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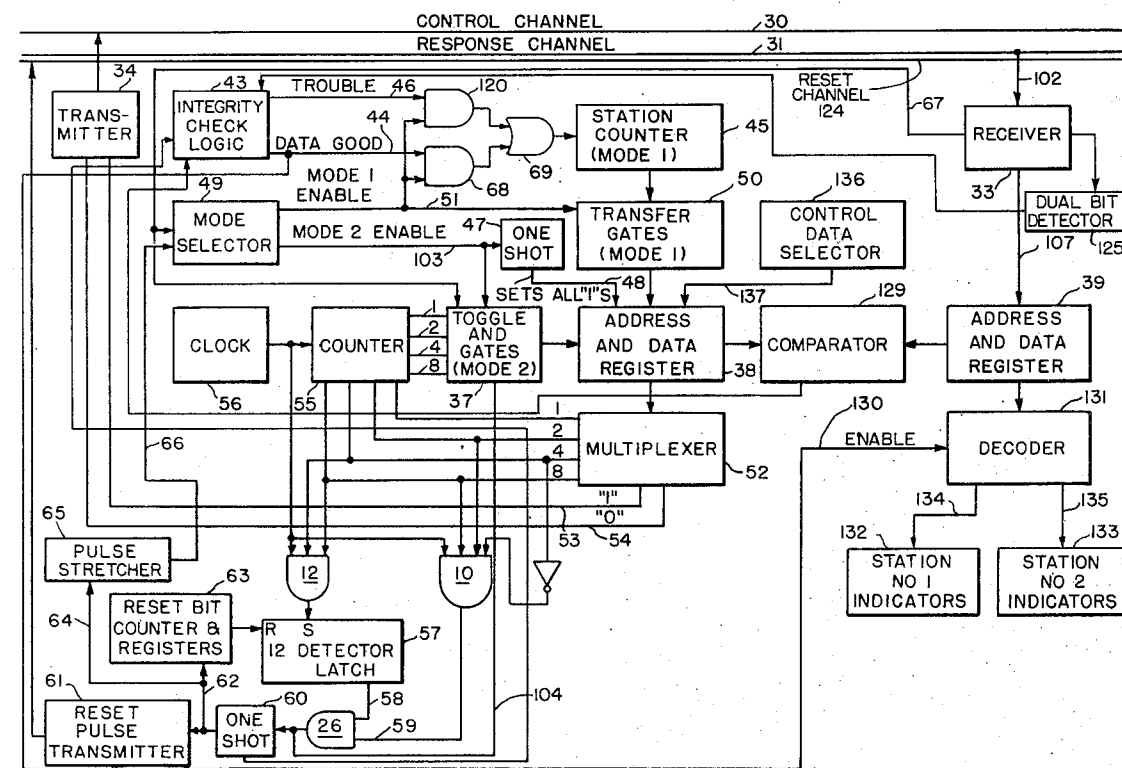
A code communication system for interrogating remote stations from a central station during successive communication cycles wherein a start at a remote station is effective when received at the central station to cause the central station to transmit in a superiority search mode. Cycle reset means is provided governed by a remote station having initiated a cycle by a start pulse for causing the communication system to reset for starting a new communication cycle whenever a bit of the code superiority address transmitted from the central station disagrees in character with the address code of the station having transmitted the start pulse. Such a restart causes the transmission of another cycle which has an address code bit changed in character for the last address bit transmitted in the prior cycle. In this way an address code is completed only for the most superior station having registered a start.

