Dec. 21, 1943. W. F. GRUPE 2,337,386

PRINTING PRESS AND METHOD OF PRINTING THEREWITH

Filed Sept. 23, 1940 4 Sheets-Sheet 1

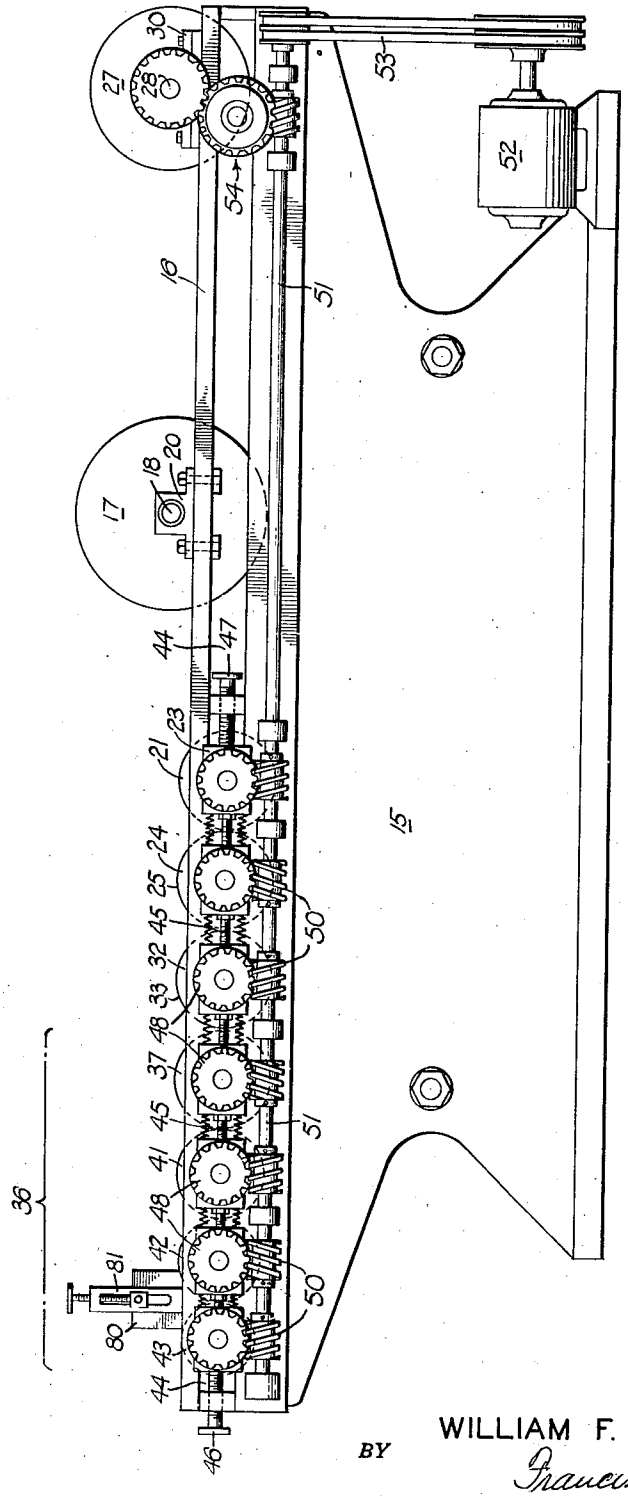


FIG. 1

INVENTOR.
WILLIAM F. GRUPE

BY Francis H. Baker
ATTORNEY.

Dec. 21, 1943. W. F. GRUPE 2,337,386

PRINTING PRESS AND METHOD OF PRINTING THEREWITH

Filed Sept. 23, 1940 4 Sheets-Sheet 2.

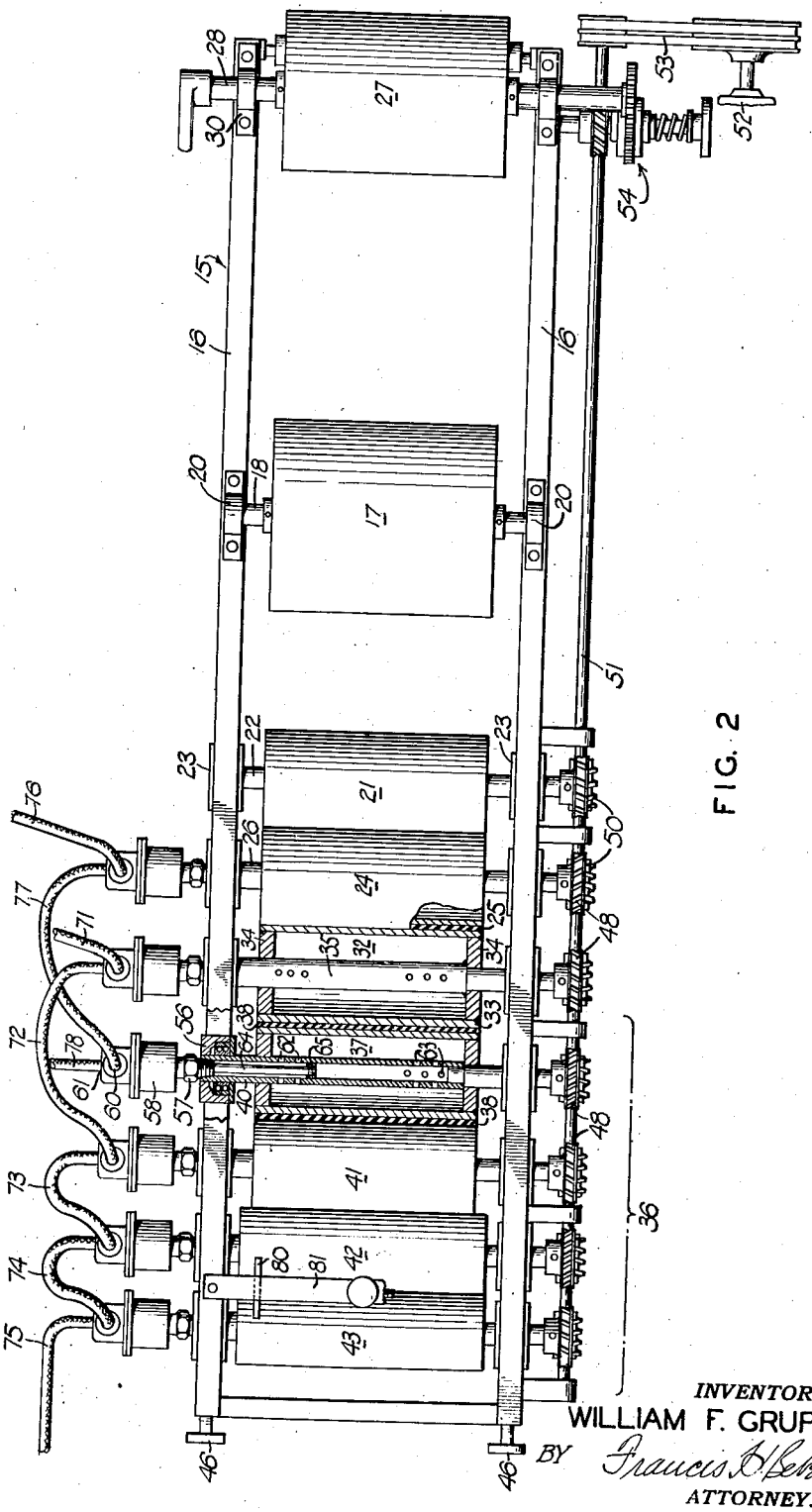


FIG. 2

INVENTOR.
WILLIAM F. GRUPE
BY Francis H. Lee
ATTORNEY.

Dec. 21, 1943. W. F. GRUPE 2,337,386

PRINTING PRESS AND METHOD OF PRINTING THEREWITH

Filed Sept. 23, 1940 4 Sheets-Sheet 3

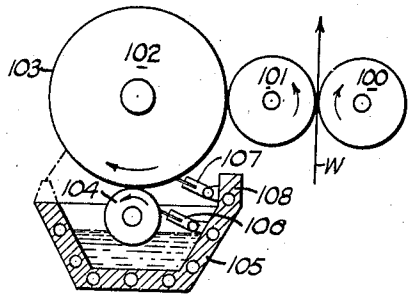


FIG. 4

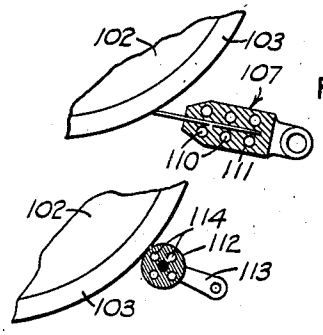


FIG. 5

FIG. 6

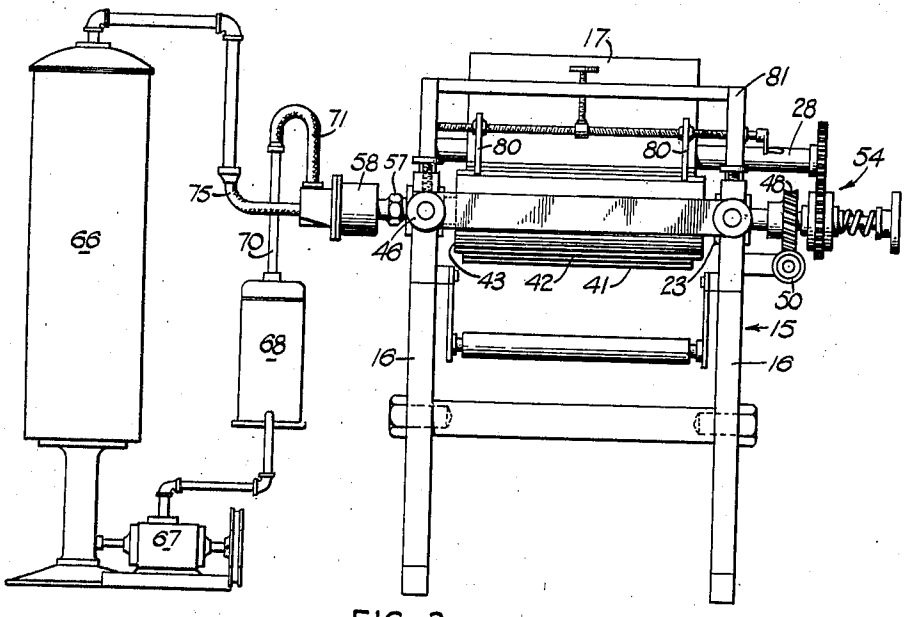


FIG. 3

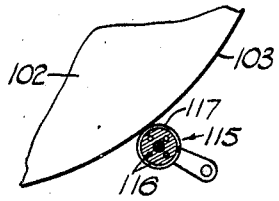


FIG. 7

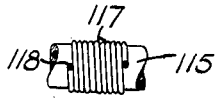


FIG. 8

INVENTOR.
WILLIAM F. GRUPE
BY Francis H. Betts
ATTORNEY.

Dec. 21, 1943. W. F. GRUPE 2,337,386

PRINTING PRESS AND METHOD OF PRINTING THEREWITH

Filed Sept. 23, 1940 4 Sheets-Sheet 4

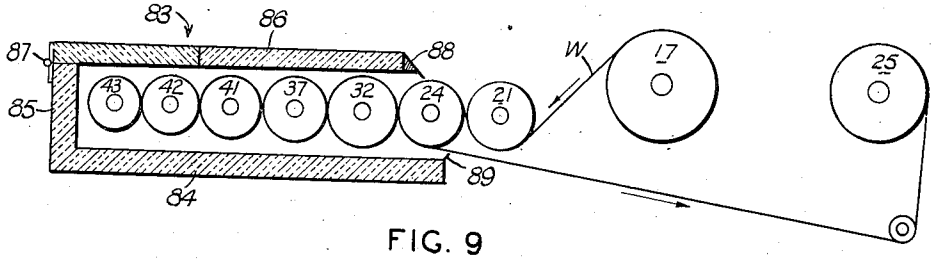


FIG. 9

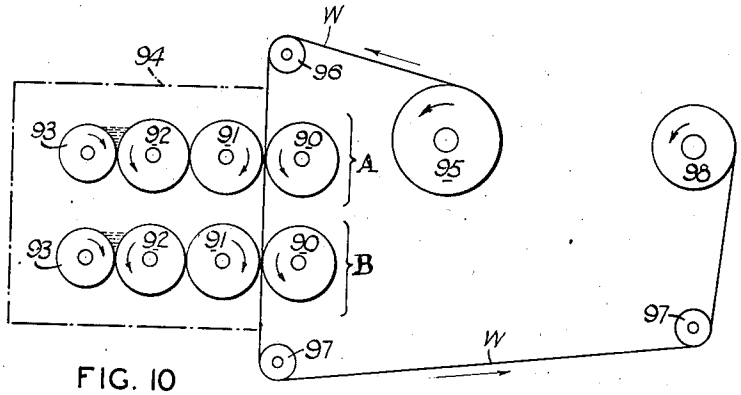


FIG. 10

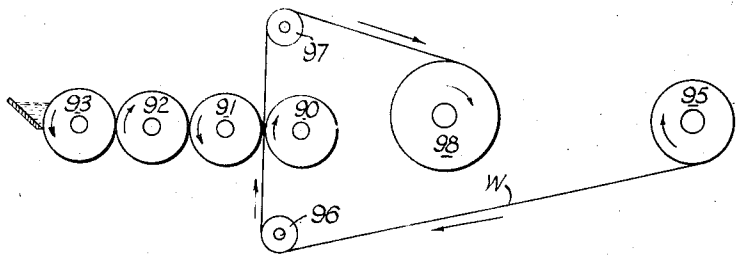


FIG. 11

INVENTOR.
WILLIAM F. GRUPE

BY Francis K. Bebee

ATTORNEY.

Patented Dec. 21, 1943 2,337,386

UNITED STATES PATENT OFFICE

2,337,386

PRINTING PRESS AND METHOD OF PRINTING THEREWITH

William F. Grupe, Lyndhurst, N. J., assignor to Interchemical Corporation, New York, N. Y., a corporation of Ohio

Application September 23, 1940, Serial No. 357,839

9 Claims. (Cl. 101—216)

This invention relates to printing presses and aims to provide an improved typographic printing press which is particularly adapted for use with thermoplastic or hot melt inks.

There are now available for use in printing thermoplastic or hot melt inks which are pigmented printing materials of such a character that at normal room temperatures (about 25° C.) they are solid but may be converted to liquid condition by heating to an elevated temperature. Such inks have been printed on webs and sheets of paper and other base materials both typographically and by gravure, particularly in the production of spot carbon paper and thermoplastic transfer sheets; but, due to their physical characteristics and properties when in a liquid state, many difficulties are encountered, especially in typographic printing. For example, hot melt inks set by cooling, usually caused by contact with the cold paper, and the ink film therefore penetrates very little into the paper and produces an embossed effect; because of this and the high solid content of such inks, it is necessary to apply an ink film which is considerably thinner than that applied with conventional typographic inks, and the usual typographic ink distribution system does not lend itself well to this. Furthermore, the fact that hot melt inks must be heated for application means that the ink distribution system must be heated, and this creates objectionable working conditions in the press room and, in addition, causes many troubles in the rubber or composition ink distributing rollers.

I have discovered that most, if not all, of the known difficulties encountered in the typographic printing of hot melt inks may be eliminated and such inks may be printed typographically with results and operating conditions that are comparable to those encountered in conventional typographic printing; and I have devised an improved typographic printing press with which these results may be accomplished.

In accordance with my invention, there is provided an improved printing press in which the usual typographic ink distributing system is entirely eliminated and, in lieu thereof, an enlarged form roller is employed. A film of thermoplastic or hot melt ink of the desired consistency and thickness is applied to the form roller for subsequent application to the plate or printing cylinder by means of an aligned system of metal milling and coating cylinders which may be readily heated, without damage to the outside surfaces thereof, to the desired temperature for melting and spreading out an even film of ink, said cylinders having progressively increased surface speeds from the ink inserting end to the form roller so as to cause a stretching or thinning of the film of thermoplastic ink to the desired thickness in its transfer from one cylinder to the next. Due to the aligned arrangement of the cylinders forming the ink applying system of my invention, the entire heated portion of the printing press may be suitably insulated from the remainder of the press. Another feature of my invention consists in cooling the form roller so that the film of hot melt ink of the desired thickness transferred thereto by the adjacent metal applying roller will tend partially to set on the surface of the form roller and be subsequently remelted by contact with the heated printing cylinder and transferred to the type for application to the web or sheet of paper. The ink remaining on the form roller after contact with the plate cylinder is suitably spread and distributed over the entire form roller surface by means of a heated doctor blade, bar or roller cooperating with said form roller.

The above and other features and objects of my invention will become apparent upon consideration of the following detailed description and the accompanying drawings, in which:

Fig. 1 is a side elevational view of one form of printing press embodying the essential features of the invention;

Fig. 2 is a top plan view, with certain portions broken away and in section, of the printing press shown in Fig. 1;

Fig. 3 is an end elevational view of the printing press shown in Fig. 1;

Fig. 4 is a schematic view of a modified form of printing press embodying the essential features of my invention;

Figs. 5, 6 and 7 are somewhat enlarged fragmentary sectional views of three different types of doctoring devices that may be used in conjunction with the large form roller.

Fig. 8 is an enlarged fragmentary detailed view of the doctor bar shown in Fig. 7;

Fig. 9 is a schematic side elevational view, partially in section, of the printing press arrangement shown in Fig. 1, and illustrating particularly the manner of feeding the web therethrough and insulating the heated ink applying cylinders;

Fig. 10 is a a schematic side elevational view of a modified form of printing press embodying my invention and particularly adapted for the printing of two colors; and

Fig. 11 is a schematic view, similar to Fig. 10, showing a one-color printing press arrangement in which the ink applying cylinders are reduced in number.

Referring now to Figs. 1 and 2, it will be observed that one form of printing press embodying the essential features of my invention, may comprise a base or table member 15 having a pair of spaced side frame members, 16, 16 secured to the upper surface thereof in any convenient manner. These side frame members 16, 16, which may be of any suitable construction and in the present instance consist of elongated horizontally disposed bars of steel, form a support for a reel 17 of the material to be printed, said reel 17 being provided with a shaft 18 journalled in a bracket 20 attached to the top side of the horizontally disposed side frame members 16. A web W (Fig. 9) is fed from the supply reel 17 beneath a feeding and guiding roller 21 having a shaft 22 suitably journalled in bearings 23 mounted in the side frames 16. Feed roller 21 is mounted in cooperative engagement with a suitable impression cylinder 24 having a resilient outside surface or sheath 25 and a shaft 26 which is similarly journalled in bearings provided in the side frames 16. As shown in Fig. 9, the web W passes from beneath the feeding roller 21 over and around the resilient surfaced impression cylinder 24 and is returned to a suitable rewind roller 27 where it may be rewound as the printing takes place. This rewind roll 27 is provided with a shaft 28 which is journalled in suitable bearings provided in brackets 30 attached to the top edge of the side frames 16, 16.

Cooperatively mounted with respect to the impression cylinder 24 is a printing or plate cylinder 32 which, in the form shown in the present instance, is a hollow cylinder having an outside typographic printing surface 33, end walls 34 and a hollow shaft 35 journalled in suitable bearings provided in the side frames 16, 16. This printing cylinder 32 is preferably heated, in a manner to be described more fully hereinafter, to a temperature somewhat above the melting point of the particular thermoplastic ink being used.

Thermoplastic ink is applied to the plate cylinder 32 in a film of the desired thickness by means of an ink milling, spreading and applying mechanism which, in Figs. 1 and 2, is designated as a whole by the reference numeral 36. This system or mechanism comprises a hollow form cylinder or roller 37 having an outside resilient surface 38 and a hollow shaft 40 which is mounted in suitable bearings provided in the side frames 16, 16. As shown, the form roller 37 is of substantially the same diameter as the printing cylinder 32 and receives its ink from a cooperatively mounted metal cylinder 41 which forms part of the remainder of the inking system including cooperatively mounted metal rollers or cylinders 42 and 43, respectively. The rollers 41, 42 and 43 constitute, in effect, a three-roller ink mill and, as best shown in Fig. 1, are of progressively increasing diameters so that, if the shafts thereof are rotated the same number of revolutions per unit of time, the outside metal surfaces of said rollers will have different speeds which increase progressively from the first cylinder 43 up to the form roller 37. Thus, if a quantity of ink is deposited between the rollers 42 and 43 it will be initially milled and spread over the surfaces thereof and transferred from the surface of the roller 42 to the roller 41. Since these three rollers rotate at increasing surface speeds from left to right and there is a pressure contact between them, the amount of ink on the cylinder 43 will be greater than that on the surface of the cylinder 42 since the latter is rotating at a higher speed and tends to spread out the film in a well known manner. The same action takes place in transferring the ink from the surface of the cylinder 42 to the cylinder 41 upon which an even thinner film will be deposited. It will be understood that by increasing the number of the rollers in the ink mill, the film of ink may be reduced to substantially any desired thickness within practical operating limits.

As best shown in Fig. 1, the bearings for all of the cylinders 21, 24, 32, 37, 41, 42 and 43 are slidably mounted in the side frames 16, 16 which are provided with suitable guideways 44 for this purpose. The distance between the rotating surfaces of all cylinders may be regulated and adjusted by means of suitable set screws 45 mounted between the bearings thereof, and all of said cylinders may be maintained in operative position in the guideways 44 of the side frames 16, 16 by means of a large screw 46 engaging the bearing of the cylinder 43 and a similar screw 47 engaging the bearings of the feeding cylinder 21. One end of the shaft for each of the cylinders projects through its associated bearing and beyond the side frame 16 and is provided at the end thereof with a gear 48. Each gear 48 meshes with a suitable helical gear 50, and all of the gears 50 are mounted on a shaft 51 which is rotated at the desired speed in any convenient manner, such as by means of a motor 52 and cooperating belt driving means 53. All of the gears 48 and 50 are, in the present instance, identical in size and construction so that the shafts of all of the cylinders associated therewith will be rotated at the same number of revolutions per unit of time. Suitable gearing 54, which preferably includes a conventional slipping clutch mechanism, may be provided for rotating the rewind roll 27 at the desired speed.

When thermoplastic or hot melt inks are employed in my improved apparatus as is contemplated by this invention, it has been found necessary to maintain the cylinders or rollers with which the thermoplastic inks contact in a heated condition, and preferably heated to a temperature above the melting point of the particular thermoplastic inks. For the purpose of providing the desired thermal treatment for each of the cylinders 24, 32, 37, 41, 42 and 43, the shafts thereof are all hollow and constructed in the manner indicated in Fig. 2 where the cylinders 32 and 37 are shown in section. All of the hollow shafts are identical in construction and, as shown in Fig. 2, the shaft 40 extends through its associated bearing 56 and is connected to a nipple 57 provided on a conventional rotary joint 58 having an inlet opening 60 and an outlet 61. Fluid for providing the desired thermal treatment is pumped through the inlet 60, rotary joint 58, nipple 57, and into the hollow shaft 40. A plurality of openings 62 are provided in the hollow shaft and the fluid passes through these openings into the hollow cylinder 37 where it circulates and transfers heat to the walls thereof. After circulating through the cylinder, the thermal treating fluid passes through apertures 63 provided in the other end of the hollow shaft 40 and progresses through said shaft to the end of an outlet pipe or conduit 64 which is concentri-

cally mounted in the hollow shaft 40 and sealed from the openings 62 by means of a plug 65. This outlet pipe 64 passes through the rotary joint 58 and nipple 57 and is connected with the outlet 61 so that the fluid, after circulating through the associated cylinder, may be passed back to the source of supply or to one of the other cylinders, as desired.

In order to supply a heating fluid to the cylinders of the apparatus which are to be heated, and to circulate said fluid through the cylinders in the manner described above, a fluid such as oil or water may be pumped from a supply tank 66 by means of a pump 67 to a suitable heater 68 where said fluid is heated to the desired temperature (see Fig. 3). From the heater 68 the heated fluid passes upwardly through a conduit 70 to a flexible tube 71 which is connected with the inlet of the rotary joint for the printing cylinder 32. The heated fluid circulates through the printing cylinder 32 and is passed by means of a conduit 72 from the outlet of the rotary joint for the printing cylinder to the inlet associated with the cylinder 41. A conduit 73 connnects the outlet for the cylinder 41 with the inlet for the cylinder 42 and a conduit 74 connects the outlet of the cylinder 42 with the inlet of the cylinder 43 so that the heating fluid may be circulated from one cylinder to the next. Upon passing through the cylinder 43, the fluid may be returned to the supply tank by means of a conduit 75 connected with the outlet for the cylinder 43 and the supply tank. In this manner, the heating fluid in its most heated condition first circulates through the printing cylinder and then, respectively, through the cylinders 41, 42 and 43 with the result that, although the circulation may be fast enough to maintain all of said cylinders in substantially the same heated condition, the printing cylinder 32 will have its surface at the highest temperature and the cylinder 43, which is the last through which the fluid circulates, will be at the lowest temperature. It will of course be understood that separate circulating systems and controls may be provided for the printing cylinder and the cylinders 41, 42 and 43, if desired.

It will be noted that the form roller 37 and the impression cylinder 24, which are also provided with means for circulating a thermal treating fluid therethrough, are not included in the heating system described above. Although there may be occasions when it would be desired to heat one or both of the cylinders 24 and 37 during certain uses of the apparatus, I have found that in normal typographic printing with thermoplastic materials, it is preferable to cool both of said cylinders. For this purpose a cooling fluid, such as cold water or brine, may be fed from a suitable source of supply (not shown) through a conduit 76 connected to the inlet of the rotary joint associated with the impression cylinder and circulated through said cylinder and conducted by means of a conduit 77 from the outlet for the cylinder 24 to the inlet 60 of the rotary joint 58 for the form roller 37. Upon circulation through the form roller 37 the cooling fluid may be conducted through a conduit 78 back to the source of supply, or it may be disposed of in any desired manner. By cooling the impression cylinder in the manner just described, the side of the web which is not being printed will be maintained in a cool condition so as to cause the printed material to set substantially immediately upon application to the web; such cooling will also prevent smudging of any first applied impression in the event that the apparatus is being use for second side printing. By cooling the form roller 37, the tendency for deterioration of the resilient surface 38 thereof is greatly reduced, and, if the cooling is sufficient, in accordance with my invention, the film of thermoplastic ink transferred to the resilient surface 38 from the cylinder 41 will be caused to set or harden, at least partially, so that upon contact with the printing cylinder, which is heated to a temperature above the melting point of the ink, a remelting takes place as the thermoplastic ink is transferred from the form roller to the type. I have found that such operation of the apparatus produces an accurate control of the film thickness applied to the type and provides an effective control of the consistency and viscosity of the ink in its transfer from the form roller to the type on the printing cylinder.

It will be understood that during operation of the apparatus the outer surface of the rubber form roller 37 will become heated as it contacts the plate cylinder 24 and the steel applying roller 41. However, due to the transfer of heat to the cooling fluid circulating through the form roller, the surface 38 thereof is at all times cooler than the cylinders 41 or 32 and may be maintained sufficiently cool to prevent the ink from flowing on the surface of the form roller by a chilling of the ink to a point just beneath the flow point and at which it is plastic. As this solid or semi-solid ink surface contacts the heated plate cylinder, it will be melted out in the required amounts and transferred to the type.

In the construction shown in Figs. 1, 2 and 3, the temperature of the steel cylinder 41 and the pressure between the surface thereof and the resilient surface 38 of the form roller may be adjusted so that the unused ink on the form roller will meet the ink film on the applying roller 41 and be blended therewith and leveled out, such action being further facilitated by the difference in surface speeds of these two rollers. However, I prefer to effect the wiping out and spreading of the ink remaining on the form roller by means of a heated doctor bar or roller which will be described more fully hereinafter.

In operation of the apparatus shown in Figs. 1 to 3, chips or blocks of thermoplastic ink are placed in the nip between the rollers 42 and 43 where it will be melted by contact with the heated surfaces of said rollers. To prevent the molten thermoplastic ink from flowing over the ends of said cylinders, I have provided a pair of ends guards 80, such as are used in the conventional ink mills, and adjustably supported them in any suitable manner in the nip between the rollers 42 and 43, such as by means of a supporting bracket 81 attached to the side frames 16, 16. As the ink melts, a film will be deposited upon the cylinder 43. Depending upon the spacing between the surfaces of the cylinders 42 and 43 and the difference in surface speeds between them, the film on the surface of the cylinder 43 will be stretched out or reduced in thickness and transferred to the surface of the roller 42. A similar action takes place in transferring the ink film from the surface of the roller 42 to the roller 41. The ink film may be thinned still further and to the finally desired thickness in its transfer from the surface of the roller 41 to the cooled form roller surface 37 where its viscosity is increased and from which it is subsequently

transferred, by remelting or softening, to the heated type of the plate cylinder 32. It will be understood that by increasing the number of steel spreading and applying rollers 41, 42 and 43, a film of any desired thickness may be transferred to the surface of the form roller 37; and the arrangement of said cylinders may be made such that the ink ingredients, such as pigment, vehicles and the like, may be inserted in the ink mill portion of the apparatus and ground and then transferred in the desired film from roller to roller and to the heated type.

Referring now to Fig. 9, where the Figs. 1 to 3 arrangement of the apparatus is shown schematically, it will be noted that the web W is fed from the supply roll 17 about the feed roller 21 and impression cylinder 24 and then between the printing and impression cylinders where it receives the ink that has been transferred to the heated type in the manner described above. Due to the fact that the web is in a cooled condition as compared with the heated ink and the impression cylinder 24 is cooled by circulating a cooling medium therethrough, the temperature of the heated ink will be lowered immediately to a point where the ink will solidify or set so that it may be passed to the rewind roll 27 and there rewound without offset. When operating at high speeds, it may be found desirable to preheat the web somewhat and to provide a supplementary cooling roller beneath the impression cylinder 24.

It will also be noted in Fig. 9 that the entire printing and inking apparatus, which is disposed in a substantially horizontal plane, is housed in a suitable housing 83 constructed of a suitable heat insulating material. This housing may take any desired form, that shown comprising a lower wall 84 which extends from beneath the impression cylinder 24 to a point beyond the last steel cylinder 43 and is there attached to an end wall 85. A top cover member 86 is hinged by means of a hinge 87 to the top edge of the end wall 85. An upper hinged cover member 88 attached to the right-hand end of the cover 86 and extending close to or into contact with the web W on the impression cylinder 24 and a similar hinged member 89 in close proximity to the web W as it leaves the impression cylinder and travels toward the rewind roller 25 complete the enclosure which may be positioned in any suitable manner between the side frames so as to provide a substantially air-tight housing. The hinge 87 permits the cover 86 to be raised so that inks may be inserted in the nip or fountain between the rollers 42 and 43. By the provision of such a housing 83, the heat generated by the heated plate cylinder 32 and steel cylinders 41, 42 and 43 will be confined effectively to the region around the press. Aside from increasing the efficiency of the heating of these cylinders, this closure prevents the heat from escaping into the press room where it can create objectionable operating conditions. It will be appreciated that if several of these presses, particularly multicolor presses, are placed in a single press room, the heat created by the heated inking system will be considerable.

In Fig. 10 I have shown a somewhat modified form of apparatus which includes a basic printing unit comprising an impression cylinder 90, a plate cylinder 91, a large form roller 92 and an ink applying cylinder 93. The impression cylinder 90 may be cooled in the manner described above, and the remaining cylinders 91, 92 and 93 heated. In this construction, I prefer to employ a steel or metal surfaced form roller 92 which, when suitably formed and aligned with respect to the plate cylinder 91, will transfer the desired film of ink to the type with a light contact uniform throughout the length of the cylinders and governed by the spacing or pressure between the cylinders 91 and 92. Steel cylinder 93 is of smaller diameter than cylinder 92 so that the latter has a greater surface speed and causes a proper reduction of and spreading of a film of ink over the surface so that it may be transferred in the desired quantities to the plate cylinder. As indicated, the thermoplastic ink is inserted in the nip between the two steel cylinders 92 and 93. In Fig. 10 I have shown two such printing units, A and B, to illustrate the compactness of a multicolor printing press embodying the features of my invention. The dot and dash line 94 shows the simplicity of arrangement of a suitable insulating housing for the heated portions of the press. When printing with the apparatus shown in Fig. 10, a web W is fed from a suitable supply roll 95 about a guide roller 96 and passes substantially vertically downwardly between the printing and impression cylinders of the two printing units A and B are then about suitable guide rollers 97 to a rewind roll 98.

