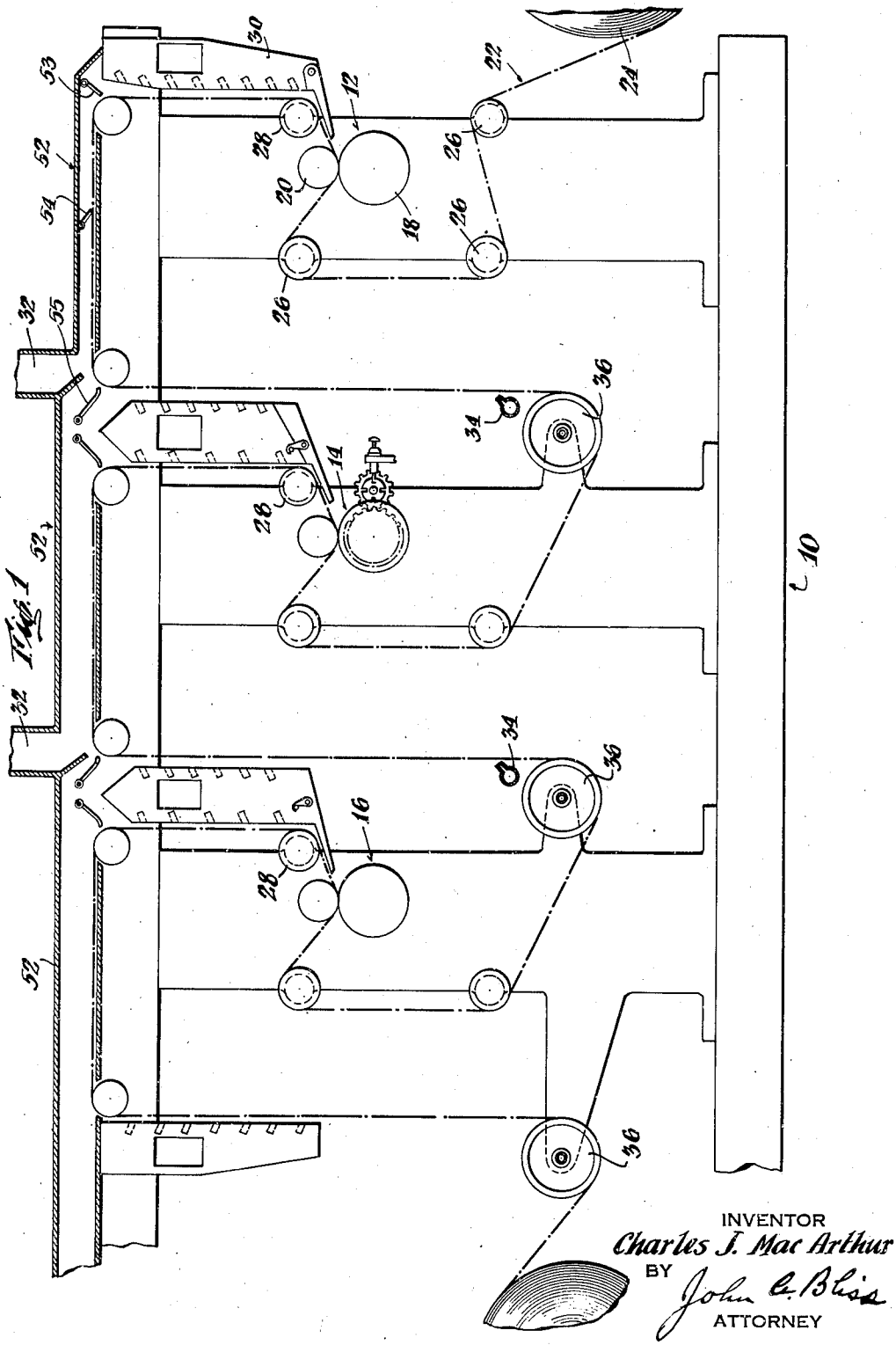
June 22, 1943. C. J. MacARTHUR 2,322,530

