United States Patent [19]

Potts

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[45] **July 16, 1974**

[54] **AUTOMATIC FILM FEED DEVICE**

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[52] **U.S. Cl.** **242/55.18,** 352/128

[51] **Int. Cl.** **B65h 17/48**

[58] **Field of Search** ..... 242/55.18, 55.19 R, 76, 242/75.52, 75.3, 188; 352/92, 126, 128; 318/6, 7

[56] **References Cited**

UNITED STATES PATENTS

1,132,369	3/1915	Lytton	242/55.18
2,894,702	7/1959	Heath et al.	242/76
3,092,764	6/1963	Cooper	318/6
3,244,954	4/1966	Branco	318/7
3,497,158	2/1970	Calaway	242/75.52 X
3,640,611	2/1972	Boudouris et al.	352/92
3,661,337	5/1972	Burth	242/55.19 R

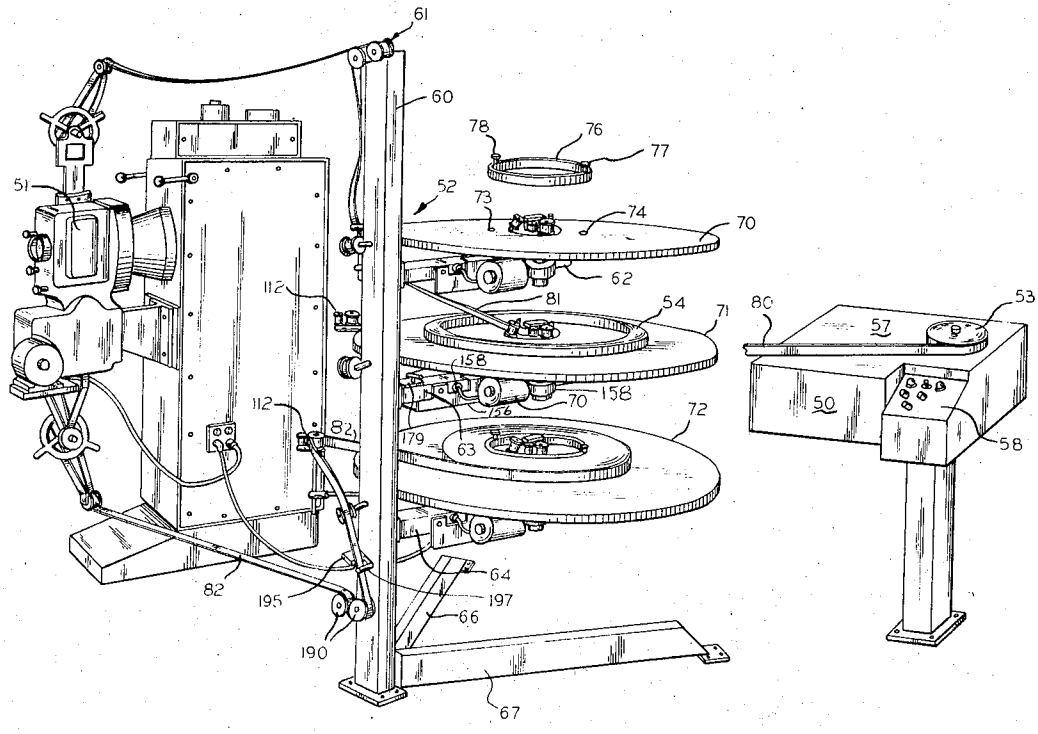
Primary Examiner—Billy S. Taylor

Attorney, Agent, or Firm—Alter, Weiss, Whitesel & Laff

[57] **ABSTRACT**

A plurality of rotatable horizontal turntable disks rotate to feed out or take up motion picture film, as it is transported through a projector. Optional threading arrangements enable any of the turntable disks to function as a supply or take up reel. Moreover, the third turntable effectively provides a spare which gives stand-by reliability. Suitable analog sensors detect film tension or broken film conditions and control the film feed accordingly. The analog sensors eliminate hunting as the mechanical operations proceed.

