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DISPLAY OF CLOSED CAPTIONING STATUS

This invention concerns television receivers having closed captioning circuitry. A closed-caption system aids the hearing-impaired in enjoying television programs. In such a system, text corresponding to the words spoken in a television program are transmitted with the picture and sound information from the broadcast transmitter. The closed-caption text is displayed at the bottom of the screen (similar to the way in which motion picture subtitles are displayed) so that a hearing-impaired viewer may better understand the television program.

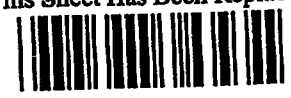
The Television Decoder Circuitry Act of 1990 requires the inclusion of a closed-caption decoder in a television receivers sold in the United States having display screens which are thirteen inches (approximately 33 cm.) or larger (measured diagonally). In a closed-caption system implemented in accordance with this Act, closed-caption text is transmitted a few characters at a time during the vertical blanking interval on television line 21. The above-mentioned closed-caption decoder captures the data on television line 21, and displays it via on-screen display circuitry. It should be noted that at the present time not all television programs are closed-captioned.

The FCC has mandated that the closed-caption display circuitry must be capable of being turned on or off at the viewers option. Clearly, the vast majority of purchasers of new television receivers are not hearing-impaired, and have little or no need for the closed-captioning capability built in to their new television receivers. Therefore, it is felt that the default state of the closed-captioning system should be the "off" state.

Unfortunately, if the default state of the closed-captioning system is the "off" state, a problem arises in that the viewer will not know when closed caption data is available for display, because, as noted above, not all television programs are accompanied by closed-caption data.

In FM stereo receivers, it is common practice to light a stereo-available indicator in response to the detection of the

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stereo pilot signal. Detection of the stereo pilot signal is a reliable indicator of the presence of stereo audio because the pilot signal always accompanies a stereo broadcast. At first glance, it might appear that one should look for a similar signal which always accompanies closed-caption information, such as the closed-caption run-in clock, or look for a NEW-CHARACTER-RECEIVED (i.e., NEWDATA) signal from the closed-caption data slicer. Unfortunately, unlike the stereo pilot signal of the above-mentioned FM stereo example, the run-in clock may be present even in the absence of closed-captioning because many television broadcasters do not turn off their closed-caption encoders in the absence of closed-caption information, but rather send a series of null characters (e.g., the code "00") on line 21. Moreover, in the absence of closed-caption information, the encoders of some broadcasters transmit a sequence of closed-caption commands which cause an erasure of data which may be remaining on the screen if, for example, a user changed from a channel which was transmitting a closed-captioned program to a channel which was not. Thus, even though no useful information is being sent, the run-in clock is present and actual closed-caption characters (i.e, null characters, or an erase sequence) are being received. For these reasons, neither the run-in clock nor a NEW-CHARACTER-RECEIVED signal is a reliable indicator of the presence of useful closed-captioning.

The present invention resides, in part, in recognizing the problem and, in part, in providing a system for solving the problem.

In a television system including closed-caption circuitry for receiving and decoding closed-caption data, a controller continually monitors the closed-caption circuitry for an indication of the presence of any of a plurality of predetermined valid closed-caption data codes. Every time any of the predetermined valid closed-caption data codes is detected, a timer is reset to begin timing a predetermined time interval, and an on-screen display indicating that closed-caption data are available is enabled. If a subsequent one of the predetermined valid closed-

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caption data codes is not detected before the expiration of the time interval, then the on-screen display indicating that closed-caption data are available is disabled. In another embodiment of the invention, a lamp is illuminated to indicate the availability of useful closed-caption data.

The invention may be better understood by referring to the enclosed drawing in which:

FIGURE 1 is a block diagram of a portion of a television receiver suitable for implementing the invention;

FIGURE 2 is an illustration of a television receiver having a screen display produced in accordance with the invention;

FIGURES 3, 4a, and 4b are flowcharts showing portions of the program of controller 110 of FIGURE 1;

FIGURE 5 is a block diagram of a portion of a television receiver suitable for implementing a second embodiment of the invention;

FIGURE 6 is an illustration of a television receiver having a screen display produced in accordance with the second embodiment of the invention;

FIGURES 7, 8, and 9 are flowcharts showing portions of the program of controller 510 of FIGURE 5;

FIGURE 10 is a block diagram of a portion of a television receiver suitable for implementing a third embodiment of the invention; and

FIGURE 4c is a flowchart showing a portion of the program of controller 1010 of FIGURE 10.

Referring to FIGURE 1, a television receiver includes an RF input terminal 100 which receives radio frequency (RF) signals and applies them to a tuner assembly 102. Tuner assembly 102 selects and amplifies a particular RF signal under control of a tuner controller 104 which provides a tuning voltage via a wire 103, and bandswitching signals via signal lines represented by the broad double-ended arrow 103', to tuner assembly 102.

Tuner assembly 102 converts the received RF signal to an intermediate frequency (IF) signal and provides an IF output signal to video (VIF) and sound (SIF) amplifier and detector unit

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130. VIF/SIF amplifier and detector unit 130 amplifies the IF signal applied to its input terminal and detects the video and audio information contained therein. The detected video information is applied as one input of a video processor unit 155. The detected audio signal is applied to an audio processor 135 for processing and amplification before being applied to a speaker assembly 136.

Tuner controller 104 generates the tuning voltage and bandswitching signals in response to control signals applied from a system control microcomputer (μC) 110. The terms "microcomputer", controller, and "microprocessor", as used herein, are equivalent. It is also recognized that the control function of microcomputer 110 may be performed by an integrated circuit especially manufactured for that specific purpose (i.e., a "custom chip"), and the term "controller", as used herein, is also intended to include such a device. Microcomputer 110 receives user-initiated commands from an infrared (IR) receiver 122 and from a "local" keyboard 120 mounted on the television receiver itself. IR receiver 122 receives IR transmissions from remote control transmitter 125. Microcomputer 110 includes a central processing unit (CPU) 112, a program memory (ROM) 114, and stores channel-related data in a random-access memory (RAM) 116. RAM 116 may be either internal to, or external to, microprocessor 110, and may be of either the volatile or non-volatile type. The term "RAM" is also intended to include electrically-erasable programmable read only memory (EEPROM) 117. One skilled in the art will recognize that if volatile memory is utilized, that it may be desirable to use a suitable form of standby power to preserve its contents when the receiver is turned off.

Microcomputer 110 also includes a timer 118 the operation of which will be described below. Microcomputer (or controller) 110 generates a control signal for causing tuner control unit 104 to control tuner 102 to select a particular RF signal, in response to user-entered control signals from local keyboard 120 and from infrared (IR) receiver 122.

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Tuner 102 produces a signal at an intermediate frequency (IF) and applies it to a processing unit 130 comprising a video IF (VIF) amplifying stage, an AFT circuit, a video detector, and a sound IF (SIF) amplifying stage. Processing unit 130 produces a first baseband composite video signal (TV), and a sound carrier signal. The sound carrier signal is applied to an audio signal processor unit 135 which includes an audio detector and may include a stereo decoder. Audio signal processor unit 135 produces a first baseband audio signal and applies it to a speaker unit 136. Second baseband composite video signals and second baseband audio signals may be applied to VIDEO IN and AUDIO IN terminals from an external source.

The first and second baseband video signals (TV) are coupled to a video processor unit 155 (having a selection circuit not shown). Electrically-erasable programmable read only memory (EEPROM) 117 is coupled to controller 110, and serves as a non-volatile storage element for storing autoprogramming channel data, and user-entered channel data.

The processed video signal at the output of video signal processor unit 155, is applied to a Kine Driver Amplifier 156 for amplification and then applied to the guns of a color picture tube assembly 158 for display. The processed video signal at the output of video signal processor unit 155, is also applied to a Sync Separator unit 160 for separation of horizontal and vertical drive signals which are in turn applied to a deflection unit 170. The output signals from deflection unit 170 are applied to deflection coils of picture tube assembly 158 for controlling the deflection of its electron beam. That portion of FIGURE 1 described thusfar is known, for example, from the RCA CTC-140 color television manufactured by Thomson Consumer Electronics, Inc., Indianapolis, Indiana.

A first embodiment of the invention will now be described with reference to the remainder of FIGURE 1, and the on-screen display illustration of FIGURE 2, and the flowcharts of FIGURES 3 and 4.

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A DATA SLICER 145 receives closed caption data at a first input from VIF/SIF amplifier and detector unit 130, and at a second input from the VIDEO IN terminal via a VIDEO SWITCH 137 which selects the proper source of closed-caption data under control of controller 110. DATA SLICER 145 supplies closed-caption data to CLOSED CAPTION OSD PROCESSOR 140 via lines 142 and 143. DATA SLICER 145 supplies closed-caption status data (NEWDATA, FIELD 1) to controller 110. Under control of controller 110, via control line 141, CLOSED CAPTION OSD PROCESSOR 140 generates character signals, and applies them to an input of video signal processor 155, for inclusion in the processed video signal. Alternatively, CLOSED CAPTION OSD PROCESSOR 140 and DATA SLICER 145 may be included in controller 110.

FIGURE 2 shows a television receiver 200 having a display screen 210. An on-screen display provides channel number information 220 (e.g., channel 29), and closed-caption information 230 (e.g., CAPTIONED or CC). Information displays 220 and 230 are displayed each time a new channel is selected by a user, and each time a "display" or "status" key on remote control unit 125 is pressed. Preferably, the CAPTIONED status message is not displayed in the absence of useful closed-captioning, although a message such as NO CC could be displayed, if desired.

It is herein recognized that although one cannot rely on the presence of the run-in clock or the NEWDATA signal, five particular closed-caption commands are reliable indicators of active closed-captioning (although other closed captioned data may be used). These commands are: ROLL UP 2 (RU2), ROLL UP 3 (RU3), ROLL UP 4 (RU4), RESUME DIRECT CAPTIONING (RDC), and END OF CAPTIONING (EOC). These commands are referred to hereinafter as valid closed-caption commands. The detection of one of these commands indicates that closed captioning is active on the currently-tuned channel. Upon detection of one of these commands, controller 110 enables an on-screen display of CAPTIONED as shown in FIGURE 2, when the user next presses the "status" or "display" key of remote control unit 125. If a new channel is tuned, the status display is automatically activated to

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display the new channel number. If one of the above-mentioned five commands is detected during the period in which the channel number is being displayed, controller 110 causes an on-screen display of CAPTIONED as shown in FIGURE 2.

It is not sufficient to simply set a CAPTIONED flag upon detection of one of the valid closed-caption commands; one must also set forth criterion for clearing the flag in the absence of useful closed-caption data. Some television programs are partially closed-captioned (such as news programs), and some non-closed-captioned programs are interspersed with commercial messages having closed-captioning. In order to avoid providing the wrong information concerning the availability of closed-captioning, it has been decided to start a timer and enable a CAPTIONED message upon detecting valid closed-captioning signals and disable the CAPTIONED message upon expiration of the timed period. In this regard, it has been observed that during a dialogue in a television program there occur lapses between the point when one person stops speaking and another begins to speak. Few of these lapses exceed 10 seconds, but some may last as long as 60 seconds. It is felt, therefore, that a range of reasonable times in which to maintain the enablement of the closed caption message is from 10 to 60 seconds, but preferably 20 seconds.

Detection of closed-caption data does not automatically cause the display of the CAPTIONED message, for the following reason. There may be portions of a televised captioned movie in which there are no words spoken (and therefore no closed-caption messages) for a a period greater than the predetermined timer period (i.e., 10 to 60 seconds). In that event, the CAPTIONED message will be disabled, and reenabled upon the next spoken word throughout the movie. This would cause repeated display of the word CAPTIONED upon each acquisition of valid closed-caption commands, which it is felt would be an annoyance to the viewer. Thus, it is felt that the better solution is to enable display of the word CAPTIONED, but refrain from displaying the message until commanded by the viewer via a status command, or a channel change command.

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In operation, a BOTTOM OF SCREEN interrupt signal is provided by the SYNC SEPARATOR 160 before the start of vertical blanking. It causes controller 110 to enter a section of its program code, shown in FIGURE 3, at step 300. At step 310 a check is made to see if the current TV field is field 1 (currently all closed-captioning data is sent on field 1). If not, the routine is exited at step 350. If the current field is field 1, a check is made at step 315 to see if the NEWDATA flag is set (indicating that the data is newly received). If the data is old, the routine is exited at step 350. If NEWDATA is set, the yes path is taken to step 320 at which a check is made to see if newly-received character 1 is the C1 (channel 1) control code. If not, the routine is exited at step 350. If so, the program advances to step 330 at which a check is made to see if the newly received data is one of the above-mentioned valid closed-caption commands (i.e., ROLL UP 2 (RU2), ROLL UP 3 (RU3), ROLL UP 4 (RU4), RESUME DIRECT CAPTIONING (RDC), and END OF CAPTIONING (EOC)). If none of those commands is detected then the NO path is taken to step 350 and the routine is exited. Otherwise, TIMER 118 is set to its maximum value at step 340 and the routine is exited.

Every 20 milliseconds, a REAL TIME CLOCK interrupt causes controller 110 to enter a portion of its program code, shown in FIGURE 4a, at step 400. The REAL TIME CLOCK (not shown) may be part of controller 110 or may be external. At step 410 the timer is checked to see if its time period has expired. If so, the routine is exited at step 430. If the count is not expired, the count is decremented at step 420, and the routine exited at step 430. During the course of executing its control program, controller 110 enters the MAIN LOOP SUBROUTINE, shown in FIGURE 4b, at step 440. At step 450, TIMER 118 is once again checked to see if its time period has expired. If not, the CAPTIONED display is enabled (for example by setting a flag bit in RAM 116). If so, the the CAPTIONED display is disabled (for example by clearing a the flag bit in RAM 116). The subroutine is exited at step 480.

In addition to closed-captioning, a text mode of operation for showing time-of-day and television programming information has

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been proposed. This text mode is intended to display seven to fifteen lines of information, and utilize the same circuitry as closed-captioning. This text mode information is likely to be transmitted to the receiver on television line 21 of field 1. An embodiment of the invention which addresses both closed-captioning and text mode is shown in FIGURE 5. Elements of FIGURE 5, having similar reference numbers to elements of FIGURE 1, have similar functions and will not be described again. A timer 519, designated TIMER 2, times the time period during which controller 110 looks for certain additional commands which indicate an actual text mode transmission. These additional commands are: TEXT RESTART (TR) and RESUME TEXT DISPLAY (RTD).

FIGURE 6 shows a television receiver 600 having a display screen 610 displaying a status display which indicates channel information 620, and the presence of both closed-caption information 630 and text mode information 640. FIGURE 7 is a flowchart showing a routine similar to that of FIGURE 3, except that two timers are employed (i.e., TIMER 1 for closed-captions and TIMER 2 for text mode). Steps of FIGURE 7, having similar reference numbers to steps of FIGURE 3, have similar functions and will not be described again. If the test performed at step 730 indicates that the newly-received data is not one of the valid closed-caption commands, then the NO path is taken to step 735 at which a check is made to see if the newly-received data is one of the above-mentioned valid text mode commands (i.e., TEXT RESTART (TR) and RESUME TEXT DISPLAY (RTD)). If neither of those commands is detected, then the NO path is taken to step 750 and the routine is exited. Otherwise, TIMER 2 (i.e., 519 of FIGURE 5) is set to its maximum value at step 745 and the routine is exited.

FIGURE 8 is similar to FIGURE 4a in that it includes steps 800-820 which check and decrement TIMER 1, but it adds steps 815 and 825 which check and decrement TIMER 2. FIGURE 9 is similar to FIGURE 4b in that it includes steps 940-970 which check TIMER 1 and enable or disable the CAPTIONED display, but

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it adds steps 955, 965 and 975 which check TIMER 2 and enable or disable the TEXT display.

An embodiment of the invention which indicates the availability of useful closed-caption data by illuminating a panel-mounted LED (or other form of lamp, such as a neon light or incandescent lamp) is shown in FIGURE 10. Elements of FIGURE 10, having similar reference numbers to elements of FIGURE 1, have similar functions and will not be described again. A lamp driver circuit comprising LED 1000, switch transistor Q1000 and associated current limiting resistors is activated by controller 1010 each for so long as the TIMER 1018 is timing. LED 1000 is extinguished when the time period timed by TIMER 1018 has expired. FIGURE 4c is substituted for FIGURE 4b when LED 1000 is employed. If the LED embodiment is used, it is felt that there is no need to wait for user-recall of status, and the LED can be illuminated immediately upon detection of the valid closed-caption codes. During the course of executing its control program, controller 1010 enters the MAIN LOOP SUBROUTINE, shown in FIGURE 4c, at step 440c. At step 450c, TIMER 1018 is once again checked to see if its time period has expired. If not, LED 1000 is illuminated at step 460c. If so, the LED 1000 is extinguished at step 470c. The subroutine is exited at step 480.

The subject invention can be applied in the event field 2 becomes active for the transmission of closed-caption and text data, by timing third and fourth periods relating to the presence of the field 2 data, and such application is felt to be within the scope of the claims. The term television receiver as used herein is intended to include television receivers and monitors having a display screen (commonly called television sets, or TVs), and television receivers not having a display screen, such as VCRs. The term television system as used herein is intended to include the television receivers mentioned above and videodisc players. It is noted that the invention will prove quite useful if built into a VCR or videodisc player since it will then provide information as to the presence of closed-captioning information to even those

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viewers not owning a television set having closed-caption capability.

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CLAIMS



1. In a television system, apparatus comprising:

means (140,155-170) responsive to a recovered video signal for displaying closed-caption information corresponding to spoken language if coded closed-caption data is present in said recovered video signal; and

means (145) for receiving and decoding said coded closed-caption data; and

means (110) coupled to said decoding means for detecting the presence or absence of a predetermined type of said closed caption information and for generating an indication of the presence of said closed-caption information, said indication being other than a display of said closed caption information.

2. The system of claim 1, wherein

said generating means (110) ceases to generate said indication when said data is absent for a predetermined time interval.

3. The system of claim 1, wherein said detecting and generating means comprises

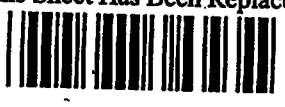
control means (112,114,116) for continually monitoring said decoded closed-caption data to detect the presence of any of a plurality of predetermined valid closed-caption data codes; and

means (118) for timing a predetermined time interval, said means for timing being controlled by said control means; and in that

said control means resets said timer to begin timing said predetermined time interval, and enables generation of a message indicating availability of closed-caption data upon detecting any of said predetermined valid closed caption data codes;

said control means disabling generation of said message if a subsequent one of said predetermined valid closed caption data codes is not detected before said time interval ends.

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4. The system of claim 3 comprising

means (120,125) for receiving data input by a user; and in that

said displaying means (140,155-170) includes on-screen display means (140) for providing a displayed status message under control of said control means (112,114,116) in response to said data input by a user; and

said control means comprises a storage location (116) for storing a flag bit in one of a set or reset state;

said control means resetting said timer (118) to begin timing said predetermined time interval, and setting said flag bit upon detecting any of said predetermined valid closed caption data codes;

said control means resetting said flag bit if a subsequent one of said predetermined valid closed caption data codes is not detected before said time interval ends; and

said control means causing said on-screen display means to display said status message in response to said input by said user if said flag bit is set to indicate that said closed caption information is available.

5. The system of claim 1 wherein said detecting and generating means comprises:

control means (112,114,116) for continually monitoring said decoded closed-caption data to detect the presence of any of a plurality of predetermined valid closed-caption data codes;

means (118) for timing a predetermined time interval, said means for timing being controlled by said control means; and

a lamp (1000 in Fig. 10); and in that

said control means resets said timer to begin timing said predetermined time interval, and illuminates said lamp, upon detecting any of said plurality of predetermined valid closed caption data codes; and

said control means extinguishes said lamp if a subsequent one of said predetermined valid closed caption data codes is not detected before said time interval ends.

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6. The system of any one of claims 3-5 wherein said predetermined valid closed caption data codes are ROLL UP 2 (RU2), ROLL UP 3 (RU3), ROLL UP 4 (RU4), RESUME DIRECT CAPTIONING (RDC), and END OF CAPTIONING (EOC).

7. The system of any one of claims 3-5 wherein said closed caption information includes text mode data and said predetermined valid closed caption codes are TEXT RESTART (TR) and RESUME TEXT DISPLAY (RTD).

8. The system of any one of claims 2-5 wherein said predetermined time interval is in the range of 10 to 60 seconds.

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