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APPARATUS AND METHOD FOR USING ENCODED VIDEO RECORDER/PLAYER TIMER PREPROGRAMMING INFORMATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

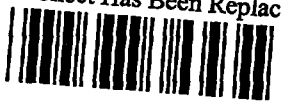
This invention relates generally to video cassette recorder systems and particularly to the timer preprogramming feature of video cassette recorders (VCRs) and to an apparatus and method for using encoded information to shorten the time required to perform timer preprogramming.

2. Prior Art

The video cassette recorder (VCR) has a number of uses, including playing back of tapes filmed by a video camera, playing back of pre-recorded tapes, and recording and playing back of broadcast and cable television programs.

To record a television program in advance of viewing it, a two-step process is often used: (1) obtain the correct channel, date, time and length (CDTL) information from a television program guide, and (2) program this CDTL information into the VCR. Depending on the model, year and type of the VCR, the CDTL information can be programmed in various ways including: (i)

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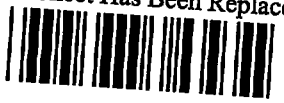


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pushing an appropriate sequence of keys in the console according to instructions contained in the user's manual, (ii) pushing an appropriate sequence of keys in a remote hand-held control unit according to instructions contained in the user's manual (remote programming), and (iii) executing a series of keystrokes in the remote hand-held control unit in response to a menu displayed on the television screen (on-screen programming). Other techniques for timer preprogramming have been suggested including: (iv) reading in certain bar-code information using a light pen (light pen programming), and (v) entering instructions through a computer or telephone modem. These various methods differ only in the physical means of specifying the information while the contents, being CDTL and certain power/clock/timer on-off commands are generally common although the detailed protocol can vary with different model VCRs. Methods (i) and (ii) described above can require up to 100 keystrokes, which has inhibited the free use of the timer preprogramming feature of VCRs. To alleviate this, new VCR models have included an "On-Screen Programming" feature, which permits remote input of CDTL information in response to a menu displayed on the television screen. Generally on screen programming of CDTL information requires an average of about 18 keystrokes, which is less than some of the prior methods but still rather substantial. Some of the other techniques such as (iv) above, require the use of special equipment such as a bar code reader.

In general the present state of the art suffers from a number of drawbacks. First, the procedure for setting the VCR to record in advance can be quite complex and confusing and difficult to learn; in fact, because of this many VCR owners shun using the timer preprogramming record feature. Second, the transcription of the CDTL information to the VCR is hardly ever error-free; in fact, many users of VCR's timer preprogramming features express concern over the high incidence of programming

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errors. Third, even for experienced users, the process of entering a lengthy sequence of information on the channel, date, time and length of desired program can become tedious. Fourth, techniques such as reading in bar-code information or using a computer require special equipment. These drawbacks have created a serious impedance in the use of a VCR as a recording device for television programs. The effect is that time shifting of programs has not become as popular as it once was thought it would be. Accordingly, there is a need in the art for a simpler system for effecting VCR timer preprogramming which will enable a user to take advantage of the recording feature of a VCR more fully and freely.

SUMMARY OF THE INVENTION

A principal object of the invention is to provide an improved system for the selection and entering of channel, date, time and length (CDTL) information by a user required for timer preprogramming of a VCR which is substantially simpler, faster and less error-prone than present techniques.

In accordance with the invention, to program the timer preprogramming feature of a video system, there is an apparatus and method for using encoded video recorder/player timer preprogramming information. The purpose is to significantly reduce the number of keystrokes required to set up the timer preprogramming feature on a VCR. In accordance with this invention it is only necessary for the user to enter a code with 1 to 7 digits or more into the VCR. This can be done either remotely or locally at the VCR. Built into either the remote controller or the VCR is a decoding means which automatically converts the code into the proper CDTL programming information and activates the VCR to record a given television program with

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the corresponding channel, date, time and length. Generally multiple codes can be entered at one time for multiple program selections. The code can be printed in a television program guide in advance and selected for use with a VCR or remote controller with the decoding means.

Other objects and many of the attendant features of this invention will be more readily appreciated as the same becomes better understood by reference to the following detailed descriptions and considered in connection with the accompanying drawings in which like reference symbols designate like parts throughout the figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic showing apparatus according to this invention with the code decoder means embedded in the video cassette recorder.

FIG. 2 is a schematic of the VCR embedded processors for command control and code decoding.

FIG. 3 is a schematic showing apparatus according to this invention with the code decoder means embedded in a remote controller.

FIG. 4 is a schematic of the processor embedded in the remote controller.

FIG. 5 is a schematic of a universal remote controller with the code decoder means embedded in the universal remote controller.

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FIG. 6 is a flow graph of the G-code decoding technique.

FIG. 7 is a flow graph of the G-code encoding technique.

FIG. 8 is an illustration of part of a television calendar according to this invention.

FIG. 9 is a flowchart for decoding for cable channels.

FIG. 10 is a flowchart for encoding for cable channels.

FIG. 11. is a flow graph of the G-code decoding for cable channels including conversion from assigned cable channel number to local cable carrier channel number.

FIG. 12 is a means for decoding including a stack memory.

FIG. 13 is a flowchart for program entry into stack memory.

FIG. 14 is a operation flowchart for sending programs from remote control to main unit VCR.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and more particularly, to FIG. 1, there is shown an apparatus for using encoded video recorder/player timer preprogramming information 10 according to this invention. The primary components include a remote controller 12 and a video cassette recorder/player with G-code decoder 14, which can be controlled by remote controller 12 via a command signal 16. The remote controller 12 can have a number of keys, which include numerical keys 20, G-code switch 22, function keys 24, program key 26 and power key 27. There are means in the

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remote controller 12 that interpret each key as it is pressed and send the proper command signal 16 to the VCR via an infra-red light emitting diode 28. Except for the G-code switch 22 on the remote controller 12 in FIG. 1, the remote controller 12 is essentially the same as any other remote controller in function. The G-code switch 22 is provided just to allow the user to lock the remote controller 12 in the G-code mode while using a G-code, which is the name given to the compressed code which is the encoded CDTL information, to perform timer preprogramming.

A G-code consists of 1 to 7 digits, although more could be used, and is associated with a particular program. A user would lookup the G-code in a program guide and just enter the G-code on the remote controller 12, instead of the present state of the art, which requires that the user enter the actual channel, date, time and length (CDTL) commands.

In order to understand the advantages of using a G-code, it is helpful to describe the best of the current state of the art, which is "on screen programming" with direct numerial entry. This technique involves about 18 keystrokes and the user has to keep switching his view back and forth between the TV screen and the remote controller while entering the CDTL information. This situation may be akin to a user having to dial an 18 digit telephone number while reading it from a phone book. The number of keys involved and the switching back and forth of the eye tend to induce errors. A typical keying sequence for timer recording using on-screen CDTL programming is as follows:

PROG 2 1 15 07 30 2 08 00 2 04 PROG

The first program (PROG) key 26 enters the programming mode. Then a sequence of numericals key 20 are pushed. The 2 means it is timer recording rather than time setting. The 1 means the

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user is now entering the settings for program 1. The 15 is the date. The 07 is starting hour. The 30 is a starting minute. The 2 means pm. The next sequence 08 00 2 is the stopping time. The 04 is channel number. Finally, the PROG is hit again to exit the program mode.

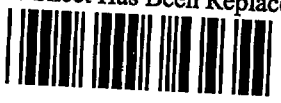
By contrast, this command could have been "coded" and entered in a typical G-code sequence as follows: PROG 1138 PROG. To distinquish that the command is a coded G-code, the G-code switch 22 should be turned to the "ON" position. Instead of having a switch, a separate key "G" can be used. The G-code programming keystroke sequence would then be: G 1138 PROG.

The use of a G-code does not preclude "on-screen" confirmation of the program information that has been entered. When the keystrokes "PROG 1138 PROG" are entered with the G-code switch in the "ON" position, the G-code would be decoded and the television could display the following message:

PROGRAM	DATE	START TIME	STOP TIME	CHANNEL
1138	15	7:30 PM	8:00 PM	4

In order for the G-code to be useful it must be decoded and apparatus for that purpose must be provided. Referring to FIG. 1, a video cassette recorder/player with G-code decoder 14 is provided to be used in conjunction with remote controller 12. The command signal 16 sent from the remote controller 12 is sensed by the photodiode 32 and converted to electrical signals by command signal receiver 30. The electrical signals are sent to a command controller 36, which interprets the commands and determines how to respond to the commands. As shown in FIG. 1, it is also possible for the command controller 36 to receive commands from the manual controls 34 that are normally built into

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a VCR. Other possible command sources include voice if a speech recognizer is incorporated into the VCR and a bar code scanner. If the command controller 36 determines that a G-code was received then the G-code will be sent to the G-code decoder 38 for decoding. The G-code decoder 38 converts the G-code into CDTL information, which is used by the command controller 36 to set the time/channel programming 40. Built into the VCR is a clock 42. This is normally provided in a VCR and is used to keep track of the date and time. The clock 42 is used primarily by the time/channel programming 40 and the G-code decoder 38 functions. The time/channel programming 40 function is set up with CDTL information by the command controller 36. When the proper date and time is read from clock 42, then the time/channel programming 40 function turns the record/playback 44 function on to record. At the same time the tuner 46 is tuned to the proper channel in the television signal 18.

An alternate way to control the recorder is to have the command controller 36 keep all the CDTL information instead of sending it to the time/channel programming 40. The command controller would also keep track of the time by periodically reading clock 42. The command controller would then send commands to the time/channel programming 40 to turn on and off the recorder and to tuner 46 to cause it to tune to the right channel at the right time according to the CDTL information.

The clock 42 is also an input to G-code decoder 38, which allows the G-code decoding to be a function of the clock, which lends a measure of security to the decoding technique and makes it harder to copy. Of course this requires that the encoding technique must also be a function of the clock.

A possible realization of the command controller 36 and the G-code decoder 38 is shown in FIG. 2. The command controller 36

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function can be realized with a microprocessor 50, a random access memory 52 and a read only memory 54, which is used for program storage. The input/output 56 function is adapted to receive commands from the command signal receiver 30, the manual controls 34 and the clock 42, and to output signals to a display 35, the clock 42, and the time/channel programming 40 function. If the microprocessor 50 interprets that a G-code has been received, then the G-code is sent to microcontroller 60 for decoding. The microcontroller 60 has an embedded random access memory 62 and an embedded read only memory 64 for program and table storage. The clock 42 can be read by both microprocessor 50 and microcontroller 60.

An alternative to having microcontroller 60 perform the G-code decoding is to build the G-code decoding directly into the program stored in read only memory 54. This would eliminate the need for microcontroller 60. Of course, other hardware to perform the G-code decoding can also be used. The choice of which implementation to use is primarily an economic one.

The blocks in Figs. 1 and 2 are well known in the prior art and are present in the following patents: Fields, patent no. 4,481,412; Scholz, patent no. 4,519,003; and Brugliera, patent no. 4,631,601. For example, clock 42 is analogous to element 7 in Scholz and element 17 in Brugliera. Other analogous elements are: command signal receiver 30 and Scholz 14 and Brugliera 12; tuner 46 and Scholz 6 and Brugliera 10; time/channel programming 40 and Scholz 8, 11 and Brugliera 16; record & playback 44 and Scholz 1, 2, 4; command controller 36 and Scholz 11, 10 and Brugliera 12; microprocessor 50 and Fields 27; RAM 62 and Fields 34; ROM 54 and Fields 33; manual controls 34 and Scholz 15, 16; and remote controller 12 and Scholz 26 and Brugliera 18.

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FIG. 3 illustrates an alternate preferred embodiment of this invention. In FIG. 3 a remote controller with embedded G-code decoder 80 is provided. The remote controller with embedded G-code decoder 80 is very similar to remote controller 12, except for the addition of the G-code decoder 82. Note that it is also possible in any remote controller to provide a display 84. The remote controller with embedded G-code decoder 80 would be used in conjunction with a normal video cassette recorder/player 70, which would not be required to have an embedded G-code decoder. The numerals for the subelements of video cassette recorder/player 70 are the same as described above for the video cassette recorder/player with G-code decoder 14 and have the same function, except for the absence of G-code decoder 38. This preferred embodiment has the advantage that it can be used in conjunction with VCRs that are presently being used. These do not have a G-code decoding capability. Replacing their remote controllers with ones that have this capability built-in can vastly improve the capability to do timer preprogramming for a modest cost.

FIG. 4 illustrates a possible realization of the G-code decoder 82 built into the remote controller with embedded G-code decoder 80. A microprocessor 60 can be used as before to decode the G-code, as well as interface with the display 84, a clock 85, the keypad 88 and the light emitting diode 28. Alternately, other hardware implementations can be used to perform the G-code decoding. The clock is provided in the remote controller 80 so that the G-code decoder 82 can be made to have the clock as one of its inputs. This allows the G-code decoding to be a function of the clock, which lends a measure of security to the decoding technique and makes it harder to copy.

The remote controller with embedded G-code decoder as described above would send channel, date, time and length

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information to the video cassette recorder/player 70, which would use the CDTL information for tuning into the correct channel and starting and stopping the recording function. The remote controller may have to be unique for each different video cassette recorder/player, because each brand or model may have different infrared pulses for each type of information sent such as the channel number keys and start record and stop record keys. The particular infrared pulses used for each key type can be called the vocabulary of the particular remote controller. Each model may also have a different protocol or order of keys that need to be pushed to accomplish a function such as timer preprogramming. The protocol or order of keys to accomplish a function can be called sentence structure. If there is a unique remote controller built for each model type, then the proper vocabulary and sentence structure can be built directly into the remote controller.

An alternate to having the remote controller with embedded G-code decoder send channel, date, time and length information to the video cassette recorder/player 70, is to have the remote controller with embedded G-code decoder perform more operations to simplify the interfacing problem with existing video cassette recorder/players. In particular, if the remote controller not only performs the G-code decoding to CDTL, but also keeps track of time via clock 85, then it is possible for the remote controller to send just channel, start record and stop commands to the video cassette recorder/player. These are usually basic one key commands, which means there is no complicated protocol or sentence structure involved. Thus, to communicate with a diverse set of video cassette recorder/player models it is only necessary to have memory within the remote controller, such as ROM 64 of FIG. 4, for storing the vocabulary for all the models or at least a large subset. The G-code would be entered on the remote controller as before and decoded into channel, date, time and

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length information, which would be stored in the remote controller. Via clock 85, the time would be checked and when the correct time arrives the remote controller would automatically send out commands to the VCR unit for tuning to the correct channel and for starting and stopping the recording. It is estimated that only two (2) bytes per key for about 15 keys need to be stored for the vocabulary for each video cassette recorder/player model. Thus, to cover 50 models would only require about 30*50 = 1500 bytes of memory in the remote controller. It would be necessary to position the remote controller properly with respect to the VCR unit so that the sent infrared signals sent by the remote controller are received by the unit.

Another preferred embodiment is to provide a universal remote controller 90 with an embedded G-code decoder. Universal remote controllers provide the capability to mimic a number of different remote controllers. This reduces the number of remote controllers that a user needs to have. This is accomplished by having a learn function key 94 function on the universal remote controller, as shown in FIG. 5. If the learn function key 94 is pushed in conjunction with another key, the unit will enter into the learn mode. Incoming infra-red (IR) pulses from the remote controller to be learned are detected by the infra-red photodiode 96, filtered and wave-shaped into recognizable bit patterns before being recorded by a microcontroller into a battery-backed static RAM as the particular IR pulse pattern for that particular key. This is done for all the individual keys.

An example of more complex learning is the following. If the learn function key 94 in conjunction with the program key 26 are pushed when the G-code switch is "ON", the unit will recognize that it is about to record the keying sequence of a predetermined specific example of timer preprogramming of the

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particular VCR involved. The user will then enter the keying sequence from which the universal remote controller 90 can then deduce and record the protocol of the timer preprogramming sequence. This is necessary because different VCRs may have different timer preprogramming command formats.

If keys are pushed without the learn function key 94 involved, the microcontroller should recognize it is now in the execute mode. If the key is one of the direct command keys, the microcontroller will read back from its static RAM the stored pulse sequence and send out command words through the output parallel I/O to pulse the output light emitting diode 28. If the key is the PROG key and the G-code switch is "OFF", then the microcontroller should recognize the following keys up to the next PROG key as a timer preprogramming CDTL command and send it out through the light emitting diode 28. If the G-code switch 22 is set to "ON" and the program key 26 is pushed, the microcontroller should recognize the following keys up to the next PROG key as a G-code command for timer preprogramming. It will decode the G-code into channel, date, start time and length (CDTL) and the microcontroller will then look up in it's static RAM "dictionary" the associated infra-red pulse patterns and concatenate them together before sending them off through the output parallel I/O to pulse the light emitting diode 28 to send the whole message in one continuous stream to the VCR.

FIG. 4 illustrates a possible realization of the G-code decoder 92 that could be built into the universal remote controller with embedded G-code decoder 90. A microcontroller 60 can be used as before to decode the G-code, as well as for interfacing with the input/output functions including the photodiode 96. Alternately, the G-code decoding can be performed with other hardware implementations.

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The universal remote controller can also be used in another manner to simplify the interfacing problem with existing video cassette recorder/players. In particular, if the universal remote controller performs not only the G-code decoding to CDTL, but also keeps track of time via clock 85 in FIG. 4, then it is possible for the universal remote controller to send just channel, start record and stop commands to the video cassette recorder/player, which as explained before, are usually basic one key commands, which means there is no complicated protocol or sentence structure involved. Thus, to communicate with a diverse set of video cassette recorder/player models it is only necessary for the universal remote controller to "learn" each key of the remote controller it is replacing. The G-code would be entered on the universal remote controller as before and decoded into channel, date, time and length information, which would be stored in the universal remote controller. Via clock 85, the time would be checked and when the correct time arrives the universal remote controller would automatically send out commands to the VCR unit for tuning to the correct channel and for starting and stopping the recording. It would be necessary to position the universal remote controller properly with respect to the VCR unit so that the signals sent by the universal remote are received by the VCR unit.

There are a number of ways that the G-code decoding can be performed. The most obvious way is to just have a large look up table. The G-code would be the index. Unfortunately, this would be very inefficient and result in a very expensive decoder due to the memory involved. The total storage involved is a function of the number of total combinations. If we allow for 128 channels, 31 days in a month, 48 on the hour and on the half hour start times in a twenty four hour day, and 16 length selections in half hour increments, then the total number of combinations is 128x31x48x16 = 3,047,424. This number of combinations can be

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represented by a 7 digit number. The address to the table would be the 7 digit number. In the worse case, this requires a lookup table that has about 4,000,000 rows by 15 to 16 digital columns, depending on the particular protocol. These digital columns would correspond to the CDTL information required for "on screen programming". Each digit could be represented by a 4 bit binary number. Thus, the total storage number of bits required for the lookup table would be about 4,000,000x16x4 = 256,000,000. The present state of the art has about 1 million bits per chip. Thus, G-code decoding using a straightforward table lookup would require a prohibitively expensive number of chips.

Fortunately, there are much more clever ways of performing the G-code decoding. FIG. 6 is a flow diagram of the preferred G-code decoding technique. To understand G-code decoding, it is easiest to first explain the G-code encoding technique, for which FIG. 7 is the flow chart. Then the G-code decoding technique, which is the reverse of the G-code encoding will be explained.

The encoding of the G-codes can be done on any computer and is done prior to preparation of any program guide that would include G-codes. For each program that will be printed in the guide, a channel, date, time and length (CDTL) code 144 is entered in step 142. Step 146 separately reads the priority for the channel, date, time and length in the priority vector storage 122, which can be stored in read only memory 64. The priority vector storage 122 contains four tables: a priority vector C table 124, a priority vector D table 126, a priority vector T table 128 and a priority vector L table 130.

The channel priority table is ordered so that the most frequently used channels have a low priority number. An example of the data that is in priority vector C table 124 follows.

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channel	4	7	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

Generally the dates of a month all have an equal priority, so the low number days in a month and the low number priorities would correspond in the priority vector D table as in the following example.

date	1	2	3	4	5	6	7	8	9	10 ..
priority	0	1	2	3	4	5	6	7	8	9 ..

The priority of the start times would be arranged so that prime time would have a low priority number and programs in the dead of the night would have a high priority number. For example, the priority vector T table would contain:

time	6:30pm	7:00pm	8:00pm	7:30pm	...
priority	0	1	2	3	...

An example of the data that is in the priority vector L table 130 is the following:

length of program (hours)	0.5	1.0	2.0	1.5	3.0	...
priority	0	1	2	3	4	...

Suppose the channel date time length (CDTL) 144 data is 5 10 19.00 1.5, which means channel 5, 10th day of the month, 7:00 PM, and 1.5 hours in length, then the C_p, D_p, T_p, L_p data 148 for the above example would be 4 9 1 3. Step 150 converts C_p, D_p, T_p, L_p data to binary numbers. The number of binary bits in each conversion is determined by the number of combinations involved. Seven bits for C_p, which can be denoted as C_7 C_6 C_5 C_4 C_3 C_2 C_1, would provide for 128 channels. Five bits for D_p, which can be denoted as D_5 D_4 D_3 D_2 D_1, would provide for 31 days in a month.

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Six bits for T_p, which can be denoted as T_6 T_5 T_4 T_3 T_2 T_1, would provide for 48 start times on each half hour of a twenty four hour day. Four bits for length, which can be denoted as L_4 L_3 L_2 L_1, would provide for a program length of up to 8 hours in half hour steps. Together there are 7+5+6+4 = 22 bits of information, which correspond to 2**22 = 4,194,304 combinations.

The next step is to use bit hierarchy key 120, which can be stored in read only memory 64 to reorder the 22 bits. The bit hierarchy key 120 can be any ordering of the 22 bits. For example, the bit hierarchy key might be:

L_8	C_3	...	T_2	C_2	T_1	C_1	L_1	D_5	D_4	D_3	D_2	D_1
22	21	...	10	9	8	7	6	5	4	3	2	1

Ideally the bit hierarchy key is ordered so that programs most likely to be the subject of timer preprogramming would have a low value binary number, which would eliminate keystrokes for timer preprogramming the most popular programs. Since all the date information has equal priority, then the D_5 D_4 D_3 D_2 D_1 bits are first. Next T_1 C_1 L_1 are used, because for whatever date it is necessary to have a time channel and length and T_1 C_1 L_1 are the most probable in each case due to the ordering of the priority vectors in priority vector storage 122. The next bit in the hierarchy key is determined by the differential probabilities of the various combinations. One must know the probabilities of all the channels, times and lengths for this calculation to be performed.

For example, the probability for channels may be:

channel	4	7	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

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probability(%)	5	4.3	4	3	2.9	2.1	2	1.8 ...

The probabilities for times might be:

time	6:30pm	7:00pm	8:00pm	7:30pm	...
priority	0	1	2	3	...
probability(%)	8	7.8	6	5	...

And, the probabilities for lengths might be:

length of program (hours)	0.5	1.0	2.0	1.5	3.0	...
priority	0	1	2	3	4	...
probability(%)	50	20	15	5	4	...

The probabilities associated with each channel, time and length, as illustrated above, are used to determine the proper ordering. Since the priority vector tables are already ordered by the most popular channel, time, and length, the order in which to select between the various binary bits for one table, for example selecting between the C_7 C_6 C_5 C_4 C_3 C_2 C_1 bits, is already known. The C_1 bit would be selected first because as the lowest order binary bit it would select between the first two entries in the channel priority table. Then the C_2 bit would be selected and so on. Similarly, the T_1 and L_1 bits would be used before any of the other time and length bits. A combination of the C_1, T_1, L_1 and D_5 D_4 D_3 D_2 D_1 bits should be used first, so that all the information is available for a channel, date, time and length. The D_5 D_4 D_3 D_2 D_1 bits are all used because the date bits all have equal priority and all are needed to specify a date even if some of the bits are binary zero.

At this point the bit hierarchy key could be:

T_1 C_1 L_1 D_5 D_4 D_3 D_2 D_1

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The first channel binary bit C_1 by itself can only select between $2^1 = 2$ channels, and the first two channels have a probability percent of 5 and 4.3, respectively. So the differential probability of C1 is 9.3. Similarly, the differential probability of T_1 is 8 + 7.8 = 15.8, and the differential probability of L_1 is 50 + 20 = 70. If the rules for ordering the bit hierarchy key are strictly followed, then the first 8 bits of the bit hierarchy key should be ordered as:

$$C_1\ T_1\ L_1\ D_5\ D_4\ D_3\ D_2\ D_1,$$

because L_1 has the highest differential priority so it should be first, followed by T_1, and then C_1.

The question at that point is what should the next bit in the hierarchy key be: T_2, C_2, or L_2. This is determined by the differential probabilities, which can be calculated from the above tables for each bit. Since we are dealing with binary bits, the C_2 in combination with C_1 selects between $2^2 = 4$ channels or 2 more channels over C_1 alone. The differential probability for C_2 is then the additional probabilities of these two additional channels and for the example this is: 4 + 3 = 7. In a similar manner C_3 in combination with C_1 and C_2 selects between $2^3 = 8$ channels or $4 = 2^{(3-1)}$ more channels over the combination of C_1 and C_2. So the differential probability of C_3 is the additional probabilities of these four additional channels and for the example this is: 2.9 + 2.1 + 2 + 1.8 = 8.8. In a similar manner, the differential probabilities of T_2 and L_2 can be calculated to be 6 + 5 = 11 and 15 + 5 = 20, respectively. Once all the differential probabilities are calculated, the next step is determining which combinations of bits are more probable.

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Now for the above example, which combination is more probable: T_2 with C_1 L_1, or C_2 with T_1 L_1, or L_2 with T_1 C_1. This will determine the next bit in the key. So, which is greater: 11x9.3x70= 7161; 7x15.8x70= 7742; or 20x15.8x9.3= 2938.8? In this case the combination with the greatest probability is 7x15.8x70= 7742, which corresponds to C_2 with T_1 L_1. So, C_2 is selected as the next bit in the bit hierarchy key.

The next bit is selected in the same way. Which combination is more probable: C_3 with T_1 L_1, or T_2 with C_1 or C_2 and L_1, or L_2 with C_1 or C_2 and T_1. For the example shown, which has the greatest probability: 8.8x15.8x70= 9732.8; 11x(9.3+7)x70= 12551; or 20x(9.3+7)x15.8= 5150.8? In this case the combination with the greatest probability is 11x(9.3+7)x70= 12551, which corresponds T_2 with C_1 or C_2 and L_1. So, T_2 is selected as the next bit in the bit hierarchy key. This procedure is repeated for all the differential probabilities until the entire key is found.

Alternately, the bit hierarchy key can be just some arbitrary sequence of the bits. It is also possible to make the priority vectors interdependent, such as making the length priority vector dependent on different groups of channels. Another technique is to make the bit hierarchy key 120 and the priority vector tables 122, a function of clock 42, as shown in FIG. 7. This makes it very difficult for the key and therefore the coding technique to be duplicated or copied.

For example it is possible to scramble the date bits in the bit hierarchy key 120 as a function of the clock. This would not change the effectiveness of the bit hierarchy key in reducing the number of binary bits for the most popular programs, because the date bits all are of equal priority. This could be as simple as

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switching the D_1 and D_5 bits periodically, such as every day or week. Thus the bit hierarchy key 120 would switch between

$$\ldots \; C_1 \; T_1 \; L_1 \; D_5 \; D_4 \; D_3 \; D_2 \; D_1 \quad \text{and}$$

$$\ldots \; C_1 \; T_1 \; L_1 \; D_1 \; D_4 \; D_3 \; D_2 \; D_5.$$

Clearly other permutations of the bit hierarchy key as a function of the clock are possible.

The priority vector tables could also be scrambled as a function of the clock. For example, the first two channels in the priority channel table could just be swapped periodically. If this technique is followed, then the C_p of 148 in FIG. 7 would change as a function of the clock 42. For example,

channel	4	7	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

would change periodically to:

channel	7	4	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

This would be a fairly subtle security technique, because a decoder that was otherwise correct would only fail if those first two channels were being used. Other clock dependencies are also possible to provide security for the coding technique.

However it is derived, the bit hierarchy key 120 is determined and stored. In step 154 the binary bits of C_p, D_p, T_p, L_p are rearranged according to the bit hierarchy key 120 to create one 22 bit binary number. Then the resulting 22 bit

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binary number is converted to decimal in the convert binary number to decimal G-code step 156. The result is G-code 158.

If the priority vector and the bit hierarchy key are well matched to the viewing habits of the general population, then it is expected that the more popular programs would require no more than 3 or 4 digits for the G-code.

Now that the encoding technique has been explained the decoding technique is just reversing the coding technique. This is done according to the flow chart of FIG. 6. This is the preferred G-code decoding that can be built into G-code decoder 38 in VCR 14 or the remote controller G-code decoders 82 and 92 in FIGs. 3 and 5.

The first step 102 is to enter G-code 104. Next the G-code 104 is converted to a 22 bit binary number in step 106. Then the bits are reordered in step 108 according to the bit hierarchy key 120 to obtain the reordered bits 110. Then the bits are grouped together and converted to decimal form in step 112. As this point we obtain C_p,D_p,T_p,L_p data 114, which are the indices to the priority vector tables. For the above example, we would have at this step the vector 4 9 1 3. This C_p,D_p,T_p,L_p data 114 is then used in step 116 to lookup channel, date, time, and length in priority vector storage 122. The CDTL 118 for the example above is 5 10 19.00 1.5, which means channel 5, 10th day of the month, 7:00 PM, and 1.5 hours in length.

If the coding technique is a function of the clock then it is also necessary to make the decoding technique a function of the clock. It is possible to make the bit hierarchy key 120 and the priority vector tables 122, a function of clock 42, as shown in FIG. 6. This again makes it very difficult for the key and therefore the coding technique to be duplicated or copied. It is

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also possible to have the decoding and encoding techniques dependent on any other predetermined or preprogrammable algorithm.

Although the above G-code encoding and decoding technique is a preferred embodiment, it should be understood that there are many ways to perform the intent of the invention which is to reduce the number of keystrokes required for timer preprogramming. To accomplish this goal there are many ways to perform the G-code encoding and decoding. There are also many ways to make the encoding and decoding technique more secure besides just making the encoding and decoding a function of the clock. This security can be the result of any predetermined or preprogrammed algorithm.

It is possible in the G-code coding and decoding techniques to use mixed radix number systems instead of binary numbers. For example, suppose that there are only 35 channels, which would require 6 binary bits to be represented; however, 6 binary bits can represent 64 channels, because $2^6 = 64$. The result is that in a binary number system there are 29 unnecessary positions. This can have the effect of possibly making a particular G-code longer than it really needs to be. A mixed radix number system can avoid this result. For example, for the case of 35 channels, a mixed radix number system with the factors of 7^1 and 5^0 can represent 35 combinations without any empty space in the code. The allowed numbers for the 7^1 factor are 0, 1, 2, 3, and 4. The allowed numbers for the 5^0 factor are 0, 1, 2, 3, 4, 5, and 6. For example, digital 0 is represented in the mixed radix number system as 00. The digital number 34 is represented in the mixed radix number system as 46, because $4*7^1+6*5^0 = 34$. The major advantage of a mixed radix number system is in prioritizing the hierarchy key. If the first 5 channels have about equal priority and the next 30 are also about equal, then the mixed radix number

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system allows the two tiers to be accurately represented. This is not to say that a mixed radix number system is necessarily preferable. Binary numbers are easier to represent in a computer and use of a fixed radix number system such as binary numbers allows a pyramid of prioritization to be easily represented in the hierarchy key.

Another feature that is desirable in all of the embodiments is the capability to key in the G-code once for a program and then have the resulting CDTL information used daily or weekly. Ordinarily the CDTL information is discarded once it is used. In the case of daily or weekly recording of the same program, the CDTL information is stored and used until it is cancelled. The desire to repeat the program daily or weekly can be performed by having a "WEEKLY" or "DAILY" button on the remote controller or built into the VCR manual controls. Another way is to use one key, such as the PROG key and push it multiple times within a certain period of time such as twice to specify daily or thrice to specify weekly. For example, if the G-code switch is "ON" and the G-code for the desired program is 99 then daily recording of the program can be selected by the following keystrokes:

"PROG 99 DAILY PROG"

or by:

"PROG 99 PROG P ROG".

The G-code 99 would be converted to CDTL information, which would be stored and used daily in this case. The recording would begin on the date specified and continue daily after that using the same channel time and length information. A slight twist is that daily recording could be automatically suspended during the weekends, because most daily programs are different on Saturday and Sunday.

Once a daily or weekly program is set up, then it can be used indefinitely. If it is desired to cancel a program and if

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there is a "CANCEL" button on the remote controller or manual control for the VCR, then one way to cancel a program (whether it is a normal CDTL, daily or weekly entry) is to key in the following:

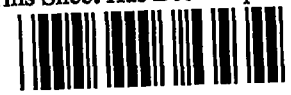
"PROG xx CANCEL", where xx is the G-code.

Again as before there are alternate ways of accomplishing this.

If "on screen programming" is available, then the programs that have been selected for timer preprogramming could be reviewed on the screen. The daily and weekly programs would have an indication of their type. Also the G-codes could be displayed along with the corresponding CDTL information. This would make it quite easy to review the current "menu" and either add more programs or cancel programs as desired.

A television calendar 200 according to this invention is illustrated in FIG. 8. As shown, the television calendar has multiple day of year sections 202, multiple day sections 204, multiple time of day sections 206, channel indications 208, and descriptive program indications 210 arranged in a manner that is common in television guide publications. Arranged in relation to each channel indication is a compressed code 212 or G-code containing the channel, date, time and length information for that entry in the television calendar. FIG. 8 shows how easy it is to perform timer programming. All one needs to do is find the program one wants to watch and enter the compressed code. This is in contrast to having to deal with all the channel, date, time and length entries separately. At least the channel, date and time are explicitly stated in the television guide. The length is usually only available by searching the guide to find the time of day section 204 where a new program begins and then performing some arithmetic to find the length of the program. Using the compressed G-code avoids all these complications.

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For cable television programs, there is an additional issue that needs to be addressed for the compressed G-code to be useful. In a normal television guide, CDTL information is available for all the normal broadcast channels in the form of numbers including the channel numbers, such as channel 4 or 7. However, for cable channels like HBO, ESPN etc., only the names of the channels are provided in most television listings. The reason for this is that in some metropolitan areas, such as Los Angeles, there may be only one (1) edition of television guide, but there may be quite a few cable carriers, each of which may assign HBO or ESPN to different cable channel numbers. In order for a compressed code such as the G-code to be applicable to the cable channels as published by a wide area television guide publication, the following approach can be used.

First, all the cable channels would be permanently assigned a unique number, which would be valid across the nation. For example, we could assign ESPN to cable channel 1, HBO as cable channel 2, SHO as cable channel 3, etc. This assignment would be published by the television guide publications.

The video cassette recorder apparatus, such as the remote controller, the VCR unit or both, could then be provided with two (2) extra modes: "set" and "cable channel". One way of providing the user interface to these modes would be to provide two (2) extra buttons: one called SET and one called CABLE CHANNEL. The buttons could be located on the video cassette recorder unit itself or located on a remote controller, as shown in FIGs 1, 3 and 5, where SET is element 168 and CABLE CHANNEL is element 170. Of course, other user interfaces are possible.

Next, the television viewer would have to go through a one-time "setting" procedure of his VCR for all the cable channels that he would likely watch. This "setting" procedure would

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relate each of the assigned numbers for each cable channel to the channel number of the local cable carrier. For example, suppose that the local cable carrier uses channel 6 for ESPN, then cable channel number 1 could be assigned to ESPN, as shown in the following table.

Cable Channel Name	Assigned Cable Chan. No.	Channel Number in the local cable carrier
EPSN	1	6
HBO	2	24
SHO	3	23
.	.	.
.	.	.
.	.	.
DIS	8	25

The user could perform the "setting" procedure by pushing the buttons on his remote controller as follows:

SET 06 CABLE CHANNEL 1 PROGRAM
SET 24 CABLE CHANNEL 2 PROGRAM
SET 23 CABLE CHANNEL 3 PROGRAM
SET 25 CABLE CHANNEL 8 PROGRAM

The "setting" procedure would create a cable channel address table 162, which would be loaded into RAM 52 of command controller 36. For the above example, the cable channel address table 162 would have the following information.

CABLE CHANNEL ADDRESS TABLE 162

1 6

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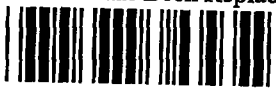
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2	24
3	23
.	
.	
.	
8	25

After the "setting" procedure is performed, the TV viewer can now select cable channels for viewing by the old way: eg. pushing the key pad buttons 24 will select HBO. He can also do it the new way: eg. by pushing CABLE CHANNEL 2, which will also select HBO. The advantage of the new way is that the television guide will publish [C2] next to the program description, so the viewer will just look up the assigned channel number instead of having to remember that HBO is local cable channel 24. When the CABLE CHANNEL button is pushed, command controller 36 knows that it will look up the local cable channel number in cable channel address table 162 to tune the VCR to the correct channel.

For timer preprogramming and for using the compressed G-code, a way to differentiate between broadcast and cable channels is to add an eighth channel bit, which would be set to 0 for normal broadcast channels and 1 for cable channels such as HBO. This eighth channel bit could be one of the low order bits such as the third bit C_3 out of the eight channel bits, so that the number of bits to specify popular channels is minimized, whether they be normal broadcast or cable channels. For a normal broadcast channel, the 7 other bits can be decoded according to priority vector C table 124. For a cable channel, the 7 other bits can be decoded according to a separate cable channel priority vector table 160, which could be stored in ROM 54 of microcontroller 36. The cable channel priority vector table can be set ahead of time for the entire country or at least for an

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area covered by a particular wide area television guide publication.

A television guide that carries the compressed code known as the G-code will now print the cable channel information as follows:

```
        6:30 pm
[C2]    HBO  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (4679)
        xxxxxx(program description)xxxxxxxxxx
        xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

The [C2] in front of HBO reminds the viewer that he needs only to push CABLE CHANNEL 2 to select HBO. The (4679) is the G-code for this particular program.

FIG. 8 shows a section of a television guide. The cable channels all have an assigned cable channel number 188 after the cable channel mnemonic. Other than that the cable channel information is arranged the same as the broadcast channels with a compressed G-code 212 associated with the channel.

For timer preprogramming, the viewer need only enter the number 4679 according to the unit's G-code entry procedure, eg. PROG 4679 PROG. The G-code decoder unit will decode this G-code into "cable channel 2" and will also signal the command controller 36 with a cable channel signal 164, as shown in FIGs. 1 and 2, because the extra channel bit will be "1" which distinquishes that the G-code is for a cable channel; then, since the association of "cable channel 2" with channel 24 has been established earlier in the "setting" procedure, the command controller, if it has received a cable channel signal, will immediately look up 2 in the cable channel address table 162 to translate it to cable channel 24, which will be used as the

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recording channel at the appropriate time. By associating the G-code with the assigned cable channel number rather than the local cable channel number, the G-code for that program will be valid in the whole local area, which may have many different cable carriers each of which may have different local cable channel numbers.

To include the cable channel compressed G-code feature, the decoding and encoding algorithms are as shown in FIGs 9 and 10, respectively. The encoding should be explained first before the decoding. The primary change in FIG. 10 from FIG. 7 is that a cable channel priority vector table 160 has been added and is used in look up priority step 180 if a cable channel is being encoded. Also if a cable channel is being encoded then the cable channel bit is added in the correct bit position in the convert $C_pD_pT_pL_p$ to binary numbers step 182. This could be bit C_3, as discussed before. The bit hierarchy key could be determined as before to compress the number of bits in the most popular programs; however, it needs to be 23 bits long to accommodate the cable channel bit. The maximum compressed G-code length could still be 7 digits, because 2^{23}= 8,388,608.

The decoding is shown in FIG. 9 and is just the reverse of the encoding process. After step 108, test cable channel bit 174 is added and effectively tests the cable channel bit to determine if it is a "1". If so then the command controller 36 is signaled via cable channel signal 164 of FIGs. 1 and 2 that the CDTL 118 that will be sent to it from G-code decoder 38 is for a cable channel. Then the command controller knows to look up the local cable carrier channel number based on the assigned cable channel number. In step 176 of FIG. 9, the priority vector tables including the cable channel priority vector table 160 are used to look up the CDTL 118 information.

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An alternate to having the command controller receive a cable channel signal 164 is for the G-code decoder to perform all of the decoding including the conversion from assigned cable channel number to local cable carrier number. This would be the case for the remote controller implementation of FIG. 3. FIG. 11 shows the implementation of the entire decode algorithm if this step is included. All that needs to added is convert assigned channel to local cable carrier channel step 166, which performs a lookup in cable channel address table 162, if the cable channel bit indicates that a cable channel is involved. Step 166 effectively replaces step 174 in FIG. 9.

Another issue that needs addressing is the number of programs that can be preprogrammed. Since the G-code greatly simplifies the process of entering programs, it is likely that the user will quickly learn and want to enter a large number of programs; however, some existing VCRs can only store up to four (4) programs, while some can store as many as eight. Thus, the user may get easily frustrated by the programming limitations of the VCR.

One approach to this problem, is to perform the compressed G-code decoding in the remote controller and provide enough memory there to store a large number of programs, eg. 20 or 40. The remote controller would have the capability of transferring periodically several of these stored programs at a time to the VCR main unit. To provide this capability, extra memory called stack memory 76 is required inside the remote unit, as shown in Fig. 12, which other than that is identical to FIG. 4. Stack memory 76 can be implemented with a random access memory, which may in fact reside in the microcontroller itself, such as RAM 62.

The stack memory 76 is where new entry, insertion & deletion of timer preprogramming information is carried out. It is also

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where editing takes place. The top memory locations of the stack, for example the first 4 locations, correspond exactly to the available timer preprogramming memory in the VCR main unit. Whenever the top of the stack memory is changed, the new information will be sent over to the VCR main unit to update it.

FIG. 13 shows the sequence of events when the user enters a G-code program on the keypad of the remote controller. For illustration purposes, suppose the VCR main unit can only handle four (4) programs. Suppose also that the stack memory capacity is 20 timer preprograms. Referring to the flow chart in FIG.13, when the user enters a G-code in step 230, the microcontroller 60 first decodes it into the CDTL information in step 234 and displays it on the display unit with the additional word "entered" also displayed. The microcontroller then enters the decoded program into the stack memory in step 236.

If this is the first program entered, it is placed at the top location of the stack memory. If there are already programs in the stack memory, the newly entered program will first be provisionally placed at the bottom of the stack memory. The stack memory will then be sorted into the correct temporal order in step 240, so that the earliest program in time will appear in the top location and the last program in time will be at the bottom. Notice that the nature of the temporally sorted stack memory is such that if stack memory location n is altered, then all the locations below it will be altered.

For example, suppose the stack memory has six (6) entries already temporally ordered, and a new entry is entered whose temporal ordering places it in location 3 (1 being the top location). If this entry is placed into location 3, information which was in location 3, 4, 5, 6 will be shifted to locations 4, 5, 6, and 7. Locations 1 and 2 will remain unchanged.

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The microcontroller 60, after doing the temporal ordering, checks in step 242 whether the first n entries have changed from before, where for the current example n equals 4. In this case, since a new program has been entered into location 3, what used to be in location 3 now moves to location 4. Since the VCR's main unit program menu of 4 entries should correspond exactly to location 1 through 4 of the stack memory, entries 3 and 4 on the VCR main unit must now be revised. The microcontroller therefore sends out the new entries 3 & 4 to the main unit, in step 244 of FIG. 13. If the newly entered program, after temporal ordering, gets entered into location 5, then entries 1 through 4 have not changed from before and the microcontroller will not send any message to the VCR main unit and the microcontroller will just resume monitoring the clock 85 and the keyboard 88 as per step 246. It is assumed that when the user enters the G-code in step 230, the remote controller is pointed at the VCR main unit. The other steps of FIG. 13 happen so fast that the changes are sent in step 244 while the remote controller is still being pointed at the VCR main unit.

If the user decides to delete a program in step 232, the deletion is first carried out in the stack memory. If the first 4 entries are affected, the microcontroller will send the revised information over to the VCR main unit. If the first 4 entries are not affected, then again the remote controller unit will not send anything. The deletion will only change the lower part of the stack (lower meaning location 5 to 20). This new information will be sent over to the VCR main unit at the appropriate time.

In the meantime, the VCR main unit will be carrying out its timer programming function, completing its timing preprogramming entries one by one. By the time all 4 recording entries have been completed, the stack in the remote must send some new

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entries over to "replenish" the VCR main unit (if the stack has more than 4 entries).

The real time clock 85 in the remote controller unit is monitored by the microcontroller to determine when the programs in the main unit have been used up. Referring to the flow chart in FIG. 14, the microcontroller periodically checks the clock and the times for the programs at the top of the stack in step 250 (say the first 4 entries), which are identical to the VCR's main unit's menu. If on one of the periodic checks, it is determined that the recording of the main unit's menu is complete, then if there are more entries in the stack, which is tested in step 252, the display unit will be set to a blinking mode or display a blinking message in step 258 to alert the user to send more programs. Next time the user picks up the remote unit, the blinking will remind him that the VCR main unit's program menu has been completed and it is time to replenish the VCR main unit with program entries stored in the remote. The user simply picks up the remote and points it towards the VCR main unit and presses "ENTER". This will "pop" the top of the stack memory in step 260, ie. pop all the entries in the stack up by four locations. The microcontroller will then send the new "top of the stack" (ie. top 4 entries) over to the VCR main unit in step 262. This process will repeat until the whole stack has been emptied.

It is thought that the apparatus and method for using encoded video recorder/player timer preprogramming information of the present invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts thereof without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore

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described being merely a preferred or exemplary embodiment thereof.

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We Claim:

1. A method of using compressed codes for recorder preprogramming comprising the steps of:

providing a television guide wherein each program description has an associated compressed code representing the channel, date, time and length of the program;

providing a means for entering a compressed code having at least one digit;

providing a means for decoding a compressed code having at least one digit into channel, date, time and length commands;

converting said compressed code into a binary compressed code;

providing a bit hierarchy key that specifies the reordering of said binary compressed code;

reordering all the bits in said compressed code according to said bit hierarchy key to obtain a reordered binary compressed code;

separating said reordered binary compressed code into binary channel, date, time and length priority indices;

providing priority vectors for channel, date, time and length;

using said channel, date, time and length priority indices to lookup channel, date, time and length commands from said priority vectors for channel, date, time and length;

providing a clock means for keeping time;

comparing said date, time and length commands to said clock means;

providing a means for tuning channels;

tuning said means for tuning channels to the channel indicated by the channel in said channel, date, time and length commands when said clock means compares with the date and time of said channel date time and length commands;

providing a means for recording;

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turning ON said means for recording when said clock means compares with the date and time of said date and time commands; and

turning OFF said means for recording when said length of said length command matches time of recording on said clock means.

2. A system for the automatic recording of a television program on a video cassette recorder comprising:

a television calendar visually listing television programs by the date and time of each program and the television channel on which each program is to appear, the calendar having a unique compressed coded indication for each of the programs comprising a set of digits corresponding to the start of the corresponding program and representing the channel of which such program will appear, the date and time such program is to start, and the length of such program; and

a means for automatically controlling recording of television signals by a video cassette recorder comprising means for receiving representations of the digits of the compressed coded indications from the television calendar and for enabling such video cassette recorder to commence recording television signals carrying the program on the channel, on the date, at the time and terminating after the length of time represented by any of said compressed coded indications.

3. The system of claim 2 wherein the means for automatically controlling recording comprises:

an input for receiving the representation of the digits of each of the compressed coded indications;

a decoder for decoding the representation of each of the compressed coded indications into corresponding separate channel, date, time and length commands;

a channel selector for selecting the channel identified in the channel command; and

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an on/off controller for enabling recording by the video recorder of the television program on the selected channel and comprising means operative for turning on the recording commencing at the date and the time specified by the date and time commands and terminating recording after the length of time specified by the length command.

4. A system for automatically controlling recording by a video cassette recorder of a channel of video signals under control of a channel command beginning on the calendar day specified by a day command, at the time-of-day specified by a time-of-day command, and for the length of time specified by a length command, the system comprising:

an input for receiving representations of compressed coded indications, each representative of, and compressed in length from, the combination of one of each said channel command, day command, time-of-day command, and length command; and

a decoder for decoding and expanding any said compressed coded indication to individual channel command, day command, time-of-day command, and length command for control of the video cassette recorder.

5. The system of claim 4 wherein the input and decoder are an integral part of the video cassette recorder.

6. The system of claim 4 comprising a remote transmitter which comprises said input.

7. The system of claim 5 or 6 wherein the video cassette recorder includes control means for interpreting whether said compressed coded indication has been received by the video cassette recorder.

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8. The system of claim 7 wherein said control means comprises a microprocessor.

9. The system of claim 4 comprising a remote hand transmitter which comprises said input and decoder.

10. The system of claim 9 wherein said remote handheld transmitter comprises a universal remote controller capable of learning protocols of different remote controllers with which said universal remote controller interfaces.

11. The system of claim 6 or 9 wherein said input comprises a keyboard entry device.

12. The system of claim 5 or 9 wherein said decoder comprises a microprocessor.

13. The system of claim 4 comprising a clock for providing an output as a function of time and wherein the decoder comprises means for generating said channel, day, time-of-day and length commands as a function of the output of the clock.

14. The system of claim 4 wherein said decoder comprises:

means for converting said compressed coded indication into a compressed code of binary bits;

means for reordering the bits in said compressed code of binary bits to obtain a reordered binary compressed code;

means for grouping said reordered binary compressed code into binary channel, date, time and length priority numbers; and

means for using said binary channel, date, time and length priority numbers to derive said channel, day, time-of-day and length commands.

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15. The system of claim 14 comprising a clock providing an output as a function of time and wherein said means for reordering the bits in said compressed code comprises means for reordering the bits as a function of the output of the clock.

16. The system of claim 14 comprising a clock providing an output as a function of time wherein said means for deriving said channel, day, time-of-day and length commands comprises means for deriving said channel, day, time-of-day and length commands as a function of the output of the clock.

17. The system of claim 4 wherein said decoder comprises:

means for converting said compressed coded indication into a compressed code of mixed radix bits;

means for reordering the bits in said compressed code of mixed radix bits to obtain a reordered mixed radix compressed code;

means for grouping said reordered mixed radix compressed code into mixed radix channel, date, time and length priority numbers; and

means for using said mixed radix channel, date, time and length priority numbers to derive said channel, day, time-of-day and length commands.

18. The system of claim 4 further comprising:

a clock providing an output as a function of time;

means for comparing the day and time-of-day information to the clock output for a predetermined relation;

a channel selector for selecting the channel specified in the channel command after the predetermined relation is found to exist; and

an on/off controller for enabling recording by the video cassette recorder of the video signals on the selected channel

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comprising means operative for turning on the recording after the predetermined relation is found to exist.

19. The system of claim 18 wherein the controller comprises means for utilizing the length command to terminate the recording.

20. The system of claim 4 wherein said decoder comprises:

means for entering encoded data into the decoder;

means for decoding said encoded data to determine channel, date, time and length of the channel of video signals to be recorded; and

means for generating control commands from said encoded data for selection of said channel of video signals for recording and for control of the video cassette recorder to start and stop the recording of the selected channel by the video cassette recorder.

21. In a system for automatically controlling recording of channels of television programs by a video cassette recorder, apparatus for decoding encoded television program information, where the program information comprises channel, date, time and length of the program information, said apparatus comprising:

means for entering the encoded information into the apparatus;

means for decoding said decoded encoded information to determine channel, date, time and length of program to be recorded: and

means for generating control commands from said decoded information for selection of a channel for recording and for control of the video cassette recorder to start and stop the recording of the selected channel by the video cassette recorder.

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22. A method of programming a system for automatically controlling recording by a video cassette recorder of a channel of video signals specified by a channel command beginning at the time-of-day specified by a time-of-day command, on the calendar day specified by a day command and for the length of time specified by a length command, the steps comprising:

receiving compressed coded indications, each representative of the combination of one of each said channel command, day command, time-of-day command, and length command; and

decoding and expanding any said compressed coded indications to individual said channel command, day command, time-of-day command and length command for control of the video cassette controller.

23. The method of claim 22 comprising the step of receiving the compressed coded indication in the video cassette recorder.

24. The method of claim 22 comprising the step of receiving the compressed coded indication in a transmitter remote from the video cassette recorder.

25. The method of claim 23 or 24 wherein the step of receiving comprises the step of interpreting whether said compressed coded indication has been received by the video cassette recorder.

26. The method of claim 25 wherein the step of interpreting is performed by a microprocessor.

27. The method of claim 22 comprising the steps of receiving the compressed coded indication and decoding and expanding the compressed coded indication in a transmitter remote from the video cassette recorder.

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28. The method of claim 22 further comprising the step of using a remote handheld transmitter, which interfaces with different remote controllers for learning the protocols of the different controllers.

29. The method of claim 24 or 27 wherein the step of receiving comprises the step of inputting the compressed coded indications with a keyboard entry device.

30. The method of claim 23 or 27 wherein the step of decoding comprises the step of decoding the compressed coded indication with a microprocessor.

31. The method of claim 22 wherein the step of decoding and expanding comprises the step of performing said decoding and expanding as a function of the output of a clock.

32. The method of claim 22 wherein the step of decoding and expanding comprises the steps of:

converting said compressed coded indication into a compressed code of binary bits;

reordering the bits in said compressed code of binary bits to obtain a reordered binary compressed code;

grouping said reordered binary compressed code into binary channel, date, time and length priority numbers; and

deriving said channel, day, time-of-day and length commands from said binary channel, date, time and length priority numbers.

33. The method of claim 32 wherein the step of reordering comprises the step of performing said reordering as a function of the output of a clock.

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34. The method of claim 32 wherein the step of deriving comprises the step of performing said deriving as a function of the output of a clock.

35. The method of claim 22 wherein the step of decoding and expanding comprises the steps of:

converting said compressed coded indication into a compressed code of mixed radix bits;

reordering the bits in said compressed code of mixed radix bits to obtain a reordered mixed radix compressed code;

grouping said reordered mixed radix compressed code into mixed radix channel, date, time and length priority numbers; and

deriving said channel, day, time-of-day and length commands form said mixed radix channel, date, time and length priority numbers.

36. The method of claim 22 further comprising the steps of:

comparing the day and time-of-day commands to the output of a clock for a predetermined relation;

selecting the channel specified in the channel command after the predetermined relation is found to exist; and

enabling recording by the video cassette recorder of the video signals on the selected channel by commencing recording after the predetermined relation is found to exist.

37. The method of claim 36 comprising the step of utilizing the length command to terminate the recording.

38. The method of claim 22 wherein the step of decoding and expanding comprises the steps of:

entering encoded data into the decoder;

decoding said encoded data to determine channel, date, time and length of the channel of video signals to be recorded; and

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generating control commands from said encoded data for selection of said channel of video signals for recording and for control of the video cassette recorder to start and stop the recording of the selected channel by the video cassette recorder.

39. A television calendar for combined visual selection of programs for direct viewing and for use in automatic recording of programs for future viewing, the combination comprising:

a day section for each of a plurality of calendar days and, positioned in a predetermined relation with each day section, an associated unique day visual identifier;

a time-of-day section for each of a plurality of program starting times within each day section and, positioned in a predetermined relation with each time-of-day section, an associated unique time-of-day visual identifier;

a plurality of unique channel visual identifiers and corresponding to each such channel visual identifier, a program identifier within each time-of-day section for such program that starts at the time of such time-of-day section and that is associated with the day section and time-of-day section within which it is positioned; and

an additional unique coded indication for each said program positioned in a predetermined relation to each said channel visual identifier, the coded indication for each such program representing the channel, the time-of-day, the calendar day, and the length of time for the associated program in the calendar.

40. The television calendar of claim 39 wherein at least some of the unique coded indications comprises a plurality of digits.

41. A television calendar of claim 40 wherein each of the day, time-of-day and channel identifiers is represented by one or more digits and wherein the sum of the number of digits of the

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unique coded indication is less than the number of digits in all of the identifiers plus the number of digits representing the length of time for the associated program.

42. A television calendar of claim 39 wherein each of at least some of said channel visual identifiers comprise a unique cable channel visual identifier and wherein the television calendar further comprises an assigned cable channel number positioned in a predetermined relation to each said cable channel visual identifier, the assigned cable channel number representing the cable channel corresponding to said cable channel visual identifier for said cable television program.

43. A method of creating a television calendar for combined visual selection of programs for direct viewing and for use in automatic recording of programs for future viewing, comprising the steps of:

creating a day section and an associated unique day visual identifier for each of a plurality of calendar days;

positioning in relation to each of the day sections the associated day visual identifier;

creating a time-of-day section for each day section, for each of a plurality of television program starting times and an associated unique time-of-day visual identifier;

positioning in relation to each of the time-of-day sections the corresponding associated unique time-of-day visual identifier;

creating a plurality of unique channel visual identifiers and a corresponding program identifier for each such channel visual identifier, within each time-of-day section for such program that starts at the time of such time-of-day section, and that is associated with the day section and time-of-day section within which it is positioned;

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creating a unique coded indication for each said program, the coded indication representing the channel, the calendar day, the time-of-day, and the length of time for said program; and

positioning in a predetermined relation to each program identifier, the unique coded indication for each said program.

44. The method of claim 43 wherein the step of creating a unique coded indication for each said program comprises the step of

creating the unique coded indication to have less digits than the sum of the number of digits in all of the identifiers associated with said program plus the number of digits representing the length of time associated with said program.

45. The method of claim 43 wherein the step of creating the unique coded indication comprises the step of encoding digits representing the identifiers based on probabilities as to the frequency of occurrence of the identifiers in the calendar.

46. The method of claim 44 wherein the step of creating the unique coded indication comprises the step of:

encoding the digits in all of the identifiers associated with each said program, plus the digits representing the length of time associated with said program, based on probabilities assigned to the channel associated with the channel identifier, calendar day associated with the day identifier, time-of-day associated with the time-of-day identifier and length of time associated with said program.

47. The method of claim 43 wherein the step of creating a plurality of unique channel visual identifiers further comprises the steps of:

creating at lease some of said channel visual identifiers to comprise unique cable channel visual identifiers; and

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positioning in a predetermined relation to each said cable channel visual identifier and assigned cable channel number representing the cable channel corresponding to said cable channel visual identifier for said cable television program.

48. The method of claim 43 wherein the step of creating a unique coded indication comprises the steps of:

creating a separate representation for each of a channel, day, time and day and length for any program in the calendar;

using said representation to derive a priority number for each of said channel, date, time and length representations;

converting the priority numbers into a binary number for each of said channel, day, time and length commands;

reordering the bits of said binary numbers to obtain a compressed code of binary bits; and

converting the compressed code of binary bits into one said unique coded indication.

49. The method of claim 48 wherein the step of reordering comprises the step of performing said reordering as a function of a bit hierarchy key.

50. The method of claim 48 wherein the step of reordering comprises the step of performing said reordering as a function of the output of a clock.

51. The method of claim 48 wherein the step of using said representation to derive a priority number comprises the step of performing said derivation as a function of the output of a clock.

52. The method of claim 43 wherein the step of creating a unique coded indication comprises the steps of:

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creating a separate representation for each of a channel, day, time and day and length for any program in the calendar;

using said representation to derive a priority number for each of said channel, date, time and length representations;

converting the priority numbers into a mixed radix number for each of said channel, day, time and length commands;

reordering the bits of said mixed radix numbers to obtain a compressed code of mixed radix bits; and

converting the compressed code of mixed radix bits into one said unique coded indication.

53. A television calendar on a display medium for combined visual selection of programs for direct viewing and for use in automatic recording of programs for future viewing, the combination comprising:

a day section for each of a plurality of calendar days and, positioned in a predetermined relation with each day section, a unique day visual identifier on the display medium;

a time-of-day section for each of a plurality of program starting times within each day section and, positioned in a predetermined relation with each time-of-day section, a unique time-of-day visual identifier on the display medium;

a plurality of unique channel visual identifiers on the display medium and corresponding to each such channel visual identifier a program identifier within each time-of-day section for such program that starts at the time of such time-of-day section and that is associated with the day section and time-of-day section within which it is positioned; and

an additional unique coded indication for each said program positioned on the display medium, in a predetermined relation to each said channel visual identifier, the coded indication representing the channel, the time-of-day, the calendar

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day and the length of time for the associated program in the calendar.

54. The television calendar on a display medium of claim 53 wherein at least some of the unique coded indications comprises a plurality of digits.

55. The television calendar of claim 54 wherein each of the day, time-of-day and channel identifiers is represented by one or more digits and wherein the number of digits of the unique coded indication is less than the sum of the number of digits in all of the identifiers plus the number of digits representing the length of time for the associated program.

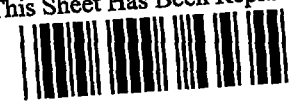
56. A television calendar of claim 53, wherein each of at least some of said channel visual identifiers comprise a unique cable channel visual identifier and wherein the television calendar further comprises an assigned cable channel number positioned in a predetermined relation to each said cable channel visual identifier, the assigned cable channel number representing the cable channel corresponding to said cable channel visual identifier for said cable television program.

57. A method of creating a television calendar on a display medium for combined visual selection of programs for direct viewing and for use in automatic recording programs for future viewing, comprising the steps of:

creating on the display medium a day section and an associated unique day visual identifier for each of a plurality of calendar days;

positioning on the display medium, in relation to the day section the associated day visual identifier;

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creating on the display medium, a time-of-day section and associated unique time-of-day visual identifier, within each day section, for each of a plurality of television program starting times;

positioning on the display medium in relation to the time-of-day section the associated unique time-of-day visual identifier;

creating on the display medium a plurality of unique channel visual identifiers and a corresponding program identifier to each such channel visual identifier, within each time-of-day section for such program that starts at the time of such time-of-day section, and that is associated with the day section and time-of-day section within which it is positioned;

creating on the display medium a unique coded indication for each said program, the coded indication representing the channel, the calendar day, the time-of-day, and the length of time for said program; and

positioning in a predetermined relation to each said channel visual identifier, the unique coded indication for each said program.

58. The method of claim 57 wherein the step of creating on a display medium a unique coded indication for each said program comprises the step of;

creating the unique coded indication to have less digits than the sum of the number of digits in all of the identifiers associated with said program plus the number of digits representing the length of time associated with said program.

59. The method of claim 58 wherein the step of creating the unique coded indication to have less digits comprises the step of:

encoding the digits in all of the identifiers associated with said program, plus the digits representing the length of time

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associated with said program, based on probabilities assigned to the channel associated with the channel identifier, calendar day associated with the day identifier, time-of-day associated with the time-of-day identifier, and length of time associated with said program.

60. The method of claim 57 wherein the step of creating on a display medium a plurality of unique channel visual identifiers further comprises the steps of:

creating on a display medium at least some of said channel visual identifiers to comprise unique cable channel visual identifiers;

positioning on a display medium in a predetermined relation to each said cable channel visual identifier an assigned cable channel number representing the cable channel corresponding to said cable channel visual identifier for said cable television program.

61. The method of encoding a set of variables comprising the steps of:

entering an input value for each variable;

providing a priority vector table for each variable wherein the priority vector table for each variable lists every possible value of the variable in the order of its relative priority and assigns a unique priority number;

performing a table look up in said priority vector table on said input value for each variable to find its unique priority number;

converting each said unique priority number for said input value for each variable to a binary number and concatenating the resulting binary numbers to form one long binary number;

providing a binary bit hierarchy key arranged in the order of highest differential probability to least differential

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probability of the combination of bits representing all the variables, wherein the differential probability is a measure of the relative importance of a bit from one variable over a bit from another variable in minimizing the length of codes which are most often used;

reordering all bits in said one long binary number according to the order of said binary bit hierarchy key to form a compressed code.

62. An apparatus for using compressed codes for recorder preprogramming that comprises:

means for entering and transmitting a compressed code;

means for receiving a command signal coupled to said means for entering and transmitting a compressed code entry;

means for command control electrically coupled to said means for receiving a command signal;

a means for keeping time electrically coupled to said means for command control;

means for decoding a compressed code having at least one digit into channel, date, time and length commands electrically coupled to said means for command control;

means for recording coupled to said means for command control;

means for turning said means for recording ON and OFF in response to comparison of said decoded date, time and length commands from said means for command control with said means for keeping time; and

means for tuning channels electrically coupled to a signal input and to said means for recording and to said means for command control and responsive to decoded channel commands to tune to selected channels from said means for command control.

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63. The apparatus for using compressed codes for recorder preprogramming of claim 62 wherein:

said means for keeping time is electrically coupled to said means for decoding a compressed code into channel, date, time and length commands; and

wherein the decoding of a compressed code by said means for decoding a compressed code into channel, date, time and length commands is a function of said means for keeping time.

64. The apparatus for using compressed codes for recorder preprogramming of claim 63 which further comprises:

means coupled to said means for command control for daily using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date specified in said channel, date, time and length (CDTL) commands for recording a program daily.

65. The apparatus for using compressed codes for recorder preprogramming of claim 63 which further comprises:

means coupled to said means for command control for weekly using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date specified in said channel, date, time and length (CDTL) commands for recording a program weekly.

66. The apparatus for using compressed codes for recorder preprogramming of claim 64 or 65 wherein said means for entering and transmitting a compressed code comprises:

means for remote control having a signal transmit means coupled to said means for command control receiver; and

means for compressed code entry electrically coupled to said means for remote control.

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67. The apparatus for using compressed codes for recorder preprogramming of claim 64 or 65 wherein said means for entering and transmitting a compressed code comprises:

means for manual control electrically coupled to said means for a command signal receiver; and

means for compressed code entry means electrically coupled to said means for manual control.

68. The apparatus for using compressed codes for recorder preprogramming for a recorder that comprises:

means for remote control having a means for transmitting signals;

means for compressed code entry electrically coupled to said means for remote control;

means for decoding a compressed code having at least one digit into channel, date, time and length commands electrically coupled to said means for transmitting signals on said remote control;

means for receiving a command signal coupled to said means for transmitting signals;

means for command control for controlling a recorder electrically coupled to said means for receiving a command signal;

a first means for keeping time electrically coupled to said means for command control;

means for recording coupled to said means for command control;

means for turning said means for recording ON and OFF in response to comparison of said decoded date, time and length commands from said means for command control with said first means for keeping time and

means for tuning channels electrically coupled to a signal input and to said means for recording and to said means for

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command control and responsive to decoded channel commands to tune to selected channels from said means for command control.

69. The apparatus for using compressed codes for recorder preprogramming of claim 68 which further comprises:

means coupled to said command controller for daily using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date specified in said channel, date, time and length (CDTL) commands for recording a program daily.

70. The apparatus for using compressed codes for recorder preprogramming of claim 68 which further comprises:

means coupled to said command controller for weekly using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date specified in said channel, date, time and length (CDTL) commands for recording a program weekly.

71. The apparatus for using compressed codes for recorder preprogramming of claim 68, 69 or 70 that further comprises:

a second means for keeping time electrically coupled to said means for decoding a compressed code into channel, date, time and length commands;

wherein the decoding of a compressed code by said means for decoding a compressed code into channel date time and length commands is a function of said second means for keeping time.

72. An apparatus for using compressed codes for recorder preprogramming for a recorder that comprises:

means for universal remote control having a means for transmitting signals and a means for receiving signals;

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a learn switch electrically coupled to said means for universal remote control wherein when said learn switch is "ON" said means for universal remote control can learn another remote controller functions via said means for receiving signals;

means for compressed code entry electrically coupled to said means for universal remote control;

means for decoding a compressed code having at least one digit into channel, date, time and length commands electrically coupled to said means for transmitting signals on said universal remote control;

means for receiving a command signal coupled to said means for transmitting signals;

means for command control for controlling a recorder electrically coupled to said means for receiving a command signal;

a first means for keeping time electrically coupled to said means for command control;

means for recording coupled to said means for command control;

means for turning said means for recording ON and OFF in response to comparison of said decoded date, time and length commands for said means for command control with said first means for keeping time; and

means for tuning channels electrically coupled to a signal input and to said means for recording and to said means for command control and responsive to decoded channel commands to tune to selected channels from said means for command control.

73. The apparatus for using compressed codes for recorder preprogramming of claim 72 which further comprises:

means coupled to said command controller for daily using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date

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specified in said channel, date, time and length (CDTL) commands for recording a program daily.

74. The apparatus for using compressed codes for recorder preprogramming of claim 72 which further comprises:

means coupled to said command controller for weekly using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date specified in said channel, date, time and length (CDTL) commands for recording a program weekly.

75. The apparatus for using compressed codes for recorder preprogramming of claim 72, 73 or 74 that further comprises:

a second means for keeping time electrically coupled to said means for decoding a compressed code into channel, date, time and length commands; and

wherein the decoding of a compressed code by said means for decoding a compressed code into channel, date, time and length commands is a function of said second means for keeping time.

76. The method of controlling a television controller for selecting a cable channel for viewing, the steps comprising:

providing a television calendar with assigned cable channel number identifiers associated with each cable channel;

providing a television controller having a cable channel address table with memory for a set of assigned cable channel numbers and a corresponding set of local cable carrier channel numbers and having the capability to convert an assigned cable channel number into a local cable carrier channel number by using said cable channel address table;

setting up said cable channel address table with said set of assigned cable channel numbers and said corresponding set of local cable carrier channel numbers;

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entering an assigned cable channel number identifier corresponding to a cable channel selected for viewing; and

conversion of said assigned cable channel number identifier into a corresponding local cable carrier channel number by said television controller.

77. The apparatus for using compressed codes for recorder preprogramming of claim 62 wherein:

said means for decoding a compressed code having at least one digit into channel, date, time and length information electrically coupled to said means for command control further comprises a means for detecting that said channel information corresponds to an assigned cable channel number; and

said means for command control further comprises a means for converting an assigned cable channel number into a local cable carrier channel number.

78. The apparatus for using compressed codes for recorder preprogramming of claim 68 or 72 wherein said means for decoding a compressed code having at least one digit into channel, date, time and length commands further comprises:

a means for detecting that said channel commands corresponds to an assigned cable channel number; and

a means for converting an assigned cable channel number into a local cable carrier channel number.

79. The apparatus for using compressed codes for recorder preprogramming of claim 68 or 72 that further comprises:

a stack memory coupled to said means for decoding a compressed code for storing a plurality of programs consisting of channel, date, time and length commands for timer preprogramming;

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a second means for keeping time electrically coupled to said means for decoding a compressed code into channel, date, time and length commands; and

wherein said means for decoding a compressed code further comprises a means for periodically comparing said date and time commands for said stack memory and transmitting said channel, date, time and length commands to said means for receiving a command signal when said date and time commands compare with said second means for keeping time.

80. The method of permitting a large number of programs to be timer preprogrammed for recording by a video cassette recorder for time shifted viewing where the video cassetter recorder can store only N timer preprogrammed programs, the steps comprising:

providing a remote controller having a means for keeping time;

entering into said remote controller compressed codes each having at least one digit and each representative of, and compressed in length from, the combination of channel, time-of-day, day and length commands for a program; and

decoding each compressed code having at least one digit of channel, time-of-day, day and length commands;

providing a memory;

entering each said channel, time-of-day, day and length commands into said memory;

reordering said channel, time-of-day, day and length commands in said memory into temporal order; and

testing whether first N entries in said memory have changed and if yes, sending changed entries in first N entries to said video cassette recorder.

81. The method of permitting a large number of programs to be timer preprogrammed of claim 80, the steps further comprising:

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periodically checking whether stop time of Nth entry of said first N entries in memory has passed; and

if stop time of Nth entry has passed and number of entries in memory is greater than N, then turning on a means for alerting a user to activate remote controller to send more programs to said video cassette recorder and once remote controller is activated, setting next N entries in said memory to be the first N entries in said memory and sending said first N entries to said video cassette recorder and turning off said means for alerting a user.

82. An apparatus for using compressed codes for recorder preprogramming that comprises:

means for remote control having a means for transmitting signals;

means for compressed code entry electrically coupled to said means for remote control;

means for decoding a compressed code having at least one digit into channel, date, time and length commands electrically coupled to said means for remote control;

means for storing said channel, date, time and length commands in said remote control;

a means for keeping time electrically coupled to said means for remote control;

means for command control electrically coupled to said means for remote control;

means for recording coupled to said command control; and

wherein said means for command control compares the stored date, time and length commands to said means for keeping time and sends at the appropriate time, record ON and OFF commands and channel select commands to a means for recording via said transmit signals from said means for remote control.

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83. The apparatus for using compressed codes for recorder preprogramming of claim 82 that further comprises:

means for storing a plurality of protocol sets of transmit signals for commands for varying models of said means for recording electrically coupled to said means for remote control; and

means for selecting for a particular means for recording a protocol set of transmit signals for sending commands.

84. The apparatus for using compressed codes for recorder preprogramming of claim 82 wherein:

said means for remote control is a universal remote controller and can learn a protocol of the transmit signals for sending commands to a particular model of a means for recording.

85. The system of claim 14 wherein said decoder further comprises:

means for detecting that said binary channel priority number contains a set cable channel bit indicating an assigned cable channel priority number; and

means for using said detected assigned priority cable channel priority number to derive a corresponding local cable channel command.

86. The method of claim 32 wherein the step of decoding and expanding further comprises the steps of:

detecting that said binary channel priority number contains a set cable channel bit indicating an assigned cable channel priority number; and

using said detected assigned priority cable channel priority number to derive a corresponding local cable channel command.

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87. The method of claim 47 wherein the step of creating a unique coded indication comprises steps of:

using said representation to derive a priority number for each of said channel, date, time and length representations;

converting the priority numbers into a binary number for each of said channel, day, time and length commands;

adding a cable channel bit set to "1" if said representation is for a cable channel;

reordering the bits of said binary numbers to obtain a compressed code of binary bits; and

converting the compressed code of binary bits into one said unique coded indication.

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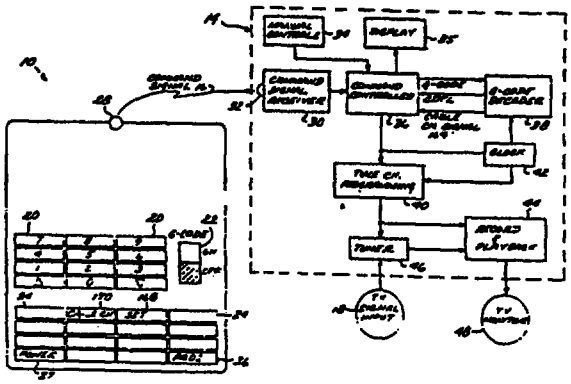
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(54) Title: APPARATUS AND METHOD FOR USING ENCODED VIDEO RECORDER/PLAYER TIMER PREPROGRAMMING INFORMATION

(57) Abstract

Encoded video recorder/player timer preprogramming information (212) listed in a television guide (200) allows a timer preprogramming feature on a video cassette recorder (VCR) (14) to be programmed using a compressed code (102, 158, 212) of only 1 to as few as 7 digits, which are decoded by a decoder (38) built into either the video cassette recorder or a remote controller (82) to convert the compressed code into channel, date, time and length (118, 142) information. The channel, date, time and length information is communicated to a VCR and used to automatically activate the VCR to record a given television program with the corresponding channel, date, time and length. Alternately, the channel, date, time and length information is decoded directly in a remote controller (80) and only start record, stop record and channel selection commands are sent to the VCR (70) at the appropriate times. The compressed codes (212) associated with each television program can be printed in a television program guide (200) in advance and used with a VCR or remote controller with the decoding means. The compressed codes for timer preprogramming can be utilized for just one program or repeatedly for daily or weekly use. The algorithm (100) for decoding the compressed codes can be a function of time (120, 42, 122) to ensure security of the decoding method. A method is included for use of the compressed codes with cable channels (176, 160, 162, 166) and a method and apparatus is described for timer preprogramming for a large number of programs (76). The coding technique can also be used for compressed coding of any multidimensional vector for commercial or industrial applications.



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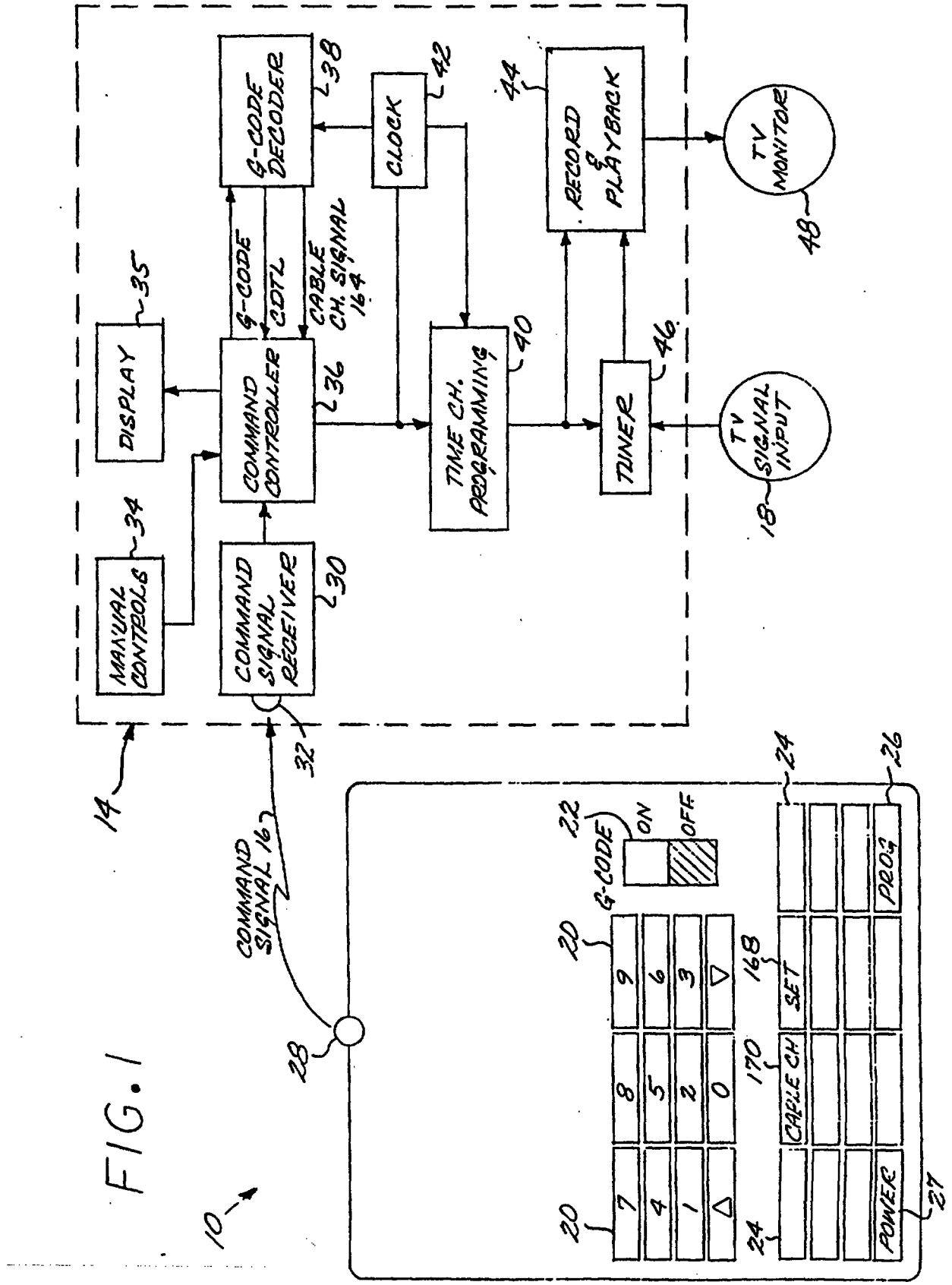


FIG. 1

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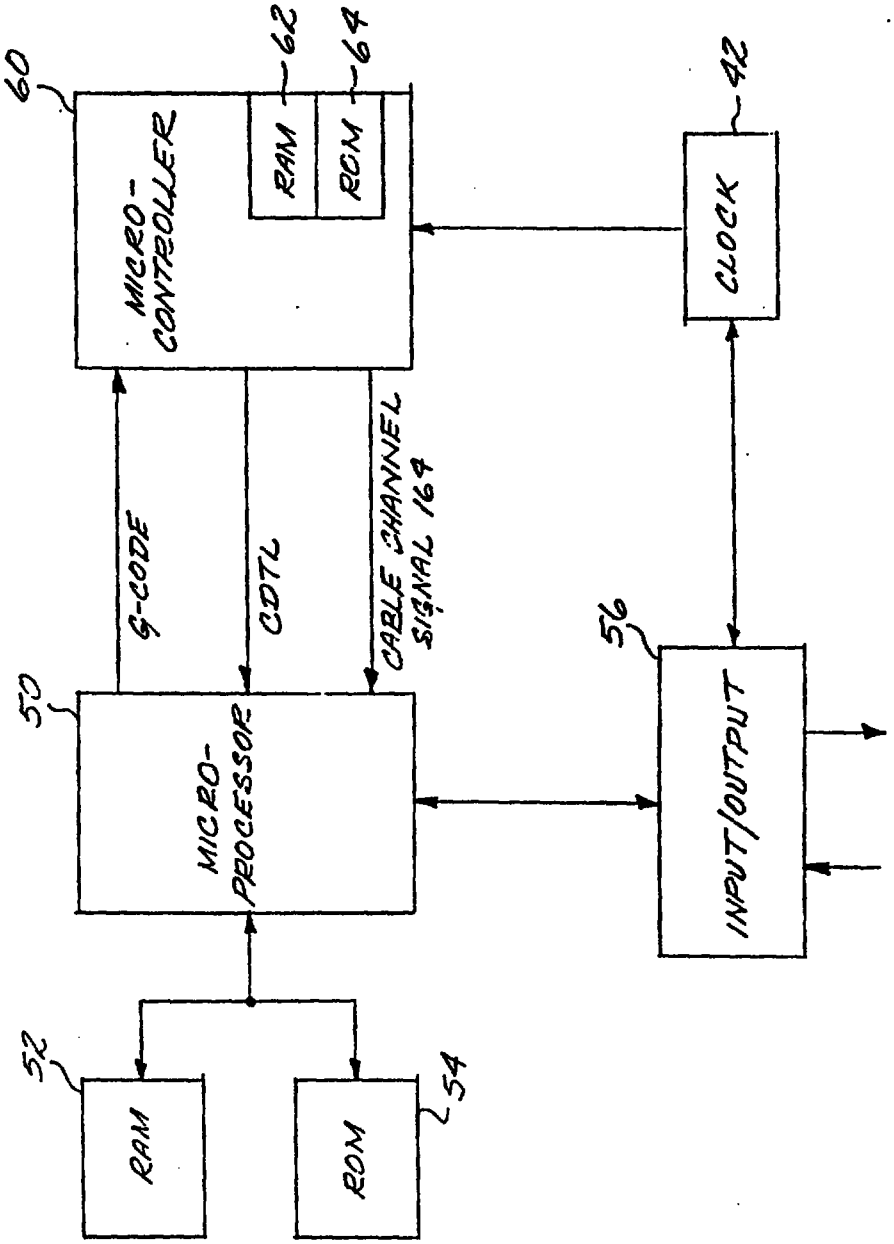


FIG. 2

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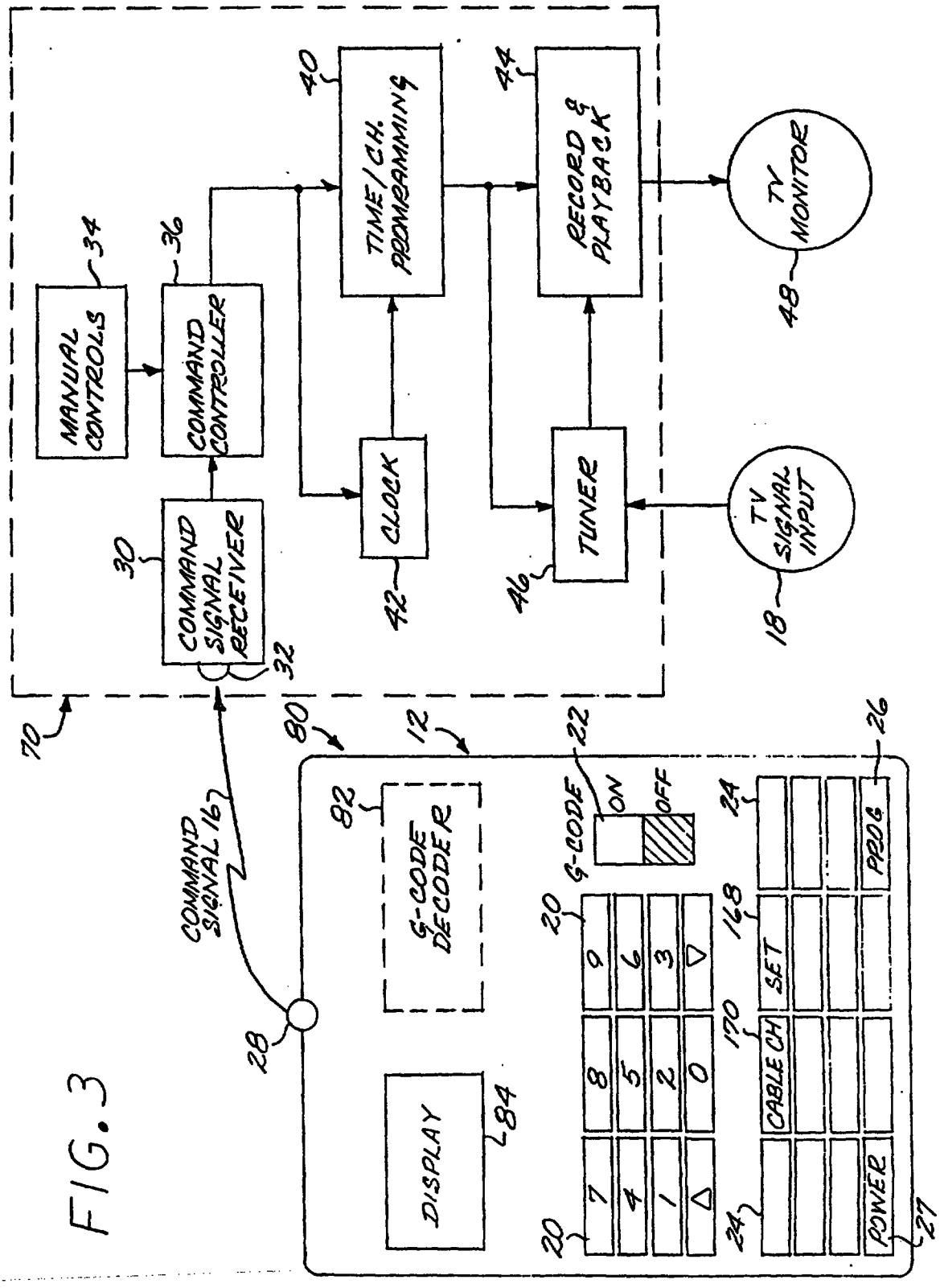


FIG. 3

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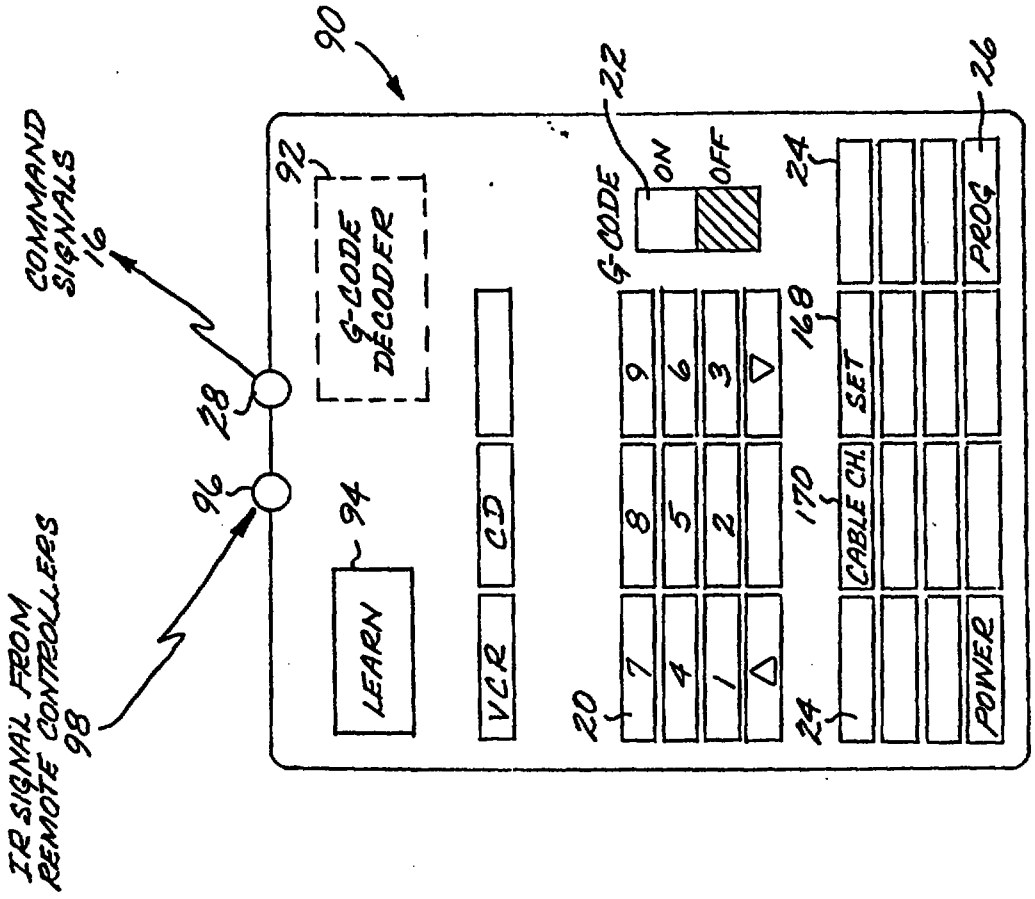


FIG. 5

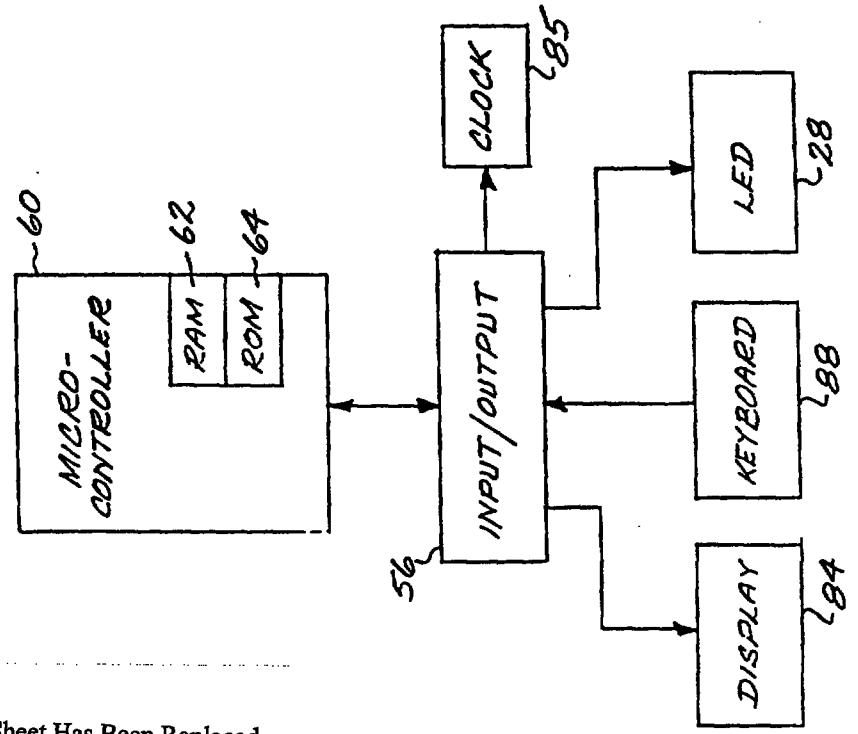


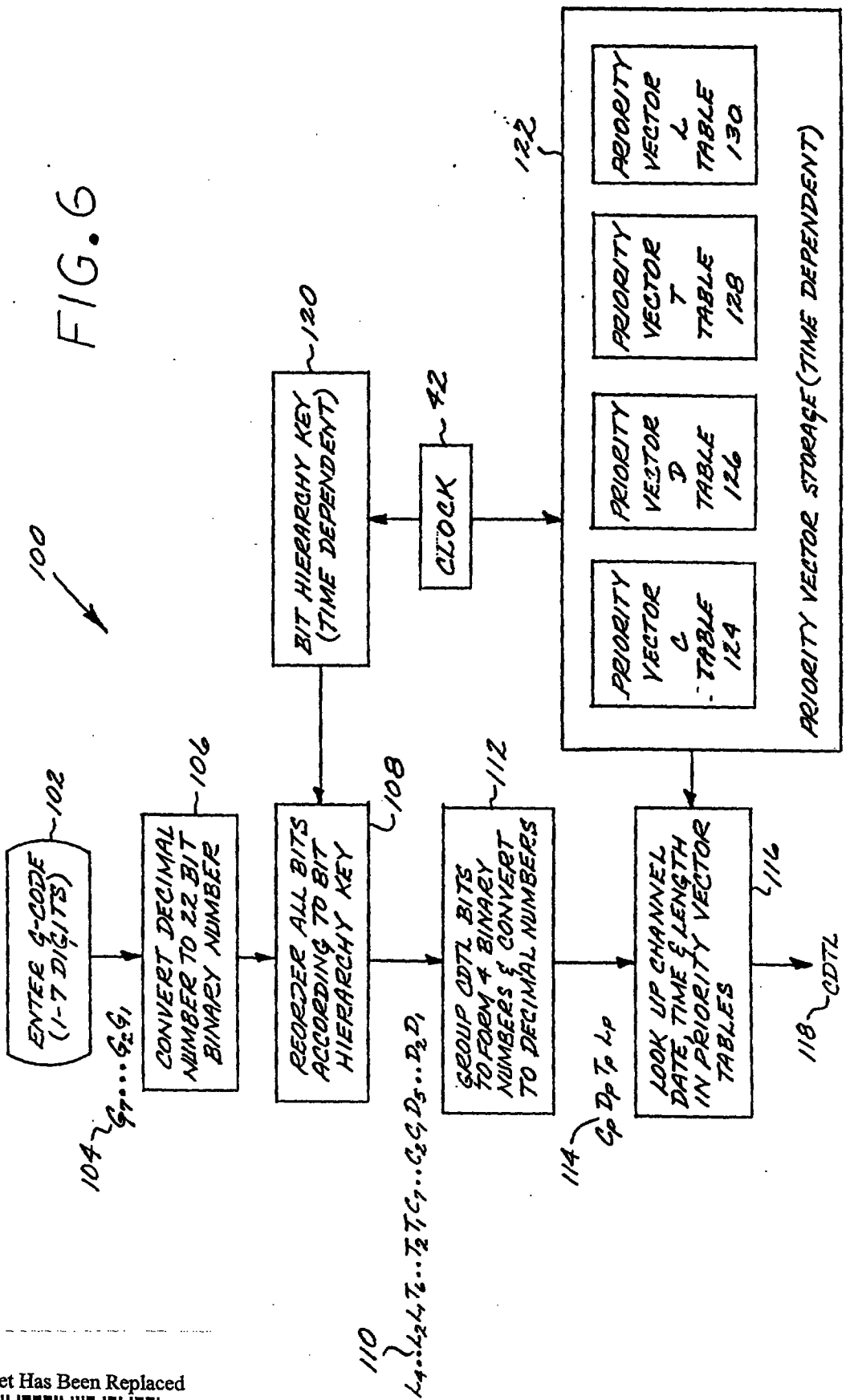
FIG. 4

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FIG. 6



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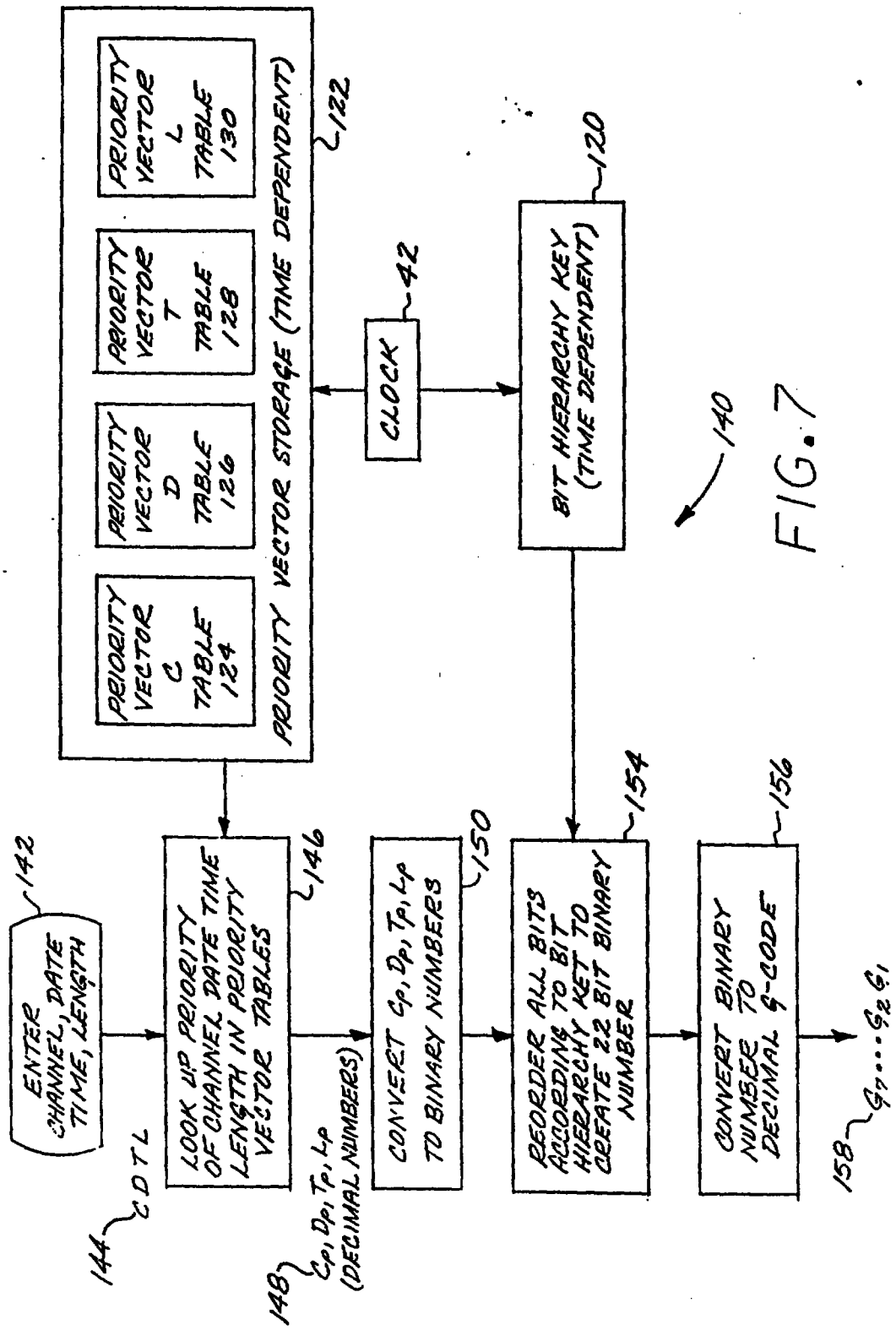


FIG. 7

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Thursday 204

6PM
7PM

February 9, 1989 202

clever to be outsmarted,the family devises an elaborate joke to play on him. 208
(18) SPORTS RETROSPECTIVE; 60 Min. [68713]
(24) NATURESCENE [5321]
A visit to the Colorado National Monument near Grand Junction, where wildflowers, insects and birds are observed. 210
(34) (52) NOTICIAS [62921] [496649]
(40) DWIGHT THOMPSON--Religion; [68553]
(50) HUMANITIES THROUGH THE ARTS [493065]
(56) BEVERLY HILLBILLIES--Comedy [496777]
Con man Shifty Shafer (Phil Silvers) meets Jed in the Ozarks. Jed: Buddy Ebsen. 188
(C15) (A&E) BARRY DOUGLAS--Music; 90 min. (37897)
(C8) (DIS) MOVIE--Drama;70 min. (23627113)
"The Return of the Big Cat."
(C16) (DSC) BEYOND 2000--Magazine; 60 min.(5289)
(C1) (ESN) COLLEGE BASKETBALL (32009)
North Carolina at North Carolina State. Carolina defeated the Wolfpack 84-81 on Jan. 21. Steve Bucknall and Kevin Madden combined three-point shot as time expired. (Live) [Time approximate.]
(C2) (HBO) MOVIE(CC)--Science Fiction;(32041)
1hr., 50 min.
"Batteries Not Included."
(C6) (MAX) MOVIE--Documentary; 85 min. (34089)
"Sign o'the Times."
(C14) (NIK) MR WIZARD'S WORLD (CC)-Science (7145)
(C17) (PT) NHL HOCKEY (37961)
Los Angeles Kings at Boston Bruins, aired on a 90-minute tape delay.
(C10) (TMC) MOVIE--Comedy; 1hr., 35 min.
"Back Roads." (11828777)
(C7) (USA) SHE-RA:PRINCESS OF POWER (3401)
--Cartoon

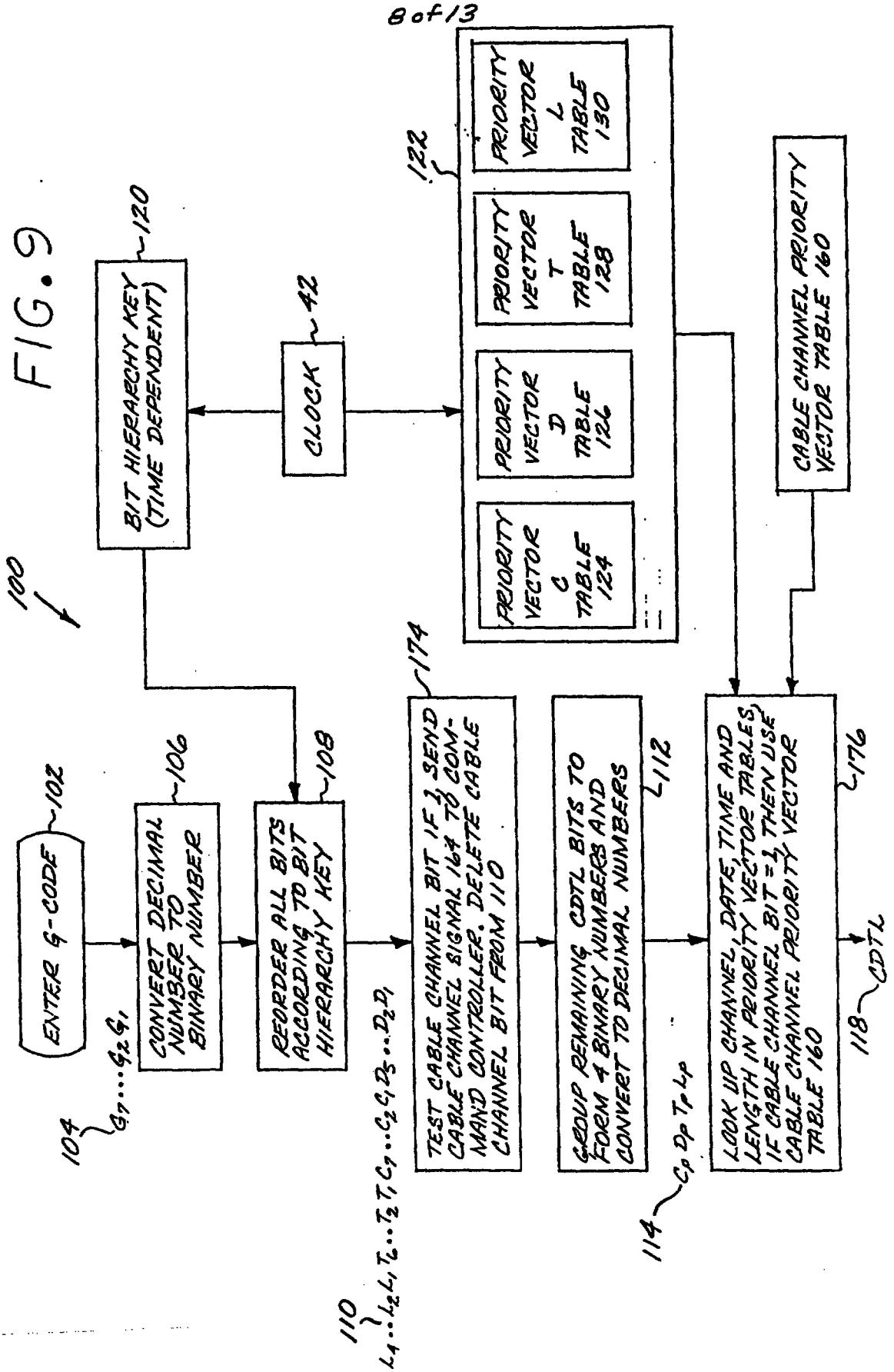
(C19) (WOR) UNTOUCHABLES--Drama BW; 60 min. (5385)
6:30 (11) FAMILY TIES (CC)--Comedy [15657] 206
Mallory's reunion with her college boy friend (John Dukakis) has her worried that she may not be as interesting to him as she once was.
(13) GIMME A BREAK-Comedy [15593]
Nell (Nell Carter) receivesan inheritance and insists on sharing it with everyone-that is, until the check bounces. Addy: Thelma Hopkins
(24) FALL AND RISE OF REGINALD PERRIN --Comedy [19401]
Something is lacking in the dinner party Reggie has for his boss-specifically, the food.
(28) Mac NEIL, LEHRER NEWSHOUR: [78729]
(34) NOTICIERO UNIVISION-Ramos/Salinas [77001]
(50) BUONGIORNA ITALIA!-Instruction [507145]
(52) NOTICIERO TELEMUNDO/CNN [510729]
--Salazar/Gestoso
(56) HOGAN'S HEROES-Comedy [510857]
Carters masquerade as a traitor may be kaput: a lovely Fraulein is trying to poison him. 188
(C14) (NIK) DOUBLE DARE-Game (29225)
(C11) (TNN) VIDEOCOUNTRY (29129) 212
(C7) (USA) CARTOON EXPRESS (23561)
7PM (5) CHARLES IN CHARGE (CC) - Comedy [1065]
While planning a pizza-palor party, Charles allenates the Powell children by dismissing their suggestions about organizing the event.
(6) FAMILY TIES (CC)-Comedy [1225]
The family's cousin June (Danielle Von Zerneck) stops by to tell them about her trip to Europe-but instead reminisces about the past visits with the Keatons. Alex: Micheal J. Fox.
(7) (3) ABC NEWS (CC) [1001] [1129]
(9) LOVE CONNECTION-Game [4841]
(11) M*A*S*H [1257]

FIG. 8

200

7 of 13

FIG. 9



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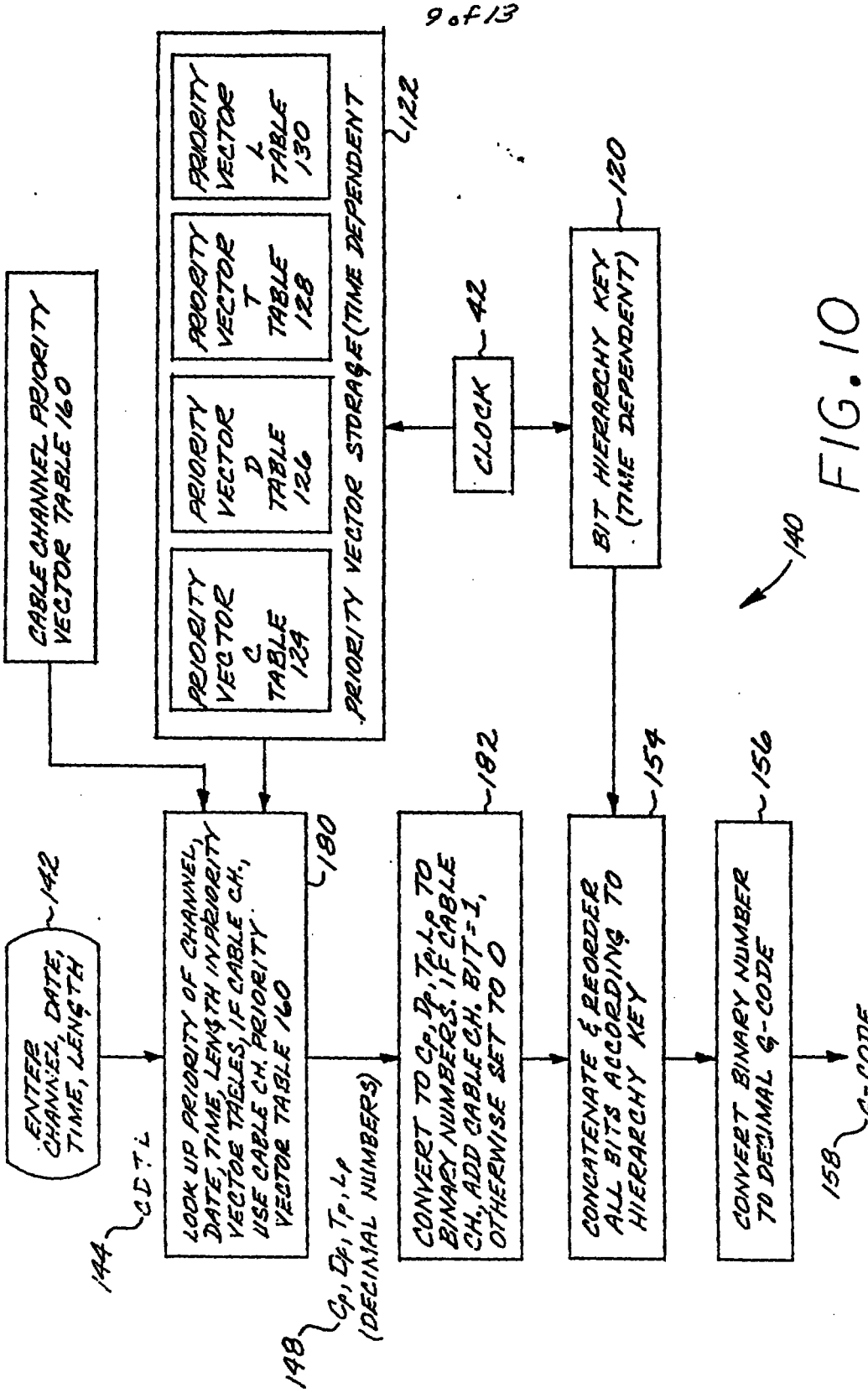


FIG. 10

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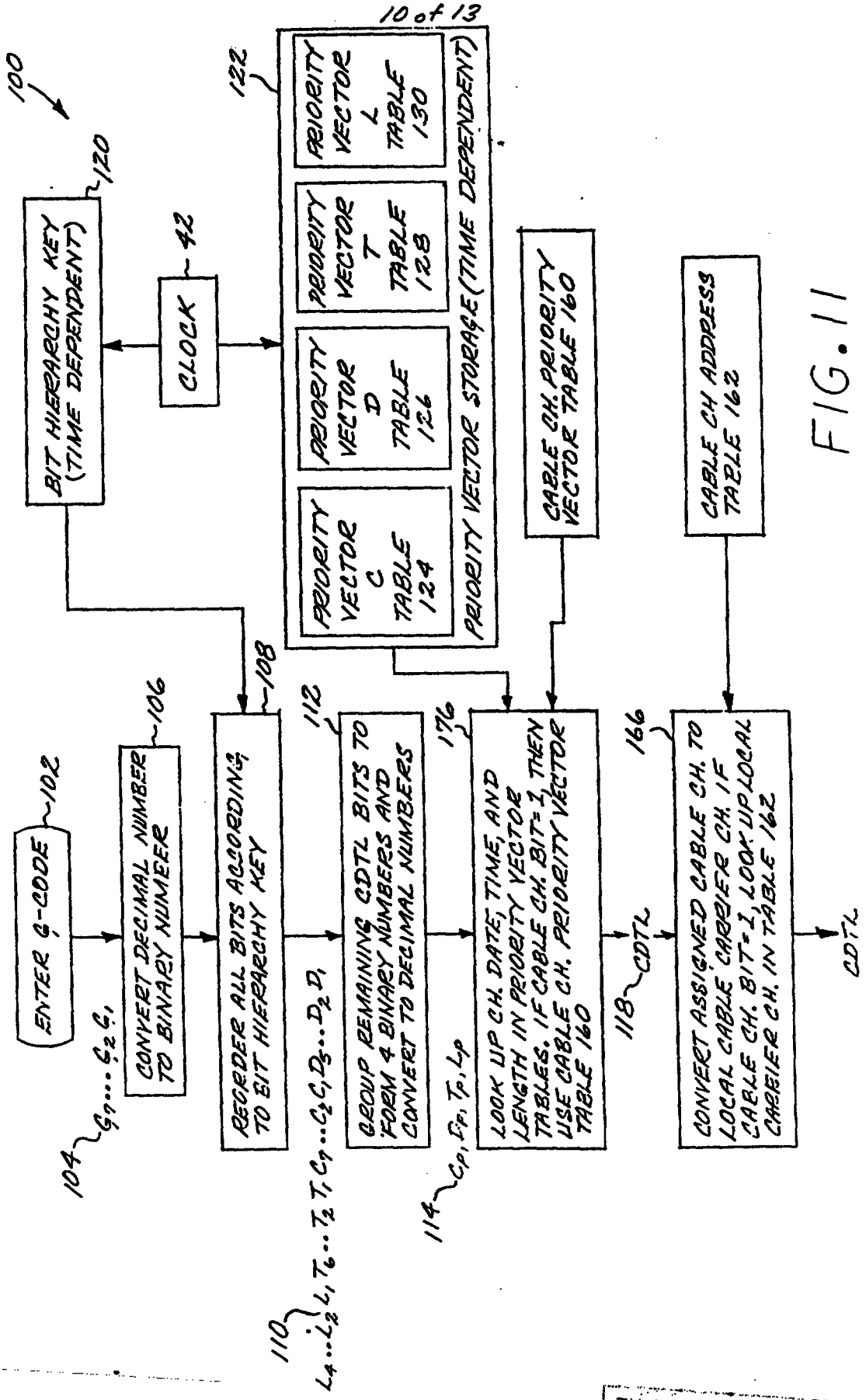


FIG. 11

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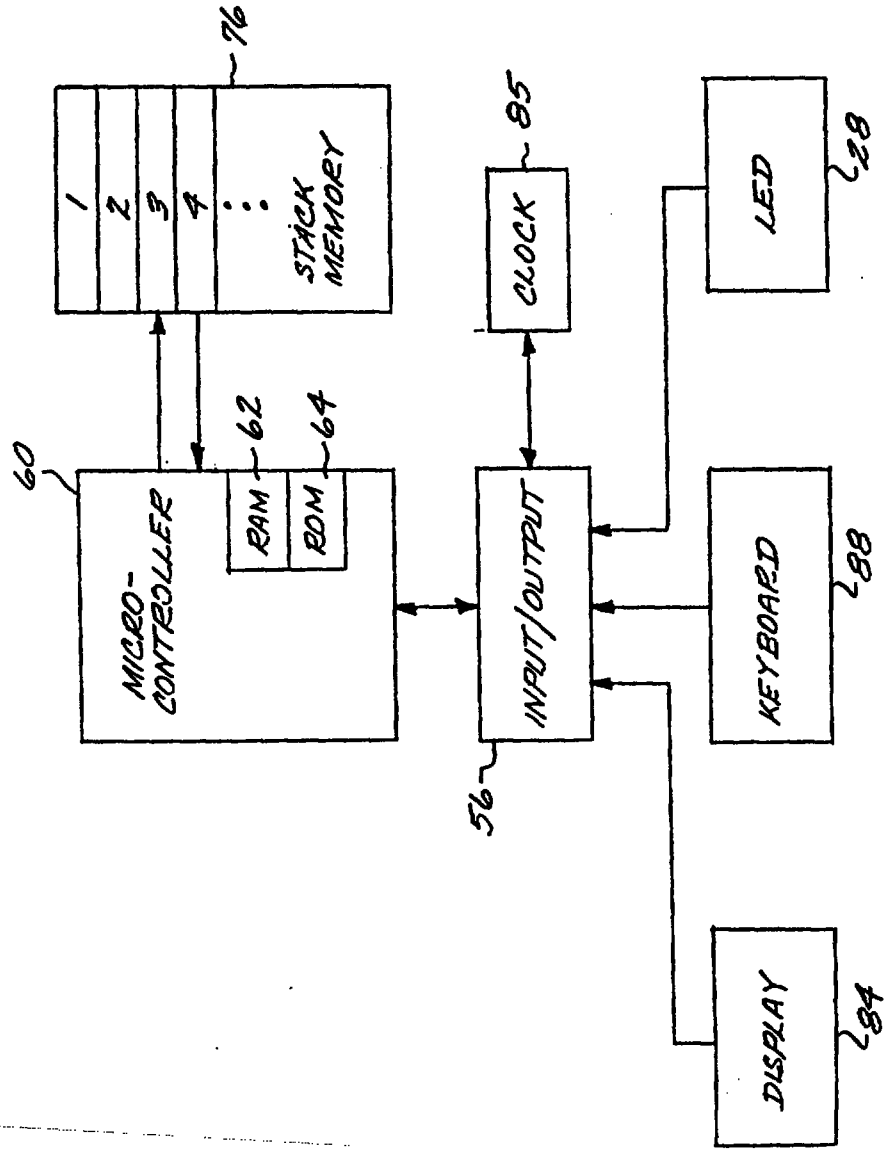


FIG. 12

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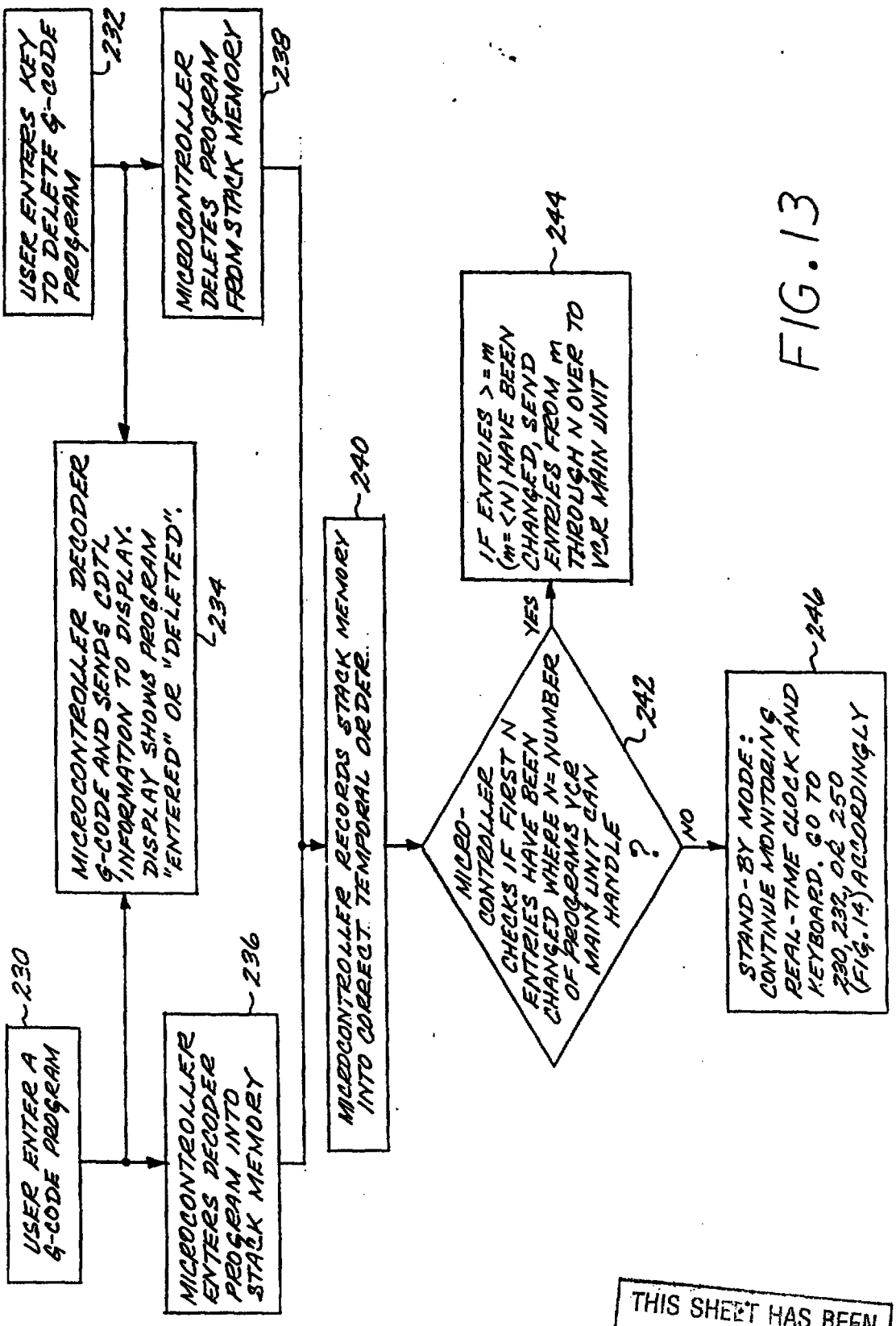


FIG. 13

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APPARATUS AND METHOD FOR USING ENCODED VIDEO RECORDER/PLAYER TIMER PREPROGRAMMING INFORMATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to video cassette recorder systems and particularly to the timer preprogramming feature of video cassette recorders (VCRs) and to an apparatus and method for using encoded information to shorten the time required to perform timer preprogramming.

2. Prior Art

The video cassette recorder (VCR) has a number of uses, including playing back of tapes filmed by a video camera, playing back of pre-recorded tapes, and recording and playing back of broadcast and cable television programs.

To record a television program in advance of viewing it, a two-step process is often used: (1) obtain the correct channel, date, time and length (CDTL) information from a television program guide, and (2) program this CDTL information into the VCR. Depending on the model, year and type of the VCR, the CDTL information can be programmed in various ways including: (i)

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pushing an appropriate sequence of keys in the console according to instructions contained in the user's manual, (ii) pushing an appropriate sequence of keys in a remote hand-held control unit according to instructions contained in the user's manual (remote programming), and (iii) executing a series of keystrokes in the remote hand-held control unit in response to a menu displayed on the television screen (on-screen programming). Other techniques for timer preprogramming have been suggested including: (iv) reading in certain bar-code information using a light pen (light pen programming), and (v) entering instructions through a computer or telephone modem. These various methods differ only in the physical means of specifying the information while the contents, being CDTL and certain power/clock/timer on-off commands are generally common although the detailed protocol can vary with different model VCRs. Methods (i) and (ii) described above can require up to 100 keystrokes, which has inhibited the free use of the timer preprogramming feature of VCRs. To alleviate this, new VCR models have included an "On-Screen Programming" feature, which permits remote input of CDTL information in response to a menu displayed on the television screen. Generally on screen programming of CDTL information requires an average of about 18 keystrokes, which is less than some of the prior methods but still rather substantial. Some of the other techniques such as (iv) above, require the use of special equipment such as a bar code reader.

In general the present state of the art suffers from a number of drawbacks. First, the procedure for setting the VCR to record in advance can be quite complex and confusing and difficult to learn; in fact, because of this many VCR owners shun using the timer preprogramming record feature. Second, the transcription of the CDTL information to the VCR is hardly ever error-free; in fact, many users of VCR's timer preprogramming features express concern over the high incidence of programming

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errors. Third, even for experienced users, the process of entering a lengthy sequence of information on the channel, date, time and length of desired program can become tedious. Fourth, techniques such as reading in bar-code information or using a computer require special equipment. These drawbacks have created a serious impedance in the use of a VCR as a recording device for television programs. The effect is that time shifting of programs has not become as popular as it once was thought it would be. Accordingly, there is a need in the art for a simpler system for effecting VCR timer preprogramming which will enable a user to take advantage of the recording feature of a VCR more fully and freely.

SUMMARY OF THE INVENTION

A principal object of the invention is to provide an improved system for the selection and entering of channel, date, time and length (CDTL) information by a user required for timer preprogramming of a VCR which is substantially simpler, faster and less error-prone than present techniques.

In accordance with the invention, to program the timer preprogramming feature of a video system, there is an apparatus and method for using encoded video recorder/player timer preprogramming information. The purpose is to significantly reduce the number of keystrokes required to set up the timer preprogramming feature on a VCR. In accordance with this invention it is only necessary for the user to enter a code with 1 to 7 digits or more into the VCR. This can be done either remotely or locally at the VCR. Built into either the remote controller or the VCR is a decoding means which automatically converts the code into the proper CDTL programming information and activates the VCR to record a given television program with

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the corresponding channel, date, time and length. Generally multiple codes can be entered at one time for multiple program selections. The code can be printed in a television program guide in advance and selected for use with a VCR or remote controller with the decoding means.

Other objects and many of the attendant features of this invention will be more readily appreciated as the same becomes better understood by reference to the following detailed descriptions and considered in connection with the accompanying drawings in which like reference symbols designate like parts throughout the figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic showing apparatus according to this invention with the code decoder means embedded in the video cassette recorder.

FIG. 2 is a schematic of the VCR embedded processors for command control and code decoding.

FIG. 3 is a schematic showing apparatus according to this invention with the code decoder means embedded in a remote controller.

FIG. 4 is a schematic of the processor embedded in the remote controller.

FIG. 5 is a schematic of a universal remote controller with the code decoder means embedded in the universal remote controller.

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FIG. 6 is a flow graph of the G-code decoding technique.

FIG. 7 is a flow graph of the G-code encoding technique.

FIG. 8 is an illustration of part of a television calendar according to this invention.

FIG. 9 is a flowchart for decoding for cable channels.

FIG. 10 is a flowchart for encoding for cable channels.

FIG. 11. is a flow graph of the G-code decoding for cable channels including conversion from assigned cable channel number to local cable carrier channel number.

FIG. 12 is a means for decoding including a stack memory.

FIG. 13 is a flowchart for program entry into stack memory.

FIG. 14 is a operation flowchart for sending programs from remote control to main unit VCR.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and more particularly, to FIG. 1, there is shown an apparatus for using encoded video recorder/player timer preprogramming information 10 according to this invention. The primary components include a remote controller 12 and a video cassette recorder/player with G-code decoder 14, which can be controlled by remote controller 12 via a command signal 16. The remote controller 12 can have a number of keys, which include numerical keys 20, G-code switch 22, function keys 24, program key 26 and power key 27. There are means in the

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remote controller 12 that interpret each key as it is pressed and send the proper command signal 16 to the VCR via an infra-red light emitting diode 28. Except for the G-code switch 22 on the remote controller 12 in FIG. 1, the remote controller 12 is essentially the same as any other remote controller in function. The G-code switch 22 is provided just to allow the user to lock the remote controller 12 in the G-code mode while using a G-code, which is the name given to the compressed code which is the encoded CDTL information, to perform timer preprogramming.

A G-code consists of 1 to 7 digits, although more could be used, and is associated with a particular program. A user would lookup the G-code in a program guide and just enter the G-code on the remote controller 12, instead of the present state of the art, which requires that the user enter the actual channel, date, time and length (CDTL) commands.

In order to understand the advantages of using a G-code, it is helpful to describe the best of the current state of the art, which is "on screen programming" with direct numerial entry. This technique involves about 18 keystrokes and the user has to keep switching his view back and forth between the TV screen and the remote controller while entering the CDTL information. This situation may be akin to a user having to dial an 18 digit telephone number while reading it from a phone book. The number of keys involved and the switching back and forth of the eye tend to induce errors. A typical keying sequence for timer recording using on-screen CDTL programming is as follows:

PROG 2 1 15 07 30 2 08 00 2 04 PROG

The first program (PROG) key 26 enters the programming mode. Then a sequence of numericals key 20 are pushed. The 2 means it is timer recording rather than time setting. The 1 means the

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user is now entering the settings for program 1. The 15 is the date. The 07 is starting hour. The 30 is a starting minute. The 2 means pm. The next sequence 08 00 2 is the stopping time. The 04 is channel number. Finally, the PROG is hit again to exit the program mode.

By contrast, this command could have been "coded" and entered in a typical G-code sequence as follows: PROG 1138 PROG. To distinquish that the command is a coded G-code, the G-code switch 22 should be turned to the "ON" position. Instead of having a switch, a separate key "G" can be used. The G-code programming keystroke sequence would then be: G 1138 PROG.

The use of a G-code does not preclude "on-screen" confirmation of the program information that has been entered. When the keystrokes "PROG 1138 PROG" are entered with the G-code switch in the "ON" position, the G-code would be decoded and the television could display the following message:

PROGRAM	DATE	START TIME	STOP TIME	CHANNEL
1138	15	7:30 PM	8:00 PM	4

In order for the G-code to be useful it must be decoded and apparatus for that purpose must be provided. Referring to FIG. 1, a video cassette recorder/player with G-code decoder 14 is provided to be used in conjunction with remote controller 12. The command signal 16 sent from the remote controller 12 is sensed by the photodiode 32 and converted to electrical signals by command signal receiver 30. The electrical signals are sent to a command controller 36, which interprets the commands and determines how to respond to the commands. As shown in FIG. 1, it is also possible for the command controller 36 to receive commands from the manual controls 34 that are normally built into

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a VCR. Other possible command sources include voice if a speech recognizer is incorporated into the VCR and a bar code scanner. If the command controller 36 determines that a G-code was received then the G-code will be sent to the G-code decoder 38 for decoding. The G-code decoder 38 converts the G-code into CDTL information, which is used by the command controller 36 to set the time/channel programming 40. Built into the VCR is a clock 42. This is normally provided in a VCR and is used to keep track of the date and time. The clock 42 is used primarily by the time/channel programming 40 and the G-code decoder 38 functions. The time/channel programming 40 function is set up with CDTL information by the command controller 36. When the proper date and time is read from clock 42, then the time/channel programming 40 function turns the record/playback 44 function on to record. At the same time the tuner 46 is tuned to the proper channel in the television signal 18.

An alternate way to control the recorder is to have the command controller 36 keep all the CDTL information instead of sending it to the time/channel programming 40. The command controller would also keep track of the time by periodically reading clock 42. The command controller would then send commands to the time/channel programming 40 to turn on and off the recorder and to tuner 46 to cause it to tune to the right channel at the right time according to the CDTL information.

The clock 42 is also an input to G-code decoder 38, which allows the G-code decoding to be a function of the clock, which lends a measure of security to the decoding technique and makes it harder to copy. Of course this requires that the encoding technique must also be a function of the clock.

A possible realization of the command controller 36 and the G-code decoder 38 is shown in FIG. 2. The command controller 36

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function can be realized with a microprocessor 50, a random access memory 52 and a read only memory 54, which is used for program storage. The input/output 56 function is adapted to receive commands from the command signal receiver 30, the manual controls 34 and the clock 42, and to output signals to a display 35, the clock 42, and the time/channel programming 40 function. If the microprocessor 50 interprets that a G-code has been received, then the G-code is sent to microcontroller 60 for decoding. The microcontroller 60 has an embedded random access memory 62 and an embedded read only memory 64 for program and table storage. The clock 42 can be read by both microprocessor 50 and microcontroller 60.

An alternative to having microcontroller 60 perform the G-code decoding is to build the G-code decoding directly into the program stored in read only memory 54. This would eliminate the need for microcontroller 60. Of course, other hardware to perform the G-code decoding can also be used. The choice of which implementation to use is primarily an economic one.

The blocks in Figs. 1 and 2 are well known in the prior art and are present in the following patents: Fields, patent no. 4,481,412; Scholz, patent no. 4,519,003; and Brugliera, patent no. 4,631,601. For example, clock 42 is analogous to element 7 in Scholz and element 17 in Brugliera. Other analogous elements are: command signal receiver 30 and Scholz 14 and Brugliera 12; tuner 46 and Scholz 6 and Brugliera 10; time/channel programming 40 and Scholz 8, 11 and Brugliera 16; record & playback 44 and Scholz 1, 2, 4; command controller 36 and Scholz 11, 10 and Brugliera 12; microprocessor 50 and Fields 27; RAM 62 and Fields 34; ROM 54 and Fields 33; manual controls 34 and Scholz 15, 16; and remote controller 12 and Scholz 26 and Brugliera 18.

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FIG. 3 illustrates an alternate preferred embodiment of this invention. In FIG. 3 a remote controller with embedded G-code decoder 80 is provided. The remote controller with embedded G-code decoder 80 is very similar to remote controller 12, except for the addition of the G-code decoder 82. Note that it is also possible in any remote controller to provide a display 84. The remote controller with embedded G-code decoder 80 would be used in conjunction with a normal video cassette recorder/player 70, which would not be required to have an embedded G-code decoder. The numerals for the subelements of video cassette recorder/player 70 are the same as described above for the video cassette recorder/player with G-code decoder 14 and have the same function, except for the absence of G-code decoder 38. This preferred embodiment has the advantage that it can be used in conjunction with VCRs that are presently being used. These do not have a G-code decoding capability. Replacing their remote controllers with ones that have this capability built-in can vastly improve the capability to do timer preprogramming for a modest cost.

FIG. 4 illustrates a possible realization of the G-code decoder 82 built into the remote controller with embedded G-code decoder 80. A microprocessor 60 can be used as before to decode the G-code, as well as interface with the display 84, a clock 85, the keypad 88 and the light emitting diode 28. Alternately, other hardware implementations can be used to perform the G-code decoding. The clock is provided in the remote controller 80 so that the G-code decoder 82 can be made to have the clock as one of its inputs. This allows the G-code decoding to be a function of the clock, which lends a measure of security to the decoding technique and makes it harder to copy.

The remote controller with embedded G-code decoder as described above would send channel, date, time and length

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information to the video cassette recorder/player 70, which would use the CDTL information for tuning into the correct channel and starting and stopping the recording function. The remote controller may have to be unique for each different video cassette recorder/player, because each brand or model may have different infrared pulses for each type of information sent such as the channel number keys and start record and stop record keys. The particular infrared pulses used for each key type can be called the vocabulary of the particular remote controller. Each model may also have a different protocol or order of keys that need to be pushed to accomplish a function such as timer preprogramming. The protocol or order of keys to accomplish a function can be called sentence structure. If there is a unique remote controller built for each model type, then the proper vocabulary and sentence structure can be built directly into the remote controller.

An alternate to having the remote controller with embedded G-code decoder send channel, date, time and length information to the video cassette recorder/player 70, is to have the remote controller with embedded G-code decoder perform more operations to simplify the interfacing problem with existing video cassette recorder/players. In particular, if the remote controller not only performs the G-code decoding to CDTL, but also keeps track of time via clock 85, then it is possible for the remote controller to send just channel, start record and stop commands to the video cassette recorder/player. These are usually basic one key commands, which means there is no complicated protocol or sentence structure involved. Thus, to communicate with a diverse set of video cassette recorder/player models it is only necessary to have memory within the remote controller, such as ROM 64 of FIG. 4, for storing the vocabulary for all the models or at least a large subset. The G-code would be entered on the remote controller as before and decoded into channel, date, time and

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length information, which would be stored in the remote controller. Via clock 85, the time would be checked and when the correct time arrives the remote controller would automatically send out commands to the VCR unit for tuning to the correct channel and for starting and stopping the recording. It is estimated that only two (2) bytes per key for about 15 keys need to be stored for the vocabulary for each video cassette recorder/player model. Thus, to cover 50 models would only require about 30*50 = 1500 bytes of memory in the remote controller. It would be necessary to position the remote controller properly with respect to the VCR unit so that the sent infrared signals sent by the remote controller are received by the unit.

Another preferred embodiment is to provide a universal remote controller 90 with an embedded G-code decoder. Universal remote controllers provide the capability to mimic a number of different remote controllers. This reduces the number of remote controllers that a user needs to have. This is accomplished by having a learn function key 94 function on the universal remote controller, as shown in FIG. 5. If the learn function key 94 is pushed in conjunction with another key, the unit will enter into the learn mode. Incoming infra-red (IR) pulses from the remote controller to be learned are detected by the infra-red photodiode 96, filtered and wave-shaped into recognizable bit patterns before being recorded by a microcontroller into a battery-backed static RAM as the particular IR pulse pattern for that particular key. This is done for all the individual keys.

An example of more complex learning is the following. If the learn function key 94 in conjunction with the program key 26 are pushed when the G-code switch is "ON", the unit will recognize that it is about to record the keying sequence of a predetermined specific example of timer preprogramming of the

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particular VCR involved. The user will then enter the keying sequence from which the universal remote controller 90 can then deduce and record the protocol of the timer preprogramming sequence. This is necessary because different VCRs may have different timer preprogramming command formats.

If keys are pushed without the learn function key 94 involved, the microcontroller should recognize it is now in the execute mode. If the key is one of the direct command keys, the microcontroller will read back from its static RAM the stored pulse sequence and send out command words through the output parallel I/O to pulse the output light emitting diode 28. If the key is the PROG key and the G-code switch is "OFF", then the microcontroller should recognize the following keys up to the next PROG key as a timer preprogramming CDTL command and send it out through the light emitting diode 28. If the G-code switch 22 is set to "ON" and the program key 26 is pushed, the microcontroller should recognize the following keys up to the next PROG key as a G-code command for timer preprogramming. It will decode the G-code into channel, date, start time and length (CDTL) and the microcontroller will then look up in it's static RAM "dictionary" the associated infra-red pulse patterns and concatenate them together before sending them off through the output parallel I/O to pulse the light emitting diode 28 to send the whole message in one continuous stream to the VCR.

FIG. 4 illustrates a possible realization of the G-code decoder 92 that could be built into the universal remote controller with embedded G-code decoder 90. A microcontroller 60 can be used as before to decode the G-code, as well as for interfacing with the input/output functions including the photodiode 96. Alternately, the G-code decoding can be performed with other hardware implementations.

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The universal remote controller can also be used in another manner to simplify the interfacing problem with existing video cassette recorder/players. In particular, if the universal remote controller performs not only the G-code decoding to CDTL, but also keeps track of time via clock 85 in FIG. 4, then it is possible for the universal remote controller to send just channel, start record and stop commands to the video cassette recorder/player, which as explained before, are usually basic one key commands, which means there is no complicated protocol or sentence structure involved. Thus, to communicate with a diverse set of video cassette recorder/player models it is only necessary for the universal remote controller to "learn" each key of the remote controller it is replacing. The G-code would be entered on the universal remote controller as before and decoded into channel, date, time and length information, which would be stored in the universal remote controller. Via clock 85, the time would be checked and when the correct time arrives the universal remote controller would automatically send out commands to the VCR unit for tuning to the correct channel and for starting and stopping the recording. It would be necessary to position the universal remote controller properly with respect to the VCR unit so that the signals sent by the universal remote are received by the VCR unit.

There are a number of ways that the G-code decoding can be performed. The most obvious way is to just have a large look up table. The G-code would be the index. Unfortunately, this would be very inefficient and result in a very expensive decoder due to the memory involved. The total storage involved is a function of the number of total combinations. If we allow for 128 channels, 31 days in a month, 48 on the hour and on the half hour start times in a twenty four hour day, and 16 length selections in half hour increments, then the total number of combinations is 128x31x48x16 = 3,047,424. This number of combinations can be

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represented by a 7 digit number. The address to the table would be the 7 digit number. In the worse case, this requires a lookup table that has about 4,000,000 rows by 15 to 16 digital columns, depending on the particular protocol. These digital columns would correspond to the CDTL information required for "on screen programming". Each digit could be represented by a 4 bit binary number. Thus, the total storage number of bits required for the lookup table would be about 4,000,000x16x4 = 256,000,000. The present state of the art has about 1 million bits per chip. Thus, G-code decoding using a straightforward table lookup would require a prohibitively expensive number of chips.

Fortunately, there are much more clever ways of performing the G-code decoding. FIG. 6 is a flow diagram of the preferred G-code decoding technique. To understand G-code decoding, it is easiest to first explain the G-code encoding technique, for which FIG. 7 is the flow chart. Then the G-code decoding technique, which is the reverse of the G-code encoding will be explained.

The encoding of the G-codes can be done on any computer and is done prior to preparation of any program guide that would include G-codes. For each program that will be printed in the guide, a channel, date, time and length (CDTL) code 144 is entered in step 142. Step 146 separately reads the priority for the channel, date, time and length in the priority vector storage 122, which can be stored in read only memory 64. The priority vector storage 122 contains four tables: a priority vector C table 124, a priority vector D table 126, a priority vector T table 128 and a priority vector L table 130.

The channel priority table is ordered so that the most frequently used channels have a low priority number. An example of the data that is in priority vector C table 124 follows.

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channel	4	7	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

Generally the dates of a month all have an equal priority, so the low number days in a month and the low number priorities would correspond in the priority vector D table as in the following example.

date	1	2	3	4	5	6	7	8	9	10 ..
priority	0	1	2	3	4	5	6	7	8	9 ..

The priority of the start times would be arranged so that prime time would have a low priority number and programs in the dead of the night would have a high priority number. For example, the priority vector T table would contain:

time	6:30pm	7:00pm	8:00pm	7:30pm	...
priority	0	1	2	3	...

An example of the data that is in the priority vector L table 130 is the following:

length of program (hours)	0.5	1.0	2.0	1.5	3.0	...
priority	0	1	2	3	4	...

Suppose the channel date time length (CDTL) 144 data is 5 10 19.00 1.5, which means channel 5, 10th day of the month, 7:00 PM, and 1.5 hours in length, then the C_p, D_p, T_p, L_p data 148 for the above example would be 4 9 1 3. Step 150 converts C_p, D_p, T_p, L_p data to binary numbers. The number of binary bits in each conversion is determined by the number of combinations involved. Seven bits for C_p, which can be denoted as C_7 C_6 C_5 C_4 C_3 C_2 C_1, would provide for 128 channels. Five bits for D_p, which can be denoted as D_5 D_4 D_3 D_2 D_1, would provide for 31 days in a month.

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Six bits for T_p, which can be denoted as T_6 T_5 T_4 T_3 T_2 T_1, would provide for 48 start times on each half hour of a twenty four hour day. Four bits for length, which can be denoted as L_4 L_3 L_2 L_1, would provide for a program length of up to 8 hours in half hour steps. Together there are 7+5+6+4 = 22 bits of information, which correspond to 2**22 = 4,194,304 combinations.

The next step is to use bit hierarchy key 120, which can be stored in read only memory 64 to reorder the 22 bits. The bit hierarchy key 120 can be any ordering of the 22 bits. For example, the bit hierarchy key might be:

L_8	C_3	...	T_2	C_2	T_1	C_1	L_1	D_5	D_4	D_3	D_2	D_1
22	21	...	10	9	8	7	6	5	4	3	2	1

Ideally the bit hierarchy key is ordered so that programs most likely to be the subject of timer preprogramming would have a low value binary number, which would eliminate keystrokes for timer preprogramming the most popular programs. Since all the date information has equal priority, then the D_5 D_4 D_3 D_2 D_1 bits are first. Next T_1 C_1 L_1 are used, because for whatever date it is necessary to have a time channel and length and T_1 C_1 L_1 are the most probable in each case due to the ordering of the priority vectors in priority vector storage 122. The next bit in the hierarchy key is determined by the differential probabilities of the various combinations. One must know the probabilities of all the channels, times and lengths for this calculation to be performed.

For example, the probability for channels may be:

channel	4	7	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

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probability(%)	5	4.3	4	3	2.9	2.1	2	1.8 ...

The probabilities for times might be:

time	6:30pm	7:00pm	8:00pm	7:30pm	...
priority	0	1	2	3	...
probability(%)	8	7.8	6	5	...

And, the probabilities for lengths might be:

length of program (hours)	0.5	1.0	2.0	1.5	3.0	...
priority	0	1	2	3	4	...
probability(%)	50	20	15	5	4	...

The probabilities associated with each channel, time and length, as illustrated above, are used to determine the proper ordering. Since the priority vector tables are already ordered by the most popular channel, time, and length, the order in which to select between the various binary bits for one table, for example selecting between the C_7 C_6 C_5 C_4 C_3 C_2 C_1 bits, is already known. The C_1 bit would be selected first because as the lowest order binary bit it would select between the first two entries in the channel priority table. Then the C_2 bit would be selected and so on. Similarly, the T_1 and L_1 bits would be used before any of the other time and length bits. A combination of the C_1, T_1, L_1 and D_5 D_4 D_3 D_2 D_1 bits should be used first, so that all the information is available for a channel, date, time and length. The D_5 D_4 D_3 D_2 D_1 bits are all used because the date bits all have equal priority and all are needed to specify a date even if some of the bits are binary zero.

At this point the bit hierarchy key could be:

$$T_1\ C_1\ L_1\ D_5\ D_4\ D_3\ D_2\ D_1$$

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The first channel binary bit C_1 by itself can only select between $2^1 = 2$ channels, and the first two channels have a probability percent of 5 and 4.3, respectively. So the differential probability of C1 is 9.3. Similarly, the differential probability of T_1 is 8 + 7.8 = 15.8, and the differential probability of L_1 is 50 + 20 = 70. If the rules for ordering the bit hierarchy key are strictly followed, then the first 8 bits of the bit hierarchy key should be ordered as:

$$C_1\ T_1\ L_1\ D_5\ D_4\ D_3\ D_2\ D_1,$$

because L_1 has the highest differential priority so it should be first, followed by T_1, and then C_1.

The question at that point is what should the next bit in the hierarchy key be: T_2, C_2, or L_2. This is determined by the differential probabilities, which can be calculated from the above tables for each bit. Since we are dealing with binary bits, the C_2 in combination with C_1 selects between $2^2 = 4$ channels or 2 more channels over C_1 alone. The differential probability for C_2 is then the additional probabilities of these two additional channels and for the example this is: 4 + 3 = 7. In a similar manner C_3 in combination with C_1 and C_2 selects between $2^3 = 8$ channels or $4 = 2^{(3-1)}$ more channels over the combination of C_1 and C_2. So the differential probability of C_3 is the additional probabilities of these four additional channels and for the example this is: 2.9 + 2.1 + 2 + 1.8 = 8.8. In a similar manner, the differential probabilities of T_2 and L_2 can be calculated to be 6 + 5 = 11 and 15 + 5 = 20, respectively. Once all the differential probabilities are calculated, the next step is determining which combinations of bits are more probable.

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Now for the above example, which combination is more probable: T_2 with C_1 L_1, or C_2 with T_1 L_1, or L_2 with T_1 C_1. This will determine the next bit in the key. So, which is greater: 11x9.3x70= 7161; 7x15.8x70= 7742; or 20x15.8x9.3= 2938.8? In this case the combination with the greatest probability is 7x15.8x70= 7742, which corresponds to C_2 with T_1 L_1. So, C_2 is selected as the next bit in the bit hierarchy key.

The next bit is selected in the same way. Which combination is more probable: C_3 with T_1 L_1, or T_2 with C_1 or C_2 and L_1, or L_2 with C_1 or C_2 and T_1. For the example shown, which has the greatest probability: 8.8x15.8x70= 9732.8; 11x(9.3+7)x70= 12551; or 20x(9.3+7)x15.8= 5150.8? In this case the combination with the greatest probability is 11x(9.3+7)x70= 12551, which corresponds T_2 with C_1 or C_2 and L_1. So, T_2 is selected as the next bit in the bit hierarchy key. This procedure is repeated for all the differential probabilities until the entire key is found.

Alternately, the bit hierarchy key can be just some arbitrary sequence of the bits. It is also possible to make the priority vectors interdependent, such as making the length priority vector dependent on different groups of channels. Another technique is to make the bit hierarchy key 120 and the priority vector tables 122, a function of clock 42, as shown in FIG. 7. This makes it very difficult for the key and therefore the coding technique to be duplicated or copied.

For example it is possible to scramble the date bits in the bit hierarchy key 120 as a function of the clock. This would not change the effectiveness of the bit hierarchy key in reducing the number of binary bits for the most popular programs, because the date bits all are of equal priority. This could be as simple as

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switching the D_1 and D_5 bits periodically, such as every day or week. Thus the bit hierarchy key 120 would switch between

... C_1 T_1 L_1 D_5 D_4 D_3 D_2 D_1 and

... C_1 T_1 L_1 D_1 D_4 D_3 D_2 D_5.

Clearly other permutations of the bit hierarchy key as a function of the clock are possible.

The priority vector tables could also be scrambled as a function of the clock. For example, the first two channels in the priority channel table could just be swapped periodically. If this technique is followed, then the C_p of 148 in FIG. 7 would change as a function of the clock 42. For example,

channel	4	7	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

would change periodically to:

channel	7	4	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

This would be a fairly subtle security technique, because a decoder that was otherwise correct would only fail if those first two channels were being used. Other clock dependencies are also possible to provide security for the coding technique.

However it is derived, the bit hierarchy key 120 is determined and stored. In step 154 the binary bits of C_p,D_p,T_p,L_p are rearranged according to the bit hierarchy key 120 to create one 22 bit binary number. Then the resulting 22 bit

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binary number is converted to decimal in the convert binary number to decimal G-code step 156. The result is G-code 158.

If the priority vector and the bit hierarchy key are well matched to the viewing habits of the general population, then it is expected that the more popular programs would require no more than 3 or 4 digits for the G-code.

Now that the encoding technique has been explained the decoding technique is just reversing the coding technique. This is done according to the flow chart of FIG. 6. This is the preferred G-code decoding that can be built into G-code decoder 38 in VCR 14 or the remote controller G-code decoders 82 and 92 in FIGs. 3 and 5.

The first step 102 is to enter G-code 104. Next the G-code 104 is converted to a 22 bit binary number in step 106. Then the bits are reordered in step 108 according to the bit hierarchy key 120 to obtain the reordered bits 110. Then the bits are grouped together and converted to decimal form in step 112. As this point we obtain C_p,D_p,T_p,L_p data 114, which are the indices to the priority vector tables. For the above example, we would have at this step the vector 4 9 1 3. This C_p,D_p,T_p,L_p data 114 is then used in step 116 to lookup channel, date, time, and length in priority vector storage 122. The CDTL 118 for the example above is 5 10 19.00 1.5, which means channel 5, 10th day of the month, 7:00 PM, and 1.5 hours in length.

If the coding technique is a function of the clock then it is also necessary to make the decoding technique a function of the clock. It is possible to make the bit hierarchy key 120 and the priority vector tables 122, a function of clock 42, as shown in FIG. 6. This again makes it very difficult for the key and therefore the coding technique to be duplicated or copied. It is

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also possible to have the decoding and encoding techniques dependent on any other predetermined or preprogrammable algorithm.

Although the above G-code encoding and decoding technique is a preferred embodiment, it should be understood that there are many ways to perform the intent of the invention which is to reduce the number of keystrokes required for timer preprogramming. To accomplish this goal there are many ways to perform the G-code encoding and decoding. There are also many ways to make the encoding and decoding technique more secure besides just making the encoding and decoding a function of the clock. This security can be the result of any predetermined or preprogrammed algorithm.

It is possible in the G-code coding and decoding techniques to use mixed radix number systems instead of binary numbers. For example, suppose that there are only 35 channels, which would require 6 binary bits to be represented; however, 6 binary bits can represent 64 channels, because $2^6 = 64$. The result is that in a binary number system there are 29 unnecessary positions. This can have the effect of possibly making a particular G-code longer than it really needs to be. A mixed radix number system can avoid this result. For example, for the case of 35 channels, a mixed radix number system with the factors of 7^1 and 5^0 can represent 35 combinations without any empty space in the code. The allowed numbers for the 7^1 factor are 0, 1, 2, 3, and 4. The allowed numbers for the 5^0 factor are 0, 1, 2, 3, 4, 5, and 6. For example, digital 0 is represented in the mixed radix number system as 00. The digital number 34 is represented in the mixed radix number system as 46, because $4*7^1+6*5^0 = 34$. The major advantage of a mixed radix number system is in prioritizing the hierarchy key. If the first 5 channels have about equal priority and the next 30 are also about equal, then the mixed radix number

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system allows the two tiers to be accurately represented. This is not to say that a mixed radix number system is necessarily preferable. Binary numbers are easier to represent in a computer and use of a fixed radix number system such as binary numbers allows a pyramid of prioritization to be easily represented in the hierarchy key.

Another feature that is desirable in all of the embodiments is the capability to key in the G-code once for a program and then have the resulting CDTL information used daily or weekly. Ordinarily the CDTL information is discarded once it is used. In the case of daily or weekly recording of the same program, the CDTL information is stored and used until it is cancelled. The desire to repeat the program daily or weekly can be performed by having a "WEEKLY" or "DAILY" button on the remote controller or built into the VCR manual controls. Another way is to use one key, such as the PROG key and push it multiple times within a certain period of time such as twice to specify daily or thrice to specify weekly. For example, if the G-code switch is "ON" and the G-code for the desired program is 99 then daily recording of the program can be selected by the following keystrokes:

"PROG 99 DAILY PROG"

or by:

"PROG 99 PROG P ROG".

The G-code 99 would be converted to CDTL information, which would be stored and used daily in this case. The recording would begin on the date specified and continue daily after that using the same channel time and length information. A slight twist is that daily recording could be automatically suspended during the weekends, because most daily programs are different on Saturday and Sunday.

Once a daily or weekly program is set up, then it can be used indefinitely. If it is desired to cancel a program and if

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there is a "CANCEL" button on the remote controller or manual control for the VCR, then one way to cancel a program (whether it is a normal CDTL, daily or weekly entry) is to key in the following:

"PROG xx CANCEL", where xx is the G-code.

Again as before there are alternate ways of accomplishing this.

If "on screen programming" is available, then the programs that have been selected for timer preprogramming could be reviewed on the screen. The daily and weekly programs would have an indication of their type. Also the G-codes could be displayed along with the corresponding CDTL information. This would make it quite easy to review the current "menu" and either add more programs or cancel programs as desired.

A television calendar 200 according to this invention is illustrated in FIG. 8. As shown, the television calendar has multiple day of year sections 202, multiple day sections 204, multiple time of day sections 206, channel indications 208, and descriptive program indications 210 arranged in a manner that is common in television guide publications. Arranged in relation to each channel indication is a compressed code 212 or G-code containing the channel, date, time and length information for that entry in the television calendar. FIG. 8 shows how easy it is to perform timer programming. All one needs to do is find the program one wants to watch and enter the compressed code. This is in contrast to having to deal with all the channel, date, time and length entries separately. At least the channel, date and time are explicitly stated in the television guide. The length is usually only available by searching the guide to find the time of day section 204 where a new program begins and then performing some arithmetic to find the length of the program. Using the compressed G-code avoids all these complications.

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For cable television programs, there is an additional issue that needs to be addressed for the compressed G-code to be useful. In a normal television guide, CDTL information is available for all the normal broadcast channels in the form of numbers including the channel numbers, such as channel 4 or 7. However, for cable channels like HBO, ESPN etc., only the names of the channels are provided in most television listings. The reason for this is that in some metropolitan areas, such as Los Angeles, there may be only one (1) edition of television guide, but there may be quite a few cable carriers, each of which may assign HBO or ESPN to different cable channel numbers. In order for a compressed code such as the G-code to be applicable to the cable channels as published by a wide area television guide publication, the following approach can be used.

First, all the cable channels would be permanently assigned a unique number, which would be valid across the nation. For example, we could assign ESPN to cable channel 1, HBO as cable channel 2, SHO as cable channel 3, etc. This assignment would be published by the television guide publications.

The video cassette recorder apparatus, such as the remote controller, the VCR unit or both, could then be provided with two (2) extra modes: "set" and "cable channel". One way of providing the user interface to these modes would be to provide two (2) extra buttons: one called SET and one called CABLE CHANNEL. The buttons could be located on the video cassette recorder unit itself or located on a remote controller, as shown in FIGs 1, 3 and 5, where SET is element 168 and CABLE CHANNEL is element 170. Of course, other user interfaces are possible.

Next, the television viewer would have to go through a one-time "setting" procedure of his VCR for all the cable channels that he would likely watch. This "setting" procedure would

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relate each of the assigned numbers for each cable channel to the channel number of the local cable carrier. For example, suppose that the local cable carrier uses channel 6 for ESPN, then cable channel number 1 could be assigned to ESPN, as shown in the following table.

Cable Channel Name	Assigned Cable Chan. No.	Channel Number in the local cable carrier
EPSN	1	6
HBO	2	24
SHO	3	23
.	.	.
.	.	.
.	.	.
DIS	8	25

The user could perform the "setting" procedure by pushing the buttons on his remote controller as follows:

SET 06 CABLE CHANNEL 1 PROGRAM
SET 24 CABLE CHANNEL 2 PROGRAM
SET 23 CABLE CHANNEL 3 PROGRAM
SET 25 CABLE CHANNEL 8 PROGRAM

The "setting" procedure would create a cable channel address table 162, which would be loaded into RAM 52 of command controller 36. For the above example, the cable channel address table 162 would have the following information.

CABLE CHANNEL ADDRESS TABLE 162

1	6

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2	24
3	23
.	
.	
.	
8	25

After the "setting" procedure is performed, the TV viewer can now select cable channels for viewing by the old way: eg. pushing the key pad buttons 24 will select HBO. He can also do it the new way: eg. by pushing CABLE CHANNEL 2, which will also select HBO. The advantage of the new way is that the television guide will publish [C2] next to the program description, so the viewer will just look up the assigned channel number instead of having to remember that HBO is local cable channel 24. When the CABLE CHANNEL button is pushed, command controller 36 knows that it will look up the local cable channel number in cable channel address table 162 to tune the VCR to the correct channel.

For timer preprogramming and for using the compressed G-code, a way to differentiate between broadcast and cable channels is to add an eighth channel bit, which would be set to 0 for normal broadcast channels and 1 for cable channels such as HBO. This eighth channel bit could be one of the low order bits such as the third bit C_3 out of the eight channel bits, so that the number of bits to specify popular channels is minimized, whether they be normal broadcast or cable channels. For a normal broadcast channel, the 7 other bits can be decoded according to priority vector C table 124. For a cable channel, the 7 other bits can be decoded according to a separate cable channel priority vector table 160, which could be stored in ROM 54 of microcontroller 36. The cable channel priority vector table can be set ahead of time for the entire country or at least for an

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area covered by a particular wide area television guide publication.

A television guide that carries the compressed code known as the G-code will now print the cable channel information as follows:

6:30 pm
[C2] HBO xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (4679)
xxxxxx(program description)xxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

The [C2] in front of HBO reminds the viewer that he needs only to push CABLE CHANNEL 2 to select HBO. The (4679) is the G-code for this particular program.

FIG. 8 shows a section of a television guide. The cable channels all have an assigned cable channel number 188 after the cable channel mnemonic. Other than that the cable channel information is arranged the same as the broadcast channels with a compressed G-code 212 associated with the channel.

For timer preprogramming, the viewer need only enter the number 4679 according to the unit's G-code entry procedure, eg. PROG 4679 PROG. The G-code decoder unit will decode this G-code into "cable channel 2" and will also signal the command controller 36 with a cable channel signal 164, as shown in FIGs. 1 and 2, because the extra channel bit will be "1" which distinquishes that the G-code is for a cable channel; then, since the association of "cable channel 2" with channel 24 has been established earlier in the "setting" procedure, the command controller, if it has received a cable channel signal, will immediately look up 2 in the cable channel address table 162 to translate it to cable channel 24; which will be used as the

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recording channel at the appropriate time. By associating the G-code with the assigned cable channel number rather than the local cable channel number, the G-code for that program will be valid in the whole local area, which may have many different cable carriers each of which may have different local cable channel numbers.

To include the cable channel compressed G-code feature, the decoding and encoding algorithms are as shown in FIGs 9 and 10, respectively. The encoding should be explained first before the decoding. The primary change in FIG. 10 from FIG. 7 is that a cable channel priority vector table 160 has been added and is used in look up priority step 180 if a cable channel is being encoded. Also if a cable channel is being encoded then the cable channel bit is added in the correct bit position in the convert $C_pD_pT_pL_p$ to binary numbers step 182. This could be bit C_3, as discussed before. The bit hierarchy key could be determined as before to compress the number of bits in the most popular programs; however, it needs to be 23 bits long to accommodate the cable channel bit. The maximum compressed G-code length could still be 7 digits, because 2^{23}= 8,388,608.

The decoding is shown in FIG. 9 and is just the reverse of the encoding process. After step 108, test cable channel bit 174 is added and effectively tests the cable channel bit to determine if it is a "1". If so then the command controller 36 is signaled via cable channel signal 164 of FIGs. 1 and 2 that the CDTL 118 that will be sent to it from G-code decoder 38 is for a cable channel. Then the command controller knows to look up the local cable carrier channel number based on the assigned cable channel number. In step 176 of FIG. 9, the priority vector tables including the cable channel priority vector table 160 are used to look up the CDTL 118 information.

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An alternate to having the command controller receive a cable channel signal 164 is for the G-code decoder to perform all of the decoding including the conversion from assigned cable channel number to local cable carrier number. This would be the case for the remote controller implementation of FIG. 3. FIG. 11 shows the implementation of the entire decode algorithm if this step is included. All that needs to added is convert assigned channel to local cable carrier channel step 166, which performs a lookup in cable channel address table 162, if the cable channel bit indicates that a cable channel is involved. Step 166 effectively replaces step 174 in FIG. 9.

Another issue that needs addressing is the number of programs that can be preprogrammed. Since the G-code greatly simplifies the process of entering programs, it is likely that the user will quickly learn and want to enter a large number of programs; however, some existing VCRs can only store up to four (4) programs, while some can store as many as eight. Thus, the user may get easily frustrated by the programming limitations of the VCR.

One approach to this problem, is to perform the compressed G-code decoding in the remote controller and provide enough memory there to store a large number of programs, eg. 20 or 40. The remote controller would have the capability of transferring periodically several of these stored programs at a time to the VCR main unit. To provide this capability, extra memory called stack memory 76 is required inside the remote unit, as shown in Fig. 12, which other than that is identical to FIG. 4. Stack memory 76 can be implemented with a random access memory, which may in fact reside in the microcontroller itself, such as RAM 62.

The stack memory 76 is where new entry, insertion & deletion of timer preprogramming information is carried out. It is also

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where editing takes place. The top memory locations of the stack, for example the first 4 locations, correspond exactly to the available timer preprogramming memory in the VCR main unit. Whenever the top of the stack memory is changed, the new information will be sent over to the VCR main unit to update it.

FIG. 13 shows the sequence of events when the user enters a G-code program on the keypad of the remote controller. For illustration purposes, suppose the VCR main unit can only handle four (4) programs. Suppose also that the stack memory capacity is 20 timer preprograms. Referring to the flow chart in FIG.13, when the user enters a G-code in step 230, the microcontroller 60 first decodes it into the CDTL information in step 234 and displays it on the display unit with the additional word "entered" also displayed. The microcontroller then enters the decoded program into the stack memory in step 236.

If this is the first program entered, it is placed at the top location of the stack memory. If there are already programs in the stack memory, the newly entered program will first be provisionally placed at the bottom of the stack memory. The stack memory will then be sorted into the correct temporal order in step 240, so that the earliest program in time will appear in the top location and the last program in time will be at the bottom. Notice that the nature of the temporally sorted stack memory is such that if stack memory location n is altered, then all the locations below it will be altered.

For example, suppose the stack memory has six (6) entries already temporally ordered, and a new entry is entered whose temporal ordering places it in location 3 (1 being the top location). If this entry is placed into location 3, information which was in location 3, 4, 5, 6 will be shifted to locations 4, 5, 6, and 7. Locations 1 and 2 will remain unchanged.

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The microcontroller 60, after doing the temporal ordering, checks in step 242 whether the first n entries have changed from before, where for the current example n equals 4. In this case, since a new program has been entered into location 3, what used to be in location 3 now moves to location 4. Since the VCR's main unit program menu of 4 entries should correspond exactly to location 1 through 4 of the stack memory, entries 3 and 4 on the VCR main unit must now be revised. The microcontroller therefore sends out the new entries 3 & 4 to the main unit, in step 244 of FIG. 13. If the newly entered program, after temporal ordering, gets entered into location 5, then entries 1 through 4 have not changed from before and the microcontroller will not send any message to the VCR main unit and the microcontroller will just resume monitoring the clock 85 and the keyboard 88 as per step 246. It is assumed that when the user enters the G-code in step 230, the remote controller is pointed at the VCR main unit. The other steps of FIG. 13 happen so fast that the changes are sent in step 244 while the remote controller is still being pointed at the VCR main unit.

If the user decides to delete a program in step 232, the deletion is first carried out in the stack memory. If the first 4 entries are affected, the microcontroller will send the revised information over to the VCR main unit. If the first 4 entries are not affected, then again the remote controller unit will not send anything. The deletion will only change the lower part of the stack (lower meaning location 5 to 20). This new information will be sent over to the VCR main unit at the appropriate time.

In the meantime, the VCR main unit will be carrying out its timer programming function, completing its timing preprogramming entries one by one. By the time all 4 recording entries have been completed, the stack in the remote must send some new

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entries over to "replenish" the VCR main unit (if the stack has more than 4 entries).

The real time clock 85 in the remote controller unit is monitored by the microcontroller to determine when the programs in the main unit have been used up. Referring to the flow chart in FIG. 14, the microcontroller periodically checks the clock and the times for the programs at the top of the stack in step 250 (say the first 4 entries), which are identical to the VCR's main unit's menu. If on one of the periodic checks, it is determined that the recording of the main unit's menu is complete, then if there are more entries in the stack, which is tested in step 252, the display unit will be set to a blinking mode or display a blinking message in step 258 to alert the user to send more programs. Next time the user picks up the remote unit, the blinking will remind him that the VCR main unit's program menu has been completed and it is time to replenish the VCR main unit with program entries stored in the remote. The user simply picks up the remote and points it towards the VCR main unit and presses "ENTER". This will "pop" the top of the stack memory in step 260, ie. pop all the entries in the stack up by four locations. The microcontroller will then send the new "top of the stack" (ie. top 4 entries) over to the VCR main unit in step 262. This process will repeat until the whole stack has been emptied.

It is thought that the apparatus and method for using encoded video recorder/player timer preprogramming information of the present invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts thereof without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore

described being merely a preferred or exemplary embodiment thereof.

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We Claim:

1. A method of using compressed codes for recorder preprogramming comprising the steps of:

providing a television guide wherein each program description has an associated compressed code representing the channel, date, time and length of the program;

providing a means for entering a compressed code having at least one digit;

providing a means for decoding a compressed code having at least one digit into channel, date, time and length commands;

converting said compressed code into a binary compressed code;

providing a bit hierarchy key that specifies the reordering of said binary compressed code;

reordering all the bits in said compressed code according to said bit hierarchy key to obtain a reordered binary compressed code;

separating said reordered binary compressed code into binary channel, date, time and length priority indices;

providing priority vectors for channel, date, time and length;

using said channel, date, time and length priority indices to lookup channel, date, time and length commands from said priority vectors for channel, date, time and length;

providing a clock means for keeping time;

comparing said date, time and length commands to said clock means;

providing a means for tuning channels;

tuning said means for tuning channels to the channel indicated by the channel in said channel, date, time and length commands when said clock means compares with the date and time of said channel date time and length commands;

providing a means for recording;

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turning ON said means for recording when said clock means compares with the date and time of said date and time commands; and

turning OFF said means for recording when said length of said length command matches time of recording on said clock means.

2. A system for the automatic recording of a television program on a video cassette recorder comprising:

a television calendar visually listing television programs by the date and time of each program and the television channel on which each program is to appear, the calendar having a unique compressed coded indication for each of the programs comprising a set of digits corresponding to the start of the corresponding program and representing the channel of which such program will appear, the date and time such program is to start, and the length of such program; and

a means for automatically controlling recording of television signals by a video cassette recorder comprising means for receiving representations of the digits of the compressed coded indications from the television calendar and for enabling such video cassette recorder to commence recording television signals carrying the program on the channel, on the date, at the time and terminating after the length of time represented by any of said compressed coded indications.

3. The system of claim 2 wherein the means for automatically controlling recording comprises:

an input for receiving the representation of the digits of each of the compressed coded indications;

a decoder for decoding the representation of each of the compressed coded indications into corresponding separate channel, date, time and length commands;

a channel selector for selecting the channel identified in the channel command; and

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an on/off controller for enabling recording by the video recorder of the television program on the selected channel and comprising means operative for turning on the recording commencing at the date and the time specified by the date and time commands and terminating recording after the length of time specified by the length command.

4. A system for automatically controlling recording by a video cassette recorder of a channel of video signals under control of a channel command beginning on the calendar day specified by a day command, at the time-of-day specified by a time-of-day command, and for the length of time specified by a length command, the system comprising:

an input for receiving representations of compressed coded indications, each representative of, and compressed in length from, the combination of one of each said channel command, day command, time-of-day command, and length command; and

a decoder for decoding and expanding any said compressed coded indication to individual channel command, day command, time-of-day command, and length command for control of the video cassette recorder.

5. The system of claim 4 wherein the input and decoder are an integral part of the video cassette recorder.

6. The system of claim 4 comprising a remote transmitter which comprises said input.

7. The system of claim 5 or 6 wherein the video cassette recorder includes control means for interpreting whether said compressed coded indication has been received by the video cassette recorder.

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8. The system of claim 7 wherein said control means comprises a microprocessor.

9. The system of claim 4 comprising a remote hand transmitter which comprises said input and decoder.

10. The system of claim 9 wherein said remote handheld transmitter comprises a universal remote controller capable of learning protocols of different remote controllers with which said universal remote controller interfaces.

11. The system of claim 6 or 9 wherein said input comprises a keyboard entry device.

12. The system of claim 5 or 9 wherein said decoder comprises a microprocessor.

13. The system of claim 4 comprising a clock for providing an output as a function of time and wherein the decoder comprises means for generating said channel, day, time-of-day and length commands as a function of the output of the clock.

14. The system of claim 4 wherein said decoder comprises:

means for converting said compressed coded indication into a compressed code of binary bits;

means for reordering the bits in said compressed code of binary bits to obtain a reordered binary compressed code;

means for grouping said reordered binary compressed code into binary channel, date, time and length priority numbers; and

means for using said binary channel, date, time and length priority numbers to derive said channel, day, time-of-day and length commands.

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15. The system of claim 14 comprising a clock providing an output as a function of time and wherein said means for reordering the bits in said compressed code comprises means for reordering the bits as a function of the output of the clock.

16. The system of claim 14 comprising a clock providing an output as a function of time wherein said means for deriving said channel, day, time-of-day and length commands comprises means for deriving said channel, day, time-of-day and length commands as a function of the output of the clock.

17. The system of claim 4 wherein said decoder comprises:

means for converting said compressed coded indication into a compressed code of mixed radix bits;

means for reordering the bits in said compressed code of mixed radix bits to obtain a reordered mixed radix compressed code;

means for grouping said reordered mixed radix compressed code into mixed radix channel, date, time and length priority numbers; and

means for using said mixed radix channel, date, time and length priority numbers to derive said channel, day, time-of-day and length commands.

18. The system of claim 4 further comprising:

a clock providing an output as a function of time;

means for comparing the day and time-of-day information to the clock output for a predetermined relation;

a channel selector for selecting the channel specified in the channel command after the predetermined relation is found to exist; and

an on/off controller for enabling recording by the video cassette recorder of the video signals on the selected channel

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comprising means operative for turning on the recording after the predetermined relation is found to exist.

19. The system of claim 18 wherein the controller comprises means for utilizing the length command to terminate the recording.

20. The system of claim 4 wherein said decoder comprises:

means for entering encoded data into the decoder;

means for decoding said encoded data to determine channel, date, time and length of the channel of video signals to be recorded; and

means for generating control commands from said encoded data for selection of said channel of video signals for recording and for control of the video cassette recorder to start and stop the recording of the selected channel by the video cassette recorder.

21. In a system for automatically controlling recording of channels of television programs by a video cassette recorder, apparatus for decoding encoded television program information, where the program information comprises channel, date, time and length of the program information, said apparatus comprising:

means for entering the encoded information into the apparatus;

means for decoding said decoded encoded information to determine channel, date, time and length of program to be recorded: and

means for generating control commands from said decoded information for selection of a channel for recording and for control of the video cassette recorder to start and stop the recording of the selected channel by the video cassette recorder.

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22. A method of programming a system for automatically controlling recording by a video cassette recorder of a channel of video signals specified by a channel command beginning at the time-of-day specified by a time-of-day command, on the calendar day specified by a day command and for the length of time specified by a length command, the steps comprising:

receiving compressed coded indications, each representative of the combination of one of each said channel command, day command, time-of-day command, and length command; and

decoding and expanding any said compressed coded indications to individual said channel command, day command, time-of-day command and length command for control of the video cassette controller.

23. The method of claim 22 comprising the step of receiving the compressed coded indication in the video cassette recorder.

24. The method of claim 22 comprising the step of receiving the compressed coded indication in a transmitter remote from the video cassette recorder.

25. The method of claim 23 or 24 wherein the step of receiving comprises the step of interpreting whether said compressed coded indication has been received by the video cassette recorder.

26. The method of claim 25 wherein the step of interpreting is performed by a microprocessor.

27. The method of claim 22 comprising the steps of receiving the compressed coded indication and decoding and expanding the compressed coded indication in a transmitter remote from the video cassette recorder.

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28. The method of claim 22 further comprising the step of using a remote handheld transmitter, which interfaces with different remote controllers for learning the protocols of the different controllers.

29. The method of claim 24 or 27 wherein the step of receiving comprises the step of inputting the compressed coded indications with a keyboard entry device.

30. The method of claim 23 or 27 wherein the step of decoding comprises the step of decoding the compressed coded indication with a microprocessor.

31. The method of claim 22 wherein the step of decoding and expanding comprises the step of performing said decoding and expanding as a function of the output of a clock.

32. The method of claim 22 wherein the step of decoding and expanding comprises the steps of:

converting said compressed coded indication into a compressed code of binary bits;

reordering the bits in said compressed code of binary bits to obtain a reordered binary compressed code;

grouping said reordered binary compressed code into binary channel, date, time and length priority numbers; and

deriving said channel, day, time-of-day and length commands from said binary channel, date, time and length priority numbers.

33. The method of claim 32 wherein the step of reordering comprises the step of performing said reordering as a function of the output of a clock.

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34. The method of claim 32 wherein the step of deriving comprises the step of performing said deriving as a function of the output of a clock.

35. The method of claim 22 wherein the step of decoding and expanding comprises the steps of:

converting said compressed coded indication into a compressed code of mixed radix bits;

reordering the bits in said compressed code of mixed radix bits to obtain a reordered mixed radix compressed code;

grouping said reordered mixed radix compressed code into mixed radix channel, date, time and length priority numbers; and

deriving said channel, day, time-of-day and length commands form said mixed radix channel, date, time and length priority numbers.

36. The method of claim 22 further comprising the steps of:

comparing the day and time-of-day commands to the output of a clock for a predetermined relation;

selecting the channel specified in the channel command after the predetermined relation is found to exist; and

enabling recording by the video cassette recorder of the video signals on the selected channel by commencing recording after the predetermined relation is found to exist.

37. The method of claim 36 comprising the step of utilizing the length command to terminate the recording.

38. The method of claim 22 wherein the step of decoding and expanding comprises the steps of:

entering encoded data into the decoder;

decoding said encoded data to determine channel, date, time and length of the channel of video signals to be recorded; and

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generating control commands from said encoded data for selection of said channel of video signals for recording and for control of the video cassette recorder to start and stop the recording of the selected channel by the video cassette recorder.

39. A television calendar for combined visual selection of programs for direct viewing and for use in automatic recording of programs for future viewing, the combination comprising:

a day section for each of a plurality of calendar days and, positioned in a predetermined relation with each day section, an associated unique day visual identifier;

a time-of-day section for each of a plurality of program starting times within each day section and, positioned in a predetermined relation with each time-of-day section, an associated unique time-of-day visual identifier;

a plurality of unique channel visual identifiers and corresponding to each such channel visual identifier, a program identifier within each time-of-day section for such program that starts at the time of such time-of-day section and that is associated with the day section and time-of-day section within which it is positioned; and

an additional unique coded indication for each said program positioned in a predetermined relation to each said channel visual identifier, the coded indication for each such program representing the channel, the time-of-day, the calendar day, and the length of time for the associated program in the calendar.

40. The television calendar of claim 39 wherein at least some of the unique coded indications comprises a plurality of digits.

41. A television calendar of claim 40 wherein each of the day, time-of-day and channel identifiers is represented by one or more digits and wherein the sum of the number of digits of the

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unique coded indication is less than the number of digits in all of the identifiers plus the number of digits representing the length of time for the associated program.

42. A television calendar of claim 39 wherein each of at least some of said channel visual identifiers comprise a unique cable channel visual identifier and wherein the television calendar further comprises an assigned cable channel number positioned in a predetermined relation to each said cable channel visual identifier, the assigned cable channel number representing the cable channel corresponding to said cable channel visual identifier for said cable television program.

43. A method of creating a television calendar for combined visual selection of programs for direct viewing and for use in automatic recording of programs for future viewing, comprising the steps of:

creating a day section and an associated unique day visual identifier for each of a plurality of calendar days;

positioning in relation to each of the day sections the associated day visual identifier;

creating a time-of-day section for each day section, for each of a plurality of television program starting times and an associated unique time-of-day visual identifier;

positioning in relation to each of the time-of-day sections the corresponding associated unique time-of-day visual identifier;

creating a plurality of unique channel visual identifiers and a corresponding program identifier for each such channel visual identifier, within each time-of-day section for such program that starts at the time of such time-of-day section, and that is associated with the day section and time-of-day section within which it is positioned;

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creating a unique coded indication for each said program, the coded indication representing the channel, the calendar day, the time-of-day, and the length of time for said program; and

positioning in a predetermined relation to each program identifier, the unique coded indication for each said program.

44. The method of claim 43 wherein the step of creating a unique coded indication for each said program comprises the step of

creating the unique coded indication to have less digits than the sum of the number of digits in all of the identifiers associated with said program plus the number of digits representing the length of time associated with said program.

45. The method of claim 43 wherein the step of creating the unique coded indication comprises the step of encoding digits representing the identifiers based on probabilities as to the frequency of occurrence of the identifiers in the calendar.

46. The method of claim 44 wherein the step of creating the unique coded indication comprises the step of:

encoding the digits in all of the identifiers associated with each said program, plus the digits representing the length of time associated with said program, based on probabilities assigned to the channel associated with the channel identifier, calendar day associated with the day identifier, time-of-day associated with the time-of-day identifier and length of time associated with said program.

47. The method of claim 43 wherein the step of creating a plurality of unique channel visual identifiers further comprises the steps of:

creating at lease some of said channel visual identifiers to comprise unique cable channel visual identifiers; and

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positioning in a predetermined relation to each said cable channel visual identifier and assigned cable channel number representing the cable channel corresponding to said cable channel visual identifier for said cable television program.

48. The method of claim 43 wherein the step of creating a unique coded indication comprises the steps of:

creating a separate representation for each of a channel, day, time and day and length for any program in the calendar;

using said representation to derive a priority number for each of said channel, date, time and length representations;

converting the priority numbers into a binary number for each of said channel, day, time and length commands;

reordering the bits of said binary numbers to obtain a compressed code of binary bits; and

converting the compressed code of binary bits into one said unique coded indication.

49. The method of claim 48 wherein the step of reordering comprises the step of performing said reordering as a function of a bit hierarchy key.

50. The method of claim 48 wherein the step of reordering comprises the step of performing said reordering as a function of the output of a clock.

51. The method of claim 48 wherein the step of using said representation to derive a priority number comprises the step of performing said derivation as a function of the output of a clock.

52. The method of claim 43 wherein the step of creating a unique coded indication comprises the steps of:

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creating a separate representation for each of a channel, day, time and day and length for any program in the calendar;

using said representation to derive a priority number for each of said channel, date, time and length representations;

converting the priority numbers into a mixed radix number for each of said channel, day, time and length commands;

reordering the bits of said mixed radix numbers to obtain a compressed code of mixed radix bits; and

converting the compressed code of mixed radix bits into one said unique coded indication.

53. A television calendar on a display medium for combined visual selection of programs for direct viewing and for use in automatic recording of programs for future viewing, the combination comprising:

a day section for each of a plurality of calendar days and, positioned in a predetermined relation with each day section, a unique day visual identifier on the display medium;

a time-of-day section for each of a plurality of program starting times within each day section and, positioned in a predetermined relation with each time-of-day section, a unique time-of-day visual identifier on the display medium;

a plurality of unique channel visual identifiers on the display medium and corresponding to each such channel visual identifier a program identifier within each time-of-day section for such program that starts at the time of such time-of-day section and that is associated with the day section and time-of-day section within which it is positioned; and

an additional unique coded indication for each said program positioned on the display medium, in a predetermined relation to each said channel visual identifier, the coded indication representing the channel, the time-of-day, the calendar

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day and the length of time for the associated program in the calendar.

54. The television calendar on a display medium of claim 53 wherein at least some of the unique coded indications comprises a plurality of digits.

55. The television calendar of claim 54 wherein each of the day, time-of-day and channel identifiers is represented by one or more digits and wherein the number of digits of the unique coded indication is less than the sum of the number of digits in all of the identifiers plus the number of digits representing the length of time for the associated program.

56. A television calendar of claim 53, wherein each of at least some of said channel visual identifiers comprise a unique cable channel visual identifier and wherein the television calendar further comprises an assigned cable channel number positioned in a predetermined relation to each said cable channel visual identifier, the assigned cable channel number representing the cable channel corresponding to said cable channel visual identifier for said cable television program.

57. A method of creating a television calendar on a display medium for combined visual selection of programs for direct viewing and for use in automatic recording programs for future viewing, comprising the steps of:

creating on the display medium a day section and an associated unique day visual identifier for each of a plurality of calendar days;

positioning on the display medium, in relation to the day section the associated day visual identifier;

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creating on the display medium, a time-of-day section and associated unique time-of-day visual identifier, within each day section, for each of a plurality of television program starting times;

positioning on the display medium in relation to the time-of-day section the associated unique time-of-day visual identifier;

creating on the display medium a plurality of unique channel visual identifiers and a corresponding program identifier to each such channel visual identifier, within each time-of-day section for such program that starts at the time of such time-of-day section, and that is associated with the day section and time-of-day section within which it is positioned;

creating on the display medium a unique coded indication for each said program, the coded indication representing the channel, the calendar day, the time-of-day, and the length of time for said program; and

positioning in a predetermined relation to each said channel visual identifier, the unique coded indication for each said program.

58. The method of claim 57 wherein the step of creating on a display medium a unique coded indication for each said program comprises the step of;

creating the unique coded indication to have less digits than the sum of the number of digits in all of the identifiers associated with said program plus the number of digits representing the length of time associated with said program.

59. The method of claim 58 wherein the step of creating the unique coded indication to have less digits comprises the step of:

encoding the digits in all of the identifiers associated with said program, plus the digits representing the length of time

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associated with said program, based on probabilities assigned to the channel associated with the channel identifier, calendar day associated with the day identifier, time-of-day associated with the time-of-day identifier, and length of time associated with said program.

60. The method of claim 57 wherein the step of creating on a display medium a plurality of unique channel visual identifiers further comprises the steps of:

creating on a display medium at least some of said channel visual identifiers to comprise unique cable channel visual identifiers;

positioning on a display medium in a predetermined relation to each said cable channel visual identifier an assigned cable channel number representing the cable channel corresponding to said cable channel visual identifier for said cable television program.

61. The method of encoding a set of variables comprising the steps of:

entering an input value for each variable;

providing a priority vector table for each variable wherein the priority vector table for each variable lists every possible value of the variable in the order of its relative priority and assigns a unique priority number;

performing a table look up in said priority vector table on said input value for each variable to find its unique priority number;

converting each said unique priority number for said input value for each variable to a binary number and concatenating the resulting binary numbers to form one long binary number;

providing a binary bit hierarchy key arranged in the order of highest differential probability to least differential

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probability of the combination of bits representing all the variables, wherein the differential probability is a measure of the relative importance of a bit from one variable over a bit from another variable in minimizing the length of codes which are most often used;

reordering all bits in said one long binary number according to the order of said binary bit hierarchy key to form a compressed code.

62. An apparatus for using compressed codes for recorder preprogramming that comprises:

means for entering and transmitting a compressed code;

means for receiving a command signal coupled to said means for entering and transmitting a compressed code entry;

means for command control electrically coupled to said means for receiving a command signal;

a means for keeping time electrically coupled to said means for command control;

means for decoding a compressed code having at least one digit into channel, date, time and length commands electrically coupled to said means for command control;

means for recording coupled to said means for command control;

means for turning said means for recording ON and OFF in response to comparison of said decoded date, time and length commands from said means for command control with said means for keeping time; and

means for tuning channels electrically coupled to a signal input and to said means for recording and to said means for command control and responsive to decoded channel commands to tune to selected channels from said means for command control.

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63. The apparatus for using compressed codes for recorder preprogramming of claim 62 wherein:

said means for keeping time is electrically coupled to said means for decoding a compressed code into channel, date, time and length commands; and

wherein the decoding of a compressed code by said means for decoding a compressed code into channel, date, time and length commands is a function of said means for keeping time.

64. The apparatus for using compressed codes for recorder preprogramming of claim 63 which further comprises:

means coupled to said means for command control for daily using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date specified in said channel, date, time and length (CDTL) commands for recording a program daily.

65. The apparatus for using compressed codes for recorder preprogramming of claim 63 which further comprises:

means coupled to said means for command control for weekly using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date specified in said channel, date, time and length (CDTL) commands for recording a program weekly.

66. The apparatus for using compressed codes for recorder preprogramming of claim 64 or 65 wherein said means for entering and transmitting a compressed code comprises:

means for remote control having a signal transmit means coupled to said means for command control receiver; and

means for compressed code entry electrically coupled to said means for remote control.

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67. The apparatus for using compressed codes for recorder preprogramming of claim 64 or 65 wherein said means for entering and transmitting a compressed code comprises:

means for manual control electrically coupled to said means for a command signal receiver; and

means for compressed code entry means electrically coupled to said means for manual control.

68. The apparatus for using compressed codes for recorder preprogramming for a recorder that comprises:

means for remote control having a means for transmitting signals;

means for compressed code entry electrically coupled to said means for remote control;

means for decoding a compressed code having at least one digit into channel, date, time and length commands electrically coupled to said means for transmitting signals on said remote control;

means for receiving a command signal coupled to said means for transmitting signals;

means for command control for controlling a recorder electrically coupled to said means for receiving a command signal;

a first means for keeping time electrically coupled to said means for command control;

means for recording coupled to said means for command control;

means for turning said means for recording ON and OFF in response to comparison of said decoded date, time and length commands from said means for command control with said first means for keeping time and

means for tuning channels electrically coupled to a signal input and to said means for recording and to said means for

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command control and responsive to decoded channel commands to tune to selected channels from said means for command control.

69. The apparatus for using compressed codes for recorder preprogramming of claim 68 which further comprises:

means coupled to said command controller for daily using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date specified in said channel, date, time and length (CDTL) commands for recording a program daily.

70. The apparatus for using compressed codes for recorder preprogramming of claim 68 which further comprises:

means coupled to said command controller for weekly using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date specified in said channel, date, time and length (CDTL) commands for recording a program weekly.

71. The apparatus for using compressed codes for recorder preprogramming of claim 68, 69 or 70 that further comprises:

a second means for keeping time electrically coupled to said means for decoding a compressed code into channel, date, time and length commands;

wherein the decoding of a compressed code by said means for decoding a compressed code into channel date time and length commands is a function of said second means for keeping time.

72. An apparatus for using compressed codes for recorder preprogramming for a recorder that comprises:

means for universal remote control having a means for transmitting signals and a means for receiving signals;

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a learn switch electrically coupled to said means for universal remote control wherein when said learn switch is "ON" said means for universal remote control can learn another remote controller functions via said means for receiving signals;

means for compressed code entry electrically coupled to said means for universal remote control;

means for decoding a compressed code having at least one digit into channel, date, time and length commands electrically coupled to said means for transmitting signals on said universal remote control;

means for receiving a command signal coupled to said means for transmitting signals;

means for command control for controlling a recorder electrically coupled to said means for receiving a command signal;

a first means for keeping time electrically coupled to said means for command control;

means for recording coupled to said means for command control;

means for turning said means for recording ON and OFF in response to comparison of said decoded date, time and length commands for said means for command control with said first means for keeping time; and

means for tuning channels electrically coupled to a signal input and to said means for recording and to said means for command control and responsive to decoded channel commands to tune to selected channels from said means for command control.

73. The apparatus for using compressed codes for recorder preprogramming of claim 72 which further comprises:

means coupled to said command controller for daily using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date

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specified in said channel, date, time and length (CDTL) commands for recording a program daily.

74. The apparatus for using compressed codes for recorder preprogramming of claim 72 which further comprises:

means coupled to said command controller for weekly using said channel, date, time and length (CDTL) commands decoded from said compressed code wherein the start date is the date specified in said channel, date, time and length (CDTL) commands for recording a program weekly.

75. The apparatus for using compressed codes for recorder preprogramming of claim 72, 73 or 74 that further comprises:

a second means for keeping time electrically coupled to said means for decoding a compressed code into channel, date, time and length commands; and

wherein the decoding of a compressed code by said means for decoding a compressed code into channel, date, time and length commands is a function of said second means for keeping time.

76. The method of controlling a television controller for selecting a cable channel for viewing, the steps comprising:

providing a television calendar with assigned cable channel number identifiers associated with each cable channel;

providing a television controller having a cable channel address table with memory for a set of assigned cable channel numbers and a corresponding set of local cable carrier channel numbers and having the capability to convert an assigned cable channel number into a local cable carrier channel number by using said cable channel address table;

setting up said cable channel address table with said set of assigned cable channel numbers and said corresponding set of local cable carrier channel numbers;

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entering an assigned cable channel number identifier corresponding to a cable channel selected for viewing; and

conversion of said assigned cable channel number identifier into a corresponding local cable carrier channel number by said television controller.

77. The apparatus for using compressed codes for recorder preprogramming of claim 62 wherein:

said means for decoding a compressed code having at least one digit into channel, date, time and length information electrically coupled to said means for command control further comprises a means for detecting that said channel information corresponds to an assigned cable channel number; and

said means for command control further comprises a means for converting an assigned cable channel number into a local cable carrier channel number.

78. The apparatus for using compressed codes for recorder preprogramming of claim 68 or 72 wherein said means for decoding a compressed code having at least one digit into channel, date, time and length commands further comprises:

a means for detecting that said channel commands corresponds to an assigned cable channel number; and

a means for converting an assigned cable channel number into a local cable carrier channel number.

79. The apparatus for using compressed codes for recorder preprogramming of claim 68 or 72 that further comprises:

a stack memory coupled to said means for decoding a compressed code for storing a plurality of programs consisting of channel, date, time and length commands for timer preprogramming;

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a second means for keeping time electrically coupled to said means for decoding a compressed code into channel, date, time and length commands; and

wherein said means for decoding a compressed code further comprises a means for periodically comparing said date and time commands for said stack memory and transmitting said channel, date, time and length commands to said means for receiving a command signal when said date and time commands compare with said second means for keeping time.

80. The method of permitting a large number of programs to be timer preprogrammed for recording by a video cassette recorder for time shifted viewing where the video cassetter recorder can store only N timer preprogrammed programs, the steps comprising:

providing a remote controller having a means for keeping time;

entering into said remote controller compressed codes each having at least one digit and each representative of, and compressed in length from, the combination of channel, time-of-day, day and length commands for a program; and

decoding each compressed code having at least one digit of channel, time-of-day, day and length commands;

providing a memory;

entering each said channel, time-of-day, day and length commands into said memory;

reordering said channel, time-of-day, day and length commands in said memory into temporal order; and

testing whether first N entries in said memory have changed and if yes, sending changed entries in first N entries to said video cassette recorder.

81. The method of permitting a large number of programs to be timer preprogrammed of claim 80, the steps further comprising:

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periodically checking whether stop time of Nth entry of said first N entries in memory has passed; and

if stop time of Nth entry has passed and number of entries in memory is greater than N, then turning on a means for alerting a user to activate remote controller to send more programs to said video cassette recorder and once remote controller is activated, setting next N entries in said memory to be the first N entries in said memory and sending said first N entries to said video cassette recorder and turning off said means for alerting a user.

82. An apparatus for using compressed codes for recorder preprogramming that comprises:

means for remote control having a means for transmitting signals;

means for compressed code entry electrically coupled to said means for remote control;

means for decoding a compressed code having at least one digit into channel, date, time and length commands electrically coupled to said means for remote control;

means for storing said channel, date, time and length commands in said remote control;

a means for keeping time electrically coupled to said means for remote control;

means for command control electrically coupled to said means for remote control;

means for recording coupled to said command control; and

wherein said means for command control compares the stored date, time and length commands to said means for keeping time and sends at the appropriate time, record ON and OFF commands and channel select commands to a means for recording via said transmit signals from said means for remote control.

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83. The apparatus for using compressed codes for recorder preprogramming of claim 82 that further comprises:

means for storing a plurality of protocol sets of transmit signals for commands for varying models of said means for recording electrically coupled to said means for remote control; and

means for selecting for a particular means for recording a protocol set of transmit signals for sending commands.

84. The apparatus for using compressed codes for recorder preprogramming of claim 82 wherein:

said means for remote control is a universal remote controller and can learn a protocol of the transmit signals for sending commands to a particular model of a means for recording.

85. The system of claim 14 wherein said decoder further comprises:

means for detecting that said binary channel priority number contains a set cable channel bit indicating an assigned cable channel priority number; and

means for using said detected assigned priority cable channel priority number to derive a corresponding local cable channel command.

86. The method of claim 32 wherein the step of decoding and expanding further comprises the steps of:

detecting that said binary channel priority number contains a set cable channel bit indicating an assigned cable channel priority number; and

using said detected assigned priority cable channel priority number to derive a corresponding local cable channel command.

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87. The method of claim 47 wherein the step of creating a unique coded indication comprises steps of:

using said representation to derive a priority number for each of said channel, date, time and length representations;

converting the priority numbers into a binary number for each of said channel, day, time and length commands;

adding a cable channel bit set to "1" if said representation is for a cable channel;

reordering the bits of said binary numbers to obtain a compressed code of binary bits; and

converting the compressed code of binary bits into one said unique coded indication.

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APPARATUS AND METHOD FOR USING ENCODED VIDEO RECORDER/PLAYER TIMER PREPROGRAMMING INFORMATION

ABSTRACT

Encoded video recorder/player timer preprogramming information (212) listed in a television guide (200) allows a timer preprogramming feature on a video cassette recorder (VCR) (14)) to be programmed using a compressed code (102, 158, 212) of only 1 to as few as 7 digits, which are decoded by a decoder (38) built into either the video cassette recorder or a remote controller (82) to convert the compressed code into channel, date, time and length (118, 142) information. The channel, date, time and length information is communicated to a VCR and used to automatically activate the VCR and used to automatically activate the VCR to record a given television programme with the corresponding channel, date, time, and length. Alternatively, the channel, date, time and length information is decoded directly in a remote controller (80) and only start record, stop record and channel selection commands are sent to the VCR (70) at the appropriate times. The compressed codes (212) associated with each television program can be printed in a television program guide (200) in advance and used with a VCR or remote controller with the decoding means. The compressed codes for timer preprogramming can be utilized for just one program or repeatedly for daily or weekly use. The algorithm (100) for decoding the compressed codes can be a function of time (120, 42, 122) to ensure security of the decoding method. A method is included for use of the compressed codes with cable channels (176, 160, 162, 166) and a method and apparatus is described for timer preprogramming for a large number of programs (76). The coding technique can also be used for compressed coding of any multidimensional vector for commercial or industrial applications.

Figure 1

REPLACEMENT SHEET
17 MAR 1987

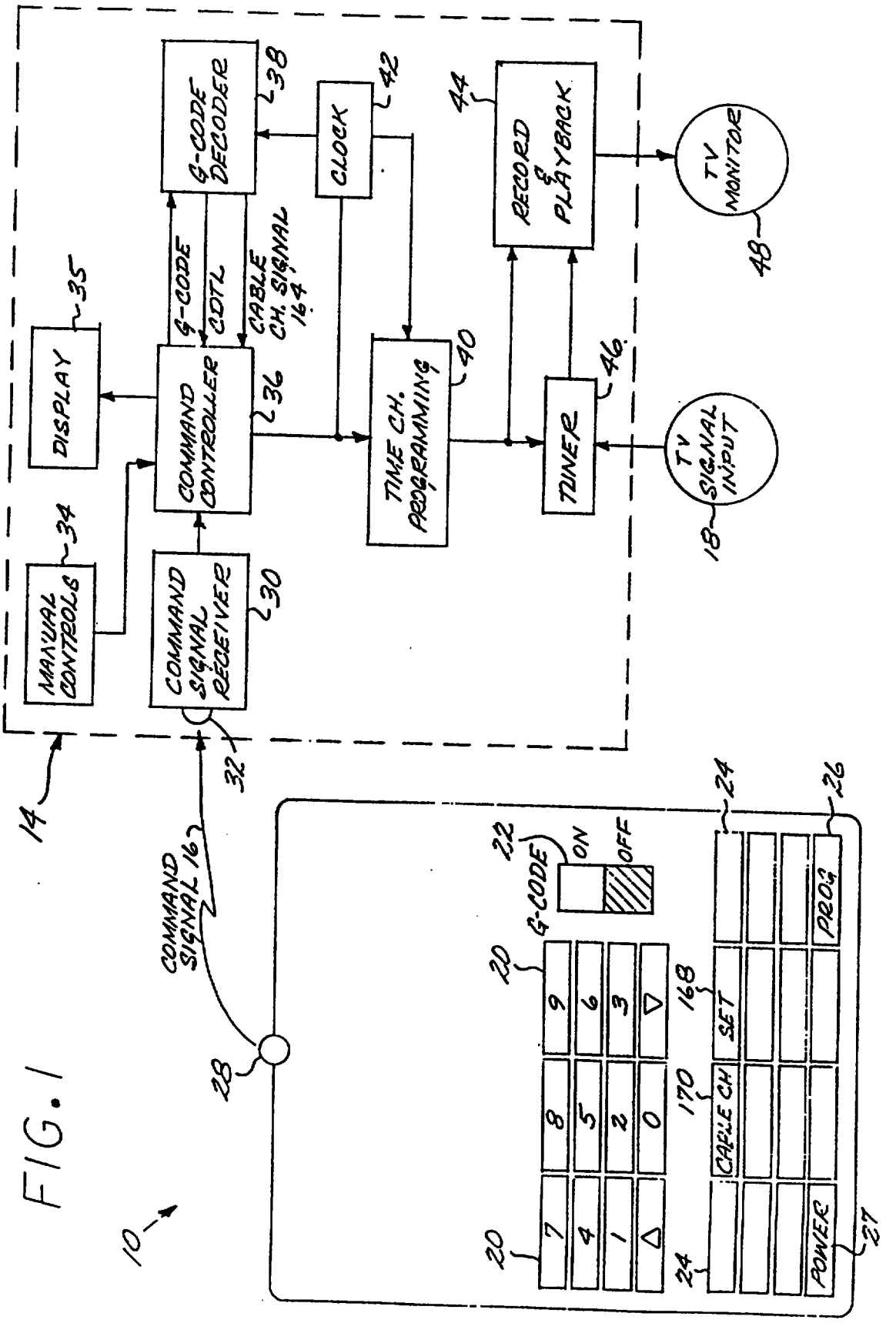


FIG. 1

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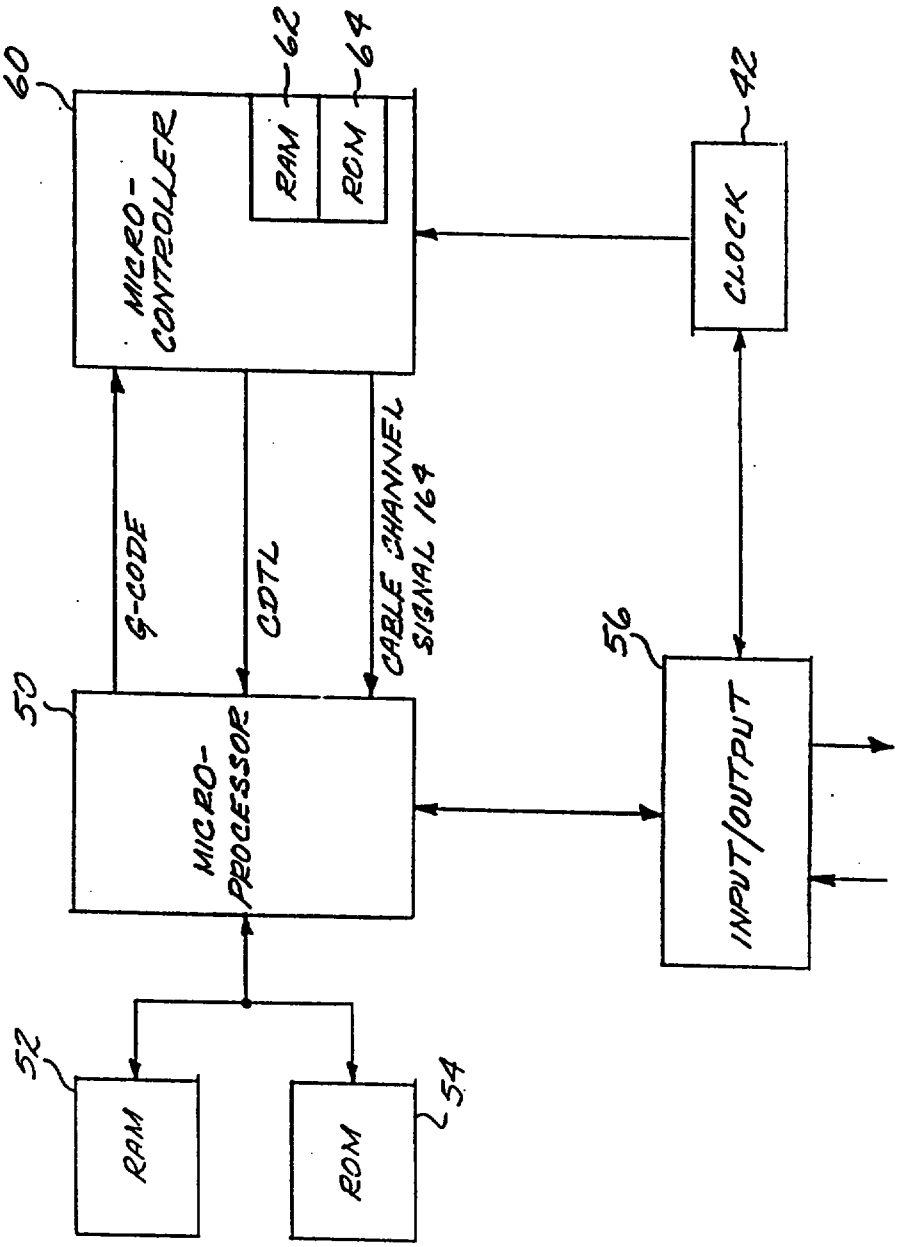


FIG. 2

REPLACEMENT SHEET
17 MAR 1987

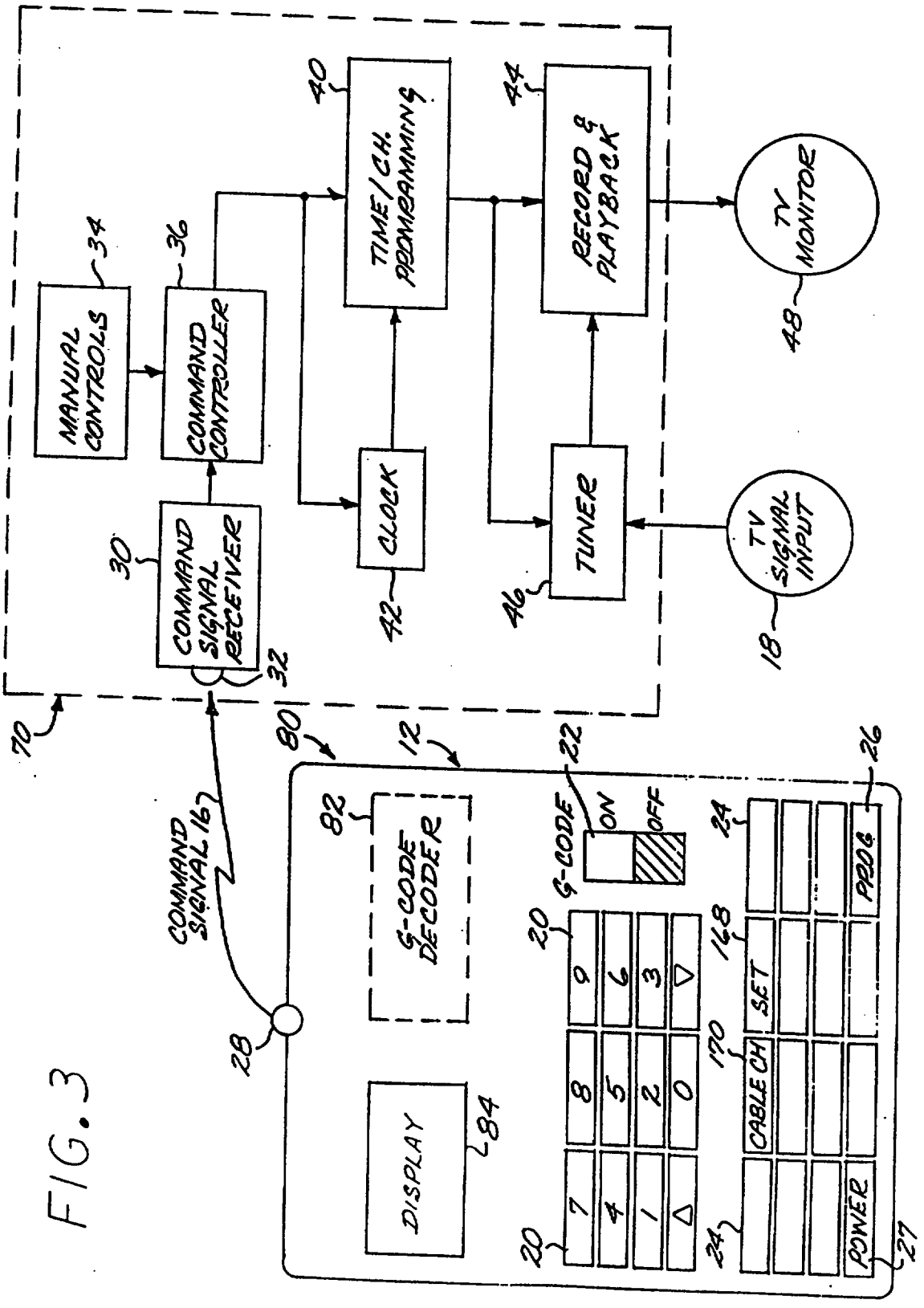


FIG. 3

FIG. 4

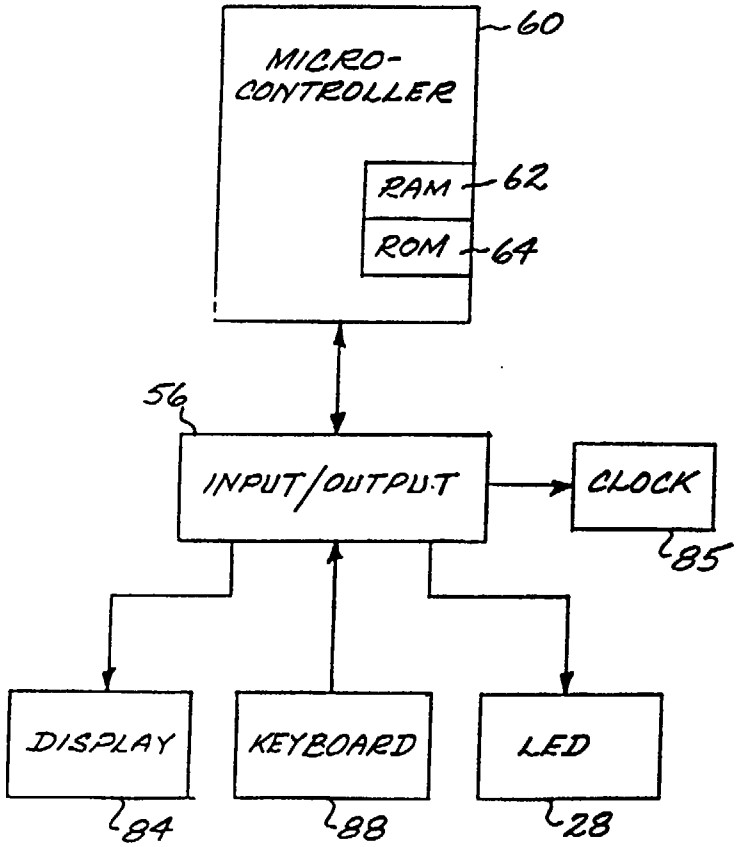
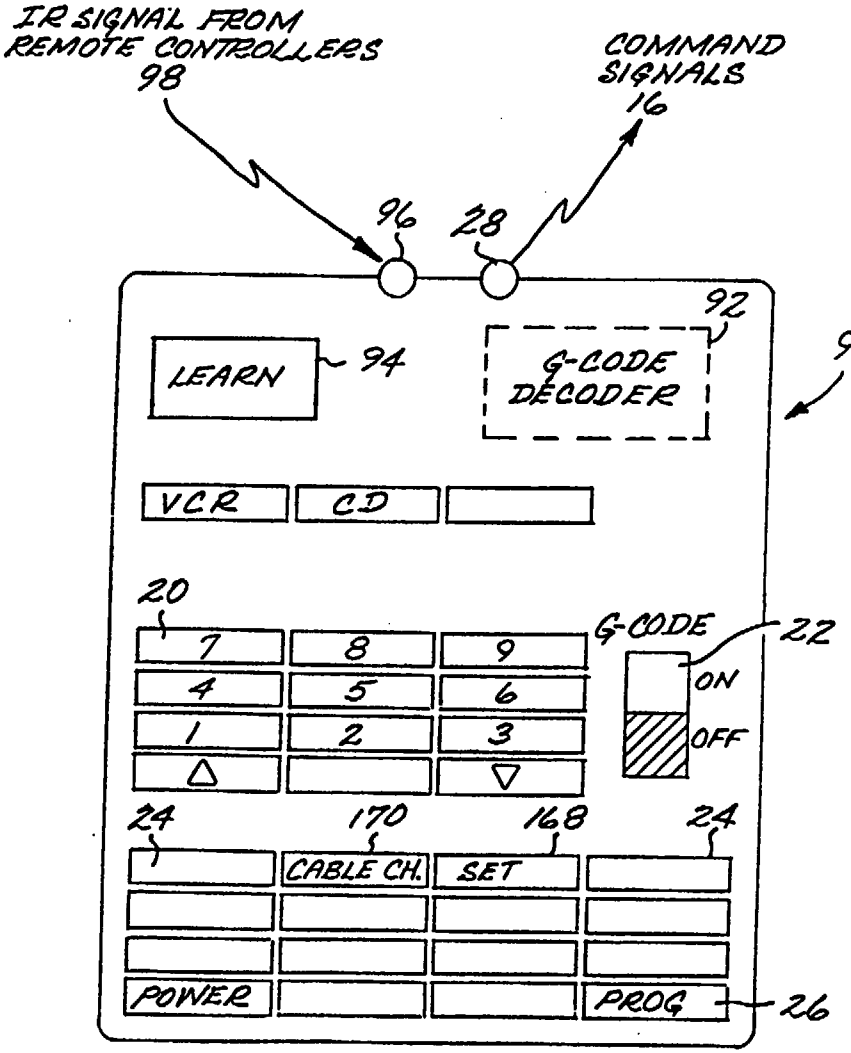


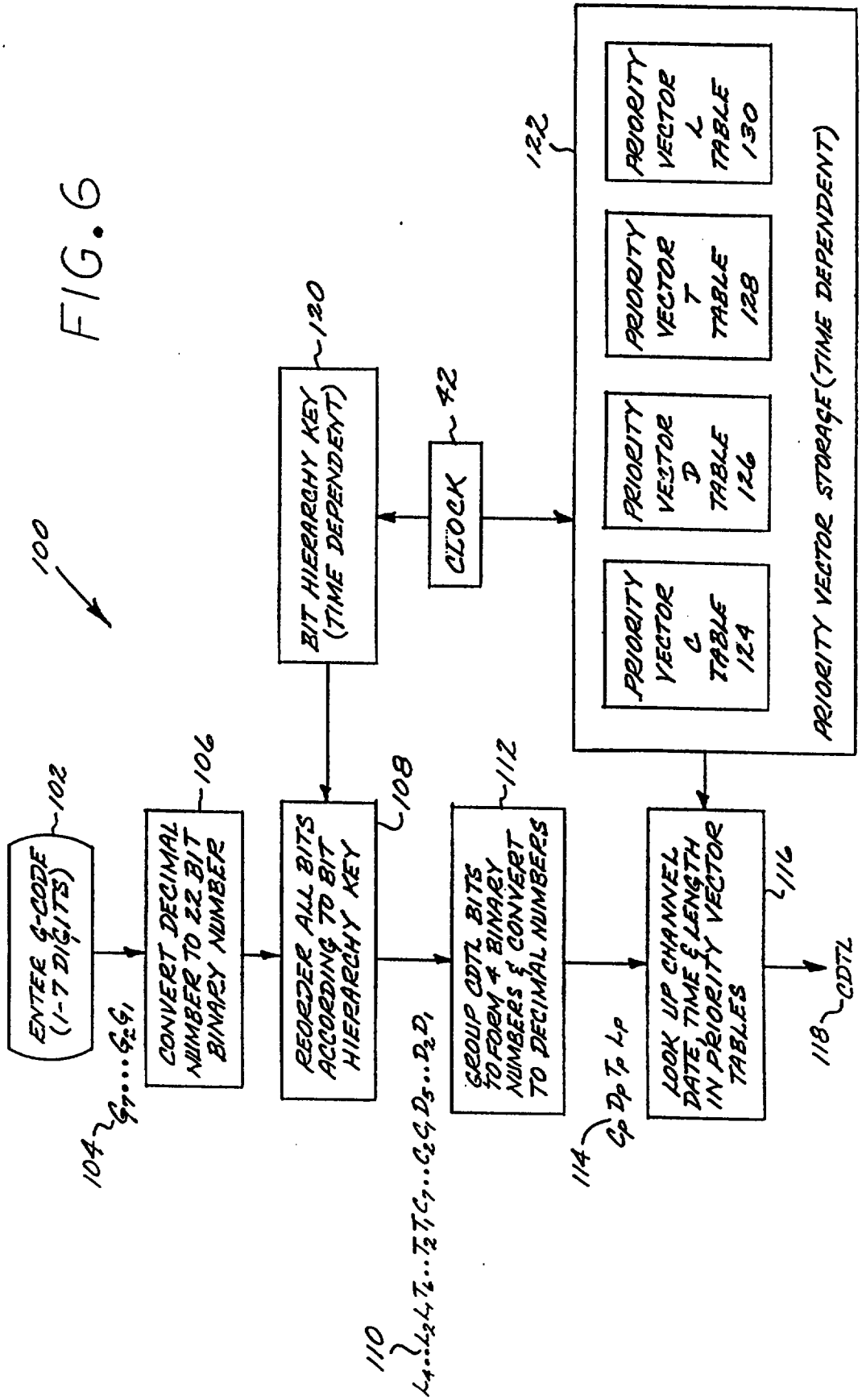
FIG. 5



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FIG. 6



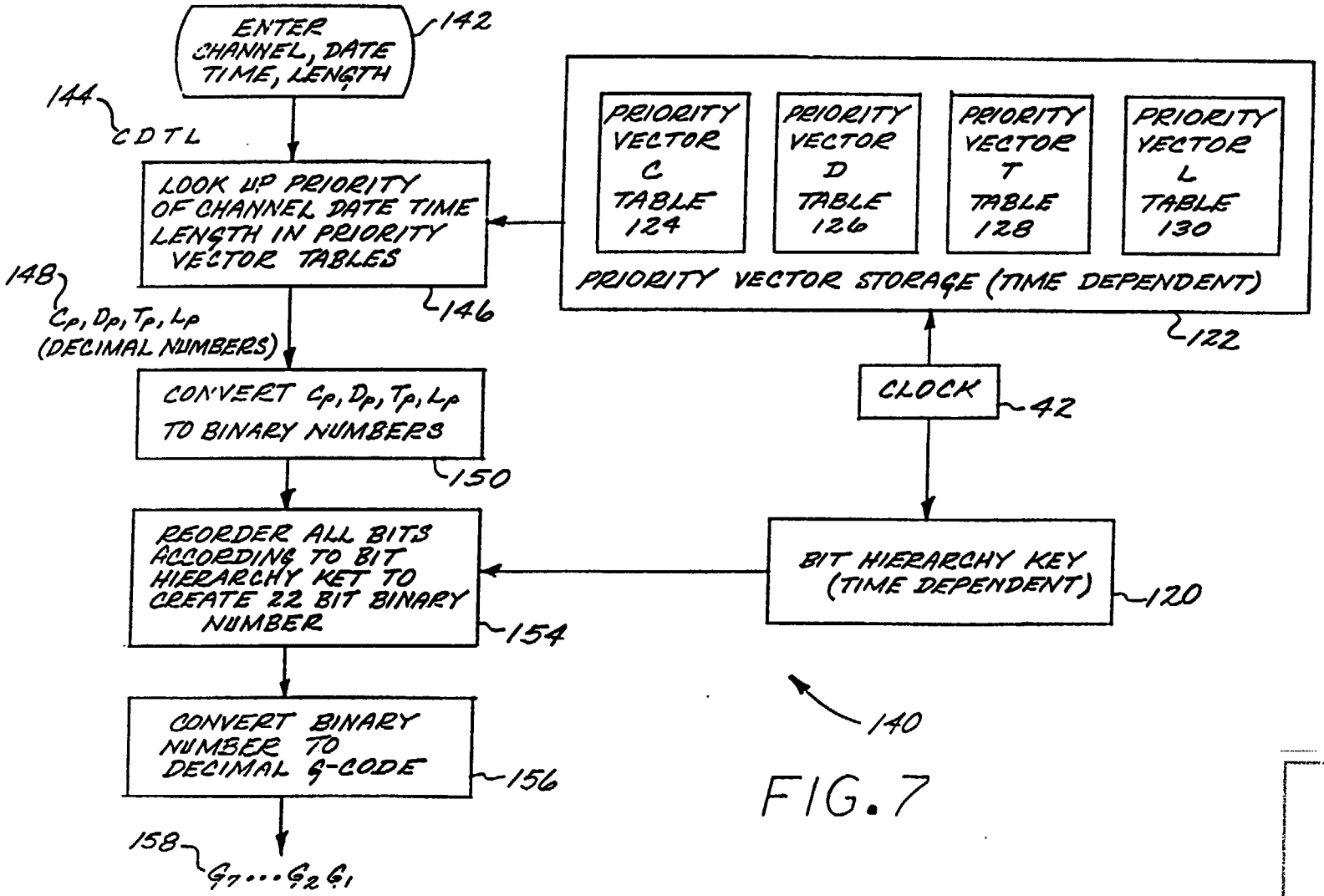


FIG. 7

REPLACEMENT SHEET
Nov 17 2008

Thursday 204

6PM
7PM

February 9, 1989 202

clever to be outsmarted, the family devises an elaborate joke to play on him.
208
18 SPORTS RETROSPECTIVE; 60 Min. [68713]
24 NATURESCENE [5321]
210
A visit to the Colorado National Monument near Grand Junction, where wildflowers, insects and birds are observed.
34 52 NOTICIAS [62921] [496649]
40 DWIGHT THOMPSON--Religion; [68553]
50 HUMANITIES THROUGH THE ARTS [493065]
56 BEVERLY HILLBILLIES--Comedy [496777]
188
Con man Shifty Shafer (Phil Silvers) meets Jed in the Ozarks. Jed: Buddy Ebsen.
C15 A&E BARRY DOUGLAS--Music; 90 min. (37897)
C8 DIS MOVIE--Drama;70 min. (23627113)
"The Return of the Big Cat."
C16 DSC BEYOND 2000--Magazine; 60 min.(5289)
C1 ESN COLLEGE BASKETBALL (32009)
North Carolina at North Carolina State. Carolina defeated the Wolfpack 84-81 on Jan. 21. Steve Bucknall and Kevin Madden combined three-point shot as time expired. (Live) [Time approximate.]
C2 HBO MOVIE(CC)--Science Fiction;(32041)
1hr., 50 min.
"Batteries Not Included."
C6 MAX MOVIE--Documentary; 85 min. (34089)
"Sign o'the Times."
C14 NIK MR WIZARD'S WORLD (CC)-Science (7145)
C17 PT NHL HOCKEY (37961)
Los Angeles Kings at Boston Bruins, aired on a 90-minute tape delay.
C10 TMC MOVIE--Comedy; 1hr., 35 min.
"Back Roads." (11828777)
C7 USA SHE-RA:PRINCESS OF POWER (3401)
--Cartoon

200

C19 WOR UNTOUCHABLES--Drama BW; 60 min. (5385)
6:30 11 FAMILY TIES (CC)--Comedy [15657]
206
Mallory's reunion with her college boy friend (John Dukakis) has her worried that she may not be as interesting to him as she once was.
13 GIMME A BREAK-Comedy [15593]
Nell (Nell Carter) receivesan inheritance and insists on sharing it with everyone-that is, until the check bounces. Addy: Thelma Hopkins
24 FALL AND RISE OF REGINALD PERRIN --Comedy [19401]
Something is lacking in the dinner party Reggie has for his boss-specifically, the food.
28 Mac NEIL, LEHRER NEWSHOUR: [78729]
34 NOTICIERO UNIVISION-Ramos/Salinas [77001]
50 BUONGIORNA ITALIA!-Instruction [507145]
52 NOTICIERO TELEMUNDO/CNN [510729]
--Salazar/Gestoso
56 HOGAN'S HEROES-Comedy [510857]
188
Carters masquerade as a traitor may be kaput: a lovely Fraulein is trying to poison him.
C14 NIK DOUBLE DARE-Game (29225)
C11 TNN VIDEOCOUNTRY (29129) 212
C7 USA CARTOON EXPRESS (23561)
7PM 5 CHARLES IN CHARGE (CC) - Comedy [1065]
While planning a pizza-palor party, Charles allenates the Powell children by dismissing their suggestions about organizing the event.
6 FAMILY TIES (CC)-Comedy [1225]
The family's cousin June (Danielle Von Zerneck) stops by to tell them about her trip to Europe-but instead reminisces about the past visits with the Keatons. Alex: Micheal J. Fox.
7 3 ABC NEWS (CC) [1001] [1129]
9 LOVE CONNECTION-Game [4841]
11 M*A*S*H [1257]

FIG. 8

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REPLACEMENT SHEET
17 MAR 1989

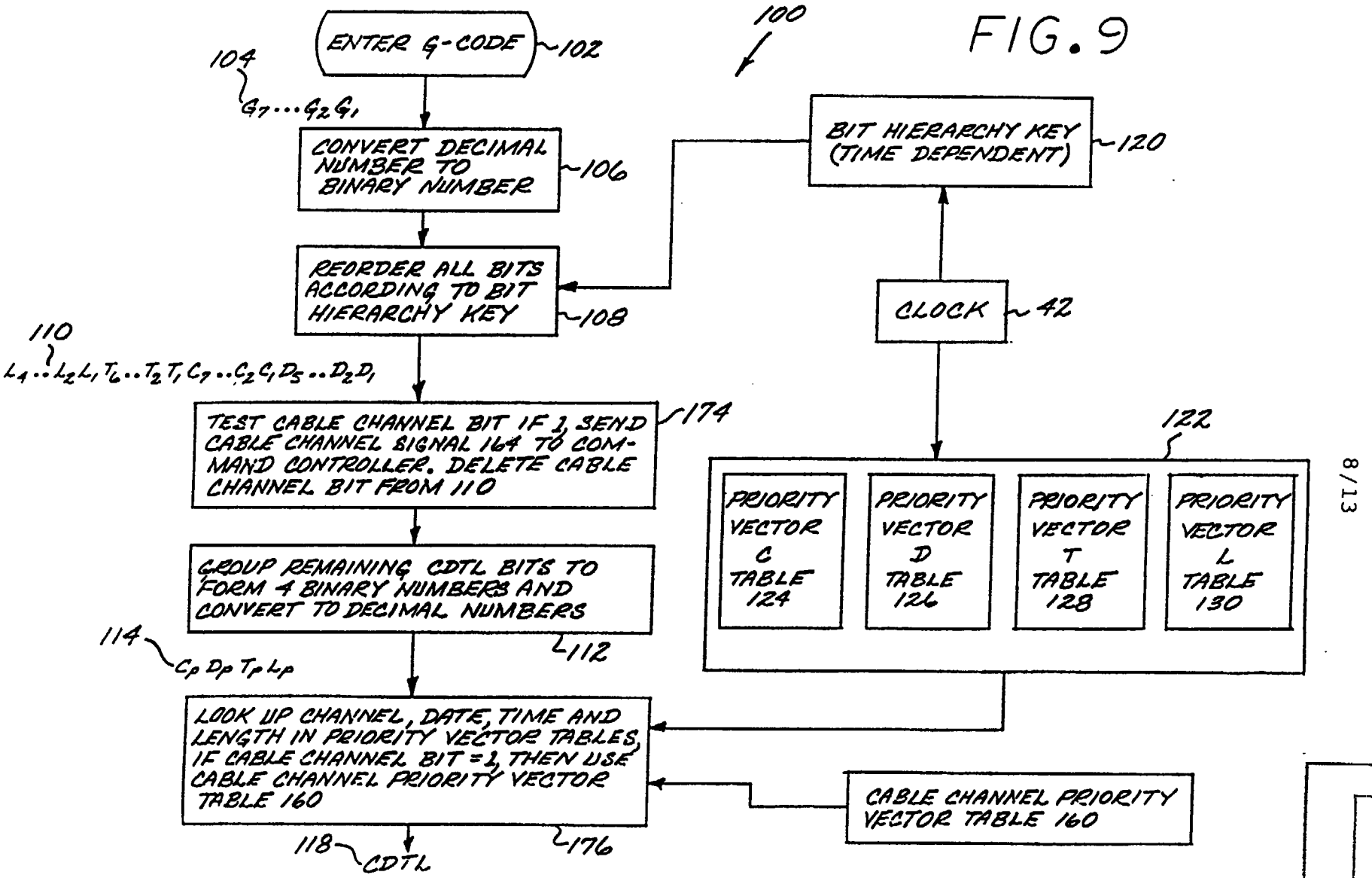


FIG. 9

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17 MAR 1997

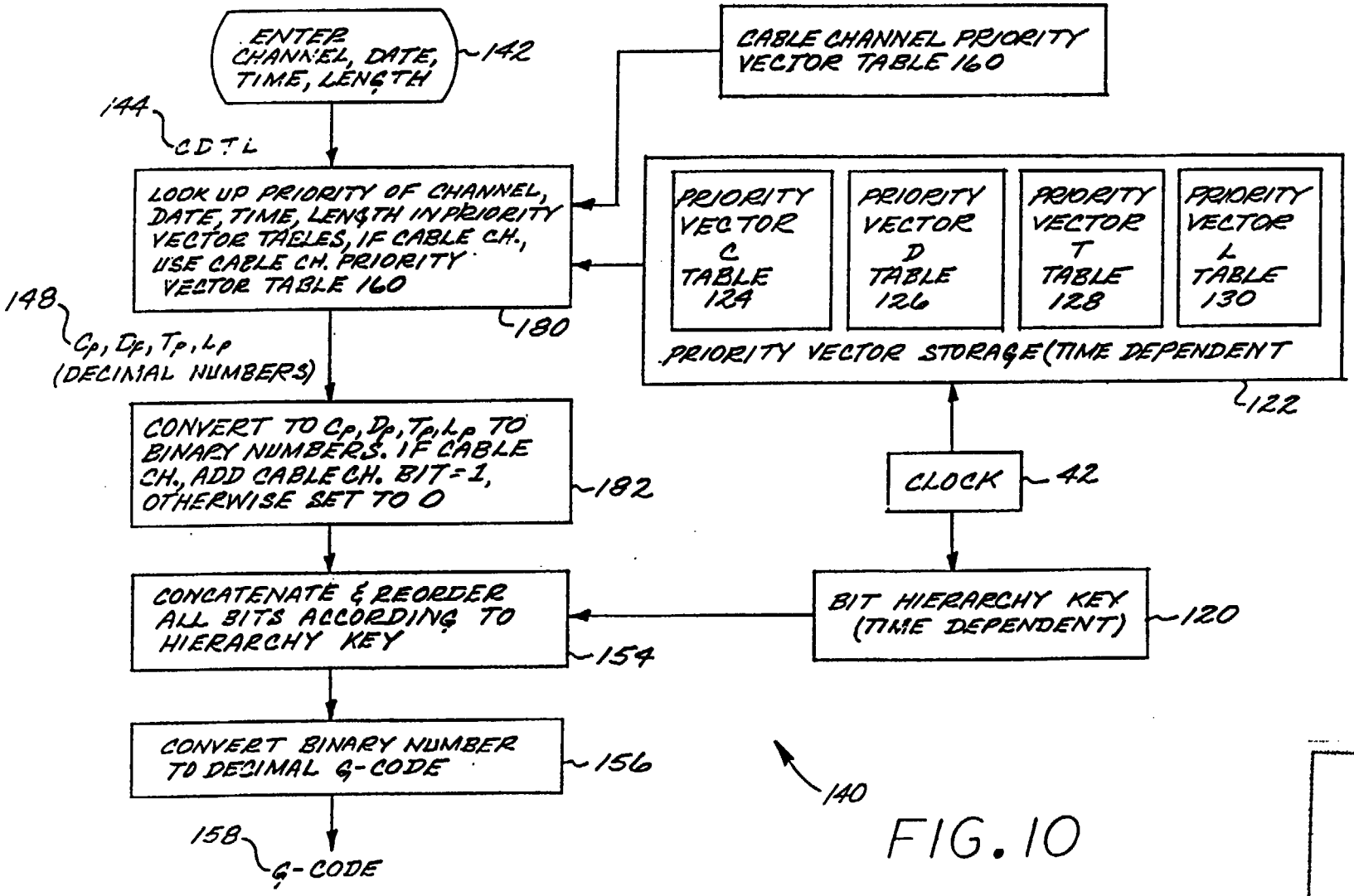


FIG. 10

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HEILAGENSTADT SHEET
17 MAR 1997

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17 MAR 1997

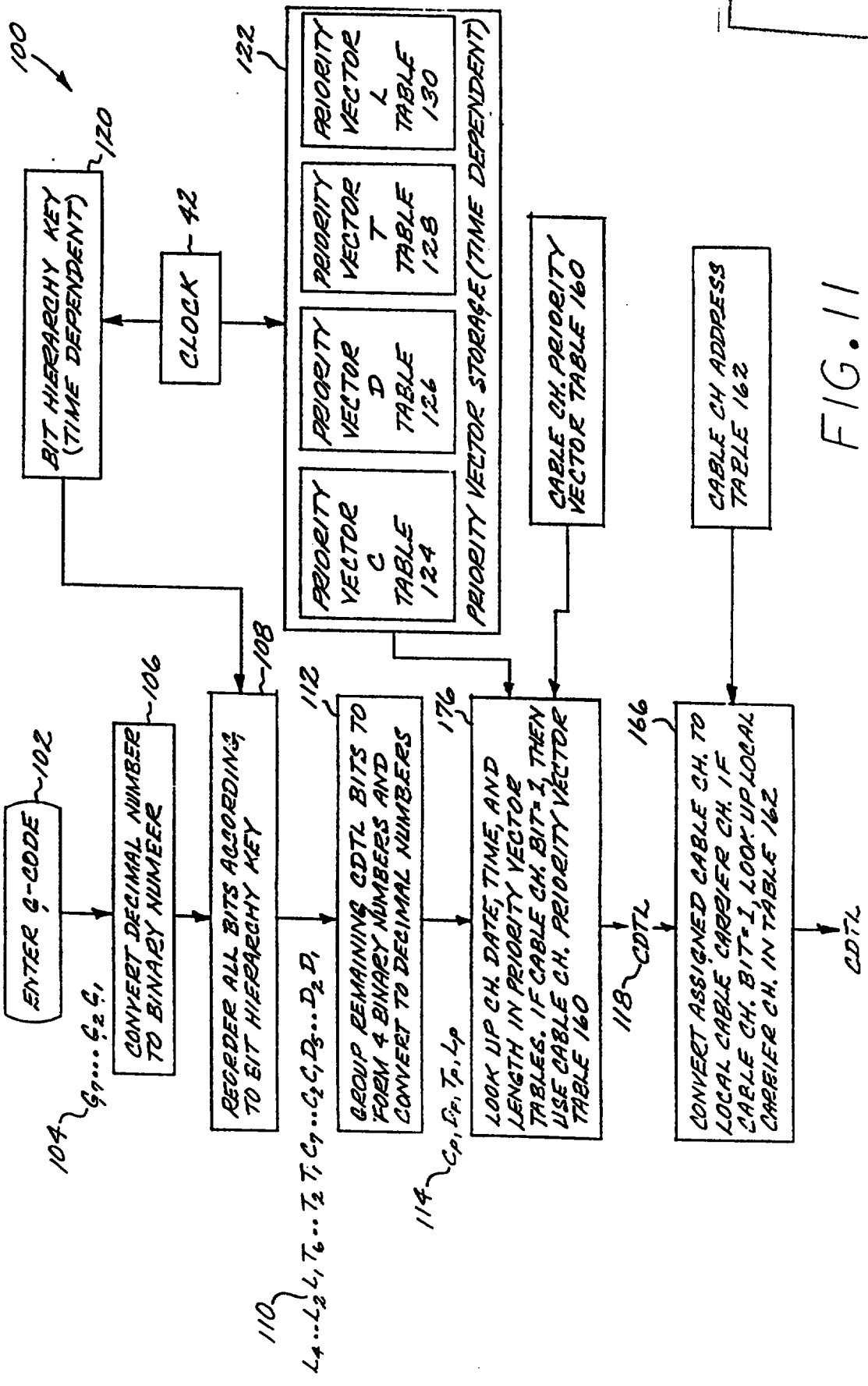


FIG. 11

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17 MAR 1997

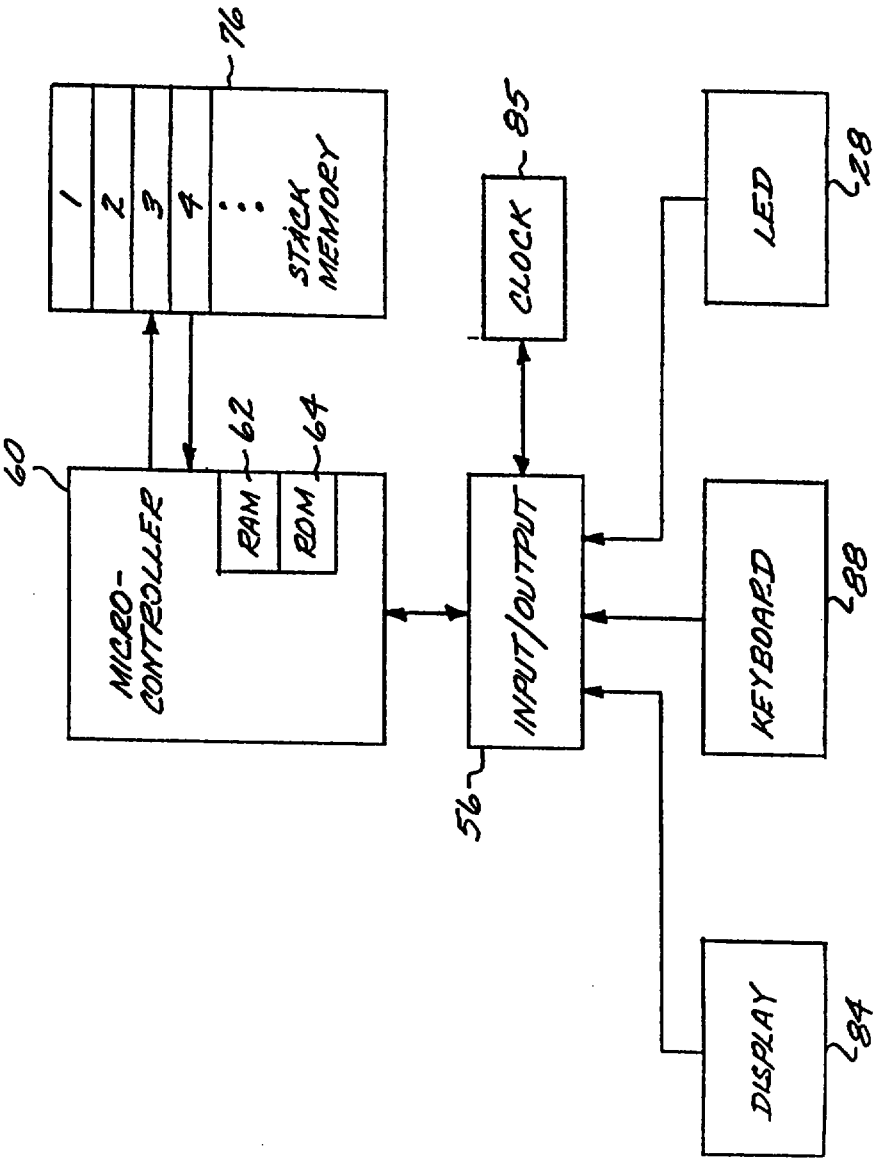


FIG. 12

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17 [illegible] 1997

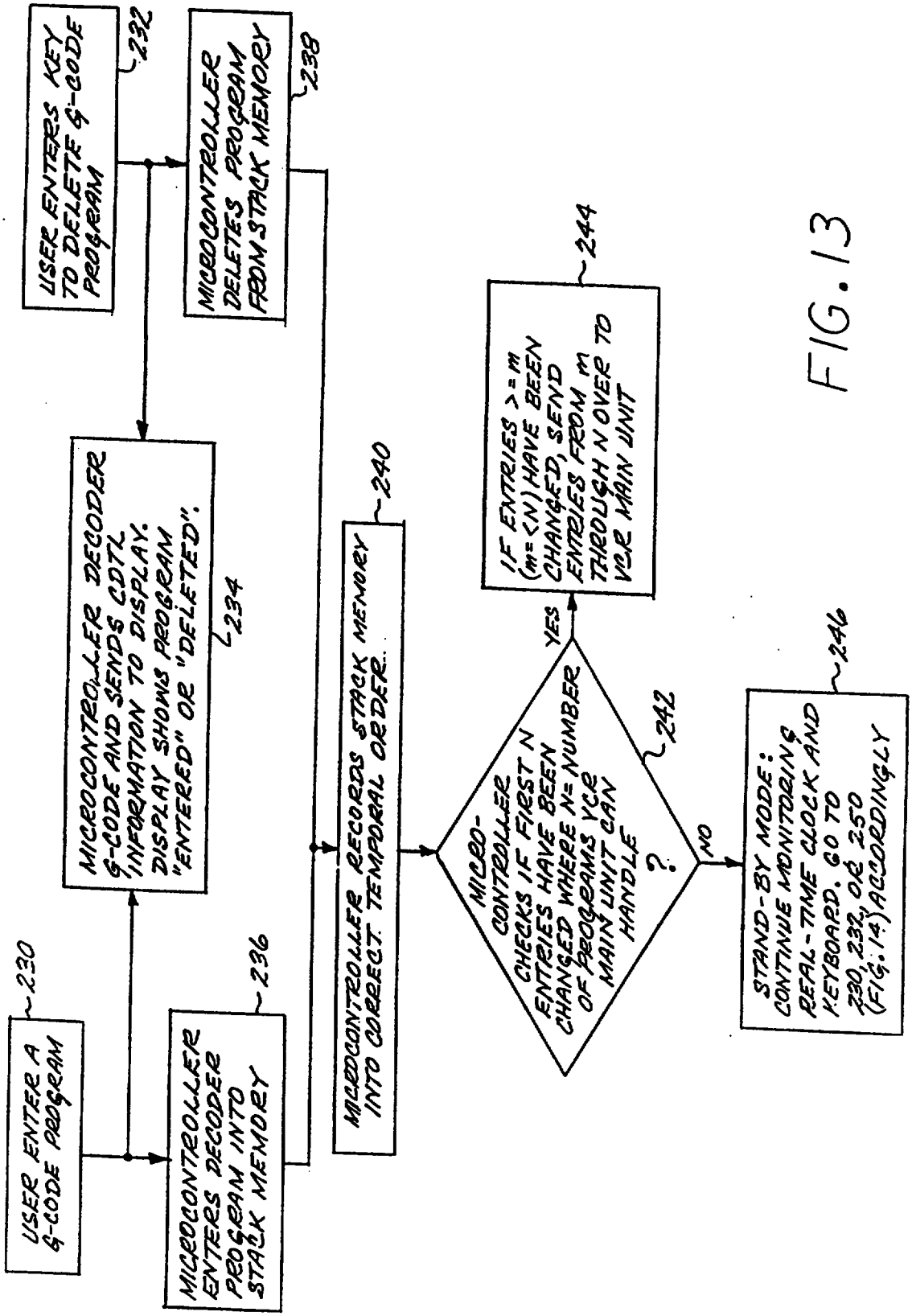


FIG. 13

REPLACEMENT SHEET
17 MAR 1997

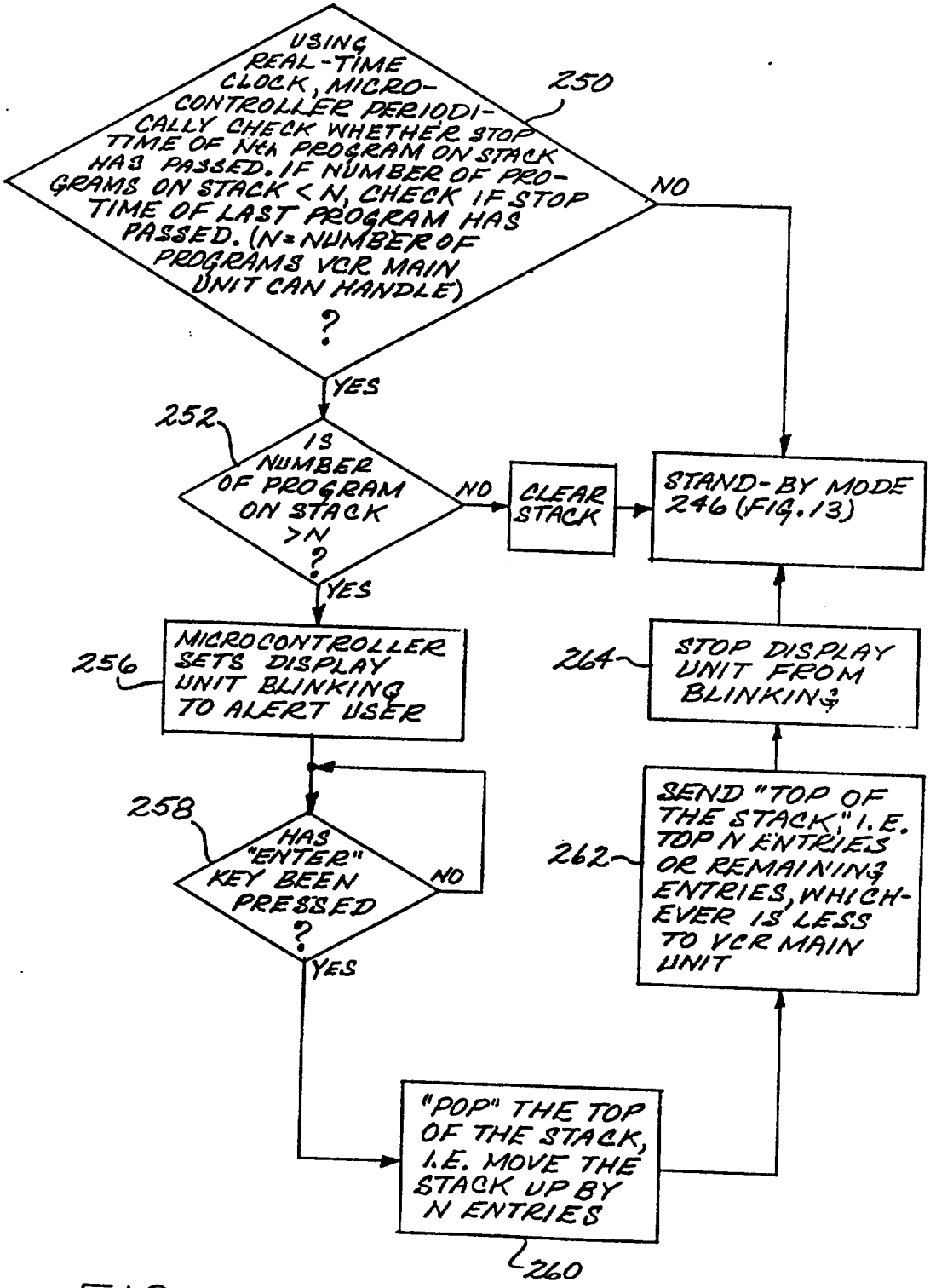


FIG. 14