An object of the invention is to provide a method of metering ink applied by a resilient form roller (90) to a printing plate (P). A metering roller (14) and a transfer roller (12) are positioned in pressure indented relation to form an ink metering nip (N). The metering roller (14) and transfer roller (12) are rotated such that adjacent surfaces move in the same direction to form a film (104) of ink on the transfer roller (12). An ink applicator roller (10) is positioned in pressure indented relation with the resilient form roller (90) and the ink transfer roller (12). The ink transfer roller (12) is rotated such that its surface speed is less than the surface speed of the ink applicator roller (10).
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INKER FOR NEWSPAPER PRESS

BACKGROUND OF INVENTION

To combat "ghosting", inkers for lithographic newspaper printing plates generally comprise four form rollers in rolling engagement with a printing plate, each of the form rollers receiving ink from one or more vibrator rollers in a train of rollers of varying diameters. Ink is usually delivered to the train of rollers over a doctor roller which oscillates into and out of engagement with a film of ink formed by a flexible doctor blade urged into engagement with the hard surface of an ink fountain roller by ink keys in an effort to vary the input of ink to conform to the output.

The multiple roller inkers require complex drive trains and are relatively expensive to operate because of the power required for rotating the rollers. Difficulty has been encountered in metering and applying ink uniformly to printing plates.

Inkers of the type disclosed in Patent Application Serial No. 918,228, filed June 23, 1978 entitled "REVERSIBLE NEWSPAPER PRESS", offered significantly improved ink metering and control because ink was continuously supplied to a single form roller by a variable speed transfer roller. The speed of the hard surfaced transfer roller could be adjusted to increase or decrease the volume of ink supplied to a
resilient surface on the form roller.

The present invention addresses the problem of reducing the power required to drive rollers at different speeds in an inker of the type disclosed in Serial No. 918,228 while retaining the improved metering capability which results from "slipping" the rollers.

SUMMARY OF THE INVENTION

The improved inker construction comprises a metering roller and a transfer roller one having a hard surface and the other having a resilient surface urged into pressure indented relationship. The metering roller is adapted to meter an excess of low viscosity ink at a flooded metering nip between the metering roller and the transfer roller such that a uniform film of ink is metered onto the surface of the transfer roller. The film of ink on the transfer roller is sheared and metered at a transfer nip between the transfer roller and an applicator roller. The speed differential between the applicator roller and the transfer roller permits slippage for forming a thin, smooth layer of ink on the applicator roller. The applicator roller applies ink to the form roller.

The applicator roller and the form roller are driven at approximately the surface speed of the printing plate which engages the form roller.

If the printing plate is hard, the form roller should have a resilient surface. To reduce power required for slipping rollers at the transfer nip, the applicator roller is provided with a hard surface and is driven at a greater surface speed than a resilient covered transfer roller against which it slips.

When two rollers are urged together in pressure
indented relation and rotated at equal surface speeds, the thickness of the ink films on the two rollers will be approximately equal. Thus, a transfer roller engaging a form roller will carry a thinner film than a transfer roller which engages an applicator roller which in turn engages a form roller, if the form roller carries a film of the same thickness in each instance. By slipping between the transfer roller and the applicator roller, rather than between the transfer roller and a form roller, lubrication is sufficient to reduce power required to meter the ink.

The applicator roller and the transfer roller are preferably smaller in diameter than the form roller to minimize the shear area of indentation at the transfer nip. Since the hard surface on the applicator roller is driven faster than the adjacent resilient surface on the transfer roller, the resilient surface moving into the transfer nip is maintained in tension to prevent excessive deformation of the resilient cover.

Variation in deformation of the resilient surface at the transfer nip results in variation of the stripe width and the shear area at the transfer nip.

When the portion of the resilient surface approaching the transfer nip is moving faster than the adjacent hard surface, the resilient surface is subjected to compressive loading and tends to wrap around the hard surface. This would increase the stripe width and increase the power required to slip one roller against the other because additional power is required to deform the resilient cover material.

