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(54) CARTRIDGE TYPE CAMERA

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to photographic and motion picture cameras of the kind adapted to receive a film cartridge having film supply and take-up chambers and means defining a film plane across which a filmstrip can be advanced from the film supply chamber to the take-up chamber, such cameras hereinafter being referred to as cartridge-type cameras.

Amateur photography has, since the introduction of cartridge loading cameras, been substantially standardized in the case of motion picture cameras to the use of the traditional camera styling concept of a vertical forward pointing gun-type design and in the case of still cameras to the use of a rectangular parallelepiped shaped housing which is normally held so that the two longest dimensions are parallel to the object plane and the shortest dimension is perpendicular to such plane.

Such motion picture cameras are customarily provided with a handle either rigidly, pivotally or removably attached to the camera housing for improved camera steadiness and operating comfort. However, the provision of handles adds bulk to the camera and does not entirely solve the problem of camera steadiness in that, even if the camera is held with two hands, the position of the hands (i.e. one above the other) is unnatural and invites camera movement. The two major dimensions of prior art still cameras are normally dictated by the size of the film

cartridge while the minor dimension, i.e. the dimension parallel to the direction of incident light, is predetermined by the back focus distance of the objective. As such, cameras have until the present invention had a rather large minor dimension. The size and shape of the cameras of this format have limited the carrying convenience in that the minor dimension has been too large to permit the camera to be carried in a pocket or similar small place in the operator's clothing. Further, because of the bulk of the camera and the position in which it is held during operation, camera steadiness has been impaired, frequently resulting in blurred or unsteady pictures.

By the use of a folded optical path between the scene to be photographed and the film plane, we have provided cartridge-type cameras having shapes which may be comfortably held steady as the scene is photographed.

It has been suggested in the past to provide a folded optical path in motion picture cameras between the object and the film plane in order to permit the receipt of light from the scene along an axis substantially parallel to the film plane. U.S. Patent No. 3,259,448 shows a high speed motion picture camera having feed and take-up spindles to accommodate "standard" daylight loading film spools arranged so that the axes of rotation of the spindles and spools are parallel and spaced from each other. The optical system of the camera includes a series of reflectors for folding the light path from the objective to the film plane. It is noted that the camera is adapted for high speed photography at frame rates of over 10,000 frames per second for scientific and industrial uses and obviously not designed to receive film cartridges of the type commonly used in amateur photography.

It also has been known that still camera size can be reduced by providing a folded

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optical path between the objective and the film plane such as shown in US Patents Nos. 3,478,662 and 3,479,936. Such folded optical paths have not been provided for cameras adapted to receive film cartridges of the type having cylindrical supply and take-up chambers and connecting means therebetween to define a film plane. Until the present invention, the size of such cameras has been considered to be predetermined by the size of the exposure aperture in the cartridge and the camera optics.

In accordance with the present invention there is provided a cartridge-type camera comprising an optical system for directing light from a scene to be photographed along a folded optical path to a primary image plane to form thereat an image of the scene and means for locating a film cartridge with its film plane in the primary image plane, wherein the folded optical path has at least three successive axes from the scene to the primary image plane and the optical system includes zooming and compensating lens components located along the next to last of said successive axes taken in the direction of light travel towards the primary image plane.

In the accompanying drawings:—
 Fig. 1 is an exploded, front perspective view of a motion picture camera according to the present invention and of a motion picture film cartridge received therein.

Fig. 2 is a view, to an enlarged scale, of a portion of the camera shown in Fig. 1, including the optical system;

Fig. 3 is a view, to an enlarged scale, of another embodiment of the optical system of the camera shown in Fig. 1;

Fig. 4 is a view, to an enlarged scale, of yet another embodiment of the optical system of the camera shown in Fig. 1;

Fig. 5 shows a rear perspective view of a partially broken away film cartridge and the optical system of another embodiment of a motion picture camera according to the present invention;

Figs. 6-15 are partially broken away perspective views of other embodiments of a motion picture camera according to the present invention;

Fig. 16 is a partially broken away perspective view of a still camera according to the present invention; and

Fig. 17 is a partially broken away perspective view of another embodiment of a still camera according to the present invention.

Because cameras are well known, the present description will be directed in particular to elements forming part of, or cooperating more directly with, apparatus in accordance with the present invention. It is to be understood that camera elements not specifically shown or described may take various forms well known to those skilled

in the art.

