April 2, 1963 E. H. GRIFFITHS, JR 3,083,911

ELECTROSTATIC ATOMIZING HEAD

Filed March 17, 1960 2 Sheets-Sheet 1

Fig. 1.

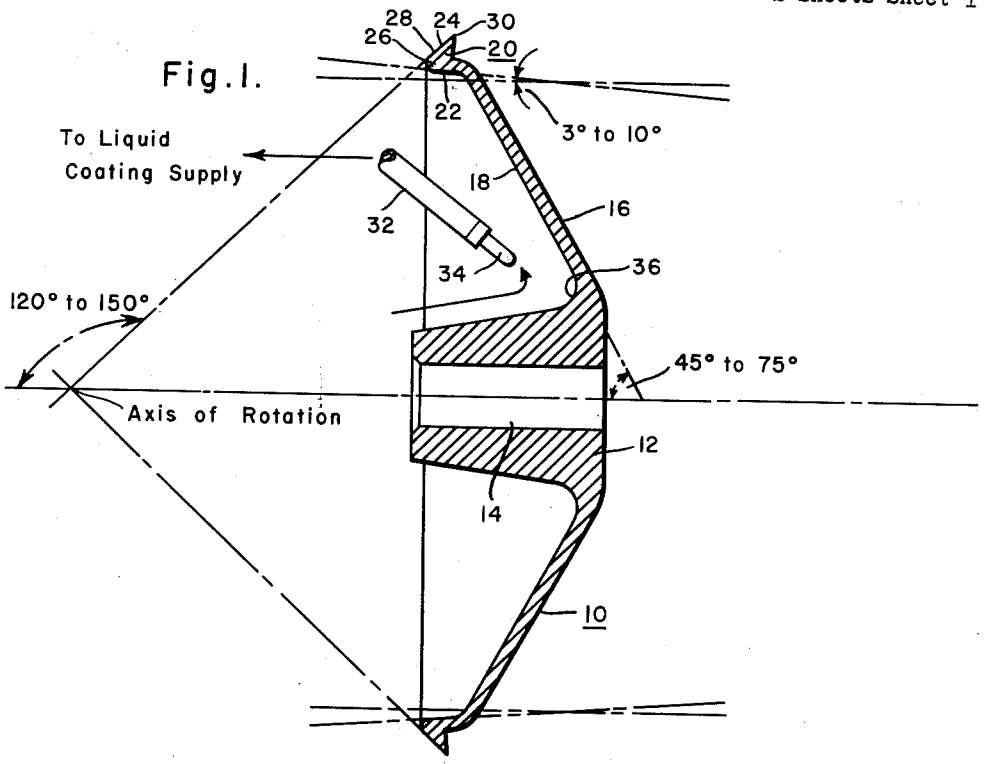
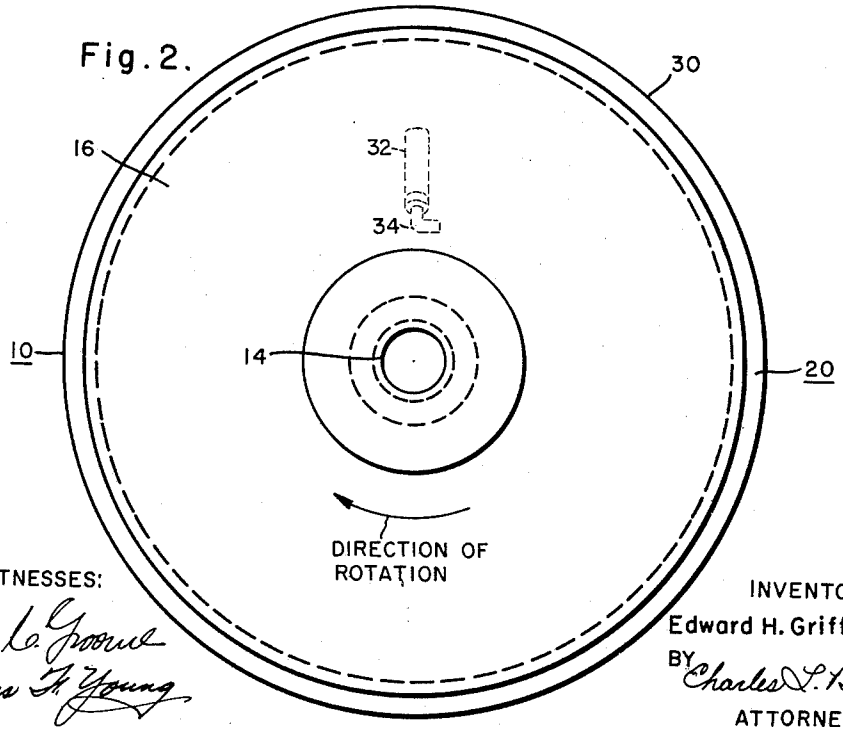


Fig. 2.



WITNESSES:

Kw. C. Goode

James F. Young

INVENTOR

Edward H. Griffiths, Jr.

BY Charles L. Board

ATTORNEY

April 2, 1963 E. H. GRIFFITHS, JR 3,083,911

ELECTROSTATIC ATOMIZING HEAD

Filed March 17, 1960

2 Sheets-Sheet 2

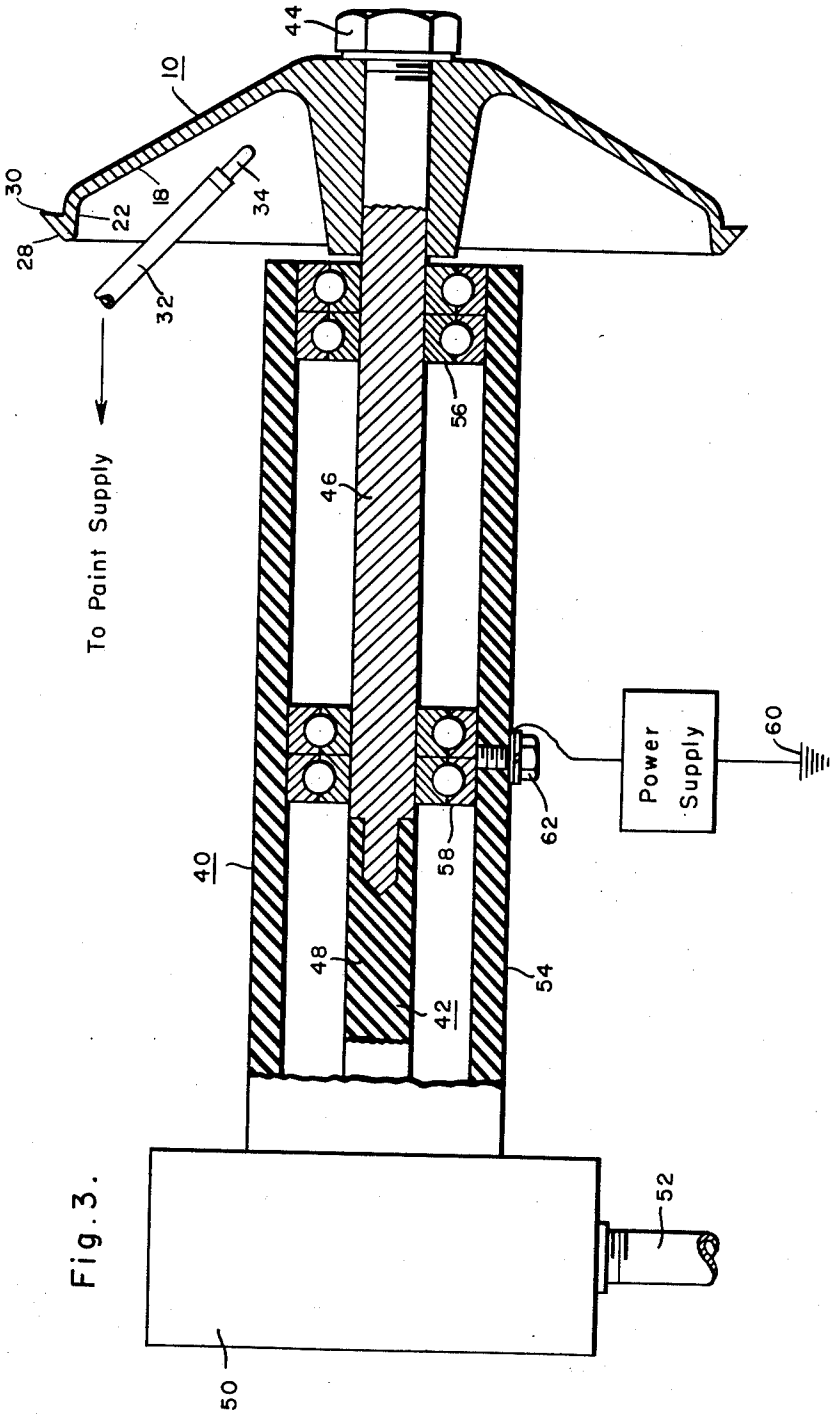


Fig. 3.

United States Patent Office 3,083,911 Patented Apr. 2, 1963

3,083,911

ELECTROSTATIC ATOMIZING HEAD

Edward H. Griffiths, Jr., Penn Hills Township, Allegheny County, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Filed Mar. 17, 1960, Ser. No. 15,687
6 Claims. (Cl. 239—15)

This invention relates to a rotatable atomizing head and has particular reference to a rotatable atomizing head adapted to atomize liquid coating materials by the action of centrifugal force. This invention also relates to the electrostatic deposition of the centrifugally atomized liquid coating materials.

This invention is directed to a novel structure for and mode of functioning of a rotatable atomizing head in which liquid coating material to be atomized thereby is formed into an annular film by the action of centrifugal force, and subsequently atomized into finely divided, discrete particles from the outer edge of the thus formed annular film by the influence of centrifugal force.

The novel structure of the rotatable atomizing head of this invention provides for the discharge of the centrifugally atomized liquid coating material in substantially uniform finely divided particles and in a well defined substantially uniformly distributed spray pattern.

For a full and complete understanding of the nature of this invention, reference is made to the following detailed description and drawing, in which:

FIGURE 1 is an axial section through a rotatable atomizing head of this invention;

FIG. 2 is an end view of the atomizing head; and

FIG. 3 is a view in elevation, partly in section, illustrating atomizing apparatus embodying the rotatable atomizing head of this invention.

Referring to FIGURE 1 of the drawing, there is illustrated a rotatable atomizing head 10 of this invention. The rotatable head 10 comprises a central hub portion 12 having a central aperture 14 adapted to receive an end of a rotatable shaft to which the atomizing head 10 is secured during operation.

A dished or saucer-shaped portion 16 is connected to and concentric with hub portion 12, the inner surface 18 of which extends rearwardly at an angle of from about 45° to 75° to the axis of rotation of the hub portion 12, the preferred angle being about 60°.

A short circular flange 20 is disposed at the outer periphery of the dished portion 16. The circular flange 20 flares outwardly from the outer periphery of dished portion 16 and the inner surface 22 thereof forms an angle of from about 3° to 10° to the axis of rotation of hub portion 12, the preferred angle being about 5°.

The circular flange 20 has an external sharp edged ring portion 24 provided with a smooth rounded lip 26 extending from the exterior of circular flange 20 and flaring forwardly into a short flat conical surface 28 that terminates in a relatively sharp edge 30. The surface 28, when extended to intersect the axis of rotation, forms therewith an angle of from about 120° to 150°, with the preferred angle being about 135°.

During operation, the atomizing head 10 is secured or affixed to a rotatable shaft and rotated at a high rate of speed, usually of the order of from about 2000 to 4000 revolutions per minute, and liquid coating material to be atomized is supplied to the interior surface of the head at a controlled rate by means of feed tube 32, which is preferably a flexible tube prepared from rubber, for example. The liquid coating material can be supplied through the feed tube 32 by any convenient means such, for example, as by a pump, a pressure pot or merely by means of gravity. It is preferred that the nozzle 34 of

liquid feed tube 32 be pointed in the direction of rotation of the atomizing head 10, during operation.

