N° 2463 A.D. 1915

Date of Application, 16th Feb., 1915—Accepted, 6th Jan., 1916

COMPLETE SPECIFICATION.

Improvements in Colour Photography.

I, PERCY DOUGLAS BREWSTER, of 65, Prospect Street, East Orange, Essex County, State of New Jersey, United States of America, Manufacturer, 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 improvements in color photography, and more particularly to the production of colored motion pictures or cinematograph pictures. In my prior Application No. 1073 filed 22nd January, 1915, I have described and claimed a method of photographically reproducing images in color upon a film or support sensitized on both sides, this method consisting in dividing the light from the object being photographed into light groups at a point between the object and the emulsion coatings on the film, which light groups are then directed one on each side of the film. After the film has been treated in the ordinary manner as by developing and fixing, the images produced by the action of the light on one side are colored one color, for instance green to blue, and the images on the other side are colored a different color, for instance, red to orange. I have also described a camera for use in this method of color photography, this camera being provided with means for dividing the light from the object into two groups which act on opposite sides of a double coated film, color screens of different color being interposed (if desired) one in the path of each light group between the film and the light-dividing means.

Now in accordance with my present invention I provide improvements in the camera described in my aforementioned application. In the aforementioned application I have illustrated the use of mirrors for the purpose of dividing the light into groups, but in accordance with one feature of my present invention I provide improved constructions of cameras employing prisms arranged in a number of positions in order to produce the results desired, and in some cases these prisms are replaced by or used in conjunction with mirrors or special arrangements of lenses.

In order that my invention will be more fully understood reference will be made to the accompanying drawings in which

Fig. 1 is a diagrammatic plan of a double lens camera made in accordance with my aforesaid prior application and employing mirrors, which mirrors are, in accordance with the present invention, replaced by prisms as shown in Fig. 7

Fig. 2 illustrates a camera employing a reflecting prism which directs half of the light to one side of the film but permits the passage of the other half of the light to the other side of the film.

Fig. 3 illustrates a camera provided with a banded prism which divides the light into two groups which are directed on opposite sides of the film.

Fig. 4 is a horizontal projection of the banded prism shown in Fig. 3.

Fig. 5 illustrates a modified form of the camera shown in Figs. 3 and 4.

Fig. 6 is an enlarged detail of Fig. 5.

[*Price* 6*d*.]

Fig. 7 is a twin lens camera in which the light passes entirely through glass.

Fig. 8 illustrates a camera in which the light is divided into two groups between the lens members by a mirror.

Fig. 9 is a camera similar to that of Fig. 8, with prism in place of the mirror.

Fig. 10 is a plan view partly in section of a completed camera, using a lens system such as is shown in Fig. 3.

Fig. 11 a section on line A—B of Fig. 10.

Fig. 12 is a diagrammatical view of the shutter and film gate.

Fig. 1 illustrates a camera using reflectors as in my aforesaid earlier application, there being two lenses 15, 15ª, each exposing one side of the film; the light projected from the lens 15 is directed by mirrors or prisms 11 and 12 through filters 13 against one side of the film 1, while the light projected by the lens 15ª is reflected by mirrors or prisms 16, 17 and 18 through filter 14 against the other side of the film 7. Reference to Fig. 7, which will be made later, will indicate how this same division and transmission of the light is effected by means of prisms in accordance with the present invention. Most of the cameras hereinafter described are shown provided with color screens or filters similar to the screens 13 and 14 shown in Fig. 1. These screens or filters may be omitted, provided that a film is used which is coated on opposite sides with emulsions, one of which is chiefly sensitized to light of one color group, such as orange and red, while the other is chiefly sensitized to light of another color group, such as blue and green; but I may also use the combination of color filters 8 and 9 and a film specially sensitized in the manner described, in which case the filters are much lighter and pass practically all of other color light and enable higher speed to be used in taking the pictures. This statement as to the use of color screens or color sensitive emulsions applies generally to all the cameras hereinafter described, that is, one or other or both may be used. Any or all of the prisms or reflectors may be provided with vertical or longitudinal adjustments or both, and may be moved to equalize the focal distance on two sides of the film and to secure registry between the images on the two sides.

Fig. 2 illustrates the single lens type of camera in accordance with one feature of my present invention in which a portion of the light from the lens 19 is intercepted by the prism or mirror 20 and reflected against the prism or mirror 24, by which the light is directed through the filter 25 against one side of the film 1, while the rest of the light is reflected by the mirror or prism 23 through a filter 22 against the other side of the film. If a splitting prism such as 20 is used to divide the light, it is necessary to interpose a glass block or prism 21 of equivalent optical thickness to secure images of approximately the same size on the two sides of the film; any proportion of light can be transmitted or reflected by controlling the distance the prism projects above or below the center of the rays from the lens.

It will be noted that the lower edge of the prism 20 lies near the plane of the optical center of the system, and the lens 19 is preferably so constructed as to have its second principal or nodal point either behind the rear vertex, or as near the rear vertex as possible, so that a proportional amount of light rays, directed to all parts of the image, will be reflected equally over the whole surface of the film on both sides.

Fig. 3 illustrates a camera in which the back face of the splitting prism 55 is provided with narrow strips of silver or other reflecting material such as is shown at 62 in Fig. 5. The prism 55 is cemented by a light transmitting agent, such as Canada balsam to another prism 26. The light from the lens 54 striking the silvered reflecting strips 62 on prism 55 is thereby reflected by the silvered prism or mirror 31 through the color filter 32 against one side of the film 1, while the light striking the clear spaces 63 on the prism 55 is transmitted (by the balsam) into the other prism 29 after which it

is reflected by the prism or mirror 30 through the filter 29 against the other side of the film 1. It is desirable that the prism 26 should form an optical path for the light transmitted which is equivalent to the optical path for the reflected light. Any proportion of light can be transmitted or reflected, dependent upon the relative width of the clear and silvered strips 63, 62, or a series of dots or checkered spaces may be substituted for the strips.

If a prism 55 is mounted to be totally reflecting, it may be cemented to the other prism 26 by strips or bands of a light transmitting agent, such as Canada balsam, while a clear space is left between the bands of balsam, so that the prism will totally reflect light from the portions opposite the clear spaces and will transmit light through the balsam, thus avoiding the use of the silvered strips 62.

Figs. 5 and 6 illustrate a similar type of camera in which the small prism 33 cemented to the large prism 34 has a series of recesses 36, 36 ground in its face, separated by spaces 37, 37 which are cemented to the large prism by balsam or other light conductive agent. The light to be singly reflected to one side of the film passes through the cemented places, while the light for the other side is reflected by the totally reflecting portions of the undersurface of the prism 34 superposed over the recesses 36 in the prism 37.

Fig. 6 is an exaggerated view of the contact line of the cemented prisms 34 and 33 with arrows showing the rays of light striking those surfaces of the prism 34 which lie over the spaces 36, this light being reflected, while the other rays pass through the cemented portions.

Fig. 7 illustrates a type of twin lens camera in which light is passed through filters 38 and 38ª before reaching the lenses 39 and 38ª respectively. One light group is reflected twice in the prism 40, (the rear surface of which is silvered) on to the film 1, while the other light group passes through glass block 41 and is reflected by prism 42.

In Fig. 8 a type of camera is illustrated in which the light groups are divided between the lens members at or near the second principal or nodal point in the lens system. The image is projected by lens members 44 through diaphragm 51 on to the inclined mirror 47, projecting about half way across the diaphragm opening. The portion of the light reflected by the mirror passes through the second lens member 45 and on to the mirror or prism 48, through filter 49 on to one side of the film 1, while the other light group passes through the lens member 46, similar to 45, on to mirror 50, through filter, and screen 51 on to the opposite side of the film 1.

Fig. 9 represents a similar optical system using the prism 52 for splitting the light in place of the mirror. It is desirable to interpose a block of glass 53 of the same optical length as the prism 51 in the path of the other light group.

It is to be understood that any or all of the prism or mirrors may be equipped with adjustments in azimuth, or altitude, or both, and that either the film gate or prisms or both may be moved in and out to secure focus.

It will be understood that after the negative has been taken in my improved cameras, as described above, the film is developed and fixed on both sides, and the image on one side is stained one color, for instance red, and the image on the other side is stained another color, for instance green. The positive (consisting of a film or support having two images one on each side corresponding with the images on the negative) can be printed from the negative by a number of different methods. One such method is to use a positive film which is coated on one side with a transparent emulsion sensitive to one color group such as blue and green, and on the other side with emulsion sensitive to another color group such as red and orange, as described in my aforesaid prior patent application. The side of the positive film carrying the transparent emulsion is placed in contact with the negative and printed in the usual way. Another method of printing a positive from a negative using a film of the

kind described in my aforesaid patent application consists in illuminating the negative film from a source of light and the image is projected by the lens against the transparent (green) sensitive side of the film so that the green group of colors in the negative will affect the transparent side of the positive while the red group of colors in the negative will act on the other side of the positive.

Positives may also be made from negatives by means of the devices and methods set forth in my co-pending Application No. 14,102 of 1915 which is a division of the present application.

In cinematographic work, in connection with which the present invention is primarily designed for use, the film is fed intermittently through the film gate by well-known intermittent feeding means, the camera lens being provided with a shutter adapted to be closed while the film is moving. I find it advantageous, however, in accordance with my present invention, to provide some means for varying the time of exposure to light of the emulsion on one side of the film as compared with the time of exposure on the other side, in order to compensate for differences in the rapidity with which the emulsion is acted upon by the light. Instead of the single shutter above referred to, I preferably provide two shutters, one on each side of the film, which intermittently intercept the light falling on the film, and I arrange so as to be able to adjust these shutters in order that the time of exposure of one film relative to the other may be varied.

Such a structure will now be described with reference to Fig. 10 which illustrates the camera structure as it may be used in practice. The lens 19 projects the image through the splitting prism 20, where it is divided, one portion passing through filter 25 and being reflected by mirror 24 against one side of the film, while the other portion passes through filter 22 and is reflected by mirror 23 on to the other side of the film (as shown in Fig. 2). The splitting prism is mounted preferably on a plate 106 adapted to turn on an axis which intersects the point where the axial ray from the lens strikes the reflecting surface of prism 20, the movement of the plate being controlled by the capstan screw 108 working between stops 107, 107 and the prisms being held in place by spring clips 105, 105. By shifting this plate 106 the images can be moved along the film gate until exact registration in azimuth is obtained. The reflecting mirrors 23, 24 mounted respectively on base-plates 109 and 110, adjustable vertically in the bearings 114, 114 in the lugs attached to the base-plates (Fig. 11) so that its axis of revolution is in the same plane as the axial ray from the lens. To secure individual focus on one side of the film either of the plates 109, 110 may be moved parallel to the film. Adjustment in altitude is secured by shifting one of the capstan screws 111, 112, passing through lugs 113 provided on the reflecting mirrors 23, 24, until the images register.

An individual shutter, controlling the amount of light admitted to either side of the film, is mounted on the shutter shaft 103 journalled in bracket 102. Either of the shutters are similar to the standard shutters and comprises permanent sections 97, 100 and a movable section 98, 99 respectively. The thumb screws 101, 101 may be loosened and the free members 98 and 99 of the shutters shifted to the proper location and secured by slipping a pin provided for the purpose into any of the holes 115, 115. The object of this adjustment is to compensate for the excess of different colors in the light at various times of day, for example the excess of blue-green near noon time and the excess of orange-red near sunset.

It will be understood that the present invention makes it possible to take color photographs consisting of colored images which, when projected upon a screen, gives a reproduction of the object photographed in close approximation to natural colors. As a result of the present improvements it is not absolutely necessary to use a film having a transparent emulsion, nor is it

necessary to use a film which is coated with emulsion sensitive to one color on one side and emulsion which is sensitive to a different color on the other side, although this may be done. The present invention permits the use of any kind of double-coated film in a method of this sort, irrespective of whether it is specially color sensitive or panchromatic. The invention is capable of embodiment in a great number of constructional forms, a number of which have been described by way of example, and I wish it to be understood that I reserve the right to make any changes or variations in my method and apparatus which come within the spirit of my invention.

Two single coated films, either entirely separate or superposed over each other and attached along one edge may be fed through the same film gate in any of the cameras described preferably by the same film-feeding teeth, the sensitized emulsions on the two films being either back to back or face to face or one emulsion inside and the other outside. In this manner two separate negatives are secured of the object photographed one by light of one color group and the other by action of light of another color group. These negatives may be printed one on each side of a double coated positive film and the images stained in different colors. The negative films used may be panchromatic or specially sensitized to the color groups that act upon them.

It will of course be understood that the present invention does not provide a means whereby every color in nature can be accurately reproduced; the invention makes it possible to reproduce an approximation to a number of these which will be sufficiently close to produce a pleasing effect.

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

1. A camera for color photography provided with prisms for dividing the light from the object into two groups which act on opposite sides of a double coated film, color screens of different color being interposed one in the path of each light group between the film and the light-dividing means, for the purpose specified.

2. A camera for color photography provided with prisms disposed in position to divide the light from the object into two groups which act on opposite sides of a double coated film, for the purpose specified.

3. A camera of the kind described, provided with a pair of lenses combined with prisms so arranged that the light from one lens acts upon the emulsion coating on one side of the film while the light from the other lens acts upon the emulsion coating on the other side of the film, for the purpose specified.

4. A camera of the kind described provided with a prism arranged with its edge located near or at the axis of the light ray projected by the camera lens, said prism dividing the light into two groups one of which is reflected and transmitted to one side of the film, while the rest of the light is directed against the other side of the film, preferably through a compensating prism, for the purpose specified.

5. A camera of the kind described provided with a prism reflector for dividing the light into two groups, one face of each reflector is provided with portions or bands of reflecting material so that the light striking said reflecting material is reflected and transmitted on to one side of the film, while the light passing between the clear spaces of the prism is transmitted (preferably by means of Canada balsam or equivalent material on the other prism) against the other side of the film, for the purpose specified.

6. A camera of the kind described provided with a prism reflector consisting of a pair of prisms which divides the light into two groups, one of these prisms being provided with a series of recesses and the contacting spaces between the two prisms being cemented together with Canada balsam or the equivalent so that one group of light can pass through the contacting portion

of the two prisms but the other group will be reflected by the intervening reflecting surfaces of the prism reflector, for the purpose specified.

7. A camera of the kind described and provided with light reflecting means, such as mirrors or prisms, located between the front and rear lenses of the lens system, the lenses between said dividing means and the film being arranged in duplicate sets, one set in the path of each light group, for the purpose specified.

8. A camera of the kind described for moving picture making including light-dividing means, and a device to compensate for required difference in time of exposure of one side of the film relative to the other, said device preferably comprising a pair of shutters provided one on each side of the film-gate, and each shutter being preferably adjustable in area, for the purpose specified.

9. The improvements in the art of color photography substantially as described and illustrated, for the purpose specified.

10. The improved negatives and other pictures made by means of the herein-described cameras for the purpose specified.

Dated this 16th day of February, 1915

For the Applicant:

H. A. GILL & Co.,
Chartered Patent Agents,
55/56, Chancery Lane, London, W.C.

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A.D. 1915. Feb. 16. N° 2463.
BREWSTER'S Complete Specification.

(3 SHEETS)

SHEET 1.

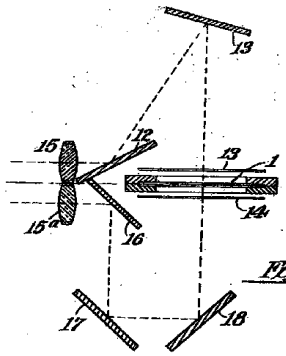

Fig.1

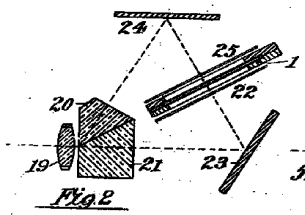

Fig.2

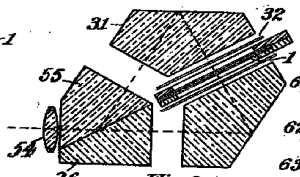

Fig.3

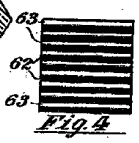

Fig.4

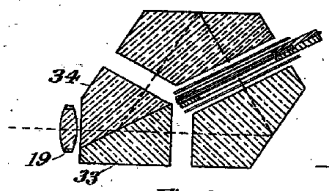

Fig.5

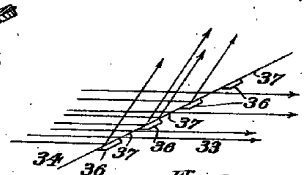

Fig.6

SHEET 2.

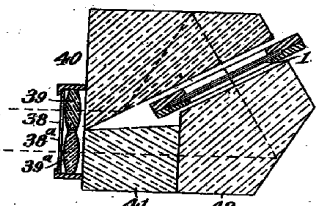

Fig.7

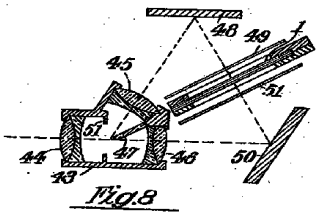

Fig.8

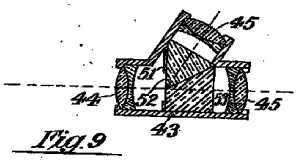

Fig.9

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BREWSTER'S Complete Specification.

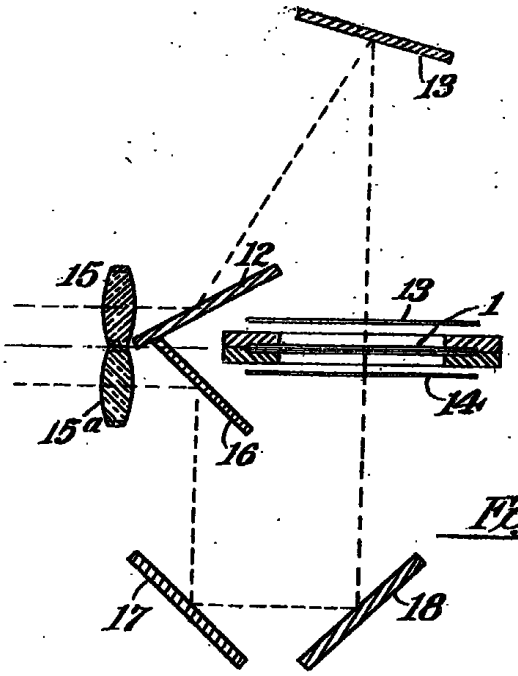
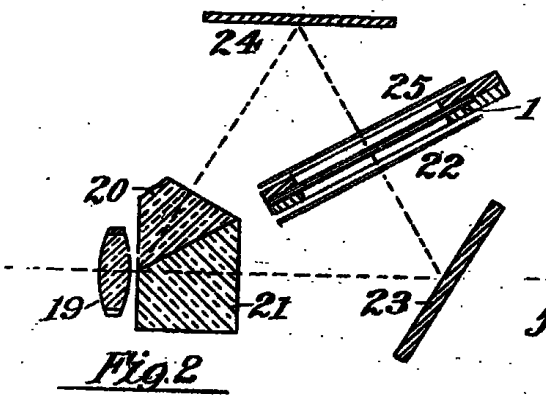


Fig.1



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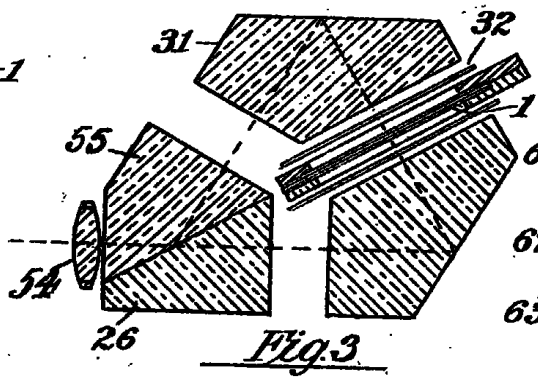

Fig.3

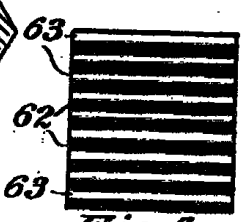

Fig.4

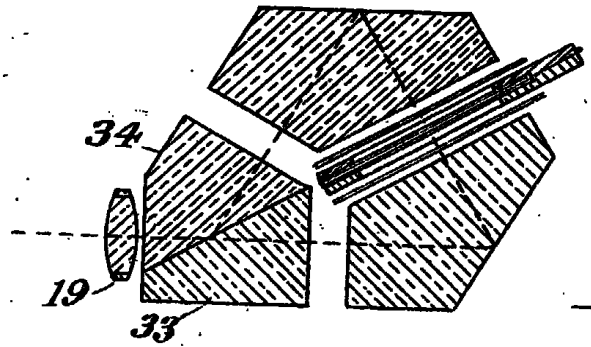

Fig.5

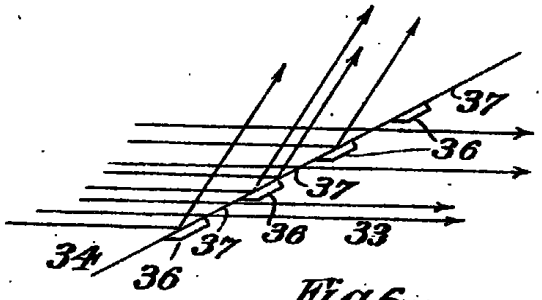

Fig.6

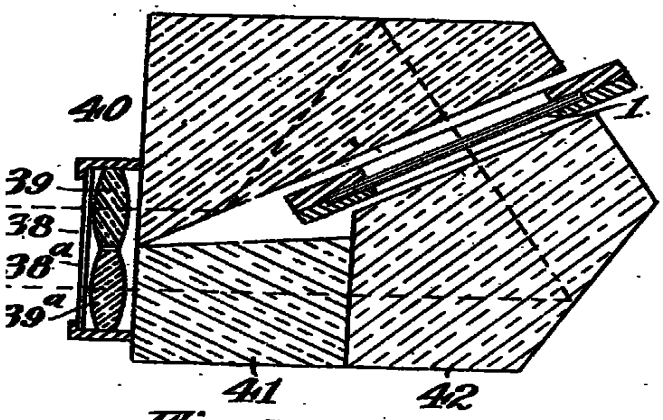

Fig. 7

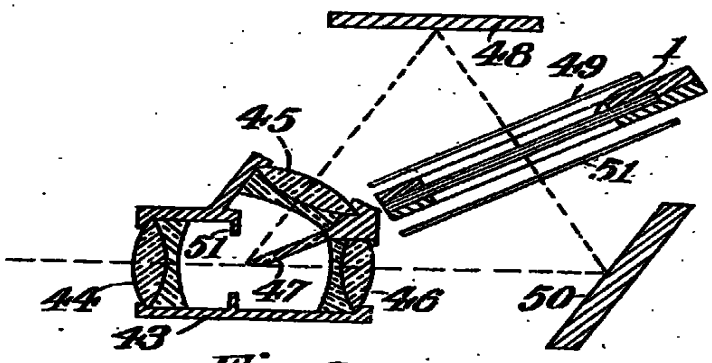

