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3,368,894 2/1968 Matkan et al. 118/637 LX
3,384,051 5/1968 Hunstiger 118/637 LX
3,424,126 1/1969 Mahoney 118/637 LX
3,485,738 12/1969 Carreira 355/17

FOREIGN PATENTS

1,301,044 7/1961 France 204/18 PC

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[54] **MATERIALS APPLICATION APPARATUS**
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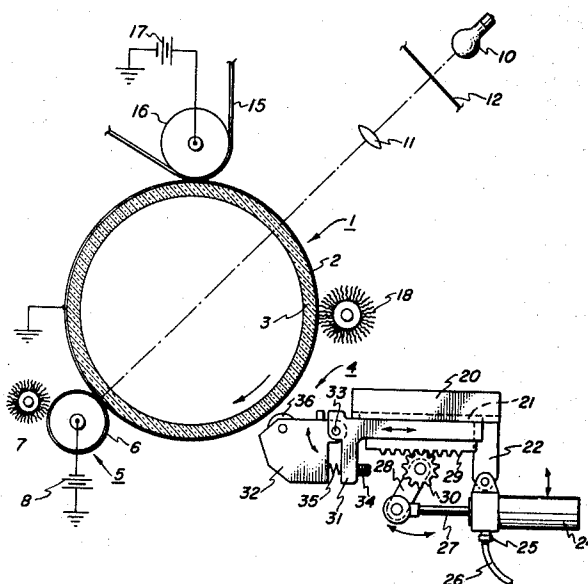
[50] Field of Search 118/637
LX; 355/3, 17; 204/18 PC, 181

[56] **References Cited**

UNITED STATES PATENTS

3,227,076 1/1966 Castle 204/18 PC

ABSTRACT: Apparatus for supplying a fluid coating to a surface. The apparatus has an extruder extending across the length of a movable surface with a manifold fluid supply system to force the fluid through the extruder. One embodiment includes a roller applicator as part of the extruder and a vacuum pickup to remove excess fluid from the surface.



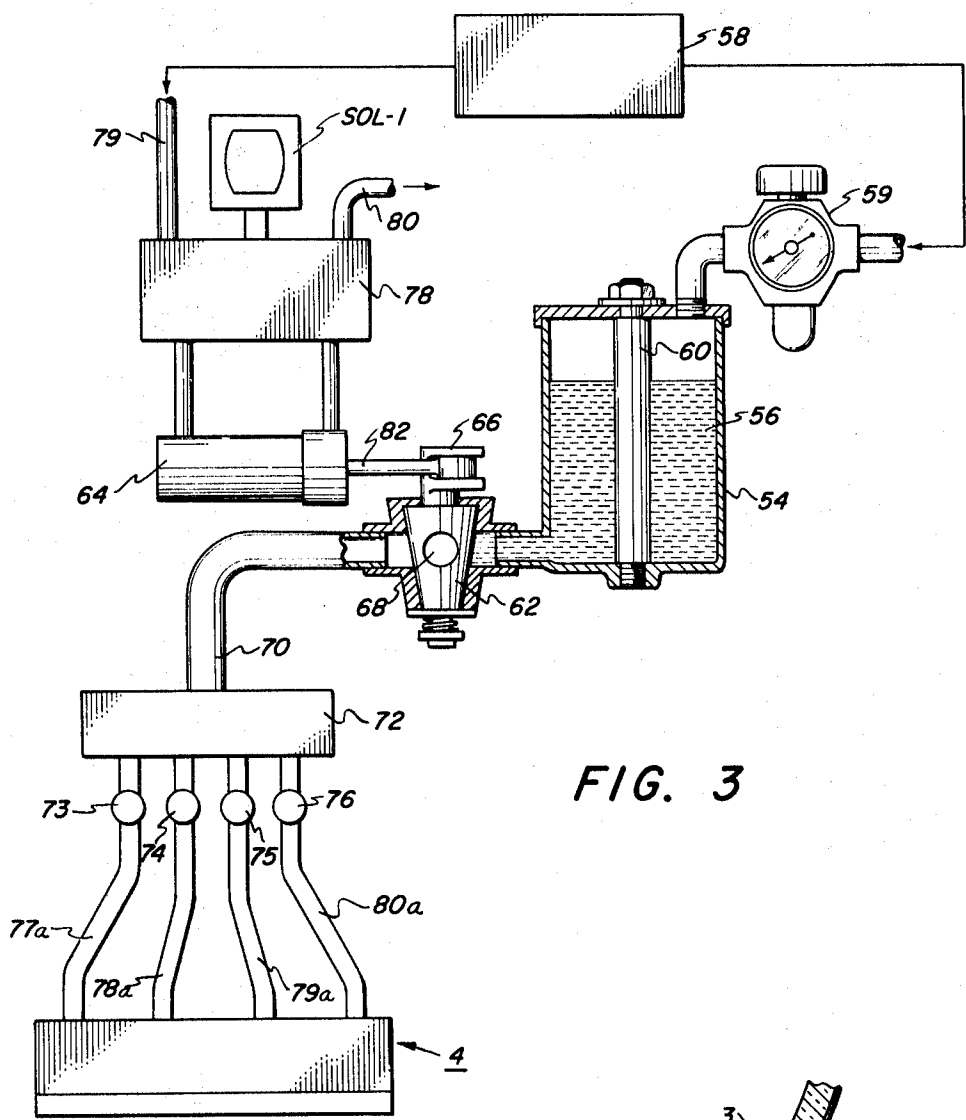
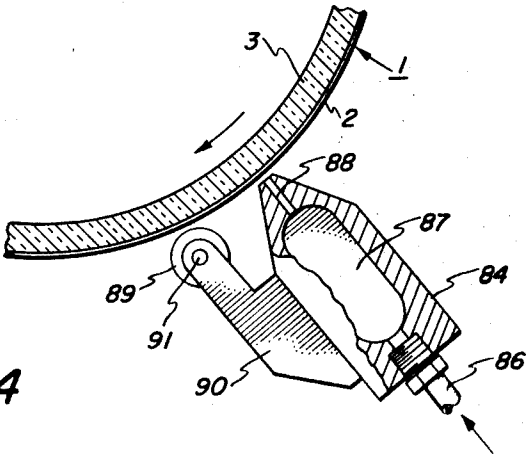


