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(54) PHOTOGRAPHIC FILM UNIT AND CARTRIDGE ASSEMBLY THEREFOR



(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:—

This invention relates to photographic film units and to cartridge assemblies therefor.

It has been known previously to provide a photographic system wherein the photosensitive material is in the form of a disc arranged to be rotated in a camera to position image areas thereof on an optical axis of the camera for exposure. All such prior known systems have suffered from one or more serious disadvantages which has prevented viable commercial realisation of the system.

A disadvantage which has arisen with previous systems has been the accurate location of intended image areas of the photosensitive material on the optical axis of the camera and the accurate reproducible location of the exposed and processed areas in subsequent utilization, e.g. projecting or printing of the images. A further disadvantage arose in that either the photosensitive material had to be handled at some stage or if it was mounted in or on a support, it had to be stripped therefrom for processing if residual processing fluid, affecting the processed material, were to be avoided.

It is an object of the present invention to provide a photographic film unit, and a cartridge assembly therefor wherein such disadvantages have been minimised or overcome.

According to the present invention, there is provided a photographic film unit comprising a disc of photosensitive material having a plurality of image areas and a rigid hub having a radially outwardly opening recess, the perimeter of a central aperture in the disc being received in the recess and

being permanently secured therein so that the disc is rotatable with the hub.

The invention further comprises a cartridge assembly including a film unit as aforesaid of laminar construction having an exposure window in a casing wall thereof, the window being spaced from the axis of rotation of the film unit a distance such that the image area may be presented sequentially thereat.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is an exploded perspective view of the photographic cartridge assembly described herein,

Figure 2 is a plan view of one face of the cartridge assembly shown in Figure 1 with a portion of one outer casing member wall removed;

Figure 3 is a plan view of the opposite face of the cartridge assembly of Figure 1;

Figure 4 is a fragmentary enlarged cross-sectional view taken along line 4—4 of Figure 2;

Figure 5 is an enlarged view of a portion of Figure 4;

Figure 6 is a cross-sectional view taken along line 6—6 of Figure 4;

Figure 7 is a cross-sectional view taken along line 7—7 of Figure 4;

Figure 8 is a cross-sectional view corresponding to the view of Figure 4, including a portion of a cooperating camera mechanism, and showing the relationship of structural parts at an initial stage of operation of the cartridge assembly;

Figure 9 is a cross-sectional view taken along line 9—9 of Figure 4, but including a portion of a cooperating camera mechanism;

Figure 10 is a cross-sectional view taken along line 10—10 of Figure 8;

Figure 11 is a cross-sectional view corresponding to the view of Figure 8 and showing the relationship of structural parts at a later stage of operation of the cartridge

assembly;

Figure 12 is a cross-sectional view taken along line 12—12 of Figure 11;

Figure 13 is a plan view, similar to that of Figure 3, partially broken away for the sake of illustration, but including a lock arrangement different to that shown in the earlier Figures;

Figure 14 is a view similar to that of Figure 13 but showing the different lock arrangement in a later condition;

Figure 15 is a cross-sectional view of a portion of a modified wall of a cartridge casing;

Figure 16 is a cross-sectional view, similar to that of Figure 15, of a portion of a further modified wall of a cartridge casing;

Figure 17 is a cross-sectional view, similar to that of Figures 15 and 16, of a portion of yet another modification of a wall of a cartridge casing;

Figure 18 is a perspective view of a camera according to a preferred embodiment of the present invention, suitable for loading with a cartridge assembly of any of the forms shown in the preceding figures;

Fig. 19 is a perspective view of the camera shown in Fig. 18 illustrating that camera inverted and pointed in the opposite direction and with its cover door open to receive a cartridge assembly;

Fig. 20 is a plan view of mechanism incorporated in the camera shown in Fig. 19, depicting the respective positions of the illustrated mechanism components when a film cartridge assembly has been loaded into the camera but before a film disc hub has been moved from its initial position;

Fig. 21 corresponds to Fig. 20 but depicts the illustrated mechanism in the process of engaging the film disc hub to effect the initial rotational movement thereof;

Fig. 22 corresponds to Figs. 20 and 21 and illustrates the respective positions of the mechanism components after completion of the first indexing operation which removes the cover slide from the exposure window and locates the first exposure area in position for exposure;

Fig. 23 is a fragmentary enlarged cross sectional view taken along line 23—23 of Fig. 20;

Fig. 24 is a fragmentary perspective view of a film support frame member incorporated in the camera;

Fig. 25 is a somewhat schematic cross sectional view of a gate structure and optical elements associated therewith, included in the camera illustrated in Figs. 18 to 24;

Fig. 26 is an enlarged view of a portion of Fig. 22 illustrating the advancing pawl tooth and the indexing pawl tooth;

Fig. 27 is an enlarged partially cross sectional view taken along line 27—27 of Fig. 20;

Fig. 28 is a plan view corresponding to Figs. 20—22 but depicting the components of the camera located below the mechanism plate illustrated in those figures;

Fig. 29 is an enlarged fragmentary perspective view of a portion of the shutter release mechanism illustrated in Fig. 28;

Fig. 30 is an enlarged exploded view of the cover latching mechanism of the camera illustrated in Figs. 18—29;

Fig. 31 is a somewhat schematic plan view of a second embodiment of a camera having a simple manual film advancing mechanism utilising a slightly modified film disc hub;

Fig. 32 is an enlarged fragmentary view of the advancing and positioning teeth employed in the mechanism shown in Fig. 31, and illustrates the respective positions of those teeth when the film disc is positioned for exposure;

Fig. 33 corresponds to Fig. 32 and shows the respective positions of the advancing and positioning teeth after the film disc hub has completed its rotation to return the cover slide to the cartridge assembly's exposure window;

Fig. 34 is a somewhat schematic plan view of a third embodiment of a camera having an automatic film advancing mechanism, showing the depicted components of that mechanism in their respective positions during the camera loading operation;

Fig. 35 illustrates the door latch device incorporated in the mechanism depicted in Fig. 34, showing that device in its latching condition;

Fig. 36 corresponds to Fig. 34 and shows the door latch device in its released condition;

Fig. 37 corresponds to Fig. 34 and shows the respective positions assumed by the various illustrated components as the film disc is advanced and exposed;

Fig. 38 illustrates a modification of the film unit advancing and indexing mechanism shown in Figs. 34 and 37;

Fig. 39 depicts another modification of the mechanism shown in Figs. 34 and 37, with the illustrated components shown in the positions that they assume after completion of a film indexing operation;

Fig. 40 corresponds to Fig. 39 but shows the depicted components in their respective positions during a film advancing operation;

Figure 41 is a perspective view of a film unit as described herein;

Figure 42 is a perspective view of a plurality of film units arranged for handling subsequent to exposure; and

Figure 43 is a cross-sectional view of a portion of the equipment illustrated in Fig. 42.

Various terms such as "cartridge", "cassette" and "magazine" have been used to refer

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to film containers which, loaded with film, are put into cameras. Such a container, loaded with film, is herein referred to as a "cartridge assembly". Because cartridges, cartridge assemblies and photographic cameras for use therewith are well-known, the present description is directed in particular to elements forming part of, or cooperating more directly with, cartridge assembly elements to which the present invention is specifically directed. Apparatus that is not specifically shown or described herein is understood to be selectable from apparatus shown in the art.

Figure 1 shows, in exploded perspective, a cartridge assembly 11 which includes a film unit 17 and a casing. The film unit 17 is comprised of a film disc 10 and a hub 12, (see Figure 41) together with a cover slide 14 and an opaque masking member 16. The casing includes a casing member 18 including a hub support 19. The cartridge assembly (see also Figures 2 and 3) is suited for cooperation with a camera of the form illustrated for example, in Figures 18 to 30.

The film disc 10, as shown herein, is formed in the shape of a disc with a generally circular outer perimeter 20. Although herein referred to as a "disc", other non-circular shapes such as polygonal, for example, hexagonal or octagonal, may, however, be adopted for use in embodiments of the present invention. The film disc 10 includes a moderately flexible but self-supporting base sheet which may be formed of, for example, cellulose acetate or poly(ethylene terephthalate), the latter being sold under the trademark "Mylar". The base sheet carries photosensitive materials on one face thereof, thus providing a photographic imaging surface 13 on which one or more latent photographic images may be recorded and subsequently photographically developed.

The film disc 10 has a central opening 22. The hub 12 is mounted in the central opening 22 of the film disc 10, with the hub and disc having a particular orientational relationship, as will be described later. The film disc 10 and hub 12 are designed to remain attached for handling as a unit not only during exposure in a camera but also during processing, printing, viewing and other post-exposure operations. The film unit has first and second faces which face in opposite directions along the axis A of rotation of the film unit. The hub 12, being mounted in the film disc opening 22, constitutes (by means of its axially-oppositely facing faces) a portion of each of the film unit faces (see Fig. 41). Both faces of the hub are available to carry or present structure of the type hereinafter described for handling the film unit.

The hub 12, which may be formed by

suitable plastic molding techniques, includes a stepped ring structure 15 (see Fig. 4), a portion of which projects through the film disc's central opening 22. During manufacturing operations, the film disc 10 and the hub 12 are preliminarily aligned in predetermined relationship by means of a key 24 on the film disc 10 which projects into the central opening 22 and is closely received within a correspondingly shaped keyway 26 (see Fig. 5) formed in the hub. The film disc 10 may be secured to the hub 12 by, for example, adhesive which causes a bonding of the disc to the hub. Alternatively, if the hub 12 is formed of a deformable material such as polystyrene, the film disc 10 may be secured by applying heat and/or pressure to the hub 12. Figure 5 shows a finger 28 which is formed adjacent the hub keyway 26 and which may be deformed (from its initial position shown in phantom in Fig. 5) onto the surface of the film disc 10 to secure the key 24 within the keyway 26 and clamp the disc to the hub. Further fingers or other means of attaching the hub to the film disc may be provided around the hub and opening as necessary, to ensure that both attachment and required orientational relationship are maintained throughout the useful life of the film unit.

According to a preferred embodiment, the keyway 26 is a radial indentation of an annular recess extending around the hub and opening only away from the axis of rotation of the unit. The disc 10 is received in the recess and clamped by or bonded to the recess sidewalls. One method for producing such a preferred structure involves beginning with a hub of a deformable material such as polystyrene, substantially as shown in Fig. 5 but without the fingers 28. The film disc 10 is placed in its desired position and a ring of polystyrene placed in a position corresponding to the final position of finger 28. The ring is then welded to the hub by heat, ultrasonics or other similar method to clamp the disc permanently in a tight annular recess. The hub and ring can be constructed to form a tight interference fit prior to welding to assist in the welding operation. Alternatively, the ring may form an integral axial wall which is deformable to form a radial wall of the annular recess and simultaneously to clamp the disc therein. With this structure, during subsequent processing, liquid is less likely to become trapped in the recess and later cause streaking if subjected to centrifugal force in processing.

