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SMALL PARTS CLEANING PROCESS

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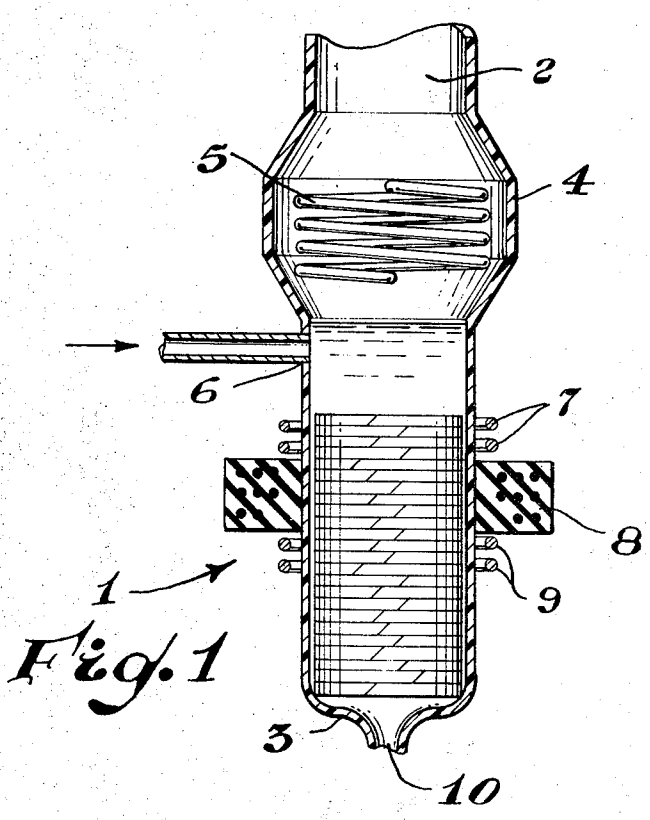



Fig. 1

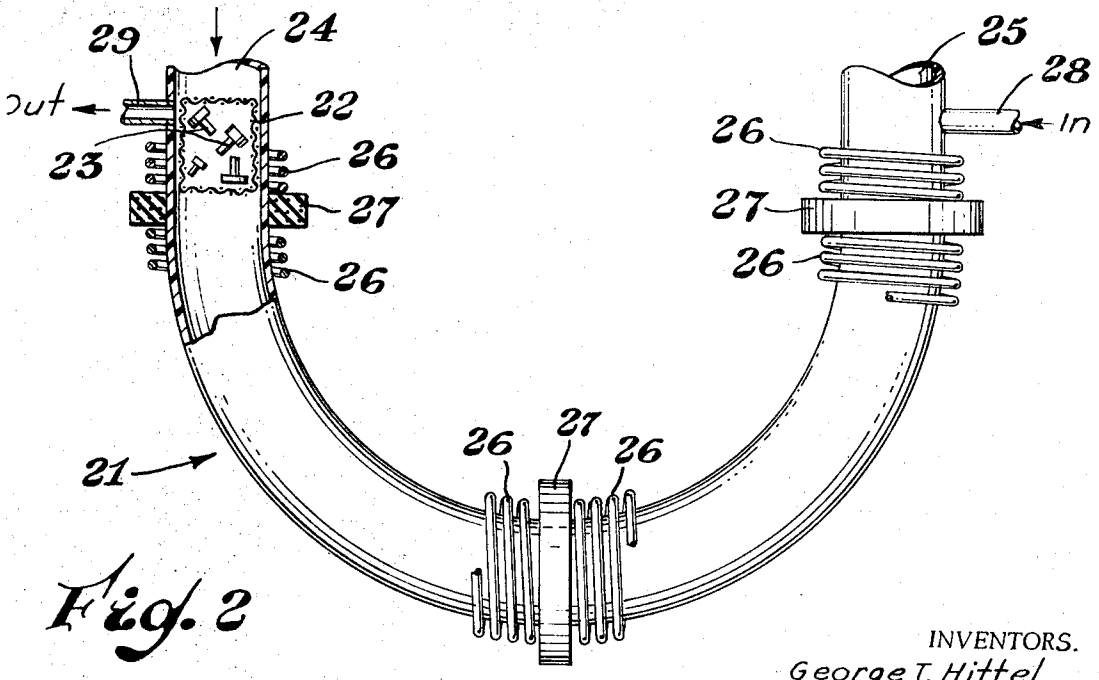



Fig. 2

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# SMALL PARTS CLEANING PROCESS

