No. 812,495. PATENTED FEB. 13, 1906.

J. W. IPPERS.

PHOTOMECHANICAL PRINTING.

APPLICATION FILED JUNE 26, 1905.

Fig. 1

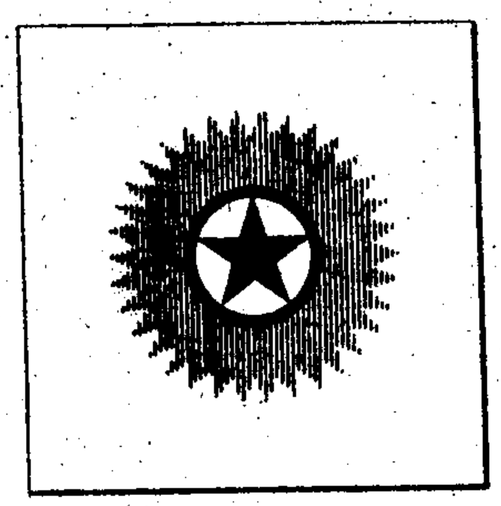


Fig. 2

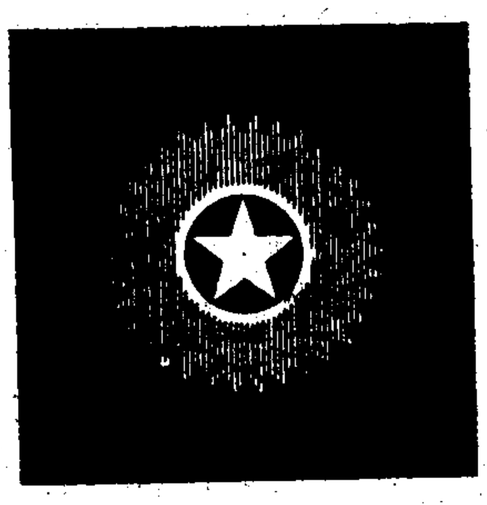


Fig. 3

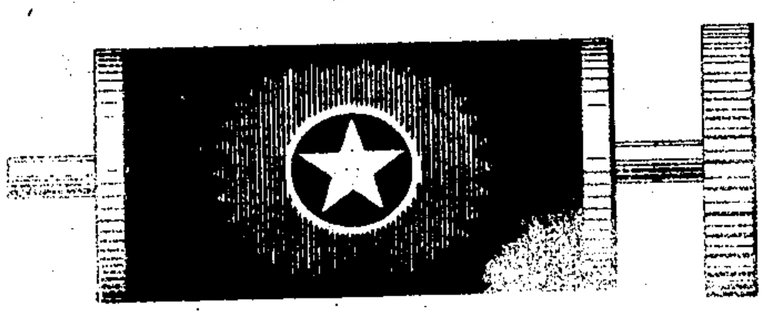
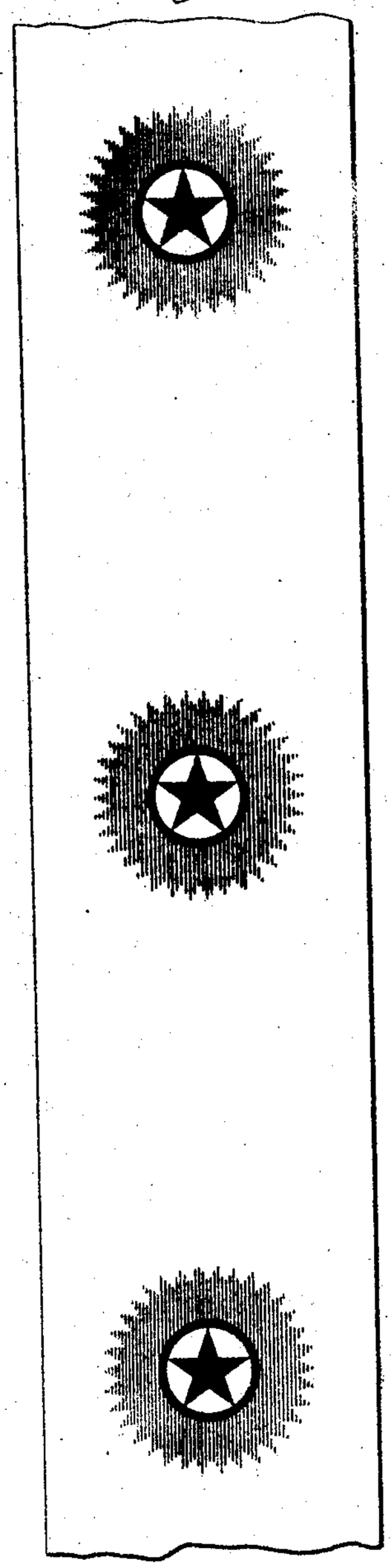


