

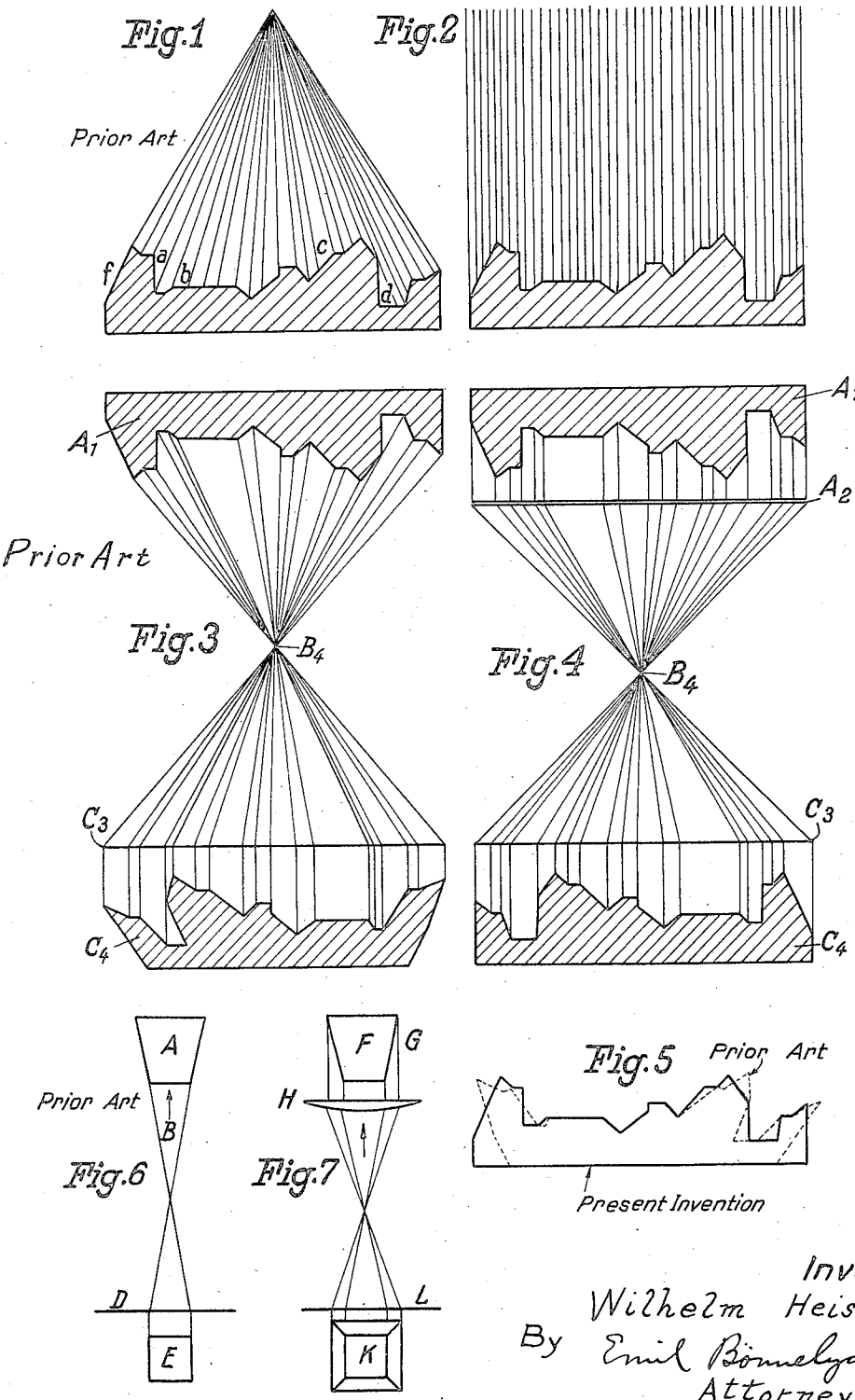
May 5, 1936.

W. HEISE

2,039,412

PROCESS FOR THE MECHANICAL PRODUCTION OF SHADING PLATES

Filed April 19, 1932



UNITED STATES PATENT OFFICE

2,039,412

PROCESS FOR THE MECHANICAL PRODUCTION OF SHADING PLATES

Wilhelm Heise, Munich-Pasing, Germany

Application April 19, 1932, Serial No. 606,247
In Germany April 20, 1931

6 Claims. (Cl. 95—5)

The present invention relates to a process for the mechanical production of shading plates for use in mapmaking to take the place of the time-consuming and expensive hand processes which have hitherto always been employed. The process according to this invention has the great advantages of simplicity of manipulation, the saving of considerable expense and the attainment of extreme precision and correct tone values by a simple optical-mechanical transfer. Attempts have already been made in America to record the tone values of the slopes in map-making photographically by illuminating a relief body and to utilize them in making shading plates. The same procedure was afterwards also tried in Germany but apparently without success. Not only have the correct gradations of tone in the degree of slope to be retained but the photographic reproduction must not be accompanied by distortions of any kind, so that the shading plate can be caused to coincide very exactly with the topographical map.