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U.S. Cl. 134—1 5 Claims

## ABSTRACT OF THE DISCLOSURE

Apparatus and method for cleaning small metal and plastic parts by causing the same to rotate in a confined zone in a vaporizable cleaning liquid, treating said parts to induce vaporization of the cleaning liquid at the surface of the part and withdrawing the part clean and dry.

## BACKGROUND OF INVENTION

The art of cleaning metals is an ancient and well-documented art. The general methods for conducting such cleaning is to introduce the part to be cleaned into a bath or the vapors of a solvent for removal of the greases and oils. The dirt and grime are washed from the surfaces as the grease and oils are dissolved by the solvent. Many innovations have been made in process steps and equipment design to improve or enable the cleaning of the numerous and varied shapes which metal parts take in today's industrial world. However, particular machining operations (e.g., lapping, polishing) carried out on many small parts simultaneously create a difficult cleaning problem. For example, piston rings are ground or lapped several at a time. This package of lapped rings is bound together by the grease, oil, lapping compound and fines from the operation. To clean these rings without damaging the surface is a time-consuming and almost one piece-at-a-time operation. It is to overcome this and like problems that the present invention is directed.

## BRIEF DESCRIPTION OF THE INVENTION

The present invention comprises a process, and an apparatus for carrying out the process, for cleaning metal and plastic parts by subjecting the parts to a rotary motion and heating in a zone which contains a cleaning liquid. The present invention has particular utility for cleaning piston rings. In the case of piston rings, the rotation is circumferential about the axis of the rings. Each ring in relation to one another, imparting a scrubbing action to the surfaces which are in juxtaposition to one another. The rotation of the metal parts is preferably generated by employing a fixed stator (preferably a three-phase stator) surrounding the zone of cleaning and using the metal part as the rotor. It is to be understood that other means can be employed to impart rotary motion to the part, such as by the use of jets or other liquid flow patterns created mechanically within the liquid zone. The heating is preferably accomplished by induction coils or the like.

The apparatus is simple and easily maintained. As illustrated in the drawings, and having particular utility for cleaning piston rings, a tubular chamber manufactured from a non-magnetic, insulating material is provided of a size slightly larger than the part being cleaned. One form of the apparatus comprises, as shown in FIG. 1, a chamber only enough larger than the rings to permit circumferential rotation of the rings. The chamber is not much larger than the part or the retaining basket, otherwise the part may wobble and jam the chamber. The chamber is provided with an expanded entrance throat in which is located a series of coils or tubes through which water or



other cooling medium can pass. Below the throat and positioned around the outer periphery of the chamber is a series of windings of an induction heating unit. Directly below the induction heating windings is located a stator of a three-phase motor. Below the stator is a second series of induction heating windings.

In one mode of operation of the apparatus, the tube is filled with a grease solvent, such as a chlorinated hydrocarbon, to a level below the expanded throat. A stack of piston rings, for example, which have been ground or lapped, is introduced into the tube. Current is supplied to both the induction windings and the stator. Current to the latter causes the rings to rotate in the same manner as a rotor of a motor. This movement of the rings through the solvent exposes the greases, grinding compounds and fines to a washing action. The induction windings transmit heat to the rings but not the solvent. The heating of the rings particularly at the surface cause the solvent at that point to boil. Thus, there is established a small force, somewhat similar to an explosion, known as "nucleate boil," which assists in removing the fines and chips which might otherwise effectively shield the oil and grease beneath them from the action of the solvent.

