Nov. 20, 1956 T. J. KEARNEY 2,771,086

APPARATUS FOR TREATMENT WITH SOLVENTS

Filed Oct. 12, 1954 2 Sheets-Sheet 1

FIG_1_

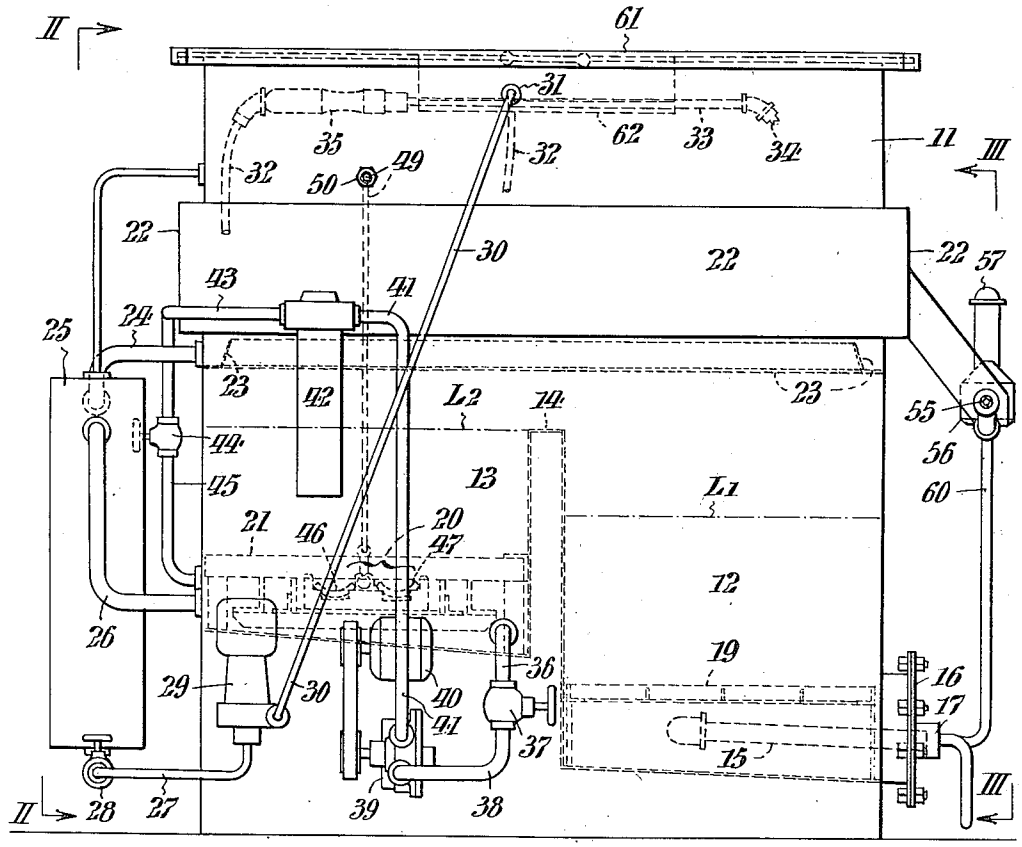

FIG_4_

