

May 23, 1961

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2,985,719

AUTOMATIC DIRECT PAGING SYSTEM

Filed Nov. 12, 1959

4 Sheets-Sheet 1

FIG. 1

FIG. 4
FIG. 2
FIG. 3

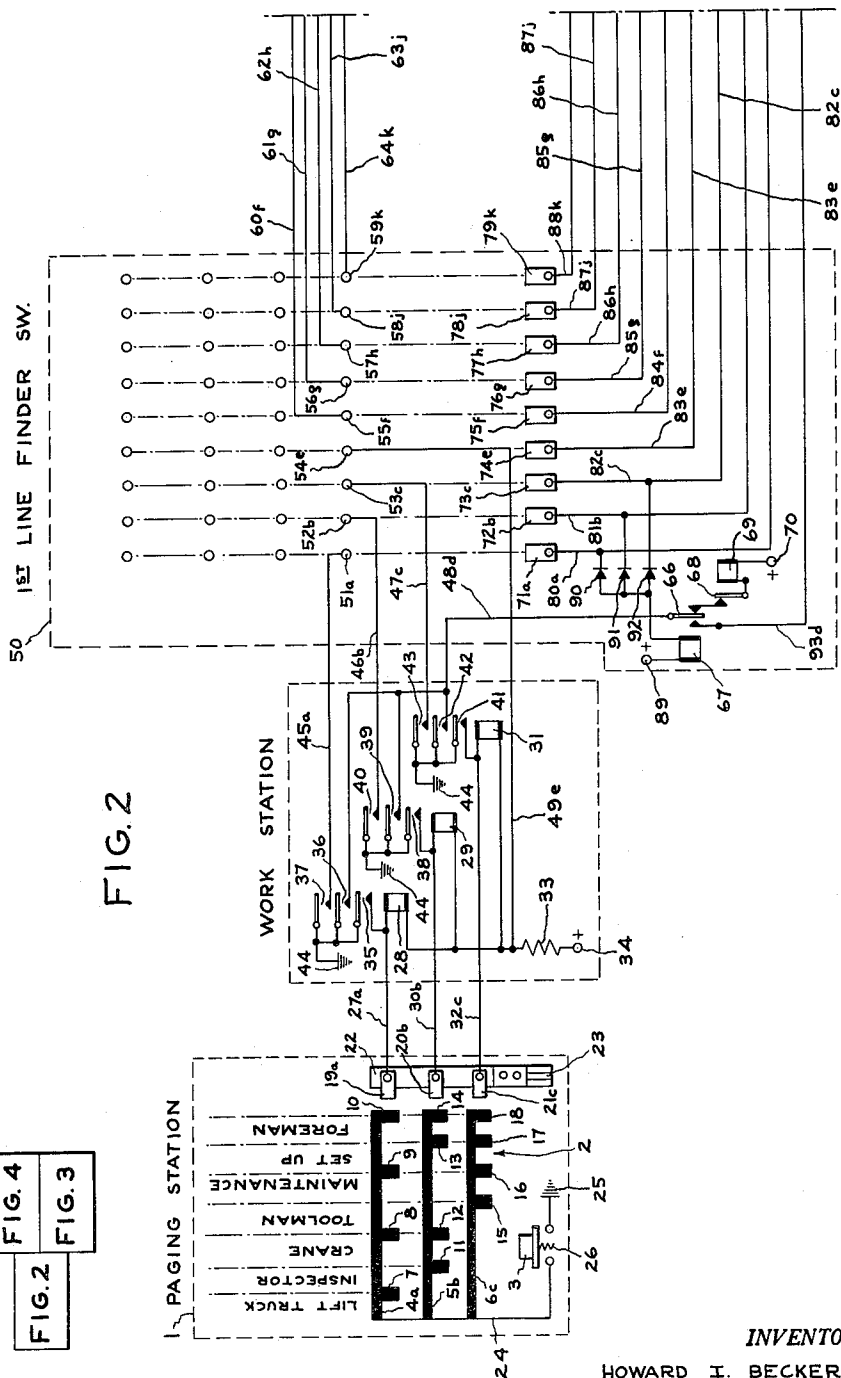


FIG. 2

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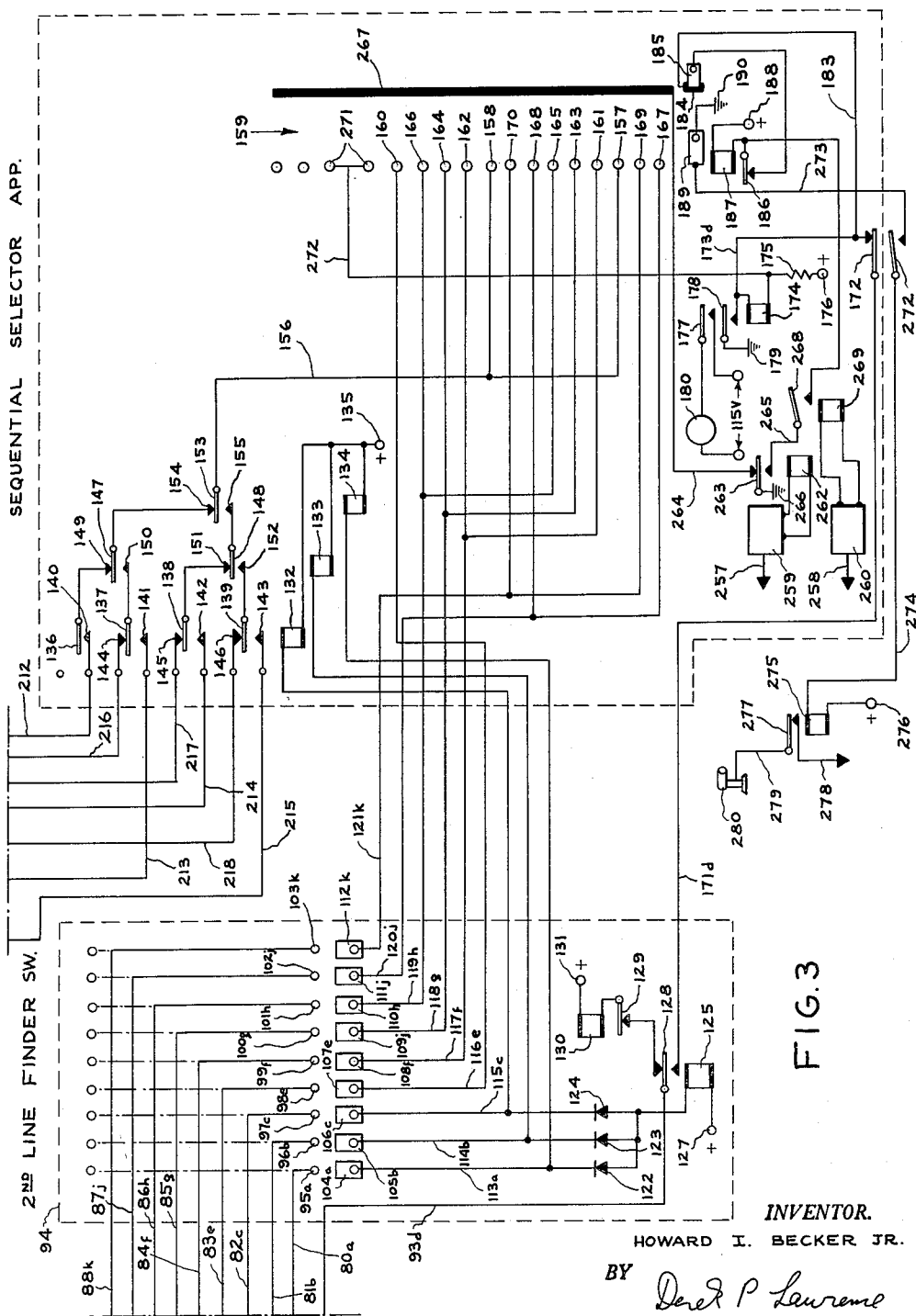


FIG. 3

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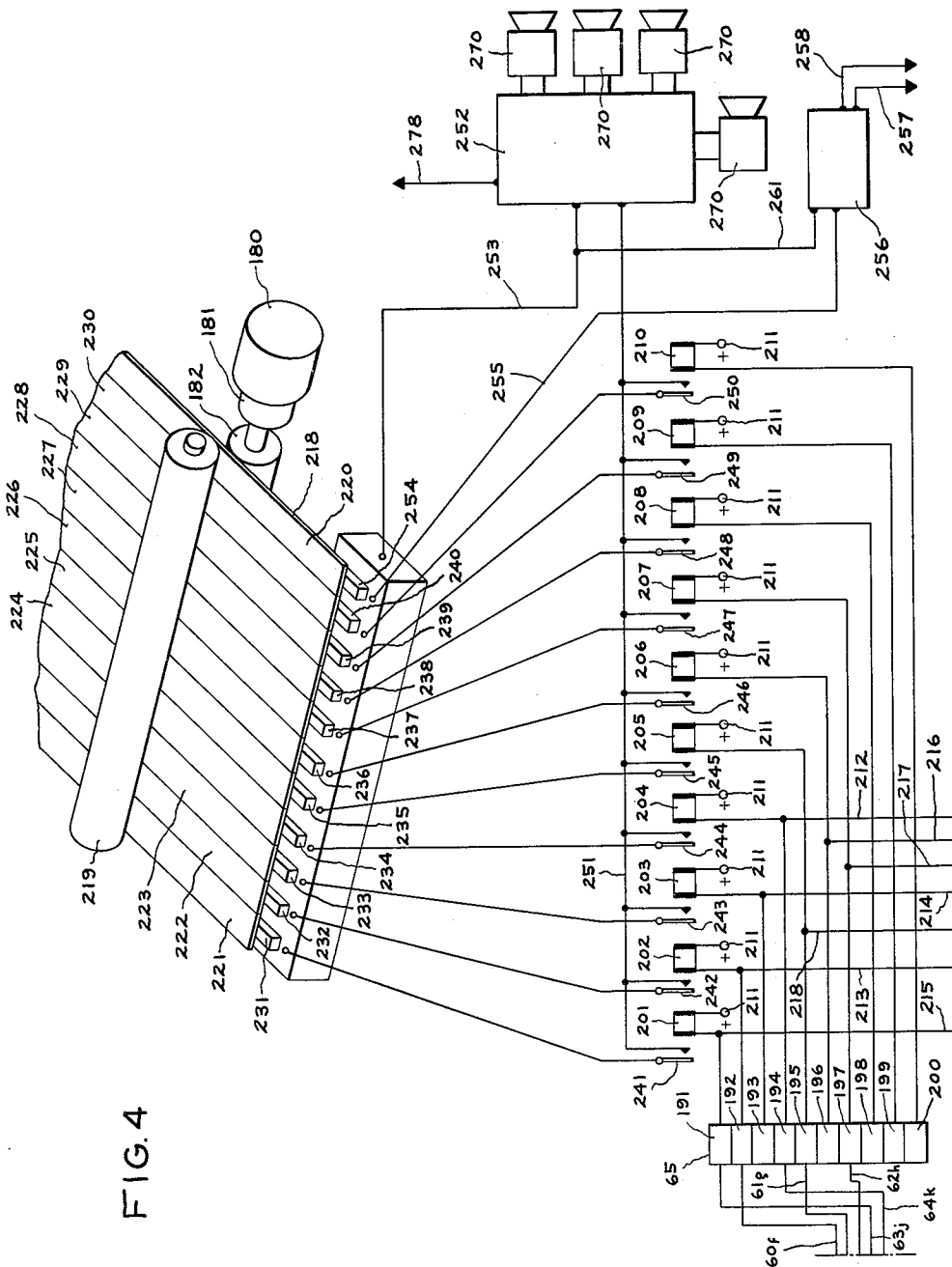


FIG. 4

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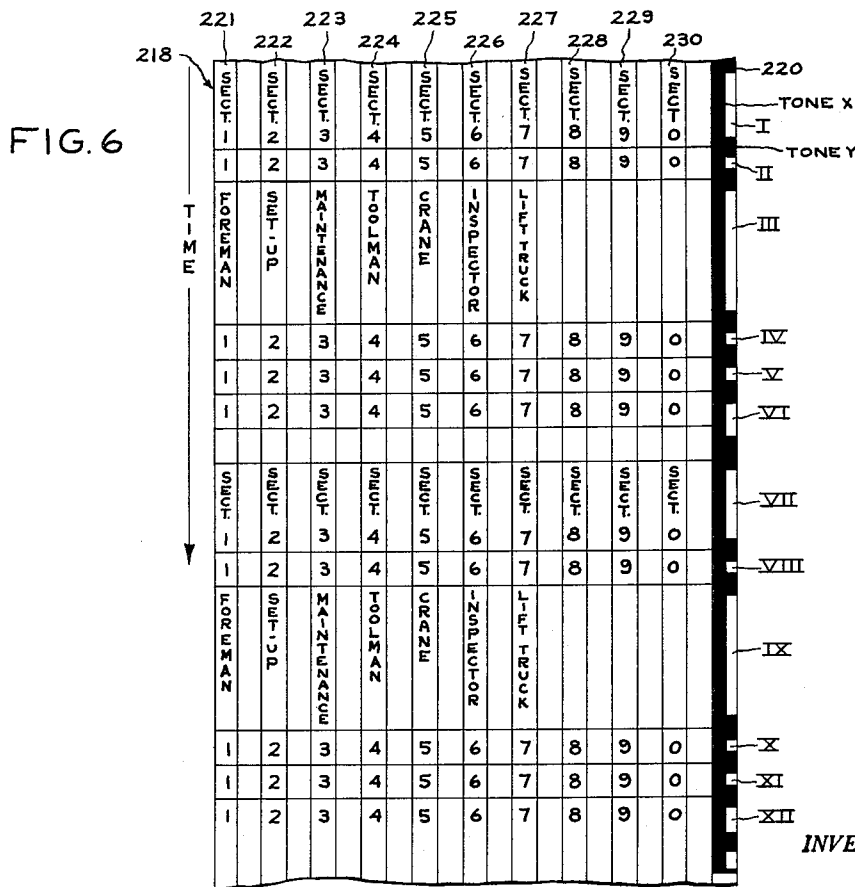
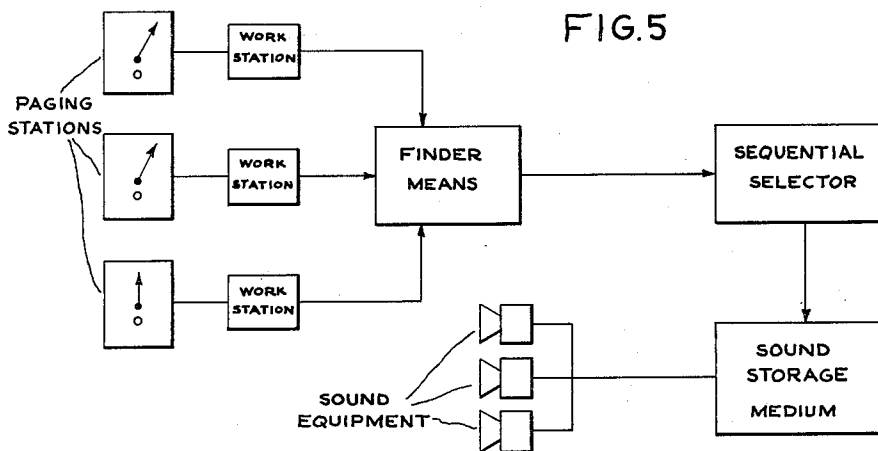
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AUTOMATIC DIRECT PAGING SYSTEM

Filed Nov. 12, 1959

4 Sheets-Sheet 4



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2,985,719

AUTOMATIC DIRECT PAGING SYSTEM

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17 Claims. (Cl. 179—1)

This invention relates to paging systems, and more particularly to a paging system of the type in which the party to be paged is, by a manual operation performed at the paging station, automatically and audibly called and directed to the paging station.

In modern industrial plants and in many other operations, such as for instance, hospitals, it is of very substantial importance that individuals be able to reach each other quickly regardless of the location of the person sought. The most commonly provided means of achieving such communication are, for instance, paging systems with a central operator who relays the message, and systems wherein a dispatcher is required to report to the paging station and then convey the message to the party being paged. Such systems have major drawbacks in that they permit the message to be incorrectly relayed since it is subject to the human error factor, require additional expense in the form of the services of the person who must perform the relaying function, and, where a dispatcher is used, may require a substantial length of time.

It is, therefore, an object of this invention to provide an automatic direct paging system wherein the person being paged is sought out directly by the action of the paging individual.

A further object of the invention is to have a paging system wherein the system audibly states the paged and paging parties directly in response to the action of the paging party.

Yet a further more specific object of the invention is to achieve a direct paging system wherein the paged and paging parties are audibly stated in response to a simple manual operation performed at the paging station.

Yet another object of the invention is to provide a direct paging system where, in response to a simple manual operation at the paging station, the system will retain the information if a paging operation is already in progress, and will then transmit the audible message.

In carrying out my invention, I provide a paging system wherein there are a plurality of paging stations, each of which includes manually operable means movable to a plurality of positions. Each position corresponds to a party to be paged and provides a predetermined control signal. A number of speakers are distributed over the area wherein the paged parties are to be found, and are connected to electrical sound pickup means which cooperate with sound storage means. The storage means contains sounds which can be combined in sequence to correspond to all parties to be paged and to the identities of all paging stations. I further provide finder means which, in response to use of the manually operable means, moves to a position which is determined by the identity of the paging station used. The last basic element of my inventive combination is a sequential selector means, responsive to operation of the manually operable means to connect the pickup means to the speakers. When this occurs there is provided in predetermined sequence a statement through the speakers which includes the identity of the paging station and of the party selected to be

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paged; the control signal determines which party is stated to be paged, and the finder means position determines which is the stated paging station.

The subject matter which constitutes my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention itself, however, both as to organization and method of operation, together with further objects and advantages of the invention, may best be understood by reference to the following description taken in conjunction with the accompanying drawings.

In the drawings,

Figure 1 is a schematic representation of the proper arrangement of several of the drawings in order to show a total coordinated system;

Figure 2 illustrates the circuitry at each paging station and its connection to a portion of the central system;

Figure 3 illustrates additional circuitry in the central system;

Figure 4 represents the remainder of the circuitry in the central system and its connection to the sound-producing means;

Figure 5 is a block diagram showing schematically the main elements of my improved system and the manner in which the information is passed through them and converted into a spoken signal; and

Figure 6 is a schematic representation of the sound storage means incorporated in my improved system.

Referring first to Figure 5 of the drawings for a comprehensive view of the system, it shows a plurality of paging stations distributed through an area so as to be convenient to persons having to work therein. For instance, in a factory area the paging stations would preferably be located close to the machine operators with; for instance, one paging station for each one or two machine operators. All of the paging stations are connected through work stations to finder means which, as will be explained, include suitable equipment for determining—in cooperation with the work stations—which paging station is being used and what party is being paged. This information is then forwarded to a sequential selector, which causes a sound storage medium to transmit signals to sound-reproducing equipment in a suitable sequence so as to provide, through each of the pieces of sound equipment, a spoken signal as to what party is being paged and from which paging station the signal is coming.

Referring now to Figure 2, a single paging station 1 is shown, it being understood that it is representative of all of the paging stations used. The paging station includes, essentially, a manual selector switch assembly 2 and a manual actuating switch 3. The selector switch includes, in the present case, three conductive bars 4a, 5b and 6c. Conductor 4a includes four stationary projecting contacts 7, 8, 9 and 10, conductor 5b includes stationary contacts 11, 12, 13 and 14 and, similarly, conductor 6c includes stationary contacts 15, 16, 17 and 18. The selector switch also includes three movable contacts 19a, 20b and 21c which are secured on a non-conductive bar 22 manually movable by a handle 23. It can readily be seen that as the handle 23 is moved to the left contacts 10, 14 and 18 will be engaged in the first position reached, contacts 13 and 17 will be engaged in the next position; and so forth. It will further be observed that each position of the movable contacts causes a different combination of the conductors 4a, 5b and 6c to be engaged. Also, as shown, each position is marked by suitable indicia to indicate the party that will be paged if the movable contacts are left at that position. For instance, in a factory operation the machine operator who uses the paging station may at different times need any one of the parties indicated on the switch such as a lift truck, an

inspector, a crane, a tool man, maintenance, a set-up, or the foreman.

All three of the conductors 4a, 5b and 6c are connected through a conductor 24 and pushbutton switch 3 to ground, as represented by the numeral 25. Switch 3 is of the type which includes a spring 26 so that when manually depressed it will, when released, move back to open position.

Contact 19a is connected through a conductor 27a to a relay coil 28. Similarly, conductor 20b is connected to a relay coil 29 by conductor 30b and contact 21c is connected to a relay coil 31 through conductor 32c. All three relays are connected through a suitable current regulating resistor 33 to a source of power schematically indicated at 34. It can thus be seen that for a circuit between the source of power 34 and ground 25 to be completed, pushbutton 3 must be depressed after handle 23 has been moved to one of the contact engaging positions.

Depending on the position to which the switch handle 23 is moved, when button 3 is depressed either one or any combination of two or three of the relays 28, 29 and 31 may be energized. Energization of relay 28 closes the three groups of contacts 35, 36 and 37; similarly, energization of relay 29 closes the three groups of contacts 38, 39 and 40, and energization of relay 31 closes the groups of contacts 41, 42 and 43. Closing of contacts 35 completes a circuit through the relay 28 from the source of power 34 to a ground indicated by the numeral 44, so that the relay remains energized even after pushbutton 3 is released. Contacts 38 and 41 perform similar functions for, respectively, relays 29 and 31. The closure of contacts 37 by relay 28 connects conductor 27a to a conductor 45a. Similarly, closure of contacts 40 connect conductor 30b to a conductor 46b, and closure of contacts 43 connects conductor 32c to a conductor 47c. Contact groups 36, 39 and 42 are all connected to a conductor 48d which is thus connected at one end to ground 44. In addition, connected to the source to power 34 through resistor 33 is another conductor 49e.

Relays 28, 29, and 31, and their respective associated contacts, form a work station; each paging station has an associated work station. In fact, the work station may be included as part of the paging station at the same physical location, if so desired, but the fact that there are five conductors extending out from each work station—and but three extending into it—makes it more convenient if all the work stations are centrally located adjacent the other equipment presently to be described.

The five conductors 45a, 46b, 47c, 48d and 49e extend from the work station to a line finder switch, generally indicated by the numeral 50, which forms part of what I shall refer to as my finder means (see Figure 5). Conductors 45a, 46b, 47c and 49e are respectively connected to a line of contacts 51a, 52h, 53c and 54e which are provided in a conventional stepping switch. In the same line of contacts with contacts 51a through 54e there are five additional contacts 55f, 56g, 57h, 58j, and 59k. These additional five contacts are used, as will be further described in connection with the explanation of the operation of the structure, to denote the particular paging station being used, and for this purpose they are respectively connected through conductors 60f, 61g, 52h, 63j and 64k to the appropriate sections of a peg board schematically indicated by the numeral 65 (Figure 4). Thus, the contacts 51a through 59k and the conductors connected thereto represent the connections which will be made for a given paging station.

It will readily be understood that the other lines of contacts in switch 50, schematically indicated in the drawing above contacts 51a through 59k, are connected in a similar fashion, each row being connected to a particular paging station. In a typical factory installation, the factory area will be divided into a number of sections, with many machines in each section. Thus, for the purposes of the particular installation being described, it

may assume (as will be described in full detail below) that the contacts 55f, 56g and 57h are used to transmit the intelligence of the number of the particular machine or paging station while contacts 58j and 59k are used to transmit the intelligence of the section of the factory area in which the particular paging station is located.

Returning now to conductor 43d and its connection to ground in the work station, it will be seen that at its other end conductor 48d is connected through a movable relay contact 66 of a relay 67 and a stepping relay contact 68 of a stepping relay 69 to a source of power, such as a battery, indicated schematically by the numeral 70. The relay 69 controls the position of a line of nine stepping contacts 71a, 72b, 73c, 74e, 75f, 76g, 77h, 78j and 79k.

As will be recalled, it has been stated that switch 50 is a conventional stepping switch of the type frequently found, for instance, in telephone equipment. In this type of switch the energization and release of relay 69 causes contacts 71a through 79k to be advanced one contact position each. The energization of the relay also causes the movable contact 68 to open thereby de-energizing the relay 69. The de-energization of the relay 69 permits contacts 68 to move back to closed position, and in response to this the relay 69 is again energized and released to again move contacts 71a through 79k forward one position, and open contact 68. It can thus be seen that relay 69 will cause contacts 71a through 79k to step forward until such time as they reach the line of contacts 51a through 59k.

Contacts 71a through 79k are connected respectively to conductors 80a through 88k. Each of the conductors 80a, 81b and 82c is connected through suitable filtering means to relay 67 and to a source of power 89. Suitable diodes 90, 91 and 92 are incorporated as the filtering means in the circuit between contacts 71a, 72b and 73c on the one hand and the relay 67 on the other hand to prevent sneak circuits from affecting the operation; the three diodes represent a conventional system used for insuring proper operation in switching circuits of this type and therefore are not further discussed. When relay 69 causes contacts 71a through 79k to step around, upon reaching contacts 51a through 59k a circuit will be completed from power source 89 and relay 67 through at least one of the conductors 45a, 46b and 47c to ground, energizing relay 67. The energization of relay 67 pulls contact 66 down into engagement with a conductor 93d, and opens the circuit to relay 69 to prevent further movement of contacts 71a through 79k which therefore remain in engagement with contacts 51a through 59k.

Conductors 80a through 88k and 93d all extend into a second line finder switch generally indicated by the numeral 94. It will be understood that the number of lines of circuits on a single line finder stepping switch has practical limitations; therefore, if there are, for instance, seventy-five different paging stations in a factory area, the most practical approach in such a system may well be to use three line finder switches each having twenty-five lines of contacts, each line of contacts being connected to one of the work stations. In such a case, it then becomes necessary to employ a fourth line finder stepping switch to select one of the first three switches. In other words, assuming three line finder stepping switches each having each row of contacts connected to a work station, the line finder stepping switch 94 will have three lines of contacts, one for each of the first three line finder stepping switches. Thus, conductors 80a to 88k extend respectively to contacts 95a to 103k which are all in a single line. These contacts are, as in the first line finder switch, all engaged at the same time respectively by stepping contacts 104a through 112k, the stepping contacts in turn respectively being connected to conductors 113a through 121k.

The first three conductors 113a, 114b, and 115c are, in similar fashion to contacts 71a, 72b and 73c, connected

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through diodes 122, 123 and 124, and a relay coil 125 to a source of power indicated at 127. Also, circuit "d" which is carried through conductor 93d extends to a contact 128 controlled by relay 125, a stepping switch interrupter contact 129, and a stepping relay 130 which controls contact 129, to a source of power 131. When relay 130 is energized it steps the contacts 104a through 112k and opens contact 129; contact 129 returns to its closed position in response to the consequent de-energization of relay 130, and so the movable contacts step along until they reach contacts 95a through 103k. At this point a circuit is completed to one of the grounds 44 from the source of power 127 to energize coil 125 and pull contact 128 to its down position thereby de-energizing relay 130.

Conductors 113a through 121k and conductor 171d all connect with a control circuit group having the function of selecting the sounds to be provided to form the paging message in response to the intelligence imparted to it by relays 28, 29 and 31 and by the position of contacts 71a through 79k and 104a through 112k. This control circuit group is called the sequential selector means, and is indicated in dotted outline in Figure 3.

Conductors 113a, 114b and 115c extend respectively to the coils of relays 132, 133 and 134 in the sequential selector, the three relays being respectively connected at their other ends to a source of power 135. Relay 132 controls contacts 136, 137, 138 and 139; when the relay is energized contact 136 engages a stationary contact 140, contact 137 engages contact 141, contact 138 engages contact 142, and contact 139 engages contact 143. When relay 132 is de-energized contact 137 engages contact 144, contact 138 engages contact 145, and contact 139 engages contact 146. In similar fashion, relay 133 controls two movable contacts 147 and 148; contact 147 engages a stationary contact 149 when the relay 133 is deenergized and moves into engagement with contact 150 when the relay is energized. Similarly, contact 148 engages a contact 151 when relay 133 is de-energized and moves into engagement with a contact 152 when the relay is energized. Relay 134 controls a contact 153 which is engageable either with a contact 154 when the relay is de-energized or with a contact 155 when the relay is energized. Contact 153 is connected through a conductor 156 to a pair of contacts 157 and 158 which form part of a stepping switch generally indicated by the numeral 159.

By tracing back through the "a," "b" and "c" circuits to ground 44, it will be observed that relays 132, 133 and 134 can be energized only if relays 31, 29 and 28 respectively are energized. Thus, each different combination of relays 31, 29, 28 provides, in effect a different control signal, and each different control signal connects conductor 156 with a different one of contacts 140 through 146. Incidentally, it is to be observed at this point that the relays 132, 133 and 134 are prevented from improper operation due to sneak circuits by the aforementioned diodes 90, 91, 92, 122, 123 and 124.

Contact 106e is connected through conductor 116e to a contact 160 of switch 159. Similarly, conductor 117f is connected to contacts 161 and 162, contact 118g is connected to contacts 163 and 164, conductor 119h is connected to contacts 165 and 166, conductor 120j is connected to contacts 167 and 168, and conductor 121k is connected to contacts 169 and 170.

