A shutter control apparatus of the type having leading and trailing members which are biased to move from respective cocked positions to respective rest positions for respectively initiating and terminating exposure, includes apparatus for selecting either automatic electric exposure or mechanical exposure control. The apparatus includes means for retaining the trailing member at its cocked position and means for moving the retaining structure to a retracted position when the leading member is moved from its cocked position to its rest position. Structure is also provided for restraining the retaining structure in its operating position and an electrical timing circuit controls the time period during which the restraining structure is operative. Locking structure locks the retaining structure in its retaining position and is released by a device which is responsive to the movement of the leading member from its cocked position to its rest position. The locking structure is maintained in an inoperative position when the apparatus is set to any one of a number of automatic exposure setting positions. The shutter control apparatus also is capable of carrying out bulb exposures either using a combined mechanical and electrical exposure control, or in a modified embodiment, the bulb exposure is completely effected by mechanical mechanism only.

5 Claims, 7 Drawing Figures
CAMERA HAVING AN ELECTRIC SHUTTER

BACKGROUND OF THE INVENTION

The present invention relates to camera types which are provided with an electric shutter capable of setting automatic or manual exposure time by means of an electromagnet actuated by the output of an electric exposure control circuit. In the present invention, a mechanical shutter speed control mechanism is operated independently of the electric exposure control circuit, and there is also a mechanism which is additionally capable of controlling the bulb exposure, whereby, the exposure time can be selectively controlled by either electrical or mechanical means by means of a selection member.

Electric shutters have been widely used because of the advantageous features that the exposure time thereof can be automatically controlled, that they are mechanically durable against vibrations or the like, and that the accuracy of the shutter speed control is high. Nevertheless, they have the disadvantage that, when their power source cells are consumed, then shutter speed controlling accuracy is rapidly degraded such that in the worst case, for instance, in the case where the shutter is closed by an excited electromagnet, the shutter will be kept in an opened position, and in the case where the shutter is closed by the demagnetization of an electromagnet, the shutter will not be opened. This often results in that no photograph can be taken by such a camera provided with an electric shutter when its power source cells have been consumed.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide a novel control means for an electrically operated shutter in a camera in which the setting of the exposure time is carried out either automatically or manually by means of an electric exposure control circuit, wherein there is also the capability of controlling the shutter speed mechanically without using the electric exposure control circuit.

It is another object of the present invention to provide an inexpensive and simple mechanism which is added to the known structure of a camera to provide the capability of mechanically controlling the shutter speed and which is used at the time of the electric exposure control.

It is still another object of the present invention to provide a novel device wherein the rotation of a selection member consisting of a single shutter speed setting member enables automatic or manual exposure settings by means of an electric control, mechanical shutter speed control, and bulb exposure control.

It is further another object of the present invention to provide a simple and novel exposure control means using a mechanical shutter speed control mechanism.

It is still further another object of the present invention to provide the aforesaid bulb exposure control means in which two mechanisms for electric control and mechanical control cooperate with each other, as well as cooperate with another novel device by means of the mechanical control alone.

It is also another object of the present invention to provide various novel devices for use in a mechanical shutter speed regulating means.

SUMMARY OF THE INVENTION

The present invention comprises a shutter speed setting member operable as a selection member which is selectively shiftable to an automatic and manual exposure time setting position electrically controlling the shutter, or to a mechanical shutter speed position. A mechanical exposure control locking member is operated by a member responsive to shutter opening motion and controls a shutter closing motion acting member. The shutter closing motion acting member which is controlled either by the operation of an electromagnet or by the mechanical exposure control locking member corresponding to the shutter speed setting in accordance with either the automatic or manual exposure control by means of the electric control circuit or the mechanical control mechanism.

The mechanical shutter control device, is advantageous in that the control can be carried into effect merely by the change-over of a single shutter speed setting member, if a simple mechanism is added to the mechanism which is used in the electrical control apparatus.

The present invention further provides various means for mechanically regulating the shutter speed of the mechanical shutter control device.

In each embodiment of the shutter speed setting member, the mechanical exposure control locking member and the shutter closing motion acting member are respectively shaped into a novel and unique form in order that they are individually operable appropriately in response to the electrical control and to the mechanical control.

According to the present invention, in a camera having an electric shutter, not only the mechanical control as described above can be carried out but also a bulb exposure control can be additionally carried into effect. For this purpose, a position for the bulb exposure control is provided on the shutter speed setting member, and by adding a bulb locking member thereto in the mechanical mechanism, and further by selecting either the mechanical exposure control time or the electric exposure control time by the mechanical and electrical mechanisms, the bulb exposure control can be simply carried into effect.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing a first embodiment of a camera having an electric shutter in accordance with the present invention for obtaining mechanical shutter speed control,

FIG. 2 is a circuit diagram showing an electric exposure control circuit illustrating the operation of the present invention,

FIG. 3 is a perspective view showing a second embodiment of the present invention in which a portion of the first embodiment shown in FIG. 1 has been modified,

FIG. 4 is a perspective view showing a third embodiment of the present invention in which a part of the embodiment shown in FIG. 1 has been modified,

