

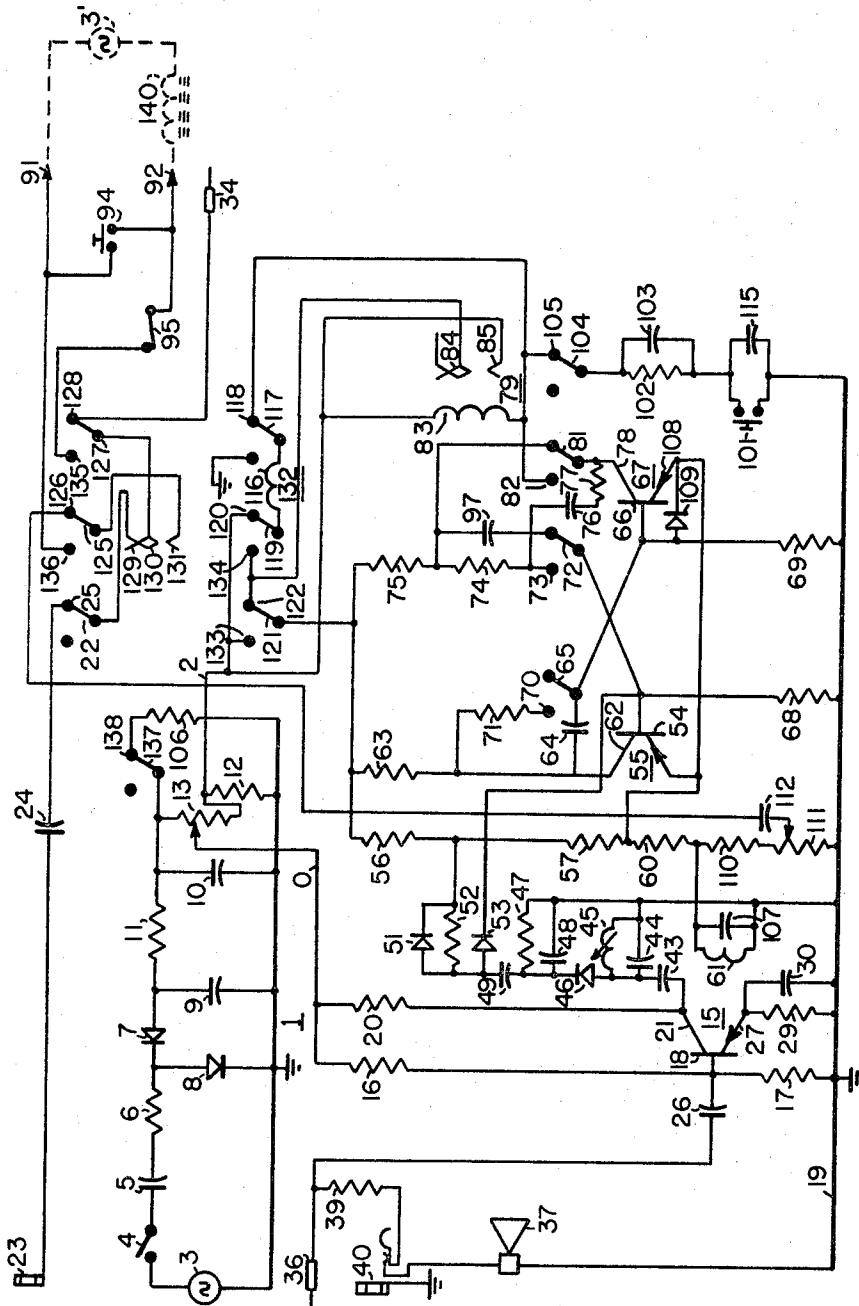
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ELECTRICAL TAPE-SLIDE SYNCHRONIZING SYSTEM

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ELECTRICAL TAPE-SLIDE SYNCHRONIZING SYSTEM

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8 Claims

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This invention relates to an electrical system for producing actuation signals for a device at selected times during the transport of a tape medium having electrical responsive properties.

The magnetic tape recorder-reproducer and the electrical pulse-actuated slide projector are widely used by the public and by educational institutions. Almost invariably these two devices are purchased separately, or at least have no means provided for coactive operation. The convenience and the enhancement of entertainment or interest brought about by automatic changing of the slides at appropriate times in a commentary or other aural presentation is highly desired.

To provide an electrical attachment for substantially any types of tape recorder-reproducer and slide or film strip projector for the synchronous operation of the two is a principal object of this invention.

Another object is to provide such an attachment as will coact with inexpensive tape and projector devices.

Another object is to provide facilities for impressing slide change signals upon ordinary magnetic tape, along with the aural program.

Another object is to provide a brief and uniform slide change signal that occurs within the usual aural spectrum.

Another object is to selectively employ one relaxation oscillator for two widely different purposes.

Another object is to provide a stable device of this type.

Other objects will become apparent upon reading the following detailed specification and upon examining the accompanying drawings, in which is set forth by way of illustration and example a typical embodiment of the invention.

The single figure shows the schematic diagram for the electrical attachment according to this invention.

Briefly, the invention embraces certain electronic elements particularly characterized by a multivibrator type relaxation oscillator and a switching system coactive therewith, which selectively provides a brief period of high frequency oscillation for recording a slide-change signal upon the aural tape while simultaneously deleting any aural program for that brief instant, or provides a monostable multivibrator for providing a brief pulse of uniform duration to surely actuate the slide projector upon the brief period of oscillation being reproduced from the tape.

In the figure, the circuit at the upper left generally identified by numeral 1 is an inexpensive low voltage power supply having a particular mode of connection and characteristics for proper operation of the remainder of the circuit. Since the device is preferably transistorized, the output voltage of the power supply at conductor 2 is of the order of minus fifteen volts. Element 3 is a source of alternating current, typically the usual 115 volt, 60 cycle, single phase type, normally available at wall outlets in buildings. A simple on-off switch 4 is connected in series with one conductor associated with power source 3 and the remainder of the power supply. A series-connected capacitor 5 and resistor 6 combination is connected to switch 4 to limit the alternating current drawn from the mains. For the voltage and frequency specified, the capacitor may have a capacitance of 2 microfarads and the resistor a resistance of 4 ohms.

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Half-wave rectification is accomplished by diode 7. Diode 8 takes the place normally occupied by a resistor in a voltage divider composed of elements 5, 6 and 8. By employing diode 8 the ripple is reduced at output conductor 2.

Shunt-connected capacitors 9 and 10, with series-connected resistor 11, comprise the filter of the power supply, and are connected to the output of the half-wave diode 7. For proper functioning the capacitors may have a capacitance of 250 microfarads each and the resistor a resistance of 1,000 ohms. Since the operating voltage at this point is relatively low, these capacitors may have a working voltage rating of fifteen volts, thus being relatively small and inexpensive. Resistors 12 and 13 are connected in series and together in shunt to capacitor 10. The combined resistance may be 700 ohms. These resistors act as a constant load on the power supply and thus improve its regulation. The values given, particularly of resistors 11, 12 and 13, provide the proper balance between low hum level, the desired output voltage, and stability of regulation.

Resistor 13 is made variable, a potentiometer, to adjust the output of transistor stage 15, so that the apparatus will operate on tape recorders having a low output as well as those having a high output level. The change signals from the low output tape recorders require more amplification of the incoming signal to actuate the monostable circuit mode of the multivibrator. More amplification is obtained by moving the slider of the potentiometer 13 upwards. High output tape recorders may, under certain conditions, operate the multivibrator circuit with signals other than those desired if the gain is set too high. This particularly occurs if the tapes being played are noisy. The noise triggers the unit by shock exciting the filter that will be later described. The remedy in each case is to suitably adjust the slider on potentiometer 13. This may be a screwdriver adjustment and ordinarily need not be readjusted for a given tape recorder.

From output conductors 0 and 2 of power supply 1, direct current energizing power is conducted to the required points in the rest of the circuit. Output conductor 0 is connected to amplifying transistor 15, which transistor may be a GE2N190 pnp type. Resistors 16 and 17 comprise a voltage divider to provide bias on base 18 of transistor 15, these resistors being connected in series between conductor 0 and the ground, or common connection, 19. Resistor 16 may have a resistance of 100,000 ohms, and resistor 17 only one-tenth that amount. Base 18 is connected to the junction between these two resistors and is thus biased at one-eleventh of the potential of conductor 0. Resistor 20, of 4,700 ohms, connects from conductor 0 to collector 21 of transistor 15 and serves as the output impedance of that transistor.

Inherent in the present device is means for selectively connecting various elements for either recording a slide-change signal upon moving tape during recording of sound, or for reproducing this signal as an actuating electrical pulse for changing slides in the projector during the reproduction of the program. This means conveniently takes the form of a multiple-pole two-position switch.

Switch arm 22 is a part of this switch. Throughout the figure the switch is shown in the "record" position, to the right. Jack 23 receives the plug from the microphone; which element is not shown, being a part of the tape recorder-reproducer known apparatus. The line wire connects between jack 23 and right-hand switch contact 25, through capacitor 24, thence to arm 22 when this arm is in the right-hand position. The ground return wire is not shown, according to usual drafting practice. Capacitor 24 passes the voice frequencies, etc. of the program being recorded and prevents the oscillator signal from po-

tentiometer 111 from being shorted by the microphone at jack 23. From arm 22 the voice program goes through contacts 129 and 130 of relay 132, through arm 127 and contact 128 of another section of the multiple-pole two-position switch and thence out to plug 34, to enter the usual microphone jack of the tape recorder.

Relay 132 performs the function of interrupting the voice program momentarily by opening contacts 129 and 130 while simultaneously supplying the oscillation change signal through contacts 131 and 130. This relay is manually actuated by the operator depressing switch 101, but is deactivated after a few milliseconds by the functioning of capacitor 103 and resistor 102. This functioning is more fully described later.

During this very brief interval any output from the microphone is interrupted to insure that such output does not interfere with the proper interpretation of the change signal when the program is being reproduced. A capacitor 26, of 0.005 microfarad capacitance, is included between plug 36 and base 18 to provide direct current isolation between the microphone circuit and the bias placed upon base 18, as has already been described.

The emitter 27 of transistor 15 is connected to resistor 29, the opposite end of which resistor is connected to ground bus 19. The resistor has a resistance of the order of 1,000 ohms. A capacitor 30, of 50 microfarads, capacitance, is connected in shunt to resistor 29, and causes transistor 15 to function as an amplifier.

Plug 36 plugs into the output jack of the tap recorder-reproducer (not shown) for providing an electrical output from the magnetic tape for both loudspeaker 37 and an input to stage 15. The output for the loudspeaker is obtained by connecting resistor 39, of 39 ohms resistance, to plug 36, and through a normally closed jack to loudspeaker 37. Jack 40 allows an external loudspeaker to be placed in the circuit. When the plug therefrom is inserted into jack 40 internal speaker 37 is disconnected.

Transistor stage 15 is the first of several elements employed to form the brief and uniform slide-change signal. Accordingly, capacitor 43, of 0.001 microfarad, is connected to collector 21 for coupling purposes, and also to capacitor 44, of 0.005 microfarad capacitance, and to inductor 45. Capacitor 44 and inductor 45 are connected in parallel and compose a parallel resonant circuit tuned to the frequency of oscillation high in the useful range of audible sounds employed for the slide-change signal; for example, 6,500 cycles per second. The second terminal of this resonant circuit is connected to ground bus 19. Inductor 45 is preferably a small coil having a variable inductance magnetic core to give an inductance range of from 40 to 250 millihenries. Within this range a suitable resonant frequency high in the useful range of audible sounds can be obtained.

The anode of diode 46 also connects to the second terminal of capacitor 43, and may be of the 1N191 type. It acts to rectify the oscillatory slide-change signal and so to form a unidirectional pulse for triggering the one-shot multivibrator. Resistor 47, of 470,000 ohms resistance, is connected from the cathode of diode 46 to ground bus 19. Resistor 47 is shunted by capacitor 48, of 0.01 microfarad capacitance. These two elements aid in forming the triggering pulse.

The cathode of diode 46 also connects to capacitor 49, of 0.22 microfarad capacitance, which acts as a coupling capacitor from the filter-pulse forming elements just recited to the monostable multivibrator.

Turning now to this multivibrator, diode 51 anode is connected to the second terminal of coupling capacitor 49, and resistor 52, of 33,000 ohms resistance, is shunted across the diode. The anode of an additional diode 53 is also connected to capacitor 49, and its cathode to base 54 of multivibrator transistor 55. Both diodes may be of the 1N191 type. These diodes and resistor 52 form an input circuit for triggering the multivibrator when it is connected to be monostable. Transistor 55 is kept con-

ducting current by this input circuit, in concert with bias resistors 56 and 57, until the situation is altered by the arrival of a slide-change signal pulse.

Resistor 56 may have a resistance of 22,000 ohms and resistor 57 3,300 ohms. The upper terminal of resistor 56 is connected to negative voltage supply conductor 2 through contact 133 and arm 121 of another section of the record-reproduce switch, the arm being at the left-hand reproduce position for this connection. This bias circuit is completed through resistor 60, of 560 ohms, and through inductor 61 to ground bus 19. A connection to the cathode of diode 51 and to resistor 52 is made to the junction connection between resistors 56 and 57.

Transistor 55 may be a pnp type 2N396. The emitter thereof connects directly to the junction connection between resistors 57 and 60. Collector 62 connects through resistor 63 to power supply conductor 2 when switch arm 121 contacts contact 133, for reproduction. Resistor 63 may have a resistance of 1,800 ohms. Also connected to collector 62 is capacitor 64, of 0.005 microfarad capacitance, the second terminal of which connects to arm 65 of still another section of the record-reproduce switch, and also to base 66 of the second multivibrator transistor 67. Base 54 of transistor 55 is connected to ground bus 19 through resistor 68, of 22,000 ohms resistance, while base 66 is similarly connected through resistor 69, of 15,000 ohms resistance.

When in the reproduce position, arm 65 contacts contact 70, and resistor 71, 22,000 ohms, is placed in parallel with capacitor 64. This allows transmission of a signal from collector 62 through capacitor 64 to base 66, so that transistor 67 will become conducting.

In a similar manner, base 54 of transistor 55 is connected to arm 72 of still another section of the record-reproduce switch. In the left-hand, reproduce, position this arm contacts contact 73, which also connects to resistors 74 and 75 in series. The upper terminal of this series connects through arm 121 and contact 133 to power supply conductor 2, when all of the switch arms are in the reproduce position. Resistor 74 may have a resistance of 18,000 ohms and resistor 75 a resistance of 1,800 ohms.

Also connected to contact 73 is capacitor 76, 20 microfarads, and resistor 77, 18,000 ohms, connected in series in that order; the second terminal of resistor 77 connecting to collector 78 of transistor 67. Capacitor 76 functions to set the time interval during which transistors 67 is conducting. This timing must be uniform, since it determines how many frames are advanced in some types of projectors. Resistor 77 performs a relatively important function of isolating the triggering circuit of the multivibrator, comprised of transistors 55 and 67, from transients produced by the switching on and off of contacts of relay 79. It has been found that without resistor 77 the slide change system may turn itself on and off due to feedback and thereby become inoperable for the intended purpose.

In the reproduce, monostable, mode of the apparatus, arm 81 of still another section of the record-reproduce switch contacts left-hand contact 82. This connects through coil 83 of relay 79 to output conductor 2 of the power supply, when all sections of the switch are in the reproduce position, as now being considered. When a current pulse is allowed to flow through transistor 67, by the operation of the previously described fitted and multivibrator, in response to a previously recorded slide-change signal, then contacts 84 and 85 of the relay close. These contacts are not directly in the collector circuit of transistor 67; thus, transients which arise from the closing thereof are prevented from triggering the monostable multivibrator. Diode 109, with anode connected to base 66 and cathode to emitter 108 of transistor 67, insures that only pulses of the proper and intended polarity will switch transistor 67 from a non-conducting to a conducting mode.

Contact 84 of relay 79 connects to contacts 122 and 134 of two more sections of the multiple arm two-posi-

tion switch for record and reproduce. Contact 85 connects to the power supply conductor 2. In the left position of arm 119, coil 116 of relay 132 has conductor 2 connected to one of its terminals, while the other end is connected to ground through arm 117 and the left-hand contact associated therewith. Actuation of relay 132 closes its contacts 130 and 131. This provides a closed-switch circuit at output points 91 and 92, through switch arms 125 and 127, when these are in the left-hand positions. This operates the slide-change mechanism of the projector long enough to change one slide, or to advance a strip film one frame, as the case may be. The circuit for this mechanism is shown dotted, and comprises a connection to 115 volt power 3' and solenoid coil 140. An equivalent circuit employing a motor is employed on some projectors, rather than the solenoid.

A normally-open switch 94 connects across 91 and 92 and a normally-closed switch 95 is connected in series between contact 135 and output point 92. Switch 94 is operated manually to advance the film strip, for instance, to the place where it is synchronized with the sound tape. Switch 95 is operated when film, or equivalent, is ahead of the tape, to manually delay the film strip to achieve synchronism.

Considering now the operation of the apparatus when the change signals are to be recorded on the tape, along with the sound program, all of the switch arms are to the right, as is shown. Arm 22 contacts contact 25, thus connecting the output of the microphone or equivalent program source to plug 34 through contacts 129 and 130 of relay 132, arm 127 and contact 128. Particularly important, however, is the fact that the multiple switch now causes the multivibrator to continuously oscillate as long as it is energized.

Switch arms 65 and 72 now being in the right-hand position, shunt resistor 71 is removed from across capacitor 64 and another capacitor 97 is connected between base 54 of transistor 55 and the junction connection between resistors 74 and 75. These resistors are connected to output conductor 2 of the power supply through arm 121, contact 122, and contacts 84 and 85 of relay 79. The multivibrator will thus be energized only when relay 79 is energized. Means are therefore provided to energize this relay for only a brief and uniform time interval regardless of how long manually operated switch 101 is closed.

One contact of switch 101 is connected to ground bus 19 and the other is connected to resistor 102 and capacitor 103. The second terminals of both of these thus-paralleled elements are connected together and to arm 104 of still another section of the record-reproduce switch. For recording, contact is thus made with contact 105 and thus to coil 83 of relay 79, the lower connection to the coil being to conductor 2, as before. The second terminals of the paralleled elements are also connected through contact 118 and arm 117 to coil 116 of relay 132. The second terminal of coil 116 is connected through arm 119 and contact 120 to conductor 2. When actuated, coil 116 opens contacts 129 and 130, momentarily breaking the input from jack 23 to plug 34 and closing contacts 130 and 131; thereby applying the oscillator signal to plug 34 from arm 125, contact 126 and capacitor 112.

Resistor 102 may have a resistance of 10,000 ohms and capacitor 103 a capacitance of 25 microfarads. These values are such that when switch 101 is first depressed by the operator for the purpose of inserting a slide-change signal upon the moving tape in recording, the charging current to capacitor 103 is sufficient to actuate relays 79 and 132, thus energizing the free-running multivibrator. This also removes the voice program input from jack 23 and applies the output of the multivibrator to plug 34. However, capacitor 103 charges sufficiently in a few milliseconds such that the current through this circuit is insufficient to keep the relays in the actuated position, thus, contacts 84 and 85 open and de-energize the multivibra-

tor. This produces change pulses that are uniformly short and unnoticed, as may break into a word and still not destroy the intelligibility.

Resistor 106 is connected from output conductor 2 to ground. It acts as an additional bleeder when the circuit is in the record mode only. This arrangement, through switch arm 137 and contact 138 prevents the multivibrator from changing from an initially higher tone to a lower tone upon the oscillations being started, because of a greater load upon the power supply when the record mode is used and a change in the voltage of the power supply when changing from one mode to the other.

The output waveform of a multivibrator is essentially a square waveshape. An essentially sinusoidal waveshape is preferred for recording upon the magnetic tape because of an increase in stability through the use of a resonant circuit, because the sinusoidal waveshape has a more pleasing sound, and because it represents a more efficient use of power in accomplishing the purpose.

A sinusoidal waveshape is provided by parallel resonant circuit inductor 61 and capacitor 107, one junction of which is connected to ground bus 19. Inductor 61, of 2.5 millihenries, and capacitor 107, of 0.25 microfarad, give a broad resonant response at approximately 6,000 cycles. The second junction of this resonant circuit connects through resistor 60 to emitter 108 of transistor 67. The oscillatory output of the multivibrator is approximately the same frequency as the fundamental oscillatory frequency of the resonant circuit and so excites the latter to sinusoidal oscillation. The amplitude thereof is reduced by shunt-connected resistor 110 and potentiometer 111, which are connected in series, one with the other, as a voltage divider. Initially the impedance of the resonant circuit is low with respect to that of the multivibrator and the potentiometer allows a fraction of the voltage produced to be usefully employed. Resistor 110 may have a resistance of 1,800 ohms and potentiometer 111 a resistance of 130 ohms. Coupling capacitor 112 connects from the slider contact upon potentiometer 111 to plug 34, through contact 126, arm 125, contacts 130, 131, arm 127 and contact 128, in order that the group of slide-change oscillations will be recorded on the tape as desired. Capacitor 112 may have a capacitance of 0.01 microfarad.

The amplitude of oscillation recorded is adjusted by altering the position of the slider contact on potentiometer 111. This amplitude control is required to insure that the level of oscillation control can be adjusted to correspond to the sound program level for the particular tape recorder employed.

It is to be noted that the apparatus according to this invention has a high use factor, both in recording and in reproducing. The high frequency employed for the slide change signal allows a number of circuit elements to be small and inexpensive as compared to the use of a low (subaudible) frequency. Because transistors are used and the capacitors can have a low voltage rating the device of this invention is further reduced in size and in cost.

The frequency characteristic of the filter 44-45 is sufficiently broad so as to be effective in extracting the desired change pulse oscillations although the speed of the magnetic tape in reproducing may differ a practical amount from the speed of the tape in recording. This allows tapes to be recorded on one recorder-reproducer and reproduced on other recorder-reproducers.

Also, tapes prepared according to this invention can be duplicated complete with slide-change signals by merely rerecording. This is not possible where a conductive patch, notch or hole in the tape is employed for accomplishing slide changes.

Although modifications in the characteristics of the circuit elements, details of circuit connections and alteration of the coactive relation between circuit elements may be taken in general from the illustrative embodiment herein disclosed, certain modifications may not be made in practical apparatus. One of these is the placement of

transistor stage 15 after filter 43-49 rather than before it, as has been shown. Inductor 45 produces a relatively large pulse, of the order of 5 volts. Such a signal amplitude cannot be properly amplified by stage 15, since the nominal input thereto is 0.1 volt or less. A regulated power supply may be employed, in which case resistor 106 and switch section 137-138 may be eliminated.

Having thus fully described this invention and the manner in which it is to be practiced, I claim:

1. In an audio-visual apparatus for automatically changing pictures exhibited by an intermittently operable picture projector by means of change signals recorded upon an audio tape,

said apparatus being selectively operable for applying said change signals to said audio tape, the combination of:

- (a) electrical means to reproduce electrical variations corresponding to audible sounds from said tape,
- (b) an amplifier connected to said electrical means,
- (c) a filter connected to said amplifier to pass a frequency high in the useful range of said audible sounds,
- (d) a multivibrator,
- (e) first circuit means,
- (f) second circuit means,
- (g) switching means to selectively connect said multivibrator with said first circuit means to operate said multivibrator as a free running oscillator at said frequency high in the useful range of said audible sounds for recording change signals upon said tape,

and to selectively connect said multivibrator with said second circuit means to operate said multivibrator as a monostable multivibrator and to connect said monostable multivibrator to said filter to produce an electrical pulse for automatically changing one of said pictures.

2. The apparatus of claim 1 in which said multivibrator has two transistors, each said transistor having a collector and the capability of conducting electric current, and

- (a) a resistor connected to the collector of the transistor not normally conducting current and through a capacitor connected to the transistor normally conducting current, to inhibit false operation of said multivibrator by circuit transients

when said multivibrator is connected for monostable operation.

3. The apparatus of claim 1 in which:

- (a) said multivibrator includes an inductive-capacitive parallel resonant circuit having an impedance low with respect to the impedance of said multivibrator,

to provide a sinusoidal waveshape to said change signal.

4. The apparatus of claim 1 in which said switching means includes:

- (a) a contact for connecting a resistor in shunt to the power supply for said multivibrator, at the switch position which produces said change signal, thereby to maintain the frequency of said change signal substantially constant.

5. The apparatus of claim 1 in which said switching means additionally includes:

- (a) relay contact means connected to interrupt recording said audible sounds upon said tape at the time said change signals are recorded upon said tape.

6. The apparatus of claim 1 which additionally includes:

- (a) rectifying means connected to said filter,
- (b) capacitive means connected to said rectifying means to form a substantially unidirectional electrical pulse from the electrical output of said rectifying means, and
- (c) means to connect said capacitive means to said multivibrator for the triggering thereof by said substantially unidirectional electrical pulse.

7. The apparatus of claim 1 in which the circuit of said multivibrator includes:

- (a) manually operable electrical means to insert said change signals, and
- (b) a resistive-capacitive circuit connected to said manually operable electrical means to limit the period of oscillation of said multivibrator to a brief fixed time interval regardless of how long said manually operable electrical means is actuated.

8. The apparatus of claim 7 in which:

- (a) said brief fixed time interval is a small fraction of one second.

References Cited

UNITED STATES PATENTS

3,200,206	8/1965	Johnson	179—100.1
3,227,814	1/1966	Ferris et al.	179—100.1

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