Dec. 7, 1965 F. M. JERNT 3,221,654

PLASTIC PRINTING PLATE AND METHOD FOR MANUFACTURE

Filed Sept. 22, 1960 3 Sheets-Sheet 1

FIG. 1

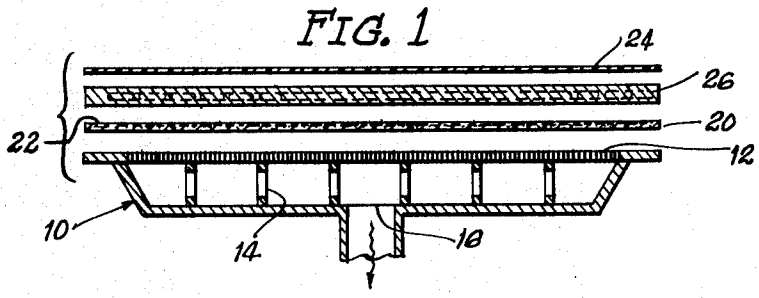


FIG. 2

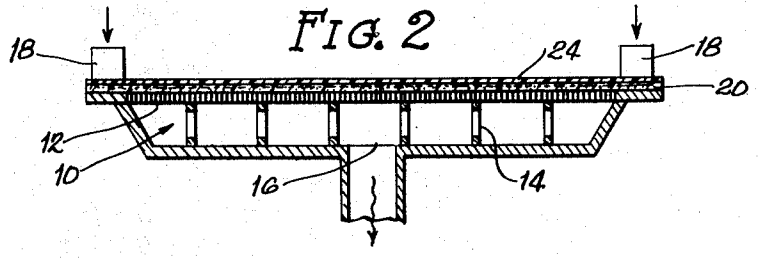


FIG. 3

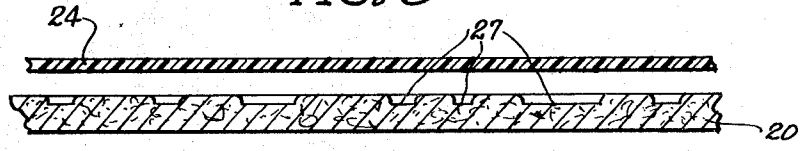


FIG. 4

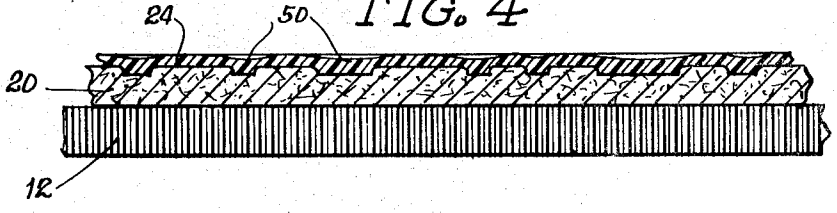
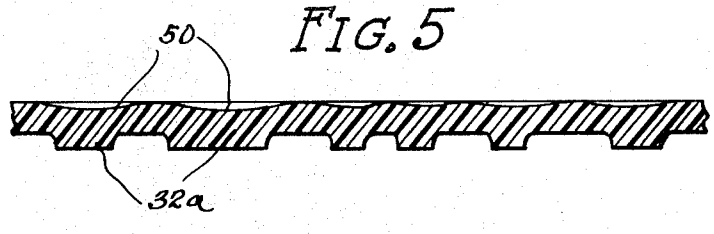