FIG. 4



MATERIALS APPLICATION APPARATUS

This invention relates to coating systems and in particular to a fluid extruder system.

Systems exist that require working with layers of fluids, especially viscous liquids, that must be uniformly applied to a surface for working on the surface. One such system improved by a uniform coating technique and by the invention herein is the photoelectrophoretic imaging process.

A detailed description of this process is given in U.S. Pat. Nos. 3,384,565, 3,384,566 and 3,383,993. These patents disclose how to produce a visual image at one or both of two electrodes between which a photoelectrophoretic particle suspension is placed. The particle suspension is comprised of photosensitive particles suspended within an insulating liquid carrier. The particles appear to undergo a net change in charge polarity or a polarity alteration by interaction with one of the electrodes upon exposure to activating electromagnetic radiation. The theory of operation is that the particles have a net charge when suspended in the liquid carrier and are attracted to the electrodes under the influence of an electrical field placed between them. Mixtures of two or more differently colored particles can secure various colors of images. The particles will migrate from one of the electrodes under the influence of an electric field when struck with energy of a wavelength within the spectral response of the colored particles.

Since the disclosure of the basic processes, continuous imaging machines have been disclosed, for example, in U.S. Pat. No. 3,427,272. It becomes important to be able to supply uniformly thin layers of the imaging suspension to one of the electrodes in such automated devices in order to form the best possible images from the machine.

It is also helpful in many instances to stress the suspension with a shear stress. This apparently improves the imaging qualities of the suspension.

Therefore, it is an object of this invention to improve fluid-coating means. Another object of this invention is to improve means for uniformly coating liquids on a surface. Still another object of this invention is to extrude fluids onto a surface. Yet another object of this invention is to prestress fluids for application to a surface.

The invention herein is described and illustrated in a specific embodiment having specific components listed for carrying out the functions of the apparatus. Nevertheless, the invention need not be thought of as being confined to such a specific showing and should be construed broadly within the scope of the claims. Any and all equivalent structures known to those skilled in the art can be substituted for specific apparatus disclosed as long as the substituted apparatus achieves a similar function. It may be that other processes or apparatus will be invented having similar needs to those fulfilled by the apparatus described and claimed herein and it is the intention herein to describe an invention for use in apparatus other than the embodiment shown.

These and other objects of this invention are accomplished by employing a system for forcing fluids to a moving surface through an extruder mechanism adapted to supply a uniformly thin coating of the fluid on the surface moving thereby. A smoothing means and a pulsed fluid manifold ensure the uniformity of the thin layer of fluid on the coated surface.

These and other objects and advantages of this invention will become apparent to those skilled in the art after reading the description in conjunction with the accompanying drawings wherein:

FIG. 1 schematically represents an embodiment of this invention in conjunction with a photoelectrophoretic imaging system;

FIG. 2 is a closeup of the application member with portions broken away to show internal structure;

FIG. 3 is a fluid supply system shown, for example, for use in conjunction with the apparatus of FIG. 4; and

FIG. 4 shows an alternative embodiment of apparatus according to this invention.

There are certain terms of art used in conjunction with the photoelectrophoretic imaging process that should be defined. The "injecting electrode" is so named because it is thought to inject electrical charges into activated photosensitive particles during imaging. The term "photosensitive" for the purpose of this disclosure refers to the property of a particle which, once attracted to the injecting electrode, will alter its polarity and migrate away from the electrode under the influence of an applied electric fluid when exposed to activating electromagnetic radiation.

The term "suspension" may be defined as a system having solid particles dispersed in a solid, liquid or gas. Nevertheless, the suspension used in the disclosure herein is of the general type having a solid suspended in a liquid carrier. The term "imaging electrode" is used to describe that electrode which interacts with the injecting electrode through the suspension and which once contacted by activated photosensitive particles will not inject sufficient charge into them to cause them to migrate from the imaging electrode surface. The imaging electrode is covered with a dielectric surface composed of a material having a volume resistivity preferably in the order of 10^9 or greater ohm-cm and a conductive member which is preferably a resilient material such as a conductive rubber used to give flexibility to the imaging electrode.

For photoelectrophoretic imaging to occur it is that these steps, (not necessarily listed in the sequence that they occur) take place: (1) migration of the particles toward the injecting electrode due to the influence of an electric field, (2) the generation of charge carriers within the particles when struck by activating radiation within their spectral response curve, (3) particle deposition on or near the injecting electrode surface, (4) phenomena associated with the forming of an electrical junction between the particles and the injecting electrode, (5) herein imaging charge exchange with the injecting electrode, (6) electrophoretic migration toward the imaging electrode, (7) particle deposition on the imaging electrode. This leaves an optically positive image on the injecting electrode.

The schematic representation of FIG. 1 shows a photoelectrophoretic imaging apparatus having an injecting electrode 1 with a coating of a transparent conductive material 2 such as tin oxide over a transparent glass member 3. Such a combination is commercially available under the name NESA glass from Pittsburgh Plate Glass Company of Pittsburgh, Pa. However, other electrically conductive transparent coatings over transparent substrates are suitable for use herein. Imaging suspension is applied to the surfaces of the injecting electrode by the extruder mechanism 4 where it is carried because of the motion of the injecting electrode to the imaging area between the injecting electrode 5.

The imaging electrode 5 has a surface 6 composed of a dielectric material sleeve and a conductive substrate 7 which is preferably a resilient material such as electrically conductive rubber. The imaging electrode prevents sufficient charge injection into the particles to cause them to migrate from its surface. The imaging electrode is connected to a potential source 8 while the injecting electrode is shown as electrically grounded to give the necessary field effect of the imaging area between the two electrodes. An exposure mechanism including an illumination means 10 and a lens 11 presents a flowing image of the object 12 at the image area which coincides with the optical image plane. The image is moving at the imaging area at the same rate as are the moving surfaces of the injecting and imaging electrodes. The image thus formed at the imaging area is carried by the injecting electrode to the transfer station where it is transferred to a support sheet 15. The transfer roller 16 is coupled to an electrical source 17 providing a field with the injecting electrode opposite in sign from that at the imaging area. A cleaning brush 18 removes residual particles from the surface of the injecting electrode that the imaging cycle may be completed with other images being formed.

The extruder mechanism 4 is mounted on a brace 20 which has rails 21 therein. A stationary bracket 22 mounts an air cylinder 24 having an air inlet 25 and an air intake hose 26. The piston 27 of the cylinder, through the crank arm 28, moves a rack 29 and pinion 30 to engage and disengage the extruder in suspension application interface with the injecting electrode surface 2. The rack moves the extruder mounting 31 in the rails 21 of the brace 20.

The interfacing portion 32 of the extruder is pivoted about a pin 33 and is preset with an interface pressure-adjusting screw 34 and an adjusting spring 35. The interfacing member shown in FIG. 1 is a smoothing rod 36 which can be grooved, wound wire, knurled, or smooth surfaced to present a uniformly thin layer of suspension on the injecting electrode surface.

FIG. 2 is a closeup of the interfacing portion 32 of the extruder with the sidewall removed so that internal parts are seen. The suspension is pulsed in through the inlet tube 40 into a chamber 42 enclosed by the smoothing rod 36, a frame member 43, a coater blade 44 and a scraper blade 46. The smoothing rod 36 is driven with outboard oversize drive wheels pressed against the ends of the injecting electrode cylinder so that it moves when the wheels are in contact with the cylinder. A coater blade 44 limits the amount of suspension traveling around the periphery of the smoothing rod 36 for contact with the injecting electrode surface 2. The scraper blade 46 prevents used imaging suspension from contaminating the suspension held in the chamber 42 while preventing the suspension within the chamber 42 from leaking out of the chamber. The chamber 48 of the interfacing portion 32 of the extruder is a vacuum chamber for removing suspension materials within its housing walls 50. The materials are carried through the outlet 52 for removal from the vicinity of the injecting electrode and the imaging system. The drive wheels are larger in diameter than is the smoothing rod 36. The difference in diameter determines the clearance between the smoothing rod 36 and the surface 2. The thickness of the coated fluid on the surface is more or less equal to the clearance.

FIG. 3 demonstrates the gas and suspension supply system for the extruder. A few definitions of terms will be helpful at this point to more fully understand the use intended herein. A "negative pressure source" refers to a cylinder or other means which is partially evacuated of gases to lower its internal pressure below atmospheric pressure. Similarly a "positive pressure source" refers to a cylinder or other means containing a compressed gas to create an internal pressure greater than atmospheric pressure.

The term "vacuum" refers to a negative pressure but not necessarily to an absolute void. The term "fluid" encompasses both gases and liquids. The gases referred to are those commonly found in the atmosphere and identified generally as air.

The imaging suspension holding tank 54 maintains a quantity of imaging suspension 56 in its hermetically sealed chamber. Gases from the positive pressure gas source 58 enter the tank 54 through a gas regulator 59 which sets the positive pressure in the suspension-holding tank 54. The mechanism 60 maintains the seals in the closure of the tank to prevent fluids escaping therefrom.

To reach the extruder 4, the suspension must pass through a valve 62 operated by a cylinder 64 and crank arm linkage combination 66. The valve has a passageway 68 therein

which, when turned in the proper direction, permits a pulsed shot of suspension to pass through the conduit 70 to the distribution manifold 72 for passage through the individual ink flow metering valves 73-76. The valve 62 is opened and closed by the action of the solenoid SOL-1 and the four-way valve 78 having a gas intake conduit 79 and an exhaust conduit 80. The solenoid and four-way valve operate to move the piston 82 of the cylinder 64 to rotate the valve 62 thus opening and closing the passageway. This connects the suspension 56 from the tank 54 to the conduit 70 allowing for pulsed shots of suspension through the distribution manifold 72 and conduits 77a-80 to the extruder 4.

An alternative embodiment for an extruder mechanism is shown in FIG. 4. An extruder housing 84 with a suspension intake connection 86 has an internal chamber 87 for accumulating suspension.

The suspension is forced through the extruder at the exit aperture 88 for application to the surface 2 of the injecting electrode 1. To ensure that a smooth uniform layer of suspension moves to the imaging area, a smoothing rod 89 is placed downstream from the extruder along the path of movement of the surface. The smoothing rod is journaled through the support bracket 90 on a shaft 91 to freely rotate while being driven by the injecting electrode 1.

While this invention has been described with reference to the structures disclosed herein and while certain theories have been expressed, it is not confined to the details set forth; and this application is intended to cover such modifications or changes as may come within the purposes of the improvements and scope of the following claims.

What is claimed is:

1. Apparatus for forming images from particle suspensions including:

- first electrode means capable of maintaining an image;
- second electrode means for interfacing with said first electrode at an imaging area;
- means to present activating electromagnetic radiation at the image area;
- means to couple an electrical source to said electrode means for producing a field therebetween at the image area;
- means adjacent one of said electrode means for supplying the particle suspension to the surface thereof including chamber means for maintaining a reservoir of the suspension;
- a narrow egress port in said chamber means juxtaposed to the adjacent electrode means, and
- smoothing means to form a uniform layer of suspension on the surface of the adjacent electrode.

2. The apparatus of claim 1 wherein said means adjacent the surface includes pressure-adjusting means.

3. The apparatus of claim 1 wherein said means for supplying a liquid includes pulsing valve means.

4. The apparatus of claim 1 including means for moving said means adjacent the surface toward and away from the surface.

5. The apparatus of claim 4 wherein said means for moving includes a rack and pinion means.

6. The apparatus of claim 1 further including a vacuum chamber adjacent the chamber means.

7. The apparatus of claim 6 including a scraper blade separating said chamber means and said vacuum chamber.