United States Patent [19]

Akiyama

[11] **3,739,704**

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[54] **FOCAL PLANE SHUTTER CONTROL MECHANISM FOR A PHOTOGRAPHIC SHUTTER**

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[73] Assignee: **Minolta Camera Kabushiki Kaisha,** Osaka-shi, Osaka-fu, Japan

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[21] Appl. No.: **196,353**

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Nov. 14, 1970 Japan 45/112516

[52] **U.S. Cl.** **95/57,** 95/53
[51] **Int. Cl.** **G03b 9/28**
[58] **Field of Search** 95/57, 53

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Primary Examiner—Samuel S. Matthews
Assistant Examiner—E. M. Bero
Attorney—Watson, Cole, Grindle & Watson

[57] **ABSTRACT**

A focal plane shutter control mechanism wherein means are provided for equlizing the inertias of the front and rear screens and their associated drive mechanisms so as to eliminate uneven exposures. A transmission means for driving first and second wind-up gears associated respectively with the front and rear screens is disengaged and a cam member is actuated by over-driven bias means to compensate for the overlap of the front and rear screens in their cocked positions.

14 Claims, 14 Drawing Figures

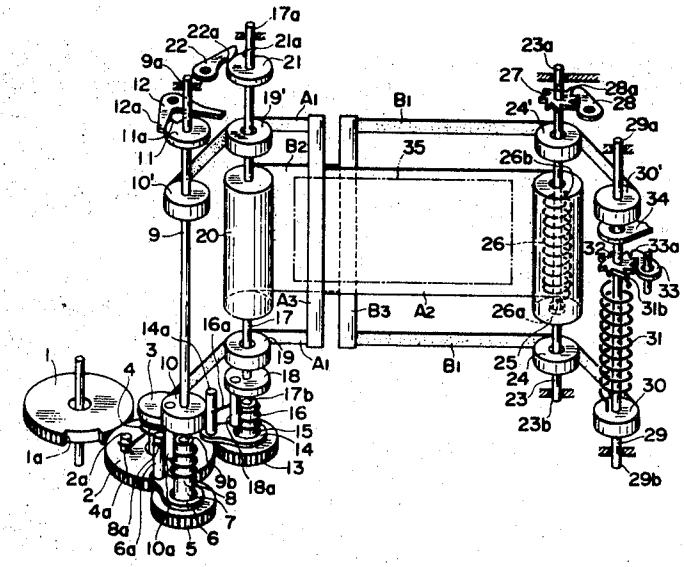


FIG. 1

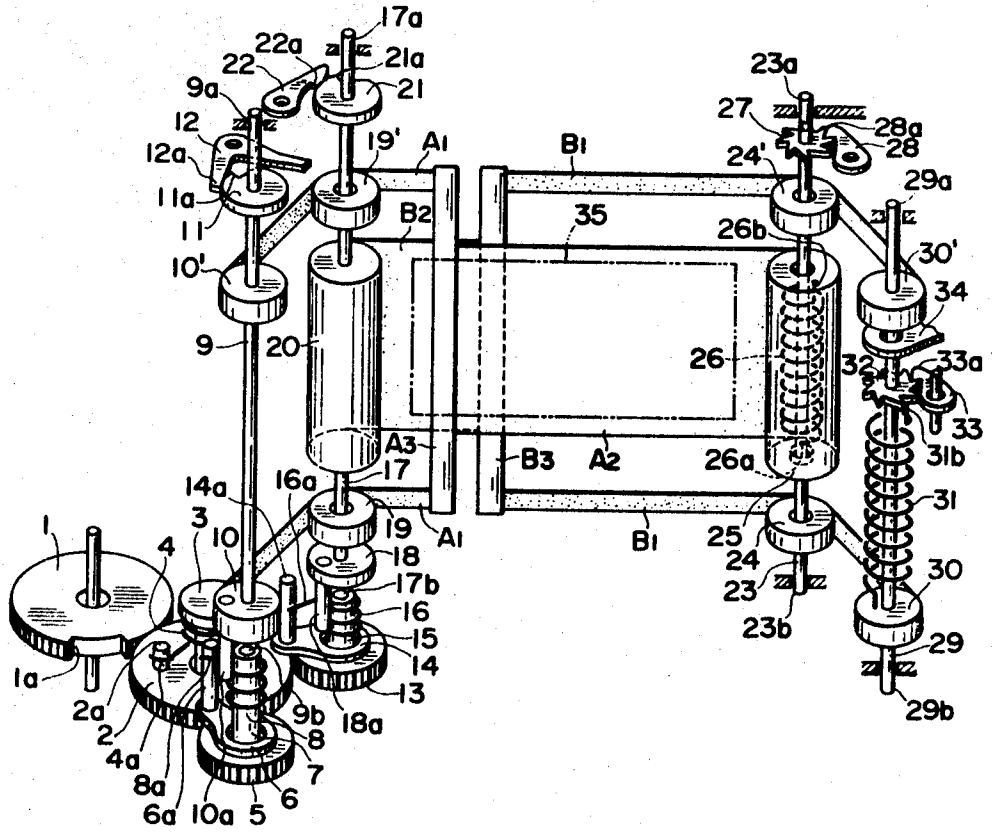

17a
22a
22
21a
21
9a
12
12a
11a
11
10'
9
20
19'
A1
B2
B1
35
23a
27
28a
28
24'
29a
26b
30'
34
26
32
33a
33
31b
31
30
29
29b
A3
17
B3
A2
26a
25
24
23
23b
14a
16a
3
10
19
18
17b
16
15
14
13
18a
9b
8
7
6
10a
5
6a
8a
4a
2
2a
4
1
1a

FIG. 2

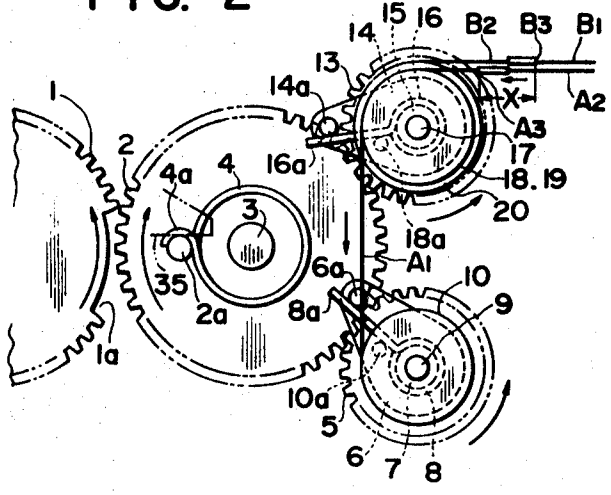


FIG. 3a

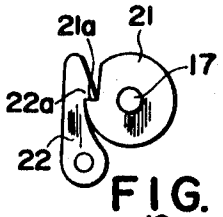


FIG. 3b

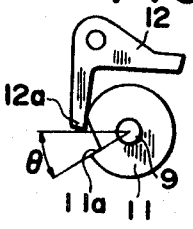


FIG. 4

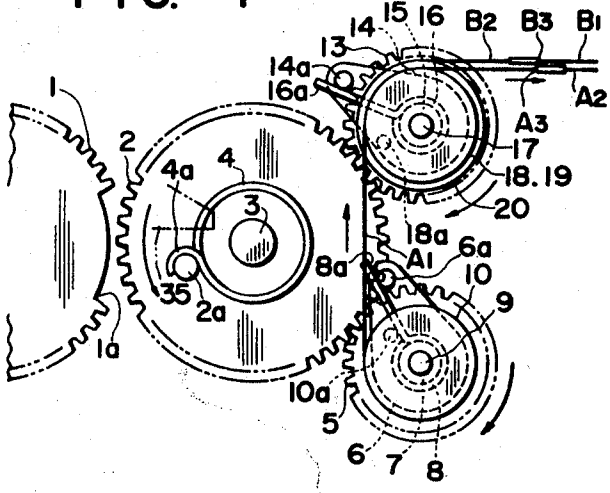


FIG. 5a

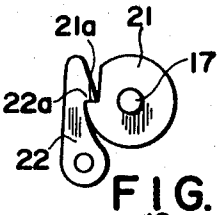


FIG. 5b

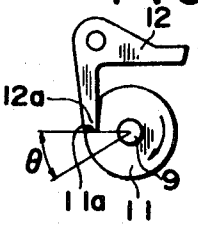


FIG. 6

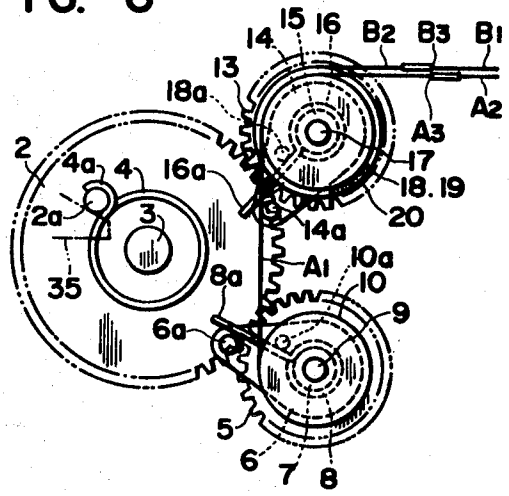

14
15
16
B2
B3
B1
13
18a
A2
A3
2
4a
4
16a
17
18.19
2a
3
20
14a
A1
10a
35
8a
10
9
6a
5
6
7
8

FIG. 7

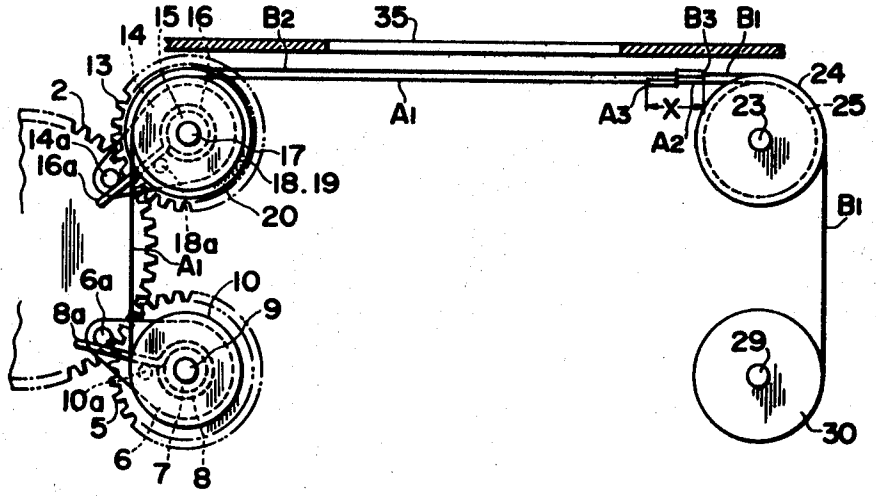

15
16
B2
35
B3
B1
14
13
24
2
A1
A3
X
23
25
A2
14a
16a
17
18.19
20
B1
18a
A1
6a
10
8a
9
29
10a
5
6
7
8
30

FIG. 8

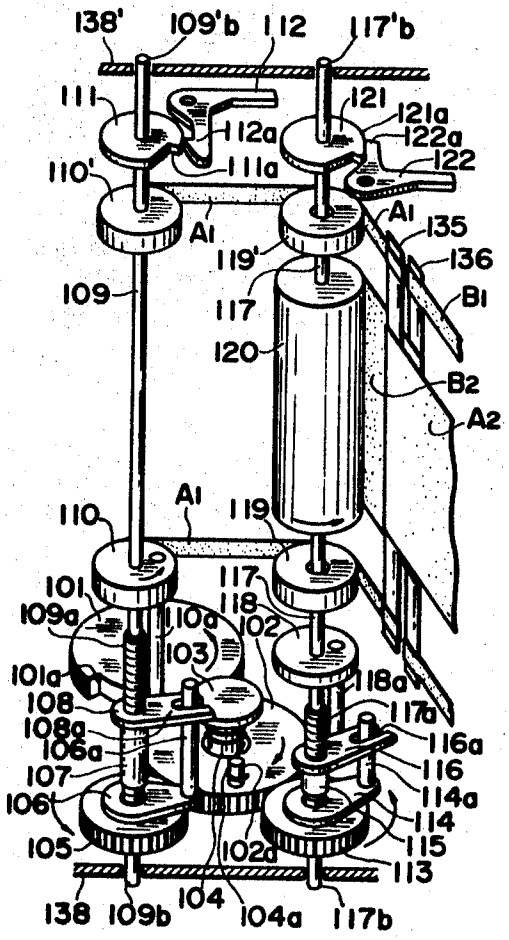


FIG. 9a

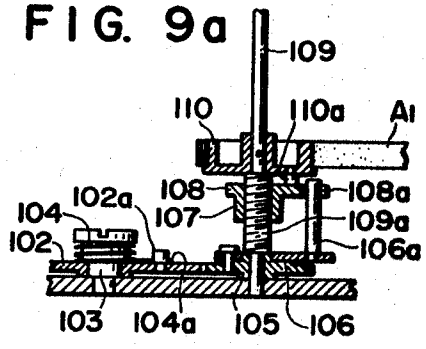


FIG. 9b

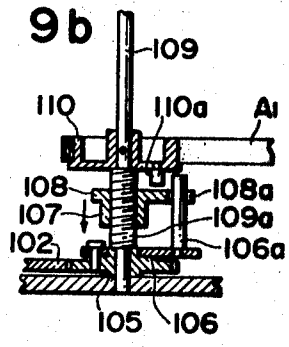


FIG. 9c

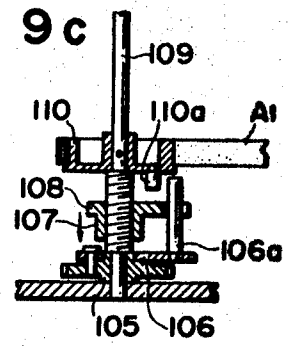
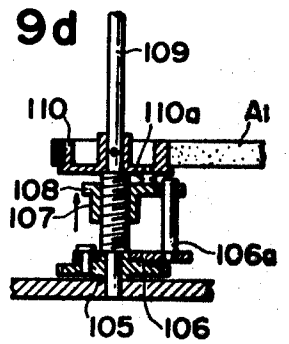


FIG. 9d



FOCAL PLANE SHUTTER CONTROL MECHANISM FOR A PHOTOGRAPHIC SHUTTER

BACKGROUND OF THE INVENTION

The present invention relates to a focal plane shutter mechanism for a photographic camera, and more particularly to a focal plane shutter mechanism for a photographic camera adapted to effect the exposure by adjusting the time when a front screen and a rear screen are released.

In such a kind of focal plane shutter mechanism for a photographic camera, in order to obtain an exposure suitable for a photosensitive film from the deviation of the starting time of both screens and hold such deviation uniform, it is necessary to equalize the driving force on the front screen side at the time when the front screen is released and equalize the inertia of a member driven together with the front screen with the driving force on the rear screen side and equalize the inertia of a member driven together with the rear screen.

Thereupon, in the present invention both inertias are equalized and the starting position of the rear edge of front screen coincides with the starting position of the front edge of closing screen.

In this respect, in the prior focal plane shutter mechanisms for a photographic camera a driving gear for cocking the shutter and a first wind-up gear for driving a first wind-up shaft to cock the front screen and a second wind-up gear for driving a second wind-up shaft to cock the rear screen are meshed at least until the shutter is released. Therefore, the overlap given to the rear edge of the front screen and the front edge of the rear screen so as to prevent light leakage when the shutter is cocked is out of the starting position of the rear edge of the front screen and the starting position of the front edge of the rear screen. Also, the inertia of a member driven together with the front screen is different from the inertia of a member driven together with the rear screen, so that an uneven exposure is effected when the shutter is released.

In addition, in the prior focal plane shutter mechanism for photographic cameras the driving energy for driving both shutter screens depends only upon springs respectively built in winding cylinders for taking up the shutter screen, therefore, the initial running speed of both screens is not increased rapidly.

OBJECT OF THE INVENTION

One object of the present invention is to provide a focal plane shutter mechanism for a photographic camera in which a winding gear group for cocking the shutter breaks off the connection with the first and second wind-up shafts and returns the winding gear group at the termination of shutter cocking.

Another object of the present invention is to provide a focal plane shutter mechanism for a photographic camera which enables the starting position of the rear edge of the front screen coincide with the starting position of the front edge of the rear screen when the front and rear screens are released from the cocked position.

Further another object of the present invention is to provide a focal plane shutter mechanism for a photographic camera in which springs provided respectively on a first wind-up gear and a second wind-up gear engage respectively with a first wind-up shaft and a second wind-up shaft to cock the shutter, and the springs provide give the returning rotation force respectively to the first and second wind-up gears and break off the connection with the first and second wind-up shafts simultaneously with termination of shutter cocking, and decrease the intertias of the members driven together with the front and rear screens respectively by the driving members when the shutter is released and at the same time equalize both inertias.

Still further another object of the present invention is to provide a focal plane mechanism for a photographic camera in which spring means for returning the first and second wind-up gears provides an initial driving torque to the respective first and second wind-up shafts when the shutter is released.

SUMMARY OF THE INVENTION

In order to attain the above-mentioned objects, the present invention provides a first wind-up gear for cocking the focal plane shutter mechanism for a photographic camera having a toothless portion and interlocked with a transmission gear meshing with a first wind-up gear engaged with a first wind-up shaft for cocking the front screen via a first interlocking member and given a returning tendency by a spring and a second wind-up gear engaged with a second wind-up shaft for cocking the rear screen and given a returning tendency by a spring. At the termination of shutter cocking after a restraining member restrains the first and second wind-up shafts at the cocked positions. The interlocking between the cocking gear and the first and second wind-up gears is broken by the toothless portion of the cocking gear, and the first and second wind-up gears are returned to rotate so as to break off the engagement of the first and second interlocking members on the first and second wind-up gears with said the first and second wind-up shafts.

The focal plane shutter mechanism for a photographic camera formed as described above in accordance with the present invention has the following features:

1. The inertias of the interlocking movable systems driven by driving members on the front screen side and on the rear screen side are respectively decreased and equalized with each other. As a result, the screen movement is stabilized and it is possible to obtain a sufficient overlap between both screens when cocked and enables the starting positions of both screens to coincide with each other so as to effect an even exposure.

2. It is possible to permit the interlocking systems on the front screen side and on the rear screen side to move independently by means of interlocking members for engaging with and disengaging from the first and second wind-up shafts provided on first and second wind-up gears having a returning tendency and thereby increase the initial running speed of the front and rear screens and stabilize the running thereof.

3. Both the first and second wind-up gears are rotated to return by making the interlocking members for the first and second wind-up gears respectively spring means and to provide an initial driving torque respectively to the first and second wind-up shafts when the shutter is released, to improve the acceleration thereof and weaken the tension given to both screens as well.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view showing the formation of the essential portion of an embodiment in accordance with the present invention.

FIG. 2 is a plan view showing the relative disposition of the winding gear, first and second wind-up gears, and the first and second wind-up shafts just prior to termination of shutter cocking in the embodiment of FIG. 1.

FIGS. 3*a* and 3*b* are plan views showing the relationship between the restraining plate of both wind-up shafts and the restraining member at that time, wherein FIG. 3*a* shows the first wind-up shaft and FIG. 3*b* shows the second wind-up shaft.

FIG. 4 is a plan view showing the relative disposition of the winding gear, the first and second wind-up gears as they are rotated to return, and the first and second wind-up shafts after termination of shutter cocking in the embodiment of FIG. 1. FIGS. 5*a* and 5*b* are plan views showing the relationship between the restraining plate of both wind-up shafts and the restraining member at that time, wherein FIG. 5*a* shows the first wind-up shaft and 5*b* shows the second wind-up shaft.

FIG. 6 is a plan view showing the relative disposition of the first and second wind-up shafts at the termination of returning in FIG. 4.

FIG. 7 is a plan view showing the relative disposition of the first and second wind-up shafts at the termination of shutter release.

FIG. 8 is a plan view showing the formation of the essential portion of another embodiment in accordance with the present invention.

FIGS. 9*a*–9*c* are partial side views in section for illustrating the operation of the first wind-up shaft of the second embodiment, wherein FIG. 9*a* shows the state just prior to the termination of cocking, FIG. 9*b* shows the state the wind-up gear is returned through about one round, FIG. 9*c* shows the state the wind-up gear is returned through about two rounds, and FIG. 9*d* shows the state when the running of the shutter screen is terminated.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the first embodiment shown in FIG. 1 through FIG. 7 in accordance with the present invention winding gear 1 fixed to a winding lever not shown in the drawings is provided with toothless portion 1*a* which breaks off the connection at the meshing position with a connection gear for meshing with winding shutter rocking gear 1 just after termination of winding.

Connection gear 2 is pivoted rotatably on fixed shaft 3 on the base plate of a camera body, and on the top surface of connection gear 2 pin 2*a* is fixed, and onto pin 2*a* is supported one end 4*a* of return spring 4, the other end of which is fixed to fixed shaft 3.

Front screen gear 5 and rear screen gear 13 are meshed with connection gear 2 as shown in the drawings and fitted respectively on front and rear screen bearing rings 7 and 15 fixed on the base plate. Driving plates 6 and 14 are respectively fixed on gears 5 and 13 and on the projection pieces of plates 6 and 14 driving pins 6*a* and 14*a* are respectively provided.

On the peripheries of bearing rings 7 and 15 springs 8 and 16 are respectively fitted one ends of which are respectively fixed to bearing rings 7 and 15 and the other free ends of which engage respectively with driving pins 6*a* and 14*a* and also sngage respectively with first and second wind-up shaft pins 10*a* and 18*a* mounted respectively on front screen disk 10 and rear screen disk 18 so as to cooperate with each other.

The upper ends 9*a* and 17*a* of first and second wind-up shafts 9 and 17 are supported respectively on the base plates of the camera body and the lower ends 9*a* and 17*b* thereof are respectively fitted in bearing rings 7 and 15. Front screen cylinders 10 and 10′ and front screen restraining plate 11 are fixed to first wind-up shaft 9 and circumferential edge front screen ribbon A_1 is pasted thereto.

Front screen restraining plate 11 is provided with notched portion 11*a* and supported by a pin on the base plate of the camera body and engageable with front screen restraining pawl 12 rotatable in interlocking with the shutter release. And, just before shutter cocking is terminated there is an angle θ between tip 12*a* of restraining pawl 12 and notched portion 11*a* of restraining plate 11 as shown in FIG. 3*b* and simultaneously with the termination of cocking both members engage with each other to be restrained thereby.

Rear screen disk 18, rear screen cylinder 20 the circumferential edge thereof to which one end of rear screen B_2 is pasted, and rear screen restraining plate 21 are fixed to second wind-up shaft 17. Further,, on the upper and lower sides of rear screen cylinder 20 guide rollers 19 and 19′ for guiding front screen ribbon A_1 are fitted loosely.

Rear screen restraining plate 21 is provided with notched portion 21*a* and supported by a pin on the base plate of the camera body and engageable with rear screen restraining pawl 22. And just before shutter cocking is terminated restraining pawl 22 engages with restraining plate 21 as shown in FIG. 3*a*.

Front and rear screen driving springs are disposed nearly symmetrically to the take-up shaft on the opposite side to first and second wind-up shafts 9 and 17 relative to the optical axis of FIG. 1, and front screen driving spring 26 is fixed to front screen spring shaft 23 at one end 26*a* thereof and the other end 26*b* thereof is fixed to a portion of front screen cylinder 25 fitted rotatably on spring shaft 23 and pasted with the tip of front screen A_2. Spring 26 is contained in cylinder 25.

Upper and lower ends 23*a* and 23*b* of front screen spring shaft 23 are supported respectively by a pin on the base plate of the camera body, and on the upper and lower sides of front screen cylinder 25 guide rollers 24 and 24′ for guiding rear screen ribbon B_1 are fitted loosely. Near the upper end 23*a* ratchet wheel 27 is fixed so as to check the counterclockwise rotation of spring shaft 23 by means of ratchet 27. And, by means of ratchet wheel 27 and ratchet 28 it is possible to moderate the required front screen driving force by adjusting the initial number of winding.

Rear screen spring 31 is fixed at one end thereof to a portion of rear screen spring disk 30 fixed to rear screen spring shaft 29 and the other end thereof is fixed to ratchet 32 fitted loosely on spring shaft 29 and more fully described below.

Rear screen spring shaft 29 is supported at upper and lower ends 29*a* and 29*b* thereof by pins on the base plate of the camera body, and to the upper and lower portions of spring shaft 29 rear screen spring disks 30 and 30′ are fixed respectively. On the circumferential edges of disks 30 and 30′ the tip of rear screen ribbon B_1 is pasted. And, ratchet wheel 32 is arranged to engage with ratchet 33 supported by a pin on intermediate base plate 34 fitted loosely on spring shaft 29 to check ratchet wheel 33 from rotating counterclockwise.

Rear screen spring 31 fitted on rear screen spring shaft 29 is fixed at one end thereof onto rear screen spring disk 30 and at the other end thereof onto a portion of ratchet wheel 33 to rotate spring shaft 29 clockwise so as to energize it.

Therefore, opening screen cylinder 25 to which front screen A_2 is pasted and rear screen spring disks 30 and 30' to which rear screen ribbon B_1 is pasted are ordinarily rotated clockwise to be energized and accordingly front and rear shutter screens A_2 and B_2 are arranged to move to the right in front of exposure opening frame 35.

And, the structure is so arranged that the inertias of movement of the front and rear screens, namely, the inertias of first wind-up shaft 9 and front screen cylinders 10 and 10' are equal to the inertias of rear screen spring shaft 29 and rear screen spring disks 30 and 30'. The inertias of front screen guide rollers 19 and 19' are equal to the inertias of rear screen guide rollers 24 and 24'. The inertia of front screen spring cylinder 25 is equal to the inertias of second wind-up shaft 17 and rear screen cylinder 20. Finally, the inertia of front screen restraining plate 11 is equal to the inertia of rear screen restraining plate 21.

Since the present invention is constructed as described above, upon turning the film winding lever, driving gear 1 interlocked therewith is rotated counterclockwise and connection gear 2 meshed with driving gear 1 is rotated clockwise, thereby over energizing return spring 4. Simultaneously therewith, front and rear screen gears 5 and 13 meshed respectively with said connection gear 2 and driving plates 6 and 14 fixed in a body respectively with screen gears 5 and 13, also are rotated counterclockwise using bearing rings 7 and 15 respectively as a center.

At this juncture, since driving pins 6*a* and 14*a* on driving plates 6 and 14 move in the energizing direction counterclockwise free ends 8*a* and 16*a* of springs 8 and 16 fitted respectively on bearing rings 7 and 15. Free ends 8*a* and 16*a* come into contact respectively with screen shaft pins 10*a* and 18*a* provided respectively on front screen cylinder 10 and rear screen disk 18 fixed in a body respectively with first and second wind-up shafts 9 and 17 so as to rotate shafts 9 and 17 counterclockwise. As a result, front screen ribbon A_1 pasted on the circumferential edges of front screen cylinders 10 and 10' is led by front screen guide rollers 19 and 19' fitted loosely on second wind-up shaft 17 to move front screen A_2 to the left. Therefore, front screen spring cylinder 25 with front screen A_2 is rotated counterclockwise about front screen spring shaft 23 as a center to energize front screen driving spring 26 accommodated in spring cylinder 25. And, with the progress of rotation of second wind-up shaft 17 rear screen cylinder 20 fixed thereto is rotated counterclockwise. Therefore, rear screen B_2 on screen cylinder 20 is wound to move to the left along with rear screen ribbon B_1. Since rear screen ribbon B_1 led by rear screen guide rollers 24 and 24' fitted loosely on front screen spring shaft 23 is pasted on rear screen spring disks 30 and 30' fixed in a body with front screen spring shaft 29, it energizes rear screen driving spring 31 simultaneously with the driving of the rear screen.

At this juncture, the positions of the edge end of the front and rear screens are as shown in FIG. 2 and rear edge A_3 of the front screen is advanced to the left by a distance X from front edge B_3 of rear screen and the screen overlap quantity required to screen the light is maintained.

And, just before winding is terminated front and rear screen restraining plates 11 and 21 fixed respectively to first and second wind-up shafts 9 and 17 hold the relative position as shown in FIG. 3*b*. Rear screen restraining plate 21 is in a position where notch 21*a* thereof engages with hook 22*a* of rear screen restraining pawl 22, and in the meantime front screen restraining plate 11 is in a position where the front screen is wound up excessively by an angle Θ equivalent to the screen overlap portion X from the engage position of tip 12*a* of front screen restraining pawl 12.

Then, upon reaching the winding state, as shown in FIG. 4 toothless portion 1*a* of driving gear 1 is rotated to mesh with connection gear 2 and accordingly driving gear 1 is disengaged from connection gear 2, and connection gear 2 starts to be rotated counterclockwise to return by virtue of the force of return spring 4. And, at the same time front and rear screen gears 5 and 13 meshed with connection gear 2 are rotated clockwise as shown by the arrows in FIG. 4, being accompanied by driving plates 6 and 14 fixed in a body therewith and accordingly springs 8 and 18 in contact with fixed driving pins 6*a* and 14*a* also follow in interlocking therewith via free ends 8*a* and 16*a*.

Then, front and rear screen cylinders 10 and 20 are disconnected respectively from free ends 8*a* and 16*a* and front and rear screen shaft pins 10*a* and 18*a* follow in relationship therewith clockwise also by the force of front and rear driving springs 26 and 31 respectively. However, in the case of rear screen B_2 notch 21*a* of restraining plate 21 engages with restraining pawl 22 so that the running movement of the rear screen is checked.

However, front screen A_2 is wound up excessively by an angle Θ from the engage position of tip 12*a* of front screen restraining pawl 12 along notch 11*a* of front screen restraining plate 11 and accordingly unwinds following after the reverse of front screen gear 5 until restraining plate 11 is meshed with restraining pawl 12 by the front of screen driving spring 26. Thereby, front screen A_2 is moved alone by a distance X to the right and positions of the rear edge A_3 of front screen and front edge B_3 of rear screen coincide with each other.

Subsequently, the reverse and return of connection gear 2 takes place and at a position where connection gear 2 is rotated through about a half revolution front and rear screen gears 5 and 13 and driving plates 6 and 14 fixed thereto are arranged to rotate through about one revolution, so that driving pins 6*a* and 14*a* and screen shaft pins 10*a* and 18*a* are respectively arranged nearly on one straight line relative to first and second wind-up shafts 9 and 17. Free ends 8*a* and 16*a* of spring 8 and 16 which come to this position following the contact and interlocking with driving pins 6*a* and 14*a* come into contact with the opposite side of screen shaft pins 10*a* and 18*a* in the positions shown in FIG. 2 to be restrained and disconnected from driving pins 6*a* and 14*a*.

Thereafter, connection gear 2 continues a counterclockwise rotation only by means of the force of return spring 4. Therefore, front and rear screen gears 5 and 13 and driving plates 6 and 14 start the second revolution and at last as shown in FIG. 4 pin 2*a* on connection gear 2 runs against fixed stop plate 35 shown by a one point chain line in FIG. 4 to terminate the reverse re-

turn movement. At this juncture, driving pins **6***a* and **14***a* fixed in a body with front and rear screen gears **5** and **13** are positioned before coming into contact with free ends **8***a* and **16***a* of springs **8** and **16** as shown in FIG. **6.**

Next, upon depressing the release button, not shown in the drawings, front screen restraining pawl **12** is rotated clockwise as shown in FIG. **5***b* and tip **12***a* thereof comes out of notch **12***a* of front screen restraining plate **11** to release the front screen. Therefore, front screen A_2 moves to the right by the force of front screen driving spring **26** and spring **8** via front screen guide rollers **19** and **19'**, accompanied by the rotation of first wind-up shaft **9**, and front screen cylinders **10** and **10'** and front screen restraining plate **11.** Thereby an exposure to a film accommodated in the rear of exposure opening frame **35** is made.

After the movement of the front screen is started, when the time required elapses hook **22***a* of rear screen restraining pawl **22** is retreated to rotate from notch **21***a* of rear screen restraining plate **21** by the action of a well-known governor gear omitted in the embodiment and releases the rear screen. Therefore, rear screen B_2 runs to the right in the same way as the front screen by the force of rear screen driving spring **31** and spring **16** along with the rotation of rear screen cylinder **20** and rear screen restraining plate **21.** Thereby, the exposure to of the film is terminated.

In the process of the shutter movement, springs **8** and **16** for have free ends **8***a* and **16***a* engaged with driving pins **6***a* and **14***a* to push them and promote shutter movement during about one revolution from the starting of front and rear screen cylinders **10** and **20.** However, after ends **8***a* and **16***a* engage with the opposite side of driving pins **6***a* and **14***a* to stop, front and rear shutter screens A_2 and B_2 are driven only by means of the force of front and rear screen driving springs **26** and **31.** Front screen cylinder **10** and rear screen disk **18** are rotated through about two revolutions from their starting point, and screen shaft pins **10***a* and **18***a* run against free ends **8***a* and **16***a* to terminate the movement of the shutter. The positions of the components at this juncture are shown in FIG. **7** and the impact force accompanied by the stopping of the shutter is absorbed by an elastic deformation of free ends **8***a* and **16** *a* of springs **8** and **16.** The front edge of the rear screen is advanced to the right by a distance X as shown in FIG. **7** as compared with the rear edge of front screen and the screen overlap required to screen the light is obtained.

In connection with FIG. **8** and FIG. **9** the construction of the second embodiment in accordance with the present invention will be described hereinafter.

Driving gear **101** interlocks with a winding lever not shown in the drawings and is provided with toothless portion **101***a* which disconnects with connection gear **102** which meshes with winding gear **101** just after termination of winding.

Connection gear **102** is pivotted rotatably on fixed shaft **103** on base plate **138** of the camera body and on the top surface of gear **102** pin **102***a* is mounted. And, onto pin **102***a* is suspended one end **104** of return spring **104** wound round fixed shaft **103.**

Front and rear screen gears **105** and **113** mesh with connection gear **102** to constitute a speed up gear train and are fitted loosely on first and second wing-up shafts **109** and **117** respectively. And, onto gears **106** and **114** front and rear screen driving plates are respectively fixed and on the projection piece portions of both plates **106** and **104** driving pins **106***a* and **114***a* are provided.

The upper and lower ends of first and second wind-up shafts **109** and **117** are supported respectively on bearing portions **109***b*, **109'***b* and **117***b*, **117'***b* of base plates **138** and **138'** of the camera body. At respective positions on shaft **109** and **117** control screws (right-hand screws) **109***a* and **117***a* are respectively threaded, with which front and rear screen control nuts **107** and **115** are coupled. In fork portions **108***a* and **116***a* of control plates **108** and **116** fixed to nuts **107** and **115,** driving pins **106***a* and **114***a* are fitted respectively to engage with each other and also engage respectively with front and rear screen shaft pins **110***a* and **118***a* mounted respectively on front screen cylinder **110** and rear screen disk **118** described below. As shown in FIG. **9***d* driving pins **106***a* and **114***a* engage with shaft pins **11***a* and **118***a* respectively and cooperate respectively with each other in contacting with each other also during winding. And, the engaging relation of both pins is so arranged that they are engaged or disengaged by going up and down through about one revolution of both control plates **108** and **116.**

Further, to first wind-up shaft **109** there are fixed front screen cylinders **110** and **110'** on which circumferential edge front screen ribbon A_1 is pasted, and front screen restraining plate **111.** And, front screen restraining plate **111** is provided with notch **111***a* and engageable with pawl **112***a* of front screen restraining lever **112** supported by a pin on base plate **138'** of the camera body and rotatable in interlocking with the release operation. Restraining lever **112** and pawl **112***a* are formed to engage with each other to be restrained at the termination of winding.

And, to second wind-up shaft **117** there are fixed rear screen disk **118,** rear screen cylinder **120,** on which circumferential edge one end of rear screen B_2 is pasted, and rear screen restraining plate **121.** And on the upper and lower sides of rear screen cylinder **120** guide rollers **119** and **119'** for guiding front ribbon A_1 are respectively fitted loosely. And, rear screen restraining plate **121** is provided with notch **121***a* and engageable with pawl **122***a* of rear screen restraining lever **122** supported by a pin on base plate **138'** of the camera body and rotatable in interlocking with the release operation and so formed as to engage to be restrained at the termination of winding.

In addition, front screen ribbon A_1 is connected with front screen A_2 via front screen rear edge plate **135,** and rear screen B_2 is connected with closing screen ribbon B_1 via rear screen front edge plate **136,** and it is understood that screens A_2 and B_2 are formed to move always to the right by a well-known driving means not shown in the drawings.

Since the second embodiment is constructed as described above, upon turning the winding lever driving gear **101** interlocked therewith is rotated in the direction shown by the arrow (counterclockwise) and accordingly connection gear **102** meshed with driving gear **101** is rotated in the direction shown by the arrow (clockwise) thereby over energizing return spring **104,** using fixed shaft **103** as a center via pin **102***a* on gear **102.** Front and rear screen gears **105** and **113** meshed with gear **102** are rotated, front and rear screen driving plates **106** and **114** fixed in a body respectively with

gears **105** and **113**, and driving pins **106***a* and **114***a* mounted respectively on driving plates **106** and **114** are rotated in the direction shown by the arrow (counterclockwise). Therefore, front and rear screen control plates **108** and **116** for engaging respectively with driving pins **106***a* and **114***a* and front and rear screen control nuts **107** and **115** fixed in a body respectively with control plates **108** and **116** are rotated in the same direction (counterclockwise). And thereby both screen shaft pins **110***a* and **118***a* in contacting respectively with the end portions of front and rear screen control plates **108** and **116** are moved and accordingly a counterclockwise rotation is given to first and second wind-up shafts **109** and **117** to which front screen cylinder **110** and rear screen disk **118** having shaft pins **110***a* and **118***a* mounted thereon are respectively fixed.

Therefore, front and rear screen cylinders **111**, **110'**, and **119** fixed in a body respectively to first and second wind-up shafts **109** and **117** also are rotated counterclockwise to wind up front and rear screens A_2 and B_2. Restraining pawls **112***a* and **122***a* engage respectively with front and rear screen restraining plates **111** and **121** to terminate winding. (See FIG. **9***a*).

Upon termination of winding, toothless portion **101***a* of driving gear **101** meshes with connection gear **102** and thereby the connections with both gears **101** and **102** are broken off, and connection gear **102** and first and second wind-up gears **105** and **113** are reversed to return by the force of return spring **104.** And at the same time front and rear screen control plates **108** and **116** and control nuts **107** and **115** also are reversed in the same direction via driving pins **106***a* and **114***a* on front and rear screen driving plates **106** and **114** fixed respectively to first and second wind-up gears **105** and **113.**

At this juncture, since first and second wind-up shafts **109** and **117** are respectively restrained by front and rear restraining pawls **112***a* and **122***a*, with the clockwise rotation of front and rear screen control nuts **107** and **115.** Thereby control nuts **107** and **115** are control plates **108** and **116** can come down, and on the returning motion where about one revolution is effected, as shown in FIG. **9B**, front and rear shaft pins **110***a* and **118***a*, and front and rear control plates **108** and **116** start to come down from the engage position where front and rear screen shaft pins **110***a* and **118***a* come into contact respectively with front and rear screen control plates **108** and **116.** Thereby, further returning rotation is continued and the return is terminated at the winding start position shown in FIG. **9***c*.

Then, upon depressing the release button, through the rotation of front screen restraining lever **112** interlocked with the release button, front screen restraining plate **111** is released and accordingly first wind-up shaft **109** and front screen cylinders **110** and **110'** start to rotate clockwise in a body. And successively, by means of a well-known governor gear or an electric time delay circuit rear screen restraining lever **122** releases rear screen restraining plate **112** and second wind-up shaft **117** and rear screen disk **119** are rotated clockwise in a body.

At this juncture, front and rear screen control plates **108** and **116** and control nuts **107** and **115** are fixed via front and rear screen driving pins **106***a* and **114***a* fixed in a body respectively with first and second wind-up gears **105** and **113.** Only control screws **109***a* and **117***a* are rotated and thereby control nuts **107** and **115** and control plates **108** and **116** come up, and when front and rear screen cylinder **110** and **119** come to the stop position front and rear screen shaft pins **110***a* and **118***a* come into contact respectively with front and rear screen control plates **108** and **116** which have moved up. Shutter screens A_2 and B_2 are stopped and take the position shown in FIG. **9***d*.

And, front and rear screen shaft pins **110***a* and **118***a* are in contact respectively with front and rear screen control plates **108** and **116,** and then simultaneously with winding, first and second wind-up gears **105** and **113,** front and rear screen driving pins **106***a* and **114***a*, front and rear screen control plates **108** and **116,** and first and second wind-up shafts **107** and **119** also are rotated together with. Therefore, when winding is terminated the components return to the position shown in FIG. **9***a*.

Since the second embodiment is constructed as described above, by lengthening the control screw the rotation angle of the screen cylinder can be enlarged, and provided that the shutter screen running distance is L, the screen cylinder radius of R, and the rotation angle of the screen cylinder is Θ, $R \cdot \Theta = L$, and the inertia of the screen cylinder is proportional to R^4. Therefore, when the rotation angle Θ of the screen cylinder is enlarged, *R* becomes smaller and accordingly the inertia thereof can be decreased.

I claim:

1. A focal plane shutter control mechanism for a camera having front and rear screens respectively biased to be driven from cocked positions to rest positions, a first retaining member for retaining said front screen in said cocked position, a second retaining member for retaining said rear screen in said cocked position, a first wind-up shaft for winding said front screen, and a second wind-up shaft for winding said rear screen, comprising:

driving means rotatable in response to shutter wind-up operation;

first and second wind-up gears;

transmission means for driving said first and second wind-up gears in shutter wind-up directions in response to the movement of said driving means;

first means for interconnecting said first wind-up shaft with said first wind-up gear when said first wind-up gear is driven in the shutter wind-up direction;

second means for interconnecting said second wind-up shaft with said second wind-up gear when said second wind-up gear is driven in the shutter wind-up direction;

said driving means including means for disengaging said transmission means therefrom when said front and rear screens are in said cocked positions, and said transmission means being biased to return to a rest position with said wind-up gears when said driving means disengages said transmission means therefrom;

said first means disconnecting said first wind-up gear from said first wind-up shaft when said first wind-up gear is driven in a direction opposite to said shutter wind-up direction; and

said second means disconnecting said second wind-up gear from said second wind-up shaft when said second wind-up gear is driven in a direction opposite to said shutter wind-up direction.

2. A focal plane shutter control mechanism as claim 1, wherein said driving means is a gear and said means for disengaging is a non-toothed segment thereof.

3. A focal plane shutter control mechanism as in claim 2, wherein said front and rear screens in said cocked positions partially overlap with each other, and further comprising means for compensating said partial overlap when said first and second screens are released for an exposure.

4. A focal plane shutter control mechanism as in claim 3, further comprising a first cam member mounted on said first wind-up shaft to rotate therewith and engageable with said first retaining member, and a second cam member mounted on said second wind-up shaft to rotate therewith and engageable with said second retaining member, said first cam member is rotatable beyond the position to be engaged by said first retaining member with said second cam member rotating to the position to be engaged by said second retaining member whereby said first cam member is returned through the bias for the first screen until said first cam member engages with said first retaining member thereby compensating for said overlap when said first wind-up gear is disconnected from said first wind-up shaft.

5. A focal plane shutter control mechanism as in claim 3, wherein said first and second means each comprises a first pin respectively rotatable with said first and second wind-up gear, a second pin respectively rotatable with said first and second wind-up shaft, and a coil spring energized in the direction opposite to said shutter wind-up direction of said first or second wind-up gears, and said coil spring having an extension for engaging said first and second pins whereby said first pin drives said second pin by means of said coil spring when said first or second wind-up gear is driven in the shutter wind-up direction.

6. A focal plane shutter control mechanism as in claim 5, wherein the gear ratio of said transmission means and said first wind-up gear and the gear ratio of said transmission means and said second wind-up gear are so selected that both said first and second wind-up gears rotate more than one revolution until said transmission means rotates to said rest position, whereby said coil springs also drive said front and rear screens.

7. A focal plane shutter control mechanism as in claim 4, wherein each of said first and second means comprises a first pin respectively rotatable with said first and second wind-up gear, a second pin respectively rotatable with said first and second wind-up shaft, an intermediate member having a slot to receive said first pin, and means for moving said intermediate member in accordance with the relative movement of said first or second wind-up shaft and with said first or second wind-up gear whereby said intermediate member is engageable with said second pin with said first or second wind-up gear driven in the shutter wind-up direction and disengaged from said second pin with said first or second wind-up gear driven in the reverse direction.

8. A focal plane shutter control mechanism as in claim 7, wherein said means for moving comprises a threaded portion formed on said first and second wind-up shafts, and an internally threaded bore formed in said intermediate member and engaging said threaded portion.

9. A focal plane shutter control mechanism as in claim 1, wherein said first and second means each comprises a first pin respectively rotatable with said first and second wind-up gear, a second pin respectively rotatable with said first and second wind-up shaft, and a coil spring energized in the direction opposite to said shutter wind-up direction of said first or second wind-up gears, and said coil spring having an extension for engaging said first and second pins whereby said first pin drives said second pin by means of said coil spring when said first or second wind-up gear is driven in the shutter wind-up direction.

10. A focal plane shutter control mechanism as in claim 9, wherein the gear ratio of said transmission means and said first wind-up gear and the gear ratio of said transmission means and said second wind-up gear are so selected that both said first and second wind-up gears rotate more than one revolution until said transmission means rotates to said rest position, whereby said coil springs also drive said front and rear screens.

11. A focal plane shutter control mechanism as in claim 1, wherein each of said first and second means comprises a first pin respectively rotatable with said first and second wind-up gear, a second pin respectively rotatable with said first and second wind-up shaft, an intermediate member having a slot to receive said first pin, and means for moving said intermediate member in accordance with the relative movement of said first or second wind-up shaft and with said first or second wind-up gear whereby said intermediate member is engageable with said second pin with said first or second wind-up gear driven in the shutter wind-up direction and disengaged from said second pin with said first or second wind-up gear driven in the reverse direction.

12. A focal plane shutter control mechanism as in claim 11, wherein said means for moving comprises a threaded portion formed on said first and second wind-up shafts, and an internally threaded bore formed in said intermediate member and engaging said threaded portion.

13. A focal plane shutter control mechanism as in claim 1, wherein the inertia of said front screen and members driven with the front screen is approximately equal to that of said rear screen and members driven with said rear screen.

14. A focal plane shutter control mechanism as in claim 13, further comprising winding members around which a respective one end of said front screen and said rear screen is wound, the other end of said front and rear screen is respectively wound around respective ones of said first and second wind-up shafts and rotatable with respect to each of said first and second wind-up shafts; and rotatable biasing means between said first and second wind-up shafts and said winding members to drive respectively said front and rear screens to said rest positions from said cocked positions relative to said first and second wind-up shafts; and at least one of said first or second wind-up shafts is rotatable and the rotating position thereof is fixed adjustably to said winding member in the rest position thereof.

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