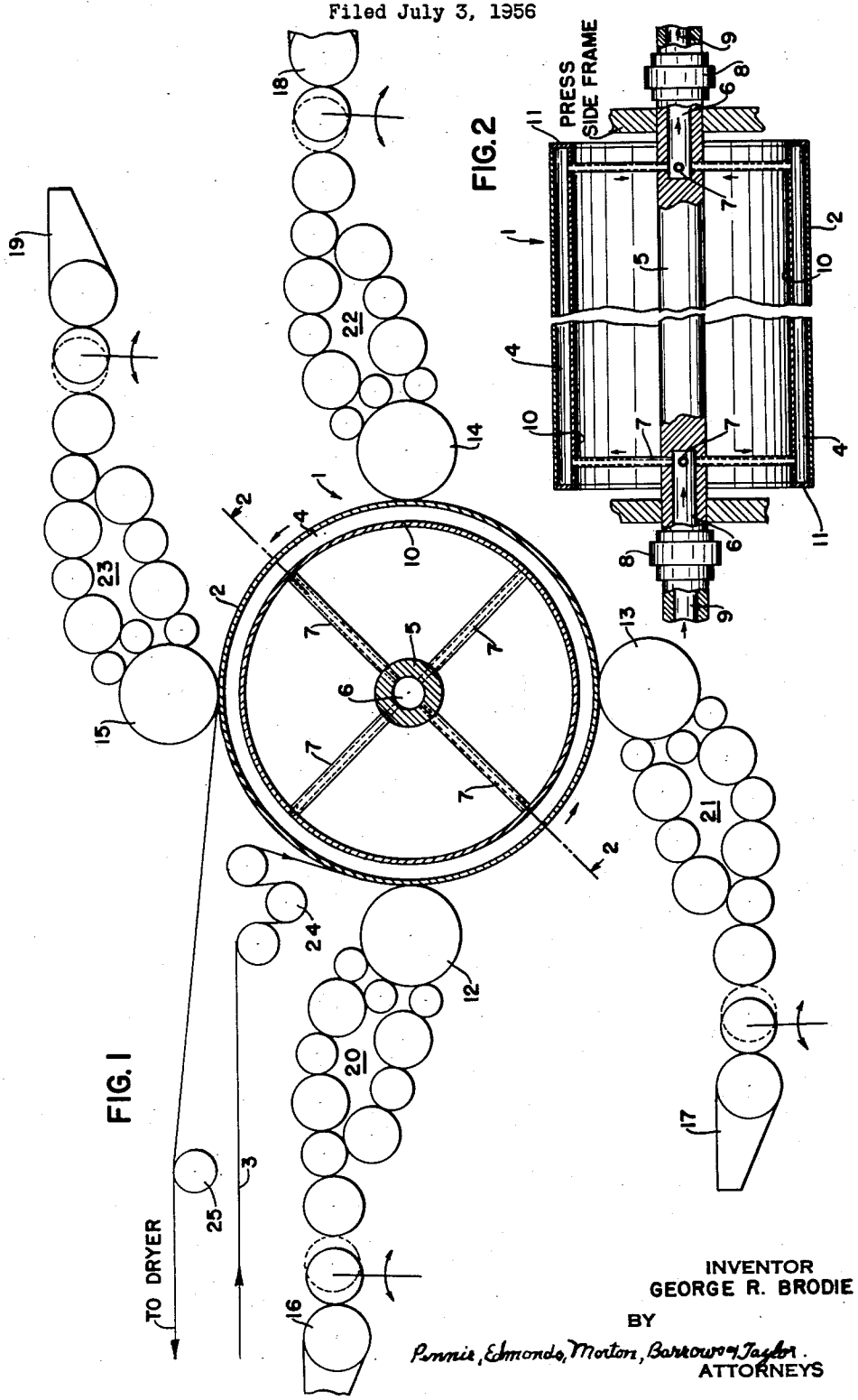
June 27, 1961 G. R. BRODIE 2,989,917

MULTI-COLOR PRINTING PROCESS

Filed July 3, 1956



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United States Patent Office 2,989,917 Patented June 27, 1961

2,989,917

MULTI-COLOR PRINTING PROCESS

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Filed July 3, 1956, Ser. No. 595,612
3 Claims. (Cl. 101—211)

This invention relates to multi-color printing and more particularly to multi-color printing operations of the type in which a plurality of impressions of inks of different color are applied in rapid succession to a web as it passes about a common impression cylinder.

