Sept. 25, 1934. R. P. MATTERN 1,974,965

PROCESS FOR CLEANING METAL

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Fig. 1.

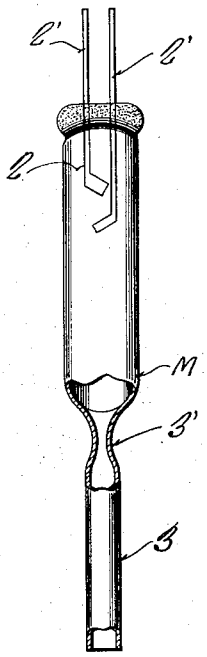
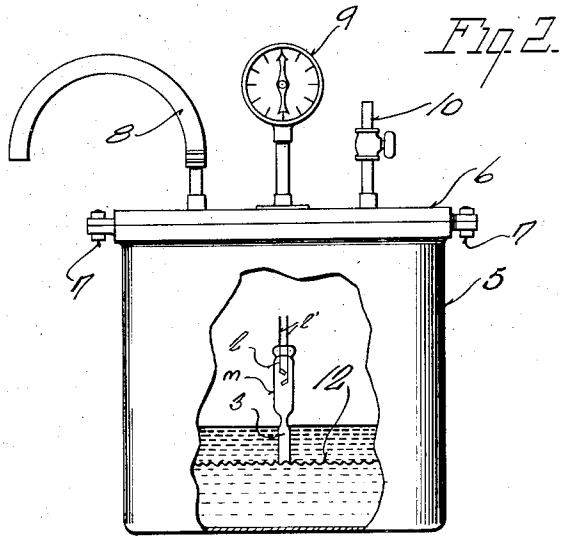


Fig. 2.



INVENTOR.

Raymond P. Mattern.

BY

Bottum, Hudnall, Lahey, McNamara & Michael

ATTORNEYS

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PROCESS FOR CLEANING METAL

Raymond P. Mattern, Elkhart, Ind., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

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7 Claims. (Cl. 200—152)

This invention relates in general to a cleaning process and more particularly to a process for removing oxide coating or scale from metallic surfaces. The invention while particularly adapted for removing the oxide coating or scale from the surfaces of the electrodes of mercury switches is also capable of other uses and applications.

During the course of manufacture of mercury switches the electrodes become coated with oxides of the metals composing the electrodes. This oxidation takes place during the welding of the electrodes to the leading-in wires and during the process of sealing the electrodes through the glass case. Additional oxidation occurs during the annealing of the glass case and electrode assembly which is carried out just previous to the filling of the switches with the proper amount of mercury. The presence of the oxides on the electrodes of the switches as finally manufactured has the following bad effects on the operation and life of the switch: poor contact between mercury and electrode because these oxides are poor electrical conductors; high resistance between electrode and mercury causing excessive heat to be developed within the switch; excessive arcing as the circuit is made and broken due to the resistance of the oxides on the surface; contamination of the mercury due to some of the oxygen of the oxides combining with the mercury under the temperature of the arc which is produced by the making and breaking of the circuit; contamination of the arc suppressing gas filling the switch caused by some of the oxygen of the oxides being released under the temperature of the arc produced when the circuit is made or broken, and combining with the gas within the switch.

The principal object of the present invention is to provide simple, practical and effective process of removing oxide coating or scale on metallic surfaces and in connection with mercury switches to remove the oxide coating or scale from the electrodes thereof whereby the mercury switches with the electrodes so cleaned have the following advantages over switches in which the oxide coating has not been removed: better contact between electrode and mercury; lower resistance between electrode and mercury; less arcing when circuit is made; less contamination of the mercury, no contamination of the arc suppressing gas constituting the atmosphere within the switch; less heat developed within switch during operation; increased electrical capacity (about 25%); longer life (about ten times); and more constant and more uniform operating angle.

