FIG. 7.

HARDNESS CHARACTERISTICS OF ELASTOMERIC BACKINGS FOR PRINTING PLATE BLANKS

PLATE THICKNESS - IN INCHES

SHORE D DUROMETER READINGS
ABSTRACT OF THE DISCLOSURE

My improved printing plate blank essentially comprises a metallic body composed of an appropriate printing plate metal having a printing surface on one face thereof onto which printing images can be applied wholly within the thickness of the metallic body itself, as by etching the surface thereof to form the images in relief or intaglio, said body having inseparably bonded to the outside for thereof, as by casting thereon by means of suitable mold apparatus, or applying thereto in any other suitable manner, an elastomeric backing in the form of a relatively hard but flexible thermo-setting plastic layer which assures high quality printing with little or no preliminary makeready in the use of printing plates made from my improved blanks. The elastomeric backing preferably comprises a blend of polymerized rigid and flexible unsaturated alkyd polyester resins, such as "Polyllite" and "Polyllite" respectively, or their equivalents, with the hardness of the backing being inversely proportional to the over-all thickness of the printing plate blank as a whole, in a practical thickness range from about 0.017 inch to about 0.375 inch. Printing plate blanks of this type have proven highly satisfactory when the resin blend aforesaid ranges in the proportion of from about 10% to 48.5% rigid resin to about 90% to 51.5% flexible resin, by volume, with a Shore D hardness of the backing ranging from about 35 to 78 for printing plate blanks having an over-all thickness ranging from about 0.375 inch to about 0.017 inch, in inverse proportion to the hardness range. Such printing plate blanks and improved backing compositions thereon are particularly applicable to the making of direct and indirect printing plates of either flat or curved types, including wrap-around plates for rotary letterpresses and the like, and which can be readily processed to produce printing images thereon, as by etching or otherwise, according to conventional and/or more recently developed new methods and equipped commonly utilized for the making of direct printing plates.

This application is a continuation-in-part of my earlier filed application Serial No. 150,793, filed November 7, 1961, which is to be abandoned effective with the filing of the continuation-in-part application.

The invention relates to improved printing plate blanks and their applications in the various fields of the printing industry. Although my invention will be disclosed herein as especially applicable to the manufacture of printing plates for rotary letterpresses, it is to be understood that it is not limited thereto and can be applied to other types of printing presses, including those of rotary wrap-around letterpress, rotary dry offset or the flat-bed type.

An object of my printing plate blank is to satisfactorily meet the requirements of a direct printing rotary letterpress plate and also meet the specifications of dry offset applications in the field of offset lithography. These blank printing plates take advantage of the desirable qualities of the offset lithography process, namely, step and repeat plates of large size, greater press speeds, reduced make-ready, ease of handling and storage, and, in some phases, as will be pointed out, will exceed the advantages of offset lithography.

As this printing plate blank is usually a large one-piece printing plate utilizing the full printing surface of rotary presses (not a duplicate plate for mounting on presses to obtain multiple images to the capacity of the presses), I find that this printing plate blank also has applications in some phases of the other major printing processes.

For example, there are four major printing processes: (1) Letterpress which prints when the relief surfaces of an inked plate are pressed directly against the paper; (2) Offset Lithography which applies ink from a non-relief or flat printing plate to paper via an intermediate rubber blanket; (3) Gravure which is a method of printing from tiny ink-holding wells in the printing plate surface; and (4) Flexography consisting of a flexible relief rubber plate which prints primarily on plastic foils.

Letterpress in recent years was the dominant printing process. However, steady advances in technology within the offset industry and a period of stagnant growth in the letterpress field were the direct causes of offset becoming the dominating printing process at the present time. The future of letterpress promises to regain its position as a leader in the graphic arts if the estimates of foreign and domestic wrap-around rotary letterpress manufacturers prove sound.

Wrap-around printing seeks to provide the high quality offered by letterpress while canceling out old letterpress disadvantages, i.e., cumbersome forms, heavy electros, lengthy makeready and lock-up times and slow press speeds, also taking advantage of the speed, economy and flexibility of the offset process and, at the same time, eliminating one of the major problems of offset, which is the complicated ink-water balance that must be maintained for proper ink color control.

It is these advantages of wrap-around that provide the basis of three new techniques in the letterpress field, namely, Wrap-around Letterpress, Wrap-around Dry Offset, and Adapting existing Rotary Letterpress to Wrap-around. The availability of Rotary Letterpress presses, which use thin wrap-around plates, Type 32 (having a thickness of 0.025") effectively increases letterpress printing capacities to where they compare with Offset, thereby putting letterpress in an excellent competitive position.

Wrap-around Dry Offset utilizes existing offset presses for its technique, by using a type 25 (thickness 0.025") Wrap-around Relief Plate to transfer its inked image to a rubber transfer blanket, then to paper stock. This eliminates the vexing problem of ink-water balance in the Offset Process.

Traditional rotary letterpresses that used the cumbersome individual heavy electros, can be made fully competitive again by the use of Type 60 (thickness 0.060") Wrap-around plates and the use of saddles, and my printing plate blank with its various Wrap-around plate thicknesses without saddles.

My printing plate blank can be identified as a Wrap-around plate when manufactured in any caliper up to approximately 0.060", and can be identified as a precured Rotary Flexible Letterpress plate when manufactured in calipers over 0.060", and can be mounted completely around the cylinders of traditional rotary letterpresses.