2 Claims, 20 Drawing Figures



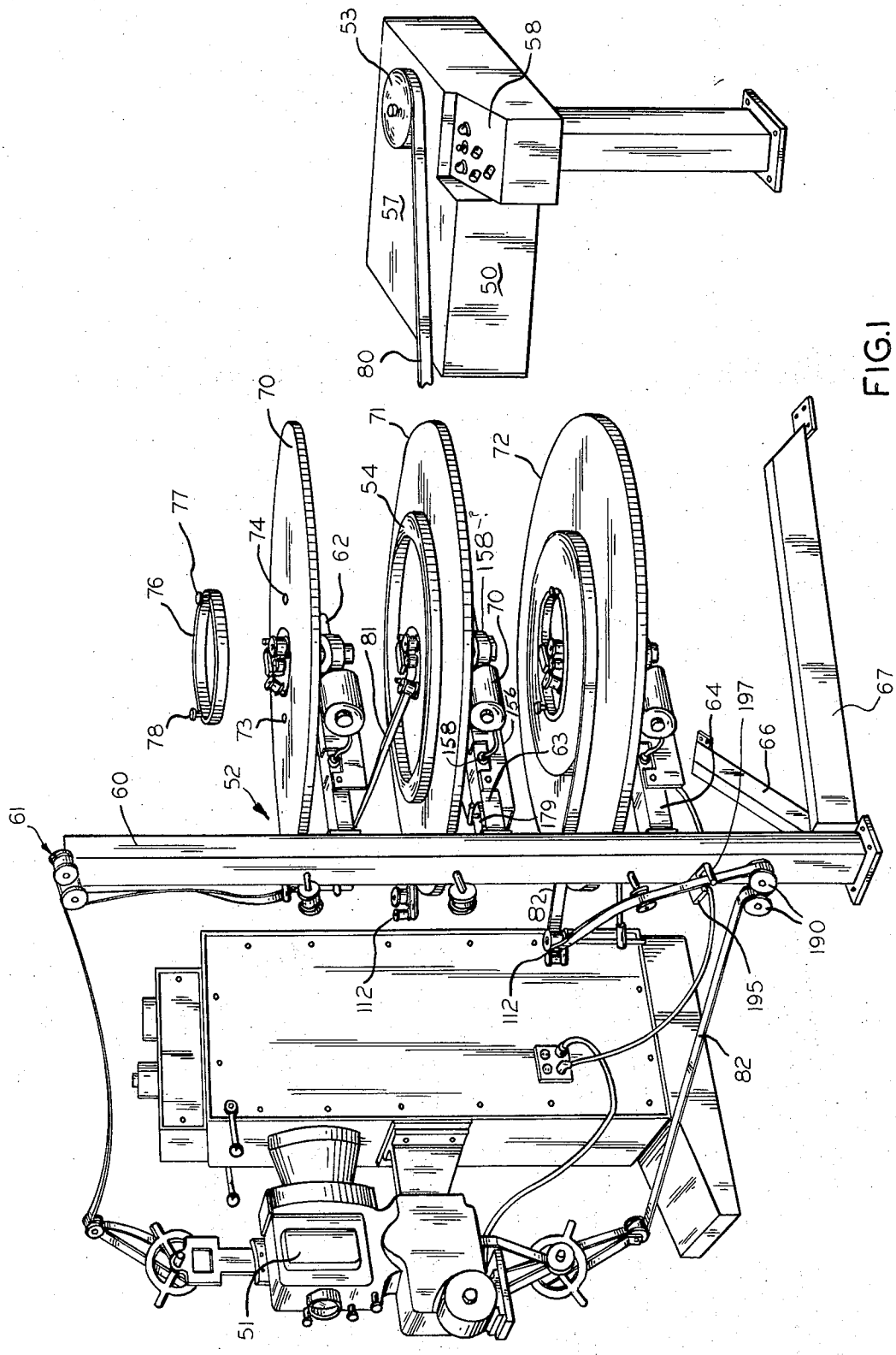

53
58
57
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80
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71
72
54
77
74
62
76
158
70
81
78
73
158
156
63
64
197
67
66
52
60
61
179
82
112
112
190
195
82
51

