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METHOD OF FORMING LAMINATED PRINTING PLATE WITH PLASTIC CORE

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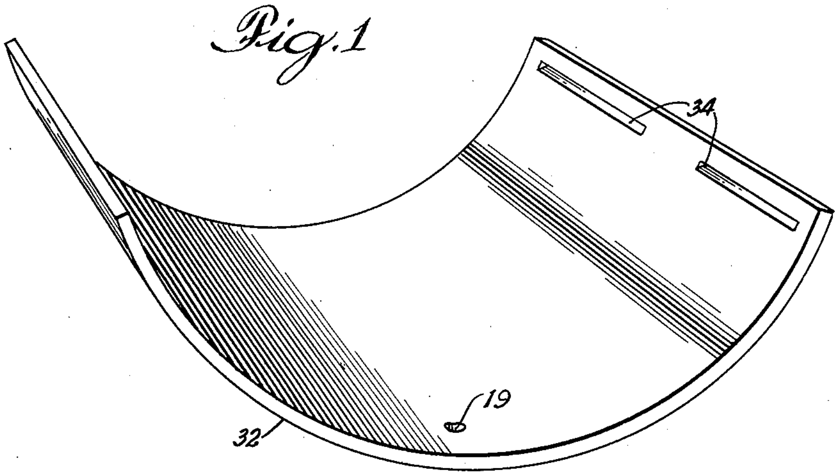

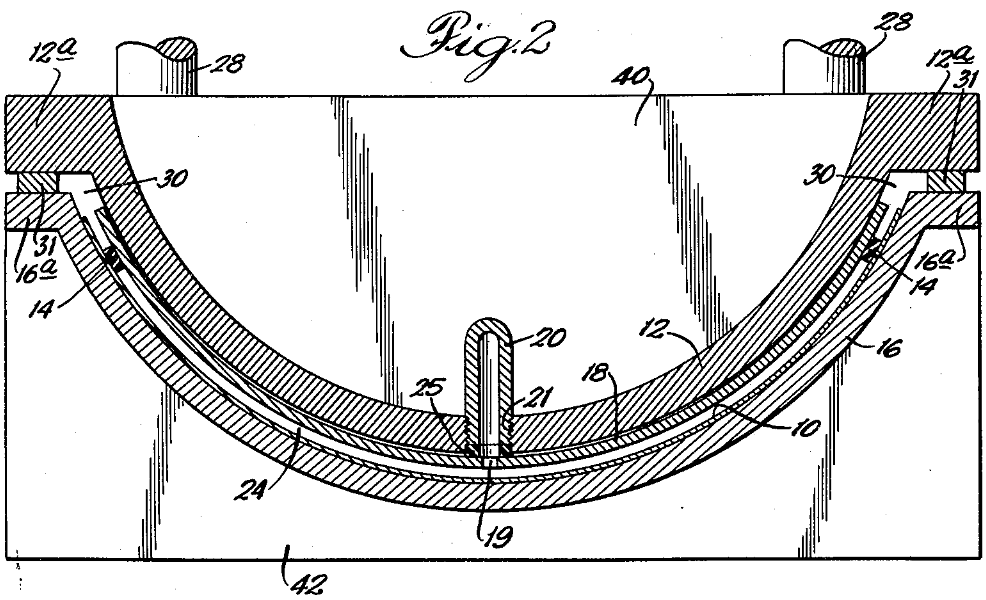

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METHOD OF FORMING LAMINATED PRINTING PLATE WITH PLASTIC CORE

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This invention relates to an improved method for preparing printing plates and more particularly to a method for making rigid plates of precise contour and thickness which accurately conform to the cylinders of rotary presses.

In multi-color printing it is essential that the several plates printing each of the different colors register perfectly. The outlines of the colors must coincide as closely as possible. In accordance with the commercially used process, fragile electrotype printing shells, usually made from copper, are reinforced by casting a relatively thick layer of lead over the back surface thereof. The lead flows into all the depressions or voids of the highly irregular back side of the electrotype shell and is adhered thereto by means of a fluxing agent, such as tin foil. After cooling, the flat laminate (consisting of the electrotype and a thicker layer of lead) is rendered uniform in thickness by shaving the lead or back side. The plate is then pounded with the electrotype lying against a steel slab to smooth out any unwanted depressions in the printing surface. Special care must be taken to prevent undue distortion of the printing surface during this pounding operation. The plate is then curved to the contour of the cylinder by passing it between forming rolls. In curving the plate the concave side (lead surface) is compressed and the convex side (electrotype surface) is distended. Considerable distortion results in the printing face due to curving and the distortion is not uniform from one plate to the other. The lead backing is soft and distorts more in some cases than in others. Likewise, the type face printing areas of the electrotype will distort more than the half-tone printing areas, primarily due to the neutral plane being consderably lower in the more deeply depressed type areas. Consequently, the several plates required in multi-color printing frequently do not register and must be replaced with a great delay in press starting time. Considerable time must also be spent in remedying the irregularities in plate thickness. During this operation, which is usually referred to as "make ready," the irregularities in the surface of the electrotype shell are compensated for by placing shims between the plates and the cylinders and by shaving the lead on the back of the plates, as required. It is also sometimes necessary to cut the plate into sections to obtain better register.

The primary object of the present invention is to obviate the foregoing difficulties and to provide a method for making relatively rigid curved printing plates which accurately conform to the printing roll without shimming, shaving or pounding.

Another object is to provide a curved printing plate consisting of an electrotype shell bonded to a lightweight backing plate by means of a layer of rigid thermosetting resin.

In one form of the invention a curved electrotype shell is bonded to a precurved aluminum plate by means of an epoxy resin which adheres tenaciously to the electrotype on one side and the aluminum plate on the other. Synthetic resins which may be converted from the liquid state to a hard infusible mass at low pressure are preferred for use in this invention. The laminated plate of the invention is light in weight and highly desirable for use in high speed presses. Plates of this type are also very rigid and can be clamped to the cylinder under tension without

distortion. The rigidity of the plate also provides a firmer, less yielding printing surface for better impressions.

Another object is to provide a method for preparing laminated printing plates wherein a curved electrotype shell is laminated to a reinforcing resin under slight pressure in a mold having a cavity conforming precisely to the curvature of the printing roll.

These and other objects will become apparent from the following description when read in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a perspective view of a finished plate made in accordance with the invention and

FIGURE 2 is a sectional view through the mold and the force producing members which hold the mold in closed position during the molding operation.

The mold consists of two complementary plates—a convex plate 12 of one radius and a concave plate 16 of larger radius. The contour is selected to produce a laminated printing plate that will fit the press cylinder as specified by the printer. In the form shown in the drawing, the mold is adapted to produce a printing plate that extends over 120° of the roll circumference. It will be understood, however, that the mold may be designed to produce any sized plate from 45° to 180° depending on the press cylinder for which the plates are being prepared. The plates 12 and 16 terminate at either edge in flat flanges 12*a* and 16*a* and preferably are fixed to the platens of the press or other force producing means in which the plate is formed; but they may be separate if desired. The platens of the forming press are usually flat and, in such case, a suitable adapter must be used to support the curved plates while they are in the press. The male adapter for what is normally the upper platen is a block, indicated by the numeral 40, and the female adapter for what is normally the lower platen is formed block 42. The press lies in a horizontal position with the platens disposed vertically. The plate 12 and block 40 are movable to open and close the mold by movement of ram members 28.

The width of the mold cavity 30 which is formed between spaced plates 12 and 16 is determined by the bearers or spacers in the form of bars 31 which extend between the flanges 12*a* and 16*a* on either side of the plates. The final thickness of the laminated printing plate is determined by the thickness of the bearers 31. It will be noted that plate 12 has a tapped opening 21 through the center of the back near the top into which a tubular sprue 20 is screwed. The sprue is in the form of an elbow which turns upwardly and terminates above the top of the cavity 30 to serve as a filler tube for the cavity. A resilient gasket or washer 25 is adhered to the end of the tube 20 and is adapted to seal the end of the tube against the backing plate comprising part of the printing plate, as explained hereinafter.

The electrotype shell is curved so that it fits approximately to the contour of the printing roll. It is made in accordance with conventional practice from copper or a copper alloy and is usually about .012" to .014" thick. The shell may have depressions .040" deep in some areas. The curving may be effected between curving rolls, well known in the art. An electrotype of this kind is identified in the drawing by the numeral 10. The electrotype 10 is placed in the female portion of the mold while the plates 12 and 16 are separated, i.e. the press is open. Next, a rubber gasket 14 is laid over the marginal edge of the electrotype 10 around its entire periphery to form a seal between the electrotype and the aluminum backing plate 18, which lies against plate 12. The gasket 14 is of slightly greater thickness than the space between the plates, as determined by bearers 31, so that it is under compression. The backing plate 18, which may be made from aluminum, magnesium or other suitable strong, lightweight material which is easily machined, has an opening 19 through the back thereof which is aligned with the sprue 20. The gasket 25 bears against the margin of the plate surrounding the opening 19 to seal the opening.

