

Description

The present invention relates generally to radio receivers and, more particularly, to a radio receiver by which a listener can readily select a target broadcasting station without knowing the frequency of the broadcasting station or its broadcasting time.

Overseas broadcasts are generally performed by use of a shortwave band. In some broadcasting stations, the broadcasting schedule is determined as shown, for example, in Fig. 1. In Fig. 1, hatched portions represent time periods in which the broadcasts are performed. In this example, during the time period T1, two broadcast waves of frequencies f1 and f2 are employed to broadcast the same radio program (the same content); during the time period T2, the broadcast wave of frequency f2 is employed to broadcast the next radio program; and during the time period T3, the broadcast wave of frequency f3 is employed to broadcast a different radio program. Accordingly, when a user wants to listen to the radio program transmitted during the time period T1, the user can select one optimum frequency of the frequencies f1 and f2 and can listen to the selected radio program. Further, during the time periods T2 and T3, the listener can selectively listen to a desired one of the radio programs because different radio programs are broadcast using the broadcast waves of frequencies f2 and f3 during the time periods T2 and T3.

According to the above-mentioned radio broadcasting system in which a certain broadcasting station performs radio broadcasts in different time periods by utilizing a plurality of frequencies, dedicated listeners or those with some expertise in the use of shortwave radio can enjoy the benefits of such a radio broadcasting system because they remember the broadcast frequencies and broadcast times on the basis of their experience. It is, however, frequently observed that beginners or ordinary listeners are perplexed by the operation of shortwave radio broadcasting stations so that they cannot listen to the desired radio broadcast without difficulty because they are required to make a channel selection on the basis of the broadcast time schedule shown in Fig. 1. Further, the manufacturers that make radio receivers for receiving overseas radio broadcasts must prepare similar time schedules for the convenience of those who buy and use the radio receivers.

Various devices have been described which might be considered relevant to this problem.

The Patent Abstract of Japan of JP-A-56 87 940 describes a radio which may be programmed to turn on at various times to receive different or similar channels. The prior art portion of claim 1 is based upon the document.

Document DE-A-3,504,060 describes a radio which uses automatic transmitter identification, and has in memory the programme structures of a number of transmitters, and a knowledge of the types of the programmes. When an operating element, e.g. a button, is used which is allocated to a certain type of programme, e.g. a news programme, the radio searches the programme structures to find the programme of that type which starts nearest to the present time.

Document DE-A-2,843,215 describes a radio receiver, specifically a shortwave receiver, which uses two receiving sections to determine and remember when two or more frequencies allocated to the same broadcasting station are used for the same broadcast.

It is an object of the present invention to provide an improved radio receiver that eliminates the defects or inadequacies encountered with the prior art.

More specifically, it is an object of the present invention to provide a radio receiver by which a listener can readily select a target broadcasting station without knowing the frequency of the broadcasting station at a particular broadcasting time.

It is another object of the present invention to provide a radio receiver that enables beginners or listeners in general to listen to a desired overseas radio broadcast with ease.

According to the present invention there is provided a radio receiver comprising:

phase locked loop means for generating an output oscillation signal;

means responsive to the output oscillation signal for receiving and frequency-converting a radio broadcast;

a memory having a data table including broadcasting station identification data and frequency data,

a timer for generating time data; and

a user operable key for selecting a broadcasting station; wherein in use:

frequency data is read out of said data table on the basis of and corresponding to input data and supplied to said phase locked loop means, whereby a predetermined frequency indicated by said frequency data is selected;

characterised in that the data table further includes broadcasting time data, the frequency data being the data necessary for receiving a predetermined radio broadcast at a predetermined broadcasting time, the identification data being for a plurality of stations each of which broadcasts on two or more frequencies; in that

in response to operation of said key by the user, the selection of said broadcasting station and said time data are supplied to said data table as said input data and by further comprising means

for supplying to the phase locked loop a frequency on which the selected broadcasting station is transmitted at the same or a later time.

The foregoing and other objects, features and advantages of the present invention will be apparent in the following detailed description of the preferred embodiments thereof when read in conjunction with the accompanying drawings, in which the same reference numerals are used to identify the same or similar parts in the several views.

Fig. 1 is a schematic diagram of a radio broadcasting schedule, to which reference will be made in explaining how to select and listen to a desired radio broadcast;

Fig. 2 is a block diagram showing a first embodiment of a radio receiver constructed in accordance with the present invention;

Fig. 3 is a schematic representation of a broadcasting frequency assignment, to which reference will be made in explaining the operation of the radio receiver shown in Fig. 2;

Fig. 4 is a flowchart of a program which is stored in a read only memory of the radio receiver of Fig. 2 and to which reference will be made in explaining the operation of the same;

Fig. 5 is a schematic representation of a data table which is stored in a read only memory of the radio receiver of Fig. 2 and to which reference will be made in explaining the operation of the same;

Figs. 6A-6D are schematic representations to which reference will be made in explaining examples of displays made on a liquid crystal display device of the radio receiver of the present invention;

Fig. 7 is a flowchart to which reference will be made in explaining the operation of the present invention;

Fig. 8 is a block diagram showing a radio receiver according to a second embodiment of the present invention; and

Fig. 9 (formed of Figs. 9A and 9B to permit the use of a suitably large scale) is a flowchart to which reference will be made in explaining the operation of the second embodiment.

The present invention will hereinafter be described with reference to the drawings.

Fig. 2 shows the general or overall construction of the radio receiver according to a first embodiment of the present invention.

In Fig. 2, it will be seen that a broadcast signal is received at an antenna 1 and is fed to an antenna tuning circuit 2. The antenna tuning circuit 2 of the example is of an electronic tuning type and derives a desired AM broadcast signal S_r having a frequency f_r .

This signal S_r is supplied through a high frequency amplifier 3 to a mixer circuit 4. A voltage-

controlled oscillator (VCO) 11 derives an oscillation signal S_o having a frequency f_o which is expressed by the following equation

$$f_o = f_r + 450 \text{ (kHz)} \quad (1)$$

This signal S_o is supplied to the mixer circuit 4 as a local oscillation signal, whereby the signal S_r is converted to an intermediate frequency signal S_i having a frequency of 450 kHz. This signal S_i is supplied through an intermediate frequency amplifier 5 to an AM detecting circuit 6, from which there is derived an audio signal. This audio signal is supplied through a low frequency amplifier or an audio amplifier 7 to a speaker 8.

The VCO 11 and circuits 12, 13, 14 and 15 constitute a phase locked loop (PLL) circuit 10. More specifically, the signal S_o from the VCO 11 is supplied to a variable frequency dividing circuit 12 and is thereby frequency-divided by N . The frequency-divided signal is then supplied to the phase comparing circuit 13, and the reference oscillating circuit 14 produces a reference oscillation signal S_p having a reference frequency of 5 kHz which in also supplied to the phase comparing circuit 13. The phase comparing circuit 13 phase-compares the frequency-divided signal and the oscillation signal S_p , and the compared output therefrom is supplied through the low-pass filter 15 to the VCO 11 as its control voltage. The output from the low-pass filter 15 is supplied also to the mixer or tuning circuit 2 as a channel-selection voltage.

Accordingly, in the stationary state, the frequency of the frequency-divided signal from the frequency-dividing circuit 12 is equal to that of the oscillation signal S_o so that the frequency of the oscillation signal S_o is expressed by the following equation

$$f_o = 5 \text{ (kHz)} \times N \quad (2)$$

In that event, equation (1) is established.

Therefore, as shown on the first line of Fig. 3, if the frequency-dividing ratio N is changed by "1" each in a range of 411 to 6089, then the local oscillation frequency f_o will be changed by an interval of 5 kHz in a frequency range of 2055 kHz to 30445 kHz as shown on the second line of Fig. 3. Thus, the receiving frequency f_r is changed by an interval of 5 kHz in a frequency range of 1605 kHz to 29995 kHz in response to the frequency-dividing ratio N as shown on the third line of Fig. 3.

The frequency-dividing ratio N is set in the frequency dividing circuit 12 by a microcomputer 20 which is used to control the whole system. The microcomputer 20 may comprise an M-50932 produced by Mitsubishi Electric Corporation for the channel-selection system, and an M-34200 pro-

duced by Mitsubishi Electric Corporation for the timer system.

More specifically, in the microcomputer 20, reference numeral 21 designates a central processing unit (CPU) of, for example, 4 bits, 22 a read only memory (ROM) that stores a program shown in Fig. 4, 23 a random access memory (RAM) used as a work area, 24 a read only memory (ROM) that stores a data table shown in Fig. 5, and 25 a nonvolatile RAM that stores "last-station" data (data indicating the name of a station that was being received when the power source of the radio receiver was last turned OFF). Further, in Fig. 2, reference numerals 31 and 33 designate ports, 34 a timer (timer circuit), and 35 a driver for driving a liquid crystal display (LCD) device 39. The LCD device 39 indicates the station name, receiving frequency f_r and the like in a digital fashion. These circuits 22 to 25 and 31 to 35 are connected to the CPU 21 via a system bus line 26.

The data table DTBL written in the ROM 24 has the following contents, which will be described with reference to Fig. 5.

As Fig. 5 shows, data are classified to provide data corresponding to each broadcasting station. Also, for each group of broadcasting stations (British Broadcasting Corporation (BBC), Voice of America (VOA), etc.), predetermined numbers of sets of station name data BRDC, broadcast start time data BGNT, end time data ENDT thereof and frequency-dividing ratio N corresponding to frequency f_r broadcast during the periods of time delimited by BGNT and ENDT are written in the data table DTBL. However, the frequency f_r may not be directly written in the data table DTBL because the frequency-dividing ratio N is written therein as frequency data.

The port 31 (Fig. 2) is connected with two pairs of keys Kn, Kb; and Ku, Kd each of which is a non-lock type push switch. The keys Kn, Kb are channel-selection keys for selecting broadcasting stations, and the keys Ku, Kd are frequency keys for selecting the frequency f_r (radio program) of the selected broadcasting station.

The RAM 25 is constructed as a nonvolatile memory, backed up by a battery, so that its contents are preserved when the radio receiver is turned OFF. The timer 34 always keeps track of the time regardless of the operating state of the radio receiver. Further, the LCD driver 35 is adapted to read data from a display address DSPA in the addresses of the RAM 23 and to convert the same into display data. This display data is supplied to the LCD device 39.

The apparatus described above receives the radio broadcasting program in accordance with a routine 40A of a flowchart forming Fig. 4.

In Fig. 4, after a power switch (not shown) is turned ON, the processing by the CPU 21 begins with step 41 of the routine 40A, and the routine proceeds to step 42. At step 42, the last-station data is read out of the RAM 25, i.e. station name data BRDC of the broadcasting station (BBC, VOA, etc.) which was selected just before the power switch was last turned OFF, is read out from the RAM 25. Then the routine proceeds to the next step 53, whereat time data TIME indicating the present time is generated from the timer 34.

At the next step 54, the data table DTBL is checked on the basis of station name data BRDC and time data TIME, and the appropriate frequency-dividing ratio N is obtained in accordance with the data BRDC and TIME. In this case, the frequency-dividing ratio N is obtained according to the following rule:

When the broadcasting schedule of the broadcasting station, indicated by station name data BRDC, is presented as, for example, shown in Fig. 1, if the time data TIME indicates a time t_1 within the period T1, then a frequency-dividing ratio N will be obtained so as to receive one of the frequencies f_1 and f_2 broadcast during the period T1 including the time t_1 . For example, the frequency f_1 may be selected. The selection of the frequency f_2 will be described later. If on the other hand the time data TIME indicates a time t_2 that is located between the periods T1 and T2, then a frequency-dividing ratio N will be obtained so as to receive the frequency f_2 of the period T2, which is the first broadcasting period after the time t_2 , even though the time t_2 is located nearer to the period T1 than it is to the period T2, as shown in Fig. 1. Further, if the time data TIME indicates a time t_3 included in both the periods T2 and T3, then a frequency-dividing ratio N will be obtained so as to receive the frequency f_3 of the one of the periods T2 and T3 whose ending time is the later.

At step 54, the frequency-dividing ratio N is obtained together with the time data BGNT and ENDT forming a pair with the frequency-dividing ratio N . The routine then proceeds to step 55.

At step 55, a receiving frequency f_r is calculated from the frequency-dividing ratio N by use of equations (1) and (2). Then the frequency f_r , the time data BGNT, ENDT, and the station name data BRDC, each of which is obtained at step 54, are written in the display address DSPA of the RAM 23. Therefore, the LCD device 39 displays the station name BRDC, the broadcasting times BGNT, ENDT, and the receiving frequency f_r on the basis of the data written in the RAM 23 in a digital fashion as shown in Fig. 6A. Simultaneously, the current time (e.g., 20:15 Japan standard time) is displayed on the LCD device 39 on the basis of the time data TIME of the timer 34.

More specifically, as shown in Fig. 6A, the last-station data is "BBC" and the current time is "20:15 JST," whereby the group of "BBC" is selected from the data table DTBL (Fig. 5) and third data (data on the third line), i.e. "BBC," "2000," "2030," and "2481," are derived from the data table DTBL. Then a receiving frequency "11955 kHz" (= fr) is calculated from these data, i.e. station name "BBC," broadcasting time "20:00 - 20:30" and data "2481" (= N), and is displayed on the LCD device 39 (Fig. 6A). Further, the current time "20:15 JST" counted by the timer 34 is also displayed on the LCD device 39.

As Fig. 4 shows, the processing by the CPU 21 then proceeds from step 55 to the next decision step 56. At step 56, it is determined by the CPU 21 whether or not the broadcasting is being performed at the present time via the frequency fr selected at step 54. In other words, it is determined whether $BGNT \leq TIME \leq ENDT$ (condition at times t1 and t3 of Fig. 1) is satisfied or whether $TIME < BGNT$ or $TIME > ENDT$ (condition at time t2 of Fig. 1) is satisfied. If a YES is obtained at step 56, then the routine proceeds from step 56 to step 57. At step 57, the LCD device 39 displays "now receiving" as shown in Fig. 6A. If a NO is supplied as an output at step 56, then the routine proceeds to step 58, whereat the LCD device 39 displays "standby mode" as shown in Fig. 6C.

The processing by the CPU 21 proceeds from step 57 or 58 to the next step 59, whereat the frequency-dividing ratio N obtained at step 54 is set in the frequency-dividing circuit 12. Therefore, from the time at which the step 59 is executed, the radio receiver of this embodiment is set in the channel selection state for selecting the broadcasting station and the frequency now displayed on the LCD device 39. If broadcasting is performed (at times t1, t3 and so on), it can be received. If on the other hand the broadcasting is not yet performed or the time is before the broadcasting (at time t2 and so on), the radio receiver is set in the standby mode awaiting the start of broadcasting.

Accordingly, when the power switch of the radio receiver is turned ON, the receiver is automatically tuned to the frequency of the current or next broadcast of the station previously selected. When the broadcast commences, the listener will be able to listen to it. Further, the broadcasting station name and the like are displayed as shown, for example, in Fig. 6A.

The processing by the CPU 21 proceeds from step 59 to step 49, and in step 49, the station name BRDC of the broadcasting station now selected at step 49 is written in the RAM 25 as the last-station data.

The processing by the CPU 21 proceeds from step 49 to the next decision step 51. At step 51, it

is determined by the CPU 21 whether or not any of the keys Kn, Kb; and Ku, Kd are depressed. If it is determined that they are not depressed, as represented by a NO at step 51, then steps 51, 61, 71 and 81 are repeated and the radio receiver of this embodiment waits for the key input by one of the keys Kn to Kd. During the period in which the radio receiver awaits such a key input, the radio receiver is continuously set in the receiving mode for receiving the broadcasting station and the frequency of that station selected at step 59, or the radio receiver is set in the standby mode awaiting the start of broadcasting.

When the radio receiver is set in the standby mode, the program cycles through steps 51, 61, 71 and 81, awaiting depression of one of the keys Kn, Kb, Ku, Kd. If the "next-station" key Kn is depressed, this is identified by a YES at step 51, and the routine proceeds from step 51 to step 52. At step 52, the station name data BRDC up to that time is incremented from the station name data of the corresponding group to the station name data of the next group so that the station name data BRDC of the broadcasting station, which was represented as "BBC" in Fig. 5, may be incremented to present "VOA" of the next group. If the station name BRDC of the broadcasting station up to that time is the station name data of the last group on the data table DTBL, then the station name data of the next group will become the station name of the first group, i.e. "BBC" in Fig. 5. In other words, the data table is in effect circular or endless.

Then the routine proceeds from step 52 to step 53. Accordingly, in steps 53 to 59, the current or next broadcast frequency of the next broadcasting station is selected. For example, if the "next-station" key Kn is depressed under the condition that the "BBC" is received as shown in Fig. 6A, then the next station "VOA" will be selected and the frequency "15160 kHz" on which the broadcasting is performed at that time will be selected and received as shown in Fig. 6D.

Similarly, each time the "next-station" key Kn is depressed, the next broadcasting station is selected from the data table DTBL of Fig. 5, and the current or next broadcast frequency of that station is selected.

When the radio receiver is set in the standby mode awaiting a key input at steps 51, 61, 71 and 81 and the "preceding-station" key Kb, for example, is depressed, the depression of the key Kb is identified at decision step 61. If a YES is obtained at step 61, then the routine proceeds to step 62. At step 62, the station name data BRDC is decremented from the station name data of the present group to the station name data of the preceding group so that the station name data "VOA" of the present group is changed to "BBC" of the preced-

ing group as shown in Fig. 5. If the station name data BRDC indicates the station name data of the first group of the data table DTBL, then the station name data of the next group (i.e., after decrementing) will become the station name data of the last group of the data table. In other words, as indicated above, the data table is in effect circular or endless.

Then, the routine proceeds from step 62 to step 53. Accordingly, in steps 53 to 59, the current or next broadcast frequency of the preceding broadcasting station in the data table of Fig. 5 is selected. For example, if the "preceding-station" key Kb is depressed under the condition that "VOA" is received as shown in Fig. 6D, then the preceding station "BBC" will be selected, and the frequency "11955 kHz" on which the broadcasting is performed at that time will be selected and received as shown in Fig. 6A.

Similarly, each time the "preceding-station" key Kb is depressed, the preceding broadcasting station is selected from the data table DTBL of Fig. 5, and the current or next broadcast frequency of that station is selected.

Further, when the radio receiver of this embodiment is set in the standby mode awaiting a key input at steps 51, 61, 71 and 81 and the "up" key Ku, for example, is depressed, the depression of the "up" key Ku is identified at decision step 71. Then the routine proceeds from step 71 to the next step 72. At step 72, if the broadcasting station and the frequency received up to that time are "BBC" and "11955 kHz" at "20:00 - 20:30" as shown in Fig. 6A, then the set of the next broadcasting times BGNT and ENDT and the frequency-dividing ratio N within the present broadcasting group up to that time is selected so that the data are changed to the data of the broadcasting station "BBC" and the frequency "15360 kHz" at "20:00 - 20:30" as shown in Fig. 6B. If the current set of data is the last set of the group of a particular broadcasting station, then the next set selected will be the first set of the same group, because the several groups in the data table are also arranged in a pattern that is in effect circular or endless.

Then the routine proceeds from step 72 to step 55. Therefore, in the steps 55 to 59, the broadcasting station is not changed, and only the receiving frequency fr is changed to the next receiving frequency of the same station. If broadcasting is then being performed at that frequency, then the broadcast will be received, while if broadcasting at that frequency is not then being performed but is only scheduled for a future time, then the radio receiver is set in the standby mode until such time as broadcasting at that frequency begins.

Similarly, each time the "up" key Ku is depressed, then the receiving frequency fr is incre-

mented to the next frequency of that broadcasting station without changing the broadcasting station.

When the radio receiver is set in the standby mode awaiting a key input at steps 51, 61, 71 and 81 and the "down" key Kd, for example, is depressed, then the depression of the "down" key Kd will be identified at step 81, and the routine proceeds from step 81 to step 82. At step 82, if the broadcasting station and the frequency received up to that time are "BBC" and "15360 kHz" at "20:00 - 20:30" as shown in Fig. 6B, the set of the next broadcasting times BGNT, ENDT and the frequency-dividing ratio N within the present broadcasting station group up to that time is selected such that they are changed to the data of the broadcasting station "BBC" and the frequency "11955 kHz" at "20:00 - 20:30" shown in Fig. 6A. If the current set of data within one broadcasting group is the first set, then the next set selected will be the last set of the same group, because of the circular or endless nature of the several groups in the data table.

The routine proceeds from step 82 to step 55. Accordingly, in steps 55 to 59, the broadcasting station is not changed, and only the receiving frequency fr is changed to the preceding receiving frequency of the same station. If broadcasting is then being performed at that frequency, then the broadcast will be received by the radio receiver of this embodiment. If broadcasting at that frequency is not then being performed but is only scheduled for a future time, then the radio receiver of this embodiment will be set in the standby mode until such time as broadcasting at that frequency begins.

Similarly, each time the "down" key Kd is depressed, the broadcasting station is not changed, and the receiving frequency fr is decremented to the preceding frequency of the same broadcasting station.

Therefore, if the "up" key Ku or the "down" key Kd is depressed, when the same radio program is broadcast by two or more frequencies in the same time period, as in the case of the period T1 of Fig. 1, it is possible for the listener to select the frequency which provides the best reception. When different radio programs are broadcast at time t3, it is possible for the listener to select a preferred radio program.

As described above, according to the present invention, the data table DTBL shown in Fig. 5 and the timer 34 shown in Fig. 2 are provided, whereby when a particular broadcasting station is selected by either of the keys Kn and Kb, a frequency on which that station can be received then or as soon as the next broadcast begins is selected. Thus beginners and other listeners can listen to overseas radio broadcasts with ease.

After a particular broadcasting station is designated, any of the frequencies on which that station broadcasts can be selected by operating the keys Ku and Kd, thus making it possible to select the frequency that gives the best reception of the desired radio program.

Further, since the desired frequency or a radio program of the desired broadcasting station can be selected merely by operating the keys Kn, Kb, Ku and Kd, it is not necessary to prepare a users' manual setting out the broadcasting schedule shown in Fig. 1.

A radio receiver according to a second embodiment of the present invention will be explained next.

In the first embodiment, the desired frequency or program of the desired broadcasting station is selected by operating the keys Kn, Kb, Ku and Kd as described above. In the second embodiment, the next-station key Kn and the preceding-station key Kb shown in Fig. 2 are replaced with n lock-type station-name keys (n corresponds to the number of predetermined broadcasting station groups), and these n station name keys are given labels "BBC," "VOA" and the like. In this manner, the listener can directly select the desired broadcasting station.

In the second embodiment, the broadcasting is received in accordance with a routine 40B shown in a flowchart forming Fig. 7. More specifically, the steps 51, 52, 61 and 62 of the flowchart forming Fig. 4 are replaced with steps 65 and 66 of Fig. 7. In Fig. 7, the CPU 21 determines at step 65 whether or not any of n station-name keys is depressed. If the CPU 21 determines that one of n station-name keys is depressed as represented by a YES at step 65, then the routine proceeds to step 66. At step 66, data of the depressed station-name key is read out. The other arrangements and steps in the routine 40B for receiving the radio broadcast in accordance with the second embodiment are the same as those of the first embodiment.

Fig. 8 is a block diagram of a radio receiver according to a third embodiment of the present invention. In Fig. 8, parts corresponding to those of Fig. 2 are marked with the same references and therefore need not be described in detail.

In the third embodiment, as Fig. 8 shows, five broadcasting station names are registered in keys K1 to K5, whereby the station selection can be directly performed by operating the keys K1 to K5.

A routine 40C shown in a flowchart forming Fig. 9 is stored in the ROM 22. In the routine 40C, steps 41 to 82 are the same as those of the routine 40A of the flowchart of Fig. 4.

Further, the microcomputer 20 is provided with a port 32, and the station-name keys K1 to K5 and an "enter" key Ke are connected to the port 32.

Each of these keys K1 to K5 and Ke is a push switch of non-locking type. The RAM 25 includes address areas A1 to A5 in which there are stored data corresponding to the keys K1 to K5 in addition to the last-station data.

During a period in which the radio receiver receives a radio broadcast or is in a standby mode, steps 51, 61, 71, 81 and 91 are repeated and the receiver awaits a key input.

When, for example, "BBC" (regardless of frequency fr) is received, if any of the keys K1 to K5 is depressed, or if, for example, the key K1 and the key Ke are depressed at the same time, then the depression of the key K1 is identified at decision step 91, and the routine proceeds to the next decision step 92. At step 92, it is determined by the microcomputer 21 whether or not the key Ke is depressed together with the depression of the key K1. If both keys are depressed, then the routine proceeds to step 93. At step 93, the station name "BBC" is written in the RAM 25 at its address area A1 assigned to the key K1, because the radio receiver of this embodiment is now receiving the station-name data BRDC of the broadcasting station, viz. "BBC." The routine then returns to step 51.

If any one of the station-name keys K1 to K5 and the enter key Ke are simultaneously depressed upon receiving the desired broadcast, then the station name data BRDC of the broadcasting station received will be registered in response to the station-name key depressed.

If it is determined that the enter key Ke is not depressed together with the depression of the key K1 at step 92, then the routine proceeds to step 94. At step 94, the station-name address BRDC is read out of the RAM 25 at one address area corresponding to the depressed station-name key in the address areas A1 to A5. The routine then proceeds to step 53. Accordingly, if any of the station-name keys K1 to K5 is depressed in the key input waiting mode, the station name registered by the depressed key is selected, and the frequency of the present broadcast or the frequency of the next broadcast will be selected and that broadcast can be received.

Therefore, by means of the radio receiver of this embodiment, it becomes possible to listen to a radio program of a broadcasting station with which the listener is familiar by operating the keys K1 to K5 without remembering the broadcasting frequencies and broadcasting times thereof.

In the first, second and third embodiments, when station selection is performed at time t3, the frequency f3 whose ending time is later can be received. According to a further embodiment of the present invention, it is possible to receive the frequency f2 whose starting time is earlier.

In still another embodiment of the present invention, the status of the power switch is monitored by the microcomputer 20, which is always powered, and only the power supply of the receiving system is turned ON and OFF on the basis of the monitored result. Alternatively, when the power supply switch is turned OFF manually, the power supply of the microcomputer 20 is also turned OFF, and the microcomputer 20 is set in the sleep mode (power-down mode). Then, when the power supply switch is turned ON, the microcomputer 20 is restored from the sleep mode to the normal operating mode, whereby the power supply of the receiving system is turned ON, and the routines 40A, 40B and/or 40C can be executed.

The timer 34 can be any accurate, conventional timer such as a quartz crystal timer and can even be realized by software.

In the data table DTBL, the end time ENDT may be replaced with the broadcasting period. Further, the ROM 24 may include a data table in which station name data BRDC of the broadcasting stations and the code number of each broadcasting station are stored in such a way that "BBC" is represented as "1," "VOA" is represented as "2," and so on. Furthermore, the station-name data BRDC of the data table DTBL may be employed as the code number. In addition, the ROM 24 may be replaced with a RAM and may be formed of a nonvolatile memory by backing up the same with a battery as in the case of the RAM 25.

According to the present invention, as set out above, there are provided the data table DTBL shown in Fig. 5 and the timer 34, whereby, when the broadcasting station is selected by the keys Kn and Kb, one of the broadcasts of the broadcasting station is selected. Specifically, the broadcast on the frequency that can be received at that time or the broadcast on the frequency that will be received during the next broadcast period is selected. Thus, beginners and ordinary listeners can listen to overseas radio broadcasts with ease.

After the broadcasting station is designated, one of the frequencies of the broadcasts made by the designated broadcasting station can be selected by the keys Ku and Kd, whereby the frequency for best reception or the preferred radio program can be selected.

Furthermore, since the desired frequency or the radio broadcast of the desired broadcasting station can be selected by operating the keys Kn, Kb, Ku and Kd, it is not necessary to prepare the broadcasting schedule table shown in Fig. 1.

The preferred embodiments of the invention are described above in detail with reference to the accompanying drawings. The present invention is of course not limited to those precise embodiments; many changes and modifications can be

effected therein by one skilled in the art without departing from the spirit and scope of the invention as defined in the appended claims.

Claims

1. A radio receiver comprising:

phase locked loop means (10) for generating an output oscillation signal;

means (2, 3, 4) responsive to the output oscillation signal for receiving and frequency-converting a radio broadcast;

a memory (24) having a data table (DTBL) including broadcasting station identification data and frequency data,

a timer (34) for generating time data; and

a user operable key (Kn, Kb) for selecting a broadcasting station; wherein in use:

frequency data is read out of said data table on the basis of and corresponding to input data and supplied to said phase locked loop means (10), whereby a predetermined frequency indicated by said frequency data is selected;

characterised in that the data table (DTBL) further includes broadcasting time data, the frequency data being the data necessary for receiving a predetermined radio broadcast at a predetermined broadcasting time, the identification data being for a plurality of stations each of which broadcasts on two or more frequencies; in that

in response to operation of said key (Kn, Kb) by the user, the selection of said broadcasting station and said time data are supplied to said data table as said input data and by further comprising means for supplying to the phase locked loop a frequency on which the selected broadcasting station is transmitted at the same or a later time.

2. A radio receiver according to claim 1 further comprising:

a random access memory (25) for containing data indicating a broadcasting station; and

additional key means (K1, K2, K3, K4, K5, Ke) for selecting a broadcasting station; wherein:

in response to operation of said additional key means (K1, K2, K3, K4, K5, Ke), the data indicating said broadcasting station is selectively written into or read from said random access memory (25), the data read from said random access memory (25) and the time data are employed to extract corresponding frequency data from said data table (DTBL), and the frequency data thus extracted is supplied to said phase locked loop means (10), where-



In still another embodiment of the present invention, the status of the power switch is monitored by the microcomputer 20, which is always powered, and only the power supply of the receiving system is turned ON and OFF on the basis of the monitored result. Alternatively, when the power supply switch is turned OFF manually, the power supply of the microcomputer 20 is also turned OFF, and the microcomputer 20 is set in the sleep mode (power-down mode). Then, when the power supply switch is turned ON, the microcomputer 20 is restored from the sleep mode to the normal operating mode, whereby the power supply of the receiving system is turned ON, and the routines 40A, 40B and/or 40C can be executed.

The timer 34 can be any accurate, conventional timer such as a quartz crystal timer and can even be realized by software.

In the data table DTBL, the end time ENDT may be replaced with the broadcasting period. Further, the ROM 24 may include a data table in which station name data BRDC of the broadcasting stations and the code number of each broadcasting station are stored in such a way that "BBC" is represented as "1," "VOA" is represented as "2," and so on. Furthermore, the station-name data BRDC of the data table DTBL may be employed as the code number. In addition, the ROM 24 may be replaced with a RAM and may be formed of a nonvolatile memory by backing up the same with a battery as in the case of the RAM 25.

According to the present invention, as set out above, there are provided the data table DTBL shown in Fig. 5 and the timer 34, whereby, when the broadcasting station is selected by the keys Kn and Kb, one of the broadcasts of the broadcasting station is selected. Specifically, the broadcast on the frequency that can be received at that time or the broadcast on the frequency that will be received during the next broadcast period is selected. Thus, beginners and ordinary listeners can listen to overseas radio broadcasts with ease.

After the broadcasting station is designated, one of the frequencies of the broadcasts made by the designated broadcasting station can be selected by the keys Ku and Kd, whereby the frequency for best reception or the preferred radio program can be selected.

Furthermore, since the desired frequency or the radio broadcast of the desired broadcasting station can be selected by operating the keys Kn, Kb, Ku and Kd, it is not necessary to prepare the broadcasting schedule table shown in Fig. 1.

The preferred embodiments of the invention are described above in detail with reference to the accompanying drawings. The present invention is of course not limited to those precise embodiments; many changes and modifications can be

effected therein by one skilled in the art without departing from the spirit and scope of the invention as defined in the appended claims.

Claims

1. A radio receiver comprising:
 - phase locked loop means (10) for generating an output oscillation signal;
 - means (2, 3, 4) responsive to the output oscillation signal for receiving and frequency-converting a radio broadcast;
 - a memory (24) having a data table (DTBL) including broadcasting station identification data and frequency data,
 - a timer (34) for generating time data; and
 - a user operable key (Kn, Kb) for selecting a broadcasting station; wherein in use:
 - frequency data is read out of said data table on the basis of and corresponding to input data and supplied to said phase locked loop means (10), whereby a predetermined frequency indicated by said frequency data is selected;
 - characterised in that the data table (DTBL) further includes broadcasting time data, the frequency data being the data necessary for receiving a predetermined radio broadcast at a predetermined broadcasting time, the identification data being for a plurality of stations each of which broadcasts on two or more frequencies; in that
 - in response to operation of said key (Kn, Kb) by the user, the selection of said broadcasting station and said time data are supplied to said data table as said input data and by further comprising means for supplying to the phase locked loop a frequency on which the selected broadcasting station is transmitted at the same or a later time.
2. A radio receiver according to claim 1 further comprising:
 - a random access memory (25) for containing data indicating a broadcasting station; and
 - additional key means (K1, K2, K3, K4, K5, Ke) for selecting a broadcasting station; wherein:
 - in response to operation of said additional key means (K1, K2, K3, K4, K5, Ke), the data indicating said broadcasting station is selectively written into or read from said random access memory (25), the data read from said random access memory (25) and the time data are employed to extract corresponding frequency data from said data table (DTBL), and the frequency data thus extracted is supplied to said phase locked loop means (10), where-

by a predetermined frequency indicated by said frequency indicated by said frequency data is selected.

3. A radio receiver according to claim 2 wherein said additional key means comprises a station key (K1, K2, K3, K4, K5) and an enter key (Ke), said station key and said enter key being employed together to write said data indicating said broadcasting station in said random access memory (25) and said station key being thereafter employed to read said data indicating said broadcasting station from said random access memory.
4. A radio receiver according to any one of claims 1, 2 or 3 further comprising display means (39) for displaying at least one of the current time, an identification of the selected broadcasting station, the beginning and ending times of the current or next broadcast of said station, said predetermined frequency, and an indication whether said receiver is now receiving said broadcast or is on standby to receive said broadcast.
5. A radio receiver according to any preceding claim wherein said phase locked loop means (10) comprises a voltage-controlled oscillator (11) for producing said output oscillation signal, a frequency divider (12) for dividing said output oscillation signal by N to produce a 1/N output, a reference oscillation circuit (14) for producing a reference oscillation signal, a phase comparing circuit (13) responsive to the 1/N output and the reference oscillation signal for producing a comparison signal, and a low-pass filter (15) responsive to the comparison signal for producing a voltage signal, said voltage-controlled oscillator (11) adjusting the frequency of said output oscillation signal in response to said voltage signal.
6. A radio receiver according to claim 5 wherein said frequency data is stored in said memory (24) as a function of N, further comprising circuit means (20) responsive to said memory (24) and connected to said frequency divider (12) for communicating a value of N to said frequency divider (12) selected in accordance with said broadcasting station identification data and said broadcasting time data, whereby said 1/N output is adjusted in accordance with said broadcasting station identification data and said broadcasting time data.

Patentansprüche

1. Radioempfänger
mit einer Phasenregelschleife (10) zur Erzeugung eines Oszillator-Ausgangssignals,
mit durch das Oszillator-Ausgangssignal ansteuerbaren Mitteln (2, 3, 4) für den Empfang und die Frequenzwandlung eines Rundfunksignals,
mit einem Speicher (24) mit einer Tabelle (DTBL), die Rundfunkstations-Identifizierungsdaten und -frequenzdaten enthält,
mit einem Zeitgeber (34) zur Erzeugung von Zeitdaten
sowie mit einer von dem Benutzer betätigbaren Taste (Kn, Kb) zur Auswahl einer Rundfunkstation,
wobei im Betrieb Frequenzdaten auf der Basis von und nach Maßgabe von Eingabedaten aus der Tabelle ausgelesen und der Phasenregelschleife (10) zugeführt werden und dadurch eine durch diese Frequenzdaten vorbestimmte Frequenz ausgewählt wird,
dadurch gekennzeichnet,
daß die Datentabelle (DTBL) ferner Sendezeitdaten enthält, wobei die Frequenzdaten die Daten sind, die für den Empfang einer vorbestimmten Rundfunksendung zu einer vorbestimmten Sendezeit benötigt werden, und die Identifizierungsdaten zur Identifizierung mehrerer Stationen dienen, von denen jede auf zwei oder mehr Frequenzen sendet,
daß in Abhängigkeit von der Betätigung der Taste (Kn, Kb) durch den Benutzer die Auswahl der Rundfunkstation und die Zeitdaten als die genannten Eingabedaten an die Datentabelle geliefert werden,
und daß ferner Mittel vorgesehen sind, durch die der Phasenregelschleife eine Frequenz zugeführt wird, auf der die ausgewählte Rundfunkstation zur gleichen oder zu einer späteren Zeit sendet.
2. Radioempfänger nach Anspruch 1, ferner mit einem Speicher (25) mit wahlfreiem Zugriff für Daten, die eine Rundfunkstation kennzeichnen,
und weiteren Tasten (K1, K2, K3, K4, K5, Ke) zur Auswahl einer Rundfunkstation,
wobei in Abhängigkeit von der Betätigung der weiteren Tasten (K1, K2, K3, K4, K5, Ke) die Daten, die die genannte Rundfunkstation kennzeichnen, selektiv in den Speicher (25) mit wahlfreiem Zugriff eingeschrieben oder aus ihm ausgelesen werden und die aus dem Speicher (25) mit wahlfreiem Zugriff ausgelesenen Daten und die Zeitdaten dazu verwendet werden, entsprechende Frequenzdaten aus der





Tabelle (DTBL) zu entnehmen, und wobei die auf diese Weise entnommenen Frequenzdaten der Phasenregelschleife (10) zugeführt werden und dadurch die vorbestimmte Frequenz ausgewählt wird, die durch die genannten Frequenzdaten gekennzeichnet ist.

3. Radioempfänger nach Anspruch 2, bei dem die weiteren Tasten eine Stationstaste (K1, K2, K3, K4, K5) und eine Eingabetaste (Ke) umfassen, wobei die Stationstaste und die Eingabetaste zusammen verwendet werden, um die die Rundfunkstation kennzeichnenden Daten in den Speicher (25) mit wahlfreiem Zugriff einzugeben, und wobei die Stationstaste anschließend dazu verwendet wird, um die die Rundfunkstation kennzeichnenden Daten aus dem Speicher (25) mit wahlfreiem Zugriff auszulesen.

4. Radioempfänger nach einem der Ansprüche 1,2 oder 3, ferner mit Anzeigemitteln (39) zur Anzeige zumindest der laufenden Zeit, einer Identifizierung der ausgewählten Rundfunkstation, der Anfangs- und Endezeit der laufenden oder der nächsten Sendung dieser Rundfunkstation und einer Angabe, ob der Empfänger diese Sendung gerade empfängt oder sich in Bereitschaftsstellung befindet, um diese Sendung zu empfangen.

5. Radioempfänger nach einem der vorhergehenden Ansprüche, bei dem die Phasenregelschleife (10) einen spannungsgesteuerten Oszillator (11) zur Erzeugung des Oszillator-Ausgangssignals aufweist, ferner einen Frequenzteiler (12) zum Teilen der Frequenz des Oszillator-Ausgangssignals durch den Faktor N zur Erzeugung eines 1/N-Ausgangssignals, eine Referenzoszillatorschaltung (14) zur Erzeugung eines Oszillator-Referenzsignals, eine von dem 1/N-Ausgangssignal und dem Oszillator-Referenzsignal angesteuerte Phasenvergleicherschaltung (13) zur Erzeugung eines Vergleichersignals und ein von diesem Vergleichersignal angesteuertes Tiefpaßfilter (15) zur Erzeugung eines Spannungssignals, wobei der spannungsgesteuerte Oszillator (11) die Frequenz des Oszillator-Ausgangssignals in Abhängigkeit von diesem Spannungssignal einstellt.

6. Radioempfänger nach Anspruch 5, bei dem die Frequenzdaten in dem genannten Speicher (24) als Funktion von N gespeichert sind, wobei ferner von dem Speicher (24) ansteuerbare Schaltungsmittel (20) vorgesehen sind, die mit dem Frequenzteiler (12) verbunden sind und an diesen einen Wert N liefern, der in Abhän-

gigkeit von den genannten Rundfunkstations-Identifizierungsdaten ausgewählt ist, wodurch das 1/N-Ausgangssignal in Abhängigkeit von den Rundfunkstations-Identifizierungsdaten und den Sendezeitdaten eingestellt wird.

Revendications

1. Récepteur radio comprenant :
 - un moyen de boucle à verrouillage de phase (10) pour générer un signal d'oscillation de sortie ;
 - un moyen (2, 3, 4) sensible au signal d'oscillation de sortie pour recevoir et convertir en fréquence une diffusion radio ;
 - une mémoire (24) comportant une table de données (DTPL) incluant des données d'identification de station de diffusion et des données de fréquence ;
 - une minuterie (34) pour générer des données temporelles ; et
 - une touche actionnable par utilisateur (Kn, Kb) pour sélectionner une station de diffusion, dans lequel, en utilisation :
 - des données de fréquence sont lues dans ladite table de données sur la base de données d'entrée et en correspondance avec celles-ci et sont appliquées audit moyen de boucle à verrouillage de phase (10) d'où il résulte qu'une fréquence prédéterminée indiquée par lesdites données de fréquence est sélectionnée,
 - caractérisé en ce que la table de données (DTBL) inclut en outre des données temporelles de diffusion, les données de fréquence étant les données nécessaires pour recevoir une diffusion radio prédéterminée à un instant de diffusion prédéterminé, les données d'identification étant prévues pour une pluralité de stations dont chacune réalise une diffusion sur deux fréquences ou plus, et
 - en ce qu'en réponse à l'actionnement de ladite touche (Kn, Kb) par l'utilisateur, la sélection de ladite station de diffusion et desdites données temporelles sont appliquées à ladite table de données en tant que dites données d'entrée et en ce qu'il comprend en outre un moyen pour appliquer à la boucle à verrouillage de phase une fréquence sur laquelle la station de diffusion sélectionnée émet au même instant ou ultérieurement.
2. Récepteur radio selon la revendication 1, comprenant en outre :
 - une mémoire vive (25) pour contenir des données indiquant une station de diffusion ; et
 - un moyen de touche supplémentaire (K1, K2, K3, K4, K5, Ke) pour sélectionner une



station de diffusion,
dans lequel :

en réponse à un actionnement dudit moyen de touche supplémentaire (K1, K2, K3, K4, K5, K6), les données indiquant ladite station de diffusion sont écrites sélectivement dans ladite mémoire vive (25) ou elles sont lues, les données lues dans ladite mémoire vive (25) et les données temporelles sont utilisées pour extraire des données de fréquence correspondantes dans ladite table de données (DTBL) et les données de fréquence ainsi extraites sont appliquées audit moyen de boucle à verrouillage de phase (10) d'où il résulte qu'une fréquence prédéterminée indiquée par ladite fréquence indiquée par lesdites données de fréquence est sélectionnée.

3. Récepteur radio selon la revendication 2, dans lequel ledit moyen de touche supplémentaire comprend une touche de station (K1, K2, K3, K4, K5) et une touche d'entrée (K6), ladite touche de station et ladite touche d'entrée étant utilisées ensemble pour écrire lesdites données indiquant ladite station de diffusion dans ladite mémoire vive (25) et ladite touche de station étant utilisée pour lire lesdites données indiquant ladite station de diffusion dans ladite mémoire vive.

4. Récepteur radio selon l'une quelconque des revendications 1, 2 ou 3, comprenant en outre un moyen d'affichage (39) pour afficher au moins le temps courant, une identification de la station de diffusion sélectionnée, les instants de début et de fin de la diffusion courante ou de la diffusion suivante de ladite station, ladite fréquence prédéterminée et une indication consistant à savoir si oui ou non ledit récepteur est en train de recevoir ladite diffusion ou est en attente de réception de ladite diffusion.

5. Récepteur radio selon l'une quelconque des revendications précédentes, dans lequel ledit moyen de boucle à verrouillage de phase (10) comprend un oscillateur commandé en tension (11) pour produire ledit signal d'oscillation de sortie, un diviseur de fréquence (12) pour diviser ledit signal d'oscillation de sortie par N afin de produire une sortie 1/N, un circuit d'oscillation de référence (14) pour produire un signal d'oscillation de référence, un circuit de comparaison de phase (13) sensible à la sortie 1/N et au signal d'oscillation de référence pour produire un signal de comparaison et un filtre passe-bas (15) sensible au signal de comparaison pour produire un signal de tension, ledit oscillateur commandé en tension (11) réglant

la fréquence dudit signal d'oscillation de sortie en réponse audit signal de tension.

6. Récepteur radio selon la revendication 5, dans lequel lesdites données de fréquence sont stockées dans ladite mémoire (24) en tant que fonction de N, comprenant en outre un moyen de circuit (20) sensible à ladite mémoire (24) et connecté audit diviseur de fréquence (12) pour communiquer une valeur N audit diviseur de fréquence (12) sélectionnée en relation avec lesdites données d'identification de station de diffusion et avec lesdites données temporelles de diffusion d'où il résulte que ladite sortie 1/N est réglée en relation avec lesdites données d'identification de station de diffusion et avec lesdites données temporelles de diffusion.