FIG. 5



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PLASTIC PRINTING PLATE AND METHOD FOR MANUFACTURE

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FIG. 6

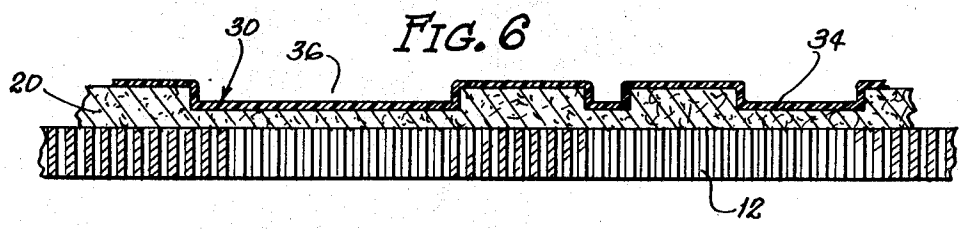


FIG. 7

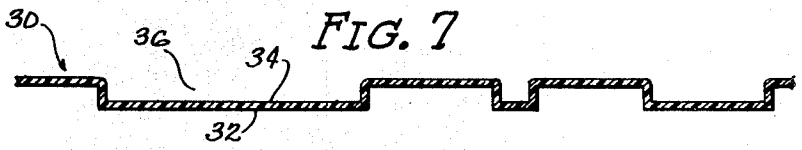


FIG. 8



FIG. 9

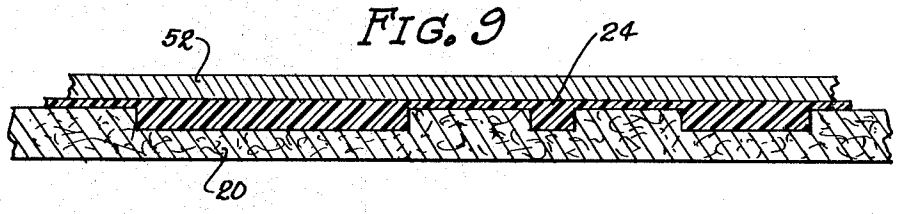


FIG. 10

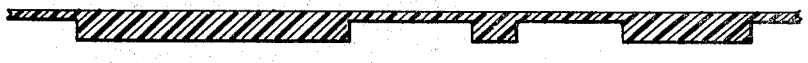
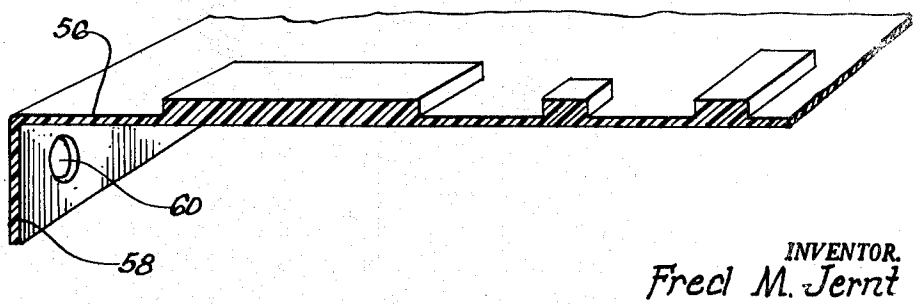