The space between the electrotype shell 10 and the plate 18 is filled with a liquid curable resin 24 characterized by good adhesion to copper and aluminum and capable of being cured at elevated temperature below 400° F. As the liquid resin is poured into the tube 20, the cavity between members 10 and 18 is gradually filled. The liquid resin has the ability to flow into the bottom of the deepest crevices in the electrotype shell to impart excellent support to the printing surface. After filling, pressure may be applied to the resin in an amount not exceeding 20 pounds per square inch gauge. Above this value dead metal areas in the electrotype may be pushed up. At about 15 pounds per square inch gauge the electrotype 10 and the plate 18 are brought into firm contact with the plate 16 and the plate 12, respectively, of the mold. The laminate is thus shaped accurately to the mold contour. Pressure is exerted continuously until such time as the resin has cured. Upon curing, the resin is converted from the liquid state into a hard infusible mass. Heat may be used if desired to accelerate the cure of the resin. With most resins the curing time at elevated temperature is less than one-half hour. Electrical heating elements or steam jackets (not shown) may be placed behind the plates 12, 16 for this purpose. For confining the mold, force may be applied to opposed plates 12, 16 by means of a hydraulic press as indicated, or by means of mechanical clamps, or by any other convenient means. Only a relatively small force is required, namely, the force sufficient to prevent the mold from opening when pressure up to 20 pounds per square inch is applied to the resin 24. Pressure may be applied to the cavity and the resin 24 by attaching an air hose to the end of the tube 20 while the mold is assembled as shown in FIGURE 2. More or less resin may be used between the electrotype shell and the backing plate 18 depending upon the depth of the cavity, which in turn is regulated by the thickness of bearers 31. Usually the final laminated plate will range from .200″ to .250″ in thickness.

After the resin has hardened or cured the mold is opened and the laminated printing plate 32 is removed therefrom. The resin used adheres tenaciously to both the copper or copper alloy of the electrotype and to the aluminum or other lightweight metal backing 18. It provides excellent support for the raised portions of the electrotype shell. The laminated plate is characterized by light weight and rigidity. The printing surface of the electrotype is accurately formed by molding to the contour of the mold cavity. Thus, there is very little, if any, adjustment to be made in assembling the printing plate to the rotary cylinder of the press. After molding the only operation required is the conventional cutting of the grooves 34, best shown in FIGURE 1, and trimming the margin. The grooves may be intermittent as illustrated or may extend across the entire width of the plate. These grooves are adapted to cooperate with the clamps fixed to the printing roll for securing the plates thereto. The clamps lock the plates in tension in the well known manner. Plates designed for compression lock-up require no grooves. The size of the margin is determined by the location of the sealing gasket 14 in the mold. Preferably, it is placed far enough out so that the laminated layers 10, 18 and cured resin 24 may be very accurately trimmed on four sides. The dimensions, in other words, are not determined by the location of the gasket but by the trimming step. The gasket, of course, is stripped from between the face sheets 10, 18 before trimming for reuse.

Suitable resins for use in accordance with this invention are exemplified by the polyesters and epoxys. Both are well known in the pastics art. Polyester resins consist of a copolymerizable mixture of the reaction product of a polyhydric alcohol and a polybasic acid (the polyester) and styrene, or some other liquid polymerizable solvent for the polyester. The polyester portion of the resinous mixture may be prepared by reacting glycerin, ethylene glycol or the like with a dibasic acid such as succinic acid, maleic acid, malonic acid, phthalic acid, etc. This reaction product is admixed with the styrene to form the liquid polyester resin. The polyesters cure readily by copolymerization of the styrene with the polyester. They are liquid in form before curing and during polymerization are converted into a hard, glassy type resinous material. The term "polyester resin" embraces many different chemical compounds, some of which will polymerize at room temperature and others only at elevated temperature. Almost all polyesters require the presence of an oxidizing agent to effect the polymerization. Benzoyl peroxide is the oxidizing agent commonly used in curing polyester resins. These resins are sold commercially under various trade names, for example, Laminac and Vibrin. Detailed descriptions for the preparation of these resins may be found in the following publications: Ellis United States Patent 2,255,313 and British Patents 540,167, 8 and 9. These resins are also disclosed by Vale in "The Chemistry of Unsaturated Polyester Resins," a paper published in British Plastics, September 1953, pages 327–332.

Another class of resins that can be used for purposes of this invention is that group known as epoxy resins. These resins are made from copolymerizing polyphenols with epihalogenhydrin or dihalogenhydrin. One of the most common resins of this kind is made by reacting 4,4′ dihydroxydiphenyldimethyl methane with epichlorohydrin in sodium hydroxide solution. Resins of this type are conveniently converted into infusible masses in the presence of polyamines, and preferably upon application of heat. Suitable amines include paraphenylene diamine, benzidine and 1,3 diaminobutane. Detailed descriptions of epoxy resins may be found in United States Patents 2,500,600; 2,668,807; 2,553,718, and Swiss Patent 278,476. These resins are known to be excellent adhesives and are particularly suitable for the present application for this reason. By adding the polyamine curing agent to the resin, the resin may be converted from a liquid to a hard infusible solid within a relatively short period of time at 300° F. to 350° F.

Although we have mentioned specifically two different types of resins that are suitable for use in the invention, it will be obvious that other resins which are normally fluid and which can be converted to hard solids at relatively low temperatures are likewise useful. Those skilled in the art will also appreciate that the resins may be modified by addition of fillers such as pigments, mineral fillers, glass fibers and the like.

From the foregoing description it will be apparent that we have provided a process whereby printing plates can be manufactured to precise contours. Furthermore, the laminated plate is light in weight so that it is particularly suitable for use with high speed rotary presses. The centrifugal force tending to throw the plate from the cylinder during printing is reduced considerably by the relatively large decrease in the weight of the plate effected by the invention. This, of course, prevents distortion at high speeds. The aluminum base or other lightweight metal base provides for tension lock-up and permits application of considerable force without distortion. Most important, the printing surface is uniform since it conforms precisely to the mold cavity in which the laminated sandwich is prepared. Each of the plates which is used in color printing is prepared in an identical mold and, consequently, they all have exactly the same contour and provide accurate registration. It will also be apparent that the process is relatively simple and can be carried out quickly since it eliminates much of the "make ready" operation.

As indicated, the printing plate may be formed without a metal backing member 18. The resin is capable of being ground or machined for providing grooves 34. However, the metal is slightly easier to work and it is not necessary to provide means for preventing adhesion of the resin to the mold which would result if the printing plate was prepared without the backing plate 18 disposed within the cavity.

Although the invention has been described in connection with the production of a curved printing plate, it will be apparent that the present construction also provides many advantages in a flat plate.

Other modifications of the invention will become apparent to those who are skilled in the art from the foregoing description. It is not our intention to limit the invention to the specific forms shown and described herein other than as necessitated by the scope of the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A method of forming printing plates which comprises the steps of preparing a thin easily-deformable electrotype metal shell having a printing surface and an opposed surface containing voids, applying sealing means to said opposed surface around its periphery, placing said shell in a mold having an accurately-machined curved cavity of predetermined thickness with the printing surface thereof in contact with one face of the mold cavity, closing the mold to seal the enclosed space behind said electrotype shell, filling by gravity flow said enclosed space with a freely flowing hardenable liquid resin, applying fluid pressure to the liquid resin in an amount sufficient to bring said shell into precise conformity with said mold cavity and to fill said voids, but not in excess of about 20 pounds per square inch, maintaining said pressure until the resin hardens thereby producing a unitary laminated rigid printing plate of precise curvature, and removing said laminated printing plate from the mold.

2. A method of forming printing plates which comprises the steps of preparing a thin easily-deformable electrotype metal shell having a printing surface and an opposed surface containing voids, applying sealing means to said opposed surface around its periphery, placing said shell in a mold having an accurately machined curved cavity of predetermined thickness with the printing surface thereof in contact with one face of the mold cavity, placing a metal supporting plate in contact with the other face of the mold cavity, closing the mold to seal the enclosed space between said electrotype shell and said metal plate, filling by gravity flow said enclosed space with a freely flowing hardenable liquid resin, applying fluid pressure to the liquid resin in an amount sufficient to bring said shell into precise conformity with said mold cavity and to fill said voids, but not in excess of about 20 pounds per square inch, maintaining said pressure until the resin hardens thereby producing a unitary laminated rigid printing plate of precise curvature, and removing said laminated printing plate from the mold.

3. The method of claim 1 wherein the liquid resin consists essentially of a copolymerizable mixture of a polyester and styrene.

4. The method of claim 1 wherein the liquid resin consists essentially of a copolymerizable mixture of a polyphenol and epihalogenhydrin.

5. The method of claim 2 wherein heat is applied to said resin simultaneously with said pressure.

6. A method of forming printing plates for press cylinders which comprises the steps of preparing an electrotype metal shell having a printing surface, curving the shell to cylinder contour, placing the shell in a mold of cylinder contour with the printing surface thereof in contact with one face of the mold cavity, said cavity being of predetermined thickness and accurately shaped to the contour of the final printing plate, placing a precurved metal plate in contact with the other face of the mold cavity, placing a resilient gasket between said shell and said precurved plate around the periphery thereof, closing the mold to seal the space between said shell and said curved plate within the confines of the gasket, filling said space by gravity with a hardenable freely-flowing liquid resin, applying fluid pressure not in excess of about 20 pounds per square inch to the resin to bring the shell and metal plate into precise conformity with the mold, maintaining said pressure until the resin hardens, thereby producing a unitary laminated rigid printing plate of precise curvature, and removing said laminated printing plate from the mold.

7. The method of claim 6 in which said liquid resin consists essentially of a copolymerizable mixture of a polyphenol and epihalogenhydrin, and a curing agent therefor.

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