FIG.1

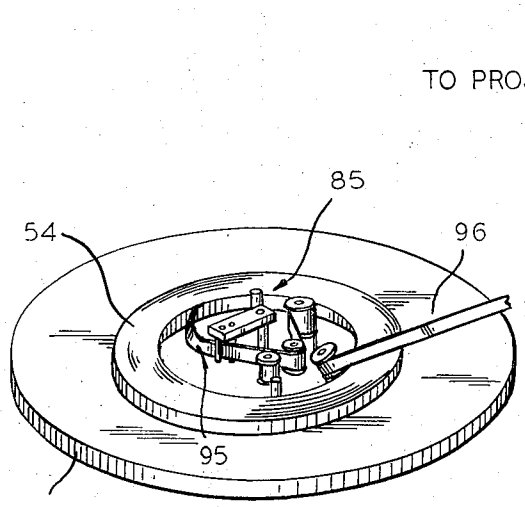


FIG. 2A

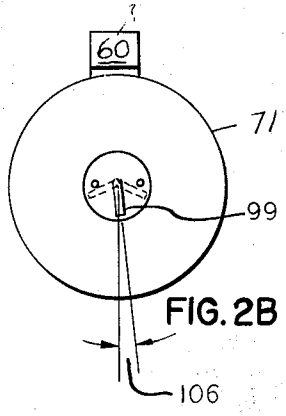


FIG. 2B

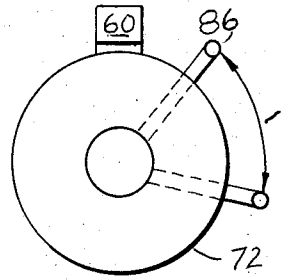


FIG. 2D

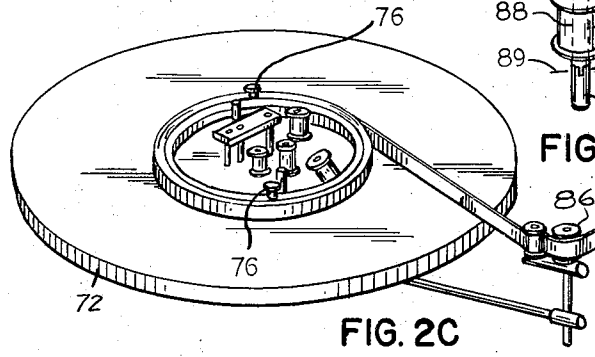


FIG. 2C

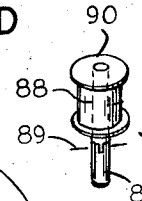


FIG. 2E

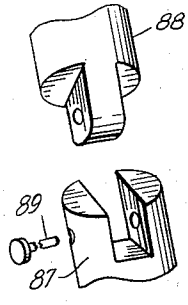


FIG. 2F

FIG. 2G

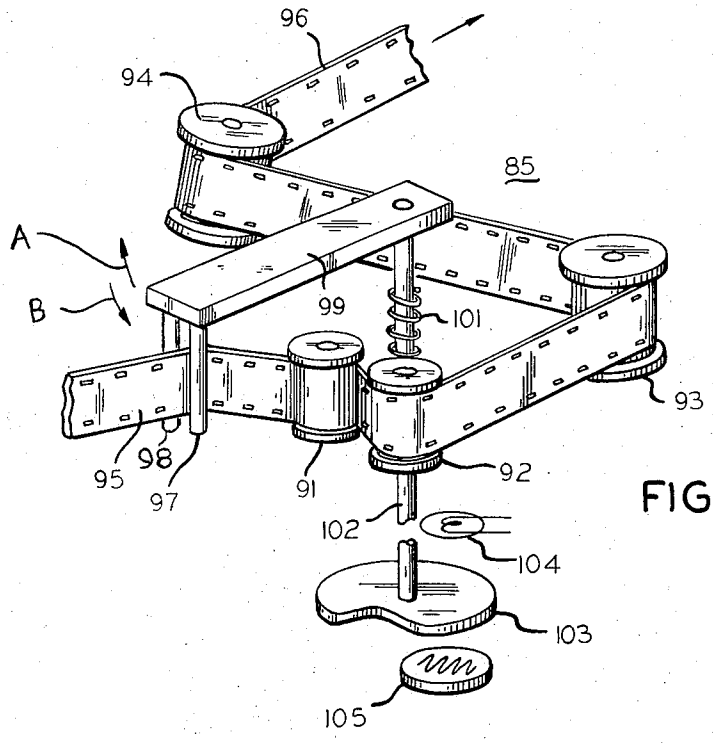

96
94
85
A
B
99
101
93
95
98
97
91
92
102
104
103
105

FIG.3

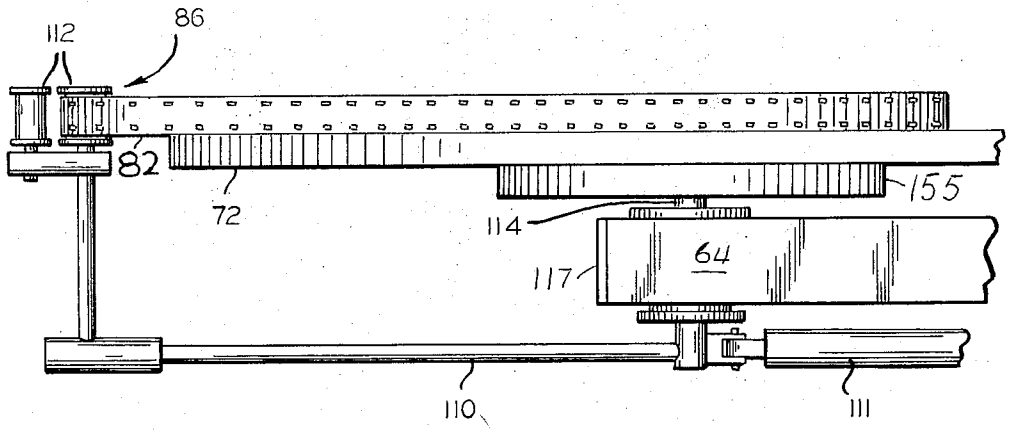

112
86
82
72
155
114
64
117
110
111

FIG.4

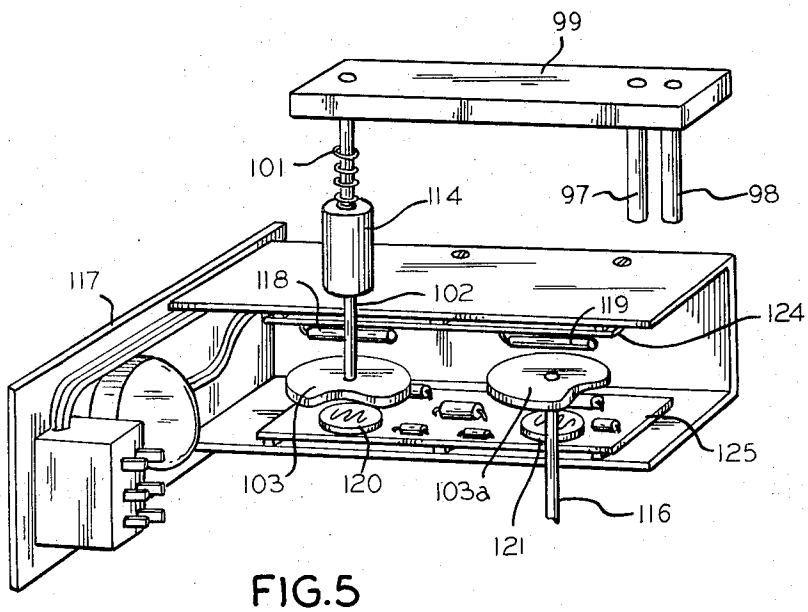


FIG.5

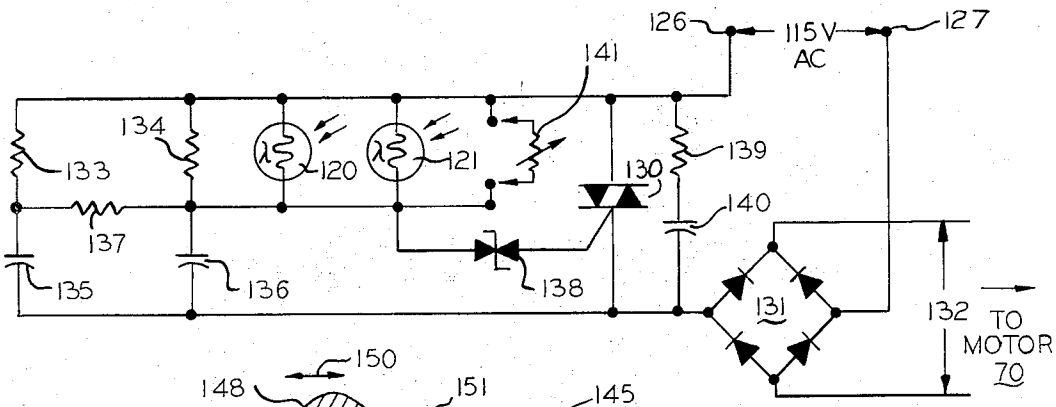
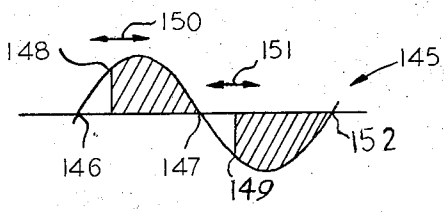