Referring to Fig. 1, a motion picture camera 10 is adapted to receive a film cartridge 12 which in the embodiment shown is of the type known as a Super 8 cartridge. Cartridge 12 is more clearly shown in Fig. 5 where it can be seen that six rectangular sides form a rectangular parallelepiped shaped casing 14 having a minor depth dimension d' which is substantially smaller than its major length and width dimensions l and w , respectively. In a commercially available cartridge, dimensions d , l and w are approximately 1 inch, 3 inches and 2½ inches, respectively.

Casing 14, together with a partition 16, defines adjacent film take-up and supply chambers. The supply chamber contains a freely rotatable core 18 upon which a film supply roll 20 is wound. Similarly, a film take-up roll 22 is shown in the other chamber. The core of the take-up roll is driven through a friction clutch to advance film into the take-up chamber by means of a pair of drive lugs 24 and 25 (Fig. 1). In passing from the supply to the take-up chamber, the film passes an opening 26 in the casing wall through which the film is exposed by light received from the scene to be photographed. The film is advanced past opening 26 by means of a claw 27 (also Fig. 1), which is conventionally driven by a pull-down mechanism (not shown) powered through a gear train from a motor 35.

Now referring back to Fig. 1, the camera 10 comprises a housing 28 formed of a plurality of walls which, together with a door 38, form a light-tight enclosure defining a volume 30 having a minor depth dimension d' substantially smaller than the major length and width dimensions l' and w' respectively. Dimensions d' , l' and w' are slightly larger than dimensions d , l and w , to permit reception of cartridge 12 in volume 30. The camera size and shape are such as to provide a comfortable and stable format. The camera embodiment of Fig. 1 accomplishes these desirable results by providing an optical system described in conjunction with Figs. 2-4 which permits housing 28 to have a depth D of approximately 1½ inches, a length L' of approximately 5 inches and a width W' of approximately 4 inches. In any event, it is preferable that each of the length and width dimensions be at least twice as long as the depth dimension.

A drive member 32, which is located to cooperate with drive lugs 24 and 25 of the cartridge, extends into volume 30 through a rear partition 34 and is connected on the other side of partition 34 to the drive motor 35. The connection between drive member 32 and motor 35 is not shown, but would preferably consist of a series of gears, the

design of which would readily occur to a person skilled in the art. The motor and other camera mechanisms are powered by a set of batteries 36 also housed beside volume 30. Volume 30 is closed by means of a door 38 hingeably attached to the camera housing 28 by means of a hinge 40.

Camera 10 has an upper compartment 42 which has been provided for the optical system for the camera and for much of the conventional camera operating mechanism. A partition 44 is located between upper compartment 42 and housing volume 30 and defines an exposure aperture 48 through which light entering the camera 10 through an opening 49 in the front wall thereof may pass to expose the area of film located below aperture 48. Opening 49 has a transparent cover 50.

The front wall of the camera 10 is provided with two other openings besides opening 49, namely opening 51 which is provided for the camera range finder lens 52 and opening 53 which is provided for the viewfinder lens 54. Of course there is an opening in the back wall (not shown) of the upper compartment 42 through which the operator views the scene.

The camera is actuated by manually depressing a push button 56 and, in the case of a camera provided with a zoom lens, the lens may be zoomed manually by turning a knob 57.

Referring to Fig. 2, there is shown an optical system for directing light from the scene along a folded path to form an image at the primary image plane of the camera shown in Fig. 1. The optical system shown in Fig. 2 comprises a pair of mirrors 58 and 60 with a zoom portion 62 interposed between the mirrors. Zooming portion 62 comprises an objective 64 held in axially movable lens mount 65, a zooming component 66, and a compensating component 68. Light which enters camera 10 from the object or scene through protective cover 50 falls upon mirror 58 which reflects the light through objective 64 and zooming and compensating components 66 and 68, respectively, to mirror 60. Mirror 60 in turn reflects the light through a relay objective 70 to the film located below exposure opening 26 in cartridge 12. The parameters of the optical system require special attention in order to provide a desired focal length range with an overall size commensurate with the camera format shown in Fig. 1.

Zoom control is accomplished by turning zoom knob 57 to adjust the position of a zoom lever 71, preferably formed of flexible plastics material. Zoom knob 57 has a double ramp 72 with telephoto and wide angle positions juxtaposed at 180° with a smooth detent at each position. This permits 360° rotation in either direction with de-

tectable stops at the telephoto and wide angle positions. Zoom lever 71 comprises two portions 73 and 74 connected together by a necked region 75 which permits relative angular movement of portions 73 and 74.