INTAGLIO PRINTING

Filed June 14, 1939 3 Sheets-Sheet 1



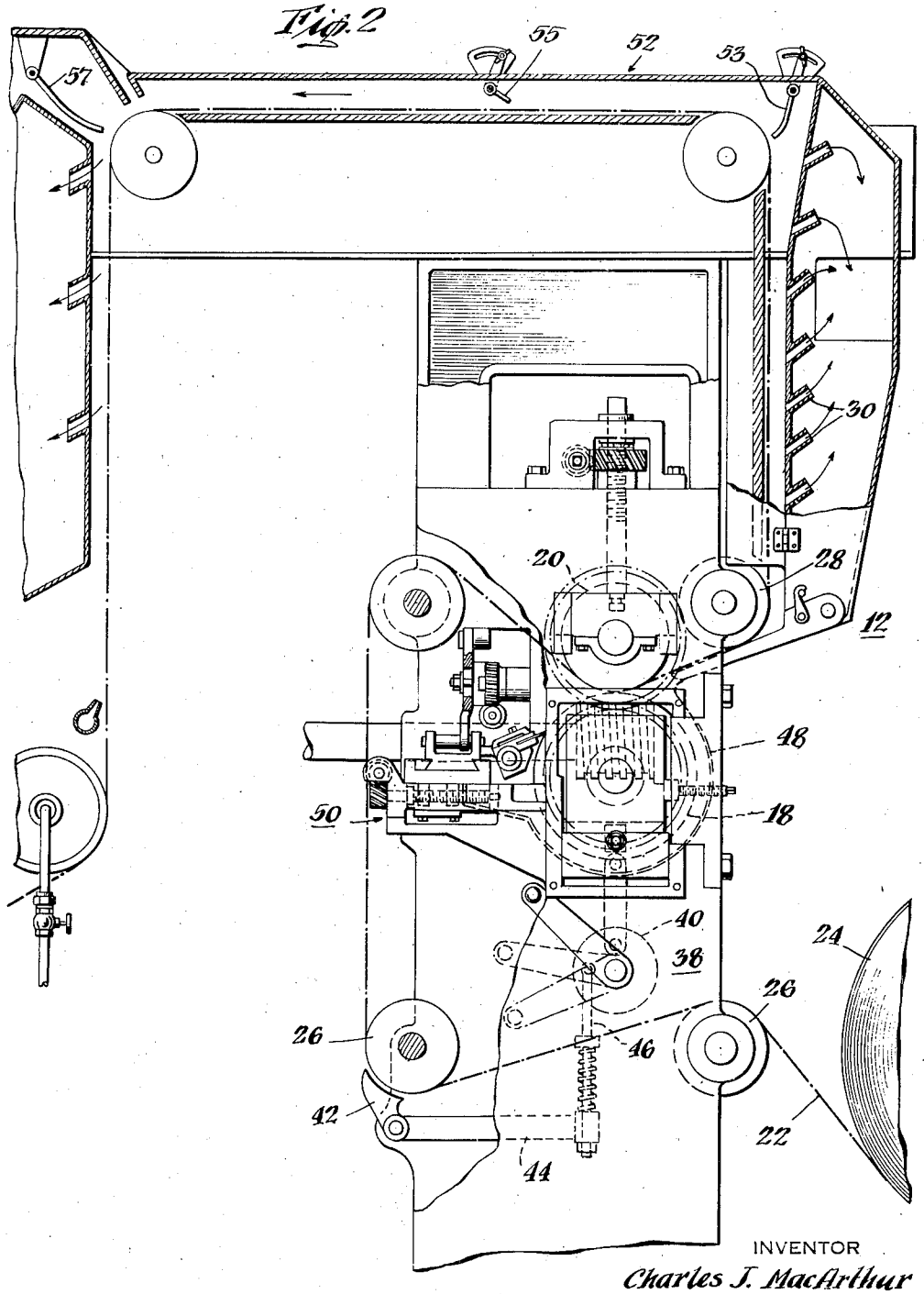
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Fig. 2