## DETAILED DESCRIPTION OF INVENTION

The following description of specific embodiments of the present invention have reference to the illustrations in the drawings.

FIG. 1 represents, in cross-sectional view, a tubular embodiment of an apparatus for cleaning piston rings;

FIG. 2 represents another tubular embodiment, in partial section, for continuous operation for cleaning small parts retained in a basket.

The apparatus shown in FIG. 1 of the drawings comprises a tubular chamber **1** which is open at its top **2** and substantially closed at its bottom end **3**. As illustrated in FIG. 1, the portion of the chamber **1** near the open end **2** is expanded circumferentially to form a throat **4** of larger diameter than the tubular chamber **1**. Within the throat **4**, recessed sufficiently to provide a passage equivalent to the internal diameter of the chamber **1**, is a series of coils or pipes **5**. These pipes **5** carry cooling water and are connected by appropriate piping and valving (not shown) to a source of cold water. At a point below the throat **4** and passing through the wall of the chamber **1** is a solvent inlet **6**. Immediately beneath the inlet and surrounding the outside wall of the chamber **1** is an induction heating unit **7**. Again surrounding the exterior of the chamber **1** and below the heating unit **7** is a stator **8** of a three-phase motor. Below the stator **8** is positioned a second induction heating unit **9**. The bottom end **3** of the chamber **1** being substantially closed forms the outlet **10** for solvent which has dissolved grease and oils and which carries the fines. The solvent exiting from the chamber **1** through outlet **10** is directed to settling zones, filters, storage tanks and a pump activated delivery system (not shown) to return solvent to the chamber **1**.

The materials of construction for the chamber must be a non-electron conducting material which is not soluble in the solvent used and which is not attacked by the fatty-acids which are used in the lapping and grinding operations. Suitable materials are the plastics and ceramics such as the polyethylenes, the polytetrafluoroethylenes, polyepoxides, polyamides, the acrylics and the like, glass, vitreous tile and brick, quartz, both natural and synthetic, and the like, as well as asbestos.

The solvents which can be employed are those well known to the metal cleaning industry. For example, the hydrocarbons, such as benzene, toluene, Stoddard solvent, naphtha, the halogenated hydrocarbons such as perchloro-

ethylene, trichloroethylene, dichloroethylene (both the cis, trans and mixtures thereof), methylene chloride, carbon tetrachloride, 1,1,1-trichloroethane, 1,1,2-trichloroethane, the fluorocarbons, and the like. These solvents may contain additives to assist in the removal of the oils and greases. While it is to be understood that in some few instances water and aqueous based cleaning solutions can be employd, they are not preferred. The preferred class of solvents are the halogenated hydrocarbon solvents, particularly the chlorinated hydrocarbon solvents, methylene chloride, carbon tetrachloride, 1,1,1- and 1,1,2-trichloroethane, perchloroethylene, cis and trans dichloroethylene, and trichloroethylene.

The means for imparting the rotary motion is not critical and may take the form above set forth as well as the use of flow patterns developed mechanically as by jetting the liquid into the chamber to impart motion to the part. The preferred means is the three-phase stator.

The construction of the stator is not critical. It must, of course, fit around the exterior surface of the chamber and produce a flux which will be sufficient to rotate the metal part being cleaned.

The means for heating the part to induce nucleate boil when the part contacts the liquid is not critical, however, induction heating is preferred. It is feasible to preheat the part prior to introduction into the cleaning liquid either by passing the part through a furnace or infrared heating units.

Conventional commercially available induction heating units are preferably employed.

