Nov. 18, 1924.

1,516,199

F. H. MONTEATH

PHOTOMECHANICAL PROCESS FOR PRODUCING BAS RELIEFS

Filed Sept. 23, 1922

2 Sheets-Sheet 1

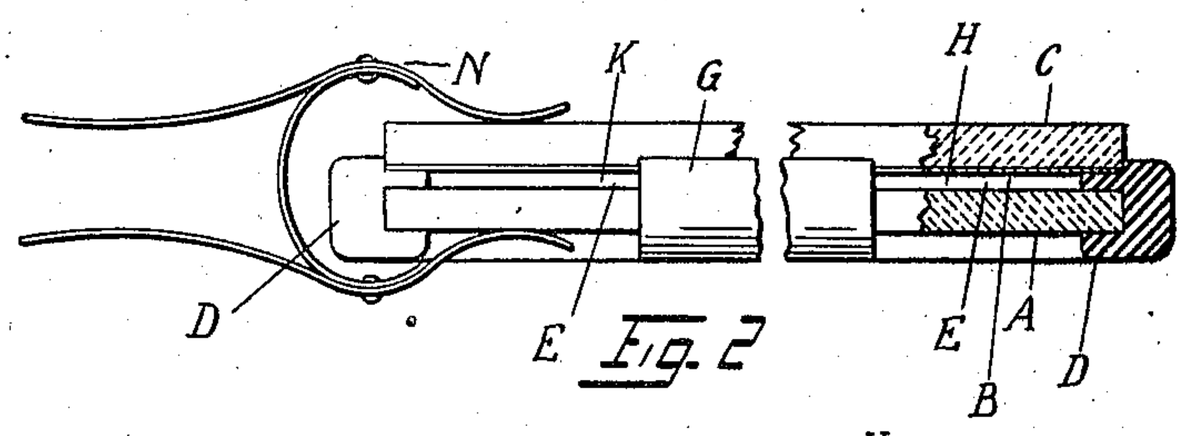
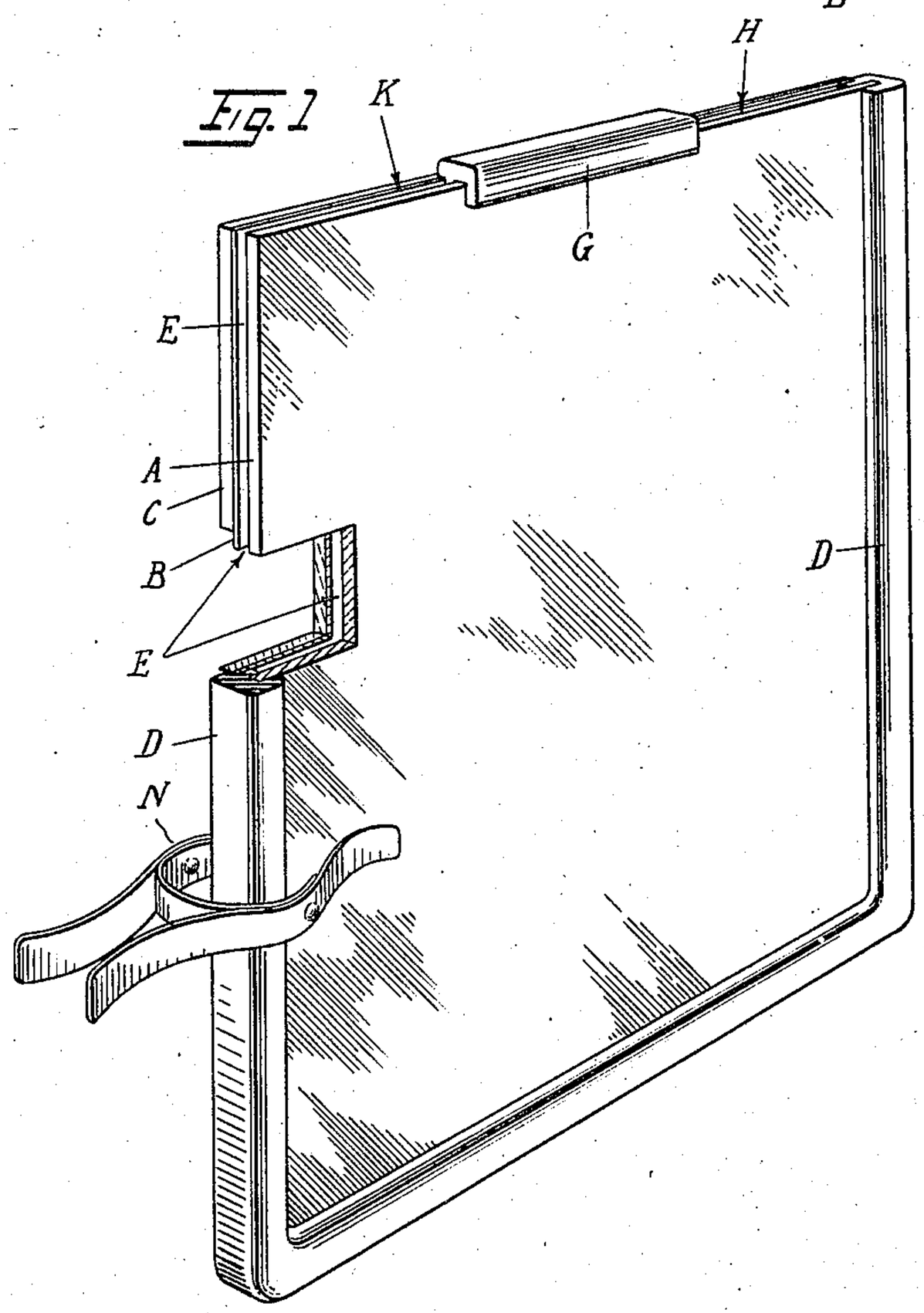


