PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to Motion Picture Cameras

I, PERCY DOUGLAS BREWSTER, a citizen of the United States of America, of 28, Gillespie Avenue, Fair Haven, New Jersey, United States of America, 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:—

My invention relates to motion picture cameras especially colour motion picture cameras and provides means for exposing two or three films simultaneously to images projected by a single lens, but for purposes of colour photography, recorded by light of two or three different colours. After development these films become colour separation negatives and are used for the production of two or three colour positive films.

The use of the camera according to the invention is not limited to colour cinematography; the camera may be used for any purpose where two or more films are required to be made simultaneously by light rays projected by one lens, such as "process shots" in photoplay production.

In colour motion picture cameras all the films must be exposed to images projected from the same lens to avoid parallax, which would result in the failure of the images to register in the colour print and would cause colour streaks about the margins of the projected pictures. They must also be exposed simultaneously, otherwise a moving object would be recorded in different positions in the three films and in the colour positive print the moving object would be surrounded by bands of colour. Standard black and white motion picture cameras for studio work commonly use wide angle lenses of 40 or 50 mm. focus, or less, especially for photographing large "sets" or scenes, so it is important that a colour camera be able to use at least 50 mm. lenses, though lenses of longer focal length can be used when desired. Colour cameras require much more light than is necessary for black and white photography making it very desirable that they be able to use very fast lenses such as F/2 lenses of 50 mm. focus. Finally, it is advantageous that a colour camera use two or three separate films rather than to make two or more colour separations, one above the other, on the same film. Separate films may be specially sensitized only for the light rays they are to record enabling much faster emulsions to be obtained and avoiding the use of inefficient filters; for example, a film recording blue only requires no filter, and a film, especially sensitized for green, permits the use of an efficient yellow filter in place of the inefficient green filter.

It has heretofore been proposed to provide a motion picture photographic camera having means for simultaneously exposing three films to the light from a single lens, and in which the exposure of the films is controlled by two intermeshing double bladed rotary mirrors. In such prior arrangement however no independent film feeding and film positioning mechanisms were provided.

The invention has among its objects to provide a three colour camera, which is adapted to operate with a single very fast lens of a speed, for example, of F/2 and having a focal length not exceeding 50 mm., and which is adapted to expose three separate films simultaneously. Another object is to provide simple and reliable means for adjusting and determining the position of the films during exposure to insure exact registry or superposition of the component colour images on the colour print: a further object is to provide a compact camera, simple to operate and so shaped as to allow a soundproofing house or "blimp" to be placed over the camera when in use. Other objects will appear later in the specification.

These objects are attained in the mechanism illustrated in the accompanying drawings. Light rays projected from a single lens are reflected from two front surfaced or polished mirrors having usually three blades. These mirrors are mounted to revolve, controlled by gearing, so that their blades do not touch. If the mirrors make two revolutions for each

[*Price* 1/-]

picture or "frame" photographed on each of the films, six successive pictures will be projected by the mirror blades during each picture cycle but if as is usual the shutter is closed for a third of the time, (120 degrees) to permit movement of the film, only four separate exposures will be recorded on each film during each cycle. Part of the light rays projected by the lens will be reflected from one mirror through a red filter onto one film to record the red negative separation; and another part of the light rays, reflected by the other mirror, will record directly on the film sensitized exclusively for blue light (which does not require a filter) to record the blue separation negative: while the rest of the light rays from the lens, passing in between the mirror blades, and through a yellow filter, will be recorded on the film, specially sensitized for green, directly opposite the lens to form the green separation negative These exposures are not of course actually simultaneous, but by reason of the speed of rotation of the mirror the time interval between is so slight that the four separate exposures blend together to form one image, so that as has been proven, in practice, the fastest action near the camera will not show any colour banding when projection upon the screen at normal speed takes place.

For correct colour reproduction, it is essential that each film should receive an equal exposure to light over its entire surface. Therefore, each laterally disposed film should receive light rays reflected by a fixed number of mirror blades, to an amount equivalent to that received by the film exposed to direct light. To secure the maximum exposure (a very important consideration in colour cinematography) I prefer to reflect light from four blades to its appropriate film and to cut off the light from the mirrors by a suitably geared shutter during the passage of two mirror blades to permit the films to be fed forward by one frame. The shutter is proportioned to shut off the light from the lens for 120° and to permit exposure for 240°. It is an important feature of my invention that period in which the shutter operates to cut off the light from the lens is related to the number of mirror blades used for reflecting the images on the film, e.g. if the mirrors are geared so as to pass a total of eleven blades during the cycle of operation of which only seven operate during exposure, then the shutter should cut off light from the lens for 4/11 of the time of operation which can be secured by shaping the shutter to the angle corresponding to 4/11 of a complete revolution i.e. 130.8°.

Exact registry or superimposition of the three component colour images is absolutely essential in the colour prints. To secure this registry in the colour prints the three negatives must have the images spaced exactly equally distant from the controlling perforations. An error of .00025" is noticeable and an error of .0005" seriously affects the picture. This need for extreme accuracy is further complicated by the extremely small space available for three of these registry mechanisms. Using a 50 mm. F/2 lens, there is only about 35 mm. (1-3/8") from the rear vertex of the lens to the focal plane. The two revolving mirrors must pass through this space as well as to leave room for the filter frames and the aperture plate to support the films.

An important feature of my invention is the provision of three film-feeding and registering mechanisms, hereinafter termed the "mechanism" which, as entirely independent units, connected by gearing to the camera drive, function to feed the film intermittently, register the film perforations on fitted pins, and to press the film against the aperture plate during exposure of the picture. The aperture plate is also a fixed part of the mechanisms. These mechanisms are adjustable in all three planes so that any error in registry can be easily corrected and micrometers, permanently fixed in the camera, enable the cameraman to take out the "mechanisms" for inspection or cleaning as well as for adjustment, and to replace them within a fraction of a thousandth of an inch. The exact position of the revolving mirrors are also controlled by accurate adjustments, also checked by fixed micrometers.

