UNITED STATES PATENT OFFICE

2,572,597

FOROSITY TESTER FOR COATING MATERIALS

Thomas J. Connor, Lower Merion, Pa., assignor to General Electric Company, a corporation of New York

Application January 2, 1951, Serial No. 204,013

1 Claim. (Cl. 175—183)

This invention relates to apparatus for testing coating materials and more particularly to apparatus for determining porosity in non-conducting coating materials applied to metallic surfaces.

The common method of protecting exposed metallic surfaces is to cover them with a thin layer of a non-conducting coating material such as paint, lacquer or the like. Where a metallic surface is to be exposed to the atmosphere, for example are many transformer and circuit breaker tanks, it is especially important that the protecting layer be continuous over the entire surface. Even small holes or pores in the coating layer, imperceptible to the human eye, may lead to flaking of the layer and the forming of rust and corrosion on the metallic surface.

In the past, the detection of these small pores in the layer of coating material has presented a serious problem. The means principally employed for determining the condition of the layer of coating material has been visual inspection, but unfortunately, visual inspection, no matter how carefully performed is often subject to serious error. Layers of coating material which appear to the eye to be continuous throughout may in fact contain a myriad number of extremely small holes or pores.

It is an object, therefore, of this invention to provide new and improved means for determining porosity in non-conducting coating material applied on metallic surfaces.

It is another object of this invention to provide a new and improved portable device for determining porosity in non-conducting coating material applied on metallic surfaces, which harms neither the layer of coating material nor the metallic surface by its operation.

In this invention, the metallic structure, on whose surface lies the non-conducting coating layer for which a porosity test is desired, is connected in open series circuit with a source of electrical potential, a current indicating device, and a metallic member or plate. The metallic plate is positioned to contact a pad of absorbent material saturated with a water solution of a volatile salt, such as ammonium carbonate. The metallic plate, the absorbent pad, and a supply of the solution for continuously wetting the pad are ordinarily contained in a portable application member. To test for porosity in the coating layer, the pad is rubbed over the coating layer so that the solution contained in the pad permeates any pores in the coating layer. The contact of the electrically conductive solution with any bare metal of the metallic surface completes the circuit through the indicating device. The indicating device by its deflection provides an indication of the presence of the pores in the coating layer.

For a better and more complete understanding of my invention, together with additional objects and advantages thereof, reference should now be had to the following description and accompanying drawing which is a schematic diagram of a preferred embodiment of this invention.

Referring to the drawing, a metal sheet 1 has a layer 2 of non-conducting coating material, such as paint, applied over the greater portion of one of its surfaces. An alligator clip 3 by gripping sheet 1 in an area which is not covered by layer 2 provides a good electrical connection to the sheet. Clip 3 is connected by a wire 4 to an output terminal 5 of a portable battery and meter case 6.

In case 6, terminal 5 is serially connected with two dry cell batteries 7 and 7a, an indicating device 8, such as a direct current ammeter, and an output lead 9. Lead 9 is connected through wire 10 to a terminal 11 mounted on the closed end of a portable applicator member 12. Applicator member 12 is shown in the drawing as a tubular container having a closed end and an open end. The shape of member 12 is not essential to the operation of the device, but whatever shape is employed, it must form a container having at least one opening to the space enclosed within it.

Positioned within member 12 is a member or plate 13 which is made of an electrically conducting metal such as silver. In the preferred embodiment of this invention illustrated in the diagram, plate 13 is movable within member 12. However, plate 13 may be positioned permanently by screws or other means without appreciably affecting the functioning of the device, so long as the positioning means used do not seal off the space on one side of plate 13 from the space on the other side. Filling the open end of member 12 and contacting plate 13 is a pad 14 formed of absorbent material, such as felt. Pad 14 is held in place by friction with the inner wall of member 12. In order that sufficient friction be provided to hold pad 14 securely, pad 14 is made slightly oversize with respect to the opening in member 12 and is forced into the opening. Plate 13 is so positioned within member 12 that, when pad 14 comes to firm contact with the plate, a portion of pad 14 still protrudes beyond extremity of member 12.
A spring 15 provides an electrical connection between terminal 11 and plate 13, and, when plate 13 is movable, also serves to keep plate 13 in firm contact with pad 14. The space surrounding spring 15 is filled with an electrically conducting water solution 16 of a volatile salt, such as ammonium carbonate. Since plate 13 does not seal off the space surrounding spring 15, pad 14 is continuously wetted by solution 16.

