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PATENT SPECIFICATION

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402,902

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Complete Accepted: Dec. 14, 1933.

COMPLETE SPECIFICATION.

Colour Photography.

We, I. G. FARBENINDUSTRIE AKTIENGESELLSCHAFT, a Joint Stock Company, organised according to the laws of Germany, of Frankfurt a/Main, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to the manufacture of partial-colour pictures and more particularly to the manufacture of partial-colour pictures by printing on to a smooth film the different colour sensations registered on a lenticular film having parallel linear lenticular elements by exposure of the film behind a multi-colour filter associated with the objective.

A known method of producing separate partial-colour pictures by printing from a negative contained on a film embossed with refractive microscopic elements, of the kind, for instance, used in the well-known Berthon process, consists in illuminating the film in such a manner that it is traversed by the rays of light, and projecting, with the aid of the objective with which the negative was taken, a real picture of the original on a light-sensitive layer, there being placed in the plane in which the multi-colour filter was placed during the exposure, a diaphragm or stop which intercepts, in the case of each partial picture the areas of all stripes of the colour filter except one.

According to this invention there is provided an optical arrangement for use in the production of partial-colour pictures from lenticular negatives. The characteristic feature of this arrangement is the application not of the objective with which the pictures were taken, but of any other objective, for instance, one having a different focal length. The application of an objective other than that used for taking the pictures is necessary in many cases, for instance in the printing of enlarged partial-colour pictures.

The optical arrangement comprises any kind of objective and a stop which in their mutual cooperation are subject to the condition that a pupil of entrance of determined properties is formed. By giving the stop a suitable size and arranging it at a determined distance from the film and the objective, the pupil of entrance is adjusted so that the apparent distance of the multi-colour filter from the lenticular film during its exposure, when viewed from the side of the negative, is equal to the apparent distance of the stop in the printing apparatus from the negative film, also when viewed from the side of the negative, whereas the apparent breadth of the aperture of the stop when none of the areas of the filter plane is obturated must be equal to or smaller than the apparent breadth of the sum of the filter stripes of the multi-colour filter used during the exposure of the lenticular film.

In a preferred form of the invention, the objective and the diaphragm are chosen and arranged so that the apparent breadth of the pupil of entrance is not greater than the breadth of that colour stripe of the exposure filter that corresponds in each case with the colour sensation to be printed. Under these conditions and when operating in a manner which will be fully described hereinafter, it is possible to use objectives with smaller apertures than those which would correspond with the total breadth of the exposure filter.

Reference is now made to the accompanying drawings in which:—

Fig. 1 represents diagrammatically the relation between the multi-colour filter, the objective and the lenticular film during the taking of the negative.

Fig. 2 represents diagrammatically the printing of the different colour sensations, registered on the lenticular film, on a smooth film according to the invention to produce prints of the same size as the negative on the lenticular film.

Fig. 3 represents diagrammatically the same printing operation as Fig. 2 with the difference that an enlarged copy is obtained.

Fig. 4 represents diagrammatically the printing of the colour sensations of the lenticular film with an objective of small aperture.

Figs. 5, 6 and 7 represent diagrammatically the printing of the different colour sensations wherein the position of

[*Price* 1/-]

Price 4s 6d

the objective of small aperture is not changed but the film is turned for the printing of each colour sensation at an angle defined by the conditions which existed when the lenticular film was exposed.

In the drawings the same reference characters are applied to denote corresponding parts.

In Fig. 1, which shows the arrangement for taking a picture, 1 is the lenticular film having the lenticular elements 2 and the light-sensitive layer 3. The light proceeding from an object is projected on the lenticular film by means of the objective 4 after having passed through a three-colour filter arranged before the objective and dyed in the usual colours red, green and blue. The optical centres of the three-colour areas are marked 6, 7 and 8. In the Fig. the rays are shown for producing a picture point 9. The parallel light rays coming from an infinite distance (there are shown those which pass through points 6, 7 and 8 of the three-colour filter) are collected by the objective so as to meet at point 9. An eye at point 9 looking in direction of the objective would see not the filter 5, but the virtual image 5^1 thereof. The optical centres 6^1, 7^1 and 8^1 of the virtual image of the filter correspond with the optical centres 6, 7 and 8 of the filter itself and lie on the straight lines drawn from point 9 to the points 6, 7 and 8. a is the distance of the virtual image of the filter from the negative.