FIG. 5 is a perspective view showing a fourth embodiment of a camera having an electric shutter in accordance with the present invention, wherein, the mechanical shutter speed control and the bulb exposure control can be both carried into effect.
FIG. 6 is a perspective view showing a fifth embodiment of the present invention in which a part of the fourth embodiment shown in FIG. 5 has been modified, and FIG. 7 is a detail view of the locking lever structure of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows a first embodiment of the invention, in which the electric circuit for controlling automatic or manual exposure time and the curtain shutter section shown in the lower part below the chain line Z — Z are constructed in accordance with a known electrically controlled curtain shutter. The reference numeral 1 denotes a shutter release member which is biased by a spring (not shown in the drawing) to a raised position, and the lower end of shutter release member 1 is in contact with transmittal plate 2 having transmittal rod 3. The lower end of transmittal rod 3 is in contact with one end of lever 4, and other end of the lever 4 is kept in contact with another lever 5 which is biased to turn about axis 5a in the clockwise direction 5b. The lever 5 engages through a lever 7, lever 8 which is biased in the counterclockwise direction 5c, and lever 8 is pivotally mounted to one end of a spindle 9 on which mirror 10 is rigidly mounted. The lever 8 is engageable with a lever 11 which is in turn engaged with an opening curtain locking lever 12, and a pawl 12a is engaged with a cam 13 which is fixed to the lower end of a spindle 14. When the pawl 12a is disengaged from the cam 13, the spindle 14 releases the locking of the shutter opening curtain 21 via gears 15 and 16. The spindle 14 is provided with a switch operating piece 17 which opens a trigger switch 24 in an electric circuit at the time when the spindle 14 starts to turn. The trigger switch 24 is provided across delay capacitor C in the exposure time control circuit shown in FIG. 2.

The numeral 18 designates a closing curtain operating lever which is switched in the case where the electric control circuit for the automatic or manual exposure time shown in FIG. 2 is used, to contact b connecting a light receiving photocell Rb with the capacitor C through a change-over switch Sb when the automatic exposure time setting is as is well known, and is switched to contacts a1, a2, a3, etc. connecting variable resistors R1, R2, R3, etc. with the capacitor C through the change-over switch Sb when the manual exposure time setting is as is in FIG. 2. A switch Sb in FIG. 2 is a setting switch which is connected in series with a power source switch Sb and which is closed in relation to the depression of the release button. Setting switch Sb is kept closed when a shutter speed setting dial 28 described hereinafter is set for electric exposure control. In the exposure time control circuit described above, because trigger switch 24 is opened simultaneously with the starting motion of the opening curtain 21, the capacitor C is charged selectively via either the light receiving photoco nductive cell Rb or one of resistors R1, R2, R3, etc. The selection is accomplished by the change-over switch Sb, and when the voltage charged by capacitor C reaches a definite value, a switching circuit consisting of transistors T1, T2, etc. is actuated so that an electromagnet M is demagnetized. Electromagnet M confronts armature 24 provided at one end of the closing curtain operating lever 18. Before the capacitor C is charged to the aforesaid voltage, the armature 24 is retained by the electromagnet M, so that the closing curtain operating lever 18 is held counterclockwise turned against the bias of spring 19. Therefore, an arm portion 18a is kept engaged with a pin 20a erected on a gear 20 so as to lock the closing curtain 22 against its running-out tendency. At the same time when the capacitor C is charged, the electromagnet M is demagnetized and the closing curtain operating lever 18 is clockwise turned by spring 19. Closing curtain 22 is unlocked so as to movement of the closing curtain to be started.

The numeral 28 denotes a shutter speed setting dial, and on the top face thereof are provided three types of scales which include an electrical automatic exposure control scale E, an electric manually exposure control scale M consisting of such numerals as 30, 60, 125, 250, etc., and a mechanical exposure time control scale X.

Also, provided bodily and coaxially with the shutter speed setting dial 28 is a setting cam plate 30 having a concave segment 30b and a pin 30a which controls the open and closing motion of the setting switch S2 in the exposure control circuit. When the scale E or any one of numerals of the scale M on the shutter speed setting dial 28 is brought coincident with an index 29, the pin 30a on the setting cam plate 30 is disengaged from the setting switch S2 so that the switch is closed. Concave segment 30b is also kept disengaged from a pin 31a provided on a mechanical exposure control locking lever 31 which is endowed with a clockwise turning tendency by spring 39. When the scale X on the shutter speed setting dial 28 is brought coincident with the index 29, the setting switch S2 is opened by the pin 30a so as to render the exposure control circuit non-operative. Concurrently therewith, the mechanical exposure control locking lever 31, having a clockwise turning tendency due to the spring 39, is turned clockwise until the pin 31a erected thereon is brought into engagement with concave segment 30b of the setting cam plate 30. Locking arm 31b of the locking lever 31 is thereby turned against the bias of the spring 19 until it is engaged with a pin 18a erected on the closing curtain operating lever 18 which is then located at a position arresting the closing curtain from its being released.