Fig. 4



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UNITED STATES PATENT OFFICE.

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PHOTOMECHANICAL PRINTING.

No. 812,495. Specification of Letters Patent. Patented Feb. 13, 1906.

Application filed June 26, 1905. Serial No. 266,932.

To all whom it may concern:

Be it known that I, JOHN W. IPPERS, a citizen of the United States, and a resident of the city of New York, State of New York, have invented certain new and useful Improvements in Photomechanical Printing, of which the following description and claims constitute the specification.

The object of my invention is to make ungraduated deposits of printing-ink or "color" in flat masses or in unbroken lines on paper or on cloth or on any other suitable surface or material, and thereby to print any geometric or other pattern, picture, or design which can be made with such ungraduated deposits.

The nature of my invention consists in making a sensitive gelatin plate on an elastic base and in exposing that sensitive gelatin plate to light through a translucent sheet having thereon a positive or a negative specimen of the pattern or picture or design to be reproduced and in developing that exposed gelatin plate by bathing it in water, and thereby swelling some parts of its surface into relief, while leaving other parts of its surface in depression, and in drying that developed gelatin plate in air and in afterward using that plate in producing intaglio, relief, or planographic printing-surfaces with which to make the desired ungraduated deposits of ink or color, and thus to print the particular pattern, picture, or design to be reproduced.

Figure 1 of the accompanying drawings represents a translucent glass or celluloid sheet having thereon a design composed of a flat area of opaque surface in the form of a five-pointed star and of a flat opaque circle surrounding the star and of a series of unbroken parallel lines arranged around the circle. Fig. 2 represents a developed gelatin plate the background of which is in depression and the relief portions of which correspond with the star, the circle, and the lines which are black in Fig. 1 and which are white in Fig. 2. Fig. 3 is a view of a copper roller which has received on its periphery certain deposits of ink from the depressed surfaces of the gelatin plate of Fig. 2 and which deposits correspond with the translucent areas of the sheet of Fig. 1. Fig. 4 is a fragment of an indefinitely long strip of paper or cloth which has had the opaque design of Fig. 1 repeatedly printed thereon by means of deposits of printing-ink or color from those surfaces of the copper roller of Fig. 3 which are white in that figure.

The program illustrated by the drawings is performed as follows: I produce the sheet shown in Fig. 1 of the drawings from a translucent glass or celluloid sheet by making the opaque design thereon, while making or leaving the background of the sheet translucent. The design on the sheet of Fig. 1 may be made thereon photographically or by the pen or pencil of an artist, and in the latter case the artist may draw the design upon the translucent sheet as an original composition or may copy it from some other object or may trace it from a corresponding design on paper or cloth or other material, or the design may be applied to the translucent sheet in any one of several other ways, so as to produce the primary instrumentality employed in my invention, which primary instrumentality is a translucent sheet having some opaque design or pattern applied thereto. The developed gelatin plate of Fig. 2 is made by the following means, in describing which I specify quantities by troy weights: I dissolve one ounce of hard German gelatin in six ounces of water in a vessel of its own. I also dissolve one hundred and twenty grains of bichromate of ammonia in six ounces of water in a vessel of its own. Thereupon I add the solution containing bichromate of ammonia to the gelatin solution, and then I add four ounces of alcohol thereto, and then I filter the compound solution two or three times. The resulting composition of matter is a sensitized gelatin emulsion, the ingredients of which I mix together and filter and keep in a dark room or in a room dimly lighted with red light. I make a stock solution by mixing twenty-eight ounces of water and one hundred and eighty grains of citric acid and five hundred and twenty grains of nitrate of potassium and seventy grains of chrome-alum and half an ounce of liquid ammonia in a vessel of its own. I then take two ounces of that stock solution and mix it with twelve ounces of glycerin and six ounces of water in a vessel of its own, and thus produce a glycerin solution. I next take a sheet of celluloid about one-fiftieth of an inch thick and provide it by means of a sand-blast or otherwise with a uniform finely-grained surface on each of its sides unless it is already so grained. I thoroughly