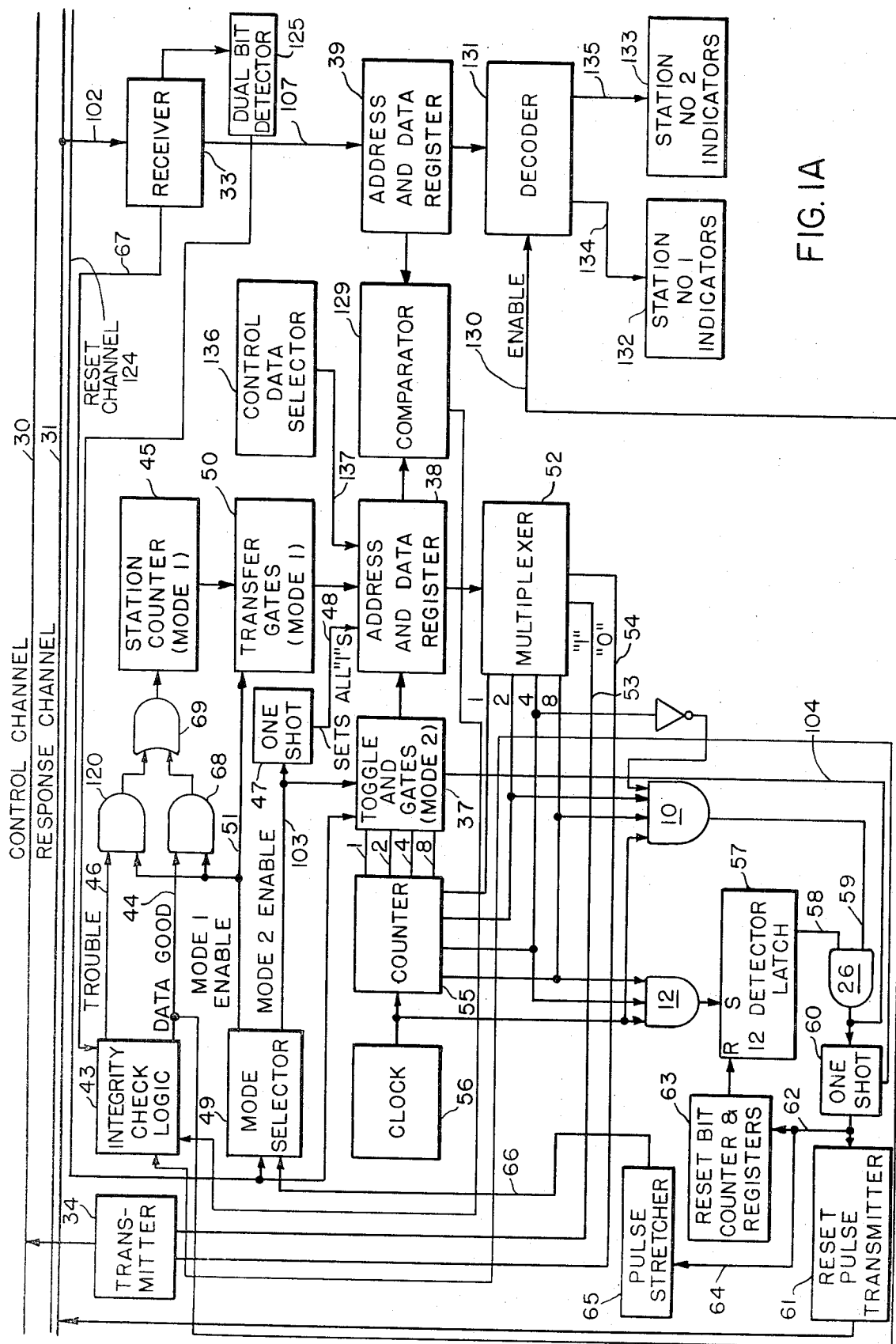
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19 Claims, 3 Drawing Figures