If a winding lever 34 is turned counterclockwise in order to cock the shutter, the opening curtain gear 15 is rotated clockwise via gears 35, 36, 37 and 38, and opening curtain 21 is accordingly cocked through the gear 16. Since a connection pin 20b, formed on the under face of the closing curtain gear 20, is then pushed by a connection pin 15a, formed on the upper face of the opening curtain gear 15, the closing curtain gear 20 is also rotated so that the closing curtain 22 is also charged simultaneously.

Toothed portion 31c formed on one end of the mechanical exposure control locking lever 31 is meshed with a gear 32 fixed on the shaft of an inertia wheel 32a. Consequently, in the operation of closing curtain 22, when the shutter speed is mechanically controlled, the pin 15a on the gear 15 rotates counterclockwise together with the opening motion of the opening curtain 21 is going to escape from the pin 20b on the closing curtain gear 20, and closing curtain gear 20 is thereby going to turn counterclockwise as does opening curtain gear 15.

However, the pin 18a at one end of the closing curtain operating lever 18 is kept in contact with the mechanical exposure control lever 31 having a clockwise
turning tendency, and the inertia wheel 32a is inter-locked via the gear 32 with the end portion of the lever 31. Therefore, the turning tendency of the gear 20 as aforesaid is appropriately braked by the inertia wheel 32a in such a manner that the pin 20a is disengaged from the arm portion 18b when a certain definite time has passed after the opening curtain 21 was released. Because of this operation, the running motion of the closing curtain is started after a definite delay time and the shutter is thereby closed.

The first embodiment of the present invention operates as described hereinbelow. In the case of the automatic electrical control or the manual setting control, if either the scale E or any one of numerals of the scale m is first brought coincident with the index 29, the radially larger segment of the setting cam plate 30 pushes aside the operating pin 31a of the mechanical exposure control locking lever 31 in the counterclockwise direction against the clockwise turning tendency due to the spring 39. Thereby locking arm 31b is disengaged from the pin 18a of the closing curtain operating lever 18. Moreover, since the setting switch Ss is not engaged with the pin 30a of the setting cam plate 30, and therefore is kept closed, the operating condition of the exposure control circuit is maintained.

In this situation, if the shutter release member 1 is pressed down, the left end of the lever 4 is pushed down via the transmittal plate 2 and the transmittal rod 3, the right end of the lever 4 is thereby disengaged from the lever 5 so as to allow the lever 5 to turn about its axis 5a in the direction of arrow W4 to kick up the lever 7 which is in turn disengaged from the lever 8. Thereby, lever 8 having been biased in the direction of arrow W2 enables mirror 10 to jump up as well as lever 11 to turn clockwise, and opening curtain locking lever 12 is thereby turned counterclockwise so that pawl 12a is disengaged from the cam 13.

Spindle 14 is thereby unlocked so that the shutter opening curtain 21 interlocked thereto via the opening curtain gear 15 and the gear 16 starts to run. Simultaneously with the start of the rotation of the spindle 14, the switch operating cam 17 fixed to the spindle 14 opens the trigger switch Ss.

Accordingly, the charging of capacitor C in the circuit shown in FIG. 2 is commenced selectively via either the photoconductive cell R2 or one of resistors R5, R6, Rg, etc., and that selection is accomplished by the changeover switch Ss. When capacitor C is charged to a predetermined voltage, the electromagnet M is demagnetized so as to allow the closing curtain operating lever 18 and armature 24, which has been retained by electromagnet M to be turned clockwise by the bias of the spring 19. Accordingly, the pin 20a formed on the closing curtain gear 20 is disengaged from the arm portion 18b of the closing curtain operating lever 18, thereby, the closing curtain gear 20, which is idly fitted on the spindle 14, allows the shutter closing curtain 22 to commence running. The shutter can be thereby closed corresponding to the brightness of any object field or the setting of any exposure time.

However, if the shutter speed is to be mechanically controlled in the case where the power source cells have been consumed, the scale X of the shutter speed setting dial 28 must be brought coincident with the index 29. In this case, as the setting switch Ss in the exposure control circuit is opened by the pin 30a of the setting cam plate 30, the circuit is not operable. But operating pin 31a of the mechanical exposure control locking lever 31 enters concave segment 30b of the setting cam plate 30, and the locking arm 31b is thereby turned clockwise by the bias of the spring 39 and is engaged with the pin 18a. Thus, closing curtain operating lever 18 is therefore turned counterclockwise against the bias of the spring 19 and locks the closing curtain gear 20.

In this situation, if the shutter release member 1 is pressed down, the opening curtain 21 is released as opening curtain locking lever 12 is turned in the same way as in the previously described case of the automatic control or the manual setting. By the counterclockwise rotation of the opening curtain gear 15 at the time of the opening motion of the opening curtain 21, the connection pin 15a of the opening curtain gear 15 is retracted from the connection pin 20b of the closing curtain gear 20, thereby the closing curtain gear 20 is also free to rotate counterclockwise as is gear 15. However, in this case, the inertia wheel 32a is interlocked with the closing curtain operating lever 18 via the mechanical exposure control locking lever 31, therefore, because of the braking resistance of the inertia wheel 32a, the pin 20a is disengaged from the arm portion 18b of the closing curtain operating lever 18 at the moment after a certain definite time has passed after the opening curtain was opened. Closing curtain gear 20 is thereby rotated so as to allow the closing curtain 22 to move.

