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LIQUID FEEDING APPARATUS

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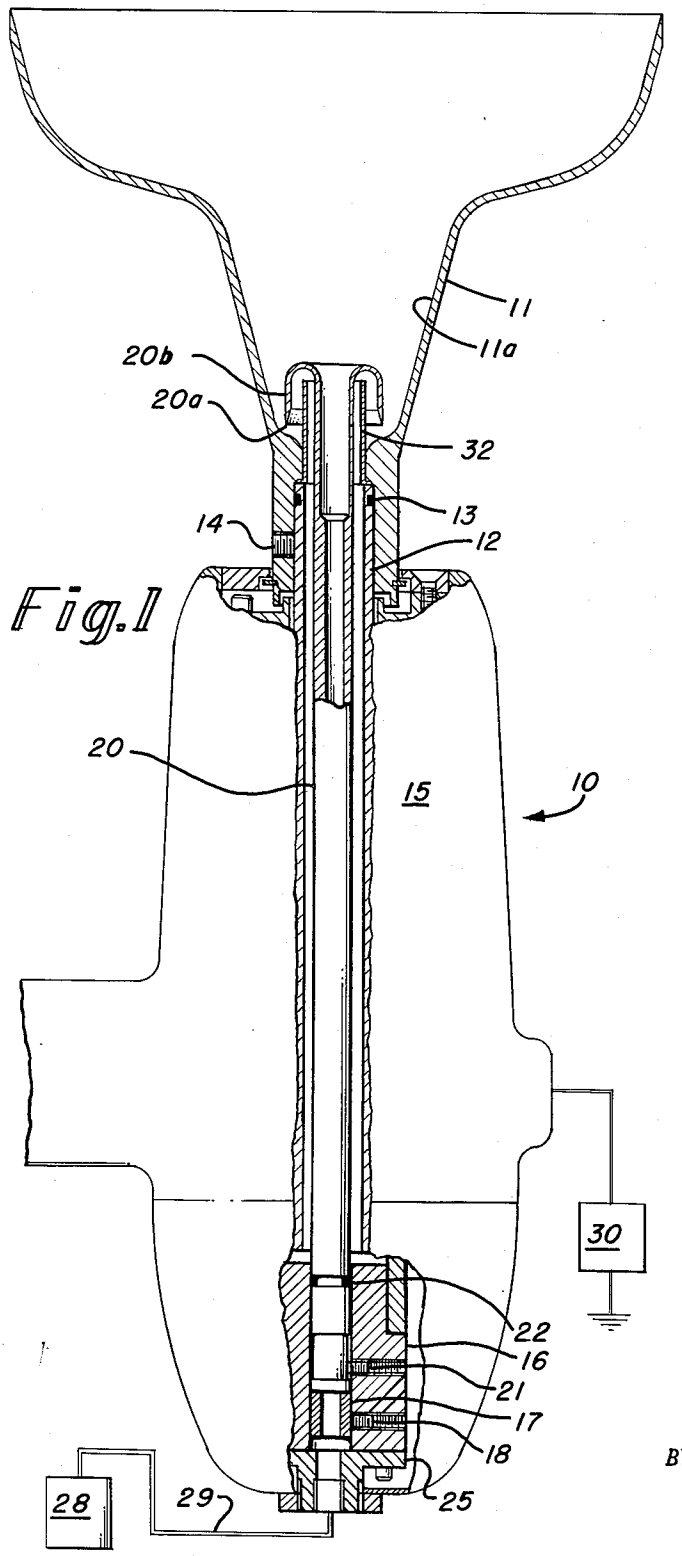


Fig. 1

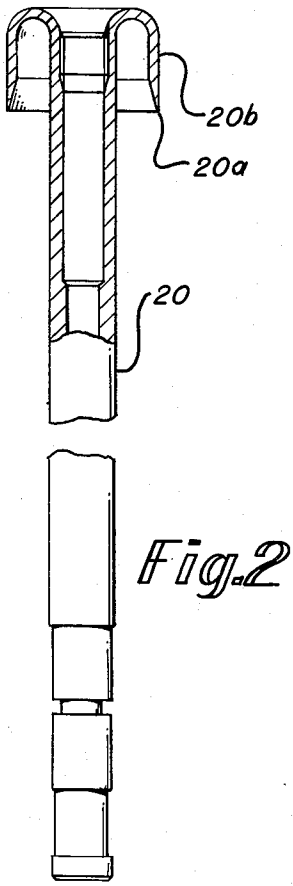


Fig. 2

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LIQUID FEEDING APPARATUS

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My invention relates to apparatus for feeding liquid from a stationary member to a rotating member, particularly for feeding liquid coating material generally upwardly from a stationary tube to the atomizing edge of a rotating bell-shaped atomizer.

Numerous industrial processes require that a liquid be fed with an upward component from one stationary member to another moving member without appreciable loss or leakage of the liquid from its desired path of flow. For example, in the electrostatic spray coating of the lower surfaces of articles of manufacture it is often desired to feed liquid coating material from a stationary reservoir to a rotating conical, i. e. bell-shaped, atomizing device located generally beneath the articles for atomization therefrom and electrostatic deposition of the coating material on the articles.

It is well known that certain liquid coating materials, particularly some pigmented paints, have extremely abrasive qualities and that on exposure to air most liquid coating materials leave a gummy residue. Moreover, liquid coating materials generally contain solvents which readily attack the materials used in conventional liquid sealing devices. These qualities make the useful life of conventional sealing devices very short. Once the liquid coating material leaks past its seal, its abrasive and gummy qualities will quickly render the bearing structure and other moving parts of the rotating atomizing device unserviceable. For this reason it is desirable in feeding liquid coating material to such an atomizing bell that conventional mechanical seals and related packings be eliminated. However, excessive turbulence in the transfer of the liquid from the stationary member to the rotating bell is to be avoided as this may adversely affect the character of the atomized particles and cause uneven and undesirable coating of the articles.

An object of my invention is to provide improvements in a rotary device for the protection of the bearing structure and other movable parts. Another object is to provide means for feeding liquid without the use of conventional packings or liquid sealing devices. A further object is to provide a more efficient means for feeding liquid coating material and the like with an upward component to the atomizing edge of a rotating bell-shaped atomizer.

I have discovered a novel liquid feeding device which comprises a rotatable hollow shaft whose axis has a vertical component and an annular-edged atomizing bell concentrically mounted for rotation on the upper end of the shaft. The atomizing bell has an inner surface which flares conically outward to an annular atomizing edge. The bell may include a generally cylindrical liquid dam mounted at its lower end concentrically within the inner surface of the bell so that the dam projects upwardly. A stationary feed tube extends concentrically through the hollow shaft and terminates at its upper end in a lipped portion whose edge surrounds and overhangs the projecting end of the liquid dam. Means are provided for rotating the hollow shaft, atomizing bell and liquid dam while liquid is fed through the stationary feed tube for flow over its lipped portion to the inner surface of the rotating atomizing bell.

Means for accomplishing the above stated and related objects of my invention will now be described in detail with reference to the accompanying drawing in which:

Fig. 1 is a partially broken away elevational view of an atomizing device embodying my invention for use in an electrostatic coating system; and

Fig. 2 is a detailed view of the stationary feed tube shown in Fig. 1.

My invention is particularly adapted for use with a bell-shaped atomizer (herein called a bell) for spray coating but the invention may assume many different forms and the above mentioned drawings and the following description should be understood as merely illustrative of the principles of the invention. The scope of the invention is not limited to the following description.

Referring to the drawing, there is shown an atomizing device **10** which includes a flaring, somewhat conically shaped atomizing bell **11** mounted on one end of a generally vertical rotatable hollow shaft **12**. The adjoining surfaces of bell **11** and shaft **12** are sealed by an O-ring **13** and the two are held together by a set screw **14**. Bell **11** has an inner liquid-guiding surface with an innermost conical throat portion **11***a* extending outwardly from the juncture of bell **11** and shaft **12** generally toward the bell's annular edge at an angle of approximately 15° to the axis of the bell and shaft. The bell and shaft may be rotated by an integral motor assembly lying within atomizer housing **15** whose details are not shown as my invention is independent of the motor or other driving means for bell **11**.

Shaft **12** extends axially through housing **15**. At its lower end there is affixed to housing **15** a stationary tube support **16** having an axial passageway concentric with the shaft. A hollow cylindrical tube stop **17** is positioned within the passageway in tube support **16** by a set screw **18**. A stationary feed tube **20** is securely mounted concentrically within the passageway in tube support **16** with its lower end positioned against the upper annular face of tube stop **17** by means of a set screw **21**. The adjoining surfaces of support **16** and tube **20** are sealed by an O-ring **22** of flexible material. A back plate **25** having an axial passageway communicating with the passageway in tube support **16** is securely mounted on the lower face of the stationary tube support. Liquid coating material to be atomized is fed from a reservoir **28** at a controlled rate by a supply tube **29** through the pasageway in back plate **25** and through tube stop **17** to the lower end of feed tube **20**. Atomizing device **10** may be maintained at high electrical potential by connection to a high voltage source **30** as shown or other means known to the art employed to effect a particle-depositing potential difference between the atomized coating material and the articles. This is generally accomplished by maintaining the articles and their supports at a difference of potential from the atomizer, preferably by grounding the articles and maintaining the atomizer at high voltage as shown.

The details of stationary feed tube **20** are shown in Fig. 2 with the upper liquid discharging portion of the tube shown in cross section. In order to properly feed liquid coating material to the inner surface **11***a* of the bell the upper end of stationary feed tube **20** is lip-like. This upper lipped portion of the tube terminates in a preferably sharp knife-like annular edge **20***a* generally concentric with the axis of the tube. The outer liquid guiding surface **20***b* of the feed tube over which liquid flows to be discharged onto inner surface **11***a* of the bell is generally cylindrical and parallel with the axis of the tube. Edge

20*a* should be sufficiently spaced from surface **11***a* to permit the formation of discrete liquid droplets which will not bridge the gap between tube edge **20***a* and surface **11***a*; and with most commercial coating materials the edge should be spaced not less than 0.125 inch from the inner surface of the bell.

To prevent liquid coating material from reaching the bearing structure of atomizer **10** a generally cylindrical sleeve or liquid dam **32** may be pressed or otherwise mounted in the throat of bell **11**. It is to be understood that dam **32** may be an integral part of the bell but for ease of construction a separate cylindrical member securely fitted into the bell has been found more convenient. Liquid dam **32** is preferably concentric with the bell and extends upwardly into the central passageway formed by bell surface **11***a* so that the uppermost end of the dam is surrounded by surface **20***b* of the feed tube. Thus edge **20***a* should lie in a plane lower than the uppermost end of dam **32**.

Liquid discharged from feed tube **20** onto the inner surface of rotating bell **11** will spread into a thin film which will move upwardly to the annular atomizing edge of the bell under the influence of centrifugal force. Any liquid which might tend to flow downwardly toward shaft **12** will be stopped by liquid dam **32**. The dam serves the further function of preventing liquid on the inner surface of the bell from running downwardly toward the bearing structure when the bell is not rotating or when the centrifugal force is not sufficient to move the liquid coating material in an upwardly direction.

One commonly used atomizing device which embodies my invention includes a rotating hollow shaft having an inner diameter of approximately 0.75 inch and a bell in which surface **11***a* makes an angle of approximately 15° with the axis of the bell and shaft. Various coating operations employing this device require liquid to be fed to surface **11***a* of the bell at rates of from 15 to 900 cubic centimeters per minute. The bell may be rotated at speeds of from several hundred to several thousand revolutions per minute.

The inner diameter of feed tube **20** is approximately 0.25 inch. Liquid discharge edge **20***a* is of knife-like sharpness and has a diameter of approximately 1.125 inches. Edge **20***a* lies approximately 0.75 inch below the uppermost portion of the feed tube and is spaced 0.15 inch from surface **11***a*. Cylindrical surface **20***b* is substantially parallel to the axis of the feed tube. Liquid dam **32** is approximately 1.25 inches in length and extends within the space bounded by tube surface **20***b* a distance of approximately 0.5 inch.

Although atomizer **10** is shown in Fig. 1 in a vertical position, it may be operated with its axis substantially inclined. Liquid can be properly fed to the bell so long as the axis of the atomizer has a vertical component.

I claim:

1. A device for feeding liquid comprising a rotatable hollow shaft whose axis has a vertical component; a bell-shaped atomizer mounted for rotation on the upper end of said shaft, said atomizer having an interior surface portion flaring conically at a substantial angle to the axis of said shaft and atomizer; a cylindrical liquid dam mounted at its lower end concentrically within the interior surface portion of said atomizer with the upper end of said cylindrical dam projecting upwardly from said interior surface portion; a stationary feed tube extending concentrically through said shaft and terminating in an upper lip-like portion having an annular liquid discharge edge or knife-like sharpness concentric with said interior surface portion of the atomizer and encircling the upper end of said cylindrical dam, said edge being spaced from said interior surface portion a distance greater than a drop of the liquid can bridge; means for rotating said shaft and atomizer; and means for feeding liquid upwardly through said feed tube and over its upper lip-like portion to the inner surface of said rotating atomizer.

2. Apparatus as set forth in claim 1 wherein the interior surface portion of the atomizer lying adjacent the upper portion of the feed tube is conical and forms an angle of 15° to the axis of the shaft and atomizer.

3. A device for feeding liquid comprising a generally vertical rotatable hollow shaft; an atomizing bell concentrically mounted for rotation on the upper end of said shaft, said bell having an inner surface portion flaring conically at an angle to the axis of said shaft of approximately 15°; a cylindrical liquid dam mounted at one of its ends within the inner surface portion of said bell concentrically with the axis of said bell with the other end of said cylindrical dam projecting upwardly from said inner surface portion; a stationary feed tube extending concentrically through said hollow shaft and terminating in an upper lipped portion having a knife-like liquid discharge edge overhanging the projecting edge of said liquid dam; said edge being spaced more than .125 inch from the inner surface portion of the bell; means for rotating said shaft, bell and dam; and means for feeding liquid to said feed tube for flow therethrough and over said liquid discharge edge to the inner surface of the rotating bell.

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