

[54] **COMMUNICATIONS SECRECY SYSTEM**
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[22] Filed: **Nov. 2, 1970**

[21] Appl. No.: **85,918**

[52] U.S. Cl. **178/5.1, 331/153**
 [51] Int. Cl. **H04n 1/44**
 [58] Field of Search **178/5.1; 331/143, 153, 130, 331/111**

2,609,506 9/1952 Siezen 331/130
 2,999,208 9/1961 Ruehlmann.....331/130
 3,100,269 8/1963 Barry.....331/153

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EXEMPLARY CLAIM

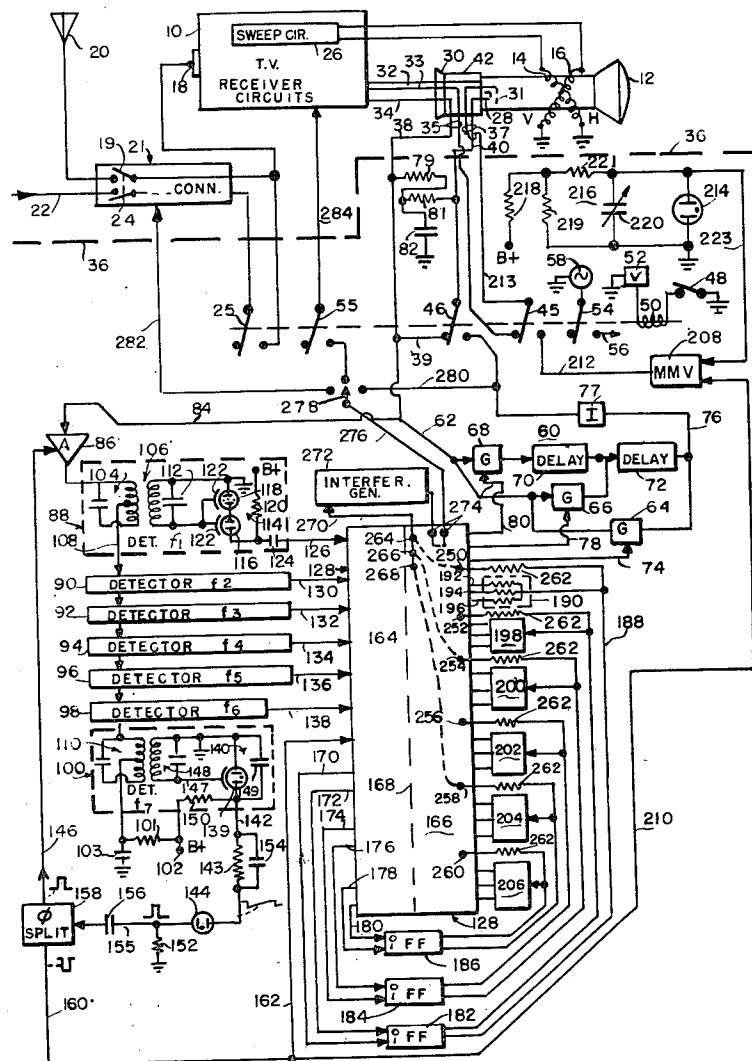
1. A decoder for use with a receiver in a secrecy system of the type in which at least part of the intelligence signals are scrambled, comprising means for employing at a given time a unique unscrambling code for decoding the scrambled intelligence signals, and means in the decoder for coding at least some of the intelligence signals during any of said given time in which no code whatsoever is employed to effect said decoding.

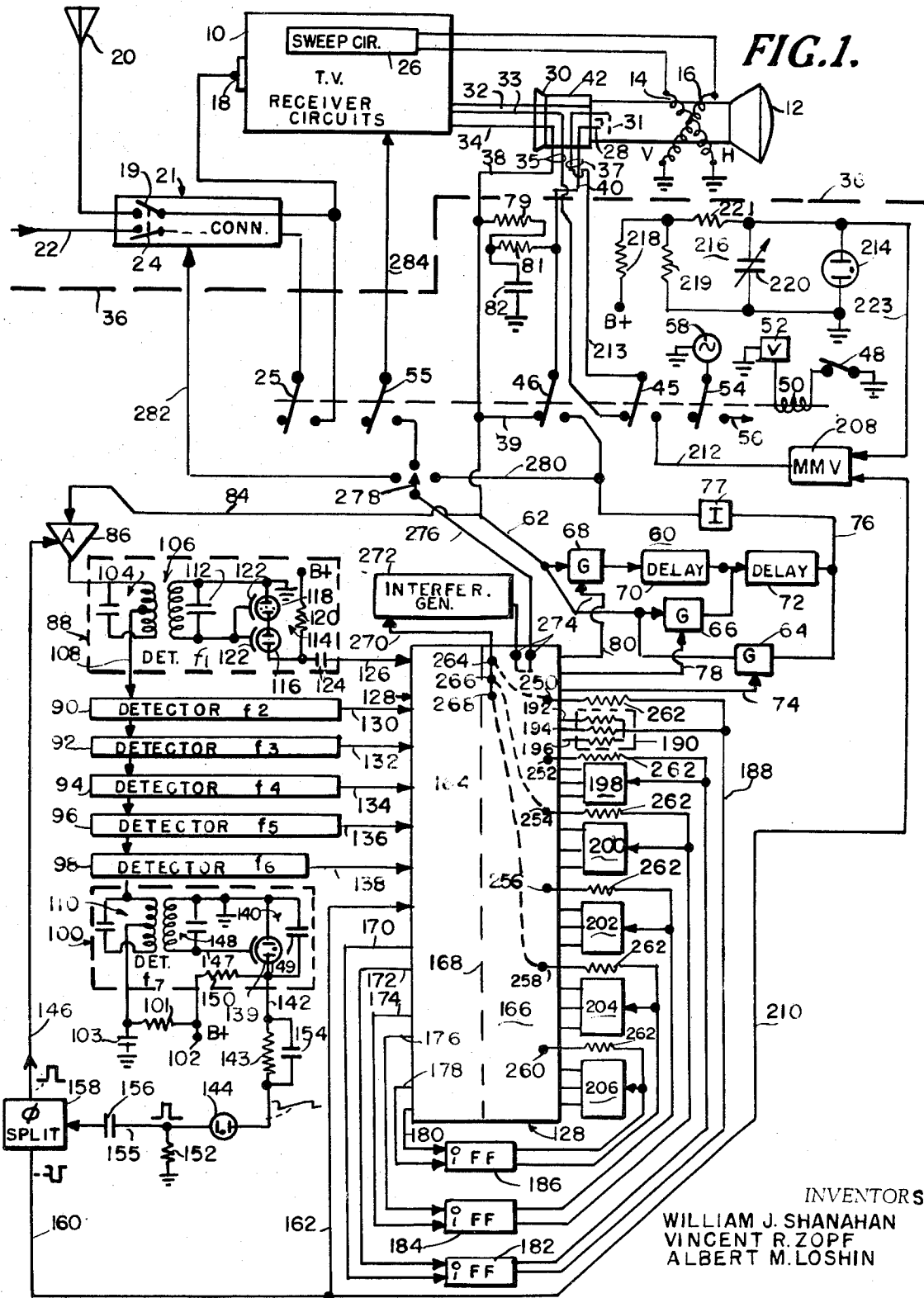
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24 Claims, 5 Drawing Figures





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FIG. 2.

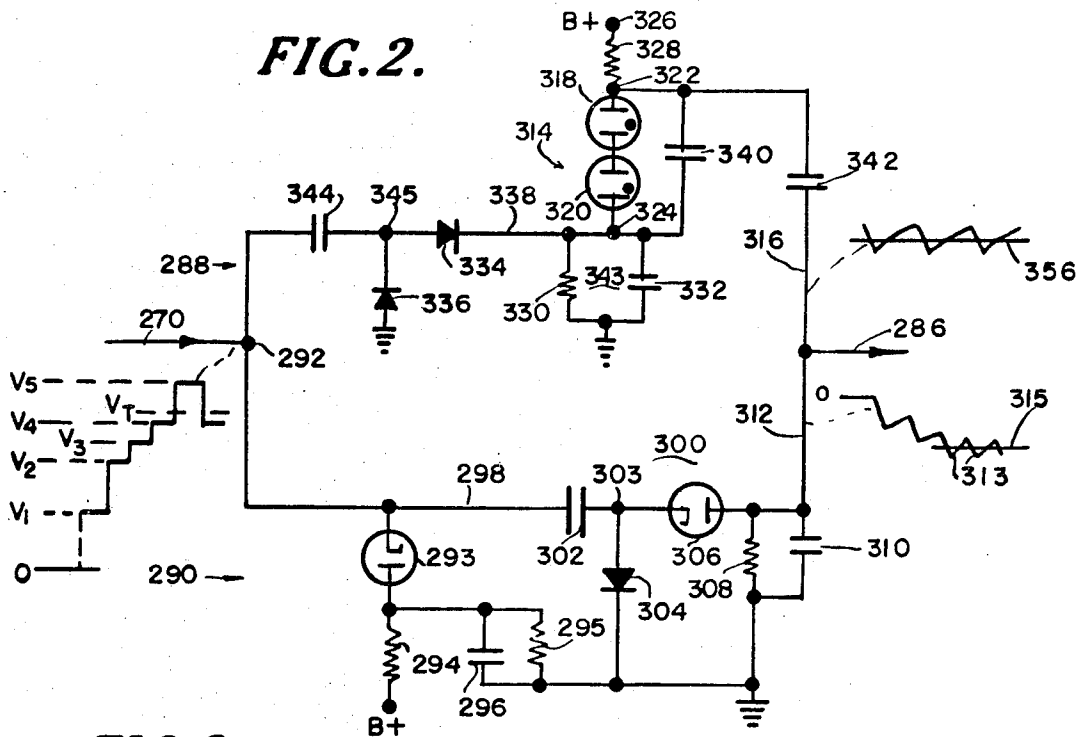


FIG. 3.

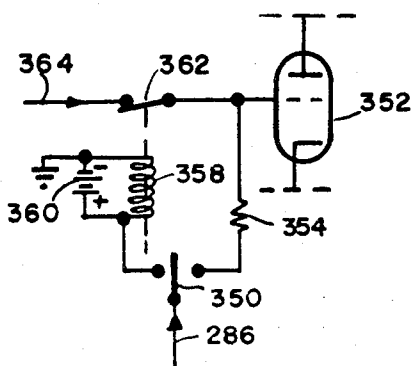


FIG. 5.

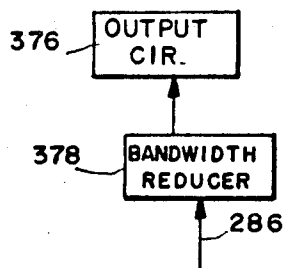
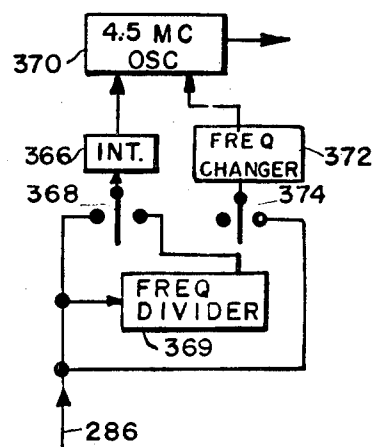


FIG. 4.



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COMMUNICATIONS SECRECY SYSTEM

This invention relates to a decoder which may be employed in a communications secrecy system to increase the coding of the intelligence signals if no decoding or incorrect decoding is effected by the decoder, and particularly to a decoder which is usable in a scrambled television system to effectively code an otherwise uncoded sound signal unless the picture signals are being properly decoded.

In the copending application of Zopf and Shanahan Ser. No. 85,917, filed even date herewith, and also in the Shanahan et al. U.S. Pat. No. 3,538,243, there is a scrambling television transmitter system described which codes the transmission at least partially in accordance with any one of a variety of different code signal combinations representing a dynamic coding schedule. At least a partial representation of the dynamic coding schedule is transmitted in the form of various combinations of groups of different frequency bursts which are termed "control signal combinations" since they can function to control decoding functions. With this invention, the scrambled picture signals may be properly decoded in response to the received control signal combinations if the correct unscrambling code is employed in the decoder, and further in accordance with this invention the transmitted audio signal need not be coded since if the picture signals are not being properly decoded, a signal is derived in the decoder to interfere with and effectively code the uncoded audio signals. This is true whether the unscrambling code is a wrong one of the regular or legitimate unscrambling codes or none of those codes including no code whatsoever.

In a broad sense, the invention provides a decoder which increases the coding of transmitted program signals, whether coded in whole or in part, i.e. whether the picture or sound program signals, or both, are received in scrambled form, if the scrambled program signals are not being properly decoded, and such is its primary object.

Another object of this invention is the provision in a scrambled television decoder of apparatus for causing interference at least with an uncoded audio signal if the coded picture signals are not being properly decoded by the decoder.

Another object of this invention is to provide coding means whereby the decoding control signals associated with a coded signal may be used to provide supplemental coding of a simple nature by sampling for any invalid decoding signal into which the control signals may be incorrectly transformed. Still other objects of this invention will become apparent to those of ordinary skill in the art by reference to the following detailed description of the exemplary embodiments of the apparatus and the appended claims. The various features of the exemplary embodiments according to the invention may be best understood with reference to the accompanying drawings, wherein:

FIG. 1 illustrates a decoder in conjunction with a television receiver and a converter for closed circuit type operation;

FIG. 2 is an exemplary circuit which forms at least part of the interference generator in the decoder of FIG. 1;

FIGS. 3, 4 and 5 illustrate respective circuits which may be employed to use the output pulses from the cir-

cuit of FIG. 2 to effect interference with the received program signals.

In FIG. 1, block 10 indicates television receiver circuits which along with cathode ray tube 12, and deflection coils 14 and 16, form a conventional television receiver such as might be found in any home. As illustrated, the receiver may have its normal input terminal 18 connected to an antenna 20, if such is needed, via switch 19 (which may be within converter 21 if desired) for receiving radiated video signals. In the alternative, the video signals may be coupled to input terminal 18, for closed circuit operation for example, by line 22 when switch 24 is closed and switch 25 is in its rightward position. As is conventional, sweep circuits 26 provide the necessary signals to the horizontal deflection coil 14 and vertical deflection coil 16 for controlling the sweep of the cathode ray beam emanating from cathode 28 in an electromagnetic deflection manner well known in the art.

Converter 21 is preferably employed in a closed circuit system in which it is desired to provide all the video signals for a given program in a frequency spectrum range which is different than any of the normal frequency channels to which receiver 10 is tunable. This is the situation which exists, for example, when it is desired to give to the receiver user a choice of any one of two or more different programs at a time via line 22. In such a case, each different program is assigned its own frequency range and by an appropriate converter range selector (not shown), the selected range, regardless of which one it is, is converted to a predetermined one of the usable frequency channels in receiver 10. It is preferred that the ranges of the different program signals on line 22 be below the lowest frequency channel of the receiver so that the converter always converts the incoming range upward to the same one of the receiver channels to be used. A converter of this sort and means for mixing several sets of different program signals at the transmitter are disclosed in U.S. Pat. No. 3,078,337 to William J. Shanahan et al.

Normally, there is a tube socket connected to the "pin" end of the cathode ray tube. Such a socket is shown at 30, and it conventionally conveys operation potentials over line 32 from the receiver circuits to the cathode ray tube, along with the demodulated or detected video signals on line 34 to an intensity control such as the beam intensity control electrode of the cathode ray tube. In some television receivers, the beam intensity control electrode is the control grid, while in others it is the cathode. Either may be used with this invention, but as illustrated, it is preferred that the detected video signals be coupled to cathode 28. In such a case, control grid 31 is normally connected directly to line 33 which is terminated in the receiver circuits in conventional fashion.

A picture signal decoder with which this invention may be used is shown below dash line 36, and has a single pair of input lines 35 and a single pair of output lines 37, no other connecting lines to the receiver being necessary. The decoder is connected to the receiver preferably by use of a socket adapter 42 inserted between socket 30 and the pin end of the cathode ray tube, so that the video signals on line 34 are intercepted and extracted onto the decoder input line 38 with the video signals then from the decoder being present on

line 40 for direct coupling to cathode 28. When the decoder is not in use, the video signals on line 38 are directly coupled back to line 40 via line 39 and relay switch 46 which is then leftwardly set as illustrated. At the same time, control grid 31 is connected to the receiver output line 33 via relay switch 45. To operate the decoder, a switch 48, which may be disposed externally on the decoder as it might be encased, may be depressed to cause the relay solenoid 50 to be actuated by a potential from source 52, which in turn causes relay switches 25, 45, 46, 54, and 55 to be set rightwardly. This allows a decoder operating potential to be available on line 56 from source 58. This potential may be employed in any desirable manner to provide the biases necessary in the decoder circuitry. The voltage for source 52 may be a battery, or preferably may be obtained from source 58 before switch 54.

When switch 48 is operated so as to cause switch 46 to be set in its rightward position, the video signals on line 38 are conveyed through the signal translating means 60 back to the decoder output line 40. As received at terminal 18, the picture signal components of the video signals are in any one of a plurality of various coded modes due to time shifting of the picture signals relative to periodically recurring synchronizing signal components in the video signal. These same picture and synchronizing signal components, after detection in the receiver circuits, appear on line 34, and consequently on line 38 and the input line 62 of the signal translating means. It is assumed that the picture signals may appear in any one of three different modes, i.e., with no time shifting relative to the synchronizing signals, with some time shifting, or with a second and greater amount of such time shifting. To compensate for this time shifting, the signal translating means includes gates 64, 66 and 68 along with delay units 70 and 72. Therefore, when signals on line 62 are prevented from passing through gates 66 and 68, but not through gate 64 because of an enabling signal on line 74, they appear on the signal translator output line 76 with no time shift effected relative to the synchronizing signals which operate sweep circuits 26. However, when only gate 66 is enabled by a signal on line 78, the video signals will pass through delay 72 to line 76, thereby giving those signals a given, small amount of time shift. Further, when only gate 68 is enabled by a signal on line 80, the video signals will be delayed an amount corresponding to the delay times of delay lines 70 and 72. The decoded video signals on line 76 pass through converter 77 (which may have amplification properties if desired) and, as previously indicated, are directed via switch 46 to line 40, and thence to cathode 28 for a picture presentation thereof on the screen of the cathode ray tube 12.

Since it is desirable to maintain for cathode 28, the DC brightness level given to the video signals on line 34 by the conventional DC reinsertion circuits in the television receiver, and since that level may be lost in the video signal translator 60, means is provided in the decoder to maintain that level. In particular, this means comprises an integrator including resistors 79, 81, and condenser 82. When switch 46 is in its rightward or decoding position, the integrator passes the video signals to ground, but retains the DC voltage level thereof for line 40 whereby that level is reinserted or

recombined with the decoded video signals from switch 46. In its leftward position, switch 46 shorts out the integrator to prevent grounding of any unencoded video signals. An exemplary, without limitation intended, resistors 79 and 81 may each be 330K ohms while condenser 82 is 0.1 uf.

In order to get the enabling signals on lines 74, 78 and 80 to occur mutually exclusively so that only one of gates 64, 66 and 68 is enabled at a time, the following described circuitry may be employed. As indicated above, the present decoder is particularly useful in a scramble television system in which the transmitter provides any number of a plurality of individual signals during each mode determining interval, for example during each vertical retrace period. These individual signals, in one embodiment, are characterized by having different frequencies, though they may be differently characterized as by amplitude differences, etc.

As explained in the above mentioned Zopf et al. application, Ser. No. 85,917, these individual signals are "tones" or frequency bursts which are timed at the transmitter to occur, if at all, respectively between adjacent post-horizontal synchronizing pulses in each vertical retrace interval. Also as referred to in that application, the picture and blanking signals may be amplitude inverted, so the synchronizing signals when added thereto are of sufficient amplitude to rest on the inverted blanking signals at the normal pure white amplitude and extend through the picture signal amplitude range to their normal 100 percent modulation height. The tones or frequency bursts as mixed with the video signal and clipped at the transmitter are generally coextensive in amplitude with the synchronizing signals, so they likewise extend through the picture signal amplitude range in such a case. Consequently, the picture and blanking signals which occur on line 34 from the television receiver circuits are amplitude inverted and include these different frequency tones as they occur during each vertical retrace period. Re-inversion of the picture signals to normal black for black and white for white, is accomplished by inverter 77, which of course may be in line 62 instead. Preferably, it is not in line 38, however, because it is not desired to invert the tones too.

From line 38, all of the video signals thereon, including the tone bursts, are coupled by line 84 to a gated amplifier 86, the output of which is applied to detectors 88, 90, 92, 94, 96, 98 and 100. The output signals from amplifier 86 may be coupled to detectors 88-100 in parallel, or as illustrated, the detectors may be serially connected to a source of B+ at terminal 102 for energization of the plate circuit of amplifier 86. Each of the detectors may be similarly constructed in accordance with the detailed illustration for the detector 88 or 100. In any case, as in detector 88, the output signals from amplifier 86 are connected to a tuned circuit 104 the coil of which may be the primary winding of a transformer 106. From the mid-point of the primary winding, there extends an output line 108 which is coupled to the next detector at its primary tuned circuit as shown for example for tuned circuit 110 in detector 100. The secondary winding of transformer 106, which preferably has a 3:1 turns ratio with respect to the primary winding, is also tuned by a condenser 112 thereacross, and the output of the secondary tuned cir-

cuit is coupled to a pulse forming circuit 114. As indicated in detector 88, this pulse former or generator may include two neon glow discharge tubes 116, 118 (for example, of the NE-2 type), which are serially connected between ground and B+ via condenser charging resistor 120. The output from the secondary tuned circuit may be connected directly to the connection between the neon bulbs, or it may be coupled thereto by aluminum foil 122 wrapped around the bulbs. In any event, whenever the primary and secondary tuned circuits are at resonance, a sufficient output voltage is impressed on the neon bulbs to cause them to fire. This effects a discharge of condenser 124 which otherwise is charged by current through resistor 120. Accordingly, a pulse is generated and applied via line 126 to the decoding switch matrix 128.

Each of the detectors 88-100 is tuned to a different frequency, for example frequencies f_1 - f_7 , respectively, with both tuned circuits in any one detector being tuned to the same frequency, for detecting any occurrence of the respective individual signals which may be present during the vertical retrace intervals. As will be noted, detector 100 is similar in detail to detector 88 but employs only a single neon bulb 139 (still of the NE-2 type, for example) in its signal forming circuit 140, though it could as well use two as the other detectors can use one. Use of two neon bulbs instead of one provides for a larger voltage swing between "off" and "on" conditions. The outputs from detectors 90-98 are applied via lines 130, 132, 134, 136 and 133 to matrix 128, and as illustrated the output of detector 100 as it occurs on line 142 is DC coupled by resistor 143 to neon bulb 144.

As explained in the above mentioned copending application, Ser. No. 85,917, a given one of the individual signals (tones or frequency bursts) may be made to occur during each mode determining interval, i.e., during each vertical retrace period. For a given program, this given individual signal has the same frequency, but from program to program, the frequency of this signal may be varied. Preferably, this individual signal which occurs during each vertical retrace interval, always occurs at the same time during each of such intervals, and further, is preferably always the last one of any of the individual signals to occur. That is, if there are seven different tones possible and seven (or nine, as in the above mentioned Zoph et al. application) post-horizontal "slots" in which the tones may occur with six of the tones occurring randomly, the other tone preferably occurs every vertical retrace interval in a predetermined one of those slots, and more preferably in the last one thereof. Since it always occurs at a given time, this tone signal, whether it occurs last or not, may be employed to enable and disable the gated amplifier 86 so that it is open substantially only during the time period in which any of the individual signals might occur during a vertical retrace interval. By so operating amplifier 86, the detectors are prevented from providing an output signal in response to picture intelligence signals which may be of frequencies similar to that to which one or more of the detectors is tuned. As will be later apparent, this gating of amplifier 86 prevents changing of the decoding pattern except during the mode determining intervals.

Assuming that the frequency burst to be employed for gating amplifier 86 has a frequency of f_7 , the output of detector 100, when this frequency burst is received, causes a disabling signal on line 146 so that amplifier 86 is thereafter closed until near the beginning of the next mode determining interval. In particular, the signal forming circuit 140 is a gated relaxation oscillator or sawtooth waveform generator. In the absence of the detection of a tone having an f_7 frequency no signal is present on line 147 from the tuned secondary 148, so neon bulb 139 is then in a nonconductive condition. During such time, condenser 149 charges through resistor 150 from B+ at terminal 102. The resultant linearly rising voltage on line 142 eventually obtains an amplitude sufficient to fire neon bulb 144 (of the NE-96 type, for example) which in turn causes a sharp rise in voltage across its output resistor 152. This new voltage level is maintained as long as bulb 144 remains firing, but that is only until a tone of frequency f_7 is detected. The detection of such a tone raises the voltage on line 147 in detector 100 considerably, causing bulb 139 to fire. This in turn effects a rapid discharge of condenser 149 and immediately lowers the voltage applied to bulb 144 below its extinguishing point. Condenser 154 across resistor 143 improves the fall time of the sawtooth wave as coupled to bulb 144. As soon as the f_7 tone subsides, condenser 149 begins charging again. The charging constants for that condenser are predetermined such that from the beginning of a charging time due to the ending of an f_7 tone in one vertical retrace interval, the charge builds up relatively slowly during the remainder of that interval and the next following vertical trace interval, and does not reach a potential sufficiently high to cause bulb 144 to fire until sometime before any tone could possibly arrive in the very next following vertical retrace interval. Preferably, the parameters are set so that bulb 144 fires at, if not just slightly before, the beginning of that next vertical retrace interval. As soon as bulb 144 fires, the sawtooth applied to it flattens out, as illustrated, and stays relatively flat until the f_7 tone occurs in that next vertical retrace interval, so it may be approximately the last 5 (or less) to 10 percent of the sawtooth wave which effects the illustrated positive output pulse on line 155. This pulse may be, for example, approximately 1,000 usec. in duration, and when coupled via condenser 156 and the phase splitter 158 to line 146, without inversion as illustrated, will enable amplifier 86 during its duration. During the absence of a pulse on line 155, which is at least during the whole of each vertical trace interval (except perhaps the last few lines thereof), amplifier 86 is disabled. Since normally the vertical retrace period is 21 lines long, and since any frequency bursts which occur during each such interval occur fairly late therein, i.e., during the post-horizontal synchronizing signal portion of the interval, it is apparent the beginning of the flat portion of the sawtooth wave need not be sharply defined and that the flat portion may be reasonably wide without fear of any picture intelligence signals passing through amplifier 86. However, as above indicated it is preferable to cause bulb 144 to fire just slightly, say one or two lines, before the beginning of each vertical retrace interval. It is not necessary to enable amplifier 86 so early, but when the pulse on line 155 is also effectively employed to generate a vertical

blanking signal as latter described, it is desirable to have the pulse start that early.

Phase splitter 158 also provides an output pulse which is the inversion of the pulse on line 155. The resultant negative pulse on line 160 may be directed via line 162 to the decoding switch matrix 128, along with the other detector output signals on lines 126, 130-138. The signal on line 162 may be employed via the matrix for any desired decoding purpose consonant with the transmitter coding.

In reality, matrix 128 is in effect two separate switching matrices, but for convenience is illustrated with two portions 164, 166 as divided in an exemplary manner by dash line 168. Either portion of the matrix may include a plurality of conventional variable switches set before hand in accordance with a given code, but each is preferably a portion of a coded card unique in its coding for the particular program instantly being viewed. More preferably, the decoding switch matrix 128 comprises a coded printed circuit card and card sensing means such as brushes, for example as described in the Shanahan et al. U.S. Pat. No. 2,977,434. In any event, section 164 of the matrix routes the signals on the input lines from the detectors including line 162, in a predetermined manner to the output lines 170, 172, 174, 176, 178 and 180. These lines are connected as input lines to a respective plurality of stores, which in the instant example may be the "0" and "1" sides of flip-flops 182, 184 and 186. Conventional operation of the flip-flops is effected, i.e., a signal to the "0" side thereof effects a relatively high level output from the "0" store and a relatively low level output from the "1" store, while a signal applied to the input of the "1" store effects a reverse output level situation.

The output of each side of each flip-flop is coupled to at least one input of section 166 of the decoding switch matrix. Preferably, each flip-flop output line is effectively divided into at least three sections by an isolating circuit, so that any flip-flop output line potential may be variously mixed with any of the other output line potentials by the particular routing then existing in the switch matrix portion 166, to form the actuating signals for the video signal translator 60 mutually exclusively on lines 74, 78 and 80. That is, as indicated for flip-flop output line 188, an isolation circuit 190 may be employed to divide the line into three sections 192, 194, 196 by respective resistors in circuit 190. Circuits 198, 200, 202, 204 and 206 may be similar to circuit 190 in that they may employ isolating resistors, but any of the isolating circuits may use diodes or neon bulbs, for example, instead of resistors.

In order to prevent the necessity of making connections internally of the receiver circuits 10 to obtain signals for blanking purposes, and particularly because it often happens that when the contrast control of the television receiver is turned up high the blanking signals are somewhat squashed so as not to appear to a sufficient degree in the video signal as it occurs in the output of inverter 77, it is desirable to manufacture vertical and horizontal blanking signals in the decoder itself. For vertical blanking, this may be easily obtained by connecting the output of circuit 158, as present on line 160 in the form of a negative pulse, to a blanking circuit such as monostable multivibrator 208 via line

210. The leading edge of this pulse triggers the multivibrator to its unstable state with the remainder of the pulse holding it there. When the pulse ends, the multivibrator changes back to its stable state after a given time determined by the delay time of the multivibrator. This delay time is so set that the end of the generated blanking signal, as that signal occurs in a negative pulse form on line 212, corresponds to the end of the vertical retrace time. By virtue of the multivibrator output being coupled by line 212 and switch 46 to line 213 and grid 31, the resultant blanking of the cathode ray screen during each vertical retrace interval prevents any of the tones or other signals in the video signal from appearing as white marks across the screen during the vertical retrace interval. As an alternative, the output of multivibrator 208 may be coupled with opposite polarity, to cathode 28 via relay switch 46 to effect the desired blanking, in which case the control grid line 33 can be connected directly to grid 31 instead of through the decoder.

To obtain horizontal blanking signals, of course the horizontal flyback pulse in the television receiver circuits may be directly employed, but in an effort to prevent the necessity of making connections within those circuits, the horizontal blanking waveform is generated by electrostatic induction. That is, the neon glow discharge tube 214 is disposed in the area of the radiated or electrostatic field of the horizontal deflection yoke 14, so that when the radiated field therefrom occurs due to the normal flyback of the conventional sawtooth signal driving that yoke, a sufficient breakdown voltage is electrostatically induced momentarily across the neon bulb, causing it to conduct. The radiated flyback pulse may be in the order of 1,000 volts, but of course only a fractional part of that voltage is effectively coupled to the neon bulb itself. However, it has been found that there is sufficient voltage present to fire the bulb, especially when it is, for example, of the NE-2 type. Bulb 214 is employed as the discharging device of a relaxation oscillator or sawtooth generator which otherwise includes the integrator or resistor-condenser network 216. Resistors 218 and 219 as coupled between B+ and ground, act as a potential divider to maintain the voltage across bulb 214 below its firing point in absence of a radiated flyback pulse. During horizontal trace times, condenser 220 is charged substantially linearly by current through resistor 221, to effect a rising sawtooth waveform, which has a sharp negative-going drop when tube 214 fires. The sawtooth signal is conveyed to monostable multivibrator 208 over line 223 and may be AC, though preferably DC, coupled thereto, and is preferably clamped at its lowest voltage level to ground, all by means not shown. While the negative pulse on line 210 may be coupled to one grid (or like element) in the multivibrator for vertical blanking purposes, the positive sawtooth pulse on line 223 is coupled to the other grid to effect a horizontal blanking signal on line 212 of the same polarity as the vertical blanking pulses thereon. This is accomplished by allowing the positively rising portion of the sawtooth signal on line 223 to trigger multivibrator 208 to its unstable state slightly before the end of the positive sweep of the sawtooth, say 5 percent before, by properly setting the multivibrator biasing requirements and phasing the input signal thereto by adjusting the

capacitance of condenser 220. When the inherent delay time passes, the multivibrator returns to its stable state, ending the horizontal blanking signal. The output of the multivibrator is consequently properly timed to coincide with the normal horizontal blanking interval.

As much of the picture signal decoder as has been above described relative to FIG. 1, is disclosed in the Carwin et al. copending application, Ser. No. 86,115 filed even date herewith. In the aforementioned copending application, Ser. No. 85,917 and U.S. Pat. No. 3,538,243, there is described a scrambled television transmitter system with which the decoding system of the present application may be employed, though limitation thereto is not intended. In those transmitter systems, and in many other types, and one of a large variety of decoder control signal combinations, for example different groups of frequency bursts or tones may be transmitted during each vertical retrace or other mode determining interval, to represent at least in part the dynamic coding, i.e., in a past history sense or not as desired, of the video signals transmitted in the next vertical trace interval. At the receiving end then, the received tones or control signals are employed to effect decoding as above described, but it is necessary to employ the proper code to unscramble the coded video signals, or else the decoder will operate as though it were receiving incorrect control signals, thereby preventing an unscrambling of the video signals. As above indicated, one of the main purposes of the present invention is to eliminate the need for coding the audio signals at the transmitter by interfering with the otherwise uncoded audio signals at the receiving end to render them undesirable if anything but the correct unscrambling code is employed with the decoder.

To effect this purpose, at least one of the output lines from each of the flip-flops 182, 184, 186 has connected thereto another resistor 262 which in turn may be connected to a respective input terminal of section 166 of the decoding switch matrix. As illustrated, all six of the flip-flop output lines are respectively coupled to the matrix terminals 250, 252, 254, 256, 258 and 260 via the six respective resistors 262. These resistors 262 are in addition to those which may be in the previously mentioned isolating circuits 190, 198 200, 202, 204, 206. As the resistors in those isolating circuits may be replaced by diodes, neon bulbs, cathode followers or any other desirable type isolators, so may resistors 262; but in all instances, resistors are preferred for they are more economical and may be operated at lower voltages than neons for example. Three of the terminals 250-260 are illustrated connected as by the dotted lines (for example by a printed circuit card in the matrix) to three other matrix terminals 264, 266 and 268, with these latter three terminals being connected together permanently, or impermanently by way of the switch matrix if desired. From these three terminals, there is an output line 270 which may be directed back through the switch matrix if desired, and thence to an interference generator 272, a detailed description of which is given later. The output of the interference generator, or any intermediate point in the generator may be routed through the decoding switch matrix as via terminals 274, if desired, so that it may be effective or not in accordance with whether or not the terminals 274 are interconnected by the instant circuit connec-

tions in the matrix. When these terminals are connected, the interference generator output as present on line 276 may be employed to interfere with either the sound program signals or the picture program signals, or both, as desired. For example, when switch 278 is set to the right, the interference signal may be operative via line 280 to change the signal emanating from cathode 28 so as to increase the coding of the picture if a wrong one of a multiplicity of possible unique unscrambling codes is effected in matrix 128, or if no one of such possible codes is employed therewith. If switch 278 is positioned to the left so as to apply the interference generator output to line 282 and thence to converter 21, then one or the other or both of the picture and sound signals may be interfered with according to the circuitry within interference generator 272. In a similar manner, either one or both of the picture and sound signals in receiver 10 may be interfered with, when switch 278 is in its center position and switch 55 is to the right, according to the structure of generator 272 and the point in the receiver circuits to which line 284 is connected.

The interference generator 272 of FIG. 1 may include circuitry such as that shown in FIG. 2. The upper half of FIG. 2, i.e., the circuitry above input line 270 and output line 286 may be considered a pulse generator 288 which generates pulses continuously when the signal on line 270 does not change from time to time, due, for example, to no code whatsoever being employed with switch matrix 128 of FIG. 1. On the other hand, the circuitry below input line 270 and output line 286 includes a pulse generator 290 which generates pulses of given amplitude only if a wrong one of the possible legitimate or unique unscrambling codes is employed with switch matrix 128.

With an output from each flip-flop 182, 184, 186 of FIG. 1 being averaged with the others via the three of resistors 262 that are instantly connected together by the matrix and to input line 270 in FIG. 2, there is a possibility of four different voltage levels which can appear at terminal 292. That is assuming for example that any one flip-flop output load may be at 70 volts when the flip-flop is in one state and at 30 volts when it is in its other state, then according to the instant states of all three flip-flops the average of the output voltages therefrom (one from each flip-flop) can be either 30, 43, 57, or 70 volts. Further, if the outputs of only two flip-flops is being averaged for input terminal 292 because no connection is being instantly made in the matrix to either of the resistors 262 connected to the outputs of the third flip-flop, then the possible voltage levels at terminal under such conditions would be 30, 50, or 70 volts depending on the state of each of the two flip-flops whose outputs are averaged. If only one flip-flop has an output connected to terminal 292, then the voltage level thereat will be either 30 or 70 volts, but if none of the flip-flop outputs is coupled to that terminal then its voltage will be zero.

It is apparent then that there may be any one of six different voltage levels which could appear on the input line 270 to FIG. 2 according to which, if any, of the outputs from flip-flops 182, 184, 186 are averaged and coupled thereto and according to the state of each so coupled flip-flop. Specifically, in keeping with the above example, the voltage level at terminal 292 may be, at any one instant, either at 0, 30, 43, 50, 57 or 70

volts. The 0 level input can result only if the flip-flop outputs themselves are zero volts due for example to their power supplies being off, or if none of their outputs is coupled to FIG. 2 because of no decoding card for example being inserted into the switch matrix or because an inserted card does not establish connection between any of resistors 262 and matrix output line 270.

Any one of the other five voltage levels may occur on that output line, however, according to the instant state of the flip-flops and which one or ones of the resistors 262 is then coupled to output line 270. As previously explained, the instant state of the flip-flops is determined by the last group of control tones received by amplifier 86, and further by the routing of detected tones to the flip-flops as effected by section 164 of the switch matrix, for example by the particular connections therein made by a printed circuit card. At the transmitters in either of the aforementioned application Ser. No. 85,917 and U.S. Pat. No. 3,538,243, there are a plurality of flip-flops the combined output conditions of which at the end of each vertical retrace interval (and after any necessary change in the effective condition of any of the flip-flops during that interval to effect mutually exclusive gating operations as described in those applications) are employed in connection with a static coding system such as switches to code the video signals during at least the following vertical trace interval. The combined flip-flop output condition may change from interval to interval and represent the dynamic coding schedule, which is preferably random. That dynamic code is further represented, at least in part, by the tones or frequency bursts transmitted each vertical retrace interval, so it will be appreciated that any one of great variety of control tone groups may be received by the decoder during each vertical retrace interval. Following any such interval then, the picture signals are decoded in accordance with at least the last received group of control tones, but only if the correct unscrambling code is employed in matrix 128. This will not be the case, for example, if a wrong stable state combination exists as to flip-flops 182, 184, 186. As will be appreciated, the number of flip-flops determine the number N of flip-flop output conditions which may exist, there being eight such stable state combinations for three flip-flops in FIG. 1. Generally speaking, if N such combinations are possible, at least one if not more is an invalid decoding signal combination when the transmitter coding is such as to cause that type of operation. For convenience any invalid decoding signal combination from the flip-flops is herein referred to as the Nth flip-flop stable state combination, no reference thereby being made to the last in line of the possible combinations if any order could be assigned to them, but just to any predetermined one or ones of the N possible combinations. If the routing of the detected tones to the flip-flops by section 164 of the switch matrix is correct, then those flip-flops are restricted from and will never assume any invalid or Nth stable state combination. However, if the detected tones are translated to the flip-flops incorrectly as by use in the matrix of a wrong code (i.e., by insertion for example of a printed circuit card which interconnects the input and output terminals of matrix section 164 incorrectly, including perhaps not connecting some or all

which should be), then an Nth stable state flip-flop combination may be recurrently effected as long as a wrong code is used. That is, when a wrong code is actually in use, the flip-flops may change from one state combination to another with every change in combination of received tones (though change in flip-flop states does not necessarily occur even if tone combinations change since a wrong code may mean that the switches in matrix section 164 whose outputs should be connected to flip-flop inputs are actually not effectively so connected or are effectively set to an open position, for example by an inserted printed circuit card not making any connection between the detector outputs and flip-flop inputs) but as the flip-flops change from time to time they will provide invalid decoding signal combinations now and then. Of course, all of the decoding signal combinations from the flip-flops during the use of a wrong unscrambling code are "wrong" from the standpoint that they occur at the wrong time to decode the picture signal properly though some otherwise may be valid decoding signal combinations. Any decoding signal combination, however, which should never occur, when decoding is to proceed in a given manner, because then it could never effect proper decoding, is an "invalid" decoding signal. The recurrence rate of an invalid flip-flop state combination may vary from time to time as long as the transmitted tone groupings vary randomly, but it recurs frequently enough to be usable as a source for increasing the coding of the program signals at the receiving end as long as a wrong unscrambling code is employed in matrix section 164.

Assuming the eight possible flip-flop state combinations as representable by the eight successive binary numbers 000 through 111 and that a 0 represents 30 volts output on one of the flip-flop leads while a 1 represents a 70 volt output, then if the flip-flops step through all eight state combinations there will be only one of those combinations (000) which will cause a 30 volt output level on line 270 in FIG. 1. Similarly, there will be only one of the flip-flop state combinations (111) which will cause a 70 volt output level on that line. Three other of the eight combinations will cause a 43 volt level on output line 270 while the remaining three combinations will effect thereon a 57 volt level. So, if it is the 000 flip-flop combination which should not occur but does due to a wrong code being employed in matrix section 164, then the interference generator 272 of FIG. 1 should respond to a 30 volt level on its input line 270 to cause interference with the program signals. On the other hand, if the 111 flip-flop combination is the one which recurs only when a wrong unscrambling code is employed, then generator 272 should cause interference in response to a 70 volt level on its input line 270. The part of the interference generator illustrated in FIG. 2 and referred to as pulse generator 290 is an embodiment which responds to recurring maximum voltage levels (e.g., 70 volts) rather than recurring minimum levels (e.g., 30 volts) for generating pulses when the wrong code is in use in matrix section 164. However, it will be apparent from this disclosure to one of ordinary skill in the art, how generator 290 can be modified to respond to recurring minimum levels if that level is the one which does not occur when the correct unscrambling code is employed.

Before describing FIG. 2 in detail, one more point should be made, and that is that even though the correct unscrambling code is effected in switch matrix section 164, still the maximum voltage level (or minimum voltage level if operating in that mode) will occur on the interference generator input line 270 if the unscrambling code employed in the other (output) section 166 of the switch matrix is incorrect. That is, as above described, if only one of resistors 262 is coupled via the matrix to line 270, the voltage thereon will vary only as between two levels, i.e., will be either 30 volts or 70 volts in keeping with the above presumed minimum and maximum voltage levels. So regardless of whether the pulse generator 290 of FIG. 2 responds only to a minimum or maximum voltage level, such a wrong or incomplete connection in switch matrix section 166 will cause operation of the interference generator. Similarly, if only two different flip-flops rather than three have a respective output coupled to the interference generator input line 270, the voltage on that line will be at different times both the maximum and minimum levels whether or not those respective outputs are the correct ones for the two respective flip-flops. Also, even if three flip-flop outputs are coupled to line 270 by the matrix, one of the maximum or minimum voltages levels or both will occur thereon unless those three outputs are the proper ones, i.e., the ones that should be so coupled in accordance with the correct unscrambling code.

For the foregoing reasons, the voltage on line 270 may be zero or any one of five levels V_1 to V_5 as indicated in FIG. 2. Though the input waveform there shown is in successive steps upward, in reality the various levels V_1 to V_5 if and as they occur will not likely succeed one another in that order since their order is preferably random. Neither will the time the different V_1 to V_5 levels exist be necessarily equal since their on times are also preferably random. Nevertheless the illustrated waveform will properly serve for the following description of FIG. 2.

As above indicated, pulse generator 290 operates to generate pulses for recurrent maximum (rather than minimum) voltage levels on line 270. Therefore, pulses are to be generated thereby when the V_5 level recurs on line 270, and not when the V_4 or lower levels recur thereon. In other words, pulses are to be delivered to output line 286 by generator 290 only when there is a recurrence on line 270 of a voltage which is above the V_4 level. Though the V_4 level itself could theoretically be employed as the threshold operating level for generator 290, for practical considerations including tolerance the threshold level is preferably set as a voltage somewhere between the V_4 and V_5 levels, say at the illustrated V_T level slightly above the V_4 level.

Diode 293 in FIG. 2 with its plate connected to the potential determined by a voltage divider including resistors 294 and 295 the latter of which is in parallel with bypass condenser 296, establishes the above mentioned V_T threshold level and effectively gates to its output line 298 only those input signals which have a voltage above that V_T level. As above explained when the wrong code is being employed in either section of the decoding switch matrix 128 of FIG. 1, the V_5 voltage level will be recurrently present at terminal 292 in FIG. 2 as long as that wrong code is still employed. There-

fore, line 298 will have recurrent pulses thereon during such times. The circuit 300, which is between line 298 and output line 286, is effectively a step integrator in that it integrates each successive pulse on line 298 and steps the output voltage to different initial voltage values for, say, the first two of such pulses, then steps to a further initial voltage value for the next pulse and back to that further value or thereabouts for each of the succeeding pulses on line 298 assuming each such pulse follows its predecessor within a given time.

During the absence of a pulse on line 298, the voltage on that line is the threshold voltage V_T due to the limiting or clipping action of diode 293. Consequently, as a discussion starting point, condenser 302 may be considered as initially charged to the threshold voltage with its left side positive and junction 303 at ground potential due to the orientation of diode 304 and its connection to ground. Then when a positive pulse appears on line 298, the charge on condenser 302 increases to voltage V_5 , but junction 303 remains at zero volts since the increase is a positive one. However, when the positive pulse on line 298 terminates the potential across condenser 302 reduces back to the V_T voltage. This reduction cannot take place instantaneously so junction 303 immediately goes negative by an amount equal to $(V_5 - V_T)$ and proceeds back to zero volts as the potential across condenser 302 reduces to the V_T value. As soon as junction 303 becomes negative, diode 306 becomes conductive drawing current upwardly through condenser 310 (rather than through resistor 308 since the impedance of the condenser is much lower considering the rapid rise time involved). Consequently, condenser 310 begins charging rapidly (its charging time constant may be in the order of 100 usec. for example) and a resultant sharp drop in voltage occurs on line 312. When the negatively increasing voltage across condenser 310 becomes larger in amplitude than the decreasing negative voltage at junction 303, diode 306 stops conducting. Condenser 310 then begins discharging through resistor 308 relatively slowly, for example, the discharging time constant may be approximately 0.25 sec. If a second pulse occurs on line 298 and ends before condenser 310 becomes fully discharged again, then the trailing edge of that second pulse effects a charge of condenser 310 to an initial negative voltage level which is greater than that effected by the first pulse on line 298. Similarly, if a third pulse occurs on line 298 and ends before condenser 310 can discharge to a negative amplitude less than that to which it discharged at the beginning of the second pulse, then the termination of the third pulse causes condenser 310 to charge again with an initial voltage level more negative than that to which it stepped at the end of the second pulse, etc., until successive pulses 313 (or alternate ones perhaps) effectively oscillate about line 315 as long as the trailing edges of the pulses on line 298 recur frequently enough to cause same which is generally the condition when a wrong code remains to be employed in the matrix of FIG. 1.

It is desired that condenser be stepped to at least one initial voltage less than that corresponding to the charge related to line 315 because even when the correct code is being employed in the matrix at least one transient type pulse may occur on line 298 due to the

flip-flops changing state during a vertical retrace interval. Such a condition will not be sufficient or recur frequently enough however, to cause a stepping of condenser 310 to its line 315 charge voltage. For safety's sake, the circuit may be made such that condenser 310 will not step thereto unless three successive pulses occur on line 298 and even then the last two of such pulses would have to terminate within a given time after its predecessor terminated in order to effect a charge of condenser 310 to the line 315 level. As above indicated, the charging circuit associated with condenser 310 effects a relatively fast charge condition, but the discharge thereof is relatively slow. Exemplary values for resistor 308 and condenser 310 are 1.2 megohms and 0.25 microfarads. Pulses 313 will continue to occur as long as any wrong unscrambling code continues to be effected in the matrix of FIG. 1 as by any incorrect, or lack of proper interconnection therein.

From the foregoing, it will be appreciated that step integrator 300 is effectively a step counter with provisions for preventing the output voltage from being held substantially constant as is the usual case with a step or storage type counter which normally includes in its output circuit only a condenser such as condenser 308 rather than also a resistor in parallel therewith. As between the M different possible voltage levels V_1 - V_s possible on line 270, it effectively counts the occurrence thereon of only one of those levels. In the specific example illustrated, that is the V_s level, though as above indicated it could be the V_1 level if minor changes such as reversing diode polarities were made. In any case, the Mth level is the one effectively counted.

The circuit of FIG. 2 as so far described in detail is sufficient to cause pulses on line 286 any time any effective switch of the matrix is incorrectly positioned, i.e., open when it should be closed or vice versa, or connects the wrong matrix terminals. This may occur when a wrong decoding card is inserted in the matrix, or when no card is inserted therein, but a user attempting for example to pirate the picture signals makes one or more wrong connections between the matrix terminals or makes less than all the necessary correct connections. As will be hereinafter described, the pulses 313 resulting under any such conditions may be employed to cause interference with the program signals and especially any otherwise uncoded audio signals so they may not be pleasantly heard until the proper code is employed to effect unscrambling of the picture signals. Pulses 313 will not be generated, however, if no one of the flip-flop outputs is coupled to input line 270, or if they are but the flip-flops are not caused to change state from time to time, i.e., if the detected tones are not coupled to the flip-flop inputs. In other words, there will be no pulses 313 if all switches in matrix section 164 and/or 166 are open which would be the case if no decoding card were employed and no pirating were attempted. But then, if the audio signals are received uncoded, all a decoder user would need to do to listen to the sound part of any transmitted program without interference being imparted thereto, is turn on his receiver-decoder and prevent the flip-flop input and/or output signals from being translated at all as by not inserting any decoding card into his decoder.

To prevent this, the interference generator 272 in FIG. 1 may have a second pulse generator, which causes recurrent output pulses while the potential on line 270 somehow changes but stays below the minimum voltage V_1 , or that second generator may be embodied such that it causes recurring pulses if there is no substantial change in the potential of line 270 after a predetermined time whether that potential is zero or any of the other potential levels which can occur thereon. Either type embodiment is usable when the flip-flop outputs to resistors 262 are routed through the matrix, but the latter embodiment is more advantageous than the former under the conditions of none of the resistors 262 being connected to the matrix but three of those resistors, one from each flip-flop, being permanently connected together outside the matrix and directly to the interference generator input line 270. These conditions are the ones presently contemplated, rather than resistors 262 being coupled to the matrix as illustrated, so the second pulse generator 288 in FIG. 2 is designed to provide recurrent output pulses onto line 286 if the voltage on input line 270 does not change from whatever it might be (0, V_1 , V_2 , etc.) to another voltage level every so often.

These pulses may be generated by any type of inhibitable free-running oscillator such as the relaxation oscillator 314 in FIG. 2. This relaxation oscillator is of the neon glow discharge lamp variety which provides recurrent sawtooth type pulses on line 316 as illustrated by the waveform associated with that line. In general, the discharge device need comprise only one of the neon bulbs 318, 320, though two are preferred to provide a larger voltage swing between the off and on conditions of the relaxation oscillator. These bulbs, each of which may be of the NE-2 type, are conductive only if a predetermined potential is impressed across them, i.e., between junctions 322 and 324, and this is accomplished by applying B+ between terminal 326 and ground. The B+ voltage must of course be greater than that necessary to make the neon bulbs fire, since there is a voltage drop across resistor 328 and the DC impedance presented by the parallel combination of resistor 330 and condenser 332, which as a combination are in series with the neon bulbs via junction 324. As soon as the B+ voltage is applied, the neon bulbs become conductive if junction 324 is not being held at too high a potential as by an existing substantial charge on condenser 332, and current flows through resistor 330. Condenser 332 consequently charges causing an increasing voltage thereacross which at a given point raises the voltage at junction 324 sufficiently to cause the voltage directly across the neon bulbs to be decreased beyond their extinguishing point. Consequently, the neon bulbs become non-conductive, and the charge on condenser 332 discharges via resistor 330 in parallel with the back impedance of diodes 334 and 336. As soon as that condenser discharges sufficiently to lower the voltage at junction 324 to a point which provides the necessary firing potential across the neon bulbs, they then again become conductive to effect another similar cycle. In other words, the neon bulbs are alternately conductive and non-conductive until such time as they are inhibited by an input signal on line 338. The output of the relaxation oscillator 314 is coupled via condensers 340 and 342 to output line

286. The main purpose with the neon bulbs 314 an oscillatory circuit of the conventional variety to assist in effecting the sawtooth pulses. Condenser 340 may be eliminated if desired, though its presence is preferred to provide better stability and a suitable low oscillation frequency; and in such an instance the RC network 343 may be considered primarily an integrating circuit operative particularly as part of the step integrator next to be described and secondarily as an aid to effecting oscillation.

The circuit including condenser 344, diodes 334, 336, resistor 330, and condenser 332 may be considered a step integrator similar to circuit 300 previously described except that it counts leading edges of positive-going signals instead of trailing edges as circuit 300 does. Whenever the voltage on line 270 substantially increases from whatever it might have been (0, V_1 , V_2 , V_3 or V_4 volts), the anode of diode 334 immediately becomes positive relative to its cathode and current flows downward through resistor 330 causing condenser 332 to charge until diode 334 is cut off by the voltage at junction 324 becoming larger than that at junction 345. If condenser 332 was not already charged to a voltage above that which presents firing of neon bulbs 318, 320, it charges to and beyond the voltage when diode 334 is conductive. When that diode is cut off, condenser 332 begins discharging mainly through resistor 330. If no further positive going voltage excursion appears on line 270 before discharging of the condenser reduces the voltage at junction 324 to that which will allow the neon bulbs to fire, then those bulbs become conductive and the relaxation oscillator begins operating. However, if the correct code is being used in the matrix of FIG. 1, or even if it is not but the matrix connections are such as to allow the voltage on line 270 to change from time to time in response to changing groups of detected input signals to the matrix and consequent variation in the outputs of one or more of flip-flops 182, 184, 186, the voltage on line 338 is maintained high enough to prevent the potential across bulbs 318, 320 from becoming sufficient to allow firing thereof. Consequently, under such conditions there are no output pulses delivered to line 286 via condenser 342.

The output pulses available on line 286 of FIG. 2 may be employed in any one of a number of ways to increase the coding of the program signals. That is, either the picture or sound program signals or both, may be interfered with by the pulses on line 286 which occur any time other than when the correct unscrambling code is employed. One form of interference may result from causing the picture of audio signals or both to be repeatedly interrupted, so as to be converted to visual display or sound intermittently.

This may be accomplished as shown in FIG. 3. With switch 350 in a rightward position, the pulses on line 286 as coupled to the grid of tube 352 via resistor 354 can cause that tube to be biased off recurrently while the pulses on line 286 are more negative in amplitude than a given amount such as that indicated by lines 315 and 356 on the waveforms respectively associated with lines 312 and 316 of FIG. 2. In like manner, if switch 350 of FIG. 3 is positioned leftwardly, relay coil 358 which is normally energized by battery 360 to effect a closing of relay switch 362, may be recurrently de-

energized by the pulses on line 286 when they reach a given negative amplitude. Alternatively, relay 358 may be sufficiently fast operating to follow the voltage excursions about lines 315 and 316 in FIG. 2. In either case, tube 352 is caused to be alternately conductive and non-conductive of any signal on its grid input line 364. Tube 352 may be any tube or like component in either the converter 21 or receiver circuits 10 of FIG. 1. For example, it may be a preselector amplifier, a mixer, or local oscillator. If it is any of these three in either the converter or receiver circuits, then both the audio and picture signals will be repeatedly interrupted once per pulse on line 286, effecting a "motor-boating" condition and preventing the sound from being received, except sporadically, in any intelligible form and actually increasing the degree of coding of the picture.

Another way to cause interference especially with the audio signal is to produce a strong oscillation of substantially the same frequency as the sound carrier frequency, for example 4.5 mc. This is illustrated in FIG. 4. Successive pulses arriving on line 286, may be integrated in integrator 366 when switch 368 is positioned leftwardly, to key on oscillator 370 the output of which is made strong enough to feed through the receiver to produce interference with the sound signal sufficient to render it unusable. To further the degree of interference, oscillator 370 may be caused to key on and off at an annoying rate. This may be accomplished by moving switch 368 to its rightward position so that the pulses on line 286 can be counted down, periodically or randomly as desired, by frequency divider 369, so that the integration thereof is insufficient to keep oscillator 370 keyed on continuously. Alternatively, the pulses on line 286 may be applied directly to the oscillator, which in such a case would be made sufficiently responsive to be keyed on and off once per input pulse.

If oscillator 370 is relatively unstable in its frequency output so that it normally sweeps slightly above and below its center frequency, such as 4.5 mc., then the precision to which the oscillator must be set may be minimized if it is keyed on and off in either of the aforementioned manners. Alternatively, a relatively stable oscillator may be employed in conjunction with frequency changer 372 which may be of the reactance tube or of the motor driven variable inductance or capacitance type. With such a frequency changer in operation while switch 374 is positioned rightwardly, switch 368 may be in either its right or left position or off as desired.

Still a further way to cause interference particularly with the uncoded audio signal, is to cause a relay or vacuum tube for example to change its operating condition so as to cut down on the bandwidth of the output of the converter or any subsequent circuit in the receiver circuits including the audio circuits therein. If the bandwidth is reduced sufficiently, the picture signals may still come through, though perhaps with reduced fidelity, but the sound signals are eclipsed. FIG. 5 shows one way of eclipsing the sound signals. It may be presumed that circuit 376 is the output circuit of the converter for example, and that the bandwidth reducer 378 is a circuit which changes the Q of that output circuit by a reactance tube method or by vary-

ing an inductance, or capacitance in the output circuit in any desirable manner, as by a motor driven arrangement or relay. As an example, reducer 378 may be effective to narrow the output circuit bandwidth to approximately 2 mc., so as to eclipse the audio signals (and part of the video signals) once per input pulse on line 286.

Thus it is apparent that this invention successfully achieves the various objects and advantages herein set forth.

Modifications of this invention not described herein will become apparent to those of ordinary skill in the art after reading this disclosure. Therefore, it is intended that the matter contained in the foregoing description and the accompanying drawings be interpreted as illustrative and not limitative, the scope of the invention being defined in the appended claims.

What is claimed is:

1. A decoder for use with a receiver in a secrecy system of the type in which at least part of the intelligence signals are scrambled, comprising means for employing at a given time a unique unscrambling code for decoding the scrambled intelligence signals, and means in the decoder for coding at least some of the intelligence signals during any of said given time in which no code whatsoever is employed to effect said decoding.

2. A decoder for use with a receiver in a secrecy system of the type in which at least part of the intelligence signals are scrambled, comprising means for employing at a given time a unique unscrambling code for decoding the scrambled intelligence signals, and means in the decoder for coding at least some of the intelligence signals during any of said given time in which any code other than said unique code including no code whatsoever is employed to effect said decoding.

3. A decoder for use with a receiver in a secrecy system of the type in which at least part of the intelligence signals are scrambled comprising means for employing at a given time a unique unscrambling code for decoding the scrambled intelligence signals, and means in the decoder for increasing the coding of the said intelligence signals during any of said given time in which no code whatsoever is employed to effect said decoding.

4. A decoder for use with a receiver in a secrecy system of the type in which at least part of the intelligence signals are scrambled and in which continually varying code signal combinations corresponding to at least part of the system's scrambling code are transmitted to control decoding functions at least partially: comprising a plurality of storage stages each of which has at least two storage conditions; means, including variable connection means for effectively applying each combination of transmitted code signals to said storage stages to cause same to change their storage conditions from time to time at least when the connections in said variable connection means are made in accordance with at least part of a predetermined unscrambling code for decoding said scrambled intelligence signal only when said predetermined unscrambling code should be and actually is in effect; and means coupled to the output of at least certain of said storage stages for interfering with at least some of the intelligence signals when no one of the so coupled

storage stages changes its storage condition from time to time.

5. A decoder for use with a receiver in a secrecy system of the type in which at least part of the intelligence signals are scrambled and in which different code signal combinations corresponding to at least part of the system's scrambling code are transmitted to control decoding functions: comprising a plurality of storage stages each of which has at least two storage conditions; means, including a plurality of switching means each of which is effectively settable to any one of a plurality of positions for effectively applying each combination of transmitted code signals to said storage stages, for decoding said scrambled intelligence signal when the said switching means are effectively set to a respective predetermined position; and means coupled to the output of at least certain of said storage stages for interfering with at least some of the intelligence signals when the said switching means are effectively set in such positions as to effectively apply none of the code signal combinations to any of the storage stages.

6. A decoder as in claim 5 wherein one of the positions for each of the said switching means is an open position and the intelligence signal gets interfered with when each of the switching means is effectively set to its open position.

7. A decoder for use with a receiver in a television system of the type in which one but not the other of the picture program signals and sound program signals is scrambled and in which decoding control signals are transmitted, comprising means for effecting a plurality of different output conditions changeable from time to time conditionally in response to different ones of said control signals when operated at least partially in accordance with a given unscrambling code during a given period of time for decoding the scrambled program signals when that code is in effect during that time period, and means responsive to said output conditions for interfering with at least the unscrambled program signals if said output conditions do not change from time to time in response to different control signals.

8. In a decoder for use with a receiver in a television system of the type in which the received picture signals but not the received audio signals are scrambled, their being apparatus in the decoder for generating invalid decoding output signals if any wrong unscrambling code is employed with the decoder by a user thereof, and for generating continually changing valid decoding output signals, the improvement of means for rendering the uncoded audio signals unsatisfactory to listening if anything but the correct unscrambling code including no code whatsoever is employed, comprising means for generating recurring signals in response to repeated generations of said invalid decoding signal in the decoder, means for generating other recurring signals in response to the lack of change from time to time in the output signal from said generating apparatus, and means responsive to at least some of said recurring signals from each of said means for interfering with the uncoded audio signals.

9. For use with equipment having a terminal on which any one of a plurality of different voltage levels can occur at different times with at least one of those levels being on one polarity relative to a given threshold voltage and the remainder of the levels being

of the opposite polarity relative to that voltage, apparatus for generating one pulse per each recurrence of the said one polarity voltage level within a given time after it has recurred a predetermined number of times during a predetermined period of time, comprising means for passing only those levels which are of the said one polarity, and a step integrator for integrating each of said one polarity levels so passed and stepping to a different initial voltage for each of the said predetermined number of times that the one polarity level occurs within said predetermined period of time and then stepping, if said predetermined number of the said one polarity levels occurred within said period of time, to a further initial voltage for each successive recurrence of the said one voltage level which follows its predecessor within said given time, each such step to said further voltage being one of said pulses.

10. Apparatus as in claim 9 wherein said stop integrator is a step counter having means for decreasing its output potential toward said given threshold voltage after each received one of the said one polarity levels is counted thereby.

11. For use with equipment having a terminal on which any one of a plurality of different voltage levels can conditionally occur at different times with at least one of those levels being of a first polarity relative to a threshold voltage and the remainder of those levels being of the opposite polarity relative to that voltage, means for generating pulses whenever the voltage level at said terminal does not change at least in a certain direction within a predetermined time, and means for generating one pulse per each recurrence of the said first polarity voltage level within a given time at least after it has recurred a predetermined number of times during a predetermined period of time,

wherein the last mentioned means includes means for passing only those levels which are of the said one polarity, and a step integrator for integrating each of the said one polarity levels so passed and stepping to a different initial voltage for each of the said predetermined number of times that the one polarity level occurs within said period of time, to a further but limiting initial voltage for each successive recurrence of the said one voltage level which follows its predecessor within said given time, each such step to such limited voltage being one of the said pulses.

12. Apparatus as in claim 11 wherein the first mentioned means includes a discharge device which is conductive only when at least a predetermined potential is impressed across it, means including a parallel combination of a condenser and an impedance serially coupled via a junction to said device, means for applying a potential greater in amplitude than said predetermined potential across the series combination of said device and last mentioned means to cause alternate conduction and nonconduction of said device, and means for applying at least certain changes in voltage levels as they occur at said terminal to said junction to charge said condenser and prevent said discharge device from conducting.

13. Apparatus as in claim 12 wherein said discharge device includes at least one neon bulb.

14. Apparatus as in claim 11 wherein said step integrator is a step counter having means for decreasing its output potential toward said second threshold voltage after each received one of the said one polarity levels is counted thereby.

15. In a decoder for use with a receiver in a scrambled television system of the type in which received decoding signals are variable from time to time to represent any one of a variety of different signal combinations, the decoder being of the type to establish at a given terminal in conditional response to said different signal combinations any one of M-1 different voltage levels when the proper unscrambling code is employed in the decoder and to establish a recurring Mth level when an improper unscrambling code is employed therein, the improvement of apparatus for causing interference with a program signal only when other than the proper unscrambling code is operative in the decoder, comprising means for generating one pulse per each recurrence within a given time of the said Mth level at least after it has recurred a predetermined number of times during a given time period, means for generating pulses whenever the voltage at said terminal does not change at least in a certain direction after a predetermined time, and means for utilizing the pulses from both of said generating means for interfering with a program signal.

16. Apparatus as in claim 15 wherein the means for generating pulses whenever the voltage at said terminal does not change comprises a relaxation oscillator and means coupled to said terminal for inhibiting operation of the relaxation oscillator in response to at least certain voltage changes at said terminal.

17. Apparatus as in claim 15 wherein the means for generating pulses when the voltage level at said terminal does change which is conductive only when at least a predetermined potential is impressed across it, means including a parallel combination of a condenser and an impedance serially coupled via a junction to said device, means for applying a potential greater in amplitude than said predetermined potential across the series combination of said device and last mentioned means to effect at least said predetermined potential across said device and a consequent conduction thereof whereupon a charge builds up on said condenser and increases the voltage at said junction so that the potential across said devices reduces and makes the device nonconductive while the condenser discharges through at least said impedance until the voltage at said junction decreases sufficiently to again place at least said predetermined potential across said device to cause it to conduct again, and means coupled between said terminal and condenser for charging the latter in response to at least certain changes in the voltage at said terminal to maintain said discharge device nonconducting for a predetermined time.

18. Apparatus as in claim 15 wherein the means for generating one pulse for each recurrence of the said Mth voltage level at least after it has recurred a predetermined number of times during a given time period, includes means for gating out a signal each time the Mth voltage level occurs, and a step integrator for integrating each of the said gated pulses.

19. Apparatus as in claim 15 wherein the means for interfering with said picture signal comprises means

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responsive to a pulse from either of said pulse generating means to cause momentary interruption of a program signal.

20. Apparatus as in claim 19 wherein the interruption means includes means for temporarily cutting off at least a portion of the total program signal.

21. Apparatus as in claim 20 wherein the means for temporarily cutting off at least a part of the program signals includes means for momentarily reducing the bandwidth of a circuit through which program signals pass.

22. Apparatus as in claim 15 wherein the interfering

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means includes means responsive to pulses from both said generating means for causing generation of a signal which itself interferes with at least a part of the program signal to make that part unsuitable in reproduction.

23. Apparatus as in claim 22 including means for causing the generated signal to be keyed on and off at an annoying rate.

24. Apparatus as in claim 22 including means for causing the frequency of the generated signal to sweep above and below its center frequency.

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