Fig. 2

Fig. 1



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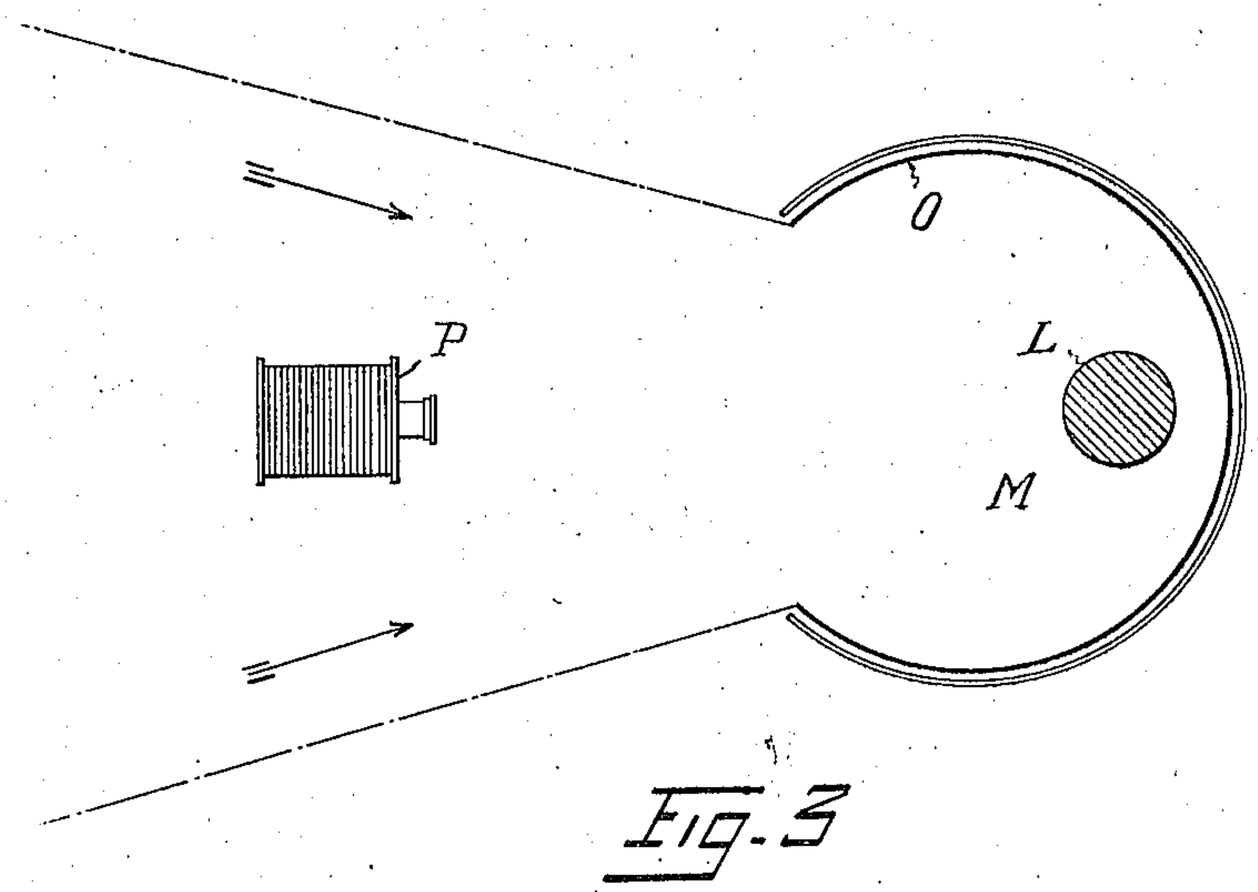