FIG. 3 illustrates the second embodiment of the present invention. The operation thereof in the case of the automatic control or the manual setting is thoroughly similar to that of the first embodiment.

In the mechanism for mechanically controlling the shutter speed, an inertia wheel as is used in the first embodiment is not provided therein, that mechanism is constructed such that, when the mechanical exposure control locking lever 31 is turned counterclockwise, edge 31b and pin 18a produce a frictional resistance.

In the case where the shutter speed is mechanically controlled, when the scale X of the shutter speed setting dial 28 is brought coincident to the index 29, the operating pin 31a of the mechanical exposure control locking lever 31 enters concave segment 30b of the setting cam plate 30 by the bias of the spring 39. Locking arm 31b is engaged with the pin 18a of the closing curtain operating lever 18, which is in turn rotated counterclockwise so as to have arm portion 18b engaged with the pin 20a to obstruct the counterclockwise rotation of the gear 20.

In this situation, if the shutter release member 1 is pressed down, the opening curtain 21 is first released, and the connection pin 15a on the opening curtain gear 15 is retracted from the connection pin 20b at the time of the opening motion of the opening curtain 21. Thereby, closing curtain gear 20 is also free to be rotated counterclockwise, so that the pin 20a of the closing curtain gear 20 tends to be disengaged from the arm portion 18b of the closing curtain operating lever 18. However, the clockwise turning of the closing curtain operating lever 18 is realized at the moment after a definite time has passed subsequent to the opening of opening curtain 21 by operations such as the bias of the spring 39 which forces the mechanical exposure control locking lever 31 to turn clockwise, the frictional resistance generated between the pin 18a and one edge
of the arm portion 31b, and the like. Consequently, the closing curtain is released after a definite delay time from the release of the opening curtain.

FIG. 4 illustrates the third embodiment of the present invention which is similar to that shown in FIG. 3 wherein the shutter speed is mechanically controlled. In this embodiment, the mechanical exposure control locking lever 31 is formed as an inertia weight, and thus, when the opening curtain 21 is released, the closing curtain gear 20 is also counterclockwise rotated simultaneously with the rotation of the opening curtain gear 15. Pin 20a tends to be disengaged from the arm portion 18b of the closing curtain operating lever 18. However, the clockwise turning motion of the closing curtain operating lever 18 in this occasion is realized at the moment after a definite time has passed subsequent to the release of opening curtain 21 by operations, such as the inertia weight of the mechanical exposure control locking lever 31, the bias of the spring 40 to force the lever 31 to turn counterclockwise, and the frictional resistance generated between the pin 18a and one edge of the arm portion 31b.

FIG. 5 illustrates the fourth embodiment of the present invention, wherein, a shutter release member 101, movable vertically with respect to the main body of the camera, is biased to a raised position. Operative slant surface 101a is formed on the side face of the shutter release member 101, which is interlocked with a starting motion locking lever 102 via a mechanism such as, for example, a lever system 2 through 11 shown in FIG. 1. The starting motion locking lever 102 is pivotedly mounted to the camera body and biased with a clockwise turning tendency. When control plate 103 is turned counterclockwise interlocking with the shutter winding operation against the bias of spring 104, one end portion 102a of the starting motion locking lever 102 is engaged with claw 103c of the control plate 103. The starting motion locking lever 102 is turned counterclockwise interlocking with the depressed movement of the shutter release member 101, so that the control plate 103 is disengaged from the starting locking lever 102 and clockwise turned about an axle A by the bias of the spring 104. The control plate 103 is also provided with, operating arm 103c having a pin 103b protruding thereunder, angled arm 103c engaged with a lever 110 which will be described hereinafter, and cocking arm 103d.

Pin 103b is engaged with a fork portion 108b of a switch lever 108, and a sliding contact 108a is formed on the other arm of the switch lever 108. The switch lever 108 is engaged with engaging pin 105a protruding from opening curtain locking lever 105, and lug 105b, formed on another arm of the opening curtain locking lever 105, is engageable, in the cocked condition of the shutter, with a click portion 106b of a cam plate 106a which is fixed to the opening curtain spindle 106. Sliding contact 108a is kept in sliding contact with prong base plate 109. An opening curtain 107 is fixed to and wound on the opening curtain spindle 106.

The print base plate 109 is made of a conductive material and an insulator face 109a is printed on the top surface thereof. Accordingly, when the control plate 103 is turned clockwise so as to have the switch lever 108 turned counterclockwise, the sliding contact 108a is shifted from the conductive face of the print base plate 109 to the insulator face 109a. A well known trigger switch S1 (FIG. 2) in parallel with a delay capacitor C of the electric exposure control circuit is thereby opened so as to permit the timing circuit to commence its delaying operation. Electromagnet M is demagnetized due to the reversal of the switching circuit after a certain definite time has passed.