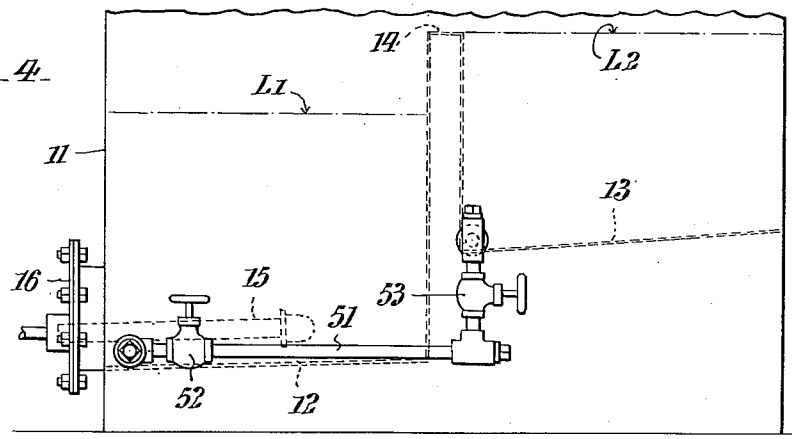

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FIG_ 2_

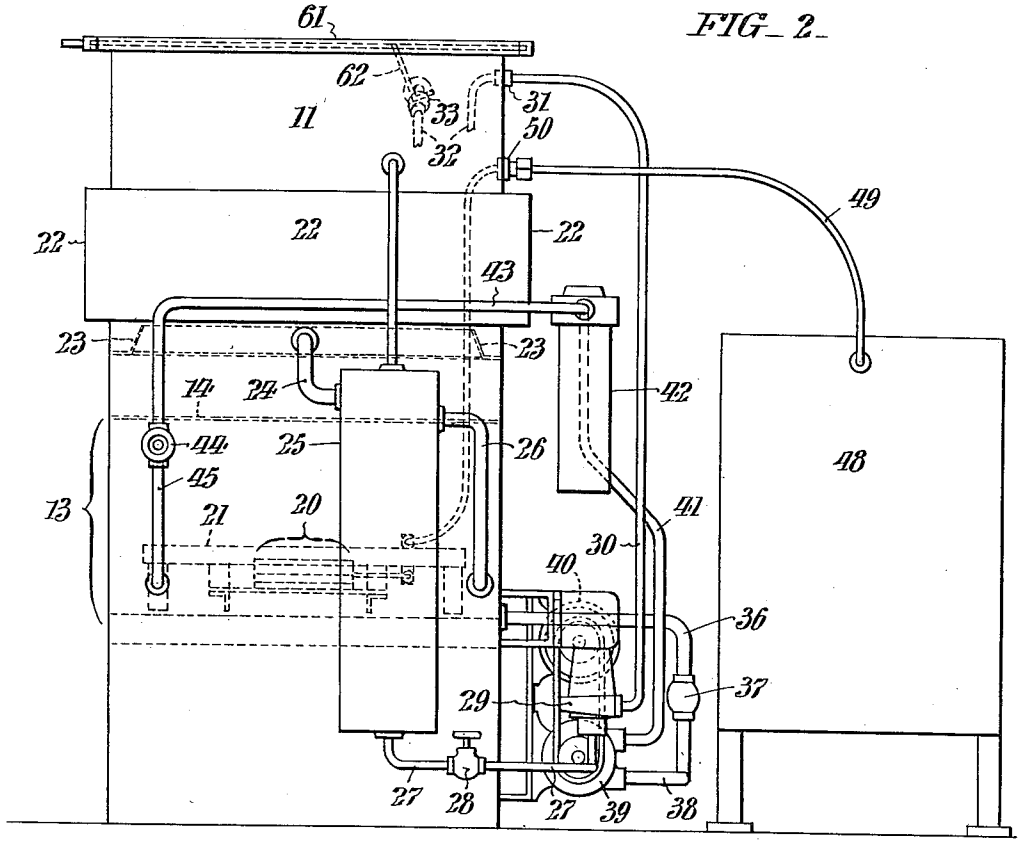
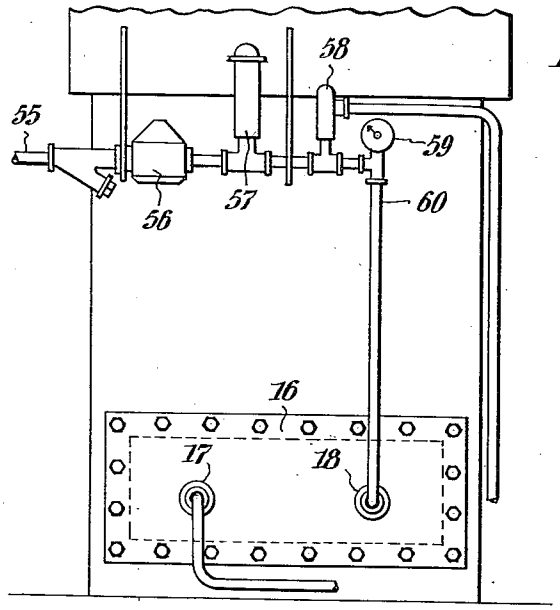


