United States Patent

Aizawa et al.

[15] **3,656,420**

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[54] ELECTRIC DRIVING DEVICE FOR A CAMERA

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[52] **U.S. Cl.**.....**95/31 EL,** 95/53 E

[51] **Int. Cl.**.....**G03b 17/44,** G03b 19/04

[58] **Field of Search**.....95/31 EL, 53 E; 352/121, 175

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[57] **ABSTRACT**

According to an embodiment of the electrical drive disclosed, a first drive motor winds the film in the camera and a second drive motor operates the shutter. A control mechanism includes member movable between one position in which the mechanism actuates the first drive motor and a second position in which the mechanism actuates the second drive motor. A manually operable switch in the mechanism starts the second motor and enables it for actuation. The control mechanism responds to the completion of operation of the second motor for moving the member to the first position. A resilient detector detects increases in exertion of the first motor beyond a given value and causes the mechanism to move the control member from the first position to the second position. The mechanism disables the switch from starting the second motor when the member is in the first position.

14 Claims, 6 Drawing Figures

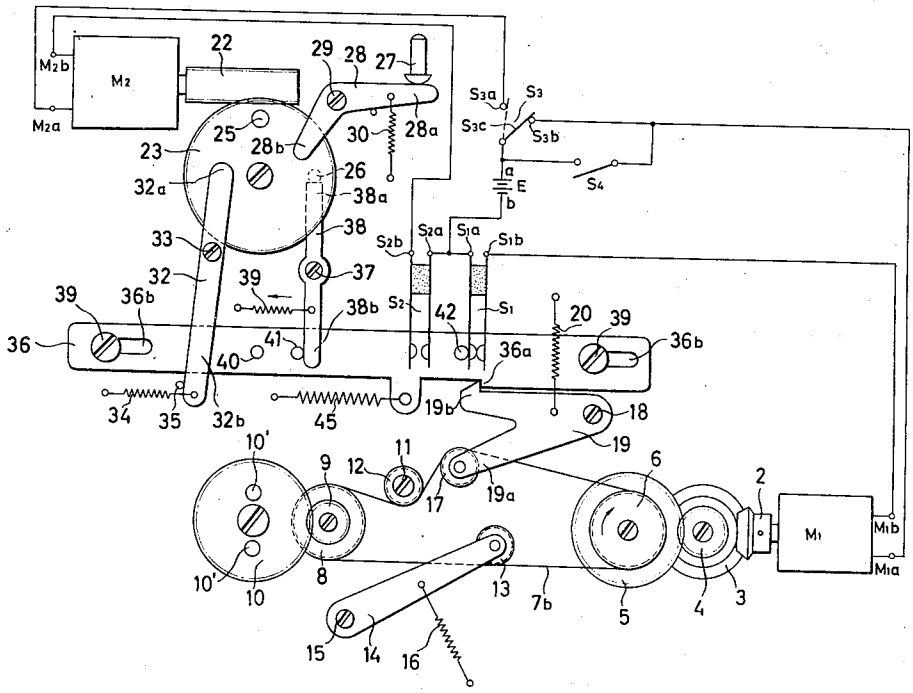

FIG. 1

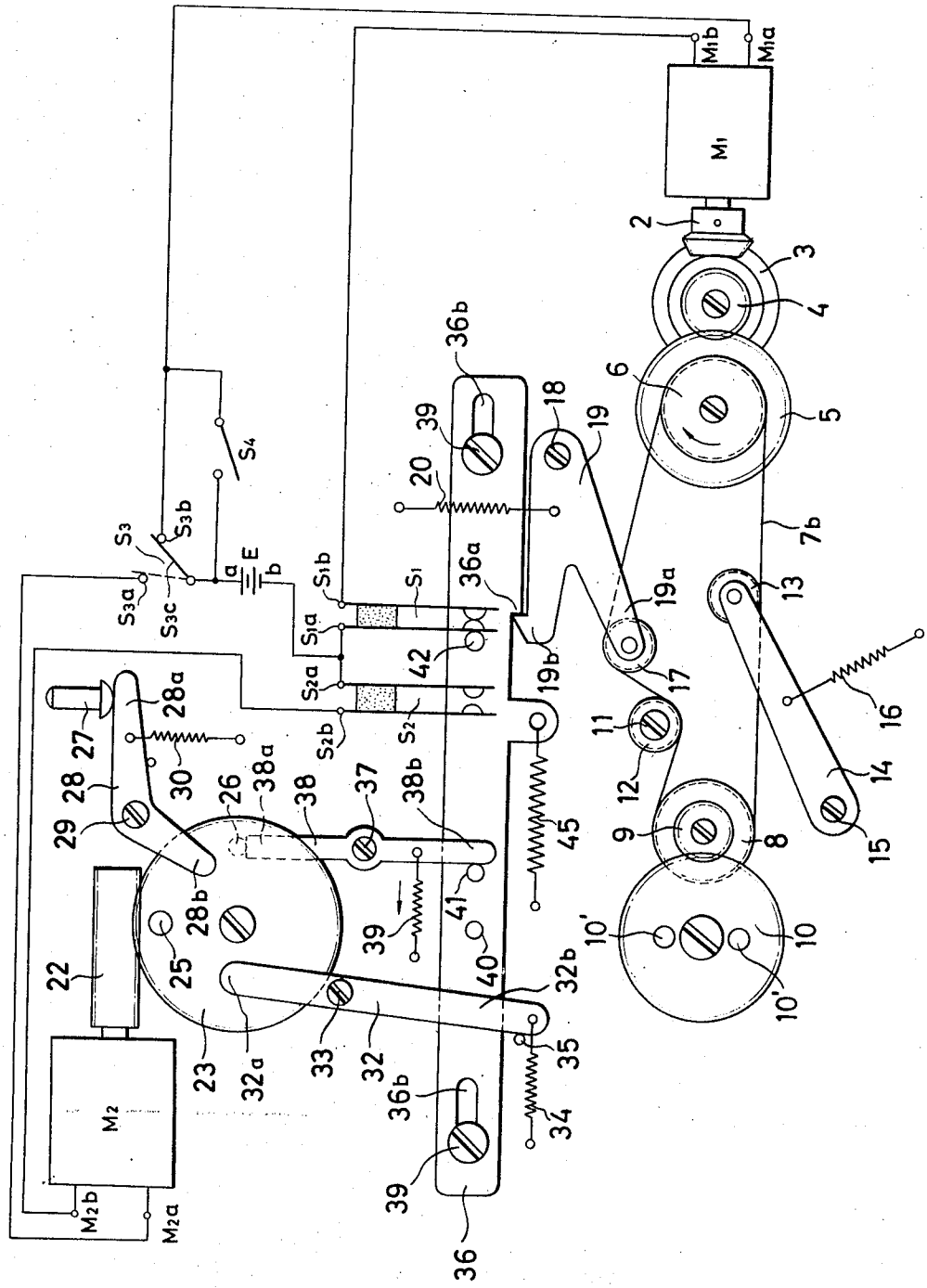

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FIG. 2

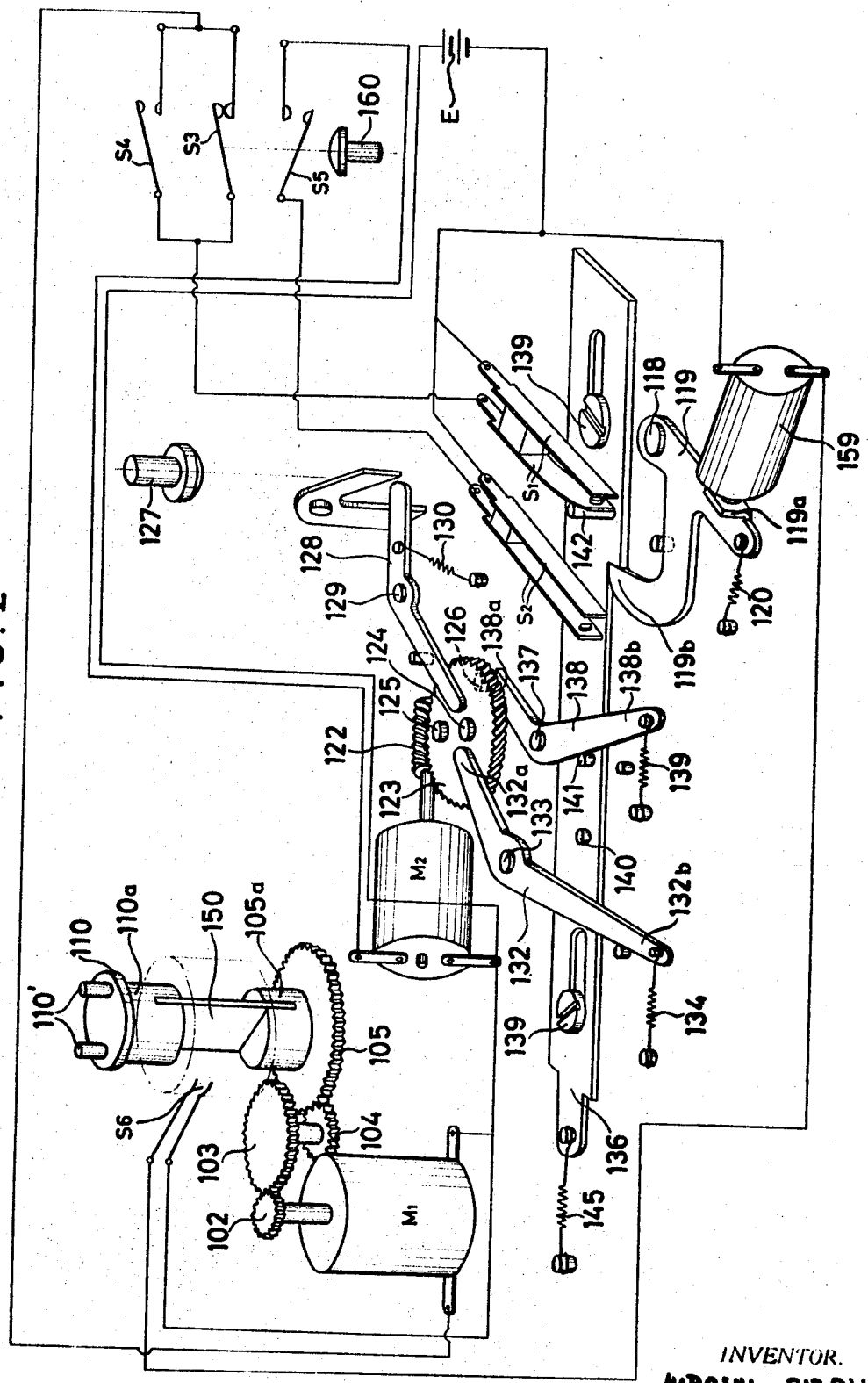

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FIG. 4

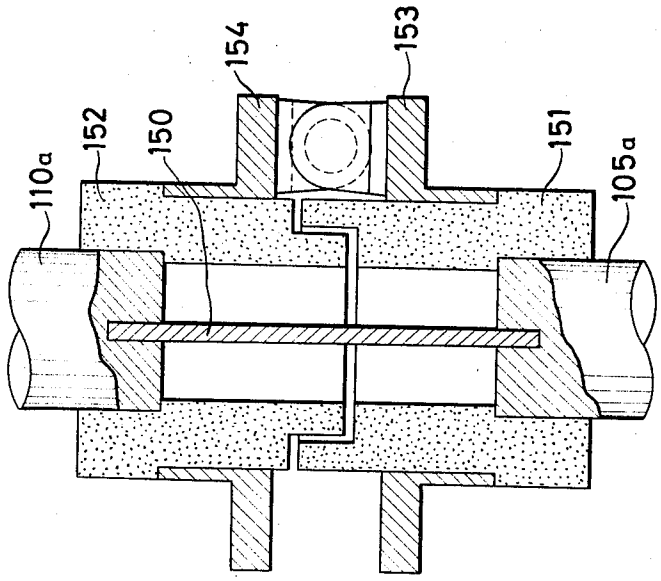

FIG. 3

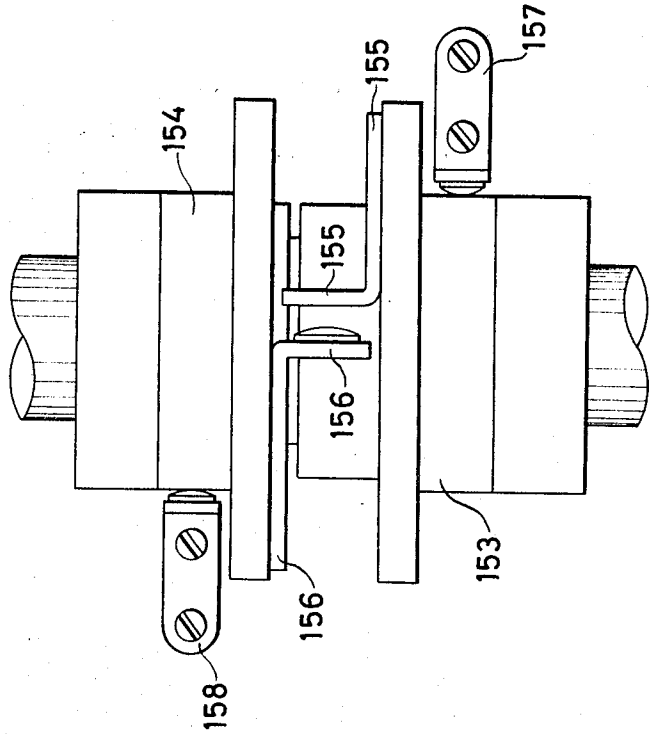

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FIG. 5

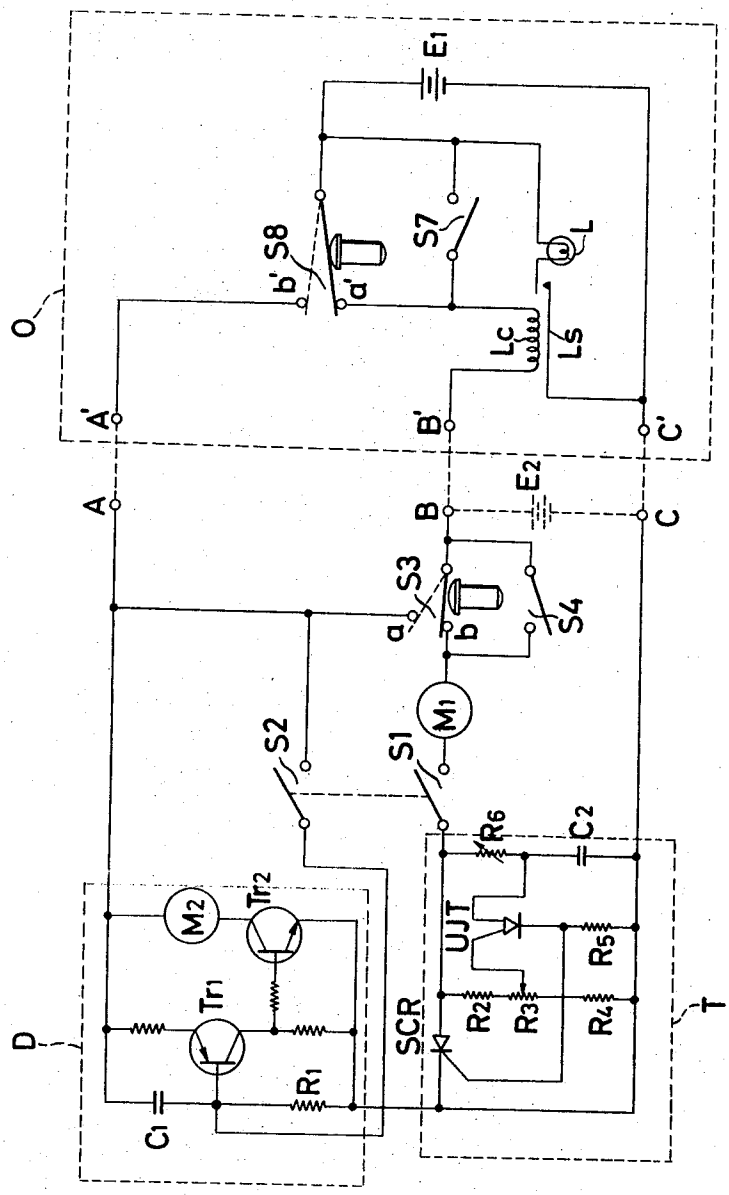

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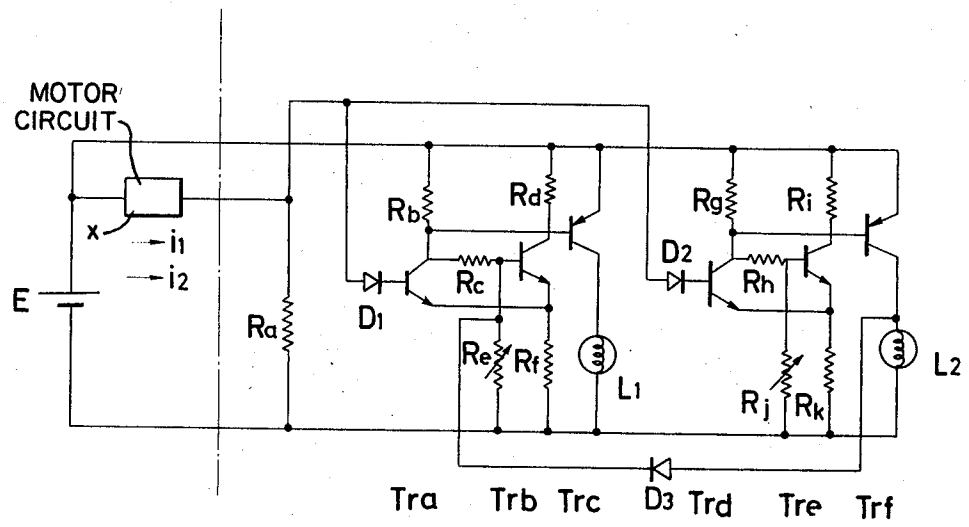
FIG. 6



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ELECTRIC DRIVING DEVICE FOR A CAMERA

The present invention relates to an electric drive for a camera of the focal plane shutter type. One of the main features of the present inventions, lies in that four