FIG. 11



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PLASTIC PRINTING PLATE AND METHOD FOR MANUFACTURE

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FIG. 12

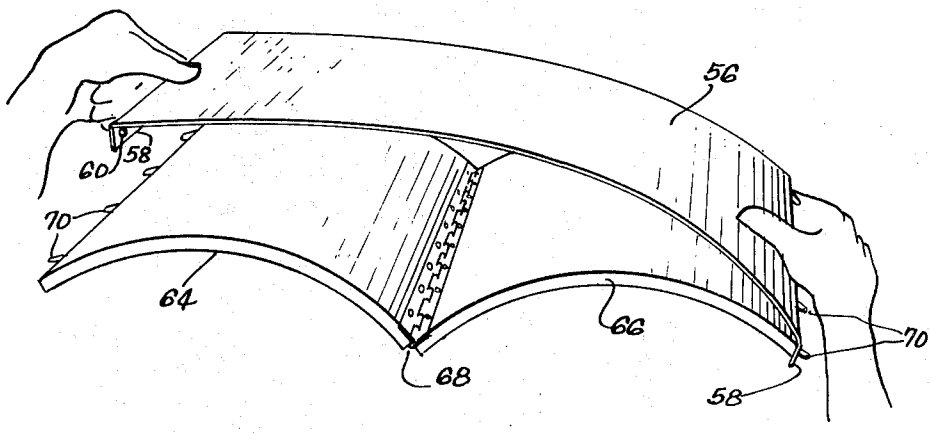
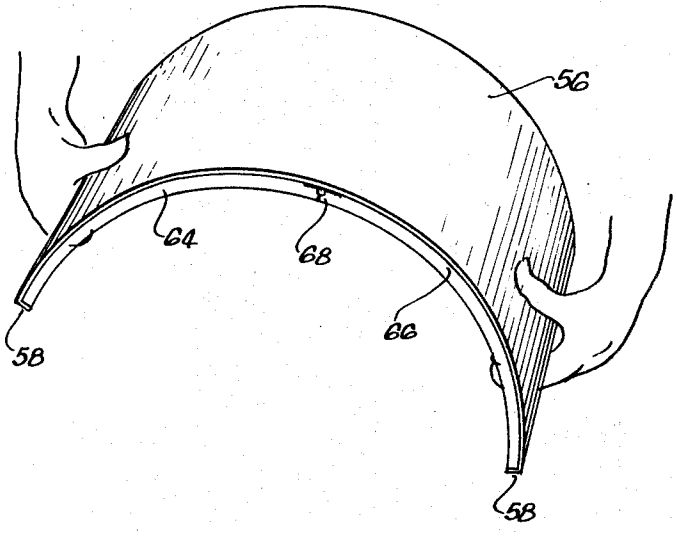


FIG. 13



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United States Patent Office

3,221,654

Patented Dec. 7, 1965

3,221,654

PLASTIC PRINTING PLATE AND METHOD FOR MANUFACTURE

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Filed Sept. 22, 1960, Ser. No. 57,757

7 Claims. (Cl. 101—401.1)

This invention relates to the art of printing plates for use with rotary and the like printing presses and it relates more particularly to a printing plate formed of sheet plastic and to a new and improved method for the preparation of same.

It is an object of this invention to produce printing plates of sheet plastics and it is a related object to provide a simple and inexpensive means for producing plastic printing plates of the type described from which copy of good quality can be secured.

These and other objects and advantages of this invention will hereinafter appear and for purposes of illustration, but not of limitation, embodiments of the invention are shown in the accompanying drawings in which—

FIG. 1 is a schematic sectional elevational view showing the arrangement of elements in an initial step in the fabrication of a plastic printing plate in accordance with the practice of this invention;

FIG. 2 is a schematic sectional elevational view showing the arrangement of elements in an intermediate stage in the fabrication of the plastic printing plate;

FIG. 3 is an enlarged sectional elevational view of the elements used in the fabrication of a plate as they appear immediately prior to imaging the plastic sheet;

FIG. 4 is a schematic sectional elevational view showing the arrangement of elements in a final stage in the fabrication of the plastic printing plate;

FIG. 5 is a fragmentary sectional elevational view of a plastic printing plate prepared in accordance with the practice of this invention;

FIG. 6 is a schematic sectional elevational view similar to that of FIG. 4 illustrating the preparation of a plastic printing plate embodying the features of this invention;

FIG. 7 is a sectional elevational view of a fragmentary portion of the plate produced in FIG. 6;

FIG. 8 is a fragmentary sectional elevational view of a modification in the printing plate of FIG. 7;

FIG. 9 is a schematic sectional elevational view of a modification in the arrangement of elements illustrated in FIG. 4 for the production of a finished plastic printing plate;

FIG. 10 is a fragmentary sectional elevational view of the plastic printing plate produced in accordance with FIG. 9;

FIG. 11 is a perspective view in section of the construction embodied in the ends of the plastic printing plate of this invention for use in one means for mounting the plates onto the cylinder of a printing press;

FIG. 12 is a perspective view of a saddle which can be used as a means for mounting the plastic printing plate on the plate cylinder of a rotary printing press, showing the saddle in collapsed position, and

FIG. 13 is a perspective view similar to that of FIG. 12 with the saddle in position of use with a plastic printing plate of this invention mounted thereon.