FIG_ 3_



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APPARATUS FOR TREATMENT WITH SOLVENTS

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Application October 12, 1954, Serial No. 461,871

3 Claims. (Cl. 134—60)

This invention relates to apparatus for treating a work object. More specifically, it is concerned with hand operated apparatus for cleaning and degreasing intricately formed metal parts, as for example, cutters for electric razors, hypodermic needles and deep drilled parts, through the combined application of heated chlorinated hydrocarbon solvents and ultrasonic energy.

It is an object of the present invention to provide a new and improved hand operated mechanism for cleaning and degreasing a work object with ultrasonic energy in a liquid solvent.

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 drawings.

Fig. 1 represents a view in front elevation of a cleaning apparatus constructed in accordance with the invention;

Fig. 2 represents an end view of the apparatus taken as indicated by the lines and arrows II—II of Fig. 1;

Fig. 3 represents a view of the opposite end of the apparatus as indicated by the lines and arrows III—III appearing in Fig. 1; and

Fig. 4 represents a view in rear elevation of the apparatus of Fig. 1.

Turning now to the drawings and the specific form of the invention selected for illustration therein, the cleaning apparatus comprises a housing **11**, which may be of sheet metal, in the lower portion of which are serially arranged a boiling well **12** and an ultrasonic well **13** separated by an overflow dam **14**. A liquid solvent, preferably a chlorinated hydrocarbon liquid such as trichlorethylene, is normally maintained at a level L1 in boiling well **12** and is constantly boiled by the action of a submerged heating coil **15**, the ends of which are supported in a removable cleanout door **16** at **17** and **18**. Arranged over the heating coil **15** is a work rest **19** on which the work object to be cleaned is placed during the boiling step of the process.

The ultrasonic well **13** is kept filled with liquid solvent to a level indicated at L2, and disposed within said well near the bottom are ultrasonic vibration means **20** which may be of the form disclosed in the co-pending patent application of Thomas J. Kearney, Serial No. 435,888, filed June 10, 1954. Arranged above the ultrasonic vibration means **20** is a work rest **21** on which the work object is placed for ultrasonic cleaning.

The solvent vapors generated in boiling well **12** rise within housing **11** and are condensed by a cooling jacket **22** which completely surrounds housing **11** at a level above the surface of the liquid solvent but well below the top of housing **11**. A coolant (which may be water) is circulated within the jacket **22** which condenses the rising solvent vapors and prevents the escape of said vapors through the open top of housing **11**. The open top of housing **11** provides an access through which the work object is passed to the wells **12** and **13** for cleaning. The condensed vapors are collected in a trough **23** which extends entirely around the interior of the housing **11** below the cooling jacket **22**. From trough **23**, the condensed

vapors are conducted through a conduit **24** into a condensate receiver **25** for storage and cooling. Upon reaching a predetermined height, excess condensate overflows through a conduit **26** into ultrasonic well **13**. This excess condensate introduced into the ultrasonic well **13** causes the solvent in well **13** to overflow dam **14** into boiling well **12** where the solvent vapors are formed and given off to be subsequently condensed, cooled and returned to the boiling well, thus maintaining a continuous solvent cycle.

The condensate that does not pass through conduit **26** is drawn from condensate receiver **25** through a conduit **27** and a valve **28** by a centrifugal pump **29** and thence conducted through a conduit **30** into the housing **11** at **31**, and through flexible conduit **32** to spray lance **33** having a nozzle **34** and a handle **35**. This spray lance **33** is used to flush the condensed clean distilled solvent over the work object to remove any loosely affixed dirt particles remaining thereon. The flexible conduit **32** permits moving the spray lance **33** to any desired position to accomplish the said flushing.

For the purpose of keeping the liquid solvent within ultrasonic well **13** clean, there is provided a filter system which comprises a conduit **36** leading from the bottom of well **13** through the housing **11**, a valve **37**, a conduit **38**, a pump **39**, belt driven by a motor **40**, a conduit **41**, a filter **42**, a conduit **43**, a valve **44**, and a conduit **45** which returns to the bottom of well **13** through the housing **11**. The liquid solvent in ultrasonic well **13** is constantly circulated through and cleaned by this filter system during the operation of the apparatus.

Two curved barium titanate transducers **46** and **47** are mounted in the bottom of ultrasonic well **13** in a manner such as shown in co-pending application, Serial No. 435,888, filed on June 10, 1954. The temperature of the solvent in well **13** is maintained below that of the solvent in well **12** by diverting the hot condensate through the condensate receiver **25** and by circulating the solvent of well **13** through the filtering system. There is a further diversion and cooling of solvent through the spray system. Transducers **46**, **47** beam ultrasonic energy through the liquid solvent contained in well **13**. Power is supplied to transducers **46** and **47** by an electric oscillator unit **48** (Fig. 2) through electrical conductors **49** which enter housing **11** through fitting **50** and pass downwardly into ultrasonic well **13** to transducers **46**, **47**.

Fig. 4 illustrates the drain conduit **51** and its associated valves **52** and **53**. Drain conduit **51** leads from the bottom of wells **13** and **12** to a liquid solvent storage tank (not shown) and permits the draining of said wells and the storage of said liquid when the apparatus is not in use.

Fig. 3 illustrates the apparatus and conduits associated with submerged heating coil **15**. The steam passes through a conduit **55**, a steam pressure reducer **56**, a hydramotovalve **57**, a pop-off valve **58**, a gauge **59** and a conduit **60** to removable cleanout door **16** and **18**.

A lid **61** is provided to cover the open top of housing **11** when the apparatus is not in use. Extending downwardly from lid **61** is a spray lance support **62** which supports spray lance **33** when the apparatus is not being operated.

A work object to be cleaned in the hereinbefore described apparatus is first immersed in the boiling solvent of well **12** where it is placed on work rest **19**. Then the work object is removed from well **12** and immersed in the solvent of ultrasonic well **13** and is supported therein by work rest **21**. While submerged in the solvent of well **13**, the work object is subjected to the ultrasonic energy transmitted through the solvent for a period of time sufficient to accomplish the required cleaning. The work object is then removed from the ultrasonic well **13** and a spray of solvent condensate from spray lance **33** is forced over the work object to give it a thorough liquid rinse.

The work object is then held in the vapors present between the surface of the liquid and jacket **22** for a final solvent vapor rinse and then dried before removal from the apparatus.

Various other processes of cleaning may be used with the apparatus of this invention. For example, in one such process, the work object is not immersed in the liquid solvent of boiling well **12**, but instead is positioned in the hot solvent vapors rising from said well. In another method of cleaning, the work object is subjected to a spray of solvent condensate prior to being immersed in ultrasonic well **13**.

Where the ultimate in cleaning of the solvent condensate and removal of solids therefrom is required, the solvent condensate is passed through a 10 micron or smaller filter (not shown) to eliminate dust picked up by the condensate, preventing said dust from being deposited thereby on the work object.

The transducers **47** can be arranged in any desired position, in parallel or in series, or on a side of the wall in a vertical position for special applications or specific sized or shaped parts.

It is to be understood that the form of the invention herein shown and described is to be taken as a preferred embodiment. Various changes may be made in the shape, size and arrangement of parts. Equivalent elements may be substituted for those described herein, parts may be reversed, and certain features of the invention may be utilized independently of the use of other features, all without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described my invention, I claim:

1. Apparatus for treating a work object with a chlorinated hydrocarbon comprising, a housing, a boiling well mounted within the housing and containing a liquid chlorinated hydrocarbon, heating means arranged to boil said liquid to form a vapor, an ultrasonic well mounted within the housing and containing a liquid chlorinated hydrocarbon, a piezoelectric transducer submerged in the liquid of the ultrasonic well and adapted for emitting ultrasonic energy, said transducer being energized by an electrical circuit independent of said liquid, an overflow dam positioned between said boiling and ultrasonic wells and adapted for allowing said liquid to overflow from said ultrasonic well into said boiling well, cooling means positioned on the housing above said wells for condensing said vapor into a condensate, collecting means mounted beneath said cooling means for catching said condensate, condensate receiver means connected to said collecting means for storing said condensate, and conduit means connecting said condensate receiver means with said ultrasonic well, whereby a continuous circulating cycle is maintained, said liquid being vaporized in the boiling well, then condensed, collected, stored and returned to the ultrasonic well, then overflowing into the boiling well to again be vaporized, a spray lance having a spray nozzle, and flexible conduit means connecting said condensate receiver means with said spray lance whereby to feed said condensate to said spray nozzle for flushing over the work object and returning said condensate to said wells.

2. In apparatus for cleaning a work object by treatment with a chlorinated hydrocarbon, a housing; a boiling well within the housing containing a liquid chlorinated hydrocarbon and heating means whereby to boil said liquid to give off a vapor; a work rest on which the work object is placed in the boiling well, said work rest being submerged in the liquid of said boiling well; an ultrasonic well within the housing containing solvent which is subjected to ultrasonic energy; a second work rest on which the work object is placed in the ultrasonic well, said second work rest being submerged in the liquid of said ultrasonic well; an overflow dam between said boiling and said ultrasonic well adapted to permit solvent to overflow to the boiling from the ultrasonic well; a cooling jacket positioned on the housing above the said wells adapted to condense the said vapors into a condensate; a collecting means mounted on the housing beneath said cooling jacket adapted to catch the said condensate; condensate receiver means in which the condensate is stored; conduit means connecting said condensate receiver means with said ultrasonic well whereby a continuous circulating cycle is maintained; a liquid being vaporized in the boiling well, then condensed and returned to the ultrasonic well, then overflowing into the boiling well to again be vaporized; a spray lance having a spray nozzle, and flexible conduit means connecting said condensate receiver means with said spray lance whereby to feed said condensate to said spray nozzle for flushing over the work object and returning said condensate to said wells.

3. Apparatus for ultrasonically degreasing a work object by treatment with a chlorinated hydrocarbon solvent comprising a housing; a boiling well within the housing containing said solvent; heating means positioned within said boiling well beneath the surface of said solvent whereby to boil said solvent to give off a solvent vapor; a work rest on which the work object is placed in the boiling well, said work rest being positioned below the surface of the solvent in said boiling well to subject the work object while placed on the work rest to the action of the solvent while boiling; an ultrasonic well within the housing containing said solvent, the solvent within the ultrasonic well being maintained at a temperature below boiling and at a level above the level of the solvent in said boiling well; ultrasonic means located in the ultrasonic well below the surface of the solvent; a second work rest on which the work object is placed in the ultrasonic well, said second work rest being submerged in the solvent of said ultrasonic well and being positioned to subject the work object to the action of said ultrasonic means; an overflow dam separating said ultrasonic and boiling wells and adapted to permit solvent to overflow from the higher level of the ultrasonic well to the lower level of the boiling well; a cooling jacket positioned on the housing above the said wells adapted to condense the solvent vapors emitted by the boiling well; a collecting means mounted within the housing beneath said cooling jacket adapted to catch the condensed solvent; condensate receiver means, mounted outside the housing and connecting with said collecting means, wherein the condensed vapors are stored and cooled; a spray lance positioned within the housing above the wells, connecting means including a pump and a flexible conduit between said condensate receiver means and said spray lance; said ultrasonic well having an inclined bottom; a filter means positioned outside the housing; conduit means including a pump leading from the lower portion of said inclined bottom of the ultrasonic well, through said filter means to filter and cool the solvent, and back to said ultrasonic well; wherein the solvent is boiled in the boiling well to emit solvent vapor, condensed by said cooling jacket, collected by said collecting means, cooled and stored by said condensate receiver means, sprayed on the work object above said ultrasonic well and returned to said well, subjected to ultrasonic action within the ultrasonic well, withdrawn from said ultrasonic well, filtered, and returned to said ultrasonic well, and passed over said overflow dam from the ultrasonic well into the boiling well, thus completing the solvent cycle.

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