Portion 74 is pivotally mounted on the camera housing by means of a pivot 76 and has a resilient portion 77 which presses sideways against a stationary housing abutment (not shown) to urge the lever 71 in a clockwise direction about pivot 76, thereby holding the free end of portion 73 against the cam surface 72. By turning zoom knob 57, zooming and compensating components 66 and 68, respectively, are moved by the angular displacement of the portion 74 of the lever 71. A more detailed description of the zoom control mechanism can be found in our co-pending Application No. 34473/71 (Serial No. 1,313,810).

Objective 64 of zoom portion 62 and its mount 65 are moved axially to adjust the camera focus by means of a rotatable ring 85 which extends through the rear wall of the camera so that it can be turned by the operator's right thumb. Rotation of ring 85 moves objective 64 axially by means of a conventional cam and follower arrangement, not shown.

A ranging mirror 78 is coupled to the ring 85 by means of a cam 79 on the ring and pivots about a rod 81 as the ring is turned. An image of the object to be ranged on is reflected by a mirror 78 through a lens 83 to the surface of a half-silvered mirror 80 where it is superimposed upon the same object seen by the viewfinder and reflected through the system to the operator's eye.

Because of the formats of the camera, the viewfinder can be much shorter than in conventional cine cameras and, as such, occupies much less volume. For example, a finder with .8x magnification, projected frame and capable of a field of view for a 7mm taking lens may occupy only .4 cubic inch. If focal length is long enough and minimum cost is desired, a straight through tunnel may be used with plane glass covers front and rear. For shorter focal length lenses, a reversed Galilean finder of the type well known in still photography arts may be used. In either case, zoom compensation will be desirable in instances where the camera is equipped with zoom capability. This may be accomplished by either a conventional variable frame mechanism to define a field angle corresponding to that of the objective or by a conventional zoom finder coupled to the zoom objective.

The various controls for the camera of the present invention can be operated without the operator removing either hand from the camera. Zoom knob 57 is left-hand operated. Focusing element 64 extends from the

back of the camera where it is operated by the right thumb, and push button 56 is operated by the forefinger of the right hand.

Referring to Fig. 3, there is shown an alternative embodiment of the optical system for the camera shown in Fig. 1. In this embodiment, an objective 82 of zoom portion 62 is located between the scene or object and the reflecting mirror 58. As in the embodiment shown in Fig. 2, mirror 58 reflects the image through zooming and compensating components 66 and 68, respectively. The embodiment of Fig. 3 permits focusing and triggering with the forefinger of the right hand without removing the hand from the camera. Focusing ring 85 may extend through the side wall of the camera or may protrude from the camera front. Note that there is no need for a protective cover such as cover 50 shown in Fig. 2, objective 82 serving to protect mirror 58.

The embodiment shown in Fig. 4 is a further optical system which may be used with the camera shown in Fig. 1. The embodiment includes a reflex finder system. Light entering through a first element 86 is reflected by mirror 58 through a second element 87 which is movable by turning a geared knob 88. Knob 88 may extend through the rear wall of the camera. Second and third zoom components 89 and 90, respectively are spaced on either side of an adjustable diaphragm 91. The use of a beam-splitter 92 at the second fold of the optical path permits the use of a simple, compact reflex viewfinder. An erecting prism 93 directs scene light to the operator's eye.

The optical reflecting systems shown in Figs. 2-4 are arranged for cameras of the type shown in Fig. 1, i.e. cameras wherein the cartridge loads from the front of the camera, the terms front, rear, top and bottom being used herein to refer to camera directions as they would occur with the camera held in a normal position to take a picture of the horizon. Thus, the front side of the camera is that side closest to the scene when a picture is taken and through which light passes into the camera interior.

In Fig. 5, there is shown a portion of an optical system for a camera of similar format to that of Fig. 1 except that the film cartridge 12 is inserted from the rear of the camera (the side furthest from the scene). Note that in this embodiment, the film drive system has been moved to the front of the camera and the drive motor has been repositioned on the right-hand side of the cartridge as viewed in Fig. 5. The cartridge locating features have been modified so that the cartridge is reversed with respect to the scene from the cartridge position shown in Fig. 1. As such, mirrors 100 and 102 have been positioned to intercept light entering

from the left-hand side of the camera front and to reflect that light to an optical system 104 which focuses an image of the viewed scene on the film in the cartridge. Referring back to Figs. 1-4, it will be noted that the mirrors shown in those embodiments intercept light entering from the right-hand side of the camera front. The different arrangement of the Fig. 5 embodiment is necessary to properly orient the image on the film.