The present invention enables both these objects to be attained and the deficiencies accompanying the earlier processes to be overcome by illuminating the relief body with or exposing it to parallel rays instead of to a cone of rays derived from a luminous point.

In the drawing:—

Figure 1 is a diagrammatic view showing the light rays and a relief according to the prior art,

Figure 2 is a similar view showing the same details according to the present invention,

Figure 3 is a diagrammatic view showing the distortions according to the prior art,

Figure 4 is a similar view as carried out according to the present invention,

Figure 5 diagrammatically shows two results of the prior art and the present invention superposed.

Figure 6 is a diagrammatic view showing the photographic process according to the prior art,

Figure 7 is a similar view showing the photographic process according to the present invention.

The kinds of radiation and their effect will be rendered clear by comparing Figures 1 and 2.

Figure 1 shows the non-applicability of the ordinary rays starting from a point source of light. In this case only those light rays striking perpendicularly on the centre point of the relief would be correct, while the light rays near the periphery would lose in intensity and would be incident at various incorrect angles corresponding to the shapes of the relief. For example in

Figure 1 the light rays strike *a* at an acute angle, whereas the perpendicular surface at this point should not be illuminated at all. On the other hand the rays strike *b* at a similar acute angle, although in contradistinction to *a* they should be incident at a right angle and consequently provide maximum illumination at this point. At *c* the rays strike almost at a right angle, whereas in this case they should strike at a suitable acute angle. A comparison with Figure 2 shows that the correct mode of illumination can only be obtained by means of a parallel projection as shown in Figure 2. Only with this method of illumination do the light rays strike at the correct angle corresponding to the shape of the relief and only in this way can they produce the effect which is necessary for obtaining the correct tone values.

An extremely accurate relief in plaster of the territory or map is made. The plaster relief of the territory is coated with a light sensitive emulsion such as is used in the manufacture of photographic dry plates. The prepared plaster model is then illuminated with parallel light rays whereupon the relief is developed and fixed in the same manner as a photographic plate. There is thus obtained a relief showing on its surface variations of tone, namely, such different brilliancy values as correspond to the angles of incidence of the respective light rays. Vertically impinging rays impart to the coating a darker color than obliquely impinging rays. This relief with enhanced tone contrast is now photographed yielding a diapositive of the original relief. From this diapositive a negative is obtained by contact printing, viz. by placing in a printing frame an unexposed dry plate above the diapositive, exposing, and developing the said plate. The resultant true negative is used for enlargement purposes by enlarging it on a sensitive plate which can then be used for printing copies.

The diapositive can also be used for increasing the tone contrast of the relief body in taking a photographic exposure of the latter, which of course is not then coated with a light sensitive emulsion.

The invention therefore includes both the pretreatment of the relief in order to enhance the tone contrast of the relief itself by applying a light sensitive coating and the enhancement of the tone contrast during the exposure by inserting the diapositive obtained as described.

Either method or both methods in combination may be employed, depending upon which appears to be necessary for the portion under treatment.

In order to reproduce photographically com-

pletely undistorted the relief provided with tone values according to the above described method, the relief, according to the present invention, is converted, so to speak, into a flat surface by parallel rays from an optical system, for example, a plano-convex lens, and is then brought onto a plate by a photographic camera. Practically, this achieves what is illustrated in Figures 3 and 4.

Figure 3 shows in section the distortions which the reproduction contains when it is made directly from the relief, while Figure 4 shows the appearance of the reproduction when the relief, as above described, is first converted into the flat state by an optical system, for example, a plano-convex lens. This reproduction corresponds most faithfully with the original. Figure 5 shows the two sections superposed in order to demonstrate the considerable differences with all clearness.

