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[54] CLEANING APPARATUS

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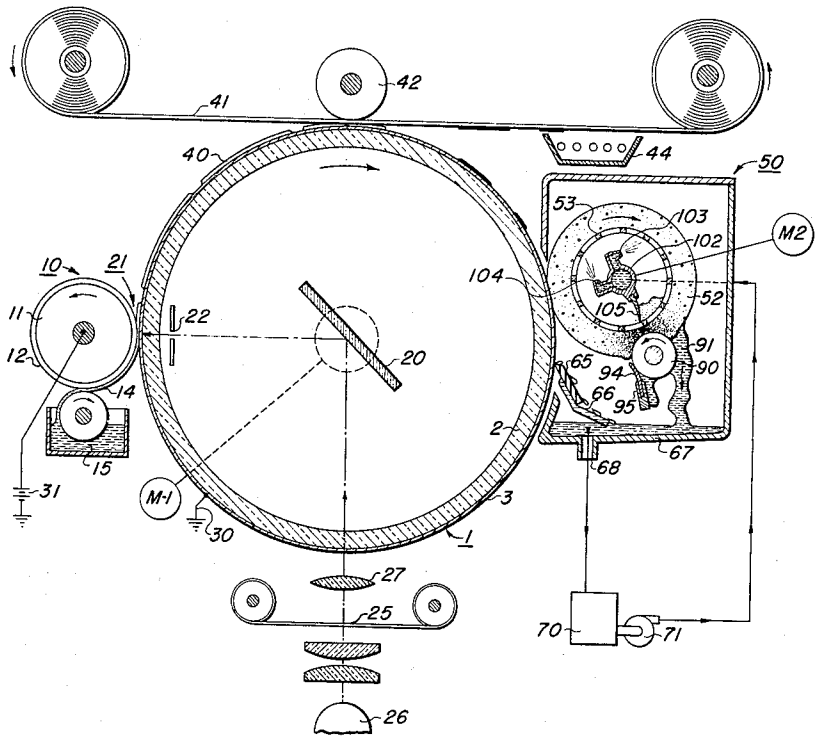
[57] **ABSTRACT**

An improved cleaning mechanism for removing contaminants from generally non-porous surfaces. A sponge-like member surrounds a hollow perforated core. Sprayers, internal to the core, spray liquids under pressure to aid in removing contaminants from the sponge-like member. A pinch roll squeezes the sponge-like member against the core at a position where an internal baffle strip contacts the core. This seals the squeezed sponge-like member at the core preventing liquids and contaminants from passing the seal barrier formed.