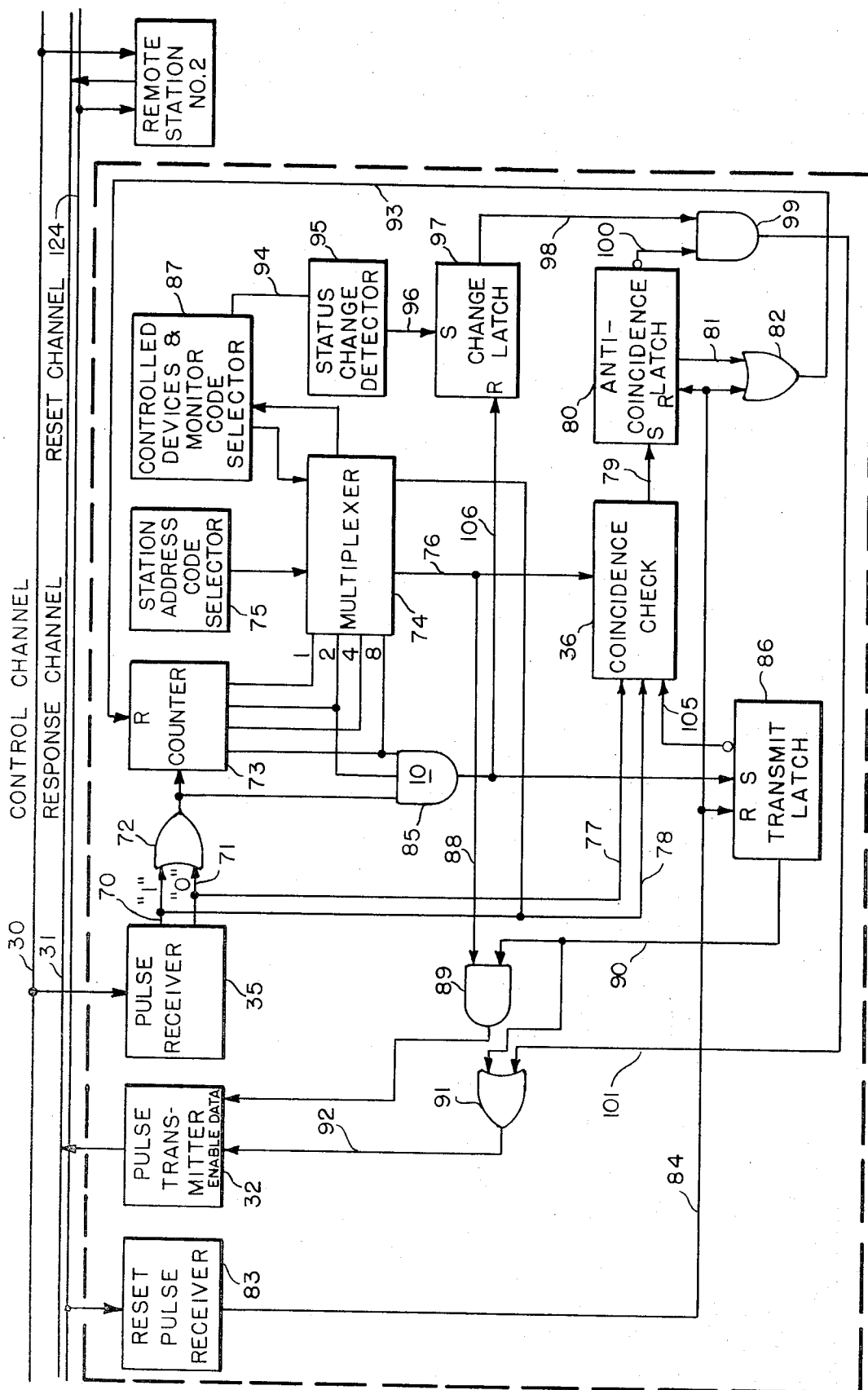
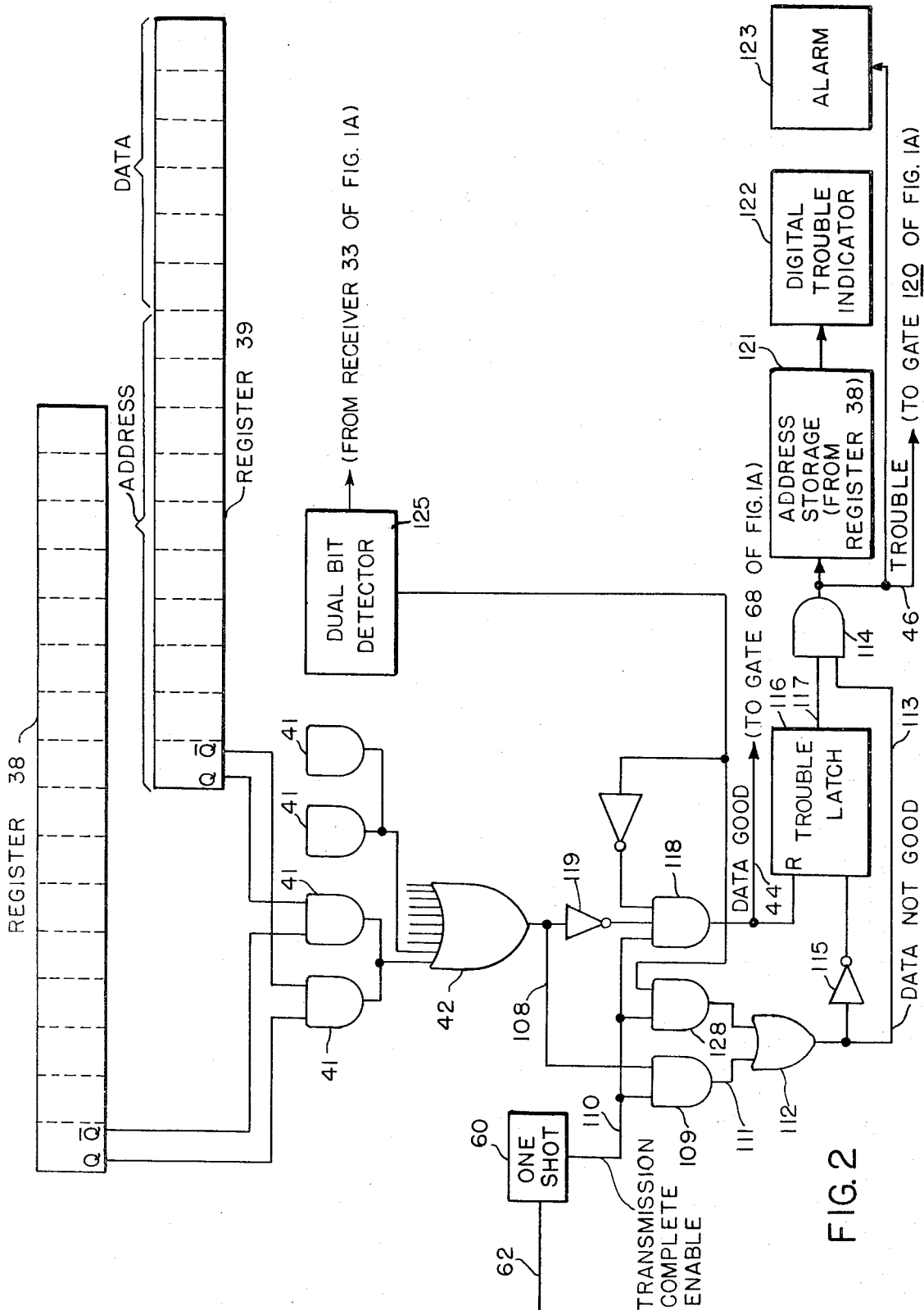


FIG. 1B

REMOTE STATION NO. 1



CODE COMMUNICATION SYSTEM

While the invention is subject to a wide range of applications, it is especially suited for use in a supervisory code communication system and will be particularly described in that connection.

Code communication systems of this nature generally provide for code communication between a plurality of remote stations and a central station. Such a system can operate in first and second modes wherein the mode 1 interrogates the remote stations from the central stations in the roll call manner. In response to a change in the condition of apparatus at one of the remote stations, the system can be shifted into mode 2 wherein the station having a change will communicate information to the central station. Mode 1 is for supervisory purposes to check periodically that each remote station is operable, while the operation of the system in mode 2 is to convey information to an abnormal nature such as an alarm condition to the central office.