Fig. 3

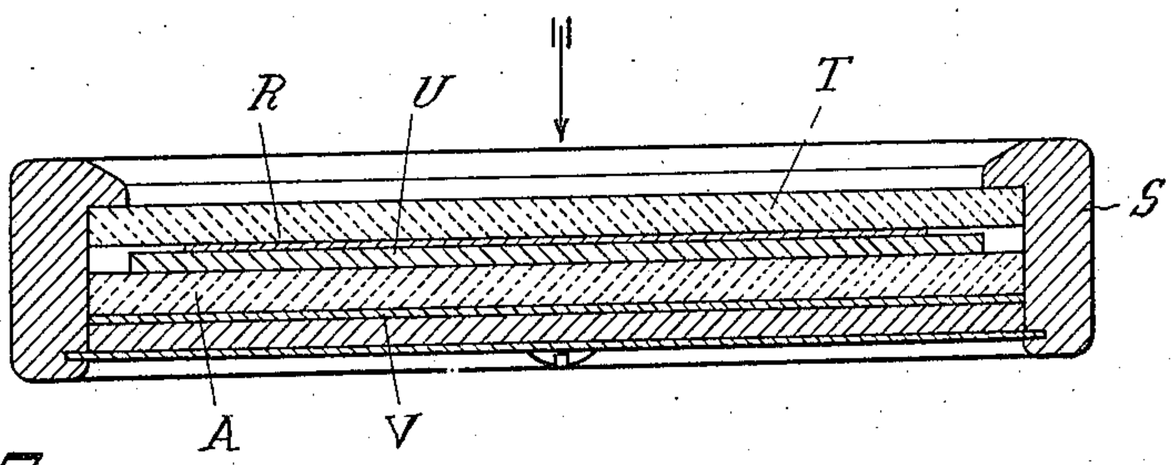

Fig. 4

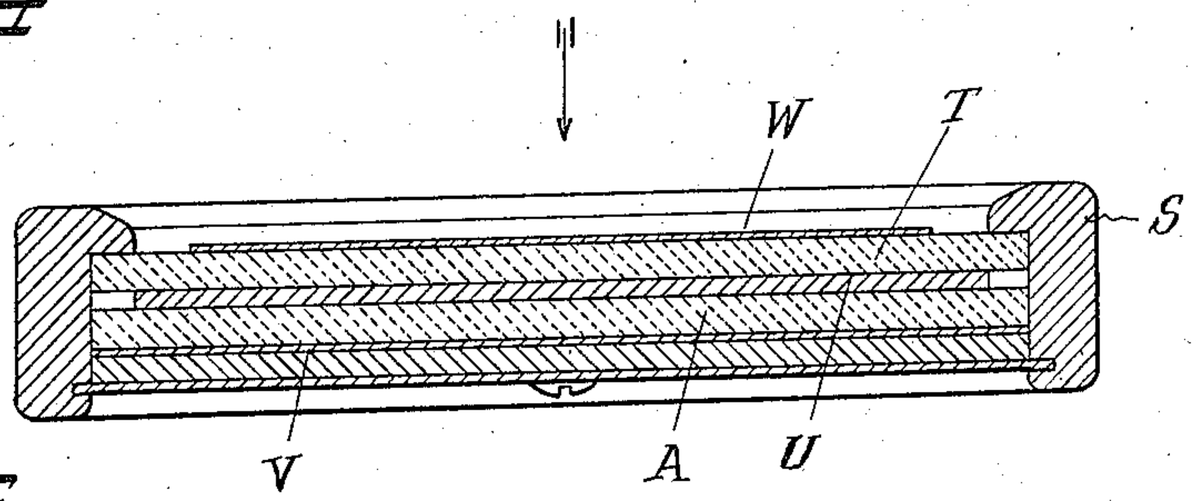

Fig. 5

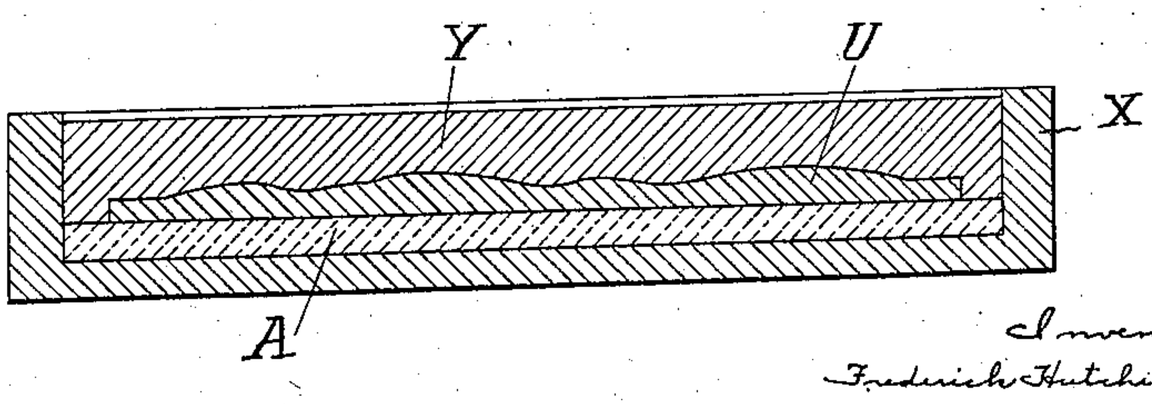

Fig. 6

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UNITED STATES PATENT OFFICE.

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PHOTOMECHANICAL PROCESS FOR PRODUCING BAS-RELIEFS.

Application filed September 23, 1922. Serial No. 590,202.

To all whom it may concern:

Be it known that I, FREDERICK HUTCHISON MONTEATH, a subject of the King of Great Britain and Ireland, residing at Victoria Arcade, 44 Castlereagh Street, Sydney, New South Wales, Australia, have invented new and useful Improvements in Photo-mechanical Processes for Producing Bas-Reliefs, of which the following is a specification.

This invention consists in a photo-mechanical process for producing bas-reliefs. Bas reliefs of portraits and other subjects produced in plaster, wax, or like substances by this process may be bronzed, electro-plated, or otherwise surfaced to procure any desired finish effect, or they may be utilized as moulds or matrices for the production of repetitions by known processes.