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Fig. 3

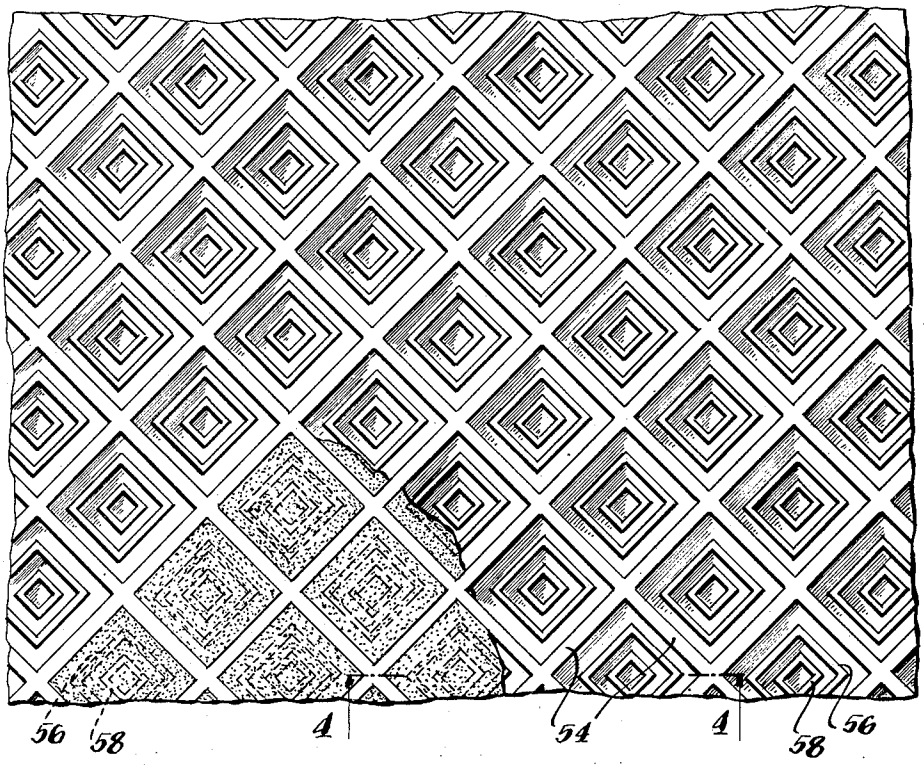


Fig. 4

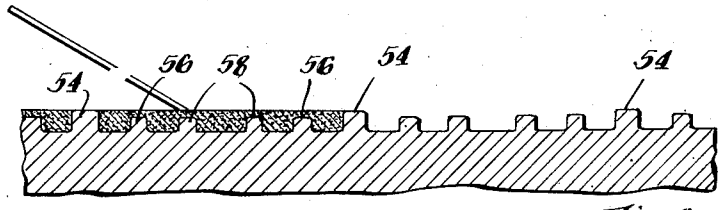


Fig. 5

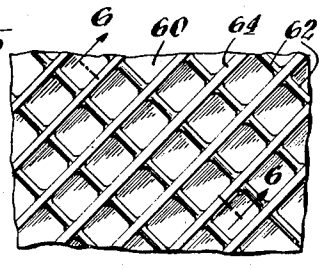
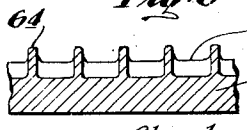


Fig. 6



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INTAGLIO PRINTING

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Application June 14, 1939, Serial No. 279,012

3 Claims. (Cl. 101—401.1)

This invention relates to improvements in intaglio printing machines for applying and drying coatings and printings on web materials in continuous operations.

The advantages to be gained by the use of attractively printed light-proof, moisture-proof, and dust-proof packaging materials are in some measure restrained by the material cost and printing cost of suitably tough and flexible materials which naturally possess all of the above desirable properties.