clean this celluloid sheet with alcohol, and then I glue it down upon a perfectly-flat bright steel plate about a quarter of an inch thick by the following means: I take ordinary fish-glue and apply it to the upper surface of the steel plate by means of an inking-roller, and then I apply soft paper to that surface of the steel plate and press it down with a plain roller and leave it a few minutes to dry. Thereupon I apply more fish-glue to the upper surface of the paper, and then I press the celluloid sheet down upon that paper by means of a plain roller, taking care to exclude all air from between the celluloid and the steel. To confirm the union of the celluloid sheet with the steel plate through the intervention of the paper and the fish-glue, I pile the plate thus composed with other like plates, with sheets of felt interposed between them, and then I put a heavy weight upon the top of the pile and leave it there until each celluloid sheet is firmly and smoothly adherent to its steel plate; or I accomplish the same result by pressing the pile together in a powerful press. I next clean the celluloid side of the composite plate with alcohol, and I then pour my gelatin emulsion over that side of the plate, and then I place that plate with that gelatin emulsion thereon exactly horizontal in a drying-oven, and I leave it there until the gelatin emulsion is coherently dried and baked upon the celluloid surface. Thereupon I take the plate out of the oven and pour a second coat of the same gelatin emulsion on the first coat, and then I bake the plate, as before. This production of a sensitive baked gelatin plate must be made in a dark room or in a room dimly lighted with red light, which light may come from an incandescent electric lamp having a red bulb or may be admitted to a dark room through a pane of red glass. The sensitive baked gelatin plate when finished must be kept dark and dry until it is used. I treat my sensitive baked gelatin plate as follows, so as to produce therefrom the developed gelatin plate of Fig. 2: I put that sensitive baked gelatin plate in a photographic contact-frame with the sheet of Fig. 1 between it and the translucent front of the frame and with its face upon the gelatin plate. I then expose the baked gelatin plate to light passing through the sheet of Fig. 1 for spaces of time varying from four to ten minutes. The result of this exposures is to harden the different areas of the gelatin coating on the plate in proportion to the number of rays of light reaching those areas, respectively, through the different areas of the sheet of Fig. 1. As no rays of light will pass through the areas covered by the opaque design on the sheet of Fig. 1, the corresponding areas of the plate of Fig. 2 are not hardened; but as strong and uniform rays of light will pass through the translucent areas of the sheet of Fig. 1 the corresponding areas of the plate of Fig. 2 are uniformly hardened by the exposure. The sensitive baked gelatin plate having been thus exposed to light is removed from the frame in a dark room and is immersed and bathed in that room first in slightly warm water and then in cool water. That bathing causes the absorption of water by the unhardened parts of the gelatin coating, and the absorbed water causes those parts of the gelatin coating to swell upward, and that swelling brings the design on Fig. 1 into relief on the gelatin surface of Fig. 2, while leaving in depression the other parts of the surface of the gelatin plate. If I am working in a temperature above 65° Fahrenheit, I next bathe the gelatin plate for from three to five minutes in a solution of five drams of chrome-alum in twenty-four ounces of water; but this bathing is not necessary when I am working in a temperature as low as 60° Fahrenheit. The bathing of the gelatin plate in the solution of chrome-alum tends to prevent the swollen area of the gelatin from receding entirely down to the original horizontal level of the plate when the water is expelled from that swollen area by the drying of the plate by means of a current of air produced by an electric fan or otherwise and which drying is the next operation to which the plate is subjected. Still that drying causes the swollen area of the gelatin plate to somewhat recede; but the gelatin coating under that area remains comparatively soft and porous, while the gelatin coating under the depressed surface of the plate continues to be comparatively hard and dense. I now strip the celluloid base of the developed gelatin plate of Fig. 2, together with its gelatin coating, away from the steel plate to which the celluloid base was glued before the gelatin emulsion was applied thereto, for the steel plate has now performed its function of keeping the celluloid sheet perfectly flat and perfectly level while the gelatin emulsion was being baked thereon.

I prepare the copper roller of Fig. 3 in the following manner: I first apply the above-described glycerin solution to the flexible developed gelatin plate of Fig. 2. That solution adheres to and is absorbed by the relief parts of that plate, because they are porous, but is repelled by its depressed parts, because they are hard. I then remove the surplus glycerin from that flexible developed gelatin plate by means of tissue-paper applied thereto and removed therefrom, and I repeat this operation, if necessary, until no free glycerin solution remains upon the surface of the plate. I next apply printing-ink to the flexible developed gelatin plate of Fig. 2 by a soft and elastic inking-roller or by a succession of such rollers, which ink is taken by the depressed surfaces of that plate; but it is not taken by its relief surfaces, because it is repelled therefrom by the glycerin solution

therein. The ink which is thus applied to the plate is composed by melting together one pound of asphaltum, one pound of rosin, half a pound of beeswax, one pound of mastic, and three ounces of mutton-tallow and then mixing that composition with double its quantity of the crayon-ink of commerce, which crayon-ink is made of cooked linseed-oil and lampblack without any fat. Thereupon I roll a plain copper roller having a well-polished periphery over the inked plate of Fig. 2 with pressure enough to cause sufficient ink to be transferred from the inked surface of the plate to the corresponding part of the periphery of the roller. Thereupon I change that ink into an enamel by means of the application thereto of an enameling-powder and by means of heat. That enameling-powder is composed of two parts of rosin, one part of shellac, and two parts of alcohol, melted together and then cooled and finely pulverized. I apply that powder with a cotton ball to the inked surface of the copper roller, so as to make the powder adhere to the inked portions of that surface without adhering to the naked portions thereof.. Then I heat the copper to a temperature high enough to melt the enameling-powder into the ink, to which it has adhered. This heating results in changing the ink on the surface of the copper roller into an enamel, and that enamel will protect those areas of the copper roller covered thereby from the eating of the etching liquid, which is subsequently applied to the copper roller. I next protect the interior of the roller, if it is hollow, and also its ends, with asphalt varnish from the action of the etching liquid, which I next apply to the periphery of the roller. I make that application by simply causing the roller to rotate above a pan containing the etching liquid and with all portions of the periphery of the roller successively passing through the etching liquid in the pan as the roller is rotated. That etching liquid, which may be chlorid of iron, eats into the naked portions of the periphery of the copper roller, while not affecting those portions of that periphery which are covered by the enamel. I cause the etching liquid to do its etching work for a greater or less length of time, according as I intend to etch more or less deeply into the periphery of the copper roller, and thus give more or less depression to its etched surfaces. After the periphery of the copper roller has been etched I wash it with water to remove the etching solution, and then I remove the enamel from its relief surfaces with turpentine. The periphery of the copper roller having been thus provided with depressed or intaglio printing-surfaces the roller is used in a printing-machine as if it had received those surfaces from the hands of an engraver. That use consists in applying ink or color to the periphery of the roller and in scraping or wiping it away from the relief surfaces thereof and in drawing a strip of paper or cloth between it and a plain roller opposite thereto and in transferring ink or color from the depressed surfaces of the roller to that strip of cloth or paper.

The particular program illustrated in the drawings has thus far been the subject of this description. That program is confined to intaglio-printing of flat masses and of unbroken lines of one color on strips of paper or cloth. Though this invention is not confined to intaglio-printing, it is confined to printing flat masses or unbroken lines as distinguished from graduated or modulated printing of pictures of natural or artificial subjects. Printing in flat masses of one color is illustrated by the star and by the circle in each copy of the design shown in Fig. 4, while printing in unbroken lines is illustrated by the parallel lines in the same design. Such printing is applicable to silk or cotton dress goods and to oil-cloths and to wall-papers, where the designs to be printed are ungraduated, and such printing is applicable to printing copies of line drawings or line engravings on velvet, or on satin, or on other fabric, or on paper.

The process of this specification is not applicable to the production of any printing-surface capable of printing copies of pictures which are composed of graduated and structureless gray. If such a graduated picture were to be taken as the original subject of this process, the result of the process would be a failure to make any copy of that subject, and that failure would be explainable as follows: The translucent negative photograph which would be made from the original graduated structureless gray picture would also be in structureless gray, and that structureless gray would be graduated from light to dark, and the different areas of that negative would transmit more or less light, according to their respective translucency. When the sensitive gelatin plate of this specification would be exposed to light through that negative and would afterward be developed and dried, its surface would not be composed of uniform relief parts and uniform depressed parts, but would be composed of depressed parts of continually-varying depths, shading off into relief parts of continually-varying heights. Those depressed parts when provided with printing-ink would be filled with ink, though at varying depths, and that ink when transferred to a solid metal surface would cover all those areas of that surface which would be opposite to the depressed and ink-carrying parts of the developed gelatin plate. Those inked areas of the metal would thus be protected by the ink thereon from the etching liquid afterward applied thereto and would therefore be left in uniform relief thereby. Then if the metal surface were to be used for relief-printing it

would print solid ungraduated black for the graduated structureless gray of the original picture, or if the metal surface were to be used for intaglio-printing solid white would appear on the printed paper or cloth where the original picture was graduated structureless gray.

Relief-printing according to my present invention differs from intaglio-printing in that the primary instrumentality of the process is a negative translucent sheet instead of being a positive sheet, like that of Fig. 1, and in that the copper roller is etched more deeply for relief-printing than for intaglio-printing and in that the copper roller may be finely roughened for relief-printing instead of being well polished for intaglio-printing before the ink is applied thereto from the gelatin plate.

A copper roller is said in the description to be the printing instrumentality which is made and used in my process; but such a roller may be made of aluminium, zinc, or other metal and may be prepared and used as set forth in this specification, except that different metals are best etched with different etching liquids, and while this specification particularly contemplates a metal roller as being the best printing instrumentality to be prepared and used in the process the process is also applicable to the preparation and use of a plate of copper or other metal for intaglio-printing or for relief-printing in flat masses or unbroken lines.

Planographic printing on slabs of stone or plates of zinc can also be conducted according to my present invention by means which include the process of my present claims and such other means as would be employed if a pattern or a picture or a design in flat masses or in unbroken lines were to be put upon stone or zinc by the brush or pen of an artist.

The translucent sheet of Fig. 1 is said in the description to be glass or celluloid; but it may be of some other material than celluloid or glass, and it may also be rigid or be flexible, with good results in particular cases.

My flexible celluloid sheet is said in the description to be temporarily glued down upon a flat and horizontal steel plate while the gelatin coat is being coherently dried and baked thereon. This flat and horizontal condition and position of the celluloid base causes the gelatin coat to set and dry upon the celluloid base with uniform thickness throughout all parts of its area. The flat plate upon which the flexible celluloid sheet is glued down while the gelatin coat is setting and drying thereon may be of some other metal than steel, or it may be glass. The flexible celluloid sheet, with its gelatin coat, may be stripped from that flat plate before it is exposed to light or after it is exposed to light and before it is bathed in water instead of being kept upon the flat plate until after it is bathed in water. If the flat plate is metal, the gelatin plate, with the flexible celluloid base, should be stripped from the flat plate before the glycerin solution is applied to the gelatin coat in order to avoid any chemical reaction between the metal of the flat plate and any of the chemicals in the glycerin solution; but if the flat plate is glass the gelatin plate, with its flexible celluloid base, may be left on the flat plate until after the glycerin solution is applied to the gelatin plate and, indeed, until after the gelatin plate is inked.

