

PATENT SPECIFICATION

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- (21) Application No. 8356/77 (22) Filed 12 May 1976
 (62) Divided out of No. 1550695
 (31) Convention Application No. 583343 (32) Filed 2 Jun. 1975 in
 (33) United States of America (US)
 (44) Complete Specification Published 15 Aug. 1979
 (51) INT. CL.² H03J 1/02
 G04C 17/00
 (52) Index at Acceptance
 H3Q 6L 6U LX
 G3T 101 301 303 308 407 AAA
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(19)



(54) RADIO/CLOCK COMBINATION

(71) We, MOTOROLA, INC., a corporation organized and existing under the laws of the State of Delaware, United States of America, of Corporate Offices, Motorola Center, 1303 East Algonquin Road, Schaumburg, Illinois 60196, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to radio receivers and particularly to a radio/clock combination and the present application is divided out from Patent Application No. 19581/76.

According to the present invention there is provided a radio/clock combination comprising a radio which produces an output signal representative of the frequency to which the radio is tuned, a clock which produces an output signal representative of the time of day, oscillator means producing an output signal of a predetermined frequency, means for processing said oscillator produced signal for tuning said radio, means for processing said oscillator produced signal for producing the time base for said clock, control means selecting either said radio output or clock output signal including means for predeterminedly processing the selected signal to activate selected readout drivers, and readout devices coupled to corresponding drivers which, when activated, produce a desired display, whereby the readout selectively displays either the frequency to which the radio is tuned or the time of day.

The invention will be described by way of example only with particular reference to the accompanying drawing, the single figure of which is a block diagram of an AM/FM radio and identical with Figure 1 of said Patent Application No. 19581/76 (Serial No. 1550695).

An antenna 12 collects broadcast RF sig-

nals and conducts them via line 14 to the diplexer 15. The diplexer contains low and high pass filters routing the FM band signals to the FM front end 16, and the AM signals to the AM front end 18. A bandswitch control acts through a tuning control 20 to activate a selected front end 16 or 18. Each front end 16, 18, contains an RF filter which is tunable over a desired band to pass selected signals. In the preferred embodiment, the tuning component in the FM filter is a reverse biased silicon junction diode whose capacitance changes in a predetermined way as a function of a control voltage applied at front end terminal 19 by tuning control 20. The AM tuning element is a saturable core reactor whose inductance changes as a function of current applied at AM front end terminal 21 via a voltage-to-current driver 22 which also receives a tuning control signal at its input 23.

A synthesizer 24, connects to mixers located within each front end. Line 25 connects the synthesizer 24 to the FM front end at terminal 26, and to the AM front end at terminal 27. The synthesizer 24 is tunable oscillator, which derives its tuning signal from the tuning control 20 at synthesizer input terminal 29. In response to signals from the tuning control 20, the synthesizer 24 produces signals of predetermined frequency which, when mixed with the front end signals, produce an output at each front end 16, 18 centred at a single intermediate frequency. In the preferred embodiment, the synthesizer 24 signal translates the FM front end signals to 10.7 MHz, the resultant signal appearing at the FM front end output terminal 31, and, similarly, translates the AM front end signals to the same intermediate frequency, i.e. 10.7 MHz, the resultant signal appearing at the AM front end output terminal 32.

While the preferred embodiment illustrates only two front ends, it should be

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understood that any number of front ends could be used. Other desirable front end bands might include short wave, weather information, long wave and the like. Further, while the preferred embodiment converts each front end to the same IF frequency, it should be understood that an embodiment which up-converts the AM band to obtain the image rejection benefits described hereinbelow also falls within the scope of the invention even if a common IF is not used. Moreover, while the preferred embodiment employs a crystal stabilized synthesizer to produce the local oscillator frequencies, it should be understood that a radio/clock combination of the present invention might use conventional local oscillator circuitry.

As the front end outputs are all at a single predetermined intermediate frequency, each may be processed through a common IF stage 36. The IF stage contains filters, centered about the intermediate frequency, which provide tuning selectivity. Also, a common IF amplifier is used for all input signals. In addition, in applications wherein another local oscillator stabilization technique is desired, e.g. conventional local oscillator designs, the common IF could include a crystal discriminator, centered at the IF, which produces an output feedback signal at output terminal 41 coupling to the synthesizer at the synthesizer terminal 42. This feedback assures that the synthesizer translates the front end signals to precisely the predetermined intermediate frequency. The common IF 36 provides a first output for AM signals at 43 and a second output for FM signals at 44. These outputs 43, 44 are applied to a common phase lock loop FM/AM demodulator 50. The demodulator 50, acts in one mode to decode FM signals, reproducing them at the FM demodulator output terminal 52. In a second mode it demodulates the AM signals reproducing these signals at the AM demodulator output 53. In addition, the demodulator provides an output AGC signal at AGC output 55 which is fed back both to the AM front end at terminal 56 and to the common IF AGC terminal 57. This feedback signal controls an attenuator located within the AM front end which acts to limit the signal amplitude applied to the front end mixer, and similarly controls an attenuator located in the common IF. Similarly, a demodulator 50 output on line 107 provides an AGC control signal to the FM tuner AGC input 58. Also, a signal is produced at the demodulator output 61 which is applied to the synthesizer input 62 whereby frequency compression is achieved.

Electronic switches located within the demodulator 50, which are used to select either the AM or FM mode of demodulation, are controlled at the demodulator in-

put 66 by the panel switches indicated generally at 70. The panel switches are manually operable from the front of the radio receiver. In the instant embodiment, the switches allow a radio user to select either the AM or FM band, to select a pre-programmed tuning frequency, to actuate a tuning scan mode, to adjust the setting of an internal clock, and to turn the radio on or off.

The FM output terminal 52 of the demodulator couples to the input 71 of a stereo demodulator 73. In a well known manner, the stereo demodulator 73 decodes the stereo FM signal and produces a left channel output at terminal 74 and a right channel output at terminal 75. These channels, along with an audio signal from an auxiliary source 76 and the audio outputs from a stereo tape deck 79, all feed into an audio source selector 80. The source selector 80 is comprised of a series of electronic switches, all of which are controlled via signals from the panel switches 70 to the source selector control terminal 82.

The source selector 80 rotates selected audio inputs to the audio processor 88. The processor includes internal circuitry which varies the amplitude and frequency characteristics of input signals in response to DC control voltages applied at the processor inputs 91, 92 and 93. The control signal inputs originate at the front panel controls 94 which, as shown, are operable to set volume, tone, and balance. These panels controls are connected to a push-button analog translator 96 which in turn provides DC control voltages at processor inputs 91, 92 and 93 suitable for achieving the required amplitude, balance, and tone processing. In an alternative embodiment the panel controls 94 may comprise controls having a direct analog output, e.g. potentiometers, thus obviating the need for translator 96. Thereafter, the audio signals couple to left and right drivers 98, 99 respectively; the drivers couple to power amplifiers 102, 103 and thereafter the signals are transduced to audibility via speakers 105, 106 respectively.

A display control 110 produces at a read out 112 a digital display representative of a parameter status such as the frequency to which the radio is tuned. The display control 110 is comprised of processing circuitry and readout driver circuitry. An input signal to the control 110, for example an input from tuning control 20, is selected from panel switch grouping 70 and is predeterminedly scaled and processed to activate selected readout drivers, which drivers in turn activate corresponding segments of the readout. In the preferred embodiment the readouts are of the seven segment light emitting diode type, but it should be understood that other types, such as liquid crystal, or plasma

discharge devices may be used. Such display and display control circuitry is well known in the art, as, for example, in digital voltmeter applications. The display control 110 is provided with switching to allow an auxiliary display input 114, of an electronic clock, to be fed into the display control thereby reading out the time, on the digital display 112. Where the synthesizer 24 utilizes a high stability crystal oscillator, the oscillator output can be used as the time base for the clock, thus providing extreme timing accuracy. For the preferred embodiment, the oscillator output 63 is shown coupled to the clock input 65.

WHAT WE CLAIM IS:-

1. A radio/clock combination comprising a radio which produces an output signal representative of the frequency to which the radio is tuned, a clock which produces an output signal representative of the time of

day, oscillator means producing an output signal of a predetermined frequency, means for processing said oscillator produced signal for tuning said radio, means for processing said oscillator produced signal for producing the time base for said clock, control means selecting either said radio output or clock output signal including means for predeterminedly processing the selected signal to activate selected readout drivers, and readout devices coupled to corresponding drivers which, when activated, produce a desired display, whereby the readout selectively displays either the frequency to which the radio is tuned or the time of day.

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Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1979.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

