Jan. 16, 1962 R. A. ARTMAN ETAL 3,017,115

ELECTROSTATIC PAINT SYSTEM

Filed Sept. 18, 1958

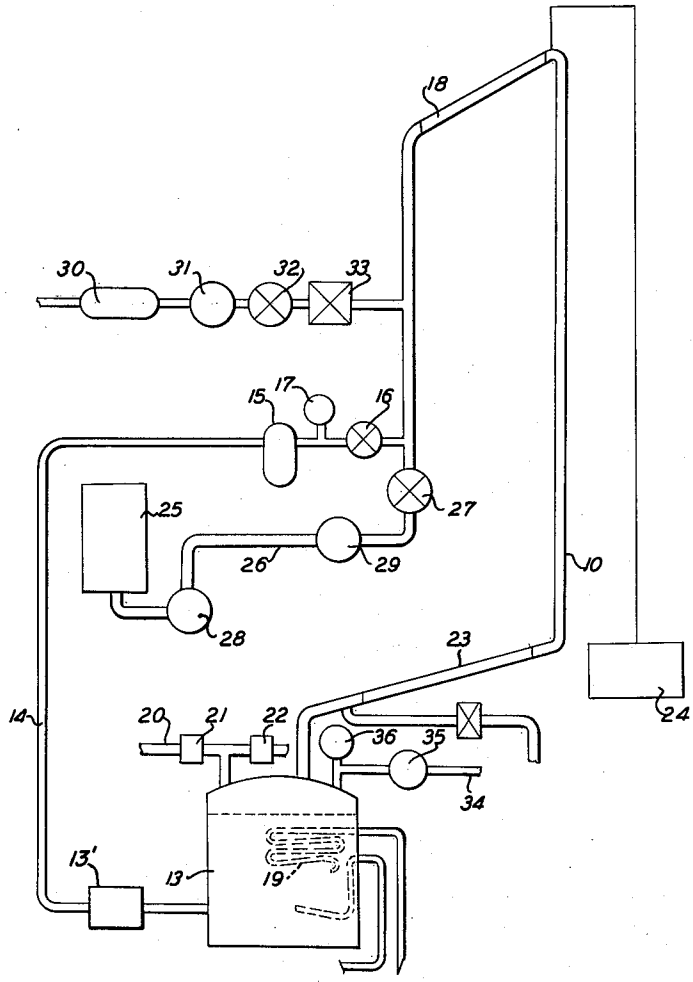


FIG. 1

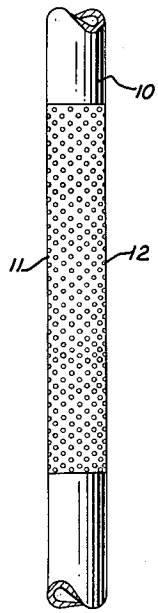


FIG. 3

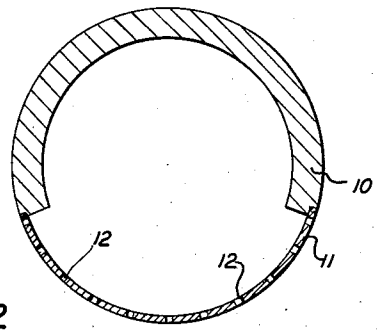


FIG. 2

R. A. ARTMAN
R. C. ROOT
A. H. TURNER
INVENTORS

BY E. C. McRae
J. R. Faulkner
D. H. Oster
ATTORNEYS

United States Patent Office 3,017,115 Patented Jan. 16, 1962

3,017,115

ELECTROSTATIC PAINT SYSTEM

Robert A. Artman, Dearborn, and Richard C. Root and Allen H. Turner, Ann Arbor, Mich., assignors to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

Filed Sept. 18, 1958, Ser. No. 761,726
4 Claims. (Cl. 239—3)

This invention relates to the coating art and is specifically concerned with a process and apparatus for the use of electrostatic force for the application of paint repetitiously to similar objects. This application relates to the subject matter of application Serial No. 574,325 filed March 27, 1956 in the name of Roderick Hines.

The art is aware that it is possible by means of electrostatic force to atomize paint away from the edge of a small orifice through which it has been caused to flow by other means. No claim is made here to this broad concept. This invention is concerned with an improvement on this method of painting which makes it possible to operate such a painting system continuously.

The invention is explained in connection with the figures of drawing in which:

FIGURE 1 is a somewhat schematic drawing of the entire system;

FIGURE 2 is a cross section of a portion of a painting tube which forms a part of this system; and,

FIGURE 3 is a plan view of such painting tube.

The structure of the painting tube which has been designated **10** is best understood from FIGURES 2 and 3. This painting tube is constructed from a brass tube three-eighths of an inch in diameter and six feet long. The central four feet of the painting tube has had a section of the tube removed and replaced by foraminous sheet **11** provided with openings **12**. Foraminous sheet **11** has a thickness of 0.003 inch and is provided with twelve thousan openings **12**. These openings have a diameter of 0.003 inch and are arranged on a square pattern with the centers of the holes spaced apart 0.040 inch. The holes are arranged in horizontal rows with ten holes comprising one horizontal row. There are one thousand two hundred such horizontal rows.

Turning to FIGURE 1, paint is supplied to painting tube **10** from paint reservoir **13** by pump **13'** through conduit **14**, filter **15**, valve **16** and conduit **18**. The pressure in the system is indicated by gage **17**. The point is maintained at the proper temperature by heat exchanger **19** located in reservoir **13**. Conduit **20** is connected to a source of vacuum and is connected to paint reservoir **13** through valve **21**. Reservoir **13** may also be connected directly to the atmosphere through valve **22**. It is preferred that valves **21** and **22** be solenoid valves with valve **21** normally closed and valve **22** normally opened. Conduit **23** serves to return to reservoir **13** paint which escapes atomization in painting tube **10**.

Conduits **18** and **23** are fabricated from a highly insulating material such as polyethylene plastic and serve to electrically isolate painting tube **10** from the rest of the system. Painting tube **10** is electrically connected to high voltage source **24** which is capable of charging painting tube **10** to a potential at least equal to 100 kilovolts.

Means, not shown, are provided for conveying the articles to be painted past painting tube **10** and in alignment with openings **12**. It is preferred that the workpieces be solidly grounded and that painting tube **10** be held at a potential negative with respect to the workpieces.

Conduit **14** is also connected to a solvent tank **25** by means of conduit **26** and valve **27**. Pump **28** and filter **29** are provided to insure the delivery of clean solvent under pressure into the system. Conduit **14** is also connected with a source of compressed air flowing from air tank **30** through filter **31**, gage valve **32** and quick-opening valve **33**. The supply of paint in paint reservoir **13** may be replenished through conduit **34** in which is installed valve **35** and gage **36**.

In order to insure a uniform flow of paint through all of the openings **12** in painting tube **10**, it is essential that a uniform pressure differential be maintained between all portions of painting tube **10** and the atmosphere. This is most readily obtained by causing paint to flow through painting tube **10** with such a velocity that the pressure drop through the length of painting tube **10** due to the viscous flow of the paint therethrough just balances the increase in hydrostatic head from the top to the bottom of the tube. While in most circumstances a uniform coating of paint is to be desired, it is also within the purview of the invention to be so adjust the pressure drop through painting tube **10** and the hydrostatic head to cause any desired flow pattern from different portions of the tube. The desired flow pattern, whether uniform or non-uniform, is obtained by adjusting such parameters as paint viscosity, paint temperature, paint flow and the configuration of painting tube **10** itself. While painting tube **10** has been shown as mounted in a vertical position this is not necessary as long as painting tube **10** has a sufficient vertical component to be matched with the inherent pressure drop of paint flowing through the tube.

It has been found by experience that using conventional commercial primers such as one containing an epoxy base resin, a solvent and pigments that the pigment tends to bridge openings **12** and restrict the flow of paint therethrough. In many circumstances the holes become completely plugged in a matter of a few minutes. To enable apparatus of this type to be employed successfully, recourse has been had to the expedient of applying at spaced intervals a momentary vacuum to the head space above the paint in paint reservoir **13**. This is accomplished by applying electrical energy to valve **21** which is normally closed and valve **22** which is normally opened to cause valve **21** to open and valve **22** to close. The air over the head space in paint reservoir **13** flows into conduit **20** which is connected to a source of vacuum. This lowers the pressure in reservoir **13**, which lowered pressure is reflected along conduits **14**, **18** and **23** into painting tube **10**. Since the pressure within painting tube **10** then becomes less than atmospheric, paint is caused to flow in a reverse direction back to the interior of painting tube **10** and so destroys any deposits which may have a tendency to bridge and close openings **12**. It has been found satisfactory to energize valves **21** and **22** for three seconds out of each thirty seconds. This gives a painting cycle of twenty-seven seconds and a cleaning cycle of three seconds. It is obvious that in commercial work the cleaning cycle could be timed to coincide with the absence of work before the painting tube. The exact timing and duration of the existence of the subatmospheric pressure within painting tube **10** is not critical as long as the negative pressure is applied at periods of time shorter in duration than the time required for the plugging of any of openings **12** beyond opening by the reverse flow of paint.

The compressed air supply originating in tank **30** and the solvent supply originating in solvent tank **25** have been provided for cleaning and blowing out the entire system when it is desired to start up the system or shut down the system or change colors. Cooling coil **19** has been provided to regulate the viscosity and temperature of the paint.

The conductivity of some commercial paints may be such that it is impossible to satisfactorily use such in an electrostatically propelled system. Such paint should have included in their thinner some polar solvent such as methyl alcohol or acetone to raise their conductivity. If the paint conductivity is satisfactory, it may be thinned by conven-

tionally known non-polar solvent. It is preferred to operate the paint at a viscosity between 1.6 and 2.0 poises. In painting with a paint of this viscosity it has been found that the described painting tube working under a pressure of approximately one pound per square inch at the tube will discharge three gallons of paint per hour in a satisfactory spray.

Having thus described a preferred form of our invention, what we claim and desire to secure by United States Letters Patent is:

1. An apparatus for electrostatically coating an object with a siccative liquid comprising a painting tube provided with a plurality of small openings and arranged at a substantial angle to the horizontal, means for maintaining an electrical potential between the painting tube and the object to be coated, means for flowing a siccative liquid through the painting tube under a slightly superatmospheric pressure, means for regulating the flow of siccative liquid through the painting tube so that the pressure drop through the length of the painting tube due to the flow of siccative liquid is substantially neutralized by the hydrostatic head of siccative liquid in the painting tube, and means for periodically reducing the pressure within the painting tube to a value substantially under atmospheric to cause a reversal of the flow of siccative liquid through the small openings and a concomitant cleansing of the small openings.

2. A process for continuously electrostatically atomizing a siccative liquid through a plurality of small openings comprising establishing an electrical potential between the siccative liquid and a receiver to accomplish atomization of the siccative liquid, impressing a small superatmospheric pressure upon the siccative liquid to cause it to flow through the small openings, and periodically impressing momentarily upon the siccative liquid a subatmospheric pressure to cause the flow of siccative liquid through the small openings to reverse and cleanse the small openings of accumulated deposits.

3. A process for continuously electrostatically atomizing a siccative liquid through a painting tube having a plurality of small openings and arranged at a substantial angle to the horizontal comprising establishing an electrical potential between the painting tube and a receiver to accomplish atomization of the siccative liquid, impressing a small superatmospheric pressure upon the siccative liquid in the painting tube to cause it to flow through the small openings, circulating siccative liquid through the painting tube at a rate such that the pressure drop due to the flow of siccative liquid through the painting tube is substantially neutralized by the hydrostatic head of siccative liquid in the painting tube and periodically impressing momentarily upon the siccative liquid a subatmospheric pressure to cause the flow of siccative liquid through the small openings to reverse and cleanse the small openings of accumulated deposits.

4. A process for continuously electrostatically atomizing a siccative liquid through a painting tube having a plurality of small openings and arranged at a substantial angle to the horizontal comprising establishing an electrical potential between the painting tube and a receiver to accomplish atomization of the siccative liquid, impressing a small superatmospheric pressure upon the siccative liquid in the painting tube to cause it to flow through the small openings and circulating siccative liquid through the painting tube at a rate such that the pressure drop due to the flow of siccative liquid through the painting tube is substantially neutralized by the hydrostatic head of siccative liquid in the painting tube.

References Cited in the file of this patent

UNITED STATES PATENTS

2,221,876	Mackin	Nov. 19, 1940
2,665,171	Stievater	Jan. 5, 1954
2,733,171	Ransburg	Jan. 31, 1956
2,749,180	Andrews	June 5, 1956
2,750,232	Szantay et al.	June 12, 1956
2,764,508	Feick	Sept. 25, 1956
2,794,417	Starkey	June 4, 1957
2,800,365	Hodges	July 23, 1957
2,855,245	Sedlacsik	Oct. 7, 1958