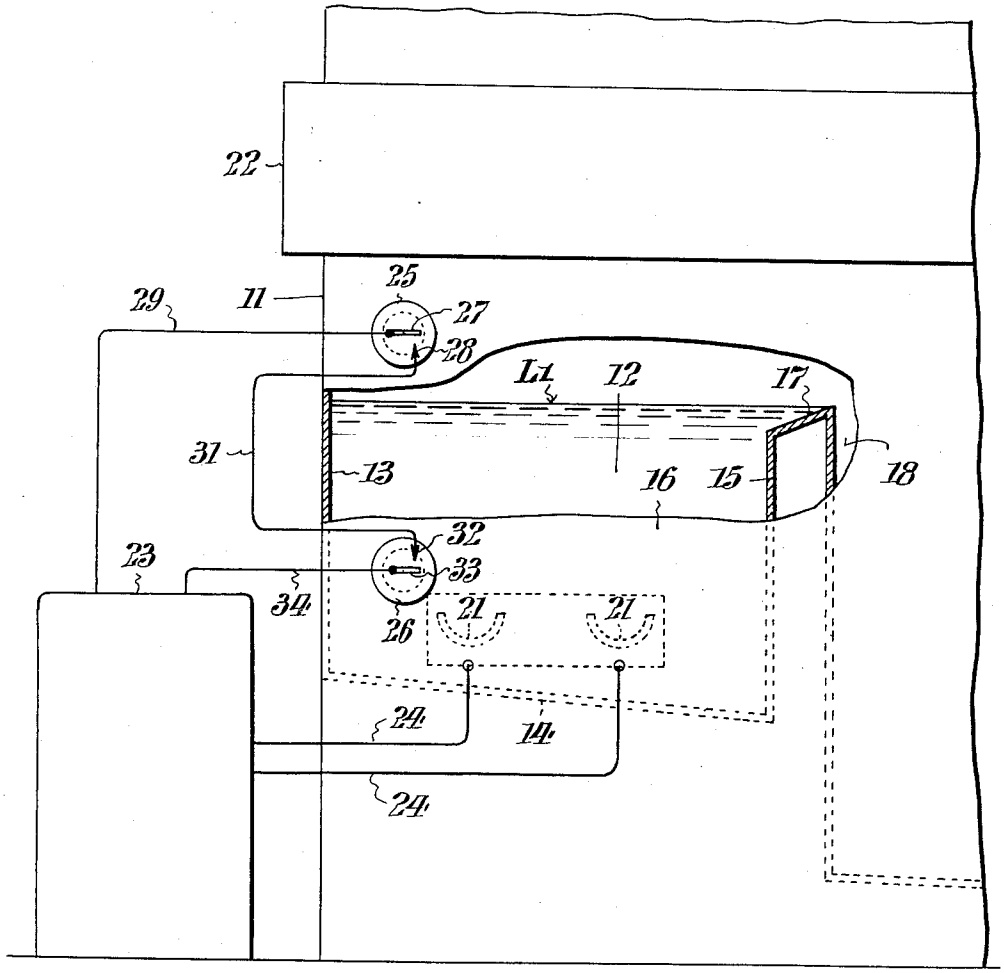
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LIQUID LEVEL AND TEMPERATURE APPARATUS

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LIQUID LEVEL AND TEMPERATURE APPARATUS

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This invention relates to improvements in apparatus for treating a work object. It is concerned with apparatus for cleaning and degreasing intricately formed metal parts through the combined application of chlorinated hydrocarbon solvents and ultrasonic energy. More particularly, this invention relates to control of cleaning apparatus through control of temperature and liquid level.

The ultrasonic well of present day ultrasonic cleaning and degreasing apparatus contains a chlorinated hydrocarbon solvent having ultrasonic transducers submerged therein. The liquid in the ultrasonic well performs several functions besides its principal one of acting as a cleaning agent. One of these functions is to cool the curved or flat transducers since these elements are destroyed by excessive heat. If electrical energy is applied to these transducers when they are not submerged in and cooled by a liquid they are destroyed quite rapidly.

