[Second Edition.]

PATENT SPECIFICATION

419,894

Convention Dates (France)

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Corresponding Applications in United Kingdom

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No. 21,313/33 } *(One Complete Specification Left)*

Specification Accepted: Nov. 21, 1934.

COMPLETE SPECIFICATION.

Improvements in or relating to Colour Kinematography.

We, FRANCITA, SOCIETE DE FILMS EN COULEURS NATURELLES, a body Corporate organized under the Laws of France, of 29, Avenue de l'Opera, Paris, Seine, France, 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:—

Numerous methods and devices have already been proposed for the colour kinematography, but these methods and devices have not already been used on a large scale on account of their imperfect results due either to insufficient colouring effects, or to the complicated or cumbersome optical systems, or to the necessity of using films having special dimensions, or to the impossibility of using projectors of usual construction.

Methods for bi-colour kinematography have been proposed but it has been experienced that, in order to obtain a true reproduction of the natural colours, it is necessary to form at least three images selected through three filters having complementary colours, such as red, green and blue for instance. Methods have even been proposed for obtaining images corresponding to more than three colours, but these methods require complicated optical systems or films with special dimensions, or provided with coatings of differing sensitivity.

For the three colour kinematography, it has been proposed to make successive series of groups of three images, these three images being taken at short time intervals, but since the positions of the objects in the scene to be photographed vary continuously, consequently the three selected images are not quite identical and are thus not superposable. When these three images are projected simultaneously on the projection screen, the resulting image is not perfectly pure, due to the lack of superposition, and fringes of different colours are produced having a disagreeable effect on the eyes of the spectator.

It has also been proposed to make successive series of groups of three images taken simultaneously through three objectives which are necessarily at a distance from each other. The three images are consequently not taken from the same point of view and are consequently not identical nor superposable, and when said images are projected the same drawbacks are produced as for the first method above described. Moreover, it is obvious that in such methods it is necessary to use optical systems which are complicated in order to obtain simultaneously three images.

It has also been proposed to make successive series of groups of three images taken simultaneously through optical systems giving simultaneously three identical images of the same object and from one point of view. With this method, superposable and identical images are obtained, but it is necessary to use complicated optical systems; moreover, it is necessary to use films having special dimensions, or standard films which are driven then at the considerable speed of three standard images at a time, said condition requiring special driving mechanism and consequently no use can be made of the usual projectors commonly utilized in the play-houses for projecting the monochrome films.

It is proposed, in the present invention, to obtain successive series of three images selected through three filters having red, green and blue colours on a standard film adapted to be driven through an ordinary projector by means of an optical system as simple as possible and having relatively large objectives. For this purpose, use is made of the known fact according to which the fringes due to the projection of a blue image on two red and green images which are exactly superposable, do not affect in any disagreeable manner the

eyes of the spectator, in contradistinction with the prejudicial effect produced when the red image or the green image is not superposable on the two other coloured images.

The present invention has for its object a method for taking views for tri-colour kinematography, characterized in that two images are taken simultaneously and from the same point of view by means of a light dividing device and of two objectives and two filters, the one red and the other green, on two diagonally disposed portions of a standard image area of a standard film, and after a displacement of the film through half the height of a standard image, a third image is taken through one of said objectives and through a blue filter on a free space in said same standard image area.

When it is desired to project a positive film obtained by said apparatus, the three images corresponding to the red, green and blue colours, are projected simultaneously on the screen, and the standard film is displaced after each projection on a distance corresponding to the height of a standard image. It is thus not necessary to modify the driving mechanism of the usual projector and it is sufficient, in order to project said positive film, to replace the usual objective of the projector by another objective composed of three elements.

It is observed that, in the apparatus for taking the views, the two objectives are spaced at a distance from each other corresponding to the distance between said two diagonally disposed images, whereby a greater space is available for said objectives, and consequently use may be made of relatively large objectives.

Bi-colour cinematography methods have also been proposed in which an optical system produces simultaneously two images of the same object and from the same point of view, these two images being disposed diagonally in a standard image area of a standard film; the present invention differs from these methods by the fact that the present invention relates to tri-colour cinematography and produces three series of selected images through three filters having different colours.

The accompanying drawings illustrate, by way of example, the application of the invention to colour motion pictures.

