United States Patent

Tsunoda

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[54] **AUTOMATIC FILM-LOADING PROJECTOR**

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[52] **U.S. Cl.** **352/158,** 352/72, 352/159, 242/195

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

[58] **Field of Search**.....352/73, 157, 158, 159; 242/195, 210, 193; 226/91, 92

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Assistant Examiner—Alan A. Mathews
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[57] **ABSTRACT**

An automatic film-loading projector including means for automatically effecting all loading operations, including leading a cartridge selected from a plurality of stored film cartridges into a predetermined position in the projector, and actuating the projector to automatically project a picture on the film in the cartridge.

7 Claims, 11 Drawing Figures

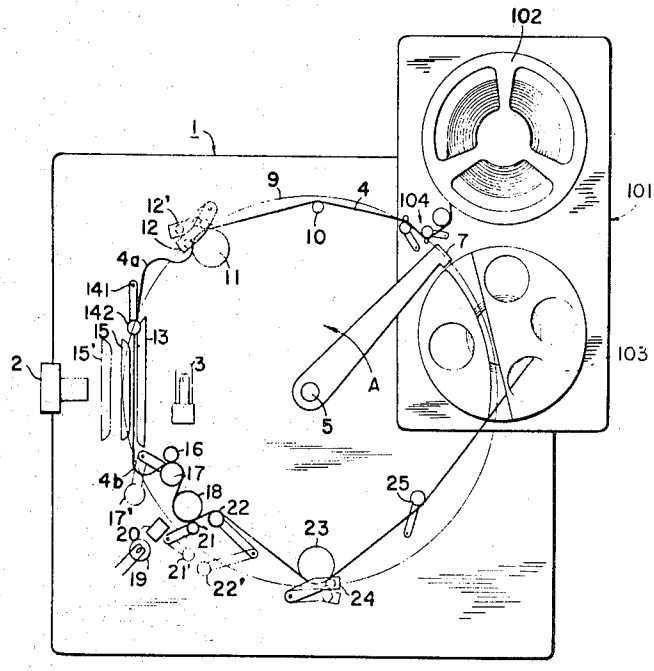
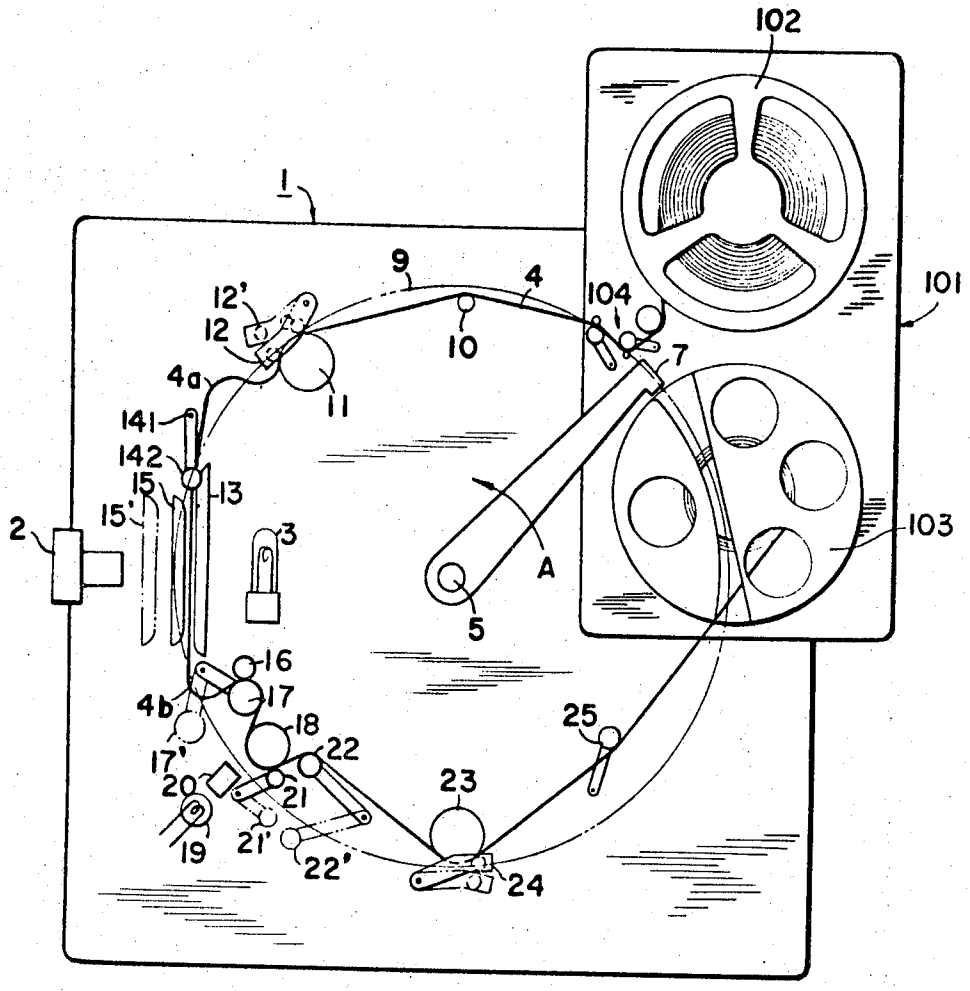


