UNITED STATES PATENT OFFICE.

A. F. BURSON, OF MOUNT BLANCHARD, OHIO.

PROCESS FOR ENGRAVING COPPER, &c.

Specification forming part of Letters Patent No. **45,224**, dated November 29, 1864.

To all whom it may concern:

Be it known that I, AARON FENTON BURSON, of Mount Blanchard, in the county of Hancock, in the State of Ohio, have invented a mode of engraving on copper-plates by preparing the plates so that they are made by that means sensitive to light, the action of which produces images on the plates or coating of them, the lights of which may be made prominent by the deposition of metal thereon, more particularly copper, by galvanic agency, while the shades are left free from metallic deposit, so that with ink prints may be taken from them; and I do hereby declare that the following is a full decription thereof.

The nature of my invention consists in preparing copper-plates so that light will produce an image thereon, either in camera obscura or under a paper or glass on which is an image or anything that will give a sharp and well-defined image of light and shade upon the prepared sensitive coating of the plates; and the image thus produced can be rendered sufficiently deep in its shades to receive ink by electrotyping them, or may be etched by proper instruments.

The photope and photo-electrotype is produced in the following manner, which I here explain so that others skilled in photography and electro-metallurgy may produce the results desired.

With a cork, a woolen patch, rouge in fine powder, and one-fourth saturated solution of hyposulphite of soda, occasionally adding lime-water, rub a well-polished clean copper-plate for about five minutes, passing over every part of plate, changing it in the vise so as the ends and corners may be polished uniformly. Then wash the plate under a stream of water with cotton flannel or soft paper, and dry with clean soft cotton-flannel. Then place the plate on a vise-bed and use a woolen patch and alcohol over a cushion the size of a hulled walnut, made by stuffing a quantity of clean carded raw cotton in a cloth made by coating it with gutta-percha or india-rubber, so as to make it impermeable to alcohol, and continue to polish for five minutes, (one-sixth size daguerreotype-plate,) changing plate frequently, so that the rubbing will be uniform. This to some extent deoxidizes the plate, which is necessary. Now remove all traces of the rouge with cotton-flannel clean and perfectly clear of grease. Rub and polish the plate with buff or chamois leather or silk velvet (which is best) perfectly clean and clear of grease, using another cushion made of cotton cloth stuffed with carded cotton, using occasionally a little rouge; and a brush should be used to equalize the powder over the buff. Continue this buffing until the plate is sufficiently polished, and clearing it of any film that may have formed on the polished surface by brushing the buff and rubbing the plate so as to remove it. Now, with a soft brush remove the dust from the surface of the plate and slide it over first box. iodine until it assumes a red or incipient steel color, and then polish with rouge, hyposulphite of soda, cork, woolen patch, and lime-water, as in first place, but not more than three minutes for one-sixth the size daguerreotype-plate, being particular to pass over every part of the plate. Wash and dry, and use the rouge, alcohol, patch, and cushion finishing with buff, as at first. The plate is now ready for coating. The edges of the plate must be smoothed and polished. A plate that has been exposed to mercury should be polished with rotten-stone or washed tripoli, or the like, to cut off the coating of mercury, which strikes deep into the plate, before using the rouge, as above directed; and it impossible to electrotype a picture that has not been thoroughly cleared of mercury. Brush it and take to dark room and slide it over bromine solution in water, so as to coat in fifteen or twenty seconds, changing the plate in coating-box. Coat the plate to deep red or incipient steel, and then coat over iodine three or four seconds. (The particulars with regard to the preparation of iodine-boxes, mercury bath, &c., will be given hereinafter.) Brush the plate, and it is ready for the image. We will suppose a photograph as the object to be engraved. Lay it face upward on glass in printing-frame and place the polished surface on it; lay woolen cloth over as a compress, and place the board over all them; with a screw apply gentle pressure, and place in sunlight three minutes. The time required in different degrees of light experience alone will teach, and it will be much modified by the thickness of paper, glass, &c., used, through which the light is to pass. In camera obscura it will require one half-hour. Now, if the plate is viewed in feeble light in dark room, a plain sharp image will be perceived,