The invention is especially applicable to such multi-color letter press printing and will be described with particular reference thereto. However, the invention is also applicable to offset printing in which the impressions are applied to the web by means of cylindrical blankets operating in contact with the respective cylindrical printing plates.

In letter press printing operations, of the type to which the present invention relates, normally liquid inks of the respective colors, and containing substantial proportions of volatile solvent, are passed from separate ink fountains, over separate trains of ink transfer and spreading rolls, to the respective plate cylinders positioned about the circumference of a common impression cylinder about which the web is rapidly passed in contact with the respective printing plates in rapid succession, and is passed from the impression cylinder, after the final impression has been made thereon, to a drier by means of which the volatile solvent is evaporated from the ink and the composite ink impression set and dried on the web.

It would be understood, of course, that there is affixed to each plate cylinder a plate designed to apply ink of a particular color to the required areas of the print, either contiguous to, or superimposed upon, an area to which ink of a different color has been previously applied and is still in an undried condition.

It is essential to high quality printing by this method that the successively applied films of ink adhere uniformly to the previous applied ink films and that the previously applied ink not be picked up by, or transferred to, a plate carrying ink of a different color subsequently passed in contact therewith.

The phenomenon by which such objectionable lifting of the ink from the web is inhibited is commonly referred to as trapping. Trapping is effected when the ink film on the web is sufficiently more tacky than the ink film on the plate passing in contact with the previously applied impression on the web.

In order to effect this trapping, it has been necessary for the ink-maker to supply to the printer inks of different degrees of tackiness varying with the color of the ink. The first ink to be applied to the web, e.g. yellow, has been the most tacky. The next color to be applied, e.g. red, has been somewhat less tacky. The next color, e.g. blue, has been even less tacky and the last applied ink, e.g. black, has been the least tacky.

This variation in tackiness, from color to color, has been considered necessary, as previously noted, where a film of ink of one color is being superimposed upon a film of wet ink of a different color so that the subsequently applied ink film will adhere uniformly to the previously applied, still wet, ink film rather than having the previously applied ink or a portion thereof lifted from the paper by ink adhering to the printing form.

With the present tendency toward increased press speeds, there has arisen a constant demand that the range of differences in tackiness characteristics of inks of the various colors be decreased and the ink maker's problems

have been compounded by increasingly narrow tolerances in tack characteristics.

The present invention provides an improved method of effecting trapping in multi-color printing operations of the type described whereby all of the inks used, regardless of color or order of application to the web, may have the same tackiness characteristics.

I have found that the necessary tackiness differential to promote trapping of inks of the type described may be brought about entirely by differences in temperature. I have found that such inks of substantially the same tackiness characteristics may be applied to the web in rapid succession at normal press operating temperatures and satisfactory trapping obtained merely by cooling that portion of the web to which the impressions are being successively applied, to a temperature slightly below the normal press operating temperature.

The optimum extent of cooling will vary somewhat depending upon the composition of the particular inks used, i.e. the temperature-tackiness characteristics of the inks. Inks of the type marketed under the registered trademark Flashdri, for instance, have been found to vary materially in tack with temperature changes of the order of 5°–10° F. However, for best results, I usually find it advantageous to cool the web to a temperature at least about 20°–40° F. below the normal operating press temperature.

This cooling of the web is with advantage effected by chilling the peripheral surface of the impression cylinder about which the web passes in close contact. The cooling of the impression cylinder may be effected by passing a cooling fluid, cold water for instance, through the interior of the cylinder or through an inner jacket in thermal contact with the peripheral wall of the cylinder. In place of cold water other mild refrigerants may be used.

In modern high-speed presses so designed and operated that the web is in contact with the impression cylinder for a period of time inadequate to effect optimum cooling of the web before the second ink impression is applied thereto, or where it is desired to avoid the necessity of maintaining the impression cylinder at a temperature sufficiently low to effect such optimum cooling of the web in the brief time interval, the web may be precooled to a greater or less extent before it is passed to the impression cylinder. This may be effected by passing the web over a precooling roll, or a plurality of such rolls, or by other suitable cooling means.

In the continuous operation of high speed presses, there is a tendency for the printing rolls to become heated, somewhat above press room temperature, by reason of friction. In using inks of the type with which we are here concerned, which contain volatile solvents, it is important to avoid excessive ink train temperatures in order to prevent excessive evaporation of the volatile solvent from the ink before the ink is applied to the web. To avoid such excessive evaporation, modern presses are usually designed so as to maintain a substantially uniform normal operating temperature over the entire ink supply train, from the ink fountain to the printing surface, not in excess of about 110° F., advantageously between 90°–100° F. Under such circumstances, satisfactory trapping is attained in accordance with my present invention by cooling the web as it passes about the impression cylinder, either with or without precooling, to a temperature of about 60°–70° F. so as to effect a temperature difference between the ink on the printing surface and that on the web of at least about 20°–40° F.

The invention will be further described and illustrated with reference to the accompanying drawings which represents conventionally and diagrammatically a multi-color, web-fed printing press for letter press printing, and of which

FIG. 1 is a diagrammatic transverse sectional view of the press, and

FIG. 2 is a somewhat diagrammatic longitudinal sectional view of the impression cylinder along line 2—2 of FIG. 1.

The impression cylinder, somewhat out of proportion for clarity, is represented at 1. This impression cylinder may be of any conventional type and mounted in any conventional manner, except that it is provided with internal means for uniformly chilling its outer periphery 2 about which the web 3 passes in contact. As shown in the drawing, the cylinder is provided with an internal annular chamber 4 adjacent its periphery and means for circulating a cooling fluid, for instance water, therethrough. It is rotatably supported by a coaxial shaft indicated at 5 extending through and outwardly beyond each end of the cylinder and which in turn is supported at each end by the press side frames and is adapted to be driven in any customary manner.

Each end of shaft 5 is hollowed out to form a manifold chamber 6. These manifold chambers extend inwardly coaxially with the shaft, somewhat beyond the end of the cylinder, and each is connected with the annular chamber 4 by means of a plurality of radially extending conduits 7. One of these manifold chambers is connected, by any suitable means, for instance, a water-tight coupling 8 and conduit 9, to a supply of cooling fluid under pressure and the manifold chamber at the opposite end of the shaft is similarly connected for discharging the cooling fluid after it has passed through the annular chamber in heat-exchange with the web.

The cylindrical wall 2 of the cylinder and the inner-wall 10 of annular chamber 4 are supported coaxially with shaft 5 in any suitable manner, the annular chamber 4 being closed at each end by annular plates 11. These two cylindrical walls may be tied together by means of the end plate 11 and the inner wall 10 supported by spokes, not shown, extending outwardly from the shaft. The conduits 7 may extend through such spokes or may be entirely separate therefrom. Also the peripheral wall 2 may be connected at points intermediate its ends, with wall 10 by tie rods, or the like, extending between the walls 2 and 10 and baffles may be provided within the annular chamber 4 to promote uniform flow of the cooling fluid therethrough.

Uniformly spaced about the impression cylinder are a plurality of plate cylinders, indicated respectively at 12, 13, 14 and 15, each provided in the conventional manner with an ink train adapted to convey ink from the respective ink fountains 16, 17, 18 and 19 and apply it to printing plates or forms secured about the peripheries of the respective plate cylinders.

In operation, inks of the respective colors, for instance yellow, red, blue and black, having substantially identical tack characteristics are supplied to the respective ink fountains and conveyed therefrom in the customary manner over the ink trains indicated respectively at 20, 21, 22 and 23 and applied to the respective printing plate adapted to operate in rolling contact with the web 3 passing about the periphery of the impression cylinder in heat exchange with said cylinder.

The entering web, either before or after it has been printed on one side, passes about the rollers 24, around the impression cylinder and from thence over guide roller 25 to a drier, whereby the solvent is evaporated from the ink impressions applied to the web by plate cylinders 12, 13, 14 and 15, respectively, and the ink thereby set and dried on the web.

Where it is desired to precool the web before passing it to the impression cylinder, one or more of the rolls 24 may be chilled by passing water or other coolant therethrough. The optimum extent at which the web is thus precooled will depend primarily upon web speed and the cooling capacity of the impression cylinder. For instance, these precooling rolls may be maintained at a temperature of about 40°–60° F.

The respective ink fountains are at a normal press room temperature. However, as previously noted, considerable frictional heat is developed by the ink trains so that by the time the ink has reached the respective plate cylinders it has become heated somewhat, to what has been herein referred to as normal operating press temperature, and which on conventional press is usually within the range of 90°–110° F. The ink film on each of the printing forms, in normal operation, will be at substantially the same temperatures, within the range just indicated, and consequently the inks of the respective colors will be of the same tackiness, since each has the same tack-temperature characteristic.

Ordinarily, under such circumstances, the ink applied by cylinder 12, for instance, would not trap the ink subsequently applied by cylinder 13 because of their substantially identical tackiness. However, in accordance with my present invention, the ink applied by the cylinder 12 is immediately chilled, upon application to the web, to an extent such that its tackiness is materially increased before passing in contact with cylinder 13; consequently, the ink on that cylinder is effectively trapped by the initially applied ink.

The web speed may be varied over a considerable range, say from 1200 feet to 2000 feet per minute. The period of contact between the web and the cooled surface of the impression cylinder will, of course, vary proportionally. It is usually desirable at the higher speeds, other conditions remaining constant, to maintain the periphery of the impression cylinder at a somewhat lower temperature, so as to increase the rate at which heat is extracted from the web. Also, where heavier stock is used, it may be found desirable to maintain the periphery of the impression cylinder at a somewhat lower temperature so as to expedite cooling of the outer, printing surface of the web.

For example, in four-color printing, in accordance with this invention, on a web of coated paper of conventional periodical weight traveling through the press at about 1200 feet per minute and using petroleum base heat-set inks of the type previously described and of identical tack-temperature characteristics, operating press temperature being maintained at 90°–100° F., satisfactory trapping is obtained by cooling the web passing about the impression cylinder to a temperature of approximately 50° F.

The extent of cooling will depend somewhat upon the tack-temperature characteristics of the particular inks being used. Optimum impression cylinder temperature for any particular combination of operating conditions is readily determinable by simple tests. However, temperature conditions within the indicated ranges will be found to give generally satisfactory trapping.

I claim:

1. In a process of multi-color printing on a rotary, web-fed printing press whereby the ink images of the respective colors are transferred from the printing forms to the web in rapid succession and normally liquid inks of the respective colors, containing a substantial proportion of a volatile solvent and which are set and dried on the web by evaporation of the solvent, are supplied to the respective printing forms over separate ink trains adapted to work the ink into thin film and whereby the ink is raised to an elevated temperature by frictionally generated heat, the method of controlling trapping which comprises supplying to the respective ink trains inks of the various colors, all having substantially the same tackiness characteristics, and effecting trapping by maintaining that portion of the web to which the inks are being applied at a temperature within the range of 10 to 50° F. below the temperature of the ink being applied thereto.

2. The process of claim 1 in which the ink being applied to the web is at a temperature within the range of

90° to 110° F. and that portion of the web to which the ink is being applied is at a temperature within the range of 60°–70° F.

3. The process of claim 1 in which that portion of the web to which the ink is being applied is cooled to a temperature of about 20 to 40° F. below the temperature of the ink being applied thereto.

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