Photo-engravers are processing Wrap-around plates of three solid metals, zinc, magnesium, and copper. However, these plates buckle very easily, are difficult to handle on the press, and buckles cannot be eliminated from the plate. Also, they tear, fracture and stretch when clamped on the plate cylinders. Metal restrictions as to size and caliper are other factors that need correcting. Photo-engravings in the rigid pre-curved rotary letterpress field at the present time are limited to one-half the diameter.
of the cylinder and are usually segments that offer slight advantage over the heavy individual duplicate electroplates.

My printing plate blank eliminates the above-mentioned faults of existing solid metal wrap-around plates. In addition, limitations of the etched relief depth on solid metal wrap-around plates specify that the etched depth not exceed 50% of the total plate caliper. These limitations are not applicable to my printing plate blank. All that is needed is approximately 10% to 20% of the base metal bonded to an elastomeric backing. Thus, at least 80% of the base metal can be devoted to etched relief in the ultimate printing plate. This, at the same time, makes my wrap-around principle feasible in the field of pre-curved direct printing plates that are utilized on existing rotary letterpress presses that now depend on segmented duplicate plates. My printing plate blanks from types 100 (0.10") to 375 (0.375") are completely flexible and can utilize the complete cylinder of the rotary letterpress presses.

As the result of extensive activities in the letterpress platemaking industry in the past decade or so, many new improved developments have occurred, such as the relatively new process of powderless etching of magnesium, zinc and copper (which are the usual base metals of most printing plates). Brass and other alloys can also be used to provide printing plates having a surface upon which an image can be imposed by any method which can subsequently be etched by one or more of the various conventional or currently developed etching processes to obtain the required relief to satisfy their requirements of the various printing processes used in rotary or flatbed presses.

My invention is primarily concerned with the making of improved printing plate blanks intended to provide a satisfactory printing plate, meeting and surpassing the requirements and specifications of the new rotary wrap-around letterpressing presses recently introduced by the United States and foreign press manufacturers, which can be readily processed by the methods and equipment already in use. The new printing plate blank also expands and extends the use of existing conventional letterpresses which are the widest used type of presses in the printing industry.

Another principal object of my invention is to provide an improved backing for metal printing plates, said backing being composed of an elastomeric plastic material which readily bonds to zinc, magnesium, copper and brass, or the like, said bond being achieved preferably without a special separate bonding agent, and the elastomeric material being relatively flexible, but strong and durable. Preferably, my improved backing material comprises a blend of rigid and flexible thermosetting resins, such as polyester resins of the type commercially known as "Polylite." The blend may be varied as desired to suit the particular conditions of use and/or the specific press or presses for which the printing plates are intended to be used. The plastic backing material is preferably cast directly onto the back face of an appropriate photo-engraver's metal plate blank of appropriate thickness, and the plastic is intimately bonded thereto so as to be inseparable therefrom under normal conditions of use.

In the case of printing plates for rotary letterpresses, the blank plate having my improved elastomeric backing is preferable made in the form of a cylinder which is split at one side either during the initial manufacture of the plate blank or subsequent thereto, as desired. In either case, the elastomeric backing and the metal are sufficiently flexible to allow the plate cylinder to be opened up at its split side so that the cylinder can be laterally passed over and onto the printing cylinder of the press, and can then be fastened in place on the printing cylinder by existing conventional mounting practices and instrumentality, or in any other suitable manner.

The following definitions are given of terms pertaining to the advantages of my printing plate blank:

(1) Makeready

Makeready is a term applied to printing that refers to all the operations involved in making a printing press ready to print single or multiple images on suitable re-production plates with single or multi-color inks impressions of the printing plate or plates (depending on the number of colors) in register and of satisfactory quality:

A. Mounting plates on press;
B. Register of plates;
C. Adjust printing pressures, offset lithography (plate cylinder to blanket and blanket to impression cylinder);
D. Ink trapping (multi-color);
E. Length of print control;
F. Correct balance of ink and water; and
G. Adjust press to feed sheets in proper location.

(2) Press Speeds

Flat bed (2700 sheets per hour);
Wrap-around (up to 8,000 sheets per hour);
Offset (6,000 sheets per hour); and
Gravure (6,500 sheets per hour).

(3) Step and Repeat

Placing single or multi-color images on one plate in perfect register and position, it being only necessary to register one plate per color (one step of makeready).

(4) Distortion

The change of print length of an image whether printed flat or curved to fit a cylinder. A flat plate, curved to fit a cylinder, will have greater print length. Therefore it is necessary to that maintain register the image on a wrap-around plate, it must be printed on a cylinder having the same diameter as the press, prior to etching the plate, to assure perfect register.

By utilizing the combinations of various calipers of metals, together with the fact that my elastomeric backing can be formulated to varying degrees of flexibility and resiliency, my printing plate blank has applications in other fields of the printing industry, as follows:

Applying in the Field of Offset Lithography

(1) Dry offset (Type 25 Plate)—0.025" and also Type 17 plate (0.017"). My printing plate blank can be utilized in this segment of offset lithography with the following advantages:

A. Eliminates the bothersome ink-water balance in the offset process which will maintain better color control in printing ink densities on the printed sheet;
B. The resilient elastomeric backing on the printing plate blank will work to good advantage in absorbing some of the pressure from plate to blanket and thus extend overall plate life and improve image impression on the blanket;
C. Plates can be photo-composed flat (by step and repeat) directly on plate, eliminating step and repeat negatives as distortion of a plate of this caliper would be minimal;
D. Material waste is greatly reduced, eliminating the necessity of maintaining the ink-water balance in offset.