Therefore, this invention has for its object the provision of methods and a machine whereby web materials of relatively low cost or comparatively low tensile strength can be suitably treated and printed in continuous operations and produce an attractively printed, tough, flexible material, which is substantially impervious to light, moisture and surrounding atmosphere.

Another object of this invention is to provide in such a machine a fixed path for the web material while it is in motion or at rest and also while the printing and coating cylinders are rotating either in or out of contact therewith.

A further object is to provide in this machine a web path wherein the length of web receiving ink and coat drying application between coating and printing operations is considerably longer than the length of web not receiving drying application.

A further object is to include in a machine of this character several of the improved features embodied in my web-fed printing press, and which are disclosed in my copending patent application Serial No. 180,285 to obtain certain advantages thereof in web control, printing register, and prevention of web wastage.

Also, the invention includes the broad concept of providing a gravure printing cylinder, preferably mechanically knurled ,in such fashion that the cylinder is adapted for the high speed application of relatively thick and uniform coatings of continuous film forming materials upon continuous web materials; the knurled gravure cylinder adapted for coating, by a unique arrangement of printing and drying assemblies, may be included in a multi-color gravure printing press so that the web may be first coated, the coating dried, and then the coated web printed upon the coated side, or alternatively, the web may be first printed and then coated by the continuous film coating, and dried, in continuous operations, all of which will become clear from the description hereinafter set forth.

Heretofore, the application of film forming substances, such as cellulose acetate or like cellulosic derivatives or rubber derivatives, shellac, or the like, to paper or to metal foil, or like sheet material, has been accomplished by roller coating, by spraying, or by running the sheet material over a drum and by the application of the film forming substances in liquid form to the sheet material from a hopper, with or without extrusion and stretching operations, and then subsequent drying operations, all of which entailed solvent losses and expensive and complicated machinery: also, such methods were commonly open to the criticism that the films produced were not uniform, but varied in thickness due to the difficulty in making adjustments in continuous commercial runs.

Also, heretofore, it has been common practice to etch gravure printing cylinders with a multitude of tiny pits, so that such cylinders could be used to apply color tints to a continuous web traveling through gravure presses. However, no one has suggested or devised an apparatus which is suited for multi-color printing and application of relatively thick film coatings upon a continuous web in such fashion that the coating can be applied to the web and dried, and then overprinted with multi-color printing, or alternatively, an apparatus which allowed the multicolor printing of a web in a gravure printing press and then the coating of the web at any desired printing unit in the same press with a film coating of any desired character, such as a cellulosic derivative type, rubber derivative type, or resinous coatings.

Therefore, it is an object of my invention to provide a gravure printing cylinder preferably suitably mechanically knurled so that it is provided with suitable ink (or coating material) traps or wells that substantial film coatings may be applied by such gravure printing cylinders to rapidly traveling webs of packaging material or printing stock or the like. While in my preferred form of invention the gravure cylinder will be mechanically knurled, and while by ordinary methods the mechanical knurling of an ordinary gravure cylinder apparently is the most feasible manner in which to provide the suitable ink (or coating material) traps or wells; nevertheless, it is within the purview of this invention to provide chemically etched gravure printing rollers suitable for the high speed application of substantially continuous coatings upon web materials.

It is a further object of my invention to provide an improved gravure printing press so arranged

that when substantial coatings (of solids in volatile solvents) have been applied to a rapidly moving web, that the coating may be dried before coming into contact upon its coated side with idler rollers or successive printing units, and such part of my invention will be more specifically described later.

It is a further object of my invention to scientifically apply definitely uniform coatings of film forming materials in volatile solvents by means of an intaglio printing cylinder in an improved gravure printing press, such printing cylinder preferably being mechanically knurled, but in any event being provided with a new and improved ink (or coating material) well, the said well being adapted to trap and retain substantial quantities of ink or coating material, despite the wiping action of an oscillating doctor blade to wipe away surplus quantities of ink or coating fluid.