of a negative aspect. The image should be brushed with a very soft brush, so as to remove every particle of dust, and after placing an oval mat (the mat is most suitable after taking image in camera obscura) on the polished surface and securing it by means of clasps made of slips of copper-plate, so as to cut off the mercury from the margin of the plate, place it over the mercury bath (further, you will perceive how the mercury bath is prepared) and raise the thermometer up to 80°. With a fine print the mercury need not be raised so high within a period of ten minutes. Now remove the plate, and, after taking off mat, slide it over the second box of iodine, and leave it there from ten to forty minutes, until the picture is properly developed. If it is intended to be simply a photope—that is, an image to guide the instrument of etching or engraving—the development need not be carried so far; and if the image is to be made a photo-electrotype, the development must be carried to a point where the iodine and coating on surface of plate will be a protection of the shades from the deposit of copper in the electrotype apparatus. Judging from the colors of the lights of the image, that point where the change takes place from deep orange to blue or violet is the best point to take out the plate, for the image, in the development, assumes all the colors of the solar spectrum. This color—namely, violet—will begin on the extreme lights first, and gradually become extended over the surface until the lights become blue. If development is not carried far enough, the metal will be deposited on shades as well as lights, and if carried too far the whole image assumes an ash color, and the coating peels off when put in the depositing-cell. The development, however, may be carried to an hour's time without the coating becoming detached in the cell, and many times with good effect; but it will be found best to discontinue the development at the period when, at any time after ten minutes, the picture on the shades assumes the sharpest and best-defined appearance, the lights having passed through orange to violet. After the plate is taken from the mercurial bath, it should be kept from light, and no light admitted on it until after it has been a few minutes in the developing-box, and even after it is thoroughly developed, if the sun's rays or bright light should fall on the image, the copper would be deposited on the shades as well as the lights in the decomposition-cells; but if to be used for a photope only, light does not seem to injure it, but improves it.

I will now particularize. The mercury bath must be scoured and washed with sand and water, and then filled with sulphate of zinc in saturated solution, and then drained out a few minutes, and the lamp applied so as to dry it. There then will be a white coating of sulphate of zinc lining the bath. Renew it once in fifteen pictures. One-half ounce mercury must now be put in bath, and it is ready for use. The manner of renewing the zinc coating is simply, take a long-handled soft brush and dip in zinc solution and moisten every part of inside of mercury bath half-way up the sides, and again the sulphate of zinc dries, and must be moistened by aqueous vapor once after every six or eight photopes, and is to be done by making a ball of paper as large as a hickory-nut and wetting it in water and making it into a ball, pressing out the principal part of the water, and having a string attached to it, so that it can be conveniently taken out of the bath. Place it in mercury bath immediately after taking off the plate on which the image is and leave it in until the mercury in the thermometer falls to 55°. Then take out by means of the string. It is then ready for the next picture. The bath should be covered only by the plate on which is the picture being mercurialized, except over night, as it is necessary the fumes should escape. Now, if there is too much moisture in the bath, moisture would be discovered in the image when taken from bath, and a spoiled picture would be the consequence. Therefore you must exercise great care and not leave the vapor ball in the bath too long.

In transforming a photope into a photo-electrotype, the plate on which is the developed picture should be varnished thoroughly on the back and edges and dried, and the varnish should be so thick as to protect the part covered from deposit. If globules or grains of copper begin to form on back or edges, they become points of attraction, and injure or ruin the image by diverting the metal from where it should be deposited. Dust may be brushed from surface of image just before varnishing. The plate should be placed in cell containing solution of sulphate of copper, in horizontal position, and the wire sustaining it covered with wax, so that the metal will not deposit thereon, and the corroding metal or pole must be somewhat smaller than the image, and pierced full of holes in center, so as to resemble bobinet. The holes should be close in center and wider apart toward edges, and thin muslin fastened over the lower side, so that the particles of the corroding copper-plate will not fall on the picture. This may be done by using shellac varnish on the edges and pressing the margin of cloth against it, so that it will adhere. If the battery is weak, the sulphate copper and alum solution in the cell should be weak also. The plate should hang in the cell without connecting the poles of the battery with it for ten or fifteen minutes, and then be connected. Keep the solution in the cell clear of dust, and do not let the battery flag, as it would cause a rough deposit. The deposit of copper and alum, in the proportion of two parts of sulphate of copper to one of alum, on lights sometimes is rough, which is caused also by the plate not being polished perfectly clean. The deposit is much smoother by using one-half saturated solution of supercarbonate of soda. After varnishing plate,

pour it on, and then, after leaving it on one-half minute, wash by flooding the picture with rain-water, and place it in depositing-cell before it dries. To flood the plate, pour rain-water on the corner of the plate, letting it extend over it.