Fig. 2 illustrates the invention in the case when there is used in the printing process an objective having an aperture such that the virtual image of the stop (suitably arranged in the path of the beam of light) occupies the position of the virtual image of the three-colour filter which was used in taking the negative on the lenticular film. For the production of the single partial-colour picture the stop has an aperture of breadth at most equal to that of one colour area of the three-colour filter. In Fig. 2 the objective is marked 4; it has the same aperture as that shown in Fig. 1, but has focal length different from that shown in Fig. 1. The position of stop 10 is such that the apparent distance a of the stop from the negative is exactly equal to the distance a of the virtual image of the filter from the lenticular film when the negative was taken. The virtual image of the stop, forming the pupil of entrance, is shown at 10^1. In printing the different colour sensations the centre of the aperture of the stop occupies with respect to the film the same positions as the points 6, 7 and 8 in Fig. 1. All the light passing through the aperture of the stop converges to copy the point 9 at point 9^1 on the printing material. As printing is only effected through the stop 10, the copy formed on the printing material 11 must be one partial-colour picture. In Fig. 2 there is shown printing of the red sensation; the green and the blue sensations are produced in the same manner by displacing the stop in its plane parallel to the negative film. The centre of the virtual image of the stop must, for printing each colour sensation, be situated at the same position with respect to the film as one of the points 6^1, 7^1 and 8^1 shown in Fig. 1. If, as shown in Fig. 2, the copying objective is equidistant from negative and print, there is no enlargement of the original.

In Fig. 3 there is shown an optical arrangement for printing in which the aperture of the copying objective is the same as in Fig. 2 but wherein the copy obtained is larger than the original. Also in this case for printing each colour sensation the size of the pupil of entrance must equal that of the virtual image of the corresponding colour area in Fig. 1, and its centre must occupy the same position with respect to the film as the appropriate point 6^1, 7^1 or 8^1 of Fig. 1.

In Fig. 4 there is shown an arrangement for the case in which the objective used for the enlargement has an aperture of such a small size that the virtual image of the colour filter used in taking the lenticular negative cannot be projected without being obturated. In the arrangement shown in this Fig. the size of the aperture of the stop itself is exactly equal to that of one colour area of the three-colour filter, since, as the objective 4 is placed between the copying material and the stop, the stop itself forms the pupil of entrance. It may be pointed out, however, that only the dimension of the aperture of the stop in the direction parallel to the linear lenticular elements is arbitrary but that the dimension of the aperture of the stop in the direction perpendicular to the lenticular elements should at most be equal to the breadth of the virtual image of the corresponding colour area used when the negative was taken. If the opening of the diaphragm has a smaller breadth, of course an objective of smaller aperture can be used. In the printing operation illustrated in Fig. 4, the objective cannot remain in the same position for printing all the partial-colour pictures; however, the position of the stop with regard to the objective remains the same. The three positions for printing the three colour sensations are determined, as in the arrangements illustrated

in Figs. 2 and 3, by points 6^1, 7^1 and 8^1 of Fig. 1; the points with which the centre of the aperture in the stop must coincide are indicated by the numbers 6^1, 7^1 and 8^1 in Fig. 4, the objective and stop being shifted in accordance therewith. The area occupied by the printing material 11 must also be displaced in such a manner that point 9 of the negative film is always projected to the same place of this area.

This lateral displacement can be avoided. In this case the objective and stop remain fixed in the position in which the centre of the stop occupies the point 7^1 of Fig. 4, and the negative and the printing material are turned around axes which pass through the points at which the optical axis of the objective intersects the negative and the printing material respectively and are parallel to the lenticular elements of the negative. The negative must be turned to such an extent that for each printing operation the perpendicular drawn from the centre of the picture field passes through one of the points 6^1, 7^1 and 8^1 of Fig. 4; that is to say, so that one of the lines drawn from the point 9 to the points 6^1, 7^1 and 8^1 and turning with the negative passes through the centre of the stop. The printing material must be turned in the same direction and through the same angle as the negative. In the case of the printing material, the condition need only be observed approximately, the permissible degree of variation from the true inclination depending on the sharpness of the print obtainable with the objective; this is of course dependent on the definition obtainable with the printing objective in use.

In Figs. 5, 6 and 7, there are shown the three steps of the last-described process. Point 9 of the negative and the centre of the objective 4 lie in each step in the same straight line. The stop (not shown) is arranged with its centre at the point 7^1 indicated in Fig. 4. The film is turned around an axis formed by a line parallel to the lenticular elements of the negative and passing through 9. In all the Figs. 5, 6 and 7 the lines $9—6^1$, $9—7^1$, and $9—8^1$ have been drawn. For printing each partial-picture, the negative is turned to such an extent that the aforesaid lines $9—6^1$, $9—7^1$ and $9—8^1$ pass one after the other through the centre of the objective. In the position shown in Fig. 5 the line $9—7^1$ passes through the centre of the objective; in this case the green sensation is printed. In the position shown in Fig. 6 the line $9—8^1$ meets the centre of the objective and the blue sensation is printed. Correspondingly in the arrangement shown in Fig. 7 the red sensation is printed.

