United States Patent

Hayami

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[54] MOTION PICTURE PROJECTOR WITH AUTOMATIC REWIND

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[73] Assignee: **Kabushiki Kaisha Koparu,** Tokyo-to, Japan

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[52] **U.S. Cl.**.....**242/189,** 242/71.6, 242/200, 242/205, 352/124

[51] **Int. Cl.**.....**G03b 1/22,** G03b 1/58

[58] **Field of Search**.....242/186, 189, 190, 193, 200, 242/205, 71.5, 71.6, 67.4; 352/123, 124, 173

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Assistant Examiner—Werner H. Schroeder
Attorney—Cushman, Darby & Cushman

[57] **ABSTRACT**

A motion picture projector with automatic rewind, comprising: a wheel adapted to rotate at a constant speed for feeding film, a mechanism operative to relieve the engagement between the film and said wheel and to cause the retreat of both a pressure plate of a film gate and a film drive claw from the film face, and a mechanism operative to cause the change-over of the connections of power source switches to a driving motor by the actions of members adapted to be actuated by the resultant tension produced in the film, causing the interruption and subsequent resumption of motion of said driving motor so as to rotate said supply reel at high speed in the direction in which the film is taken up by said supply reel.

6 Claims, 11 Drawing Figures

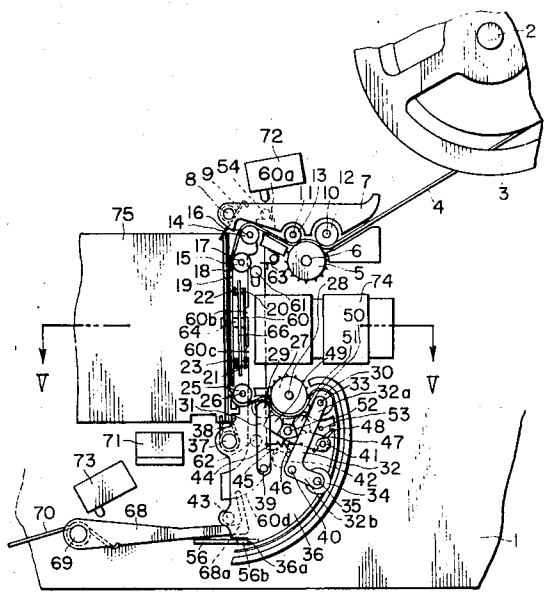


FIG. 1

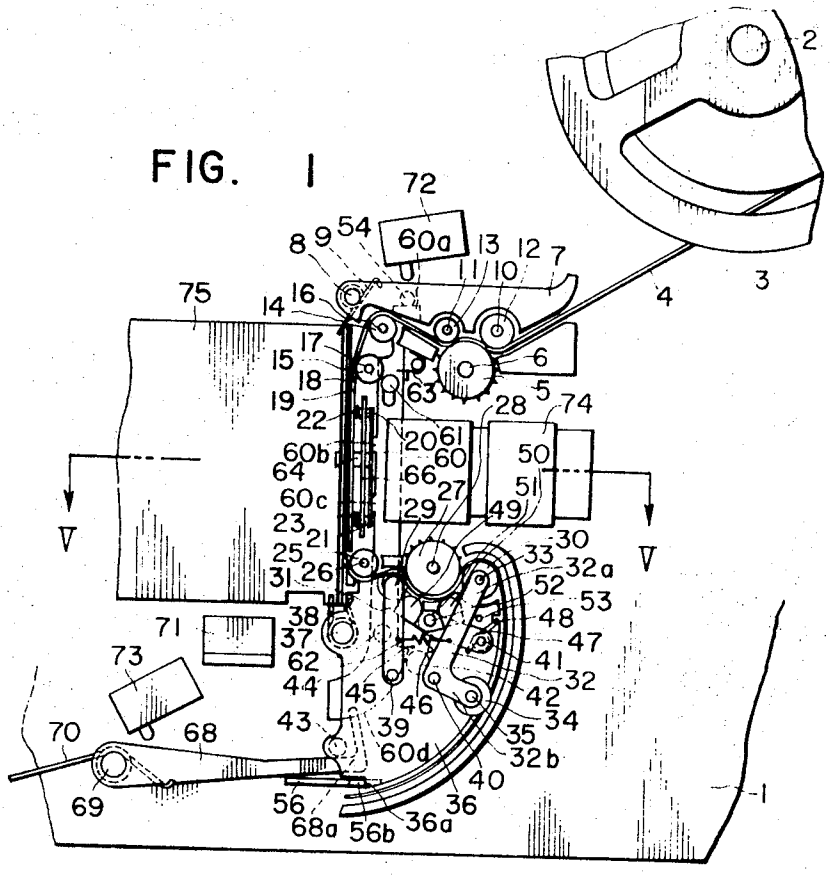


FIG. 2

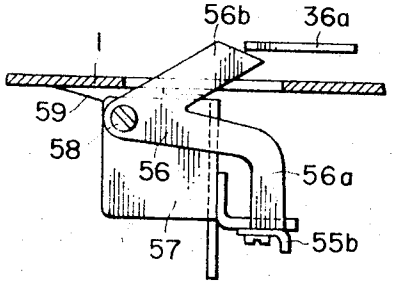


FIG. 3

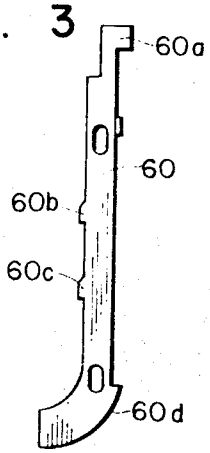


FIG. 4a

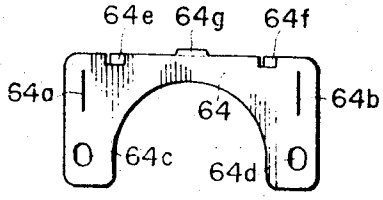


FIG. 4b

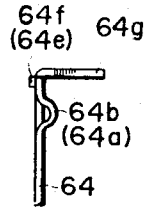


FIG. 5

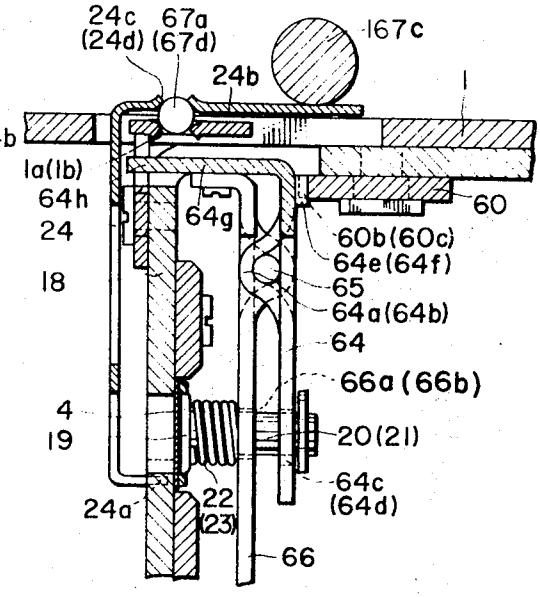


FIG. 6

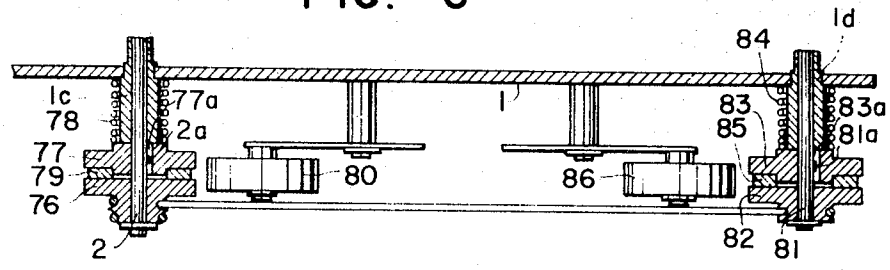


FIG. 7

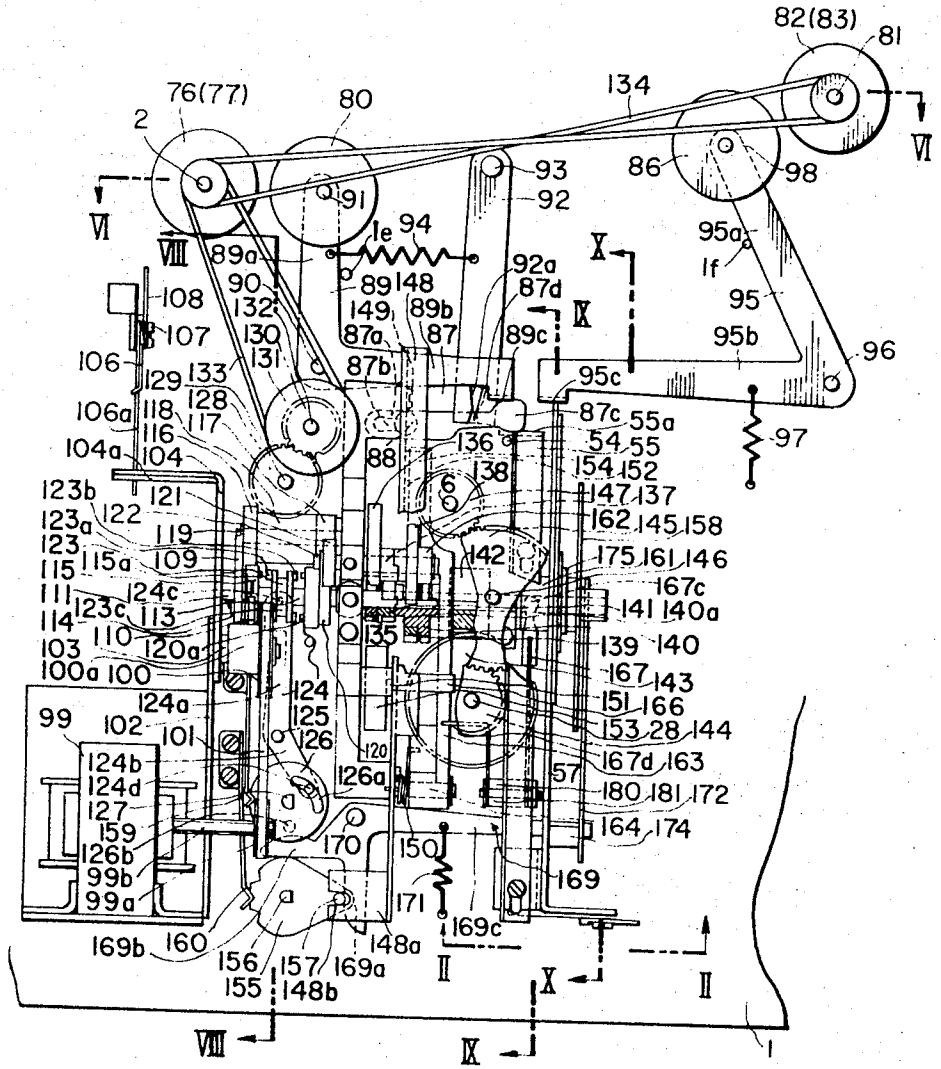

82(83)
81
76(77)
80
134
2
VI
93
92
86
98
91
1e
94
95a
1f
X
92a
87d
IX
95
89a
90
89
148
149
89b
87
89c
95b
96
108
132
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87a
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131
87b
95c
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106a
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87c
55a
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104a
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123b
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137
123a
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115a
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167c
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124c
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123c
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167d
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124b
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126a
57
180
181
172
124d
127
164
174
159
170
150
126b
169
99b
171
169c
99a
169b
160
156
157
169a
148a
II
155
148b
VIII
IX
1

FIG. 10

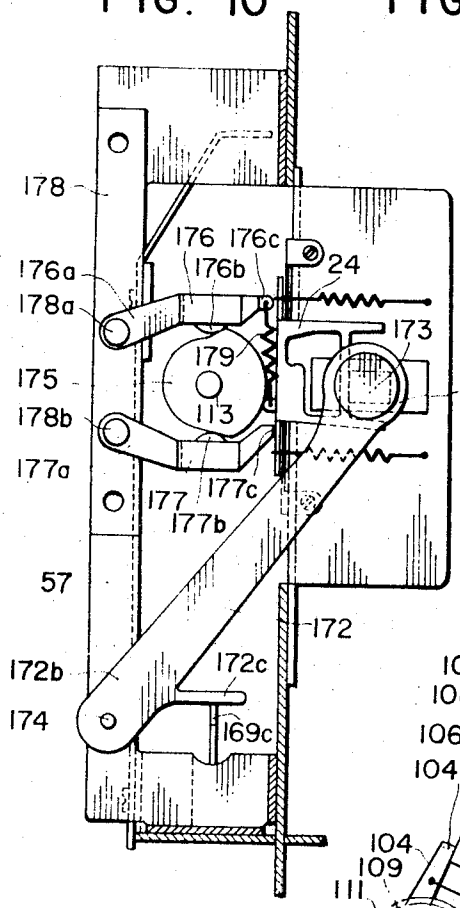


FIG. 9

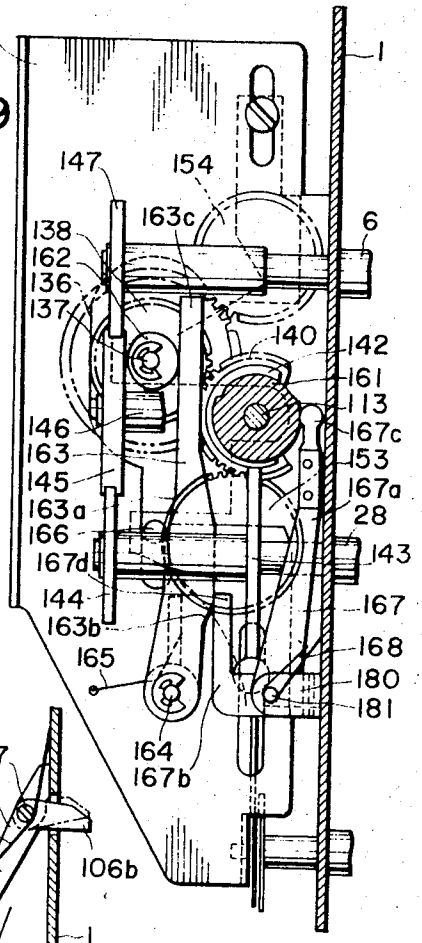
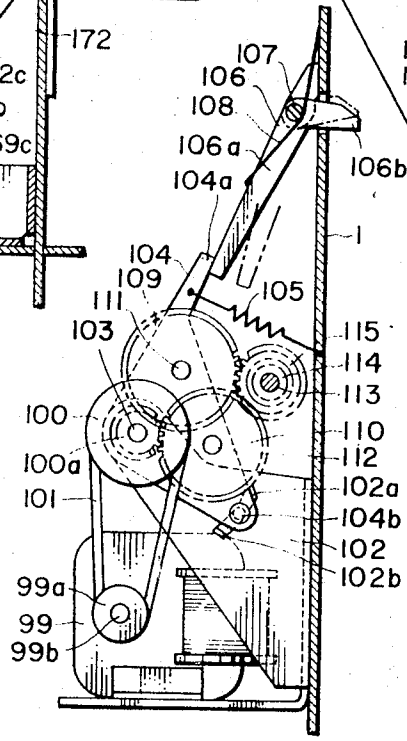


FIG. 8



MOTION PICTURE PROJECTOR WITH AUTOMATIC REWIND

BACKGROUND OF THE INVENTION

a. Field of the Invention

The present invention is concerned with a motion picture projector with an automatic rewinding mechanism, and more particularly, it relates to a motion picture projector with an automatic rewind having a mechanism which is operative so that, after the completion of projection, the film is automatically rewound quickly around the supply reel.

b. Description of the Prior Art in conventional

In general, in case rewinding of the film is performed in a motion picture projector, it is necessary that the engagement between the film and the wheel assigned for feeding said film be relieved and also that the pressure plate of the film gate and the film driving claw be caused to retreat from the film face, in order to effect a smooth travel of the film which is rewound. These operations which were necessary in rewinding the film were performed manually in the past. For example, they were performed in the following manner is conventional motion picture projectors. A knob for rewinding is manipulated. Whereupon, the mechanism which is interlocked with said knob is actuated. A pressure plate and a film driving claw which are both interlocked with said mechanism are caused to retreat from the film face. Also, in a conventional motion picture projector of the simple type, the film which has been wound around a take-up reel is delivered directly to a supply reel from said take-up reel without passing through the path of film for projection, so that the terminal end of the film is engaged again by the supply reel. Thus, the film is rewound around the supply reel. In the case of the former, however, the arrangement described in connection therewith was limited to projectors of the sprocket-less type. Even when the aforesaid requirements were met in a motion picture projector of the sprocket type, the performance required the use of a complicated mechanism for relieving the engagement between the film and the sprocket teeth. Also, the change-over of said mechanism was done manually, and therefore, the handling of the projector was troublesome. In the case of the latter projector, on the other hand, the film which has been projected required to be rewound around the supply reel. This operation required additional labor. It has, therefore, been desired to develop an improved arrangement which insures that the film which has been wound around the take-up reel be automatically rewound around the supply reel.

SUMMARY OF THE INVENTION

It is, therefore, a primary object of the present invention to provide a motion picture projector with automatic rewinding mechanism for rewinding the film around the supply reel, upon completion of a projection, from the take-up reel on which the film has been wound.

Another object of the present invention is to provide a motion picture projector having a mechanism which is operative so that the film which has been wound around the take-up reel is rewound automatically around the supply reel without virtually changing the film path leading from the supply reel to the take-up reel which was followed by the film during the projection.

Still another object of the present invention is to provide a motion picture projector having a mechanism which is operative so that the automatic rewinding mechanism is actuated by the tension which is produced in the film between the film driving claw and the supply reel to which the terminal end of the film is fixed, upon completion of a projection.

Yet another object of the present invention is to provide a motion picture projector having a mechanism which is operative so that, upon completion of a projection, the engagement between the film and the wheel for feeding this film is relieved and also that the pressure plate of the film gate and the film driving claw are both caused to retreat from the film face.

The foregoing and other objects as well as the characteristic features of the present invention will become more apparent and more readily understandable by reading the following description and the appended claims when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary sectional left side elevational view of a sound motion picture projector embodying the invention, showing the film guiding mechanism in its operative position;

FIG. 2 is a fragmentary enlarged sectinal view taken along the line II—II in FIG. 7;

FIG. 3 is a plan view of an actuator plate;

FIG. 4*a* is an enlarged plan view of a plate for opening and closing a pressure plate;

FIG. 4*b* is an enlarged side elevational view of said plate for opening and closing the pressure plate;

FIG. 5 is an enlarged fragmentary sectional view of the film alignment assembly taken along the line V—V in FIG. 1;

FIG. 6 is a fragmentary sectional view of the assembly mechanism of shaft blocks for a supply and take-up reels, taken along the line VI—VI in FIG. 7;

FIG. 7 is a fragmentary sectional view of the projector showing the internal structure of said assembly mechanism in its still position;

FIG. 8 is a fragmentary view of a gear block for changing-over the speed of projection, taken along the line VIII—VIII in FIG. 7;

FIG. 9 is a fragmentary sectional view of the structure for changing-over the projection speed, taken along the line IX—IX in FIG. 7; and

FIG. 10 is a fragmentary view of the shuttle mechanism and the filter means, taken along the line X—X in FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1, there is shown a film guiding section in a sound motion picture projector.

The housing (not shown) of said projector has a side wall **1** from which projects a rotatable shaft **2** for securing a supply reel **3** thereto. A film **4** is seen in the state of being wound around the supply reel **3**. An upper sprocket wheel **5** for feeding the film **4** is secured to a rotatable shaft **6** which projects outwardly from said side wall **1**. A film feeding member **7** has shafts **10, 11** extending outwardly from the side wall **1**, and upper pressure rollers **12, 13** are rotatably mounted on these shafts **10, 11**, respectively. Said film feeding member **7** is rotatably mounted on a shaft **8** extending outwardly from said side wall **1** in such a way that said member **7** is urged to rotate clockwise by a spring **9**. An upper guide roller **14** is rotatably mounted on a shaft **16** extending outwardly from the swingable free end of a member (not shown), the other end of said member being secured to said side wall **1**. Another upper guide roller **15** is rotatably mounted on a shaft **17** extending outwardly from said side wall **1**. A film gate plate **18** is secured to said side wall **1** integrally therewith. As will be understood best from FIG. **5**, a pressure plate **19** has pins **20, 21** which are received in through-holes **66***a*, **66***b*, respectively, formed in a receiving plate **66** which, in turn, is secured to said film gate plate **18**. The film **4** is urged against said film gate plate **18** by the force exerted by springs **22** and **23**. As will be best understood from FIGS. **5** and **10**, a claw member **24** is incorporated in a film alignment assembly. A lower guide roller **25** is rotatably mounted on a shaft **26** extending outwardly from said side wall **1**. A lower sprocket wheel **27** is secured to a shaft **28** which extends outwardly from said side wall **1** and which is adapted to rotate at a constant speed. A lower pressure rollers **29** and **30** for urging the film **4** against said sprocket wheel **27** are rotatably mounted on a shaft extending from one end of a lever **31** and on a shaft **33** extending from one **32***a* of the two arms **32***a* and **32***b* of a lever **32**, respectively. A guide roller **34** is rotatably mounted on a shaft **35** which extends from the other **32***b* of the two arms of said lever **32**.

An operating plate **36** is rotatably mounted on a shaft **37** which extends from said side wall **1**, and this operating plate **36** is urged to rotate clockwise by the action of a spring **38**. Shafts **39**, **40** and **41** extend from that surface of said operating plate **36** seen in the foreground of FIG. **1**, and pins **42** and **43** extends from the rear side of said operating plate **36**. Said operating plate **36** is of a notch **36***a* formed locally therein. Said levers **31** and **32** are pivotably attached to said shafts **39** and **40**, respectively. These two levers **31** and **32** are caused to pull themselves toward each other by the action of a spring **44** provided therebetween. Said lower pressure rollers **29** and **30** jointly urge the film **4** against the lower sprocket wheel **27**. Stoppers **45** and **46** for the levers **31** and **32**, respectively, extend from said operating plate **36**. A lever **47** is pivotably mounted on said shaft **41** and this lever **47** is urged to rotate clockwise by the action of a spring **48**. A head attachment plate **51** to which an erasing head **49** and a recording and reproducing head **50** are both secured is rotatably mounted on a shaft **52** which extends from the free end of said lever **47**. A stopper **53** for said lever **47** extends from said operating plate **36**. A pin **54** extending from the rear side of the film feeding member **7** projects through said side wall **1**. This pin **54** engages the lower face of a bent portion **55***a* formed at the upper end of a coupling plate **55**, as will be seen in FIG. **7**. As is best shown in FIG. **2**, a holding lever **56** having two arms **56***a* and **56***b* is pivotably mounted on a shaft **58** which extends from a supporting plate **57** which is secured to said side wall **1**, and this holding lever **56** is urged to rotate counter-clockwise by the action of a weak spring **59**. An arm **56***a* of said lever **56** is engageable with a lower end portion **55***b* of said coupling plate **55**, whereas the arm **56***b* of said lever **56** is engageable with the notch **36***a* of said operating plate **36**. As will be best understood from FIG. **1**, an actuator plate **60** shown in FIG. **3** is able to make vertical sliding movement because of the fact that upper and lower guide pins **61** and **62** extending from said side wall **1** are received in upper and lower elongated slots formed in said actuator plate **60**. Said actuator plate **60** is normally urged downwardly by a spring **63**. Said actuator plate **60** has formed, in the upper end portion thereof, an arm **60***a* assigned to engage with said pin **54**, and it also has, formed in an intermediate portion thereof, two projections **60***b* and **60***c* which are engageable with two protrusions **64***e* and **64***f*, respectively, of a plate **64** intended for opening and closing said pressure plate **19**, and furthermore, it has, formed in the lower end portion thereof, a work face **60***d* which is engageable with said pin **42**. The plate **64** for opening and closing the pressure plate **19**, shown in FIGS. **4***a* and **4***b*, is provided further with pin-receiving portions **64***a* and **64***b*, elongated slots **64***c* and **64***d*, and a bent arm **64***g*, in addition to said protrusions **64***e* and **64***f*. As will be best understood by referring to FIG. **5**, the plate **64** for opening and closing the pressure plate **19** is pivotably mounted onto a receiving plate **66** fixed to said film gate plate **18**, by a hinge pin assembly which is comprised of a pin-receiving portion of said receiving plate **66**, a hinge pin **65** and said pin-receiving portions **64***a* and **64***b*. Said pins **20** and **21** are received in said elongated slots **64***c* and **64***d* of the plate **64**, respectively. The protrusions **64***e* and **64***f* of said plate **64** are arranged so that they are engageable with the projections **60***b* and **60***c*, respectively, of said actuator plate **60**, and that the foremost end portion **64***h* of the bent arm **64***g* of said plate **64** is engageable with said claw member **24**. The claw member **24** which is provided with a claw **24***a* formed at its foremost end, an arm **24***b* and ball-receiving portions **24***c* and **24***d*, respectively, is capable of moving moving vertically (in a direction perpendicular relative to the sheet of drawing in FIG. **5**) because of the fact that said ball-receiving portions **24***c* and **24***d* engage balls **67***a* and **67***b*, respectively, which are placed in guide grooves **1***a* and **1***b* provided in said side wall **1**, respectively. Also, said claw member **24** is able to swing sideways about balls **67***a* or **67***b* serving as the fulcrum. An auxiliary lever **68** shown in FIG. **1** is urged to rotate counter-clockwise by a spring **70** about a shaft **69** extending from said side wall **1**. The free end **68***a* of said auxiliary lever **68** engages the pin **43** of said operating plate **36**. A stopper plate **71** for limiting the rotation of the operating plate **36** is fixed to said side wall **1**. A micro-switch **72** which is secured to the side wall **1** and which normally is in the closed state is rendered to the open state whenever a pin plunger of said micro-switch **72** is pushed by the film feeding member **7**. A micro-switch **73** which is secured to said side wall **1** is rendered from the open state to the closed state whenever its pin plunger of said micro-switch **73** is pushed by said auxiliary lever **68**. These two switches **72** and **73** are connected in parallel with each other. The combination of these two switches connected in parallel is connected between a motor **99** shown in FIGS. **7** and **8** and a power source. A lens housing **74** and a lamp housing **75** are both secured to the side wall **1**. As shown in FIGS. **6** and **7**, said shaft **2** rotatably passes through a bearing **1***c* which extends from said side wall **1**. This shaft **2** is provided with a key **2***a*. A pulley **76** is rotatably mounted on said shaft **2**. A disk **77** having a diameter identical with that of said pulley **76** is rotatably mounted on said shaft **2**. This disk **77** is of a key groove **77***a* for engagingly receiving the key **2***a* therein. Said disk **77** is urged toward said pulley **76** by a spring **78** wound around the shaft **2**. A frictional member **79** is sandwiched between said pulley **76** and said disk **77**. A resilient roller **80** can be brought into contact simultaneously with both peripheral faces of the pulley **76** and the disk **77**. A series of members for the take-up reel, i.e., a shaft **81**, a bearing **1***d*, a key **81***a*, a pulley **82**, a disk **83**, a key groove **83***a*, a spring **84**, a frictional member **85** and a resilient roller **86**, are arranged in the same relationship with the series of members described above in connection with the shaft **2**.

As shown in FIG. **7**, an intermediate lever **87** which has an elongated slot **87***b* formed in one end portion **87***a* and a work face formed on the other end portion **87***c* is attached to the side wall **1** in such a way that a pin **88** extending from the side wall **1** is received in said elongated slot **87***b*, so that said intermediate lever **87** is allowed to move sideways. The end portion **87***c* rests on the face of the bent portion **55***a* of the coupling plate **55**. A lever **89** having two arms **89***a* and **89***b* is pivotably mounted on a shaft **90** extending from the side wall **1**. Said resilient roller **80** is rotatably mounted on a shaft **91** which extends from said arm **89***a*. The other arm **89***b* of said lever **89** is provided with a bent portion **89***c* formed at the foremost end thereof. This bent portion **89***c* is engageable with the work face formed at said other end portion **87***c* of the intermediate lever **87**. A change-over lever **92** having a notch **92***a* at its one end is pivotably mounted on a shaft **93** which extends from the side wall **1**. This notch **92***a* engages a bent portion **87***d* formed at an intermediate part of said intermediate lever **87**. Said change-over lever **92** and said lever **89** pull themselves toward each other by a spring **94** which is provided therebetween. A lever **95** having two arms **95***a* and **95***b* is pivotably mounted on a shaft **96** extending from the side wall **1** so as to be rotated counter-clockwise by a spring **97**. The aforesaid roller **86** is rotatably mounted on a shaft **98** which extends from the foremost end portion of one **95***a* of the two arms of said lever **95**. The other **95***b* of said two arms has a bent portion **95***c* which is formed at its foremost end portion, and this bent portion **95***c* is engageable with the work face formed at the end portion **87***c* of said intermediate lever **87**. Pins **1***e* and **1***f* which extend from the side wall **1** are intended to limit the movement of the levers **89** and **95**. As is seen from FIGS. **7** and **8**, a driving motor **99** is fixed to the side wall **1**. A pulley **99***a* is mounted on a shaft **99***b* of said motor **99**. A belt **101** is applied to both pulley **99***a* and a pulley **100** which is formed integrally with a toothed wheel **100***a*. Said pulley **100** is rotatably mounted on a shaft **103** which extends from a plate **102** which, in turn, is fixed to the side wall **1**. In FIG. **8**, it will be seen that a rotatable plate **104** having a bent portion **104***a* is pivotably mounted on the shaft **103** so as to be urged to rotate clockwise about said shaft **103** by the action of a spring **105**. Said rotatable plate **104** is provided with a pin **104***b* extending therefrom, and this pin **104***b* is guided by an elongated slot formed in the aforesaid plate **102** by the fact that said pin **104***b* is received

therein so that said rotatable plate **104** is allowed to make pivotal movement between two stoppers **102***a* and **102***b* which are formed at the opposite ends of said elongated slot. As will be understood from FIG. **8**, a change-over lever **106** having two arms **106***a* and **106***b* is pivotably mounted on a shaft **107** fixed to the side wall **1**, and said change-over lever **106** is urged to rotate counter-clockwise by the action of a spring **108**. The arm **106***a* is engageable with the bent portion **104***a* of the rotatable plate **104**. Toothed wheels **109** and **110** are of the same diameter, and they are rotatably mounted on shafts **111** and **112**, respectively, which extend from said rotatable plate **104**. Toothed wheels **114** and **115** having different diameters relative to each other are rotatably mounted on a shutter shaft **113**. Said toothed wheel **115** is provided with clutch pins **115***a* formed integrally therewith. Toothed wheels **109** and **114**, or toothed wheels **110** and **115** are arranged so that toothed wheels **109** and **114** form a pair and toothed wheels **110** and **115** form another pair, and that the two toothed wheels in either one of these two pairs will be brought into the state of meshing with each other as a result of the change-over operation of said change-over lever **106**. A toothed wheel **116** is of a diameter greater than that of a toothed wheel **117**. Between these two toothed wheels is interposed a worm **118**, and these three members are united to each other to form an integral assembly. This integral assembly is rotatably mounted on a shaft **119**. A toothed wheel **120** having the identical diameter with the toothed wheel **117** is provided with clutch pins **120***a*, and this toothed wheel **120** is rotatably mounted on the aforesaid shaft **113**. Whereas, a toothed wheel **121** having the identical diameter with the toothed wheel **117** is rotatably mounted on a shaft **122**, and this toothed wheel **121** meshes with both of the toothed wheels **117** and **120**. A clutch member **123** is mounted on said shutter shaft **113** in such a way that it is united integrally with said shutter shaft **113** in the direction of rotation of the latter and that it is axially movable, by means of a key (not shown). Said clutch member **123** is provided with clutch pins **123***a* and **123***b* which are formed on both side faces thereof, and also with a groove **123***c* formed in an intermediate portion thereof. Said clutch pins **123***a* are engageable with said clutch pins **115***a*, whereas the clutch pins **123***b* are engageable with the clutch pins **120***a*. A lever **124** for changing-over the direction of rotation is provided with two arms **124***a* and **124***b*, and this lever **124** is pivotably mounted on a shaft **125** extending from the side wall **1**. A cam plate **126** for changing-over the direction of rotation is provided with a cam slot **126***a* and a pin **126***b*, and this cam plate **126** is mounted on a shaft **127** which rotatably passes through the side wall **1**. A pin **124***c* which extends from the foremost end portion of one **124***a* of the two arms of said lever **124** engages in the groove **123***c* formed in an intermediate portion of said clutch member **123**. Whereas, a pin **124***d* extending from the foremost end portion of the other **124***b* of the two arms of said lever **124**, engages in the cam slot **126***a* of said cam plate **126**. A worm gear **128** is rotatably mounted on a shaft **129** which extends from the side wall **1**, and this worm gear **128** meshes with said worm **118**. A toothed wheel **130** is formed integrally with a pulley **131**, and this integral toothed wheel is rotatably mounted on a shaft **132** extending from the side wall **1**, and it meshes with said worm gear **128**. A belt **133** is applied between said pulley **131** and said pulley **76** **76**. A belt **134** is applied between said pulley **76** and said pulley **82**. A toothed wheel **135** is fixed to said shutter shaft **113**. A toothed wheel **136** is provided with teeth in number which is the multiplication of the number of the teeth of the toothed wheel **135** by integer. This toothed wheel **136** is rotatably mounted on a shaft **137** extending from the side wall **1**, and it meshes with the toothed wheel **135**. A toothed wheel **138** is rotatably mounted on said shaft **137** and it is coupled integrally with said toothed wheel **136**. A ring-like toothed wheel **139** is of an identical diameter and an identical number of teeth with those of the toothed wheel **138**. A toothed wheel **140** is of a projection **140***a* and is provided with an identical diameter and an identical number of teeth with those of the toothed wheel **139**, and it is rotatably mounted on the shutter shaft **113**. Said toothed wheel **139** is rotatably mounted on said projection **140***a* of the toothed wheel **140**.

A toothed wheel **141** having an identical diameter and an identical number of teeth with those of the toothed wheel **135** is rotatably mounted on the shutter shaft **113** and it is coupled integrally with the toothed wheel **140**. A worm **142** is rotatably mounted on the shutter shaft **113**, and it is coupled integrally with the toothed wheel **140**. A worm gear **143** which meshes with the worm **142** is coupled integrally with a toothed wheel **144**, and it is secured to the shaft **28** on which the lower sprocket wheel **27** is mounted. A toothed wheel **145** is rotatably mounted on a shaft **146** and it meshes with the toothed wheel **144**. A toothed wheel **147** is secured to the shaft **6** on which the upper sprocket wheel **5** is mounted, and this toothed wheel **147** meshes with the toothed wheel **145**. As will be best understood from FIGS. **7** and **9**, a plate **148** for changing-over the cycles of rotation is attached, for vertical movement by screws **149** and **150**, to a member which, in turn, is secured to the side wall **1** integrally therewith. This plate **148** is of shafts **151** and **152** and it also has, in the lower part thereof, a bent portion **148***a* which has a notch **148***b* formed in its foremost end. Toothed wheels **153** and **154** each having a wide breadth are rotatably mounted on said shafts **151** and **152**, respectively. These members are arranged so that, in accordance with the vertical movement of the plate **148**, either there is produced the meshing between the toothed wheel **153** and the toothed wheels **135** and **141** simultaneously, or there is produced the meshing between the toothed wheel **154** and the toothed wheels **139** and **140** concurrently. A click plate **155** is secured to a shaft **156** which passes through the side wall **1**. This click plate **155** is provided with a pin **157** which, in turn, engages the notch **148***b* formed in said plate **148** assigned for changing-over the cycles of rotation. A shutter blade **158** is secured to the shutter shaft **113**. Click springs **159** and **160** engage the cam plate **126** assigned to change-over the direction of rotation and also engage the click plate **155**, respectively. Cams **161** and **162** both of which are intended to cause pivotal movement of the claw member **24** are secured to said shutter shaft **113** and the shaft **137**, respectively. A lever **163** for changing-over the speed of projection is pivotably mounted on a shaft **164** extending from said plate **148** assigned for changing-over the cycles of rotation, so as to be urged to rotate counter-clockwise by the action of a spring **165**. This lever **163** has two stopped portions **163***a* and **163***b* which are both formed in an intermediate part of this lever. One **163***a* of these two stepped portions is engageable with a pin **166** which extends from a member fixed to the side wall **1**. The free end portion **163***c* of said lever **163** is engageable with a cam **162** which, in turn, is coupled integrally with the toothed wheel **138**. A lever **167** having two arms **167***a* and **167***b* and being intended for causing pivotal movement of the claw member **24** is pivotably mounted on a shaft **181** inserted in a shaft-bearing plate **180** which, in turn, is secured to the side wall **1**, so as to be urged to rotate counter-clockwise, as viewed from FIG. **9**, by the action of a spring **168**. The foremost end portion **167***c* of one **167***a* of said two arms engages said cam **161**, whereas the other **167***b* of these two arms has a bent portion **167***d* which is formed at its foremost end, and this bent portion **167***d* is engageable with the stepped portion **163***b* of said lever **163**. As is shown in FIGS. **7** and **10**, a lever **169** having three arms **169***a*, **169***b* and **169***c* and being intended for changing-over the positions of a filter arm **172** is pivotably mounted on a shaft **170** extending from the side wall **1**, so as to be urged to rotate clockwise by the action of a spring **171**. One **169***a* of these three arms is engageable with the pin **157** of said click plate **155**. Another arm **169***b* is engageable with a pin **126***b* of said cam plate **126**. The third arm **169***c*is engageable with a projection **172***c* of a filter arm **172**. This filter arm **172** is pivotably mounted, at its one end portion **172***b*, on a shaft **174** extending from the supporting plate **57** so as to be urged to rotate about said shaft **174**, and furthermore, said filter arm **172** is provided with said pro-

jection 172*c* formed in the vicinity of said shaft 174. A filter 173 is attached to the free end 172*a* of said filter arm 172. A cam 175 for causing pivotal movement of the claw member 24 is secured to the shutter shaft 113. Arms 176 and 177 for transmitting, to the claw member 24, their movement of causing the pivotal movement of the claw member 24 are pivotably mounted, for rotation, on shafts 178*a* and 178*b* both of which extend from a regulator plate 178 which, in turn, is provided on the supporting plate 57 in such a manner as to slide over this supporting plate 57. These two arms 176 and 177 are provided with bulging portions 176*b* and 177*b*, respectively, which are formed at intermediate portions of these two arms, respectively. These two arms 176 and 177 both engage the opposite sides of said cam 175 at the faces of their bulging portions 176*b* and 177*b*. One end of a spring 179 having the other end secured to the claw member 24 engages the free end 176*c* of the arm 176. Whereas, the free end 177*c* of the arm 177 is coupled to the claw member 24. The motion picture projector having the foregoing arrangement is operated in the manner as described hereunder.

Description will be made first on the automatic rewinding mechanism. In an ordinary projection, as shown in FIG. 1, the film 4 which has been delivered from the supply reel 3 is pressed by the upper pressure rollers 12, 13 against the upper sprocket wheel 5 as the film 4 proceeds, so as to be engaged by the sprocket wheel 5, and therefrom the film 4 is fed, by virtue of the counter-clockwise rotation of this upper sprocket wheel 5, so as to pass around the upper guide rollers 14 and 15 and therefrom to proceed on toward the film gate plate 18. When this film 4 enters into the passageway between the film gate plate 18 and the pressure plate 19, it is then fed downwardly intermittently by the action of the claw member 24 to proceed on further. Then, the film 4 is guided by the lower guide roller 25 to pass between the lower pressure rollers 29, 30 and the lower sprocket wheel 27. By virtue of the counter-clockwise rotation of this lower sprocket wheel 27, the film 4 is then fed at a constant speed. The film 4 is then guided by another lower guide roller 34 and is led to the take-up reel in a known manner. Since an erasing head 49 and a reproducing head 50 are arranged so as to be in pressure contact with said lower sprocket wheel 27, it is possible to effect either recording or reproduction of sound onto or from the sound track provided on the face of the film 4, as required. Let us assume that the terminal end of the film 4 is secured to the hub (not shown) of the supply reel 3. It will be understood then that, upon completion of projection, the film 4 will be tensioned between the upper guide roller 14 and the supply reel 3 owing to the actions of the upper sprocket wheel 5 and the claw member 24. Accordingly, the film feeding member 7 is caused to make counter-clockwise rotation against the action of the spring 9. During the course of this counter-clockwise rotation of the film feeding member 7, the latter member pushes the pin plunger of the switch 72, so that the connection between the motor 99 and the power source is broken, resulting in that the rotation of the lower sprocket wheel 27 and the movement of the claw member 24 are suspended, thereby preventing the film 4 from its sustaining a damage. On the other hand, the pin 54 extending rearwardly from the film feeding member 7 is brought into engagement with the upper bent portion 55*a* of the coupling plate 55 to pull the coupling plate 55 upwardly. Until this movement of the coupling plate 55 takes place, the lower end portion 55*b* (see FIG. 2) of said coupling plate 55 was in engagement with the end portion of an arm 56*a* of the holding lever 56 which was actuated, by the weak spring 59, to thrust outwardly through the side wall 1, so that this engagement contributed in keeping said holding lever 56 stationary even when the end portion of the other arm 56*b* of the holding lever 56 was pushed. Also, the operating plate 36 was urged to rotate clockwise by the spring 38 having a greater spring force than did the weak spring 59 so that the notch 36*a* of this operating plate 36 was in engagement with the end face of the arm 56*b* of the holding lever 56, to maintain their relative positions as shown in FIG. 1. As the coupling plate 55 is pulled upwardly as stated above, the engagement between the lower end portion 55*b* of the coupling plate 55 and the arm 56*a* of the holding lever 56 is relieved accordingly, and owing to the fact that the spring 38 is of a greater spring force than is the spring 59, the holding lever 56 is caused to make clockwise rotation (as seen from FIG. 2), with the result that the operating plate 36 is rotated continuously until its pin 43 hits the stopper plate 71.

During this rotation of the operating plate 36, its pin 43 pushes the work face 60*d* formed in the lower end portion of the actuator plate 60 so that, as a consequence, the latter plate 60 is pushed upwardly against the action of the spring 63, and at the same time, the pressure plate 19 is caused to be pulled up from its position of being in pressure contact with the film gate plate 18 as will be described hereunder in further detail, so that, as a result, the claw 24*a* of the claw member 24 is caused to retreat from the path of the film 4.

More specifically, the two protrusions 64*e* and 64*f* of the plate 64 for opening and closing the pressure plate 19 are brought into engagement with the projections 60*b* and 60*c* of the actuator plate 60 (see FIGS. 3 through 5) so that the plate 64 for opening and closing the pressure plate 19 is rotated during the course of the upward movement of said actuator plate 60. Because of the fact that the elongated slots 64*c* and 64*d* of this plate 64 are in engagement with the pins 20 and 21 of the pressure plate 19, the rotation of said plate 64 causes the pressure plate 19 to be pulled up from the film gate plate 18 against the forces of the springs 22 and 23, with the sequential result that the foremost end portion 64*h* of the bent arm 64*g* of the plate 64 pushes the claw member 24 to rotate the latter member to cause the retreat of the claw 24*a* of the claw member 24 from the path of the film 4.

Owing to the upward movement of the actuator plate 60, the arm 60*a* which is located in the upper end portion of this plate 60 pushes the pin 54 further, so that the film feeding member 7 is retained in its pushed-up state. During its rotation, the operating plate 36 performs a series of actions as described above. However, the torque of the spring 38, which serves as the source of driving force for the operating plate 36 to perform these actions, attenuates progressively with the progress of the rotation of the operating plate 36. In order to make up with this attenuation of spring force of said spring 38, there is provided a stronger spring 70 to assist the operating plate 36 in its rotation through the intervention of an auxiliary lever 68.

It should be noted that, during projection, even when the pulley 76 is rotated at high speed in the direction of rewinding, there will occur slippage between the pulley 76 and the disk 77, so that the shaft 2 for the rewinding reel, i.e., the supply reel (see FIG. 6) is allowed to rotate in the reverse direction to follow the reverse feeding of the film 4. On the other hand, as the coupling plate 55 is moved upwardly (see FIG. 7) as a result of the aforesaid actions of the related members, the upper bent portion 55*a* of this coupling plate 55 will push the bent portion 89*c* of the lever 89 upwardly via the end portion 87*c* of the intermediate lever 87 to rotate said lever 89 counter-clockwise (as viewed from FIG. 7) so that the resilient roller 80 is brought into pressure contact with both of the pulley 76 and the disk 77 to thereby couple the latter two members integrally to each other. Whereupon, both the shaft 2 and the supply reel 3 mounted thereon are rendered almost instantaneously to the state in which they are allowed to rotate in the direction in which the film 4 is rewound. Thus, the supply reel 3 is now rendered to the mode of taking up the film 4. At this moment, the auxiliary lever 68 pushes the pin plunger of the switch 73 to connect the motor 99 to the power source to start the latter 99. Accordingly, the film 4 which has already been relieved of its engagement with both the upper and the lower sprockets 5 and 27, the pressure plate 19 and the claw 24*a* of the claw member 34 can now be rewound quickly around the reel 3 owing to the high speed rotation of the shaft 2 in the direction of rewinding.

In starting a projection from the aforesaid state of the projector, it is only necessary to return the position of the operating plate **36** until the end portion of the arm **56***b* of the holding lever **56** is brought into engagement with the notch **36***a* formed in said operating plate **36**. Whereupon, the actuator plate **60** is moved downwardly by the action of the spring **63**, with the result that the pressure plate **19** and the claw member **24** are both set free and also that the film feeding member **7** is returned to its initial position. Furthermore, the coupling plate **55** is also lowered of its position, resulting in suppressing the end portion of the arm **56***a* of the holding lever **56** to thereby block the returning movement of the operating plate **36** to its initial position which this operating plate **36** would tend to make by being urged by the spring **38**, and thus, the projector as a whole resumes its initial mode of projection.

Description will next be directed to the quick film feeding operation, that is to say, an operation for feeding the film **4** at high speed from a take-up reel (not shown) on which the film **4** has been wound, by referring to FIGS. **1**, **6** and **7**. This operation is performed in the manner described as follows. With the change-over lever **92** being in the state of having been moved to the right side on FIG. **7** by manipulating a knob (not shown), the film feeding member **7** is pulled upwardly manually. Whereupon, the related members perform a series of sequential actions in the manner as described in connection with the operation of automatic rewinding of film. During this operation, the notch **92***a* formed in the foremost end portion of the change-over lever **92** still holds therein the intermediate lever **87**. Accordingly, this intermediate lever **87** is caused to move toward the right side, and the foremost end portion **87***c* of this lever **87** travels toward the right side over the upper bent portion **55***a* of the coupling plate **55** to eventually engage the bent portion **95***c* of the lever **95**, while being relieved of its engagement with the bent portion **89***c* of the lever **89**. In this state, the pin **54**, and accordingly, the foremost end portion **87***c* of the intermediate lever **87**, are both shifted in their positions upwardly. As a result, the resilient roller **86** mounted on the lever **95** is brought into pressure contact with the peripheral edges of both the pulley **82** and the disk **83**. Accordingly, the pulley **82** and the disk **83** are united together as an integral body, causing the take-up reel (not shown) to be rotated at high speed. Thus, a quick feeding operation is performed. In order to shift this quick feeding operation to normal feeding, it is only necessary to release the change-over lever **92** and to manually return the operating plate **36** to its initial position. Whereupon, the projector will be rendered to the mode of normal projection in the manner described previously.

The change-over of the speed of projection may be performed in the manner described as follows (see FIGS. **7** and **8**). The change-over lever **106** is manipulated to rotate the rotatable plate **104** to bring the two toothed wheels in either one of the two pairs of toothed wheels, namely, wheels **109** and **114**, or wheels **110** and **115**, to mesh with each other. Whereupon, the toothed wheel **114** is imparted a speed of rotation which is **24** strips of film per second, whereas the toothed wheel **115** is given a speed of rotation which is 18 strips of film per second. The switching-over operation of the change-over lever **106** may be performed either manually or by the use of a film catridge (not shown) having notches for differentiating the projection speed. The mechanism for transmitting the rotations of the toothed wheels **114** and **115** to the shutter shaft **113** will be described later.

Description will hereunder be made on the reverse projection (see FIG. **7**). Since the toothed wheels **115** and **116**, and the toothed wheels **117**, **120** and **121** are all of the same diameter, respectively, it will be understood that the toothed wheels **115** and **120** can be rotated in the reverse directions at the same cycle of rotation. On the other hand, between the toothed wheel **115** and the toothed wheel **120**, there is provided a clutch member **123** which is keyed to the shutter shaft **113** so as to be fixed thereto with respect to the direction of rotation but movable axially. Accordingly, by turning the knob (not shown) of the cam plate **126** assigned to change-over the direction of rotation, the clutch member **123** may be moved sideways via the cam slot **126***a* and the lever **124** assigned for changing-over the direction of rotation. In accordance with the direction in which this clutch member **123** is moved, the clutch pins **123***a* and **123***b* of the clutch member **123** are brought into engagement with the clutch pins **115***a* and **120***a* of the toothed wheels **115** and **120**, respectively. As a result, the shutter shaft **113** and its related members can be rotated either in normal direction or in reverse direction.

Description will further be made on the halting of the motion of projection and also on a slow-motion projection. First, reference will be made to FIGS. **7** and **9**. The toothed wheel **135** which is secured to the shutter shaft **113** drives, about the shaft **137**, the toothed wheel **136** having teeth in number multiplied by the number of the teeth of the toothed wheel **135** with an integer. Owing to the fact that the toothed wheel **138** which is coupled integrally with said toothed wheel **136** is in mesh with the toothed wheel **139** which is slidably mounted on the projection **140***a* of the toothed wheel **140** which, in turn, is rotatably mounted on the shutter shaft **113**, and that the toothed wheel **138** has the same diameter with the toothed wheel **139**, it will be understood that the toothed wheel **139** is driven in the same direction of rotation with the toothed wheel **135** and at the cycle of rotation per second which is 1/an integer of the number of rotation per second of the toothed wheel **135**. Now, in case it is intended to perform a normal projection, a knob (not shown) which is secured to the shaft **156** which is integral with the click plate **155** may be turned so that the plate **148** for changing-over the cycle of rotation is moved upwardly owing to its engagement with the pin **157**. As a result, the toothed wheel **153** meshes simultaneously with both of the toothed wheels **135** and **141** so that the rotation of the toothed wheel **135** which is secured to the shutter shaft **113** and which effects rotation at normal speed is transmitted to the toothed wheel **141**. The resultant rotation of the toothed wheel **141** is transmitted to the worm gear **143** via a toothed wheel **140** which is integrally coupled with said toothed wheel **141** and with a worm **142**, so that the lower sprocket wheel **27** which is secured to the shaft **28** effects rotation of feeding at normal speed. Furthermore, the resultant rotation of the worm **143** is transmitted to the toothed wheel **147** via a toothed wheel **144** which is integral with said worm gear **143** and a toothed wheel **145** which is in mesh with the toothed wheel **144**, with the result that the upper sprocket wheel **5** effects rotation of feeding at normal speed.

Next, when it is intended to perform a still projection from the foregoing mode of projection, a knob (not shown) which is integral with the click plate **155** is turned. Whereupon, the plate **148** for changing-over the cycle of rotation is placed in an intermediate position as shown in FIG. **7**, setting both of the toothed wheels **153** and **154** free. Whereupon, the motion of the toothed wheel **141** is brought to a halt. As a result, the motions of the related upper and the lower sprocket wheels **5** and **27** are accordingly brought to a halt. On the other hand, the cams **161** and **162** for causing pivotal movement of the claw member **24** are moving jointly with the shutter shaft **113**, respectively, and the levers **163** and **167** are in the state of being engageable with these cams **161** and **162**, respectively, during the aforesaid operation. The lever **163** which, during normal mode of projection, is slidably mounted on the shaft **164** which extends from the plate **148** for changing-over the cycle of rotation will move jointly with the upwardly moving plate **148**. Whereupon, the bent portion **167***d* formed at the foremost end of the lever drops into the recessed portion of the stepped portion **163***b*, causing the foremost end portion **167***c* of the said lever **167** to be brought into engagement with the cam **161**. As a consequence, the arm **24***b* of the claw member **24** is pushed forward once in one complete revolution of said cam **161** to thereby cause the retreat and advancement of the claw **24***a* formed at the foremost end of said claw member **24** to occur relative to the film **4**. In the case of a still

projection, the foremost bent portion **167***d* of the lever **167** rides on the raised portion of the stepped portion **163***c* of the lever **163**, and at the same time, the fixed pin **166** limits the counter-clockwise rotation of the lever **163**, as shown in FIG. **9**. Accordingly, the foremost end portion **167** *c* of the lever **167** always pushes the arm **24***b* of the claw member **24**, keeping the claw **24***a* in its position of being withdrawn from the face of the film **4**. As a consequence, the film **4** will be kept in its position of being at halt, simultaneously as the upper and the lower sprocket wheels **5** and **27** are brought to a halt. The arm **169***a* of the lever **169** which rotates about the shaft **170**, on the other hand, is in engagement with the pin **157** extending from the click plate **155**, and therefore, said arm **169***a* will be rendered to the state as shown in FIG. **7** in the still mode of projection. Whereas, the arm **169***c* of said lever **169** pushes the projection **172***c* of the filter arm **172** upwardly in the manner as shown in FIG. **10** to interpose the filter **173** in the foreground of the projection window. During the mode of normal projection, the pin **157** is caused to move, so that the lever **169** is accordingly caused to rotate clockwise by the action of the spring **171**, with the result that the arm **169***c* of said lever **169** is caused to retreat from the state of being in engagement with the projection **172***c* of the filter arm **172**. Accordingly, the filter **173** is caused to retreat from the foreground of the projection window. Also, even when the clutch member **123** is located at an intermediate position during the aforesaid time in which the direction of rotation is switched over between the positions for normal and the reverse rotations, there will be the fear that the film **4** is brought to a halt for some time and that said film may sustain a damage from burning. Such a fear is eliminated by the fact that the cam plate **126** for changing-over the direction of rotation pushes the arm **169***b* of the lever **169** by its pin **126***d* which extends from said cam plate **126** to thereby interpose the filter **173** in the foreground of the projection window for a limited period of time.

When it is intended to perform a slow-motion projection, a knob (not shown) which is integral with the click plate **155** is turned. Whereupon, the plate **148** for changing-over the cycle of rotation is lowered in its position. As a result, the toothed wheel **154** is brought into mesh with both of the toothed wheels **139** and **140** at the same time. As a consequence, the rotation of the toothed wheel **139** which is rotating at the speed which is 1/an integer (for example, ⅓) of the number of rotation per second of the shutter shaft **113** will drop the cycles of rotation of both of the upper and the lower sprocket wheels **5** and **27** to 1/an integer of their cycles via the toothed wheel **140** and the worm **142**. On the other hand, owing to the fact that the toothed wheel **138** which is transmitting the rotation to the toothed wheel **139** is in the state of being coupled integrally with the cam **162** which produce a series and fall undulation of its cam face once in its one complete revolution and that the fixed pin **166** for limiting the counter-clockwise movement of the lever **163** will move so as to be brought to the recessed portion of the stepped portion **163***a* of the lever **163** to engage therewith, it will be understood that the foremost end portion **163***c* of said lever **163** will accordingly be enable to follow the movement of the cam **162**. As a result, the said lever **163** will be able to eliminate the obstruction for the movement of the lever **167** at the rate of once in an integral number of complete revolution (for example, three revolutions) of the cam **161**. Accordingly, by appropriately setting the relative phasic positions of the cams **161** and **162**, it will be possible to effect a slow-motion projection in such a way that the claw member **24** is actuated at the rate of 1/an integer of the cycles of rotation per second of the shutter shaft **113** in accordance with the pre-set integral ratio between the toothed wheels **135** and **136**. In such an instance, the rotating shutter blade **158** is secured to the shutter shaft **113**, and therefore, the flickering condition of projection in this slow-motion projection is in no way different from the condition for the normal projection.

It should be understood that the projecting mechanism having the aforestated various internal mechanisms can be applied, without requiring any modification, to silent motion picture projectors also.

What is claimed is:

1. In an automatic film rewinding mechanism in a motion picture projector comprising a claw member adapted to be brought into engagement with the film perforations for feeding the film intermittently, a film gate plate positioned adjacent said claw member, a film gate formed on said film gate plate, a pressure plate urging the film against said film gate plate, at least one wheel adapted to be rotated at a constant speed for feeding the film, and a supply reel carrying the wound film whose terminal end is fixed thereto, the combination comprising:

a film feeding member pivotably arranged at a position above said film gate plate;

a first spring fixed to said film feeding member for pressing the film on the wheel through said film feeding member and transmitting the rotation of said wheel to said film, said film feeding member being spaced away from said wheel by the film tensioned between said supply reel and said claw member upon completion of projection, since the terminal end of said film is fixed to said supply reel;

a first member pivotably arranged at a position below said film gate plate;

a second spring fixed to said first member for urging said first member in one rotational direction;

a blocking means for blocking said first member against said second spring during projection;

means engaged with said film feeding member and capable of relieving, as a result of the movement of the film feeding member in becoming spaced away from said wheel, said blocking means from said first member to allow the rotation of this latter member then positioned for projection;

a second member having an end portion to be coupled to said film feeding member and said first member, respectively, and to be movable vertically, so that, when this second member is shifted in its position as a result of the rotation of said first member from the position for projection, said second member retains said film feeding member in a position apart from said wheel;

a third member being connected with said pressure plate having engaging parts to be engaged with said second member, and being engageable with said claw member for causing said claw member to retreat from the film face and also for causing the pressure plate to move away from the film face;

a driving motor for rotating said wheel;

circuit means for connecting the driving motor to a source of electrical power;

a first switch connected between said power source and said driving motor and adapted to be positioned in a contacting state during projection and adapted to be positioned in a non-contacting state by virtue of the movement of said film feeding member parting away from said wheel; and

a second switch connected in parallel with said first switch and adapted to be positioned to be in the non-connecting state during projection, and adapted to be rendered to the connecting state by virtue of the movement of said first member rotating from its position for projection for rewinding the film.

2. An automatic film rewinding mechanism according to claim **1**, in which said mechanism further comprises a guide member pivotably arranged at a position above said film gate plate and capable of absorbing the tension produced intermittently in the film between said wheel intended for feeding the film at a constant speed and said claw member for feeding the film intermittently.

3. An automatic film rewinding mechanism according to claim **1**, in which a loop forming section is provided in said film feeding member to form a loop of film for absorbing therein the tension produced intermittently in the film

between the wheel intended for feeding the film at a constant speed and the claw member for feeding the film intermittently.

4. An automatic film rewinding mechanism according to claim 1, in which said means capable of relieving the blocking means from said first member comprises a slidable plate arranged for vertical movement and having one end coupled to said film feeding member, and a fourth member pivotably mounted on a shaft provided in parallel relative to said film gate plate and capable of being brought into engagement with said slidable plate to retain said first member in the position for projection and adapted to retain said first member in the position for projection when said fourth member is in engagement with said slidable plate, and adapted to allow the first member to rotate when said engagement is relieved.

5. An automatic film rewinding mechanism according to claim 1, in which said wheel adapted to be rotated at a constant speed for feeding said film is provided one each at positions above and below said film gate plate, and in which said first member is provided with heads for sound arranged so as to be brought into contact with said film during projection.

6. An automatic film rewinding mechanism according to claim 1, in which said movement of the film feeding member in becoming spaced away from said wheel is performed by the film tensioned between said supply reel and said claw upon completion of projection owing to the fact that the terminal end of said film is fixed to the supply reel.

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