The invention relates to a method of transferring in a television receiver, information messages between a control member and several components to be controlled, in accordance with which said information components are digitally encoded and sequentially transmitted over a line.

It also relates to a television receiver whose control or switching data are transferred, in digitally encoded form, from control means available to the user to television receiver members to be controlled.....

The invention is of interest to the electronic industry and more specifically to television manufactures..

In a television receiver, a plurality of information components must be transferred between the control members accessible to the user and the functional circuits of the television set, which must respond to these commands. The control members are, for example, the control knobs for brightness, contrast, sound volume or knobs for switching tapes and standards, for switching from "black and white to colour" or from "mono to stereo" etc. Generally, these control elements are concentrated in the what is commonly referred to as the control panel. The components to be controlled are distributed over the receiver and the transfer of the commands requires a large number of special connecting lines, whose configuration is expensive and are difficult to repair. Consequently in the prior art proposals have been made to use an addressing system of elements to be controlled, associated with a

sequential transmission of information components. Such a method is, for example, disclosed in United Kingdom Patent Specification 2,006,559. In the television set disclosed in said document, each control member is connected to an encoding circuit via a matrix, this encoding circuit being connected to a microprocessor which itself is connected to the control members via a multi-wire line, the so-called data bus, and a further multi-wire line, the so-called address bus, in accordance with a known method which is universally utilized in microprocessor systems.....

The technique described in said document is very complicated, since it uses a microprocessor.....

This technique can be advantageously applied to high-gamma television sets. The connection to the components to be controlled by two buses represents a large number of wires, whose configuration is expensive. For that reason, applicants wish to reduce for customary television sets the number of wires to be provided and furthermore to avoid the use of a microprocessor, and therefore investigation have been made to obtain the simplest and cheapest possible method.....

The basic idea of the invention is to take advantage, instead of using a specialised clock as is now current usage with a microprocessor or a microcalculator, of the line scan synchronisation present in all television sets, to ensure the time control in a sequential digital transmission.....

(10)

Thus, according to the invention, a method is particularly characterized in that each start of a message is triggered synchronously with a so-called television field signal, in that the bits of each information is transferred sequentially over said line, which is a one-wire line, and in that the ordinal number of each scanning line in the picture is used to define the relevant element to be controlled by a bit transmitted at a predetermined instant, and also the significance of this bit.....

This method has the advantage that it does not require a special clock for controlling the digital transfer, and also no microprocessor.....

In one variant, the method is characterized in that one bit is transferred in each scanning line of the picture.....

Thus, the structure of the time counters by means of which it can be determined to which element each bit must be addressed is simplified to the maximum possible degree, and yet a sufficient transmission capacity is available.....

An improvement of the method according to the invention consists in that the sole line via which the data are transferred is also used for transferring line and field synchronising signals, thanks to a dual analogue encoding.....

Thus, an additional wire is saved.....

A television set according to the invention is

(11)

characterized in that each element or groups of elements to be controlled comprises a circuit intended for recognising one or more predetermined picture scanning lines so as to authorize the transferred bits to control said element at predetermined instants only.....

Thus it is possible to avoid the use of an address bus, which consequently saves expensive wiring between the different elements.....

Advantageously, a television set according to the invention comprises a single-wire line for sequentially transferring the data towards the elements to be controlled.

Thanks to this characteristic the wiring of the multi-wire bus of the prior art is not necessary.....

Furthermore, said single-wire line advantageously transfers the sequence of data simultaneously with the data themselves, thanks to a two-level amplitude coding....

This again saves a wire.....

The following description which is given with reference to the accompanying drawings, and describes a non-limitative embodiment will make it better understood how the invention can be put into effect.....

Fig. 1 shows a simplified block diagram of the components used for putting the method into effect.....

Fig. 2 shows a what is commonly referred to as a "sandcastle" signal and a data signal.....

Fig. 3 shows a signal transmitting both messages and synchronising signals,.....

Fig. 4 shows a circuit arrangement for generating the signal.....

Fig. 5 shows a block diagram of a "receiver" included in each of the elements to be controlled.....

Fig. 6 shows a block diagram of a "transmitter" included in a control element, for transmitting control and switching data.....

Fig. 7 shows a block diagram of a different implementation of a "transmitter" included in a control element, for transmitting control and switching data.....

Fig. 1 shows components of a television set according to the invention whose control or switching data are transferred, by means of a digital coding in bits, from control means 3, which the user has at its disposal to the elements 6, 7, 8, 9 to be controlled.....

The components 1 and 2 represent a remote control transmitter and an associated receiver, the combination 1-2 consequently having a function comparable to the function of the control means 3, which are themselves constituted by the potentiometers and/or switches arranged on the television receiver itself. The means and method used for encoding, transferring and decoding the remote control commands are conventional means and are not part of the invention.....

The elements 6, 7, 8, 9 are, for example, a line time base, a tuner, a colour and brightness decoding control board, the so-called chroma control board, and a

(12)

control board for sound, the so-called audio control board.....

A single-wire line 5 serially conveys the data from the control elements 1, 2, 3 to the elements 6, 7, 8, 9 to be controlled.....

This line may simultaneously transfer the data sequence.....

Reference numeral 10 represents a bus writing device, which is a "serialized sequencer" converting the data supplied in parallel by the arrangement 2 and 3 into sequential information messages.....

At 4 a display device is represented by means of which the user is given an indication which program or which control is running at a given instant.....

A non-limitative list, which is given by way of example of information components likely to the transferred in accorcance with the invention is as follows:.....

Video controls	- luminance.....
	- contrast.....
	- colour saturation.....
Audio controls	- volume.....
	- trebble.....
	- base.....
	- balance.....
Audio switchign actions	- mono/stereo.....
	- "spatial" effect.....
	- physiological effect.....

(14)

	- sound cutting.....
	- second language.....
Program controls	- tuning.....
	- automatic frequency control.
Program switching operations	- program selection.....
	- band selection.....
	- standard selection.....
	- temporary cutting-off the AFC
	- permanently cutting-off the AFC.....
	- slow switching.....
	- presence of a transmission..
Further functions	- presetting storage.....
	- presetting recall.....
	- display (program function...)

In accordance with the method of the invention, for transferring in a television receiver information messages between a control member 1, 2, 3 and several members 6, 7, 8, 9 to be controlled, said information components are digitally encoded, are sequentially transferred to a line 5, each beginning of a message is triggered synchronously with a television field signal, the bits of each information are sequentially transferred through said line 5 which is a single-wire line, and the ordinal number of each scanning line in the picture is used to define the relevant member to be controlled using a bit transmitted at a predetermined instant and the significance of this

(15)

bit.....

To obtain synchronisation with the field signals and to know the ordinal number of each line, a signal called "sand-castle" signal by a person skilled in the art, is advantageously used. This signal, which is shown at 11 in Fig. 2 has a porch 14 of an average height (for example 2.5 V) during the field and frame retrace periods; in addition it comprises pulses 13 which correspond to the "line retrace" period and have a high level, for example 4.5 V. Colour pulses, not shown, and which are here of no interest, are superposed on said pulses.....

The digitally encoded and sequentially applied information components to be transferred are shown at 12. It is, for example, suitable to start the transmission from the first line pulses after the ends of the "field retrace". The ordinal number of each scanning line, that is to say the ordinal number of the pulse 13 indicates the meaning of each bit in the sequence 12. Here one bit per picture scanning line is consequently transferred. It would be possible to choose other bit quantities per line or lines per bit, at the cost of a more complex encoding or decoding circuit. For example in signal 12, the bits 0 to 7 which are denoted by A and have here the value 11011000, represent a control value A which may be the sound volume, the bits 8 to 15 denoted by B and here having the value 00010001, a further control value B which may be the trebble volume, and so forth, values utilizing less in-

formation capacity may be inserted in the bit sequence or placed at the end. Here the two-bit value D may be an indication of the standard (SECAM, PAL, NTSC, ...), the one-bit values E, F represent the positions of the switches, such as "mono/stereo".....

The "sand-castle" signal 11 is present in the majority of sub-assemblies of a television set, so that between such sub-assemblies and the "transmitter" modules only one sole wire need to be provided for conveying the signal 12. However, the signal 11 is usually not applied to some of the sub-assemblies (for example the audio sections), It is then advantageous if the single line 5, which conveys the information components would additionally be used for transferring line and field synchronising signals, thanks to a dual analog encoding operation. This can, for example, be obtained with the aid of the signal 30 of Fig. 3. Reference numeral 14 represents the "field retrace" periods, during which the signal is, for example, at a voltage level of 3 volts. During this field retrace the line retrace signals 13 remain visible, while reaching a voltage level of, for example, 12 volts. During the transfer of the data signals, these line return signals reach different voltage levels depending on whether the transferred bit is "1" or "0". They reach, for example, 12 Volts for a 1 and 5 volts for a zero. Comparing the signal 30 with a threshold 31, of, for example, 4.5 volts, renders it possible to distinguish the line return pulses. A comparison with a threshold

32 of, for example, 9 volts, renders it possible to distinguish the data signal and finally a comparison with a threshold 33 of, for example, 2 volts renders it possible to distinguish the field and line retrace pulses.....

The circuit diagram of Fig. 4 shows how the signal of Fig. 3 can be generated from the two signals 11, 12 of Fig. 2. The signal 11 is applied to a level detector 15 which separates the field and line signals and conveys them to the pulse shaping circuits 161 and 162, respectively. Finally, they are added together in the circuit 16 which controls the wire 5. This circuit supplies from its output two current levels which produce two voltage levels in the resistor 19. The data signal 12 controls a transistor 213 which causes the voltage on the wire 5 to decrease in a ratio determined by the resistors 19 and 203. This data signal can be fed into the wire 5 in several different points, which is indicated by the presence of further transistors 211 and 212 and further resistors 201 and 202. Each of these transistors will be rendered conductive, for example when an 1 bit is applied to it and is rendered non-conductive for a 0 bit, or when it is not its turn to transmit. Thus the signal 30 of Fig. 3 is created on the wire 15. By arranging the circuits 161, 162 and 16 in such a position that the line and field return signals are separately available, the level detector 15 can be omitted. This is possible as each of the components of the group of components (161, 162, 16), (19), (211, 201), (212, 202),

(18)

(213, 203) can be connected to any point on the wire 5....

From the following description it will be apparent how a "receiver" function inside a member to be controlled can be realised, thereafter how a control by means of +/- Keys can be realised, and finally how a control by means of potentiometer can be realised. As regards a receiver function, "inside a member to be controlled" must be understood to mean that, the essential parts of the circuits of such an element being realised in integrated circuit technique, the receiver function will be realised on the same silicon substrate as the remaining portions of the member, at the price of enlarging the extremely small surface area, all the controls then being controlled by means of a single terminal pin, which is very advantageous.

In Fig. 5A, the wires 20A and 21 convey the signals 12 and 11 (of Fig. 2), respectively. The signal 11 is applied to the component 22. In this component a comparison with the threshold voltage 16 (Fig. 2) produces a signal at the end of the field retrace porch, which signal is conveyed to the element 25 via the wire 23A. The line return pulses are eliminated, either by a time constant, or by utilising a sampling operation between said pulses.....

In the component 22 a comparison is also effected with a higher voltage than the field retrace threshold, for example 3.5 volts, and it applies line pulses to the component 25 via the wires 24A.....

The component 25 comprises a counter which is

(19)

triggered by the pulse on the line 23A, and counts the pulses on the wire 24A. Let it be assumed that one wants to convey 256 bits sequentially over the wire 20A (signal 12, Fig. 2), it will then be necessary to use a counter constituted by 7 consecutive divide-by-two dividers. At a given instant the 7 outputs of these 7 counters produce a 7-bit digital number. The digital comparison of this number with a predetermined number furnishes an indication whether the transmitted information components are applied or not applied to the relevant components. Let it, for example, be assumed that the components is an "audio" amplifier and that the control or sound volume is transmitted in eight bits, corresponding to the picture lines 64 to 71. All these relevant numbers have the left-hand portion 1000XXX in common. The three X's indicate that the three right-hand bits may have any value. Then the above-mentioned digital comparison consists of checking whether the four left-hand bits are 1000. If so, an enable signal is applied to the register 26, which serially records at the rate of the lines (supplied by the wire 24A) the bits conveyed over the wire 20A. At the line count: "72", that is to say 1001000, the enable signal has disappeared and the counter is stopped, having as its contents the bits corresponding to the line numbers: 64 to 71. These bits are then stored in the memory and are continuously supplied to the digital-to-analog converter 28 which produces an analog control quantity at the terminal 29. It

will be obvious that provisions have been made to prevent this quantity from taking a faulty value during loading of the register 26: these conventional provisions are well known to a person skilled in the art. The same "audio" amplifier component can also receive a one-bit command (for example "mono/stereo". The same counter included in the component 25 will have its counting position compared with a different word, consisting of seven bits, so that for a predetermined,single count the bit present on the line 20A has the meaning "mono" or "stereo". This bit is stored in a flip-flop 126 which controls an on/off switch 128. It will be obvious that all the control commands for the same components are decoded by the same counter in the component 25, its outputs being compared to the same amount of binary numbers as there are numbers of different controls to be realised. The above example, using the number 1000XXX, has been chosen intentionally because of its simplicity. If all the controls are formed by eight bits, this example may be generalised for all the decoding components, by simply using other "roots" or blocks of left-hand bits. When different numbers are chosen, a person skilled in the art will easily know how to realise the required digital comparison, for example by means of a combination of OR-circuits.....

Fig. 5B gives an example of a circuit by means of which the data signal 12 and the signal 11 of Fig. 2 can be recovered. Three comparators 151, 152, 153 which have 2

volts, 2.5 volts and 9 volts thresholds, respectively are connected to the wire 5. The signal received from the comparator 151 is delayed in the circuit 17, for example by means of two consecutive inverting gates, and is applied to the data input D of a D-type flip-flop 191. The clock input H of this flip-flop is energised by the output signal from the comparator 152. At the output 23B a high level is found during the field retrace, and a low level during the remaining portion of the time. The output signal of the comparator 152 on the connection 24B which produces the line retrace pulses is delayed in the circuit 18, which is similar to the circuit 17 and is applied to the clock input 4 of a second flip-flop 192 of the same type; whose data input D is connected to the output of the comparator 153 and the reset-to-zero input R is connected to the output 23B. The output signal 20B has consequently zero value during the field retrace pulses and is equal to the data signal 12 of Fig. 2 during the remaining portion of the time.....

The signals 20B, 23B, 24B of this assembly can be fed into the respective connections 20A, 23A, 24A of the Fig. 5A, the circuit 22 then being superfluous.....

As regards the element available to the user, or "transmitter" elements, two cases can be distinguished: for example the remote control element 1 uses only push-buttons and the analog functions are then controlled by progressive modifications in the desired direction, operating the "+" and "-" push-buttons. In contrast therewith, a control ele-

ment 3 arranged on the television set may comprise potentiometers which mechanically fix a control position. Similarly, as regards the change-over operations the remote control buttons will respond to pulses in a logic sequence: "a push = off, a push = on". In contrast therewith, the knobs of the television set can mechanically be maintained in a position determined by the user.....

Fig. 6 shows how a control panel based on +/- buttons and push-buttons can be realised. The example chosen relates to the setting and selecting of programs. The device comprises a keyboard 58, a decoding element 57, a setting value memory 51, a buffer memory 50, a varicap voltage generator 52, a band and standards generator 53; modules 46 to 49 for writing the line, a synchronisation detection element 42, a sequence former 44. This obviously all relates to line 5 of Fig. 1. The assembly of the components 42 to 56 forms a portion of the block 10 of Fig. 1 (a different portion being constituted by the components of Fig. 7).....

The assembly formed by the keyboard 56 and its decoding system 57 is realised in a conventional way. The keyboard 58 may be positioned on the television receiver. Any presence of some additional push-buttons intended to utilize to the best possible extent the possibilities offered by the digital implementation, will not change the known principles of this assembly 57, 58. An encoded information indicating the operation to be effected at a

(23)

given instant then occurs at the output of the decoding element 57, on the single-wire bus line 54, which transfers both addresses and data. This information may only be temporarily present on the bus 54. The latter must consequently be read periodically at an appropriate rate for each element 50, 52, 53 connected thereto. This is also a further known property of arrangements of this type. Reading at the picture rate is sufficient, and makes it possible to update the memories during the duration of a field retrace. Actually, each time there is only one memory to be updated, which will be designated by the bus 54. The types of operation which can be realised by this device are, for example:.....

- change of program.....
- changing the band or the standard.....
- controlling the receiving frequency of a program; increase or decrease it;.....
- automatic program search.....

At a given moment, the buffer memory 50 contains the characteristics of the running program: its number, the varicap tuning voltage, the band and the standard.....

The memory 51 stores permanently the characteristics of each program according to its number. These characteristics are: the varicap tuning voltage, the band and the standard.....

By means of the two memories 50,51 it is consequently possible to change temporarily the setting of the

current program, without affecting the program stored in the memory 51. If in contrast therewith it is desired that the values contained in 50 are entered in 51 for storing them definitely this can indeed be effected. It is alternatively possible to replace at any instant the values contained in 50 by a value read from 51. These two operations can be advantageously effected via the data wire 5. The memories 50 and 51 can actually each "write" on this wire via the components 46, 48, 49, and each can "read" on this wire via the component 47. During the duration of an image one can consequently transfer the information components from 50 to 51 or vice versa, the significance of the data being indicated by their temporal position, and the read or write commands being given by the bus 54.....

The component 52 is used for manual or automatic tuning. It comprises an up/down counter which is incremented/decremented by operating a +/- key of the keyboard 58, and which thus progressively changes the varicap voltage. This voltage is written on the wire 5 by the component 48. The incrementing/decrementing operation is controlled by a pulse generator, not shown, which is used as a clock for the up/down counter and whose rate of operation depends on the information supplied to the keyboard by the user.....

The component 53 comprises also a small counter (by 4) which is incremented one step when the user pushes a key which has for its object to change the standard. A

further comparable arrangement is used to change the band..

The tuning voltage can be indicated by 12 bits (4096 different values), the band and the standard by 2 + 2 bits, the number of the programs by 4 bits (for 16 programs). The single-wire bus 56 is comprised of a total of 20 wires, which all leads to the component 50, 16 wires (12 + 2 + 2) leading to the component 51, 12 to the component 52, 4(namely 2 + 2) to the component 53. At the other end of the bus line four wires lead to the component 46 for writing the program number, 12 wires lead to the component 48 for writing the varicap voltage, 4 wires (namely 2 + 2) lead to the component 49 for writing the standard and the band. It should be noted that the bus lines 54, 55, 56 are included in the integrated circuit, which means that there is no wiring in the television set. As the so-called "sandcastle" signal is applied at 41 to the component 42, the latter withdraws therefrom the line retrace pulses and the field retrace pulses, which it applies via the connection 42 to the component 44. The latter comprises a line pulse counter which is reset to zero by the field pulse. These functions are comparable to the functions of the components 52 and 25 described in the foregoing with reference to Fig. 5. Similarly, the digital comparison of the number of counted lines to a predetermined number determines which of the write components 46 to 49 on the line must be rendered operative and when. Each of these components is a parallel-series register. It receives in pa-

rallel via the multi-wire bus line 56 the information components to be transferred and conveys them serially over the line 5, at a rate of one bit per picture scanning line, from a starting moment determined by the component 44. So the latter applies clock pulses to each of the registers 46 to 49 via the multi-wire bus 55, each pulse train being applied to each register during its associated period. This is effected by means of gates which allow line pulses to pass to one or other of the components 46 to 49, depending on an authorisation produced by the result of the comparison of the line counts to several predetermined numbers which each correspond to one of the relevant registers.....

Simultaneously with the line pulses serving as clock pulses, the component 44 applies a message transfer authorisation signal via the line 5 to the components 46 to 49, which is then selected. In the absence of this signal the output of each component 46 to 49 on the line 5 is in a what is commonly referred to as the high impedance state....

Fig. 7 shows how a control on the basis of potentiometers and mechanical push-buttons can be realised. Reference numeral 65 denotes trimming potentiometers, 66 denote mechanical circuit breaker push-buttons. The position of all these potentiometers and all the circuit breakers is checked, for example once in each picture, which is more than sufficient. The component 75 which directly writes on the line 5 comprises a circuit breaker flip-flop unit, in this example formed by three flip-flops.

The "sandcastle" signal is applied via 41 to the component 62 which distributes the line and field pulses over the bus line 63, and also the counting bits of the number of lines of each picture. The component 75 is enabled when the addressing by the bus 63 corresponds to its address: when the desired line number has been reached, a bit which corresponds to the position of the circuit breaker is conveyed over the line 5 by connecting the output of the corresponding flip-flop to the line 5.....

In a similar way, the component 68 connects each of the sliding contacts of the potentiometer to the input wire 74 of the analog-to-digital converter 80 by means of the analog circuit breaker. The result of this conversion is immediately conveyed to the memories 71 via the bus-line 64.....

All the memories are updated for each picture. The desired memory is selected by an information conveyed over the bus 81 by the component 68 and is induced to write by an information supplied by the converter 80 when the conversion has ended. The conversion command is given by the component 69 at the desired instant of each picture. By comparing the result of the count present on the bus 63 to a predetermined number, each component 70 controls the connection at the desired instant of each memory 71 via the bus 73 to the register 67, which then serially transfers the contents thereof over the line 5, at a rate of one bit per picture line. The buses 63, 64, 81 are here also

included in the integrated circuit.....

It will be obvious that optionally a circuit combining the data bits with the synchronising signal, arranged for example as shown in Fig. 4, is placed downstreams of the assembly shown in Fig. 6 and the assembly shown in Fig. 5.....

In non-digitized television sets the presence of remote control implies that the functions accessible by means of remote control are controlled by +/- push-buttons which here are comprised in the television set. Actually, if there are potentiometers whose individual positions corrspond to a precise control value, this value might be changed by operating the remote control, in contradistinction to the position of the potentiometer and without the possibility of correction. In the case of digitization associated with logic circuits, it is possible to associate a potentiometer on the television set with +/- push-buttons on the remote control. It is, for example, predictable, that acting with a predetermined amplitude on a potentiometer (the amplitude which is digitally converted is digitally compared to the value previously stored in the memory) resets to zero the previous accumulated effect of the operations "+" or "-" of the remote control, which reset-to-zero can be very easily effected digitally. Thus the potentiometer takes priority when it is appropriately activated.....

It should be realised that when a control assembly based on +/- push-buttons and an assembly based on

potentiometers has been described this does not imply a dichotome, and it is easy to conceive an integrated circuit comprising control means of different types.....

Each of the circuits described with reference to the Figures 6 and 7 can advantageously be realised in integrated circuit technique. It can be advantageous to provide two distinct circuits, one circuit for the programs and the other one for the control operations, as their physical positions in the television set are often remote from each other..

The display 4 of Fig. 1 may be considered to be one out of several so-called "receiver" members. Its role actually consists in receiving from the line 5 information components which are of interest for the display and to display them. Its "receiver" portion according to the invention will therefore be similar to that of other receivers, described with reference to Fig. 5, the digital/analog converter 28 there obviously having been replaced by the display device, in general a digital display, and an on/off switch such as 128 here being used to control a light-emitting diode.....

The receiving circuits of Fig. 5 can, instead of being integrated in each function to be controlled, be grouped in a receiver integrated circuit, especially adapted for decoding the information components written on line 5, and mounted on the chassis with the components to be controlled. This implies a very large number of connections on the printed circuit of this chassis for connecting this cir-

cuit to several control functions, but in spite of that it has the advantage that there ist has only one sole (or two) wire(s) between the chassi and the front.....