In carrying out the present method, the interiors of the mercury switches are filled with a cleaning solution such as sodium cyanide and an electric current is impressed on the electrodes of the switch and caused to travel from one electrode to the other through the cleaning solution. This causes the cleaning solution to boil with the result that the oxide coating on the electrodes is instantly removed and the electrodes rendered clean and bright. It is to be understood, of course, that the same method is employed when cleaning various other metallic articles, that is to say, the articles, whether they be electrodes or other structures, are immersed in a solution of sodium cyanide in a confined space and then an electric current is passed through the articles and through the solution to cause the solution to boil and exert its cleaning action.

In connection with mercury switches as well as various other structures, there is a real problem in expeditiously placing the solution in the interior of the switch and in washing the switch after the cleaning of the electrodes has been effected, this problem being aggravated by the fact that it is desirable to clean the switches at that stage of their manufacture in which the glass case containing the electrodes is closed off except for a rather constricted and elongated tubulation. This difficulty is overcome in the present method by alternately utilizing a vacuum and atmospheric pressure to supply fluid to and exhaust the liquid from the interior of the tube. Thus, in filling the switches with the cleaning solution the air is evacuated therefrom by means of a vacuum exerted through the cleaning solution in which the tubulations of the switches are submerged and thereafter the cleaning solution is forced into the switches by restoring atmospheric pressure to the environment of the cleaning solution. After the cleaning action, whatever remains of the cleaning solution is exhausted from the interiors of the switches by a vacuum and in the subsequent washing operations the washing fluid such as water is forced into the switches first by exhausting the air therefrom by means of a vacuum exerted on the surface of the water in which the tubulations of the switches are submerged and then forcing the water in the form of a spray into the switches by restoring atmospheric pressure. After the final washing operation, the switches are dried in a drying oven and are ready for the final manufacturing steps.

In the drawing,

Figure 1 represents a mercury switch in that stage of manufacture in which it is subjected to a cleaning process embodying the present invention; and

Figure 2 is a view in elevation with parts broken away for the sake of illustration and showing an apparatus which may be employed for carrying out the process embodying this invention.

Referring to Figure 1 of the drawing, there is shown a mercury tube switch M (sometimes hereinafter referred to as a tube) in that stage

of its manufacture in which it is about to be subjected to the cleaning process embodying the present invention. At the stage of the manufacture shown in Figure 1, the electrodes 2 have been sealed in through the outer glass case and a tubulation 3 has been formed on the case to provide a means for exhausting the switch of air, introducing the proper amount of mercury thereinto and filling the switch with an arc suppressing gas, and further to provide a structure which lends itself to the sealing off operation, the latter consisting in heating the constricted portion of the tubulation and twisting it to form a sealing tip.

The switch shown in Figure 2 has not only been manufactured to the extent indicated but has also been annealed.

The present invention proposes to subject the switches in the condition shown in Figure 1 to a cleaning process which is effective to remove all of the oxide coating or scale from the electrodes and render the electrodes clean and bright.

It is to be understood that while the invention is described as particularly adapted for advantageous use with mercury switches that this example is taken for the purpose of illustration and that the method is adaptable for use in cleaning and preparing metal articles for electroplating and enameling, for cleaning the interiors and electrodes of ionization (Geissler) tubes, and in in general for cleaning various metals and in particular ferrous and non-ferrous alloys attacked by sodium cyanide solution, together with all the solid metallic elements, rare elements included.

In carrying out the cleaning method embodying the present invention, the apparatus shown in Figure 2 is employed and comprises a vacuum kettle 5 having a removable top or cover plate 6 adapted to be secured to the body of the kettle 5 by means of releasable fastening devices or the like designated at 7 and operating to set up hermetic sealing engagement between the cover 6 and the kettle 5. The removable top of the kettle is provided with a connection 8 leading to a vacuum pump (not shown), with a vacuum gauge 9 and with a valve controlled air connection 10. Adjacent to but above the bottom of the kettle is a perforated partition or supporting member designated at 12. This partition or supporting member may be a wire screen or a perforated plate and is designed to engage the lower ends of the tubulations 3 of the mercury switches to support the switches in a vertical position in the manner shown in Figure 2. If desired, a suitable rack may be employed above the perforated supporting member to aid in the stable support of the switches. A cleaning solution designated at C is provided in the vacuum kettle in sufficient amount to have its level above the supporting plate 12 to the extent shown in Figure 2.

The cleaning solution is composed of sodium cyanide and while the concentration of the solution may be varied within wide limits, one strength of solution that may be advantageously employed consists of five parts of distilled water to about one part of sodium cyanide. With the tubes placed in the kettle in the position shown in Figure 2 and the cover having sealing engagement with the kettle, the vacuum pump is operated and the kettle is evacuated to about 68 centimeters of mercury. As a result of this evacuation the air is not only drawn out of the kettle above the solution but the air is drawn out of the interiors of the switches, the air passing down through the solution and out to the vacuum pump.

After this operation has been carried out to effect thorough evacuation of the air, the pump is stopped or disconnected and air is admitted to the interior of the kettle in any suitable way, as, for example, by opening the valve controlled air connection 10. Thereupon the air entering the kettle will force the cleaning solution up through the tubulations and into the interiors of the switches inasmuch as the tubulations are immersed in the cleaning solutions and the interior of the switches have been evacuated. As thus far described, the method involves broadly the filling of the switches with the cleaning solution and the realization of this operation in an effective and expeditious manner.

The switches with the cleaning solution therein are now removed from the kettle and placed on suitable racks (not shown) and have the external ends of their lead-in wires 2' (Figure 1) placed in series with a source of alternating current which may be a 60 cycle current delivering about 5 amperes at 24 volts. Due to the resistance of the cleaning solution, at this potential drop between the electrodes, the heat developed soon causes the solution to boil. The boiling sodium cyanide solution instantly removes the oxides on the surface of the metallic electrode and leaves the electrodes clean and silvery white.

The tubes or switches are now placed back into the empty vacuum kettle with their tubulations downward and interengaged with the supporting screen as before and the kettle is again evacuated to about 68 centimeters of mercury. This evacuation drives out any excess cleaning solution that may remain in the tubes after the electric treatment, the excess solution so remaining from the tubes running down into the compartment below the screen. Upon allowing the air to re-enter the kettle, the ends of the tubulations being held off of the floor of the kettle by the raised screen, the excess cleaning solution is prevented from being driven back into the tubes and they are removed substantially free from liquid.

The interior of the kettle and the exteriors of the tubes are washed in running tap water. Clean tap water is now run into the kettle to about the level of the cleaning solution shown in Figure 2 and the tubes returned to the kettle with their tubulations supported on the screen and immersed in the water. The kettle is evacuated as before and then the air is allowed to rush into the kettle through the air valve (Figure 2). This causes the wash water to be forced up through the constrictions 3' in the tubulations (Figure 1) and breaks it up into a fine spray which thoroughly rinses all parts of the interior of the tubes.

Without removing the tubes this rinsing action is repeated several times.

The rinse water is now drained from the kettle, and the water in the tubes removed by the same method employed in removing the excess cleaning fluid.

Distilled water is used for a second rinsing, the method used being exactly similar to the tap water rinse.

Finally a third rinse is given the tubes using distilled water and they are then dried as well as they can be under the pump. They are then placed in an electrically heated oven with the tubulations downward and thoroughly dried at about 275° F.

The tubes are then ready to be filled and tipped off.

The invention claimed is:

1. The hereindescribed method of cleaning the electrodes of mercury switches which consists in immersing the opening of the switch in a cleaning solution with the switch and the solution in a confined space, evacuating the space to exhaust the air from the interior of the switch, restoring atmospheric pressure to the confined space to force the cleaning solution into the switch, subsequently passing an electric current through the electrodes of the switch and consequently through the solution to cause the solution to clean the electrodes, then replacing the cleaning solution with water and causing the water to enter and leave the interior of the switch by alternately setting up a vacuum in the confined space and restoring atmospheric pressure thereto.

2. The hereindescribed method of cleaning the electrodes of mercury switches which consists in immersing the opening of the switch in a cleaning solution with the switch and the solution in a confined space, evacuating the space to exhaust the air from the interior of the switch, restoring atmospheric pressure to the confined space to force the cleaning solution into the switch, subsequently passing an electric current through the electrodes of the switch and consequently through the solution to cause the solution to boil, then replacing the cleaning solution with water and causing the water to enter and leave the interior of the switch by alternately setting up a vacuum in the confined space and restoring atmospheric pressure thereto.

3. The hereindescribed method of cleaning the electrodes of mercury switches of the type having a restricted tubulation affording the only opening of the switch, which consists in immersing the opening of the switch into a cleaning solution with the switch and the solution in a confined space, evacuating the space to exhaust the air from the interior of the switch, restoring atmospheric pressure to the confined space to force the cleaning solution through the restricted opening into the switch, subsequently passing an electric current through the electrodes of the switch and consequently through the cleaning solution to cause the cleaning solution to clean the electrodes, then replacing the cleaning solution with a rinsing solution and causing the rinsing solution to enter and leave the interior of the switch through the restricted opening by alternately setting up a vacuum in the confined space and restoring atmospheric pressure thereto, the restricted opening causing the rinsing solution to enter the switch in the form of a spray and thus rinsing the electrodes.

4. The hereindescribed method of cleaning the electrodes of mercury switches of the type having a restricted tubulation affording the only opening of the switch, which consists in immersing the opening of the switch into a cleaning solution with the switch and the solution in a confined space, reducing the pressure in the space to exhaust the air from the interior of the switch, increasing the pressure in the confined space to force the cleaning solution through the restricted opening into the switch, subsequently passing an electric current through the electrodes of the switch and consequently through the solution to cause the cleaning solution to clean the electrodes, then replacing the cleaning solution with a rinsing solution and causing the rinsing solution to enter and leave the interior of the switch through the restricted opening by alternately reducing and increasing the pressure in the confined space, the restricted opening causing the rinsing solution to enter the switch in the form of a spray and thus rinsing the electrodes.

5. In a method of cleaning metallic articles located in a confined space within a container, having a restricted opening therein, first submerging the opening in the container into a cleaning solution, applying a vacuum to the surface of the cleaning solution to exhaust the air from the container, restoring atmospheric pressure to the surface of the cleaning solution to force the cleaning solution through the restricted opening into the interior of the container and thus into contact with the metallic articles, second, activating the cleaning solution by passing an electric current therethrough to cause the cleaning solution to clean the metallic articles, third, applying the vacuum again to remove the cleaning solution from the container, and then removing the container from the cleaning solution, fourth, submerging the opening in the container into a rinsing solution, applying a vacuum to the surface of the rinsing solution to exhaust the air from the container, restoring atmospheric pressure to the surface of the rinsing solution to force the rinsing solution through the restricted opening in the form of a spray into the interior of the container and thus rinsing the metallic article.

6. In a method of cleaning metallic articles located in a confined space within a container, having a restricted opening therein, first, submerging the opening in the container into a cleaning solution, reducing the pressure on the surface of the cleaning solution to exhaust the air from the container, increasing the pressure on the surface of the cleaning solution to force the cleaning solution through the restricted opening into the interior of the container and thus into contact with the metalic articles, second, activating the cleaning solution by passing an electric current therethrough to cause the cleaning solution to clean the metalic articles, third, again reducing the pressure to remove the cleaning solution from the container, and then removing the container from the cleaning solution, fourth, submerging the opening in the container into a rinsing solution, reducing the pressure on the surface of the rinsing solution to exhaust the air from the container, increasing the pressure on the surface of the rinsing solution to force the rinsing solution through the restricted opening into the interior of the container in the form of a spray and thus rinsing the metallic articles.

7. The hereindescribed method of cleaning the electrodes of a mercury switch which consists in immersing the opening of the switch in a sodium cyanide solution with the switch and the solution in a confined space, evacuating the space to exhaust the air from the interior of the switch, restoring atmospheric pressure to the confined space to force the cleaning solution into the switch, subsequently passing an electric current through the electrodes of the switch and consequently through the solution to cause the solution to boil, then replacing the cyanide solution with water and causing the water to enter and leave the interior of the switch by alternately setting up a vacuum in the confined space and restoring atmospheric pressure thereto.

RAYMOND P. MATTERN.