In the preferred embodiment of our invention, the applicator roller is an idler roller in rolling engagement with the form roller. The transfer roller is driven by a variable speed motor at a slower surface speed than the applicator roller. Thus, the
applicator roller, in pressure indented relation with the faster driven form roller and the slower driven transfer roller, is driven at an intermediate speed such that most or all of the slippage occurs between the applicator roller and transfer roller. The surface speed of the applicator roller varies with changes in pressure between the applicator and transfer rollers, with changes in differential speed of the form roller and the transfer roller, and the thickness of the film of ink on the applicator roller and the transfer roller.

A primary object of the invention is to provide an inker wherein the ink film thickness is controlled by varying the surface speed of one form roller relative to the surface speed of an adjacent roller.

Another object of the invention is to provide an inker equipped with rollers having relatively small diameters to provide substantial indentation and pressure at a transfer nip while minimizing the stripe width and shear area between a transfer roller and an applicator roller.

Another object is to minimize the power required to slip one roller against another roller at an ink transfer nip by maintaining an ink film thickness adjacent the transfer nip to assure lubrication.

A further object is to provide a hard surfaced roller and a resilient surfaced roller in pressure indented relation to meter ink wherein the resilient surface moves slower than the hard surface to minimize deformation of the resilient surface at the nip.

A still further object of the invention is to provide a hard surfaced idler roller between a pair of resilient rollers, the resilient rollers having different surface speeds, to control the thickness
of an ink film applied to one of the resilient rollers. Other and further objects will become apparent upon referring to the following detailed description and the attached drawings.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Drawings of a preferred embodiment of the invention are annexed hereto so that the invention may be better and more fully understood, in which:

Figure 1 is a diagrammatic illustration of the inking system for a lithographic printing press illustrating the various films of ink and dampening fluid;

Figure 2 is a front elevational view illustrating the metering, transfer, and applicator rollers and support structure;

Figure 3 is a cross-sectional view taken along line 3-3 of Figure 3;

Figure 4 is a diagrammatic view of a standard printing unit;

Figure 5 is a diagrammatic view of a reversed printing unit;

Figure 6 is a diagrammatic view of the electrical hookup of the motors of dampening and inking units.

Numeral references are employed to designate like parts throughout the various figures of the drawing.

**DESCRIPTION OF A PREFERRED EMBODIMENT**

In Figure 1 of the drawing, the numeral 1 generally designates an ink applicator apparatus for applying ink and dampening fluid to a lithographic printing plate of a printing press. The water applicator 200 is a dampener of the type disclosed in United States Patent No. 3,937,141, entitled "DAMPENER FOR LITHOGRAPHIC PRINTING PLATES" which issued February 10, 1976 to Harold P. Dahlgren. The
disclosure of Patent No. 3,937,141 is incorporated herein by reference in its entirety for all purposes.

As best illustrated in Figure 2, ink applicator 1 comprises spaced side frames 2 and 4 joined by tie bars (not shown) forming a strong rigid structure for supporting form roller 90, ink applicator roller 10, ink transfer roller 12 and ink metering roller 14. Side frames 2 and 4 may be the side frames of a press or may comprise inker side frames connectable to side frames of a printing press.

Throw-off links 16 and 18 are pivotally secured by stub shafts 20 and 22 to the respective side frames 2 and 4. Throw-off cylinders 24 and 26 are pivotally connected between side frames 2 and 4 and throw-off links 16 and 18, respectively, for pivoting throw-off links 16 and 18 about stub shafts 20 and 22 for moving transfer roller 12 into position, as will be hereinafter more fully explained, for delivering ink over an applicator roller 10 to a form roller 90 in a lithographic printing system.

A skew arm 28 is mounted for pivotal movement of one end of a metering roller 14 about the axis of ink transfer roller 12. As diagrammatically illustrated in Figure 2, skew arm 28 is rotatably secured to stub shaft 30 extending between link 18 and skew arm 28 adjacent an end of ink transfer roller 12.

Skew arm 28 and throw-off link 16 have grooves 28a and 16a, respectively, formed in the inner surfaces thereof in which blocks 36, carrying self-aligning bearings 38, are slidably disposed. Blocks 35 are rigidly secured in the upper portion of grooves 28a and 16a by screws 37 to provide suitable support for shafts 31 and 32 of the ink transfer roller 12. Suitable means such as resilient springs 40 between blocks 35 and 36 urge blocks 36 longitudinally of skew
arm 28 and throw-off link 16 in a direction away from the longitudinal axis of transfer roller 12. A pressure adjustment screw 42 urges block 36 longitudinally of skew arm 28 and throw-off link 16 against the bias of springs 40. Stub shafts 44 and 46, extending outwardly from opposite ends of metering roller 14, are received in self-aligning bearings 38 to rotatably secure metering roller 14 in pressure indented relation with transfer roller 12. Stub shafts 31 and 32, extending outwardly from opposite ends of transfer roller 12, are received in bearings 39 in blocks 35.

It should be readily apparent that rotation of pressure adjustment screws 42 will move opposite ends of metering roller 14 relative to the axis of transfer roller 12 for controlling pressure between transfer roller 12 and metering roller 14.

As illustrated in Figure 3, suitable means is provided for establishing and maintaining a desired angular relationship between throw-off link 18 and skew arm 28. In the form of the invention illustrated in Figure 3, an adjusting screw 50 is rotatably secured to skew arm 28 and extends through threaded apertures in pivotal blocks 52a and 52b. Blocks 52a and 52b are pivotally secured to lug 54 on arm 28 and lug 56 on link 18. By adjusting screw 50, the spacing between lugs 54 and 56 is adjusted to move skew arm 28 relative to link 18 about shaft 30.

Side frames 2 and 4 have suitable adjustable stop means such as stop blocks 5 having set screws 5a extending therethrough for engaging throw-off links 16 and 18 when rods of throw-off cylinders 24 and 26 are extended for establishing a desired pressure relationship between the transfer cylinder 12 and an ink coated applicator roller 10 arranged to transfer ink over a form roller 90 in a lithographic or relief printing
plate 112 on plate cylinder P, as will be hereinafter more fully explained. Stop means such as stop blocks 6, having set screws 6a secured thereto, provide an "off-impression" limit when piston rods of throw-off cylinders 24 and 26 are retracted to move the transfer roller 12 away from the surface of applicator roller 10.

Stub-shaft 31, extending outwardly from the end of transfer roller 12, has a gear 60, rigidly secured thereto by a key 61, which is in meshing relation with a gear 62 secured on shaft 44.

Gear 62 is secured in meshing relation with gear 71 on shaft 58 which is rotatably secured through an opening in side frame 2. Shaft 58 is secured to the shaft of a reversible variable speed drive means such as a reversible variable speed electric gear-motor 69. It should be appreciated that gear-motor 69 may be replaced by other drive means such as gears, sprockets, or pulleys arranged to be driven from the printing press drive, preferably through a gear box or similar variable speed control apparatus.

Power supply line 80 is connected through a variable rheostat 84 to the terminals of motor 69 so that motor may be run at variable speeds to control the speed of rotation, and, consequently, the surface speeds of transfer roller 12 and metering roller 14 independently of the press drive. If it is deemed expedient to do so motor 69 could be replaced by a speed-variable coupling which connects shaft 58 to the press drive means, as hereinbefore described.

Suitable means is provided for delivering an abundant supply of ink to the ink metering nip N between adjacent surfaces of transfer roller 12 and metering roller 14. In the particular embodiment of the invention illustrated in Figure 1, a portion of the
surface of metering roller 14 is submerged in ink 14a in ink pan 14b.

Ink 14a preferably comprises a low viscosity ink such as the type employed for inking raised image areas in letter press printing or the type used in direct or offset lithographic printing or newsprint or similar materials.

Transfer roller 12 preferably comprises a hollow tubular sleeve having stub shafts 31 and 32 formed thereon. A resilient cover 12c is secured about the outer surface of the sleeve. The material of transfer roller 12 is selected so as to be oleophilic and the surface may be smooth or textured.

The metering roller 14 is preferably hard and has an exterior surface which may be smooth or textured and which is ink receptive or oleophilic. Ink metering roller 14 may, therefore, have an exterior surface of materials such as copper, steel or plastic. The surface of metering roller 14 may be either hard or resilient.

To reduce the tendency of ink to accumulate adjacent the ends of transfer roller 12, metering roller 14 is longer than transfer roller 12 such that ends of the metering roller 14 extend beyond the ends of transfer roller 12. The transfer roller 12 is preferably longer than applicator roller 10 which is in turn longer than form roller 90 to minimize accumulation of excess ink adjacent ends of form roller 90.

Form roller 90 is preferably cut to be the same length as the printing plate to also eliminate accumulation of excess ink which will tend to build on the form roll if longer than the printing plate.

Applicator roller 10 has a hard smooth surface similar to that on metering roller 14.
Referring to Figure 1 of the drawing, transfer roller 12 is preferably positioned in pressure indented relation with applicator roller 10. Applicator roller 10 preferably has a metal tubular core to the ends of which are secured stub shafts extending outwardly therefrom and rotatably journaled in bearings (not shown) carried by the side frames 2 and 4 which include means to urge applicator roller 10 into pressure indented relation with form roller 90.

Form roller 90 is preferably driven by a gear 90a in meshing relation with a gear 90b driven with the press and has a smooth resilient outer cover.

An ink storage roller 94a, preferably a vibrator roller, is adapted to remove ink from areas 128" from ink film 128 on the surface of form roller 90 and add the ink to the depleted areas 128' thereby creating a more uniform film of ink on the surface of roller 90 moving from the nip 120 toward nip A.

A second ink storage roller 94b, similar to roller 94a, is positioned between plate cylinder P and dampener 200 to smooth the ink film upon reversal of form roller 90 as will be more fully explained hereinafter.

A material conditioning roller 86, preferably a vibrator roller, is rotatably supported on shaft 86a in blocks 86d and is adapted to condition and smooth the surface of ink film 100 to make the film more receptive to accepting dampening fluid. Screws 86b and 86c are adapted to urge blocks 86d and roller 86 into pressure indented relation with form roller 90. The surface of material conditioning roller 86 is preferably of similar material to that of form roller 90 such that the surface has the same affinity for ink as does the surface of form roller 90.

As the ink film 100 emerges from the nip A between form roller 90 and applicator roller 10, it is slick, and calendared. A slick film of ink is not
particularly receptive to dampening fluid since the surface tension of the molecules of ink may reject the thin layer dampening fluid to be applied by dampener 200. Material conditioning roller 86 will receive a portion of the film 100 of ink thus splitting the film 100 of ink and producing a film 100' on roller 86 thus leaving film 100a with a matte finish having microscopic indentations. The matte finish on film 100a will more readily accept the thin layer of dampening fluid due to molecular attraction which is now greater than the surface tension of the dampening fluid forming a film 216.

Material conditioning roller 86 and ink storage rollers 94a and 94b are preferably constructed of diameters such that as they rotate, ink will be properly applied or extracted and redistributed on the surface of form roller 90.

Vibrator rollers 86, 94a and 94b are preferably provided with drive means (not shown) to oscillate the rollers in a longitudinal direction. Suitable oscillator drive means is well known to persons skilled in the printing art and further description is not deemed necessary. Rotation is provided through friction contact with adjacent surfaces.

