June 8, 1943. W. M. BACON 2,320,997

COMMUNICATION SYSTEM

Filed Aug. 17, 1940 5 Sheets-Sheet 1

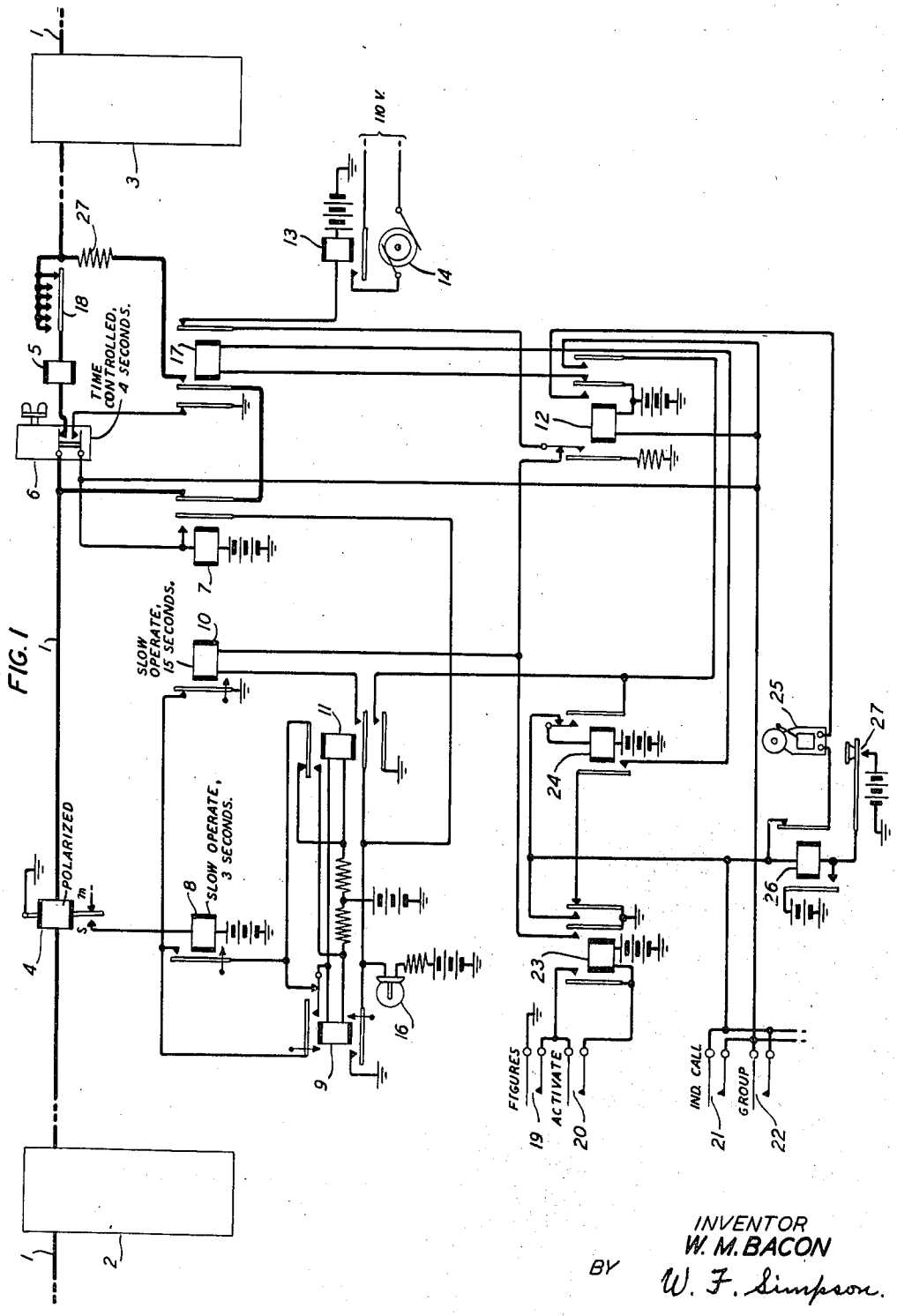

FIG. 1

INVENTOR
W. M. BACON
BY W. F. Simpson.
ATTORNEY

June 8, 1943. W. M. BACON 2,320,997

COMMUNICATION SYSTEM

Filed Aug. 17, 1940 5 Sheets-Sheet 2