Another feature of my invention is the feed, registry and pressure plate device built in these "mechanisms" that feed, register and lock the film in position for exposure in 120° in the film cycle, enabling the film to be exposed for 240° in the cycle.

The camera is driven preferably by a vertical motor that operates the "mechanisms" by efficient and silent spur gears that permits slight movement of the "mechanism" for registration.

Another feature of my invention is the construction of the film feeding and take-up magazine in which the driving sprocket is incorporated in the magazine and a guide or scoop is provided just beyond the sprocket drawing film from the film feed magazine to turn this film at right angles to form an ideal loop to feed the film into its respective mechanism. The position of the three magazines

at the three sides of the top of the camera, opposite the lens, makes the camera very compact and permits a comparatively small soundproof covering or "blimp" to be fitted over the camera and its magazines. This magazine construction is a great aid in efficiently threading and serving the camera.

A camera constructed according to the invention is diagrammatically illustrated by way of example in the accompanying drawings in which:—

Figure 1 is a front elevation of the camera, partly in section;

Figure 2 is a horizontal section on line A—B, Figure 1;

Figure 3 is an enlarged plan view of the mirror and its control devices;

Figure 3*a* is a detail side elevation of same partly in section;

Figure 4 is an end elevation on an enlarged scale of the "mechanism" (with the aperture plate removed), including a portion of the camera frame;

Figure 5 is a section on line C—D, Figure 4;

Figure 6 is a top view of the mechanism on an enlarged scale;

Figure 7 is a section on line E—F, Figure 5;

Figure 8 is a diagram showing the stroke of the film feeding arm in the "mechanism";

Figure 9 is a diagram showing the positions of the film feed, registry pin and pressure plate during the cycle of a single exposure; and

Figure 10 is a perspective view of a magazine illustrating the method of feeding the film to the mechanisms.

The camera, Figure 1, consists of the base 1 with sidewalls 2 in which are hinged the doors 3, 3, Figure 2. The lens 4, (shown in dotted lines, Figure 1 or in Figure 2) mounted in suitable focussing means, is adapted to project a portion of its light rays to form an image on the film 5 in "mechanism" 6 through the filter 7, another portion of the light rays are reflected by the mirror 8, through filter 9 onto film 10 supported by mechanism 11, while the third portion of the light rays are reflected by mirror 12, through filter 13 onto film 14 in the "mechanism" 15. The mirror 12 is mounted on shaft 16, which in turn, is adapted to revolve in swivel bearing 17 and adjustable bearings 18, driven by gears 19, 19 from the drive shaft 20. The mirror 8, larger in diameter than mirror 12, is mounted on shaft 21 which crosses shaft 16 at a lower level and is driven by gears 22, 22 from drive shaft 20 and is journalled in swivel bearing 23 and adjustable bearing 24. The mirrors are further described in connection with Figures 3 and 3*a*.

The camera is preferably driven by the synchronous vertical motor 25, by gearing 26 through an adjustable idler gear 27, to gear 28 which is attached to and drives mechanism 11; the idler gear 27 also meshes with gear 29 which drives mechanism 6 and thence through the adjustable idler gear 30 to gear 31 which drives the "mechanism" 15. By these series of gears the three (or two) mechanisms are run in exact synchronism. While I usually prefer that all three "mechanisms" operate simultaneously in feeding the films, the mechanism can be "timed" to feed at different times, one ahead of the other for any purpose, as for example, a colour motion picture camera for photographing still objects such as cartoons. In that case mirrors having a single blade may be used and the light reflected successively to the films. In such cases the mechanisms might feed successively after the exposure was completed on that film. This can be arranged by changing the mesh of the teeth on the gears. The position of the idler gears 27 and 30 may be set to exactly mesh with the gears they connect by moving their adjustable brackets 32 and 33 respectively.

The motor also drives the mirrors, shutter and magazines through gears 34, 34, shaft 35, gears 36, 36 to shaft 20 which operates the mirrors, and, through gears 37, 37, operates the shutter 38. A hand drive is provided by shaft 39 which is connected through gears 40 to the shaft 35. The shutter and "mechanisms" make one revolution for each frame photographed preferably with the shutter cutting off the light from the films for 120° to correspond to three bladed mirrors making two revolutions for each frame, and the "mechanisms" feeding in 120°.

The three detachable film magazines 41, 42 and 43, the construction of which is described in detail later in the specification, are driven from three gears 41*a*, 42*a* and 43*a*, mounted near the top of the camera and operatively connected to the camera drive. The driving method is shown clearly in case of the magazine 43, which in Fig. 1 is shown in section. The gear 105 (Figs. 1 and 10) is mounted on shaft 104 together with feed sprocket 103 and take up sprocket 108. When the magazine 43 is placed in position on top of the camera, this gear 105 meshes with the drive gear 43*a* and connects the film sprockets 105 and 108 with the camera drive; similar means are used to drive the sprockets in the other magazines. The gears 41*a* and 43*a* are mounted on

shaft 44*a* journalled in brackets 44*b*, 44*b* attached to the top of the camera and are driven by bevel gears 44 from the vertical shaft 30*a*, preferably flexible, from the idler gear 30, while the gear 45, adapted to drive the sprockets in magazine 42 is driven from shaft 44*a* through bevels 42*a*.

