

Signal Reproducing Apparatus

The present invention relates to a wireless type signal reproducing apparatus.

A signal reproducing apparatus embodying the invention comprises a recording medium player, an audio signal receiver and a remote controller, the audio signal receiver receiving audio signals from the recording medium player, the remote controller being attached to the audio signal receiver to provide remote control over the recording medium player, wherein a status signal indicating the current operating status of the recording medium player is multiplexed with the audio signals for transmission to the audio signal receiver containing a display means, the status signal causing the display means to display the current operating status of the recording medium player so that the recording medium player will be controlled from a distance in accordance with the current operating status thereof.

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REPLACED SHEETS	SG
☒ Description : paged ...1... to paged ...14...	
☒ Claim(s) : paged ...5... to paged ...16...	
☒ Drawing(s) : paged ...14... to paged ...49...	
☒ Abstract : paged ...17... to paged ...27...	
DATE OF RECEIPT	

One type of the Walkman (registered trade name) stereo headphone cassette player (simply called the player hereunder) or the like has been known to operate on a wireless transmission method involving wireless signal transmissions between the player proper and its headphones.

Fig. 3 is a perspective view of a typical wireless player of the above-described type. In the figure, reference numeral 1 is a player, and 6 is a dedicated receiver with headphones.

In the player 1, left- and right-hand channel stereo audio signals L and R are reproduced from a cassette tape, not shown. The signals L and R are converted to FM signals SL and SR on two carriers which are a predetermined frequency apart. After conversion, the signals SL and SR are transmitted to the receiver 6.

On receiving the FM signals SL and SR from the player 1, the receiver 6 demodulates these signals and recovers the audio signals L and R therefrom. The signals L and R are supplied respectively to acoustic units 7L and 7R on the left- and right-hand side of the headphones 7.

In the above setup, the receiver 6 may measure as small as 2.5 cm wide, 8 cm high and 1.5 cm thick, or even less.

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To operate the apparatus, the user puts the player 1 in his briefcase or in her handbag, and places the receiver 6 in the breast pocket or clips it on to a lapel or to the necktie. In this manner, the user on, say, a commuter train may reproduce a desired cassette tape without being bothered by a headphone cord.

The receiver 6 operates within a 1.5-meter radius of the player 1. The operative distance is restricted so as to comply with relevant wireless telegraphy regulations and to provide against another user operating the same type of apparatus nearby. Apparatuses of this type are disclosed in Japanese Patent Application No. 61-254966 (Japanese Patent Laid-Open No. 63-108825) and Japanese Patent Application No. 62-280489 (Japanese Patent Laid-Open No. 1-122223).

With the above-described wireless type apparatus, the player 1 in operation is usually separated from the headphones 7 (hence the wireless scheme). One disadvantage of this conventional apparatus is that it is bothersome to operate controls on the player 1 to switch its operation mode, particularly when the player 1 is placed deep in the briefcase or in the handbag.

To overcome the above disadvantage, this applicant proposed a remote controller disclosed in Japanese Patent Application No. 1-177404. This remote controller involves



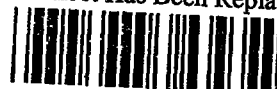
having the headphone set equipped with a commander (operating unit) that is used to transmit coded control signals to the player for control over the operation mode thereof.

One remaining disadvantage of the proposed remote controller is that it is difficult for the user to know the current operation mode of the player, especially the tape running direction.

For example, when it is desired to reproduce a tape part considerably distant from the currently reproduced tape part, the user operates the commander to feed forward or rewind the tape at high speed until the desired part is reached. But because it is impossible immediately to verify the direction in which the tape is currently running, there is a possibility that the tape will be fed fast in the wrong direction.

It is therefore an object of the present invention to provide a wireless type signal reproducing apparatus controlled by radio signal from a distance in accordance with the current operating status of the player contained therein.

In carrying out the invention and according to one aspect thereof, there is provided a wireless type signal reproducing apparatus comprising (in reference to Figs. 1



and 2): a reproducing section 1 for reproducing audio signals from a recording medium (magnetic tape); a transmitting section 20 for transmitting the audio signals to the reproducing section 1; an audio signal receiving section 6 for receiving the audio signals from the transmitting section 20; a remote control section 8, attached to the audio signal receiving section 6, for providing remote control over the reproducing section 1; and a control signal receiving section 50 for receiving control signals from the remote control section 8; wherein the reproducing section 1 contains a status signal generating means 110 for generating a status signal indicating the current operating status of the reproducing section 1, the status signal being multiplexed with the audio signals for transmission; and wherein the audio signal receiving section 6 contains a display means 130 for displaying the current operating status of the reproducing section in accordance with the transmitted status signal.

The setup above allows the user to know the current operating status of the reproducing section which in turn may be controlled accordingly from a distance.

The invention will be further described by way of non-limitative example with reference to the accompanying drawings, in which:

Fig. 1 is a block diagram showing major components of a wireless type signal reproducing apparatus as a pre-



ferred embodiment of the invention;

Fig. 2 is a block diagram depicting the other major components of the embodiment; and

Fig. 3 is a perspective view of a typical wireless type signal reproducing apparatus shown for explanatory purposes in connection with the invention.

One preferred embodiment of the present invention will now be described with reference to Figs. 1 and 2.

Figs. 1 and 2 are block diagrams depicting the constitution of the wireless type signal reproducing apparatus embodying the invention.

Specifically, Figs. 1 and 2 illustrate a player 1 and a receiver 6 respectively in terms of their components, the player and the receiver constituting the embodiment. The receiver 6 is equipped with an operating section (commander) 8 for remote control.

The player 1 comprises an audio signal reproducing circuit 10, an audio signal transmitting circuit 20, a system control circuit (microcomputer) 40 and a control signal receiving circuit 50. The receiver 6 contains an audio signal receiving circuit 60, a system control circuit (microcomputer) 80 and a control signal transmitting circuit 90.



The player 1 further comprises a mode signal generating circuit 110 that generates a mode signal indicating the current operation mode thereof. The receiver 6 further contains a mode signal separating circuit 120 and an LCD indicator 130, the latter displaying the current operation mode of the player 1.

Below is a description of how the embodiment works in terms of audio signal and control signal transmission on a wireless basis.

In the player 1 of Fig. 1, left- and right-hand channel audio signals are reproduced from a tape MT by magnetic heads 11L and 11R, respectively. The left- and right-hand channel audio signals are then supplied to equalizing amplifiers 12L and 12R, respectively. Output audio signals L and R from amplifiers 13L and 13R are sent to a headphone jack 14. At the same time, the signals L and R are fed past amplifiers 21L and 21R of the audio signal transmitting circuit 20 and supplied to frequency modulators 22L and 22R. In turn, the frequency modulators 22L and 22R generate a pair of FM signals SL and SR, respectively.

With this embodiment, original carrier frequencies f_l and f_r are illustratively set as low as

$$f_l = 12.67 \text{ MHz}$$

$$f_r = 12.21 \text{ MHz}$$

These frequencies are mixed by mixers 23L and 23R with an



output signal S_{up} from an oscillator 24 having a frequency of

$$f_{up} = 88.67 \text{ MHz}$$

Upon receipt of the mixed frequencies from the mixers 23L and 23R, band pass filters 25L and 25R produce carrier frequencies f_L and f_R illustratively set as high as

$$f_L = 76.00 \text{ MHz}$$

$$f_R = 76.46 \text{ MHz}$$

The FM signals S_L and S_R with the above frequencies are then fed past high-frequency amplifiers 26L and 26R and transmitted from an antenna 27.

In a tape feed control means 30, a motor 33 coupled with capstans 31F and 31R is controlled by a system control circuit 40 via an amplifier 34. A control mechanism 35 utilizes the torque of the motor 33 to control the mechanical status of the player 1. The system control circuit 40 also controls the control mechanism 35 via a plunger 36 and an amplifier 37.

The system control circuit 40 has a remote control decoder 41 that decodes the output of the control signal receiving circuit 50. The operating status of the player 1 is controlled on the basis of a control signal output by the decoder 41 or on a control signal from operating keys 41 on the player side.

A power supply battery 43 is illustratively a second-



ary battery with a voltage of 1.2 V and a capacity of 600 mHA. The battery 43 directly powers the amplifiers 34 and 37 of the tape feed control means 30. The power of the battery 43 is also supplied via a switch 44 to the audio signal reproducing circuit 10 and the audio signal transmitting circuit 20. The battery 43 powers the system control circuit 40 and the control signal receiving circuit 50 through a boosting circuit 45 and a switch 46. The switch 46 is controlled by the system control circuit 40.

In the receiver 6 of Fig. 2, the FM signals SL and SR from the player 1 are received by an antenna 61. The signals are sent past a band pass filter (tuning circuit) 62 and a high-frequency amplifier 63 and are fed to a mixer 64. The mixer 64 mixes the FM signals SL and SR with an output signal SL0 from a local oscillator 65. The frequency fL0 of the signal SL0 is illustratively set as

$$fL0 = 65.76 \text{ MHz}$$

The FM signals SL and SR are converted to intermediate frequency signals whose frequencies f_i and f_j are illustratively set as

$$f_i = 10.24 \text{ MHz}$$

$$f_j = 10.70 \text{ MHz}$$

These intermediate frequency signals are fed respectively through intermediate frequency filters 66L and 66R as well as amplifiers 67L and 67R and into frequency demodulators



68L and 68R. The frequency demodulators 68L and 68R demodulate the FM signals respectively and recover the audio signals L and R therefrom. The audio signals L and R are supplied to the headphones 7 via amplifiers 71L and 71R.

The output of the frequency demodulator 68L is supplied to an AFC voltage forming circuit 69. An AFC voltage from the circuit 69 is fed to the local oscillator 65.

The system control circuit 80 for remote control has an encoder 81 that codes a control signal coming from operating keys 82. The coded control signal is transmitted by a transmitting circuit 90 in frequency modulated format. The carrier frequency f_{CT} of the FM signal S_{cr} is illustratively set as

$$f_{CT} = 88.67 \text{ MHz}$$

The voltage of the battery 83 on the side of the receiver 6 is illustratively three volts. Unlike the player 1, the receiver 6 has no need for boosting circuits.

Below is a description of how a mode signal is transmitted and how mode displays are provided in the embodiment. A mode signal generating circuit 110 on the side of the player 1 has two mode signal generators 111 and 112. The frequency f_{ma} of one mode signal generator 111 is higher than the audio frequency band, and the frequency f_{mb} of the other mode signal generator 112 is lower than the audio frequency band. Illustratively, these frequen-



11

cies are set as

$f_{ma} = 40 \text{ kHz}$

$f_{mb} = 10 \text{ Hz}$

Mode signals Sma and Smb output by the generators 111 and 112 are fed respectively past switches 113 and 115 as well as switches 114 and 116 and into the frequency modulators 22L and 22R of the audio signal transmitting circuit 20. The mode signals Sma and Smb are multiplexed by the frequency modulators 22L and 22R together with the left- and right-hand channel audio signals L and R before being transmitted.

With this embodiment, the system control circuit 40 controls the four switches 113 - 116 in accordance with the current operation mode of the player 1. In each operation mode, as shown in Table 1 below, one of the mode signals Sma and Smb is output over either the left-hand channel Lch or the right-hand channel Rch.

In stop mode, neither of the mode signals Sma and Smb is transmitted because the switch 44 of the player 1 is opened.

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Table 1

Signal Mode		Sma		Smb	
		Lch	Rch	Lch	Rch
Reproduction	Forward	○	—	—	—
	Reverse	—	○	—	—
Fast-forward	Forward	—	—	○	—
	Reverse	—	○	○	—
Fast-rewind	Forward	○	—	—	○
	Reverse	—	—	—	○
Stop		—	—	—	—

On the side of the receiver 6, the mode signals Sma and Smb demodulated respectively by the frequency demodulators 68L and 68R in the audio signal receiving circuit 60 are separated from the left- and right-channel audio signals L and R by high-pass filters 121 and 123 as well as by low-pass filters 122 and 124 in the mode signal separating circuit 120. The high-frequency mode signal Sma is supplied through detectors 125 and 126 to the system control circuit 80.

The system control circuit 80 determines the operation mode of the player 1 based on the combination of the received mode signal Sma or Smb with the left- or right-hand channel on which the signal is transmitted. A control signal representing the operation mode thus determined is



supplied to the LCD indicator 130. In turn, the LCD indicator 130 selects and displays one of the symbols illustrated.

Taking a look at the display, the user can readily ascertain the current operation mode of the player 1 which is located away from the receiver 6. Accordingly, the user may carry out necessary remote control operations regarding the player 1.

The LCD indicator may alternatively be replaced with an LED display.

As described, the wireless type signal reproducing apparatus according to the invention has an operating status signal multiplexed with audio signals and transmitted to the receiver containing the display means, the status signal indicating the current operating status of the player. On receiving the status signal, the display means indicates the current operating status of the receiver. This allows the user to control the player accordingly from a distance without the intervention of wires.

As many apparently different embodiments of the present invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.



Fig. 1

- | | |
|---------------------------------------|--------------------------------------|
| 1) Player | 10) Audio signal reproducing circuit |
| 20) audio signal transmitting circuit | |
| 23L, 23R) Mixer | 30) Tape feed control means |
| 35) Control mechanism | 40) System control circuit |
| 41) Decoder | 45) Boosting circuit |
| 50) Control signal receiving circuit | |
| 110) Mode signal generating circuit | |

Fig. 2

- | | |
|---|--------------|
| 6) Receiver | 8) Commander |
| 60) Audio signal receiving circuit | 64) Mixer |
| 80) System control circuit | 81) Encoder |
| 90) Control signal transmitting circuit | |
| 120) Mode signal separating circuit | |
| a) To various parts | |

Fig. 3

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|---------------|-------------|
| 1) Player | 6) Receiver |
| 7) Headphones | |

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- 15 -

CLAIMS

1. A signal reproducing apparatus operating on a wireless basis, said apparatus comprising:

a reproducing section for reproducing audio signals from a recording medium;

a transmitting section for transmitting said audio signals from said reproducing section;

an audio signal receiving section for receiving said audio signals from said transmitting section;

a remote control section, attached to said audio signal receiving section, for providing remote control over said reproducing section; and

a control signal receiving section for receiving control signals from said remote control section;

wherein said reproducing section contains a status signal generating means for generating a status signal indicating the current operating status of said reproduction section, said status signal being multiplexed with said audio signals for transmission; and

wherein said audio signal receiving section contains a display means for displaying the current operating status of said reproducing section in accordance with said transmitted status signal.

This Sheet Has Been Replaced





- 16 -

2. A signal reproducing apparatus according to claim 1, wherein the status signal indicates the status of the reproducing section by respective combinations of signals on the left or right audio channels.
3. A signal reproducing apparatus according to claim 1 or 2 wherein the status signal indicates the status of the reproducing section by respective combinations of higher and lower frequency signals.
4. A signal reproducing apparatus according to claim 3 wherein the higher and lower frequency signals are respectively higher and lower than the transmitted audio signals.
5. A portable cassette player including signal reproducing apparatus according to any one of the preceding claims.

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