Sept. 11, 1951 T. M. BURKHOLDER 2,567,762

METHOD OF COATING NICKEL WITH MERCURY

Filed March 7, 1947

FIG. 1.

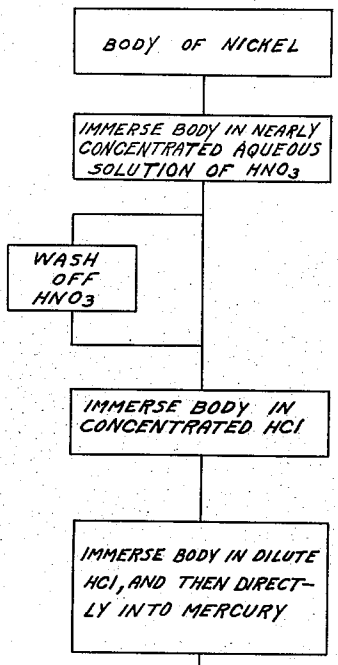


FIG. 2.

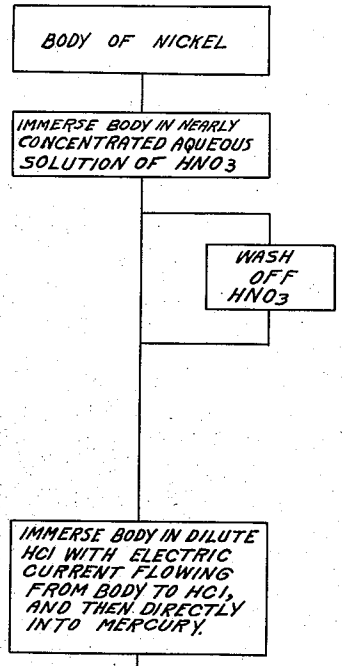


FIG. 3.

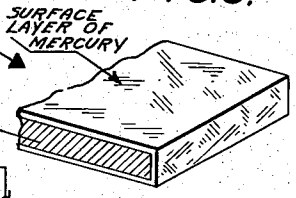


FIG. 4.

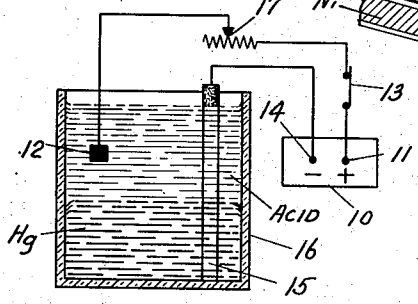
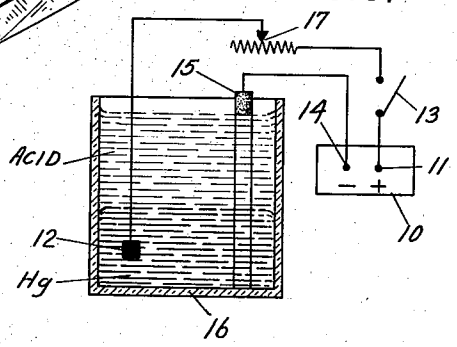


FIG. 5.



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METHOD OF COATING NICKEL WITH MERCURY

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7 Claims. (Cl. 117—51)

1

The present invention relates in general to the coating of nickel bodies with mercury, and in particular to methods for providing such coatings in a short time.

It is an object of this invention to provide methods for coating nickel with mercury in a short space of time.

It is another object to provide such methods that are easy to carry out and inexpensive.

It is still another object to provide readily available mercury coated nickel articles.

A further object is to improve the performance of mercury switches of both the instant action and the delayed action types through the use of such articles.

The foregoing and other objects and features of the invention will be best understood from the following description of some illustrative embodiments thereof, reference being had to the accompanying drawings, wherein:

Fig. 1 indicates steps in the method of coating nickel with mercury;

Fig. 2 indicates steps in an alternative method;

Fig. 3 shows in greatly enlarged cross-section a portion of a mercury coated nickel article;

Fig. 4 shows diagrammatically a bath for treating the nickel electrolytically in hydrochloric acid in accordance with the method of Fig. 2; and

Fig. 5 is like Fig. 4, but shows the condition of the bath when the nickel is immersed in the mercury.

Nickel is useful in mercury switches because when properly cleaned and processed it may be wetted by mercury and at the same time is not amalgamated in mercury and thereby destroyed with consequent contamination of the mercury. This characteristic of nickel makes it particularly useful as a material for flow-controlling orifices in time delay switches, for then smaller orifices can be used and greater time delays attained than when a non-wettable material is used. It has been found that the advantages attendant upon this characteristic of nickel can be enhanced if a layer or coat of mercury is desposited upon the surface of the nickel. Further it has been found that mercury does not adhere readily to nickel when nickel is merely immersed in mercury, but that if a coat of mercury does remain on nickel after such immersion, it is only after the nickel has been immersed for a very long time, of the order of years. The present invention provides methods and means for depositing a coat of mercury on nickel in a matter of minutes, by simple processes which can be carried out at ordinary room temperatures. While reference has been made to mercury switches as articles in which the present invention can be employed to advantage, it should be understood that the invention is susceptible of general application, as will appear from the following description.

2

Referring to Fig. 1, a body of nickel to be coated is immersed first in a strong aqueous solution of nitric acid. This solution should have a small amount of water in it, a satisfactory proportion being about one part water to seven parts nitric acid by volume, and can be used at room temperature. Immersion should be for about one to two minutes with a solution of this strength. Following treatment in nitric acid, the body may, if desired, be cleansed of nitric acid, as by washing with water.

The body is then immersed in concentrated hydrochloric acid, also at room temperature, for about fifteen to thirty seconds. Following immersion in concentrated hydrochloric acid, the body is treated in a bath consisting of a quantity of mercury with dilute hydrochloric acid floating on top. The dilute acid is satisfactory if it is made up of about one part water and one part hydrochloric acid by volume, and the entire bath may be used at room temperature. The body is treated in two stages in this bath, being in the first stage immersed in the dilute acid for about five to ten seconds, and agitated therein, and then, in the second stage, being pushed down into the mercury. After about five to ten seconds in the mercury, where the body should be agitated for even results, the nickel is coated with mercury (Fig. 3).

If the mercury coated nickel body is to be used right away, it may be removed from the mercury-hydrochloric acid bath and washed in distilled water to remove the acid, following which the body may be dried in any manner that will not injure the mercury coating. For example, the coated body may be immersed in clean mercury to remove the water by flotation, or it may be washed in methanol.

If the coated body is not to be used until later, it may be left in the mercury-hydrochloric acid bath or it may be washed with distilled water, as above, and then immersed in mercury until needed.

Prolonged exposure to the air should be avoided, because of the danger that the mercury coating will be oxidized. This danger is not present when the coated body is an element in a mercury switch, for example, for in such switches there is no oxygen present.

In the coating method discussed above, it is believed that the action of the nitric acid solution is both to clean and etch the nickel body. This prepares the surface for coating, and provides a relatively large area to be coated. The step of washing or cleansing the nickel of nitric acid is desirable as a refinement, but not vital to the result, it being understood that the hydrochloric acid bath that follows will last longer if the nitric acid is washed away before the nickel element is immersed therein. The function of the concentrated hydrochloric acid bath is not completely understood, but it is believed to contribute materially to the cleaning of the surface of the nickel.

It has been found that the nickel should be immersed in an acid just prior to its immersion in mercury for the coating step, and both acetic acid and sulphuric acid also yield good results. If not for the fact that concentrated hydrochloric acid has a detrimental effect on mercury, the nickel element could be immersed directly in mercury from the concentrated hydrochloric acid, and a good coating of mercury would adhere to the nickel body. To protect the mercury, however, the dilute hydrochloric acid is floated thereon rather than concentrated hydrochloric acid, and the body is placed in the dilute acid first and then into the mercury. It is highly desirable that the body be moved directly from the acid used into the mercury, as stated above, and thus the bath consisting of mercury with the acid floating thereon is particularly advantageous. In this way any air that may be on the surface of the nickel is removed and the surface is as clean as possible to receive a good coating of mercury thereon.

The method illustrated in Fig. 2 is like the method of Fig. 1 as far as the nitric acid bath. Thereafter the concentrated hydrochloric acid bath is omitted, and the nickel body is immersed in dilute hydrochloric acid floating on mercury. Again the intermediate step of cleansing the body of nitric acid is desirable, but not necessary to the result. When the body is in the dilute acid, an electric current is passed through it into the acid attracting negative ions to the body. This can be accomplished as illustrated in Fig. 4.

In Fig. 4, a battery **10** is connected at its positive terminal **11** to the body **12** through a switch **13**, and at its negative terminal **14** to an electrode **15**, which may be made of carbon, immersed in the bath. The bath is contained in a beaker or other container **16**. When the acid is hydrochloric acid, chlorine ions (Cl^-) are liberated at the nickel body when the switch **13** is closed. A rheostat **17** controls the amount of current that flows when the switch is closed.

There is no electroplating of mercury on the nickel, for the polarity is not suitable for such action. The current required varies for the size of the nickel element being treated, depending on the surface area to be coated. With a small, cup-shaped body slightly smaller in diameter than the end of a pencil and about one-quarter inch deep, a current of about 3.5 amperes for ten to fifteen seconds was found to be satisfactory. The voltage required to obtain this current was, in the case under discussion, about ten volts, but it will be understood that this will vary with local conditions, such as the resistance of the inter-connecting wire and the amount and kind of acid used.

When electrical treatment in the acid is completed, the body is immersed immediately in the mercury, and the switch **13** is opened as shown in Fig. 5. The switch should be opened just prior to immersion of the body in the mercury, to avoid short-circuiting the battery. The nickel body immediately takes on a coat of mercury, and the process is completed. The handling of the mercury coated nickel body thereafter may be as outlined above, to preserve the mercury coating from oxidation or other kinds of damage.

The methods and means described above are subject to many variations within the scope of the invention, and these variations will occur to those skilled in the art. It is therefore desired that the appended claims be given a broad interpretation commensurate with the scope of the invention within the art.

What is claimed is:

1. The process for coating a nickel body with a surface layer of mercury which comprises etching the surface of said body with nitric acid, then immersing said body in a bath of an acid selected from the group consisting of acetic, hydrochloric and sulphuric acids, the acid of said bath resting upon a layer of mercury, and then immersing said body in said mercury immediately from said acid.

2. The process for coating a nickel body with a surface layer of mercury which comprises etching the surface of said body with nitric acid, then cleaning said surface, then wetting said surface with an acid selected from the group consisting of acetic, hydrochloric and sulphuric acids, and then wetting said surface with mercury.

3. The process for coating a nickel body with a surface layer of mercury which comprises immersing said body in a nearly concentrated aqueous solution of nitric acid, then immersing said body in hydrochloric acid, and then immersing said body in mercury.

4. The process for coating a nickel body with a surface layer of mercury which comprises immersing said body in a nearly concentrated aqueous solution of nitric acid, then cleasing said body of nitric acid, then immersing said body in a hydrochloric acid bath resting on a layer of mercury, and then immersing said body in said mercury.

5. The process for coating a nickel body with a surface layer of mercury which comprises immersing said body in a nearly concentrated aqueous solution of nitric acid, then immersing said body in concentrated hydrochloric acid, then immersing said body in a dilute solution of hydrochloric acid, and finally immersing said body in mercury.

6. The process for coating a nickel body with a surface layer of mercury which comprises immersing said body in a nearly concentrated aqueous solution of nitric acid, then immersing said body in concentrated hydrochloric acid, then immersing said body in a dilute solution of hydrochloric acid, and finally immersing said body in mercury immediately from said last mentioned solution.

7. The process for coating a nickel body with a surface layer of mercury which comprises immersing said body in a solution of nitric acid consisting substantially of seven parts nitric acid and one part water by volume for one to two minutes, then immersing said body in concentrated hydrochloric acid for fifteen to thirty seconds, then immersing said body in a solution consisting substantially of one part water to one

part concentrated hydrochloric acid for five to ten seconds, and finally immersing said body in mercury for five to ten seconds, said entire process being carried out at an ordinary room temperature.

THEODORE M. BURKHOLDER.

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