Before ink is transferred from the inked gelatin plate to a solid surface the inked gelatin plate should be stripped from any flat plate to which it may have been glued, because the gelatin plate must be elastic at that time. That elasticity is necessitated by the fact that the inked gelatin plate must be pressed very hard against the copper roller or other solid surface in order to transfer ink enough from the depressions in the gelatin plate to the solid surface and by the fact that that hard pressure would crush or distort the relief parts of the surface of the gelatin plate if the base of that plate were rigid at that time and by the fact that good ink impressions cannot be made between two unyielding surfaces. The elasticity of that base at that time is made available to prevent such crushing or distortion and to produce good ink impression by means of the presence below that base of some cushioning material, such as felt or soft rubber.

The permanent base of the gelatin plate of Fig. 2 may be a flat and rigid plate instead of being a flexible celluloid sheet, provided such a flat and rigid plate is furnished on its upper surface with an elastic layer of rubber or other elastic material, on the upper side of which layer the gelatin emulsion is spread and upon which it is dried or baked. The rigid foundation of such a gelatin plate may be glass and may be a quarter of an inch thick or more. A layer of elastic material, such as soft vulcanized rubber, may be spread over with a rubber solution and then fastened down upon such a rigid foundation by drying that adhesive substance. Thereupon the elastic side of the plate thus composed may be coated with a solution of water-glass and albumen, and that solution may be dried on that surface, so as to give to the elastic side of the plate an insoluble and porous surface for the reception of the gelatin emulsion and the firm retention of the gelatin film.

The gelatin plate of Fig. 2 may be made with only one coat of gelatin emulsion instead of two coats. In that case I make the gelatin emulsion with one ounce more of alcohol and two ounces less of water than I specify when two coats of gelatin emulsion are to be applied to the base of my gelatin plate.

When a rigid plate is used instead of a flexible celluloid sheet as the foundation of a gelatin plate, that gelatin plate will retain

that foundation through all the stages of its manufacture and use, including the transferrence of ink from its developed gelatin surface to the copper roller or other solid surface, which is applied to it for the reception of that ink. When that application occurs, the elastic layer between the gelatin surface and the rigid foundation of the plate will yield enough to enable the copper roller or other solid surface to take ink from all the depressions in that gelatin surface without crushing or distorting the relief portions thereof.

Some of the instrumentalities and some of the transactions which are described in this specification are also described in the Ippers patent, No. 785,735, of March 28, 1905; but this specification differs substantially from that patent in a number of essential particulars, and in its combination of elements, and in its mode of operation, and in its result. Each of the claims of that patent contains elements and features which are absent from this specification, and the claim which I make in this specification contains elements and features which are absent from that patent.

I claim as my invention—

The following process in photomechanical printing: making a gelatin emulsion, sensitized with bichromate of ammonia: applying that gelatin emulsion to a flat base, and drying and baking it thereon: exposing the resulting baked gelatin plate to light, through a sheet having a uniformly-translucent area, and a uniformly-opaque area: developing that exposed gelatin plate, by bathing it in water, and thereby swelling into smooth and uniform relief, that area thereof which was under the opaque area of that sheet during the exposure, while leaving in smooth and uniform depression, that area thereof which was under the translucent area of that sheet during the exposure: drying that developed gelatin plate in air: applying glycerin solution to the smooth and uniform relief area of that dried gelatin plate: applying printing-ink to the smooth and uniform depressed area of that glycerined gelatin plate: and transferring printing-ink from that smooth and uniform depressed area, to a smooth and solid surface of stone or metal; all substantially as described.

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