(2) Metal decorating (OFFSET lithography).

A. Plates will print clean in non-image areas because of etched relief areas;
B. Distortion from stretch in zinc and aluminum plates is eliminated as printing plate blank is laminated or backed up with an elastomeric backing;
C. Printing pressure (plate to blanket) is reduced as the elastomeric backing can be formulated to absorb the required amount of pressure which would extend plate life (since metal lithographers normally print with excess squeeze);
D. Dense color coverage can be obtained as the plate eliminates the ink-water balance. Metal lithography requires more ink deposit than can normally be balanced with the ink-water system; and long runs can be expected as printing pressures are reduced.

3 Applying in the field of flexography. If the transfer roller is rubber covered (which is available):

(A) My printing plate blank which is flexible can be utilized;

(B) The elastomeric backing can be made flexible enough to allow the plate to print on various surfaces;

(C) Can be ideal for printing plastics;

(D) It will not be necessary to build in master flat plates;

(E) Plate will not deteriorate (as rubber);

(F) Achieves exceptionally long runs;

(G) Metal surface of plate will give good ink reception and release and becomes more polished as run increases, thus increasing its printing qualities;

(H) No solvent problems (as rubber);

(I) Better printing qualities with no halo effect around characters and better halftone reproductions.

4 My printing plate blank also has advantages in the field of rotary letterpress over the duplicate plate methods of rotary letterpress which includes electrotypes, stereotypes and all types of plastic duplicating plate methods:

(A) Does not have to be ground to finished calipers;

(B) Not limited to size (up to full-size of press specifications);

(C) Achieves savings in cost, so not necessary to assume the added cost of making original engraving and duplicate plates;

(D) It is not necessary to incorporate in the original master photo-engraving certain qualities that are required of engravings submitted to electrotypes or others for manufacturing duplicate plates. These qualities do not exist with the engraver from faithfully incorporating in the plate the desired treatment that will render a better printed image of the original;

(E) Eliminates make ready time in mounting and registering plates on press by approximately 80% and in some cases, is entirely eliminated; and

(F) Eliminates distortion from flat to curved plates.

The effect of computer photo-composition on my printing plate blank in the field of graphic arts gives the following advantages:

(1) Computerized systems of composition lowers composition cost, produces at data processing speeds, renders best quality, is more accurate, and will store composition on tapes (eliminating storage of metal). These systems will increase continually the volume of typesetting as this method of composition becomes economically possible;

(2) If history is a valid barometer, automation will eventually increase, not arrest, the volume of activity and employment in the field of graphic arts.

(3) Automated typesetting's promise lies in the application of a wide variety of auxiliary equipment. One phase of this is platemaking processes. It is in this field, also, that my printing plate blank has application—in particular:

A. Book-magazine publishing:

(1) One-piece printing plate of multiple pages exact caliper eliminating much make ready;

(2) Ease of composing individual pages in layouts;

(3) Light weight plates increase press speeds; and

(4) Precision caliper and surface of the plate provide better ink coverage (with less ink) and better image impressions.

B. Newspaper field:

(1) Increasing use of photo-composition necessitates photo-engravings being processed of whole pages, which, in turn, are then stereotype for curved printing plates. My blank could be printed direct on press with these advantages:

(A) Eliminates stereotyping;

(B) Achieves better rendition of halftone reproduction;

(C) Provides a resilient backing on the plate which will print better on newsprint stock (a feature which is desired but not available); and

(D) Light-weight plate increases the press speed of newspaper presses tremendously, as stereotypes are heavy lead plates and can be thrown off press if speed increases over a certain limit.

20 Miscellaneous other advantages of my improved plate blank:

(1) The resilient elastomeric backing on my printing plate blank can be custom-formulated to meet the make-ready specifications required in printing the image of the printing plate on various types of printing materials such as:

A. Paper stock:

(1) Heavy carton boards of coarse and coated surfaces;

(2) Fine coated papers and machine-finish papers;

(3) Coarse newsprint;

(4) Paper foils;

(5) Fine and coarse cover stock.

B. Metallic foils.

C. Plastic foils.

(2) Tests indicate that my printing plate blank when converted into a rotary direct printing plate uses less ink to obtain a better ink coverage on the printed material and maintains this coverage with less manipulation of the inking fountain on the press.

(3) Plates can be repaired, if damaged, by pressure (small tooling hammer) applied from back of plate through the elastomeric backing without damage to the elastomeric backing, since the backing has the facility to transmit sudden shock to the metal enough to change the metal structure (when its printing surface is held against a conforming surface) to repair any defect that normally can be repaired by any conventional letterpress plate, and the plates can also be soldered or otherwise repaired with many of the plastic or metallic type adhesives.

(4) My printing plate blank is also so flexible that it can be printed (applying the image of the negative to the printing plate blank prior to etching in the photo-engraving process) in the curved state and subsequently flattened so that it can be etched in a flat etching machine. In this manner, curved distortion would be incorporated in the plate.