The casing member 18, which is opaque and may be formed of paperboard, plastic sheeting or other material, forms a first wall 30 and a double-layer second wall 32 which is formed by flaps F₁, F₂, F₃, and F₄ extending from the first wall 30. As more fully explained in connection with Figures 15 to 130

17, at least a portion of the casing's first wall 30 is thinned. Also this portion is more flexible than, at least, the second wall 32, inasmuch as the first wall 30 is of only a single thickness. During cartridge assembly manufacturing operations, the flaps F_1 — F_4 are folded into place, envelope fashion, and secured, as by adhesive, to house the film unit assembly. Semicircular openings 31a, 31b, 31c and 31d in the flaps F_1 , F_2 , F_3 and F_4 combine, upon folding the flaps, to form a central circular aperture 34 (see Fig. 2) which is of such a diameter as to accommodate a portion of the hub 12 and thereby render one face of the hub 12 accessible to a film-advancing mechanism of a camera. A rectangular exposure window 33 is formed in flap F_3 and in flaps F_2 and F_4 , by cooperating cutout portions 35 and 35' which register with the window in flap F_1 when flaps F_2 and F_4 are folded into position beneath flap F_3 .

As seen in Figures 2 and 3, the casing member 18 may be asymmetrically shaped, relative to an axis of rotation of the hub, as by having unevenly dog-eared corners (compare 56 and 56') in order to cooperate with a correspondingly shaped pocket in a camera to ensure that the cartridge will be insertable in the camera in one predetermined orientation only.

The first wall 30 of the casing member has a generally centrally located circular opening 36 within which the circular hub support 19 is secured, such as by adhesive. Alternatively, the support 19 could be formed integrally with the casing member 18 as by known plastic molding techniques. The film unit 17, by means of its hub 12, is mounted on the hub support 19 by a snap-latching arrangement which, as described in greater detail below, holds the film unit 17 and the hub support 19 in assembled relationship while permitting rotation of the film unit 17 with respect to the support 19.

The passage of light rays through the exposure window 33 and onto the photosensitive film disc 10 is precluded (when the cartridge assembly is not protectively encased by a camera) by means of the cover slide 14 and the masking member 16. The cover slide 14 may be formed of thin, but relatively stiff, opaque sheet material and includes a generally fan-shaped leaf portion 40 of such a size as to be capable of covering the exposure window 33. The cover slide 14 also includes an annular portion 42 that encircles a cylindrical shoulder 44 (Fig. 5) on the hub 12. The annular portion 42 has at least one keying projection 46 that is closely receivable within a hub keyway 48 whereby the cover slide 14 is positioned and retained on the hub 12 for rotation with the film unit. The masking member 16 is opaque and may also be

formed of sheet material and has a central aperture 50 of such a size and so located as to admit the hub's shoulder 44. The masking member 16 also includes a window 52 corresponding generally in shape and size to, and aligned with, the exposure window 33. The member 16 is shaped to nest closely within the casing member 18 and is thereby constrained against rotation relative to the member 18.

When the cartridge assembly is not encased in a camera, the film unit is so oriented within the casing 18 (by an initial hub locking mechanism described below) as to place the leaf portion 40 of the cover slide 14 in light-blocking relationship with the exposure window 33 and the window 52 of the masking member. Inasmuch as the leaf portion 40 is larger than the aligned windows 33 and 52 between which it is interposed, a labyrinthine light baffling arrangement is created to restrict the access of actinic light rays to the film disc 10 through the windows 33 and 52.

Certain materials, such as poly (ethylene terephthalate), for forming the base sheet of the film disc, may exhibit the ability to "light pipe" (i.e. distribute impinging light rays internally within the sheet), and thereby fog the photosensitive materials carried by the base sheet even in areas of the base sheet that are remote from the point of impingement. As a precaution against such fogging, the film disc 10 has a cut-out notch 54 of truncated sector shape extending inwardly from the outer perimeter 20 of the film disc. The notch 54 has an arc length on a circular path P on which lie image areas that is at least as large as the arc length of one of the image areas 65 along that path P (Fig. 2). The notch 54, together with the regions of the film disc bordering the notch 54, are overlain by the leaf portion 40 of the cover slide 14. The area of the film disc which is located proximate the aligned exposure windows 33 and 52 is thus minimized by the notch 54 so as further to protect the film disc from any scattered light rays which may infiltrate through the labyrinthine light lock such as during prolonged exposure of the cartridge assembly to a light source.

Figure 5 depicts an enlarged partial cross-sectional view through a cartridge assembly. As seen therein, the cartridge assembly components are retained in assembled relationship by the engagement of the hub 12 and the hub support 19. The hub support 19, which is disposed within the circular opening 36 in the first wall 30 of the casing, includes a generally circular base plate 38 having an annular shelf 41 on which the margin of the casing wall 30 bounding the opening 36 is seated and is adhered by an adhesive. A key 37 (see Fig. 1) on the first wall 30 cooperates with a keyway 39 on the hub sup-

port 19 preliminarily to orient the support 19 during manufacturing operations. A cylindrical wall 57 extends from the base plate 38 and has, on its radially outer surface, a groove 58 extending around the circumference of wall 57. At its distal end, the cylindrical wall 57 has a frusto-conical face 60, as shown in Fig. 5. When the support 19 and the hub 12 are assembled, the cylindrical wall 57 telescopes within a cylindrical wall 61 of the hub 12. A plurality of radially inwardly projecting latching teeth 59 are distributed along the wall 61, each such tooth including an inclined camming surface 62. During assembly operations, sliding engagement between the camming surfaces 62 and the frusto-conical face 60 guides the walls 57 and 61 into telescoping engagement and the resultant wedging action produces some slight flexing of one or both of the walls 57 and 61 to permit the latching teeth 59 to slide axially along the wall 57 until they snap into latching engagement with the circumferential groove 58. The groove 58 and the latching teeth 59 provide a reliable but relatively loose fitting latching engagement so as to retain the hub 12 and the support 19 in telescoping relationship while permitting rotation of the hub relative to the hub support. The telescoped walls 57 and 61 additionally cooperate to define a labyrinthine light lock tending to protect the film disc 10 from fogging by light rays which may enter any of the several openings in the hub or hub support that are surrounded by the walls 57, 61. An annular shoulder portion 63 of the hub support 19 cooperates with an annular recess 64 at the base of wall 61 to provide an additional labyrinthine barrier protecting the film disc 10 from fogging.

When it is necessary to remove the film unit from the cartridge assembly for photographic processing, the hub 2 may be unlatched from the hub support 19 by inserting a suitable, e.g. a wedge-shaped, probe into coring holes 55 which are associated with each of the latching teeth 59. The holes 55 also facilitate injection molding of the latch teeth. By means of the inserted probe, the wall 57 and/or the hub 12 may be flexed to release the teeth 59 from the circumferential groove 58, thereby unlatching the hub from the hub support. The casing 18 may be opened, for extraction of the film unit assembly, by slitting or tearing. Preparatory to processing, the cover slide 14, since it is not permanently affixed to the hub 12 and since its function is completed after the film unit is removed from the cartridge assembly, may be stripped from the hub 12 and discarded, thereby also eliminating the possibility of photographic processing fluid being entrapped between the cover slide and the film disc 10. Similarly, the masking

member 16, being only loosely retained on the hub 12 is stripped from the film unit and discarded. Both the cover slide 14 and the masking member 16 may be provided with structurally weakened tearlines to facilitate their removal from the hub.

The film disc 10 is capable of recording photographic images in a plurality of image areas 65 (see Fig. 2) which are spaced along the circular path P that is concentric with an axis A of the film unit (which axis A is defined by the centre of a circular bore 116 in the hub 12. See Fig. 2). The path P is disposed between the outer perimeter of the hub 12 and the outer perimeter 20 of the film disc. Desirably, the image areas 65 are bounded by a surrounding border region 67 which has been photographically pre-exposed (sometimes called "pre-flashed") prior to exposure of the image areas 65 in a camera. Such pre-exposure may be included as part of the cartridge assembly manufacturing operation and, in combination with the indexing means described below, ensures that the latent images generated on the photosensitive film disc due to exposure in a camera will lie, if at all, in predetermined locations (i.e., the image areas) on the sheet.

In order that an image area 65 may be precisely positioned for exposure by a camera (or positioned at the gate of a printer, viewer or other apparatus) the hub 12 has a plurality of generally radially extending indexing teeth 114, which are disposed in a generally circular path along the perimeter of the hub 12. The number of teeth 114 corresponds to the number of image areas 65. (For illustrative purposes, ten teeth 114 are shown spaced 30° apart with an open arc of 90° radially aligned with the notch 54). Each image area 65 bears the same predetermined spatial relationship to a corresponding index tooth 114 as each of the other image areas 65 bears to its corresponding tooth 114 and this same relationship is desirably maintained in all film units of the form described herein. By precisely positioning the teeth 114 on the hub 12 in predetermined relationship with the respective image areas 65 as described above, a given the relative durability and resistance to de-image area may be precisely located by mechanically engaging and positioning its associated indexing tooth 114. Because of formation of the indexing teeth 114 as opposed, for example, to a simple film perforation as is commonly used in other film metering or indexing arrangements, the film unit can be repeatedly positioned with reliability, thereby facilitating post-exposure indexing operations such as printing and viewing.

To enable the photographer to determine which one of the several image areas 65 is

positioned for exposure, an exposure numbering system is provided as seen with reference to Figures 3 and 5. Figure 3 depicts a series of through-bores 120 formed in the hub support 19 and spaced along a circular path, concentric with the axis A, at the same angular pitch as the exposure areas 65 are located on their path P. Each through-bore 120 has associated with it an exposure area identification number 122 which is carried on the hub support 19 and which corresponds to one of the image areas 65, as may be seen in Fig. 3. An L-shaped foot member 124, carried by the hub 12 at a predetermined location relative to the image areas 65, has a surface 126 facing the hub support 19 and so located as to overlie the circular path along which the through-bores 120 in the support 19 are disposed. The surface 126 preferably is coated with a highly visible light-reflective material. As the hub 12 is indexed, the surface 126 registers successively with respective ones of the through-bores 120 and is visible, in use, through a camera cover door window 436 (see Fig. 19) to indicate visually to the user which of the image areas is in position for exposure.

It will be apparent that rotation of the film unit while the cartridge assembly is not housed within a camera or other light-tight means would result in the exposure of at least those image areas that are rotated past the cartridge assembly exposure window 33 and, perhaps, in the fogging of adjacent image areas. It will also be apparent that to rotate the film unit through more than one complete revolution would result in doubly exposing at least one of the image areas. Accordingly, a feature of the cartridge assembly is a two-mode hub locking mechanism that is housed entirely within the cartridge assembly. In one locking mode rotation of the film unit is prevented prior to insertion of the cartridge assembly in a camera, and includes means for cooperating with the camera to release the film unit for rotation and may serve also to lock the film unit relative to the assembly after all image areas have been exposed. The other locking mode precludes rotation of the film unit through more than one complete revolution. If locked in the first mode after exposure, or in the second mode, the lock preferably cannot be released by re-inserting an exposed cartridge into the camera.

