Aug. 6, 1946. W. G. MULLEN 2,405,513

PHOTOGRAVURE PRINTING PLATE

Original Filed June 22, 1942

Fig. 1

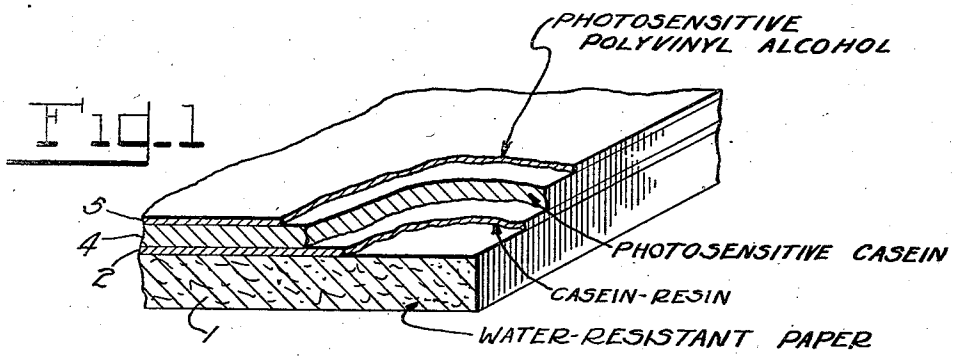



Fig. 2

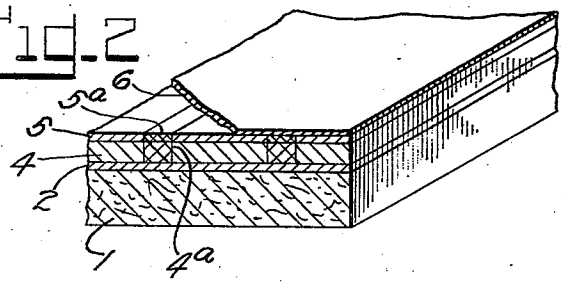



Fig. 3

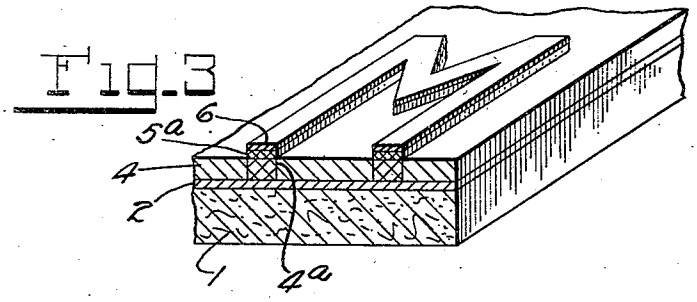
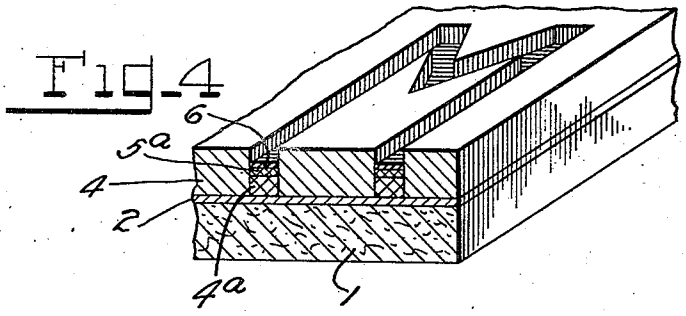



Fig. 4




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# UNITED STATES PATENT OFFICE

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## PHOTOGRAVURE PRINTING PLATE

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Original application June 22, 1942, Serial No. 447,887. Divided and this application December 16, 1944, Serial No. 568,457

1 Claim. (Cl. 95—8)

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This invention relates to an improvement in photogravure printing plates and is a division of my application Serial No. 447,887, June 22, 1942.

In accordance with established practice, photogravure printing usually involves the use of either stone, wood or etched metal plates, on the one hand, or plates having a printing surface of a sensitized hydrophilic protein, on the other hand. The stone, wood and metal plates are expensive, particularly at present, and their use is generally limited to applications where economic considerations are not of primary importance. Printing plates having a printing surface formed primarily of a colloidal material have been used to a considerable extent and are relatively inexpensive, but are subject to well recognized disadvantages and limitations. The herein described invention provides a printing plate having a colloidal printing surface which is less subject to the objections of previous plates and has proved more satisfactory in actual use. Printing plates embodying my present invention have been used in fast presses and have produced as many as 75,000 satisfactory impressions.

