

[54] ELECTRONIC CLOCK

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[22] Filed: **Jan. 25, 1974**

[21] Appl. No.: 436,681

[52] U.S. Cl..... 58/38; 58/23 R; 58/50 R;
58/152 R; 325/396

[51] **Int. Cl.**..... **G04c 3/00; G04b 19/30**

[58] **Field of Search**..... 58/50 R, 23 R, 33, 38,
58/152 B; 325/396; 340/309.1

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[57] **ABSTRACT**

AC voltage input to a solid state, clock circuit having a 60 Hz sinusoidal waveform, is transmitted through field effect transistors to the light emitting diodes of a numeric display for time indicating purposes. The rectifying action of the light emitting diodes momentarily interrupts illumination in view of the AC drive, enabling use of high peak currents during short duty cycles.

10 Claims, 2 Drawing Figures

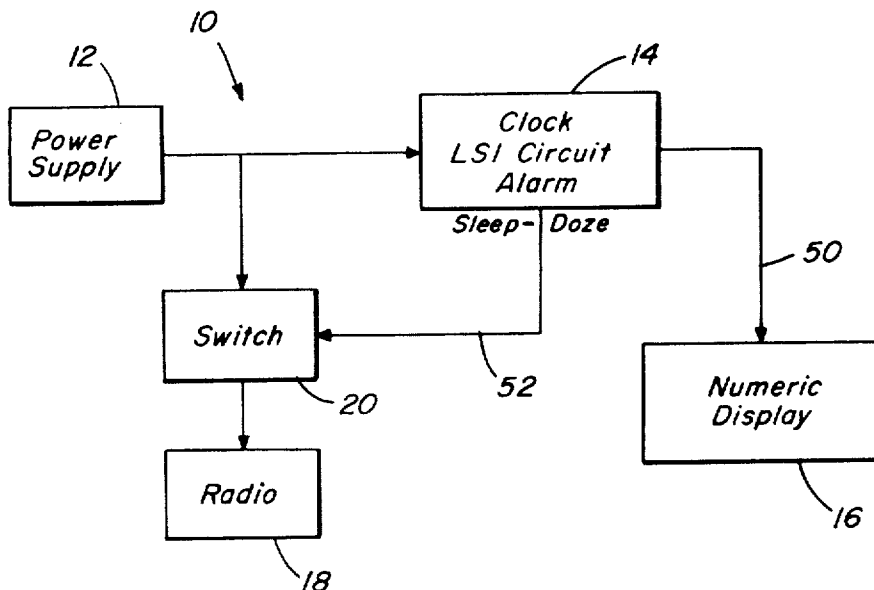


Fig. 1

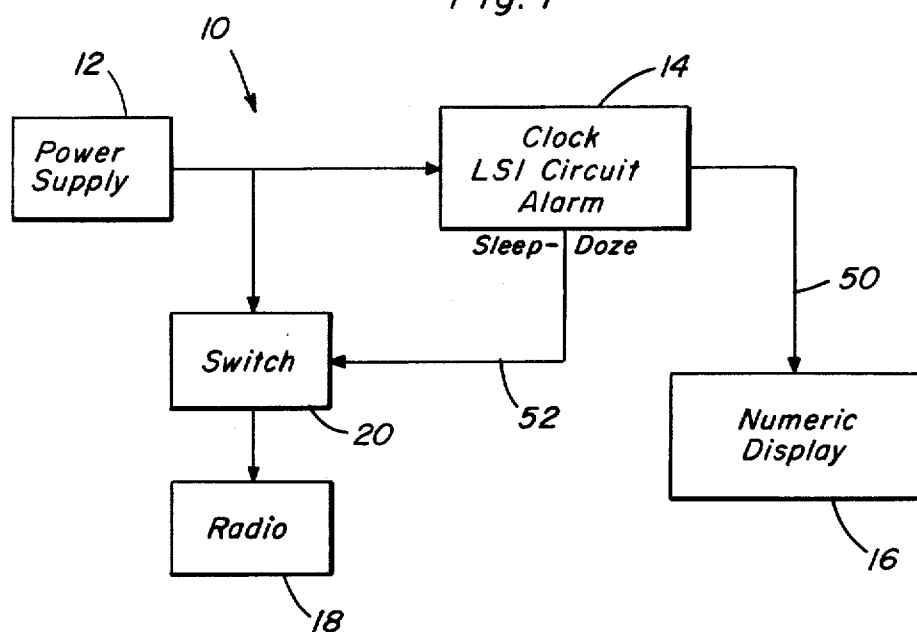
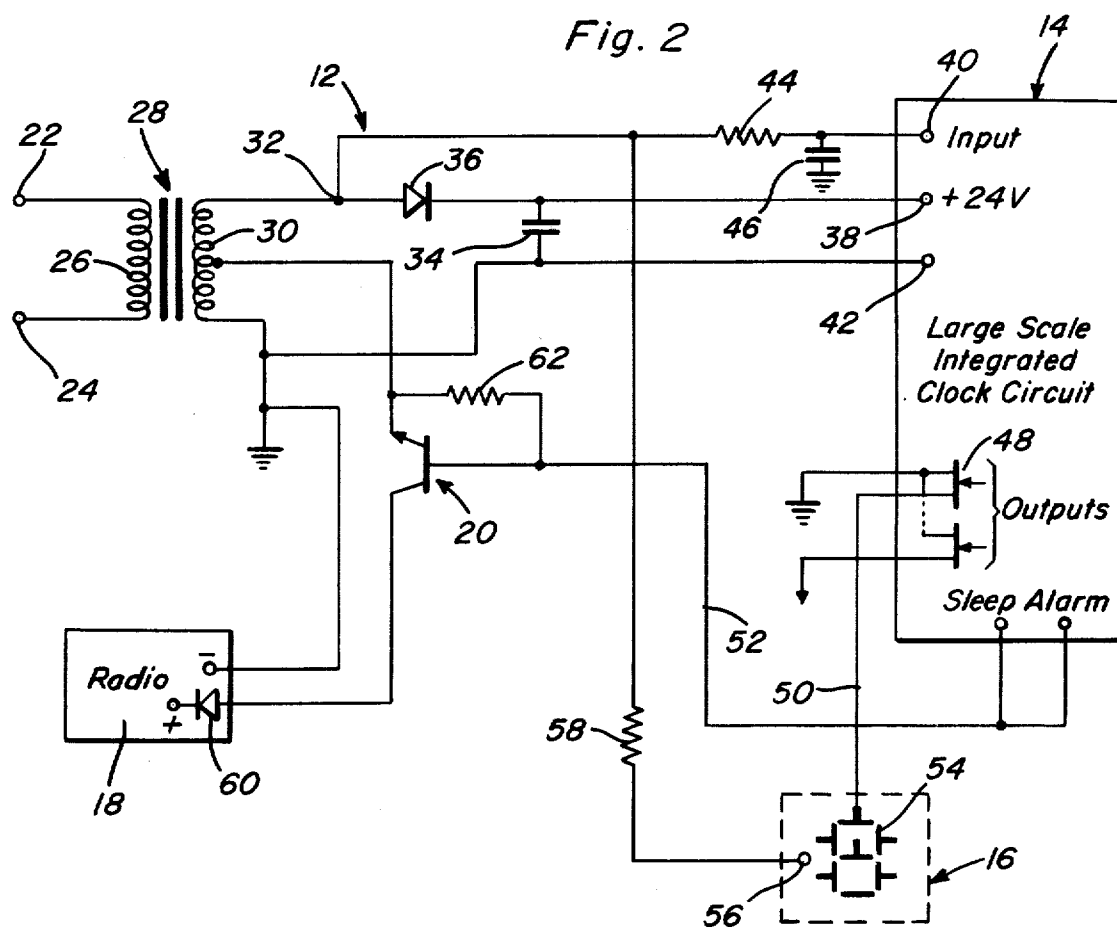


Fig. 2



ELECTRONIC CLOCK

This invention relates to electronic clocks and clock-radio combinations which feature a visual numeric display of illuminated, time indicating characters.

Electronic clocks of the foregoing type have generally been either very noisy during operation or quite expensive because of the facilities used to overcome the noise problem associated with the operation of the numeric display. This noise problem usually arose because of the use of multiplexed or strobe type displays. It has therefore been almost impossible to manufacture an economical electronic clock for assembly with a radio in a common cabinet. Accordingly, it is an important object of the present invention to provide an economical electronic clock capable of being used with an alarm triggered radio in the same cabinet because of extremely quiet operation of the numeric display associated with the clock.

In accordance with the present invention, a large scale integrated clock circuit is supplied with an AC input voltage from a conventional 60 Hz source. The sinusoidal waveform of the AC source is transmitted by the field effect transistors of the clock circuit to drive the light emitting diodes forming the numeric display. This method of excitation for the numeric display eliminates internal noisy switching associated with prior art arrangements and therefore permits the housing of a radio in the same cabinet with the clock circuit and display device. Operating voltage for the radio is applied through a transistor switch in response to an alarm signal from the clock circuit.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

FIG. 1 is a schematic block diagram of the clock radio combination of the present invention.

FIG. 2 is an electrical circuit diagram of the system depicted in FIG. 1.

Referring now to the drawings in detail, FIG. 1 schematically depicts an electronic clock and radio combination generally denoted by reference numeral 10. A power supply 12 furnishes electrical energy to a solid state clock circuit 14 from which a plurality of clock outputs are fed to a low current, numeric display device 16 establishing visual indicia of time. The power supply also furnishes electrical energy to a radio 18 through a switch 20 that is actuated by a preselected alarm signal from the clock circuit 14 to operate the radio.

The power supply 12 as shown in FIG. 2 is connected to a conventional source of AC voltage through power terminals 22 and 24. The AC voltage of the source which is in the form of a 60 Hz sine wave is applied to the primary winding 26 of a voltage step-down transformer 28 having a center-tapped secondary winding 30 connected between ground and an AC output junction 32. A filter capacitor 34 is connected between ground and a rectifying diode 36 connected between the junction 32 and clock terminal 38 to supply a rectified DC voltage to the clock circuit 14 for operation thereof. The clock circuit may be of the large scale integrated circuit type, such as used in the digital alarm clock, Model MM 53-16, manufactured by National Semiconductor Corp. A continuous 60 Hz driving volt-

age is applied to the clock circuit through input terminals 40 and 42 connected across the secondary winding 30 in series with a voltage reducing resistor 44. A grounded filter capacitor 46 is connected between resistor 44 and terminal 40. Driving outputs at the low 60 Hz frequency of the power source are accordingly obtained from the clock circuit through a plurality of field effect transistors 48 with a common source ground connection and drain electrodes connected to the numeric display device 16 through output signal lines 50. The clock circuit is manually preset to produce an alarm signal at a predetermined time, this alarm signal being conducted through signal line 52 to the switch 20.

The numeric display device includes a plurality of light emitting diodes 54 arranged in a visual image producing pattern forming numerical time indicating indicia or characters. The cathodes of the diodes 54 are respectively connected to the signal output lines 50 while a common anode 56 is connected through a bias limiting resistor 58 to the AC source at junction 32. Thus, the 60 Hz AC voltage applied to the clock circuit also provides drive for the light emitting diodes 54 that are turned on and momentarily turned off during relatively short duty cycles. For exceptionally brilliant illumination, the numeric display 16 could be of the Gallium Phosphide (GaP) type, such as that manufactured by the Opoca Corporation under a model designation of SL3.

The alarm signal in line 52 is applied to the base of a PNP transistor as shown in FIG. 2 constituting the switch 20 causing the transistor to turn on and conduct AC current to the radio 18 that is internally rectified by diode 60. The emitter of the transistor is connected to the center tap of the secondary winding 30 from which operating current for the radio is derived. A resistor 62 interconnecting the emitter and base normally maintains the transistor in a nonconductive state. Thus, the radio is automatically operated in response to the alarm signal from the clock circuit. The radio may be housed in the same cabinet with the clock circuit and the display device without any noise problem because of quiet operation of the display device.

Because of the drive of the numeric display by the relatively low frequency, AC power source routed through the clock circuit, as distinguished from generated higher frequency drives in prior art arrangements, complex switching circuits are eliminated. The clock circuit and display may accordingly be assembled on a mounting card in an extremely small and compact form. Further, since the rectifying action of the light emitting diodes 54 momentarily turns off or interrupts illumination of the display device during a short duty cycle, larger peak currents may be conducted through the system without damage caused by heating. This permits use of larger numeric displays and produces more brilliant illumination. This method of exciting the numeric display with a non-DC excitation voltage is feasible despite the interruption in illumination because of the normal vision retention of viewers.

The system hereinbefore described may be adapted for drive of a calendar display utilizing light emitting diodes, through a binary counter and a resettable decoder driver.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those

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skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. In combination with a source of AC voltage and a DC powered clock device having a plurality of outputs, a light emitting display having low current rectifying devices connected to said outputs, voltage rectifying means connected to said source for supplying DC energizing voltage to said clock device, and means connected to said source for transmitting a continuous, polarity changing excitation voltage to the low current rectifying devices of the display through the outputs of the clock device.

2. In combination with a source of AC voltage and a DC powered clock device having a plurality of outputs connected to a numeric display device, voltage rectifying means connected to said source for supplying DC energizing voltage to said clock device, and means connected to said source for transmitting a continuous, polarity changing excitation voltage to the numeric display device through the outputs of the clock device, said numeric display device including a plurality of light emitting diodes respectively connected to the out-

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puts of the clock device and means connected to said source for biasing all of the light emitting diodes.

3. The combination of claim 2 including a radio adapted to be energized by said source, and switch means responsive to an alarm signal from the clock device for connecting the radio in said source.

4. The combination of claim 3 including means connected to said source for exciting all of the low current rectifying devices.

5. The combination of claim 2 wherein said clock device is a large scale integrated clock circuit.

6. The combination of claim 4 wherein said outputs of the clock device are field effect transistors.

7. The combination of claim 6 wherein said clock device is a large scale integrated clock circuit.

8. The combination of claim 7 wherein said outputs of the clock device are field effect transistors.

9. The combination of claim 6 wherein said outputs of the clock device are field effect transistors.

10. The combination of claim 9 wherein said numeric display device includes a plurality of light emitting diodes respectively connected to the outputs of the clock device and means connected to said source for biasing all of the light emitting diodes.

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