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PATENT SPECIFICATION

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(54) IMPROVEMENTS RELATING TO THE COATING OF THE INTERNAL SURFACES OF HOLLOW OBJECTS

- (71) I, ADAM ALGOT OEHLÉN-SCHLAGER, a Danish subject, of Algade 68, DK—5500 Middelfart, Denmark, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- This invention relates to the provision of a coating of a thermoplastic or thermosetting material on the inner surface of a hollow object particularly a cylindrical object, which has at one end an opening which may be coaxial with the hollow space, by subjecting the object to a treatment suitable for causing the plastics material to adhere to the inner surface and heating the object to a temperature above the melting point of the plastics material.
- The provision of such inner coatings has previously depended substantially on manual operations, for instance spraying, but recently attempts have been made to produce the coatings by using a relatively fine powder of the plastics material with which an object is to be coated. This has provided a practical process, but only when outer surfaces, particularly plane surfaces are to be coated. The object of the present invention is to provide a method for the coating of the inner surface of a hollow object, for instance a cylindrical container, and obtain a rapid smooth coat or a coat that varies exactly to meet specific requirements.
- According to the present invention the object whose internal surface is to be coated is heated to a temperature above the melting point of the plastics material to be used for the coating and is caused to rotate about the axis of its hollow interior with the opening facing upwardly, while the axis of the hollow interior has an inclination of from 10—15° to the vertical, whereupon finely divided plastics materials is introduced into the interior by injection through the opening and the object is then immediately tilted

into a further inclined position, this tilting being continued at a rate adjusted to the shape of the hollow interior, to the desired thickness of the coating and to the angle of slide of the finely divided plastics material, the rate of rotation also being adjusted in accordance with this last factor so as to cause the material to perform a steady sliding movement during the tilting of the object without free fall of the components of the material, after which the object is finally tilted into a position in which the opening faces downwards for the discharge of excess plastics material.

When the plastics material is passed into the heated object, the inner surface of which has been pre-treated to ensure adhesion of the material, the material will melt immediately on contact with the inner surface and settle thereon. As a result of the rotation the finely divided material lying inwardly of the directly melted layer will continue to circulate within the cavity and as the object is simultaneously tilted about a horizontal axis the circulating material will successively contact the entire inner surface, which will thus receive a layer of material the thickness of which is determined completely by the quantity of material introduced, the rate of rotation and the rate of tilting. Thus the thickness of the coat may be adjusted to requirements by selection of the said speeds, and it will be possible to apply a thicker coat in locations where it is significant or where sharp edges for instance require a thicker coat. The tilting and rotation rates can likewise be adjusted to the shape of the hollow interior of the object. In this way it will be possible to provide a plastics coating rapidly and effectively on the inner surface of hollow objects such as containers, for instance oil or water tanks, where it is important to obtain a coat that effectively protects the container material against corrosion. It has also been found that projecting members, for instance tubes disposed within the

hollow space, will likewise be covered effectively by the coating material when this method is applied. The rate of rotation, as already mentioned, can be varied and this means that also the direction of rotation can be changed once or more times during the process.

While the plastics material is being introduced the object or container must rotate, but it is obvious that the introduction of material will take a certain time, not least because there must be an excess of plastics material, and to avoid a too thick coat over the region where the material first settles, the filling must be performed as rapidly as reasonably possible, and as soon as it is completed the tilting must be started and the object rapidly tilted away from the starting position in order that the material can spread quickly over the other portions of the inner surface of the space.

The adjustment of the tilting and rotation rates to the angle of slide of the material is necessary to ensure an even coat and to avoid formation of lumps on the surface.

The invention will now be described in greater detail, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 shows an apparatus for use in a method according to the invention viewed in side elevation; and

Figure 2 presents a section along the line II—II in Figure 1.

The apparatus comprises a base 1 with two bearing blocks 2 in which a main shaft 3 is journaled. The main shaft supports a frame 4 on which two pairs of lifting arms 5 and 6 are pivotally mounted to be operated by means of hydraulic cylinders, 7 and 8 respectively, the spindles of which are connected to crossbars 9 and 10 respectively, inter-connecting the two lifting arms 5 and 6.

At either end of the frame 4 are provided centreing members 11 and 12 provided with fingers 13 adapted to abut against the ends of an object such as a cylindrical container 14 having an opening 30 at one end. The centreing members 11 and 12 are mounted rotatably in brackets 15 and 16, and the member 12 is connected to a belt or chain pulley 17 driven through a belt or chain 18 by a motor 19 which is rigidly connected to the bracket 16. The two brackets 15 and 16 are adjustably mounted by means of spindles 20 and 21, which are slidable in the frame 4 and are operated by means of hydraulic pistons 22 and 23, pressure medium being supplied through a central pipe branch 24 or through two pipe branches 25 and 26 so that the two spindles are moved either away from each other or towards each other for respective removal from or engagement with the object 14.

The frame 4 is further provided with a 180° toothed sector 27 engaging a gearwheel 28 driven by a motor 29. By means of this motor the whole frame including the object 14 may be tilted to assume the different desired positions.

When the apparatus is to be used the lifting arm 6 is lowered to make the apparatus ready to receive the heated object 14, which may be rolled into position from a conveyor belt provided adjacent to the apparatus, and when the object reaches the arm 5 the arm 6 is raised to the position shown, whereupon both arms 5 and 6 are moved upwards to the position in which the object is to be centred. The two centreing members 11 and 12 are removed towards the object by means of the hydraulic operating arrangement until the fingers 13 engage both ends of the object 14, after which the arms 5 and 6 are lowered. As soon as the arms 5 and 6 are free of the object 14 the motor 19 is started and the object is caused to rotate. Also the motor 29 is started, whereby the entire frame 4 is caused to tilt by means of the gear wheel 28 and the toothed sector 27, and this tilting motion is continued until the opening 30 faces upwards, with the axis of the object 14 at an inclination of between 10 and 15° to the vertical.

In this position finely divided plastics material is introduced while the object 14 is being rotated continuously, and as soon as the required amount of material has been introduced the object 14 is tilted back towards the horizontal by means of the motor 29 at a tilting rate which is preferably between 3 and 9° per second. The tilting is then discontinued more or less completely at a position in which the axis of the object has an inclination to the horizontal of from 5 to 10°, and in that position it is maintained in rotation for about 10 seconds. During this operation the material will distribute quietly over the approximately horizontal portion of the container sides and the tilting may then be continued to enable material to be spread also to the end in which the opening 30 is located. As the object approaches its vertical position with the opening facing downwards excess material will be discharged, and the coating is then complete.

The motor 29 then returns the whole frame and the object 14 to the position indicated in Fig. 1, the two arms 5 and 6 are raised into engagement with the object and the centreing members 11 and 12 are withdrawn to permit the arm 5 to be tilted downwards so that the object will roll along the arm 6 and away from the apparatus to be received in any convenient manner by a conveyor member and removed from the machine.



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WHAT I CLAIM IS:—

1. A method for forming a coating of a thermoplastic or thermosetting plastics material on the inner surface of a hollow object having an opening at one end, in which the object is heated to a temperature above the melting point of the plastics material and is caused to rotate about the axis of its hollow interior with the opening facing upwardly, while the axis of the hollow interior has an inclination of from 10—15° to the vertical, whereupon finely divided plastics material is introduced into the interior by injection through the opening and the object is then immediately tilted into a further inclined position, this tilting being continued at a rate adjusted to the shape of the hollow interior, to the desired thickness of the coating and to the angle of

slide of the finely divided plastics material, the rate of rotation also being adjusted in accordance with this last factor so as to cause the material to perform a steady sliding movement during the tilting of the object without free fall of the components of the material, after which the object is finally tilted into a position in which the opening faces downwards for the discharge of excess plastics material.

2. A method according to claim 1 substantially as described and as illustrated with reference to the accompanying drawings.

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