The present invention is not limited to the foregoing Examples nor to the specific details given therein. It may be applied to the manufacture of as many partial-colour pictures as there are colours in the multi-colour filter used in exposing the lenticular film.

In the foregoing description the printing of partial-colour pictures from lenticular negatives has been described. It is to be understood, however, that lenticular positives may be similarly printed from, the partial-colour pictures produced in this case being negatives when developed in the usual way, and positives when developed by the reversal method.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A device for printing separate partial-colour pictures from negatives taken on linear lenticular films through a multi-colour filter, which comprises an objective arranged between the negative and the printing material, said objective having an aperture equal to or smaller than that of the objective which was used in exposing the lenticular film and differing from the exposure objective either in its aperture or in its focal length or in both these respects, and a stop inserted in the path of the beam of light, said stop forming a pupil of entrance at a distance from the negative equal to that of the multi-colour filter, or its virtual image, from the negative when the latter was taken, said pupil of entrance having a breadth at most equal to that of the same colour area of the multi-colour filter, or its virtual image, used when the negative was taken.

2. A device as defined in Claim 1, wherein the aperture of the printing objective is smaller than that of the objective used when the negative was taken (the focal lengths of the objectives being the same or different) and the pupil of entrance formed by the stop has a breadth smaller than that of the same colour area of the multi-colour filter, or its virtual image, used when the negative was taken.

3. A process of printing separate partial-colour pictures from negatives taken on lenticular films through a multi-colour filter, which comprises inserting between the lenticular film and the printing material an objective of a smaller aperture than that of the objective which was used in taking the negative and a stop

forming a pupil of entrance at a distance from the negative equal to that of the multi-colour filter or its virtual image, which was used in taking the negative, said pupil of entrance having a breadth at most equal to that of the same colour area of the multi-colour filter or its virtual image, displacing the objective and the stop for printing each partial-colour picture into a position such that the centre of the pupil of entrance coincides in respect of the negative with the optical centre of the corresponding colour area of the multi-colour filter, or its virtual image, which was used in taking the negative, and displacing the area occupied by the printing material correspondingly.

4. A process as defined in claim 3, wherein, instead of displacing the objective and the stop, the negative is turned around an axis which passes through the point at which the optical axis intersects the negative and is parallel to the lenticular elements of the negative for printing each partial-colour picture while leaving the objective and stop in their fixed position, to an extent such that the lines defined by the centre of the picture and the optical centre of each of the colour areas of the multi-colour filter, or its virtual image, which was used in taking the negative pass one after the other through the centre of the pupil of entrance and the centre of the printing objective, and the printing material is turned to the same extent as the negative, or more or less, according to the desired sharpness of the print, around an axis which passes through the point at which the optical axis intersects the printing material and is parallel to the lenticular elements of the negative.

Dated this 8th day of September, 1932.

ABEL & IMRAY,
30, Southampton Buildings, London,
W.C. 2,
Agents for the Applicants.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1933.

[This Drawing is a full-size reproduction of the Original.]

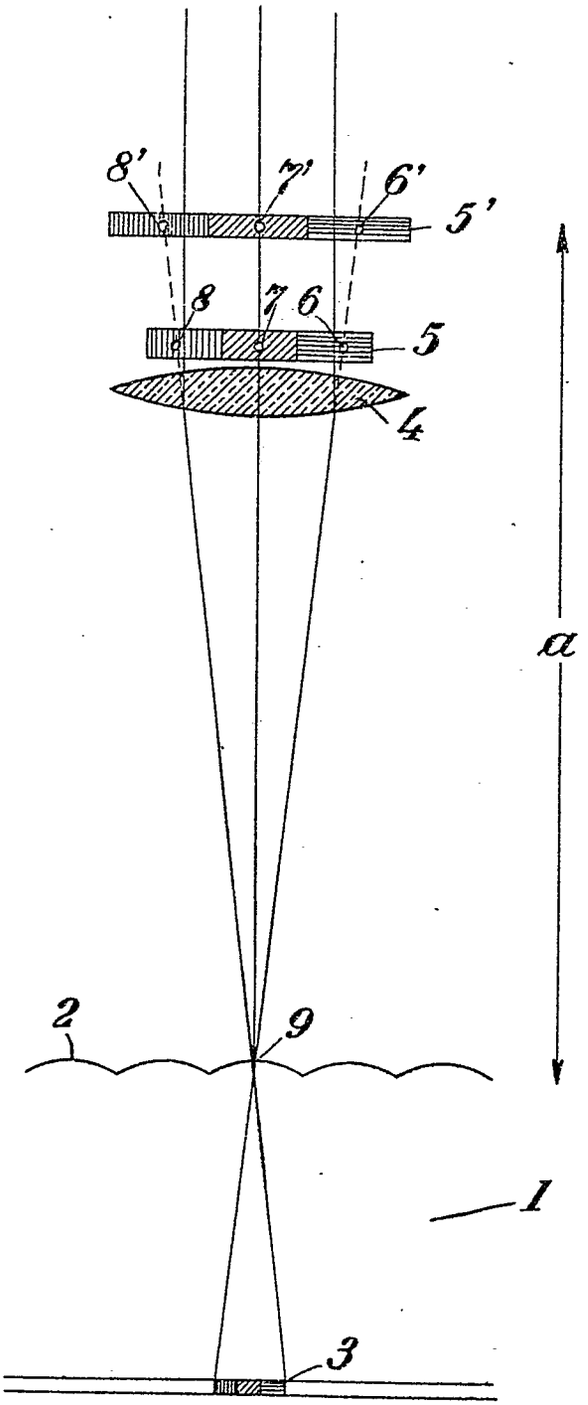

Fig. 1

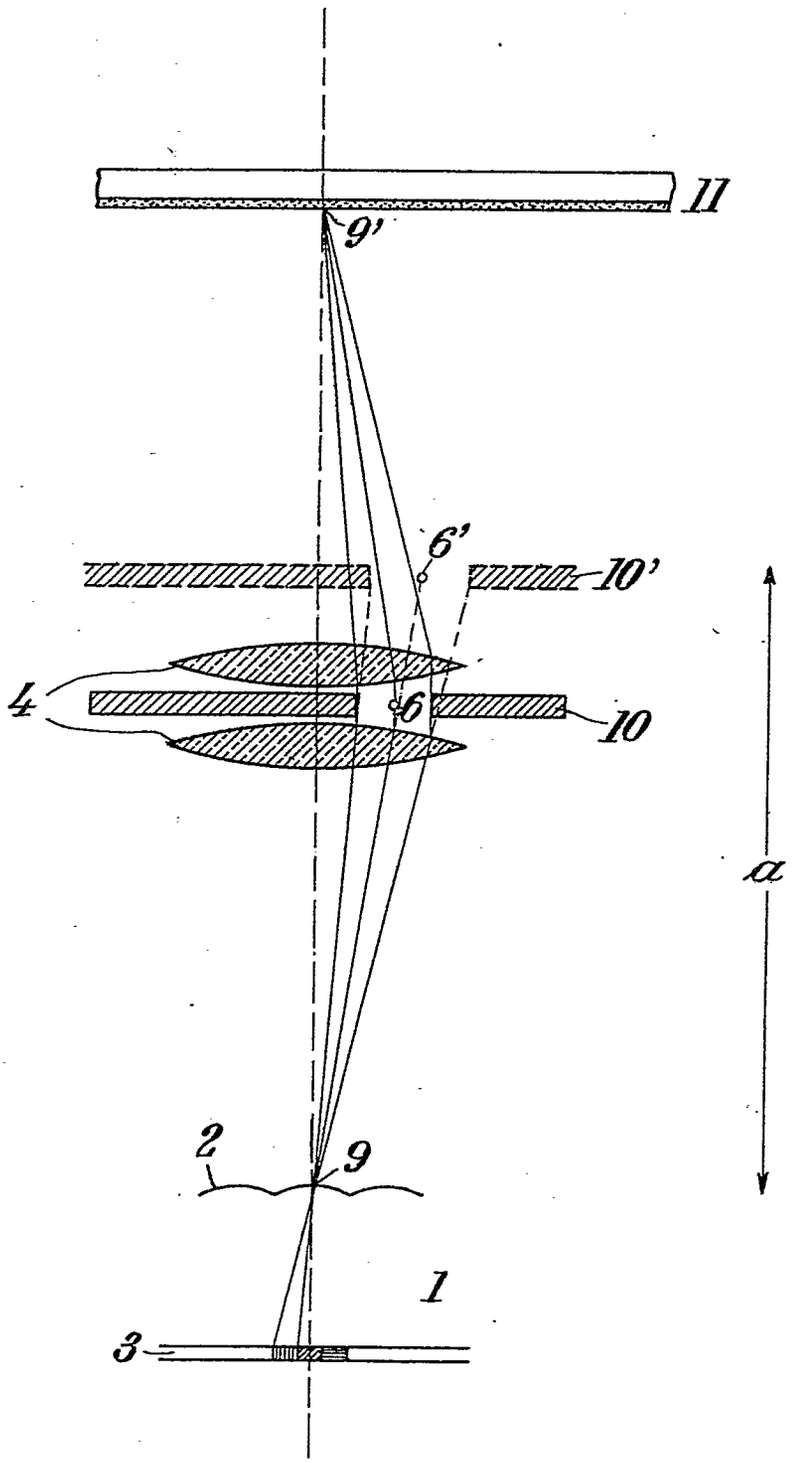

Fig. 2

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[This Drawing is a full-size reproduction of the Original.]

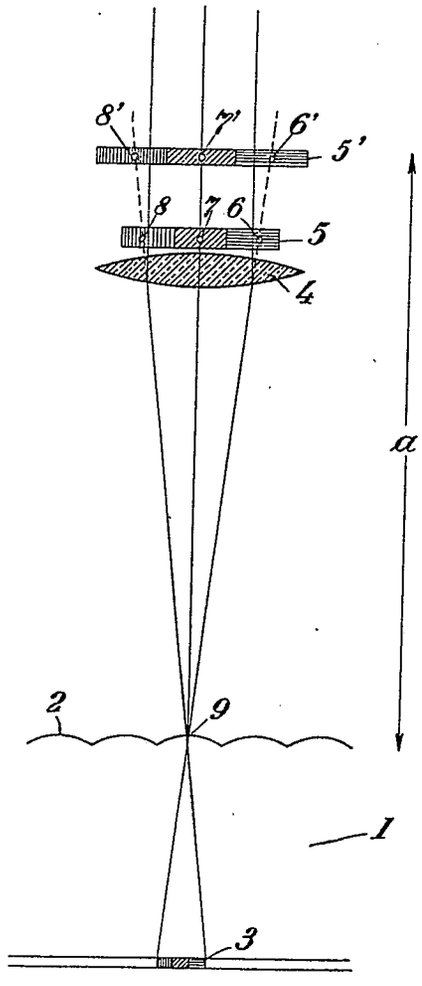

Fig. 1

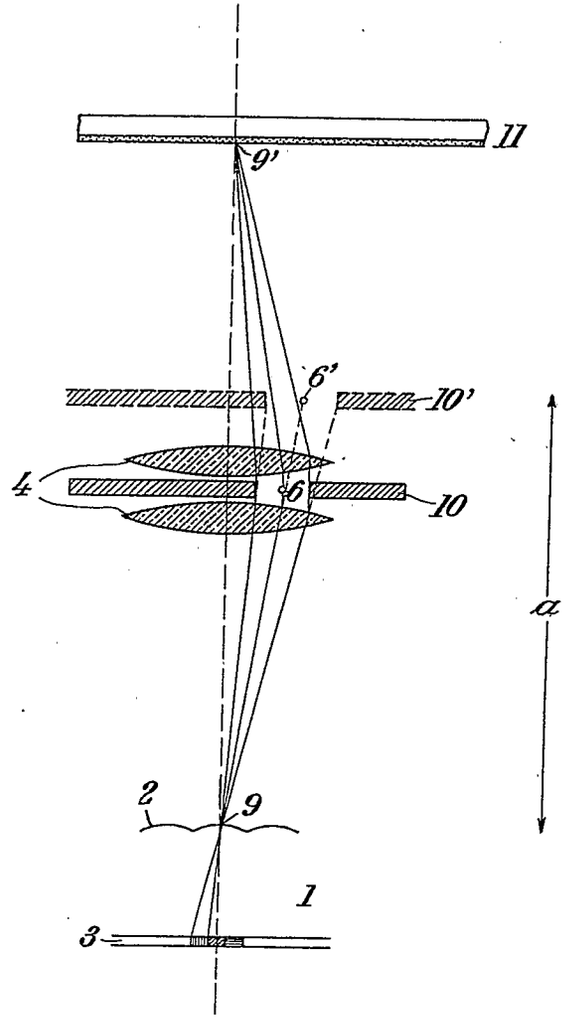

Fig. 2

[This Drawing is a reproduction of the Original on a reduced scale.]

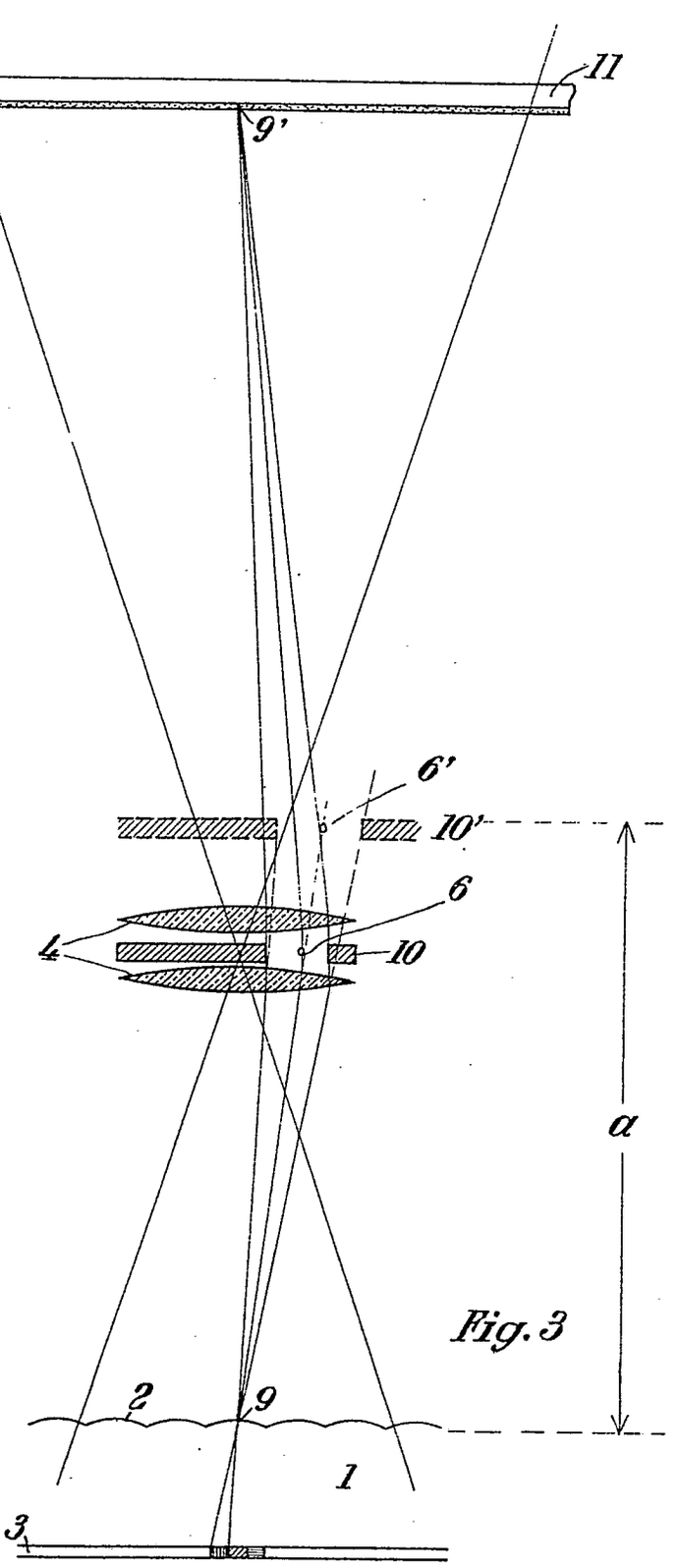

Fig. 3

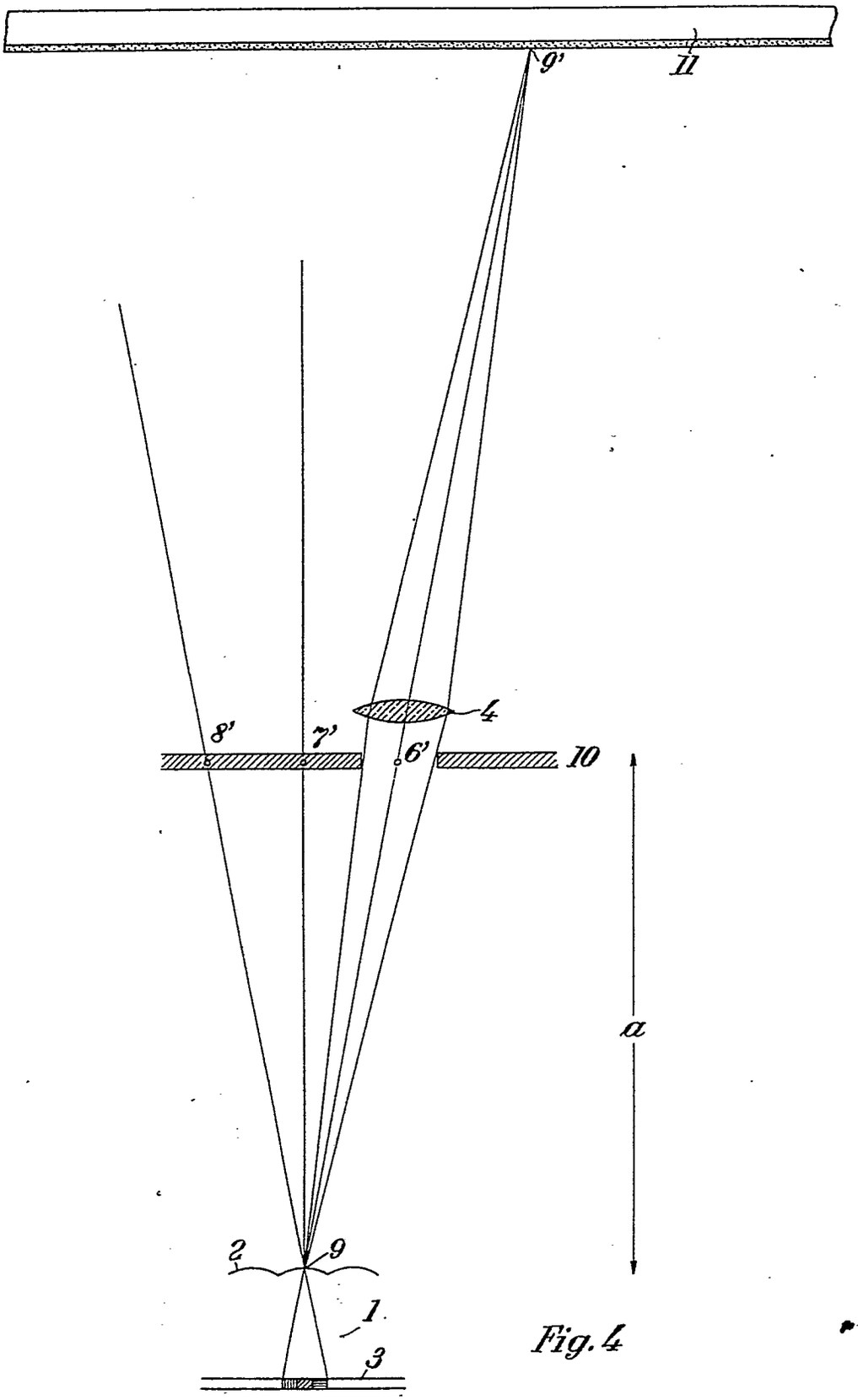

Fig. 4

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[This Drawing is a reproduction of the Original on a reduced scale.]

