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R. W. JONES ET AL

3,011,435

METHOD AND APPARATUS FOR CONTROL OF MISTING

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Fig. 1

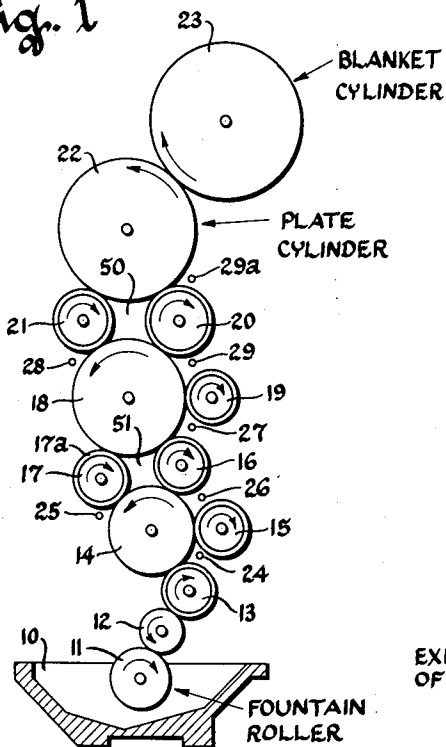


Fig. 2

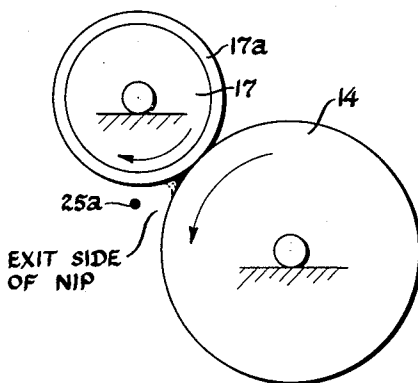
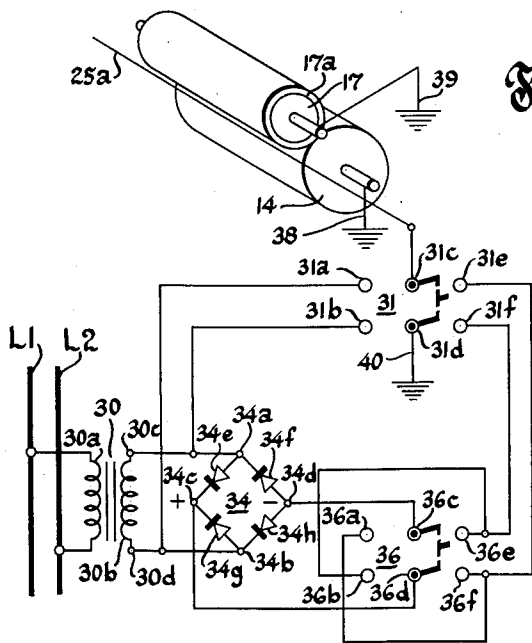


Fig. 3



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METHOD AND APPARATUS FOR CONTROL OF MISTING

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7 Claims. (Cl. 101—350)

This invention relates generally to methods and apparatus for the electrostatic control of particles.

While not limited thereto, the invention relates particularly to methods and apparatus for electrostatically controlling ink mist produced in ink distribution systems or ink trains of high speed printing presses.

So-called "ink mist" or "ink fog" in press rooms has long been a serious problem in the printing industry and is becoming more aggravated as printing press speeds increase. The presence of ink mist affects the health and morale of press room personnel, creates hazardous conditions, wastes ink, contaminates the finished printed product, and necessitates costly periodic cleanups and elaborate and expensive control measures. Ink mist or fog, which is to be distinguished from so-called "ink sling" or "ink fly," i.e., ink particles occasionally thrown off of individual inked rollers in an ink train by the action of centrifugal force, is formed when the ink film between a roller couple splits at the exit side of the roller nip. As the ink film splits, filaments of ink are formed which rupture almost as quickly as they are formed into extremely small ink particles which eventually find their way into the atmosphere in the form of mist. Prior attempts to eliminate, suppress or otherwise control ink mist, as by filter or blower systems, use of special types of ink or even certain methods of electrostatic precipitation, have not proven entirely satisfactory from the standpoint of efficiency or cost.

Accordingly, it is an object of this invention to provide improved methods and apparatus for controlling mist generated in apparatus, such as printing presses or the like, which employ roller couples to convey liquid material from one roller to another.

Another object is to provide improved methods and apparatus of the aforesaid character which return the mist to its source as distinguished from methods and apparatus which attempt to remedy the mist condition after the mist particles have escaped from the nip area.

Still another object is to provide improved methods and apparatus of the aforesaid character which employ electrical principles to drive liquid particles back onto the rollers from whence they came before they can escape from the nip area.

A more specific object is to provide improved methods and apparatus of the aforesaid character wherein electrical effects accompanying a corona discharge are employed to electrically charge liquid mist particles as they are formed and to create an electrostatic field which acts to force said charged mist particles back onto said rollers.

An even more specific object is to provide improved apparatus whereby mist particles generated at the exit side of the nip of a roller couple are forced back onto said roller as the result of electrical effects attending a corona discharge when a highly charged conductive member is disposed adjacent the nip on the exit side thereof, said corona effect being accompanied by an electrostatic field which exists between said conductive member and said rollers and by electrical charging of said mist particles.

Still another object is to provide apparatus of the aforesaid character which is practical, efficient, relatively economical to manufacture and employ, fundamental in concept, employs a minimum number of components, and

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which lends itself readily to a wide variety of applications.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate preferred embodiments of the invention, it being understood that the embodiments illustrated are susceptible to modification with respect to details thereof without departing from the scope of the appended claims.

FIGURE 1 is a schematic showing the ink distribution system or ink train of a typical printing press with which the invention is employed;

FIG. 2 is an enlarged view of two rollers, or a roller couple, of the ink train shown in FIG. 1 showing the disposition of a corona wire with respect thereto; and

FIG. 3 is a diagrammatic showing of the electrical circuitry for effecting energization of the corona wire shown in FIG. 2 from alternating current or either polarity of direct current.

FIGURE 1 schematically depicts part of the ink distribution system or ink train of a typical modern high speed printing press with which the invention is employed to particular advantage. The numeral 10 designates an ink fountain from which ink is picked up by the fountain roller 11 and subsequently transferred to ten other rollers 12, 13, 14, 15, 16, 17, 18, 19, 20 and 21, to thin it and evenly distribute it before it is finally transferred to the plate cylinder 22 which is adjacent the blanket cylinder 23. The several rollers and cylinders may be assumed to be suitably supported by a framework (not shown) and are driven in the direction of the arrows by suitable driving means (not shown) when the printing press is in operation. In a typical high speed newspaper press the peripheral velocity of the inking rollers might range, for example, from 1,700 feet per minute to 2,120 feet per minute. At such speeds anywhere from 40,000 to 70,000 printed copies can be produced. In the ink train, the inking rollers 11, 12, 14 and 18 may be assumed to be made of steel whereas the rollers 13, 15, 16, 17, 19, 20 and 21 are made of steel covered with a layer of resilient material. Thus, for example, in one roller couple shown in FIGS. 1, 2 and 3 the roller 14 may be assumed to be of steel and the roller 17 with which it is contiguous may be assumed to be of steel covered with a layer 17a of Buna-N rubber or like material on the order of one-half inch thick. The area of contact between two rollers, such as rollers 14 and 17 in FIGS. 1, 2 and 3, is called the "nip" and the exit side of the nip, which is so labeled in FIG. 2, is the location whereat ink mist is initially produced. Although it is to be understood that the ink mist is generated at the exit side of the nip of each roller couple, the nips of some couples are so situated that the mist generated thereat is not able to escape from the immediate area. Two such areas, for example, are designated by the numerals 50 and 51 in FIG. 1. The locations of the major sources of mist formation in the particular ink train illustrated are designated as position 24, 25, 26, 27, 28, 29 and 29a in FIG. 1 but in other apparatus these locations might differ.

Mist is formed when the ink film on two rotating contiguous rollers, such as rollers 14 and 17 in FIGS. 1, 2 and 3, splits at the exit side of the nip. Filaments of ink are formed as the film splits and the filaments rupture almost as quickly as they are formed. Rupture of the filaments results in the formation of extremely small particles of ink which comprise the mist. The mist particles are not expelled into the atmosphere at the nip exit where they are formed but tend to follow the periphery of the rollers in an air stream therearound until they are forced from this path by the air turbulence resulting from the air stream around other rollers. However, some particles leave the periphery of the rollers on a tangential line about 45 degrees from the nip from whence they originate.

Generally speaking, the nature of the ink filaments and the amount of mist produced depends on ink film thickness, the rheological properties of the particular ink employed, the peripheral velocity of the rollers, and roller interference. Thus, for example, an ink film thickness of from 0.0002 to 0.0004 inch on the rollers might occur when newspapers are being printed, whereas a thicker film and more viscous ink would be needed for printing cardboard. Peripheral velocities may vary, as hereinbefore discussed, depending on press speeds.

In accordance with the present invention, control or suppression of the ink mist is effected by electrostatically forcing the ink particles back onto the rollers from whence they originate. To accomplish this, electrically conductive members, such as wires, are disposed close to the exit side of the roller nips in parallel relationship to the rollers. The rollers forming the couple are maintained at ground potential and the conductive members are raised to a high electrical potential from a suitable source of electrical power so that a corona discharge occurs therealong and so that an electrical field is established between the conductive member and the rollers. The corona discharge is attended by intense ionization of the air surrounding the conductive member and the electrical charge is transferred from the air to ink mist particles in the nip area. The ink particles are repulsed from the conductive member and then forced back onto the rollers as a result of the force exerted on the charged ink particles by the electrical fields which exist between the conductive members and the rollers adjacent thereto.

Referring to FIG. 1, it is to be understood that it is preferable to locate the conductive members at the position designated 24, 25, 26, 27, 28, 29 and 29a which locations are the major sources of mist production, as hereinbefore explained. However, to facilitate understanding of the invention, only the construction and operation of the conductive member 25a, shown in FIGS. 2 and 3, located at position 25, shown in FIG. 1, in association with the rollers 14 and 17 will hereinafter be described.

Referring now to FIGS. 2 and 3, it is seen that a conductive member such as a wire 25a is arranged parallel to and in close proximity to the exit side of the nip between rollers 14 and 17. In practice, the wire 25a can be mechanically mounted on a suitable portion of the ink train frame (not shown) provided it is electrically insulated therefrom. However, other means (not shown) for supporting the wire 25a in proper position may be employed. In producing corona emission, higher voltages are required as wire diameter increases, therefore, it is preferred to employ a wire of small diameter to reduce power requirements, but of sufficient mechanical strength to be drawn taut. Steel wires having a diameter of from 0.004 to 0.064 inch were found satisfactory when located as shown and energized to the degree hereinafter more particularly described. In locating the wire 25a with respect to the adjacent rollers, it is desirable that it be as close thereto as is consistent with practical considerations, but not in electrical contact therewith, in order to have maximum electrical field strength between the wire 25a and the rollers 14 and 17, which rollers serve as grounded electrodes, as will hereinafter appear. Preferably, field strength between wire 25a and each roller 14 and 17 should be equal, and since, as hereinbefore described, roller 14 is steel and roller 17 is electrically insulated to some extent by a rubber cover 17a, it is necessary to place wire 25a closer to roller 17 than to roller 14 to obtain equalized field strength. Assuming, for example, wires of the diameter hereinbefore described and energization thereof to the degree hereinafter described, a distance of three-fourths of an inch between wire 25a and the surface of roller 14 and a distance of three-eighths of an inch between wire 25a and the surface of roller 17 are found to be quite satisfactory from the standpoint of effectiveness of mist control, current requirements, and practicality.

FIG. 3 shows schematically the electrical circuitry employed to effect energization of wire 25a. The voltage applied to wire 25a must be sufficiently high to produce corona emission therefrom capable of charging all ink mist particles in the vicinity and to create an electrical field strong enough to drive all of the charged ink particles back onto the rollers 14 and 17. The voltage required to effect this is related to wire diameter and its distance from the rollers. Assuming wire diameters hereinbefore described and location hereinbefore described, a voltage of the order of 15,000 to 20,000 volts with a current of approximately 0.5 milliamperes per foot of wire produces satisfactory results. The power applied to wire 25a may be supplied from a direct current source of either polarity or from an alternating current source.

As FIG. 3 shows, wire 25a is adapted to be energized either by alternating current to provide an alternating corona and electrostatic field or by direct current of either polarity to provide a positive or negative corona and electrostatic field. Alternating or positive or negative energization of wire 25a results in different corona effects, as will hereinafter appear.

FIG. 3 shows power supply lines L1 and L2 which may be assumed to be energized from a suitable source of alternating current power supply (not shown). A step-up transformer 30 whose primary winding 30a is connected across lines L1 and L2, is provided to afford a source of high voltage energization of the corona wire 25a. Corona wire 25a is adapted to be energized directly from the secondary winding 30b of transformer 30 through switch 31 to provide an alternating corona, or from the secondary winding 30b of transformer 30, through rectifier bridge 34, switch 36 and switch 31 to provide a direct current corona of either polarity.

The end terminals 30c and 30d of secondary winding 30b of transformer 30 are connected to the terminals 31b and 31a, respectively, of the normally open double pole, double throw knife switch 31. Blade 31c of switch 31 is connected to corona wire 25a and blade 31d is connected through conductor wire 40 to ground.

The end terminals 30c and 30d of secondary winding 30b of transformer 30 are also connected to the input terminals 34a and 34b, respectively, of the rectifier bridge 34 which is of the well known type and comprises four dry rectifiers 34e, 34f, 34g and 34h which are poled as shown in FIG. 3. The output terminals 34c and 34d of rectifier bridge 34, which may be assumed to be positively and negatively charged, respectively, are connected to the blades 36c and 36d, respectively, of the normally open double pole, double throw knife switch 36. The terminals 36a and 36b of switch 36 are connected to the terminals 36f and 36e, respectively, of switch 36 and the latter terminals are connected to the terminals 31e and 31f, respectively, of switch 31.

The conductors designated 38 and 39 which are connected to the rollers 14 and 17, respectively, indicate the connection of those rollers to grounded potential.

As will be understood, similar circuitry would be employed to effect energization of wires located at the positions 24, 26, 27, 28, 29 and 29a, in FIG. 1. If desired, conductor wires located at those positions and similar to wire 25a could be connected in parallel with wire 25a across the power supply, as will be apparent to those skilled in the art.

The invention operates as follows:

Assume that the printing press and the ink train thereof are in operation and that ink is being conveyed from roller to roller at such speed that ink mist is being produced at the location 24, 25, 26, 27, 28, 29 and 29a and is escaping from the nip area, as hereinbefore described. To simplify discussion, only the operative effect of wire 25a on the mist from rollers 14 and 17 will be hereinafter described in detail. Further assume the lines L1 and L2 are energized, that transformer 30 is energized therefrom,

that the switches 31 and 36 are both open and that wire 25a is not energized.

Suppression or control of the mist produced by rollers 14 and 17 is accomplished by effecting energization of wire 25a from either the alternating current source or the direct current source. When wire 25a is energized to a high electrical potential a corona discharge occurs therealong and, in addition, an electrical field is established between the wire and the rollers 14 and 17 which act as grounded electrodes.

The corona discharge is visible as a bluish glow in a limited region around the emitting surface of the wire. The glow is caused by intense ionization which produces large numbers of ions of both polarities. Ions with polarity opposite to that of the emitting surface of the wire are attracted to the emitting surface and are neutralized. Ions of the same polarity as the emitting surface of the wire are repelled from the emitting surface and form a region of ions of a single polarity beyond the glowing region. In their travel, many of the ions of single polarity bombard ink mist particles and the ions are captured by those particles. The charged ink mist particles are driven back onto the ink rolls by the forces exerted on the charged ink particles by the high voltage electrical field which exists between wire 25a and the two rollers 14 and 17, which rollers are at ground potential. In this manner, ink mist particles are forced back onto the rollers 14 and 17 before they have an opportunity to escape from the nip area.

Upon deenergization of wire 25a the effect ceases and ink particles again escape from the nip area as hereinbefore described.

A direct current "positive" corona (the term "positive" referring to the polarity of the ions in the corona) is produced by connecting wire 25a to the positive terminal 34c of rectifier bridge 34 and connecting the negative terminal 34d of the bridge 34 to ground. This is accomplished by closing switch 31 to the right-hand side so that blades 31c and 31d thereof make contact with contacts 31e and 31f thereof, respectively, and by closing switch 36 to the right-hand side so that blades 36c and 36d thereof make contact with contacts 36e and 36f thereof, respectively.

A direct current "negative" corona (the term "negative" referring to the polarity of the ions in the corona) is produced by connecting wire 25a to the negative terminal 34d of rectifier bridge 34 and connecting the positive terminal 34c of bridge 34 to ground. This is accomplished by closing switch 31 to the right-hand side so that blades 31c and 31d thereof make contact with contacts 31e and 31f thereof, respectively, and by closing switch 36 to the left-hand side so that blades 36c and 36d thereof make contact with contacts 36a and 36b thereof, respectively. The difference between a positive and negative corona is that positive discharge produces a continuous glow along wire 25a whereas negative discharge produces glow at discrete points along the wire. More important, however, a negative corona can be maintained at higher potential than a positive corona before arcing occurs and therefore might be preferred because efficiency of ink particle repulsion is dependent upon applied voltage.

Ink mist control can be effected by use of alternating current. To accomplish this, switch 36 is maintained open and the blades of knife switch 31 are moved in the left-hand direction to connect wire 25a to the end terminal 30d of secondary winding 30b of transformer 30 and to connect end terminal 30c to ground. The ink mist particles are forced back onto the rollers 14 and 17 as hereinbefore described except that ionization charges and field direction alterate at the frequency of the applied voltage and the efficiency of the A.C. system is somewhat lower.

The advantages of the hereinbefore described apparatus and method for effecting ink mist control or suppression are manifold. In operation, assuming proper location of the corona wire and adequate energization thereof, the

suppression of mist is almost 100 percent efficient. Furthermore, as is apparent, the installation is relatively simple from an electrical and mechanical standpoint and employs a minimum of components. In practice, only one source of power would be required depending upon whether D.C. or A.C. was found to be most suitable for individual needs. Since the present invention attacks the ink mist problem at its source and by preventing escape of the mist from the nip area, rather than by collection of mist already widely dispersed in the atmosphere, no waste ink collects or is precipitated which needs to be disposed of.

It will be apparent that the invention disclosed herein is applicable to control mist comprised of material other than ink and generated by roller couples employed in machines other than printing presses.

We claim:

1. In a printing press, a roller couple for transferring liquid material from one roller of the couple to the other, said couple when in operation causing minute particles of said liquid material in the form of a mist to be produced in the atmosphere adjacent the exit side of the nip of said couple which mist if not suppressed contaminates the surrounding atmosphere, and means for suppressing said mist to prevent the latter from contaminating the atmosphere comprising an electrical conductor disposed adjacent to said rollers of said couple and in relatively short spaced relation to the exit side of said nip, and means for applying a high electrical potential between said conductor and at least one roller of said couple to establish a corona discharge about said conductor and to establish an electrical field between said conductor and said roller of said couple, said corona discharge effecting electrical charging of said particles and said electrical field acting upon said charged particles to repel the latter back onto said roller.

2. In combination, a roller couple for transferring ink from one roller of the couple to the other, said couple when in operation tending to produce mist particles of said ink at the exit side of the nip of the couple, and electrically conductive means disposed adjacent to said couple but spaced apart therefrom on the exit side of the nip, said conductive means with said rollers electrically grounded being energizable to establish a corona discharge thereabout and to establish an electrical field between itself and said rollers, said corona discharge effecting electrical charging of said ink mist particles and said electrical field acting upon said ink mist particles when the latter are charged to force said particles back onto said rollers.

3. The combination according to claim 2, wherein said electrically conductive means comprises a wire which is disposed parallel to the nip of said roller couple and is spaced with respect to each of said rollers in said couple so that electrical fields of substantially equal strength exist between said wire and said roller.

4. The combination according to claim 3 together with a source of voltage and means for selectively connecting the same to said wire and ground to subject said wire to a potential with respect to ground creating a corona discharge thereabout, and the electrical field between said wire and said rollers.

5. The combination according to claim 3 wherein said source of voltage when connected to said wire and ground subjects said wire to a D.C. potential with respect to ground of a polarity creating a negative corona discharge about said wire.

6. In a printing press having an ink distribution system wherein ink is transferred from one roller to another, in combination, at least one roller couple for transferring ink from one roller of the couple to the other when the couple is in operation, said couple tending to produce ink particles at the exit side of the nip of the couple where the ink film splits which particles normally leave the nip area in the form of mist, at least one conductor disposed adjacent to and parallel to said nip on the exit side thereof but spaced apart from said rollers, and means to electrically energize said conductor

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to produce a corona effect thereabout and an electrical field between said wire and said roller couple, said corona effect further being accompanied by charging of said ink particles which charged ink particles when acted upon by said electrical field are propelled back onto said roller couple. 5

7. The method of suppressing ink mist produced by a high speed roller couple wherein ink is being transferred from one roller of the couple to the other, which comprises generating an electrical field between an energizable member and rollers of said couple in the vicinity of the exit side of the nip of the roller couple where said ink mist is produced and electrostatically charging the ink particles comprising said mist while said ink particles are present in said electrical field, said 10 15

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charge being of such polarity with respect to said electrical field that said ink particles are forced back onto said rollers.

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