FIG. 1


102
1
9
4
101
12'
12
10
104
7
4a
11
141
142
15
13
15'
2
3
A
103
5
16
4b
17
18
25
17'
22
20
21
23
19
21'
22'
24

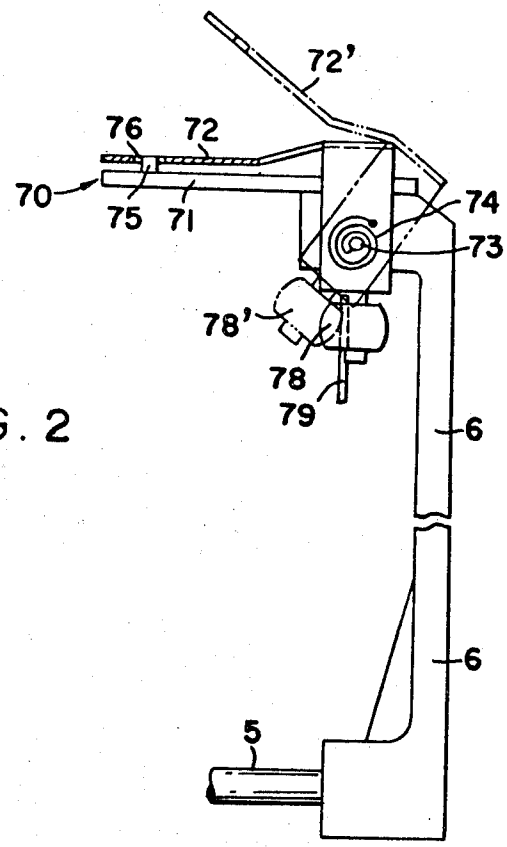


FIG. 2

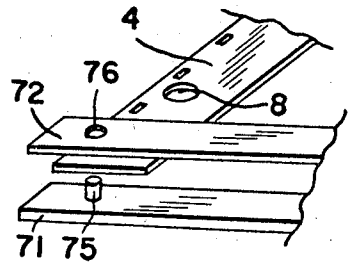


FIG. 3

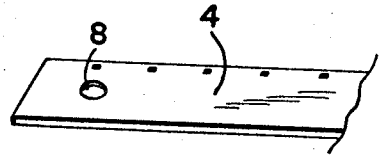


FIG. 4

FIG. 5A

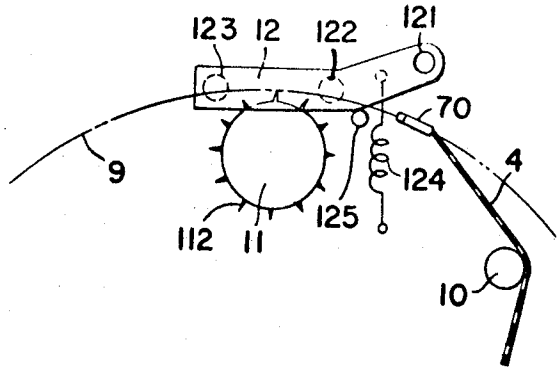


FIG. 5B

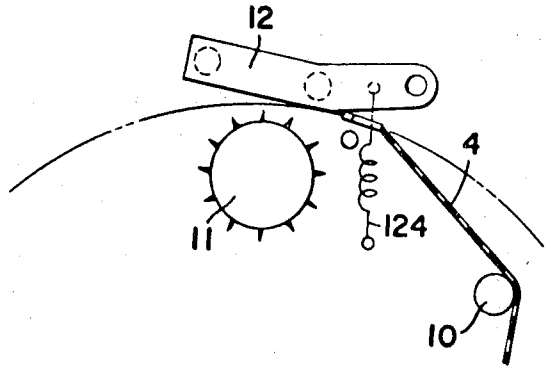


FIG. 5C

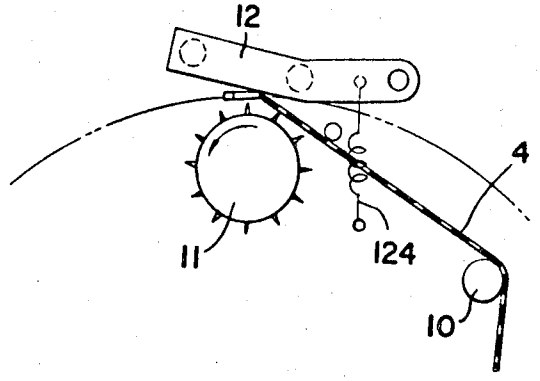


FIG. 5D

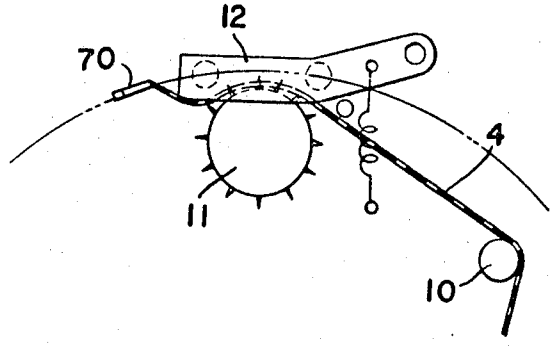


FIG. 6

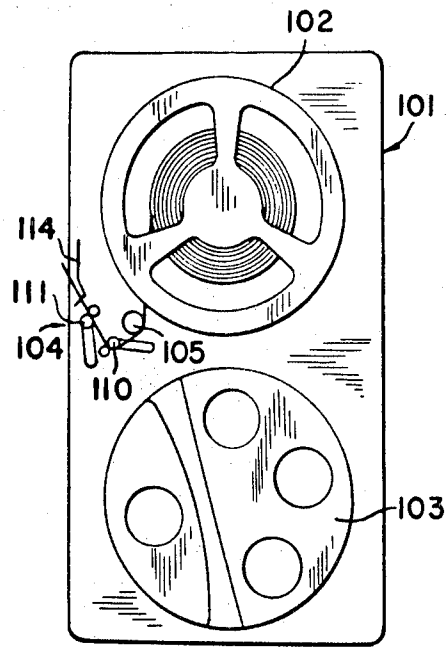


FIG. 7

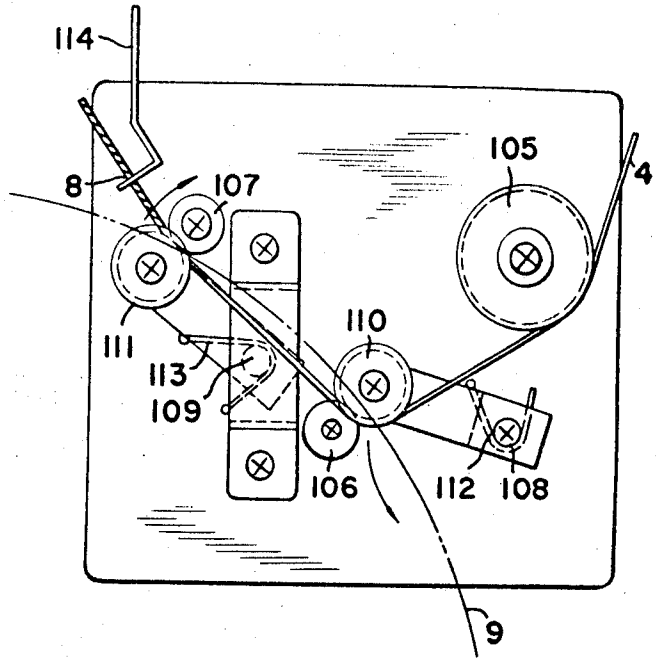
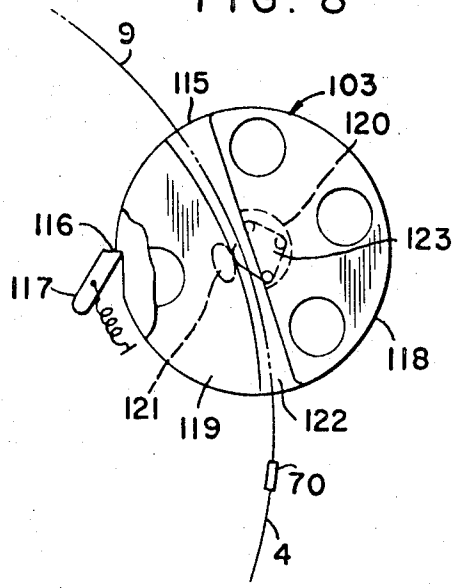


FIG. 8



AUTOMATIC FILM-LOADING PROJECTOR

This invention relates to automatic film loaders, and particularly to projectors capable of automatically loading films.

Various types of motion picture film projectors, in which a cartridge containing a film supply reel and a film take-up reel is loaded in position for projecting the film, have been suggested.

Particularly in motion picture film projectors such as used for transmitting images in T.V. broadcasting stations, it is desirable to provide means capable of automatically carrying out all operations including the loading of a cartridge selected from a plurality of stored cartridges into a predetermined position of the projector and the actuation of the projector so as to automatically project picture of the particular film in the cartridge. It is essential that such a projector must operate acurately and reliably.

Accordingly, one of the objects of the present invention is to provide a motion picture film projector which satisfys the requirements as set forth hereinabove and is capable of automatically loading a cartridge comprising a film supply reel and a film take-up reel in a predetermined position and of automatically projecting the film.

According to the present invention, the automatic film-loading projector comprises various elements for defining a film path or channel arranged circumferentially along a circle, and a rotary arm rotatable about an axis, i.e. the center of the circle to rewind the film from the supply reel. During approximately one rotation of the rotary arm, the leading end portion of the film is automatically grasped by a film nipper mechanism provided at the free end of the rotary arm, so that while rewinding the film from the supply reel, the film is passed through various mechanisms provided respectively with the film path defining elements in such a manner that the film is engaged with the elements and that the film leading end portion is secured to the core of the film take-up reel by the film nipper mechanism of the arm, whereby to make the projector in stand-by state or immediately projectable state.

Another object of the present invention is to provide a cartridge containing a film supply reel and a film take-up reel and usable in the automatic film-loading projector of the present invention.

Other objects and advantages of the present invention will become clear by the following description of a preferred embodiment of the present invention with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic view showing various elements of a projector of the present invention,

FIG. 2 is a side view in an enlarged scale of the film leading arm shown in FIG. 1,

FIG. 3 is an enlarged view of a part of the film nipper mechanism of the film leading arm,

FIG. 4 is a schematic view of the leading end portion of film of a supply reel,

FIG. 5*a* through 5*d* respectively show progressive states of the film leading end portion relative to a sprocket roller which is one of the film path defining elements and to be engaged with the film,

FIG. 6 is a front view of a cartridge to be used in association with the projector,

FIG. 7 is an enlarged plan view of a film holding mechanism in the cartridge, and

FIG. 8 is a front partially cut off view of a film take-up reel in the cartridge, illustrating its notch in detail.

Referring now first to FIG. 1, there is shown a projector 1 associated with a cartridge 101. The projector 1 is provided with a projection lens 2 and a projection light source 3. Images are projected to the left side of the lens 2 to a viewer of FIG. 1. The lens, the light source and the drive mechanism in the projector may be of the conventional type used in conventional projectors of the prior art, therefore, descriptions thereof are omitted.

A cartridge 101 containing a film supply reel 102 wound with a film 4 and a film take-up reel 103 is adapted to be readily fitted in a predetermined position of the projector 1.

The automatic film loader of the present invention is provided with an arm 6 rotatably connected to a shaft 5. The shaft 5 is connected to a projection motor (not shown) through a suitable transmission mechanism so that the free end of the arm 6 may be moved counterclockwise to complete a turn at a rate slightly slower than a predetermined film feed rate of the projector during the projection in response to a signal for actuating the automatic film loader.

As more clearly shown in FIGS. 2 and 3, the free end of the arm 6 is provided with film nipper means 70.

As shown in FIG. 4, the leading end portion of the film 4 has a hole 8 formed in a predetermined position.

The film nipper means 70 provided at the free end 7 of the arm 6 comprises a mechanism which engages with the hole 8 formed through the free end 7 of the film 4. In a preferred form of the film nipper means as shown in FIGS. 2 and 3, an L-shaped film pulling plate 71 is secured to the free end 7 of the arm 6, a movable plate 72 is pivotally mounted to the arm and a spring 74 is interposed between the plates 71, 72 so that the movable plate 72 is normally biased and abutted against the plate 71 whereby to nip the film leading end therebetween. The plate 71 has an upright cylindrical pin 75 secured near its end while the movable plate 72 is provided with a corresponding hole 76 near the end thereof at a position in alignment with the upright pin 75 so as to render the pin 75 to be passed through the hole 76. During the film nipping operation, the pin 75 passes through the hole 8 in the film leading end and the hole 76 in the movable plate 72 whereby to positively catch the leading end portion of the film 4 between the plates sufficiently to withstand the force to pull the film out of the film supply reel. A spherical cam follower 78 depending normally relative to the shaft 73 is engaged with a face cam 79 secured to an appropriate portion of the projector body as the arm 6 is turned whereby the cam follower is replaced to a position indicated by dotted line 78', thus at the same time, the movable plate 72 is also replaced to its dotted line position 72' to move the pin 75 out of the hole 76 in the plate 71.

Referring again to FIG. 1, various elements defining the film path in the projector are arranged circumferentially along an imaginary circle 9 (shown by chain line) with the shaft 5 as its center. When the automatic film loader is actuated by an actuation signal, the arm 6 begins to turn counterclockwise as described hereinbefore and the film nipper first automatically siezes the leading end portion of the film 4 in the supply reel 102,

then while drawing the film out of the cartridge **101**, it advances along the circle **9** at the rate slightly slower that the film feeding rate during the projection to mount the film onto the various elements defining the film path in the projector successively. In other words, the film nipper **70** at the free or head end **7** of the arm **6** first is passed the outer side of a guide roller **10** disposed inside the circle **9** to mount the film thereon. Then the nipper **70** carrying the film is passed through an upper sprocket roller **11** being rotated at the normal film feed rate simultaneously with the actuation of the projector, and a film pressing pivotal member **12** which is biased counterclockwise by a spring **124** (see FIG. **5**), while temporarily raising the member **12** against the bias of the spring **124** as shown in FIGS. **5B** and **5C**. Since the pivotal member **12** is normally biased by the spring so as to be abutted against the upper sprocket roller **11** as just described, it returns to its normal position after the nipper **70** on the head of the arm **6** has been passed through between the roller **11** and the member **12** as shown in FIG. **5D**.

The film pressing pivotal member **12** is provided with a pair of film pressing rollers **122** and **123** and the counterclockwise pivotal movement of the member **12** due to the bias of the spring **124** is limited by a stop pin **125** so that it will remain in the normal position until it is raised by the nipper as it is passed between the upper sprocket roller **11** and the member **12** as shown in FIG. **5**. When the member **12** returns from its raised position (FIG. **5C**) to it's normal position (FIG. **5D**), teeth of the sprocket roller **11** do not always mesh properly with the perforation in the film, however, the teeth will become accurately engaged with the film perforation in a short time, since the roller **11** is rotating at the normal film feed rate while the film nipper **70** is advancing at a rate slightly slower than the film feed rate.

As shown in FIG. **1**, the film nipper **70** on the arm head **7** passed between the pivotal member **12** and the upper sprocket roller **11** is then passed through between an aperture plate **13** and a flanged guide roller **142** pivotally mounted by a pin **141** and normally abutted against the aperture plate **13** while temporarily displacing the guide roller **142** as in case of the film pressing pivotal member **12**. The flanged guide roller **142** serves to prevent the film from any undesired lateral displacement during the film loading operation, and is disposed in such a position that it will not contact with the film that may cause undeserable deflection of picture during the projection.

As pointed out hereinbelow, since the rate at which the film **4** is pulled out of the supply reel by the nipper **70** on the arm **6** is slower than the rotation of the roller **11**, i.e. than the normal film feed rate during the projection, a certain length of the film is slackened as indicated by a loop **4*a*** (see FIG. **1**) which length corresponds to the product of the differential rate multiplied by a time progressed before the nipper **70** attained to the aperture plate **13**.

During the automatic film loading operation, a push plate **15** oppositely arranged to the aperture plate **13** is moved to a position **15'** outside the circle **9** shown by dotted line to permit the nipper to be passed through the space therebetween, then it is returned to its normal position shown by solid line while the film is engaged by a suitable cam claw (not shown) whereby it is advanced or fed at the normal feed rate.

A sound regeneration section following the projection section comprises an impedance roller **16**, a push roller **17** associated with the roller **16**, a sound drum **18**, an exciter lamp **19**, a sound lens **20**, a second push roller **21** in a magnetic recording head, and a guide roller **22**. Among these components of the sound regeneration section, rollers **17**, **21** and **22** are moved to the outside of the circle **9** as shown respectively by their dotted line positions **17'**, **21'** and **22'** to provide a passage for the film carrying nipper **70** during the film loading operation, and they are returned to their normal positions shown by solid line after the nipper has passed between a lower sprocket roller **23** and its associated pivotal member **24** in the same manner as described with reference to the upper sprocket roller **11** and its pivotal member **12**. The film leading end portion carried by the nipper on the head of the arm **6** is transferred and attached to the take-up reel **103** after passing a take-up tension roller **25**, and is released from the nipper **70** as will be described later.

The arm **6** thus carried out its duty is further rotated until it is engaged by a stop pin, disconnected from the drive mechanism and held in its normal position. In this manner, the film has been loaded automatically in the projector which is now in standby state for the projection.

A lower film loop **4*b*** and a portion of the film passing through a winding path portion in the sound regeneration section are provided in the same manner for providing the upper loop **4*a***, i.e. by the principle using a difference between the normal film feed rate and the rate of the film loading operation, however, it is clear that the amount of the film to be slackened in the sound regeneration section is larger than that required to form the upper loop **4*a***, and this may be accomplished by simultaneously stopping the rotation of the upper and lower sprocket rollers **11**, **23** for a very short time of about 0.2 second, after the arm head or the nipper has passed through between the roller **23** and its associated pivotal member **24**, with the film being remained in engaged state with cam claw.

The displacement of the push plate **15** and the rollers in the sound regeneration section may be achieved through micromotors or solenoids with iron pieces or microswitches provided respectively for the individual elements and arranged to be successively actuated with rotation of the arm **6**, or alternatively by directly utilizing the mechanical force provided by the movement of the arm.

The cartridge **101** containing the film supply reel **102** and the film take-up reel **103**, is provided with a film leading end holding and securing mechanism **104**. As shown in FIGS. **6** and **7**, the film leading end holding and securing mechanism comprises a guide roller **105**, a stationary rollers **106**, **107**, and flanged tension rollers **110**, **111** respectively rotatable about their shafts **108**, **109** and normally abutted against the stationary rollers **106**, **107** by means of springs **112**, **113** respectively.

The film **4** fed from the film supply reel **102** is held by the rollers **105**, **106**, **107**, **110** and **111** in position as shown in FIG. **7**, and the hole **8** formed at the leading end of the film is engaged with a pin **114** provided in the cartridge **101** to prevent the film **4** from being wound back to the supply reel. With the arrangement of the film leading end holding and securing

mechanism in the cartridge **101** as described, not only the positioning of the film leading end portion may be properly accomplished but also the film leading end portion may be held by the mechanism positively at all times without any possibility of deviation in its position or detachment from the mechanism due to any external shock from any direction.

In the attached state of the cartridge **101** to the projector as shown in FIG. **1**, various elements of the mechanism **104** are arranged so as to be placed circumferentially along the circle **9**. Thus, when the nipper **70** on the head **7** of the arm **6** is passed between the rollers **106** and **110** and between the rollers **107** and **111**, the film is deliverably held therebetween and the pin **114** of the cartridge inserted into the hole **8** of the film leading end is replaced by the upright pin **75** of the plate **71** of the nipper so that the film leading end is grasped by the nipper and advanced therewith.

Referring now to FIG. **8**, the mechanism which functions to transfer the film leading end from the nipper **70** on the head **7** of the arm **6** to the winding core of the film take-up reel **103** thus allowing to wind the film therearound, will be described. The film take-up reel **103** to be placed in the cartridge **101** is provided with a notch **116** formed at a portion of the periphery of its lower disk **115**. The notch **116** is so arranged that it is engaged by a latch or stop arm **117** pivotally mounted to the projector body to stop the reel **103** at a predetermined position. The upper disk of the take-up reel is divided into two portions **118**, **119** and the winding core thereof is also divided into two portions **120** and **121** and secured by any suitable means in their positions in spaced relation across a channel **122** form circumferentially along the circle **9**. In the final stage of the arm **6** making one rotation, the nipper **70** on the head of the arm **6** moves upwardly into the channel **122** and pushed up a leaf spring **123** mounted in the core portion **120** to position the film between the core portions **120** and **121**, then as the nipper further advances pulling the film out of the supply reel, the movable plate **72** of the nipper **70** is raised to its open position **70'** as described hereinbefore to release the film leading end from the nipper, whereup the nipper hits the stop arm or detent **117** being engaged with the notch **116** in the lower disk of the film take-up reel to disengage the detent from the notch and finally stops at the position as shown in FIG. **1**. At this time, the take-up reel **103**, of which notch **116** has been disengaged from the stop arm **117**, becomes rotatable and is held in film take-up state since the leading end of the film is held firmly between the core portion **121** and the leaf spring **123**. Thus the film loading operation has been completed automatically.

It is understood that the rotary arm **6** is locked in the position shown in FIG. **1** all times and thus the stop arm **117** of the take-up reel **103** is held in its disengaged position, until the automatic film loading operation is required.

The merits and advantages of the projector according to the present invention described in detail hereinabove may be enumerated as follows:

a. Since various elements defining the film path are arranged circumferentially along a circle, the automatic film loading operation may be accomplished by a film carrier arm rotatable about an axis corresponding to the center of the circle.

b. Since the rotation of the arm is controlled to a rate slightly slower than the normal feed rate of the film, upper and lower film loops required before and after passing the aperture plate may be automatically provided.

c. The sizes of the upper and/or lower loops already formed may be relatively altered by stopping the rotation of the upper and/or lower sprocket rollers while maintaining the cam claw in actuated state, after the film leading end has been passed the lower sprocket roller.

d. By the virtue of the guide roller abutted against the top portion of the aperture plate, undesired possible lateral displacements of the film at the aperture plate section due to the presence of the upper film loop may be prevented.

e. Since the film pressing pivotal members respectively associated with the upper and lower sprocket rollers and the guide roller provided for the aperture plate are arranged to be pushed open by the head of the arm then automatically return to their normal positions during the automatic film loading operation, a separate drive mechanism for driving each of such elements is not required and any misloading of the film due to its slip out from the elements may be prevented.

f. The nipper on the head of the arm provided with the pin and its associate hole for securing the film end insures the positive pull and carriage of the film during the film loading operation.

g. The film leading end may be automatically and readily grasped by the nipper since the cartridge has a mechanism for positively holding the film leading end in a predetermined position in the cartridge.

h. Since the winding core of the film take-up reel is formed of two separate parts to provide a space therebetween for receiving and holding the film leading end, a positive film take-up operation may be obtained with a very simple mechanism.

What we claim is:

1. An automatic film-loading projector including elements for defining a film path arranged and positioned circumferentially about a circle comprising: guide rollers, a pair of upper and lower film feed sprocket rollers, an aperture plate, and sound regeneration means; and a film carrier arm rotatable about the center of the circle, a nipper for gripping the leading end portion of a film, said nipper comprising a fixed plate and a movable plate, a resilient member adapted to move said movable plate toward said fixed plate so as to grip and hold a free end portion of the film between said plates, drive means for imparting a circumferential speed to the free end of said carrier arm which is less than the film feed rate of said sprocket rollers to provide for the formation of upper and lower film loop portions, whereby each revolution of said film carrier arm by means of said drive means facilitates engagement of the film with said elements for defining the film path.

2. An automatic film-loading projector according to claim **1**, comprising a mechanism for adjusting the relationship between the upper film loop portion and the lower film loop portion, said mechanism including means for preventing rotation of said lower sprocket roller for a short period of time, said elements including a cam claw being maintained in actuated state by said means during said time after the free end of said film carrier arm has passed said lower sprocket roller.

3. An automatic film-loading projector according to claim 1, comprising a film guide roller arranged adjacent to said aperture plate, said guide roller having a flange portion and a roller portion independently rotatable relative to each other so as to prevent lateral displacement of the film at the film loop portions and to minimize friction between the flange portion of said roller and the edge portion of the film.

4. The combination of an automatic film-loading projector, according to claim 2, and of a detachable cartridge comprising a hold mechanism including a latch pin to be engaged with a hole formed in the leading end portion of film withdrawn from a film supply reel in said cartridge and at least two guide rollers for supporting the leading end portion of the film so that the leading end portion extends along a portion of the circle around which the film path defining elements are arranged, the leading end portion of the film being arranged so as to be gripped by the nipper as the arm is rotated and so as to be positively secured by said nipper simultaneously with disengagement of the latch pin from the hole formed in the leading end portion of the film during rotation of said arm.

5. A film cartridge co-operable with an automatic film-loading projector according to claim 1, in which a film supply reel is wound with continuous film the leading end portion of which is formed with a hole to receive an upright pin of the film nipper, a holding mechanism engageable with the hole formed in the leading end portion of the film, a film take-up reel, means for releasing the film from said nipper, and means for attaching the leading end portion of the film to said film take-up reel.

6. A film cartridge according to claim 5, in which said holding mechanism and said means for attaching the leading end portion of the film to the take-up reel are automatically disposed circumferentially along the circle by attaching the cartridge to a predetermined operative part of the automatic film loader.

7. In an automatic film-loading projector comprising film path defining elements including a guide roller, a damping roller, sprocket rollers, an aperture plate, a cam claw and sound regenerating means arranged circumferentially about a circle, and a film carrier arm rotatably supported at the center of the circle for carrying the leading end portion of the film and to engage the film with said film path defining elements automatically as it is rotated circumferentially, the improvement comprising a nipper for gripping the leading end portion of the film, said nipper including a film pulling plate secured to the free end of said film carrier arm and a movable plate pivotally mounted on the arm and resiliently biased towards said film pulling arm, said film pulling plate having an upright pin adapted to extend through a hole formed in said movable plate and through a hole provided at the leading end portion of a film for clamping between said plates.

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