The "mechanism" 6 (Figures 4 to 8) is a self-contained unit that consists of an intermittent film feed, a reciprocating pin registry device, a reciprocating pressure plate adapted to force the film, during exposure, into position against the aperture plate, (which is also a fixed part of the mechanism), and to release this pressure when exposure is completed to permit the film to move freely. The film is threaded in the annular slot formed between the mechanism proper and the pressure plate. The mechanism is preferably driven through a vertical shaft 46 (Figure 5) by means of gear 29 which is driven from the motor. Spiral gears 47, 47 drive the horizontal shaft 48 (Figures 5 and 8) to which is attached the harmonic cam 49 and gear 50. The intermittent film feed device consists of a frame 51, with a vertical slot 52 adapted to fit the periphery of the harmonic cam 49 and a horizontal slot to fit the periphery of the harmonic cam 53, mounted on shaft 54 which is suitably journalled in the sides of the mechanism. The shaft 54 is preferably driven by two to one gears 55 and 50 from the shaft 48. The cam 53 controls the feed of the film by reciprocating the frame 51, one end of which is mounted to turn on pin 57 in the sliding block 58. This block is moved in and out (at right angles to the film), sliding on the inside of the mechanism, operated by cam 49 working in the vertical slot 52 and consequently controls the position of the feeding finger 56 in relation to the film to cause it to enter the film perforation before the beginning of the down stroke, and to withdraw before the return stroke starts. The frame 51 is preferably made flat and as light as possible on account of its high reciprocating speed and operates, in line with one row of perforations in the film, between the inside surface of the mechanism 59 and the flat bearing cover 60 (Figure 8). The horizontal position of the pivot pin 57 (and consequently of the feed finger 56) is controlled by the harmonic cam 49, and the vertical position of the feed finger by harmonic cam 53. The path described by the tip of the film feeding finger is roughly shown by the dotted lines in Figure 8.

While this movement is not limited to the use of harmonic cams they are very desirable on account of their silence (for sound pictures) and their feed stroke of 120° followed by a "dwell" or stationary period of 60° during which time the feeding pin can be withdrawn from the film. For colour cameras in which the film feeding time must be reduced to a minimum (to allow more time for exposure) and especially when used in connection with the revolving mirrors where the shutter is limited to 120°, I prefer to use the gears 50, 55, having a two to one relation so the cam 53 will reciprocate the feed finger twice for each frame and to proportion the cam 49 to hold the feed finger away from the film every other stroke making in effect a "hit and miss" movement and actually feeding the film in 60°. If these gears 50, 55, be made of equal size, the cams will each make one revolution and the film will require 120° for the feed stroke only, and probably a shutter of 180°. Any other desired gear ratio can be used with corresponding shutter openings.

The position of the feeding finger when operating in 60° is shown by the dotted line XX in the 360° diagram in Figure 9.

The aperture plate 61 is attached to the "mechanism," preferably by screws, and is provided with an aperture 62 through which the film is exposed, and alongside, the holes 63, 63 to fit the registry pins 64, 65 and in front a groove in which filters may be mounted.

The registry device consists of two registry pins, the master pin 64 which is adapted to fit snugly both horizontally and vertically in the perforations in the film, and the narrow pin 65 adapted to fit the perforations on the other side vertically only (which is well known in the art). These registry pins are attached to or made a part of rods 66 and 67 and are connected by yoke 68, the rods being fitted to slide in holes in the main body of mechanism 6 operated by the offset driving pin 69 on the vertical drive shaft 46, sliding in the slot 70 in yoke 68 which forms in effect a crosshead. The stroke of these pins is preferably constant as indicated by dotted lines YY in Figure 9 and the dotted pins. Any means can be used to reciprocate these pins, such as cams, etc., especially if it is desired to hold the pins stationary for any period while in the films. After describing the action of the pressure plate the functioning of the registry pins will be further discussed.

After the straight portions of the registry pins have entered the perforations, the pressure plate 71, mounted on tube 72, and controlled by cam 73 on vertical shaft 46 is forced, by action of

the spring 74, against the film to hold it against the pressure plate during exposure even after the registry pins are withdrawn. Its action is shown by the full line ZZ in the diagram in Figure 9. The headed screw-threaded bolt 75, which is adapted to move inside the tube 72 and withdraw the pressure plate 71 against the action of spring 74, is adjustably attached to the channel-shaped lift 76 which contacts the cam 73. The adjusting screw-threaded bolt 75 is locked in place by a nut. To enable the film to be threaded, the mechanism is set at a position in which the feeding pin and registry pins are withdrawn from the film (for example at about 260° to 280° in the diagram) and the pressure plate is withdrawn by the cam 77 which operates in a slot 78 in the tube 72. By moving the handle 78^x the cam 77 is turned against the action of the spring 79 to withdraw the tube 72 and, consequently, the pressure plate 71 from the film. The film may now readily be passed between the pressure plate and aperture plate.

The "mechanism", in its preferred form, feeds the film forward one frame in 60° and, while the feed pin is still, at least partly, in the film perforation, the tapered registry pin starts to enter its perforation and shifts the film (preferably slightly back) to its exposure position. The registry pins quickly enter the perforation (they are in fast moving portion of their stroke) and then the pressure plate is forced by its spring (released by its eccentric or cam) against the film to hold it firmly against the aperture plate for the whole exposure period. The shutter now opens and the exposure period begins. The registry pins moving continually in their cycle withdraw from the film but the pressure plate prevents the films moving. Just before the exposure is completed the feeding pin starts to enter the perforation for another feed stroke. Simultaneously with, or immediately after, the shutter closes, the pressure plate is withdrawn and the film feed starts. In practice this feed and registry cycle is completed in 120° and could be made faster. This cycle is clearly shown in the diagram shown in Figure 8. The "mechanism" is almost silent in operation due, largely, to the fact that all parts are moved continuously and cams are avoided except harmonic cams (which are practically silent).

