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MATRIX FOR MOLDING A POSITIVE RELIEF IMPRESSION

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FIG. 1

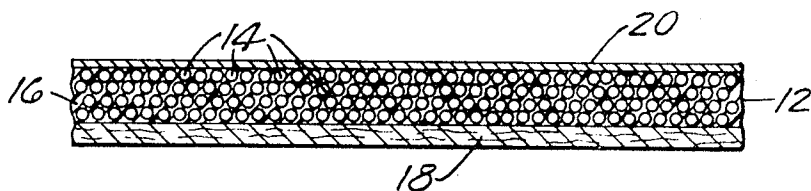
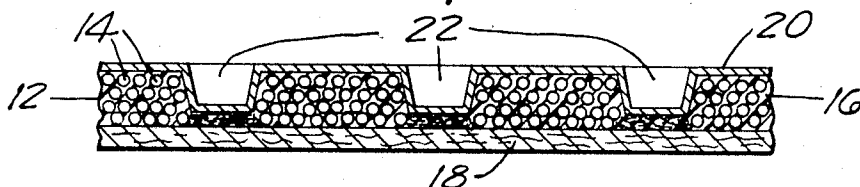


FIG. 2



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**MATRIX FOR MOLDING A POSITIVE
RELIEF IMPRESSION**

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4 Claims

This invention relates to a matrix which receives a negative relief impression of a desired image and thereby provides a mold from which a positive relief impression of the image can be cast onto a receptor sheet.

One aspect of this invention concerns the imaging of letter-press printing plates. With particular reference to letter-press flexography, the printing plates thereof are flexible rubber sheets that have a printing surface which contains a positive relief impression of the image to be printed. The plate is made from an uncured rubber sheet material which is placed in contact with a matrix having a negative relief impression of the image. The composite is placed in an oven press where the rubber sheet is pressed into conformity with the impressed surface of the matrix and then heat-cured. A positive relief image matching the negative relief impression of the matrix is thus permanently formed on the cured rubber sheet.

The quality of the image that is received by the printing plate is dependent on the clarity of the impression that is carried by the matrix. Great care is therefore taken to insure that the image is properly formed in the matrix. Accordingly, it is the common practice in the printing art to impression printing plate matrices with an image bearing typecasting. The typecasting is constructed from individual metal type slugs that are made on a Linotype machine or the like. The slugs are placed into their proper position in a type casting frame, and leveled and locked together within the frame to thereby form the typecasting. A curable mat material is laid over the typecasting and the composite is placed in an oven press. The image bearing face of the typecasting is pressed into the matrix material to produce therein a negative relief impression of the image. The mat or matrix is cured for about eight or ten minutes to permanently mold the image into the mat. The mat is then ready to produce in turn a positive relief printing plate as described above.

This process of imaging a matrix is both time consuming and expensive. Although there are a number of techniques for applying images to sheet materials that are much faster and less expensive, none have been successfully used for impressing a matrix from which letter-press printing plates can be molded. For example, the common typewriter is used to form impressions on many types of sheet materials. However, because the impressing force of the striking typewriter keys is applied only instantaneously, the memory factor of the sheet material tends to modify the depression that is formed. The memory factor can be reduced by using softer materials, but such materials will not properly retain the molded image and become deformed when subjected to the pressure of an oven press during formation of the plate. The deformation of the mat affects the impressed image and accordingly produces a defective printing plate.

As far as I am aware, no one has heretofore suggested a satisfactory construction for a sheet material useful as a printing plate matrix which can be impressed on a type-

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writer and retain that impression without distortion when subjected to the heat and pressures in the operation of molding a printing plate therefrom. The preferred embodiment of my invention offers such a construction and generally comprises a base sheet coated with a unified layer of microspheric glass bubbles and a ductile release layer bonded over the bubble layer. The composite structure is sufficiently flexible to conform to the cylindrical platen of a typewriter. The bubbles of the intermediate layer shatter under the impact of the typewriter keys to receive a sharp impression of the type. The shattered bubbles retain no memory, and the remaining unshattered bubbles are sufficiently strong to withstand the heat and pressure of the oven press applied in the plate molding operation. The release layer conforms to the impressions and provides a continuous smooth surface for easy separation of the plate and matrix when the composite is removed from the oven press. The plate is then ready to be mounted in a printing press.

The invention and its advantages will be further understood by reference to the following detailed description and drawing wherein:

FIG. 1 is a side view of a matrix for a letter-press printing plate illustrating a preferred form of the invention, and

FIG. 2 is a cross-sectional view of the matrix of FIG. 1 after it has been impressed.

In the illustrated preferred form of my invention, a layer 12 of fracturable hollow bubbles 14, unified by a resin binder 16, is bonded to one side of a backing sheet 18, and a ductile release film 20 is bonded over the bubble layer. The backing sheet 18 can comprise any of a number of flexible sheet materials, as for example, a low bond paper sheet. A suitable film 20 may be any thin, dead-soft, highly malleable ductile metal. 0.001 inch lead, 0.00025 inch aluminum, 0.0005 inch tin, 0.001 inch tin, 40-60 solder, and 50-50 solder have all been tried successfully. The lead foil, however, permits the greatest indentation without breaking and is therefore preferred. (Although only metal foils have been mentioned, other materials are contemplated, e.g. suitable plastics and the like.)

For this embodiment of my invention, I prefer a glass bubble layer having a thickness of between about .015 and .040 inch, but satisfactory results can be attained with somewhat greater thicknesses. A suitable glass bubble size is about 125 microns in diameter (or, in the alternate system of measuring, a bubble size that will pass through a 120 mesh sieve). The hollow bubbles should contribute about 14% to 56% by weight of the total weight of the cured layer 12, while providing a void volume therein of about 40% to 70%. I have successfully used, without notable change or preference, bubbles having densities ranging from 0.18 to 0.50. Also, the spherical shape of the bubbles is not deemed critical, and thus, micro-bubbles of other shapes are contemplated.

Suitable micro-bubbles are hollow glass microspheres available from Minnesota Mining and Manufacturing Company. Other micro-bubbles are described in the Veatch et al. U.S. Patent Nos. 2,797,201; 2,978,339; 2,978,340; and 3,030,215.

The preferred binder 16 is sufficiently flexible to permit the matrix to be flexed around a typewriter platen and has a low shear strength to permit substantial indentations 22 of the bubble layer when struck by the keys of a typewriter. It furthermore has little or no elastic memory which would tend to modify the indentations.

As noted heretofore, a matrix constructed in accordance with the above can be imaged on a common typewriter. The composite is sufficiently flexible to conform to the typewriter platen; the striking force of the typing keys is adequate to shear the binder 16 and shatter the bubbles 14 for deeply impressing the bubble layer, and the film 20, is sufficiently ductile or stretchable to conform to the modified surface area of the impressions 22. Furthermore, the unshattered bubbles are sufficiently strong to withstand the pressure exerted in an oven press when a plate is molded therefrom, and the smooth release surface of film 20 allows the molded plate and matrix to be easily separated. It is to be noted that where the film 20 is not sufficiently ductile, the film will break in the impressed areas to lay bare the underlying fragments of the shattered bubbles. During the molding operation, the softened plate material will become embedded in said fragments and make separation of the plate and matrix difficult.

As compared with the prior art matrices for flexographic printing plates, the above described matrix is easier to impression, i.e. it does not require the skill of a Linotype operator for making typesetting, or persons skilled in the operations of a rubber curing oven press; it is less expensive to impression, i.e. a suitable typewriter can adequately impression the matrix of the example as opposed to the very expensive Linotype machines required for making the slugs used in typesetting; and it is much faster to impression, i.e. by the simple and fast operation of direct typing as opposed to the time of (a) making the slugs on a Linotype machine, (b) setting the slugs into position in a typesetting frame, (c) locking and leveling the slugs into the frame, and (d) placing a suitable mat material over the typesetting and pressure molding a mat therefrom in an oven press. The present invention thus offers to the printing industry the substantial advantage of expediently producing positive relief letter-press copy without first casting that copy from hot typemetal.