Bas-reliefs of full depth and having effective "definition" are obtained by the present invention. All the detail of the subject is brought out, and a better effect is obtained than that usually offered by wrought bas-relief. Low reliefs (stiacciato) as commonly used on coins are surpassed in depth effect. The process may be used for the production of corresponding results in intaglio.

Numerous methods have been suggested heretofore for obtaining relief effects by photo-mechanical means. These methods in most cases involve actinic printing through a photographic negative on a surface of bichromated gelatin, and subsequent "swelling" of the printed gelatin by causing it to absorb water thereby to raise it in the lights proportionately to their clarity whilst retaining at or near the surface level the opaque portions and deep shadows of the print which are in a relatively non-absorbent condition. It is therefore to be understood that no claim is made broadly in respect of such known methods. For a variety of reasons well known in the art none of these known methods has been proven profitable or even operative commercially. The relief depths obtained have in most cases sufficed only for the production of printing plates for "collotype" and other printing processes, and in a limited number of cases, none of which is believed to be operatable commercially, an imperfect low stiacciato effect only has been obtained. The present invention is therefore concerned only with commercially usable means whereby deep bas-relief effects are obtained photo-mechanically without requiring sculptural or retouching accentuation.

Irrespective of the process used, deep bas-reliefs cannot be produced through the intermediary of films of gelatin as the depths obtained by swelling a film is too little to offer much more than a mere impression of very low relief, which suffices for printing surfaces but is useless for portrait plaques and the like. Plates of gelatin having a thickness of the order of one-eighth of an inch must be used. Where attempts have been made heretofore to obtain bas-reliefs through the medium of thick films or plates, the gelatin was sensitized whilst in a liquid condition by addition to it of dissolved potassium bichromate and was formed into plates by setting it in flat pan moulds and allowing it to solidify therein. Successful results are not obtainable with such films or plates. The presence of scummy matter on the gelatin surface, mechanical imperfections in that surface, and the inclusion of air bubbles in the mass all operated to affect the result adversely; and ineffective depth was obtained, as the negatives were taken with lateral or rearward lighting and printing was effected from the negative only without overprinting the margin to augment non-absorbency and thereby assure the desired height of swelling of the print of the subject. The necessary differentiation between field, shadows, and high lights cannot be obtained by printing from a negative only, as if exposure sufficient for the margin or field flattening were effected, the subject would be overprinted and low relief only would be procured in the result.

In the accompanying drawing—

Fig. 1 is a perspective view of a gelatin slab mould with a portion cut away from one edge of it and part of the edge margin removed to better exhibit the detail construction;

Fig. 2 is a broken half transverse section

and top plan showing a spring clamp for embracing the mould sides;

Fig. 3 is a diagram illustrating the position of the subject when the negative is being made;

Figs. 4 and 5 are vertical sectional elevations through a printing frame at different stages in the process; and

Fig. 6 a sectional elevation through a box in which the plaster mould is cast.

According to the present invention, a subject L to be re-produced in bas-relief is positioned in a chamber M which is lined with black velvet O or like light absorbent material and is open at the front only. The camera P is directed squarely towards the open front of the chamber with the lighting admitted behind the camera, and the view is sharply focussed. The subject may be touched up to accentuate parts which will appear as shadows or high lights respectively, and in the case of a living subject to tone the color of the hair to correspond actinically with the skin color. A good printing negative is required which may be retouched according to usual studio practice. After development, it is masked to oval, circular, or other shape, and to leave a marginal field or surround; and any lettering or like additional matter required to appear in relief is painted reversely on the transparent areas of the negative.