Another important feature of my invention is the fact that the film is never free or loose in the "mechanism". Before the feed pin withdraws the registry pins enter and the pressure plate holds the film until the feed pins enter the perforation for the next stroke.

As explained above, it is very necessary that the film be set in position with extreme accuracy for purposes of registry and that the "mechanisms" be shifted with great accuracy. By my invention, the position of the film (in terms of its perforation entered by the master pin 65) is not adjustable in relation to the mechanism or the aperture plate and that the whole mechanism is shifted in making these adjustments and micrometers are permanently mounted in the camera for reading and checking these adjustments.

In one construction the mechanism 6 has a flange or check 80, 80, on either side at or near the top which supports the body of the mechanism in a slot in the camera base 81 (Figure 4), wide enough to permit adjustment of the mechanism. Between the flanges 80 and the camera base 81 are shims 82, 82 that control the height of the mechanisms. To adjust the camera vertically, shims 82 of various thicknesses are used. Side adjustment of the camera is secured by inserting shims 83, 83 of varying thicknesses between the stop 84, shown as a part of the camera base, and the side of the flange 80. Any means may be used for forcing the mechanism against the shims such as the springs 85, 85 mounted in the stop 86.

After the mechanism is set with proper shims in all three planes, the screws 87, which pass through clearance holes in the flanges 80 and are tapped in the camera base 81, are tightened to hold the mechanisms finally in place.

Then, according to my invention, the exact position of the mechanism (and consequently of the images on the film) is determined or checked by micrometers permanently set in the camera in any or all planes Horizontal position on the two sides of the mechanism (to detect taper or tilt) is determined by micrometers 95 and 96 respectively; vertical registry by micrometers 97 and 98; and distance from the lens is determined by micrometer 99. By these means, not only can the mechanisms be adjusted any given amount to correct errors in registry, but a mechanism can be removed for cleaning or adjustment and then replaced and its position checked without fear of error in mounting or dirt affecting the height of the shims and thereby destroying the registry.

The method of adjusting and checking the position of the mirrors is shown in Figures 3 and 3*a* which are typical of both mirrors. The revolving mirror 12, having preferably three blades is mounted on the shaft 16 which is journalled in

bearings in the brackets 17 and 18 mounted on sub-base 109, which is adapted to turn on the pin 110 fitted in the camera base 81. To adjust the angularity of the mirror 12, for registry purposes, the sub-base 109 is turned on the pin 110, controlled by shims 111, inserted between the side of the bracket 18 and the stop 112. After the adjustment is made the sub-base 109 is tightened on base 81 by screws 113, 113 and its position checked by micrometer 114 permanently mounted on the stop 112. The mirror 12 is adjusted laterally by a screw thread acting against the outer face of the ball bearing in the bracket 18 (not illustrated) and its position is accurately checked by micrometer 115 mounted in bearing bracket 18. The necessary lateral movements of the mirror for purposes of registry are so slight as not to seriously interfere with the meshing of the teeth on the drive gear 19.

The camera magazines are preferably of the double type with the rolls of films alongside of each other with a feed-off and take-up sprocket in each magazine driven from the camera. A colour camera is necessarily very large, and it is important to arrange the magazines as compactly as possible on top especially for colour sound cameras that require a soundproof housing or " blimp " fitted over the cameras.

According to my invention the three magazines are mounted across the back and two sides of the camera top and the film is turned practically to right angles by a throat or scoop on the magazine.

The relations of a single magazine and the corresponding mechanism is shown in Figure 10. The magazine 43 carries two rolls of film alongside each other 101 being the feed-off roll and 102 the take-up roll. The feed film 101*a* passes over the sprocket 103, mounted on shaft 104 which is journalled in the magazine headers and driven by gear 105 from the camera drive. The film 101*a*, after leaving the sprocket is deflected by throat or guide 106 practically at right angles to bring it in line with the film throat 107 in the mechanism 6. The film is fed intermittently through the mechanism as described above and the gearing between the mechanism and the sprockets insures the maintenance of the proper loops. After the film passes out of the mechanism it is drawn by sprocket 108 through approximately at right angles into the magazine and is taken up on roll 102. The usual slip belt means for driving this take-up roll are used but are not illustrated in Figure 10.

It is well known to feed film into a camera from a magazine and to form various turns and loops, but a feature of my invention is that the deflecting guides or throats 106, mounted on the magazines and removable with them, deflect the films practically at right angles to form ideal loops to travel forward to the " mechanisms ". There is so little space between the film slots in the mechanism that film guides built as a part of the camera would be very much in the way when threading the camera or adjusting the filters. By mounting these guides on the magazines the space in the camera above the " mechanisms " is left entirely clear.

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 motion picture photographic camera having three independent film feeding and positioning mechanisms for each film, characterised by the fact that said mechanisms are adjustable in relation to each other and serve to feed the films intermittently and to position them in proper registration with each other which films are positioned one directly in front of a single entering light beam and the others laterally to right and left, the films being exposed substantially simultaneously to the light from a single lens by means of two intermeshing multiple bladed rotary mirrors co-operating with a rotary shutter and with the film feeding elements of the aforesaid mechanism, whereby each film is exposed uniformly over its entire surface.

2. A photographic camera, according to claim 1 wherein each film feeding and positioning mechanism carries an aperture plate and serves alternately to press the film against the aperture plate for exposure and to free the film to allow the feeding mechanism to advance it one image space.

3. A photographic camera as claimed in claim 1 or 2, in which each independent mechanism feeds a film intermittently, inserts registry pins in the perforations in the film properly to position the film for exposure, presses the film against the aperture plate then withdraws the registry pins and finally releases the pressure on the film prior to further feeding of the film.