Fig. 8

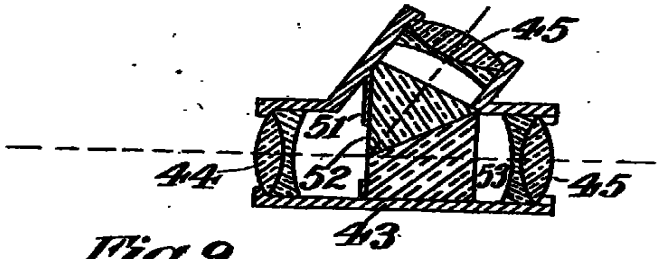

Fig. 9

Malby & Sons, Photo-Litho.

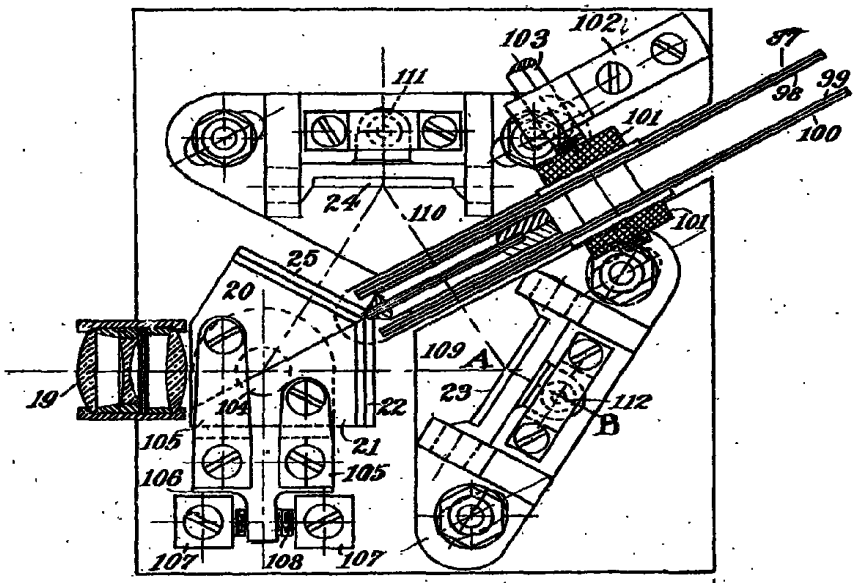

Fig. 10.

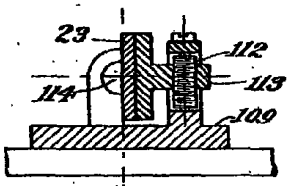

Fig. 11.

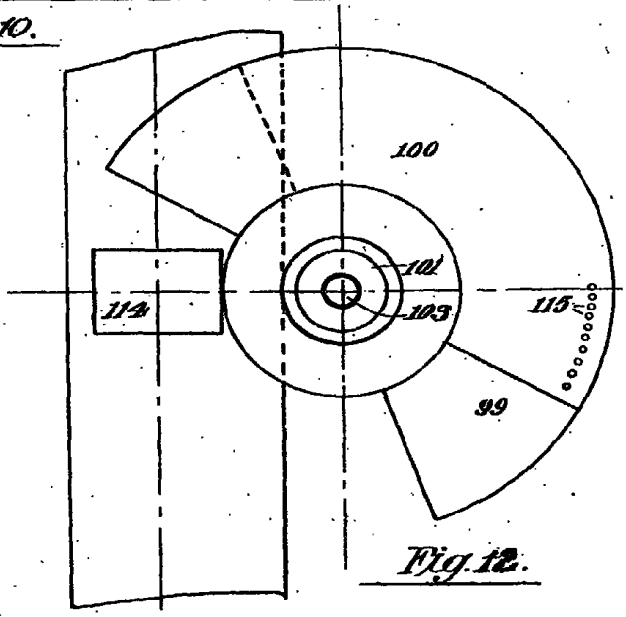

Fig. 12.

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

Malby & Sons, Photo-Litho.