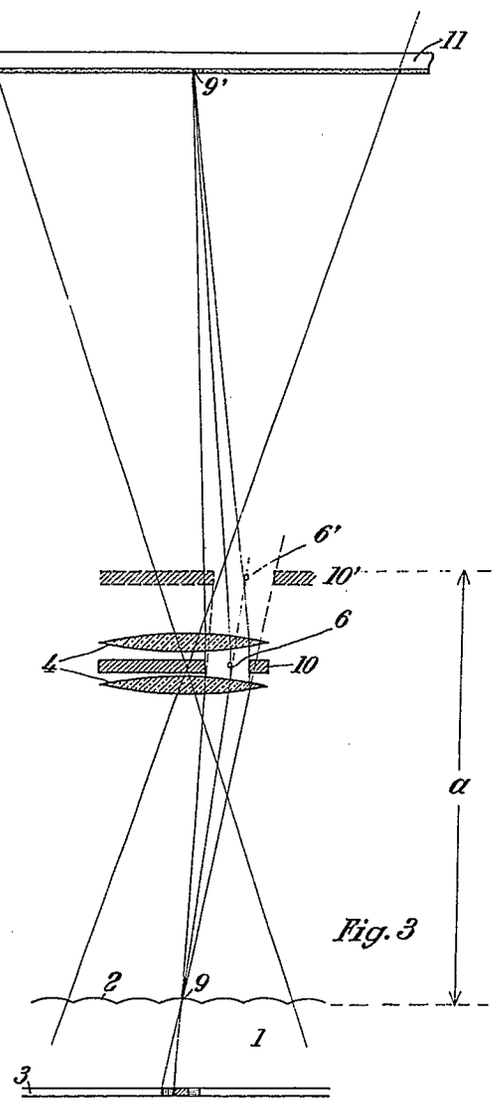

Fig. 3

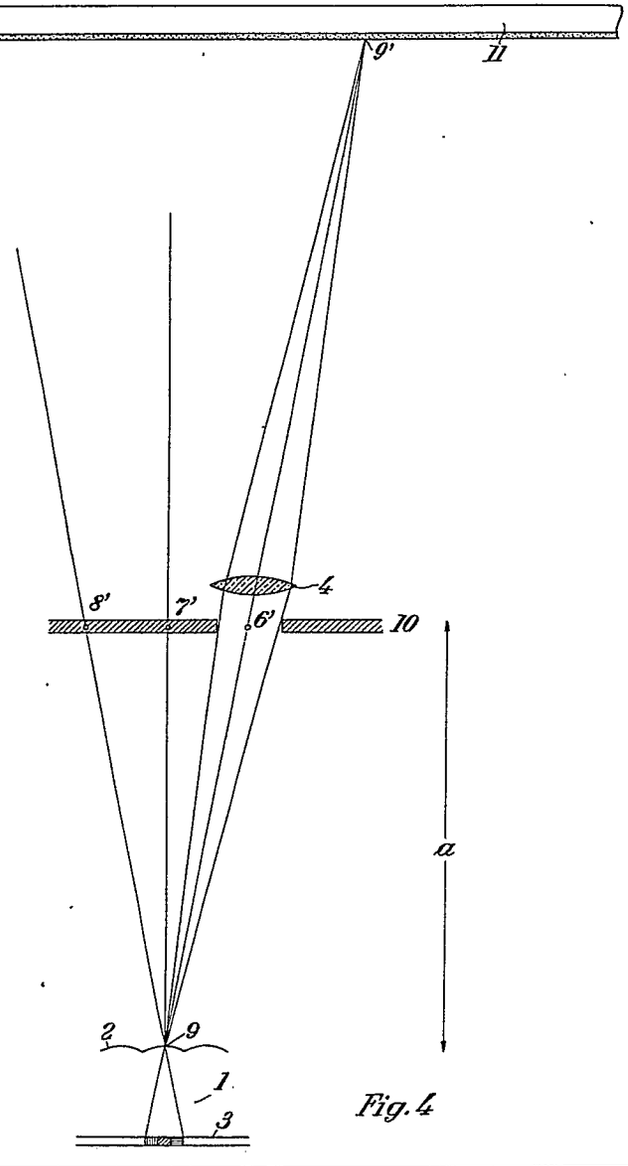

Fig. 4

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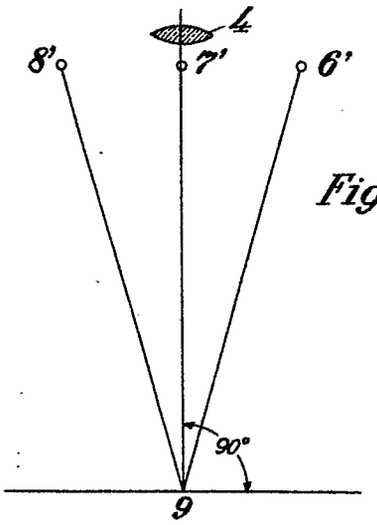

Fig. 5

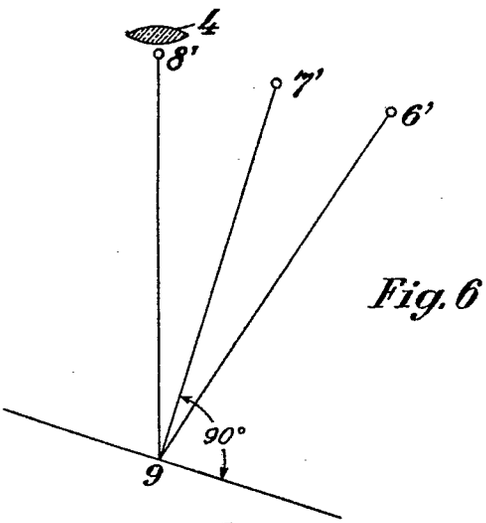

Fig. 6

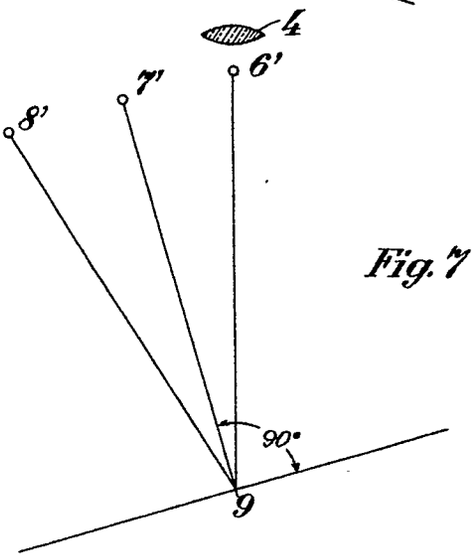

Fig. 7

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