The drive lever 110 engaged with angled arm 103c of the control plate 103 is composed of a sleeve 110a fitted on the axle A and two levers 110b and 110c which are formed respectively on the upper and lower ends of the sleeve 110a. A cut-out portion of the lower lever 110c is engaged with angled arm 103c, and drive pin 110d is projected upwardly from the upper lever 110b. Drive lever 110 is biased with a clockwise turning tendency by spring 112 which is bridged between the drive pin 110d and the camera body.

The drive pin 110d is idly mounted within hole 111a of a closing curtain operating lever 111 which functions as the shutter closing motion acting member. Closing curtain operating lever 111 is pivotedly supported on the axle A and provided with an armature 113 fixed to a pin 111b on one end thereof, and also is provided with an engaging claw 111c on the other end thereof. Armature 113 confronts electromagnet M in the electric exposure control circuit, and the engaging claw 111c is engageable with a mechanical exposure control locking lever 119 which will be described hereinafter. Side face 111d of the closing curtain operating lever 111 is kept engaged with a pin 114a of the closing curtain locking lever 114 which is pivotally supported to the camera body. Closing curtain locking lever 114 is provided with pin 114a on one end thereof.

The shutter speed setting member comprises a shutter speed setting dial 120 and a setting cam plate 121 bodily and coaxially constructed with the dial 120 and having a concave segment 121a provided thereon. Dial 120 is provided with four types of scales arranged on the upper surface thereof so as to confront index 125. The scales comprising automatic exposure time control scale E, a manual exposure time setting scale M which includes a plurality of numerals 1, 2, 4, etc., a mechanical exposure time control scale X, and a bulb scale B. Contact 121b is projected from setting cam plate 121 so that, in the case where the shutter is electrically controlled by the automatic or manual exposure time setting, and in the case where it is controlled by the bulb exposure setting, the change-over switch S2 of the electric control circuit as shown in FIG. 2 is thereby made operative.

When the scale X of the shutter speed setting dial 120 is brought coincident to the index 125 provided on the camera body, the setting switch S2 of the electric exposure control circuit is opened as shown in FIG. 1, and an operating toucher 119a, provided on the mechanical exposure control locking lever 119 which is biased with a clockwise turning tendency by spring 122, enters concave segment 121a of the setting cam plate 121. The mechanical exposure control locking lever 119 is also provided with fork-shaped arms consisting of a locking arm 119b and an unlocking arm 119c, and one of the side faces of the locking arm 119b is in contact with slant face 101a of the shutter release member 101. Also, the extreme end of the locking arm 119b is engageable with the engaging claw 111c of the closing curtain operating lever 111 at the time when the locking lever 119 is turned clockwise. Unlocking arm 119c is then engaged with unlocking cam 124 fixed on the top end of opening curtain spindle 106. When
a click member \(124a\) of the unlocking cam \(124\) is engaged with the unlocking arm \(119c\), the mechanical exposure control locking lever \(119\) is counterclockwise turned against the bias of a spring \(122\) (not shown), thereby, the engaging claw \(111c\) is disengaged from the locking arm \(119\).

Additionally, instead of the setting switch \(S_2\) provided as shown in FIG. 1, when the mechanical exposure time control scale \(X\) is aligned with index \(125\), the contact \(121b\) constituting the change-over switch \(S_2\) comes into contact with a contact capable of carrying out the highest or next highest speed exposure control. Thereby, the high speed exposure can be controlled by means of the electric exposure control circuit. In other words, when the high speed exposure is electrically controllable by virtue of the constitution as described above, the operation thereof is once interrupted by the mechanical exposure control, and the mechanical exposure control is thereafter made operative.

A projection \(117a\) is formed on winding gear \(117\) which is necessary for film winding and shutter cocking. When winding gear \(117\) is rotated clockwise, the projection \(117a\) is engaged with cocking arm \(103d\) and pushes the control plate \(103\) to be rotated counterclockwise against the bias of a spring \(104\) until the claw \(103e\) thereof is engaged with the starting motion locking lever \(102\).

The fourth embodiment of the present invention.

In the case where the automatic or the manual control is electrically carried out, the scale \(E\) or any one of numerals of the scale \(m\) on the shutter speed setting dial \(120\) is first of all brought coincident with the index \(120\). Thereby, the radially large segment of the setting cam plate \(121\) pushes the operating arm \(119a\) of the mechanical exposure control locking lever \(119\) counterclockwise against the bias of the spring \(122\). Thus, locking lever \(119\) is released from engagement with the slant face \(101a\) of the release member \(101\) by the release of locking arm with claw \(111c\). Also, unlocking arm \(119e\) is separated from the turning radius of the unlocking cam \(124\). Further, the setting switch \(S_2\) is closed by the contact \(121b\), so that the electric exposure control circuit is made operable.

In this situation, when the shutter release member \(101\) is pressed down, the switch \(S_2\) is closed, the electromagnet \(M\) is thereby magnetized to retain armature \(113\). The starting motion locking lever \(102\) is rotated counterclockwise against the bias of a spring (not shown), so that the claw \(103e\) is disengaged therefrom. Accordingly, the control plate \(103\) is rotated clockwise by the bias of the spring \(104\), and the switch lever \(108\) is turned counterclockwise by pin \(103b\), and opening curtain locking lever \(105\) is also turned clockwise by engaging pin \(105a\). The opening curtain spindle \(106\) is thereby unlocked so as to permit the opening curtain \(107\) to run, and the shutter is therefore opened. Concurrently, the sliding contact \(108a\) is shifted from the conductive face of base plate \(109\) to insulated face \(109a\), and trigger switch \(S_1\) (in FIG. 2) is thereby opened and the electric exposure control circuit is accordingly started. Consequently, even though the control plate \(103\) is turned clockwise as described above, and angled arm \(103c\) is released from engagement with drive lever \(110\), the drive lever \(110\) is not rotated because the closing curtain operating lever \(111\) is kept stationary regardless of the bias of the spring \(112\) by virtue of the magnetized electromagnet \(M\) which holds the armature \(113\) stationary.

At the moment when the electromagnet \(M\) in the electric exposure control circuit is demagnetized after a certain definite delay time, the closing curtain operating lever \(111\) is turned clockwise together with the drive lever \(110\) pulled by the bias of the spring \(112\). Thereby, the side face \(111d\) forces the closing curtain locking lever \(114\) to be turned clockwise, so that the closing curtain \(116\) starts to run, and the shutter is accordingly closed.

However, in the case where the shutter is mechanically controlled when, for instance, the power source cells have been consumed, the scale \(X\) of the shutter speed setting dial \(120\) is brought coincident with the index \(125\). In this case, the electric exposure control circuit is not operable, because the setting switch \(S_2\) (refer to FIG. 1 and FIG. 2) of the circuit is then opened by the contact \(121b\) of the setting cam plate \(121\). Operating arm \(119a\) of the mechanical exposure control locking lever \(119\) moves into the concave segment \(121a\). Thereby mechanical exposure control locking lever \(119\) is turned clockwise so as to permit the locking arm \(119b\) thereof to come into contact with the slant face \(101a\) of the release member \(101\). The clockwise rotation of the locking lever \(119\) by the bias of the spring \(122\) being obstructed by its contact with the slant face \(101a\).

In this situation, when the shutter release member \(101\) is pressed down, the locking arm \(119b\) is turned clockwise by slant face \(101a\), until it is engaged with the engaging claw \(111c\) and the unlocking arm \(119c\) comes into contact with the unlocking cam \(124\). When the shutter release member \(101\) is further pressed downwards, the control plate \(103\) is unlocked from the starting motion locking lever \(102\). Thereby the control plate \(103\) is turned clockwise by the bias of the spring \(104\), whereas, the switch lever \(108\) is turned counterclockwise so as to have the opening curtain locking lever \(105\) turned by pin \(105a\), and opening curtain \(107\) is thereby started to run, the shutter being accordingly opened. As described above, the closing curtain operating lever \(111\) is locked by its engagement with the locking arm \(119b\) therefore, even though angled arm \(103c\) releases drive lever \(110\), the clockwise turning of the operating lever \(111\) by the bias of the spring \(112\) is still restrained by the locking arm \(119b\).

At the time when the opening curtain spindle \(106\) is rotated by a certain definite amount, the unlocking arm \(119c\) is pushed by the click member \(124a\) of the unlocking cam \(124\) which is bodily fixed to the spindle \(106\), so that the mechanical exposure control locking lever \(119\) is turned counterclockwise against the bias of the spring \(122\). Closing curtain operating lever \(111\) is thereby unlocked from the locking arm \(119b\), and accordingly, the closing curtain operating lever \(111\) and the closing curtain locking lever \(114\) are respectively turned in sequence. Thereby, closing curtain \(116\) starts to run, and the shutter is accordingly closed.

The exposure time in this case is determined by the time from the start of the unlocking of cam \(124\) to the moment when click member \(124a\) pushes the unlocking arm \(119c\), which time is, determined by the initial location of the click member \(124a\). However, in this embodiment, as only one shutter speed is controllable, it is desirable that the speed is set at one-sixtieth seconds which is available for both flash photography and
daylight photography, and that the exposure is regulated by means of the iris aperture.

Additionally, in the case where the change-over switch \( S_5 \) is used instead of setting switch \( S_4 \), for switching to the mechanical exposure control, the electric control circuit is set at a high speed exposure time control very close to the highest speed, therefore, the electromagnet \( M \) has been already demagnetized before the click member \( 124a \) acts on the unlocking arm \( 119c \).

In every case described hereinabove, when the winding gear \( 117 \) is rotated clockwise after an exposure for the purpose of winding the film and cocking the shutter, projection \( 117a \) thereof is engaged with cocking lever \( 103d \) and forces the control plate \( 103 \) to be turned counterclockwise against the bias of the spring \( 104 \), so that the claw \( 103e \) is locked by the starting motion locking lever \( 102 \). Further, the drive lever \( 110 \) is turned counterclockwise by angled arm \( 103c \) against the bias of the spring \( 112 \), so that the closing curtain operating lever \( 111 \) is turned to the position where the armature \( 113 \), fixed to the closing curtain operating lever \( 111 \), comes into contact with the electromagnet \( M \). Thus, the apparatus is as shown in FIG. 5, which is a completed condition ready for the subsequent photographing.

In the case of the bulb exposure, the scale \( B \) of the shutter speed setting dial \( 120 \) is aligned with index \( 125 \), thereby the setting switch \( S_5 \) (FIG. 2) of the electric exposure control circuit is closed by the contact \( 121b \). The variable resistance of the electric exposure control circuit is concurrently set at a time, for instance, at one-thirty seconds which is longer than the mechanical exposure control time, for example, one-sixty seconds, and the operating arm \( 119a \) faces concave segment \( 121a \) of the setting cam \( 121 \).

In this situation, if the release member \( 101 \) is pressed down, the locking arm \( 119b \) is engaged with the engaging claw \( 111c \) of the closing curtain operating lever \( 111 \), thereby the shutter is started to open and the armature \( 113 \) is simultaneously retained by the electromagnet \( M \). Consequently, at the time when the mechanical exposure control time of one-sixty seconds has passed, first of all, the locking arm \( 119b \) is unlocked from the locking claw \( 111c \) by the click member \( 124a \), but the closing curtain operating lever \( 111 \) is still held by the electromagnet \( M \). When click member \( 124a \) has passed over the unlocking arm \( 119c \), both the locking arm \( 119b \) and the locking claw \( 111c \) are engaged again, therefore, even if the electromagnet \( M \) is demagnetized after one-thirty seconds has passed, the shutter is not closed because of the engagement of the locking arm \( 119b \) with the locking claw \( 111c \).

When the shutter release member \( 101 \) is released, the locking arm \( 119b \) is unlocked from the locking claw \( 111c \), and because of the clockwise turning of the closing curtain operating lever \( 111 \), the closing curtain \( 116 \) starts to run, and the shutter is accordingly closed. The bulb exposure is thereby effected.

Moreover, in the embodiments aforementioned, the closing curtain operating lever \( 111 \) and the drive lever \( 110 \) are two separate members, it is however apparent that both members can be constructed as one body, and that the locking arm \( 119b \) can be engaged with the drive lever \( 110 \), and such modifications are included in the scope of the present invention.

FIG. 6 shows the fifth embodiment of the present invention which is a modification of the fourth embodiment shown in FIG. 5. In this embodiment, the bulb exposure is completely effected by mechanical means only.

Concave segment \( 221a \) corresponding to the mechanical exposure time control and another concave segment \( 221c \) corresponding to the bulb exposure, the latter concave segment being deeper than the former concave segment, are formed on setting cam \( 221 \). An operating toucher \( 126a \) engageable with the setting cam \( 221 \) is integrally formed by shaft \( 126c \) and bulb exposure locking lever \( 126 \). Formed on the extreme end of the bulb locking lever \( 126 \) is a locking arm \( 126b \) on which angled arm \( 126d \) is located at a position where a slant face \( 101a \) of a release member \( 101 \) comes into contact with the locking arm \( 126b \). A mechanical exposure control locking lever \( 127 \) is rotatably fitted onto shaft \( 126c \) on top of the bulb exposure locking lever \( 126 \), and is biased by means of a spring or the like not shown in the drawing so that its edge is kept in contact with angled arm \( 126d \). The mechanical exposure control locking lever \( 127 \) is shaped in a fork-like form consisting of a locking arm \( 127b \) and an unlocking arm \( 127c \) which confronts unlocking cam \( 124 \) fixed to the opening curtain spindle \( 106 \). The engaging claw \( 111c \) on the extreme end of the closing curtain operating lever \( 111 \) is engageable with locking arms \( 126b \) and \( 127b \).

In the case of the automatic control or the manual setting, the operation thereof at the time when the scale \( E \) or any one of the numerals of scale \( m \) on the shutter speed setting dial \( 120 \) is aligned with the index \( 125 \) is completely similar to that of the fourth embodiment. In this case, locking arms \( 126b \) and \( 127b \) are both located at a position spaced from the engaging claw \( 111c \) because of the operating toucher \( 126a \) which is brought into contact with the radially large segment of the cam plate \( 221 \).

In the case where the shutter speed is mechanically controlled, the scale \( X \) of the shutter speed setting dial \( 120 \) is brought coincident with the index \( 125 \), accordingly, the operating toucher \( 126a \) moves into the concave segment \( 221a \) of the setting cam plate \( 221 \), and bulb exposure locking lever \( 126 \) is thereby turned clockwise until its angled arm \( 126d \) comes into contact with the slant face \( 101a \).

In this situation, when the shutter release member \( 101 \) is pressed down, the bulb exposure locking lever \( 126 \) is turned until its operating arm \( 126a \) comes into contact with the concave segment \( 221a \), and the mechanical exposure control locking lever \( 127 \) is also turned concurrently therewith, so that locking arm \( 127b \) is engaged with the engaging claw \( 111c \) of the closing curtain operating lever \( 111 \) which is still kept stationary at the cocking location, whereas the locking arm \( 126b \) of the bulb exposure locking lever \( 126 \) is not engaged with the engaging claw \( 111c \) at this time, because the concave segment \( 221a \) is comparatively shallow.

When the shutter release member is further pressed down, the opening curtain spindle \( 106 \) is rotated so as to have the shutter opened similarly as in the case of the fourth embodiment, and at the moment when the unlocking arm \( 127c \) is pushed by the click member \( 124a \), the engaging claw \( 111c \) is unlocked from the locking arm \( 127b \) so as to allow the closing curtain op-
The operating lever 111 to be turned closing curtain 116 thereby starts to run and the shutter is closed.

In the case of the bulb exposure, the scale B of the shutter speed setting dial 120 is aligned with the index 125. Accordingly, the setting switch S of the electric exposure control circuit is opened to render the circuit non-operable as compared to the fourth embodiment shown in FIG. 5. And the operating toucher 126a confronts concave segment 221c which is deeper than the concave segment 221a.

In this situation, when the shutter release member 101 is pressed down, the operating toucher 126a is turned until it comes into contact with the concave segment 221c, and as the concave segment 221c is deep, both locking levers 126 and 127 are together turned clockwise to the position where the individual locking arms 126b and 127b are both engageable with the engaging claw 111c, so that the closing curtain operating lever 111 is locked thereat.

Consequently, the opening curtain 107 starts to run, the unlocking arm 127c is pushed by the click member 124a so that the engaging claw 111c is disengaged from the locking arm 127b. However, as the engaging claw 111c is still kept engaged with the locking arm 126b, the turning of the closing curtain operating lever 111 is kept obstructed. The relative positions of both locking arms 126a and 127b with respect to the engaging claw 111c in this case are displaced in such a way that the engaging claw 111c is kept locked by the locking arm 127b until the unlocking arm 127c is pushed by the click member 124a. However, after the unlocking arm 127c is pushed by the click member 124a, the locking arm 127b is retracted, and the engaging claw 111c is locked by the locking arm 126b. When the release operation is finished and the release member 101 is returned to its raised position, the engaging claw 111c is unlocked from the locking arm 126b, and the closing curtain operating lever 111 is thereby turned so that the closing curtain shutter starts to close the shutter, and the bulb exposure is thus carried into effect. In this fifth embodiment, the closing curtain operating lever 111 and the drive lever 110 are two separate members, but these members can be formed into one body similar to the fourth embodiment as described above. Alternatively, the locking arms 126b and 127b can be arranged so that both are engaged with and disengaged from the drive lever 110 with the identical relationship therebetween with that described above.

What is claimed is:

1. Shutter control apparatus for a camera having a leading member biased to move from a cocked position to a rest position for initiating exposure and a trailing member biased to move to a cocked position to a rest position for terminating the exposure, and wherein said trailing member is restrained in the cocked position with said leading member in the cocked position, comprising:

- a manual member settable to at least any one of a number of electrical exposure setting positions and a mechanical exposure position;
- means for retaining said trailing member at said cocked position;
- means for moving said means for retaining to a retracted position from the retaining position thereof with the movement of said leading member from said cocked position to the said rest position;
- means for restraining said means for retaining in the operating position thereof against said means for moving;

an electric timing circuit for controlling the time period during which said means for restraining is energized;

- means for locking said means for retaining in said retaining position;
- means responsive to the movement of said leading member from said cocked position to said rest position for releasing said means for locking with said leading member having moved a predetermined distance; and
- means for holding said means for locking in an operative position thereof with said manual member set at any one of said automatic exposure setting positions.

2. Shutter control apparatus for a camera as in claim 1 wherein said manual member includes a rotatable cam member including a first segment corresponding to said mechanical exposure control position; said means for restraining includes a rotatable locking lever biased to prevent its engagement with said means for retaining, said means for locking including a cam follower contacting said cam member and including a rotatable lever having an arm whereby said locking lever is in said retaining position with said manual member set to said mechanical exposure control position, means for delaying the release of said means for locking, said electric timing circuit includes a multi-position switch rotatable with said manual member wherein respective positions of said switch control the individual settings for automatic or manual exposure control, and wherein said means for delaying further includes a rotatable timing cam and means for engaging with said rotatable lever to release said means for locking from engagement with said means for retaining, said timing cam is actuated by release of said leading member.

3. Shutter control apparatus as in claim 2 wherein said manual member is also settable to a bulb exposure position, said cammed member includes a second cutout segment, said second cutout segment corresponding to said bulb exposure position, said means for locking including a second rotatable lever rotated for engagement with said locking lever, said second locking lever including said means for engaging with said responsive means, and said first and second rotatable levers are engaged with said locking lever with said means for selecting set to said bulb exposure position.

4. Shutter control apparatus as in claim 2 wherein one position of said multi-position switch provides a time delay greater than the time delay provided by said timing cam.

5. Shutter control apparatus as in claim 2 wherein said manual member is also settable to a bulb exposure position, a position of said multi-position switch provides a time delay with said manual member at said bulb exposure position greater than the time delay of said timing cam, said means for locking is operative with the release of said locking lever by said rotatable timing cam, and said means for restraining further includes means for reengaging said arm with said locking lever whereby said means for locking is operative with said electric circuit actuated, and said arm is disengaged from said locking lever with the return of the camera shutter release member to initiate closing of said trailing member.