The liquid supplied to the interior of the atomizing head by means of the liquid feed tube 32 and through nozzle 34 will spread out over the inner surface of the head under the influence of centrifugal force forming a thin film of the liquid coating material which flows toward the peripheral edge of the atomizing head. The liquid coating material is preferably delivered at or near zone 36 where hub portion 12 and dished portion 16 are connected.

During rotation of the atomizing head 10, liquid coating material supplied through nozzle 34 of feed tube 32, and deposited at or near zone 36, is spread out into a relatively thin substantially uniform film over the surface 18 of the dished portion 16. The surface 18 may be referred to as the feeding zone of the atomizing head. As the liquid flows outwardly over the surface 18 or feeding zone, the centrifugal force acting on it increases and the velocity of liquid flow toward the periphery thereof accordingly increases. The inner surface 22 of circular flange 20 acts as a deterrent or slowing medium to the outward movement of the liquid coating material and thereby provides a more uniform film of liquid coating material on the flat conical surface 28. The inner surface 22 may be referred to as a slowing zone, and the flat conical surface 28, as the delivery zone of the head 10. The uniform film which is thus provided on the flat conical surface 28 or the delivery zone results in the uniform discharge of finely divided discrete particles of the liquid coating material from the sharp edge 30.

The substantially uniform, evenly distributed film of liquid coating material is ruptured as it reaches the periphery or edge 30 and the liquid is broken up or atomized into finely divided particles by the influence of centrifugal force. The finely divided particles are discharged in substantially uniform particle size and in a well defined and substantially uniformly distributed spray pattern.

Owing to the novel structure of the atomizing heads of this invention and particularly to the incorporation therein of the circular flange 20, the inner surface 22 of which acts as a slowing zone, it is possible to prepare relatively compact rotatable atomizing heads of about 5½ inches in diameter as measured along the plane of edge 30. Larger or smaller heads can be prepared. Thus, the atomizing heads of this invention can be prepared so that the surface 18 extends from the hub portion 12 to the circular flange 20 disposed at its outer periphery a distance of from about 1½ inches to 4 inches. The inner surface 22 of circular flange 20 will extend a distance of from about ⅛ to ½ inch to rounded slope 26. The conical surface 28 will extend from rounded slope 26 a distance of from about ⅛ to ¼ inch. The above measurements are given by way of example and are not intended to limit the invention.

The rotatable atomizing heads of this invention are adapted particularly for use in the centrifugal atomization of paint and like liquid coating materials. The paint is discharged therefrom in substantially uniform, finely divided discrete particles, and in a well defined spray pattern. The distribution of the particles of paint on the surface of an article to be coated is substantially uniform.

The rotatable atomizing head of this invention is adapted particularly well for use in well-known electrostatic paint spraying methods. Thus, for example, the finely divided discrete centrifugally atomized particles of liquid coating material are given a negative electrical charge at the time they leave the periphery of the rotating atomizing head. Deposition of the particles is primarily the result of electrostatic forces attracting the

charged particles to the surface of the member to be coated.

Referring to FIG. 3 of the drawing, there is shown apparatus **40**, embodying the rotatable atomizing head of this invention, adapted for centrifugally atomizing liquid coating material, and adapted for applying to the centrifugally atomized particles a negative electrical charge. It is obvious from FIG. 3, that an outward direction on the atomizing head designates a direction away from the axis of rotation. The terms "forward" and "rearward" are employed herein to designate the directions such that the atomized electrostatically sprayed particles move "forward" from the spray head to the article to be coated. Accordingly, the inner surface **18**, extends rearwardly, the inner surface **22** flares outwardly and the conical surface **28** flares forwardly.

The rotatable atomizing head **10** is secured to rotatable shaft **42** by means of a cap nut **44**. The rotatable shaft **42** is formed of two sections, an electrical conducting section **46** to which the atomizing head **10** is directly secured and a section **48** formed of electrically insulating material, such, for example, as a solid shaft member prepared from convolutely wound sheets of kraft paper impregnated with and bonded together by a thermoset phenolic resin. Such electrically insulating materials are available commercially under the proprietary name Micarta.

The rotatable shaft **42** is rotated at speeds of from about 2000 to 4000 revolutions per minute, depending on the viscosity of the coating material employed, by means of air motor **50**. Higher speeds are employed for coating materials of high viscosity, and lower speeds are employed for low viscosity coating materials. Air, under pressure, is supplied to air motor **50** through orifice **52** causing the motor to rotate and to thus rotate shaft **42**.

A stationary sleeve or tube **54**, prepared from electrically insulating material, encloses a major portion of the shaft **42**. The tube **54** can be prepared from any known electrically insulating material of desired physical properties. Tubes formed by well known methods from paper sheeting and a thermoset resin, such as a phenolic resin, have proved highly satisfactory. The rotatable shaft **42** is rotatably supported from and within tube **54** by means of bearings **56** and **58**.

One side of a high voltage source **60** is electrically connected to the atomizer head, which, when employed for electrostatic spraying applications is prepared from electrically conducting material such as steel, copper, aluminum or the like, by means of a terminal post **62**, which terminal post **62** is electrically connected to bearing **58**. Bearing **58** is electrically connected to shaft section **46**, which is connected electrically to atomizing head **10**. The other side of the same high voltage source **60** is connected to ground. The high voltage source when energized serves to establish an electric field between the extended edge **30** of atomizing head **10** and the surface of an article (not shown) to be coated. Appropriate electrical controls (not shown) permit application of the high voltage from a remote position by an operator at ground potential. The articles, the surfaces of which are to be coated, are preferably maintained at ground potential, and can be passed into and through a zone where the coating material is applied thereto by well known conveyor means.

The flexible supply tube **32**, when employed in an apparatus as shown in FIG. 2, is prepared from electrically insulating material; flexible rubber hoses have proven to be highly satisfactory.

Application of liquid coating materials, paint in particular, has proven to be highly satisfactory through use of the atomizing head of this invention. The use of electrostatic methods for deposition of centrifugally atomized coating material provides for more efficient application of the liquid coating material to the surface of the article to be coated.

It is to be understood that the above description and drawing are illustrative of the invention and not in limitation thereof.

I claim as my invention:

1. A rotatable atomizing head adapted for the centrifugal atomization of liquid coating materials comprising a central hub portion adapted for attachment to a rotatable shaft, a dished portion connected to the hub portion and concentric therewith, said dished portion having an inner surface that extends rearwardly at an angle of from about 45° to 75° to the axis of rotation of the hub portion, a short circular flange disposed at the outer periphery of the dished portion, the circular flange having an inner surface that extends rearwardly and flares outwardly at an angle of from about 3° to 10° to the axis of rotation to provide for slowing the outward movement of liquid coating material, the circular flange having an external sharp edged ring portion provided with a smooth rounded lip extending from the circular flange and flaring forwardly into a short flat conical surface that terminates at a sharp edge, said flat conical surface extending at an angle of from about 120° to 150° to the axis of rotation, whereby liquid coating material will flow around the rounded lip to the flat conical surface and will be projected from the sharp edge.

2. A rotatable atomizing head adapted for the centrifugal atomization of liquid coating materials comprising a central hub portion adapted for attachment to a rotatable shaft, a dished portion connected to the hub portion and concentric therewith, said dished portion having an inner surface that extends rearwardly at an angle of about 60° to the axis of rotation of the hub portion, a short circular flange disposed at the outer periphery of the dished portion, the circular flange having an inner surface that extends rearwardly and flares outwardly at an angle of about 5° to the axis of rotation to provide for slowing the outward movement of liquid coating material, the circular flange having an external sharp edged ring portion provided with a smooth rounded lip extending from the circular flange and flaring forwardly into a short flat conical surface that terminates at a sharp edge, said flat conical surface extending at an angle of about 135° to the axis of rotation, whereby liquid coating material will flow around the rounded lip to the flat conical surface and will be projected from the sharp edge.

3. In electrostatic coating apparatus, a rotatable atomizing head adapted for the centrifugal atomization of liquid coating materials comprising a central hub portion adapted for attachment to a rotatable shaft, a dished portion connected to the hub portion and concentric therewith, said dished portion having an inner surface that extends at an angle of from about 45° to 75° to the axis of rotation of the hub portion, a short circular flange disposed at the outer periphery of the dished portion, the circular flange having an inner surface that flares outwardly at an angle of from about 3° to 10° to the axis of rotation, the circular flange having an external sharp edged ring portion provided with a smooth rounded lip extending from the circular flange and flaring into a short flat conical surface that terminates at a sharp edge, said flat conical surface extending at an angle of from about 120° to 150° to the axis of rotation, means for supplying liquid coating material to the inner surface of said dished portion, means for rotating the head to cause the liquid so supplied to be formed under the influence of centrifugal force into a film covering the inner surface of said dished portion and to flow outwardly toward the inner surface of the circular flange where the outward movement of the liquid film is slowed and thereafter to flow around the rounded lip to the flat conical surface to be projected from the said sharp edge, and means including a high-voltage source electrically connected to said film.

4. In electrostatic coating apparatus, a rotatable atomizing head adapted for the centrifugal atomization of

liquid coating materials comprising a central hub portion adapted for attachment to a rotatable shaft, a dished portion connected to the hub portion and concentric therewith, said dished portion having an inner surface that extends at an angle of about 60° to the axis of rotation of the hub portion, a short circular flange disposed at the outer periphery of the dished portion, the circular flange having an inner surface that flares outwardly at an angle of about 5° to the axis of rotation, the circular flange having an external sharp edged ring portion provided with a smooth rounded lip extending from the circular flange and flaring into a short flat conical surface that terminates at a sharp edge, said flat conical surface extending at an angle of about 135° to the axis of rotation, means for supplying liquid coating material to the inner surface of said dished portion, means for rotating the head to cause the liquid so supplied to be formed under the influence of centrifugal force into a film covering the inner surface of said dished portion and to flow outwardly toward the inner surface of the circular flange where the outward movement of the liquid film is slowed and thereafter to flow around the rounded lip to the flat conical surface to be projected from the said sharp edge, and means including a high-voltage source electrically connected to said film.

5. In electrostatic coating apparatus, a rotatable atomizing head adapted for the centrifugal atomization of liquid coating materials comprising a central hub portion adapted for attachment to a rotatable shaft, a dished portion connected to the hub portion and concentric therewith, said dished portion having an inner surface that extends rearwardly at an angle of from about 45° to 75° to the axis of rotation of the hub portion, a short circular flange disposed at the outer periphery of the dished portion, the circular flange having an inner surface that flares outwardly at an angle of from about 3° to 10° to the axis of rotation, the circular flange having an external sharp edged ring portion provided with a smooth rounded lip extending from the circular flange

and flaring forwardly into a short flat conical surface that terminates at a sharp edge, said flat conical surface extending at an angle of from about 120° to 150° to the axis of rotation, means for supplying liquid coating material to the inner surface of said dished portion, means for rotating the head to cause the liquid so supplied to form a film on said inner surface, to flow outwardly toward the inner surface of the circular flange where the outward movement of the liquid film is slowed and thereafter to flow around the rounded lip to the flat conical surface and to be discharged from the said sharp edge, said means for supplying liquid positioned to point in the direction of rotation of said head and means including a high-voltage source electrically connected to said head to electrically charge the atomized liquid.

6. An electrostatic coating apparatus having a rotatable atomizing head adapted for the atomization of liquid coating materials and nozzle means for supplying the liquid coating materials to said rotatable head, said head comprising a hub portion attached to a rotatable shaft, an imperforate dished radial portion connected to the hub portion having a surface extending radially and rearwardly from said hub portion at an angle of about 45° to 75° to the axis of rotation of said hub, said nozzle means being pointed in the direction of rotation of said head and a high voltage source electrically connected to said head to electrically charge the atomized liquid coating materials.

References Cited in the file of this patent

UNITED STATES PATENTS

442,865	Kinder	Dec. 16, 1890
2,764,712	Juvinall	Sept. 25, 1956
2,926,106	Gauthier	Feb. 23, 1960

FOREIGN PATENTS

629,135	France	July 18, 1927
1,170,337	France	Sept. 22, 1958