Reference is now made to Figure 4 which depicts the hub locking mechanism in an initial locking position wherein rotation is prevented prior to insertion of the cartridge assembly in a camera. As seen therein the hub support 19 carries an elongate flexible spring finger 128 attached at its proximal end to the support 19. The finger 128 has a distal end 129 which is so disposed as to engage a latch member 130 carried by the

hub 12. Prior to insertion of the cartridge assembly into a camera the distal end 129 of the spring finger 128 lies within (as seen in phantom in Figures 8 and 10) an initial latching detent 132 formed on the underside of the latch member 130. Initial locking engagement of the finger's distal end 129 with the latching detent 132 precludes rotation of the hub 12 relative to the hub support 19. Because the locking mechanism is placed in the initial locking position during a cartridge assembly manufacturing operation, inadvertent film unit rotation (with probable resultant film exposure) is precluded prior to insertion of the cartridge assembly into a cooperating camera. Upon insertion of the cartridge into a camera, a camera's coupling pin 433, being of an appropriate length, penetrates the drive bore 118 and contacts a raised boss 134 on the facing surface of the finger 128 (see also Fig. 9). Contact by the pin 433 flexes the finger 128 downward (as seen in Figs. 8 and 9) thereby freeing its distal end 129 from the initial latching detent 132 and releasing the hub 12 for rotation relative to the hub support 19. As the hub 12 is rotated, the coupling pin 433 slides off the raised boss 134 and the finger's distal end 129 is cammed along one of the downward-facing cam surfaces 133, 135 of the latch member 130 until, depending upon the direction of hub rotation, it slides from beneath the tip 136 or 138 of one of the tapered wings 140, 142 of the latch 130 and flexes upward to a neutral position as shown in Figure 4. Because the hub 12 is so mounted on the hub support 19 as to be rotatable in both clockwise and counterclockwise directions and because the latch 130 is symmetrically structured it is apparent that the hub 12 may be rotated in either direction following unlatching and, as described below, may also be relatched regardless of the direction of rotation.

Alternatively, the spring finger 128 may be freed from the first latching detent by means of a modified form (not shown) of a camera's spindle 432 (See Figs. 8 and 19). In such an arrangement, a spindle that is appropriately longer than the camera spindle 432 shown in such Figures penetrates the bore 116 a distance sufficient to contact the spring finger 128 and depress it to release the distal end 129 of the finger from the initial latching detent 132. Because the spindle 432 coincides with the hub's axis of rotation A, a lengthened spindle as described above bears continually on the finger 128. In such an arrangement the length of the spindle must be carefully chosen to avoid depressing the distal end 129 of the finger 128 below the tips 136, 138 of the tapered wings 140, 142.

Referring now to the description of the

illustrated embodiment, if the film unit is to be rotated by the hub through 360°, as the hub approaches a complete revolution, the spring finger 128 again encounters the latch member 130. However, as seen in progressing phantom positions in Figure 6, the spring finger 128, (having snapped upward into its neutral position after being released from the coupling pin and the latch member) encounters, depending on the direction of rotation, one of the upwardly facing cam surfaces 144, 146 of the latch member 130. Continued rotation after such contact cams the distal end 129 upward and carries it into a final locking detent 148 that is positioned atop the latch member 130, as seen in Figures 11 and 12. As also seen in Figure 11, the finger 128, having been flexed upwardly beyond its neutral position by the camming action of one of the surfaces 144, 146, tends to remain engaged in the final locking detent 148 and resist being dislodged. The pin 433 is now unable to perform its unlocking function because, even though the pin 433 bears on the boss 134 it exerts only a downwardly-applied force that forces the distal end into the final locking detent 148 and is incapable of releasing the finger from the final locking detent. Having assumed the final locking position, it is apparent that the hub 12 cannot be rotated relative to the hub support 19 even if the finally locked assembly is removed from and re-inserted into a camera. Because the fan-shaped leaf portion 40 of the cover slide 14 of a finally locked cartridge assembly is in light-blocking relationship with the framing window 52, the latent images recorded on the disc 10 are protected until the film unit is removed from the cartridge assembly for photographic processing.

Figs. 13 and 14 show an alternative mechanism for initial and final lock between the hub 12 and the hub support 19. The support 19 includes a first flexible locking finger 190 having a bearing surface 193 which engages a cooperating bearing surface 194 on the hub to prevent counterclockwise rotation of the hub. Upon insertion in a camera, a pin 433 on the camera pushes finger 190 axially to release the bearing surfaces 193 and 194 from mutual engagement to permit such counter-clockwise rotation.

A second flexible locking finger 191 on the hub support has a protrusion 195 which initially engages a surface 198 of lug 192 on the hub initially to prevent clockwise rotation of the hub. After release from the first locking finger 190, the hub is rotated by the camera in a counter-clockwise direction whereby the lug 192 rides off the surface 199 of the finger 191 and in so doing flexes it to the broken line positions shown in Fig. 13. The hub can be rotated by the camera through 360° until the lug 192 engages a slot 196 (shown in Fig. 14) in the second

locking finger 191. During the last portion of the allowed rotation the lug 192 bears against the radially inner surface of the finger 191 progressively deflecting through the broken line positions shown in Fig. 14, until the finger springs radially inwardly with the slot 196 embracing the lug 192. With the lug 192 in the slot 196 a permanent final lock is provided between the hub and the hub support.

In a camera driving arrangement disclosed more fully in Figures 19 to 30, or in a further embodiment disclosed in Figures 34 to 37, the film unit may be rotated through an angle which is sufficient to bring all of the image areas sequentially into registry with the cartridge exposure window but which is less than one complete revolution. The direction of the film unit rotation is thereupon reversed and the unit is returned to its initial position. It will be apparent that the locking arrangement herein described are suited to accommodate such an alternative camera design. As indicated above, owing to the double-taper symmetrical design of the latch member 130, i.e. the presence of oppositely facing wings 140 and 142, the spring finger 128 may approach and enter the final locking detent 148 by climbing either of the upward-facing cam surfaces 144, 146. Final locking is thereby assured regardless of whether the direction of rotation associated with final locking is the same as or opposite to the direction of rotation associated with unlocking.

In the embodiment illustrated in Figs. 13 and 14, a radially outwardly curved nose 197 ensures that if the lug 192 approaches in a clockwise direction, the finger will be cammed outward until the lug 192 enters the slot 196 at which time the finger 191 springs back.

Another feature affords means for providing a visual indication that the cartridge assembly is in the final locking configuration, thereby avoiding confusion arising from attempted re-use of an exposed cartridge. In the embodiment illustrated in Figs. 1 to 12, a coring hole 150 located in the hub 12 and positioned above the latch member 130 provides visual access to the distal end 129 of the spring finger 128 when the finger 128 is in the final locking detent 148. By colouring the upper surface of the end 129 of the finger 128 with a highly-visible light-reflective coating, and perhaps by also providing appropriate information on a label proximate the hole 150, the appearance of the coloured end 129 of the finger 128 in the hole 150 reminds the user that the film unit has been completely exposed.

In the arrangement illustrated in Figs. 13 and 14 this visual indication that the cartridge is in the final locking configuration is provided by a flag which is cammed up by

the radially outward deflection of the finger 191 under the camming influence of the lug 192.

5 A further feature in the illustrated embodiment is one which contributes to more precise positioning of the film disc 10 with respect to the focal plane of a camera. Such precise positioning is achieved by affording intimate contact between the film and camera by minimizing, or at least closely controlling, cartridge structures interposed between the film disc and the camera supporting structure. As will be described in more detail hereinafter, at least immediately prior to and during an exposure, the first wall 30 of the cartridge is contacted at the exposure station of the camera 401 by a spring-biased pressure plate 438 (see Fig. 25). The first wall 30 is thinned (relative, at least, to the double-layered second wall 32) and is thus relatively flexible at least in the region thereof that is interposed between the pressure plate 438 and the film disc 10. A rectangular film support frame 435 of a camera is of such size and shape as to penetrate the windows 33 and 52 of the cartridge assembly and contact directly on the surface 13 of the film disc 10. Images may then be recorded on the film. Because of the thinness of the first wall 30 of the cartridge in the region where it is contacted by the pressure plate 438, the image area 65 of the film disc 10 that is positioned for exposure is assured of being urged by the pressure plate 438 into close contact with the support frame 435, and this accurately positioned in the focal plane of the camera.

40 Figs. 15 to 19 show cross-sectional views of modified structures of the portion of the first wall 30 opposite the rectangular exposure window 33. In each case, the first wall 30 is constructed of relatively rigid plastic to protect the film unit, and contains a window 180 covered by a structure better able to transmit the force of a pressure plate 438 to the film unit. Fig. 15 illustrates a thin flexible web 181 of opaque plastic disposed across the window 180 and bonded to the wall around the window. Fig. 16 illustrates an integrally formed but thinned portion 182 of the opaque wall 30 having a fold 185 to facilitate displacement of the portion 182. Fig. 17 illustrates a thick plastic insert 183 held in the window by a thin opaque flexible web 184 sealed to the wall 30 around the window.

In the camera described hereinafter, a movable pressure-relieving finger 441 is actuated to allow the pressure plate 438 to press the film disc into contact with the support frame 435 at least immediately prior to and during exposure and is actuated to hold the pressure plate 438 out of clamping engagement, at least during times

when the film disc may be moved relative to the frame 435. In this way forced contact of the film disc with the frame is avoided when there is relative movement between them. Such forced contact during relative movement might cause damage to the photosensitive materials of the imaging surface 13.

In an alternative construction of cartridge assembly (not shown) the framing window 52 in the masking member 16 is approximately the same size as image area 65. In such an arrangement, the support frame 435 of a camera does not penetrate the window 52 but, rather, penetrates only the window 33 and rests upon the margins of the masking member 16 which bound the window 52. Because the masking member 16 is desirably formed of a thin, flat sheet material of relatively uniform thickness, accurate positioning of the image area 65 to be exposed relative to the support frame 435 may be attained even though the frame does not directly contact the film disc.

A preferred embodiment of a camera according to the invention is illustrated in Figs. 18 to 30 and may be called a manual film advance camera, which refers to the fact that the energy required to accomplish each successive indexing movement of the film disc is derived from a corresponding manual movement of a film advancing member.

Fig. 18 depicts the camera 401 in its operative position and shows the front wall 402 of the camera provided with an objective lens 403, a viewfinder lens 404 and a window 405 associated with a photosensitive element of an automatic exposure control device. A rectangular shutter operating button 406 is located in the top wall 407 of the camera housing 408 and is substantially flush with the top wall 407. Fig. 19 shows the camera 401 inverted from the position shown in Fig. 18 and turned end for end so that its back end wall 409 is visible. A cover door 411, which is shown in its open position in Fig. 19, is attached to the camera housing by hinges 412. When closed, the door 411 is in light-tight cooperation with the camera housing and is retained in that position by a latching device that is releasable by a slidable latch release button 413 adjacent the rear viewfinder lens 414 in the back wall 409. Operating ear 415 of a pivotally movable film advancing lever is partially visible in Fig. 19, and is substantially flush with the camera housing except during a film advancing operation. From these two figures, 18 and 19, it will be apparent that the camera is very compact and streamlined and is notably free of protruding elements which might interfere with conveniently carrying it in a shirt pocket or the like.

Because Figs. 19 to 30 all illustrate camera

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mechanisms in the same inverted orientation shown in Fig. 19, relative positional terms, such as above and below, used in describing those figures will be understood to relate to that inverted mode of orientation. For example, in referring to Fig. 19, film cartridge assembly 11 would be described as being above the camera 401.

As best shown in Fig. 19, the interior of the camera housing 408 defines a shallow internal pocket 416 of the same asymmetrical peripheral shape as the casing of the film cartridge assembly and with a central circular cavity 417 intended to receive the film disc's hub 12. The camera housing 408 forms lateral walls 418 and 419 and end wall 421 of the pocket 416 and its remaining end wall 422 and diagonal corner walls 423-426 are formed by a cover plate 427 which is held in place by screws 428. A circular central opening 429 in the cover plate 427 exposes a rotatable circular driving disc 431 pivotally supported by a stationary hub spindle 432. The driving disc 431, in turn, carries a coupling pin 433, equivalent to the pin 433 shown in Figs. 8 and 11. A rectangular opening 434 in the cover plate 427 accommodates a rectangular film support frame 435, which extends slightly above the adjacent flat face of the cover plate 427. When the cartridge assembly is installed in the pocket 416, a) the spindle hole 116 in the hub 12 receives the end of spindle 432; b) the driving pin 433 enters the coupling hole 118 in the hub; and c) the film support frame 435 enters the cartridge assembly's rectangular film exposure window 33. Because of the asymmetry of the cartridge assembly and the corresponding configuration of the pocket 416, the cartridge assembly cannot be inserted into the pocket 416 except in this proper orientation. When the cover door 411 is closed following installation of the film cartridge assembly, a transparent cover door window 436 bears against the hub support plate 19 of the cartridge assembly and maintains the hub 12 in contact with the driving disc 431. A circular window rim 437, integral with the camera's cover door 411, surrounds the hub support 19 of the cartridge assembly for light locking purposes.

A rectangular pressure platen 438 is attached to the cover door by a pair of resilient spring arms 439 which bias it away from the door. When the door is closed, the platen 438 is aligned with the film support frame 435, but is held out of clamping engagement with the film cartridge assembly by the engagement of an ear 440 on the pressure platen 438 with a pressure relieving finger 441, which projects through an opening 442 in the cover plate 427 adjacent the film support frame 435.

A mechanism plate 443, preferably made of relatively heavy sheet metal, is best shown

in Figs. 20 to 22. This plate is rigidly supported within the camera housing below the cover plate 427, which is spaced slightly above the mechanism plate 443 by spacer means, not shown. For example, screws 428 can extend through the cover plate 427, through spacer washers, through holes in the mechanism plate 443, one of which is at numeral 444, and into threaded bosses moulded into the camera housing 408. The mechanism plate 443 supports the principal operative mechanical and optical camera components as a unitary subassembly, thereby facilitating assembly and servicing of the camera and ensuring permanent stability in the relation of those components to one another.

The hub spindle 432, shown in detail in Fig. 23, is permanently staked to the mechanism plate 443 by its riveted lip 445 and rotatably supports the circular driving disc 431 and a film advancing lever 446. The upper end of the spindle 432 fits accurately into the spindle hole 116 in the hub 12 of the film cartridge assembly and thereby precisely defines the axis of rotation of the film disc 10. When the cartridge assembly is received in the camera with its hub 12 in engagement with the spindle 94, the film support frame 435 extends through the exposure window 33 of the cartridge assembly casing and engages the face of the sector-shape portion 40 of the cover slide 14. Rotation of the cover slide portion 40 out of alignment with the casing window 33 allows the window 52 in the baffle sheet 16 to pass around the frame 435 whereby the frame engages and supports the emulsion surface of the film disc 10 just outside the periphery of the film exposure area 65.

The film support frame 435 is an integral part of a gate member 447, best shown in Figs. 24 and 25, which is immovably attached to the mechanism plate 443 by screws 448 with the frame extending upwardly through the opening 434 in the cover plate 427. The frame 435 is cantilevered from the remainder of the gate member to provide a slot 449 between the frame 435 and the mechanism plate 443 to accommodate blades 451 and 452 of the camera's shutter. A rectangular opening 453 in the frame is aligned with a similarly shaped opening 454 in the mechanism plate 443, such openings 453 and 454 being slightly larger than the pre-defined exposure areas 65 of the film disc 10. To prevent deflection or bending of the frame 435, a support post 455 is located at the otherwise unsupported end of the frame 435 outside the movement path of the shutter blades 451 and 452 and bears against an ear 456 of the mechanism plate 443. Below the openings 453 and 454, a prism 457 is rigidly supported to the mechanism plate 443 by a bracket 458 in optical alignment with the

camera's objective lens 403, which is also preferably supported either to the gate member 447 or the mechanism plate 443. The axis of the objective lens 403 is substantially parallel to the plane of the film cartridge. The prism 457, (or equivalent mirror) bends the optical path through a 90° angle so that the focal plane of the lens 403 is coincident with the predetermined flat film plane defined by a flat upper film engaging face 459 of the film support frame 435. During each exposure of the imaging surface 13 of the film disc 10, the pressure platen 438 resiliently bears against the flexible casing of the film cartridge assembly and thereby presses the corresponding region 65 of the film disc 10 against the face 459 of the film support frame 435 to position the film exposure area accurately in coincidence with the plane defined by that face 459. Alternatively, the window 52 in the baffle sheet 16 could be smaller than the window 33 in the casing and the face 459 of the film support frame 435 could engage the region of the baffle sheet 16 surrounding its window 52, in which case the thickness of the baffle sheet 16 would be compensated for in establishing coincidence between the film plane and the focal plane of the objective lens.

The single reflecting surface in the optical path produces a reversed image, but this reversal can be corrected for projection or printing purposes, either by inverting the processed film disc in the projector or printer or by incorporating another single reflecting element in the projection path of such an apparatus. Fig. 28 shows the various lenses constituting the viewfinder except for its front lens 404, all of such lenses being located along an axis 461 located below the mechanism plate 443 and substantially parallel to the axis of the objective lens 403. To provide a single lens reflex type of camera construction, the reflective surface of prism 457 can be partially light transmissive and aligned with the axis of appropriate viewfinder elements, or a movable mirror can be substituted for that prism, as is well known in the prior art.

As best illustrated in Figs. 20 and 23, the circular driving disc 431 is provided on its lower face with a pinion gear 462 meshed with gear teeth 463 of a sector plate 464 that is pivotally supported to the mechanism plate 443 by a stud 465 for arcuate movement between two stationary stop pins 466 and 467. A relatively strong hairpin spring 468 biases the sector plate 464 in a counterclockwise direction. Whenever the camera is in an unloaded condition, the spring 468 holds the sector plate 464 against pin 466, as shown in Fig. 20. Accordingly, the coupling pin 433 on the driving disc 431 is positioned to be received in the cartridge hub coupling hole 118 of a film cartridge as-

sembly being loaded into the camera. An arcuate ratchet tooth segment 469 of the sector plate 464 is engagable by a releasable ratchet pawl 471 under the influence of a spring 472 to limit rotation of the film disc's hub 12 to a counterclockwise direction.

The film advancing lever 446 includes an arm 473 that extends through a slot 474 in lateral wall 419 of the camera housing 408. An ear 476 extends downwardly from arm 473 through an arcuate slot 477 in the mechanism plate 443 and is attached to a relatively strong spring 478 that biases the lever 446 in a counterclockwise direction toward the position shown in Fig. 20, on which arm 473 is in abutment with end 479 of slot 474. By means of the operating ear 415 at the end of arm 473, a photographer can manually rotate lever 446 through an angle of somewhat more than 45 degrees to the position shown in Fig. 21, which movement is limited by the abutment of the arm 473 against the opposite end 481 of slot 474.

An advancing pawl 482 is pivotally mounted to the advancing lever 446 by a stud 483 extending through an elongate slot 484 in the pawl 482. A coil spring 485 connects the advancing pawl 482 to the film advancing lever 446 to resiliently bias the pawl 482 toward the position shown in Fig. 20. In this position the pawl 482 bears against a pin 486 on lever 446 with the end of slot 484 which is located about midway along the arcuate length of the pawl 482, in contact with stud 483. When the advancing lever 446 is positioned as shown in Fig. 20, an advancing tooth 487 of the advancing pawl 482 is located adjacent the film support frame 435 near the centre of the 90° arc of the film disc's hub which lacks index ears 114, which is shown in phantom lines in Figs. 20, 21, and 22. As the photographer moves lever 446 from the position shown in Fig. 20 to the position shown in Fig. 21, the advancing tooth 487 moves along an arcuate path coincident with the movement path of the hub index ears 114. When this movement brings the sloped face 488 of the tooth 487 into contact with the hub index ear 114a, corresponding to the first available exposure area on the film disc, the engagement of the ratchet pawl 471 with the sector plate 464 prevents the tooth 487 from rotating the hub 12 in a clockwise direction. The tooth 487 therefore cams past the index ear 114a by overcoming the biasing force of spring 485 and moves to the position in which it is shown in Fig. 21.

A positioning pawl 489 is pivotally mounted to the mechanism plate 443 by an eccentric pivot stud 491 and is biased in a counterclockwise direction by a spring 492. A leg 493 of the positioning pawl 489 carries

a positioning tooth 494 that is located adjacent the advancing tooth 487 when the advancing pawl is positioned as shown in Figs. 20 and 22. As best shown in Fig. 26, the positioning tooth 494 lies below the advancing tooth 487 and an upwardly turned ear 495 on the positioning pawl 489 engages the adjacent edge of the advancing pawl 482 to establish the location of the positioning pawl 489 when the film advancing lever 446 is in the position shown in Figs. 20, 22 and 26. A second leg 496 of pawl 489 has a cam surface 497 engageable by a cam pin 498 on the film advancing lever 446. When the lever 446 is in its initial position, shown in Fig. 20, the pin 498 is out of engagement with the cam surface 497 and the positioning tooth 494 is positioned to intercept the index ear 114a of the cartridge hub 12 as the latter is rotated. Whenever the advancing lever 446 is displaced by more than approximately 10° from its initial position, however, the cooperation between the cam surface 497 and the cam pin 498 pivots the pawl 489 to the position shown in Fig. 21, thereby moving the positioning tooth 494 beyond the movement path of the hub's index ears 114.

As the advancing lever 446 is returned by the spring 478 from the position shown in Fig. 21 to the position shown in Fig. 20, a radial face 499 of the advancing tooth 487 engages the index ear 114a and thereby rotates the film disc's hub 12 and the driving disc 431 in an anti-clockwise direction in opposition to the spring 468. During the final portion of the return movement of the lever 446 toward its initial position, the cam pin 498 disengages from the cam surface 497 of the positioning pawl 489 and the spring 492 causes the positioning tooth 494 to move back into the path of movement of the index ear 114a which then abuts against that tooth 494. As shown in Fig. 22, this abutment between the index ear 114a and the positioning tooth 494 occurs slightly before the spring 478 has returned the arm 473 of the lever 446 into contact with the end face 479 of slot 474. Because the spring 478 is stronger than the spring 485, the pawl 482 is displaced slightly endwise relative to lever 446, in opposition to the spring 485; whereby the advancing tooth 447 resiliently clamps index ear 114a against a radial face 201 of the positioning tooth 494. The indexing accuracy with which the film exposure area is located in exposure position is thus determined solely by the accuracy with which the central spindle hole 116 in the hub 12 fits the spindle 432 and by the location of the positioning tooth 494. To simplify the manufacture of the camera, the eccentric pivot stud 491, best shown in Fig. 27, is riveted to the mechanism plate 443 as shown as numeral 202 but can nevertheless be

rotated by means of screwdriver slot 203. The cylindrical bearing surface 204 of the stud 491 that extends through a spacer washer 205 and through a mating hole 206 in the pawl 489 is slightly eccentric relative to the axis of the stud shank 207, thereby allowing a factory adjustment of the position of the positioning tooth 494. Once this adjustment has been made, the accuracy of the mechanism is preserved by the fact that the spindle 432, stud 491, the gate member and the optical elements 403 and 457 are all rigidly affixed to the one-piece mechanism plate 443.