(5) The elastomeric backing of the printing plate blank so enhances the metal layer of the plate that it prevents buckling and fracturing of the plate due to constant flexing of the blank when mounting on the press and clamping and drawing around the cylinder. Solid metal plates (due to metal fatigue) are subject to this buckling and fracturing. The elastomeric backing is of such toughness and flexibility that it prevents metal fatigue and will withstand constant flexing and any subsequent buckles that might occur in the plate due to mishandling of the plate will disappear when clamped on the cylinder, as the elastomeric backing adheres to the cylinder like a glove and will draw the buckle of the metal to the cylinder.

(6) My printing plate blank will withstand any of the customary solvents used to remove ink and wash up on the presses that are in use today.

(7) Basic curve of the plate will remain in the metal.
surface of the printing plate after the plate has been etched, and the plate flattens out after etching due to its flexibility which makes for easier shipping and storage of the plate. This refers to types 25, 32 and 60 plates only, considered in the Wrap-around category. Heavier caliper plates of the pre-curved type have to remain in the curved state.

(8) Varying the resiliency of the elastomeric backing can eliminate the hard edges of vigneted half-tone illustrations that are a common problem with letterpress printing.

Other and further objects and advantages of the invention will be hereinafter described and the novel features thereof defined in the appended claims.

In the drawings:
FIG. 1 is a perspective view of a flexible plastic backed metal printing plate blank according to one embodiment of the present invention, said blank being of cylindrical form and split along one side so as to permit the cylinder to be opened up by separation of the edges along the split side, as indicated by the arrows, to allow the plate to be laterally passed over and onto a printing cylinder, with the broken lines in this view representing a partially opened-up condition of the plate;
FIG. 2 is a perspective view, partially exploded, of a mold for casting the plastic backing on the metal printing portion of the blank of FIG. 1;
FIG. 3 is a view partly in top plan and partly in section on the line 3—3 of FIG. 4 of the mold assembly;
FIG. 4 is a vertical sectional view through the mold assembly as taken on the line 4—4 of FIG. 3;
FIG. 5 is a fragmentary enlarged vertical sectional view through the mold assembly as taken on the line 5—5 of FIG. 3;
FIG. 6 is a graphical representation of the formulation of polyester resin backings which have been found satisfactory in the practice of my invention; and
FIG. 7 is a graphical representation of hardness characteristics of polyester resin backings having the formulations as represented in FIG. 6.

Like reference characters designate corresponding parts in the several figures of the drawings.

In one embodiment of my invention as particularly applicable to printing plates for rotary letterpresses, the printing plate blank is of generally cylindrical form as depicted in FIG. 1 of the drawings, said blank being generally designated 1. The outer portion 2 of the cylinder is composed of metal which may be any one of the various metals that can be processed by conventional etching processes and equipment. The outer surface of the metal portion 2 of the blank is the surface upon which an image can be applied by any method which can subsequently be etched in relief to produce a finished printing plate.

Also, as clearly shown in FIG. 1, the inner metal portion of the cylindrical blank is provided with a plastic backing designated 3, said backing being of an appropriate elastomeric material such as a blend of flexible and rigid thermostetting resins, as more particularly described hereinafter. The backing material may be cast directly onto the inner face of the metal blank 2 by means of suitable casting equipment more particularly illustrated in FIGS. 3 to 5 inclusive.

As shown in the latter figures, the casting mold includes a pair of coaxially disposed cylinders respectively designated 4 and 5, the cylinder 4 being the inner cylinder and being radially spaced from the outer cylinder 5 to define therebetween an annular mold chamber 6. The opposite ends of the inner cylinder 4 are closed as by means of end heads 7, 7 which are suitably welded or otherwise secured thereto in such a manner as to define a fluid-tight thermal chamber 8 therein and into which a thermal fluid medium may be introduced and circulated therethrough. The end heads 7, 7 are preferably spaced inwardly from the extreme ends of the cylinder 4, as best seen in FIGS. 4 and 5.

Additional circular end heads 9, 9 are provided to seat on the extreme opposite ends of both cylinders 4 and 5, as clearly shown in FIGS. 4 and 5. These end heads 9, 9 are each preferably machined to provide annular channels in which the extreme ends of the cylinders 4 and 5 are snugly seated, said channels being respectively designated 4' and 5'.

The upper head 9 is provided with a pair of openings formed therethrough as indicated at 10 and 11, respectively. Extended freely through the opening 10 and connected to the upper head 7 of the chamber 8 for communication with the latter is an upwardly extended tube 12 which serves as an overflow or outlet when the chamber 8 is filled with a liquid medium. For convenience, a hose or other conduit 13 may be connected to the tube 12 to direct the fluid to any convenient point of disposal or waste.

Also attached to the upper head 7 is a fluid inlet tube 14 which preferably extends downwardly within the chamber 8 to a point near the bottom thereof, the upper end of this tube extending freely upwardly through the opening 11 in the upper head 9, and being provided with a suitable connector for connecting the same to a hose or other appropriate conduit 15 for directing a liquid medium into the chamber 8, as will be described further in the following.

Welded or otherwise suitably secured to the bottom of the lower head 9 and extending radially outwardly from therefrom is a plurality of brackets 16, each of which is provided with a clamping bolt 17 pivotally connected thereto, said bolts being freely swingable toward and away from engagement within brackets or bifurcated ears 18 rigidly welded or otherwise secured to the outer cylinder 5 near the lower end of the latter, and each bolt 17 having a nut 19 threadedly engaged with its free end to permit the bolts to be released or tightened in releasing or anchoring the outer cylinder 5 to the bottom end plate 20, as will be obvious from the drawings.