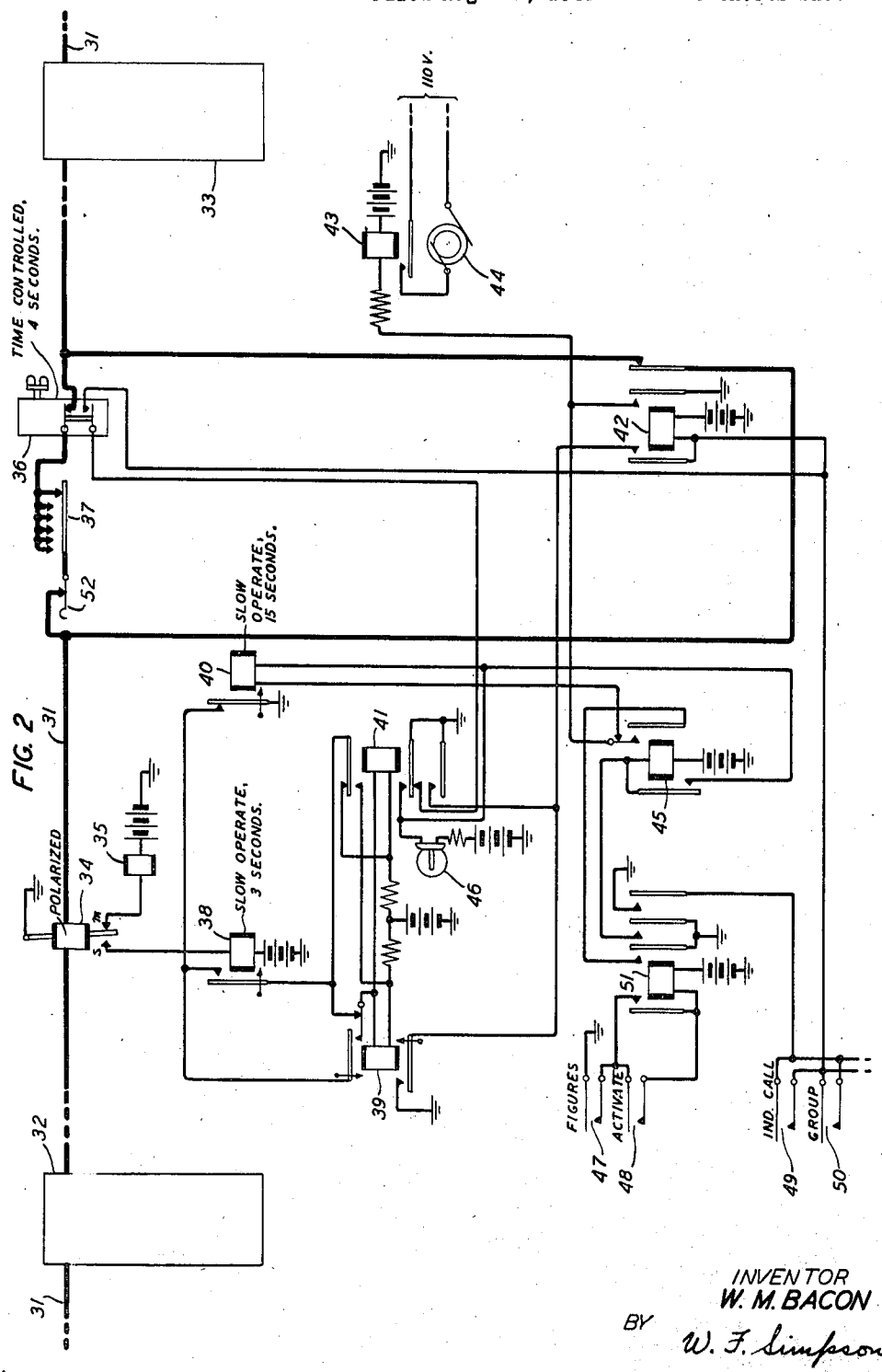

FIG. 2

INVENTOR
W. M. BACON
BY W. F. Simpson.
ATTORNEY

June 8, 1943. W. M. BACON 2,320,997

COMMUNICATION SYSTEM

Filed Aug. 17, 1940 5 Sheets-Sheet 3

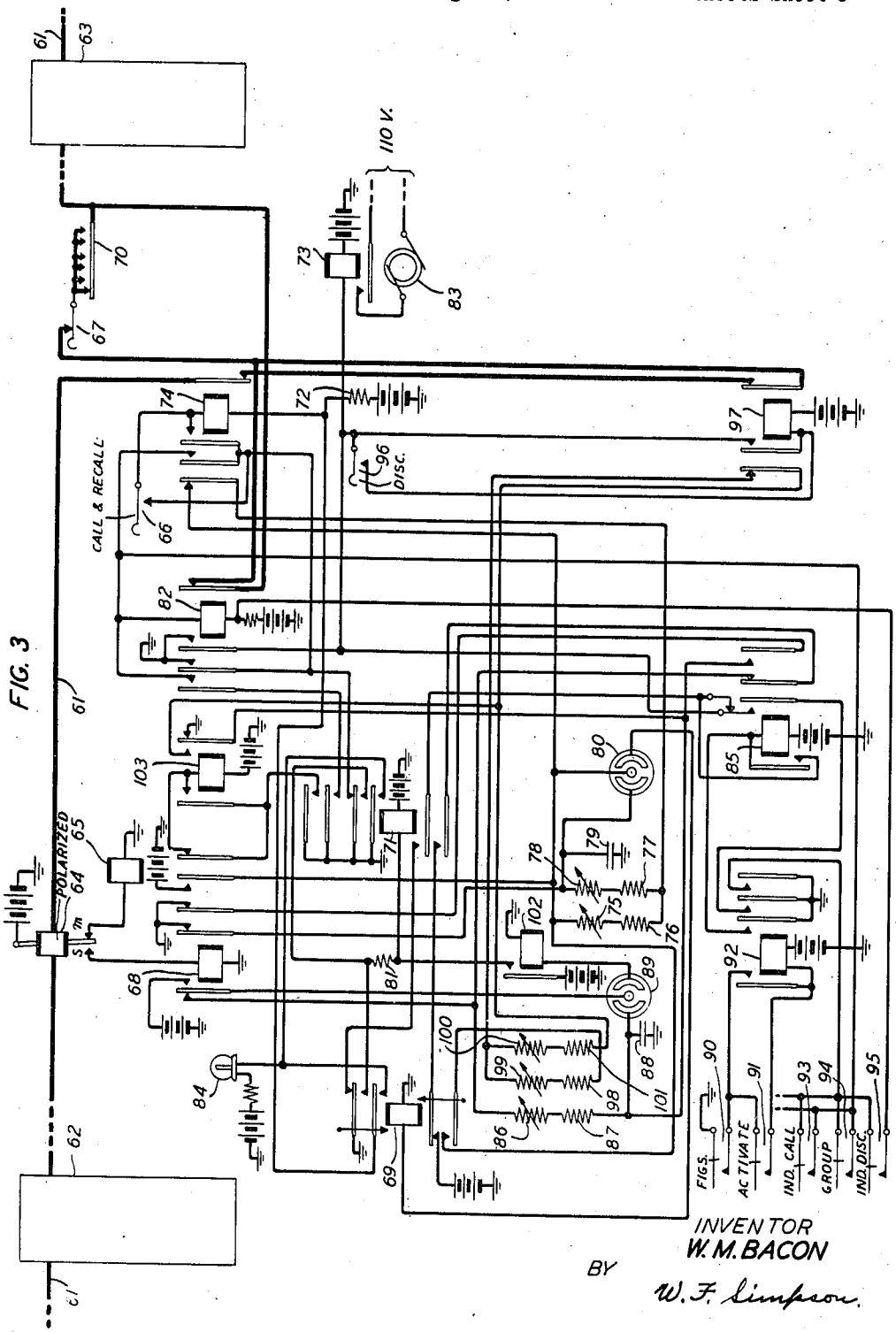

FIG. 3

INVENTOR
W. M. BACON

BY
W. F. Simpson.

ATTORNEY

June 8, 1943. W. M. BACON 2,320,997

COMMUNICATION SYSTEM

Filed Aug. 17, 1940 5 Sheets-Sheet 4

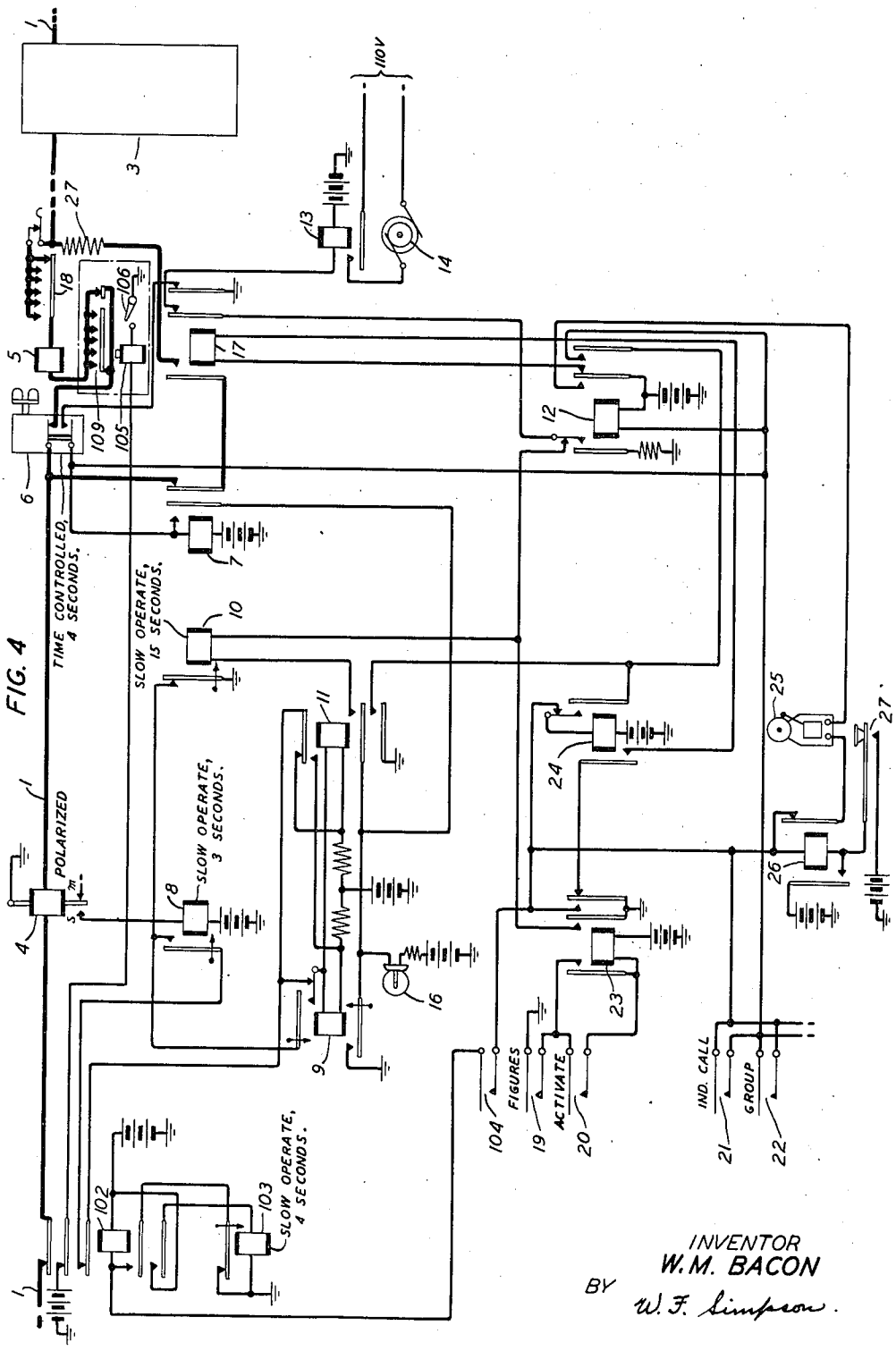

FIG. 4

INVENTOR
W. M. BACON
BY W. F. Simpson.
ATTORNEY

June 8, 1943. W. M. BACON 2,320,997

COMMUNICATION SYSTEM

Filed Aug. 17, 1940 5 Sheets-Sheet 5

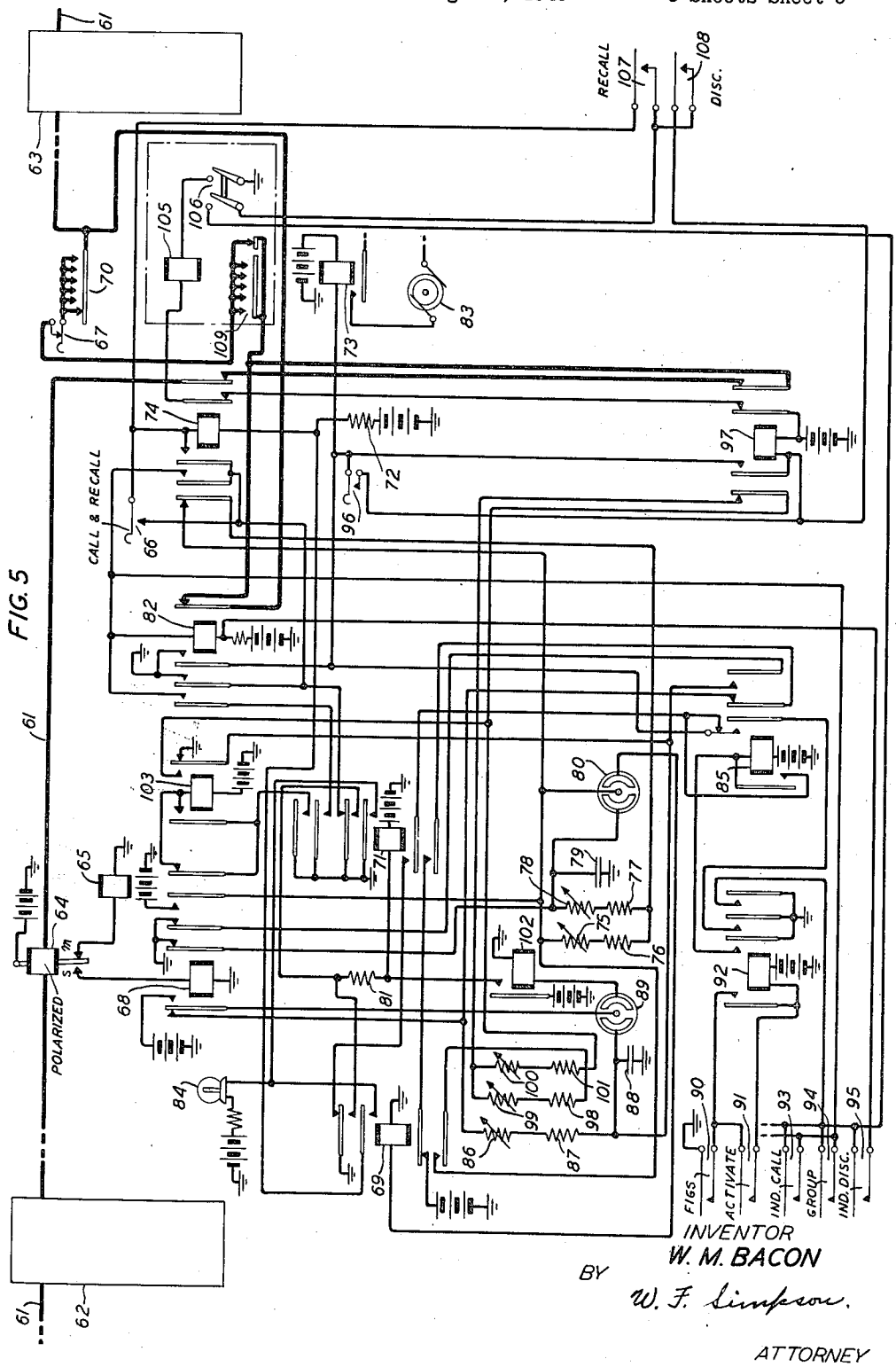

FIG. 5

INVENTOR
W. M. BACON

BY
W. F. Simpson.

ATTORNEY

Patented June 8, 1943 2,320,997

UNITED STATES PATENT OFFICE

2,320,997

COMMUNICATION SYSTEM

Walter M. Bacon, New York, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application August 17, 1940, Serial No. 353,086

12 Claims. (Cl. 178—4.1)

This application is a continuation in part of my application Serial No. 290,743, filed August 18, 1939, and relates to communication systems and more particularly to telegraph systems wherein a plurality of stations on a common channel may set up connections between each other and exclusively appropriate the channel to their own use.

The systems of this type of the prior art, such as disclosed in U. S. Patent 2,148,430, granted to Benjamin, February 28, 1939, are subject to false and improper operation due to extraneous and interfering currents. For example, if the line is momentarily opened due to some static or other stray currents or interruptions of the circuit, the motors at all of the stations will energize and continue to operate indefinitely, unless stopped by an attendant at some one of the stations.

It is an object of this invention to provide means for automatically stopping the motors at all of the stations if and when they may become accidentally or falsely started.

An object of the invention is to provide automatic means for preventing unnecessary operation of stations on a party line when such stations are not involved in a connection. In particular, it is an object of the invention to prevent unnecessary operation of the motors of a plurality of teletypewriters connected to a party line.

In accordance with this invention, and as a specific illustration of how the invention may be applied, a communication channel is provided to serve a plurality of stations each equipped with a teletypewriter. A station circuit is provided with means for sending out over the channel a prolonged signal of predetermined length for the purpose of calling in the other stations on the channel. By calling in is meant to change all the other stations from their normal non-operative condition to an operative condition in which they are able to respond to the type of signal ordinarily used for their regular operation. Specifically, a time controlled switch is provided at each station for sending out over the common channel a spacing signal (where the normal condition of the channel is marking) of the order of four seconds duration. Each other station on the channel will respond to such a signal by starting the teletypewriter motor thereat so that the mechanism of the teletypewriter will properly respond to permutation code signals.

According to the invention a slow-acting means or a timing means is provided to maintain this temporarily operative condition. Specifically, the motors of all stations will be placed in operation for a predetermined period of sufficient length for the subscriber who is establishing a connection to carry out other necessary operations. As illustrated, the motors of all other stations will run for about fifteen seconds and then if nothing else happens will automatically shut down.

During this fifteen-second interval the calling station may put the other stations on the line on what may be termed a conditionally permanent operative basis, that is, the fifteen-second timing means may be disabled so that at the end of the fifteen seconds if nothing else now happens the motors of all stations will continue in operation. Thereafter the calling station may put selected ones of said other stations on what may be termed an unconditionally permanent operative basis, that is, such selected stations are now placed beyond interference by any further operations at the calling station excepting, of course, the releasing operation. Thereafter the calling station may release those stations which are still on the conditionally permanent operative basis and by so doing cause them to be locked out of the system and rendered incapable of interfering with the proper operation thereof. In one embodiment of the invention any one of the stations, party to an established connection, may be selectively disconnected and such station will thereafter be locked out and rendered incapable of interference with the established connection. In one embodiment of the invention a locked out station may be recalled and made a party to an established connection through operations carried out at any one of the stations, party to such established connection.

Each teletypewriter forming part of the circuit of the various stations is supplied with a number of contact sets operated by the teletypewriter mechanism and in response to various and particular codes. After the stations have been put on a temporary operative basis by slow-acting or timing means, the temporary basis is changed to a conditionally permanent basis through the operation of certain of these contact sets at each station by means of common codes. Thereafter individual stations, or a group of such stations, are put on an unconditionally permanent basis by the operation of certain other contact sets by codes individual to such stations or individual to a particular group of such stations. Any particular station may be equipped with contact sets for individual calling only or for group calling only or for both. Still other contact sets

may be provided for individual disconnect or group disconnect.

At the calling station means are provided to automatically place such station on a permanent rather than a temporary operation basis. This means that the calling subscriber need only transmit the code for the particular wanted station or stations and need not transmit the code for his own station.

Any one or more of the stations on such a party line may be provided with tape transmitters. When the calling is started from an idle condition, the operation is the same as though the transmission were to be from an operator's keyboard. However, a series of messages to different stations may be punched in the tape. At the conclusion of one message the code combinations for figures and activate are followed by a common code combination which will operate a special contact set in the teletypewriter of all the stations which are so equipped. This will operate a slow-acting means which will not only send a prolonged calling-in signal over the line to return the selected stations not provided with a tape transmitter to normal and to unlock the non-selected stations, but will at the same time delay the further operation of the tape transmitter at the calling or transmitting station. This common code is then repeated to place all the other stations in a temporarily receptive condition so that by the further transmission from the punched tape, all the stations may be placed on a conditionally permanent operative basis, certain selected stations may be placed on an unconditionally permanent operative basis and the others locked out. Thus the code combinations for setting up a plurality of connections as well as the messages for each such connection may be punched in the tape and the sequential operation of setting up a connection, transmitting the message, releasing the connection, setting up a new connection and so forth will be carried out automatically. Divisible subject-matter carved from this application is disclosed and claimed in application Serial No. 474,843, filed February 5, 1943.

Any one of the parties to the established connection may transmit and all will receive such transmitted messages.

Any one of the parties to the established connection may break down such connection and restore the channel to normal where it may be used by all the subscribers thereon.

Other objects of the invention and features will appear as the description proceeds.

The drawings consist of five sheets each containing a circuit diagram and each illustrating a different form of the invention.

Fig. 1 is a circuit diagram showing a telegraph line 1 extending through a station represented by the rectangle 2, a station represented by the circuit diagram of the main part of Fig. 1 and another station represented by the rectangle 3. The stations 2 and 3 are the same as the station shown in detail in Fig. 1. It will be understood that a suitable source of current and a return circuit are provided for the telegraph line which may contain a large number of stations, and that the normal condition is a closed circuit with current flowing in the line whereby the line relay 4 and the teletypewriter line relay 5 of each station are normally held to their marking contacts. Relay 4 is a neutral type relay, that is, it is biased so that when no current flows through its winding it moves its armature to its spacing contact. It should be noted that relays 4 and 5 may be polarized relays in case polarized signals are transmitted over line 1. In case so-called neutral signals, that is, signals of current and no current are transmitted over line 1, relays 4 and 5 may be neutral relays or they may be polarized relays provided with a biasing winding and current so that they will respond to signal impulses of current and no current.

It is also within the scope of this invention to provide any suitable type of telegraph channel between the respective stations. This channel may include a full metallic telegraph line, a ground return telegraph line, a channel of the carrier telegraph system, a channel of a radio communication system, a telegraph channel of a composited telephone and telegraph line and may include both cable and open wire telegraph lines as well as a full duplex telegraph system or a channel of a multiplex telegraph system or any operable combination of these systems. The only essential is that at each of these stations the system responds to two signaling conditions of the line and that the communication system transmits to each station signals to which the two relays will respond.

When the operator at the station of Fig. 1 wishes to call in some other station, he operates the time-controlled switch 6. This will open the line circuit for a period of four seconds and at the same time will cause the operation of relays 7 and 12. Relay 4 will move to its spacing contact, thereby energizing relay 8. Relay 8 is slow operating and is adjusted to move its armature only after being continuously energized for three seconds. Since the time-controlled switch causes the relay 4 to go to its spacing contact for four seconds, relay 8 will become energized.

Relay 8 controls a pair of relays 9 and 11 which constitute a pair of counting relays well known in the art. These relays operate in one complete cycle for each two complete cycles of operation of relay 8. Thus, upon the first energization of relay 8, relay 9 becomes operated. When relay 8 becomes released at some later time, relay 11 becomes energized. When, subsequently, relay 8 again operates, relay 9 releases and when relay 8 again releases, relay 11 releases.

Relay 9, therefore, now becomes operated and through its lower armature causes busy lamp 16 to light. Through this same connection a ground is placed on the inner armature of relay 7 to hold relays 7 and 12 locked.

During the operation of the time-controlled switch 6, relay 12 is operated and through its left-hand armature energizes relay 13 for closing the circuit of the teletypewriter motor 14 whereupon this motor starts into operation.

At the end of four seconds, the time-controlled switch 6 again closes through the line and the relays 4 and 5 of the calling station as well as all the other stations on the circuit go to their marking contacts. The lower contact of the switch 6, which originally caused the energization of relay 7, is also opened but through the locking contact of relay 7 a ground is extended to the winding of relay 12 so that this relay is maintained operated. As relay 4 moves to its marking contact, relay 8 is immediately released, with the result that relay 11 becomes operated. Relay 11 now establishes an alternate locking circuit for relays 7 and 12 through its lower outer armature.

If no other action is taken by the operator at this station, the circuit will now remain in

the condition just described with motor 14 running and this condition would remain fixed indefinitely.

At all other stations on the line, such as the stations represented by the rectangles 2 and 3, the movement of the line relay 4 to its spacing contact in response to the operation of the time-controlled switch 6 at the station making the call will result in the energization of relay 8 after the relay 4 has maintained its armature on its spacing contact for three seconds. Thereupon the relay 9 will become operated and cause the busy lamp 16 to light. Thus, the busy lamps at all stations on the line become lighted. At these other stations relays 7 and 12 are not operated at this time. At the end of four seconds, the relay 8 at each of the stations releases, whereupon the relay 11 at such stations operates. Thereupon a circuit is established from ground, the contact and lower armature of relay 9, the inner lower armature and front contact of relay 11, the winding of relay 10, the normal contacts of the left-hand armature of relay 12, the right-hand armature and back contact of relay 17, winding of relay 13 to battery. Relay 13 becomes immediately energized and starts the motor 14 at each of these stations into operation. The relay 10, however, is slow to operate and must be energized in this circuit for at least fifteen seconds before it will operate. Thus, after the time-controlled switch 6 at the calling station completes its operation, there is a period of fifteen seconds during which the motors of all other stations on the line are operating and before which the relay 10 at each of these stations becomes energized.

If no other action is taken, then at the end of the fifteen seconds the relay 10 becomes energized and causes the immediate release of relays 9 and 11 which in turn causes the release of relays 10 and 13 and the stopping of the motor 14.

If within this fifteen-second interval the operator at the calling station operates his transmitting contacts 18 to transmit the code for "Figures," the contacts 19 at each station will be operated. Contacts 19 are controlled by the platen member of the receiving device and are closed in response to the reception of a figure signal by the device. Contacts 19 when operated are closed so long as the device remains in the upper case. These contacts are open by sending an unshift or letter signal which returns in mechanism to the lower case.

The other contacts 20, 21 and 22 are actuated only momentarily in response to the reception of the predesignated code combinations. These contacts close once for a short interval of time in response to the reception of each of the respective code combinations. For example, every time the activate code combination is transmitted contact 20 will momentarily close. The manner in which pairs of contacts such as 19, 20, 21 and 22 are operated is illustrated in Patent 2,120,235, granted to James F. Beattie et al June 14, 1938. If the calling operator again operates the transmitting contacts 18 within the fifteen-second interval to transmit a given code which will result in the operation of contacts 20, a circuit is established through contacts 19 and contacts 20 to the winding of relay 23. Relay 23 will operate and lock through its left-hand armature directly to the contacts 19 which remains closed until the code for "letters" or "space" is sent. All stations on the line thus have their relay 23 operated. This results in the operation of relay 24 and relay 24 locks to the lower armature of relay 11. The operation of relay 23 short-circuits relay 10 and prevents the stopping of motor 14 after the fifteen-second interval. Thus, all stations are now on a conditionally permanent instead of a temporary operating basis.

The operator at the calling station now transmits another code which may be one arranged to operate the individual call contacts 21 of some particular station on the line, or it may be arranged to operate the group calling contacts of two or more particular stations on the line. There, of course, may be several such group calling contacts for calling different combinations of stations, as indicated by the multiple conductors. In addition, the operator may transmit several of these calling code combinations each of which operates the individual contacts at different stations or each of which operates different group contacts at different groups of stations. Let it be assumed that the contacts 21 at the called station are closed. Thereupon a circuit is established from ground, the outer right-hand armature and front contact of relay 23, contacts 21, windings of relays 7 and 12, in parallel, to battery. Relay 12 thereupon substitutes an energizing circuit for relay 13 and opens the original circuit through the slow operating relay 10. Relay 12 locks up through its outer right-hand armature to the ground on the lower armature of relay 11 and relay 10 is short-circuited by the inner right-hand armature of relay 23. Thus, at the station or stations which have been called, the relay 12 is operated and such station or stations are put on an unconditionally permanent operative basis. Upon the operation of relay 12 a circuit is established through the inner right-hand armature of relay 12, the call bell 25, through the right-hand armature and contact of relay 26 to ground at the front contact and outer right-hand armature of relay 23. The operation of bell 25 notifies the attendant at the called station that his station is being called. He may stop the operation of this bell by momentarily depressing the key 27, which will cause the operation of relay 26 and which locks through its left-hand armature in order to maintain the circuit through its right-hand armature open.

The code for "letters" or "space" will now be sent to shut down the uncalled stations. This operation will cause the opening of the contacts 19 at all stations and the consequent release of relay 23. The release of relay 23 at the called stations interrupts the circuit of bell 25 and relay 26 and thus stops the operation of bell 25 if the attendant has not previously operated key 27. If the attendant has previously operated key 27, the release of relay 23 will release relay 26. The release of relay 23 at the called station also disconnects ground from the contacts 21 and 22 so that the subsequent operation of these contacts during the transmission of the following message will produce no effects upon the switching circuits or connections at any of the stations of the system.

All of the called stations are now in condition to communicate with each other for an indefinite period. Each one of the called as well as the calling stations may communicate or transmit to all of the other called or calling stations by operating a transmitting device having contacts 18. The line relays 4 and 5 at each of the stations follows the signals transmitted from the transmitting station. Relay 5 causes the receiving

teletypewriter or other receiving apparatus at each of the stations to record the message transmitted from the transmitting station. Relay 4 at each of these stations also responds to the signals transmitted over line 1. However, during the normal transmission of signals over line 1, relay 4 will not continuously remain in a spacing position for three seconds. Consequently, relay 8 will not operate at any of the stations and thus will not interfere with the established connections.

At the uncalled stations, upon the first and operation of relay 23 the slow operating relay 10 was short-circuited to prevent its operation and the consequent release of the counting relays 9 and 11, the release of relay 23 at this time in response to the "letters" or "space" code reestablishes the operating circuit through the slow operating relay 10. Relay 10 does not operate at once so relays 9 and 11 remain operated and relay 24 will be maintained locked operated. Therefore, a circuit is established from ground, the outer right-hand armature and back contact of relay 23, the left-hand armature and front contact of relay 24, the winding of relay 17 to battery through the back contact and inner right-hand armature of relay 12, resulting in the energization of relay 17 which in turn also opens the circuit of relay 13. Relay 13 releases and interrupts the operating circuit of motor 14 which motor stops at the uncalled stations. Relay 17 in operating interrupts the operating circuit of relay 10 before this relay operates so relays 9 and 11 remain operated at this time. Relay 17 also establishes a shunting connection through the resistance 27 about the transmitting contacts 18, the teletypewriter line relay 5 and the time-controlled switch 6 at all stations which are not called or wanted in this connection. Thus, at such stations the teletypewriter is shut down, interference with the established connection is prevented, reproduction of the transmission at such stations is prevented and the relays 9, 11, 17 and 24 thereat are maintained operative. The line relay 4 at such stations will operate in accordance with the code signals, but the relay 8, being arranged to respond only after being continuously energized for three seconds, will not operate. Interference with an established connection by a locked out station is prevented by a ground connection for the lower element of time-controlled switch 6 through a back contact on relay 17. Since this relay is operated at all locked out stations the operation of switch 6 at those stations will be ineffective.

At the end of the period of use any one of the stations effectively on the circuit may release the connection by operating its time-controlled switch 6 so as to cause the relay 4 at all stations to rest on its spacing contact for an equal length of time, that is, four seconds. Thereupon the relay 8 at the stations which have been locked out will come up and this time release the relay 9 and as soon as relay 8 releases, the relay 11 will release, causing the relays 17 and 24 in turn to release and thus restore such stations to normal. The release of relays 9 and 11 at both the calling and called stations will also result in the release of relays 7 and 12 and consequently the return to normal will be complete at such stations.

Fig. 2 is a simplified arrangement of the circuit shown in Fig. 1. In this case, line 31 passes through stations 32 and 33 and the station represented by the circuit diagram of Fig. 2. Relay 34 is included in the line circuit and will remain on its marking contact or its spacing contact in accordance with the condition of the line, that is, whether it is closed or open. A time-controlled switch 36 and a set of transmitting contacts 37 are also included in the line. The teletypewriter selecting magnet 35 is connected to the marking contact of relay 34.

With this arrangement an operator wishing to call another station on the line operates the time-control switch 36. The operation of the time-control switch 36 completes a circuit for the operation of relay 42 from positive battery through the winding of relay 42, lower contacts of switch 36 to ground through the lower inner break contacts of relay 41. The operation of relay 42 also completes the circuit for operating relay 43 which in turn connects power to motor 44 thus conditioning the teletypewriter for operation at the calling station for operation. The operation of relay 42 also interrupts the shunt around the upper contacts of time-control switch 36, transmitting contacts 37, and break key 52.

The operation of the time-control switch 36 and the operation of relay 42 interrupts the line circuit 31.

When line 31 is opened, relay 34 at all the stations of the system will operate the spacing contact and in three seconds cause the operation of relay 38. Relay 38 in operating completes a circuit for the operation of relay 39. At the end of approximately four seconds the upper contacts of switch 36 will close in line 31 and cause relays 34 at all of the stations to be operated to its marking position. Relay 38 at all stations on the line will then become deenergized which in turn results in the energization of the counting relay 41 thereat. The operation of relay 41 completes for maintaining relay 42 operated from positive battery through the winding of relay 42, the left-hand operated contacts of relay 42 to ground through the lower outer operated contacts of relay 41. A circuit will also be established by the operation of relay 41 from ground through the lower inner armature and front contact of relay 41 and thence in one direction through the signal lamp 46 and in another direction through the winding of relay 40, the normal contact and the right-hand armature of relay 45, winding of relay 43 to battery. Relay 43 becomes energized in series with relay 40 but relay 40 will not become energized for a period of fifteen seconds, so that if no other action is taken, the motor 44 will run for fifteen seconds whereupon the relay 40 will become operated and by releasing both relays 39 and 41 will return the station to normal.

During this period of fifteen seconds the operator at the calling station will transmit the code for figures and then the code used to operate the activate contacts 48. With contacts 47 and 48 operated, relay 51 will become operated and locked through its left-hand armature and contacts 47, resulting in the operation of relay 45 and the substitution of a permanent energizing circuit for relay 43 and at the same time the disabling of relay 40 so that this relay cannot interfere with the condition of these stations. After the Figures and Activate codes have been sent, the individual call or the group call codes will be transmitted whereupon relay 42 at those stations called will operate. Relay 42 will then lock to the lower armature of relay 39 and place all such called stations on a permanent operating basis.

At all other stations where neither the individual call contacts 49 nor the group call contacts 50 have been operated, the relay 42 will not be

energized. Therefore, when the "letters" or "space" code is transmitted by the calling station the relay 51 will be released and the circuit of relay 43 will be opened at the front contact of the innermost right-hand armature of relay 51. Relay 45 will be maintained operated as long as relay 41 is operated and the time-controlled switch 36, the transmitting contacts 37 and the break contact 52 will be rendered inoperative at these stations which are locked out of the established connection.

At the end of the period of use of this connection any one of the stations party to the connection may operate its time-controlled switch 36, with the result that the relays 38 of all stations on the line will be operated and then released, resulting in the release of relay 39 followed by the release of relay 41, whereupon all stations are returned to normal condition.

Fig. 3 shows a third form of the invention wherein trigger tubes are used for slow-acting means rather than relays adjusted mechanically. In this figure the telegraph line 61 passes through a number of similar stations two of which are illustrated by stations 62 and 63, represented by rectangles, and a third by the station shown in full in the diagram comprising the main part of Fig. 3. A line relay 64 is included in the line as well as a break key 67 and a set of transmitting contacts 70. The normal condition of the system is closed, with line relay 64 held on its marking contact. In this condition the controlling magnet 65 of the teletypewriter is held in a marking condition. At the station from which a call is established a key 66 is momentarily depressed. Thereupon a circuit is established from battery through the resistance 72, through the winding of relay 74, the contacts of key 66, the back contact and upper armature of relay 71 to ground. Relay 74 is energized in this circuit and thereafter its front contact and inner left-hand armature establishes a holding circuit independent of the key 66. The operation of relay 74 opens the line at its right-hand armature. By means of its outer left-hand armature, relay 74 at the same time removes a short circuit from about adjustable resistance 75 and fixed resistance 76.

Relay 68 is connected to the spacing contact of line relay 64 and when the line is opened by the right-hand armature of relay 74, the relay 64 moves to its spacing contact and causes the operation of relay 68. The operation of relay 68 establishes a circuit from battery through front contact and second outer right-hand armature of relay 68 through resistances 75, 76, 77 and 78 in series to condenser 79 and thence to ground. By means of the adjustable resistances 75 and 78 this circuit is adjusted so that the condenser 79 will become charged sufficiently in a period of four seconds to cause the cold cathode tube 80 to flash over.

At all other stations on the circuit, except the calling station where relay 74 has been operated, the relay 68 will establish a circuit from battery through the front contact and second outer right-hand armature of relay 68, the back contact and outer left-hand armature of relay 74, resistances 77 and 78 in series to the condenser 79 and thence to ground. At these stations and with this lower resistance in series with the condenser 79, the condenser will become charged sufficiently to cause the cold cathode tube 80 to flash over in three seconds, thus reducing the time constant of the circuit by one second. The reason for the two times used is to give a good margin of operation and to be sure that the circuit remains open long enough to operate the tubes at all stations. When the tubes flash over, continuous battery is placed on relay 69 in a circuit from battery through the front contact and second outer right-hand armature of relay 68 through the tube 80 to the winding of relay 69 and thence to ground. This current will continue to flow until relay 68 releases. Therefore, relay 69 at all stations except the calling station will operate at the end of three seconds and this same relay at the calling station will operate at the end of four seconds.

The operation of relay 69 at all the stations places ground through its upper outer armature and front contact on the winding of relay 71 through the resistance 81 and causes the operation of relay 71. This relay locks in an operated condition through the front contact and second upper armature of relay 71.

At the calling station the initial operation of relay 74 has also placed ground on the winding of relay 82 through the front contact of the middle left-hand armature of relay 74 and second upper break contacts of relay 71. Relay 82 locks through its outer left-hand armature and front contact and second upper operated contacts of relay 71 after relay 71 has become operated. The operation of relay 82 causes the operation of relay 73 which causes the teletypewriter motor 83 at the calling station to start into operation. The operation of relay 82 also removes a short circuit normally placed about the break key 67 and the transmitting contacts 70.

The operation of relay 71 at the calling station removes the original holding ground for relay 74 but this relay continues to hold up through the front contact and outer right-hand armature of relay 82 and the second outer upper operated contacts of relay 71. The operation of relay 71 also places ground on its upper inner armature and front contact to cause the operation of busy lamp 84 and at the same time through the front contact and inner upper armature of relay 69 to the point between resistance 72 and the winding of relay 74, thereby short-circuiting relay 74 and causing it to release. The release of relay 74 closes the line at its right-hand armature and back contact and this results in the movement of all of the line relays 64 to their marking contacts. This in turn releases relay 68 at all stations, with the result that the battery circuit to the tube 80 is broken, and tube 80 extinguished and relay 69 released. The release of relay 68 completes a circuit for the operation of relay 103 from battery through the winding of relay 103, the right outer break contacts of relay 68 to ground through the uppermost operated contacts of relay 71. Relay 103 in operating completes a circuit for maintaining itself operated from battery through its winding left-hand operated contacts to ground to the uppermost operated contacts of relay 71. The operation of relay 103 removes ground from the upper terminal of condenser 88 and permits it to start to charge as described hereinafter.

The release of relay 69 at all stations establishes a connection from ground, the upper outer armature and back contact of relay 69 through the front contact and inner lower armature of relay 71, the normal contacts of the inner right-hand armature of relay 85 to the winding of relay 73 which operates at all of the stations except the calling station. Relay 73 previously operated at the calling station as described above. The operation of relay 73 at all these other stations now

causes the respective motors 83 to start into operation.

At the same time that this is taking place, battery through the back contact and inner lower armature of relay 69 extending through the front contact and outer lower armature of relay 71, the middle right-hand armature and back contact of relay 85, adjustable resistance 86 and resistance 87 establishes a charging circuit for condenser 88. The resistances 86 and 87 are of the proper values to charge the condenser 88 sufficiently to cause the cold cathode tube 89 to flash over in fifteen seconds. If at the end of fifteen seconds no change has taken place in the circuit, tube 89 will flash over, placing battery through the back contact and inner lower armature of relay 69, front contact and outer lower armature of relay 71, middle right-hand armature and back contact of relay 85, back contact and left-hand armature of relay 68, through elements of tube 89 to ground through relay 102 causing this relay to operate. Relay 102 in operating connects battery to the left-hand winding terminal of relay 71 thereby short-circuiting the relay 71 and causes it to release. However, if during the fifteen-second period the figures combination and the activate combination are transmitted by the transmitting contacts 70 at the calling station, the fifteen-second feature will be stopped by the operation of relay 85.

Contacts 90 will respond to the reception of the "figures" code and contacts 91 will respond to the reception of the "activate" code whereupon relay 92 will become operated and will lock through its left-hand armature directly to ground through the contacts 90. The operation of relay 92 results in the operation of relay 85 whereupon the original energizing circuit for relay 73 is broken and a substitute connection made through the inner right-hand armature of relay 85 and the middle right-hand armature of relay 92 to ground.

The operation of relay 85 disconnects battery from the anode tube 89 and also from the charging resistance 86 thus preventing any further charge of condenser 88. The operation of relay 85 also provides a discharge path for condenser 88 from the upper terminal of condenser 88 through the left-hand outer operated contacts of relay 85 to ground through the middle set of break contacts of relay 68 thus discharging condenser 88 and preventing any discharge of tube 89 at this time.

At the time that relay 71 operates, the busy lamp 84 at all stations lights as hereinbefore described, thereby indicating that the circuit is busy. The calling station now transmits the call combination for the stations desired on the circuit. This may take the form of an individual call which will operate the contacts 93 or a group calling combination which will operate the contacts 94. The operation, however, is the same for these two conditions. With either contacts 93 or 94 closed momentarily, a connection is established from ground, the front contact and outermost right-hand armature of relay 92, the contacts 93 or the contacts 94 to the winding of relay 82 so that this relay which has already been operated at the calling station will now become operated at the particular stations called. Relay 82 at the called stations will lock through the front contact and outer left-hand armature to a ground on the front contact and second upper outer armature of relay 71. The operation of relay 82 also places ground on the winding of relay 73 to substitute for the connection hereinbefore established. The operation of relay 82 also removes the short circuits about the break key 67 and transmitting contacts 70 of those stations which have been called.

Following this, the sending of the code for "letters" or "space" will open the figures contacts 90, thereby removing the locking ground on relay 92, causing its release. Relay 85, however, will be maintained operated through its left-hand armature and front contact, the inner lower armature and front contact of relay 71 and the back contact and upper outer armature of relay 69. The release of relay 92 at the called stations will have no effect on the teletypewriter motors as these motors are now under the control of relay 82.

At the non-called stations, however, the release of relay 92 removes ground from the front contact of the middle right-hand armature, thereby releasing the relay 73 and stopping the motor 83. The control of the circuit has been removed from these non-called stations by the preceding operations. Since ground is no longer available at these stations through the call key 66 due to the operation of relay 71 and since relay 71 will remain operated throughout the ensuing period of communication, such non-called stations will be unable to break in on the circuit. At the same time the break key 67 and the transmitting contacts 70 of these non-called stations will remain short-circuited through the right-hand armature and back contact of relay 82. Thus the non-called stations are locked out.