After the first exposure area 65 has been exposed, as described later, a second reciprocative movement of the lever 446 causes the advancing tooth 487 to engage the hub's index ear 114b and to rotate the hub 12 to bring that ear 114b into engagement with the positioning tooth 494. As previously described, the cooperation between the cam surface 497 and the cam pin 498 causes the positioning tooth 494 to disengage from the index ear 114a before the pawl 482 initiates the counterclockwise rotation of the hub 12, and to return the positioning tooth 494 to its operative location before the next index ear 114b arrives at its indexed position. After the operation of indexing the film disc 10 has been repeated ten times and the final exposure area has been brought into exposure position, the 90° ear-free arc of the hub 12 is located in the clockwise direction from the advancing tooth 487, whereby the arcuate travel of that tooth 487 is insufficient to re-engage it with the index ear 114a. Accordingly, further reciprocation of lever 446 has no effect on the position of the film disc 10 which is additionally prevented from moving further in a counterclockwise direction by the abutment of the sector plate 464 against the stop pin 467.

If, during the previously described indexing operations, the film disc 10 should jam within the cartridge assembly casing, the spring biased stud 483 and slot 484 connection between the pawl 482 and film advancing lever 486, prevents the photographer from damaging the camera mechanism by attempting to force the lever 446 back to its initial position.

Because of the spacing of the hub's index ears 114, the first indexing operation requires the film advancing lever 446 to be reciprocated through an angle of slightly more than 45 degrees, but subsequent indexing operations require the lever 446 to be moved through an angle of only slightly more than 30 degrees. However, as explained below, the shutter cocking operation requires that the lever 446 be reciprocated through its maximum angular movement each time the film disc 10 is advanced. To

ensure such maximum movement of the lever 446, an anti-short-stroke dog 208, shown in Figs. 21 and 22, is pivotally carried by the stud 465 below the sector plate 464 and is resiliently biased to its depicted central position by a wire spring 209 which is staked into a slot in dog 208 and extends freely between pins 211. During the movement of the lever 446 from the position shown in Fig. 20 to the position shown in Fig. 21, arcuately disposed teeth 212 along the adjacent edge of the lever 446 engage a finger 213 of the dog 208 and rotate the dog in a counterclockwise direction as those teeth 212 move past the dog finger 213 in ratchet fashion. Consequently, once the clockwise movement of the lever 446 is initiated, that lever cannot rotate in the opposite direction until it has reached the position shown in Fig. 21 at which an arcuate notch 214 in the lever 446 is aligned with the dog tooth 213 and allows the dog 446 to reassume its depicted central position. During the subsequent return movement of the lever 446, the dog 208 performs in the same manner as the teeth 212 displace it in a clockwise direction. When the lever 446 arrives at its initial position, an arcuate notch 215 is aligned with the dog 208, which therefore again assumes its central position.

The shutter mechanism, which is best depicted in Fig. 28 comprises an opening member 216 and a closing member 217, both of which are made of thin sheet steel. These two members 216, 217 are pivotally supported below the mechanism plate 443 between washers 218 by the lower end shank 219 of the spindle 432 as shown in Fig. 23, and are retained on that shank by a snap ring 221. Two springs, represented at numerals 222 and 223 in Fig. 28, bias the respective opening and closing shutter members 216 and 217 in a counterclockwise direction. The shutter members 216 and 217 have legs 224 and 225, respectively, which include respective upwardly bent portions 226 and 227 that extend through corresponding arcuate openings 228 and 229 in the mechanism plate 143, shown in Figs. 20-22. Opening and closing shutter blades 451 and 452, carried by the respective shutter member legs 224 and 225, are parallel to the mechanism plate 443 and are in alignment with the shutter blade slot 449 below the film support frame 435.

Fig. 20 depicts the camera with its shutter in released condition, in which the opening shutter blade 451 slightly overlaps the closing shutter blade 452 with the latter blade obscuring the rectangular opening 453 of the film support frame 435. In this condition, the position of the opening member 216 is established by the engagement of its upwardly bent portion 226 with the adjacent end of the mechanism plate opening 228 and

the position of the closing member 217 is established by the abutment of its leg 225 with a downwardly bent ear 233 of the opening member 216, shown in Fig. 28. As the film advancing lever 446 is rotated in a clockwise direction, an edge 234 of that lever 446 engages the upwardly bent portion 226 of the opening member 216 and moves the two blades 452, 453 in unison in a clockwise direction.

When the clockwise movement of the shutter members 216, 217 has brought the opening blade 451 into alignment with the film support frame opening 453, as shown in solid lines in Fig. 28, a latch tooth 235 on the opening shutter member 216 is engaged by a primary latch member 236, which is pivotally mounted to the mechanism plate 443 by a pin 237 and is biased in a clockwise direction by a hairpin spring 238. A secondary latch member 239, pivotally mounted to the mechanism plate 443 by a pin 241 and biased in a clockwise direction by a hairpin spring 242, similarly engages a latch tooth 243 on the closing shutter member 217. Accordingly, the two shutter members 216, 217 are held in their respective cocked positions as the advancing lever 446 returns to its initial position to complete the film indexing and shutter cocking operation.

As also shown in Fig. 28, an ear 244 on the leg 225 of the closing shutter member 217 is in engagement with the adjacent end face of an electromagnet 245 when the shutter is in its cocked condition. This electromagnet 245 is carried by a support member 246 that is pivotally supported to the mechanism plate 443 by a rivet 247 and is biased in a counterclockwise direction by a spring 248 for movement through a narrow arcuate path limited by a stationary pin 249 extending into a slot 251 in the support member 246. This movable mounting of the electromagnet 245 allows it to engage the ear 244 of the closing shutter member 217 when the latter is in its cocked position, while allowing that member 217 to be moved slightly beyond its cocked position by the film advancing lever 446 during the film indexing and shutter cocking operation.

When the primary latch member 236 is released from the latch tooth 235 of the opening shutter member 216, as described below, the opening shutter member 216 rotates rapidly in a counterclockwise direction; thereby removing the opening blade 451 from alignment with the film support frame opening 453 to initiate the exposure of the film area supported by the film support frame 435. As the opening shutter member 216 approaches its released position shown in Fig. 20, a cam nose 252 on the opening shutter member 216 engages the rounded tip of the secondary latch member 239 engaged

with the latch tooth 243 on the closing shutter member 217 and pivots that latch member 239 out of engagement with the closing shutter member 217. If the camera's exposure control circuit has not energized the electromagnet 245, the release of the secondary latch member 239 causes the closing shutter member 217 immediately to pivot in a counterclockwise direction so that its blade 452 covers the opening 453 in the film support frame 435, thus providing a mechanically predetermined exposure duration. However, if the automatic exposure control system requires a longer exposure duration, the electromagnet 245 retains the closing shutter member 217 in its cocked position until the electromagnet is de-energized, whereupon the shutter closes. Because this general type of automatic exposure control system is well known in the prior art, details of the electronic circuitry associated with controlling the energization of the electromagnet have been omitted.

Shutter release rocker 253, shown in Figs. 28 and 29, is supported for rocking movement below the mechanism plate 443 by rivets 254 and 255 extending through ears 256 and 257 of the rocker 253 and through respective tongues 258 and 259 bent downwardly from the mechanism plate 443. The rectangular shutter operating button 406 is attached to the lower face of the rocker 253, as shown in broken lines in Fig. 28, and extends through an opening in the camera housing 408. A hairpin spring 260 is coiled around the head of the rivet 254 with one of its legs engaging a finger 261 of the rocker 253 and with its other leg bearing against the mechanism plate 443; thereby urging the release button 406 downwardly towards its extended position. At its forward end, the rocker 253 is provided with the finger 441 which projects upwardly through the mechanism and cover plates 443 and 427 and abuts against the ear 440 on the pressure platen 438 when the camera's cover door 411 is closed. The spring 260 is strong enough to overcome the tension of the spring arms 439 supporting the pressure platen 438, whereby the latter is retained out of clamping engagement with the film cartridge assembly as long as the shutter operating button 406 remains in its extended position.

A release slide 262, shown in Figs. 28 and 29, is slidably mounted to the lower face of the mechanism plate 443 by a stationary rivet 263 extending through a slot 264 and is biased toward the right and also in a counterclockwise direction by a spring 265. When the slide 262 is in its cocked position shown in solid lines in Fig. 28, its latch tooth 266 is engaged with a finger 267 of a latching tab 268, which extends upwardly from the rocker 253, as best illustrated in

Fig. 29. When the shutter operating button 406 is depressed, the corresponding upward movement of the finger 267 causes it to disengage from the latch tooth 266, whereupon the spring 265 moves the slide 262 to the right to the position shown in broken lines in Fig. 28, which is defined by the abutment of the left end of the slot 264 with the rivet 263. During this movement, a releasing ear 271 on the slide 262 engages a lower finger 272 of the primary latch member 236 and releases the latch member 236 from engagement with the opening shutter member latch tooth 235 to initiate the operation of the shutter. As previously mentioned, prior to releasing the shutter, the movement of the finger 441 causes the pressure plate 438 to squeeze the exposure area 65 of the film disk 10 into engagement with the film support frame 435 to ensure that the film exposure area is securely held in flat condition during its exposure.

As shown in Figs. 20, 21, 22 and 28, a cocking pin 273 projects downwardly from the film advancing lever 446 through an arcuate slot 274 in the mechanism plate 143. This pin 273 is adapted to engage tongue 275 on release slide 262, shown in Figs. 28 and 29, to restore that slide 262 to its cocked condition shown in Fig. 28 when lever 446 is again moved to the position shown in Fig. 21. During this recocking movement of the slide 262, it pivots slightly in a clockwise direction out of contact with a guide pin 276 as the latch tooth 266 cams past the finger 267 of the latching tab 268.

A stop pin 277, extending upwardly from the shutter release rocker 253, projects through the end of slot 274 in the mechanism plate 443 beyond the movement path of the pin 273 and is flush with the lower face of the lever 446 when the shutter operating button 406 is at its extended position. When the film advancing lever 446 is in the position shown in Figs. 20 and 22, an edge slot 278 in that lever is aligned with the end of the stop pin 277 so that the film advancing lever does not interfere with depression of the release button 406. Whenever the advancing lever 446 is moved away from its initial position, however, the shutter operating button 406 cannot be depressed because of the abutment of the pin 277 with the lower face of that lever 446. Similarly, as long as the shutter operating button remains depressed, the pin 277 prevents the lever 446 from being moved out of its initial position. Consequently, the film disk 10 cannot be rotated unless the shutter operating button 406 has first been released to retract pressure platen 438 out of clamping engagement with the film cartridge assembly.

A blocking slide 279, shown in Fig. 28 is slidably and rotatably mounted to the

lower face of the mechanism plate 443 by a rivet 281 extending through an elongate slot 282 in the slide 279 and is biased both rearwardly and in a clockwise direction by a spring 283. After the completion of each film advancing and shutter cocking operation, the slide 279 assumes the position shown in solid lines in Fig. 28, in which an edge surface 284 of the slide 279 is in abutment with a stationary pin 285 and in which the ear 476 of the film advancing lever 446 is trapped behind a blocking tooth 286 of the slide 279 to prevent the lever 446 from being moved out of its initial position. As previously explained, depression of the shutter operating button 406 causes the release slide 262 to move to the right to the position shown in broken lines, in Fig. 28, to initiate the shutter operation. This movement of the slide 262 causes its ear 287 to engage the rearward end of the blocking slide 279 and to rotate the latter in a counterclockwise direction about the rivet 281 in opposition to the spring 283, thereby moving the edge surface 284 out of engagement with the pin 285. Thereupon, the spring 283 moves the slide 279 rearwardly to the position shown in broken lines in Fig. 28, in which pin 285 is engaged with an edge 288 of the blocking slide to locate the tooth 286 beyond blocking engagement with ear 476 of the film advancing lever 446. Accordingly, that lever 446 can again be operated to advance the film disc 10 and to recock the shutter. As the film advancing lever 446 approaches the position shown in Fig. 21 during this subsequent film advancing and shutter cocking operation, its ear 476 engages a tongue 289 of the slide 279 and moves the latter forwardly so that it can again assume the position shown in solid lines. During the return movement of the lever 446 to its initial position, its ear 476 encounters the sloped face 291 of the blocking tooth 286 and momentarily cams the latter aside to allow the ear 476 to return to its blocked position. This camming action momentarily displaces the blocking slide 279 slightly in a counterclockwise direction, but not far enough to disengage the edge surface 284 from the pin 285. Accordingly, as soon as the ear 476 has moved rearwardly beyond the blocking tooth 286, the blocking slide 279 reassumes the position shown in solid lines and prevents further reciprocation of the film advancing lever 446 until after the shutter has been operated again. Thus, the blocking slide 279 ensures that each exposure area is exposed before the film disc 10 is again indexed to bring the next available exposure area 65 into exposure position.

The door latch mechanism, best shown in Fig. 30, includes a latch slide 292 slidably mounted above the mechanism plate 443 on pins 466 and 293 anchored to that plate 443

and extending through respective slots 294 and 295 in the latch plate and a release slide 296 slidably mounted below the mechanism plate 443 by the opposite ends of the same pins 466 and 293 extending through slots 297 and 298 in the release slide. An ear 299 projects upwardly through an opening 301 in the mechanism plate 443 and is adapted to engage the right edge 302 of a projection 303 on the latch slide 292. The release slide 296 is biased toward the right by a spring 304 attached to a pin 305 on the mechanism plate 443. A stronger spring 306 connects the release slide 296 to a finger 307 of the latch slide 292. The finger 307 extends downwardly through the mechanism plate opening 301, and thereby resiliently biases the edge 302 of the slide 292 against the ear 299 of the slide 296. These two springs 304, 306 thus cooperate normally to retain the two slides 292, 296 in their respective positions shown in Fig. 30, with pins 466 and 293 engaging the left ends of the slots 294 and 295 in the latch slide 292 and passing through the centres of the slots 297 and 298 in the release slide 296. When the latch slide 292 is in this position, and assuming that the camera cover door 411 is closed, a latch tooth 308 of the latch slide 292 is engageable with a latch tooth 309 on the door 411 to retain the door 411 in its closed condition.

When the latch release slide 296 is moved to the left, by means of its externally accessible latch release button 413, the ear 299 of that slide moves the latch slide 292 in the same direction and thereby moves the latch slide tooth 308 out of engagement with the door's tooth 309 to permit the door 411 to be opened. However, as best shown in Fig. 22 the sector plate 464 is located immediately above the latch slide 292 and obstructs such leftward movement of the ear 299 of the latch release slide 296 except when a notch 311 of the sector plate 464 is aligned with that ear 299, which occurs only when the driving disc 431 is in its initial position shown in Figs. 19, 20, and 21.

As previously explained, the counterclockwise indexing movement imparted to the film unit hub 12 by the advancing pawl 482 drives the sector plate 464 in a clockwise direction in opposition to the spring 468 and the engagement of the ratchet pawl 471 with the teeth of the ratchet tooth segment 469 on the sector plate 464 prevents the latter from rotating in the opposite direction. Consequently, whenever the film disc 10 is rotated to an exposure position, the latch release button 413 cannot be moved to the left to open the camera until the driving disc 431 has first been returned to its initial position to relocate the cover slide 14 over the exposure window 33 of the cartridge assembly casing. The face of the sup-

port frame 435 is so rounded as to facilitate sliding movement of the cover slide 14 into its position covering the exposure window 33.

5 To open the camera door after one or more film exposures have been made, the photographer first moves the button 413 to the right in opposition to spring 306, thereby causing the release slide ear 299 to engage a finger 312 on the ratchet pawl 471 and to withdraw the latter from engagement with the sector teeth 469. At its opposite end, the release slide 296 is provided with a finger 10 313 extending upwardly through a hole 314 in the mechanism plate 443. When the latch release slide 296 (Fig. 30) is moved to the right to disengage, by its ear 299, the ratchet pawl 471 from the ratchet tooth segment 469, this finger 313 simultaneously engages and displaces the adjacent end of advancing pawl 482 (see Fig. 20), thereby pivoting the latter in a counterclockwise direction about the stud 483, which simultaneously rotates the positioning pawl 489 in a clockwise direction about the stud 491 because of the engagement of the advancing tooth end of the pawl 482 with the positioning pawl ear 495, best shown in Fig. 26. Accordingly, the advancing tooth 487 and the positioning tooth 494 are both moved beyond the path of movement of the hub index ears 114 to allow the spring 468 to rotate the driving disk 431 back to its initial position, thus repositioning the cover slide portion 14 over the film unit's exposure window 33 and allowing the latch release slide 296 now to be moved to its extreme left position to release the cover door 411.

40 If a malfunction were to prevent spring 468 from returning the film disc hub 12 to its initial position, for example because of jamming of a faulty cartridge assembly the interlock system just described would prevent the camera from being opened and would thereby make it impossible to correct the malfunction. Therefore, provision is also made for allowing the cover door to be opened under extraordinary circumstances regardless of the orientation of the sector plate 464. This is accomplished by inserting a pin or similar tool through a hole 315 in the camera casing in alignment with an end face 316 of the latch slide 292 and thereby forcing the latch slide 292 to its unlatching position in opposition to spring 306.

55 Figs. 31 through 33 illustrate, somewhat schematically, an even simpler form of a manually operated film disc indexing mechanism that can readily be incorporated with other features of the camera previously described and which likewise ensures that the camera cannot be opened until the rotatable cover slide 14 of the film cartridge assembly is returned to a position at which it closes the exposure window 33.

For use with this particular indexing mechanism, a film disc hub 351, shown in broken lines, is similar to the previously described film disc hub 12, but additionally includes a notch 352 located somewhat off-centre in the 90 degrees ear-free arc of the hub 351. While such a notch 352 would serve no purpose in cooperation with the previously described indexing mechanism, a hub with this feature is completely compatible with that type of mechanism.

When the film cartridge assembly is installed in the camera, the central spindle hole 353 receives a stationary hub spindle 354 that also pivotally supports a film advancing lever 355. This lever 355 carries a film advancing pawl 356, which is attached to the lever by a pin 357 and a spring 358 in the same manner previously described with reference to Figs. 20—22. A positioning pawl 359 is pivotally supported by an eccentric adjustment screw 361 and is biased in a counterclockwise direction toward a stop pin 362 by a weak spring 363. When the cartridge assembly is initially loaded into the camera, the advancing tooth 364 of the film advancing pawl 356 is received in the notch 352 and the positioning tooth 365 of the pawl 359 is retained beyond engagement with the adjacent peripheral hub surface 366 by the pin 362. Flexible pawl springs 367 and 368 are adapted to engage the adjacent index ears 114 on the hub 351 to prevent the latter from rotating in a clockwise direction beyond a position at which the film advancing pawl can engage the next index ear 114 during each film indexing operation.

As film advancing lever 355 is rotated in a clockwise direction, the advancing tooth 364 of the pawl 356 rides over the first index tooth 114a and a cam surface 369 on the advancing pawl 356 engages a pin 371 on the positioning pawl 359 and raises the positioning tooth 365 to a position beyond the movement path of the hub's index ears 114. As shown in broken lines in Fig. 31, the clockwise movement of the lever 355 is limited by a stop pin 372 so that the advancing pawl tooth 364 moves only far enough to ensure its engagement with the hub index ear 114a associated with the next available exposure area. As the lever 355 is returned in a counterclockwise direction back to its initial position by a spring 373, the pawl tooth 364 advances the film disc 10 and brings the index ear 114a into abutment with the positioning tooth 365, which has returned to its operative position during the final return movement of the lever 355. As shown in Fig. 23, the index ear 114a is thus resiliently squeezed against the positioning tooth 365 by the advancing pawl tooth 364 in the same manner previously described. By repeating this operation, the photographer can bring each successive exposure area 65 130

into exposure position. Additionally, each film advancing movement of the lever 355 can also serve to cock the shutter and to perform other camera functions, as previously described.

After the last exposure area 65 has been brought to exposure position, the next reciprocative movement of lever 355 causes the advancing pawl tooth 364 to engage a face 374 of the hub notch 352 and thereby to rotate the hub through an angle sufficient to close the exposure window 33 with the cover slide 14 without quite completing a 360 degree rotation of the hub. A cartridge assembly provided with such a notched hub is also modified by widening the upper notch in its dihedral locking boss so that the hub is locked against further rotation by its final indexing movement. As best illustrated in Fig. 33, because of the off-centre position of notch face 374 between index ears 114a and 114j, which results in the slightly less than 360 degree rotation of the hub 351, the index ear 114a is now beyond the position at which it can be engaged by the advancing pawl tooth 364, which is shown in its extreme clockwise position in broken lines, thereby avoiding re-exposure of the first exposure area.

The door latching device is schematically represented in Fig. 31 by a slidable latch member 375, which is movable to the left in opposition to a spring 376 by a slide button 377 to disengage a latch tooth 378 from a cooperating latch member carried by the camera door. A pin 379 on the latch member 375 engages a cam surface 381 of a pivotally-mounted blocking member 382 and pivots the latter in a counterclockwise direction about its pivot pin 383 when the latch member is moved to the left to release the door. A locking arm 384 is pivotally mounted by a stud 385 and includes a nose 386 urged into contact with the cam surface 369 of the film advancing pawl 356 by a spring 387. When the advancing tooth 364 of the pawl 356 is received within the hub notch 352, the locking arm assumes the position shown in solid lines in Fig. 31, in which its shoe 388 is positioned beyond the movement path of a finger 389 on the blocking member 382, thereby allowing the blocking member 382 to be rotated in a counterclockwise direction by the door releasing movement of the slidable latch member 375. When the hub 351 is in any other rotational position, however, the resulting forward displacement of the nose 386 causes the locking arm 384 to be rotated in a clockwise direction from its illustrated position, as shown in broken lines in Fig. 31, whereby the shoe 388 blocks counterclockwise rotation of the blocking member 382 and thereby prevents the latch member 375 from being moved to the position at which the door is released. Conse-

quently, the door cannot be opened unless the hub 351 is at a position at which the cover slide closes the exposure window of the cartridge assembly casing.

Figures 34 to 37 schematically depict a third camera mechanism, which may be called an "automatic film advance mechanism", because the energy required to accomplish all of the successive indexing movements of the film disc is imparted to the mechanism during the operation of loading the camera.