Prior art systems of this nature generally involve considerable delay in switching from mode 1 to mode 2 because the roll call continues in its usual operation of interrogating stations successively after a change has taken place at a station until the station having the change is interrogated.

An object of the present invention is to provide a code communication system that substantially obviates one or more of the limitations and disadvantages of the described prior art systems.

Another object of the present invention is to provide a code communication system having an improved system for locating a station according to code superiority.

Another object of the present invention is to provide an improved communication system of the roll call type providing for communication of a limited number of repeat cycles in case of communication error.

Another object of the present invention is to provide an improved communication system providing selection of address codes in accordance with different modes of operation of the code communication system.

SUMMARY OF INVENTION

A code communication system is provided including at least one communication channel for interrogating remote stations from a central station during a communication cycle in response to a start pulse communicated to the central station from one of the remote stations. A transmitter at the central station is rendered operable in response to a start pulse communicated from a remote station for transmitting over the communication channel from the central office a most superior search or station address code. The search code thus transmitted is received at all remote stations and compared with the code belonging to such station. Cycle reset means, governed by a remote station having initiated a cycle by a start pulse, is provided for causing the communication system to be reset to start a new communication cycle upon reception at that remote station of an address bit in the search code being transmitted from the central station that disagrees with a station code assigned to that station. The central station is responsive to the cycle reset control for activating its transmitter to transmit another cycle including the same address code as for the next prior cycle except

that the sense of the element is changed for the last bit transmitted during such prior cycle.

The system is also operable in a roll call mode wherein means is provided at the central station for checking integrity of reply codes received during each roll call cycle. Means is provided for comparing an address code transmitted from the central station during each roll call cycle with an address code received at the central station from a remote station and for delivering a trouble output signal when the addresses compared are out of correspondence. The roll call system provides for the transmission of distinctive address codes during successive roll call cycles from the central station to the remote station except that a repeat cycle is transmitted to the same address in response to a trouble output signal generated by the comparison of addresses.

The code communication system according to the present invention is alternately operable in roll call and address search modes wherein means is provided at the central station for selecting station address codes for transmission over a communication channel to a plurality of remote stations. A digital storage register is provided at the central station for storing an address code for transmission to the remote stations. A station counter is provided for counting roll call cycles of operation and is operable when enabled to deliver digital outputs to the storage register for transmission to the remote stations in accordance with the station count accumulated. Provision is also made for setting the address storage register to a most superior address code for transmission, and a mode selector is provided that is operable in first and second modes for alternately enabling the station counter and the code setting apparatus respectively to govern the address code stored by the code storage register.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description, taken in connection with the accompanying drawings, while its scope will be pointed out in the appending claims.

FIGS. 1A and 1B when placed side-by-side illustrate a code communication system provided according to one embodiment of the present invention.

FIG. 2 illustrates more in detail part of the apparatus at a central station illustrated in FIG. 1A.

GENERAL MODE OF OPERATION

With reference to FIGS. 1A and 1B, control and response communication channels 30 and 31 are provided for connecting the central station illustrated in FIG. 1A with a plurality of remote stations such as stations No. 1 and No. 2 of FIG. 1B. Each of the remote stations such as station No. 1 has a pulse transmitter 32 that is operable to transmit a start pulse over the response channel 31 in response to a change in conditions at field station No. 1. A receiver 33 is provided at the central station for receiving the start pulse. The reception of the start pulse at the central station enables a transmitter 34 to transmit a selected most superior address code over the control channel 30 to the remote stations. Each of the remote stations has a receiver 35 for receiving addresses and control pulses communicated over the control channel 30 from the central station. Each of the remote stations also has apparatus including coincidence check circuits 36 which detect when the address code being received is out of corre-

spondence with the address assigned to the associated station. When an out of correspondence condition is detected at a station having transmitted a start pulse, the start pulse is removed from the response channel by control of the pulse transmitter 32, and this is effective at the central station through receiver 33 and toggle AND gates 37 to reset the transmitting apparatus at the central station and thus condition the system to initiate a new cycle of operation. When this resetting takes place, the toggle AND gates 37 are effective to change the character of the last address bit that has been transmitted in an address and data register 38 so that the opposite character for this bit will be transmitted as a part of the address code during the next following cycle.

With reference to FIG. 2, the system has means for comparing an answer-back address code in a register 39 with an address code that was transmitted during the first part of the cycle and is stored in register 38. This comparison is made by AND gates 41 and OR gate 42. Integrity check logic 43 delivers an output that is a data good signal on wire 44 if the answer-back code corresponds, and such output is effective to advance a station counter 45 to select a new address code for the next roll call cycle. If, on the other hand, the integrity check logic 43 detects an out of correspondence condition, an output is applied by integrity check 43 on the trouble wire 46 which does not advance the station counter on the first cycle where trouble is detected, and thus causes the station counter 45 to maintain its last stored address for the transmission of a repeat cycle.

With reference to FIG. 1A, the code communication system according to the present invention is operable alternately in roll call and superiority address search modes in accordance with station addresses stored in the address and data register 38. The address code stored in address and data register 38 is obtained when the system is in a roll call mode from station counter 45 which is operable when enabled to deliver digital outputs to the address and data register 38. When the system is in a superiority code address mode, code setting apparatus including a one-shot gate 47 is effective over wire 48 to govern the code stored in address and data register 38. A mode selector 49 is operable in first and second modes for alternately enabling the station counter 45 and the code setting one-shot gate 47 respectively to govern the address code stored in the address and data register 38.

The code communication system also has means including a dual bit detector 125 (see FIGS. 1A and 2) for detecting when two or more remote stations are responding at the same time so that they are transmitting different characters for the same bit during a cycle of operation. If such a condition is detected, an output of the detector 125 is applied through integrity check logic 43 to trouble wire 46 so as to provide the same mode of operation in case of trouble detection as has been heretofore described.

Mode 1 Operation

In mode 1, the central station addresses the remote stations over control channel 30 in accordance with a digital address code in the station counter 45 (see FIG. 1A). The station counter 45 is never reset, and is advanced one count at the end of each cycle of operation, except when the integrity check logic 43 has determined an error in the communication with a remote

station. Under these conditions, the transmission is repeated once to the same station. If the trouble still exists, the counter 45 is advanced out count, and a visual display is provided to indicate to an operator that trouble has been encountered. Transfer of address codes from the counter 45 to the address and data register 38 is rendered effective by transfer gates 50 in accordance with a mode 1 enable signal on wire 51 generated by mode selector 49 at the end of each cycle. The address and data register 38 provides multiple readout for inputs to a multiplexer 52. The multiplexer 52 comprises gates for delivery selectively 1 or 0 series outputs on wires 53 and 54, respectively, for governing the application of pulses by transmitter 34 to the control channel 30 for transmission of a code serially over the communication channel to the remote stations. The multiplexer 52 includes gates that are enabled successively by outputs of a counter 55, driven by a clock 56.

According to this embodiment of the present invention, the station address counter 45 is a 10 bit counter, and the address and data register 38 is a 16 bit register, the first 10 bits being provided for the address code, and the remaining bits being provided for data. Thus, the counter 55 is a 4 bit, 16 count binary counter, and after having completed its count of 16, starts to count another sequence of 16 counts. When the counter 55 has operated to a count of 12, an output is enabled of gate 12 to set 12 detector latch 57. This in turn delivers an output to AND gate 26, but output of the AND gate 26 will not be enabled until the counter has operated through its complete count and to a count of 10 in the next series of counts so as to enable gate 10 to deliver an output on wire 59 to gate 26. Thus the cycle length is determined by a count of 26 pulses from the clock 56.

Output of gate 26 causes a reset pulse to be generated by the one-shot 60, and output of the one-shot 60 is provided to a reset pulse transmitter 61 for transmission of a reset pulse over a reset channel 124 to reset all of the remote stations. At the same time, reset energy is applied over wire 62 to reset apparatus 63 for resetting the bit counter and registers. The reset pulse is also applied over wire 64 to a pulse stretcher 65 for application as a trigger pulse to the mode selector 49 over line 66. The mode selector 49 remains in its mode 1 enable condition unless a start pulse is received at this time over line 67 from the receiver 33. If the integrity check logic 43 has determined the data is good, an output is provided on wire 44 at this time, AND gate 68 is enabled and the station counter 45 is advanced a count through OR gate 69.

With reference to FIG. 1B, pulses transmitted during a cycle from the central station over control channel 30 are received at each remote station by a receiver 35, and outputs for 1 and 0 characters are provided on wires 70 and 71 respectively. An output on either of these wires is effective through an OR gate 72 to operate a counter 73 corresponding to the counter 55 at the central station. Thus this counter 73 is actuated by pulses received over the communication channel as clock pulses, irrespective of the character of the bits. The counter 73 in turn governs the gates of a multiplexer 74 that operates similar to the multiplexer 52 described for the central station. The station code to which the respective remote stations are responsive is selected by a station address code selector 75 which is

conditioned for each station to store a distinctive address code to which that station is responsive. A 1 or 0 output is provided by the multiplexer for each bit of the address code in correspondence with the code stored in the address code selector 75 for the associated station, such code being applied over line 76 to coincidence check circuit 36. This is compared with bit by bit the 1 or 0 character that is received and delivered to the coincidence check circuit over lines 77 and 78 respectively.

If there should be an out of correspondence condition in the checking of the address codes, an output is delivered by the coincidence check 36 over line 79 to anti-coincidence latch 80 so as to set this latch. The setting of the anti-coincidence latch 80 provides an output over line 81 through an OR gate 82 to reset the counter 73 over line 93 and maintain such counter in its reset position as long as the anti-coincidence latch 80 is in its set position. This latch is not reset until the reception of a reset pulse from the central station at the end of the cycle.

This is the mode of operation that takes place at each of the remote stations whose address does not correspond with the address communicated during the roll call cycle from the central station. At the end of the cycle, a reset pulse is received over the reset channel 124 from the central office and applied through reset pulse receiver 83 and over line 84 to the reset terminal R of the anticoincidence latch 80. The resetting of the anti-coincidence latch 80 conditions the counter 73 so that it can be responsive to the pulses of the next cycle of operation of the communication system.

To consider the mode of operation for a station that is called during the roll call mode of operation, it will be assumed that the remote station No. 1 shown in FIG. 1B is the station being addressed during roll call transmission when the system is in operation according to mode 1. Inasmuch as the entire ten bits of the station address code under these conditions will correspond with the code selected by the station address code selector 75, the anti-coincidence latch 80 will not be set during the address code, and thus the transmission will progress until the address code is completed. According to the mode of operation as has been heretofore considered, it will be noted that the receiving apparatus at each remote station is permitted to continue to count through the entire address code only provided there is no out of correspondence condition. Thus when ten counts have been counted by the counter 73 without the counter 73 having been reset, the station has been selected, and an output is provided through AND gate 85 which is responsive to the count of ten to set a transmit latch 86 for enabling transmission of data from remote station No. 1 to the central station over response channel 31. At this time, energy is removed from line 105 connecting the transmit latch with the coincidence check circuits 36 to render the coincidence check 36 ineffective to set the anti-coincidence latch 80 in response to an out of correspondence condition during transmission of data bits.

The counter 73 continues to count in response to drive pulses that are received over the control channel 30. Inputs to the multi-plexer 74 for counts 11 through 16 are used to drive the multiplexer to transmit monitoring code data as selected by control devices and monitor code selector 87. The multi-plexer 74 thus delivers 1 characters selectively for the data bits over

lines 76 and 88 to a gate 89 that is enabled for the transmission of 1's and 0's in accordance with an input from the transmit latch over line 90. Transmit latch 86 enables an output of OR gate 91 over line 92 as an enable input to the pulse transmitter 32 for transmission of 1's and 0's as selected for the respective data pulses over the response channel 31 to the central station.

Counter 73 is like the counter 55 at the central station in that it counts to 16 and then starts counting over again so that when all of the data pulses have been transmitted the system then proceeds to repeat the address of remote station No. 1 into the response channel 31 for verification at the central station. The central station is thus repeating its station code, and in that the transmit latch 86 at remote station No. 1 is in its set condition, the multiplexer provides outputs to pulse transmitter 32 to transmit the address code for station No. 1 to the central station. At the end of the address thus transmitted, the central station terminates the cycle by transmitting a reset pulse over the reset channel 124 after the count of 26 as has been heretofore considered, and such reset pulse is received by reset pulse receiver 83 at remote station No. 1 and applied over line 84 to reset the transmit latch 86 and to reset the counter 73 through OR gate 82 over line 93.

Mode 2 Operation

It will now be considered that a change in status has become effective at one of the devices 87 in FIG. 1B, and energy is accordingly applied over line 94 to a status change detector 95 which in turn delivers an output over line 96 to set a change latch 97. The setting of latch 97 applies an output over line 98 to an AND gate 99 so that such gate is enabled when the anti-coincidence latch 80 is in its reset position, thus delivering an output over line 101. Gate 99 when thus enabled delivers an output over line 101, through OR gate 91 and over line 92 to cause application of energy continuously on the response channel 31. This energy is decoded as a 0 by receiver 33 since gate 89 is de-energized. This 0 signal is the start pulse energy which has been heretofore described.

With reference to FIG. 1A, the reception at the central station of the start signal is applied over line 102 through receiver 33 to line 67, and thus to mode selector 49. The mode selector 49 becomes triggered to change from mode 1 to mode 2 enable in response to energization of line 66 by pulse stretcher 65 upon generation of a reset pulse at the end of a cycle of operation that may be in progress. The removal of energy from mode 1 enable line 51 stops the station counter 45 and removes the enable energy from transfer gates 50 for the duration of mode 2 operations.

Mode selector 49 now provides an output over line 103 to one-shot 47 to enable the one-shot to set all 1's in the address and data register 38. This is considered a most superior station code, and the system, in searching for the station or stations that have registered a start, will give preference to the station having the most superior address code. Thus, if the most superior station to which the code of all 1's is assigned has registered a start, that station will be given preference over all other stations that may have registered simultaneous starts to transmit its information because it will be addressed first in response to the start energization applied to the response channel 31. A mode 2 cycle is thus transmitted the same as has been described for

mode 1, with the characters selected by multiplexer 52 wherein the station code is determined by the address code that has been set into address and data register 38 as has been described for mode 2 operation. During this cycle, therefore, the multiplexer 52 provides outputs of all 1's as the transmission of the address progresses during the cycle.

As long as there is a remote station having applied a start pulse whose address corresponds with the address bits being transmitted from the central station, the central station continues to transmit address pulses of the character 1, however, when this character disagrees with a bit of the station code assigned to the most superior remote station having a registered start, energy is removed at such remote station from the response channel 31, and the central station senses this removal to restart the cycle and to change the character in register 38 from a 1 to a 0 for the bit that was out of correspondence.

With reference to FIG. 1B, as in a normal cycle, when an element of the address code is out of correspondence with the code assigned to a station, the anti-coincidence latch 80 becomes set, and the setting of this latch at a station having registered a status change turns off the gate 99 by removing energy from the line 100. This terminates the transmission of energy over the response channel 31 to the central station, and the removal of such energy removes energy from line 67 (see FIG. 1A) and thus from input to the toggle AND gates 37 to cause an output of the toggle AND gate 37 on line 104 to provide an input to the one-shot 60 for generating an output to reset the system for starting a new cycle of operation. Resetting takes place at each of the remote stations as has been heretofore considered at the end of a normal cycle. Upon the reset pulse having reset the anti-coincidence latch 80 (see FIG. 1B) at station No. 1, energy is again applied to line 100 to enable the gate 99 to again deliver a start signal over response channel 31 and thereby to maintain the mode selector 49 at the central station in mode 2 for the next cycle of operation. Prior to the termination of the prior cycle, the removal of energy from line 67 (see FIG. 1A) has become effective to actuate the toggle AND gates 37 to change the character of the last address bit transmitted from a 1 to a 0 for the cycle of operation now to be started. Thus the system progresses in another cycle of operation wherein at least one more address bit should be transmitted without detection of an out of correspondence condition. If the balance of the address code for the most superior station that has initiated a start is all 1's, the station will be selected on this cycle, but if the balance of the code is not all 1's for such station, the system will restart the cycle and proceed in the same manner that has been described to change the last code bit transmitted in the address and to try again to locate the most superior station.

After selection of a station when the system is operating in mode 2, the system continues to operate the same as has been described in mode 1 so as to transmit data from the remote station that has been selected to the central station and to recheck the address as has been heretofore described, thus completing a cycle having 26 bits of transmission. The transmission of the data from remote station No. 1 (see FIG. 1B) is subsequent to the setting of the transmit latch 86 as has been heretofore described, and at this time energy is removed from line 105 connecting the transmit latch with

the coincidence check circuits 36 to render the coincidence check 36 ineffective to set the anti-coincidence latch 80 in response to an out of correspondence condition during transmission of data parity bits. The output of AND gate 85, upon completing reception of an address code at a remote station, resets the change latch 97 over line 106 because of the selection of the associated station having been successful to transmit data to the central station. Because of the change latch 97 having been reset, there is no energization at the end of the cycle of the response channel 31, and accordingly at the central station the mode selector 49 is changed to mode 1 enable and thus the system is restored to its normal condition of roll call of the stations according to the condition of station counter 45. Energy applied to the mode 1 enable line 51 enables gates 68 and 69 to step the station counter 45 for each cycle completed of the roll mode, and also energy applied over line 51 enables transfer gates 50.

Integrity Check

With reference to FIG. 1A, code received from a remote station is applied by receiver 33 over line 107 to address and data register 39. This register is shown more in detail in FIG. 2 as having 16 stages, 10 of which are used for address bits, and six of which are used for data bits. The data bits are actually received before the address bits, and thus if the register 39 is a shift register, the bits are so circulated that the register 39 will be conditioned with the bits in the same order as the order in which the bits are stored in the register 38. Thus the registers 38 and 39 are compared at the end of each cycle for corresponding address codes. Results of the comparison are rendered effective to deliver data good, or data not good, outputs in accordance with an enable signal applied from the one-shot 60 at the end of the cycle.

AND gates 41 are provided for comparing the address code bits selected for transmission with the address answer-back code bits, bit for bit. These gates have outputs enabled only where there is an out of correspondence condition in one of the address bits, and in such case the output of a gate 41 is applied through OR gate 42 over line 108 to an AND gate 109 that is enabled at the end of the cycle by output of one-shot 60 on line 110. An output of gate 109 is applied over line 111 through OR gate 112 over wire 113 to AND gate 114. Energy of line 113 is also effective through an inverter 115 to set a trouble latch 116. This prevents enabling gate 114 over line 117 in order to permit the system to repeat a cycle to the same station and perhaps obtain a valid code.

If the integrity check logic 43 determines during the next cycle that the data is good, an output is provided on data good wire 44 through AND gate 118 and inverter 119 to add a count to station counter 45 (see FIG. 1A) through AND gate 68 and OR gate 69. Also, with reference to FIG. 2, the trouble latch 116 is reset by output of gate 118. If there has been only one trouble cycle, there has been no output of gate 114, because an output of this gate is enabled only provided that there are two successive trouble cycles detected. If there are two successive trouble cycles detected, the second trouble cycle causes an output of gate 114 because the trouble latch 116 is not reset, and thus an address storage 121 is enabled to store the address of the station having the trouble, the address being trans-

ferred from address and data storage 38. A digital trouble indicator 122 is provided for indicating the station number having the trouble, and an alarm 123 is actuated to call the trouble condition to the attention of an operator at the central station.

The apparatus that has been described for sensing and indicating trouble because of lack of correspondence between the address code transmitted and the address code received is also used to indicate trouble because of dual bit detection. This detection is made by the dual bit detector 125, an output of which is effective to enable AND gate 128 to provide an input to OR gate 112 to render effective the data good and data not good outputs which control the trouble indication and transmission of a repeat cycle the same as has been heretofore described by trouble sensed upon comparison of address codes.

When it has been determined that the data is good by integrity check logic 43 including comparator and dual bit detection gates (see FIG. 1A), an output is applied over line 130 to a decoder 131. The decoder 131 delivers outputs to Station No. 1 indicators 132 and Station No. 2 indicators 133 over lines 134 and 135 respectively.

The communication system is also adapted to transmit designated controls from the central station to the remote station by selecting data bits for transmission by the central station during the period in the communication cycle when the address code is not being transmitted by the central for comparison with the stored code for each remote station. A control data selector 136 is provided for this purpose. Its output governs address and data register 38 over line 137.