If it is desired to disconnect a station previously called, the figures and activate contacts 90 and 91 are operated through the sending of these codes at the previously called stations only. This is possible since the motors of the non-called stations have been shut down while the motors of the called stations are still in operation. The individual disconnect contact 95 is now operated through the sending of a particular code which is different for each station on the line. A group of stations may be disconnected by sending a group disconnect signal which will operate a contact similar to contact 95 at each station of the group. The operation of contact 95 extends ground from the front contact and outer right-hand armature of relay 92 through contact 95 to the lower terminal of the winding of relay 82, thereby causing relay 82 to release. The release of this relay breaks the lock through its outer left-hand armature, short-circuits the break key 67 and transmitting contacts 70 and removes its control of the motor and control relay 73. When a letters or space signal is now sent, relay 92 releases through the opening of contacts 90 and removes the ground which during the operation of relay 92 was placed through the inner right-hand armature of relay 85 to cause the release of the motor control relay 73. The motor at the station to be disconnected now stops and the station is in the same condition as a non-called station, described above.

To recall or add stations to the system the call and recall key 66 at any of the stations at this time connected to the line is operated. This operates relay 74 from ground through the middle left-hand armature of relay 82 and the contact of key 66 to the winding of relay 74. This opens the line for four seconds at the sending station as described in making a new call, and line relay 64 at all stations moves to its spacing contact,

operating relay 68 as hereinbefore described. This starts the timing circuit of tube 80 as hereinbefore described. In this case again at the end of three seconds at all the stations except the calling station and at the end of four seconds at the calling station relay 69 will operate. Relay 71, however, is locked operated and the opening of the circuit from ground, upper outer armature and back contact of relay 69 removes ground over the circuit previously described to the winding of relay 85, causing the release of relay 85. The release of this relay starts the motors at all of the stations previously cut off the circuit as soon as relay 69 again releases at the end of four seconds as previously described. This is done by placing ground through the upper outer armature and back contact of relay 69, the front contact and inner lower armature of relay 71, the normal contacts of the inner right-hand armature of relay 85 to the winding of relay 73. As previously described, the release of relay 69 at all of the stations starts the fifteen-second feature to operate. The circuit is now in the condition it was before the station selections were sent when a new call was being placed and the operation to select the added stations is the same as it was for adding new stations.

To return the circuit to normal or disconnect all the stations, the disconnect key 96 is operated at any of the stations on the circuit at the time. The operation of key 96 places ground used to operate relay 73 through the contacts of key 96 to the winding of relay 97 which now operates and locks through its inner left-hand armature and front contact. At the station sending the disconnect this also opens the line circuit at the right-hand armature and back contact of relay 97 and at the outer left-hand armature and back contact of this relay removes a short circuit about the resistances 100 and 101. The opening of the line releases the line relays at all the stations and operates relay 68 thereat. The operation of relay 68 places battery on the charging circuit of tube 80 and, as previously described, and at the end of three seconds this tube will flash over, operating relay 69 at all the stations. The operation of relay 69 places the battery through the front contact and second outer right-hand armature of relay 68, the front contact and lower outer armature of relay 69 on resistance 98 whereupon current flows through resistances 98 and 99 to condenser 88 at all the stations except the disconnecting station and through resistances 98, 99, 100 and 101 at the disconnecting station. These resistances are of such a value that when 98 and 99 are in the circuit alone, tube 89 will flash over at the end of six seconds and at the station doing the disconnecting where resistances 100 and 101 are also in the circuit the tube will flash over at the end of eight seconds. Battery is supplied to the anode of tube 89 through the left-hand armature and front contact of relay 68. At the stations being disconnected at the end of six seconds when tube 89 flashes over, battery through the left-hand armature of relay 68 and through tube 89 is connected to relay 102. Relay 102 operates and in turn connects battery to the grounded side of the winding of relay 71 thereby releasing this relay which in turn releases relays 82 and 85, putting out the busy lamps and stopping the motors at these stations. At the station sending the disconnect, tube 89 flashes over at the end of eight seconds thereby dropping off its relays 71, 82 and 85, turning off its motor, its busy lamp and at the same time removing the locking ground on relay 97, releasing this relay and closing the circuit through the right-hand armature and back contact of relay 97. This last circuit closed operates the line relay 64 at all stations, causing in turn the release of relay 68 and thereby breaking the battery circuits of tubes 80 and 89, thus returning the circuit to normal condition.

In order to eliminate the possibility of relay 68 following the teletypewriter signal which operates the line relay 64 and building up a charge in the timing circuits of tubes 80 and 89, the back contacts of the middle and inner right-hand armatures of relay 68 place a ground on the battery side of the charging condensers 79 and 88 each time relay 68 releases thereby discharging the condensers and only permitting tubes to operate when relay 68 remains operated for the required periods of 3, 4, 6 or 8 seconds as hereinbefore described. The circuit from ground through the outer right-hand armature and front contact of relay 85 which would normally discharge the condenser 88 is broken by the relay 68 so that the fifteen-second feature will operate when relay 85 is released.

Fig. 4 is a modification of the arrangement shown in Fig. 1. In this case the station shown in detail is equipped with a tape transmitter such, for instance, as that described in the patent to E. F. Watson No. 2,055,567 granted September 29, 1936. Any number of the stations of the system may be so equipped but it is not necessary that they be all so equipped. If the line is idle the operation is the same as that described in connection with Fig. 1 except that the figures combination for operating contact 19, the activate combination for operating contact 20, the individual call combination for operating contact 21 or the group call combination for operating contact 22 and the letters combination for locking out the non-select stations may be all punched in the tape and transmitted therefrom. The selection is started by the operation of the control switch 6. The operation of the time control switch 6 causes the motors 14 to start on the temporary basis as described above. After four seconds switch 6 will close line 1, thereafter the operator or attendant at the calling station will close switch 106 which closes the circuit of the start magnet of the tape transmitter. The tape transmitter will then transmit the signals perforated in the tape. Under these circumstances the first signals perforated in the tape should be a figures code followed by an activate signal and then the signals representing the stations it is desired to call, followed by the "letters" or "space" signal which will lock out the other stations connected to the system. Thereafter the message will be transmitted from the tape controlled transmitter in accordance with the perforations in the tape.

If it is desired to connect additional stations or a new group of stations this may be accomplished without releasing the connection and starting over manually in the following manner: The figures combination and the activate combination are punched in the tape after the conclusion of the message punched in the tape for the previously established connection. These combinations transmitted will operate relay 23 as before described. A common recall combination is then punched in the tape which, when transmitted, will result in the operation of contacts 104. The operation of these contacts at all the stations provided with these contacts including

the station where the selecting is taking place places ground through the front contact and the outer right-hand armature of relay 23, contact 104, winding of relay 102 to battery, resulting in the operation of relay 102. This relay locks through its front contact and inner lower armature to the armature and back contact of relay 103. Relay 103 is now energized in a circuit including the outer lower armature and front contact of relay 102. Relay 103, however, is slow to operate and will not move its armature for at least four seconds. Therefore, relay 102 is maintained in operation for this period of time. At the end of about four seconds relay 103 operates and releases relay 102 which relay then releases relay 103.

The operation of relay 102 opens the line at the outer upper armature of relay 102 so as to provide the same sort of operation as the operation of the time-controlled switch 6. This four-second open interval has therefore been sent over the circuit and has resulted in the operation and release of relay 8 which causes the release of relays 9, 11, and 17 at all the stations not previously selected and also those stations previously selected which are not equipped with tape transmitters and contacts 104. The selecting and previously selected stations which are equipped with contacts 104 have not been affected since the operation of relay 102 has by its innermost upper armature opened the circuit between the armature of relay 8 and the circuit of the conuting relays 9 and 11. Thus the stations previously selected remain in operative condition.

At the selecting station relay 102 through its middle upper armature and back contact opens the circuit to the start magnet 105 of the tape transmitter so as to prevent further transmission from the tape during this four-second period.

Several blank code combinations will be punched in the tape following the first common recall combination. A considerable period of time may elapse from the time of the transmission of the first common recall combination punched in the tape until contacts 104 and relay 102 operate to stop the tape transmitter. During this time at least a portion of the following code combination recorded in the tape will be transmitted by the tape transmitter. Consequently, it is necessary to record certain code combinations in the tape a portion of which may be transmitted during the operation of relay 102 and which will not materially interfere with the operation of the switching equipment on any of the stations. Any suitable spare or unused code combinations may be used for this purpose. In the preferred embodiment of this invention a blank code combination is employed. By a blank code combination is meant a code combination in which all of the impulses are spacing and represented by no current in the line combination.

