

May 11, 1943.

M. WILSON

2,319,174

METHOD OF AND APPARATUS FOR PRINTING

Filed June 23, 1942

2 Sheets-Sheet 1

Fig. 1,

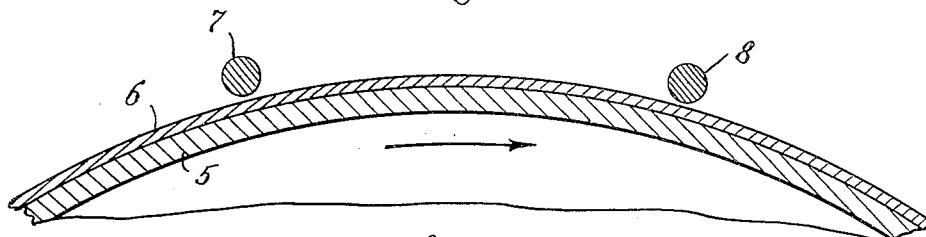


Fig. 2,

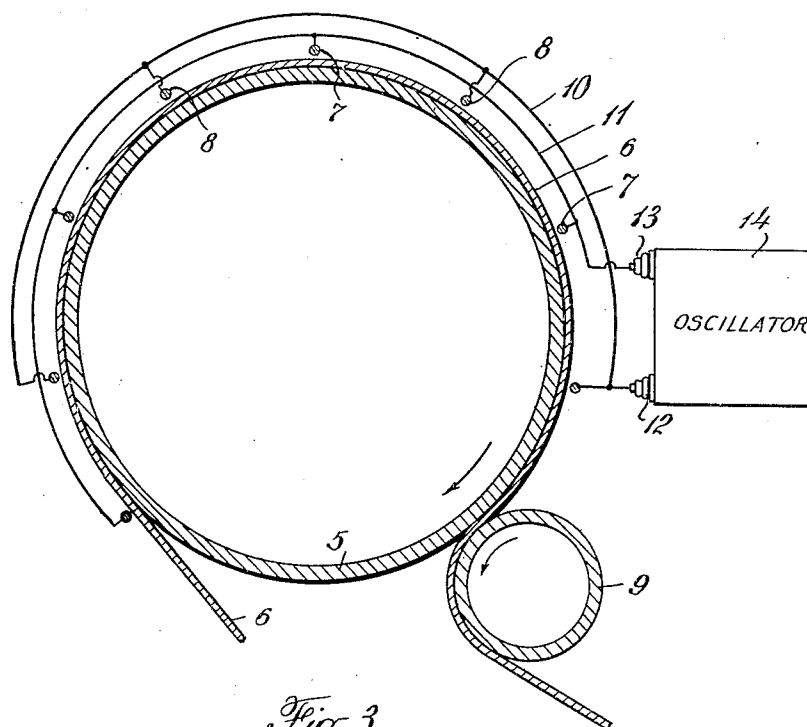
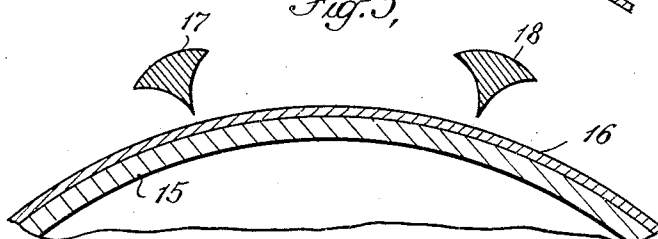


Fig. 3,



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2 Sheets-Sheet 2

Fig. 4.

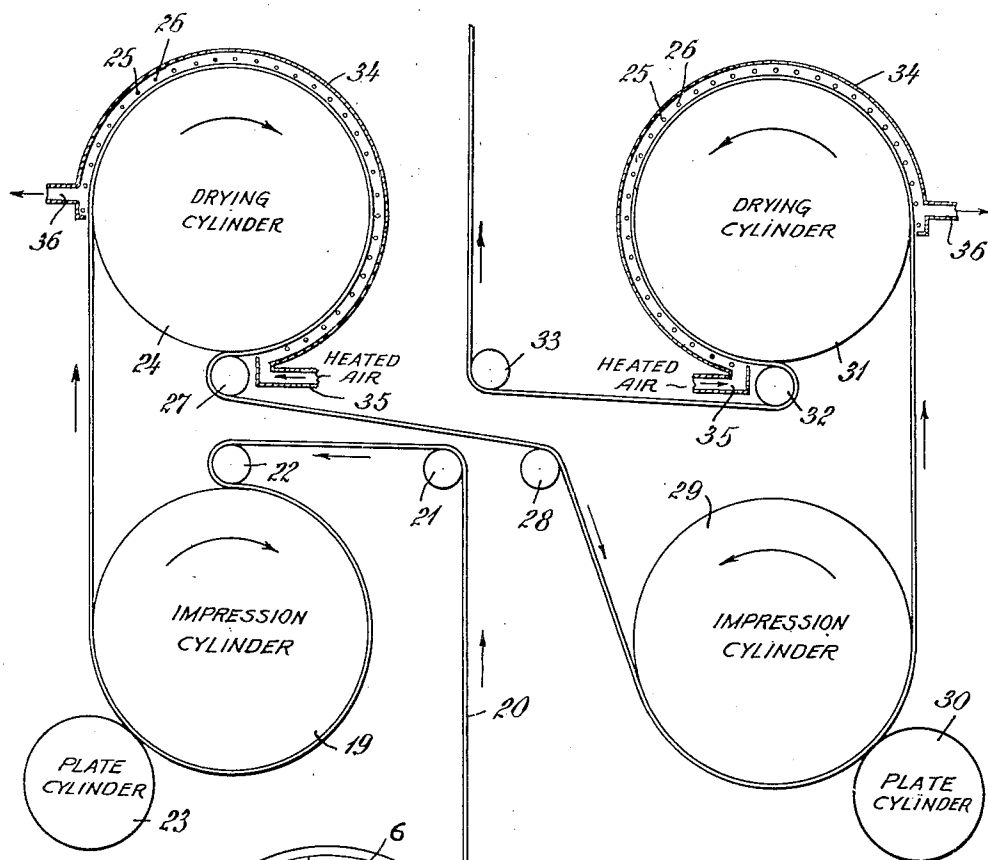
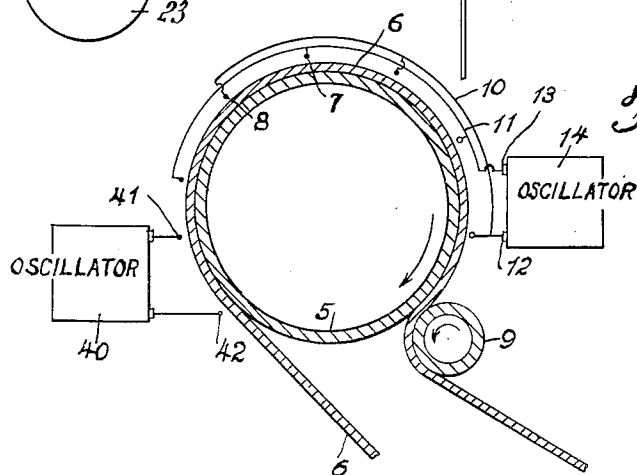


Fig. 5.



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METHOD OF AND APPARATUS FOR
PRINTING

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Application June 23, 1942, Serial No. 448,166

10 Claims. (Cl. 34-1)

This invention relates to printing and particularly to the drying of printed impressions on sheets and webs of paper or other printed material.

For many years, the ink used in letterpress printing included oils such as linseed oil which dried by oxidation. Since the oxidation of the oil vehicle proceeds rather slowly, it was necessary to insert slip sheets between the printed sheets to avoid offset and smudging. In web perfecting presses, a traveling offset web was employed to prevent smudging of the first side impression.

An improvement has been effected in recent years by utilizing quick drying inks having a vehicle composed of a suitable resin and a volatile solvent. Impressions with such inks are dried rapidly by subjecting the printed material to heat, either by passing the material over a steam-heated drum or in proximity to a heating flame. The procedure has advantages and also the disadvantage that the printed material may be subjected to overheating and possible injury. Much energy is consumed wastefully in heating the material for no useful purpose, since the ink film alone requires heat for drying.

It is the object of the present invention to provide a simple and effective method and apparatus wherein only the ink film is subjected to any substantial heating effect, and the heat is developed and applied in an efficient and dependable manner to quickly dry the ink film.

Another object of the invention is the provision of a method and apparatus for drying ink films on sheets or webs while traveling and to remove volatile constituents from the vicinity of the material, thus avoiding condensation of such constituents.

A further object of the invention is the most effective application of an alternating electrostatic field unaccompanied by corona discharge to a printed surface to develop heat directly in the ink film for the purpose of drying the film without substantially heating the paper or oxidizing the volatilized constituents of the ink.

Other objects and advantages of the invention will be apparent as it is better understood by reference to the following specification and the accompanying drawings, in which

Fig. 1 is an enlarged diagrammatic illustration of the application of the invention;

Fig. 2 is a sectional view illustrating the practical application of the electrodes in drying the ink film on a sheet or web while passing over a revolving drum;

Fig. 3 is an enlarged diagrammatic view illustrating another form of the electrodes;

Fig. 4 is a diagram showing the application of the invention to a web perfecting press; and

Fig. 5 is a view similar to Fig. 2 illustrating a modified form of the invention.

The use of alternating electrostatic fields of high frequency has been suggested heretofore for heating various materials, and the application of the principle to printing by subjecting the printed material to the stray field externally of the region between the electrodes has been described. This procedure is, however, very ineffective and exceedingly wasteful because the major part of the current available is not utilized for the intended purpose.

When two spaced electrodes are connected to opposite poles of a source of high frequency alternating current such as a suitable oscillator, an electrostatic field unaccompanied by corona discharge is set up between the electrodes. The field is concentrated in the plane of the two electrodes, and the stray field is comparatively weak and ineffective. If a sheet or web having printed impressions of a suitable ink is moved through the region of highest voltage gradient in a direction substantially parallel to the field direction, the maximum heating effect is secured and the ink impressions are rapidly heated and dried. This may be accomplished readily by moving the sheet or web tangentially to the plane of the electrodes so that it travels through the region of highest voltage gradient. By multiplying the pairs of electrodes and causing the sheet or web to travel in an arc tangential to the planes of the respective pairs of electrodes, the heating effect may be multiplied and the desired drying accomplished rapidly and successfully. The electrodes may all be supplied with current at the same frequency, which frequency may be modulated by still other frequencies, or, if desired, different pairs of electrodes may carry current at different frequencies. The frequencies are readily regulated by means of an oscillator or oscillators of well known construction.

The purpose of the invention is accomplished by providing a rotating cylinder of suitable dimensions with a surface of low loss dielectric material. About the periphery of the drum, one or more pairs of electrodes are supported in insulated and spaced relation. The electrodes may be wires of circular cross-section, though it may be desirable to use electrodes of semi-circular cross-section with the flat surfaces disposed toward the surface of the drum to assure greater concentration of the field. The drum is adapted to carry the material bearing the printed impression tangentially through the field of highest voltage gradient, that is, through the plane of the electrodes. The electrodes are properly connected to a suitable oscillator to provide current of the desired frequency.

Referring to Fig. 1 of the drawings, 5 indicates a cylinder of substantial diameter over which

the sheet or web 6 is carried in the direction indicated by the arrow. 7 and 8 represent electrodes of circular cross-section which may be suitably supported in insulated relation at one side of and slightly spaced from the surface of the sheet or web 6 so as to have no contact therewith. The electrodes 7 and 8 are positioned sufficiently close to the arcuate path of the sheet or web 6 as it passes over the cylinder 5 that a straight line extending between the electrodes will be substantially tangent to such arcuate path, with the result that the sheet or web with the printed impression thereon passes through the portion of highest voltage gradient of the electrostatic field set up when the electrodes 7 and 8 are connected to a source of high frequency alternating current.

In practical application of the invention as illustrated in Fig. 2, the cylinder 5 is mounted for rotation on its axis and the sheet or web 6 is fed at one side thereof and withdrawn at the other around an idler roll 9. A plurality of pairs of electrodes 7 and 8 are spaced about the periphery of the cylinder 5 and are connected by conductors 10 and 11 to opposite poles 12 and 13 of an oscillator 14 which may be of any suitable construction. The details of such devices are well known in the art and further description thereof is unnecessary. One or more oscillators may be provided, depending upon whether or not it may be desirable to supply current at different frequencies to different pairs of electrodes 7 and 8. When the printed impression on the sheet or web 6 is thus subjected repeatedly to the electrostatic field between each pair of electrodes 7 and 8, the ink constituting the impressions is raised to a sufficient temperature to rapidly volatilize the volatile constituents and thus to dry the ink before the sheet or web leaves the drum 5.

In Fig. 3 of the drawings, a variation of the structure shown in Fig. 1 is illustrated, in which the drum 15 carries the sheet or web 16 in the direction indicated by the arrow. Instead of being circular in cross-section, the focusing electrodes 17 and 18 are bars with concave surfaces facing the surface of the drum 15. The concave surfaces are approximately $\frac{1}{4}$ of a circle with a radius of $\frac{1}{4}$ of the distance between the bases of the electrodes. The advantage of this construction is that the curved surfaces of the electrodes serve to concentrate the field into the region between such surfaces, thus affording a sharply defined region in which the highest field intensity is maintained. Since the heating effect is proportional to the square of the voltage gradient, the movement of the printed impression tangentially to the field defined by the curved surfaces of the electrodes 17 and 18 ensures maximum effectiveness in the application of the invention.

While the invention may be utilized to dry printed impressions on sheets which may be caused to pass over a revolving drum in the manner well known in the printing art, the most desirable application of the invention occurs in web presses and particularly in web perfecting presses in which a second side impression is made directly following the drying of the first side impression. In Fig. 4 of the drawings, I have illustrated the application of the invention to a web perfecting press to permit drying of both impressions. Obviously, if desired, the drying of the second side impression may be omitted.

Referring to Fig. 4, 19 indicates the first side impression cylinder to which a web 20 is fed over

idler rolls 21 and 22. A single plate cylinder 23 is shown, but the number of plate cylinders may be multiplied as in the case of color printing.

The web 20, bearing the first side impression, is delivered to the drying cylinder 24 which is provided with pairs of electrodes 25 and 26 spaced and insulated from each other as hereinbefore described. The electrodes 25 and 26 may be connected to a suitable oscillator as illustrated in Fig. 2 of the drawings. After being subjected to the heating effect of the electrostatic fields produced between the electrodes 25 and 26, the web passes over the idler rollers 27 and 28 to the second side impression cylinder 29. A plate cylinder 30 is provided to produce the second side impression. The web then passes to the second drying cylinder 31 which, as in the case of the drying cylinder 24, is provided with electrodes 25 and 26 spaced and insulated and connected to a source of high frequency alternating current such as a suitable oscillator. The second side impression is thus subjected to the heating effect of the electrostatic fields between the pairs of electrodes 25 and 26. The web is withdrawn over idler rolls 32 and 33, the impressions on both sides being dry.

Since vapor produced by the heating effect is likely to be cooled and condensed, it is desirable to provide for the removal of such vapor. To facilitate this purpose, the cylinders 24 and 31 may be provided with housings 34 of suitable low loss dielectric material, partially enclosing the cylinders. Air or other gas, preferably heated and maintained at least to the dewpoint of the vapors, is introduced through inlets 35 and passes about the cylinders 24 and 31 in the direction opposite to the direction of rotation thereof. The presence of the electrodes 25 and 26 ensures turbulence which facilitates the removal of the vapors with the heated air or other gas which escapes through outlets 36. These outlets may be connected to any discharge system to deliver the vapors from the pressroom.

In Fig. 5 of the drawings, a further variation of the invention is shown in which a second oscillator 40 is connected to the last two electrodes 41 and 42 and is adapted to supply those electrodes with a current of a different frequency from that supplied to the electrodes 7 and 8 by the oscillator 14. In other respects the form of the invention illustrated in that figure is the same as the form of the invention illustrated in Fig. 2, and like reference characters designate similar parts.

In accordance with the invention as described, drying of the ink films is effected at low temperatures and without subjecting the impression-bearing material to any substantial rise in temperature, since the heat is concentrated in the ink film. Thus all danger of overheating the paper or other material, with its attendant disadvantages, is avoided. Likewise oxidation of solvent vapors is avoided and the difficulties incident thereto in the application of excessive heat to quick drying inks are eliminated.

The invention is applicable to use with both oil and solvent type inks including ink formulae now well known in the art. The particular inks form no part of the present invention. Inks formulated particularly to facilitate the application of the invention and capable of effecting a further improvement in printing when utilized therewith have been developed and will form the subject matter of further applications.

Various changes may be made in the form and

arrangement of the apparatus and in the procedure without departing from the invention or sacrificing any of its advantages.

I claim:

1. The method of drying sheets or films which comprises moving the sheet or film to be dried in an arcuate path, setting up an electrostatic field unaccompanied by corona discharge by connecting spaced electrodes to a source of high frequency alternating current of electricity, which electrodes are positioned at one side of and sufficiently close to said arcuate path that a straight line extending from one electrode to the other is substantially tangent to said arcuate path, whereby the sheet or film to be dried passes through the portion of the electrostatic field of highest voltage gradient.

2. The method of drying sheets or films which comprises moving the sheet or film to be dried in an arcuate path, setting up a plurality of successive electrostatic fields unaccompanied by corona discharge by connecting spaced electrodes to a source of high frequency alternating current of electricity, which electrodes are positioned at one side of and sufficiently close to said arcuate path that straight lines extending between adjacent electrodes are substantially tangent to said arcuate path, whereby the sheet or film to be dried successively passes through the portions of the electrostatic fields of highest voltage gradient.

3. The method of drying sheets or films which comprises moving the sheet or film to be dried in an arcuate path, setting up a plurality of successive electrostatic fields of varying frequency, each unaccompanied by corona discharge, by connecting spaced electrodes to sources of high frequency alternating currents of electricity of different frequencies, which electrodes are positioned at one side of and sufficiently close to said arcuate path that straight lines extending between adjacent electrodes are substantially tangent to said arcuate path, whereby the sheet or film to be dried successively passes through the portions of the electrostatic fields of highest voltage gradient.

4. The method of drying sheets or films which comprises moving the sheet or film to be dried in an arcuate path, setting up an electrostatic field unaccompanied by corona discharge by connecting spaced electrodes to a source of high frequency alternating current of electricity, which electrodes are positioned at one side of and sufficiently close to said arcuate path that a straight line extending from one electrode to the other is substantially tangent to said arcuate path, whereby the sheet or film to be dried passes through the portion of the electrostatic field of highest voltage gradient, and withdrawing vapors from the surface of the material.

5. The method of drying sheets or films which comprises moving the sheet or film to be dried in an arcuate path, setting up an electrostatic field unaccompanied by corona discharge by connecting spaced electrodes to a source of high frequency alternating current of electricity, which electrodes are positioned at one side of and sufficiently close to said arcuate path that a straight line extending from one electrode to the other is substantially tangent to said arcuate path, whereby the sheet or film to be dried passes through the portion of the electrostatic field of highest voltage gradient, and moving a current of heated gas over the surface of the material to withdraw vapors therefrom.

6. In an apparatus for drying sheets or films, a rotatable cylinder having a periphery of low loss dielectric material, a pair of insulated spaced electrodes and means for supplying high frequency alternating current to the electrodes, said electrodes being disposed adjacent to and extending longitudinally of the cylinder so that a straight line connecting said electrodes is substantially tangential to the periphery of the cylinder and a sheet or film carried on the periphery of the cylinder will pass through the portion of highest voltage gradient of the electrostatic field set up between said electrodes.

7. In an apparatus for drying sheets or films, a rotatable cylinder having a periphery of low loss dielectric material, a plurality of pairs of insulated spaced electrodes and means for supplying high frequency alternating current to the electrodes, said electrodes being disposed adjacent to and extending longitudinally of the cylinder so that a straight line connecting said electrodes is substantially tangential to the periphery of the cylinder and a sheet or film carried on the periphery of the cylinder will pass through the portion of highest voltage gradient of the electrostatic field set up between said electrodes.

8. In an apparatus for drying sheets or films, a rotatable cylinder having a periphery of low loss dielectric material, a plurality of pairs of insulated spaced electrodes and means for supplying high frequency alternating current to the electrodes, said electrodes being disposed adjacent to and extending longitudinally of the cylinder so that a straight line connecting said electrodes is substantially tangential to the periphery of the cylinder and a sheet or film carried on the periphery of the cylinder will pass through the portion of highest voltage gradient of the electrostatic field set up between said electrodes, means extending about the electrodes and with the cylinder affording a closed space, and means for maintaining a current of gas through the space.

9. In an apparatus for drying sheets or films, a rotatable cylinder having a periphery of low loss dielectric material, a plurality of pairs of insulated spaced electrodes of circular cross-section and means for supplying high frequency alternating current to the electrodes, said electrodes being disposed adjacent to and extending longitudinally of the cylinder so that a straight line connecting said electrodes is substantially tangential to the periphery of the cylinder and a sheet or film carried on the periphery of the cylinder will pass through the portion of highest voltage gradient of the electrostatic field set up between said electrodes.

10. In an apparatus for drying sheets or films, a rotatable cylinder having a periphery of low loss dielectric material, a plurality of pairs of insulated spaced focusing electrodes and means for supplying high frequency alternating current to the electrodes, said electrodes being disposed adjacent to and extending longitudinally of the cylinder so that a straight line connecting said electrodes is substantially tangential to the periphery of the cylinder and a sheet or film carried on the periphery of the cylinder will pass through the portion of highest voltage gradient of the electrostatic field set up between said electrodes.

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