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[54] FILM FORMAT AND STOP CIRCUIT FOR AN ELECTRONIC VIDEO RECORDING PLAYER

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[51] **Int. Cl.**.....**H04n 5/84**

[58] **Field of Search**.....178/6.7 A, 7.2; 242/188; 179/100.2 S, 100.3 D

[56] **References Cited**

UNITED STATES PATENTS

2,514,578	7/1950	Heller et al.	179/100.2 S
3,609,228	9/1971	Goldmark et al.	178/6.7

OTHER PUBLICATIONS

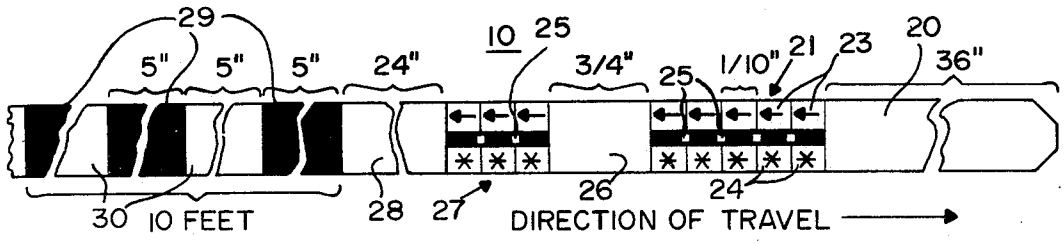
"Taking a Look at Color EVR from the Inside Out" Electronics, April 27, 1970, pages 94–101.

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[57] **ABSTRACT**

An electronic video recording player is disclosed for converting images on a film into a composite video signal for application to a television receiver to be reproduced therein. To prevent damage to the film cartridge by tearing the film loose from the cartridge when the end of the film is reached, the film is provided with a sequence of clear and opaque portions in the synchronizing signal track thereof. The player includes a timing circuit coupled with a light responsive resistor to operate a film device stop solenoid when the film end sequence is sensed. If an attempt is made to restart the forward drive of the film in any forward mode following an automatic stop at the end of the film, the sequence of opaque and clear portions at the end of the film causes reoperation of the stop solenoid. A time delay circuit operates to prevent false operation of the stop solenoid when the film leader is first threaded through the player. Clear portions also may be inserted in the synchronizing track of the film between different program materials on the film. These clear portions are long enough to cause energization of the stop solenoid when the player is being operated in a play mode but are too short to cause energization of the stop solenoid when the player is being operated in fast-forward mode of operation.

10 Claims, 3 Drawing Figures



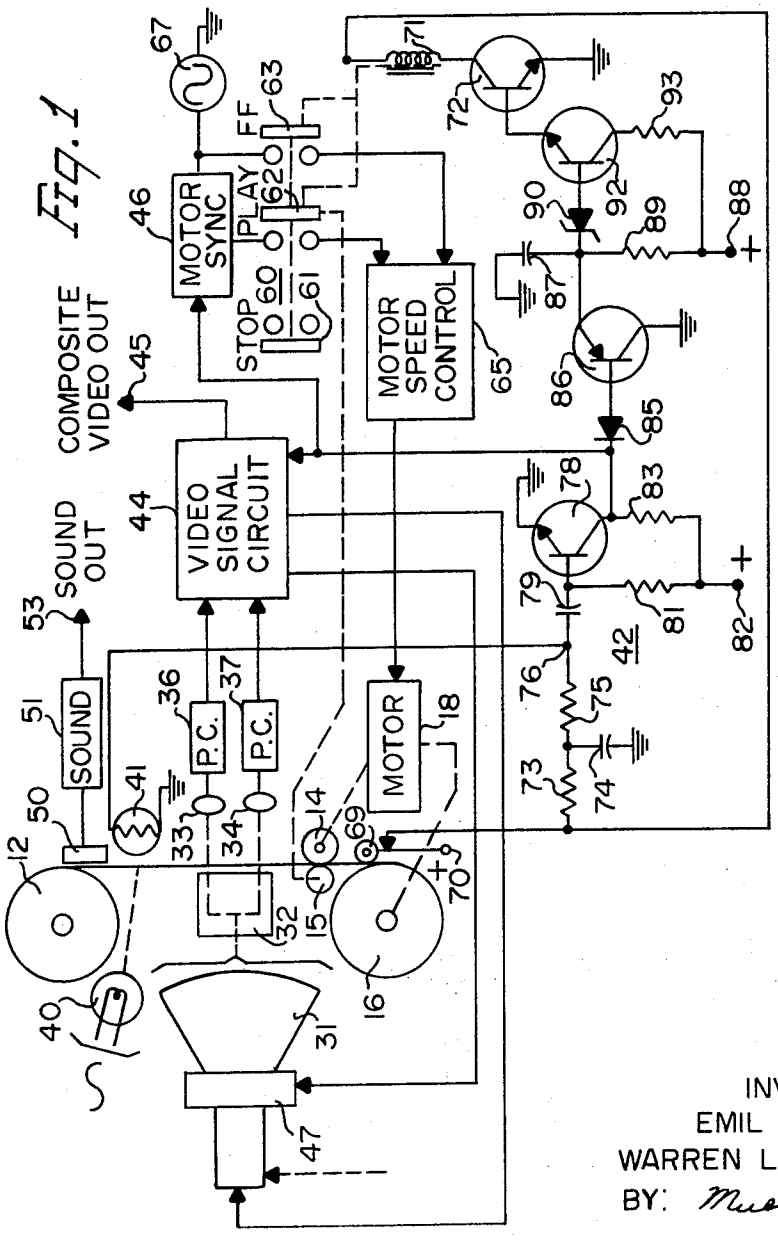


Fig. 1

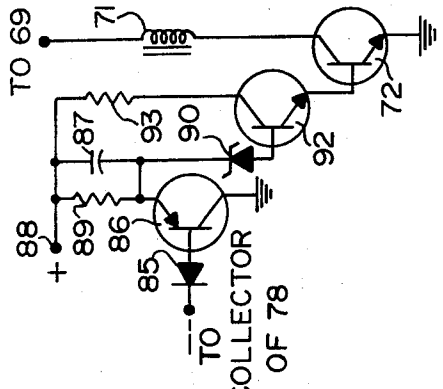


Fig. 2

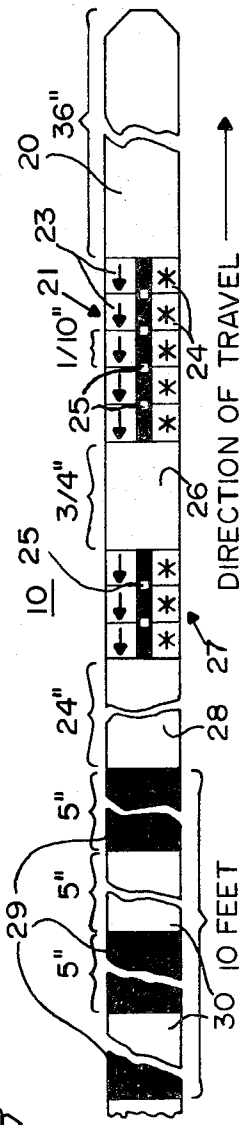


Fig. 3

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FILM FORMAT AND STOP CIRCUIT FOR AN ELECTRONIC VIDEO RECORDING PLAYER

BACKGROUND OF THE INVENTION

When an electronic video recording player is operated in a "fast-forward" mode of operation, it must be stopped prior to the end of the film to prevent the film from being torn from the film cartridge. To do this a long sync window has been inserted in the synchronizing track of the film near the end to produce a long pulse (compared with the normal synchronizing pulse). This long pulse then activated a fast-forward stop circuit to operate a fast-forward stop solenoid to stop the player. If, however, the operator of the player accidently attempted to place the player in its fast-forward or play mode of operation following such an automatic stop, the player would resume operation and the film still could be torn from the cartridge or stalling of the player could result. As a consequence, it is desirable to provide a film format and automatic stop operation which will prevent such accidental restarting of the player near the end of a film after it has been stopped under control of the fast-forward stop solenoid.

In addition, it is desirable to provide an automatic stop circuit which is nonresponsive during the leader or film threading operation, when a cartridge first is inserted into the player and the leader is being threaded through the tape driving mechanism to the take-up reel. Once the leader has been wound upon the take-up reel, however, it is necessary to cause the stop solenoid circuit to be readied for operation.

It further is desirable to be able to cause automatic stopping of the player in a play mode of operation between different program formats which might be recorded on the same channel of a film. If possible, the same stop solenoid system should be used for effecting such a stopping in the play mode of operation, but the solenoid must be nonresponsive to the passage of an end of program format when the film is being run through the player in its fast-forward mode of operation.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide an improved film format for an electronic video recording player.

It is an additional object of this invention to provide a film format having a synchronizing track with sections thereof having two different characteristics with the relative lengths of film having these different characteristics being utilized to control the formation of synchronizing pulses and to control the operation of automatic stop circuitry in a player for the film.

It is an additional object of this invention to provide a film format for an electronic video recording player which prevents erroneous starting of the player in a forward mode of operation at the end of a film.

It is a further object of this invention to provide an electronic video recording player with an improved automatic stopping circuit.

It is yet another object of this invention to provide an electronic video recording player with an automatic stop solenoid responsive to a particular film format for stopping the player in the information portion of a film automatically in response to a predetermined condition recorded on the film, with the solenoid being nonresponsive to this predetermined condition when the player is operated in a fast-forward mode.

It is still another object of this invention to provide an electronic video recording player with an automatic stop circuit operated by the output of a synchronizing track detecting device but nonresponsive to normal synchronizing signals and which stops the film in the player in response to prerecorded information on the film.

In accordance with a preferred embodiment of this invention, a film for an electronic video recording player has a leader portion, an information portion, and an end portion, with a synchronizing track extending the length of the film. This synchronizing track includes synchronizing window sections in the information portion of the film, with the synchronizing window sections having a first predetermined characteristic alternating with sections of a second predetermined characteristic (for example, clear and opaque portions respectively). The end portion of the film is encoded with a first predetermined length following the information portion and having the first predetermined characteristic throughout the length of the synchronizing track. This first length of the film end portion is several orders of magnitude longer than the length or width of the synchronizing windows and is followed by a second predetermined length of portions of film having the second characteristic alternating with portions of film having the first characteristic at least in the synchronizing track. Each of these alternating portions has a length which is at least an order of magnitude greater than the synchronizing window length.

In a more specific embodiment, the film also has a provision for separating different information sections in the information portion by a strip in the synchronizing track having the first characteristic. This strip is substantially longer than the synchronizing windows but is less than the alternating portions or the first predetermined length of the end portion of the film. This intermediate strip is employed in the player to effect an automatic stopping of the player when it is operated in its normal play mode of operation. The strip is of insufficient length to cause operation of the automatic stop mechanism of the player when it is operated in a fast-forward mode of operation.

An automatic stop circuit for interrupting the film drive in either the play or fast-forward mode of operations of the player is provided and responds to the detection of the portions of the synchronizing signal track having the first predetermined characteristic. Interval timing circuits are provided in the automatic stop circuit of the player to cause operation of the automatic stop circuit only after a predetermined uninterrupted interval of time of detection of the first characteristic on the film. The time intervals of the interval timing circuits are longer than the timing interval provided by passage of a synchronizing window, so that the stop circuit is nonresponsive to the synchronizing windows of a moving film.

The stop circuit is reset by detection of a portion of the synchronizing signal track having the second characteristic, so that the alternating pattern provided at the end of the film operates to reset and then enable for operation the automatic stop circuit to prevent false operation of the player at the end of a film. A time

delay circuit is provided in a more specific embodiment of the invention to substantially disable operation of the stop circuit for the time interval required to thread the leader portion of the film into the take-up reel of the player. This time delay circuit is reset upon removal of film from the player, so that it has no affect on the operation of the system once the initial time delay has been overcome.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a circuit diagram, partially in block form, of a preferred embodiment of the invention;

FIG. 2 is a circuit diagram of a modification of a portion of the circuit shown in FIG. 1; and

FIG. 3 depicts a film format for use with the system shown in FIG. 1.

DETAILED DESCRIPTION

Referring now to the drawing, the same reference numbers are used for the same or similar components in the several figures.

The apparatus and circuit shown in FIG. 1 functions to derive from a record medium signals representing image brightness information, signals represented by coded color information, signals representing synchronizing information, and signals representing accompanying sound. The brightness, color, and synchronizing signal information are shown as being applied to a video signal circuit to form a composite video output signal. This signal may be combined with the signal from a sound signal circuit and applied to a modulator to form a multiplex modulated carrier signal which is tunable on one channel of a standard television receiver. Or, of course, the video and sound signals may be directly applied to a cathode ray image reproducer and an audio frequency reproducing system for direct reproduction of the recorded information without going through the intervening processes of modulating and demodulating as occurs in the usual television transmission system.

The preferred form of the record medium as a photographic film, similar to conventional motion picture film. It will be apparent, however, from consideration of the following description that a record medium such as magnetic tape or an embossed strip also could be successfully operative within many aspects of the system.

In FIG. 1, the film 10 is drawn from a supply reel 12 by a capstan 14, against which the film 10 is pressed by a pressure roller 15, and is wound on a take-up reel 16. A motor 18 is used to drive the capstan 14, and the drives linking the capstan 14 and take-up reel 16 with the motor 18 may take any of a variety of conventional configurations.

The photographic film 10 which is to be used in conjunction with the player shown in FIG. 1 includes a first leader portion 20, which in FIG. 3 is illustrated as being clear. The leader portion 20 is followed by a first information portion 21 which may constitute a first program format. This first information portion 21 includes a first track or channel of video information frames 23 arranged in side-by-side relation with a second track or channel of video information frames 24. The frames 23 and 24 are separated in the central area of the film by a synchronizing track including synchronizing windows 25 located between each of the frames on the information tracks 23 and 24. These synchronizing windows 25 are in the form of clear or transparent areas of film separated by opaque portions of film, so that scanning the frames of the information portion 21 of the film can be synchronized by the player circuitry.

Following the first program format 21 on the film is a second clear or transparent area of film 26, which has a length considerably greater than the width of the synchronizing windows 25 provided in the synchronizing track. This clear portion 26 then is followed by a second information portion 27 which may be encoded with a second program format. If the film is to have a continuous or single information format from end to end, the clear portion 26 may be eliminated. It also should be noted that the information channels comprising the frames 23 and 24, illustrated in the information portion 21, may constitute two different black and white channels of information, or may comprise a luminance channel of information recorded side-by-side with a color information channel to comprise a complete color signal when both channels are reproduced simultaneously in the video signal circuits of the player.

At the end of the last information segment of portion of the film, an automatic stop sequence is provided as the end portion of the film and comprises a first clear section 28, which is substantially longer than the section 26 separating different information portions within the film. The section 28 then is followed by alternating sections of opaque and clear portions for the remainder of the film. The alternating sections 29 and 39 each are considerably shorter than the clear portion 28 but are substantially longer than the width of each of the synchronizing windows 25 formed in the film.

Sound tracks may be provided along one or both edges of the film 10 shown in FIG. 3 for providing magnetic recording of stereophonic sound information or for providing two different sets of sound information alternately usable with the images on the two channels of information recorded on the film 10.

It will be recognized that the representation of the film scanning apparatus of FIG. 1 is illustrated for clarity as longitudinally displaced, whereas actually the scanning apparatus is laterally positioned for scanning of the side-by-side images 23 and 24 on the film 10 as shown in FIG. 3. The raster generated by a cathode-ray-tube, flying-spot scanner 31 is projected through an optical splitter 32, so that the same raster image is projected through each of the frames 23 and 24 of the film 10. Associated lenses or collector prisms 33 and 34 focus the raster images on a pair of corresponding photo cells 36 and 37, the photo cell 36 providing electrical signals representing the video information of the frames 23 and the photo cell 37 providing electrical signals corresponding to the video information of the frames 24.

A continuously energized light bulb 40 provides a source of light which is guided by a suitable optical conductor device, such as a fiber optic light pipe, to the region of the film 10 opposite the synchronizing track having the synchronizing windows 25. As the synchronizing windows 25 pass the end of the optical conduction device, light passes through the windows 25 to impinge upon a light dependent resistor 41, lowering

its resistance each time it is illuminated. The change of resistance of the light dependent resistor **41** is applied through a synchronizing pulse amplifier circuit **42** to the video signal output circuit **44** and a motor synchronizing control circuit **46**.

The signals from the outputs of the photo cell **36** and **37** also are applied to the video signal circuit **44** which responds to all of the input signals applied to it to provide the composite video output signal on an output terminal **45**. The video signal circuit **44** also supplies an operating potential for the cathode of the cathode-ray flying-spot scanner **31** and supplies deflection signals to the deflection yoke **47** on the cathode-ray-tube **31** to cause a generation of the scanning raster. A magnetic pickup head **50** scans the sound track or tracks on the film **10** and is coupled to a sound circuit **51** which develops audio output signals on a terminal **53**. These audio signals may be combined with the output **45** of the video signal circuit **44** as part of a modulated composite television signal for reproduction by a standard television receiver.

Control of the particular mode of operation in which the player shown in FIG. **1** is placed is obtained from a pushbutton switch **60** having three pushbutton switch components **61**, **62** and **63** labeled "stop", "play" and "FF" (fast-forward), respectively. The switch **60** also may have other modes of operation, such as "rewind", "still", and the like if desired. The pushbutton switch **60** preferably is of the type in which depression of any one of the other pushbuttons automatically causes release of all of the pushbuttons, so that only one pushbutton circuit is engaged at any one time. This interrelation of the pushbuttons **61**, **62** and **63**, corresponding to the three modes of operation shown, is indicated by the dotted line interconnecting the pushbuttons.

Initially assume that the pushbutton **62** engages its contact, placing the player of FIG. **1** in its play mode of operation. When this occurs, a circuit is completed from the motor sync circuit **46** to a motor speed control circuit **65**, the output of which is connected to the motor **18** and controls its speed of operation. Alternating current operating potential for the motor **18** is obtained from a suitable source **67** connected to the input of the motor sync circuit **46** along the output of the synchronizing pulse amplifier circuit **42**. The combination of the output of the source **67** and the synchronizing pulses applied to the input of the motor sync circuit **46** from the amplifier **42** provide an output from the sync circuit **46** which causes the motor speed control circuit **65** to drive the motor **18** at a speed rotating the capstan **14** to continuously move the film **10** through the player at a speed of approximately 6 inches per second. It should be noted that when the play pushbutton **62** engages the contacts completing the circuit between the motor sync circuit **46** and the motor speed control circuit **65**, a mechanical link is completed to cause the pressure roller **15** and capstan **14** to engage one another causing the tape **10** to be firmly gripped therebetween and to be driven by the capstan **14**.

Upon initial threading of the film **10** on the take-up reel **16**, a roller switch **69** is engaged by the tape **10** and closes its contacts. This completes a path from a source of positive potential (not shown) applied on an input terminal **70** to one end of a solenoid operating coil **71**, the other end of which is connected to the collector of a normally nonconductive NPN transistor **72**, the emitter of which is connected to ground. With no film in the player, the switch **69** is opened, disconnecting the terminal **70** from the solenoid operating coil **71** and preventing its energization. The solenoid coil **71** operates an armature, indicated by dotted lines, to open the pushbutton contacts **62** and **63** of the pushbutton switch **60** whenever the solenoid coil **71** is energized. At this time, however, the solenoid has no affect on the circuit since the transistor **72** is nonconductive, opening the operating or energizing path for the coil **71**.

An RC time delay circuit including a resistor **73** and a capacitor **74** is connected between the roller switch **69** and ground. During the normal operation of the circuit, while the film portions bearing the video information are being pulled by the capstan **14** past the synchronizing light **40** and the light dependent resistor **41**, the time delay of the circuit **73**, **74** has been overcome and the capacitor **74** is fully charged. The potential at the junction of the capacitor **74** and the resistor **73** is applied through a resistor **75** to a junction **76** coupled to one end of the light dependent resistor **41**, the other end of which is connected to ground. The junction **76** also is connected to the base of a synchronizing pulse NPN amplifier transistor **78** through a capacitor **79**, which serves a dual function of operating as apart of an interval timer circuit to be described subsequently and also operates to couple the synchronizing pulses to the base of the transistor **78**.

Under normal conditions of operation, with no light impinging upon the light dependent resistor **41**, the potential at the junction **76** is approximately +20 volts (for +25 volts applied to the terminal **70**); and the capacitor **79** is charged to apply a forward biasing potential to the transistor **78**, rendering it conductive so that the potential on its collector is a relatively low potential. The junction between the base of the transistor **78** and the capacitor **79** also is coupled through a large value resistor **81** to a source of positive potential (not shown) applied to a terminal **82**. The sources of potential applied to the terminals **70** and **82** can be a common source, and the potential on the terminal **82** also is applied as a collector potential to the transistor **78** through a load resistor **83**.

When a synchronizing window is sensed by light passing through the window **25** and impinging upon the light dependent resistor **41**, the resistance of the light dependent resistor **41** drops, causing the potential on the junction **76** to drop (to approximately 10 volts for +25 volts on the terminal **70**). This drop is sudden and it is coupled by the capacitor **79** as a reverse bias pulse to the base of the transistor **78** turning it off. As a consequence, the potential on the collector of the transistor **78** rises and is applied as a positive synchronizing pulse to the video signal circuit **44** and the motor sync circuit **46**.

Although the junction of the capacitor **79** and the base of the transistor **78** is connected to the source of positive potential applied to the terminal **82** through the resistor **81**, the resistor **81** is of substantial magnitude; so that the charging of the capacitor **79** from the potential applied to the terminal **82** is very slow compared to the time duration of the passage of light through a synchronizing window **25**. After the

synchronizing window 25 has passed the beam of light from the lamp 40, the resistance of the light dependent resistor 41 once again rises since the light level impinging upon it is substantially reduced by the opaque portion of the synchronizing track. The potential at the junction 76 then rises, and this rise in potential again forward biases the transistor 78 into conduction, so that the potential on the collector of the transistor 78 drops to near ground potential, signifying determination of the synchronizing signal pulse.

The synchronizing signal pulses appearing on the collector of the transistor 78 also are applied through a diode 85 to the base of a PNP transistor 86, the collector of which is connected to ground and the emitter of which is connected to one terminal of a charge storage capacitor 87, the other terminal of which also is connected to ground. The charge storage capacitor 87 constitutes a timing capacitor for an interval timing circuit used to control conduction of the NPN transistor switch 72 which in turn controls energization of the solenoid coil 71. Normally, the transistor 86 is rendered conductive by the near ground potential appearing on the collector of the transistor 78; so that the timing capacitor 87 is maintained discharged through the emitter-collector path of the transistor 86.

When a synchronizing pulse renders the transistor 78 nonconductive; the transistor 86 likewise is rendered nonconductive; and the capacitor 87 commences charging from a source of positive potential (not shown) applied to a terminal 88 through a charging resistor 89.

The junction of the capacitor 87 and the resistor 89, which is coupled to the emitter of the transistor 86, also is coupled through a zener diode 90 to the base of an NPN interval timer output transistor 92, the emitter of which is connected to the base of the switching transistor 72, and the collector of which is connected through a collector load resistor 93 to the positive supply terminal 88.

The interval of time during which the transistor 86 is rendered nonconductive by a synchronizing pulse, caused by the movement of a synchronizing window 25 through the light beam emanating from the light bulb 40, is very short compared to the time constants of the circuit including the capacitor 87, charging resistor 89, and the value of the positive potential applied to the terminal 88. As a consequence, the capacitor 87 does not build up sufficient charge to overcome the zener voltage of the zener diode 90 during a synchronizing pulse. Upon the termination of the synchronizing pulse, when the transistor 86 once again is rendered conductive, the capacitor 87 once again is discharged to ground. Thus, the synchronizing pulses have no affect on the operation of the transistors 92 and 72, which both remain nonconductive.

Assume for the purposes of illustration that the film portion 21 has been moving past the synchronizing light circuit. At the end of this film portion, the three-fourths inch clear portion of film 26 separating the two program formats 21 and 27 of the information portion of the film then passes between the light source 40 and the light dependent resistor 41. During operation in the play mode of a typical electronic video recording player, the film is moving at approximately 6 inches per second. With the film format shown in FIG. 3, this section 26 constitutes three-fourths inches of clear film in the synchronizing track; so that the light dependent resistor 41 is continuously subjected to light from the light bulb 40 so long as this three-fourths inch portion 26 is passing between the light bulb 40 and the light dependent resistor 41.

The time constants required to charge the capacitor 87 to a point sufficient to overcome the zener potential of the zener diode 90 and forward bias the transistor 92 is selected to permit this charge to be reached prior to the time that the entire portion 26 has passed in front of the light dependent resistor 41 in the play mode of operation. As a consequence, the transistor 92 is rendered conductive, which in turn renders the transistor 72 conductive to cause a current path to be completed from the source 70 through the switch 69 and the transistor 72 to energize the solenoid coil 71. When this occurs, the solenoid operates and releases the pushbutton 62, thereby releasing the pinch roller 15 and disabling or stopping the motor through the motor speed control 65. Thus, the section of film 26 may be utilized with the player operating in a play mode of operation to cause an automatic turn off or stopping of the player upon termination of the first information portion or program format 21 of the film.

The section 26 may be utilized to separate different programs recorded on the same tape, so that continuous running from one program to the next will not occur. Of course, if such continuous operation of the entire length of film is desired, the clear section 26 would not be included in the film but information, including the synchronizing windows 25 separated by the opaque portions as indicated in the film sections 21 and 27, would extend throughout the length of film.

It should be noted that while the entire section 26 is shown in FIG. 3 as a clear portion, it only is necessary that the synchronizing track region is clear or transparent to effect the foregoing operation. This is true because only the synchronizing track controls the path of light between the light bulb 40 and the light dependent resistor 41.

The player in this stopped state of operation, however, requires some means for once again rendering the transistors 78 and 86 conductive to reset the automatic stop circuit so that depression of either the pushbutton 62 or the pushbutton 63 will cause a resumption of operation of the player. To effect such a resetting, even though the light dependent resistor 41 now is continuously exposed to light from the light bulb 40 through the now stopped portion of the film 26 which is between it and the light bulb 40, the capacitor 79 and resistor 81 are employed. Every time the potential at the junction 76 drops with the light dependent resistor 41 exhibiting a reduced impedance in response to light applied thereto, the capacitor 79 commences charging through the high value resistor 81 from the source applied to the terminal 82. The time constants of this latter charging circuit are selected to cause a forward biasing potential to be applied to the base of the transistor 78 after approximately one-half second.

When the transistor 78 conducts, the transistor 86 also conducts, discharging the capacitor 87. This causes the transistors 92 and 72 once again to be rendered nonconductive, and the solenoid coil 71 is deenergized. The pushbutton switches 62, 63 and 61,

of course, remain in their released position until one or these pushbuttons once again is manually depressed. Depression of the pushbutton **62** for example, then permits the player to resume playing the reproducing the film portion **27** which follows the clear strip or section **26**. As soon as an opaque portion of the synchronizing track causes the impedance of the light dependent resistor once again to rise, the potential of the junction **76** rises rapidly, charging the capacitor **79** and the initial condition of operation is established.

In FIG. **2**, there is shown a variation of the interval timer portion of the circuit comprising the transistor **86**, capacitor **87** and resistor **89**. In the circuit of FIG. **2**, the capacitor **87** is connected in parallel with resistor **89** between the terminal **88** and the emitter of the transistor **86**. With the transistor normally conductive, the capacitor **87** of FIG. **2** is charged to the value of the potential on terminal **88**, but the cathode of the zener diode is held near ground potential as in the circuit of FIG. **1**. When the transistor **86** of FIG. **2** becomes nonconductive, the capacitor **87** commences discharging through the resistor **89**; and when the potential at the junction of the capacitor **87** and the resistor **89** overcomes the zener potential of the diode **90**, the stop circuit operates as described previously. Whenever the transistor **86** conducts, the discharging of the capacitor **87** of FIG. **2** terminates and it is rapidly recharged.

The change of charge on the capacitor **87** of FIG. **2** is reflected in the form transients on the voltage supply connected to the terminal **88**, so that the circuit arrangement of FIG. **1** generally is preferred.

The operation of the circuit in the play mode during the film portion **27** is the same as that previously described for the film portion **21**. Until the portion **28** signifying the end of recorded information on the film is reached. The film portion **28** is a relatively long clear portion, shown as **24** inches in FIG. **3**; so that the circuit operates to cause energization of the solenoid coil **71** within the first three-fourths inches of the portion **28** when the player is being operated in the play mode of operation. When this occurs, the player once again terminates operation.

If, after resetting of the circuit by the operation of the one-half second timing circuit comprising the resistor **81** and the capacitor **79**, the play pushbutton **62** once again is depressed, the player continues operating in the forward direction until the entire film portion **28** moves past the light dependent resistor **41**. This occurs since, as stated previously, continued application of light to the resistor **41** once the capacitor **79** has reset the interval timing circuitry **86, 87, 90** and **92** has no affect on the operation of the circuit. The first five-inch opaque portion **29**, however, reestablishes control of the circuit from the junction **76**; so that at the next following clear portion **30**, the potential at the junction **76** once again drops upon the reduction in potential of the light dependent resistor **41**. This then causes the foregoing automatic stop sequence of operation once again to take place. If for some reason the operator of the player again depresses the pushbutton **62**, the next opaque section **29** followed by the next clear section **30** causes operation of the solenoid coil **71**, turning off the player. Sufficient alternating sections are provided to provide a clear warning to the operator that he is at the end of the tape and that a rewind of the film is necessary so that the player is protected against overrunning in the forward direction in the play mode of operation.

Now assume that the player again already is operating and reproducing the information portion **21** of the tape. If the operator then decides that he wishes to skip to another portion of the tape under a fast-forward mode of operation, the operator depresses the fast-forward pushbutton **63**. As stated previously, a conventional mechanical interlock in the pushbutton switch mechanism **60** causes release of the play pushbutton **62** at this time; so that the circuit from the motor sync circuit **46** to the motor speed control circuit **65** is broken. Closure of the contacts by depression of the pushbutton **63**, however, causes the signal from the source **67** to be applied directly to slow the motor speed control circuit **65**. Since no sync pulses are now applied through the motor sync circuit **46** slow down the operation of the motor, the motor speed control **65** causes the motor **18** to operate at a substantially higher rate of speed. In a typical electronic video recording player, this fast forward rate of speed is **120** inches per second.

Although the motor speed control indicated in FIG. **1** is illustrated as being solely an electrical control, it should be apparent that the motor speed control also could be effected by interposing different mechanical drive linkages between the motor **18** and the take-up reel **16** and/or capstan **14**. The particular details of the mechanism and circuitry for effecting the variable speed motor operation, however, have no affect on the operation of the automatic stop circuitry, so that they have not been shown.

When the play pushbutton **62** is released, the mechanical interlock between it and the pinch roller **15** causes the pinch roller **15** to be released, so that the film may be moved past the capstan **14** and no longer is driven by the capstan **14**. In the fast-forward mode rotation of the take-up reel **16** pulls the film from the cartridge **12**.

The time constant of the circuit **89** is such that with the film **10** moving at the higher fast-forward speed (about 20 times as fast as it moved during the play mode of operation), the length of the clear portion **26** is insufficient to provide a time interval sufficient to permit the charge on the capacitor **87** to reach the potential necessary to overcome the zener potential of the diode **90**. As a consequence, during the fast-forward mode of operation, the clear portion **26** does not affect the conductivity of the transistors **92** and **72**, which remain nonconductive.

This is not true, however, when the **24** inch clear portion **28**, signifying the end of the film, is reached since the length of the portion **28** is selected to be sufficient even with the player operating in a fast-forward mode of operation to permit the charge on the capacitor **87** to reach a potential sufficient to overcome the zener potential of the zener diode **90**. The transistors **92** and **72** then are rendered conductive to cause energization of the solenoid coil **71**. When this occurs, the operation of the solenoid causes the release of the pushbutton **63** and the motor speed control circuit **65** stops the motor **18**.

Thus, the automatic stop circuit shown in the drawing operates as a "play-stop" circuit to cause a stopping of the film in response to separation intervals **26** placed in the central portions of the film to separate different

film program materials from one another. The same circuit also operates in either the play mode or the fast-forward mode to cause an automatic stopping of the film drive mechanism when the end of the film is reached as signified by the 24 inch clear portion **28**.

If either of the fast-forward or play pushbuttons **63** or **62** are depressed following resetting of the circuit by the one-half second timer, comprising the resistor **81** and the capacitor **79**, the alternating 5 inch opaque and clear portions **29** and **30** of the film **10** function in either the fast-forward mode or the play mode to cause a reenergization of the stop solenoid coil **71**. This reenergization thereupon causes release of the push-buttons **62** and **63**, as described previously; so that an accidental restarting of the player in either its fast-forward or play mode at or near the end of the film is prevented. The 10 feet of these alternating 5 inch portions indicated in FIG. **3** is arbitrarily selected to provide a sufficient number of these portions to cause repeated operation of the solenoid coil **71** to clearly indicate to the operator of the player that he is at the end of the film. The particular number of alternating sections **29** and **30** and thus the length of this terminal portion of the film may be varied in accordance with the particular needs of the users of the system. As with the section **26**, it only is necessary that the synchronizing track region has the respective clear and opaque portions of the sections **28**, **29** and **30** to effect the foregoing operation.

The foregoing description has covered both the operation in the play mode and the fast-forward mode once the film is already in a playing position. A problem may arise, however, in a false operation of the stop solenoid during or just following the threading of the leader **20** onto take-up reel **16** due to a change in the detected light level following the passage of the leader **20** through the optical system. When the end of the leader **20** attached to the information portion **21** passes the light dependent resistor **41**, a change in the light level passed by the synchronizing track could cause false operation of the automatic stop circuit.

In conventional electronic video recording players, the leader **20** of the film **10** is self-threading from the film supply cartridge **12** to the take-up reel **16**, the time required for the threading operation and for the passage of the leader, which typlically is 36 inches long, past the resistor **41** is approximately 3 seconds. To prevent false operation of the stop circuitry during the leader threading operation of the player, a 3-second RC time delay circuit comprising the resistor **73** and the capacitor **74** has been provided. When the leader first is fed through the film guide mechanism it closes the roller switch **69** completing the operating circuit to the solenoid coil **71**. As stated previously, so long as the transistor **72** remains nonconductive the solenoid coil **71** is unenergized and ineffective.

Since the time required to wind the leader on the take-up reel **16** from the time the leader initially closes the switch **69** is approximately 3 seconds, the time constant of the RC circuit **73**, **74** is selected to permit the potential at the junction **76** only to reach a low voltage (of the order of 2 volts) by the time the completion of the leader winding is effective. Thus, when the beginning of the information portion **21** of the film commences moving past the optical system the potential at the junction **76** has not built up to a sufficient level to permit a reduction in the impedance of the light dependent resistor **41** to reverse-bias the transistor **78** long enough to enable the interval timer **87**, **89**, **92**. The potential on the junction **76** at this time, however, is high enough to to permit the transistor **78** to respond to the short interval synchronizing pulses caused by the passage of the synchronizing windows **25** during the beginning of the film portion **21**.

During the initial portion of the playing of the film section **21**, however, the capacitor **74** becomes charged to its full potential, thereupon causing the potential at the junction **76** to be at its normal operating value, as discussed previously. The capacitor **74** is not charged from the source applied to the terminal **82** when the switch **69** is open due to the fact that the capacitor **79** becomes fully charged through the resistor **81** and operates as a DC blocking capacitor to prevent charging of the capacitor **74** beyond a minimal value. The relative values of the capacitors **74** and **79** are such that the capacitor **74** has a capacitance more than 2 orders of magnitude greater than that of the capacitor **79**. For example, in a typical application, the capacitor **74** has a value of 220 microfarads and the capacitor **79** has a value of 1 microfarad. Thus, the 3 second time constant provided by the resistor **73** and the capacitor **74** insures that no false operation of the solenoid coil **71** will take place during and just following the time that the leader **20** is passing through the system and being wound on the take-up reel **16**.

It makes no difference whether the leader **20** is of clear or opaque material in the synchronizing signal track region which is detected by the resistor **41**. As shown in FIG. **3**, the section **20** constituting the leader **20** of the film **10** is shown as being clear. This permits the capacitor **79** to remain charged from the source **82** through the resistor **81**, causing the transistor **78** to be rendered conductive. The slow build-up of charge on the capacitor **74** does not substantially change this relationship even for an opaque leader during the time that the leader **20** is between the light bulb **40** and the light dependent resistor **41**. Once the capacitor **74** has become fully charged, following the threading of the leader **20**, normal operation of the automatic stop control circuit for energizing the solenoid coil **71** takes place, as described previously.

In a typical electronic video recording player the typical time constants for the circuit are (1) 3 seconds for the RC delay circuit comprising the resistor **73** and capacitor **74**, (2) approximately one-half second for the reset circuit **79**, **81** to render the transistor **78** conductive with continuous light impinging on the light dependent resistor **41**, and (3) the time required to charge the capacitor **87** to a potential sufficient to trigger the transistors **92** and **72** into conduction is selected to be approximately 100 milliseconds. The time duration of the synchronizing signal pulses caused by passage of the synchronizing windows **25** during the play mode of operation of the player is approximately 10 microseconds.

In a system which has been built and operated, values of the circuit components are given by the table below:

Resistor 73	15 kilohms
Resistor 75	18 kilohms
Resistor 81	1 megohm
Resistor 83	27 kilohms

Resistor 89	3.9 kilohms
Resistor 93	180 ohms
Capacitor 74	220 microfarads
Capacitor 79	1 microfarads
Capacitor 87	47 microfarads
Voltage at terminal 70	25 volts
Voltage at terminal 82	25 volts
Voltage at terminal 88	20 volts

The dimensions of the film format which has been used in conjunction with the circuit having the component values given above are shown in FIG. 3. In conjunction with the film, it should be noted that the clear and opaque portions which are indicated need only be made on the synchronizing signal track or track region since it is only this track which is detected to control the circuit operation which has been described. As stated previously, the leader 20 may be either opaque or transparent.

In addition it should be noted that it is not necessary to employ a film which has light-transparent and light-opaque portions for interrupting a beam of light; but the beam of light and the light responsive resistor 41 could be located on the same side of a film at an angle to one another, with the film constituting reflective and nonreflective strips corresponding to the clear and opaque portions shown in FIG. 3. Similarly, the operation of the circuit could be effected by the use of a magnetic record track and a magnetic pickup device instead of the light sensitive or optical system which has been shown. The circuit operation would be the same in any case upon the detection of the two different characteristics of the film in the synchronizing track.

We claim:

1. For use in an electronic video recording system, a film having a leader portion, information portion, and an end portion, with the information portion having a synchronizing track including synchronizing window sections of a first predetermined length and having a first predetermined detectable characteristic alternating with sections of a second predetermined length and having a second predetermined detectable characteristic, the end portion of said film having a synchronizing track region aligned with the synchronizing track of the information portion and the end portion of said film comprising:

a third predetermined length of film having one end attached to the end of the information portion of said film and having said first predetermined detectable characteristic throughout the length of the synchronizing track region therein, said third predetermined length being substantially longer than said first and second predetermine lengths;

a fourth predetermined length of film attached to the other end of said first predetermined length and including in the synchronizing track region thereof portions of film having said second detectable characteristic alternating with portions of film having said first detectable characteristic, each of said alternating portions having a length substantially greater than said first predetermined length.

2. The combination according to claim 1 wherein said third predetermined length is more than an order of magnitude greater than said first predetermined length of each of said alternating portions of said fourth predetermined length of film is at least an order of magnitude greater than said first predetermined length.

3. The combination according to claim 1 wherein the information portion of said film is divided into at least two sections, with said sections of said information portion being separated by a separating portion of film, at least the synchronizing track region of which has said first predetermined detectable characteristic, said separating portion of film having a fifth predetermined length at least an order of magnitude greater than said first predetermined length and approximately an order of magnitude less the said third predetermined length of film.

4. The combination according to claim 2 wherein said first and second predetermined detectable characteristics are optically detectable characteristics, one of which is provided by a transparent area of said film and the other of which is provided by an opaque area of said film.

5. In an electronic video recording player for converting images recorded on film into electrical signals fro reproduction by a television receiver, the film having a leader portion, an information portion, and an end portion with a synchronizing track region extending the length thereof, the leader and end portions of said film having first and second predetermined lengths, respectively, with the synchronizing window sections having a third predetermined length substantially less than said first and second predetermined lengths and having a first predetermined detectable characteristic separated by sections having a fourth predetermined length less than said first and second predetermined lengths and having a second predetermined detectable characteristic, with the end portion of the film including a first section adjacent the information portion and having said first detectable characteristic throughout the length of said synchronizing .rack region, said first section followed by a predetermined number of additional sections having said second predetermined detectable characteristic alternating with additional sections having said first predetermined detectable characteristic in the synchronizing track region thereof, the player including means for detecting the

6. The combination according to claim 5 wherein said control means includes a solenoid, the operation of which disables said drive means, said solenoid having a normally nonenergized operating coil with first and second ends;

first and second voltage supply terminals for connection across a DC supply;

film responsive switch means connected between said first voltage supply terminal and the first end of said operating coil; and

electronic switch means connected in series between said second voltage supply terminal and the second end of said operating coil;, said film responsive switch means being closed in response to the presence of film in said player;

said electronic switch means being normally nonconductive and being rendered conductive in response to said stop input signal to thereby complete an energizing path through said operating coil causing energization thereof to operate said solenoid, whereupon said drive means is disabled.

7. The combination according to claim 6 wherein the first circuit means includes a transistor having first,

second, and control electrodes, with the first and second electrodes thereof being connected in series circuit between said first and second voltage supply terminals, said first electrode providing an output signal at said first level with said transistor rendered conductive and providing an output signal at said second level with said transistor being rendered nonconductive, said detecting means being coupled with the control electrode of said transistor to cause said transistor to be rendered nonconductive with said detecting means detecting a section of said film having said fit detectable characteristic.

8. The combination according to claim 6 wherein said first voltage supply terminal is coupled with a source of DC operating potential and said second voltage supply terminal is connected to a point of reference potential, and further wherein said delay circuit means includes an RC time delay circuit connected between said point of reference potential and said film responsive switch means and providing a predetermined time delay corresponding to the time interval required to thread said leader portion of said film through said player upon initiation of operation of said player; and third circuit means coupling said RC delay circuit with said second interval timer means for causing said second predetermined time interval to be less than said first predetermined time interval for a period of time determined by time delay of said RC time delay circuit, said time delay being selected to substantially equal to the length of time required for said leader portion of said film to pass said detecting means upon initiation of operation of said player.

9. The combination according to claim 8 wherein said first and second detectable characteristics of said film are first and second different light transmitting characteristics, the player including a source of light directed on said synchronizing track; the first circuit means includes a transistor having collector, base, and emitter electrodes, with said collector connected through a collector load impedance to said first supply terminal and also connected to the input of said first interval timer means; said detecting means includes a light dependent resistor connected between said point of reference potential and a first junction and located to respond to light directed on said synchronizing track; said second interval timer means includes a first capacitor;, connected between said first junction and the base of said transistor and resistance means connected between the base of said transistor and said first supply terminal; and said RC time delay circuit includes first and second resistors connected together at a second junction and connected in series in the order named between said film responsive switch means and said first junction and a second capacitor connected between said point of reference potential and said second junction.

10. The combination according to claim 9 wherein said electronic switch means comprises a second transistor having base, collector, and emitter electrodes, with the collector-emitter path connected in series between the first end of said operating coil and said point of reference potential, said second transistor normally being non conductive and being rendered conductive in response to said stop input signal from said first interval timer means to complete an energizing circuit for said operating coil from said first supply terminal through said film responsive switch means said operating coil, and said second transistor to said point of reference potential.

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