Aug. 16, 1960 T. J. KEARNEY 2,949,121

CLEANING APPARATUS

Filed Oct. 3, 1956

FIG. 1.

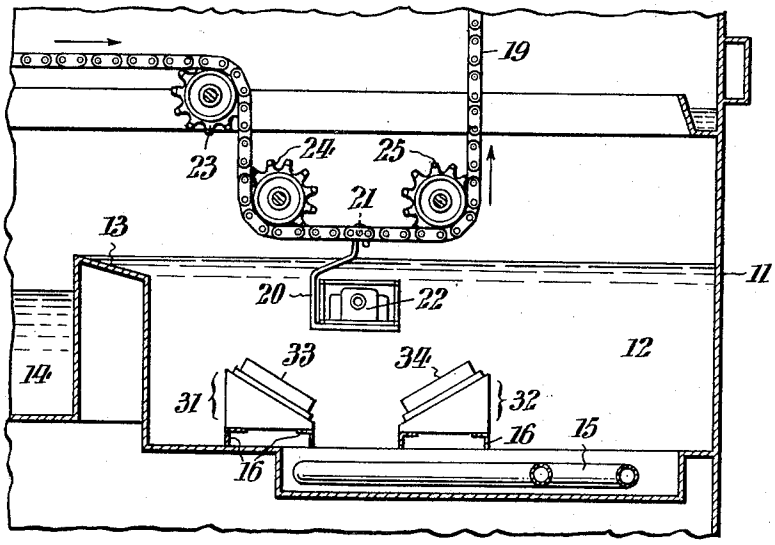
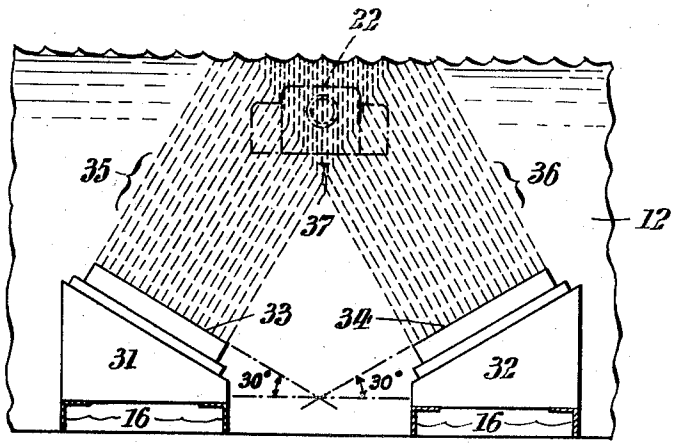


FIG. 2.



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CLEANING APPARATUS

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1 Claim. (Cl. 134—130)

This invention relates to apparatus for treating a work object. More particularly it is concerned with apparatus for cleaning and degreasing of intricately formed metal parts by application of chlorinated hydrocarbon solvents and ultrasonic energy. Reference is hereby made to my co-pending application Serial No. 438,429, filed June 22, 1954, now Patent No. 2,831,785, of which this application is a continuation-in-part.

Finely machined parts which have been buffed, lapped or ground, as for example, heads for electric razors, hypodermic needles, deep drilled metal parts and the like, are very difficult to clean and previous methods and apparatus as ordinarily constructed did not accomplish the complete removal of grease and adhering dirt or "soil" from the hollows or interstices of intricately machined parts.

The generation of ultrasonic vibrations in a bath of liquid solvent has presented some difficulty. Previously compression waves have been produced from flat piezoelectric or magnetostrictive devices and standing waves have been formed. Non-uniform washing is sometimes obtained. It is thought that standing waves produced between the source of the ultrasonic energy and the surface of the liquid solvent are the cause of alternate soiled and unsoiled strips on the work object being cleaned, the distance between strips being approximately equal to one-half the wave length of the ultrasonic wave energy being used.

United States Patent No. 2,650,872 to Goldwasser discloses a method and apparatus for eliminating the alternate soiled and unsoiled strip effect. Although devices of the character illustrated in the Goldwasser patent are entirely adequate for their intended service, the present invention performs more efficiently and is less complicated, being based on a new and entirely different principle.

Accordingly, the object of the present invention is to provide a new and improved apparatus for cleaning and degreasing with ultrasonic energy in a liquid solvent.

It is another object of this invention to overcome the disadvantages of flat transducers heretofore mentioned. Another object is to obtain satisfactory cleaning results from beams of parallel ultrasonic waves.