Dampener 200 is diagrammatically illustrated in Figure 1 and comprises a hydrophilic transfer roller 210 on shaft 210a and a resilient metering roller 212 on shaft 212a, mounted in a similar manner to inker 1, as described in Patent No. 3,937,141. Metering roller 212 meters dampening fluid 214a from pan 214 onto transfer roller 210 through flooded nip Na. Water film controlled by pressure between rollers 210 and 212 forms a thin layer of dampening fluid 204 which is metered through dampening fluid transfer nip 106a onto the matte finish of ink film 100a on the surface of form roller 90.
Dampener metering roller 212 is driven by a variable speed reversible motor 269. As illustrated in Figure 6, rheostats 84 and 284 are connected to a suitable electrical supply and are connected to a pair of ganged double pole, double throw switches 81a and 81b to control the direction of motors 69 and 269.

The operation and function of the apparatus hereinbefore described is as follows:

Pressure between the ends of transfer roller 12 and metering roller 14 is adjusted by rotating pressure adjustment screws 42.

Since long rollers urged together in pressure relation tend to deflect or bend, pressure adjacent centers of such rollers is less than pressure adjacent ends thereof. Pressure longitudinally of rollers 12 and 14 is adjusted by rotating screw 50 and rotating skew arm 28 about the axis of transfer roller 12 to a position wherein a desired pressure distribution longitudinally of rollers 12 and 14 is obtained.

Adjustment screw 5a is positioned to engage throw-off links 16 and 18 for establishing a desired pressure between transfer roller 12 and applicator roller 10.

The surface speeds of rollers 12 and 14 are regulatable by manipulating rheostat 84 as has been hereinbefore explained.

Dampener 20 is adjusted in a similar manner as inker 1.

For the purpose of graphically illustrating the novel function and results of the process of the mechanism hereinbefore illustrated and described, a diagrammic view of the metering roller 14, the transfer roller 12, applicator roller 10 and the form roller 90 is shown in Figure 1. Ink and water films shown are exaggerated for clarity.

As shown in Figure 1, metering roller 14, when employed to deliver ink to a printing plate 112, is preferably a hard surfaced roller having a smooth
surface 14c thereon and has the lower side thereof immersed in ink 14a in pan 14. The metering roller 14 is preferably rotatably mounted in pressure indented relation with transfer roller 12, and the pressure between adjacent roller surfaces is adjusted by screw 42, as hereinbefore described, so that the surface of transfer roller 12 is actually impressed by the surface of roller 14 at ink metering nip N.

As the surface of roller 14 rotates toward the ink metering nip N between rollers 12 and 14, a relatively heavy layer 101 of ink is picked up and lifted on the surface of roller 14. At the point of tangency, or cusp area at the ink metering nip N, between the rollers 12 and 14, a bead 102 of ink is piled up forming an excess of ink. The greatness of the excess of ink forming bead 102 is regulated by virtue of the fact that excess ink will fall back into the pan. The bead 102 of ink becomes a reservoir from which ink is drawn by transfer roller 12. As rollers 12 and 14 rotate in pressure indented relation, a layer of ink is sheared and/or metered between adjacent surfaces of the two rollers separated by a thin lubricating layer of ink 103. Since transfer roller 12 has a smooth oleophillic surface thereon, a portion of the film 103 adheres to the surface of roller 12 to form a film 104, the remaining portion 105 on surface 14c being rotated back or fed back to the pan 14. The film of ink 104 is distributed on the surface of roller 12 by reason of the rotating, squeezing action between rollers 12 and 14 at their tangent point at ink metering nip N.

At application nip T, it will be observed that applicator roller 10 is impressed into the resilient surface of the transfer roller 12 and that the film of ink 104 on transfer roller 12 contacts ink film 107 on applicator roller 10. The outer surface of film 104
and the outer surface of the film of ink 107 on applicator roller 10 are urged together to create a hydraulic connection between roller 10 and roller 12 as they rotate in close relationship, but there is no physical contact between the roller surfaces.

It is an important fact to note that the relative thick film of ink 104 permits rollers 10 and 12 to be rotated at different surface speeds as will be hereinafter explained.

Preferably, the applicator roller 10 is driven by form roller 90 which is rotated by gear 90a at the same surface speed as the printing plate 112, and is rotated at a greater surface speed than the speed of roller 12. By regulating the differential surface speed between transfer roller 12 and applicator roller 10, the amount of ink transferred to the applicator roller 10 and applied to form roller 90 may be regulated.

Within limits, as will be hereinafter more fully explained, if the surface speed of transfer roller 12 is increased, the ink film 104 is presented at the ink transfer nip T at a faster rate then more ink is transferred to the surface of applicator roller 10, form roller 90 and to lithographic plate 112, and the opposite is true, if the surface speed of roller 10 is decreased.

The film of ink between adjacent surfaces of rollers 10 and 12 permits rollers 10 and 12 to be rotated at different surface speeds in sliding relationship, because the film of ink 104 actually provides lubrication which permits slippage between adjacent surfaces of rollers 10 and 12 without frictional deterioration. By reason of the slippage between rollers 10 and 12, the ink film 106a is metered and distributed by shearing the ink between adjacent surfaces of roller 10 and roller 12 to create ink film 106a. The thickness of ink film 106a is controlled by the pressure between metering roller 14 and transfer roller 12 and the speed of transfer roller 12.
If it is assumed that a film of ink one unit thick is applied to image areas on the printing plate, the film 216 on form roller 90 will probably be about two units thick, half being transferred to the plate 112 and half being retained as film 128' on the form roller 90. If film 100 is equal to film 216, film 106a would be three units thick because film 100 and film 107 are of approximately equal thickness since film 128' is combined with film 106a at nip A. Film 104, assuming no slippage, would be four units thick and film 106b would be three units thick. Therefore, it should be apparent that 33% of the ink is removed from applicator roller 10 at nip A while only 25% is removed from transfer roller 12 at nip T and more ink is available at nip T to provide lubrication than at nip A. Less power is required to slip between roller surfaces at nip T than is required at nip A.

Transfer roller 12 preferably is driven at a surface speed which is within a range of for example, several hundred feet per minute slower than the surface speed of applicator roller 10 and form roller 90. For example, if a printing press has paper traveling there-through at a surface speed of 1200 feet per minute, the surfaces of printing plate 112, form roller 90, and applicator roller 10 will ordinarily have surface speeds of 1200 feet per minute. The transfer roller 10 would preferably rotate at a surface speed less than 240 feet per minute.

Ink films 106a and 130 will be combined at ink application nip A and will split when sheared as rollers 10 and 90 rotate away from ink application nip A. The fresh film 100 of ink adheres to the surface of form roller 90. Ink rejected by form roller 90 forms a feedback film 107 of ink which may be slightly irregular which adheres to the surface of applicator roller 10 and is conveyed back to the nip T to be re-metered.
Material conditioning roller 86 splits film 100, taking on a film 100' to produce a matte finish on ink film 100a. Any irregularities or streaks in film 100 will be spread and equalized to form film 100a of very uniform thickness.

The interface tension between the outer surface of the less viscous dampening fluid film 204, by reason of molecular attraction between the surface of the more viscous ink film 100a, causes a portion 216 of the smooth and regulated film 204 of dampening fluid to be added to the surface of ink film 100a, which in turn is transferred to the plate at the tangent point between the plate 112 and form roller 90 at inking nip 120.

The lithographic printing plate 112 has hydrophillic, or water liking, non-image areas 121 and oleophillic, or ink receptive, image areas 122 formed on the surface thereof. If printing plate 112 is provided with raised image areas, the dampener 200 would not be required to prevent transfer of ink to non-image areas.

At the nip 120 between form roller 90 and printing plate 112, the ink film 100 or 216 is split, forming thin films 125 of ink and water over oleophillic surfaces 122 on the printing plate. The layer 216 of dampening fluid, if dampening fluid is employed, is carried on and in the film 100 of ink and is also distributed to form a thin film 216 of dampening fluid over hydrophillic areas 121 of the printing plate.

No appreciable amount of dampening fluid remains on the surface of form roller 90 which is moving away from the nip 120, but such dampening fluid as does remain thereon is transferred with the ink film 128 to the ink film 130a on the ink storage roller 94a where the dampening fluid can be dissipated and/or evaporated to such an extent as to be of no consequence in the inking system.
Ink of film 128 remaining on form roller 90 is combined with film 130a on ink storage roller 94a and split and collected on roller 94a. Ink on roller 94a is added to depleted areas 128' in film 128 thus reducing the effect of ghosting and areas in film 128 by forming a more uniform film 130 before re-entering nip A.

The layer of dampening fluid 216 is applied in substantially the same manner. An excess of dampening fluid 202 is supplied to bead 202 to form a film 204 of dampening fluid which is applied to ink film 100a on form roller 90 at nip 106a. The film 217 of dampening fluid is returned to bead 202 to be re-metered at nip Na.

From the foregoing it should be readily apparent that the improved apparatus for applying ink to printing systems offers control of metering at ink metering nip N to provide a film 104 of ink of precisely controlled thickness by adjusting pressure between transfer roller 12 and metering roller 14 and further by controlling surface speeds of the rollers relative to each other. The rate at which the metered film 104 of ink is offered to film 107 of ink on applicator roller 10 at ink transfer nip T and also the hydraulic force for obtaining the desired film thickness is controlled.

Figure 4 illustrates a pair of inkers 1 used in the standard configuration to print on both sides of a web W. A printing unit U generally has a pair of printing couples C each of which comprise an inker unit 1 and dampener unit 200. If it is necessary to print two colors on one side of web W, then the right hand couple C as viewed in Figure 5 must be reversed such that the web W may be routed for printing on a single side. In reversing the direction of the form roller 90, dampening fluid will be applied over the thin ghosted film of ink leaving the plate 112 after ink storage roller 94b even the ink film to some extent. A fresh supply of ink will be added to the dampening fluid and ink on
form roller 90 as the roller 90 moves through nip A. Thus, the couple C may be reversed by simply reversing the drive to the couple and motors 69 and 269.

It should be readily apparent that the films of ink and dampening fluid illustrated in Figure 1 represent a standard printing couple moving in the normal or standard direction and that their films would change in location from those illustrated should the couple be reversed to apply dampening fluid first and ink on the dampening fluid.

Referring to Figure 1, our improved method of metering ink generally comprises positioning a metering roller 14 and transfer roller 12 in pressure indented relation to form an ink metering nip N and rotating the ink metering roller 14 and the ink transfer roller 12 such that adjacent surfaces move in the same direction to form a film 104 of ink on the transfer roller 14. Ink applicator roller 10 is positioned in pressure indented relation with the resilient form roller 90 and the ink transfer roller 14 and is rotated so that the surface speed thereof is substantially equal to the surface speed of form roller 90 and printing plate 112. The ink transfer roller is rotated such that the surface speed thereof is substantially less than the surface speed of the ink applicator roller 10, for example less than 20%, to ensure that ink is not accumulated to flood the ink transfer nip T.

The resilient transfer roller 12 is rotated at a surface speed less than the surface speed of the hard applicator roller to maintain that portion of the resilient surface on the transfer roller 12 which is moving to the ink transfer nip T in tension. The radius of the portion of the resilient surface on the transfer roller 12 entering the ink transfer nip T is probably less than the radius of the portion exiting said ink transfer nip T. Thus, power is not consumed to unnecessarily deform the resilient roller surface.
Transfer roller 12 and applicator roller 10 have a smaller radius than the form roller such that the width of the transfer nip $T$ is less than the width of the application nip $A$ when the transfer roller surface is indented equal distances into the form roller 90 at the application nip $A$ and into the transfer roller 12 at the transfer nip $T$. 
Having described our invention we claim:

1. A method of metering ink which is to be applied by a resilient form roller to a printing plate wherein the resilient form roller is rotated such that its surface speed is substantially equal to the surface speed of the printing plate, the improvement comprising: positioning a metering roller and a transfer roller in pressure indented relation to form an ink metering nip; supplying ink at said ink metering nip; rotating said metering roller and said transfer roller such that adjacent surfaces move in the same direction to form a film of ink on the transfer roller; positioning an ink applicator roller in pressure indented relation with the resilient form roller and the ink transfer roller; rotating the ink transfer roller such that the surface speed thereof is less than the surface speed of the ink applicator roller.
2. An inker for a printing press wherein ink of low viscosity is applied to a printing plate, the inker comprising: a form roller having a resilient surface; positive drive means to rotate said form roller; an applicator roller having a hard surface; means urging the hard surface on said applicator roller into pressure indented relation with said resilient surface on said form roller to form an application nip; a transfer roller having a resilient surface; means to form an ink film on said resilient surface of said transfer roller; means urging said hard surface on said applicator roller into pressure indented relation with said transfer roller to form an ink transfer nip; and means rotating said transfer roller at a surface speed less than the surface speed of said applicator roller.

3. An inker for a printing press according to Claim 2, said transfer roller and said applicator roller having a smaller radius than said form roller such that the width of the transfer nip is less than the width of the application nip when the transfer roller surface is indented equal distances into the form roller at the application nip and into the transfer roller at the transfer nip.

4. An inker for a printing press according to Claim 2, said means to form an ink film on said resilient surface of said transfer roller comprising: a metering roller having a hard surface urged into pressure indented relation with said transfer roller; and means rotating said metering roller and said transfer roller such that adjacent surfaces move in the same direction.
5. An inker for a printing press according to Claim 2, said means rotating said transfer roller comprising: variable speed drive means.

6. An inker for a printing press according to Claim 2, said applicator roller being an idler roller driven by force transmitted from said form roller at said application nip.

7. An inker for a printing press according to Claim 2, with the addition of a first ink storage roller in pressure indented relation with said form roller removing excess ink from the portion of the surface of the form roller which is moving from engagement with the printing plate and toward said application nip and applying excess ink removed to portions of the surface of the form roller which is depleted of ink; and a second ink storage roller in pressure indented relation with the portion of form roller which is moving from the application nip to the printing plate.
INTERNATIONAL SEARCH REPORT

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) *

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl. 3B41F 31/06; B41F31/12; B41F31/36; B41F7/36; B41L27/14

U.S. Cl. 101/351; 101/352; 101/353; 101/354; 101/355; 101/356; 101/357; 101/358; 101/359; 101/360

II. FIELDS SEARCHED

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III. DOCUMENTS CONSIDERED TO BE RELEVANT 14

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<td>US A, 3,552,311, Published 05 January 1971 Petri</td>
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<td>1-4</td>
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<td>US A, 3,647,525, Published 07 March 1972 Dahlgren</td>
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<tr>
<td>X</td>
<td>US A, 3,937,141, Published 10 February 1976 Dahlgren</td>
<td>1-4</td>
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<td>US A, 3,986,452, Published 19 October 1976 Dahlgren</td>
<td>1-4</td>
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<td>X</td>
<td>US A, 3,673,959, Published 04 July 1972 Jezuit et al</td>
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<td>X</td>
<td>US A, 4,127,067, Published 28 November 1978 Dahlgren et al</td>
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* Special categories of cited documents: 16

"A" document defining the general state of the art

"E" earlier document but published on or after the international filing date

"L" document cited for special reason other than those referred to in the other categories

"O" document referring to an oral disclosure, use, exhibition or other means

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"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention

"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search 4: 15 July 1980

Date of Mailing of this International Search Report 4: 18 JUL 1980

International Searching Authority 1

ISA/US

Signature of Authorized Officer 18: [Signature]

J. Reed Fisher

Form PCT/ISA/210 (second sheet) (October 1977)