The matrix described above is primarily useful for molding flexographic printing plates. However, it is to be understood that my invention encompasses matrices having other uses. Although I do not wish to be bound to the hereafter expressed theory, it is believed to be novel to provide a matrix that can be accurately and permanently impressed upon instantaneous impact from an image bearing typing slug or the like. This novelty is believed due at least in part to the collapsible characteristic of the bubbles whereby the shattered fragments of the bubbles have no memory factor and occupy only a fraction of the space initially occupied by the hollow bubbles. Thus, when the bubble layer is depressed, the areas of the layer adjacent to the depression remain unaffected. This differs, for example, from deformable resinous material or the like which, when depressed, merely effects a rearrangement of the material adjacent to the depression. This rearrangement of the material is referred to in the trade as "cold flow." Such material may initially receive a fairly good impression of a single type slug, but as subsequent type impressions are made, the previous impressions become distorted by the material displaced from the subsequent depressions.

Following are several specific examples of various forms of my invention, presented herein to illustrate my invention and not to limit it.

EXAMPLE 1

As a specific example of the preferred form of my invention:

First step

A one-mil lead foil was laminated to a temporary carrier sheet as follows:

The temporary carrier sheet consisted of a supercalendered, clay filled, 65 lb. kraft paper coated with a solution comprising a mixture of 25 parts cellulose acetate

butyrate, (EAB 500 1 of Eastman Chemical Products Company), 25 parts sucrose acetate isobutyrate (also from Eastman Chemical Products Company), 50 parts heptane, and 50 parts methyl ethyl ketone (MEK). The solution was applied to the paper at 18 grains per 24 in.² and dried by passing it through an oven at 200° F. for 10 minutes.

The carrier sheet was then passed over a heated laminating drum having a temperature of about 140° F. to 220° F. to soften the coating, and the 1-mil lead foil (purchased from Revere Copper and Brass Company), was applied against the softened coat of the paper under gentle pressure from a rubber roller.

Second step

The bubble layer was bonded to the foil as follows: 32 grams of glass bubble microspheres having a density of 0.25, and small enough to pass through a 120 mesh sieve (available from Minnesota Mining and Manufacturing Company) was mixed with a bonding solution consisting of 47.7 grams of Glyptal 801-238 (a non-drying coconut oil alkyd made by General Electric Company), 36.6 grams of Aroplaz 2477 (a short oil castor resin made by Archer-Daniels Midland Company), 15.7 grams of Resimene 881 (a melamine formaldehyde resin made by Monsanto), and 40 grams of methyl ethyl ketone. The mixture was evacuated under vacuum for a short time to remove entrapped air bubbles.

The above mixture was coated onto the lead foil with a smoothing bar set with .025 inch orifice. The coated foil was then dried overnight at room temperature. However, suitable drying is also achieved in a drying oven at 130° F. for ½ hour.

Third step

A backing sheet consisting of 37 lb. Nakoosa Edwards white paper was then bonded to the bubble layer with a one-mil thick pressure-sensitive adhesive. The temporary carrier sheet was then stripped from the lead foil and the remaining composite forming the completed matrix was ready to receive an impression.

Fourth step

The matrix was inserted into a self-justifying typewriter (Friden Justewriter) with the foil surface exposed to the typing keys, and a message was typed thereon. The message was impressed on the matrix in the form of permanent indentations or negative relief areas conforming to the keys. An uncured printing plate rubber such as commonly used in the art, was laid against the impressed surface of the matrix. The composite was placed in a 300° F. oven press under the pressure of 40 lb./in.² for 10 minutes. The composite was then removed from the oven and the matrix was separated from the plate.

