

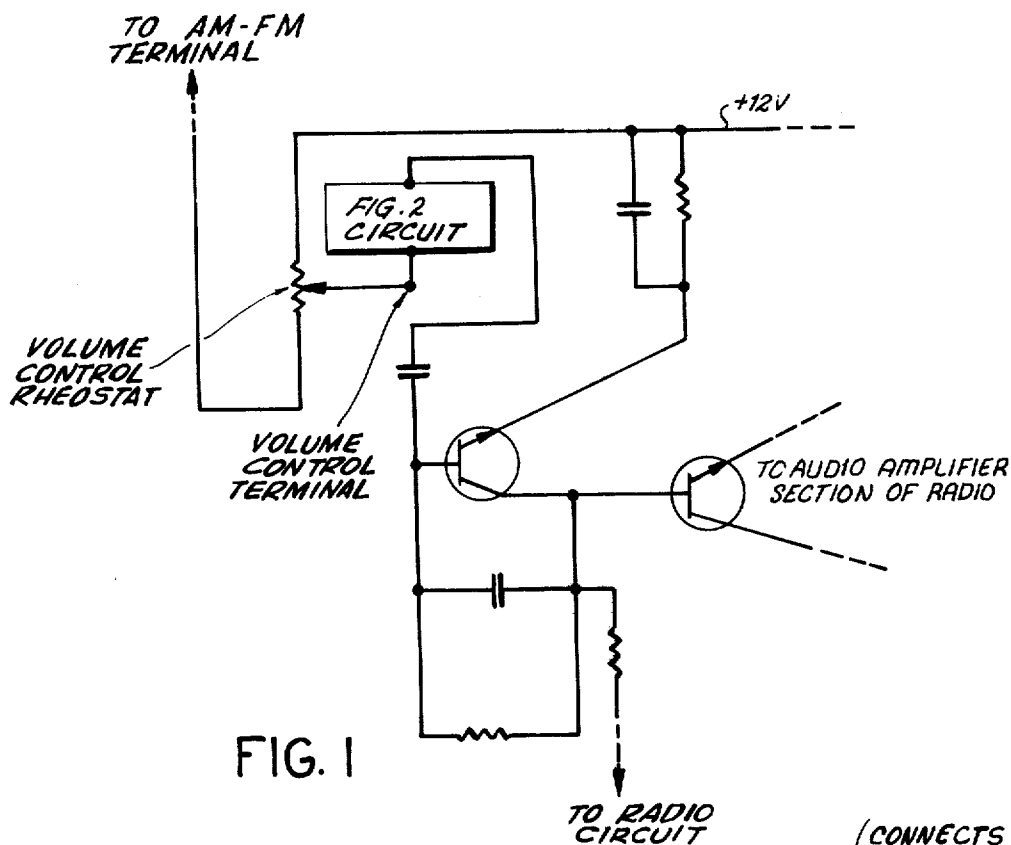


FIG. 1

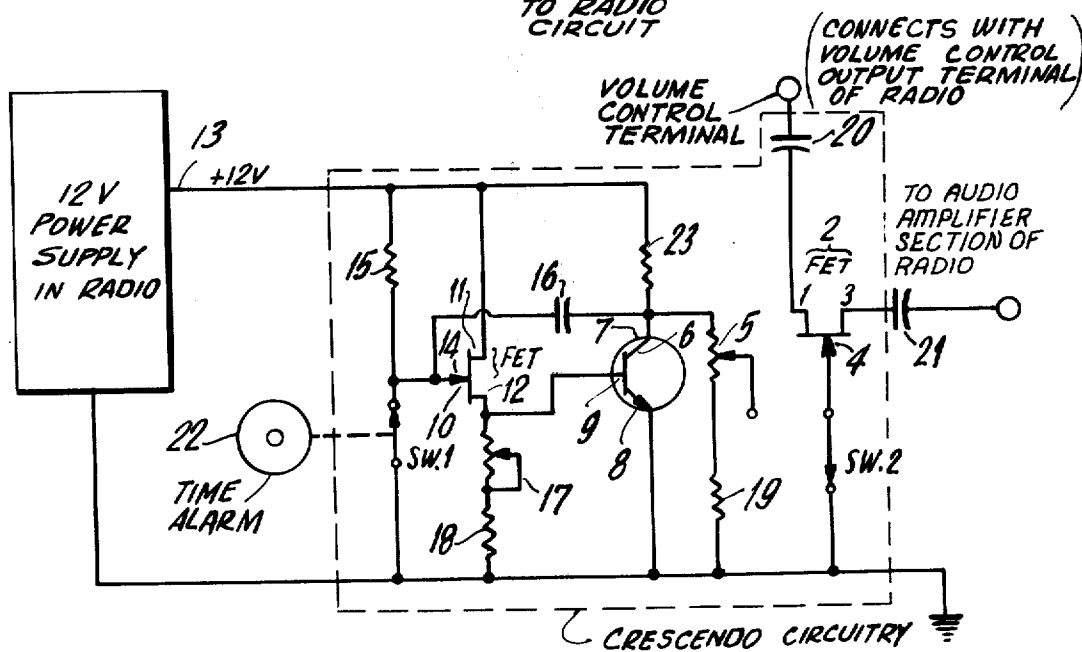


FIG. 2

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RADIO SOLID STATE CRESCENDO VOLUME ALARM

This is a continuation of application Ser. No. 134,950 filed Apr. 19, 1971.

This invention is directed to a solid state crescendo alarm, and in particular, to a clock-radio incorporating as a part of its circuitry, the crescendo alarm.

Prior to this invention, crescendo alarms of clock radio circuits made use of mechanical mechanisms such as typically illustrated by reference to U.S. Pat. No. 3,315,167 to Goldwasser, which patent discloses a mechanically controlled volume control rheostat operable by a motor drive. Although such a system accomplishes the desired crescendo effect, such a system is merely typical of the systems over which the present invention improves.

An object of this invention is a solid state crescendo device avoiding the cost, the labor of manufacture, the maintenance, the inevitable failures, the large size, and the like, associated necessarily with mechanical mechanisms, such as motor, revolving wheels, shafts, essential oiling, etc., characteristic thereof.

Another object is a solid state crescendo device of an uncomplicated circuitry, incorporating advantages such as ease and low cost of manufacture, repair, as well as the possibility of miniature size, sturdiness against breakage and/or fracture of the circuit and/or its components, and the like.

Another object is a particular circuitry which, in addition to the preceding objects, achieves the desired crescendo effect.

Another object is, alone and/or in combination with any one or more of the preceding objects, a solid state crescendo device including as a part of its circuitry combination, a clock radio having a time alarm switch for initiating the crescendo part of the circuit.

Another object is, alone and/or in combination with any one or more of the preceding objects, a radio as a part thereof, in which the crescendo part of the circuit acts to decrease directly the resistance offered by a transistor to volume signal flow through the transistor, whereby volume is increased proportionally.

Other objects are apparent from the figures and the above and following disclosure.

FIG. 1 is a fractional part of a circuit of the type normally incorporated into conventional clock radios, such as, typically, a Japanese TOYO (trade mark) Model 10 F-4H circuit, for example; the circuit of FIG. 1 discloses typically the point of incorporation of the crescendo circuit of the invention, as identified within the box-like circumscribing broken lines of rectangular box shape.

FIG. 2 discloses in depth the crescendo circuitry which in FIG. 1 is disclosed merely as the rectangular box.

Broadly, the invention is directed to an electronic solid state crescendo device which may include, as a part of its circuitry, any of a multitude of possible machines such as clocks, clock radios, any rheostat device, vault locks, cut-on switches for building heating systems, or cut-off switches for such heating systems, preparatory for the forthcoming business day and/or the ending of the business day, burglar alarms, on/off switches, similar light control switches for turning on and/or off advertising signs' lights, or the like.

The great utility of the invention lies not only in particular combinations, but also, particularly in uncomplicated solid-state circuitry of the invention, as well as the solid state nature thereof. In particular, an n-

channel field effect transistor connected for flow of the "signal to be controlled" from the source terminal through the transistor and out by way of the drain terminal of the transistor, gradually increases flow of the signal through the transistor as transistor resistance to current flow decreases by virtue of a gradually decreasing gate-source voltage. The gradual reduction of the gate-source voltage is achieved by draining to a ground by a control transistor switch which increasingly permits voltage reduction of emitter-collector as the control transistor's base element is subjected to an ever-increasing voltage from a second drain terminal of a second n-channel field effect transistor; the second field effect transistor is activated when the time alarm switch opens which disconnects the gate from the ground and produces a voltage between gate and source, which voltage varies by virtue of the gate's connection to a discharging capacitor, the other side of which capacitor is connected to the control transistor's collector.

In at least the radio-combination embodiment, as well as in other similar type circuitry, the imparting of the crescendo action to the "signal to be controlled," such as the volume control signal, is made possible while concurrently maintaining isolation of the FET, by the employment of two capacitors, one before the FET and one after the FET, in series with the FET between the radio circuit's volume control audio signal output terminal and the radio's signal-receiving terminal of the radio first audio stage.

A preferred embodiment of this invention is a crescendo device which incorporates as a part of its circuitry a clock-radio having a timing alarm of any desired or conventional type. Similarly, the radio incorporated as a part thereof may be any of desired and/or conventional circuits.

As a mere illustration of at least one complete clock-radio alarm-crescendo device of this invention, reference may be made to FIG. 1. This illustrative preferred embodiment also serves to illustrate the typical manner in which the crescendo circuitry fits in (is wired) with the radio circuitry of a complex type — the illustrated circuit being an AM and FM radio.

In reference to FIG. 2, the figure illustrates a part of a complete radio-clock crescendo-alarm circuit, however, the crescendo circuitry being merely represented by a brokenline rectangular box designated to be crescendo circuitry.

It can more clearly be seen that the radio volume control, rheostat volume-control terminal is the site connected to the source terminal 1 of the FET 2, while the drain terminal 3 is connected to the audio section of the radio. Between the terminal 1 and the rheostat volume-control terminal is mounted a capacitor 20 which is part of the crescendo circuiting. Between the FET 2 drain 3 and the audio section of the radio is mounted a capacitor 21 which is part of the radio.

When the illustrated SW 2 switch is in the "on" position, the gate 4 is connected to a variable resistor (rheostat) 5 of about 5×10 ohms, which in turn is connected to the collection element 6 of the control transistor switch 7 having its emitter 8 connected to ground. Potentiometer 23 of 4.7×10^3 ohms resistance is mounted in series between collector 6 and voltage source 13. The switch 7 opens (conducts by virtue of the base-emitter voltage which results when the time alarm switch opens and current flows from FET 10 drain terminal to ground, and the base-emitter current

increases as (and directly proportional to) the voltage to ground building up at the base 9 of switch 7.

The buildup of voltage at base 9 is thus dependent upon the extent to which resistance to flow of current has been reduced through FET 10 of current from 12V power supply 13 to terminal 11 through FET 10 to terminal 12, the degree of reduced resistance being dependent upon the voltage at gate 14. That voltage depends on the resistor 15 of 18×10^3 ohms through which capacitor 16 discharges after the time alarm switch opens.

The terminal 12 is connected to ground through a variable resistor 17 of up to 500 ohms and a fixed resistance resistor 18 of about 12 ohms. Rheostat 5 is connected to ground through fixed resistance resistor 19 of about 1.8×10^3 ohms. The SW 1 switch is illustrated in the closed position; when this switch is opened by the action of a time alarm 22, the initial activating voltage is first received at gate 14 of FET 10.

In the light of the preceding disclosure, obvious modification to equivalent circuitry for a common function is within the scope of this invention.

The timer or clock, at a predetermined time, opens SW 1 switch which is normally closed. The gate 14 of FET 10 is held at ground voltage until switch SW 1 is released by a clock operated timer. At this instant, the 44 MF capacitor 16 will begin to discharge through 18M resistor 15. The capacitor 16 is charged up through resistor 23 before SW 1 opens; however, when SW 1 is opened, capacitor 16 will begin discharging through resistor 15. Gate 14, which had been grounded before SW 1 opened, will now be hot. This will cause FET 10 to be turned on. The current through FET 10 will increase as voltage on capacitor 16 decreases and current in resistor 15 decreases because the potential difference between gate 14 and 12 will thereby increase. The voltage between 12 and ground will become sufficient to turn on control switch 7. As the capacitor 16 discharges and the current through 12 increases, the voltage between base 9 and ground will increase because 9 is connected to 12. Consequently, the current through transistor switch 7 will increase and the voltage between collector 6 and emitter 8 will decrease. FET 2 is normally operated in the voltage range from 0 to 4 between gate 4 and source 1; zero current occurs at 4 volts, maximum current at zero volts. When the voltage between gate 4 and source 1 decreases to 4 volts as a result of the decreasing voltage across resistors 5 and 19, which parallel the collector 6 and emitter 8 of the transistor switch 7, FET 2 will begin to conduct, allowing an audio signal to be coupled through from the volume control output terminal to the first audio stage in the radio. FET 2 does not conduct current when its gate-source voltage is in excess of 4.

As set forth previously, the crescendo effect is generated by turning on FET 2 harder and harder, and as the collector-emitter voltage of transistor 7 decreases, FET 2 output will be higher and higher. When the collector to ground voltage of transistor switch 7 reaches its final level closest to zero, FET 2 has its highest output, which will be equal more or less to the level set on the radio's volume control.

As can be seen from the above, the present invention provides a unique electronic crescendo system for controlling the sound over a period of time by increasing its magnitude to achieve a crescendo effect.

The conventional radio has the above-mentioned volume control rheostat which is an adjustable means for setting the maximum sound level to be produced. The FET 2, which is a controlled means having an input and output, has its input connected to the volume control rheostat of the radio, and the output of said controlled means is connected to the first audio stage of the radio. The control means which controls the volume of sound passed through by the FET 2 from the radio's volume control to the first audio stage is formed by the aforementioned transistor 7 and FET 10, operating in conjunction with capacitor 16 to provide the time-dependent magnitude variation.

The terms and expressions which are employed are used as terms of description; it is recognized, though, that various modifications are possible.

Having thus described certain forms of the invention in some detail, what is claimed is:

1. An electronic crescendo system for changing the magnitude of an audio signal over a period of time to achieve a crescendo effect, said system comprising adjustable means for setting the maximum signal level to be produced, controlled means having an input and output, said input being connected to said adjustable means, amplifier means connected to the output of said controlled means, control means connected to said controlled means for gradually varying the level of the signal produced at said output of said controlled means for said period of time to produce an increasing audio level to achieve said crescendo effect, and time responsive means including switch means activated by said time responsive means for actuating said control means and said controlled means.

2. A device according to claim 1, wherein said controlled means comprises electronically controlled automatic variable impedance means, said variable impedance means being controlled to affect said crescendo effect.

3. A device according to claim 2, wherein said variable impedance means comprises a field effect transistor.

4. A device according to claim 3, wherein said field effect transistor comprises a symmetrical construction.

5. A device according to claim 2, wherein said crescendo system is incorporated in a radio system having a volume control means and an audio input stage, said adjustable means for setting the maximum signal level comprising said volume control means.

6. A device according to claim 5, wherein said variable impedance means comprises a field effect transistor operated in its pinch-off region, the source of said field effect transistor being connected to said volume control and the drain of said field effect transistor being connected to said audio input stage.

7. A device according to claim 2, wherein said control means comprises a transistor switch normally maintained in an off state, said transistor switch being gated on, a capacitor connected to said transistor to control the conduction of said transistor for changing the value of said variable impedance means.

8. A device according to claim 1, wherein said crescendo system is incorporated in a conventional clock radio, said clock radio having clock switch means responsive to the time of day, said time responsive means comprising such clock switch means responsive to the time of day.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,900,798 Dated August 19, 1975

Inventor(s) Alfred S. Pomerantz and Imry A. Andrassy

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Abstract

Line 5, after "alarm" delete --a--
Line 10, after "channel" insert --first--
Line 12, after "gate" insert -- - -- (a hyphen)
Line 15, after "base" insert -- - -- (a hyphen)
Line 17, change "another" to --a second--
Line 19, change "closed" to --opened--
Col. 1, line 6, change ",and" to --and,--
Col. 2, line 47, change "brokenline" to --broken-line--
line 55, change "circuiting" to --circuitry--
line 60, change "10" to --10³--
line 61, change "collection" to --collector--
line 63, change "Potentiometer" to --Resistor--
line 64, delete "in series"
Col. 3, line 15, delete "resistance"
Col. 4, line 58, change "gated" to --turned--

Signed and Sealed this

thirtieth Day of December 1975

[SEAL]

Attest:

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Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks