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Receiving TV Station Selection Unit of TV-VTR

This invention relates to a receiving station selection unit of television (TV) incorporated with video tape recorder (VTR) for auto-tuning. More particularly, it relates to an automatic tuning unit to select TV channels, while reducing manufacturing costs of the TV-VTR compound set.

Fig. 7 is a block diagram of a conventional receiving station selection unit of VTR. In Figure 7, 1 is a receiving station selection portion of a microcomputer (MC) for video control, said receiving station selection portion being provided with a (not illustrated) D/A converter (Digital-Analog converter) having a resolution of a fixed bit. In addition, said receiving station selection unit is provided with a DAC terminal 1a which outputs a tuning control signal (hereinafter called "DAC value") which is subjected to a PWA (pulse wide modulation) by this D/A converter, an AFC (Automatic Frequency Control) terminal 1b where an AFC level is fed which shows an error amount corresponding to a best tuning point when the receiving station is selected, an AFC control signal output terminal 1c which outputs the AFC control signal, and a synchronous detecting signal input terminal 1d (hereinafter called "SD input terminal") where a synchronous detecting signal is fed from the synchronous detecting portion 2 and the like. The numeral 3 is an inverter, an input terminal thereof being connected to the DAC terminal 1a, while the output terminal is connected to an input terminal of a low-pass filter 4 (hereinafter called "SD input terminal"). The output terminal of the IPF 4 is connected to a tuning voltage signal input terminal 5a of a tuner 5.

The numeral 6 is an AFC control switch circuit, said AFC control switch circuit being provided with a first transistor 6c, second transistor 6e, and third transistor 6f. At a collector terminal of the first transistor 6c, a series circuit consists of a resistance 6a connected to a B power source with



one end thereof, and a resistance 6b is connected thereto. Further, an emitter terminal of the first transistor 6c is connected to the ground. A base terminal of the second transistor 6e is connected to a connecting point of said resistance 6a with said resistance 6b. An emitter terminal of the second transistor 6e is connected to the B power source through a resistance 6d. A drain side terminal of the third transistor 6f is connected to a collector terminal of the second transistor 6e and a AFC control signal input terminal 5b of the tuner unit 5. Further, a source side terminal is connected to a AFC control output terminal 5c of the tuner unit 5. The numeral 7 is a resistance connected to the drain side terminal of the third transistor 6f and the source side terminal thereof. The numeral 5d is a video signal output terminal where a video signal provided at the tuner unit 5 is output therefrom. The video signal output terminal 5d is connected to the input side of the synchronous detecting portion 2.

These operations are described as follows. In the receiving station selection unit, a DAC value is output from a terminal 1a of the receiving station selection portion 1, and lead to the inverter 3. The DAC value is output from a D/A converter having a fixed bit resolution provided at a video control microcomputer MC side.

The DAC value is reversed in the inverter to output to the low-pass filter 4, a direct current voltage signal corresponds to a duty ratio of "H" level of the fed pulse signal is formed thereby being output to the tuning voltage signal input terminal 5a of the tuner unit 5 as a tuning voltage signal VT. At the tuner unit 5, a VT-f conversion operation of the tuner is carried out based upon the VT-f conversion characteristic shown in Fig. 5 by the tuning voltage signal VT thereby tuning to the broadcast channel by the tuning frequency f to be received.

Fig. 5 is a VT-f conversion characteristics curve which shows a relation between the tuning voltage signal VT and the tuning frequency f carried out in the tuner unit 5.

When the receiving station selection unit is selecting a desired TV channel, since a AFC control signal having an "H" level is output from the AFC control signal output terminal 1c



of the receiving station selection portion 1 of the video control microcomputer MC, the first transistor 6c and the second transistor 6e are on respectively, while the third transistor 6f is off. When the second transistor is on, the AFC control signal of "H" level is fed to the AFC control signal input terminal 5b of the tuner unit 5. On the other hand, AFC signal is fed to the AFC terminal 1b of receiving station selection portion 1 from the AFC signal output terminal 5c of the tuner unit 5c.

The AFC terminal 1b of the receiving station selection portion 1 of the video control microcomputer MC is provided with an analogue input performance and converts a voltage level of the AFC signal to the digital data to judge control of "H" level or "L" level of the voltage level of the AFC signal, whereby the proceeding operation is carried out so that tuning reception may be performed at the best tuning point P of the S curve characteristic shown in Fig. 6.

When the receiving station selection is completed, the AFC control signal output terminal 1c becomes "L" level, the first transistor 6c and the second transistor 6e turn off, and the third transistor 6f comes on. When the third transistor 6f comes on, the AFC control signal input terminal 5b and AFC signal output terminal 5c of the tuner unit 5 become in a short circuit condition, and AFC operation thereafter is performed by a feed back function within the tuner and stable tuning reception with respect to the circuit can be carried out by automatic draw-in operation.

Since the conventional receiving station selection unit is constituted as above, it is necessary to set a AFC control switch circuit 6, which causes a complicated circuit constitution thereby increasing manufacturing costs.

This invention is carried out to eliminate the above problems and its object is to obtain a receiving station selection unit which simplifies the circuit constitution to decrease the manufacturing costs by removing the AFC control switch circuit.



3. BRIEF DESCRIPTION OF THE INVENTION

The receiving station selection unit of TV incorporated with VTR according to this invention is provided with a microcomputer for video control and a tuner unit, said tuner unit selecting a receiving TV channel corresponding to a tuning control signal which is fed from the microcomputer for video control, comprises:

- a TV channel receiving means which receives a TV channel corresponding to the tuning control signal fed from said microcomputer for video control;

- a tuning control signal converting means which converts said tuning control signal to TV channel;

- a fine tuning means which detects a best receiving condition when a broadcast is received from said receiving means and tunes the channel at its finest conditions;

- a tuning control signal memory means which memorizes said tuning control signal corresponding to the best receiving conditions detected by the fine tuning means; and

- a system control means which controls said tuning control signal converting means, said fine tuning means and the tuning control signal memory means.

Further, the receiving station selection unit of TV incorporated with VTR according to this invention, is provided with a microcomputer for video control and a tuner unit, said tuner unit selecting a receiving TV channel corresponding to a tuning control signal fed from the microcomputer for video control, comprising:

- a TV channel receiving means which receives a TV channel corresponding to the tuning control signal fed from the microcomputer for video control, a fine tuning means which detects the best receiving conditions and tunes the channel at its finest conditions by setting the best tuning frequency, a receiving channel searching means wherein when said TV channel is not receivable by said receiving means, said tuning control signal is converted within a fixed range so that said TV channel may be received, and a system control means which controls said fine tuning means of the receiving conditions and said receiving channel searching means.



In the receiving station selection unit of this invention, said tuning control signal is converted so that the tuning receiving condition may be best by judging whether or not the tuning receiving condition is best when the tuning control signal is fed from the microcomputer for video control to the tuner unit and the TV channel is received, the best tuning frequency with respect to the TV channel to be received is provided, said tuning control signal corresponding to the best tuning receiving condition is memorized, and since a series of these operations is performed with a center of the microcomputer for video control and realized by program operations, a AFC control switch circuit can be removed and circuit constitution is simplified thereby decreasing manufacturing costs.

In the receiving station selection unit, when the tuning control signal is fed from the microcomputer for video control to the tuner unit, said tuning control signal is converted within a fixed range so that the tuning receiving condition may be best by judging whether or not the tuning receiving condition is best, and the best tuning frequency with respect to the TV channel to be received is set and reception is performed. Accordingly, the relation between the best tuning frequency with respect to the TV channel to be received and the tuning control signal for setting the tuning frequency varies by a temperature drift of the tuner unit and stable tuning reception can be obtained in the best conditions even if a tuning lag occurs.

4. BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram which shows a receiving station selection of an embodiment of this invention.

Fig. 2 is a flow chart which shows an automatic receiving station selection operating in the receiving station selection unit of the first embodiment of this invention.

Fig. 3 is a flow chart which shows an operation of the selection of the receiving station in the receiving station selection unit according to a second embodiment of this invention.

Fig. 4 is a flow chart which shows AFC in the Fig. 3 flow chart.

Fig. 5 is a VT-f conversion characteristic graph which



shows the relation between tuning voltage signal VT and a tuning frequency f.

Fig. 6 is a characteristic curve graph which shows S-letter curve characteristic in AFC processing.

Fig. 7 is a block diagram which shows a conventional receiving station selection unit.

5. DETAILED DESCRIPTION OF THE INVENTION

The first embodiment of this invention will be described as follows with reference to the drawings.

Fig. 1 is a block diagram which shows a constitution of the receiving station selection unit of this embodiment. In Fig. 1, the explanation of parts that are the same or equivalent to parts in Fig. 7 are omitted so far as these have the same respective marks. In this receiving station selection unit of this embodiment, the AFC control signal input terminal 5b of the tuner unit 5 (receiving means) is in a pull-up state by resistance 2.

The operation is next described. Fig. 2 is a flow chart which shows an operation of the receiving station selection in the receiving station selection unit according to this embodiment. A program shown in this flow chart is stored in the memory of the microcomputer MC for video control.

In Fig. 2, first after a DAC value responding to a channel frequency to be selected is read from the memory of the microcomputer MC (tuning control signal conversion means, a fine tuning means of the tuning receiving condition, tuning control signal memory means, system control means), the DAC value is varied to input to the low-pass filter 4 through the inverter 3 from the DAC terminal 1a (step S1). A tuning voltage signal VT corresponding to the DAC value is fed to the tuning voltage signal input terminal 5a from the low-pass filter 4. When the tuner unit 5 receives an electric wave of the channel, together with the AFC signal having an S-letter curve characteristic is output from the AFC signal output terminal 5c, the video signal is output from the video signal output terminal 5d.

Then, when the tuning is carried out by watching the relation between the tuning voltage signal VT and the video



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signal, and the video signal is output from the video signal output terminal 5d, a response for a receiving tuning to a SD input terminal 1d, or whether or not the synchronizing detecting signal is fed from the synchronizing detecting portion 2 is judged (step S2). When there exists no response due to the receiving tuning to the SD input terminal 1d, the flow chart returns to the step ST1 to vary the DAC furthermore.

On the other hand, when the TV channel is received and the receiving tuning thereof responds to the SD input terminal 1d, detections of "H" and "L" levels of voltage levels of the AFC signal are carried out (step S3), and the distinct controls of "H" and "L" levels of voltage levels of the AFC signal are performed, thereby finely adjusting said DAC value. Thus, the tuning reception at the best tuning point P is performed based upon the S-curve characteristics shown in Fig. 6 (step S4, step 5). When the tuning reception at the best tuning point P is secured, the DAC value at this time is stored in the memory of the microcomputer MC for video control as a tuning value of said TV channel (step 5) and the process of the receiving station selection is completed.

In this case, since the tuner unit 5 becomes unstable due to the temperature drift and the electric intensity of the receiving electric wave and the set tuning frequency varies, the voltage level of the AFC signal varies. Accordingly, even after selection of the receiving station, the voltage level of the AFC signal is always watched to maintain the tuning reception at the best tuning point P and control said DAC value by the feed back group, microcomputer for video control → DAC value → tuner unit 5 → AFC signal → video control microcomputer MC thereby decreasing the tuning voltage signal VT.

With respect to the maintenance of said best tuning point P, since this maintenance is practically impossible to keep constant due to the temperature drift and the electric intensity of the receiving electric wave and the like, stable tuning characteristics are maintained by setting an allowable value to regard this range as the best tuning point. Thus, a decrease in manufacturing costs can be obtained.



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The second embodiment of this invention will be described with reference to the drawings as follows. The block diagram which shows the constitution of the receiving station selection unit of this invention is the same as Fig. 1. However, at the memory of the microcomputer MC for video control, programs for realizing the operations shown in the flow charts of Fig. 2 and Fig. 3 are stored differently from the first embodiment.

The operation is next described as follows. Fig. 3 is a flow chart which shows operation of the receiving station selection in the receiving station selection unit of the second embodiment. In addition, Fig. 4 is a flow chart which shows an AFC processing operation in the flow chart. In Fig. 3, a DAC value corresponding to the channel frequency of the receiving station selection is read from the memory of the microcomputer MC (distinct adjustment means of the receiving condition, search means of the tuning receiving condition) and output to the low-pass filter 4 through the inverter 3 (step S31). The tuning voltage signal VT correspondent to the DAC value is fed to the tuning voltage signal input terminal 5a from the low-pass filter 4. When the tuner unit 5 receives the broadcast electric wave of the broadcast channel, a video signal is output from the video signal output terminal 5d together with the AFC signal having the S-letter curve characteristics output from the AFC signal output terminal 5c.

When tuning is carried out watching the relation between the tuning voltage signal VT and the video signal and the video signal is output from the video signal output terminal 5d, a response due to the receiving tuning to the SD input terminal 1d, or whether or not the synchronizing detecting signal from the synchronizing detecting portion 2 is output is judged (step S32). When there is no response due to the receiving tuning to the SD input terminal 1d, said DAC value is varied by one step in the lower limit direction (step S33). In this case, one step variation means that the upper limit is a new DAC value added X [mV] to the present DAC value, while the lower limit direction is a new DAC value subtracted X[mV] from the present DAC value, wherein X[mV] value is a value divided a tuning variable range into a fixed numbers.



Then, said DAC value is varied by 1 step in the lower limit direction ($DAC = DAC - X[mV]$), and whether or not the DAC value attains the lower limit value is detected (step S34). When the DAC value does not attain the lower limit value, it is detected whether the SD input terminal 1d responds to the receiving tuning (step S35). In this step S35, when there is no response to the receiving tuning is detected, since the tuning to the channel frequency to be received is not carried out, the flow chart returns to the step ST33 and said DAC value is varied by a further step in the lower limit direction. If there is the response to the receiving tuning in a state that the DAC value does not attain the lower limit direction within a tuning variable range, the tuning to the tuning frequency according to the DAC value is taken, the process advances from step S39 to step S40 and the AFC processing operation shown in the flow chart of Fig. 4 is practiced whereby the receiving tuning to the channel frequency to be received is secured.

Further, in step ST32 if there is a response due to the receiving tuning to the SD input terminal 1d, the step advances from step S39 to step S40 and the AFC processing operation shown in the flow chart of Fig. 4 is practiced whereby the receiving tuning to the channel frequency to be received is secured.

On the other hand, in step ST34 when said DAC value is varied by 1 step in the lower limit direction, if it is detected that the DAC value attains the lower limit value within the tuning variable range, then the DAC value is varied by 1 step ($DAC = DAC + X[mV]$) toward the upper limit direction (step S36), whereby whether or not the DAC value attains the upper limit value within the tuning variable range is detected (step S37). As a result, when the DAC value is detected as not having attained the upper limit, whether or not there is a response due to the receiving tuning to the SD input terminal 1d, is detected (step S38). In step S38, when the detection is made that no response due to the receiving tuning is made, as the tuning is not taken to the channel frequency to be received, the step returns to ST36, and said DAC value is varied by 1 further step to the upper direction. This is repeated until the response due to the receiving tuning occurs in step S38 provided that the DAC



value does not attain the lower limit. When there is no response due to the receiving tuning until the DAC value attains the lower limit value within the tuning variable range, the step returns to step S33, then said DAC value varies step by step in the lower limit direction.

In step S38, when the distinction that there is a response due to the receiving tuning is made, the step advances from step S39 to step S40, the AFC processing operation shown in the Fig. 4 flow chart is practiced whereby the receiving tuning to the channel frequency to be received is secured.

Further, the AFC processing operation in step S39 is, as shown in the Fig. 4 flow chart, is realized by a fine adjustment of said DAC value of the tuning receiving at the best tuning point P by the S-letter curve characteristic shown in Fig. 6.

Further, said $\pm X[\text{mV}]$ value is necessary to determine from a specific value of the tuner since it is different by a tuning frequency from the point of the tuner characteristic. Namely, as shown in Fig. 5, since the relation between the tuning voltage signal VT and the tuning frequency f has not a linear proportional relation, the X[mV] value is determined by every range of the tuning voltage signal VT value correspondent to the tuning frequency.

According to this embodiment as described above, even if the tuning frequency set to the DAC value read from the memory of the microcomputer MC for video control is in a state which varies by temperature drift of the tuner unit and the like, said DAC value is varied automatically within the range of the upper limit value and the lower limit value of the tuning variable range to catch a broadcast channel to be received whereby the best tuning frequency to the channel frequency to be received is set. Accordingly, stable tuning reception can be obtained in the best condition.

According to this invention as described above, since the best tuning reception of the broadcast channel to be received is realized by the program operation in the microcomputer for control, deletion of the AFC control switch circuit can be realized and the circuit constitution thereof is simplified, thereby decreasing manufacturing costs.



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Further, according to this invention, even if the relation between the tuning frequency to the broadcast channel to be received and the tuning control signal for setting the tuning frequency varies by a temperature drift of the tuner unit and the like, and tuning lag occurs, it is still possible to secure stable tuning in the best condition.

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1. A receiving station selection unit for use in a television or video tape recorder, which is provided with a microcomputer for video controlling and a tuner unit, said tuner unit selecting a receiving TV channel corresponding to a tuning control signal which is fed by said microcomputer for video control, the selection unit comprising;

a TV channel receiving means which receives a TV channel corresponding to the tuning control signal fed from said microcomputer for video control;

a tuning control signal conversion means which converts said tuning control signal to TV channel;

a fine tuning means which detects best receiving conditions and tunes the channel at its finest conditions when a TV channel is received by said receiving means;

a tuning control signal memory means which memorizes said tuning control signals corresponding to the best receiving conditions detected by the fine tuning means; and

a system control means which controls said tuning control signal conversion means, said fine tuning means and said tuning control signal memory means.

2. A receiving station selection unit for use in a television or video tape recorder, which is provided with a microcomputer for video control and a tuner unit, said tuner unit selecting a receiving TV channel corresponding to a tuning control signal which is fed by said microcomputer for video control, the selection unit comprising;

a TV channel receiving means which receives a TV channel corresponding to the tuning control signal fed from said microcomputer for video control;

a fine tuning means which detects the best receiving conditions and tunes the channel at its finest conditions;

when said TV channel receiving means cannot receive a desired channel, a receiving channel searching means which enables reception of the desired channel by varying said tuning control signals within a predetermined range; and





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a system control means which controls said fine tuning means and said receiving channel searching means.

3. A receiving station selection unit constructed and arranged to operate substantially as hereinbefore described, with reference to and as illustrated in Figures 1 to 6 of the accompanying drawings.

4. A television receiver incorporating a receiving station selection unit according to any one of the preceding claims.

5. A video tape recorder incorporating a receiving station selection unit according to any one of the preceding claims.

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