4. A photographic camera according to any of the preceding claims, in which each film feeding and positioning mechanism comprises intermittent film feeding means functioning for a fraction of the film cycle, registry pins adapted to enter the film perforations, and a reciprocating

pressure plate adapted to force the film against an aperture plate and to hold it during exposure of the film, the withdrawal of registry pins, and the closure of the shutter whereupon the pressure plate releases the film to permit the feeding of further films.

5. A photographic camera according to claim 4, in which the feeding stroke is completed in 60 degrees of the film cycle.

6. A photographic camera as claimed in any of the preceding claims in which the independent mechanisms are adjustable in relation to each other and to the lens in any or all of three planes.

7. A photographic camera as claimed in claim 6, in which the adjustments of the independent mechanisms are controlled and measured by one or more micrometers integral with the camera.

8. A photographic camera as claimed in any of the preceding claims in which the mirrors are adjustable in relation to the position of the three films and the lens in any or all three planes.

9. A photographic camera as claimed in claim 8 in which the adjustments of the mirrors are controlled and measured by one or more micrometers integral with the camera.

10. A photographic camera as claimed in claim 4, in which the film feeding device comprises a frame operated by two harmonic cams, one controlling the feed stroke and the other the position of a feeding pin in relation to the film so that the feed stroke is completed in 60°.

11. A photographic camera as claimed in any of the preceding claims, in which each independent mechanism is operated from a vertical shaft extending therethrough and carrying a gear arranged to be driven by a motor mounted to operate in vertical position through a gear train including idler gears.

12. A photographic camera as claimed in any of the preceding claims, in which the means for distributing the entering beam comprises two intermeshing revolving bladed mirrors of different diameters, the drive shafts of which cross each other.

13. A photographic camera as claimed in claim 12, in which each of the mirrors has three blades and makes two revolutions for each picture, and the camera shutter cuts off light from the films one-third of the time.

14. A photographic camera as claimed in any of the preceding claims, including a double magazine mounted adjacent each of the independent mechanisms with its axis substantially as right angles to the direction of travel of the film through the respective film feeding mechanism, and including means for guiding each film from its magazine to its respective film feeding mechanism.

15. A motion picture photographic camera according to claim 14, in which the means for guiding each film out of its magazine towards its feed mechanism is a bent strip of material, the leading-away or delivery limb of which is set laterally at a substantial angle with respect to the leading-in or receiving limb.

16. A photographic camera as claimed in claim 14 or 15, in which the double magazines each have two film sprockets driven by the camera, said magazines being located each above and at substantial right angles to its respective independent mechanism, and each magazine having a film guide or throat adapted to deflect the film at substantially right angles as it is being forced out by the feed sprocket for the purpose of forming a loop.

17. The improved motion picture photographic camera substantially as hereinbefore described, with reference to the accompanying drawings, for the purpose specified.

Dated this 20th day of October, 1934.

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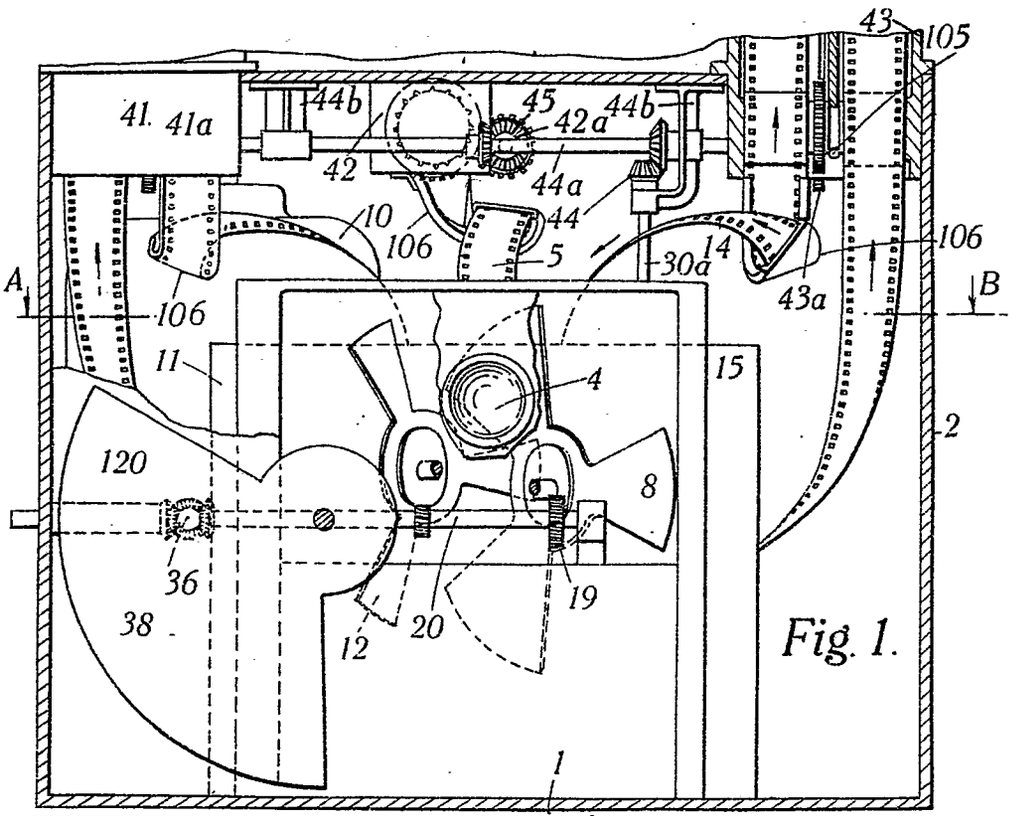


Fig. 1.

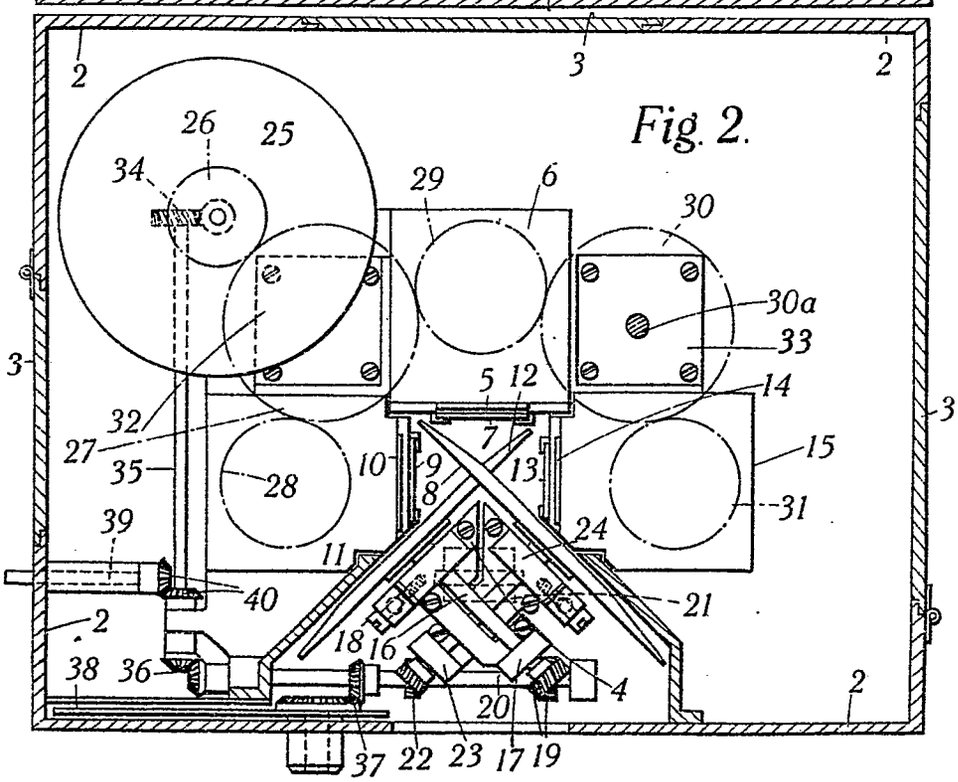
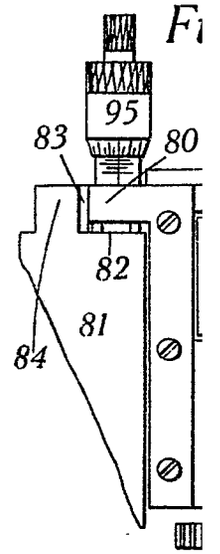


Fig. 2.

Fig.

Fig.



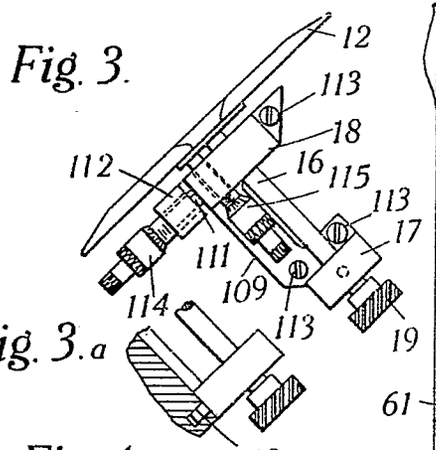


Fig. 3.

Fig. 3.a

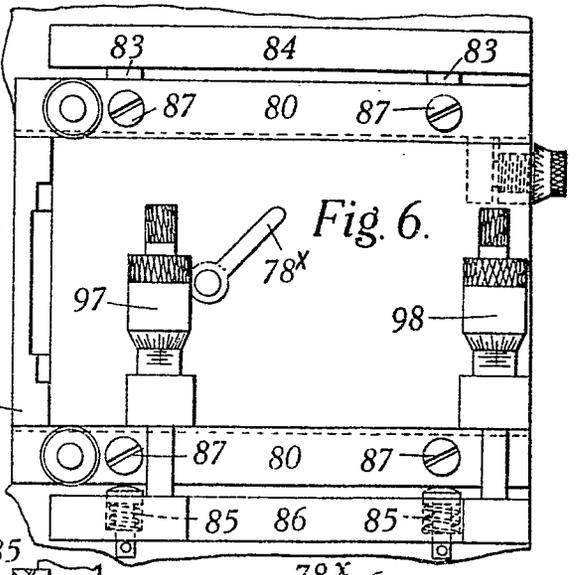
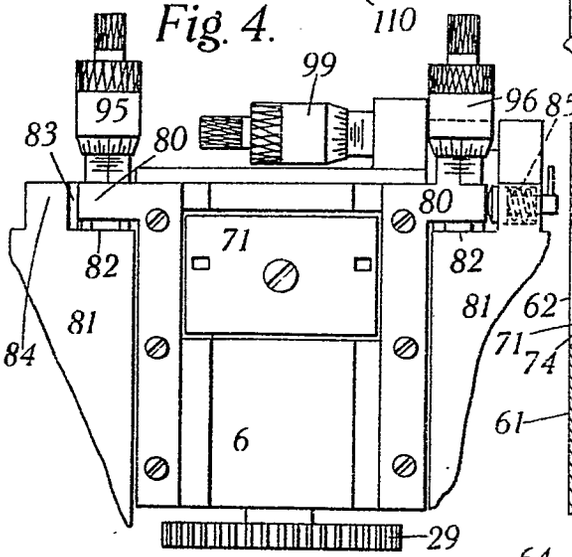


Fig. 6.