As in the previously described embodiments of the invention, this camera mechanism comprises a stationary hub support spindle 401¹, intended to be received in the central hole of the film disc hub, shown in broken lines at numeral 12. A driving disc 402¹, similar to the previously described disc 431, is rotatably supported by the spindle 401¹ and includes a pinion 403¹ and a plurality of peripheral teeth 404¹ spaced at 30 degree intervals to correspond to the spacing between adjacent index ears 114 of the hub 12. A drive sector 405¹, in meshing engagement with the pinion 403¹, is pivotally mounted on stud 406¹ and is biased in a clockwise direction by a relatively strong hair pin spring 407¹. When the sector 405¹ is in the position shown in solid lines in Fig. 32, the driving disc 402¹ is oriented with its coupling pin 408¹ (equivalent to the previously described coupling pin 433) aligned between the spindle 401¹ and the rectangular exposure opening 409¹ of the camera's film support frame structure, thereby allowing a film cartridge assembly to be installed in the camera in mating engagement with the driving disc 402¹.

A lever 411¹ is also pivotally mounted on the stud 406 and includes an ear 412¹ engageable with an edge 413¹ of the drive sector 405¹. To open the camera, the lever 411¹ is rotated in a counterclockwise direction from the position shown in broken lines in Fig. 34 and in solid lines in Fig. 37 to the position shown in solid lines in Fig. 34, thereby causing the drive sector 405¹ and the driving disc 402¹ to assume the respective positions in which they are depicted in solid lines in Fig. 34.

A latch slide 414¹, best illustrated in Figs. 36 and 37, is slidably mounted to the camera housing, not shown, by rivet pins 415¹ and 416¹ extending through an L-shaped slot 417¹ in the slide 414¹. A spring 418¹ biases the slide 414¹ both to the left and also in a clockwise direction about the pin 416¹. The camera's cover door, partially depicted at numeral 419¹, is shown in Fig. 35 in its closed position and in Fig. 36 in a partially open position. When the door 419¹ is closed, the slide 414¹ assumes the position shown in Fig. 35 with the pins 415¹ and 416¹ both received in the horizontal leg 421¹ of the slot

417¹ and with slide tooth 422¹ in engagement with latch tooth 423¹ on the cover door 419¹ to retain the latter in its closed condition. As the lever 411¹ arrives at the position shown in solid lines in Fig. 34, it engages a shoulder 424¹ of the latch slide 414¹ and displaces the latter to the right in opposition to the spring 418¹ to disengage the slide tooth 422¹ from the latch tooth 423¹ on the cover door 419¹. Just before the teeth 422¹ and 423¹ are disengaged from one another, however, vertical leg 425¹ of the slot 417¹ moves into alignment with the pin 415¹, whereupon the spring 418¹ rotates the slide 414¹ in a clockwise direction about the pin 416¹ to move slide ear 426¹ to a position to the left of the lever 411¹. After the photographer has completed the counterclockwise movement of the lever and has at least partially opened the door 419¹, the ear 426¹ retains the lever 411¹ in the position shown in solid lines in Figs. 34 and 36, thereby maintaining the sector 405¹ in the position shown in Fig. 34 as long as the cover door 419¹ remains open. When the cover door 419¹ is subsequently pressed to a closed position, edge 427¹ of the door 419¹ engages the upper edge of the slide tooth 422¹ and urges the latter downwardly so that the pin 415¹ is again aligned with the horizontal leg 421¹ of the slot 417¹; whereupon the spring 418¹ returns the slide 414¹ to its latched position shown in Fig. 35 and thereby releases the arm 411¹, which is returned by spring 428¹ to its position shown in solid lines in Figs. 37 and in broken lines in Fig. 34.

After the camera door 419¹ has been closed, the lever 411¹ no longer opposes the clockwise rotation of the sector 405¹ by the spring 407¹. Accordingly, the sector 405¹ now imparts counterclockwise rotation to the driving disc 402¹ and thereby to the film disc hub 12. As the latter rotates in a counterclockwise direction, its index ear 114a aligned with the film disc's first available exposure area 65, rotates into abutment with positioning tooth 429¹ of pivotally supported positioning lever 430¹. Accordingly, the rotatable cover slide 14 is removed from alignment with the exposure window 33 of the cartridge assembly casing and the first available exposure area is aligned with the exposure opening 409¹ in the film support frame.

The shutter structure comprises an opening shutter blade 431¹ and a closing shutter blade 432¹, which are located in superimposed relation to each other and supported for sliding movement by suitable support means, not shown. The shutter blades 431¹, 432¹ are shown in Fig. 34 in their respective cocked positions, in which an aperture 433¹ in the closing shutter blade 432¹ is aligned with the exposure opening 409¹ and in which an aperture 434¹ in the opening

shutter blade 431¹ is located to the right of the opening 409¹. The engagement of the opening shutter blade pin 435¹ with tooth 436¹ of pivotally mounted latch lever 437¹ retains the opening blade 431¹ in its cocked position in opposition to a spring 438¹ and the engagement of tooth 439¹ on the closing shutter blade with tooth 441¹ of pivotally supported latch arm 442¹ similarly retains the closing blade 432¹ in its cocked position in opposition to a spring 443¹.

A shutter release member 444¹ is schematically depicted as being slidably supported by pins 445¹ extending through an elongate slot 446¹ and is biased forwardly to its inoperative position shown in Fig. 34 by a spring 447¹ attached to a pivotally supported lever 448¹. It should be understood that this representation of the shutter release member is merely illustrative, and that such a member preferably would be located as illustrated in Fig. 18 and connected with the shutter by appropriate linkage means.

As the shutter release member 444¹ is moved rearwardly to effect an exposure, its initial movement pivotally displaces the lever 448¹ to move its finger 449¹ out of supporting engagement with pressure plate ear 451¹. The finger 449¹ and the ear 451¹ correspond respectively to the finger 441 and the pressure plate ear 440 which were described previously with reference to Figs. 18—30. This initial movement of the shutter release member 444¹ causes the camera's pressure plate to squeeze the film against the film support frame. The continuing rearward movement of the member 444¹ then brings its ear 452¹ into contact with the latch lever 437¹ and pivots the latter in a clockwise direction about its pivot stud 453¹ to the position shown in solid lines in Fig. 37. This movement of the lever 437¹ disengages its tooth 436¹ from the pin 435¹ on opening shutter blade 431¹ and positions its teeth 454¹ in alignment with pin 455¹ on that same blade 431¹. Accordingly, exposure of the film is initiated as the spring 438¹ moves the opening shutter blade 431¹ to its intermediate position, shown in solid lines in Fig. 37 in which the pin 455¹ on that blade 431¹ is engaged by the tooth 454¹ of the latch lever 437¹ and in which the opening blade aperture 434¹ is aligned with the opening 409¹ of the film support frame and with the aperture 433¹ of the closing shutter blade 432¹. As the opening shutter blade 431¹ arrives at its intermediate position, its lobe 456¹ engages lobe 457¹ on the latch arm 442¹ and disengages the latch arm 442¹ from tooth 439¹ on the closing shutter blade 432¹, thereby allowing the spring 443¹ to move the closing shutter blade 432¹ to its intermediate position, defined by the abutment of its tab 458¹ with the adjacent edge of the opening shutter blade 431¹. This movement of

the closing shutter blade 432¹ terminates the film exposure by moving the closing shutter blade aperture 433¹ beyond the film support frame opening 409¹. Thus, the shutter mechanism provides a mechanically predetermined exposure interval, which obviously could be increased by the incorporation of an electromagnet for retarding the motion of the closing shutter blade 432¹ in the same manner described in connection with Figs. 20 through 30.

As the shutter release member is returned to its initial position by the spring 447¹, the lever 448¹ causes the finger 449¹ to retract the pressure plate from operative engagement with the film cartridge assembly, whereupon ear 459¹ of the member 444¹ engages the latch lever 437¹ and returns it to its original position. This movement of the latch lever 437¹ disengages its tooth 454¹ from the pin 455¹ of the opening shutter blade 431¹ and thereby allows both shutter blades 431¹, 432¹ to move slightly further to the left to the position shown in broken lines in Fig. 37. During this final movement of the two shutter blades, edge 461¹ of the blade 431¹ engages nose 462¹ of positioning lever 430¹ and rotates the latter about its eccentric pivot pin 463¹ to the position shown in broken lines in Fig. 37, in which the positioning tooth 429¹ is disengaged from the hub index ear 114a. Consequently, the sector 405¹ now drives the driving disc 402¹ and the hub 12 in a counterclockwise direction, which causes the driving disc tooth 404a¹ adjacent finger 464¹ of cocking member 465¹ to engage that finger and to displace the member 465¹ in a clockwise direction about its pivot stud 466¹.

A cocking arm 467¹ is also pivotally mounted to the stud 466¹ below the cocking member 465¹ and is biased in a counterclockwise direction against the stop pin 468¹ by spring 469¹. A weak hairpin spring 471¹ biases the cocking member 465¹ in a clockwise direction relative to the cocking arm 467¹ to urge edge 472¹ of the cocking member 465¹ against tab 473¹ of the cocking arm 467¹. As the tooth 404a¹ of the driving disc 402¹ engages and moves past the finger 464¹ of the cocking member 465¹, the resulting clockwise rotation of the cocking member 465¹ is imparted to the cocking arm 467¹ through its tab 473¹, thus causing the arm 467¹ to move momentarily to the position shown in broken lines in Fig. 34 and then to return to its initial position. During this movement of the arm 467¹, its head 474¹ engages finger 475¹ on the opening shutter blade 431¹ and returns both blades 431¹, 432¹ to their initial cocked positions. As the arm 467¹ initially moves the shutter blades 431¹, 432¹ back to their respective cocked conditions, the edge 461¹ of the opening shutter blade 431¹ moves out of engagement

with the nose 462¹ of the positioning lever 430¹ and allows spring 476¹ to return the positioning lever 430¹ to its operative position shown in Fig. 34, whereby the rotation of the driving disc 402¹ and the film hub is again arrested when the next index tooth 114b engages the positioning tooth 429¹. Accordingly, the next available exposure area is now positioned for exposure and the shutter mechanism is recocked and restored to its initial condition. After the repetition of this operation has exposed all of the available film exposure areas, the sector 405¹ moves into abutment with stop pin 477¹, thus preventing further counterclockwise rotation of the film disc.

Because the latch slide 414¹ holds the loading lever 411¹ in the position shown in solid lines in Fig. 34 as long as the camera's cover door 419¹ is open, the film disc in a film cartridge assembly loaded into the camera cannot be rotated until the cover door has been closed, thereby preventing the film disc from being exposed inadvertently to ambient light. If desired, this feature could also be incorporated in the camera shown in Figs. 18—30 by providing that camera with a simple latch device for locking the film advancing lever 446 in the position shown in Fig. 20 whenever the camera door is open.

