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Cleveland, Ohio
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606,178, Dec. 30, 1966, now abandoned.
This application June 9, 1969, Ser. No.
831,685

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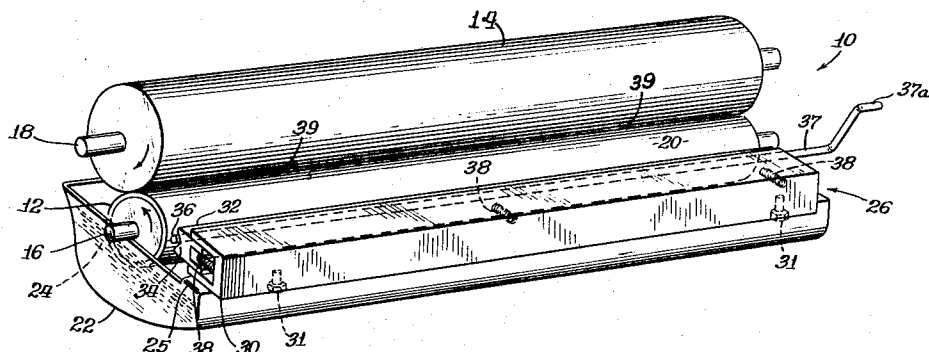
[54] **LIQUID DEVELOPING APPARATUS**
10 Claims, 7 Drawing Figs.

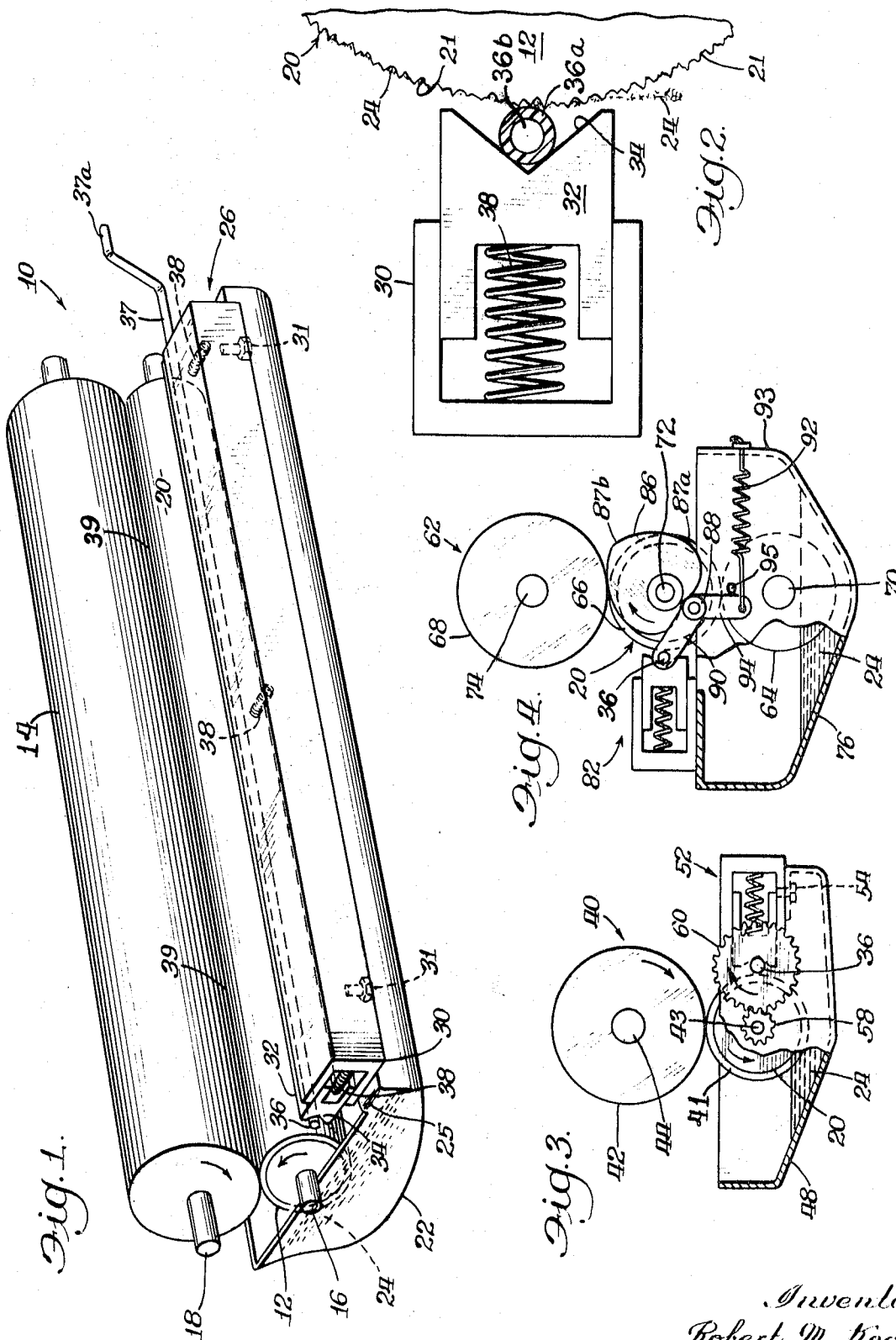
[52] U.S. Cl..... **95/89 R,**
118/261, 118/262
 [51] Int. Cl..... **G03d 5/06**
 [50] Field of Search..... **95/89, 89**
R, 89 L; 118/113, 120, 261, 262

[56] **References Cited**
UNITED STATES PATENTS

2,329,263 9/1943 Gladfelter et al. **118/262 X**

ABSTRACT: A roller-type developing apparatus with a wiping control for developing sensitized materials. The roller arrangement includes at least an applicator roller and a pressure-applying member in contacting engagement forming a developing zone. The wiping control is a rod coated with fluorocarbon plastic or a fluorocarbon coated blade that wipes controlled amounts of fluid from the applicator roll which has a surface finish smoothness expressed in terms of the average depth of the depressions or recesses formed therein, in microinches. An applicator roll having a smoothness of from 10–200 microinches centerline average smoothness (or roughness), together with the fluorocarbon plastic coated wiping control, applies less than 3.0 grams liquid per square meter of the copy sheet.





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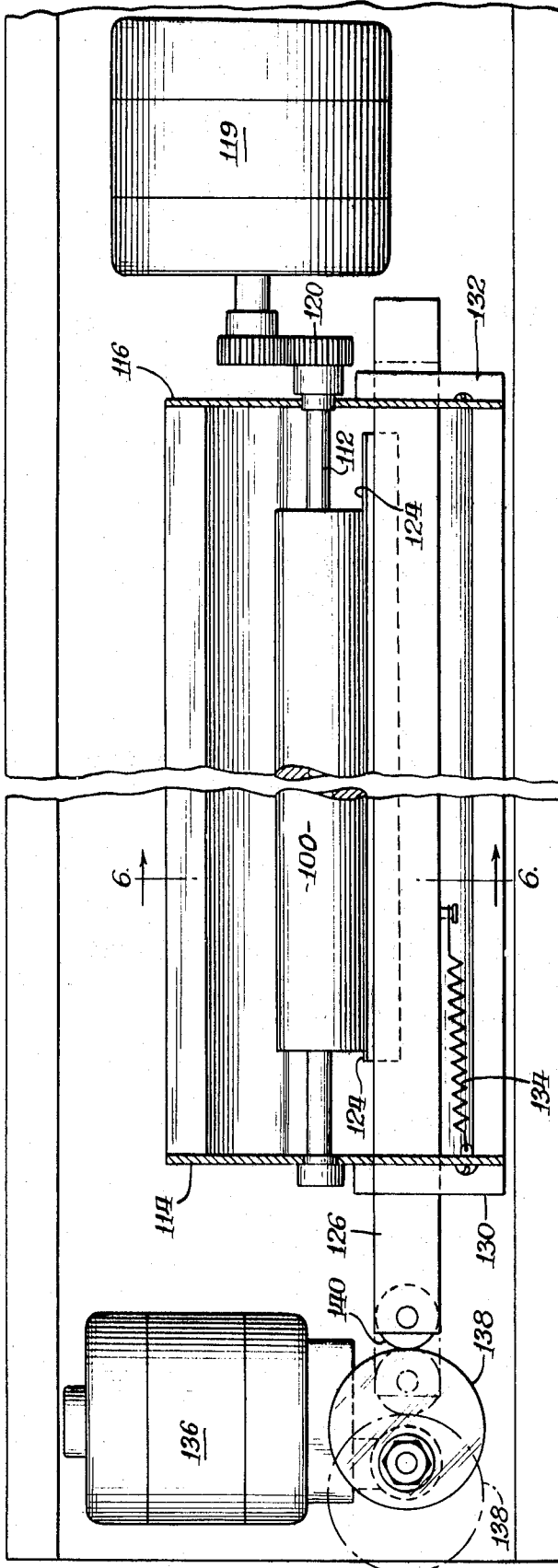


Fig. 5.

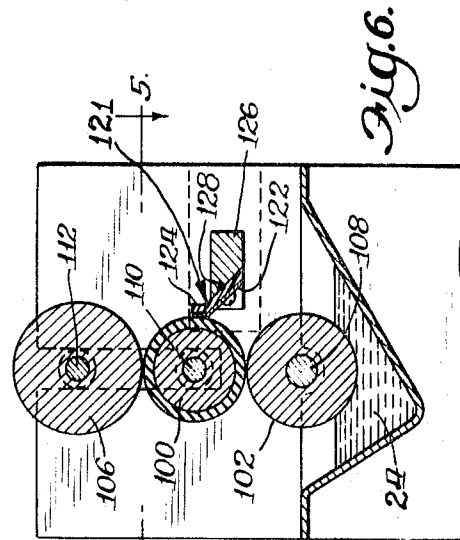


Fig. 6.

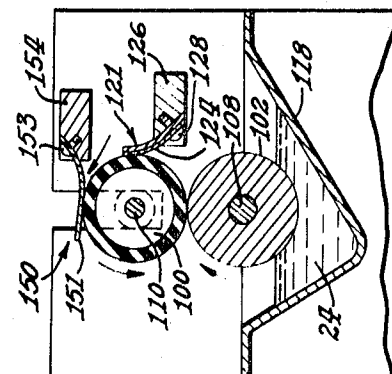


Fig. 6A.

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LIQUID DEVELOPING APPARATUS

This is a continuation-in-part of copending patent application Ser. No. 606,178, filed Dec. 30, 1966 now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to photocopying and, more particularly, to a developing apparatus for developing light-sensitive sheet material by applying, in printing fashion, precise, metered quantities of liquid developer so that the copy sheet emerges from the development processing dry to the touch.

Known diazo reproduction processes may be classified into two main groups, namely, moist and ammonia or dry, as based on the conditions necessary to develop the exposed light-sensitive material. The well-known moist process requires the application of sufficient amounts of developing liquid, which are normally low in concentration of the active ingredients, and any excess liquid is squeezed off and the sheet dried. Ammonia machines, which are generally known as the dry diazo process, require ventilation to the outside in order to remove the strong ammonia fumes. Consequently, the well-known diazotype processes have certain inherent disadvantages that detract from their being used more widely in office copying installations where the economics of the diazo processes are important and could be more fully realized.

The disadvantages inherent in known diazotype developing processes resulting in the need for exhaust equipment or the use of a drying chamber to remove excess moisture have been obviated by the novel apparatus of this invention in which a controlled amount of developer liquid is applied to the surface of the light-exposed copy sheet carrying a latent diazo image thereon. The apparatus applies, in printing fashion, only the precise amount of a highly concentrated developer liquid necessary to get a dense dye image rapidly, eliminating the necessity of drying the copy after development.

An extremely thin film of developer is printed onto the copy sheet at a rate of less than 3.0 grams per square meter. The application of the developer must understandably be uniform across the copy sheet surface in order to guarantee the formation of a uniform azo-dye image. The details of the method of development embodying this liquid control process and the materials therefor are described in detail in U.S. Pat. No. 3,446,620, issued May 27, 1969, in the name of Konrad Parker, and assigned to the same assignee as the instant application.

The principal advantage obtained by the use of such a developing method is that the copy paper emerges immediately after development in a dry-to-the-touch condition. Other advantages are realized in employing the developing apparatus of this invention in that the photocopying machines are extremely simple to operate, odor-free, and quite compact obviating the need for exhaust or drying equipment such as may be necessary to render the sheet sufficiently dry for handling as it emerges from the equipment.

Conventional liquid application techniques are incapable of putting down the precise small amounts of liquid necessary for development onto the paper. Usually, the heretofore known roller application techniques apply an excess of the developing liquid requiring subsequent drying. One such arrangement uses an applicator roller which has a specially designed roller having a pattern formed along the surface thereof. A quantity of developer fluid much greater than the maximum quantity used in the instant invention, in the neighborhood of 7.5 to 8.5 grams per square meter, is applied by the roller to a copy sheet. Because of the application of relatively large quantities of fluid, the copy requires drying to complete the process. Another problem with prior art systems is uniformity of application and evenness of development.

This is very important and normally difficult to achieve with the small quantities of developer fluid used in the invention. In fact, it is believed that in an arrangement of the type above described, wherein a particular pattern is provided on the roller surface, the use of a quantity of developer fluid on the order of 3.0 grams per square meter or below, would very like-

ly result in the printing of the pattern of the roller surface on the sensitized copy sheet. Thus, it can be seen that the roller surface is indeed important.

It has been found that in order to achieve the high degree of liquid control, the roller assembly must include an applicator roll whose surface is ground to a particular finish such that precise amounts of fluid can be retained or carried thereon. In addition to the surface characteristics, the applicator roll is operated in conjunction with a mechanical wiper against its surface creating a wiping zone to provide the finite metering and guarantee uniformity of application.

Paper lint tends to be entrapped at the wiping zone and measures must be taken to free the wiping zone of the lint in order to assure high quality streak-free development of the copy sheet. In the copending application of Rabb, et al., Ser. No. 606,332 filed Dec. 10, 1966, and now abandoned, assigned to the same assignee, a developing apparatus is disclosed which effectively applies the precise amount of liquid required to improve the operation of this device. The wiping means of this invention, the construction of which is disclosed in the above-mentioned application, is coated with a plastic material to which the paper lint does not adhere and which virtually insures that the paper lint will under no circumstances be entrapped at the wiping zone of the developing apparatus.

SUMMARY OF THE INVENTION

It is the principal object of the present invention to provide a developing apparatus that applies liquid developer to the surface of a copy sheet in a consistently controlled and uniform manner in amounts sufficient to develop the paper without applying a large excess of liquid.

Another object of this invention is to provide a roller assembly developing apparatus capable of applying less than 3 grams of liquid per square meter to the paper uniformly.

It is a further object of this invention to provide a developing apparatus which eliminates interference from paper lint, thereby assuring prolonged streak-free, uniform development of copying material by employing wiping means having a non-paper adhering wiping surface.

A preferred embodiment of a developing apparatus of this invention comprises a train of two or more rollers in driving engagement with one another, with one of the rollers being immersed in a supply reservoir of the liquid developing medium. One of the rollers in the train is an applicator roller which is in communication with the liquid supply reservoir, either directly or indirectly, and is adapted to receive and carry on its surface limited quantities of the developer liquid. Against the surface of the applicator roll, at a point upstream from where it receives the developer liquid from the supply source, there is placed a mechanical wiper extending longitudinally along its surface and parallel to the axis of rotation of applicator roll for the purpose of metering the liquid. The wiper has a wiping surface formed of a fluorocarbon plastic that insures that paper lint will not be entrapped at the wiping zone. Accurate control of the amount of liquid carried on the applicator roll surface is achieved through a proper surface finish in combination with the mechanical wiper. The roller has extremely small, randomly formed recesses in its surface created by grinding the surface to a predetermined finish so that only a slight excess of liquid is retained which is then metered to the desired amount by the action of the mechanical wiper. A pressure applying means, taking the form of a second roller, is in driving engagement with the applicator roll so as to form a developing zone along the line of contact therebetween beyond the point at which the mechanical wiping takes place on the roller surface. The applicator roll after it passes the wiping station retained only the desired amount of developer prescribed for proper development and releases this controlled amount when brought into pressure contact with the copy paper that is caused to pass through the developing zone. In effect, the developer carried in the surface of the applicator roller is

printed onto the copy paper as the latter passes through the developing zone in pressure contact with the roller.

DESCRIPTION OF THE DRAWINGS

For a better understanding of this invention as well as the objects and other features, reference will be had to the following detailed description which is to be read in conjunction with the drawings wherein:

FIG. 1 is a perspective view of one embodiment of this invention employing a rotatable wiping rod device;

FIG. 2 is an enlarged detail view schematically illustrating the action of the mechanical wiping means in operation against the applicator roll surface;

FIG. 3 is a side elevational view, partially broken away, showing another embodiment of this invention employing a wiping rod device that is continually driven;

FIG. 4 is a side elevational view, partially broken away, showing still another embodiment of this invention employing an oscillating wiping rod device;

FIG. 5 is a plan view of another embodiment of this invention employing a reciprocally mounted blade-type wiping device;

FIG. 6 is a cross-sectional view taken along line 6—6 of FIG. 5;

FIG. 6A is an enlarged detailed view schematically illustrating another embodiment employing a pressure blade and a wiping blade member in operation against the applicator roller surface.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. 1 and 2, there is shown one embodiment of the developing apparatus of this invention generally indicated as 10 including an applicator roll 12, a pressure roller 14, each carried by shafts 16 and 18, respectively, with the periphery of roller 12 made of a smooth, nonporous resilient material, such as rubber, forming an exterior carrier surface 20 having irregular depressions 21, of varying depths and sizes, (FIG. 2). The applicator roll 12 is partially submerged in a reservoir 22 containing a supply of developer liquid 24. A wiping assembly secured to the reservoir 22 identified generally as 26 extends longitudinally along the length of roller 12 and is carried on a platform 25. The rollers 12 and 14 are rotatably mounted in any suitable bearing means (not shown) being driven with conventional motor-driving means (not shown) to provide rotation as indicated.

The wiping assembly 26 includes a U-shaped channel 30 secured to the platform 25 by fasteners 31. Slidably disposed within the U-shaped channel 30 is a bearing bar 32 corresponding in length to the length of the applicator roll and having a V-grooved lead edge portion 34. The V-grooved portion 34 serves as a bearing surface in which is rotatably supported a cylindrically shaped elongated rod 36 having an extended portion 37 which is integral with a bellcrank 37a.

The rod 36 has an inner metal core 36b and an outer fluorocarbon plastic shell 36a. Because of the nonadhesive character of the plastic, paper lint does not stick to the rod 36 and is not entrapped in the wiping zone. The thickness of the shell 36a is not critical, however, the optimum thickness is in the range of from 1-5 mils. The preferred fluorocarbon plastics are tetrafluoroethylene polymer, sold under the trade name "Teflon," and trifluorochloroethylene polymer, sold under the trade name "Kel-F," the former being especially successful.

The bearing bar 32 is fittingly received within the U-shaped channel 30 being adapted to move in a direction normal to the longitudinal direction of the channel. A plurality of springs 38 are spaced at intervals along the inside of the channel 30 which tend to bias the bearing bar 32 outward from the channel 30 against the roller 12. The action of the springs 38 also serves to align the bearing bar 32 into a substantial line of pressure contact with the surface 20 along the entire extent of the roller 12.

Roller 12 has a diameter substantially greater than the diameter of the rod 36. The ratio of the roll diameter to rod diameter may be in the range of 5:1 to 20:1, and preferably is in the order of 6:1 to 10:1. It will be appreciated that the greater the ratio the greater will be the tendency to achieve substantial line contact at the wiping zone along the line of contact between the rod 36 and the surface 20. The instant mechanical wiping arrangement requires only the nominal directional force applied by the springs 38 in order to provide the necessary pressure to wipe the excess developer from the surface 20 without causing any injury or undue wear to the carrier surface.

Rod 36 is rotated independently of the rotation of the roller 12. The low coefficient of friction between the surface 20 and the rod 36 results in slippage between the two cylindrical surfaces. In general, the lubricity of the developing liquid involved permits the rod to slide, without rotating, over the surface of the roll and hence without causing noticeable wear or injury to the finish of the surface 20. The coefficient of friction between the rod 36 and the V-grooved portion 34 is greater than the frictional force between the rod 36 and the surface 20, hence the rod remains stationary.

Entrapped paper lint must be clear of the wiping zone, otherwise resulting in streaked copies due to the uneven wiping of the developer from the surface of the applicator roll. Manual rotation of the bellcrank handle 37a rotates the rod 36, thereby freeing-up the paper lint and providing a clean wiping rod face to the surface 20.

As the roller 12 leaves the wiping zone it carries on its surface the amount of liquid developer necessary to develop the latent image into an azo-dye image of suitable density. The area of contact between the rollers 12 and 14 forms a developing zone 39 in which the developer liquid is transferred under pressure from the surface of the roller 12 to the latent image-bearing surface of the copy sheet.

A preferred applicator roll is fabricated of a natural or synthetic, rubber, nonporous compound molded to a solid metal core. Rollers made from Buna-N type synthetic rubber compound have been eminently successful. The natural rubber compound polyisoprene may be used as well as such synthetic rubber compounds as styrene butadiene, polybutadiene and isobutylene isoprene. In order to function as an applicator roll the rubber hardness should be in the range of 40-60 durometer units, preferable 50-55 units. (units expressed in Shore A)

The texture or finish of the applicator roll is extremely important to the successful operation of the developing apparatus of this invention. The amount of developer liquid retained on the surface 20 and hence carried to the developing zone is dependent on its surface characteristics. It has been found that the surface best suited for carrying the proper amount of liquid to the developing zone 39 is one comprised of randomly formed recesses of varying depths and sizes providing a predetermined degree of average centerline smoothness expressed in terms of microinches in depth to be discussed in greater detail hereinafter. An applicator roller having the proper surface characteristics gives a smooth appearance to the naked eye as well as to the touch. This is not, however, a test which permits one to distinguish an acceptable from a nonacceptable applicator roller. The differences in the surfaces of applicator rollers can be illustrated under a scanning electron microscope and, as will be explained hereinafter, can be shown clearly through the use of a surface testing device known as a Talysurf Instrument, Model 4, manufactured by the Rank Organization of England.

Referring to FIG. 2, there is shown a schematic representation of the surface 20 of the applicator roll 12 formed of the small recesses 21. Small amounts of liquid 24 cover the surface of the roll filling the numerous recesses or craters 21 and adhering thereto. As the resilient surface passes beneath the wiping rod 36, the amount of liquid overflowing the depressions 21 is wiped off and only the amount of liquid below the general outer surface is delivered to the developing zone.

The aforementioned surface characteristics are correlative to the degree of smoothness of the surface. If the surface is too rough, it is indicative of too large depressions which tend to retain too much fluid and, hence, render the mechanical wiping means ineffective as a control. Too smooth a surface will carry an insufficient amount of fluid for adequate development. The limits of fluid application reside between 0.5 grams to 3.0 grams per square meter of the copy paper.

In determining the suitability of a particular finish, a surface-testing apparatus identified above as a Tallysurf Instrument Model 4, was employed. The Tallysurf instrument was chosen for use in identifying the carrier surface of an applicator roll according to the invention since the instrument provides meaningful data which can be used to distinguish roller surfaces that fall within or without a workable range of average center line smoothness; those falling outside of the range providing either too little or too great a quantity of developer fluid to copy material to be developed. It will be recognized that other techniques can also be used for characterizing the surface of the roller. However, it will be appreciated that what is intended to be defined is the smoothness (roughness) of the surface of the roller necessary to give the liquid application control, independent of the technique for measuring the surface characteristics of the roller. The Tallysurf Instrument used quantitatively measures the profile of the surface and gives an average value of the depth of the recesses comprising the surface. The instrument utilizes a diamond-tipped stylus having a radius of 0.0005 inch bearing on the test surface with a force of about 0.1 grams and traverses approximately one-half inch across the surface at a constant rate of speed. The direction of the path of the stylus is along a line generally parallel to the roller axis. As the stylus rides over the surface, it senses irregularities producing an electrical signal whose magnitude corresponds to the depth of the recess. Electrical signals are received by a calibrated unit that provides an integrated numerical roughness measurement, that is, the centerline average roughness (smoothness) at a given wavelength cutoff; the wavelength cutoff being dependent on the nature of the surface being tested. The wavelength cutoff value under test conditions is 0.030 inch.

The following is an example of a test series wherein a number of rollers of different surface smoothness were evaluated on the Tallysurf, Model 4, Instrument.

ROLLERS	1	2	3	4	5
Average Center Line Smoothness (Microinches)	24	27	39	150	318
Range of Fluid Applied (Grams/Meter ²)	0.5 to 1.2	0.6 to 1.85	0.75 to 2.0	2.5 to 3.5	5.4 to 6.0

The above chart illustrates the increased amount of fluid applied by developing apparatus according to the invention during the developing process using applicator rollers having increasingly rough surfaces. It should be noted that for each applicator roller there is listed a range of developer fluid application. To explain, the lower reading of the range indicates the fluid applied by the apparatus with the wiper control at maximum contact pressure against the applicator roller surface and the upper reading with the wiper control placed in contact with the roller surface at a minimum pressure. The fluid range shown for each roller may further be explained because of the fact that the fluid applied by developing apparatus according to the invention may also be varied by changing the type of wiper control (i.e., rod or blade); the blade applying lesser amounts of fluid than the rod for a given contact pressure. While it has been shown that in fluid application are thus possible, it should be noted that roller number 5 has a surface roughness such that any variation in wiper control pressure or wiper control structure is unable to bring the amount of fluid applied by developing apparatus within the limits; (i.e., less

than 3.0 grams/meter²) of the invention, indicating again that it is the surface characteristics of the applicator roller which are critical to the application of the developing fluid.

It has been concluded that an applicator roller having a center line average smoothness in the range of 10-200 microinches as measured on the Tallysurf, Model 4 instrument described, provided a satisfactory finish according to the invention. Preferably the roller surface of an applicator roller used in developing apparatus according to the invention has a surface smoothness in the range of 15-100 microinches.

After the surface of the roller 20 passes the mechanical wiping station, as shown in FIG. 2, that portion of the surface passing upstream of the rod 36 has metered thereon the required amount of fluid which is then carried to the developing zone 39 which is formed along the line of contact between the rollers 12 and 14. A latent image bearing diazotype copy sheet is developed by feeding the material into the nip of the rollers 12 and 14 so that the latent image bearing surface of the copy sheet makes contact with the surface 20. The roller 14 preferably made of a highly polished metal, such as, for example, stainless steel, is used to supply enough pressure at the developing zone to insure intimate contact between the sheet material being developed and the surface 20, whereby the developing fluid is printed onto the copy sheet. Other pressure-applying means, such as, for example, a blade member, may be used to form the developing zone, with equally good results to be described in neater detail hereinafter.

Referring to FIG. 3, there is shown another embodiment of a developing apparatus, identified generally as 40, similar in construction to the aforescribed apparatus. The apparatus 40 utilizes a two-roller train, similar to the apparatus 10 and a mechanical wiping assembly 52 in which the wiping rod is positively driven to rotate with the rotation of the applicator roll.

The train of rollers in the apparatus 40 includes an applicator roll 41 and a pressure roller 42 in contact therewith each mounted on shafts 43 and 44, respectively. The applicator roller 41, having a suitable carrier surface 20, comprised of depressions falling in the range of 10-200 microinches, is disposed in a reservoir 48 containing the liquid developer 24. The wiping assembly 52 is longitudinally disposed along the length of roller 41 being secured to the reservoir 48 by means of threaded fasteners 54.

The wiping assembly 52 includes a rotatably mounted rod 36 having a fluorocarbon outer shell which serves to wipe excess liquid from the carrier surface 20. The roller 41 is rotatably suspended intermediate the sidewall of reservoir 48 and roller 42 is supported in any suitable bearing means (not shown) with the pressure roller 42 being driven from its shaft 44 by a suitable drive means (not shown).

The applicator roller 41 and the rod 36 are in driving connection with one another through the gear train 58 and 60 which are attached to the end of shaft 43 and an extension of the rod 36, respectively. When roll 42 is driven it causes the applicator roll to turn in the reservoir transmitting rotation through gears 58 and 60 to the rod which in turn is caused to rotate concurrent with the operation of the developer apparatus. The diameter ratios of the gears 58 and 60 are such that the rotational speed of the rod is in the range of approximately one-third to two-thirds the speed of the applicator roll, preferably about 1/2. The continual rotation of the rod obviates the need for manually rotating the rod 36 in order to clear it of any accumulated paper lint, thereby rendering the developing apparatus of this embodiment more suited to continuous and automated operation. The differential in lineal speed, that is, the circumstance where the rod moves at a much slower rotational speed, provides the wiping action necessary to insure effective mechanical wiping or metering of the liquid. Alternately, the rod 36 can be provided with means to drive it counter to the rotation of roller surface 20 insuring proper wiping action.

Referring to FIG. 4, there is shown still another embodiment of the developing apparatus of this invention, indicated

generally as 62. The three-roller train developing apparatus 62 comprises an immersion roller 64, a driven applicator roller 66, and a pressure roller 68, all in driving engagement with one another being rotatably mounted on shafts 70, 72 and 74, respectively. The immersion roller 64 is rotatably suspended between the sidewalls of the liquid developing reservoir 76 with its surface partially immersed in the body of the developer liquid 24. The applicator roll 66, having thereon a carrier surface 20, is in rolling contact between immersion roller 64 and the pressure roller 68, the latter being motor driven through its shaft 74 which transmits the rotary motion to the entire train.

Associated with the applicator roll is a mechanical wiping assembly 82 which includes a wiping rod 36 provided with a fluorocarbon plastic shell mounted longitudinally against said applicator roll in a manner similar to the previously described embodiments. The wiping assembly 82 in the instant embodiment includes a different mode of eliminating the accumulation of paper lint calling for periodic oscillation of the rod 36 during the operation of the developing apparatus.

Fixed to the end of shaft 72 and rotatable therewith is a heart-shaped cam 86, having cam face portions 87a and 87b which impart the oscillating motion to the rod 84 through a cam follower wheel 88 mounted on the follower arm 90 attached to the portion of the rod 36 that extends beyond the roll 66. The follower wheel 88 is urged against the cam faces 87a and 87b by the biasing spring 92 stretched between the extension 94 of the follower arm and the wall 93 of the fluid reservoir 76. The spring 92 urges the arm 90 in a direction towards the sidewall 93 and the stop 95 limits the arm movement. Rotation of the roller 66 causes the heart-shaped cam 86 to turn in a clockwise direction. As the follower wheel 88 engages the portion 87a of the cam face, the arm 90 rotates in a clockwise direction pivoting about the axis of the rod 36 where the follower arm is attached, thereby imparting clockwise rotary motion to the rod. As wheel 88 moves off the cam face 87a to the face portion 87b, arm 90 being urged by the spring 92 to rotate in a counterclockwise direction, the rod 36 is correspondingly rotated in a counterclockwise direction. The oscillatory rod movement is periodically repeated as the follower 88 moves from the one face 87a to the other face 87b. This periodic oscillation of the rod 36 provides a self-cleaning arrangement of the wiping assembly, greatly enhanced by the fluoroplastic carbon coating, whereby the accumulation of paper lint is eliminated from the wiping zone.

Referring to FIGS. 5 and 6, there is shown another embodiment of a developing apparatus in which the mechanical wiping means employed is a blade member formed of a flexible spring steel placed against the applicator roll 100 (FIG. 6) which is one of a three-roll train in which the immersion roller 102 is partially immersed in the developer liquid 24 and the roller 106 is the pressure roller. The train of rollers is mounted on shafts 108, 110 and 112, respectively, being disposed between the side frames 114 and 116 (FIG. 5) extending upward from the sides of the developing reservoir 118. The roller 100 is driven by the motor 119 through a gear train 120, thereby transmitting rotational movement to the other two rolls in the roller train.

The wiping assembly (FIG. 6) includes a blade 121 having a shaft portion 122 and a fluorocarbon plastic wiping face 124. The wiping face 124 makes direct contact with the surface of the roller 100. The blade 121 is mounted on a carrier member 126 by means of fasteners 128 leaving the face portion 124 free to engage the surface of the roller 100 for wiping action thereagainst.

The carrier 126 is slidably received in the sidewalls 114 and 116 through a pair of sleeve bearing elements 130 and 132 (FIG. 5). A spring 134, having one end attached to the carrier at a point lying within the walls 114 and 116, and the other end affixed to the wall 114 biases the carrier in a lateral direction toward the wall 114. The follower wheel 140, rotatable secured to one end of the bar 126, is urged against the cam face 138 by virtue of the biasing action of the spring 134. The

motor 136 is energized concurrent with the roller drive motor 119 causing rotation of the cam 138 thereby imparting a lateral reciprocating motion to the carrier 126 as the follower wheel 140 engages the cam face 142 of the cam 138. The carrier is fully distended when the cam 138 is in the dotted outline position (FIG. 5).

This lateral reciprocating movement of the carrier 126 causes a corresponding reciprocatory motion of the plastic face 124 of the blade 121 with respect to the roller 100, which, together with the rotary movement of the roller 100, serves to free up the wiping zone of paper lint. Referring to FIG. 6A, the roller 102 is mounted for rotation on shaft 108 and is shown partially immersed at the developer liquid 24 contained in the reservoir 118. As the roller 102 rotates in a clockwise direction, its surface picks up an amount of developer liquid and applies it to the driven applicator roller 100, mounted for rotation on shaft 110, which is in rolling contact with the roller 102. As the roller 100 rotates, it encounters the wiper blade identified generally as 121, one surface of which is coated with the fluorocarbon plastic 124. The blade 121 is mounted on a carrier member 126 by means of fasteners 128 leaving the coated surface portion 124 free to engage the surface of the roller 100 for wiping action thereagainst.

Continued turning of the roller 100 brings its surface into contact with the pressure blade identified generally as 150, having a face portion 151 which makes contact with the surface of the roller 100. The pressure blade 150 is mounted on a carrier member 154 by means of fasteners 153. The path taken by the copy sheet containing the latent image thereon is shown by the arrow in FIG. 6A. The copy sheet is fed face down so that the latent image bearing surface makes contact with the roller 100 as it passes between the roller 100 and the blade 150 with the back of the sheet making contact with the blade surface 151, thereby urging the copy sheet against the roller into intimate pressure contact therewith. The controlled amount of liquid carried on the surface of the roller 100 is applied to the latent image bearing surface in the developing zone established between the roller 100 and the pressure blade 150.

It will be appreciated that the blade-type wiping mechanism offers the advantage of requiring less precise fabrication in mounting of the elements due to the flexibility of the metal employed. This tends to simplify contact alignment problems between the wiper and the roller. The flexible spring steel readily contacts the roller surface, although the roller may be somewhat out-of-round which is not too uncommon a condition of rubber materials.

Although the blade-type wiping device having a fluorocarbon plastic wiping face 124 preferably is reciprocated as described, excellent results are achieved when the blade is stationary.

The present invention has been described with reference to several illustrative embodiments, it being the intention that they be exemplary and not limiting of the scope of the invention and it is further understood that other modifications and embodiments relating to the movement control or mounting of the mechanical wiping means involved may occur to those skilled in the art which would come within the spirit and scope of the novel concepts of this invention.

I claim:

1. In a developing apparatus of the type in which a liquid developing medium from a supply source is applied to an exposed latent image bearing copy sheet, in amounts not exceeding 3.0 grams per square meter, comprising applicator roller means having a smooth nonporous resilient layer whose surface has a centerline average smoothness in the range of 10-200 microinches and being associated with said supply source for carrying a quantity of developing medium on its surface.

means establishing a developing zone including roller means in pressure contact with said applicator surface,

wiper means including a wiper surface in contact with the surface of said applicator roller means as it emerges from said supply source and before said surface enters said developing zone for reducing the quantity of liquid carried in the applicator roller surface to a predetermined level, said wiper means comprising holding means for rotatably supporting a wiper rod against said roller, said holding means being received in a channel member equipped with adjusting means for aligning said rod against said applicator roller.

The improvement wherein said wiper means is provided with a fluorocarbon plastic surface.

2. The apparatus as defined in claim 1, wherein said fluorocarbon plastic is a tetrafluoroethylene polymer.

3. The apparatus as defined in claim 1, wherein said fluorocarbon is a trifluorochloroethylene polymer.

4. In an apparatus for developing light-sensitive sheet material by the application to the sheet of an amount of a developer liquid not in excess of 3 grams per square meter, the combination comprising:

first and second roller means in driving engagement with each other forming a transfer zone along the line of contact therebetween, said second roller means being a non-porous resilient carrier surface having randomly formed recesses of varying depths and sizes whose centerline average smoothness is in the range of 10-200 microinches, capable of retaining a controlled amount of said developer liquid thereon,

means for applying to a portion of said carrier surface an excess amount of developer liquid,

wiper means in biased engagement against said second roller means forming substantially a line contact therewith as said roller emerges from said means for applying said excess liquid and before said roller surface enters said transfer zone, wiping excess liquid from said carrier surface, which wiper means comprises a substantially flat, flexible blade member, having a fluorocarbon plastic wiping surface causing said blade member to be bent into an arcuate shape whereby said blade member makes tangential contact with the second roller along its surface.

5. In a developing apparatus of the type in which a liquid developing medium from a supply source is applied to an exposed latent image bearing copy sheet, in amounts not exceeding 3.0 grams per square meter, applicator roller means having a smooth nonporous resilient carrier surface having randomly formed recesses of varying depths and sizes whose centerline average smoothness is in the range of 10-200 microinches, and being associated with said supply source for carrying a quantity of the developing medium on said surface,

means establishing a developing zone including roller means in pressure contact with said applicator surface,

wiper means including a wiping surface in contact with the surface of said applicator roller means as it emerges from said supply source and before said surface enters said developing zone for reducing the quantity of liquid carried on said surface to a predetermined level, said wiper means comprising an elongated rod and driving means for imparting oscillatory rotational movement to said rod, the improvement wherein said wiper means is provided with a fluorocarbon plastic wiping surface.

6. In a developing apparatus of the type in which a liquid developing medium from a supply source is applied to an exposed latent image bearing copy sheet in amounts not to exceed 3 grams per square meter of the surface thereof, applicator roller means having a smooth nonporous resilient layer whose surface has a center line average smoothness in the range of 10-200 microinches and being associated with said supply source for carrying a quantity of the developing medium on said surface,

means establishing a developing zone including roller means

in pressure contact with said applicator surface,

wiper means including a wiping surface in contact with the surface of said applicator roller means as it emerges from said supply source and before said surface enters said developing zone for reducing the quantity of liquid carried on the applicator roller surface to a predetermined level, said wiper means comprising a resilient blade member extending longitudinally in a direction parallel to the applicator roller axis and biased thereagainst, forming an arcuately shaped wiping surface, and

drive means for imparting reciprocating motion to the blade member in a direction parallel to the axis of rotation of said applicator roller,

the improvement wherein said wiper means is provided with a fluorocarbon plastic wiping surface.

7. In an apparatus for developing light-sensitive sheet material by the application to the sheet of an amount of developer liquid not in excess of 3 grams per square meter, the combination comprising:

pressure-applying means;

roller means in driving engagement with said pressure-applying means for forming a transfer zone along a line of contact therebetween, said roller means including a non-porous resilient carrier surface having a randomly formed recesses of varying depths and sizes whose centerline average smoothness is in the range of 10-200 microinches capable of retaining a controlled amount of said developer liquid thereon;

means for applying to a portion of said carrier surface an excess amount of developer liquid,

wiper means biased against said roller means forming substantially a line contact therewith as said roller emerges from said means for applying said excess liquid and before said roller surface enters said transfer zone, said wiper means comprising a flexible blade member having a fluorocarbon plastic wiping surface, said blade member being biased against said roller means so that said blade is arcuately shaped so as to make tangential contact with said roller surface.

8. Apparatus as claimed in claim 7 wherein said pressure applying means includes a roller member mounted in driving engagement with said roller means.

9. Apparatus as claimed in claim 7 wherein said pressure-applying means is a blade.

10. In an apparatus for developing light-sensitive sheet material by the application thereto of an amount of developer liquid not in excess of 3 grams per square meter, the combination comprising:

pressure-applying means;

roller means in driving engagement with said pressure-applying means for forming a transfer zone along a line of contact therebetween, said roller means including a non-porous resilient carrier surface having randomly formed recesses of varying depths and sizes whose centerline average smoothness is in the range of 10-200 microinches capable of retaining a controlled amount of said developer liquid thereon;

means for applying to a portion of said carrier surface an excess amount of developer liquid,

wiper means biased against said roller means forming substantially a line contact therewith as said applicator roller emerges from said means for applying said excess liquid and before said roller surface enters said transfer zone, said wiper means comprising an elongated rod as the liquid wiping element and mounting means for rotatably mounting said rod for imparting rotational movement thereto and in contact with said applicator roller, the improvement comprising wherein the surface of said rod is provided with a fluorocarbon plastic layer.

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