Fig. 4.



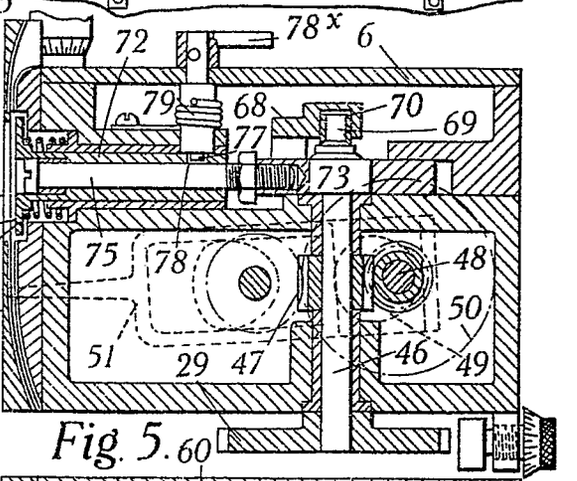


Fig. 5.

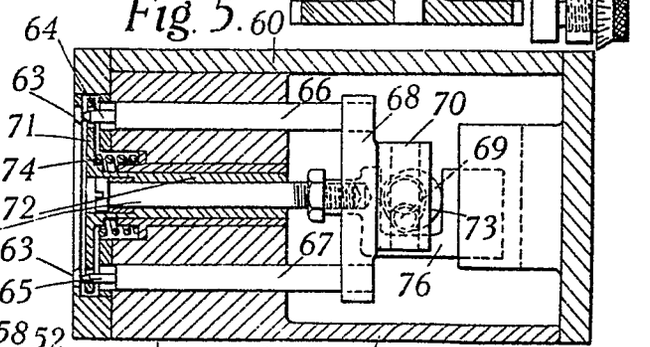
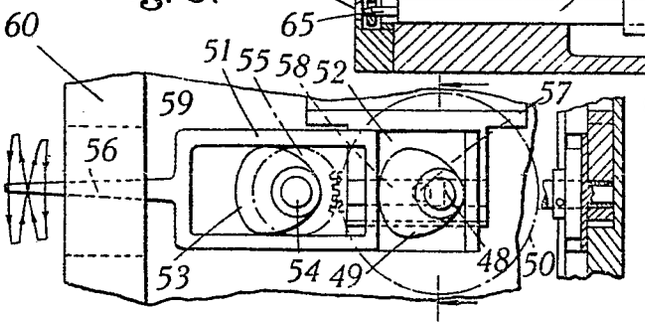


Fig. 8.

Fig. 7.



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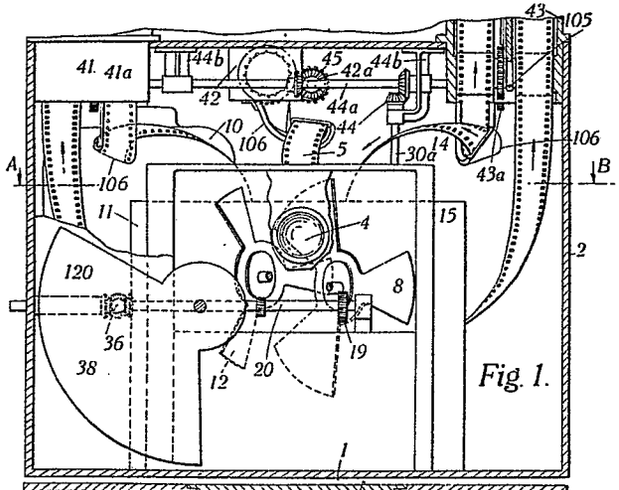


Fig. 1.

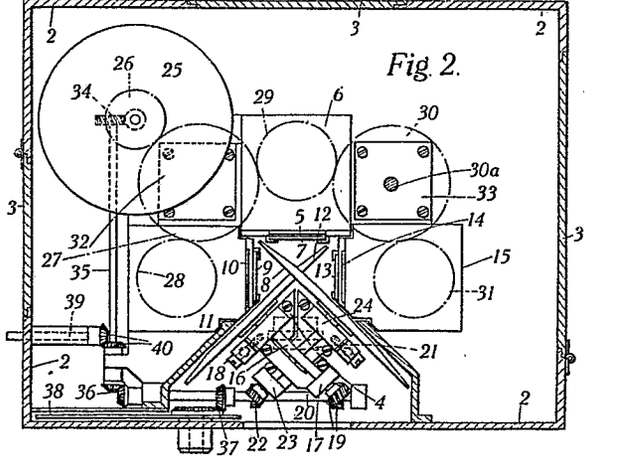


Fig. 2.

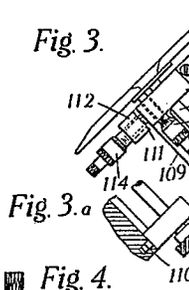


Fig. 3.

Fig. 3.a

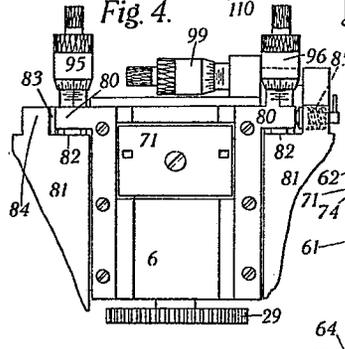
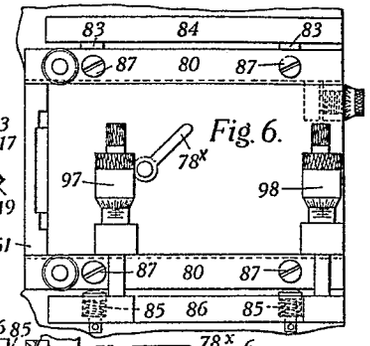


Fig. 4.



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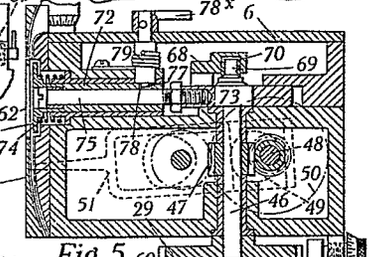

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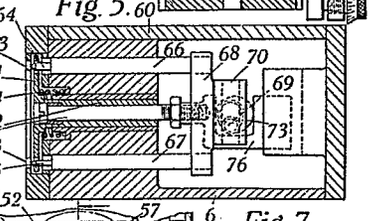

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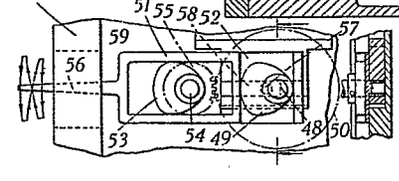

Fig. 7.

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Fig. 10.

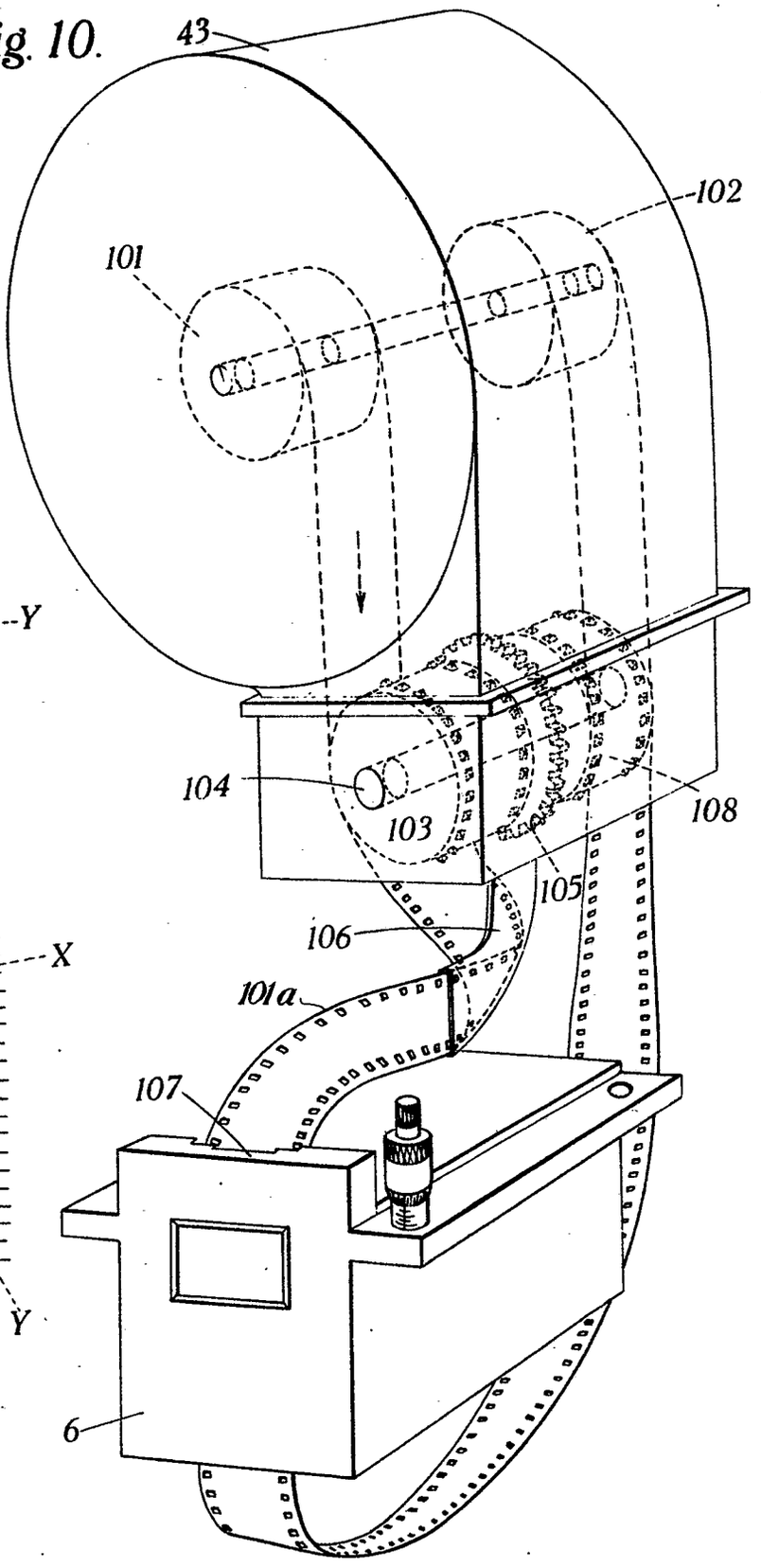
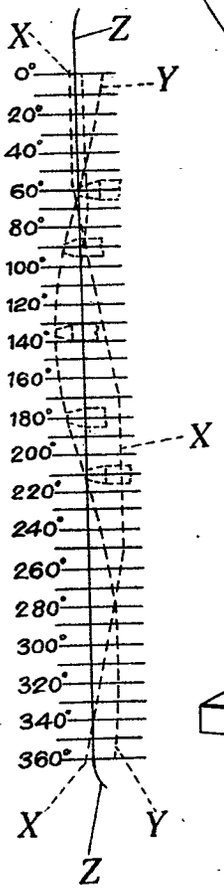


Fig. 9.



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