To remove the film cartridge assembly, after either all or only some of the available exposure areas have been used, the photographer opens the camera door 419¹ by moving the lever 411 to the position shown in solid lines in Fig. 34, thereby rotating the hub 12 in a clockwise direction back to its initial position in which the rotatable cover slide again closes the exposure window of the cartridge assembly casing and in which the hub is now locked against further rotation. During this clockwise rotation of the driving disc 402¹, the film hub index ears 114 engage the sloped face 478¹ of positioning tooth 429¹ and cam tooth 429¹ aside in opposition to the spring 476¹. The teeth 404¹ of the driving disc 402¹ similarly bypass the finger 464¹ of the cocking member 465¹ by rotating the finger 464¹ in a counterclockwise direction in opposition to the spring 471¹. Although Fig. 34 shows the shutter in a cocked condition during the camera loading operation, this situation would exist only if the preceding cartridge assembly were removed prior to exposure of all the available exposure areas. If the preceding cartridge assembly had been fully exposed, the shutter would remain uncocked, but would be recocked by the initial rotation of the driving disc 402¹ by which the first available exposure area is brought into exposure position.

Fig. 38 shows a modification of the mechanism depicted in Figs. 34—37 for use in a

camera in which the shutter is cocked other than by the film advancing mechanism, for example, by the final return movement of the shutter release member after that movement has caused the pressure plate to disengage from the film cartridge assembly. Because such a previously known shutter cocking mechanism, not shown, eliminates the need for the cocking arm 467¹ and its associated structure, those elements are omitted and the positioning lever 430¹ is provided with an escapement tooth 481¹ to provide an escapement mechanism. When the final movement of the shutter blades 431¹, 432¹ rotates the lever 430¹ to the position shown in broken lines and thereby disengages the indexing tooth 429¹ from a hub index ear, the escapement tooth 481¹ simultaneously moves into the movement path of the adjacent driving disc tooth 404¹. Accordingly, the film disc is advanced only part way to the next exposure position before the tooth 481¹ temporarily arrests further counterclockwise rotation of the driving disc 402¹. When the shutter is recocked by the final return movement of the shutter releasing member, the spring 476¹ returns the latch lever 430¹ to its position shown in solid lines and withdraws its tooth 481¹ from engagement with the driving disc tooth 404¹; whereupon the film disc completes its indexing movement to the position established by the engagement of its next index ear with the positioning tooth 429¹.

Figs. 39 and 40 show another embodiment of an escapement mechanism functionally similar to the one shown in Fig. 38 but in which both the positioning tooth 483¹ and the escapement tooth 484¹ cooperate directly with the hub index ears 114 to provide incremental indexing movements of the film disc hub 12 as it is biased in a counterclockwise direction by the driving disc 485¹. The positioning tooth 483¹ is carried by a positioning lever 486¹, pivotally supported by eccentric pivot stud 487¹, and is urged toward its operative position shown in Fig. 39 by a spring 488¹. In this position, which is defined by the abutment of the lever 486¹ against the pin 489¹, the tooth 483¹ is engaged with the hub index ear 114a to arrest the counterclockwise rotation of the film disc hub and to locate the corresponding film exposure area in exposure position. The escapement tooth 484¹ is carried by an escapement lever 491¹, which is pivotally supported by pivot stud 492¹ and provided with a cam face 493¹ adjacent pin 494¹ of the opening shutter blade 431¹ when the latter is in its intermediate position as shown in Fig. 39. An ear 495¹ on the positioning lever 486¹ engages finger 496¹ of the escapement lever 491¹ whereby the counterclockwise force supplied to the lever 486¹ by the spring 488¹

biases the lever 491¹ in a clockwise direction against pin 497¹.

When the shutter blade 431¹ moves to its final uncocked position, as shown in Fig. 40, its pin 494¹ cams the escapement lever 491¹ in a counterclockwise direction, whereby its finger 496¹ moves the positioning lever 486¹ in a clockwise direction in opposition to the spring 488¹. Accordingly, the positioning tooth 483¹ is now released from the index ear 114a, allowing the film disc hub 12 to rotate to the position shown in Fig. 40, in which that index ear 114a is engaged with the escapement tooth 484¹. As the shutter is recocked, the spring 188¹ returns both levers 486¹, 491¹ to their respective positions shown in Fig. 39, thereby releasing the tooth 484¹ from the ear 114a and causing the tooth 483¹ to intercept the index ear 114b to complete the film disc indexing operation.

Fig. 41 illustrates the basic film unit 17 as it will appear to a handler after removal from the cartridge (under darkroom conditions) and processing. It will be noted that the structural integrity of the film unit is maintained i.e. the film disc 10 and the hub 12 are still secured together. The photosensitive imaging surface 13 has been processed to provide a plurality e.g. 10 of photographic images corresponding to the image areas 65 which areas are surrounded by the now opaque preflashed borders. In such a condition, the film unit, if a negative material, is ready for printing and if a positive material, is ready for viewing for example in an apparatus diagrammatically shown in Figs. 42 and 43.

Because of the retained structural integrity of the film unit, a printing apparatus or a viewing apparatus may again utilise the indexing ears 114 of the hub 12 to position the exposed and processed image areas 65 in alignment with an optical axis of the apparatus.

Figures 42 and 43 are illustrative of apparatus utilizing some of the advantages of the film unit described herein. In Figure 42 a plurality of film units 17 bearing photographically developed images are arranged on a skewer 160 which is inserted through the circular bores 116 of the film hubs 12 of the film units 17. A longitudinal spline on the skewer 160 interfits with keyways 117 in the bores 116 and serves to align the film units and prevent them rotating relative to the skewer. An optical viewer comprising a light source 158, an optical prism assembly 164 creating an optical path 163, and associated known optical and electrical components 161 including a cathode ray tube 162, is arranged to permit viewing on the cathode ray tube of the images in the image areas 65 of the film units 17. The aligned notches 54 of the film units 17 in effect form

a channel in the stack of film units which permits the prism assembly 164 to traverse parallel to the skewer 160 a distance sufficient to place the assembly 164 in alignment with a desired film unit (17¹). The skewer 160, together with the film units 17 mounted thereon, then need only be rotated through an arc calculated to align a desired one of the image areas 65 of the film unit 17¹ with the optical path 163 created by the prism assembly. As mentioned above, this is most readily effected utilising the index ears 114 of the hub 12. The hubs 12 of the film units 17 afford a precise and uniform spacing between adjacent film discs 10. As seen in Figure 43, the prism assembly 164 may penetrate the stack of film discs 10 to engage a desired disc (17¹) without encountering interference from adjacent discs. Although, as seen in Figure 43, the discs 10 on each side of the engaged disc 17¹ may be subjected to some slight flexing, the spacing provided by the hubs 12 is such that the flexed discs do not contact their adjacent discs.

The description and drawings of the present application are similar to the descriptions and drawings of our copending application No. 9038/78 (Serial No. 1597071), our copending application No. 9039/78 (Serial No. 1597072) and its divisional application No. 8007902 (Serial No. 1597074), and our copending application No. 9040/78 (Serial No. 1597073).

WHAT WE CLAIM IS:—

1. A photographic film unit comprising a disc of photosensitive material having a plurality of image areas and a rigid hub having a radially outwardly opening recess, the perimeter of a central aperture in the disc being received in the recess and being permanently secured therein so that the disc is rotatable with the hub.

2. A film unit as claimed in claim 1 wherein the disc is secured to the hub by means of a wall of the hub, adjacent the recess, clamping the film disc in the recess.

3. A film unit as claimed in claim 2 wherein the wall of the hub is formed by a ring secured to the hub.

4. A film unit as claimed in claim 2 or 3 wherein the wall of the hub is deformed,

for example, by ultrasonics, into clamping engagement with the disc.

5. A film unit as claimed in any of claims 1 to 4 wherein the image areas are spaced around an annular path, the hub enabling the unit to be rotated sequentially to present the image area for exposure.

6. A film unit as claimed in any of claims 1 to 5 having a plurality, corresponding in number to the number of image areas, of indexing means spaced at intervals corresponding to the spacing of the images.

7. A film unit as claimed in any of claims 1 to 6 wherein the image areas are defined by preflashed borders.

8. A photographic film unit substantially as hereinbefore described with reference to Figs. 1 to 3 and 41 of the accompanying drawings.

9. A photographic cartridge assembly, including a film unit as claimed in any preceding claims, of laminar construction having an exposure window in a casing wall thereof, the window being spaced from the axis of rotation of the film unit a distance such that the image area may be presented sequentially thereat.

10. A cartridge assembly as claimed in claim 9 and having a hub support for rotatably supporting the hub of a film unit therein, the hub support and the hub together presenting a labyrinthine light trap.

11. An assembly as claimed in claim 9 or 10 further including a cover slide within the casing initially positioned relative to the exposure window to prevent the passage of light therethrough.

12. An assembly as claimed in claim 11 further including an opaque mask non-rotatably mounted within the casing between the film unit disc and the cover slide and having an exposure aperture in alignment with the exposure window.

13. A photographic cartridge assembly substantially as hereinbefore described and including a film unit as claimed in any of claims 1 to 8.

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a channel in the stack of film units which permits the prism assembly 164 to traverse parallel to the skewer 160 a distance sufficient to place the assembly 164 in alignment with a desired film unit (17¹). The skewer 160, together with the film units 17 mounted thereon, then need only be rotated through an arc calculated to align a desired one of the image areas 65 of the film unit 17¹ with the optical path 163 created by the prism assembly. As mentioned above, this is most readily effected utilising the index ears 114 of the hub 12. The hubs 12 of the film units 17 afford a precise and uniform spacing between adjacent film discs 10. As seen in Figure 43, the prism assembly 164 may penetrate the stack of film discs 10 to engage a desired disc (17¹) without encountering interference from adjacent discs. Although, as seen in Figure 43, the discs 10 on each side of the engaged disc 17¹ may be subjected to some slight flexing, the spacing provided by the hubs 12 is such that the flexed discs do not contact their adjacent discs.

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2. A film unit as claimed in claim 1 wherein the disc is secured to the hub by means of a wall of the hub, adjacent the recess, clamping the film disc in the recess.

3. A film unit as claimed in claim 2 wherein the wall of the hub is formed by a ring secured to the hub.

4. A film unit as claimed in claim 2 or 3 wherein the wall of the hub is deformed,

for example, by ultrasonics, into clamping engagement with the disc.

5. A film unit as claimed in any of claims 1 to 4 wherein the image areas are spaced around an annular path, the hub enabling the unit to be rotated sequentially to present the image area for exposure.

6. A film unit as claimed in any of claims 1 to 5 having a plurality, corresponding in number to the number of image areas, of indexing means spaced at intervals corresponding to the spacing of the images.

7. A film unit as claimed in any of claims 1 to 6 wherein the image areas are defined by preflashed borders.

8. A photographic film unit substantially as hereinbefore described with reference to Figs. 1 to 3 and 41 of the accompanying drawings.

9. A photographic cartridge assembly, including a film unit as claimed in any preceding claims, of laminar construction having an exposure window in a casing wall thereof, the window being spaced from the axis of rotation of the film unit a distance such that the image area may be presented sequentially thereat.

10. A cartridge assembly as claimed in claim 9 and having a hub support for rotatably supporting the hub of a film unit therein, the hub support and the hub together presenting a labyrinthine light trap.

11. An assembly as claimed in claim 9 or 10 further including a cover slide within the casing initially positioned relative to the exposure window to prevent the passage of light therethrough.

12. An assembly as claimed in claim 11 further including an opaque mask non-rotatably mounted within the casing between the film unit disc and the cover slide and having an exposure aperture in alignment with the exposure window.

13. A photographic cartridge assembly substantially as hereinbefore described and including a film unit as claimed in any of claims 1 to 8.

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