FIG. 2 represents an apparatus for continuous cleaning of, say, piston rings or other small parts such as bolts, the latter being illustrated. The chamber **21** takes the configuration of a U-tube of sufficient curvature to enable smooth movement of the basket **22** which may rotate within the chamber **21** through its length. The basket **22** contains the small parts **23** of irregular shape as shown. These parts **23** rotate within the confines of the basket **22**. The entrance **24** and the exit **25** are preferably of a similar design as that shown in FIG. 1 for the entrance. Several heating units **26** and rotor units **27** are provided, each similar to those shown and described in FIG. 1. The solvent inlet **28** is near the outlet **25** or exit and the solvent outlet **29** near the entrance **24** to the chamber **21**.

It is to be understood that while the apparatus has been shown and described with reference to cleaning piston rings or small parts retained in a basket, other small parts such as bearings, nuts, bolts, screws, nails, hardware, bearing rolls, galvanized, machined parts, electrical and plumbing fittings, and the like, may also be cleaned in a similar manner with but slight modification of the chamber configuration to insure rotation of the part in a manner which will not damage the finish of the part.

It is to be also understood that the method aforedescribed has utility in cleaning small plastic parts when the apparatus is modified in the following manner. For example, small plastic screws and the like can be confined in a circular wire basket. A small metal paddle-like object can be distributed among said parts or the paddle-like objects fixed rotationally within the basket. The



metal objects rotate when within the influence of the electrical field of the stator and heat-up when within the influence of the induction coils. The rotation of the paddle causes the parts to move about within the basket in a somewhat similar manner as a metal part rotates. The solvent boils at the surface of the metal paddle creating a disturbance in the fluid much in the same manner as the nucleate boil does at the surface of a metal part.

We claim:

**1.** The method for cleaning metal parts which comprises subjecting the parts to a magnetically induced rotary motion within a vaporizable cleaning liquid while simultaneously heating said metal parts at least at their surface while within said liquid to the boiling point of said liquid without heating the body of said liquid, said parts being in intimate contact with one another during the rotation.

**2.** The method of claim **1**, wherein the metal parts are introduced into said vaporizable cleaning liquid through a zone of vapors of said liquid.

**3.** The method of claim **1**, wherein the vaporizable cleaning liquid is in a container and is continuously circulated therefrom to a purification unit and is returned to the container.

**4.** The method for cleaning plastic parts which comprises immersing the plastic parts in a vaporizable cleaning liquid, mixing metal objects among said parts in said cleaning liquid, subjecting said metal objects within said cleaning liquid to a magnetically induced rotary motion, said metal objects thereby imparting a rotary motion to said plastic parts, while simultaneously heating said metal the boiling point of said liquid without heating the body of said liquid thereby to cause said liquid to boil at the surface of the metal objects to create a disturbance in the liquid at the surfaces of the plastic parts, said parts and objects being in intimate contact with one another during the rotation of the metal objects.

**5.** A method for cleaning piston rings which comprises heating said rings, at least at their surface while within a liquid vaporizable solvent, to the boiling point of said solvent without heating the body of said solvent and simultaneously imparting rotary motion to said rings by an induced magnetic field while within said solvent, and, maintaining said rings in intimate surface contact during said heating and rotational movement.


**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,016,376 | 10/1935 | Koch | 134—19 |
| 2,118,480 | 5/1938 | Somes | 134—1 |
| 2,527,666 | 10/1950 | Winter | 134—1 |
| 2,714,565 | 8/1955 | Heywang | 134—22 |
| 2,735,232 | 2/1956 | Simjian | 134—1UX |
| 3,325,309 | 6/1967 | Sutula et al. | 134—1 |



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J. T. ZATARGA, Assistant Examiner

U.S. Cl. X.R.

134—19, 33

# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

Patent No. 3,546,018 Dated December 8, 1970

Inventor(s) George T. Hittel et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 49, after "ring" insert -- rotates independently of its neighbor, thus the rings move --.
Column 4, line 31, after "metal" insert -- objects at least a their surface while within said liquid to --.

Signed and sealed this 4th day of May 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER,
Commissioner of Pater

FORM PO-1050 (10-69)