FIG.6



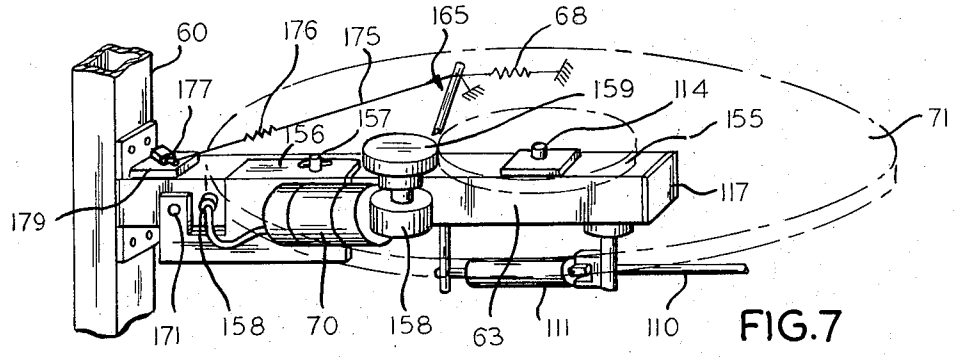


FIG.7

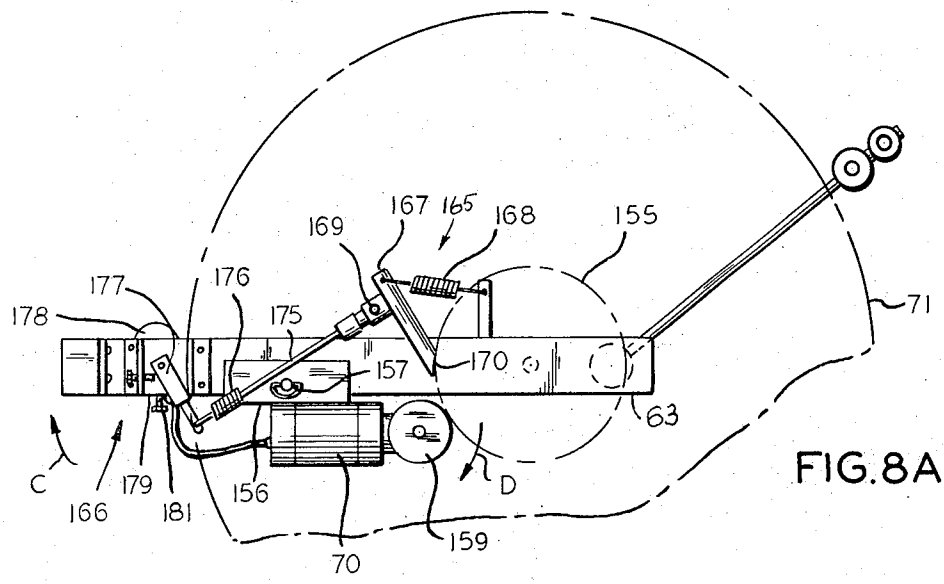


FIG.8A

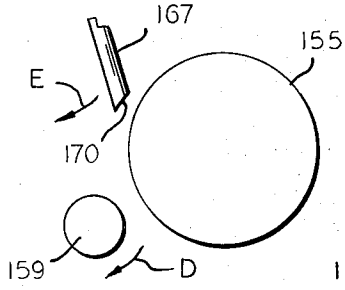


FIG.8B

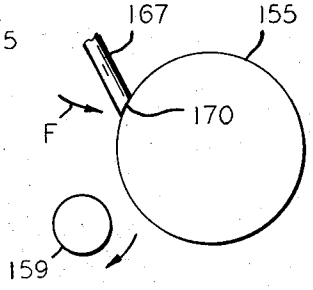


FIG.8C

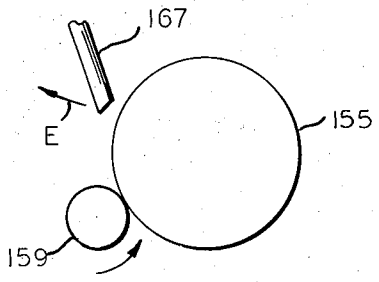


FIG.8D

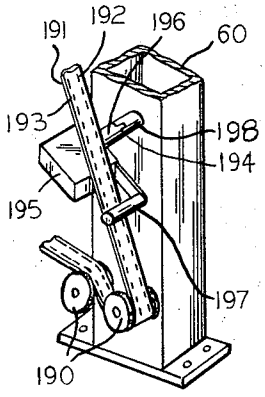


FIG.9

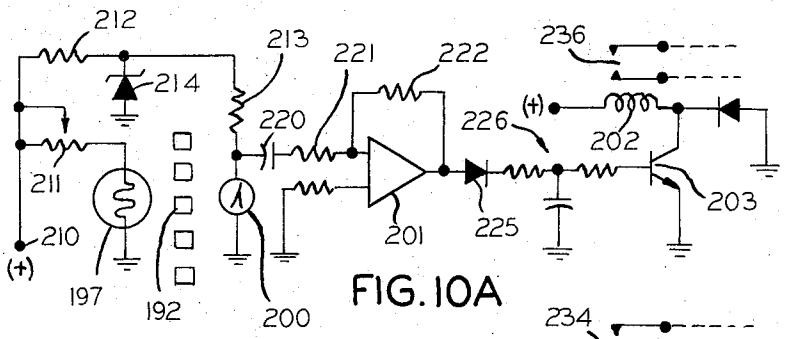


FIG.10A

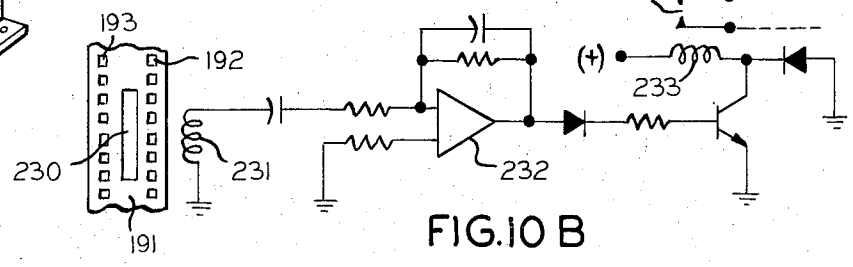


FIG.10 B

AUTOMATIC FILM FEED DEVICE

This invention relates to motion picture projectors and, more particularly — although not exclusively — to automatic film feeding means for commercial projectors used in motion picture theaters.

Commercial motion picture projectors usually have reels which contain approximately twenty minutes of program material. Hence, four to six reels may be used during a feature length motion picture having a show time of one and one-half to two hours. Each reel must be mounted, threaded, and projected. Then, it must be dismounted and rewound.

This conventional projector system is expensive and requires a substantial amount of labor with a high skill level. A number of projectors must be purchased and maintained in good working order so that the film projection may be switched with no apparent break in the picture at the end of each reel. Finally, the projectionist can become physically exhausted as he runs back and forth between the projectors, rewinding machines and the curtain, lights and music controls, if any problems should occur.

From another viewpoint, many motion picture theaters have been closed because they cannot economically compete with other forms of entertainment and, especially, with free television. If the cost of operating the theater can be reduced, it might restore the motion picture industry to a healthy and profitable condition.

Accordingly, an object of this invention is to provide new and improved automatic film-feeding devices for motion picture projectors. In particular, an object is to provide means for loading a quantity of film equal to a full evening's performance on a device for feeding the film and for automatically taking up the film after it is fed. Here an object is to virtually eliminate all manual attention at the projector, during an evening performance.

Another object of the invention is to eliminate the need for duplicate projectors. Here an object is to operate the projector continuously, and to eliminate the start and stop projector operation, and the wear resulting therefrom.

Still another object of the invention is to reduce the amount of labor required to operate a motion picture theater. Here an object is to provide an automatic theater which may be operated almost entirely from the box office so that one person may perform all labor functions.

In keeping with an aspect of the invention, these and other objects are accomplished by providing a plurality of rotatable horizontal turntable disks which feed out or take up the motion picture film as it is transported through the projector. Optional threading arrangements enable any turntable to function as either a supply or take up reel. Moreover, the third turntable effectively provides a spare which gives standby reliability. Suitable analog sensors detect the film tension or broken film conditions and control the tape feed accordingly, without causing mechanical hunting. Also, the method of winding eliminates the need for rewind. Finally, the invention may be coupled to automatic equipment which is programmed to control house lights, curtains or music.

The nature of a preferred embodiment may be understood best from a study of the attached drawings where:

FIG. 1 is a perspective view of the automatic feed system, a motion picture projector, and a make-up table;

FIGS. 2A–2F schematically show an exemplary film travel path as well as indicating alternative paths;

FIG. 3 is a perspective view of a film feed tension sensor at the film feeding point in the center of the turntable;

FIG. 4 is a side elevation view of a film take up tension sensor positioned near the periphery of the turntable;

FIG. 5 is a perspective view of a mechanical assembly including the film tension sensor controls;

FIG. 6 is a schematic diagram of the sensor circuitry for incorporation in the structure of FIG. 5;

FIG. 7 is a perspective view of a horizontal turntable drive device with a brake mechanism schematically shown in association therewith;

FIG. 8 A–D shows four stop motion, schematic views of the brake and drive sequence used during the film disassembly or tear down operations;

FIG. 9 is a perspective view of a mechanical assembly including a broken film sensor and an end of program sensor; and

FIG. 10 A–B shows two schematic circuit diagrams of the electronic equipment in the sensor of FIG. 9.

The major assemblies of FIG. 1 are a make-up table **50**, a projector **51**, and an automatic film feed structure **52**.

The make-up table **50** includes a turntable **53** on which any conventional film reels are placed. The discrete reel lengths of film are then fed to or from the turntable **53** to the automatic film feed structure, or visa versa. In this manner, any suitable number of individual discrete reel lengths of film may be spliced together to form a single large unitary roll **54** which lies on any one of three horizontal turntables on the structure **52**. Thus, an entire evening's film presentation may be drawn from one of these three turntables and returned to another.

As the many reels of film are drawn from the make-up table **50**, and spliced into a single large unitary film roll **54**, a colored adhesive tape is attached to the film at the reel end splice. Later, when the unitary roll **54** is disassembled, cut apart, and reformed into the discrete reel length segments, the colored tape is a visual indication of the end of one reel and the start of the next reel. Thus, a person in control of the make-up table stops the disassembly reeling process when he sees the colored tape leave the unitary roll **54**. The film is cut apart at the splice which was made when the discrete film reel lengths of film were joined together. A leader is reattached and a new reel is placed on table **53** to take up the next discrete length of film, as it is pulled from the unitary roll **54**. A surface **57** provides work space for making the splices. A control panel **58** provides means whereby the operator may control the make-up or disassembly operations.

The automatic film feed structure **52** comprises a vertical post **60** having a plurality of film feed spools or bobbins **61** on one side and a plurality of horizontal turntable disk support arms **62–64** on the other side. The vertical post **60** is supported on the floor by two leg members **66, 67**. Each arm includes an individual

motor **70** for driving the individually associated turntable disk in a rotary motion. Preferably, each horizontal turntable disk **70–72,** is molded from fiber glass or an equivalent structure. The desired tray characteristics are light weight, strength, and uniform weight distribution so that no balancing is necessary.

To facilitate winding, each horizontal turntable has a mounting means formed therein, comprising two or more anchor holes **73, 74,** adapted to receive a ring **76** which is secured in the anchor holes in place by any attachment means controlled by knobs **77, 78.** Before any film is loaded on a horizontal turntable disk, the ring **76** is attached in place. When the film take up winding begins in the automatic film feed structure, the leader is attached to the ring **76.** As the film winds around the ring, the unitary roll **54** is formed around the ring **76,** which functions as a spool or a bobbin for the made up roll. Then, after the unitary roll of film is assembled, the ring **76** is removed by pulling knobs **77, 78** to release the anchor means from the holes **73, 74.** The film is pulled from the center of the unitary roll, during the projection.

During make-up, the discrete reel length of film increments **80** are wound on the turntable disk **71** with the unitary roll **54,** beginning near the center of the disk and spreading outwardly so that the film is always taken up onto the outer periphery of the roll. During film projection, the film **81** is then pulled from the center of this unitary roll, and it is fed into the projector **51.** The film **82,** leaving the projector **51,** is taken-up on a second turntable disk **72,** much as it is taken-up during the original make-up operation. The number of spools or bobbins **61** enable any of the three turntable disks **70–72** to be used for any of the winding, take-up, or make-up functions.

The inside or outside diameters of the unitary roll **54** change as it receives film or loses film during the winding process. Hence, the turntable disks must rotate at different speeds during the winding process, and each turntable must rotate at its own individual speed.

According to the invention, means are provided for continuously sensing the tape tension and for feeding back an analog signal for controlling the horizontal turntable disk drive, as a function thereof. In greater detail, the film feed path is seen in FIG. **2,** which is properly interpreted as a single and unitary, somewhat exploded view which schematicly shows parts of one optional film path through the film feed assembly. In greater detail, FIG. **2A** shows the feed as being taken from turntable disk **71,** by way of example,; FIG. **2B** shows how the sensor associated with the disk of FIG. **2A** detects the presence of the film and the supply nature of the roll; FIG. **2C** shows the take up roll as being on turntable **72,** by way of example; FIG. **2D** shows the sensor associated with the disk of FIG. **2C** detects the presence of the film; FIG. **2E** shows a universally usable bobbin for guiding the film over all film paths and between any of the disks and the projector; FIG. **2F** perspectively shows the pivot for the bobbin **90** mount; and FIG. **2G** shows the array of bobbins in the film feed system. Centrally located within the unitary roll of film is a combination film feed and tension sensor **85** which is seen in detail in FIG. **3,** and a peripherally located tension take up sensor **86** which is seen in detail in FIG. **4.**

The film feed members (FIG. **3**) comprise a series of bobbins or spools **91–94** which establish a path from the center of the unitary roll on the horizontal film feed **95** to an angularly disposed plane at **96** which lifts and directs the film upwardly and over the inside edge of the film roll **54.** From this point, the film follows the path **81** to the spools or bobbins **61,** and onto the projector.

The bobbins are flexibly mounted to conform to a position of least stress upon the film. In greater detail, at least some spool or bobbin mounts comprise a post **87** having an arm **88** pivotally attached thereto at pin **89.** Post **87** is secured to vertical post **60** in any suitable manner, and bobbin **90** is free to pivot on pin **89** between two fixed angular positions responsive to the pull of the tape so that the film may be guided from any source to the bobbins **190.** As film feeds over the spool on bobbin **90,** the arm **88** swings on pivot **89** to a position of least restraint. This reduces stresses in the film to a minimum.

Means are provided for sensing the feed tension in the film as it is being pulled from the unitary roll **54.** In greater detail, the film is pulled at **95** horizontally away from the inside diameter of the unitary roll **54** to pass between posts **97, 98** on a tension sensor arm **99.** As the tension increases, arm **99** swings in direction A. As tension decreases, arm **99** swings in direction B. A suitable spring **101** normally urges arm **99** to swing into a normal or home position. As the arm **99** rotates, the shaft **102** turns, and a cam **103** rotates to cut into and selectively reduce a beam of light directed from lamp **104** onto photocell **105.** The shape of the cam **103** is such that the amount of light falling on the photocell **105** varies as a function of the shaft **102** position. Therefore, the signal out of the photocell **105** varies as a function of the film feed tension. When no film is present, the cam **103** cuts off all light, the photocell **105** has no output, and the turntable disk stops.

It should now be apparent that, as the film **95** is pulled from the roll **54,** the sensor arm **99** swings over arc **106** as the feed tension changes. Since the cam **103** cuts the light beam falling on cell **105** in a continuously variable manner (i.e. not in incremental discrete steps), there is an analog signal out of cell **105.** Hence, the film fed speed may be held fairly constant. This is as distinguished from a digital control wherein the arm **99** hunts continuously between high and low limits.

From the film feed tension sensor assembly **85** (FIG. **2**), the film advances over idler spools or bobbins **61** which direct the film over path **81** to the lens and shuttle assembly of the projector **51.** The picture is there projected in the normal and conventional manner. After the projector transports the film past the lens and shuttle assembly in the conventional manner, it discharges the film into path **82.** The path for the particular threading of FIG. **2** is shown by solid lines. Optional paths are drawn in dashed lines. There is an alternative path which enables any turntable **70–72** to function as either a supply or take up reel.

Means are provided for sensing the tension on the take-up side of the projector. In greater detail, the sensor (FIG. **4**) comprises a pivot arm **110** having a dashpot motion damper **111** associated therewith. Mounted on the end of the pivot arm **110** ar a pair of spools or bobbins **112** spaced apart for enabling the film **82** to pass between them. As the film tension changes, the pivot arm **110** swings over an arc **113** (FIG. **2**) to adjust the rotating speed of the take-up turntable disk **72.**

The two sensors **85, 86,** are positioned near the axle **114** about which the turntable disk turns. The shaft **102** of the feed tension sensor passes concentrically through a hole in the axle **114,** as seen in FIGS. **3** and **5.** An adjacent shaft **116** is controlled by the take-up sensor arm **110,** with results which are much the same as those occurring when the shaft **102** rotates. An electronic control unit **117** slides into the end of each of the arms **62–64** to provide an analog motor control signal responsive to the instantaneous positions of cams **103, 103***a*. A suitable fastener (not shown) may be provided to capture and lock the unit **117** when it is slid into position in the arm.

The control unit includes lamps **118, 119** positioned to cast light upon the photocells **120, 121.** The cams **103, 103***a* are positioned to cut into the light beams and cast shadows on the photocells **120, 121.** The cam **103** rotates under control of the feed tension sensor arm **99,** and the cam **103***a* rotates under the control of the take-up sensor arm **110.** Therefore, the amount of light striking photocell **120** is an analog of the feed tension, and the amount of light striking the photocell **121** in an analog of the take-up tension.

FIG. **6** is a schematic circuit of the electronic circuits built onto printed circuit cards **124, 125** in the unit **117.** In greater detail, commercial sixty cycle **115** volt alternating current is applied across terminals **126, 127.** The circuit energized thereby includes feed tension and take-up tension detector photocells **120, 121,** respectively, a silicone controlled rectifier (SCR) **130,** a diode rectifier bridge **131,** an output **132** to the turntable drive motor **70,** and various circuit elements **133–141.**

Since each of these elements is a well known component, it is thought that they will be understood best from a description of how the circuit operates. In greater detail, each of the resistors **133, 137** (in cooperation with capacitor **135**) provides a 90° phase shift or a total of a 180° shift of the input AC power wave form, as compared to the voltage applied across SCR **130.**

The device **138** is a bilateral switch which fires when either a positive or a negative signal exceeds more than a certain voltage level. For example, this may be a pair of back to back zener diodes which conduct when the signal on the left (as viewed in FIG. **6**) exceeds ± 28 volts. The bilateral switch **138** is connected to a gate electrode on the SCR **130.** A series circuit including resistor **139** and capacitor **140** by-passes transient voltage spikes to protect the SCR.

A potentiometer **141** may be set to provide a threshold level of operation. In greater detail, the potentiometer **141** is adjusted to a point where less than a trigger current flows to the capacitor **136** whenever the photocells **120, 121** are dark because they are covered by the shadows of cams **103, 103***a*. Since the film is only able to either feed out or take up at any given time, only one of the cams is operative at any given time. Therefore, only one of the photocells **120, 121** is operative at any given time.

As the cams **103** or **103***a* rotate to remove their shadows, away from over the photocell **120** or **121,** the internal resistance of the exposed photocell goes down. As the resistance goes down, the capacitor **136** charges. Obviously, the time required for the capacitor **136** to charge to a trigger voltage level will vary as a function of the photocell's resistance and, therefore, as a function of the cam positions or the film tension.

As graphically drawn at **145,** the capacitor **136** charges over a period of time beginning at the zero axis crossings **146, 147** and terminating when a trigger voltage level (such as ± 28 volts) is reached at **148, 149.** As indicated by the double ended arrows **150, 151,** the trigger voltage points **148, 149** may vary as a function of time responsive to the internal photocell resistance. Once the trigger voltage level is reached, the bilateral switch **138** fires, and a gate pulse switches on the SCR **130,** which conducts until the voltage reaches the zero crossing points **147, 152,** when it switches off. Hence, current flows during the period indicated by cross hatching at **145.** More or less current flows depending upon the phase angle of the commercial voltage at the instant when SCR **130** fires and switches on.

Upon reflection, it should now be apparent that bridge **131** supplies a rectified d.c. voltage to motor **70** at a level which varies as an analog of film tension. If the tension increases, one of the cams **103** turns to expose the associated photocell to more light. The resistance of the photocell goes down, and the capacitor **136** charges faster. The SCR fires sooner, and more current flows through bridge **131** to the motor **70.** The greater current speeds the motor and relieves the film tension.

The converse happens when the film tension reduces. The shadow of cam **103** increases, the photocell receives less light, the internal resistance goes up, capacitor **136** charges slower, and the SCR **130** fires later. Less current flows through bridge **131** to motor **70,** and it slows.

Since the control is an analog signal, the motor tends to hold a steady speed with only minor corrections responsive to changes in film tension. There is no continuous hunting while the motor receives an unending series of speed-up, slow-down command signals.

The turntable disk drive system is seen in FIG. **7.** In greater detail, the lower surface of the turntable disk has a dependent circular drum or flange race **155** integrally formed therein and concentrically located with respect to the axle **114** and outside periphery of the turntable disk. The center of the turntable disk is mounted and rotatable about the turntable axle **114** supported by the individually associated one of the arms **62–64.**

Mounted on the arm **63,** for example, is a pivot bracket **156** which is held in place by a spring loaded quick disconnect pin controlled by D ring **157.** A similar pin (not shown) is provided on the bottom of the bracket **156.** Supported on bracket **156** is a motor **70** having a plug-in connector **158** for making electrical connections through arm **63** and vertical member **60** (FIG. **1**). If any motor must be repaired, replaced, or exchanged, it is only necessary to pull the electrical plug **158** and the two quick disconnect pins **157.** The bracket **156** lifts or slides off the arm **63.** This way, the three motors may be exchanged with each other and the automatic film feed structure provides its own stand-by reserve of "spare parts."

Mounted on bracket **156,** adjacent the shaft of motor **70** is an angle drive unit **158** having a capstan **159** coupled thereto. When the bracket **156** is in position, capstan **159** runs on drum **155,** and thereby causes the turntable disk **71** to rotate. It is not necessary to reverse the direction of turntable rotation, since the turntable

rotates freely as the film is pulled by the turntable **53** during the disassembly of the unitary roll.

According to the invention, a combination of the motor drive assembly mounted on bracket **156** and a brake assembly **165** enables the disk tray to either be driven or to rotate freely, as shown by the four stop motion views of FIG. **8.** In greater detail, this assembly includes a motor driven actuator **166,** a brake lever arm **167,** and a return spring **168.** The brake arm is pivoted at **169,** and it has a wear resistant pad **170.** Under normal operating conditions, the return spring **168** pulls one end of the lever arm **167,** which rotates around the pivot point **169** to lift the other end **170** away from the drum **155.**

During normal operations, the motor mounting bracket **156** is held snugly against the arm **63** by a bias spring **171.** Spring **171** is a coiled or other suitable spring pushing outwardly as viewed in FIG. **7** so that bracket **156** pivots about post **157** to push capstan **159** against drum **155.** In this position, the capstan **159** is pressed against the drum **155** to drive the turntable disk **71.**

After the feature run has terminated, it is necessary to make up the original reel size incremental reel length film segments. It is desirable to pull the film off the turntable disk **71** and onto a take-up reel **53** (FIG. **1**), at a very high rate of speed. As the splice at the end of the incremental reel length film segment comes into view, the turntable **71** must be stopped very quickly. To accomplish this end, both capstan **159** and brake **167** are moved away from the drum **155,** and the turntable disk **71** rotates freely and unimpeded as the film is pulled, at high speed, onto the conventional sized reel at **53.**

At the end of each splice, the brake arm **167** is pressed tightly against the drum **155** to quickly stop the rotation.

The means for accomplishing this brake-drive operation are seen in FIG. **8.** In greater detail, a cable **175** runs from brake arm **167** to a spring **176** and a control arm **177.** A motor **178** drives a gear box **179** which controls the arm **177** and causes it to rotate, pulling the cable **175,** via spring **176,** and thereby swing the brake arm **167** against the drum **155.** The motor **178** and gear **179** are any suitable device for urging arm **177** to swing until it encounters a predetermined resistive force and thereafter to slip. The spring **176** absorbs the shock of the mechanical contact between the brake end **170** and the drum **155.** When the brake engages the drum **155,** it drags the turntable **71** to a stop, and the brake actuator motor **178** stalls. However, by selection of a proper motor type, the motor **178** may remain stalled for a relatively long period of time without any damage thereto. Since the brake is only applied momentarily, the detection of the complete brake on condition poses no problem.

The motor mounting bracket **156** pivots about pin **157** when a solenoid (not shown) adjacent motor **178** is energized. An adjustment bolt **181** limits the amount of travel imparted to the bracket **156** by this solenoid operation. Thus, as the bracket **156** is pulled in direction C, the capstan **159** swings away in direction D to disengage the drum **155.**

The brake-drive operation sequence for returning the unitary roll to the original incremental reel size segments should now be clear. An operator manipulates controls on panel **58.** The solenoid is operated to pull bracket **156** in direction C and swing capstan **159** away from the drum **155** in direction D (FIG. **8B**). Also, the spring **168** pulls brake arm **167** away (direction E) from the drum **155.** Film is pulled from the turntable disk **71** and onto the reel **53** (FIG. **1**) on make-up table **50.** The turntable disk **71** rotates freely as the film is so pulled at a very high rate of speed.

When the operator sees a piece of colored tape stuck to the film, coming off the unitary roll **54,** he performs another manual operation at the control panel **58.** The end **170** of the brake arm **167** moves (direction F) into contact with the drum **155** (FIG. **8C**). The turntable disk **71** stops turning.

Then the operator cuts the film, removes the rewound reel **53,** and starts rewinding a new reel. Then, he performs another manual operation at the control panel **58** to again place the system in the condition of FIG. **8B.** The process is repeated each time that a reel length segment of film is removed from the unitary roll. After the last segment is removed, a manual operation at the control panel **58** returns the brake and motor driven capstan to their original state (FIG. **8D**).

Sensor means are provided for detecting broken or stalled film. In greater detail, the film path **82** (FIG. **2**) leads from the projector directly to a pair of spools or bobbins **190** through which the film **191** passes (FIG. **9**). The film has the conventional and well known rows of sprocket holes **192, 193** running along each edge thereof. The movement of these sprocket holes acts as a light chopper for giving a continuous flow of pulses, thereby indicating movement of the film.

A post **198** (FIG. **9**) is rigidly affixed to the vertical member **60** near the bobbins **190.** A shaft **196** is pivotally attached at **194** to the outer end of post **198.** The shaft **196** supports a box **195** containing an electronic sensor circuit shown in FIG. **10.** This structure is mounted on a post approximately the same as the bobbin post seen at **87-90** in FIG. **2.** Hence, the sensor may freely swing to a proper position with respect to the film, where it is locked in place. The sensor also includes an arm supporting a lamp **197** positioned in front of the row of sprocket holes **192** and shining through the sprocket holes onto a photocell **200** (FIG. **10B**) in the end of the box **195.** As long as the film continues to feed, the sprocket holes chop the light beam, and the sensor enables the system to operate. If the film stops or breaks, the chopping stops and the film feed is cut off. The sensor then gives an inhibit signal to stop the system operation.

The sensor circuit for accomplishing the broken film detection is seen in FIG. **10A.** The major divisions of this circuit are the lamp **197,** photocell **200,** an amplifier **201,** and a relay **202** driven by a transistor **203.** The lamp **197** is lit from a +18 volt battery **210,** at an illumination level set by an adjustment of a potentiometer **211.** A coupling and current limiting resistor **212** connects the battery **210** to the photocell **200** via a load resistor **213** and a voltage regulating zener diode **214.**

The photocell **200** conducts each time that light passes from the lamp **197** through a sprocket hole **192** to the photocell **200.** Hence, the photocell **200** generates a series of pulses as long as the light chopping action of the sprocket holes continues.

The collector of photocell **200** is connected to the input of amplifier **201,** via a capacitor **220,** and a gain adjusting resistor **221.** Resistor **222** also helps set the gain. The capacitor **220** passes the pulses generated by

the photocell **200** responsive to the light chopping action of the sprocket holes, but blocks the d.c. bias. Hence, the amplifier **201** receives a signal only while the film is running.

The output of the amplifier **201** is rectified by diode **225** and smoothed by filter **226.** Thus, the transistor **203** is continuously held in a saturated condition as long as the chopped light caused pulse train continues. The transistor **203** provides drive current for holding relay **202** in an operated condition. As long as relay **202** is operated, contacts **236** are closed to enable the film feed operation.

If the film breaks or stalls, the light is no longer chopped by the sprocket holes **192.** Photocell **200** stays on, capacitor **220** will not pass the resulting steady state d.c. signal. Amplifier **201** switches off, and relay **202** releases. If there should be a power failure, relay **202** also releases. Either way contacts **236** open to inhibit further operation.

Means are provided for initiating an intermission sequence responsive to the completion of a predetermined amount of feature presentation. In greater detail, a short length of ferrous tape **230** (FIG. **10B**) is stuck on the film **191** at the point in the program where an intermission sequence is desired. The sensor **195** includes a pick up coil **231** in which a pulse is induced when the ferrous tape passes thereby, (i.e., the ferrous tape is a moving armature relative to the coil and therefore it changes the coil's reluctance). The pulse is fed through an amplifier **232** to operate a relay **233** and pulse a set of contacts **234.** The FIG. **10B** circuitry associated with the amplifier **232** is essentially the same as the FIG. **10A** circuitry associated with the amplifier **201** in FIG. **10A.**

When the contact **234** pulse, other control equipment (not shown) operates through a programmed sequence involving a raising and lowering of the house lights, opening and closing of the curtains, and a playing recorded music.

From the foregoing, it should be apparent that the invention provides means for automating the entire film presentation. One person may operate the box office, sell tickets, and admit patrons to the theater. When the show is to begin, a switch is operated in the box office, and the entire evening's performance is provided by drawing a single unitary roll on turntable disk **71** and depositing it on disk **72.** After an appropriate amount of film is drawn, the intermission occurs automatically; then, the film resumes after a timed intermission. After the entire program is finished, the person in the box office may go home almost as soon as the last patron leaves. There is no need to rewind the film. The next night, the film will be pulled from turntable disk **72** and fed over a different path through the projector **51** to either of the turntable disks **70** or **71.**

Those who are skilled in the art will readily perceive various changes and modifications which will fall within the scope and spirit of the invention. For example, any suitable number of turntable disks may be provided. Moreover, FIGS. **2** and **3** show two embodiments of bobbin or spool arrangement at **85.** Obviously, any of many different arrangements could also be used here or at the take up sensor **86,** as long as the film feeds smoothly and the tension may be sensed. Further, the drawings show spring **101** (FIG. **3**) which normally holds the plate **103** in home or normal position which cuts off the light of the photocell **120** and the film feed is thereby switched off. A similar spring (not shown) is inside the structure **111** to hold the cam **103*a*** in a position which switches off the take up. An advantage of this arrangement is that the device automatically feeds, takes up, etc. according to the "program" set up when the film is originally threaded. There is no need for human programming of feed, take up, etc. by operating switches, making punched cards, or the like. On the other hand, by the simple expedient of placing the potentiometer **141** (FIG. **6**) on the take up table **50,** it is possible to override the automatic speed control circuit of FIG. **6** and to run the turntables at any desired speed. In the electronic circuits, certain components are shown and described. For some of these, there are preferred characteristics. For example, the photocells **120, 121** (FIG. **5**) are preferably variable resistive devices since they operate bilaterally with either polarity, as shown in FIG. **6.** On the other hand, the photocell **200** (FIG. **10A**) is preferably a photo-Darlington transistor because it has high gain and a narrow acceptance beam, in the order of three degrees.

Other advantages and modifications will occur to those who are skilled in the art. Therefore, the appended claims are to be construed to cover all equivalent structures falling within the scope and spirit of the invention.

I claim:

1. An automatic film feed device comprising a plurality of rotatable turntable disks which rotate to feed out or take up a rool of motion picture film as it is transported through a motion picture projector,

means for providing a plurality of optional film threading paths which enable any of the turntable disks to function as either a supply or a take up reel without requiring rewinding,

means for causing said film to travel from the feed out roll to the take up roll,

at least one analog sensor means individually associated with each of the turntable disks for automatically detecting film tension at the associated turntable disks and for controlling the rate at which the associated turntable disks rotate to feed or take up the film responsive to the path selected when the film is threaded through the projector,

means as for sensing film movement through said film feed device,

means responsive to said sensor detecting a termination of said film movement for stopping said film travel,

said means for sensing film movement comprises means for projecting a light beam through sprokect holes in said film, whereby said film movement chops said light beam,

means responsive to said chopped light beam for generating a corresponding train of electrical control pulses, and

pulse responsive means for enabling said film feed means as long as said train of control pulses continue.

2. An automatic film feed device comprising a plurality of rotatable turntable disks which rotate to feed out or take up a roll of motion picture film as it is transported through a motion picture projector,

means for providing a plurality of optional film threading paths which enable any of the turntable disks to function as either a supply or a take up reel without requiring rewinding,

means for causing said film to travel from the feed out rool to the take up roll,

at least one analog sensor means individually associated with each of the turntable disks for automatically detecting film tension at the associated turntable disks and for controlling the rate at which the associated turntable disk rotates to feed out or take up the film responsive to the path selected when the film is threaded through the projector,

each of the turntable disks has an upper side and a lower side,

said lower side having a drum-shaped race formed thereon,

drive means individually associated with each of said turntable disks,

said drive means comprising a motor driven capstan running on said race,

at least one of said turntable disks having an associated brake means, and

means for selectively moving said capstan and said brake against and away from said race for selectively enabling said turntable to be driven, to rotate freely, or to be stopped.

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