The outer cylinder 5, which constitutes the outer wall of the mold chamber 6, is preferably divided in two halves of semi-cylindrical form, the diametrically opposite ends of the respective halves being flanged as at 20, 21 and provided with clamping bolts 22 for clamping the two halves together and for releasing the same for separation, at will. To insure positive alignment of the two halves during assembly of the mold, the flanges 20, 21 are respectively provided with tapered guide or dowel pins 23 and complementary holes 24, as best shown in FIG. 4.

In the use of the mold assembly, the metal blank 2 to which the plastic backing is to be applied is disposed in the annular mold chamber 6 of the mold, with the outer surface of the metal blank seating against the inner face of the outer cylindrical wall 5, as best seen in FIG. 5. When so seated, the upper and lower edges of the metal blank are seated to the inner face of wall 5 by means of flexible flat-back adhesive tape 25. When so seated, the metal blank 2 can be firmly and uniformly seated against the inner face of the outer wall 5 by applying a suction or vacuum to the outer surface of the metal blank. To accomplish this, a jacket of air-impervious material is disposed around the outside of the cylindrical wall 5 in radially spaced relation to the outer face thereof, said jacket being designated 26, and preferably composed of a suitable lightweight but durable material such as "Mylar." In mounting the "Mylar" jacket 26, the jacket is seated upon spacer rings and bars 27, 28 of appropriate thickness, said rings and bars being welded or otherwise secured to the respective halves of the outer cylindrical wall 5, as best shown in FIG. 2, so as to space the jacket 26 from the wall to provide a vacuum chamber 29 therebetween of adequate size. In order to insure complete sealing of the jacket 26 to the wall 5, double-backed ad-
hesive tape 30 is applied directly onto the outer surface of the rings 27 and bars 28, and the jacket 26 is then brought into contact with these tapes so as to be firmly sealed thereto. Additional double-backed adhesive tapes 31 are applied around the outer edges of the jacket 26, followed by suitable clamping rings and bars or straps 32, 33 which can be tightly drawn up against the jacket 26, as by cap-screws 34 extended through the entire jacket assembly and threadedly engaged with the rings 27 and bars 28 to insure complete air-tight sealing of all edges of the jacket 26 when mounted on each half of the center mold cylinder 5. The outer mold cylinder itself is provided with a plurality of rows of spaced perforations or apertures 35 which extend completely therethrough to the inner face of the outer cylindrical wall against which the metal blank 2 is seated. A hollow connector stem 36 is suitably secured to the jacket 26 for establishing communication with the vacuum chamber 29. By coupling the connector 36 with a suction pump or other equivalent means for producing a vacuum by suction, a vacuum can be established in the chamber 29 which will act through the perforations or apertures 35 to pull the metal blank 2 firmly against the inner face of the outer mold wall 5, thereby assuring uniform and precise dimensional formations of the outer surface of the metal blank which constitutes the printing surface when applied onto a printing roller of a press. As a simple means for producing such a vacuum action, the connector 36 of each jacket sector 26 may be connected by a hose 37 to the air-intake side of a conventional compressor of appropriate capacity.

In order to assure smoothness of the inner or back face of the plastic backing when it is cast on the metal blank, the outer face of the inner cylindrical wall 4 of the mold, which forms the inner face of the mold chamber 6, is preferably chrome plated, as indicated at 38. Also, a separator strip 39 is preferably inserted between the flanges 20 and 21 at one side of the mold when the mold is assembled and prepared for the casting operation. This separator strip is positioned to radially extend across the mold chamber 6 and into contact with the plated surface of the inner wall 4 so as to divide the chamber at one side where the blank is split prior to the casting of the plastic backing thereon, thereby causing the plastic backing to be similarly split or divided at the same point when the backing is cast on the metal blank.

The top head 9 at the extreme upper end of the mold assembly is preferably provided with two diametrically opposite pour holes 40, 41, said pour holes registering with the upper end of the annular mold chamber 6 defined between the cylindrical walls 4 and 5 of the mold assembly. Either pour hole may be used to direct the plastic backing material into the mold chamber 6 while the other is acting as a vent. On completion of the casting operation, the upper head 9 may be readily removed from the mold by lifting or knocking it off after the hoses 13 and 15 have been disconnected from the outlet and inlet tubes 12 and 14, respectively, which communicate with the inner chamber 8.

In preparing the mold for the casting operation, the halves of the outer cylindrical wall 5, each having a separate vacuum jacket secured thereon at the outer sides thereof, should be separated and carefully cleaned and polished as by means of a rotary, power-driven wire brush. The separator or divider strip 39 should also be cleaned, and then the two halves of the outer cylinder should be assembled by mating the tapered dowel pin 23 with the holes 24 in the opposed flanges 21, after which the flanges are firmly clamped together in abutting relation by tightly drawing up the clamping bolts 33, with the separator or divider strip 39 initially assembled between one pair of flanges 20, 21 so that the inner edge of the separator is flush with the inner surface of the assembled outer cylindrical wall. Before assembling the outer wall with the inner wall, the inner wall 4 should preferably be carefully cleaned with acetone, and the chrome plated surface should be coated and polished with a release solution such as "V-50" liquid wax, or with any other appropriate water soluble wax material, so that after casting the plastic backing onto the metal blank of the printing plate, the backing will readily separate from the mold. Both the upper and the lower end heads 9 should also be prepared in the same manner in those zones where the respective heads register with the mold chamber 6.

The lower end of the inner cylinder 4 should then be seated firmly in the annular groove 4' in the lower head 9 preparatory to assembly with the other parts of the mold. The metal blank 2 onto which the plastic backing is to be cast is next inserted into the outer assembled cylinder 5, and taped around its upper and lower edges to the inner surface of the outer cylinder, by means of tapes 25. Before inserting the metal blank, all sharp edges or corners thereof would be removed and the edges rounded so that they will not cut the sealing tapes 25. The metal blank is also preferably pre-curved to a size preferably somewhat larger than the inner diameter of the outer cylinder assembly so that when the blank is inserted in the cylinder, it will tend to spring back tightly into firm seating engagement against the inner surface of the cylinder. The blank is inserted so that its split side spans the separator or divider bar 39.

Since the metal blanks, as usually manufactured for photoengraving use, are coated with a etch-resistant coating to prevent etching on the back of the plate when the plates are processed, this coating on the back of the metal blank preferably is sanded lightly to clean the surface and to provide a clean tooth-and-bond for the plastic backing. After sanding, the surface should be carefully brushed to remove all powder residue and additionally cleaned with acetone. Thereafter, the plate should be handled very carefully so that no greasy finger prints or other foreign matter will contaminate the back of the plate prior to casting the plastic backing thereon.

The sealing tapes 25 should also be carefully cleaned, waxed, and polished, and all excess wax should be removed from those surfaces to which the wax has been applied, it being understood that no wax is applied to the back of the metal blank itself.

At this time, the vacuum hoses may be attached to the connectors 36 on the respective halves of the outer cylinder assembly so that the vacuum chamber, as well as the areas around the metal blank where it is taped to the inner face of this cylinder, can be checked for leaks. Thereafter, the outer cylinder, with the metal blank firmly seated therein and held in uniform contact therewith by the vacuum, is applied over the inner cylinder of the mold assembly, and the lower edge of the outer cylinder is carefully seated in the annular groove 5 in the bottom head 9. When so seated, the clamping bolts 17 are engaged with the brackets 18 and are tightened to anchor the outer cylinder to the bottom head 9.

At this stage of the assembly, the clamping bolts 22 at that side of the outer cylinder where the separator or divider bar 39 lies between the flanges 20, 21, should be loosened, and the separator bar should be moved radially inward until it makes firm contact with the plated surface of the inner cylinder 4, and at the same time setting the separator bar tightly against the lower head 9.

Continuing the assembly of the mold, the upper head 9 can be now be fitted onto the upper ends of the inner and outer cylinders 4 and 5, making certain that both cylinders seat tightly and snugly in the annular channels 4' and 5' formed in the lower face of the upper head 9. Thereafter, the connector on the upper end of the inlet tube is 14 can be connected to hose 15, and this hose connected in turn to a suitable source of hot water, which may be any usual hot water tap from which hot water may be derived at the normal temperature of such a supply as commonly provided in buildings and/or for domestic use. The outlet tubes 12 also can then be connected to a hose
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13 to direct the overflow from chamber 8 within the inner cylinder of the mold assembly to any suitable point of disposal. The mold is now fully assembled and ready for the performance of the casting operation.

The development of my improved printing plate blank and its subsequent field testing led to taking advantage of certain major uses and features of elastomeric resins that will impart to the engraving metals, when applied as a backing therefor, additional tensile strength (to withstand forces which tend to pull it apart in opposite directions, such as when clamping the plate on rotary cylinders), additional flexural strength (to withstand the constant flexing of the plate not only during its manufacture, but also to withstand handling while being mounted on the presses), and also additional compressive strength (to withstand the various amounts of load required to make a printed impression on various printing materials against the impression cylinder of the printing press). A further purpose of the elastomeric backing is to enhance the ability of the engraving metals to withstand metal fatigue which causes tear and stretch when used as solid metal printing plates. It also provides the printing plate blank an ability to recover itself from buckles and stress factors from which solid metal plates cannot recover, and it provides the means of eliminating tangents when clamping the plate on presses and increases the ability of the plate to conform to the plate cylinder.

One typical elastomeric backing which I have found to be highly satisfactory consists of a formulation which includes two polyester resins combined with a promoter or accelerator and a catalyst. One of these polyester resins is commercially classified as a flexible blending resin such as is commercially identified as "Polylite" 31-851 (formerly identified as 8151), and the other is classified as a rigid resin, such as "Polylite" 31-007 (formerly identified as 8007), both manufactured by Reichhold Chemicals, Inc., of White Plains, New York, and both having a low viscosity as necessary for casting relatively thin films or backings onto the back of engraving metals. Such polyesters, including "Polylite," are liquid resins of the unsaturated alkyd type dissolved in styrene and other monomers, and are 100% reactive, thermostetting and set without releasing by-products to a hard solid that will not soften on heating. By proper choice of a catalyst, the gelling, and the subsequent hardening or curing, can be done at either room or elevated temperatures. Thus, such resins may be considered as a type of polyvinyl alcohol and dibasic acid and reactive diluent, and will produce a relatively hard but elastomeric composition when reacted with an appropriate catalyst, and capable of being easily molded into a form that is useful as a superior backing for printing plate blanks.

The conversion of polyester resins from a liquid to a solid state involves the chemical reaction called copolymerization. The monomer in which the polyester resin is dissolved reacts with the unsaturated groups in the polyester chains to form a cross-linked, thermostet polymer. This copolymerization reaction is called an addition reaction, since no volatile by-products are released. The cross-linking process is activated by a free radical mecha-

nism which involves opening of the double bonds in the polyester chain or monomer. This chain reaction is triggered by the introduction of catalysts which decompose into highly active free radicals that act to seed the free radical reactions and subsequent polymerization throughout the entire mass.

The terms "accelerator" and "promoter" are herein used synonymously to refer to compounds which are added to a resin system to speed the decomposition of catalysts into free radicals at room temperature or at temperatures considerably below those required to release free radicals when the catalyst is used alone. The accelerator is used in addition to the catalyst because of the size of the printing plate blank which may be 36 inches by 60 inches (36" x 60") or larger, and the inherent thickness of the elastomeric backing which makes heating of the resin to promote cure difficult.

While "Polylite" polyester resins are primarily referred to herein, it is to be understood that other resins may be utilized to achieve the same results. Typical of such other polyester resins, to name a few are:

<table>
<thead>
<tr>
<th>Rigid</th>
<th>Flexible</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Amester&quot; 702</td>
<td>&quot;Amester&quot; 802</td>
<td>American Alkyd Industries.</td>
</tr>
<tr>
<td>&quot;Terpoly&quot; 712</td>
<td>&quot;Terpoly&quot; 700</td>
<td>General Electric Co.</td>
</tr>
<tr>
<td>&quot;Kinite&quot; 709</td>
<td>&quot;Kinite&quot; 790</td>
<td>S.S. Kresge Co.</td>
</tr>
<tr>
<td>IC-401</td>
<td>IC-401</td>
<td>Interchemical Co.</td>
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<tr>
<td>&quot;Lamine&quot; 4111</td>
<td>&quot;Lamine&quot; 4115</td>
<td>American Cyanamid Co.</td>
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<tr>
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<td>&quot;Paraplex&quot; P-44</td>
<td>Celanese Corp.</td>
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</tr>
<tr>
<td>&quot;Pleognol&quot; 1001</td>
<td>&quot;Pleognol&quot; 1001</td>
<td>Allied Chemical.</td>
</tr>
<tr>
<td>&quot;Selogynol&quot; 109</td>
<td>&quot;Selogynol&quot; 109</td>
<td>American Petrochemical Corp.</td>
</tr>
<tr>
<td>&quot;Vibron&quot; 121</td>
<td>&quot;Vibron&quot; 121</td>
<td>Pittsburgh Plate Glass Co.</td>
</tr>
</tbody>
</table>

For illustrative purposes herein, polyester resins "Polylite" 31-851 (8151) and "Polylite" 31-007 (8007) will be used as practical examples of plastic backing formulations for direct printing plate blanks ranging from Type 17 (0.017") to Type 375 (0.375"), with proportions expressed as percentages by volume, and each formulation including about 1.56% promoter, such as 6% cobalt naphthenate and about 1.56% catalyst, such as MEK Peroxide "60," which is a clear, colorless, oily liquid containing 60% methyl ethyl ketone in dimethyl phthalate solution of 40% active oxygen which is a superior catalyst for curing polyester resins either at elevated temperatures ranging from 100° F. to 200° F., or at room temperature (75° F.). By the use of 6% cobalt naphthenate as the accelerator or promoter, particularly when curing at temperatures in the lower range, the reaction of the resins is speeded so that complete hardening is achieved within a practical length of time.

The following basic properties of the aforementioned "Polylites," as given by Reichhold Chemical Inc. Technical Bulletins are useful for identification purposes:

**LIQUID "POLYLITE" 31-851 (8151)**

- **Viscosity (Brookfield), c.p.s. @ 77° F.** 300-400.
- **Color (APHA), max.** 100.
- **Specific gravity.** 1.12-1.14.
- **Weight per gallon, lbs.** 9.4-9.6.
- **SPL gel test.** 55°F-75°F.
- **Cure time, mins.** 11-15.
- **Peak exotherm temperature, °F.** 265-285.

**Unfilled castings:**

- **Shore D Hardness.** 50-60.
- **Tensile strength, p.s.i.** 1000-1500.
- **Elongation, pct.** 50-60.
- **Flexural strength, p.s.i.** Yields.
- **Flexural modulus, p.s.i. x 10^6.** do.
- **Compressive strength, p.s.i.** do.
- **Heat distortion point, °F.** do.
Table I

<table>
<thead>
<tr>
<th>Type</th>
<th>Resin 31-007 (Percent)</th>
<th>Resin 31-008 (Percent)</th>
<th>Shore D Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>375</td>
<td>30</td>
<td>80</td>
<td>60</td>
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<tr>
<td>320</td>
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<td>50</td>
<td>63</td>
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</tbody>
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Table II

<table>
<thead>
<tr>
<th>Type</th>
<th>Resin 31-007 (Percent)</th>
<th>Resin 31-008 (Percent)</th>
<th>Shore D Hardness</th>
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</thead>
<tbody>
<tr>
<td>375</td>
<td>30</td>
<td>90</td>
<td>63</td>
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<tr>
<td>320</td>
<td>27</td>
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</tbody>
</table>

Table III

<table>
<thead>
<tr>
<th>Type</th>
<th>Resin 31-007 (Percent)</th>
<th>Resin 31-008 (Percent)</th>
<th>Shore D Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>375</td>
<td>30</td>
<td>70</td>
<td>66</td>
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<tr>
<td>320</td>
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</tbody>
</table>

While heat distortion is a physical factor of the formulating resins, especially the flexible resin, field tests have proved that my backing resins will withstand photocopying procedures of burn-in by immersion methods of...
During the pouring operation, hot water may be admitted into chamber 8 to expedite the gel time of the plastic. While pouring, the opposite pour hole should be closely observed to assure the proper level of the liquid resin mixture in the mold so as to fully cover the back of the metal blank 2, and also to guard against overflow of the resin. After completing the pour, the resin is allowed to set until it gels, which usually takes from about 20 to 30 minutes, during which the resin can be observed through the pour holes to determine its condition. At that time, the vacuum boxes may be disconnected from the mold, and the outer mold cylinder can be disassembled and removed from the lower head to allow removal of the plastic backed metal blank. At this time, the plastic will still be somewhat soft so that it can be readily broken off around the taped edges of the metal plate. This facilitates trimming of the plate. Upon removal of the plate from the mold, the plastic backing should be allowed to cure for several hours, and thereafter, the blank plate is ready to be processed to produce the printing images on the outer surface of the metal layer of the composite metal and plastic blank. After each cast, the mold should be cleaned thoroughly preparatory to the next casting operation.

In lieu of the casting mold disclosed herein, my improved elastomeric backing may be applied to the engraving metal blank by any other suitable method or apparatus and the mold is not material to the printing plate blank features per se. While the particular polyesters given as examples herein have viscosities suitable for such casting molds, my invention is not limited to resins of these viscosities if appropriate measures are taken to permit the use of resins having other viscosities and will achieve comparable results within corresponding hardness ranges.

Appropriate fillers, such as so-called micro-balloons and like, can be incorporated in the resins during preparation of the mix so as to achieve or improve the desired texture, smoothness and other qualities of the backing, and to facilitate or assure release of any gases that may otherwise tend to be entrapped in the resin during mixing, casting and/or curing of the resin.

Also, a suitable filler material capable of being magnetized when subjected to an electro-magnetic field can be incorporated in the resins so that when the backing has become fully cured and has been magnetized, it can be magnetically anchored to the usual metal printing cylinders of printing presses without the need of mechanical fastenings or other conventional mechanical locking instrumentalities, or with a minimum thereof. I have found that barium ferrite in powdered or other finely divided form is an excellent filler for the resins to achieve the magnetic self-locking action referred to above when the backing has been cured and subjected to an electromagnetic field prior to use of the printing plates. The barium ferrite is relatively inexpensive and commercially available in such form so as to enable it to be readily incorporated in the resin mix during mixing of the polyesters described in the foregoing, prior to casting of the plastic backing onto the metal blanks, and without adversely affecting the other desirable qualities of my improved elastomeric backing.

It is to be understood that my invention is not limited to cylindrical printing plates, but may be equally applied to printing plates in the form of curved segments, as well as flat plates, and in casting the plastic backing thereon, the mold can be made to conform to the shape and size of the plate, utilizing the same principles as described in the foregoing.

While the specific details have been herein shown and described, the invention is not confined thereto, and other changes and alterations may be made without departing from the spirit thereof as defined in the appended claims.

I claim:

1. A printing plate blank of the class described, for use in making direct and indirect printing plates, comprising a metallic body having a printing surface on which images can be applied wholly within the limit of the thickness of the metallic body, said body having in separably bonded to the opposite face thereof an elastomeric backing in the form of a relatively hard but flexible thermoset plastic layer, comprising a blend of polymerized rigid and flexible unsaturated alkyd polyester resins, with the hardness of said backing being inversely proportional to the thickness of the blank in a thickness range from about .017 inch to about .375 inch.

2. A printing plate blank as defined in claim 1, wherein the rigid resin is inversely proportional to the thickness of the blank, and the flexible resin is conversely proportional to the rigid resin in terms of percentages by volume.

3. A printing plate blank of the class described, for use in making direct and indirect printing plates, comprising a metallic body having a printing surface on which images can be applied, said body having inseparably bonded to the opposite face thereof an elastomeric backing in the form of a relatively hard but flexible thermoset plastic layer, with the hardness of said backing being inversely proportional to the thickness of the blank, said plate thickness and hardness of the backing falling substantially within the area C-A-E-F-B-D-C diagrammatically illustrated in FIG. 7 of the annexed drawings.

4. A printing plate blank of the class described, for use in making direct and indirect printing plates, comprising a metallic body having a printing surface on which images can be applied, said body having inseparably bonded to the opposite face thereof an elastomeric backing in the form of a relatively hard but flexible thermoset plastic layer comprising a blend of polymerized rigid and flexible unsaturated alkyd polyester resins, with the hardness of said backing being inversely proportional to the thickness of the blank, said rigid and flexible resins being respectively proportioned as falling substantially within the areas S-N-H-H-N-S-S and H'-N'-S'-S'-S'-H' diagrammatically illustrated in FIG. 6 of the annexed drawings.

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DAVID KLEIN, Primary Examiner.