A bichromated gelatin slab is now prepared. Three drams of fine dry gelatin are soaked in cold (normal temperature) water for about half an hour, at the end of which time all unabsorbed water is drained off. The swelled gelatin is then placed in a vessel which is set in a water bath and the temperature raised slowly (but not above 140° Fahr.) and maintained until the gelatin is in a homogeneous liquid condition. Into this liquid gelatin 15 grains of potassium bichromate is introduced. The bichromate must be very finely powdered and well stirred into the gelatin, and the bichromated gelatin must be kept liquid by maintaining its temperature until it is poured into the slab mould which is hereinafter described. The bichromate may be added as a saturated or strong solution, but that method of sensitizing the gelatin is objectionable, as additional water is thus introduced.

It is important that the gelatin shall not carry water substantially in excess of the proportion required to bring it to liquid condition at the moulding temperature. The presence of water in excess of the minimum necessary results in undesirable shrinking in the drying out of the slab and also results in a less satisfactory swelling of the material when it is subsequently wetted.

The gelatin slab mould is constructed of a backing plate A and a thin flexible polished sheet of tinned steel or copper B of the necessary superficial area in relation to the size of the negative, an excess depth being provided for a purpose hereinafter explained. The mould is vertically disposed, the backing plate A forming one side of it and the flexible metal sheet B the other side of it. A sheet of plate glass or other rigid material C is placed behind the flexible metal sheet B to support it against internal pressure which tends to bulge it outwards when the mould is filled as hereinafter described, and if the backing plate A be a sheet of flexible material it also should be similarly backed. In practice a thick sheet of glass has been used as a backing plate; the bichromated gelatin adheres to it tenaciously, so that it forms a satisfactory carrier for the slab during the drying, printing, swelling, and moulding steps in the process. A flexible rubber rebated marginal frame D is detachably grasped on three edges of the assembled sides A—B—C to form a rectangular mould chamber E about one-eighth of an inch in width. A parting strip G of rubber is also set midway in the open top of the mould leaving clear "gate" H and "riser" K spaces between the ends of this strip G and the rubber margin pieces D which form the ends of the mould E. The mould sides are clamped by means of an appropriate number of spring jaw clamps such as N the fingers of which embrace said sides as shown in Fig. 2. Preparatory to use, the mould is warmed to the same temperature as that of the prepared liquid bichromated gelatin.

The liquid bichromated gelatin is siphoned or carefully poured through a flooded funnel into the mould through one of the spaces (the gate H) in the top edge of it, care being observed to minimize entrainment of air by which bubbles would be introduced into the mass. By siphoning the gelatin or by flooding the funnel in pouring, the risk of bringing frothy and scummy substance into the mould E is minimized. The gelatin so introduced into the mould through the "gate" H is allowed to well up into the other top edge space (the riser K) and the temperature of the mould and its contents is maintained until the gelatin contained in it in a liquid condition has become clear and all air bubbles have passed up out of the riser and the gate. The mould is now allowed to cool so that the gelatin in it will solidify into a slab. Up to this stage the operations may be conducted in actinic light but it is much preferred to conduct them in orange light. After the gelatin has cooled and set to a leathery consistency the mould is stripped. That is accomplished by pulling away the rubber margin D and releasing the support

plate C and the flexible metal side B of the mould, cautiously prying up one corner of the flexible metal sheet B, first to release the suction, and then gradually bending it backward whilst raising it so that it will peel from the gelatin without injuring the polished surface of the gelatin.

The casting and setting of the slab in the manner described above, results in the production of a slab of uniform thickness without flaws and with a smooth polished face which is not injured in the stripping of said sheet after the slab is set. The gelatin remains attached to the backing plate A which is on the other side of it, and is then allowed to dry out and harden in the dark room. Under average atmospheric conditions about four days are occupied in this drying out and hardening stage. The dried slab of bichromated gelatin is very sensitive to actinic action and is in condition for printing. It should not be overdried to such a degree that it will acquire a horny condition and leave the backing.

A mask of the subject is prepared by making a silver paper print from the negative, exposing it till black, and cutting it to form a silhouette of the area of the subject required to be brought up in relief in the gelatin above the level of the field.