Further features and objects of the invention, as well as the details of a typical and preferred embodiment thereof, will be understood from the detailed description to follow, throughout which reference is made to the accompanying drawings wherein:

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

Fig. 2 represents a view of the liquid in the well of Fig. 1 with the apparatus operating.

Turning now to the drawings, the apparatus comprises a housing **11** which, in practice, is constructed of sheet metal. Located within the housing **11** is a well **12** which includes an overflow dam **13**. Well **12** contains a chlorinated hydrocarbon liquid solvent which will rise no higher in the well than the level defined by overflow dam **13** which permits the liquid to overflow into well **14**. Well **12** is provided at the bottom with pipe coil **15** through which either water or steam is circulated as may be required to maintain the liquid in said well at the temperature desired.

A pair of supporting angles **16** are fixed to the side of housing **11** and extend horizontally into the well **12** below the surface of the liquid.

A double chain conveyor **19** has a work carrier **20** depending from a cross rod **21**. A work object **22** to be cleaned is positioned on work carrier **20**, and conveyor **19** operates to transport work object **22** around sprocket wheels **23**, **24** and **25**, immersing the work object **22** in the liquid of well **12**. Work object **22** follows a substantially horizontal path through the liquid parallel to the liquid surface.

An ultrasonic wave emitting device designated generally by the number **31** is positioned beneath the surface of the liquid in well **12**, and a similar ultrasonic wave emitting device **32** is spaced horizontally away from device **31**. The upper portion of emitting device **31** is provided with a flat emitting surface **33** which is positioned at an angle of 30° from the horizontal. Similarly, emitting device **32** is provided with a flat emitting surface **34** which is also positioned at an angle of 30° from the horizontal.

As is shown in Fig. 2, emitting device **31** produces a beam **35** of substantially parallel ultrasonic waves that are normal to flat emitting surface **33**, and emitting device **32** produces a like beam **36** that is normal to flat emitting surface **34**. The emitting surfaces **33**, **34** are canted at an angle of 30° to the horizontal for the purpose of converging beams **35**, **36** to form an overlapping, ultrasonic wave zone **37** having a peak concentration of ultrasonic energy of high intensity. It is through this high intensity energy zone **37** that work object **22** is passed to be cleaned. It is to be understood that any number of ultrasonic wave emitting devices can be used from any position within the well **12**, and the beams produced directed toward this overlapping zone **37**.

According to the present invention, the work object is immersed in a bath of chlorinated hydrocarbon liquid solvent. This solvent is preferably trichlorethylene. Perchlorethylene and methylene chloride have been used and have given satisfactory results. While immersed in the bath, ultrasonic waves in the range of about 20 to 1000 kilocycles are generated in the liquid which are focused and directed toward the work object, striking the work object while the ultrasonic waves are diverging.

The work object is transported across the ultrasonic waves in a substantially horizontal path below the surface of the liquid.

The following specific examples serve to illustrate the process of the invention:

Example 1

The work object is immersed in a bath of trichlorethylene at a temperature in the range of about 110 to 140° F. and subjected to ultrasonic waves of a frequency of about 400 kilocycles.

Example 2

The work object is immersed in a bath of perchlorethylene at a temperature in the range of about 140 to 170° F. and subjected to ultrasonic waves of a frequency of about 400 kilocycles.

Example 3

The work object is immersed in a bath of methylene chloride at a temperature in the range of about 58 to 78°

F. and subjected to ultrasonic waves of a frequency of about 400 kilocycles.

While the specific embodiment of the invention described herein has been confined to the cleaning or degreasing of a work object by contact with a chlorinated hydrocarbon solvent, it will be appreciated that the invention can be used to accomplish a variety of objects and is not limited to cleaning or degreasing. For example, the invention has application in the field of plating where the work object is immersed in a liquid and the ultrasonic vibrations induce an even coating to cover the work object. Further, the work object may be pre-dipped before being subjected to the invention.

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:

Apparatus for degreasing a work object comprising a well being adapted to contain a chlorinated hydrocarbon liquid, transducer means including a pair of spaced apart transducers mounted below the surface of said liquid for emitting ultrasonic waves, each of said transducers having a flat emitting surface from which said ultrasonic waves are emitted in a direction normal to said emitting surface, said transducer means having said emitting surfaces inclined toward each other at an angle of 30 degrees to the horizontal so that the ultrasonic waves from one overlap the ultrasonic waves from the other to create a non-uniform sound field including a wave overlapping zone of higher intensity and a non-overlapping zone of lower intensity, and means for carrying the work object through said overlapping zone so that every part of the work object is bombarded by the waves of said overlapping zone.

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