It is a further object of my invention to continuously gravure coat and print, or alternatively, print and coat in a single press composed of a plurality of printing or coating units, a rapidly traveling web of sheet material, whether the same be paper or the like or metal foil, and to arrange the web so that its printed or coated surface will not contact idler rollers or other apparatus prior to drying.

It is still a further object of my invention to provide a coating or printing cylinder which may be moved into and out of engagement with the web impressing member rotatable in a fixed axis by means of a simple cam or eccentric apparatus, and furthermore, such disengagement will automatically force a braking shoe upon the web, holding the web in locked position, and so that this feature in combination with a register relocator means will avoid the wastage of web material.

It is still a further object of my invention to provide a unique web travel circuit, so that the printed or coated web may quickly dry and to so arrange the printing or coating units to the end that coating and printing operations may follow consecutively and continuously.

It is still a further object of my invention to provide a unique and improved gravure cylinder which is surfaced with fluid coating traps adapted to permit the application of relatively thick coatings in a speedy and uniform fashion.

These and various other objects and advantages will be readily understood from the following description taken in connection with the accompanying drawings of preferred embodiments of the invention, in which modifications may be made without departing from the scope of the appended claims.

In the drawings:

Fig. 1 is a semi-diagrammatic view of a gravure printing press, including three printing or coating couples, and particularly showing the path of web travel, and also showing the drying apparatus;

Fig. 2 is a semi-diagrammatic detail of the printing couple illustrated and identified as 12 in Fig. 1;

Fig. 3 is an enlarged plan view of a mechanically knurled gravure printing cylinder provided with new and improved ink or coating fluid traps or wells adapted for the rapid application of film coatings to continuously traveling webs of sheet material;

Fig. 4 is a cross-section on the line 4—4 of Fig. 3;

Fig. 5 is an enlarged plan view of a modified type of mechanically knurled gravure cylinder, showing a different type of ink or fluid coating trap or well; and

Fig. 6 is a cross-section on the line 6—6 of Fig. 5.

Referring to the figures more in detail and particularly to Fig. 1, a gravure printing press identified as 10 is for the purposes of illustration shown as comprised of printing or coating couples 12, 14 and 16 respectively, the said printing couples each including a gravure printing cylinder 18 and an impression cylinder 20.

The metal foil web, or paper web, as the case may be, indicated as 22, is indicated as being unwound from roller 24 and as indicated in Fig. 1, the web is introduced from one side of the press, into the press over appropriate idler rollers indicated as 26 and then its direction is approximately reversed so that the web is traveling in an opposite direction from the direction of its unwind, and when traveling in such opposite direction, is introduced into the first printing or coating couple indicated as 12.

From printing couple 12 the web is guided past idler roller 28 upwardly past vacuum or exhaust ports 30, thence further inwardly towards the central portion of the press, in a horizontal direction, past a hot air blast which is fed through a pipe opening indicated as 32 and thence downwardly in a vertical direction on a long reach past a cold air blast port indicated as 34 and thence past cold water drum 36, whereupon the web is ready for entry into the second printing or coating unit, the printing or coating which was applied by the first unit being completed and fully dried. All units are in the same horizontal plane.

It will be observed and readily understood by those skilled in the art, that such a disposition of the apparatus exhausts volatile solvents from the ink or the coating materials, and then subjects them to a hot air blast, and then a cold air blast, and then past the cold water drum in succession. Prior to the contact with the cold water drum, there is no contact of the freshly printed or coated side of the web to any guide rollers or the like, thus giving a maximum amount of time for the drying of the freshly printed material or coating without contacting the freshly printed or coated side of the web to any apparatus: this by virtue of the unique web travel circuit. The web has a much longer distance to travel while drying, than it has to travel from the last drying means to the next printing unit.

If desired, each of the three units 12, 14 and 16 may be utilized to apply successive continuous film coatings, or the web may be first printed in two colors by units 12 and 14 respectively and then unit 16 utilized to apply a film coating over the printed matter, or alternatively, the coating may be directly applied to the web in unit 12 and then printing units 14 and 16 respectively utilized in successive printing operations upon the film.