Still, referring to Fig. 5, a shutter 106 carried by a shaft 108 is provided to periodically interrupt light transmittal to the film. Shutter 106 is driven by a motor 109 through gears 111 and 113.

Although not shown, it is to be understood that the embodiment of Fig. 5 and each of the embodiments hereinafter described with reference to Figs. 6 to 17, inclusive, of the accompanying drawings is provided with zooming components in a manner similar to any of the embodiments discussed with reference to Figs. 2 to 4. These zooming components have been omitted from Figs. 5 to 17 only for purposes of clarity.

In the embodiments of Figs. 1-5, the camera would normally be held with the longest dimension vertical and with the film plane at the top of the film cartridge in the camera and the primary image plane perpendicular to the object plane. In Figs. 6-7 there are shown two embodiments in which the camera is once again held with the longest dimension vertical, but wherein the film cartridge is mounted so that the film plane is at the bottom of the cartridge when in the camera.

In the embodiment of Fig. 6, film cartridge 12 is inserted into camera 110 from the front thereof. As with the earlier described embodiments, light entering the camera through a protective cover 112 is folded by mirrors 116 and 118 along three orthogonal axes 120, 121 and 122 to the cartridge film plane. Cover 112 can be omitted if mirror 116 is protected by a lens. The scene to be photographed is viewed through a viewfinder 124.

In Fig. 7, a camera 126 has been shown having a format similar to that of the camera embodiment of Fig. 6 except that the drive mechanism and optical system have been modified in a manner similar to that discussed with reference to Fig. 5 so that cartridge 12 may be loaded into the camera from the rear.

In the embodiments of Figs. 8 and 9, the camera format is such that the operator would normally hold the camera in an orientation so that the longest camera dimension is horizontal and the shortest dimension is perpendicular to the object plane. The optic system and drive mechanism of the

camera shown in Fig. 8 are arranged as shown so that the camera can be loaded from the rear while the camera of Fig. 9 is loaded from the front. In each case, light entering through covers 132 and 134, respectively, is reflected by a two-mirror system through an objective to the film plane of a cartridge 12. In the mirror orientation shown, the light path from the scene to the film plane does not travel over orthogonal axes, this mirror orientation being a feature which may be utilized in any of the embodiments described herein.

The camera embodiments shown in Figs. 10-15 provide flat, horizontal formats wherein the two largest dimensions of the camera normally will be substantially horizontal when a picture is being taken. Such a format, as with the previously discussed formats, will provide a steadier support to help eliminate camera shake. In Figs. 10 and 11, the film cartridge is inserted into the camera in an orientation such that the film plane is vertical and perpendicular to the object plane. In Fig. 10, camera 140 contains a pair of mirrors 142 and 144 which fold the light path so that light passing through cover 146 is directed through objective 148 to the film plane of cartridge 12. The camera shown in Fig. 11 is similar in design to that of Fig. 10 except that cartridge 12 is to be loaded from the bottom of the camera, light entering the camera through cover 150 being reflected by mirrors 152 and 154 through objective 156 to the film plane of cartridge 12.

The cameras shown in Figs. 12-15 are each designed to receive a film cartridge such that the film plane of the cartridge is parallel to the object plane when a picture is being taken. In the Figure 12 and 13 embodiments, the film plane is on the front side of the cartridges when they are in the camera and in the Figure 14 and 15 embodiments, the film planes will be on the back side of the film cartridges when in the camera. In Fig. 12, light entering the camera through cover 158 will be reflected by mirrors 160, 162, 164 and 166 through objective 168 to the film plane. The camera embodiment of Fig. 13 is similar to that of Fig. 12 except that the optical system has been arranged so that cartridge 12 is loaded into the camera through a door at the bottom of the camera, the Fig. 12 embodiment being loaded through the top of the camera.

In the embodiment shown in Fig. 14, light entering the camera through cover 172 travels past film cartridge 12 to mirror system 174 and is reflected thereby through objective 176 to the film plane. In that embodiment, film cartridge 12 is loaded into the camera from the top while in the embodiment shown in Fig. 15, which is similar to the Fig. 14 embodiment, film cart-

ridge 12 is inserted in the camera through a door 178 at the bottom and the optics are so arranged.

A still camera 210 shown in Fig. 16, is adapted to receive a film cartridge 212. In the embodiments shown in Figs. 16 and 17, cartridge 212 is of the popular Size 126 type comprising film supply and take-up chambers 214 and 216, respectively, and a connecting portion 218 which defines a film plane across which a film strip 220 may be advanced by means of a core (not shown) in take-up chamber 216, the end 222 of the core being shown in Fig. 16.

Camera 210 of Fig. 16 comprises a housing having a front wall 226, a back wall (not shown) which would normally be provided with a door for inserting a film cartridge, and side, top and bottom walls. A winding knob 228 is provided for advancing film 220 from supply chamber 214 to take-up chamber 216 of cartridge 212 by any suitable mechanism, such mechanisms being well known to those skilled in the art. Front wall 226 of camera 210 is provided with a lens mount 230 which carries an objective 232. Lens mount 230 is shown protruding slightly beyond wall 226, but it could of course be flush or recessed. A viewfinder cover 234 is provided in front wall 226 and a viewfinder system of any conventional structure is contained therebehind. A trigger release button 236 extends from the top of camera 210.

Light entering the camera through objective 232 is reflected by mirrors 238 and 240 to the film plane of a received film cartridge. By folding the light path in this manner, the distance normal to the film plane between the film plane and objective 232 can be greatly reduced. As seen in Fig. 16, the camera would normally be held in such a manner that the largest dimension is vertical and the shortest dimension extends from front to back of the camera. However, by relocating push button 236 to one of the sides of the camera it would be convenient to hold the camera so that the longest dimension is substantially horizontal when a picture is being taken. The shape of the picture would not be affected since Size 126 negatives are square.

Referring to Fig. 17, a camera 250 is provided with a rectangular parallelepiped housing 252 which is adapted to receive a film cartridge 212 of the size 126 type described above with reference to the embodiment of Fig. 16. The front wall 254 of camera 250 is provided with a film advance knob 256, a cover 258 through which light passes to an objective 260 and a cover 262 for the viewfinder. Light passing through objective 260 is reflected by mirrors 264 and 266 to the film plane of a received cartridge 212. A push button 268 extends from the top

wall of camera 250 for releasing the shutter mechanism to take a picture. The bottom wall of camera 250 is provided with a door (not shown) for loading and removing cartridges.

In operation, the camera normally is held so that the longest dimension is horizontal and parallel to the object plane and the shortest dimension vertical. Held in this position, the camera may be rigidly supported, reducing camera shake and thus eliminating to a large extent blurred picture.

It will be noted that in the illustrated embodiments, the camera format is such that the primary image plane is perpendicular to the object plane in the embodiments shown in Figs. 1-11 and 17 and is parallel to the object plane in the embodiments shown in Figs. 12-16.

WHAT WE CLAIM IS:—

1. A cartridge-type camera comprising an optical system for directing light from a scene to be photographed along a folded optical path to a primary image plane to form thereat an image of the scene and means for locating a film cartridge with its film plane in the primary image plane, wherein the folded optical path has at least three successive axes from the scene to the primary image plane and the optical system includes zooming and compensating lens components located along the next to last of said successive axes taken in the direction of light travel towards the primary image plane.

2. A cartridge-type camera according to Claim 1, wherein the primary image plane, in the position of use of the camera, is dis-

posed substantially perpendicular to the object plane of the scene to be photographed.

3. A cartridge-type camera according to Claim 2, wherein the axes of the folded optical path furthest from the primary image plane is disposed parallel to the primary image plane and to the cylindrical axes of take-up and supply film rolls of a received cartridge.

4. A cartridge-type camera according to Claim 2, wherein the axis of the folded optical path furthest from the primary image plane is disposed parallel to the primary image plane and perpendicular to the axes of take-up and supply film rolls of a received cartridge.

5. A cartridge-type camera according to Claim 3 or 4, wherein the three axes of the folded optical path are substantially orthogonal and the second axis is disposed parallel to the primary image plane.

6. A cartridge-type camera according to Claim 1, wherein the primary image plane, in the position of use of the camera, is disposed substantially parallel to the object plane of the scene to be photographed.

7. A cartridge-type camera according to Claim 6, wherein the axis of the folded optical path furthest from the primary image plane is disposed perpendicular to the primary image plane and to the cylindrical axes of take-up and supply film rolls of a received cartridge.

8. Cartridge-type cameras having a folded optical path substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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2. A cartridge-type camera according to Claim 1, wherein the primary image plane, in the position of use of the camera, is dis-

posed substantially perpendicular to the object plane of the scene to be photographed.

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5. A cartridge-type camera according to Claim 3 or 4, wherein the three axes of the folded optical path are substantially orthogonal and the second axis is disposed parallel to the primary image plane.

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