United States Patent

Gallina

[15] **3,700,319**

[45] **Oct. 24, 1972**

[54] **CONTROL CIRCUIT FOR SINGLE FRAME FILM ADVANCE AUDIO PROJECTOR**

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[22] Filed: **Jan. 12, 1971**

[21] Appl. No.: **105,891**

[52] **U.S. Cl.**.....**353/15,** 250/214 R, 307/311, 307/252 B

[51] **Int. Cl.**.....**G03b 31/00,** H01j 39/12, H03k 3/42

[58] **Field of Search**.....353/15, 19, 16, 17, 18; 250/214 R; 307/311, 252 B

[56] **References Cited**

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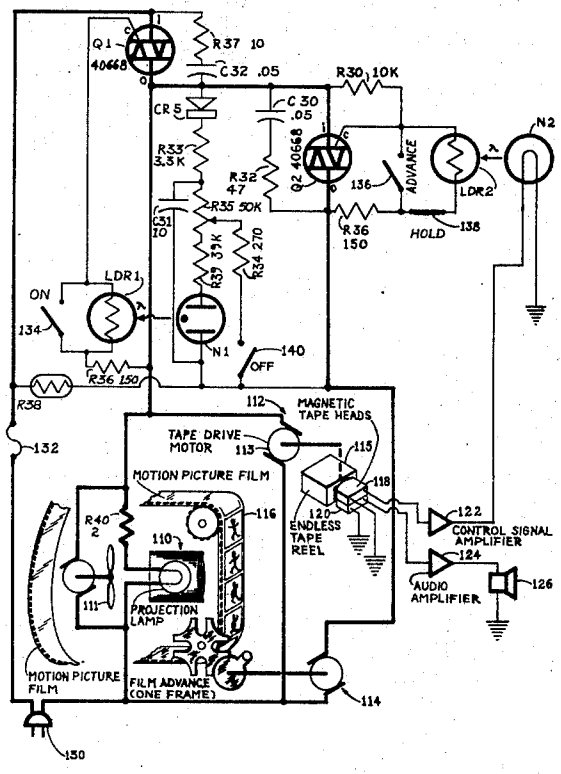
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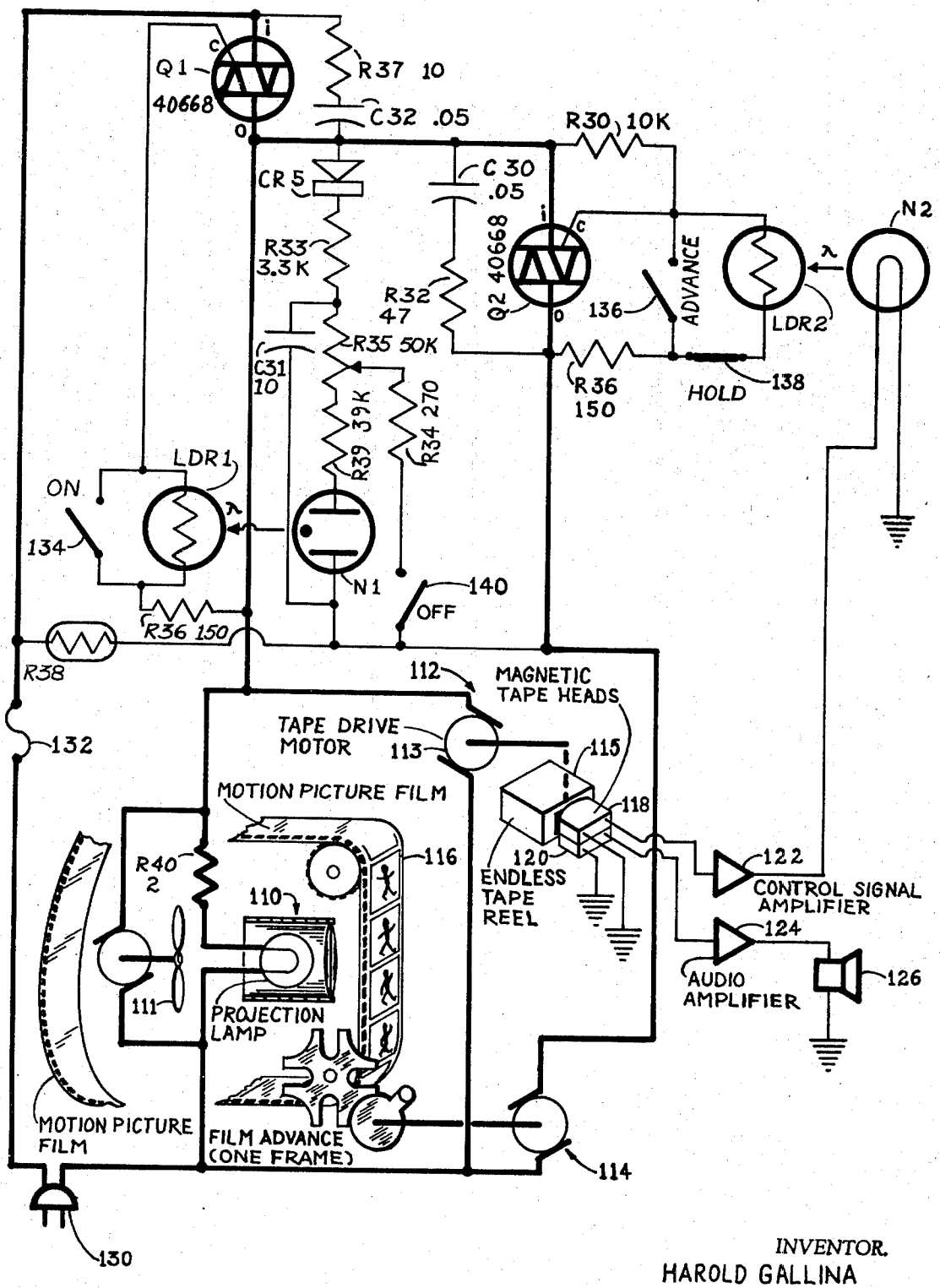
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[57] **ABSTRACT**