The optical system may consist of a large plano-convex lens H, adapted to the purpose in view, which is inserted between the photographic recording apparatus and the relief body. The effect of this lens is that the image of the relief body instead of being projected perspectively is projected geometrically on the photographic negative plate. Even the smallest distortions are avoided with the aid of this system. In order to illustrate the modus operandi of the system with the aid of a simple example a truncated pyramid has been selected in Figures 6 and 7. This will demonstrate the desired effect most clearly, the lateral surfaces of the truncated pyramid A in Figure 6 being disposed exactly in the conical path B of the rays passing through the recording objective. As further shown in Figure 6 in this method of projection the upper and lower surfaces coincide, although the upper surface is considerably smaller than the lower and it will not be possible to recognize on the frosted screen D of the photographic apparatus whether a quadrangular column, a pyramid or even only a surface would be photographically recorded. The direction of the arrow indicates the direction of view and E the image appearing on the frosted screen or negative plate.

A considerably different state of affairs is shown in Figure 7, where the same truncated pyramid F is recorded with parallel rays G with the aid of the device H hereinbefore referred to and then transmitted to the objective of the photographic apparatus. The object is to a certain extent "reduced to one plane". Owing to the interposition of the lens the object appears in its correct geometrical representation, i. e. the upper surface smaller in the correct proportion than the lower surface and the truncated pyramid can be clearly recognized in the direction of view of the arrow, as is shown by the image K on the frosted screen L.

Figure 3 shows in section the distortions produced if the relief is directly photographed, whilst Figure 4 shows the result of the photograph if the relief is first illuminated on the surface by means of an optical system. This photographic reproduction agrees very exactly with the original. In Figure 5 the two results are superimposed in order clearly to bring out the deviations.

What I claim is:

1. A process of photographing opaque cartographic reliefs by reflected rays, comprising illuminating the relief with parallel light rays produced by a plano-convex lens covering the entire surface of the relief and subjecting a light sensitive surface to photographic exposure with paral-

lel light rays thrown back from the so illuminated relief, to thereby form a non-blurred, correctly toned negative, the parallel light rays thrown back from the illuminated relief being produced by the same plano-convex lens.

2. A process of photographing opaque cartographic reliefs by reflected rays comprising coating the relief object with a light sensitive layer, exposing the coated object to parallel light rays produced by a plano-convex lens covering the entire surface of the relief and developing, washing, and drying the exposed layer, illuminating the thus treated relief object with parallel light rays by means of a plano-convex lens covering the entire surface of the relief, and subjecting a photographic plate or film to photographic exposure with parallel light rays by means of the same plano-convex lens and thrown back from the so illuminated relief object, to thereby produce a non-blurred diapositive of increased contrast, developing, washing and drying the diapositive, producing a translucent negative contact-copy from the said diapositive, and enlarging the said negative copy on a light printing plate to thereby produce a positive shading plate for producing a non-blurred picture of the cartographic relief characterized by increased contrast.

3. Apparatus for photographing opaque cartographic reliefs by reflected rays, comprising means for illuminating a cartographic relief with parallel light rays at right angles to the base of the relief, means for receiving parallel light rays emanating from the relief at right angles to its base, and a photographic camera arranged to give exposures by means of said emitted rays, the means for illuminating the said opaque cartographic relief comprising a plano-convex lens arranged in front of the relief and at least as large as the relief, and a photographic camera, the plano-convex lens being arranged between the relief and the camera.

4. Apparatus for photographing opaque cartographic reliefs by reflected rays, comprising means for illuminating a cartographic relief with parallel light rays at right angles to the base of the relief, means for receiving parallel light rays emanating from the relief at right angles to its base, and a photographic camera arranged to give exposures by means of said emitted rays, the means for illuminating the said opaque cartographic relief comprising a plano-convex lens arranged in front of the relief and at least as large as the relief, and a photographic camera, the plano-convex lens being arranged between the relief and the camera in combination with a diapositive of increased contrast obtained according to the process of claim 2 arranged in properly registering position in the path of the rays to the receiving means.

5. Apparatus for photographing opaque cartographic reliefs by reflected rays, comprising means for illuminating a cartographic relief with parallel light rays at right angles to the base of the relief, means for receiving parallel light rays emanating from the relief at right angles to its base, and a photographic camera arranged to give exposures by means of said emitted rays, the means for illuminating the said opaque cartographic relief comprising a plano-convex lens arranged in front of the relief and at least as large as the relief, and a photographic camera, the plano-convex lens being arranged between the relief and the camera in combination with a negative produced by the process of claim 1 ar-

ranged in properly registering position in the path of the rays to the receiving means.

5 6. A process of photographing reliefs comprising illuminating the relief with parallel light rays by means of a plano-convex lens covering the entire surface of the relief and subjecting a light sensitive surface to photographic exposure with parallel light rays by means of the same plano-

convex lens and thrown back from the so illuminated relief and with a diapositive of increased contrast obtained according to the process of claim 2 arranged in properly registering position in the path of said rays to the light sensitive 5 surface.

WILHELM HEISE.