9 Claims, 1 Drawing Figure



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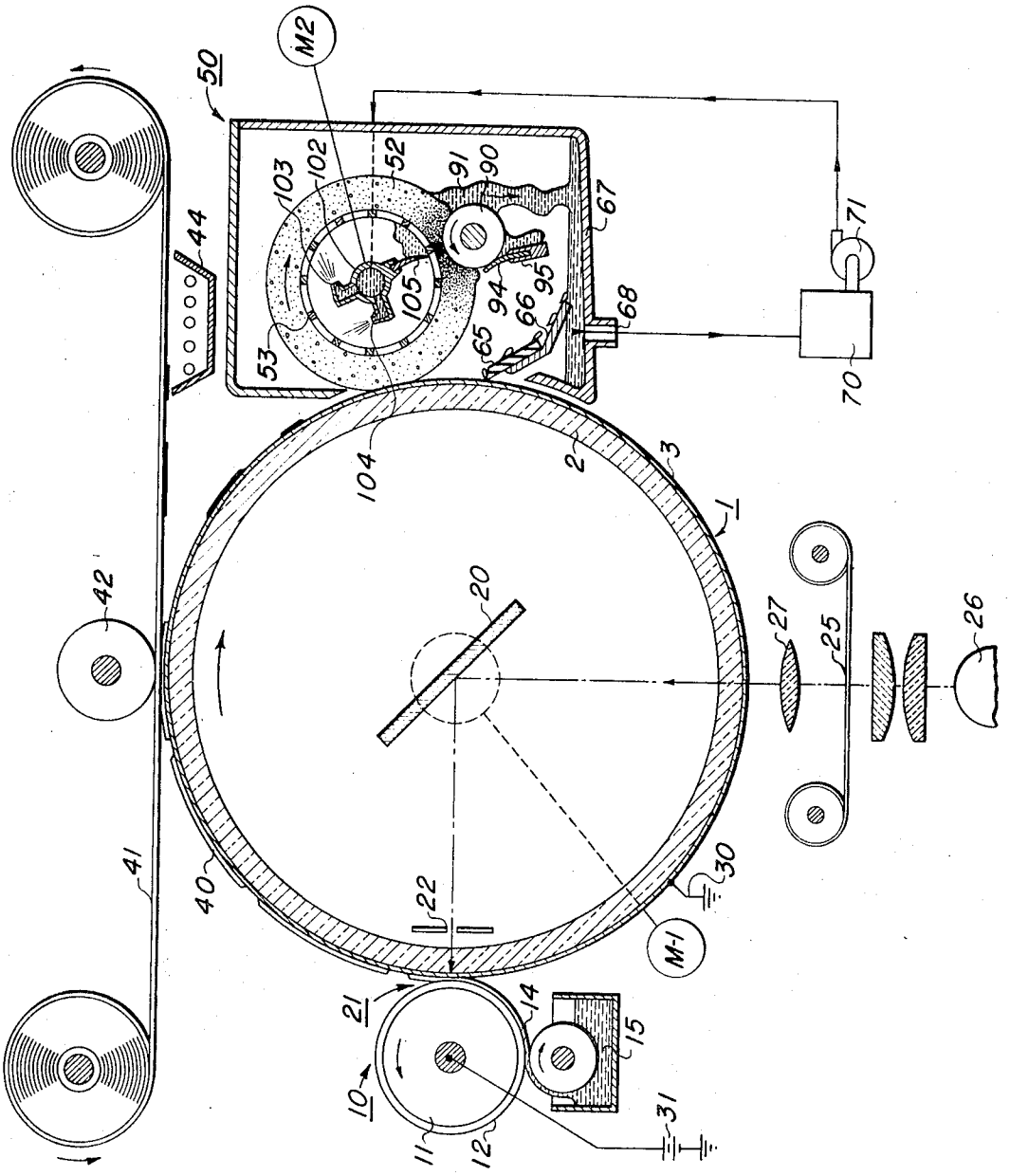

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CLEANING APPARATUS

This invention relates to cleaning systems and more particularly to apparatus for removing contaminants from a surface.

Recently, new systems were disclosed for forming black and white or full color images through the use of photoelectrophoresis. The inventions are described in U.S. Pat. Nos. 3,384,565; 3,384,566 and 3,383,993 which show systems where photoelectrophoretic particles migrate in image configuration providing a visual image at one or both of two electrodes between which the particles are placed in suspension. The particles are photosensitive and apparently 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 particles, under the influence of an electric field and when struck with energy of a wavelength within the spectral response of the colored particles will migrate from one of the electrodes toward the other.

Apparatus has been invented to better utilize the above process. U.S. Pat. No. 3,427,242 describes a continuous apparatus embodiment of the above process. The apparatus there shown as well as other apparatus operates more effectively if the electrode surfaces used for supporting suspension and transferable images are cleaned of residual pigment material after the imaging or transfer to a suitable support sheet. However, it has been found to be difficult to clean the electrode surfaces used in the above described apparatus. Sufficient quantities of pigment particles and all contaminants must be removed to prevent interference with later images being formed by the same electrodes.

Therefore, it is an object of this invention to improve apparatus for the cleaning surfaces. Another object of this invention is to improve the removal of electrophoretic particles from surfaces.

A further object of this invention is to improve cleaning of members of automated imaging machines. Still another object of this invention is to improve removal of contaminants automatically and continuously without the need for manual interaction.

Another object is to prevent misting of cleaning fluids into the environment. Still another object is to reduce the size of cleaning units. A further object is to improve the flow of cleaning fluids without increasing space requirements.

These and other objects are accomplished by providing a sponge-like contacting member in moving contact with surface to be cleaned. Fluids are added continuously internally through a perforated core to the moving sponge-like member for loosening the contaminants on the surface to be cleaned. The contaminated fluid packed member moves past and is squeezed by a hard roller at a position where fluids are trapped from moving around the perforated core to remove the fluids and contaminants from the sponge-like material. The surface cleaned is contacted by a wiper blade to dry and further clean it.

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 invention described and claimed herein and it is the intention herein to describe an invention for use in apparatus other than the embodiment shown.

The above objects and advantages will become apparent to those skilled in the art after reading the following description taken in conjunction with the accompanying drawing of a schematic side section illustration of an embodiment of the invention in a continuous processing apparatus environment for forming photoelectrophoretic images.

The FIGURE shows a rotary transparent electrode **1** in the form of a cylinder which is made up of a layer of optically transparent glass **2** carrying on its outer surface an optically transparent, electrically conductive layer **3**. The electrode can be formed of any electrically conductive, transparent material such as NESA glass which is the trade name of a commercially available tin oxide coated glass. The rotary electrode is referred to as the injecting electrode.

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 purposes of this description 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 field when epxosed 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 embodiment of this invention described herein is of the general type having a solid suspended in a liquid carrier. The term "imaging electrode" used hereinafter describes that electrode which contacts the injecting electrode through the imaging suspension and which when contacted by activated photosensitive particles will not inject sufficient charge into them to cause them to migrate from the imaging electrode.

In close proximity to the injecting electrode **1** and mounted on an axis parallel to the axis of that electrode is a rotary imaging electrode roller **10**. It has a central core **11** which is preferably of fairly high electrical conductivity and a layer of blocking electrode material **12** which may be, for example, Tedlar or baryta paper, covering the core to prevent electrical charge injection from the imaging electrode to the particles contacting it.

During the imaging process, a thin suspension layer **14** of finely divided photosensitive particles dispersed in an insulating liquid carrier is supplied from a reservoir **15** to the surface of the imaging electrode **10**. Within the rotary injecting electrode **1** is a stationary mirror **20** which receives light rays projected from a transparent object **25** to be copied. It reflects image rays through an exposure slit **22** and onto the surface of the suspension at the imaging zone **21** where the injecting electrode **1** interfaces with the imaging electrode **10**. The transparency **25** that is to be imaged passes under a light source **26**. The image is projected in sychronized flowing movement by a lens **27** onto the surface of the suspension at the imaging zone **21**.

The injecting electrode **1** is grounded by a connection **30** and the imaging electrode is connected with a potential source **31** which is in turn connected to ground. The polarity of the charge on the imaging electrode **10** is opposite to that of the polarity that is carried on the surface of the injecting electrode **1**. During imaging, drive means M–1 rotate the injecting electrode **1** in rolling interface with the imaging electrode **10** thereby carrying the imaging suspension containing the photosensitive particles into contact with the surface of the injecting electrode **1** at the site of projection of the image from the transparency **25**. The exposure under the electrical field conditions causes selective particles to migrate through the liquid carrier and adhere to the surface of the rotating imaging electrode **10** leaving a positive particle image on the surface of the injecting electrode **1**.

The image **40** on the surface of the injecting electrode **1** downstream from the imaging zone **21** is carried to contact an adhesive copy web **41** which is pressed up against the drum surface by transfer roller **42**. The web **41** moves at the same velocity as the periphery of the injecting electrode **1**. The transfer roller **42** is positioned behind the web **41** and aids in the transfer of the image from the electrode **1**. Thus, the image is adhesively transferred from the surface of the injecting electrode onto the surface of the copy web. The image on the copy web may be permanently affixed thereto in a fixing unit **44**. Transfer may also occur through other known techniques without departing from the scope of the invention.

Since the transfer does not remove all of the particles from the injecting electrode **1** and since it is necessary in this process to maintain particles on the imaging electrode **10**, it is also necessary to clean the surfaces of the electrodes. For this purpose a cleaning mechanism **50** is shown embodying this invention to clean the surfaces of the imaging and injecting electrodes respectively.

