips adhering to the parts. The parts are left in this boiling solvent for a sufficient period of time, for example ten seconds, to heat them to a temperature approaching that of the boiling solvent. During their immersion in the boiling solvent any air trapped in blind holes in the parts being cleaned is heated to approximately the boiling point of the solvent, and is thereby greatly expanded, and is either mixed with, or replaced by, solvent vapor.

The parts are then removed from the heated tank 11, and are immersed in the chilled solvent in tank 12. There the parts are rapidly chilled, and any heated air or solvent vapor in any blind holes in the parts is thereby condensed, and draws chilled liquid solvent into these blind holes to clean them. When the parts are thoroughly chilled, for example, in approximately another ten seconds or less, they are removed from the chilled tank 12 and are lowered into the vapor zone above the boiling solvent in the heated tank 12. They are left in this vapor zone for a sufficient length of time, approximately another ten seconds, to bring their temperature up toward that of the solvent vapor, which drys them, and also vaporizes any solvent which may be trapped in any blind

holes in the parts. The parts are then removed from the tank 11, thoroughly cleaned and dry.

The invention provides an improved, relatively inexpensive, and highly effective, portable parts cleaning and degreasing mechanism. It can be readily moved to any desired location in a plant, and rapidly and thoroughly cleans metal parts of any adhering oil, grease, dirt and metal chips, and also thoroughly cleans out any blind holes in such parts.

While I have illustrated and described a preferred embodiment of the present invention, it will be understood, however, that various changes and modifications may be made in the details thereof without departing from the scope of the invention as set forth in the appended claims.

Having thus described the invention, what I claim as new and desire to protect by Letters Patent is defined in the following claims.

I claim:

1. A two tank portable parts cleaning mechanism comprising:

(*a*) a portable base,

(*b*) a heated tank mounted on the base for containing heavy-vapor type solvent therein,

(*c*) a heating unit at the lower end of the heated tank for boiling solvent contained in the heated tank,

(*d*) a chilled tank shorter than the heated tank mounted on a raised support alongside the heated tank,

(*e*) a refrigerating coil surrounding the interior of the heated tank near the upper end thereof to provide a vapor restricting layer of cold air in the upper end of the heated tank, and for condensing solvent vapor on the wall of the heated tank,

(*f*) a condensate collecting trough surrounding the interior of the heated tank just below the refrigerating coil therein for collecting solvent condensate flowing down the tank wall,

(*g*) a drain tube communicating the interior of the trough with a lower point interiorly of the chilled tank for draining solvent condensate from the trough into the chilled tank,

(*h*) an overflow line communicating the interior of the chilled tank with the interior of the heated tank at the height of a working depth of solvent in the chilled tank,

(*i*) a refrigerating coil in the chilled tank below the level of the overflow line,

(*j*) a refrigerating unit mounted on the base and operatively connected to both of the coils,

the trough being at such a height relative to the chilled tank, that when the heated tank is empty, the overflow line is closed off, and the chilled tank is filled with solvent to the depth of the trough, and the overflow line is then opened to allow the solvent above the level of the overflow line to drain off into the heated tank, a working quantity of solvent is thereby provided in both tanks.

2. An arrangement according to claim 1 wherein the heating unit and the refrigerating unit are electrically energized and wherein the heating unit is connected into an electrical circuit having a first thermostatic limit switch therein, said first limit switch being exposed to the temperature at the bottom of the heated tank and adjusted to open at a temperature slightly above the boiling point of a solvent used therein, the heating unit circuit having also therein a second thermostatic limit switch exposed to the temperature within the heated tank above the level of the refrigerating coil therein, the second thermostatic limit switch being adjusted to open at a temperature well above that of the ambient atmosphere, and well below the boiling point of the solvent used, a thermostatic switch also being connected into the circuit of the refrigerating unit and mounted at approximately the height of the coil in the heated tank, whereby, in the event of a loss of solvent from the heated tank, or a failure of the refrigerat-

ing unit during operation of the heating unit, the circuit to the heating unit will be opened by the first and second thermostatic limit switches, respectively, and whereby the refrigerating unit is held inoperative until hot vapor from boiling solvent in the heated tank raises the temperature of the thermostatic switch in the refrigerating unit circuit to close it.

3. A two tank portable parts cleaning mechanism comprising:

(*a*) a portable base,

(*b*) a heated tank mounted on the base for containing heavy-vapor type solvent therein,

(*c*) a heating unit at the lower end of the heated tank for boiling solvent contained in the heated tank,

(*d*) a chilled tank mounted on the base alongside the heated tank,

(*e*) a refrigerating coil surrounding the interior of the heated tank near the upper end thereof to provide a vapor restricting layer of cold air in the upper end of the heated tank, and for condensing solvent vapor on the wall of the heated tank,

(*f*) a condensate collecting trough surrounding the interior of the heated tank just below the refrigerating coil therein for collecting solvent condensate flowing down the tank wall,

(*g*) a drain tube communicating the interior of the trough with a lower point interiorly of the chilled tank for draining solvent condensate from the trough into the chilled tank,

(*h*) an overflow line below the level of the trough and communicating the interior of the chilled tank with the interior of the heated tank at a height to maintain a required working depth of solvent in the chilled tank,

(*i*) a refrigerating coil in the chilled tank below the level of the overflow line, and

(*j*) a refrigerating unit mounted on the base and operatively connected to both of the coils.

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