The present method of avoiding such destruction of the transducers when not submerged in liquid is to provide the ultrasonic well with a float switch which opens the generator circuit when the liquid level drops below the transducers. Float switches are comparatively expensive. Further, they have moving parts which fail to function properly when soil cleaned from the work object is deposited thereon. Even though the transducers remain submerged in the liquid they still overheat and are destroyed whenever the liquid temperature becomes excessive for any reason, such as lack of cooling water, clogged filter, closed valve or other improper operation of the ultrasonic cleaning machine.

Accordingly, it is an object of this invention to provide means for preventing the energizing of the transducers when the transducers are not submerged in a liquid. Another object is to provide means for preventing the energizing of the transducers when the temperature of the liquid is too hot. A further object of this invention is to provide means for preventing the energizing of the transducers until the zone above the surface of the liquid becomes hot enough.

Other objects and advantages of the invention, including the simplicity and economy of the same, will be understood from the detailed description to follow, throughout which reference is made to the accompanying drawing which represents a view in front elevation of cleaning apparatus including liquid level and temperature apparatus constructed in accordance with the invention.

Although specific terms are used in the following description for the sake of clarity, these terms are intended to refer to the structures shown in the drawing only, and are not intended to define or limit the scope of the invention.

Turning now to the drawing and the specific form of the invention selected for illustration therein, the number **11** designates a housing which may be of sheet metal. Housing **11** contains an ultrasonic well **12** which is defined by left wall **13**, slanted bottom **14**, right wall **15**, front wall **16** and the back wall of housing **11**. Right wall **15** is part

of an overflow dam **17** which separates ultrasonic well **12** from another well **18**.

A liquid, preferably a chlorinated hydrocarbon liquid such as trichlorethylene, is contained within ultrasonic well **12** and normally maintained at level L1. Supported in the well **12** and submerged in the liquid are ultrasonic transducers **21**. Vapors are generated in a boiling well located elsewhere in the apparatus (not shown) within housing **11**. These vapors are condensed by a cooling jacket **22** which completely surrounds housing **11** at a level above the surface of the liquid.

A generator **23** is provided which supplies power to energize transducer **21**. Generator **23** is connected to transducers **21** by conductors **24**. Reference is hereby made to U. S. Patent No. 2,771,086 of Thomas J. Kearney, issued November 20, 1956, which fully describes cleaning apparatus of the type to which the present invention relates.

Mounted on wall **16** of enclosure **11** above the level L1 of the liquid in well **12**, is a thermostatic switch **25**, which may be of bulb or bi-metal types. Switch **25** has a temperature sensitive element extending within enclosure **11** into the vapor zone above well **12**. A similar thermostatic switch **26** is mounted on wall **16** of housing **11** with its temperature sensitive element extending within well **12** below the surface L1 of the liquid and above the level of the transducers **21**. Switch **25** is provided with an armature **27** and a contact **28**, armature **27** having a conductor **29** leading back to generator **23** and contact **28** having a conductor **31** leading to a contact **32** of switch **26**. Contact **32** has associated with it an armature **33** which is connected with generator **23** by a conductor **34**.

The operation of this invention will now become apparent. Using trichlorethylene as the liquid within well **12**, the top thermostatic switch **25** would be set to close when the temperature of the vapor within housing **11** above the surface L1 of the trichlorethylene reaches approximately 180° F. The lower thermostatic switch **26** is normally closed but is set to open when the temperature reaches approximately 160° F. When either switch **25** or **26** are open, and when both are open, generator **23** does not operate and no electrical energy is supplied to transducers **21**.

Top thermostatic switch **25** opens to shut down generator **23** when no vapors are generated within enclosure **11**. Switch **25** closes and energizes the electric generator circuit only when the temperature above liquid level L1 has reached the operating temperature of the machine. This is about 180° F. when trichlorethylene is the solvent.

Lower thermostatic switch **26** opens to shut down generator **23** when the level of the solvent falls below the sensitive element of thermostatic switch **26** so that it is no longer submerged in the solvent. Lower thermostatic switch **26** also opens to shut down generator **23** even though the level of the solvent is above the sensitive element of thermostatic switch **26** whenever the temperature of the solvent is too hot. Excessive temperature acts upon the sensitive element of thermostatic switch **26** to open it and shut down generator **23** whether the excessive temperature is from the vapors when the level of the solvent falls below the sensitive element of thermostatic switch **26**, or whether, the liquid level being above that sensitive element, the temperature of the solvent itself is too hot. Thermostatic switch **26** protects transducers **21** for overheating and switch **26** is positioned above transducers **21** so that as the solvent level falls, generator **23** shuts down before the solvent level falls below the level of transducers **21**. When the liquid level is falling thermostatic switch **26** shuts down generator **23** before transducers **21** emerge from the solvent.

Thermostatic switch **26** also opens when, for any reason such as lack of cooling water, a clogged filter, a

closed valve, or failure of a pump, the temperature of the liquid becomes too hot. Switch **25** is set to open at about 160° F. where trichlorethylene is the liquid used in well **12**.

While I have disclosed a preferred embodiment of this invention, it will be understood that various modifications may be made including the use of equivalent means, reversal of parts, and the use of certain features independently of the use of others, all within the spirit and scope of this invention as set forth in the appended claims.

Having thus described my invention, I claim:

1. In a well containing a chlorinated hydrocarbon liquid with an ultrasonic transducer submerged therein and with a vapor zone located above the surface of said liquid, an electrical generator and an electrical circuit connecting said transducer and generator, a liquid level and temperature control apparatus to protect said transducer from excessive heat, said apparatus comprising an upper thermostatic switch positioned in the well above the surface of the liquid and connected in said circuit, said upper switch being arranged to close when the temperature of said vapor zone reaches a predetermined value and to open when said temperature falls below said predetermined value, and a lower thermostatic switch submerged in the liquid and positioned above the ultrasonic transducer, said lower switch being connected in said circuit, said lower switch being arranged to open when the liquid temperature exceeds a predetermined value and to close when said temperature falls below said predetermined value, said lower switch being arranged to open when said liquid is below a predetermined level between the lower switch and said transducer and said lower switch is contacted by said vapor at a temperature above a predetermined value.

2. The apparatus defined in claim 1, said switches being connected in a series circuit.

3. Liquid level and temperature control apparatus comprising a well, a chlorinated hydrocarbon liquid contained within said well with a vapor zone located above the surface of the liquid, an ultrasonic transducer submerged in said liquid, a generator of electricity, conductor means connecting said generator to said transducer, a first thermostatic switch means positioned in the well above the surface of the liquid, said first switch means being arranged to close when the temperature of said vapor zone reaches a predetermined value and to open when the temperature falls below said predetermined value, a second thermostatic switch means submerged in the liquid and positioned above said transducer, said second switch means being arranged to open when the liquid temperature exceeds a predetermined value and to close when the liquid temperature falls below said predetermined value, said second switch means also opening when above the surface of the liquid and contacted by the vapor at a vapor temperature above a predetermined value with the level of the liquid below a predetermined level between the second switch means and said transducer, and an electrical circuit connecting both of said switch means with said transducer and said generator.

4. Liquid level and temperature apparatus for ultrasonic cleaning comprising a well; a cleaning liquid contained within said well; an ultrasonic transducer submerged in said liquid; electrical means for energizing said transducer; a vapor zone located in the well above the surface of said liquid for containing vapor of said liquid; an upper switch means located in the vapor zone of the well maintaining said transducer deenergized until the temperature of the vapor exceeds a predetermined value; and a lower switch means located in the well maintaining said transducer de-energized when the lower switch means is submerged in the liquid and the temperature of the liquid exceeds a predetermined value, and maintaining said transducer deenergized when the lower switch means is above the surface of the liquid and the lower switch means is contacted by the vapor at a temperature above a predetermined value; said transducer, electrical means for energizing said transducer, and upper and lower switch means being connected together in an electrical circuit.

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