Fig. 1 shows a tri-colour flag (red, blue and green) forming the subject to be photographed, in a first position corresponding to the first exposure.

Fig. 2 shows successive positions of this flag at the instants of the successive exposures.

Fig. 3 shows a portion of the negative film.

Fig. 4 is a diagrammatic perspective view, showing the relative positions of the subject, the camera and the negative film during the first exposure.

Fig. 5 is a similar view showing the positions of the parts during the next succeeding exposure.

Fig. 6 is a front view of the two mirrors of the camera.

Fig. 7 is a diagram of the projector, showing the relative positions of the positive film, the colour filters, the objective of the projector and the projection screen.

Fig. 8 is a front view of the three objective elements of the projector.

Fig. 9 is an elevational view showing the face of the objective opposite the projection screen, and illustrating the adjusting device for the three objective elements.

Fig. 10 is a longitudinal section through the objective of the projector.

In the following description, it has been assumed that the subject is a tri-colour flag; the stripe 1 situated along the staff is red, the central stripe 2 is blue and the outer stripe 3 is green. The colours are shown in the drawing by a conventional cross-hatching.

During the first exposure, it is assumed that the cloth is stretched (Fig. 1), and during the following exposures, the cloth progressively falls against the staff. Fig. 2 shows the successive positions P, P^1, P^{11}, P^{111}, of the flag corresponding to the successive exposures. O denotes the center of the field of the subject to be photographed in these various positions.

The process according to the invention, as applied to motion pictures, consists in forming on a negative film 4 (Fig. 3) successive series A, B, C, of images, each comprising three images 6a, 7a, 8a—6b, 7b, 8b. In each series, the images 6 and 7 are disposed diagonally of a standard image area of the film and are taken simultaneously through red and green filters respectively.

The images 6a and 7a correspond for example to the position P (Fig. 1) of the flag; the image 8a is taken immediately thereafter (position P^1 of the flag), in the manner hereinafter described, through a blue screen.

In the following series B, the images 6b and 7b correspond to the position P^{11} of the flag and the image 8b to the position P^{111}.

Each of these images being taken through a colour filter, the film is impressed by the corresponding colour (red stripe 1 on the images 6, green stripe 3

on the images 7, blue stripe 2 on the images 8). The negative film used may be a panchromatic film; use may also be made of a heterogeneous film, divided in zones corresponding to the areas of the selected images, the emulsion in each zone being sensitized to the radiations of the spectrum which correspond to the colour of the particular selected image to be impressed in said zone. For instance, the film may comprise at the left hand a stripe in which the emulsion is sensitized to the red radiations, and at the right hand a stripe in which the emulsion is sensitized to the green and blue radiations.

In the example herein illustrated, it is assumed for the sake of clearness that the subject comprises quite pure colours; in practice, for the various subjects of the nature, each image may reproduce substantially all the details of the subject, the actinic action on the film depending at each point upon the colour of the corresponding point of the subject.

The centres of the different images 6, 7, 8, i.e. the images of the centre O of the field of the subject to be photographed are denoted by *m*, *n*, *p*.

The negative film above described is exposed in the camera which is diagrammatically illustrated in Figs. 4 and 5. This apparatus comprises two objectives 9 and 10, whose optical axes X—X and Y—Y are distant through an amount *l*, equal to the distance between the centres of two images such as 6*a* and 7*a*, disposed diagonally of the film 4, and these objectives are so arranged that the axis X—X passes through the centre of the subject and that the trace upon the film 4 of the plane containing said axes X—X and Y—Y will coincide with the diagonal *mn*.

In front of the objective 9, and upon the axis X—X thereof is arranged an opaque mirror 11, inclined at 45° upon said axis X—X and perpendicular to the plane of axes X—X and Y—Y. The reflecting surface 12 of said mirror 11 lies opposite the subject; said mirror is formed with a series of apertures 13 of rectangular shape (Fig. 6) or of any other shape (round, oval, rhombus-shaped or polygonal or in the shape of rectilinear, curved or spiral facets, etc.). Preferably, the size of the perforations will be quite reduced but large enough to prevent diffraction of the light which passes therethrough.

Upon the axis of the second objective 10 is arranged an opaque mirror 14, whose reflecting surface 15 is turned toward the objective 10. This second mirror 14 is parallel with mirror 11, whereby the light reflected by the latter is reflected in the direction of the optical axes YY of objective 10.