The Fig. 11 arrangement is similar to one of the units A or B shown in Fig. 10. However, the web is fed in a reverse direction from supply roll 95 to rewind roll 98. Rollers 92 and 93 are shown of the same diameter and are operated at different surface speeds in any convenient manner; and a doctor blade hopper 99 is provided for the thermoplastic ink supply.

In Fig. 4 I have shown a modification of my improved printing apparatus for thermoplastic inks which includes the same essential elements illustrated in Figs. 10 and 11. However, the apparatus is somewhat differently arranged and comprises an impression cylinder 100 and a cooperating plate cylinder 101 between which a web W may be fed in the direction indicated by the arrowhead. The plate cylinder 101 is preferably heated and receives ink in the desired amounts from a large ink-applying member or form roller 102. This form roller 102 has a diameter substantially twice that of the plate cylinder 101 but is rotated at the same surface speed as said plate cylinder; and is cooled in any convenient manner, such as by the means illustrated and described above in connection with Fig. 1. It preferably has an outside or surface cover 103 of some suitable resilient material such as rubber. A film of ink of the desired thickness is transferred to the resilient surface 103 of the form roller 102 by means of a suitable coating roller 104 which is arranged to rotate, in either a forward or reverse direction, in a bath of the heated and molten thermoplastic ink contained within a suitable heated fountain housing 105. Said coating roller 104 may be a normal coating roller, or may be provided with the usual intaglio screened surface, and the thickness of the layer of ink is regulated by means of a conventional doctor blade 106 adjustably mounted on the fountain housing 105. Thus, a film of ink of the desired thickness is transferred from the coating roller 104 to the resilient surface of the form roller 102 and, since said form roller 102 is cooled and of large diameter, the thermoplastic ink will have sufficient time in passing from roller 104 to the printing cylinder 101 to set or have its viscosity increased to the point where it will be transferred in the desired manner and

thickness of film to the heated type of said printing cylinder 101.

While, as I have indicated above, a sufficient wiping and spreading of the ink remaining on the form roller after contact with the type may be accomplished by the pressure between the coating roll 104 and the resilient surface of the form roller 102, I have found it desirable to provide a heated doctor blade, bar or roller in cooperative engagement with the form roller 102 at a position between the plate cylinder 101 and the coating roller 104 in the direction of rotation of the form roller 102. In Fig. 4 I have shown a heated doctor blade 107 which is also adjustably attached to the fountain housing 105 on an extension 108 of one wall thereof which constitutes a means for returning any excess thermoplastic ink which may tend to accumulate on the doctor blade 107 to the fountain housing 105. In Fig. 5 I have shown the doctor blade 107 on a somewhat larger scale and it will be noted that said doctor blade, which may be heated in any convenient manner, is heated by means of a plurality of electrical resistance heaters 110 provided in a holder 111 in which the blade 107 is mounted and adapted to be heated by conduction. The doctor blade 107 is set at such an angle and pressure with respect to the resilie surface 103 of the form roller 102 that it will allow a thin film of ink to pass therebeyond and tend to have a spreading action so that the ink remaining on the surface after contact with the plate cylinder will be spread over and applied to the portions from which ink has been removed. Both of the doctor blades 106 and 107 may be oscillated or reciprocated in the usual manner, if desired. When the roller 104 is operated as a reverse roller coater, doctor blade 106 may be omitted and doctor blade 107 moved to the other wall of the fountain 105 as shown in dotted lines; then the roller 104 levels out the ink remaining on the surface and applies additional ink, while the heated blade 107 regulates the film thickness.

In Fig. 6 I have shown a doctor roller 112 mounted on a pair of arms 113 and adapted to be used instead of the doctor blade 107 described above. This doctor roller 112 may be heated in any convenient manner, such as by means of a plurality of electrical resistance or strip heaters 114, and is set with respect to the surface of the form roller 102 to cause a suitable spreading of the ink remaining on the surface in the manner described above with respect to the doctor blade 107. The roller 112 may be a smooth surfaced metal roller which is in pressure contact with the resilient surface 103 so as to produce the desired spreading action.

In Figs. 7 and 8 I have shown a further modification for the doctor bar. This doctor bar comprises an elongated bar 115 which may be heated by suitable heating elements 116 and has a uniformly ridged or striated outside surface 117. The ridged or striated outside surface may be formed in any desired manner, such as by closely winding wire 118 of a predetermined gauge about the surface of the bar. When a meter bar or doctor bar of this character is held in contact with the resilient surface of the form roller 102 in the position of the doctor blade 107 (Fig. 4), the small grooves formed by the wires 118 will allow a predetermined amount of the material to pass, while the ridges will cause a damming of the excess material which, due to the heating of the bar, will spread and tend to form in a uniform film throughout the length of the surface exposed to the bar.