A control circuit for an audio-visual projector of the type wherein a dual track magnetic tape recording provides an audio presentation and control signal bursts for advancing a filmstrip in single frame sequence in predetermined synchronism with said audio presentation. The projector is turned on by manual operation of a momentary contact switch; this renders conductive a main semiconductive switch which energizes the projector lamp, the tape drive motor, and, via a diode, a first circuit control bulb and a storage capacitor in parallel with said bulb. Light from the bulb is sensed by a first photoconductor in parallel with the manual switch. The first photoconductor assumes a lowered impedance, thereby to maintain the main semiconductive switch (and hence the projector lamp, tape drive motor, and first bulb) energized so that the first frame of the filmstrip is projected and the audio presentation is heard. Each burst from the control track of the audio tape advances the filmstrip one frame as follows: the burst (after amplification) briefly energizes a second circuit control bulb; this illuminates (and lowers the impedance of) a second photoconductor, thereby to render conductive a second semiconductive switch which energizes the projector's geneva film drive mechanism. The second semiconductive switch shunts the first circuit control bulb and diode but does not extinguish the first bulb when turned on briefly because the capacitor, having been charged, supplies current to maintain the first bulb on during film advance intervals. However at the end of the audio visual presentation, a long control burst is provided which turns on the second semiconductive switch long enough to cause the capacitor's charge to dissipate, whereby the first control bulb turns off, interrupting the latching action of the circuit associated with the main semiconductive switch so as to turn off the entire projector.

10 Claims, 1 Drawing Figure





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CONTROL CIRCUIT FOR SINGLE FRAME FILM ADVANCE AUDIO PROJECTOR

CROSS-REFERENCES TO RELATED APPLICATIONS

The present invention is an improvement over and/or is related to the inventions of the following applications : U.S. Pat. No. 3,252,372, issued May 24, 1966 to the present inventor for Audic-Visual Reproduction Device. U.S. Pat. No. 3,552,234, issued Jan. 5, 1971 to the present inventor for Film Drive Mechanism. Applications, Ser. Nos. 25,707 now U.S. Pat. No. 3,669,531, 25,805, 31,071, and 31,072 now U.S. Pat. No. 3,662,936, all filed Apr. 6, 1970 by D. A. Youngblood for Combination Visual and Sound Apparatus.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an audio-visual projector of the type wherein a filmstrip is projected in single frame sequence in synchronism with an audio presentation. The audio presentation is derived from one track of a dual-track tape recording; the other track provides control signals at selected times for advancing the filmstrip in single frame sequence. The present invention comprises a control circuit responsive to said control signals for sequencing the filmstrip in response to relatively short "advance" control signals and turning off the entire projector when a relatively long "turn-off" control signal is supplied at the end of the audio-visual presentation.

2. Description of the Prior Art

Heretofore, projector control circuits of the type described were relatively complicated and incorporated electro-mechanical relays which are undesirable in a projector because of their weight, bulk, expense, and lack of reliability. Although known vacuum tube and semiconductive circuits can be used to replace relays, such circuits also are undesirable. Vacuum tube devices are at least as heavy, bulky, unreliable, and subject to mechanical shock as relays. Semiconductive circuits do not provide a high degree of electrical isolation between the control circuitry and audio circuitry of the projector, on the one hand, and the alternating current power handling circuitry thereof on the other hand. A high degree of electrical isolation in this application is desirable so that the breakdown of a semiconductor device will not connect the alternating current source to the relatively delicate control and audio circuitry where damage, fires, and shocks might occur. In addition, the aforementioned high degree of isolation is required by various governmental, quasi-governmental, or governmental-approved regulating agencies.

Accordingly, one object of the present invention is to provide a novel control circuit which overcomes all the foregoing disadvantages, i.e., provides a novel, reliable, economical, rugged audio projector control circuitry in which a high degree of isolation is provided between the power handling circuitry and the audio and control circuitry of the projector. Other objects of the invention will become apparent from the ensuing description.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE of drawing shows a schematic diagram of the control circuit of the present invention, together with a pictorial presentation of closely associated audio projector components. Exemplary component values or identifications are indicated in the drawing, with resistor values being indicated in ohms and capacitor values in microfarads.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The control circuitry shown in the drawing is designed to operate three main components of the projector: a projector lamp **110**, and an audio tape player **112**, and a geneva type single frame film advance mechanism **114**.

Lamp **110** is conventional and is arranged to project light through whichever frame of a filmstrip **116** is positioned in the projector's framing aperture. Filmstrip **116** is preferably is endless and is mounted in a cartridge of the type shown in the aforementioned Youngblood applications. Lamp **110** is in series with a life-prolonging resistor **R40** and is cooled by a fan **111**.

The audio tape player **112** is connected in a parallel circuit with lamp **110** and comprises a motor **113** arranged to operate an audio cartridge **115** of the type having an endless magnetic tape mounted therein, which tape has a dual track recording thereon. Dual heads **118** and **120** are arranged to convert the respective signals recorded on the two tracks of the tape to respective signals which are sent to respective control signal and audio amplifiers **122** and **124**. Preferably these amplifiers are energized from the same circuit as the tape player **112**. The output of audio amplifier **124** is fed to a loudspeaker **126**.

The audio presentation which is recorded on the control track of the audio tape in cartridge **115** comprises a programmed series of short "advance" bursts (preferably 0.2 second) of a control tone (preferably 1kHz), each of which directs the control circuitry to cause the filmstrip to advance to the next frame. At the end of the audio presentation, a relatively long "turn-off" burst (preferably 2.5 seconds) is provided which directs the control circuitry to turn off the entire projector.

Details of one preferred film advance mechanism **114** are shown in applicant's aforementioned U.S. Pat. No. 3,552,234. Each time mechanism **114** is energized, it causes the filmstrip to advance one frame.

In the actual control circuitry now to be described, the heavier lines constitute the main power connections of the projector while the lighter lines constitute control circuit connections.

The projector is energized, via plug **130**, from a 115VAC source, one terminal of which is connected, via fuse **132**, to the line electrode *i* of a main semiconductive switch comprising triac **Q1**. The load electrode *o* of triac **Q1** is connected to the projector lamp **110** and motor **113** for tape cartridge **112**. The bottom terminals of lamp **110** and motor **113** are returned to the other side of the AC source.

The load electrode of triac **Q1** also is connected to the line electrode *i* of a second semiconductive switch comprising triac **Q2**. The load electrode *o* of triac **Q2** is

connected to the film advance mechanism **114**; the bottom terminal of mechanism **114** also is returned to the other side of the AC line.

As is well known, a triac normally provides a very high impedance between the line and load electrodes thereof, but this changes to a very low impedance when the triac's control electrode (*o*) is connected to its load electrode. The control electrode of triac Q1 is connected to its load electrode thereof via a series circuit comprising (1) combination of a momentary contact ON switch **134** and a Light Dependent Resistor or photoconductor LDR1, and (2) a resistor R36. The control electrode of triac Q2 is connected to its load electrode *o* via a series circuit comprising (1) the parallel combination of a momentary contact ADVANCE switch **136** and a second light dependent resistor LDR2 and (2) a resistor R36. In series with LDR2 is a momentary release HOLD switch **138**.

The line electrode of triac Q1 is connected to its load electrode via a series circuit comprising resistor R37 and capacitor C32. Similarly, the line electrode *i* of triac Q2 is connected to its load electrode *o* via a series circuit comprising capacitor C30 and resistor R32.

The load electrode of triac Q1 is further connected to the upper terminal of the film advance mechanism **114** via the components in the series path comprising diode CR5, resistor R33, potentiometer R35, resistor R39, and gas lamp N1. A capacitor C31 is in parallel with the series combination of R35, R39, and N1. The wiper terminal of potentiometer R35 is connected to the upper terminal of film advance mechanism **114** via resistor R34 and an OFF switch **140**.

When energized, N1 provides light and thereby illuminates LDR1. Similarly, an incandescent lamp N2, when energized by the output of control signal amplifier **122**, illuminates LDR2.

A varactor R38 of the type made of silicon carbide and sold under the trademark "Thyrite" is connected between one side of the AC line and the top electrode of film advance mechanism **114**; R38 suppresses spurious radio frequency signals which are picked up by the control circuit.

OPERATION OF THE PREFERRED EMBODIMENT

The operation of the circuit will be described according to a normal operating sequence. In the initial conditions, triacs Q1 and Q2 and nonconductive, lamps N1 and N2 are off, and, by reason of the foregoing, none of the operating elements **110**, **113**, or **114** of the projector are energized. Thus the projector screen will be dark and no sound will emanate from speaker **126**.

The projector is turned on by manual operation of ON switch **134**. This connects the control electrode of Q1 to the line electrode thereof via a relatively low impedance path, rendering Q1 conductive. This applies substantially the full line voltage to the load electrode of Q1. Projector lamp **110** thereupon is energized and the audio recording in tape player **112** is heard from speaker **126**.

The line voltage present at the load electrode of Q1 is also applied, via CR5, R33, R35, and R39, to N1. This causes N1 to illuminate LDR1, which assumes a lowered impedance and maintains a low impedance path between the control and load electrodes of Q1 even after ON switch **134** is released. The circuit including Q1, N1, and LDR 1 thus constitutes a "latch" circuit which holds the entire projector on even after switch **134** is released.

The AC voltage at the load electrode of Q1 is half-wave rectified by CR5 so that a DC voltage appears across R35, R39, and N1. This DC voltage charges C31.

The line voltage at the load electrode of Q1 is also applied to the line electrode of Q2, but since Q2 is in its high impedance state, it will not supply any significant voltage at its load electrode.

As soon as the audio presentation is begun, a prerecorded relatively short "advance" burst on the control track of the audio tape recording is supplied to amplifier **122**. After suitable amplification (and optionally, rectification, filtering, and level stabilization), a signal will energize and thereby illuminate N2 for the duration of the control burst (preferably **0.2** second). Light from N2 will illuminate LDR2, which will thereupon assume a lowered resistance, connecting the control and load electrodes of Q2 so as to turn on Q2 for the 0.2 second interval. The load electrode of Q2 is thereupon energized with the full AC line voltage, thereby energizing film advance mechanism **114** which advances the filmstrip from an initial "black" frame to the first or developed frame as soon as the projector is started.

Since Q2 is connected in shunt with the circuit elements comprising CR5, R33, R35, R39, and N1, these circuit elements will be bypassed and thereby removed from any source of electrical energization during each short control burst. However the light provided by N1 will not cease since the charge on C31 will continue to energize N1 (via R35 and R39) during each film advance interval. CR5 prevents discharge of C31 through Q2.

During the audio-visual presentation, each subsequent advance burst on the control track of the audio tape will similarly advance the filmstrip until the end of the audio tape and filmstrip is reached. At this time a relatively long "turn-off" burst (**2.5** seconds) will be provided, turning on N2 and hence Q2 for a relatively long interval. The CR5–N1 circuit will be bypassed by Q2 for a sufficiently long interval to allow the charge on C31 to dissipate sufficiently so that N1 will become extinguished. This will terminate the supply of light to LDR1, which will reassume a relatively high impedance and thereby turn-off Q1 and the entire projector. Also, the turn-on of Q2 will energize film advance mechanism **114** so that filmstrip will be advanced to the initial black frame so as to be ready for the next program presentation.

If it is desired to turn off the projector manually prior to the completion of an audio-visual program, momentary contact OFF switch **140** is actuated, thereby bypassing N1 and C31 so that the latch circuit comprising Q1, N1 and LDR1 will be deactuated.

If during the presentation of a program, the audio presentation is out of synchronism with the visual presentation, correction can be accomplished by operating either the ADVANCE switch **136** or the HOLD switch **138**. The ADVANCE switch **136** connects the control electrode of Q2 to its load electrode, thereby actuating film advance mechanism **114** and advancing the filmstrip one frame each time switch **136** is

operated. Care must be taken to operate switch **136** briefly in order to avoid turning off the entire projector however. Operation of the HOLD switch **136** disables the LDR2 circuit, thereby allowing the audio presentation to advance while preventing the filmstrip from being sequenced.

While the above description contains many specificities, these should not be construed as limitations upon the scope of the invention but merely as an exemplification of one preferred embodiment thereof. The true scope of the invention is indicated by the subject matter of the appended claims and the legal equivalents thereof.

I claim:

1. In combination:

a. a source of electrical energy, an electrical load, and switch means having a control terminal for selectively connecting said source to said load in response to a predetermined electrical input at said control terminal,

b. a source of light connected to receive energy from said electrical source and thereby provide light output when said switch connects said electrical source to said load,

c. electrical storage means connected to accumulate and store a charge when said light source receives electrical energy,

d. light responsive means positioned to receive light when provided by said light source and in response thereto supply said predetermined electrical input to said control terminal of said switch means, and realtively

e. means for selectively substantially interrupting the supply of electrical energy from said electrical source to said light source without interrupting the supply of electrical energy to said load.

2. The combination of claim **1** wherein said (e) means comprises means for interrupting the supply of electrical energy to said light source for two alternative intervals, one interval being long anough to allow said storage means to discharge sufficiently to extinguish said light source, and the other interval being shorter than necessary for said storage means to discharge sufficiently to extinguish said light source.

3. The combination of claim **1** wherein said (e) means comprises means for selectively shunting said light source.

4. The combination of claim **1** wherein said source of electrical energy is an alternating current source, said switch means is a triac, said source of light is connected to one terminal of said triac via a diode, and said storage means is a capacitor connected in shunt with said source of light.

5. The combination of claim **2** wherein said load comprises an optical projector and an audio playback unit, and wherein said (e) means comprises a recording in said playback unit arranged to supply alternatively a relatively short and a relatively long control signal, and means responsive to said control signals for interrupting said supply of electrical energy for intervals substantially equal to the temporal width of each received control signal.

6. In an audio projection apparatus of the type wherein a recorded control signal is provided in synchronism with an audio-visual presentation for sequencing the visual part of said presentation by means of a relatively short control signal, and turning off said apparatus when said presentation is terminated by means of a relatively long control signal, a control circuit comprising:

a. a source of electrical energy and an electronic switch for selectively connecting said electrical source to operate the projection lamp and audio playback unit of said apparatus in response to a predetermined electrical input to said electronic switch,

b. light means connected to receive energy from said electrical source and thereby produce light in response to the connection of said electrical source to said lamp and said playback unit,

c. electrical storage means connected to accumulate and store a charge in response to the connection of said electrical source to said lamp and said playback unit,

d. light responsive means positioned to receive light when provided by said light source and, in response thereto, supply said predetermined electrical input to said electronic switch, and

e. means responsive to said control signals for selectively substantially interrupting the supply of energy from said electrical source to said light means without interrupting the supply of electrical energy to said lamp and playback unit for respective intervals substantially equal to the temporal width of each control signal.

7. The control circuit of claim **6** wherein said electrical source is an alternating current source, said electronic switch is a triac and said light means and said storage means are connected in a parallel circuit which is connected to said triac via a diode.

8. The control circuit of claim **7** wherein said (e) means comprises (1) a second triac in shunt with said parallel circuit and said diode and (2) means for rendering said second triac conductive for the duration of each of said control signals.

9. The control circuit of claim **8** wherein said means for rendering said second triac conductive comprises a second light means for providing light for the duration of each control signal and a second light responsive means connected to receive light from said second light means, and, in response thereto, render said second triac conductive.

10. The control circuit of claim **7** wherein said light responsive means is connected between a control electrode of said triac and said projection lamp and said audio playback unit.

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