The printing plate materials that have been successfully used to mold printing plates from the matrix of the above example include methyl methacrylate-ethyl acrylate copolymer, polyethylene, polyvinyl chloride, cellulose acetate butyrate-sucrose acetate isobutyrate mixture, nitrile and SBR rubber. These materials have the common properties of being easily formed into the shape of the impressed matrix without distorting the impression. However, other materials are contemplated such as low melting alloys, cast resins, etc.

The plates bearing a positive relief impression of the message which were formed on the matrix, were mounted on a press and a number of copies were successfully printed therefrom. These copies were comparable with copies printed from prior art plates formed on matrices that are laboriously and expensively molded in an oven press from specially assembled typesetting.

Numerous variations have been successfully applied to the construction of the above preferred embodiment. However, I have found that with specific reference to the

application of the construction to flexography, certain properties are desirable. Thus, referring to the coating on the carrier sheet described in the first step of the example, it is desirable for such coating to be sufficiently tacky to adhere the foil to the sheet at a temperature low enough so that the heat will not wrinkle the foil. Furthermore, the resulting adhesion should permit the paper sheet to be stripped from the foil as per the third step of the example without damage to the smooth release surface of the foil. Other workable coating solutions may include wax or plasticizer-resin combinations.

Also certain properties of the uncured resinous binder described in the second step of the example are desirable. This solution provides a cheesy, low shear, flexible material that easily collapses for maximum indent depth, easily conforms to a typewriter platen, sufficiently holds the bubbles together in its uncured state, and strengthens when exposed to the printing plate cure cycle for increased stability against the pressure exerted in the oven press.

EXAMPLE 2

An alternate form of my invention was produced as follows:

A first laminate was constructed by bonding a .025 inch bubble layer to a .001 inch lead foil in the manner described in the first and second steps of Example 1.

A second laminate was then constructed by bonding a similar .025 inch bubble layer to a sheet of Nakoosa-Edwards white paper which was dried for 20 minutes at 200° F. Over the bubble surface of the second laminate was applied, by cold lamination, a film of precast, predried, pressure-sensitive adhesive from a stripable liner such as polyethylene. The first and second laminates were then bonded together by pressing the bubble layer surface of the first laminate against the adhesive film surface of the second laminate to form a composite consisting of .001 inch lead foil, .050 inch bubble layer (the combined thickness of the bubble layers of the two laminae), and a base paper sheet. It is noted that, whereas the thinner bubble layer of Example 1 is easy to properly form on the base, it is preferred in forming the thicker bubble layer of this example to split the desired thickness and initially apply it as two separate layers on the base and foil. The layers are then bonded together to form the desired thicker layer without the inherent difficulties of attempting to form the thicker layer in a single coating on the base.

A typecasting was formed from Linotype slugs in the manner common to the trade and as generally described heretofore. The composite was pressed against the type casting at about 700 lbs. per square inch of Linotype. The pressure was immediately released, and the impressed composite was removed from the typecasting and placed in a curving oven for 8 minutes at 300° F. (The primary advantage here being the savings in time for impressing the mat, accomplished in seconds as opposed to the eight or ten minutes of the common prior art processes).

A vinyl printing plate material, such as Rogers Poreon was then laid against the impressed surface of the composite and placed in an oven press at 300 p.s.i. at 325° F. temperature for 7 minutes. The plate was then separated from the composite and placed on a flat bed press where it successfully printed true copies of the image.

EXAMPLE 3

Another form of my invention involves the formation of an electroplated metallic printing plate for reproduction of half-tone photographs in letter-press printing. Such plates must have high quality and be suitable for long run applications. Prior art matrices presently used in the trade require heat or extremely high pressure to form an impression. Some have nonconductive surfaces and must be silvered before electroplating. The matrix described hereafter can be impressed without heat and

at moderate pressure. It also has a metallic surface for electroplating.

Two-mil lead foil was bonded to a temporary carrier as in step one of example one. A bubble mixture was then coated onto the foil with a smoothing bar set with a .010 inch orifice. This bubble mixture was prepared as follows:

A resin solution, consisting of 45.3 grams of Glyptal 801-238 (a nondrying coconut oil alkyl made by General Electric Company), 34.8 grams of Aroplaz 2477 (a short oil castor resin made by Archer Daniels Midland Company), 14.9 grams of Resimene 881 (a melamine formaldehyde resin made by Mansanto) and 1.5 grams of Cab-O-Sil (a thixotropic agent made by Cabot Corporation), was milled on a 3 roll mill. 23.4 grams of glass bubbles, having a density of 0.4 and small enough to pass through a 400 mesh sieve (available from Minnesota Mining and Manufacturing Company), 0.4 gram of Dow Corning 200 fluid (a flow agent), and 20 grams of methyl ethyl ketone were added to the mill stock. This mixture was evacuated under vacuum for a short time to remove entrapped air bubbles. 20 grams of methanol was then added to aid in flow and leveling during the coating operation.

The foil with the bubble layer bonded thereto was dried 30 minutes at 130° F. and a 37 lb. Nakoosa-Edwards paper backing was laminated to the bubble layer. A 0.025 inch aluminum (or in the alternative, a 0.025 inch vinyl sheet) was bonded to the paper with a one-mil thick pressure-sensitive adhesive to give added support and firmness to the backing. The temporary carrier sheet was stripped from the lead foil, and the remaining composite forming the completed matrix was ready to receive an impression.

The matrix was thereafter placed in a cold press in contact with a copper plate prepared in the manner common to the trade and bearing a positive image of a half-tone photograph. The pressure was increased to 5000 p.s.i., held for 10 seconds and released. The impressed matrix thus formed was given a release coat of lead chromate and electroplated. The matrix could then be stripped away, leaving a metallic printing surface.

The matrix described in this example has the advantage of being cold formed and immediately ready for electroplating, thus reducing the time and the number of operations necessary with a heat-deformable nonconductive matrix. Compared to other cold forming materials, much less pressure is required for the matrix described above.

What is claimed is:

1. A matrix for molding a positive relief impression of a desired image on a receptor sheet comprising, a base sheet overcoated with a layer of fracturable hollow micro-bubbles unified within the layer by a low shear, non-resilient binder, and a thin ductile release film laminated to the bubble layer, said layer and film receiving a permanent, sharply defined negative relief impression of the desired image upon instantaneous impact with an image bearing slug sufficient to fracture the bubbles.

2. A matrix as defined in claim 1 that can be suitably imaged on a typewriter for molding flexographic letter-press printing plates, said matrix comprising a flexible base sheet, a layer of unified micro-bubbles bonded to the base sheet, and a ductile film having a smooth release surface bonded to the bubble layer, said bubble layer comprising hollow fracturable glass micro-bubbles providing a void volume within the layer of about 40% to 70% and unified therein by a flexible, low shear, non-resilient resin binder, said layer receiving a permanent sharply defined, negative relief impression when struck by a typewriter key with sufficient impact to fracture the bubbles, and said ductile film conforming under said impact to the resulting modified surface area of the layer.

3. A matrix as defined in claim 1 for molding flexographic letter-press printing plates wherein the bubble layer is about .015 to .040 inch thick and the bubbles of

the layer are about 125 microns in diameter, and said film comprising a .001 inch thick film of lead foil.

4. A printing plate matrix as defined in claim 1 for imaging on a typewriter matrix comprising a paper base sheet, a layer of hollow fracturable micro-bubbles unified by a low shear non-resilient binder adhered to the base sheet, said bubbles comprising 14% to 56% by weight of the cured layer, said layer having a thickness of about .015 to .040 inch, and a ductile soft metal release film bonded to the layer, said film having a thickness less than about 10% of the thickness of the bubble layer.

References Cited**UNITED STATES PATENTS**

2,957,791 10/1960 Bechtold ----- 161—159

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