The cleaning mechanism **50** is used to remove residual materials (generally pigment particles in the illustrative environment) from the injecting electrode surface. The cleaning roll **52** is a sponge-like member, made, for example, of polyurethane foam or any other suitable sponge-like materials that are unaffected by the cleaning fluids. It is mounted on a tubular perforated inner core **53** which is rotated by a motor M–2 to move in the opposite direction from the surface of the injecting electrode. A wiper blade **65** of rubber, polyurethane or any other suitable resilient material which is resistant to the fluids and chemicals used contacts the surface of the injecting electrode along its path downstream from the contact position with the cleaning roll **52**. This wiper blade **65** dries the surface of the injecting electrode by removing the liquids remaining thereon after contact by the cleaning member **52**. The wiper blade **65** is mounted in a bracket **66** held within the housing **67** containing the cleaning unit **50**.

A drain **68** in the housing **67** provides a run-off for the contaminated liquid pinched out of the cleaning roll **52**. This liquid is pumped to a filter **70** by a pump **71** where the particles are removed and the liquid is returned to the sprayer **102** for reuse within the system.

A pinch roll **90** is a small diameter solid rod journaled for rotation within the housing **67**. The small rod **90** is driven because of its interference contact with the cleaning roller **52**. All or most of the liquid and particles within the sponge-like roller are removed when the pinch roll **90** compresses the material virtually squeezing the pores down to a solid, non-porous condition.

The roll **90** is formed of a hard material such as steel or aluminum and is generally only one-half inch in diameter or thereabouts. For best results the roller should be contacting the sponge-like cleaning roller **52** below the horizontal center line of the roller so that liquids forced out of the sponge-like material are not likely to fall back onto the cleaning roller **52** because of gravity. To aid in removing the liquid **91** from the pinch roll **90** before it travels around the periphery thereof, a wiper blade **94** housed in a bracket **95** contacts the surface of the pinch roll **90** in order to prevent liquids from traveling 360° around the pinch roll **90**. The blade can be rubber, polyurethane or any other suitable resilient material which is resistant to the fluids and chemicals used in the process or the cleaning. Any other squeezing mechanism that is appropriate to function in the place of the rod **90** may be substituted therefore.

The sponge-like roll **52** is mounted in an interference fit on perforated core **53** which is fastened by end caps (not shown) to a drive motor M–2 operating through the end cap or via a torque tube to give more even driving capabilities. The core **53** should be substantially perforated having as much as 50 percent or more of its area open.

Internal to the perforated core and sponge-like member is a header **102** with one or more nozzles **103** and **104** thereon. Each of the nozzles produce a uniform spray across the usable length of the sponge-like cleaning roller **52**. The spray penetrates through the perforations of the core **53** and forces whatever particles are picked up from the work station (in this case, the surface **3**) toward the outer surface of the sponge-like cleaning member **52** where they are squeezed by the solid pinch roller **90**. Directly opposite the pinch roller but on the inside of the cleaning member is a seal baffle **105** which prevents materials squeezed to the inner surface of the cleaning roller by the pinch roll from traveling around the inner surface toward the work station. Since the pinch roll squeezes the foam material of the roller to a nearly solid, non-porous mass, there is a seal between the baffle blade and the pinch roll. Therefore, the liquids squeezed out of the sponge-like material cannot pass the imaginary line formed through the pinch roll, the squeezed sponge-like material and the baffle blade. The materials are trapped unless they accumulate enough to pass through the sponge-like member upstream from the pinch roll to fall harmlessly to the bottom of the housing. The header **102** remains fixed while the sponge-like roller **52** and core **53** rotate around it. Suitable bearings between the header shaft and end caps enable this desirable movement.

This embodiment has several advantages over the external spray systems. Some of the more important benefits include the elimination of misting of the liquids sprayed to and struck against the sponge-like roller. There is less splattering and fine mist developed within the environment from the internal sprayer system. The flow direction of cleaning liquids is from the inside outward tending to prevent deep impregnation of contaminants in the sponge-like material. In fact, this direction of spraying tends to push contaminants out of the sponge-like roller for more easy removal by the pinch roller.

The entire system benefits from the more compact design possible by the internal sprayer system. Further, several sprays can be developed from a single header saving both cost and space.

An example of a mechanism that works well to achieve the desired cleaning results at the work station is one in which a polyurethane foam having 80 to 100 open ppi and being approximately three-eighths of an inch thick passes the work station with a ¼ inch interference. The inside diameter of the foam roller or the outside diameter of the sleeve on which the polyurethane foam is wrapped is 2½ inches. The solid pinch roll is a one-half or ⅜ inch diameter rod having an interference with the polyurethane foam of between five-sixteenths and eleven thirty-seconds of an inch. The wiper blades are solid polyurethane material one-sixteenth inch thick and approximately 80 durometers. The rotation of the sponge-like roller is in a direction opposite to the moving surface at the work station but at the same speed. The pinch roll is driven by the cleaning roller thus preventing undue wear and friction against the polyurethane foam. The material sprayed against the cleaning roller can be any solvent or suitable carrier for the contaminating materials to be removed from the work station. In this example mineral oil is used to clean an injecting electrode at the work station and it is forced through the system by a pressure of 20 psi. The sprayers are an internal spray system and present a more or less uniform, continuous, spray on to the polyurethane foam. This gives even saturation to the foam and prevents buildup of particles in any particular areas.

The above is cited by way of example only and should not be construed as limiting the scope of the invention claimed hereinafter. It should be apparent to those skilled in the art that other embodiments within the scope of the invention can be made from the disclosure herein.

While this invention has been described with reference to the structures disclosed herein and while certain theories have been expressed to explain the experimentally obtainable results obtained, 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 or the scope of the following claims.

What is claimed is:

1. Apparatus for cleaning a surface including

a perforated hollow core means mounted for rotation;

a porous, sponge-like member for interfacing with the surface to be cleaned at a first position, said sponge-like member being mounted externally on said perforated core means;

means internal to said core means for applying liquid therethrough to said sponge-like member;

a pinch member for squeezing the sponge-like member against the perforated core means at a second position along its surface removed from the first position.

2. Apparatus for cleaning a surface including

a perforated hollow core means mounted for rotation;

a sponge-like member for interfacing with the surface to be cleaned at a first position, said sponge-like member being mounted externally on said perforated core means;

means internal to said core means for applying liquids therethrough to said sponge-like member including spray headers and directing nozzles;

a pinch member for squeezing the sponge-like member against the perforated core means at a second position along its surface removed from the first position.

3. The apparatus of claim 2 wherein said header includes a plurality of nozzles.

4. Apparatus for cleaning a surface including

a perforated hollow core means mounted for rotation;

a sponge-like member for interfacing with the surface to be cleaned at a first position, said sponge-like member for interfacing with the surface to be cleaned at a first position, said sponge-like member being mounted externally on said perforated core means;

means internal to said core means for applying liquids therethrough to said sponge-like member wherein said means for applying liquid remains stationary during the movement of the sponge-like member;

a pinch member for squeezing the sponge-like member against the perforated core means at a second position along its surface removed from the first position.

5. Apparatus for cleaning a surface including

a perforated hollow core means mounted for rotation;

a sponge-like member for interfacing with the surface to be cleaned at a first position, said sponge-like member being externally on said perforated core means;

means internal to said core means for applying liquids therethrough to said sponge-like member;

a pinch member for squeezing the sponge-like member against the perforated core means at a second position along its surface removed from its first position;

means for sealing the perforated core means being positioned in line with the second position.

6. The apparatus of claim 5 wherein said means for sealing includes a baffle fixed against rotation internal to said core means.

7. The apparatus of claim 5 wherein said means for sealing rides along the inner surface of the core means as the core means moves.

8. The apparatus of claim 1 wherein said perforated core means includes apertures over at least 50 percent of its area, said aperture passing completely through said core means.

9. The apparatus of claim 1 wherein the sponge-like member is mounted in interference fit on said core means.

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