It will be observed from the same diagrammatic view of a printing unit shown in Fig. 2, namely the view of printing couple 12, that I make provision by an eccentric actuated block bearing identified as 38 for the vertical and horizontal adjustment of the gravure printing cylinder 18. As indicated, I provide for an intermediate position of the eccentric 40 whereby the printing cylinder may be rotated out of contact with the web, and also an extremely lowered po-

sition, which allows the removal of the printing cylinder, while at the same time a brake shoe 42 operated by arms 44 and 46 automatically locks the web in place.

By virtue of a register relocator mechanism 47 indicated semi-diagrammatically in position upon printing couple 14, it is possible to restore register, the details of such register relocator means being fully set forth and described in my co-pending patent application, Serial No. 180,285, filed December 17, 1937, entitled "Web-fed printing press."

As indicated in Fig. 2, I provide substantially a closed inking or coating applying mechanism indicated generally as 48, and an adjustable oscillating doctor blade assembly 50, and a substantially closed circuit 52 for the traveling web while the same is passing the exhaust ports, and the hot air blast. The web circuit housing may be formed of insulating board or the like if desired, and suitable hot air baffles 53, 55 and 57 will ordinarily be provided.

Impression cylinder 20 will be mounted in a fixed position but will be axially adjustable vertically. Also, as indicated in Fig. 2, the printing cylinders will be power driven and the drive of each of the individual printing cylinders will as usual be common so that the couples will be synchronized. These printing cylinders may be lowered and rotated out of printing position, but the web will be maintained in its same fixed path by means of the impression cylinders and idlers, as described more in detail in my co-pending application Serial No. 180,285.

It will be understood that the inventive concepts, either in whole or in part, described and disclosed in this application may be adapted to or used in a modified form in conjunction with the particular printing press inventions described and disclosed in my above referred to co-pending patent application.

An important element of this present application is the provision of a specially designed, preferably mechanically knurled gravure printing cylinder, specially adapted for the uniform application of film forming materials upon a rapidly traveling web of paper, foil, or the like, and so adapted by virtue of a so-called crater or subsidiary well formation, which gives greater wall surface, which prevents the picking up of the coating fluid from the ink well: in other words, the well acts as a coating fluid trap, and otherwise the doctor blade would lift out the coating or inking fluid.

The two regular geometric forms of ink or coating fluid wells illustrated in Figs. 3 and 5 are particularly adapted for the practice of my invention and it will be understood that while two plan views shown, namely Figs. 3 and 5, that these are enlarged plans, and that in fact when the configurations as shown are applied on a circular printing cylinder, that the diagonal lines, shown in the figures will spiral around the cylinder.

Considering Figs. 3 and 4, the ink cells or coating fluid cells are shown as of a generally square shape (this is a preferred form only and it might be rectangular, circular or otherwise) and are illustrated as having an outer wall 54 which outer wall contacts the web, and two subsidiary interior walls each defining a square, namely walls 56 and 58. It is these latter walls which give additional wall area for contact with the ink or coating fluid, which prevent the lifting out of the inking or coating fluids. Also, this form of cylinder has an extremely narrow wall, namely wall 54 which is in contact with the web, (the subsidiary walls are not), thereby allowing the coating fluid when it is applied to the traveling web to easily overflow from square to square, and fill in the narrow line 54 which is uninked or uncoated, as will be well understood by those skilled in the art.

In the modified type of ink or coating fluid cell shown in Figs. 5 and 6, parallel inking grooves 60 are spiralled diagonally over the surface of the gravure printing cylinders, by a knurling operation and ribs or baffles 62, forming ink traps 64, are formed crosswise to the grooves 60, namely perpendicularly to their side walls, thus giving an increased wall area to the inking grooves, and also providing traps for the coating fluids.

In each instance the patterns illustrated in Figs. 3 and 4, and also 5 and 6, are mechanically knurled upon an ordinary gravure printing cylinder, and while this is a definitely preferred and most practical procedure, those skilled in the art may devise alternate means of attaining similar patterns, as by etching.