Separate control, response and reset channels 30, 31 and 124 are illustrated in the drawings for connecting the communication apparatus at the central station with the communication apparatus at the remote stations. With this organization, direct current PCM codes can be used for communication. These can be of opposite polarity for 1's and 0's respectively. It is to be understood, however, that where conditions warrant the combining of the channels over a single line circuit, carrier station frequency communication may be employed wherein the central station would transmit on distinctive frequencies as compared to the frequencies used for the remote stations to respond.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention.

What is claimed is:

1. A code communication system including at least one communication channel for interrogating remote stations from a central station during a communication cycle in response to a start pulse communicated to the central station from one of the remote stations and with each of the remote stations having an individual station code assigned thereto and wherein the improvement comprises;

a. transmitting means at the central station responsive to a start pulse communicated over the communication channel from the central office to the remote stations a most superior station search code,

b. receiving means at each of the remote stations for receiving the search code transmitted by the transmitting means,

c. cycle reset means governed by a remote station having initiated a cycle by transmitting a start pulse for causing the communication system to be reset to start a new communication cycle in response to the reception at that remote station of a search code bit that has a sense that disagrees with a corresponding station code bit assigned to that station, and

d. means at the central station responsive to the reset means for activating the transmitting means to transmit another cycle including the same address code as transmitted during the previous cycle except that the sense is changed for the last search code bit transmitted during the previous cycle.

2. A code communication system according to claim 1, and including mode selecting means for selectively enabling the transmitting means in a first mode to transmit successive roll call addresses and in a second mode to transmit a most superior station search code.

3. A code communication system according to claim 2 wherein the mode selecting means enables the transmission of a most superior station search code in the second mode in response to the start pulse communicated from one of the remote stations.

4. A code communication system according to claim 3 wherein the mode selecting means enables the transmission of addresses in the first mode when no start pulse is received at the central station from one of the remote stations.

5. A code communication system according to claim 2 wherein:

a. means is provided for comparing each address code transmitted from the central station during each roll call cycle with the address code received at the central station over a common communication channel from the remote station being interrogated during that cycle and for delivering a recycle output signal when the addresses compared are out of correspondence, and

b. means is provided for transmitting a distinctive address code during successive roll call cycles from the central station to the remote stations except that the same address code that was transmitted during the prior cycle is transmitted in response to the recycle output signal.

6. A code communication system according to claim 4 and including limiting means for permitting the transmission of only a limited number of repeat cycles.

7. A code communication system according to claim 6 wherein the limiting means includes a trouble latch that delivers an output after transmission of a repeat cycle.

8. A code communication system according to claim 7 wherein the output of the trouble latch advances the roll call of the transmitting means to transmit the next distinctive address code in a predetermined order.

9. A code communication system according to claim 8 and including counting means for determining the order of transmission of roll call addresses.

10. A code communication system according to claim 4 and including alarm means responsive to the trouble signal for indicating the detection of a trouble condition.

11. A code communication system according to claim 7 and including alarm means that is activated by a trouble signal provided there is an output of the limiting means.

12. A code communication system according to claim 1 having means for selectively operating in roll call mode and in a code superiority address search mode and having means for sequentially selecting different station address codes for transmission over a communication channel from a central station and having:

- a. storage means for storing an address code for transmission to the remote stations,
- b. station counting means for counting roll call cycles of operation and operable when enabled to deliver digital outputs to the storage means in accordance with the station count accumulated,
- c. code setting means operable when enabled to set the storage means to a most superior search address code, and
- d. mode selecting means operable to select first and second modes in response to signals from a remote station for enabling the station counting and the code setting means, respectively, to govern the address code stored by the storage means.

13. A code communication system according to claim 12 wherein the code setting means is enabled only for a first cycle of operation of the system in said second mode.

14. A code communication system according to claim 13 wherein toggle gating means is provided that is operable when enabled to change the address stored by the storage means and including enabling means for enabling the toggle gating means in response to a control signal communicated over the communication channel to the central station.

15. A code communication system according to claim 14 wherein means is provided for rendering the

toggle gating means effective to change only the bit which was the last bit transmitted of the address code transmitted during the next prior cycle of operation of the system in said second mode.

16. A code communication system according to claim 12 wherein answer-back checking means is provided for checking an address code received at a central station during a cycle against the address code transmitted during that cycle and including means responsive to the checking means for causing the station counting means to repeat a cycle during roll call when the address code received is out of correspondence with the address code transmitted.

17. A code communication system according to claim 16 and including means to limit the number of successive cycles during which the same station address can be transmitted.

18. A code communication system according to claim 12 wherein the mode selecting means is governed by signals communicated from the remote stations over the communication channel for selectively operating the system in said first mode if no start is registered at one of the remote stations and for operating the system in said second mode if a start is registered by communication of a signal over the communication channel from a remote station.

19. A code communication system according to claim 18 wherein means is provided for communicating a manifestation from a remote station having registered a start when the system is operating in said second mode and a bit of the address code received at that station is out of correspondence with an address assigned to that station, whereby the sensing of this manifestation at the central station resets the communication apparatus at an intermediate point in a cycle to initiate a new cycle of operation.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,796,994

DATED : March 12, 1974

INVENTOR(S) : Robert F. Nuss, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the claims, column 9, line 64, delete "response" and insert --responsive--; line 65, after "communicated" insert --from one of the remote stations for transmitting--.

Signed and Sealed this

second Day of December 1975

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks