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(54) SECTORED ANTENNA RECEIVING SYSTEM

(71) We, MOTOROLA, INC., a corporation organised and existing under the laws of the State of Delaware, United States of America, located and doing business at 1303 East Algonquin Road, Schaumburg, Illinois 60196, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to a radio frequency communication system and in particular, to a sectored antenna receiving system.

Several types of sectored antenna receiving systems have been developed for application in the radio frequency communication art. Such systems are commonly used in applications wherein the remote transmitter whose signal is to be received may be positioned in any one of multiple locations. Thus, such systems are normally designed in moving vehicle type applications. By using a sectored antenna array, as opposed to, for example, an omnidirectional antenna, the signal to noise performance can be significantly enhanced thus producing a superior communication system.

The prior art sectored array antenna systems, in so far as they relate to the present application, fall into two classes. The first class contemplates a multiple sector, single receiver arrangement in which the receiver is controlled by a sampling routine to continuously scan all sectors. Hence, for the condition wherein there is no received signal on any sector, the routine calls for the receiver to sample each sector for an equal period of time. Once a transmitted signal is detected on a sector, the duty cycle is changed whereby the receiver dwells on that sector for a disproportionate period of time. Nonetheless, the receiver continues to constantly sample the other sectors in anticipation of a stronger signal thereon.

The second class of sectored array receiving systems employs a pair of receivers. A search receiver constantly scans each sector in the array in an attempt to find that sector which receives the best signal. A service receiver is coupled to that sector with the best signal until the search receiver discovers that another sector is receiving a superior signal, at which time appropriate antenna switching is accomplished to the service receiver.

Such prior art scanning systems of the first class type have proven effective for applications wherein the remote transmitter is likely to jump from the coverage area of one sector to another sector in a reasonable short time as, for example, in near range aircraft communication. However, for an application such as in land mobile systems the length of a communication message is sufficiently short compared to the coverage area of a sector and the speed of the vehicle such that a particular sector is likely to produce the best signal for the duration of the message. Such first class type prior art scanning systems are not desirable in applications such as the land mobile type since they necessarily require a constant switching from one sector to another resulting in an annoying gap in communication.

The prior art of the second class type have proven undesirable in that they require a pair of receivers. This significantly increases the cost of the system as well as system size while necessarily decreasing system reliability due to the duplication of parts.

According to the invention there is provided a radio frequency communication system comprising: a sectored antenna array means having a plurality of sectors, each sector predeterminedly oriented with respect to the remaining sectors; an antenna switch means having a plurality of input terminals, a control terminal, and an output terminal and further including means responsive to control signals at the control terminal to couple a selected input terminal to the output terminal; antenna coupling means for coupling each antenna switch means; receiver means adapted for receiving radio frequency signals, said receiver means comprising signal strength detector means for producing a signal representative of the strength of the radio frequency signal being received; receiver coupling means for coupling the antenna switch means output terminal to the receiver means; and scan control logic means, having an input coupled to the receiver means signal strength detector and an output coupled to the antenna switch means control terminal for providing control signals thereto to cause scanning of the array, the scan control logic means including storing means for storing the peak signal strength value from the sectors during the scanning modes, the scan control logic means further including: general scan means operable in a general scan mode to sequentially scan each sector and store the peak signal level therefrom in said storing means, comparator means for comparing said peak signal strength value to a predetermined reference level and activating the scan control logic to a continuing scan mode in response to a predetermined relationship therebetween, continuing scan means operable in the continuing scan mode to continue scan of all sectors for a predetermined time interval, selective scan means operable at the conclusion of the continuing scan interval to selectively scan only predetermined sectors, as determined by the comparator means, for a predetermined interval, and inhibit scan mode means for inhibiting scan and coupling the receiver to a predetermined one of the selectively scanned sectors.

In an embodiment of the invention, the communication system includes a sectored antenna array which includes a plurality of sectors, each of which is predeterminedly oriented with respect to the remaining sectors. An antenna switch couples to each of the sectors, and responds to a control signal at its control terminal to couple a selected one of the sectors to an output terminal. The output terminal from the antenna switch is suitably coupled to a radio frequency receiver. The receiver couples to a signal strength detector which produces a signal representative of the strength of the radio frequency signal being received from each sector. Scan control logic circuitry has an input coupled to the receiver signal strength detector and an output coupled to the antenna switch control terminal to cause scanning of the array. The scan control logic includes a first storage array, having a storage cell corresponding to each sector, for storing the peak signal strength value from each sector during the scanning modes. Further included in the scan control logic are general scan means which are operable in a general scan mode to sequentially scan each sector and store the peak signal level therefrom in the first storage array. Also included are comparator means for comparing each stored sector signal strength in the first storage array to a predetermined reference level stored in a second storage array and activating the scan control logic to a continuing scan mode in response to a predetermined relationship therebetween. The scan control logic operates in the continuing scan mode to continue scan of all sectors for a predetermined time interval. At the conclusion of the continuing scan interval, the control scan logic includes means operable in a selective scan mode to selectively scan only predetermined sectors as determined by the comparator means. The selective scan mode continues for a predetermined interval. Finally, the scan control logic includes inhibit scan means for inhibiting scan and coupling the receiver to a predetermined one of the selective scanned sectors.

Preferably, the scan control logic is operable in the selective scan mode to scan both that sector whose peak stored signal strength level exceeds its reference level by the greatest amount and those sectors in given spatial relationship to such selected sector. In the inhibit mode, the receiver is coupled to that one of the selected sectors which exhibits the greatest differential between its first storage array signal level and its reference level.

The invention will now be described by way of example only with particular reference to the accompanying drawings wherein:-

Figure 1 illustrates an eight sector horizontally directive antenna array mounted atop a building, which array is suitable for communication with a remotely located vehicular transmitter;

Figure 2 is a top view of the radiation pattern of the eight sector antenna array shown in Figure 1;

Figure 3 is a generalized block diagram of the sectored antenna receiving system of the invention;

Figure 4 is a block diagram illustrating operation of the scan control logic of the system of the invention;

Figure 5 is a program flow diagram used to derive the computer program for the scan control logics and

Figure 6 illustrates the computer implementation of the preferred embodiment of the scan control logic.

Figure 1 illustrates a preferred application of the invention used as a communication system for land mobile operation. Here, a sectored antenna array 10 is shown mounted atop a building 12. Communication from the array is to be established with a remotely located transmitter, which is illustrated as being carried by the vehicle 14.

The array 10 includes eight sectors, one of which is indicated at 16, which are nestled between 45° angle reflectors, two of which are indicated at 20 and 22. Each sector is horizontally directive and is predeterminedly oriented with respect to the remaining sectors such that all sectors in the array are capable of covering a total horizontal angle of 360°. It should be understood that, depending upon the particular application, any number of sectors may be employed and the sectors may be arranged to cover any desired receiving angle. For example, in an alternate embodiment of the invention 54 sectors have been used.

Horizontally directive antenna sectors are well known in the antenna art and are commercially available from many manufacturers such that a detailed description thereof is unnecessary.

Figure 2 is a top view of the antenna array 10 showing the eight antenna elements, one of which is indicated at 16, and the 45° reflectors, two being shown at 20, 22. As a result of the design of the antenna sector and its corresponding reflectors each antenna sector is capable of receiving transmitted signals which are generated from within a defined horizontal angle. It should be understood that since each sector of the antenna array is directional, the array is capable of superior signal to noise performance over an omnidirectional antenna. The fact that the sectors are horizontally directive further enhances the signal to noise characteristics.

Figure 3 is a generalized block diagram which illustrates the fundamental building blocks of the preferred embodiment of the invention. Here, the array of sectored antenna elements 30 are mounted, as for example in Figure 1, in predetermined orientation on top of a suitable structure. Each antenna sector feeds to a filter and preamplifier circuit 40 which provides gain to the sector received signals at those frequencies of interest. The amplified sector received signals pass over coax cables 50 to an antenna switch 60. The antenna switch 60 comprises a plurality of input terminals 60a - 60h, an output terminal 60j and a control input terminal 60i. In response to control signals received at its control input terminal 60i, the antenna switch 60 couples a selective one of the sectors 30 to the antenna switch output terminal 60j. Suitable switches are well known in the antenna art.

The output 60j from the antenna switch 60 is coupled via a suitable conductor 65 to the input 70a of a radio frequency receiver 70. Radio frequency receiver 70 is of conventional design in that it mixes the input radio frequency signals to an intermediate frequency, thereafter filtering the signals via an intermediate frequency stage, detecting the signals and reproducing the signals as audio or data outputs. The output from the intermediate frequency stage is available at a receiver output terminal 70b. The receiver includes conventional squelch circuitry such that when an appropriate signal is applied at a squelch input terminal 70c the output from the receiver may be disabled. In addition, the receiver includes decoding circuitry capable of detecting the presence of a coded signal on the incoming sector received signal. Such coding systems are very common in land mobile communications systems and normally would include information as to the identity of the transmitting station as well as other pertinent information of use to the system. Commonly, such coded signals are predetermined subaudible or audible tones which may be decoded by the presence of suitable bandpass filters, vibrating reeds, or the like. A second output 70d from the receiver is activated in response to the receiver decoding the presence of a coded signal on the sector received signal.

The intermediate frequency output 70b from the receiver is coupled to a signal strength detector 80 which, as is shown in Figure 3, may be a separate unit, or it may be incorporated within the receiver 70. The signal strength detector 80 produces a signal at its output 80a, which signal is indicative of the level of signals received at its input 80b. The signal strength signals are in turn passed to the first input 90a of the scan control logic circuitry 90, where the maximum signal level for each sector is stored in a first sample and hold array. The second input 90b of the scan control logic 90 couples to the coded signal output 70d of the receiver 70. The scan control logic circuitry 90 processes its input signals and produces appropriate control signals on its first output 90c which are in turn coupled to the control input terminal 60f of the antenna switch 60. Also, appropriate signals are created at the scan control logic second output 90d which are coupled to the squelch input 70c of the receiver 70. Detailed operation of the scan control logic 90 is fully described herein below with respect to Figures 4, 5 and 6. Briefly, the scan control logic 90 responds to its received input signals to operate the sectored receiving system in one of a number of modes. The peak signal strength level received by each sector is stored in a first sample and hold array. For the condition wherein none of the sectors receives an input signal above a predetermined level, as determined by stored values for each sector in a second sample and hold array, a control signal from the scan control logic applied to the control input terminal 60f of the antenna switch 60 causes the receiver to be sequentially coupled to each of the antenna sectors. Once a sector receives a signal whose amplitude is such that the output from the signal strength detector is above its given reference threshold level, the scan control logic operates the system in a second, or continuing scan mode. In this mode each antenna sector is again scanned for a predetermined continuing scan time, with the relative signal strength from each sector being stored in the first sample and hold array within the scan control logic 90. At the end of the continued sampling period that sector which recorded the largest relative signal during both scanning intervals is identified. Also identified are those sectors located in predetermined orientation with respect to the identified sector. For example, in an alternate preferred embodiment of the invention the 54 sectors are arranged to cover a full 360° horizontal angle. Once a particular sector is identified as having received the strongest relative signal, also selected are the three sectors on each side of the identified sector. Now, the scan control logic causes the system to operate in a selective scan mode wherein, for a predetermined time interval, only the selected seven sectors are scanned. As before the peak signal level from each sector is stored in the first sample and hold array.

If the system is not operating in the coded signal mode, following the selective scan interval further scanning is inhibited and the receiver is coupled to that one of the selected sectors whose first array stored signal level exhibits the strongest increase over its second array stored signal.

If, however, the system is operating in a mode whereby it only responds to input signals which contain a predetermined coded signal, at the end of the selective scan interval that sector exhibiting the greatest increase of its first array stored signal over its second array stored signal is checked for the presence of the coded signal. Scan is inhibited while looking for the coded signal. If the coded signal is present scanning remains inhibited and the receiver is coupled to said sector. At this point the scan control logic 90 causes the receiver to unsquelch and the receiver remains coupled to the selected sector until the signal level from that sector diminishes a predetermined amount for a predetermined interval, at which time the system reverts the general scan mode. If, however, the selected sector does not contain the coded signal, indicative that the incoming signal is from an interferer, the peak values stored for the interferer in the first array are transferred to the second array to be thereafter used as the reference level. Then, the system reverts to the general scan mode and operation proceeds as before. By loading the interferers stored signals into the second array the system may then "ignore" the interferer on subsequent scans and look for a received signal which does contain the proper coded signal.

It should be pointed out that in land mobile sectored communication systems, the length of any given message is generally short compared to the time it would take for the vehicle to move from the area covered by one sector to that covered by another sector. Thus, once the scan control logic determines which of the sectors is receiving the best signal from the mobile, that sector is coupled to the receiver for the duration of the message transmitted thereto.

Figure 4 illustrates construction of the scan control logic circuitry 90. Here, the signal strength levels from the signal strength detector are applied to the scan control at its input 90a. Since the preferred embodiment of the invention contemplates microprocessor control of the scanning functions, these input signals are analog to digital converted by the A/D converter 100. Thereafter they are loaded into memory cells in the first sample and hold storage array 110. The first array 110 contains a memory location for each of the antenna sectors. Thus, over the scanning sequences the maximum signal strength level produced by each sector is stored in the first array 110. A second sample and hold storage array 112 also contains a memory cell corresponding to each sector. The second array stored values are utilized as reference or threshold levels as is discussed herein below. A switch 130 responds to a control signal at its input 130a to load the values of the first array into the second array 120 for storing the reference levels therein.

A comparator 132 sequentially compares the peak signal levels stored by each sector in the first array 110 with its corresponding reference level in the second array 120. If the comparator detects that the peak signal level for any sector exceeds its reference level by a predetermined increment ΔV, the comparator activates its output 132a.

The output 132a from the comparator 132 feeds to logic circuitry 140. The logic circuitry 140 in turn produces an output signal at its output 140a which is suitable for activating the scan control logic to any one of four modes. Thus, initially the system is activated in the general scan mode 150 wherein all sectors are sequentially scanned. Once the comparator 132 determines that at least one sector contains a received signal level exceeding its reference level by the given increment ΔV, the logic circuitry 140 causes the system to activate to the continuing scan mode 160. In this mode all sectors are again scanned for a predetermined time interval determined by a timer 170. At the conclusion of the continuing scan interval the logic 140 causes the system to activate to a selective scan mode 180. Here, the logic circuitry 140 determines which of all sectors scanned exhibited the greatest increase of its first array stored signal over its second array stored signal and designates that sector as a selected sector. Further, for the alternate embodiment including 54 sectors, the three sectors on either side of the selected sector are also designated as selected sectors. Now, for a selective scan interval, also determined by the timer 170, only the selected seven sectors are scanned.

Following the selective scan interval, scan is inhibited and the receiver is coupled to that sector whose first array stored signal exceeds its second array stored signal by the greatest amount. The received signal is then checked for the coded signal by the coded signal check circuitry 190. If the selected sector received signal does contain the coded signal, the coded signal check circuitry activates its first output 190a causing the receiver to be coupled to the selected sector for the duration of the message. Also, the coded signal check circuitry first output 190a is coupled to the scan control logic output 90d to the receiver for unsquelching the same. The receiver remains coupled to the selected sector until the signal level therefrom diminishes to a predetermined level for a predetermined interval. This decision is made by the logic circuit 140 based on inputs from the comparator 132 and the timer 170.

If, however, coded signal check circuitry 190 determines that the selected sector received signal does not contain the coded signal, indicative of an interferer, it activates its second output 190b which is used to both cause the logic circuitry 140 to revert the system to the general scan mode 150 and to activate the control input 130a of the load switch 130 whereby the peak stored values from each sector caused by the interferer are loaded from the first array 110 into the second array 120. Thus, subsequent scanning will use the interferer's stored signals as the reference signal for purposes of determining the presence of a received signal.

Another feature of the system is that the timer 170a periodically activates the control input 130a of the load switch 130 when the system is operating in the general scan mode 150. In so doing, the reference to the comparator 130 as supplied from the second array 120 is constantly being updated by background noise levels whereby the system is largely noise immune.

Figure 5 is a program flow diagram illustrative of the logic flow used for programming the microprocessor preferred embodiment of the invention. A restart block 200 is loadable from the front panel and triggers intial operation of the processor sequence. Additionally, the restart block 200 may interrupt system operation. The output from the restart block 200 is fed to an initial block 210 which performs standard microprocessor functions such as zeroing out all the arrays and initialling all counters. The initial block in turn activates the start block 220. Every one millisecond the computer goes through the start block to determine which of the modes the sequence is in. From the start block the computer can either go through the general scan block 230, the continue scan block 240, the select scan seven block 250, the coded signal check block 260 or the inhibit scan block 270. Following the sequence dictated by the particular block 230-270 the system enters a delay block 280. Since some of the functions 230-270 require less operation time than others, the delay block 280 provides an appropriate time delay such that a restart control is fed to the start block 220 at precise one millisecond intervals.

Figure 6 illustrates the preferred embodiment of scan logic wherein said logic is realized via a standard microprocessor. The output 30a from the signal strength detector 80 feeds to the analog to digital converter 100 which in turn converts the analog signal strength input levels to corresponding digital levels, which are then coupled via bus 300 to a peripheral interface circuit 310. Also feeding to the peripheral interface circuit 310 is the coded signal output 70d from the receiver. The peripheral interface couples via a bus 320 to the processor bus 330 which is fed from a random access memory 340, a read only memory 350 and from the central processing unit 360. The central processing unit receives clock signals from the crystal controlled clock generator 380 which is controlled in the normal manner via a controller 370. In response to signals on the processor bus 330, the peripheral interface circuit 310 provides an output line 310a which is adapted to control the antenna switch.

The system of Figure 6 is very familiar to one of ordinary skill in the microprocessor art such that coupled with the previous discussion, and the logic flow diagram in Figure 5, the preferred embodiment of the invention could be realized without further information. It is clear to one of such ordinary skill in this art that, for example, the read only memory 350 would contain the computer program whereas the random acess memory 340 would contain, inter alia, the first and second storage arrays, Thus, realization of the aforementioned scanning sequences are easily implemented with the information contained herein and that information available to one of ordinary skill in this art.

WHAT WE CLAIM IS:-

1. A radio frequency communication system comprising: a sectored antenna array means having a plurality of sectors, each sector predeterminedly oriented with respect to the remaining sectors;

an antenna switch means having a plurality of input terminals, a control terminal, and an output terminal and further including means responsive to control signals at the control terminal to couple a selected input terminal to the output terminal;

antenna coupling means for coupling each antenna sector to a predetermined input terminal of the antenna switch means;

receiver means adapted for receiving radio frequency signals, said receiver means comprising signal strength detector means for producing a signal representative of the strength of the radio frequency signal being received;

receiver coupling means for coupling the antenna switch means output terminal to the receiver means; and

scan control logic means, having an input coupled to the receiver means signal strength detector and an output coupled to the antenna switch means control terminal for providing control signals thereto to cause scanning of the array,

the scan control logic means including storing means for storing the peak signal strength value from the sectors during the scanning modes,

the scan control logic means further including:

general scan means operable in a general scan mode to sequentially scan each sector and store the peak signal level therefrom in said storing means,

comparator means for comparing said peak signal strength value to a predetermined reference level and activating the scan control logic to a continuing scan mode in response to a predetermined relationship therebetween,

continuing scan means operable in the continuing scan mode to continue scan of all sectors for a predetermined time interval,

selective scan means operable at the conclusion of the continuing scan interval to selectively scan only predetermined sectors, as determined by the comparator means, for a predetermined interval,

and inhibit scan mode means for inhibiting scan and coupling the receiver to a predetermined one of the selectively scanned sectors.

2. A communication system as claimed in claim 1 wherein the scan control logic means further comprises reverting means for reverting from the inhibit scan mode to the general scan mode responsive to the signal level from the sector to which the receiver is coupled falling to a predetermined level for a predetermined time period.

3. A communication system as claimed in claim 1 or 2 comprising means to squelch the output from the receiver except when the scan control logic is in the inhibit scan mode.

4. A communication system as claimed in any preceding claim

wherein the scan control logic means includes a first storage array, having a storage cell corresponding to each sector, for storing the peak signal strength value from each sector during the scanning modes,

a second storage array, having a storage cell corresponding to each sector, for storing therein a reference level corresponding to each sector;

and wherein the comparator means includes means for activating the scan control logic from the general scan mode to the continuing scan mode in response to the peak signal level for at least one sector stored in the first array exceeding the reference level for that sector stored in the second array by a predetermined value.

5. A communication system as claimed in claim 4 further comprising updating means for periodically transferring stored sector signal strength values for each sector from the first storage array to the second storage array when the scan control logic means is in the general scan mode.

6. A communication system as claimed in claims 4 or 5 wherein the selective scan means includes means operable at the conclusion of the continuing scan interval for selectively scanning that sector whose first array stored value exceeds its second array stored value by the greatest amount, and those sectors in a predetermined orientation with respect to said sector.

7. A communication system as claimed in claim 6 wherein the inhibit scan means comprises means for inhibiting scan and coupling the receiver to that selectively scanned sector whose first array stored signal level exceeds the second array stored reference level by the greatest amount.

8. A communication system as claimed in any one of claims 5 to 7 wherein the receiver means comprises means for detecting the presence of a coded signal on the received sector signal.

9. A communication system as claimed in claim 8 wherein the inhibit means includes means for maintaining inhibit only if the signal from said sector contains said coded signal, the inhibit means otherwise reverting the scan control logic from the inhibit scan mode to the general scan mode.

10. A communication system as claimed in claim 9 wherein the updating means further comprises means for transferring the stored sector strength values from the first storage array to the second storage array in response to the inhibit means reverting the scan control logic from the inhibit scan mode to the general scan mode as a result of the signal from said selected sector failing to contain said coded signal.

11. A method of receiving a radio frequency broadcast comprising the steps of

providing a multisectored antenna array, orienting each sector in predetermined relationship with respect to the remaining sectors, scanning the array by sequentially switching the signal from each sector to a receiver means, detecting, via the receiver means, the strength of the signal from each sector, comparing said signal strengths to a reference level and determining the condition of the signal strength level of at least one sector exceeding said reference level, continuing scan of all sectors for a predetermined interval subsequent to determination of a sector signal strength exceeding said reference level, selectively scanning only predetermined sectors at the conclusion of the continuing scan interval for a predetermined interval and

inhibiting scan following said predetermined selective scan interval and coupling the receiver to a predetermined one of the selectively scanned sectors.

12. A method as claimed in claim 11 comprising the step of

activating from the inhibit scan mode to the scanning mode in response to the detected signal strength of the sector to which the receiver is coupled reducing to a predetermined level for a predetermined time interval.

13. A method as claimed in claim 11 or 12 comprising the step of:

squelching the receiver output except when the scan control logic is in the inhibiting scan step.

14. A method as claimed in any one of claims 11 to 13 wherein the comparing step comprises the steps of storing the peak signal strength level received by each sector during scanning in a first storage array,

storing a reference level for each sector in a second storage array, and

comparing the value stored for each sector in the first array with those stored in second array and determining the condition of at least one sector having a signal in its first array exceeding its reference level in the second array by a predetermined amount to thereby activate to the continuing scan step.

15. A method as claimed in claim 14 wherein the selectively scanning step comprises the steps of selecting for further scan that sector whose first array stored signal exceeds its second array reference level by the greatest amount and selecting for further scan those sectors which are in a predetermined orientation with respect to said selected sector.

16. A method as claimed in claim 14 or 15 wherein the step of inhibiting scan further comprises the step of coupling the receiver to that one of the selected sectors whose first array stored signal exceeds its second array reference level by the greatest amount.

17. A method as claimed in any one of claims 11 to 16 wherein the inhibiting step comprises the steps of detecting the presence of a coded signal on the selected sector signal, inhibiting scan if said selected sector signal contains said coded signal, and reverting the scan control logic to the scanning step if said selected sector signal fails to contain said coded signal.

18. A method as claimed in claim 17 comprises the further step of transferring the stored sector signal strength levels from the first storage array to the second storage array such that said transferred signals become the reference levels, in response to the inhibiting step reverting the scan control logic to the scanning step as a result of the selected sector signal failing to contain said coded signal.

19. A method as claimed in claim 18 wherein the comparing step further comprises the step of periodically transferring the first array stored signal strength levels to the second storage array, such that the transferred signals become the reference level signals when the scan control logic is in its scanning step.

20. A communication system substantially as is hereinabove described and as shown in the accompanying drawings.

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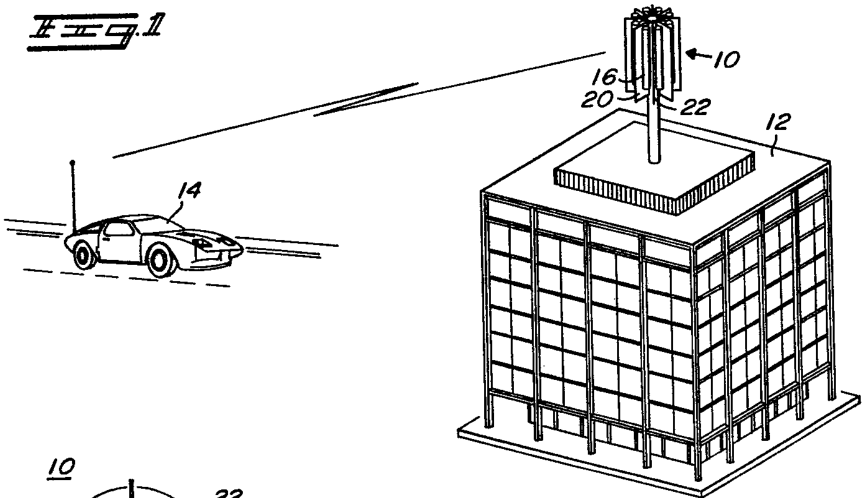
1567888 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1



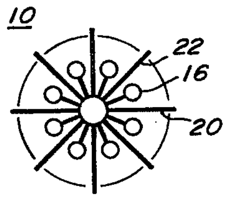


FIG. 2

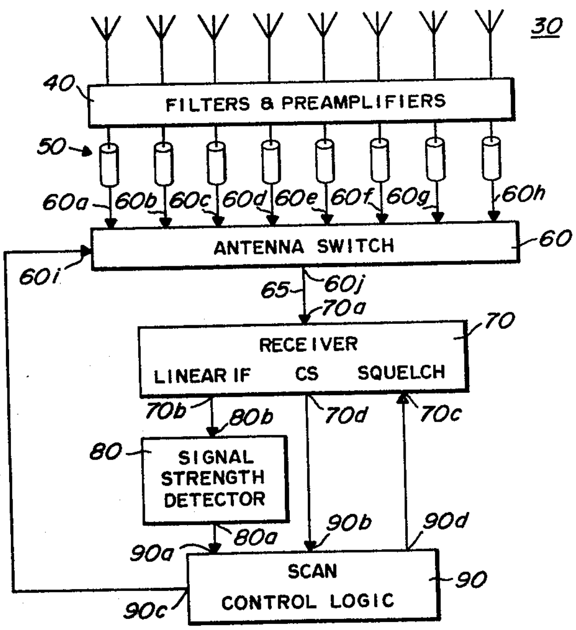


FIG. 3

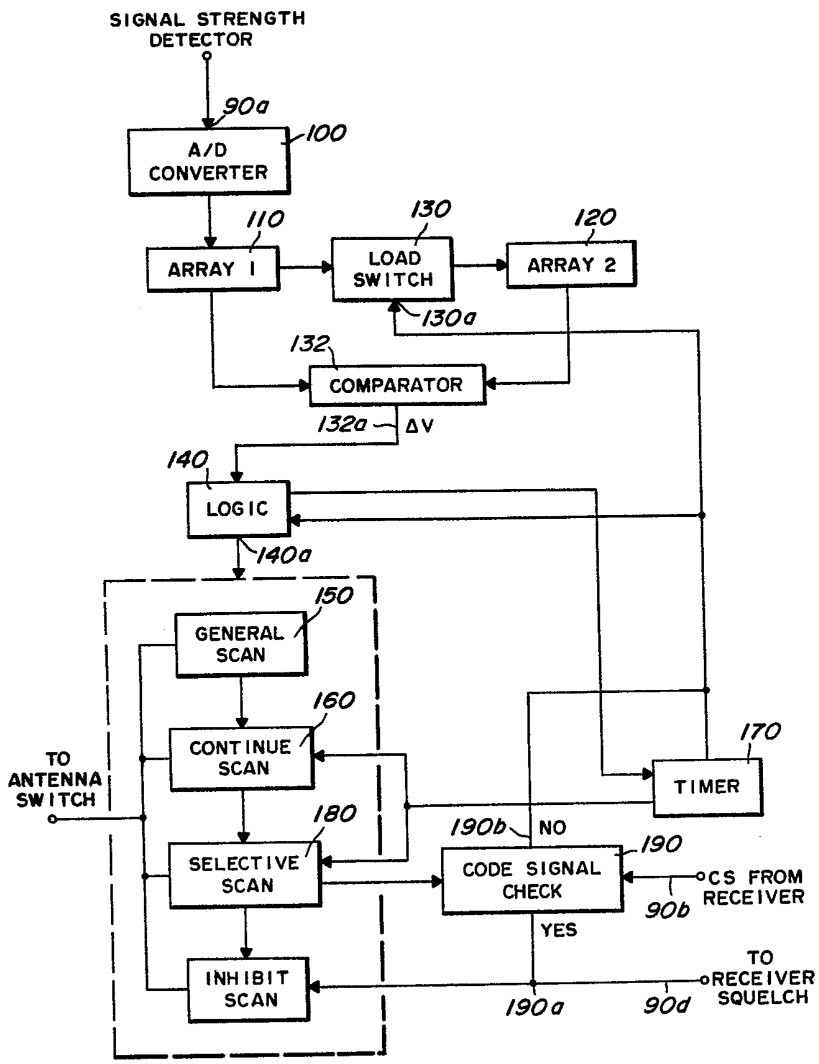

SIGNAL STRENGTH DETECTOR
90a
A/D CONVERTER
100
ARRAY 1
110
LOAD SWITCH
130
ARRAY 2
120
130a
COMPARATOR
132
132a
ΔV
LOGIC
140
140a
GENERAL SCAN
150
CONTINUE SCAN
160
SELECTIVE SCAN
180
INHIBIT SCAN
TO ANTENNA SWITCH
TIMER
170
190b
NO
CODE SIGNAL CHECK
190
CS FROM RECEIVER
90b
YES
TO RECEIVER SQUELCH
190a
90d

Fig. 4

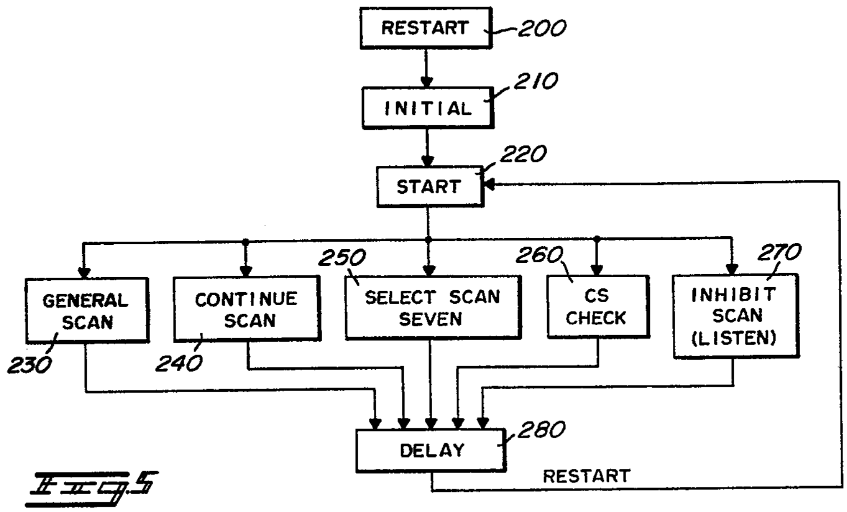

RESTART
200
INITIAL
210
START
220
GENERAL SCAN
230
CONTINUE SCAN
240
SELECT SCAN SEVEN
250
CS CHECK
260
INHIBIT SCAN (LISTEN)
270
DELAY
280
RESTART

FIG. 5

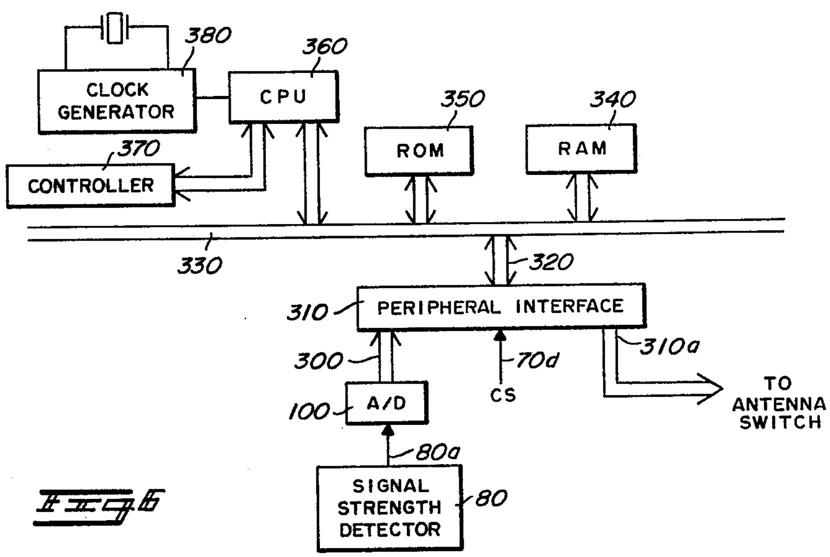

380
CLOCK GENERATOR
360
CPU
370
CONTROLLER
350
ROM
340
RAM
330
320
310
PERIPHERAL INTERFACE
310a
300
70d
CS
100
A/D
TO ANTENNA SWITCH
80a
SIGNAL STRENGTH DETECTOR
80

FIG. 6