Printing from the negative R is effected in the shade in a process printing frame S having a glass T about one-quarter of an inch in thickness, the negative being placed with its film in contact with the gelatin slab U and held thereto under heavy pressure (see Fig. 4). If the backing plate A which supports the gelatin slab U is of glass, a pad of black cloth V is placed behind it to minimize risk of halation during printing. The top edge of the slab, which may be less perfect than the lower part of it should not be included under the negative of the subject. In natural light of average actinic value an exposure of about two hours is necessary. After this printing has been effected, the negative R is removed from the printing frame S and the mask W is placed on the front face of the glass T of the printing frame in correct register with the print on the gelatin, and the masked gelatin is then again exposed in soft diffused actinic light for about ten minutes (see Fig. 5). The gelatin surrounding the masked area is thus overprinted, and the edges of the subject are gradually printed (vignetted) owing to the infiltration of light through the frame glass laterally below the edges of the silhouette mask, so that the overprinted portion of the slab is rendered totally or almost totally unabsorbent of water in the latter stages of the process and the edges of the subject are brought up in deep definition. In the first printing from the negative the gelatin is rendered unabsorbent of water in all parts of it proportionately to the intensity of the light acting on it through the negative.

When the double printing has been completed, the gelatin slab U is removed from the printing frame S and immersed in water in the dark room at normal temperature for 12 hours more or less according to the degree of relief required. It is allowed to soak until the high lights are fully risen by swelling. The shadows will rise inversely to their relative density, whilst the overprinted marginal and field parts of the gelatin will not rise at all.

The gelatin slab U thus developed in water and still carried on the backing plate A is now used as a mould (see Fig. 6). It is set in a frame or box X and thick plaster Y is spread over it, care being taken to ensure uniform distribution and absence of streaks and air bubbles in the plaster. The plaster should not be applied in too thin a condition as otherwise it will adhere to the gelatin. When the plaster is set it is lifted from the gelatin, a knife edge being first inserted cautiously at an edge to break the suction. The plaster cast if appropriately shaped in the mould may serve as an intaglio plaque. Or it may be used as a matrix from which reproductions in relief may be made in wax or plaster or metal. For the latter purpose it is varnished or otherwise surfaced and casts made from it, these final relief castings being bronzed or otherwise finished by electroplating or by other known methods. The mother plaster mould or a reproduction of it may be used as a mould for the manufacture of cast metal reproductions.

The process is primarily useful for the production of plaque bas-reliefs, portraits, but it has commercial utility also for the production of embossing dies and founder's patterns for builders' furniture and art metal work and paper embossing generally.

What I claim as my invention and desire to secure by Letters Patent is:—

1. A photo-mechanical process for producing bas-reliefs, comprising the following steps in sequence: (*a*) producing a clear printing negative of a subject, using frontal lighting and a black surround background, (*b*) bichromating gelatin by soaking it in water, removing the unabsorbed water, warming the swelled gelatin to liquefy it, and introducing potassium bichromate in the approximate proportion of 5 grains per dram of dry gelatin, (*c*) producing a slab from said liquid bichromated gelatin by casting it in a warmed vertical mould, about an eighth of an inch in thickness between a non-absorbent polished flexible sheet and a backing and cooling to set it, releasing and peeling off the flexible mould side, and drying out on the backing, (*d*) printing for

approximately two hours under the negative and vignetting for approximately ten minutes under a silhouette mask of the subject in register above the print but not in contact with it, and (*e*) swelling the printed slab to procure a bas-relief by immersing it in water (all said steps including and subsequent to the drying of the gelatin slab being performed in non-actinic light).

2. A photo-mechanical process as defined in claim 1, characterized in that the bichromating salt is added in dry powdered condition to gelatin which has been swelled by absorbing water, relieved of unabsorbed water, and rendered liquid by warming it.

In testimony whereof I have signed my name to this specification.

FREDERICK HUTCHISON MONTEATH.