In operation applicator member 12 is moved so that the exposed portion of pad 14 is rubbed on layer 2 over all the area to be tested for porosity. If any pores exist in layer 2, as pad 14 is rubbed over these pores, solution 16 penetrates them and contacts the metal surface of sheet 1. Since salt solutions in water, such as the ammonium carbonate solution 16, are electrically conductive, the contact of the solution with the metal completes the electrical circuit through indicating device 8. The wetted felt pad 14 between plate 13 and metal sheet 1 in effect forms an electrolytic cell for the passage of current. The current indicated by device 8 depends upon the area of metal contacted by solution 16, i.e. the number of holes in or the porosity of layer 2. Thus this invention not only provides means for determining the presence of porosity in a layer of coating material, but also provides a relative measurement of the seriousness of the porosity.

Solution 16 may be formed of almost any salt which does not leave a corrosive residue that will interfere with the durability of the coating layer. It has been found that a water solution of ammonium carbonate gives excellent results. The salt film deposited on the coating layer by a solution made of ammonium carbonate decomposes after a few hours into the vapors of carbon dioxide, ammonia and water. Examples of other salts which may be used to form solutions suitable for employment with this invention are ammonium carbamate, ammonium carbamate acid carbonate, ammonium formate, ammonium bicarbonate, ammonium cyanate, ammonium fluoroborate and ammonium thiocarbonate. Preferably, the salt used should be one possessing fairly high solubility as well as high ionization. In some cases it is desirable to add a small amount of wetting agent, such as aerosol, to the solution. The purpose of the wetting agent is to aid in the solution in permeating very small holes or pores in the coating layer.

Plate 13 may be perforated to allow better flow of solution 16 into pad 14, particularly when the plate is permanently positioned. The perforations not only aid the flow of solution but also help to eliminate polarization of the plate.

This invention possesses a major advantage in that, since it damages neither the metallic surface or the coating layer, the porosity test may be made on the actual surfaces which are to go into use rather than being made on a test sample. Moreover, the invention is not restricted to metallic surfaces small in area but may be used equally as well with large surfaces, such as for example the outside of power transformer tanks.

Although in accordance with the provisions of the patent statutes, this invention has been described as embodied in concrete form, it should be understood that the invention is not limited to the precise structure or exact connections shown in the drawing since these are merely illustrative and modifications and alterations will readily suggest themselves to persons skilled in the art without departing from the true spirit of this invention or from the scope of the annexed claim.

What I claim as new and desire to secure by Letters Patent of the United States is:

A device for determining porosity in a layer of non-conducting coating material applied to a metallic surface comprising a portable applicator member including a container having an open end; a metallic plate positioned within said container; a pad of absorbent material contacting said plate, filling said open end, and protruding beyond the extremity of said member; an electrically conductive water solution of a volatile salt filling said container and wetting said pad to establish electrical contact between said plate and said metallic surface through any pores in said coating material in response to movement of said pad across said coating material; and a circuit arranged to be completed by said contact including a source of voltage and a current indicating device, said contact to cause a deflection on said indicating device indicative of porosity in said layer of coating material in response to permeation of said solution into the pores in said coating material.

THOMAS J. CONNOR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,953,155</td>
<td>Currier</td>
<td>Apr. 3, 1934</td>
</tr>
<tr>
<td>2,506,478</td>
<td>Wright</td>
<td>May 2, 1950</td>
</tr>
</tbody>
</table>