Behind the objectives 9 and 10 is mounted an opaque disc 16, rotatable about an axis 16a. Said disc 16 is provided at one side with two concentric circular apertures, whose circular middle lines are distant radially through an amount *x*. Said apertures are provided respectively with a red transparent filter 17 and a green transparent filter 18. Disc 16 comprises a third transparent filter 19, coloured in blue, and diametrically opposite filter 18. Two opaque sectors 20 and 21 separate filters 17, 18 from filter 19.

The apparatus further comprises a focusing device, a diaphragm and a combined film feeding and disc driving mechanism, disc 16 also operating as an obturator. The construction of these various parts is well known or will be readily understood and does not appear to require a specific description. It should however be noted that the film feeding mechanism should be such that the film 4 is displaced in an intermittent manner in the direction of arrow f^1 (Fig. 3, 4) through a stroke equal to the distance *n p* between the centres of the images 7 and 8 to be obtained, that is through half the height of a normal image area; otherwise stated, with a standard film having four perforations per image area, the stroke of the film will be equal to two perforations. At each stroke *x* of film 4, disc 16 performs half a revolution, in the direction of arrow f^2 for instance.

The rate of the exposures may be, as desired, preferably the standard rate of twenty four times the standard stroke $2x$ per second; the film will thus be fed through 48 strokes *x* per second.

The operation is as follows: the flag being in the position P (fig. 1), the single light bundle issuing from said flag is divided by mirror 11 into two elementary bundles. One elementary bundle passes through the perforations 13, the objective 9, the green filter 18 and impresses the image 7*a* consisting mainly of the green stripe 3. The other bundle, which is identical with the former, except for the luminous intensity, is reflected by the mirrors 11 and 14, passes through the objective 10 and the filter 17 and impresses the image 6*a*, consisting mainly of the red stripe 1. Disc 16 is then rotated through 180° and, as one of the sectors 20 or 21, acting as an obturator, intercepts the light to the film 4, said film is fed in the direction of arrow f^1 through the stroke *x*. while the flag comes into the position P^1 (Figs. 2 and 4). The light bundle issuing from said flag passes through the aper-

tures 13 of mirror 11, the blue filter 19 (fig. 5) and impresses the image 8a (consisting mainly of the blue stripe 2) while the light bundle, which is reflected by mirrors 11 and 13, is intercepted by the opaque marginal portion of disc 16.

The exposures proceed similarly for any one of the other series of three images B, C . . . (Fig. 3).

The film is then developed and, from the negative thus obtained, positive copies are taken by the usual processes.

On the negative film as well as on the positive film, a narrow band 22 (figs. 3 and 7) may be left for a sound record 23 (Fig. 7).

In the positive film 24 thus obtained (Fig. 7) the location of the images 6, 7, 8 of each series is the same as on the negative film 4. The projection may be obtained by means of a usual projector, provided however with a special objective (fig. 8, 9, 10). This objective comprises three colour filters 17^1, 18^1, 19^1 respectively coloured in red, green and blue, and similar to the filters 17, 18, 19 of the selecting disc 16. Behind said filters are arranged three objective elements 25, 26, 27 of sector shape, which are respectively cut in usual circular composite objective lenses, the outline of such circular lenses appearing in dotted lines in figure 8: said elements are so assembled as to occupy the whole section of the objective, corresponding substantially to a standard image area. This arrangement affords the maximum luminous intensity. The optical centres of the objective elements are m^1, n^1, p^1 at the apices of a right angled triangle corresponding to the right angled triangle m, n, p, formed by the centres of the three images 6, 7, 8 of each series A, B, C.

Moreover, these objective elements 25, 26, 27 are so arranged that if the three images 6, 7, 8 were exactly superposed (which is true for images 6 and 7), the projections of these three images on the projection screen 28, by means of the objective elements, would be accurately superposed and would form a single image 29, the points m, n, p of the three images being projected at a single point O, which is the centre of image 29.

However, since the image 8 has not been taken at the same instant as images 6 and 7, whereby it is not accurately superposable if the subject to be photographed is in motion, the three projections on the screen will not accurately register together; nevertheless, experience shows that the blue fringes thus created are practically invisible, in contradistinction with the red, green or other fringes, which are produced by the usual processes, in which the three images are different because they have been taken successively or through objectives giving respectively different images of the same subject.

The superposition of the three projections of these parts of the subject which remain stationary during the displacement of the film through the stroke x will be obtained once for all by an initial adjustment of the three elements 25, 26, 27. For this purpose, each of these elements is located in a rabbet 30 of a mounting 31, in which it is held in place by a metal band 32, secured to the mount by screws 33 or otherwise. The three mounts are slidably held between a flange 34 (Figs. 9 and 10) of a sleeve 35, screwed on the tube 36 of the objective (fig. 10) and a washer 37, attached to flange 34 by means of rivets 38, extending through slots 43 of the mounts 31 for elements 25 and 26. Screwthreaded rods 39, carried by the mounts 31, extend through notches 40 (Fig. 9) of flange 34. By this arrangement, each element 25, 26 is rotatable about one rivet 38, and the element is slidable therein by means of slot 43. Element 27 carries two screwthreaded rods 39, so that its freedom of movement is still greater. The locking of the objective elements in the adjusted position is obtained by means of milled knobs 41 screwed upon screwthreaded rods 39, said knobs bearing upon the edges of notches 40 through the medium of bridge plates 42.

Fig. 10 shows at 17^1, 18^1 two of the three coloured filters arranged in front of the objective elements, said filters being clamped for instance between two rings 44 and 45, screwed in a sleeve 46, screwed in turn in sleeve 35.

If need be after the objective elements have been adjusted, the gaps between the elements may be filled in by any suitable means (paper, putty, etc.) so as to prevent the light from leaking therethrough.

When a positive film 24 is fed in an intermittent manner past the objective and the colour filters above described the feeding stroke of the film being equal to $2x$, the three images of each series A, B, C . . . are simultaneously projected upon the screen 28, thus giving thereon the final image in colours, resulting from the exact superposition of the images selected by the red and green filters; the fringes which are due to the lack of similitude between the blue image and the others are practically invisible.

Obviously, the invention is by no means limited to the embodiment above described and illustrated.

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 method for taking views for tricolour kinematography, characterized in that two images are taken simultaneously and from the same point of view by means of a light dividing device and of two objectives and two filters, the one red and the other green, on two diagonally disposed portions of a standard image area of a standard film, and after a displacement of the film through half the height of a standard image, a third image is taken through one of said objectives and through a blue filter on a free space in said same standard image area.

2.—A method for taking views for tricolour kinematography substantially as described and as shown in the accompanying drawings.

Dated this 25th day of July, 1933.

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Agents for the Applicants.

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Fig. 1

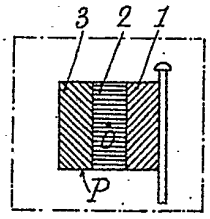


Fig. 2

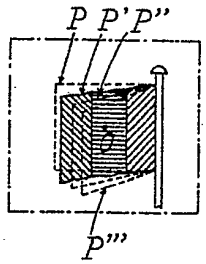


Fig. 3

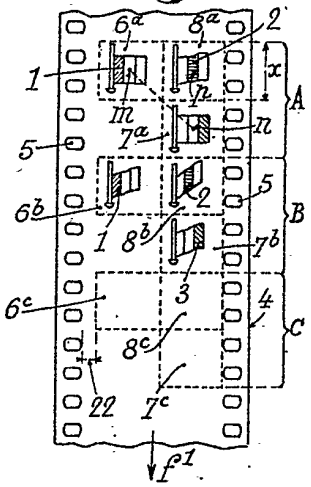


Fig. 4

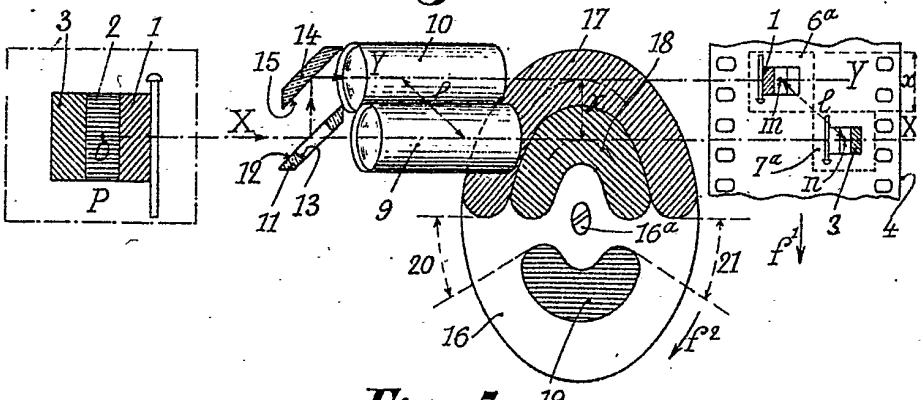


Fig. 5

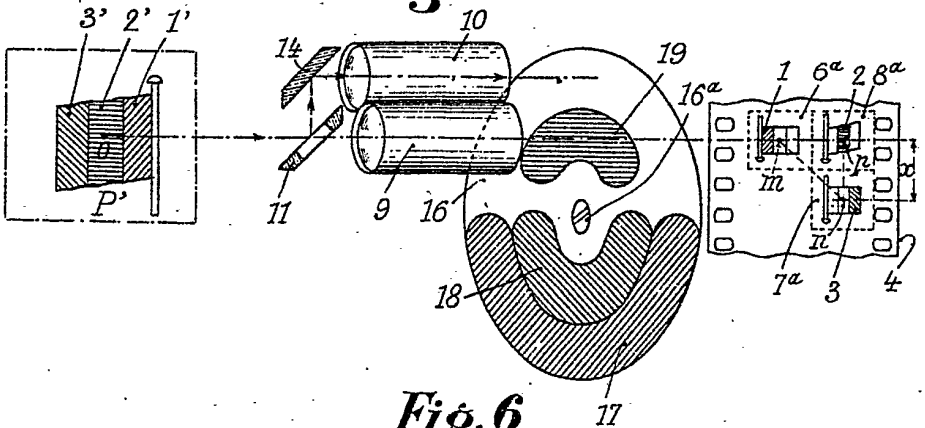


Fig. 6

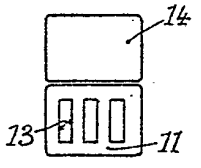


Fig. 7

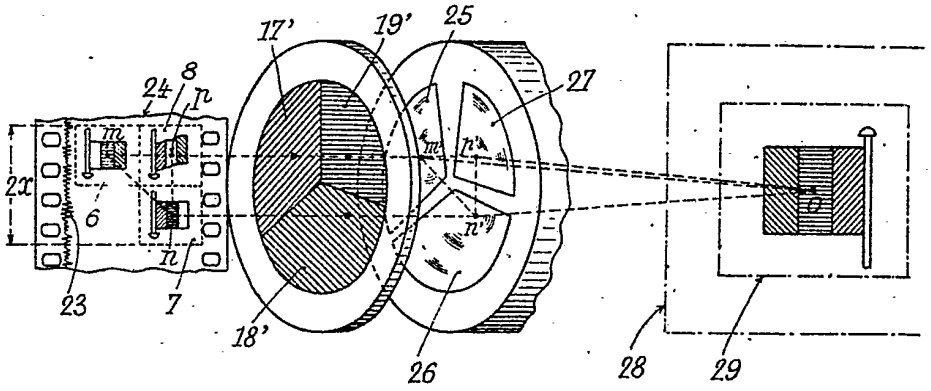


Fig. 8

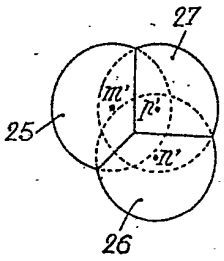


Fig. 9

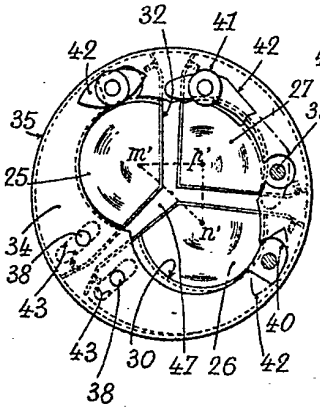
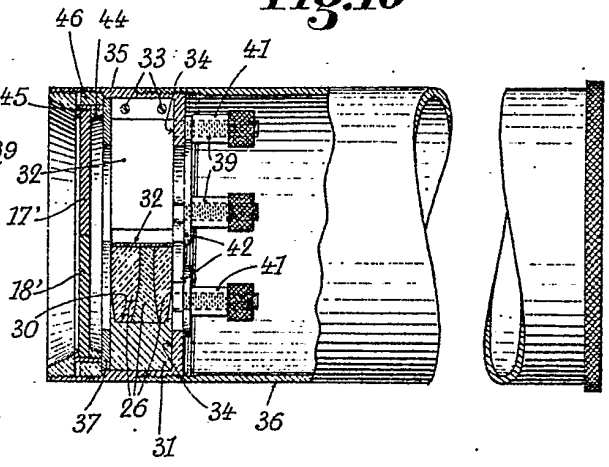


Fig. 10



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419,894 COMPLETE SPECIFICATION

2 SHEETS

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SHEET 1

SHEET 2

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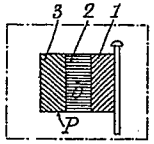
Fig. 1



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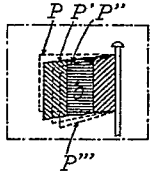


Fig. 3

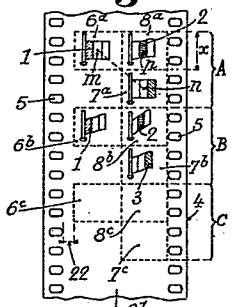


Fig. 4

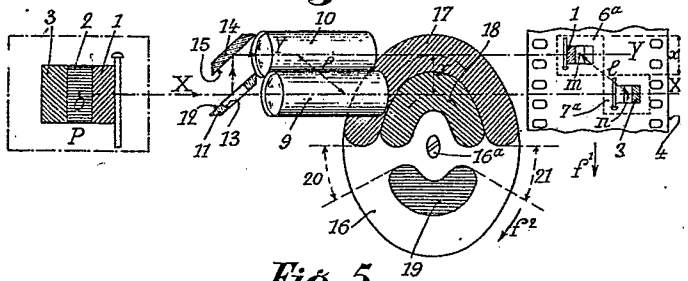


Fig. 5

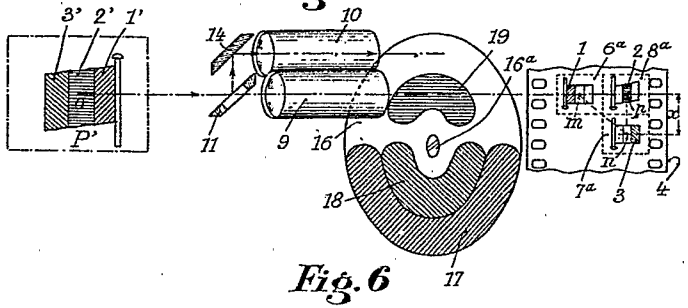


Fig. 6

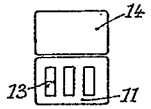
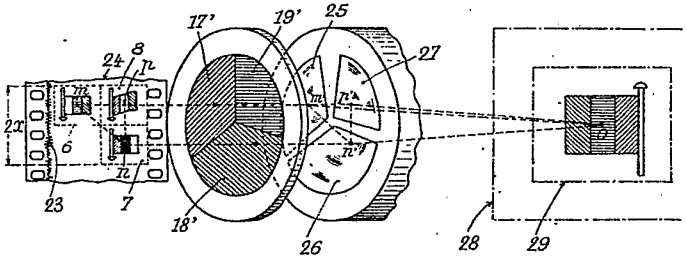


Fig. 7



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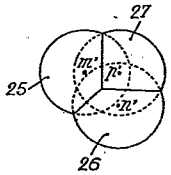

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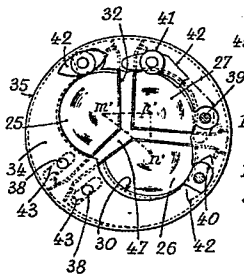
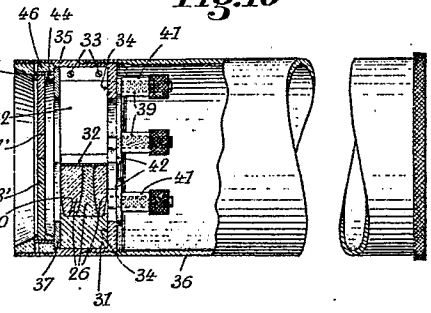


Fig. 10



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