A second common recall combination then punched in the tape will result in a second closure of contacts 104, the operation and release of relays 102 and 103 and the second opening of the line for four seconds resulting in the starting of the motors of all of the stations which were not running prior thereto. Since all stations are now prepared for the reception of the figures, activate and the series of selecting combinations, such combinations punched in the tape will result in the selection of wanted stations as hereinbefore described.

Following the second common recall combination several more blank code combinations will be perforated in the tape controlling the transmitter to insure the proper operation of the switching circuits and the tape transmitter.

In Fig. 4 the transmitting contacts 18 represent the transmitting contacts of the teletypewriter and are controlled by the teletypewriter keyboard. The tape transmitter contacts are illustrated by contacts 109. These contacts transmit signals in accordance with punches in a tape as described in the above-identified patent to Watson.

Fig. 5 is a modification of the arrangement shown in Fig. 3. Where the operation of this circuit is desired from a punched tape, two additional code combination operated contacts 107 and 108 are provided. After the system has been started by pressing the call key 66 the transmitter-distributor switch 106 is operated at the station sending the selection. The selections are then sent over the line from the transmitter-distributor as soon as the relay 74 has released and closed the circuit of the start magnet 105 through the inner right-hand armature and back contact of relay 74 and the inner right-hand armature and back contact of relay 97. As in the system shown in Fig. 4 blank code combinations are perforated in the tape preceding the switching code combinations as well as following a recall signal to insure the proper operation of the system. To recall any station or stations or disconnect the system from a punched tape a recall or disconnect combination is punched in the tape to operate either contact 107 or contact 108 after the contacts 90 and 91 have been operated. The operation of contacts 90 and 91 operates relay 92 as hereinbefore described and places ground from the contact and outer right-hand armature of relay 92 through the left-hand element of the switch 106 to the contacts 107 and 108. When either of these contacts then operates, it places ground in the one case over contact 107 to the winding of relay 74 for a recall and in the other case through contact 108 to the winding of relay 97 for a disconnect and the operation of these relays manipulates the circuit as before described. At the same time the circuit of the transmitter-distributor start magnet 105 is opened by the operation of either relay 74 or relay 97 so as to stop the feeding of further tape until the circuit is prepared to receive selecting or disconnecting combinations.

What is claimed is:

1. In a communication system, a station circuit, means responsive to a signal of a predetermined time interval for conditioning said station circuit for reception, means for holding said station circuit in said condition for a second predetermined period of time and for then automatically releasing said circuit, and means operative within said second predetermined period for disabling said automatic releasing means.

2. In a communication system, a station circuit normally in non-operative condition, slow-operating means responsive to a prolonged signal for putting said station circuit in operative condition, time-controlled means for automatically returning said station circuit to its said normal condition, and permutation code responsive means for rendering said automatic means inoperative.

3. In a communication system, a communication channel including in series a plurality of station circuits, each of said station circuits including time-controlled means for sending a pro-

longed signal over said channel to all of said station circuits included therein, means in each station circuit responsive to said signal for rendering said circuit operative, automatic means for returning each said station circuit to its normal non-operative condition after a predetermined time, means at each said station circuit responsive to a permutation code signal for disabling said automatic means, and additional means at each said station circuit responsive to a different permutation code signal for locking said station circuits in an operative condition.

4. In a communication system, a communication channel including in series a plurality of normally non-operative station circuits each including time-controlled means for sending a prolonged signal over said channel, slow-acting means in each station circuit responsive to said signal for placing said station circuit temporarily in operative condition, means in each said station circuit responsive to a common permutation code signal for placing said station circuit permanently in operative condition, means in each said station circuit responsive to a different permutation code signal for locking said station circuit against interference by further permutation code signals, and means in each said station circuit responsive to another common permutation code signal for selectively returning any operative station circuit to normal condition.

5. In a communication system, a communication channel including a plurality of station circuits, means at each station for calling one or more of the remaining stations on said channel, said means comprising means responsive to a prolonged signal for bringing all said remaining stations into a temporarily receptive condition for a limited period of time only, means operative within said temporary period responsive to a common particular normal length signal for placing all said remaining stations in a permanently receptive condition, means thereafter responsive to individual particular normal length signals for placing corresponding individual ones of said remaining stations in a receptive condition beyond interference by further normal length signals, and means thereafter responsive to a common particular normal length signal for returning all stations not placed in said last-described condition to normal and for locking such returned to normal stations effectively out of said communication channel.

6. In a communication system, a communication channel including a plurality of stations each having means to communicate with the other stations on said channel by signals of a given length, means at each station for transmitting over said channel signals of abnormal length, means comprising trigger tubes in resistance and condenser controlled circuits for timing said abnormal length signals, means responsive at all the remaining stations on said channel for bringing each of said stations from a normally non-receptive condition to a condition temporarily receptive to normal length signals, means comprising trigger tubes in resistance and condenser-controlled circuits for timing said temporary periods, and means responsive to coded normal length signals for disabling said last timing means.

7. In a communication system, a communication channel including a plurality of station circuits normally in a non-receptive condition and each provided with means to communicate with the others by signals of a given length, means at each station for transmitting over said channel signals of abnormal length, means at each station responsive to abnormal length signals for temporarily placing said stations in a receptive condition, means thereafter responsive to common coded signals of said given length for placing said station on a conditionally permanent receptive condition, means thereafter responsive to individual coded signals of said given length for placing said stations on an unconditionally permanent receptive condition, means thereafter responsive to common coded signals of said given length for returning non-selected stations to their normal non-receptive condition, means thereafter responsive to individual coded signals for returning selected stations to their normal non-receptive condition, and means thereafter responsive to said abnormal length signaling means at any one station now in a receptive condition for returning said channel and all stations thereon to normal.

8. In a communication system, a communication channel including a plurality of teletypewriter stations each equipped with a teletypewriter having a plurality of contact sets operated by the permutation code operated mechanism of said teletypewriters, means for calling said stations in for a temporary and predetermined period, and means including said contact sets for placing all stations on a conditionally permanent operative basis, apparatus for selecting particular stations and placing such selected stations on an unconditionally permanent basis and means for locking out all stations not selected.

9. In a communication system, a communication channel including a plurality of teletypewriter stations each equipped with a plurality of contact sets operated by the permutation code operated mechanism of said teletypewriters, tape transmitting means at certain of said stations, means for calling said stations in for a temporary and predetermined period, means including said contact sets for placing all stations on a conditionally permanent operative basis, instrumentalities for selecting particular stations and placing such selected stations on an unconditionally permanent basis and means for locking out all stations not selected and additional means at said stations including tape transmitters for delaying the movement of the tape during the operation of calling in said station for a temporary and predetermined period.

10. In a communication system, the method of communicating over a channel including a plurality of teletypewriter stations at least one of which is provided with a tape transmitter which consists in first transmitting a prolonged calling-in signal to place all other stations on a temporarily receptive basis and then within said temporary period transmitting permutation code signals for causing the following steps to be taken, which are (1) placing all other stations on a conditionally permanent operative basis, (2) selecting one or more stations for message reception and placing such selected stations on an unconditionally permanent operative basis, (3) locking out of non-selected stations, (4) transmission by sending station and reception by selected stations of message, (5) placing sending station on a conditionally permanent operative basis, (6) releasing selected stations, unlocking non-selected stations and returning such stations to normal and at the same time delaying the action of the operating tape transmitter.

11. In a telegraph system, telegraphic apparatus including a motor, means for starting the

motor from a remote point, apparatus for causing the motor to operate for only a temporary time interval of a definite, fixed, and predetermined duration, and apparatus selectively controllable by code combinations within said temporary time interval for continuing the operation of said motor for a further time.

12. The method of remote control of a station having telegraph apparatus including a driving motor, a line extending to said station and operatively interrelated to said apparatus which comprises starting the motor by remote control over said line and selectively either continuing the operation of the motor by impressing upon said line a special sequence of code conditions or stopping the motor after the absence of said special sequence during a predetermined interval of time.

WALTER M. BACON.