The plate embodying my invention includes a base of sheet material, preferably of a non-stretchable paper treated with some resinous material to make it impervious and having thereon two coatings, the one next the base being of a hydrophilic protein material, such as casein, albumin, gelatin or mixtures of these, and the outer one being of soluble polyvinyl alcohol. The plate is capable of being sensitized and can then be put into condition for printing by a procedure which is described in detail and claimed in a companion application, Serial No. 447,888, filed June 22, 1942, Patent No. 2,367,420. This procedure consists in exposing selected portions of the surface to light, thereby rendering them different in character from the unexposed portion, then coating the plate with a developing ink or grease which adheres to the light exposed surfaces and then washing the polyvinyl alcohol and ink or grease from the unexposed surfaces. In using this plate in printing, a priming roller applies a suitable primary liquid to the surface of the plate before the ink roller passes over it, with the result that the non-exposed areas refuse the ink while the exposed areas take it. The primary solution penetrates the unexposed surfaces which have been bared by the removal of the polyvinyl alcohol and swells these areas so that they are then raised above the exposed areas with the result that an intaglio plate is formed, the ink-receiving surfaces being slightly lower than the non-exposed surfaces.

I am aware that polyvinyl alcohol combined with other substances, such as dispersed rubber, naphthalene disulfonic acid, and sebacic acid, has been used as the colloidal coating for a colloidal printing plate, but I believe myself to be the first to make a plate having two coats, the outer of which is a polyvinyl alcohol, thereby making it possible to remove the coating from desired areas and thereafter swell the non-light exposed areas of the under layer to produce the intaglio effect which I have described.

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In the drawing:

Fig. 1 is a fragmentary perspective, on an exaggerated scale, illustrating a photogravure plate made in accordance with the present invention; and

Figs. 2, 3 and 4 are similar views illustrating successive steps in developing the plate for printing.

In accordance with the present invention, a relatively heavy coating of hydrophilic protein is applied to a suitable base such as metal, paper, synthetic sheet material or the like, which is either inherently water-resistant or previously treated so as not to become weakened or undergo appreciable dimensional changes when subjected to an aqueous treatment. The hydrophilic protein may comprise such materials as refined gelatin, albumin, soy bean protein and the like water-dispersible colloids, although for the reasons hereinafter indicated I preferably use casein. If desired, a suitable sensitizer may be incorporated in the coating solution, together with a small proportion of suitable insolubilizer, such as formalin or other aldehyde, although I prefer to sensitize the completed plate by imbibition or soaking in the manner hereinafter indicated. One or more fillers such as clay, satin white, titanium dioxide, barium sulphate, zinc oxide, zinc sulphide or the like, may if desired be incorporated in the coating solution which is applied to the base in any conventional manner to produce a smooth uniform coating. The coating thus produced retains its hydrophilic character in that it is water-sorptive and hence capable of swelling, although water-insoluble to the extent that it does not undergo disintegration or dissolution when subjected to aqueous treatment.

A layer or film, preferably relatively thin, of a water-soluble synthetic resin is then applied to the sensitized protein coating, the synthetic resin being sensitized, if desired, by incorporating therein a suitable sensitizer, although I preferably sensitize the top coat together with the underlying protein coat by imbibition or soaking in an aqueous-alcohol bichromate solution. Soluble polyvinyl alcohol of medium molecular weight is the preferred type of hydrophilic resin. The coating is applied in solution form in any conventional manner and the top coat thus produced, when photosensitized, differs from the underlying protein coating in that it is water-soluble so long as it remains unexposed. However, when selected areas of the top coat are exposed in the conven-

tional manner, such areas become water-insoluble and assume a grease receptive character and the underlying areas of the protein coating become hardened due to the penetration of light through the exposed areas of the top coat, whereas the unexposed areas of the top coat remain sufficiently water-soluble to be readily dissolved or washed off.

The base plate thus prepared may be subjected to exposure with a negative, master copy or the like, in the usual manner, the penetration of light rays through the polyvinyl alcohol film and into the protein coating being effective not only to harden the printing areas, but also to render these areas water-insoluble and grease-receptive, whereas the unexposed areas of the polyvinyl alcohol film remain water-soluble and the underlying protein coating retains its water-sorptive and grease-repellent character.

After exposure the base may be developed by applying a thin layer or film of a greasy substance such as developing ink, and following this step the entire plate may then be washed or otherwise subjected to aqueous treatment. Due to the grease-receptivity imparted to the exposed or printing areas, the developing ink clings tenaciously thereto, but because of the water-soluble character of the unexposed portions of the polyvinyl alcohol film, the latter readily dissolves and permits the greasy film to be washed off, thus leaving the unexposed areas of the protein coating which, as above noted, are grease-repellent. After having washed the plate it may then be wet with a suitable priming solution or the like, which causes the unexposed areas of the protein coating to swell to a level above that of the exposed areas, it being understood that relatively little swelling occurs in the exposed areas due to the hardening of both layers, attributable to the photochemical reaction which takes place during exposure. The article thus produced provides an intaglio printing plate in which the grease-receptive printing areas are disposed below the level of the grease-repellent, non-printing areas and hence protected thereby.

Referring to the drawing, which illustrates what is now considered a preferred procedure, the numeral 1 designates a flexible paper base, such as a heavy sheet of rope stock, kraft or the like, impregnated with a phenol-formaldehyde resin or the like water resisting composition. The paper base 1 is provided with a suitable prime coating 2, such as a casein-resin composition, upon which is applied a casein coating 4. The casein coating 4 is preferably composed of casein, satin white and a relatively small proportion of formalin, these materials first being uniformly dispersed in water to form a coating compound which may be brushed, spread or roller-coated on the primed base 1 so as to produce a uniform dry coating having a weight of the order of one ounce per square yard.

The final or top coat 5 consists of a medium molecular weight soluble polyvinyl alcohol which is applied in the form of an aqueous solution which may be brushed or spread on the dried casein coating to produce a top coat or film having a weight of the order of one-quarter of an ounce per square yard. The plate is now complete and ready for shipment or use in the manner to be described.

To render the plate photosensitive it is treated,



preferably by soaking, in an aqueous-alcohol solution preferably of ammonium bichromate. The proportion of alcohol, for instance normal propyl alcohol, to the aqueous bichromate is preferably of the order of two to one, but in any case the proportion of alcohol to water should be such as to prevent dissolving of the top coat, but insufficient to prevent swelling of the two coats and consequent imbibition of the sensitizer.

Although the proportion of polyvinyl alcohol coating to the casein coating is preferably of the order of 1 to 4, it is to be understood that this proportion may be varied throughout a wide range, but in any case the thickness of the polyvinyl alcohol film or top coat 5 should be such as to permit the penetration of light rays into the underlying casein coating 4 so that the latter, upon exposure, becomes hardened and more water-resistant than the unexposed areas. A negative or copy of the work to be reproduced is thus superposed on the polyvinyl alcohol coating 5 and the assemblage exposed to light in a conventional manner. For the purpose of illustration, it is assumed that the letter M is to be reproduced from the negative or master copy, and accordingly the areas $4^a$ of the casein coating 4, and $5^a$ of the polyvinyl alcohol coating 5, which underlie the letter M during exposure, become hardened, as indicated by the double cross-hatching, and hence grease-receptive and water-insoluble, whereas the remaining or unexposed areas of both the casein and polyvinyl alcohol coatings remain in substantially their original condition.

After exposure a film 6 of developing ink or the like greasy material is applied over the entire surface, as indicated in Fig. 2, and following this treatment the inked surface is then washed with water. Due to the water-insoluble and grease-receptive character of the areas $4^a$ and $5^a$ and the water-soluble character of the remaining unexposed areas of the coating 5, the latter readily dissolve and the overlying film of developing ink is thus washed away, whereas the hardened printing areas $5^a$ retain the film of developing ink superposed thereon, as illustrated in Fig. 3, and are raised above the surface of the unexposed areas.

The final step consists in treating the plate so as to cause the unexposed areas of the casein coating 4 to swell, and to this end a priming solution is applied to the surface of the plate, the priming solution being absorbed by the casein coating 4 which swells above the printing areas $5^a$, thus providing an intaglio plate, as illustrated in Fig. 4.

I claim:

A photogravure printing plate comprising a substantially water-resistant paper base, a relatively heavy photosensitive casein coating on said base, and a relatively thin layer of photosensitive polyvinyl alcohol on said casein coating, the character of the polyvinyl alcohol layer being such that when selected areas thereof are exposed, said areas become grease-receptive and water-insoluble while the unexposed areas remain water-soluble, and the thickness and character of said casein coating being such that unexposed areas thereof are capable of swelling to a level above that of the grease-receptive areas when said plate is treated with water.

WILLIAM G. MULLEN.