If to hang the plate in a vertical position in cell is desired, it is, if the plate be placed in that position, not necessary to place the cotton cloth over the corroding plate; but it must be (I have reference to corroding plate) pierced with holes close together near the upper end of the plate, so as to equalize the galvanic action, as the lower end of the image-plate receives a greater share of the deposit, the holes may be farther apart as they approach the lower end; but in electrotyping the plate in a vertical position, it is extremely apt to streak. I prefer, therefore, to have it in a horizontal position. If the copper deposits on shades, rest assured you have not cleaned or scoured off all traces of mercury. If a vertical plate, end downward, begins to streak, take it out and let it be placed side downward awhile. The first iodine coating-box should have iodized spongy paper, made to fit the bottom, laid in it, and no pieces of iodine. This paper may at long intervals be exposed to vapor of iodine by placing iodine under it and leaving it there during the night, which will saturate the paper, and then the grains of iodine must be removed. Perhaps, to ascertain the exact length of time required to coat in iodine-box, it would be as expedient a method as any to first try a polished copper plate and mark the length of time to coat to proper tint—that is, the iodine tint barely visible. The proper tint may be discovered by comparing the corners of the plate with the middle. After ascertaining how long it requires to produce that effect, coat the plates afterward half so long, which will probably be three or four seconds. Too much iodine takes longer time in the light, and the definition of the picture will not be so good, and too little iodine causes the mercury to be deposited on shades to some extent, and causes a kind of fogging. A few trials will give instruction to the manipulator on this point. The coating I speak of here is that immediately after the bromine. In this box the coating should assume a red color while polishing, as above stated when speaking of polishing plate, as the other iodine-box I now name gets mercury in it after considerable use in developing the mercurialized plate, and would not do for the first coat of iodine—that is, polishing-coat. The developing iodine-box should have a dram or so of iodine in it and spongy paper placed over so as to fit the box. The object of this is to equally diffuse the coating on the plate. The mercury bath should rest against something to keep it steady, and be placed not less than twenty feet from coating-boxes, and when in use place the spirit-lamp under the precise center, or the mercury will be deposited thicker on one side of the picture than the other, which will thus be injured. To prevent this, change the plate end for end in the mercury bath, dividing the time equally in changing.

The foregoing specifications relative to the preparation of the plate may be considered needlessly long; but it can scarcely be on good grounds thus viewed. For instance, it might be supposed that the first coating of the plate with iodine useless, as it is again rubbed up; but the three minutes' rubbing with rouge does not remove all of the iodine. This coat is necessary to prevent the deposition of copper upon the shades of image while being electrotyped. Now, a very good picture can be produced on copper, I have discovered by many experiments, by simply rubbing up the plate with hyposulphite-of-soda solution, lime-water, and rouge, (peroxide of iron,) and washing well, and coating deep red in bromine-box, and then coating with iodine enough to barely tinge a plate, and then proceed with sensitive plate as directed in foregoing specifications; but in that case, as in all others, the mercurial vapors must be modified by the presence of sulphate of zinc or its equivalents in bath, or there will not be a well-defined image on the plate. A photope therefore can be produced in this expeditious manner. (I gave it this name as being the work of light.) If an image thus produced is placed in the depositing-cell, it will be found that the shades will not long resist the deposit of copper.

In placing plate in mercury bath and iodine developing-box, lay it gently to its place. If there should be dusty particles on plate and the sulphate zinc should be too moist, by the vapors of water, there will be spots in the developed image. The plate should be carefully brushed just before placing in mercury baths. Brush slowly and thoroughly. The mat is applied merely to give better appearance to image after the image is produced in camera. In using a print, cut it in oval form smaller than the plate.

It is not essentially necessary to use alcohol in polishing plate, provided the film can be kept off after the rubbing with hyposulphite solution and lime-water; but the rubbing must in that case be prolonged five minutes with last-mentioned articles, and then the plate thoroughly washed with water.

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

1. A new mode of producing an iodo-polished surface on a copper-plate, as set forth. The polishing being done after the plate is iodized modifies its chemical relations and produces a surface after it has been exposed to bromine, to light, and to the modified vapors of mercury, that resists the deposit of copper while in the decomposition-cell of an electrotyping apparatus, the plate, after polishing, containing a trace of iodine.

2. The modification of the vapors of mercury by the use of the sulphates of zinc or copper or the sulphuret of antimony, (the sulphate zinc is best,) or their equivalents, by placing one or more in solution in mercurial

bath, and then drying it, which modifies the mercurial vapors, causing it to be well defined on the lights of the image that has been produced on the plate by means of light.

3. The method of iodizing polished copper-plate and modifying the vapors of mercury, which, when manipulated as described, will produce a sharp and well-defined picture, (which I designate a "photope,") and on the lights of this image, produced in this manner, copper can, by means of electro-metallurgy, be deposited, while the coating on the shades, produced in manner set forth, will remain clear of the cuprous deposits, (which I designate a "photo-electrotype,") thus giving elevation to lights and depression to shades; ink may be applied and prints obtained therefrom by means of a press; or the engraving may be used, after applying silver or gold to elevated lights, as a desirable portrait, &c.; or the image may be etched in, in place of depositing copper thereon in the usual manner. Let it here be understood that the copper coating, to be a protection from the deposit of copper in electrotype-cell, must be exposed to modified mercurial vapor, and have also been exposed to light and shade of an image.

I claim in the foregoing to have made a new discovery of a principle, a discovery of an art—an art as broad in its relations to the family of arts as the daguerreotype itself—light and electricity producing an image in solid metal as durable as bronze.

A. F. BURSON.

Witnesses:
H. S. BURSON,
G. R. BURSON.