While the proportions may manifestly be varied, I have found that in the coating fluid well pattern illustrated in Figs. 3 and 4 that the main well walls indicated as 54 are preferably in a ratio of 1 of wall top to 20 of fluid area and range in depths from .003" to .0015", according to thickness of solid coating desired; whereas etched ink cells for printing purposes normally have a ratio of 1 of wall top to 3 of fluid area, and range only to depths of about .003". I have been successful in employing 16 such coating fluid wells to the linear inch—diagonal measure—or 256 to the square inch; whereas the usual etched ink wells for printing purposes may approximate 150 wells to a linear inch or 22,500 to a square inch.

Since the surface tension of fluid lacquer coatings or the like is ordinarily greater than the interfacial tension between the metal well walls and the fluid in the case of the normal type of plain wells (without the lower well walls), the lower well walls of my invention serve two purposes, namely they increase the surface area of a given quantity of lacquer within the well and also act as traps to aid the master well walls to retain the fluid contents thereof during the scraping action of the oscillating doctor on the rotating gravure cylinder.

For a practical working example of the type of coating possible with the coating means above described, I have found that 9% of solids comprised of 75% cellulose acetate and 25% diethyl and dimethyl phthalate (the phthalates being 43% and 57% respectively) in a mixture of a solvent comprised of 80% ethylene dichloride and 20% alcohol by weight serves well to give a continuous film surface, when dried, and that the same will operate well with the wells illustrated and described. Also, that lacquer coatings comprising substantially 20% of ethyl cellulose and 80% solvent mixture comprising 20% alcohol and 80% toluol may be utilized. Other resins such as shellac, etc., may obviously be used or rubber derivative film forming substances.

By controlling the depth of the knurling, the thickness of the coating may be determined and definitely uniform coatings for thousands and thousands of yards of web material can be obtained. The well depths may vary, according to my experiments, from .003" to .0015" according to thicknesses desired, and these ranges probably could be considerably modified. Other vari-

ables of course include percentage of solids, type of solvents, etc.

If desired, cellulosic or rubber derivative films could be coated and printed by this gravure cylinder method upon backing materials from which the films could be stripped when dried.

It will be understood that in my preferred embodiment I propose to coat rapidly traveling web material running at normal gravure printing speeds in printing couple 12, by means of a gravure printing cylinder knurled in a pattern as described in conjunction with Figs. 3 and 4, that the solvent vapors of such coating will be exhausted and the coating dried, and then the coated web will be printed in one or more colors by virtue of printing couples 14 and 16.

It will be understood that while the illustrated forms of the invention which I have described illustrate certain preferred embodiments of my invention, I do not wish to be limited to the precise details which are shown, since it is obvious that the same may be considerably varied without departing from the spirit of the invention as heretofore described and that therefore, reference should be had to the appended claims for a definition of the scope of my invention.

I claim:

1. In a gravure web cylinder adapted for high-speed coating operations, a gravure cylinder having its web contact surface formed of two sets each of a plurality of relatively narrow raised lines extending diagonally of the printed surface, the lines of one set merging with the other set and in the same plane, the merging sets of relatively narrow raised lines thus forming rectangular coating solution wells, and a plurality of rectangular wall surfaces within each of said wells, one within the other and of successively lesser area, said subsidiary wall surfaces being below the web contact line, the two sets of diagonally extending and merging web contact lines being so proportioned to the wells provided thereby that a coating fluid held by the wells and applied to a traveling web will merge at the web contact lines for coverage of the web.

2. A gravure web cylinder adapted for high-speed coating operations constructed in accordance with claim 1, in which the ratio of the diagonally extending contact line surfaces bounding each well and the area of the well is about one to twenty.

3. A gravure web cylinder adapted for high-speed coating operations constructed in accordance with claim 1, in which the ratio of the boundary line surfaces of each of the contiguous primary wells to the area of the well is about one to twenty and the depth of the well ranges between .002 to .0015 inch.

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