Briefly described, the concepts of this invention reside in the preparation of a porous matrix by conventional practice of molding a sheet formed of cellulosic pulp on the type set in a suitable frame whereby the cellulosic pulp conforms to the surface to form the mirror image in relief on the underside thereof corresponding to the type. When the cellulosic pulp has been set, the imaged matrix is removed from the frame for use in the preparation of one or more plastic printing plates in accordance with the practice of this invention.

The porous matrix is then mounted with its imaged surface outermost on a perforated support having communication with a vacuum source whereby a vacuum can be drawn through the entire area of the matrix. A sheet of thermoplastic resinous material, heated to a temperature sufficient to enable plastic flow, is brought into contact with the imaged surface of the porous matrix with a sealing relationship between the edges. Air is exhausted through the matrix whereby the heated plastic is forced into intimate molding relationship with the surface of the matrix to cause displacement of the plastic into the image in relief in the surface of the matrix thereby exactly to conform with the imaged surface of the matrix. The plastic sheet is held in molding relationship with the imaged surface of the matrix until the plastic has set upon cooling and thereafter the plastic sheet can be removed from the matrix to provide a plate having the printed image formed as a direct image in offset in the surface thereof. The edges of the formed plastic printing plate can then be trimmed, if necessary, for fitting onto a saddle or other means by which the plastic printing plate is mounted onto the press and the ends can be processed for engagement by clamping means by which the plastic printing plate is held taut to conform to the curvature of the saddle or the plate cylinder on the printing press.

Having broadly defined the concepts of this invention, detailed description will now be made of the practice thereof in its various modifications. As representative of the vacuum means, reference will be made to a vacuum pan **10** covered with a flat perforated plate **12** supported by grids **14** and having an outlet opening **16** in the bottom side of the vacuum pan in communication with an exhaust means (not shown) for exhausting air from the pan and to pull a vacuum over elements mounted in sealing relationship on the surface of the perforated plate **12**. A hold-down frame for maintaining a sealing relationship about the edges of the elements mounted on the perforated plate is indicated by the frame bars **18**.

The porous matrix **20** is positioned on the surface of the perforated plate **12** with the imaged surface **22** in relief uppermost in the plate. Detailed description of the imaged matrix will not be given since it is of conventional construction formed of a porous sheet of paper pulp molded onto the type set within a frame whereby the pulp fibers of the matrix enter the depressions exactly to conform with the surface of the type face to form a reverse image in relief on the engaged surface of the porous matrix. The imaged matrix, which can also otherwise be formed, is characterized by the porosity of paper to enable air or vapor to be drawn throughout the area thereof and preferably with the face opposite the imaged surface being flat for more substantial support on the flat surface of the perforated plate **12**.

In the preferred practice of this invention, illustrated in FIG. 1, the plastic sheet **24** is mounted in spaced relationship with the imaged surface **22** of the porous matrix **20** and a heating means **26** is temporarily displaced therebetween for generation of an overall heat pattern simultaneously to heat the adjacent surfaces of the plastic sheet **24** and the imaged surface **22** of the porous matrix. The desired heat can be supplied by electrical resistance heaters in the form of Calrod units or the like. Instead, use can be made of a heated plate or of hot air or vapor or the like heat transmission means introduced into the space between the plastic sheet and the porous matrix uniformly to heat the adjacent surfaces over the entire area.

When the plastic sheet **24** has been heated to a temperature sufficient for plastic flow in response to applied force, such as to a temperature of 350° F. or above for

polyethylene and corresponding temperatures for other plastic materials, the heat means **26** is withdrawn from between the heated plastic sheet and the porous matrix and the plastic sheet, while still in the heated state, is brought into surface contact with the imaged surface of the porous matrix. The edges of the plastic sheet and the porous matrix are held in sealing relationship with the perforated plate **12** by the clamping frame **18**, as illustrated in FIG. 2 of the drawings.

When the described sealing relationship has been established, air is exhausted from the vacuum pan through the opening **16** for corresponding withdrawal of air through the porous matrix **20** whereby the softened plastic material is drawn by one or the other of the combination of forces including vacuum on one side and atmospheric pressure on the other to cause plastic to enter into the recesses **27** of the imaged surface of the porous matrix to cause the adjacent surfaces of the plastic sheet exactly to conform to the imaged surface of the matrix, as shown in FIG. 6 of the drawings. It will be understood that the entrance of the plastic into exact conformance with the imaged surface of the matrix may result from flow of the plastic material while in a stage of plastic flow or by deformation of the sheet while still in the plastic state, but it is believed that exact conformance to embody each detail of the imaged surface results from a combination of plastic flow and deformation in response to forces acting throughout the entire area of the sheet, including the base of each crevice or recess in the imaged surface through which vacuum is active as a deforming force.

It is desirable to perform the described molding operation as quickly as possible after heating, otherwise heat loss will occur from the exposed surfaces thereby to make it more difficult to effect flow of the plastic material through the innermost recesses of the imaged matrix with corresponding loss of detail in the image that is formed in offset in the adjacent surface of the plastic sheet.

Heat loss from the molded plastic sheet to the atmosphere and to the matrix and through the matrix to the perforated plate and the like occurs sufficiently rapidly to reduce the plastic of the sheet to a temperature sufficient to set the image so that the imaged plastic printing plate **30** can be unclamped for separation from the surface of the matrix in the matter of a few seconds, but it is best to retain the elements in molding relationship for a longer period of time, such as for fifteen or more seconds, to insure elimination of the possibilities of elastic memory.

When the plastic has set and the molded plastic printing plate **30** is removed from the mold, it will be found that the surface which was adjacent the imaged surface **22** of the matrix will have the image reproduced onto the surface of the plate as a direct image **32** offset from the surface of the plate. Thereafter, when the imaged plastic printing plate is mounted onto the cylinder plate of a printing press with the offset image **32** outermost, the offset image can be used as a conventional lead plate of the type heretofore cast from the matrix wherein the molded plate is inked and brought into surface contact with a web of paper advanced through the press for the transfer of the ink image from the plate onto the paper, in accordance with the normal press operation.

While it is preferred to preheat the surface of the matrix in combination with the sheet of plastic material, it will be understood that the surface of the matrix can be heated separate and apart from the sheet of plastic but preferably immediately prior to bringing the sheet of plastic into molding relationship with the surface. Such preheat of the surface of the matrix operates to increase the temperature of the surfaces whereby lesser differential in temperature will exist between the imaged surface of the matrix and the surface of the plastic sheet brought into molding contact therewith. As a result,

the surface of the plastic will be relatively free of cold shock. Instead, it will be retained in a plastic state for a greater length of time to extend plastic flow for a time sufficient to permit entrance of the plastic into the innermost recesses of the image in relief in the matrix. Preheat of the imaged surface of the matrix is not essential to the practice of this invention, especially when the sheet of plastic material embodies sufficient cross-section or body to retain the heat introduced therein for maintaining the surface in a desirable state of plastic flow or else is heated to a sufficiently high temperature to compensate for the heat loss to the surface of the matrix when brought into molding relation therewith. Under such circumstances, the sheet of plastic can be heated separate and apart from the matrix. In any event, it is desirable uniformly to heat the sheet of plastic throughout the surface area thereof.

As the plastic sheet of which the printing plate is formed, use can be made of sheet stock formed of such thermoplastic resinous materials as polyethylene, polypropylene, polyvinyl acetate, cellulose acetate, cellulose propionate, polytetrafluoroethylene, polyvinylidene chloride, polyvinyl chloride, rubber hydrochloride, and the like. The sheet can be fabricated of the clear plastic, with or without plasticizer, or use can be made of a filled plastic wherein use is made of such conventional fillers as clay, calcium carbonate, silica dust, titanium dioxide and the like. Modification to include pigments and other coloring agents to impart color to the plastic is also possible.

Use can be made of a sheet of plastic having a thickness within the range of from 0.003 to 0.020 inch. A sheet of the thickness described is immediately and substantially completely responsive to the pressure conditions existing for the conformance with the portions in relief in the matrix to form a printing plate **30** of the character illustrated in FIGS. 6 and 7. A plate formed of such thin plastic sheet stock can be easily bent while cold to conform to the curvature of the cylinder printing press or the saddle on which it is supported for clamping onto the press.

When such thin sheet stock is employed, the portion offset in the matrix to form the positive image will usually find its counterpart in relief, as illustrated by the numeral **34**, in the backside of the plate such that little, if any, backing exists for the offset imaged portions of the plate. Satisfactory performance can be secured by such plate, especially when the imaged portions are relatively free of continuous offsets of substantial area. However, when the area of offset is substantial, as illustrated by the offset **36** in FIGS. 6 and 7, the thickness of the plastic across the printing surface will be unsufficient by itself and without other support to resist the pressures existing upon contact with the ink rollers for inking the image or upon contact with the surface of the paper pressed into contact with the inked image such that incomplete image reproduction will sometimes be experienced.

Further concepts of this invention reside in the means whereby such possible limitations in the performance of printing plates of plastic can be overcome without disturbing the ease and simplicity of manufacture and utilization of plastic printing plates of the type described.

In accordance with one concept, the possible deficiencies previously described can be overcome by filling the portions in relief in the backside of the plastic printing plate with a material which can be converted to a hardened or set stage whereby the pressures applied to the printing face of the plate can be transmitted through the filling **40** to the support thereby to resist deformation of the imaged portions. For this purpose, use should be made of a material which can be applied in a fluid or plastic stage to enable the material to be introduced or forced into the recessed portions substantially completely to fill the portions in relief, as illustrated in FIG. 8.

Representative of the materials which can be used as

the filler **40** are liquid polymerizable synthetic resin forming materials either in a monomeric stage or in a low stage of polymeric growth or a polymeric resinous material dissolved in such monomeric material or low polymeric material but which materials are capable of advancement rapidly to a set or hard stage after being introduced into the relieved portions of the plate.

Instead, use can be made of a heat hardenable thermoplastic resinous or polymeric material, wax, bituminous material or the like which is characterized by a stiffened or hardened stage at ambient temperature but which is reducible to a fluid or plastic stage at elevated temperatures which are still sufficiently low to enable introduction into contact with a molded sheet of plastic material substantially to fill said recessed portions to present a relatively flat surface across the backside of the plate without raising the temperature of the plastic material to a state where the image will be deformed by elastic memory. It will be sufficient if such filler materials are introduced at a temperature less than about 200° F. and preferably at a temperature less than 150° F.

The filling material **40** can be introduced as an incidence to the molding operation while the sheet of plastic material is in molding relation with the matrix for support. Under such circumstances, the filling material may be introduced at higher temperatures. Instead, the filling material can be introduced, especially while in a liquid state, after the printing plate has already been formed and separated from the matrix to make the molding equipment and/or matrix immediately available for use in the fabrication of additional printing plates.

In a preferred concept of this invention, use is made of a sheet of plastic having sufficient thickness to provide for temperature differential through the cross-section whereby the surface adapted to be brought into molding relationship with the imaged surface of the matrix is raised to a sufficiently high temperature to permit ready flow into the relieved portions to reproduce the image in offset in the plate surface while the opposite side of the plastic sheet is at a lesser temperature sufficient to permit the effect of atmospheric pressure for image reproduction but to resist plastic flow whereby the backside of the plate does not constitute an exact reproduction of the image in relief but instead remains relatively flat with only shallow valleys or depressions, as indicated in FIGS. 4 and 5.

Under such circumstances, deformation is available in the printing surface of the plate for complete conformance of the imaged surface of the matrix to reproduce the image **32**[a] as an offset in the surface portion of the plate of material supplied from adjacent areas of the plastic in the sheet stock whereby the plastic in the offset portions is supplied from greater areas of the plastic sheet by comparison with the corresponding image such that only slight valleys or depressions appear in the opposite surface of the plate, even with opposite imaged areas of substantial dimension. A plate of the type described is illustrated in FIGS. 4 and 5 of the drawings. It will be apparent that the backside of the plastic printing plate will be relatively flat such that support will be available not only from the plastic but also from the backing or support whereby good image reproduction is available from the inked plate without the need for filling the depressions.

Such temperature differential through the cross-section of the sheet of plastic can be achieved by flash heating of the surface of the plastic subsequently brought into molding relationship with the matrix, but for such purpose, it is preferred to make use of a sheet of plastic of greater cross-section ranging from 0.020 to 0.150 inch, depending upon the type of plate that is to be produced. For a plastic plate to be used in a newspaper printing plate where plate depth of about 0.065 inch is desired, it is preferred to make use of a sheet of plastic having a maximum thickness of about 0.040 inch for use with an image depth of conventional dimension of about 0.025 inch. For flat bed presses or rotary presses used in magazine printing, sheets of plastic of greater thickness up to 0.15 inch can be used but it is preferred to make use of sheet plastic having a thickness ranging from 0.020 to 0.065 inch.

By way of still further modification, the slight valleys **50** or other unevenness obtained in the backside of the plate can be substantially completely avoided by the process illustrated in FIGS. 9 and 10 wherein a platen **52** heated to plastic flow temperature, such as about 350° F., is brought into engagement with the backside of the sheet of plastic **24** while the opposite surface of the sheet is in molding relationship with the imaged surface of the matrix **20**. For this purpose, it is desirable to make use of a platen in the form of a flat plate having foramens or porosity through the cross-section thereof for exposure of the underlying surface of the plate to the atmosphere to enable utilization of the atmospheric effect on the upper side of the plastic sheet responsive to suction on the underside of the plastic sheet. Further, the platen is preferably cored for the passage of heat transfer medium therethrough to heat the plate to a temperature for plastic deformation when pressed onto the backside of a sheet of plastic material to iron out the valleys or depressions and provide a corresponding flat surface while, at the same time, pressing the sheet of plastic material into molding relationship onto the porous matrix as an assistance in the reproduction of the image into the surface of the plastic sheet. When the desired flattening operation has been achieved, coolant may be circulated through the cored platen to reduce the temperature thereof for accelerating setting of the plastic before releasing the molded plastic printing plate.

For such operation, it is desirable to make use of a sheet of plastic material having a dimensional cross-section such as of the type previously described in connection with the fabrication of a printing plate in FIGS. 4 and 5 whereby sufficient plastic will remain beyond the offset imaged portions for displacement by the platen to form the flattened surface at the backside of the plate.

Having described the manufacture of the plastic printing plate, reference will now be made briefly to one means whereby such plastic printing plate can be mounted onto the cylinder of a printing press. Unless the sheet of plastic is originally cut to exact dimension for the plate, the edges of the formed plastic printing plate are trimmed by conventional means to the desired dimension upon completion of the molding operation.

Thereafter, the ends of the plate are molded to extend substantially perpendicularly inwardly from the body portion **56** of the printing plate to provide a pair of depending flanges **58**. The flanges are provided with a plurality of openings **60** spaced laterally across the plate intermediate the edges.

Referring now to FIGS. 12 and 13 as one means for mounting the plate on the press, the plastic printing plate **56** is adapted to be mounted upon a saddle of metallic material preformed to the curvature of the plate cylinder but subdivided across the center into two sections **64** and **66** which are hingedly mounted at **68** onto each other for rocking movement between collapsed and plate position.

Pins **70** are provided in the free end walls of each of the sections spaced to correspond to a spaced relation between the openings **60** in the plastic printing plate and spaced inwardly from the surface of the saddle by an amount corresponding to the distance between the openings **60** and the body portion **56** of the plastic printing plate.

When the saddle is collapsed, as illustrated in FIG. 12, the overall distance between the pins will be less than the length of the body portion of the plastic printing plate so that the pins **70** can be threaded through the openings **60** in the flanges at the opposite ends of the plate. When the saddle is rocked to plate position,

illustrated in FIG. 13, the body portion of the plastic printing plate which is dimensioned to correspond with the periphery of the saddle, is pulled taut over the surface of the saddle to bring the backside of the plate into engagement with the supporting surface of the saddle to conform the plate with the curvature of the saddle. Means are provided on the press for clamping the saddle with the plate mounted thereon in position of use. For removal, the saddle can be unclamped for displacement from the press after which the saddle can be collapsed to permit displacement of the flanges from the mounting pin for removal of the plastic printing plate.

With plates formed of sheet plastics having a thickness less than 0.040 to 0.050 inch, the plastic printing plate will be able to assume the curvature of the saddle without difficulty. When plates are formed of plastic sheet stock of substantially greater thickness, it may be found necessary to heat the plate slightly for softening the plate or for flexibilizing the plate to permit deformation to the desired curvature. Instead, the sheet of plastic material can be molded originally to the desired curvature coincident to or separate and apart from the imaging of the plate.

It will be apparent that the described porous matrix will be well suited to the described vacuum techniques for image reproduction into the surface of the sheet of plastic material since such portions of the matrix as will become covered by the plastic will concentrate the exhaustion of air in portions which remain separated from the plastic such that the evacuated pressure forces will become maximized at the innermost recesses and corners of the image in relief in the matrix thereby to cause entrance of the plastic into the innermost recesses for greater detail in image reproduction. The use of a matrix of porous material operates to equalize the forces throughout the cross-section for greater uniformity and completeness in image transformation.

It will be understood that changes may be made in the materials employed and in the details of construction, arrangement and operation without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. A method of preparing an imaged printing plate of thermoplastic sheet material comprising the steps of positioning the plastic sheet and a porous matrix in spaced parallel relation, introducing a heating means in between the sheet and matrix for preheating the opposing surfaces thereof, withdrawing the preheating means and bringing the preheated surfaces together into abutting relationship, exhausting the air through the porous matrix from the side opposite that which is engaged by the thermoplastic sheet to generate a vacuum between the said surfaces whereby plastic of the sheet is depressed into the recesses of the image in relief in the porous matrix for exact conformance to reproduce the image in offset in the surface of the plastic sheet, and separating the imaged plastic sheet from the porous matrix after the plastic has set.

2. The method as claimed in claim 1 in which the thermoplastic sheet is dimensioned to have a thickness within the range of 0.003 to 0.150 inch.

3. The method as claimed in claim 1 in which the thermoplastic sheet is dimensioned to have a thickness within the range of 0.003 to 0.020 inch.

4. The method as claimed in claim 1 in which the thermoplastic sheet is dimensioned to have a thickness within the range of 0.020 to 0.040 inch.

5. The method of preparation of an imaged printing plate of thermoplastic sheet stock comprising the steps of preheating a surface of a sheet of thermoplastic material, bringing the preheated surface of the thermoplastic sheet into abutting relationship with an imaged surface of a porous matrix having the image in relief in the surface thereof, exhausting air from the opposite side of the porous matrix to generate a vacuum between the preheated surface of the thermoplastic sheet and the imaged surface of the porous matrix whereby the plastic of the sheet will be displaced into the recesses of the image in relief in the porous matrix for reproduction of the image in substantially complete conformance with the image in the porous matrix and as an offset in the surface of the plastic sheet to form an imaged printing plate, pressing a heated platen having a flat face, and heated to a temperature sufficient to raise the temperature of the plastic material to flow temperature under the pressure conditions existing, against the opposite side of the plastic stock to iron out unevenness formed in said responsive to displacement of plastic material into the recesses of the image in relief in the porous matrix and separating the imaged plate of thermoplastic material from the porous matrix after the plastic has set.

6. The method as claimed in claim 5 which includes the step of cooling the platen prior to separating and while still in contact with the plastic sheet to set the plastic in the flattened state.

7. The method as claimed in claim 5 wherein said heated platen is formed of a porous material through its cross section whereby the sheet stock in engagement with the platen will be exposed to the atmosphere.

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