Any of the forms of construction of the doctor blade, bar or roller described above functions effectively to smooth and spread the ink remaining on the form roller 102 after contact with the heated type on the plate cylinder 101 and prior to a subsequent film-applying operation by the coating roller 104. It will be understood that the entire heated portion of the apparatus, to the left of the web W in Fig. 4, may also be enclosed in a suitable insulated housing, if desired. However, due to the use of the relatively large form roller 102 and the cooling thereof and the reduction in the number of heated rolls, the need for such enclosure is minimized.

Although I have described several forms of my invention and in each have explained its particular utility in connection with thermoplastic or hot melt inks, it will be apparent that many of the essential features may be used in printing apparatus generally, and any of the forms of apparatus described may be used in conjunction with conventional inks or inks other than thermoplastic inks. For example, with the construction shown in Fig. 9, inks containing particularly volatile or low-boiling solvents could be used and the housing 83 would provide an effective means for maintaining an atmosphere of volatile solvents about the entire inking mechanism. However, it will be understood, that if such inks are used in the apparatus, it would be desirable to cool all of the cylinders within the housing and omit the heating thereof. Various other changes may be made in the construction, and certain features thereof may be employed without others, without departing from my invention or sacrificing any of its advantages.

What I claim is:

1. Apparatus for the typographic printing of thermoplastic inks which are liquid when heated and solid when cooled, comprising an impression cylinder; a heated type cylinder; and means for applying a uniform film of the thermoplastic ink to the type of said type cylinder, such ink applying means including a resilient surfaced form roller having a diameter at least equal to the diameter of said type cylinder, and means for cooling the surface of said form roller.

2. Apparatus for the typographic printing of thermoplastic inks which are liquid when heated and solid when cooled, comprising an impression cylinder; a heated type cylinder; means for applying a uniform film of the thermoplastic ink to the type of said type cylinder, such ink applying means including a resilient surfaced form roller arranged in cooperative relation with said type cylinder for transferring ink directly thereto and having a diameter substantially equal to the diameter of said type cylinder, and a plurality of heated metal ink milling and applying rollers arranged in an aligned series beside said form roller; and means for circulating a heating medium first through said type cylinder and then through said metal ink milling and applying rollers.

3. Apparatus for the typographic printing of thermoplastic inks which are liquid when heated and solid when cooled, comprising an impression cylinder; a heated type cylinder; means for applying a uniform film of the thermoplastic ink to the type of said type cylinder, such ink applying means including a resilient surfaced form roller having a diameter substantially equal to the diameter of said type cylinder, and a plurality of

heated metal ink milling and applying rollers arranged in an aligned series beside said form roller; and means for circulating a cooling medium through said form roller.

4. Apparatus for the typographic printing of thermoplastic inks which are liquid when heated and solid when cooled, comprising an impression cylinder; a heated type cylinder; and means for applying a uniform film of the thermoplastic ink to the type of said type cylinder, such ink applying means including a form roller of greater diameter than said type cylinder, means for cooling said form roller, and means for redistributing the ink remaining on the surface of said form roller after contact with the heated type.

5. A method of typographic printing with an ink which is liquid when heated and solid when cooled, comprising melting a quantity of such ink and applying it in a uniform film of predetermined thickness to the surface of an ink applying member, causing the applied film at least partially to set on said surface, bringing the thus set film of ink into contact with a heated typographic printing member so as to cause a film of ink to be transferred thereto, and impressing the thus inked printing member upon the material to be printed.

6. Apparatus for typographic printing with thermoplastic inks which are liquid when heated and solid when cooled, comprising an impression cylinder; a heated type cylinder; and means for applying a uniform film of the thermoplastic ink to the type of said type cylinder, such ink-applying means including a form roller having a diameter substantially equal to the diameter of said type cylinder, means for cooling said form roller, and means for redistributing the ink remaining on the surface of said form roller after contact with the heated type.

7. Apparatus for typographic printing with thermoplastic inks which are liquid when heated and solid when cooled, comprising an impression cylinder; a heated type cylinder; and means for applying a uniform film of the thermoplastic ink to the type of said type cylinder, such ink-applying means including a form roller having a diameter substantially equal to the diameter of said type cylinder, means for cooling said form roller, and a heated roller arranged in operative contact with said form roller for redistributing the ink remaining on the surface of said form roller after contact with the heated type.

8. Apparatus for typographic printing with thermoplastic inks which are liquid when heated and solid when cooled, comprising an impression cylinder; a heated type cylinder; and means for applying a uniform film of the thermoplastic ink to the type of said type cylinder, such ink-applying means including a form roller having a diameter substantially equal to the diameter of said type cylinder, means for cooling said form roller, roller means for applying a substantially uniform film of the thermoplastic ink to said form roller, and a heated doctor roller arranged in cooperative relation with respect to the surface of said form roller for redistributing the ink remaining on the surface of said form roller after contact with the heated type.

9. Apparatus for typographic printing with thermoplastic inks which are liquid when heated and solid when cooled, comprising an impression cylinder; a heated type cylinder; and means for applying a uniform film of the thermoplastic ink to the type of said type cylinder, such ink-applying means including a form roller having a diameter substantially equal to the diameter of said type cylinder, means for cooling said form roller, roller means for applying a substantially uniform film of thermoplastic ink to said form roller, and a doctor blade arranged in cooperative relation with respect to the surface of said form roller in a position between said type cylinder and said roller means for redistributing the ink on the surface of said form roller after contact with the type.

WILLIAM F. GRUPE.