kinds of photographing a single frame and successive photographing by manual operation as well as by remote control operation can be effected easily and exactly by a single construction with two motors and one controlling member.

In a conventional electrical driving device for a camera, the following constructions are commonly employed: (A) a construction in which a joint member for interlocking with another joint provided in the camera rotates through an angle necessary for film winding and shutter charging and then automatically stops, and (B) a construction in which the joint member for interclocking with the camera can rotate beyond the above angle, and when it reaches a limit point of film winding the excessive angle is absorbed by a friction joint.

However, in (A), it is absolutely necessary that the rotation angles and the stopping positions of the both joints completely coincide. And if there is any error among them, disadvantages such as an insufficient film winding or excessive film winding are caused. And in (B) maintaining both joints in a radially compressed state even after the stop of the film winding mechanism, causes defects such as that the action of the shutter release mechanism is not smooth or a proper movement of the shutter mechanism is interferred with.

One of the objects of the present invention is to overcome the above disadvantages and deficiencies.

The present invention will be described referring to the embodiments shown in the attached drawings in which:

FIG. 1 is a schematic view showing one embodiment of the present invention.

FIG. 2 is a schematic view showing another embodiment of the present invention.

FIGS. 3 and 4 respectively show details of a torsion joint employed in the embodiment shown in FIG. 2.

FIG. 5 is a circuit useful for a further another embodiment of the present invention.

FIG. 6 is circuit for a still further another embodiment the present invention, suitable for a remote control operation.

In FIG. 1, M_1 is a D.C. motor for film winding. The out-put torque of the motor is transmitted to a pulley **6** through reduction gears **2**, **3**, **4** and **5**.

The gear **3** is fixed to the gear **4** and the gear **5** is fixed to the pulley **6**. The rotation of the pulley **6** is delivered to a pulley **8** by a belt **7**, and is further reduced by a gear **9** fixed to the pulley **8**, and delivered to a winding joint **10**. An engaging pin **10'** mounted on the joint **10** engages a winding joint provided in a camera.

The belt **7** rotates a guide roller **12** rotatably supported on a shaft **11** fixed to a housing of the device, an idle roller **13** rotatably supported on a free and of a lever **14** also rotatably supported on a shaft **15** fixed to the housing, and a tension responsive pulley **17** rotatably supported on one free end **19***a* of V-shaped lever **19** also rotatably supported on a shaft **18** fixed to the housing. The lever **14** and the lever **19** are respectively biased by a spring **16** and a spring **20** which bias the pulleys **13** and **17** against the belt **7**.

A D.C. shutter release motor M_2 transmits its output torque to a wheel **23** through a worm gear **22**. A pin **25** is fixedly provided on the front side of the wheel **23** near the periphery, and a pin **26** is fixedly provided on the rear side of the wheel **23**. A shutter release pin **27** is actuated by one end **28***a* of a release lever **28** rotatably supported on the shaft **29** fixed to the housing. The other end **28***b* of the lever **28** is in the path of the pin **25** and actuated by the motor M_2. A resetting spring **30** biases the lever **28** toward a stopper pin **31**. An intermediate lever **32** charges a control member **36**, which is rotatably supported by a shaft **33** fixed to the housing. One end **32***a* of the lever **32** is positioned in the path of the pin **25**. A tension spring **34** draws the intermediate lever **32** against a stopper pin **35**.

A lever **38** for prohibiting an excessive rotation of the wheel **23**, is rotatably supported on the shaft **37** fixed to the housing.

One end **38***a* of the lever **38** is positioned in the path of the pin **26**. A tension spring **39** biases the lever **38** clockwise. The control member **36** is slidably guided on the housing by a pin-slot engagement composed of a pin **39** and a slot **36***b*.

A pin **40** and a pin **41** are planted on the control member **36** for engagement with the end **32***b* of the lever **32** and the end **38***b* of the lever **38** respectively.

A pin **42** is a pin for switching planted on the control member **36** for selectively controlling switches S_1 and S_2 through the movement of the control member **36**. On one side of the control member **36** there is provided a stepped portion **36***a* for engagement with a hooked portion **19***b* of the lever **19**. A tension spring controls member **36**. A change-over switch which is associated with the movement of a change-over means includes fixed terminals S_3a and S_3b and a movable contact member S_3c. **46** is a change-over switch for a single frame or successive photographing, E is a battery power source. One end E*a* of the source E is selectively connected to one terminal M_1a of the film winding motor M_1 through the switch S_3 and connected to one terminal M_2a of the motor M_2 for shutter release, while the other end E*b* of the source is connected to each of respective terminals S_1a and S_2a of the switches S_1 and S_2.

The other terminal S_2b of the switch S_2 is connected to the other terminal M_2b of the motor M_2 and the other terminal S_1b of the switch S_1 is connected to the other terminal M_1b of the motor M_1. The change-over switch S_4 is provided in parallel with the switch S_3 between one terminal E*a* of the source and one terminal M_1a of the motor M_1.

Functional descriptions of one embodiment according to the present invention shown in FIG. 1 will be set forth hereinunder.

FIG. 1 shows a phase of the device in the process of film winding for photographing a single frame. In this case the motor M_1 is rotating because the circuit comprising the battery E, the change-over switch S_3 the motor M_1 and the switch S_1 is closed. Under this condition, the film winding of the camera proceeds until the film winding is finished and the joint **10** reaches and stops at a restricting point provided in the camera. Then the tension along the side **7***a* of the belt **7** increases and the pulley **17** on the lever **19** is pulled downward as shown in the drawing against the spring **20**. At this stage the loosening on the side **7***b* of the belt **7** is compensated for by the spring **16** through the pulley **13** to prevent the belt **7** from getting out of the pulleys **6** and **8**. The tension of the spring **16** must be much smaller that of the spring **20**.

Thus the hook **19***b* of the V-shaped lever **19** is disengaged from the stepped portion **36***a* of the control member **36** so that the control member is released and permitted to move slidably, in a leftwise direction as shown in the drawing, by the tension of the charged spring **34**. Thus the pin **42** departs from the switch S_1 to switch it off and then causes the switch S_2 to switch-on. In this way the film winding is finished and the motor M_1 stops. During the above process, the pin **41** moves leftwise from a position for restricting the movement of the pin **26** to a position for permitting the movement of the pin **26** as the lever **38** follows the movement of the pin **41** so that the wheel is permitted to rotate. When the motor M_1 stops, the tension in the belt **7** is relieved to release the winding joint from a radially compressed state and ready the shutter release. Also the lever **19** is returned to a state ready for engagement with the control member **36** by the spring **20**.

After these movements, the device maintains the above state and is ready for the next shutter release. When the change-over means is operated, the movable contact means S_3c contacts the terminal S_3a to close the switch S_3, and thus the circuit comprising the battery E the switch S_3 the motor M_2 and the switch S_2 is closed to start the release motor M_2. In this way the wheel **23** is rotated in a clockwise direction, and the pin **25** pushes the end **28***b* of the lever **28** to actuate the release pin **27**, and then the pin **25** pushes the end **32***a* of the lever **32** to rotate the lever **32**, with the other end **32***b* pushing the pin **40** to bring the control member **36** to the state as

shown in FIG. 1 after the opening of the switch S_2 and the closing of the switch S_1. When the switch S_2 is opened power supply to the motor M_2 is interrupted, but the motor M_2 continues to rotate the wheel 23 with its inertia, and the wheel advances to the position shown in FIG. 1 when the pin 26 is restricted and stopped by the end 38*a* of the lever 38 which is brought to the above position by the control means 36.

According to another embodiment of the invention, a frictional coupling between the motor M_2 and the worm gear 22 is employed.

So far as the changed-over means is in operation to contact the movable contact means S_3c with the terminal S_3a of the switch S_3, the device is set to stop.

When the change-over means is released, the movable contact means S_3c departs from the terminal S_3a and contacts the terminal S_3b to change over the switch S_3. Thus the circuit for the motor $M_1$is closed, and film winding is started through the state of the device shown in FIG. 1. The series of operations up to the next shutter release ready state from the shutter release constitutes one cycle for photographing a single frame.

For exposing successive frames automatically, a switch S_4 provided in parallel with the switch S_3 in the circuit for the motor M_1 is closed. The winding motor M_1 starts winding immediately after the completion of the movement of the device by the release motor M_2 even if the movable contact means S_3c does not contacts the terminal S_3b of the switch S_3. Thus, so far as the change-over means is maintained in operation to contact the movable contact means S_3c with the terminal S_3a, the film winding and the shutter release is repeated. On the other hand when the change-over means is released the device stops ready for the next shutter release.

In case the inertia of the motor M_2 is not enough to move the control member 36, the device may be modified so that the movable contact means S_3c contacts the terminal S_3a until disengagement of the lever 19 with the control member 36.

FIG. 2 shows another embodiment of the device according to the present invention, in which the completion of the film winding is detected electrically, and the control member is released to disengage from and engaging lever attracted by an electromagnet, and a switch carried on a torsion joint is employed as an electric detector.

Parts and members having similar functions as those shown in FIG. 1 are shown by corresponding numerals with addition of 100.

In FIG. 2, the rotation of the winding motor M_1 is transmitted to a gear 105 through reduction gears 102, 103 and 104, and further transmitted to a winding joint 110 through a leaf spring 150 provided between a shaft 105*a* on the gear 105 and a shaft 110*a* on the joint 110 to effect shutter charge and film winding.

The shaft 105*a* and the shaft 110*a* are fixed to insulating cylinders 151 and 152 respectively, between which cylinders is provided a switch, as shown in detail in FIGS. 3 and 4.

In FIGS. 3 and 4, terminals connect respectively with each terminal of the electromagnet 159 and continuously contact conductive rings 153 and 154 fixed on the insulating cylinders 151 and 152 respectively. Two contact members carried respectively on the insulating cylinders 151 and 152 and connected to the conductive rings 153 and 154, constitute a switching means S_6. The contacts members 155 and 156 of the switching means oppose each other with a slight space between them in a untorsioned state of the leaf spring in the torsion joint.

In a way similar to FIG. 1, the motor M_1 rotates and the film winding is finished. The joint 110 stops, but the motor M_1 continues to rotate further so that the gear 105 twistedly rotates the leaf spring 150. The contact member 155 provided on the shaft 105 contacts the contact member 156 on the side of the joint 110 to close the circuit for actuation of the electromagnet 159. Thus, the electromagnet 159 is excited to attract a projection 119*a* of the engaging lever 119 so that the lever 119 rotates in a counterclock wise direction around the shaft 118. A hook 119*b* is disengaged from the control member 136, and the control member 136 is moved to the left by a spring 145. A pin 142 opens the switch S_1 to stop power supply to the motor M_1 and then closes the switch S_2 while a pin 141 moves to the left. The lever 138 follows the pin 141 to permit the rotation of a disc 123 and the control member 136 is stopped in a state where the switch S_1 is off and the switch S_2 is on.

As the excessive rotation of the gear 105 charges the leaf spring 150, the gear 105 is rotated back to discharge the energy stored in the spring 150 so that a radial compression between the joint 110 and the joint in the camera is relieved.

Then when a change-over button 160 is pushed, a switch S_5 is closed and a switch S_3 is opened together with the switch S_5. Thus a circuit for the release motor M_2 is closed and effects similar to those in the embodiment shown FIG. 1 follow.

FIG. 5 shows a circuit for another embodiment which further comprises a unit for remote control operation, a delay circuit for delaying the start of a release motor M_2 and a timer circuit for changing intervals of a successive photographing.

The delay circuit for delaying the start of the release motor M_2 is particulariy advantageous for preventing deterioration of image quality due to incomplete stoppage of film at the shutter release immediately after the stoppage of the winding motor during automatic successive exposures, and for preventing and lowering of the durability of the shutter and irregularity in shutter speed due to severe friction in the shutter release mechanism caused by unrelieved radial compression between the joints.

The timer circuit for changing intervals of a successive photographing to delay the start of the rotation of the winding motor M_1 is advantageous when combined with the device as shown in FIG. 5 for photographing at desired constant intervals such as a frame per minute and a frame per 5 minutes to shoot intermittently a gradually moving object.

In FIG. 5, D is the delay circuit for the release motor M_2 and T is the timer circuit. In this case the switch S_1 is closed when the switch S_2 is closed and vice versa for assuring the delayed operation, contrary to that shown in FIGS. 1 and 2.

FIG. 5 shows the state of the circuit at the completion of winding of the film in which when the switch S_3 is changed over from the terminal (*b*) to the terminal (*a*), a potential at a connecting point of the capacitor C_1 and the resistor R_1 of the delay circuit is lowered as the switch S_2 is held in an off state, and a transistor Tr_1 is turned on after a given lapse of time. Accordingly, a transistor Tr_2 is turned on to start rotation of the release motor M_2. Thus the switch S_2 turns on after the shutter release, and the charge across the capacitor C_1 is discharged through the shortened switch S_2. In this way the potential between a base and an emitter of the transistor Tr_1 approaches a zero potential so that the transistor Tr_1 becomes non-conductive and thus the transistor Tr_2 is biased to cut-off and power to the motor M_2 is interrupted.

As the switch S_1 as well as the switch S_2 are closed by a control member similar to ones 36 and 136 shown in FIGS. 1 and 2, the winding motor M_1 is ready to start.

When the switch S_3 is changed over from the terminal (*a*) to the terminal (*b*), the circuit for the motor M_1 is connected to the battery E_2 and after a preset period of time T a silicon controlled rectifier ScR is turned on to start the motor M_1.

After the completion of film winding, the engaging lever is disengaged with the control member, then the switches S_1 and S_2 are simultaneously opened to stop power from reaching the motors M_1 and M_2, thus the next shutter release is ready.

In the timer circuit Tr_1, the charges across the capacitor C_2 starts to discharge, for a given period of time after the switch S_1 is closed. Discharge takes place uni-junction transistor UJT and a resistor R_5 when the potential across the capacitor C_2 of a time-constant circuit C_2R_6 rises to a potential higher than that of an anode of the uni-junction transistor UJT. The anode potential *id* determined by a bleeder circuit composed of the resistors R_2, R_3 and R_4.

The time-constant circuit C_2R_6 is connected to the anode of the uni-junction transistor UJT and the bleeder circuit R_2 R_3 and R_4 furnishes a gate potential for the uni-junction transistor

UJT. In this way, a potential due to a discharged current through the resistor R_5 is supplied to a gate of the silicon controlled rectifier SCR and thus the rectifier SCR is turned on to rotate the motor M_1. When the resistance of the resistor R_6 is variable, the time constant of the circuit C_2R_6 becomes also variable to vary the period from the opening of the switch S_1 to the starting of the rotation of the motor M_1, and thus the timer circuit T functions as an constant intervalometer for a successive photographing.

A, B and C are terminals for remote control, each of which is connected respectively to terminals A', B' and C' of a remote control unit O with an extension card. In this case the battery E_2 is removed and the battery E_1 in the remote control unit is used as the power source. The switches S_3 and S_4 are maintained in a position shown in a full line as shown in FIG. 5. A change-over switch S_8 in the unit O stands in for the switch S_3 of the device and the switch S_7 stands in for the switch S_4 of the device when the remote control unit O is used.

L is an indicator lamp contained in the remote control unit O, and the lamp illuminates when the current flows through the motor M_1 and indicates the movement of the motor M_1 to the operator of the remote control unit.

Lc is a coil of very small resistance connected in series in the circuit for the motor M_1 and Ls is a lead switch actuated by the coil Lc. When the switches S_3 and S_8 are maintained on the side of the terminals (*b*) and (*a'*) and the switch S_1 as well as the switch S_2 are closed, the current passes through the motor M_1 to rotate it, and the current also passes through the coil Lc to attract the lead switch Ls to close an indicator lamp circuit provided in parallel with the motor circuit to energize the lamp L.

In FIG. 5, the lamp L is provided only in the circuit for the motor M_1. According to another embodiment of the invention an indicator lamp circuit is provided for the motor M_2. In this case, when a successive exposure photography is performed with a remote control, the alternate illumination of the two lamps assure the device is acting in a normal manner. To provide lamps for indication of the movement of the both motors M_1 and M_2, it is necessary to connect each of the circuits for the both motors separately to the remote control unit, thus complicating the wiring. But it becomes possible to indicate the movements of the both motors with a simplified wiring as shown in FIG. 5 by constructing two indicator circuits so that two indicators show respectively the movements of the both motors. For this purpose, the difference of the currents for rotation of the both motors is utilized to detect and indicate which one of the motors rotates as shown in FIG. 6. Suppose the current for the motor M_1 is (i_1) and that for the motor M_2 is (i_2). A circuit X for motors M_1 and M_2 is connected in series with a resistor Ra to the battery E, and a connecting point of the circuit X and the resistor Ra is connected to two switching circuits respectively comprising a Schmitt circuit respectively through diodes D_1 and D_2. One of the two Schmitt circuits comprises transistors Tra and Trb, and the other Schmitt circuit comprises transistors Trd and Tre. Potentials for making the transistors Trb and Tre conductive are respectively varied by the variable resistors Re and Rj. Suppose $i_1 < i_2$, then both transistors Trc and Trf are not inverted to conductive states so that both indicator lamps L_1 and L_2 do not illuminate. In the circuits both resistor Rb and Rg furnishing base potentials for the both transistors Trc and Trf should be selected to be small so that the base potentials do not cause both transistors Trc and Trf to on-states in the above case. When current i_1 flows through a release motor and a resistor Ra, a potential i_1Ra drives through the diode D_1 the Schmitt circuit for the lamp L_1 to bring the transistor Trc to an on-state for illuminating the lamp L_1. In this case the resistance value of the resistor Rj should be preselected so that the Schmitt circuit for the lamp L_2 will not be triggered to switch on the transistor Trf for the lamp L_2. When the larger current i_2 flows through a winding motor and a resistor Ra, a potential i_2Ra drives, through the diode D_2, the Schmitt circuit for the lamp L_2 to bring the transistors Trd and Trf to on-states for illuminating the lamp L_2. A diode D_3 is provided in a feed back circuit for prohibiting the illumination of the lamp L_1. The transistor Trb is inverted to an on-state and the Transistor Trc is inverted to switch off the circuit for the lamp L_1. In this way, both the lamps L_1, L_2 do not illuminate when no current flows in the motor circuits X. Only the lamp L_1 illuminates for the current i_1 and only the lamp L_2 illuminates for the current i_2 to assure recognition of the state of camera operation. A similar circuit for warning of the end of the film may be provided as provided as a modification.

According to another embodiment of the invention, the device forms part of a separate and attachable unit.

What is claimed is:

1. An electrical driving device for a camera, comprising first drive means adapted to wind the film of the camera, second drive means adapted to operate the shutter of the camera, control means having a member movable between a first position and a second position and connected to said first drive means and said second drive means for actuating said first drive means in the first position and said second drive means in said second position, manually operable switch means connected to said second drive means for selectively enabling and disabling the actuation of said second drive means, said first control means being responsive to operation of said second drive means for moving said movable member to said first position, detecting means in said first drive means for detecting increases in exertion of said first drive means beyond a given value and connected to said control means for constraining said control means to move said control member from the first position to the second position.

2. A device as in claim 1, wherein said control means includes means for preventing said manually operable switch means from enabling the actuation of said second drive means when said control member is in the first position.

3. A device as in claim 1, wherein said detecting means includes resilient means responsive to exertion of said first drive means beyond a given value.

4. A device as in claim 3, wherein said control means includes means for preventing said manually operable switch means from enabling the actuation of said second drive means when said control member is in the first position.

5. A device as in claim 4, wherein said drive means each includes switch means responsive to said control means for actuating said drive means.

6. A device as in claim 1, wherein said detecting means includes a torsion joint responsive to operation of said first drive means and an electromagnet responsive to the operation of said torsion joint for constraining said control means to move said control member from the first position to the second position.

7. A device as in claim 1, wherein said detecting means includes a pulley system and a band, resilient means for drawing said band taut, and mechanical means responsive to the tautness of said band and connected to said control means for constraining said control means to move said control member from the first position to the second position.

8. a device as in claim 1, wherein said first drive means includes a constant intervalometer responsive to a signal actuating said first drive means for delaying the operation of said first drive means.

9. A device as in claim 1, wherein sad drive means includes delay means for responding to a signal actuating said second drive means for delaying operation of said second drive means.

10. A device as in claim 1, wherein said manually operable switch means form part of a remote control unit.

11. A device as in claim 10, wherein said remote control unit includes indicator means responsive to the operation of said first drive means.

12. A device as in claim 1, wherein said device forms part of a detachable unit.

13. An electric driving device for a camera comprising, first drive means adapted to wind the film of the camera, second

drive means adapted to control the shutter of the camera, control means having a member movable between a first position and a second position and connected to each of said drive means for actuating said first drive means in the first position and said second drive means in the second position, manually operable switch means connected to said second drive means for selectively enabling the actuation of said second drive means and alternatively connectable to said first drive means for enabling actuation of said first drive means when said second drive means is disabled, said control means being responsive to operation of said second drive means for moving said movable member to the first position, detecting means in said first drive means for detecting increases in exertion of said first drive means beyond a given value and connected to said control means for constraining said control means to move said control member from the first position to the second position, and change-over means forming a part of said manually operable switch means for causing said first drive means to be selectively continuously enabled so as to permit automatic successive exposures of successive frames in the camera.

14. A device as in claim 1, wherein said manually operable switch means are connected to said first drive means alternatively for selectively enabling the actuation of said first drive means when the actuation of said second drive means is disabled.

* * * * *