When relay 125 is energized, it will be recalled that contact 128 moves downwardly and when it does so it connects conductor 93d with a conductor 171d. Conductor 171d extends through a switch member 172 to a conductor 173d, a relay coil 174, a current regulator resistor 175, and a source of power 176. Tracing back through the "d" circuit from source of power 176, it will be observed that a complete circuit to one of the grounds 44 is provided and thus the relay coil 174 is energized to pull down contacts 177 and 178. The contact 178 moves down into engagement with conductor 173d, to complete

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an energizing circuit for relay 174 from power source 176 to a ground 179 so that the relay remains energized and by so doing keeps contact 177 closed. The closing of contact 177 completes an energizing circuit for a motor 180 which, as shown in the upper part of Figure 4, causes an appropriate gear train 181 to drive a roller member 182.

Returning to Figure 3, it will further be observed that from conductor 171d and contact 172 a circuit extends through a conductor 183 to a stationary contact 184 and then through one of the movable stepping contacts 185 of switch 159, a relay contact 186, and a relay 187, to a source of power 188. As stated before, the "d" circuit extends back to ground 44 so that relay 187 becomes energized and effects stepping of contact 185 and of a contact 189 grounded at 190 by the make and break action of relay contact 186 until contact 185 disengages from contact 184.

Returning now to the peg board in Figure 4, it will be seen that it is divided into ten sections respectively numbered 191, 192, 193, 194, 195, 196, 197, 198, 199, and 200. These are connected respectively to ten relay members 201 through 210, all connected on their other side to a power source indicated as 211.

Referring now to the switch contacts 140 through 146 in Figure 3, it will be observed that contact 140 is connected through a conductor 212 to relay 204, contact 141 is connected through conductor 213 to relay 202, contact 142 is connected through conductor 214 to relay 203, contact 143 is connected through conductor 215 to relay 201, contact 144 is connected through conductor 216 to relay 206, contact 145 is connected through conductor 217 to relay 207, and contact 146 is connected through conductor 218 to relay 204. It will further be observed at this point that, with the three relays 132, 133 and 134, any one of the conductors 212 through 217 may be connected to conductor 156. Thus, if relay 132 is energized and the other two are not, for instance, the connection from conductor 156 passes through contacts 154, 149 and 144 to conductor 212. Similarly if relays 132 and 134 are energized and relay 133 is not, the circuit from conductor 156 passes through contacts 155, 151, and 142 to conductor 214.

Referring to Figure 4, the roller 182 powered by motor 180 engages sound-storing means which in the embodiment shown takes the form of a tape 218. The tape 218 may be formed in a continuous band and, for practical purposes, an extra idler roller 219 may be provided to move the tape when motor 180 rotates roller 182. The tape has eleven channels, one numbered 220 which is not associated with any of the relays 201 through 210, and ten others 221 through 230 which are respectively associated with relays 201 through 210. Channels 221 through 230 are respectively engaged by ten pickup heads 231 through 240 which in turn are respectively connected to movable contacts 241 through 250 controlled by relays 201 through 210. Each of the relays 201 through 210, when it is energized, causes its associated movable contact to move into a position where it completes a circuit from its associated pickup head to a common conductor 251 connected to a standard paging amplifier 252. The circuit from the pickup heads through the paging amplifier is completed by another common conductor 253.

An eleventh pickup head 254 is provided which cooperates with channel 220; pickup head 254 is connected directly through a conductor 255 to suitable preamplifier means 256 which, in turn, has suitable connections 257 and 258 (see also Figure 3) controlling a pair of conventional filters 259 and 260. Pickup head 254 is connected to the common conductor 253, and the connection to the preamplifier 256 is completed through a conductor 261.

Channel 220 carries two separate tone signals, as will be further described in connection with Figure 6, and which will hereafter be denominated as tone X and tone Y. The signal from tone X is fed through the preampli-

fier 256 to filter 259 which controls a relay 262 having a movable contact 263. Contact 263 is engageable either with a conductor 264 or a conductor 265, and is grounded as shown at 266. Conductor 264 extends into connection with a conductive bar 267, and conductor 265 connects with relay 187, and includes a contact 268 of a relay 269 controlled by the filter 260 which receives the signal from tone Y through preamplifier 256.

Turning now to Figure 6, there are shown the 11 channels 220 through 230 of tape 218; the arrow at the left hand side of the tape indicates the sequence in which the different portions of the tape pass into cooperative relation with the pickup heads 231 through 240, and 254. It will be seen that as the tape 218 passes by the pickups, if tape 1 is always the one selected (that is, if relay 201 is always the one of the ten relays energized) the statement "section 1-1-foreman-1-1-1-section 1-1-foreman-1-1-1" will be fed into the paging amplifier 252 (Figure 4), and transmitted therefrom to the several speakers 270 strategically located about the area in which the party to be paged may be found. The selection of which pickup arm is actually in operation at any one time is controlled by the selection of which of relays 201 through 210 is energized. In the same manner as for channel 221, the message of each of channels 222 through 230 may be seen by reading down each of the channels as viewed in Figure 6.

During the dark colored portion of tone X it is effective to energize relay 262 to pull contact 263 into its down position, and similarly the dark colored portion of tone Y makes it effective to cause relay 269 to pull contact 268 into its down position. With both contacts 263 and 268 in the down position, an energizing circuit for relay 187 is completed, starting at ground 266, through contact 263, conductor 265, contact 268, and relay 187 to power source 188. It will be observed that the stepping contact 186 is bypassed so that as long as both relays 262 and 269 are energized they cause the relay 187 to be energized. When tone Y permits relay 269 to be de-energized, as evidenced by the white portions of the tone as shown in Figure 6, the circuit for relay 187 is opened and the relay will cause one step of contacts 185 and 189. Thus, when contact 185 leaves contact 184 and engages bar 267, control of relay 187 passes entirely over to tones X and Y. It will be observed that both relays are energized between the spoken signals on the tape and that relay 269 is de-energized during the spoken signals on the tape, so that the stepping of the contacts 185 and 189 occur between the spoken signals.

As will be further explained in connection with the operation of the paging system, the progressive stepping and pausing of the contacts 185 and 189, together with the channel selection activity of relays 132, 133 and 134, and of the line finder switches 50 and 94, causes the paging system to provide through speakers 70 a statement of what section of the factory is in question, what party is being paged, and the identity of the particular station or machines.

When the stepping contact 189 reaches contact 160, a circuit is then completed from ground 190 through contacts 189 and 160 and then through the "e" circuit which terminates with conductor 49e. Conductor 49e is in turn connected to the power source 34 through current regulating resistor 33 and this has the effect of shorting out the relays 28, 29 and 31 which depended on the power source 34 to remain energized. These relays are thus de-energized.

At the end of the paging operation both tones X and Y permit their respective relays 262 and 269 to be de-energized. This causes switch 263 to move into engagement with conductor 264, and switch 268 to open. When contact 263 moves into engagement with contact 264 to complete energizing circuit for relay 187 is provided, starting with ground 266, and proceeding through contact 263, conductor 264, conductor bar 267, contact 185, relay

contact 186, and the relay itself, to power source 188. It will be observed that this circuit is completed through the contact 186 so that relay 187 causes the contacts 189 and 185 to continue to step. When the contact 189 reaches contacts 271 it is connected through a conductor 272 to current regulating resistance 175 and power source 176. This effectively shorts out relay 174 which releases both its contacts 177 and 178. The opening of contact 177 de-energizes motor 180 so that the tape stops its movement.

The circuit for the stepping relay 187 continues to be provided until contact 185 leaves conductor bar 267 and moves back onto contact 184. At this point there is no longer a complete energizing circuit for relay 187 (because circuit "d" no longer provides a ground after relays 28, 29, and 31 are all de-energized) and the stepping ceases with the stepping contact 185 and 189 in position for another operation. In addition, it will be observed that the energizing circuits for the two relays 67 and 125, which were also dependent on circuit "d" to connect them to ground 44, are open so that the entire circuit is in readiness for a new paging operation.

To complete the description of the components, there is provided in Figure 3 suitable means for removing the paging system from its automatic control and for putting it under manual control whenever any particular message from a central source is to be provided. This consists of a switch having two movable contacts, one of which is the already mentioned contact 172 and the other is a contact 272. Contact 272 is opened when contact 172 is closed, and is closed when contact 172 is open. When contact 272 is closed it completes a circuit between a conductor 273 (which leads to ground 190) and a conductor 274 which extends through a relay coil 275 to a source of power 276. Relay 275 when energized pulls down a contact 277 which connects a conductor 278 leading to the paging amplifier 252 and a conductor 279 which is connected to an appropriate microphone 280. Thus, the system described, while provided for the purpose of automatic direct paging, is also adapted to be used manually when necessary.

For purposes of describing the operation of the machine, it will be assumed that the paging station shown is the paging station for a machine number 257 in section 14 of a factory, and that the operator of that machine wishes to page the inspector. The operator, therefore, moves handle 23 over until it is in the position showing that the inspector is to be paged, and then depresses button 3. With the "inspector-paging" position of handle 23, contacts 19a and 21c are not effective to complete any circuit. Thus, when button 3 is depressed a circuit is completed from ground 25 through contact 20b and contact 11 of conductor bar 5b, the circuit then continuing through conductor 30b and relay 29 to power source 34. The relay is then locked in through contacts 38 so that even after button 3 is released the ground 44 will provide a complete circuit. The energization of relay 29 also closes contacts 39 and 40. The closing of contacts 40 connects the ground 44 through conductor 46b to contact 52b, and the closing of contacts 39 cause an energizing circuit to be completed through relay 69 and its stepping contact 68 to power source 70.

The relay 69 therefore causes the stepping contacts 71a through 79k of switch 50 to step advance until such time as stepping contact 72b engages the stationary contact 52b. At this point a circuit is completed from ground 44 through conductor 46b, contact 52b, contact 72b, conductor 81b, diode 91, and relay 67 to power source 89. The energization of relay 67 opens contact 66 to de-energize stepping relay 69 so that the contacts 71a through 79k remain in position in engagement respectively with contacts 51a through 59k. The energization of relay 67 also causes a circuit to be completed from ground 44 through contacts 39, conductor 48d, contact

66 and conductor 93d to the stepping relay 130 and its stepping contact 129, and then to a power source 131.

This then causes a stepping function to be performed within switch 94, the stepping continuing until stepping contact 105b engages stationary contact 96b. This completes a circuit from ground 44 through the "b" circuit, diode 123, and relay 125 to power source 127. The energization of relay 125 pulls down contact 128 to de-energize relay 130 and cause the stepping contacts 104a through 112k to remain in engagement with the stationary contacts 95a through 103k. Also, the energization of relay 125 completes the "d" circuit from ground 44 through relay 174 to power source 176 to pull down contacts 177 and 178, energizing motor 180 and locking in the relay 174.

At the same time, relay 133 is energized through the "b" circuit, with relays 132 and 134 remaining de-energized so that contacts 147 and 148 are in their down position while contacts 136, 137, 138, 139 and 153 are in their up position. This then completes a circuit from conductor 156 through contacts 153, 154, 147, 150, 137 and 144, conductor 216 and relay 206 to power source 211. However, since there is no ground provided as yet, the relay 206 is not yet energized to complete the circuit from its associated pickup head 236 to the paging amplifier 252.

Returning to the "d" circuit, at the same time that relay 174 was energized, a circuit was completed through conductor 183, stationary contact 184, stepping contact 185, contact 186, and relay 187 to power source 188 to cause the stepping contacts 185 and 189 to be advanced by relay 187. At the time stepping contact 189 reaches contact 167 stepping contact 185 has moved off contact 184 (opening the circuit energizing relay 187) onto conductor bar 267.

At this point the energization of the motor and movement of the tape causes tone "X" and tone "Y" to control relays 262 and 269 to determine the future stepping of contacts 185 and 189, since the energizing circuit for relay 187 must now be completed, starting with power source 188, through the relay, contact 268, conductor 265, and conductor 263 to ground 266.

When stepping contact 189 engages contact 167, a circuit is completed from ground 190 through contact 189 to conductor 120j. The connection then proceeds through the "j" circuit to section 191 of peg board 65 which in turn is connected to the relay 201 and power source 211. A complete circuit is thus provided, and contact 241 is pulled down to connect pickup 231 to the paging amplifier and speakers 270. As a result of this that portion of channel 221 passing over pickup 231 at the time issues from speakers 270 as a spoken signal.

Referring to Figure 6, it will be seen that during the first open period I of tone "Y," that is, during the first open period of relay 269 the statement "section 1" will be emitted from speakers 270. After this, as the tape continues to advance, the dark portion of tone "Y" is picked up by pickup 254 causing relay 269 to close contact 268. Shortly thereafter the dark portion of tone "Y" is passed as motor 180 continues to move the tape, and relay 269 is de-energized opening contact 268. When contact 268 closed it energized relay 187 as previously explained. The subsequent opening of contact 268 de-energizes relay 187, causing a one-step advance of the stepping contacts 185 and 189. This then places contact 189 in engagement with contact 169. As a result there is completed from ground 190 a circuit which passes through contacts 189 and 169. The connection then continues through the "k" circuit to section 194 of peg board 64, and it will be observed that section 194 is connected through relay 204 to power source 211.

This, then, causes energization of relay 204, a closing of contact 244, and a consequent connection of the pickup 234 to speakers 270. At this point, we are in open portion II of tone "Y" so that with pickup 234 connected

to pick up sound from channel 224 the word "four" will be emitted from the speakers. It will be seen that the combination of the first and second statements gives the phrase "section one-four," which indicates that section 14 is the one in question.

The next dark portion of tone "Y" causes another stepping of contact 189 into engagement with contact 157. Contact 157 is connected to conductor 156 which, as previously described, is connected to power source 211 through relay 206 so that relay 206 is energized to cause the sound in section III of the channel 226 to be picked up and emitted through the speakers. Reference to Figure 6 shows this to be the word "inspector."

The next dark portion of tone "Y" causes an additional step of the contact 189 into engagement with contact 161. With this connection, a circuit is completed from ground 190 through contacts 189 and 161, and then through the "f" circuit to section 192 of peg board 65. Section 192 is directly connected to power source 211 through relay 202 and thus at this time the relay 202 becomes energized connecting pickup 232 to speakers 270 so that the spoken message appearing in the portion IV of channel 222 is provided. Reference to Figure 6 shows this to be the word "two."

A dark portion of tone "Y" then follows to cause an additional step of contact 189 into engagement with contact 163. This completes a circuit through the "g" circuit to section 195 of peg board 65. Section 195 is in turn connected to the power source 211 through relay 205, thereby causing pickup 235 to emit through the speakers the message provided in section V of channel 225. Reference to Figure 6 shows this to be the word "five."

There then follows another dark section of tone "Y" to cause another step of contact 189 into engagement with contact 165. This connection provides completion through the "h" circuit to section 197 of peg board 65 and then through relay 207 to power source 211. Energization of relay 207 causes pickup 237 to provide through speakers 270 the message in portion VI of channel 227, and reference to Figure 6 shows this to be the word "seven." Thus, the message provided by the particular arrangement shown is "section 1-4-inspector-2-5-7." This tells the party that is being paged, and in addition directs him to the section and the particular machine from which the call is issuing.

It will be observed that, in effect, the different combinations of the "a," "b" and "c" circuits completed through the line finder switches determine which of the group of circuits joining contacts 157 and 158 of switch 159 to relays 201 through 210 will be completed by stepping contact 189. The "j," "g," "h," "f" and "k" circuits form a second group which, in response to a particular line finder switch position, cause the sequential selector to provide the identity of the paging party.

A repetition of the message is then provided by the stepping of the contact 189, in sequence, to contacts 167, 170, 158, 162, 164 and 166 during the portions VII through XII of the tape. Of course, while it is not shown, the conventional step of shorting out amplifier 252 to mute the sound of the relays may be followed if desired.

At this point, after the next step, contact 189 engages contact 160. This completes a connection through the "e" circuit from ground 190 to power source 34 and, in effect, shorts out the relays 28, 29 and 31 causing any of those energized (in this case relay 29) to be de-energized. The next step of the contact 189 brings it into engagement with a contact 271 which provides a connection between ground 190 and power source 176 shorting out relay 174 so that contacts 177 and 178 are released. The opening of contact 177 causes motor 180 to cease rotating the tape 218 and de-energizes both relays 262 and 269 so that contact 263 moves into its upper position in engagement with conductor 264. The moving of con-

tact 263 to its upper position completes a circuit through conductors 264 and 267, and contacts 85 for relay 187 and 186 so that the relay continually steps the contacts 185 and 189 forward until such time as contact 185 leaves conductor bar 267 and returns to bar 184. At this time the energizing circuit for relay 187 is opened. It will further be observed that the opening of relay 29 has opened the energizing circuits for relays 67 and 125.

At this time if there are no further paging operations which have been put in from different stations during the paging operation just described, the apparatus will remain stationary. However, it will readily be recognized that the system described is completely capable of holding messages (through the locking-in action of relays 28, 29 and 31) and then delivering them when the system is free to do so. Thus assume, for instance, that a different paging station had, after the start of the paging operation just described, wanted to conduct a paging operation. The same selections and depression of a grounding button are, of course provided at the different station in order to energize either one, two or all three of the relays in the work station corresponding to that different paging station. There would be no interference with the paging operation being provided because of the fact that energization of relay 67 positively prevents energization of stepping relay 69 so that the stepping contacts of the line finder switches would not be affected by such a subsequent manual paging operation from a different station. Thus the paging operation would go to completion as described. Nonetheless, the relays in the work station of the other paging station being used would hold the message, and upon de-energization of relays 67 and 125 at the end of the paging operation would then cause stepping of the contacts 71a to 79k until they encountered the line which represents the connections to the particular other paging station being used. In other words, the system includes a means for holding the paging message so that the person doing the paging can merely make the selection of whom he wishes to page and depress the button 3, regardless of whether a paging operation is being performed, and regardless of whether others are ahead of him. His paging operation will be performed in a sequence determined by the stepping action of the line finder switch 50.

It will be seen from the foregoing that my invention provides a complete automatic direct paging system wherein it is simply necessary for the person doing the paging to select whom he wishes to page and then return to his business, with the paging operation then being carried out automatically; the operation is performed immediately if no other paging operation is being provided, and after the other paging operation if there is a paging operation already being performed. It will further be observed that at the end of the paging operation the system resets itself for reuse.

While in accordance with the patent statutes I have described what at present is considered to be the preferred embodiment of the invention, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and I therefore aim to cover in the appended claims all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A paging system comprising: a plurality of paging stations, each said station including manually operable means movable to a plurality of positions, each position corresponding to a party to be paged and providing a predetermined control signal; a plurality of electrically operated speakers distributed over the area wherein the paged parties are to be found; sound storage means containing sounds which can be combined in sequence to correspond to all parties to be paged and to the identity of all paging stations; sound pickup means arranged to cooperate with said sound storage means and to transmit

sound to said speakers for emission therefrom; finder means operable in response to use of said manually operable means to a position determined by the identity of one of the said paging stations used; and sequential means responsive to operation of said manually operable means to connect said pickup means to said speakers to provide in predetermined sequence a statement through said speakers including the identity of said one paging station and of the party selected to be paged, said control signal determining which party is stated to be paged and said finder means position determining which is stated to be the paging station.

2. A paging system comprising: a plurality of paging stations, each said station including manually operable means movable to a plurality of positions, each position corresponding to a party to be paged and providing a predetermined control signal; a plurality of electrically operated speakers distributed over an area; sound storage means containing sounds which can be combined in sequence to correspond to all parties to be paged and to the identities of all said paging stations; sound pickup means arranged to cooperate with said sound storage means and to transmit sounds to said speakers for emission therefrom; finder means operable in response to use of said manually operable means to a position determined by the identity of one of the said paging stations used; first and second groups of control circuits for said pickup means, at least one of said first group being partly completed in response to said control signal and to said finder means position, at least one of said second group being partly completed in response to said finder means position; and sequential selector means responsive to operation of said manually operable means to complete said first and second groups of control circuits in a predetermined sequence so as to provide a statement through said speakers of, respectively, the party selected to be paged and the identity of said one paging station.

3. A paging system comprising: a plurality of paging stations, each said station including first manually operable switch means having a plurality of positions, a plurality of relays and energizing circuits therefor, each position of said first switch means effecting partial completion of energizing circuits for a different combination of said relays, and second manually operable switch means for completing the energizing circuits of those relays whose circuits are partly completed, means biasing said second switch means to open position so that it opens upon release, a locking circuit associated with each of said relays for locking said relay in energized condition subsequent to release of said second switch means; a plurality of electrically operated speakers distributed over an area; sound storage means containing sounds which can be combined in sequence to correspond to all parties to be paged and to the identities of all said paging stations; sound pickup means arranged to cooperate with said sound storage means and to transmit sound to said speakers for emission therefrom; finder means operable in response to energization of any one of said relays to a position determined by the identity of one of the said paging stations used; a first group of control circuits for said pickup means associated with said relays respectively, a second group of control circuits for said pickup means determined by the position of said finder means, one circuit of said first group being partly completed in response to energization of a particular combination of said relays and to operation of said finder means to said position, at least one of said second group of circuits being partly completed in response to operation of said finder means to said position; and sequential selector means responsive to energization of any of said relays to complete the partly completed circuits of said first and second groups of control circuits in a predetermined sequence, completion of the partly completed control circuit of said first group providing a statement through said speakers of the identity of the party selected

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to be paged, completion of the circuits of said second group providing a statement through said speakers of the identity of said one paging station.

4. The apparatus defined in claim 3 wherein said finder means includes means operative during a paging operation to prevent further movement of said finder means until that paging operation is completed.

5. The apparatus defined in claim 1 wherein said finder means includes means effective during a paging operation to prevent further movement of said finder means until said paging operation is terminated.

6. The apparatus defined in claim 3 wherein said sequential selector means includes means for de-energizing said relays at the end of a paging operation.

7. A paging system comprising: a plurality of paging stations, each said station including manually operable means movable to a plurality of positions, each position corresponding to a party to be paged and providing a predetermined control signal; a plurality of electrically operated speakers distributed over an area; sound storage means comprising a tape having a plurality of channels, each said channel containing a plurality of sounds in sequence, the sounds of the different channels when combined in different sequences corresponding to all parties to be paged and to the identities of all said paging stations, sound pickup means arranged to cooperate with each channel of said tape, connecting means for connecting said pickup means to said speakers thereby to transmit sound to said speakers for emission therefrom; finder means operable in response to use of said manually operable means to a position determined by the identity of one of the said paging stations used; first and second groups of control circuits for said pickup connecting means, each said control circuit when completed causing connection of one of said pickup means to said speakers, at least one of said first group being partly completed in response to said control signal and to operation of said finder means to said position, at least one of said second group being partly completed in response to operation of said finder means to said position; and sequential selector means responsive to operation of said manually operable means to complete said partly completed circuits of said groups of control circuits in a predetermined sequence thereby to connect said pickup means to said speakers in a predetermined sequence so as to provide a statement through said speakers of the party selected to be paged and of the identity of said one paging station.

8. A paging system comprising: a plurality of paging stations, each said station including manually operable means movable to a plurality of positions, a plurality of relays, each position of said manually operable means causing a different combination of said relays to be energized; a plurality of electrically operated speakers distributed over an area; sound storage means containing sounds which can be combined in sequence to correspond to all parties to be paged and to the identities of all paging stations; sound pickup means arranged to cooperate with said sound storage means and to transmit sound to said speakers for emission therefrom; finder means operable in response to use of said manually operable means to a position determined by the identity of one of the said paging stations used; a first group of control circuits for said pickup means, each different combination of said energized relays causing a different one of said control circuits of said first group to be partly completed when said finder means is in said position; a second group of control circuits for said pickup means, at least one of said second group being partly completed in response to operation of said finder means to said position; and sequential selector means responsive to operation of said manually operable means to complete said partly completed circuit of said finder and second groups in a predetermined sequence so as to provide a statement through

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said speakers of the party selected to be paged and of the identity of said one paging station.

9. A paging system comprising: a plurality of paging stations, each said station including manually operable means movable to a plurality of positions, each position corresponding to a party to be paged, a plurality of station relays, a different combination of said station relays being energized at each of said positions of said manually operable means; a plurality of electrically operated speakers distributed over an area; sound storage means comprising a tape having a plurality of channels, each channel including a different party to be paged and further including sounds which can be combined in sequence with the sounds of other channels to correspond to the identities of all paging stations; sound pickup means arranged to cooperate with each of said channels, connecting relay means for said pickup means effective when energized to connect said pickup means to said speakers; finder means operable in response to energization of any of said station relays to a position determined by the identity of one of the said paging stations used; a first group of control circuits for said connecting means, each different combination of said energized station relays causing partial completion of a different one of said group of control circuits when said finder means is moved to said position; a second group of control circuits for said connecting means, at least one of said second group being partly completed in response to operation of said finder means to said position; and sequential selector means responsive to operation of said manually operable means to complete said partly completed circuit of said first group and to complete the partly completed circuits of said second group in a predetermined sequence, completion of said one circuit of said first group providing a statement through said speakers of the identity of the party selected to be paged, sequential completion of said circuits of said second group providing a statement through said speakers of the identity of said one paging station.

10. A paging system comprising: a plurality of paging stations, each said station including a first manually operable switch movable to a plurality of positions each corresponding to a party to be paged, and a plurality of station relay members and energizing circuits therefor, each position of said switch completing energizing circuits for a different combination of said station relay members, a second manually operable switch at said paging station for completing said partly completed relay energizing circuits after the party to be paged has been selected by said first switch; a plurality of electrically operated speakers distributed over an area; sound storage means including a tape having a plurality of parallel channels, each channel containing in sequence a predetermined group of sounds, the sounds of all said channels being combinable in sequence to correspond to all parties to be paged and to the identities of all said paging stations; a plurality of sound pickup means arranged to cooperate with said channels respectively; a plurality of connecting relay means for said pickup means arranged to connect said pickup means to said speakers thereby to transmit sounds to said speakers for emission therefrom; finder means operable in response to energization of any one of said station relays to a position determined by the identity of the one of said paging stations used; first and second groups of control circuits for said connecting means, one circuit of said first group being partly completed in response to energization of a combination of said station relays and to operation of said finder means to said position, each circuit of said second group being partly completed in response to operation of said finder means to said position; sequential selector means responsive to energization of any of said station relays to complete said one first group partly completed circuit and said second group of partly completed circuits in a predetermined sequence, completion of said partly completed circuit of said first group providing a statement through said speak-

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ers of the identity of the party selected to be paged, completion of the combination of partly completed circuits of said second group in sequence providing a statement through said speakers of the identity of said one paging station, and a circuit for shorting out said station relays thereby to cause them to be de-energized, said sequential selector means including means controlling completion of said shorting circuit and providing completion thereof at the end of a paging operation.

11. The apparatus defined in claim 10 wherein said shorting circuit is connected through said finder means across the relays of the one said paging station being used.

12. A paging system comprising: a plurality of paging stations, each said station including a manually operable switch movable to a plurality of positions each corresponding to a party to be paged, a plurality of station relays and energizing circuits for said relays, each position of said switch partly completing a different combination of said energizing circuits, manual means for completing said partly completed energizing circuits at each of said switch positions, and means associated with each of said relays for locking said relay in an energized condition upon energization thereof; a plurality of electrically operated speakers distributed over an area; sound storage means containing sounds which can be combined in sequence to correspond to all parties to be paged and to the identities of all said paging stations; sound pickup means arranged to cooperate with said sound storage means and to transmit sound to said speakers for emission therefrom; a line finder switch including a plurality of stepping contacts, a stepping relay for said contacts, and an energizing circuit for said stepping relay completed upon energization of any of said station relays, said finder switch further including a plurality of rows of stationary contacts consecutively engaged by said stepping contacts, each row being connected to a different paging station; first and second groups of control circuits for said pickup means, at least one of said first group being partly completed in response to energization of any one of said station relays and to engagement of some of said stepping contacts with the line of stationary contacts associated with said one paging station, at least one of said second group being partly completed in response to engagement of some others of said stepping contacts with the line of stationary contacts associated with said one paging station; and sequential selector means effective when energized to complete the partly completed circuits of said first and second groups in a predetermined sequence so as to provide respectively a statement through said speakers of the party selected to be paged and of the identity of said one paging station; said finder switch further including additional relay means for de-energizing said stepping relay and starting said sequential selector means, and an energizing circuit for said additional relay means completed upon engagement of one of said stepping contacts with one of said stationary contacts of the row associated with said one paging station.

13. The apparatus defined in claim 12 wherein said sound storage means includes tone means for controlling operation of said sequential selector means, and means are provided for making said tone means effective in response to the starting of said sequential selector means.

14. A paging system comprising: a plurality of paging stations, each said station including manually operable means movable to a plurality of positions, each position corresponding to a party to be paged and providing a predetermined control signal; a plurality of electrically operated speakers distributed over an area; sound storage means comprising a tape having a plurality of parallel channels each containing a plurality of sounds in sequence, the sound on said channels being combinable in sequence to correspond to all parties to be paged and to the identities of all said paging stations; a plurality of sound pickup means respectively arranged to cooperate with said chan-

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nels, connecting relay means for connecting said pickup means to said speakers to transmit sound to said speakers for emission therefrom; finder means operable in response to use of said manually operable means to a position determined by the identity of the one of said paging stations used; first and second groups of control circuits for said pickup means, at least one of said first group being partly completed in response to said control signal and to operation of said finder means to said position, at least one of said second group being partly completed in response to operation of said finder means to said position; and sequential selector means including a row of stationary contacts and a stepping contact, said sequential selector means being responsive to operation of said manually operable means to cause said sequential selector means stepping contact to engage said stationary contacts in a predetermined sequence, each of said sequential selector means stationary contacts being connected to a different one of said control circuits, engagement of said sequential selector means stepping contact with each of said stationary contacts completing one of said control circuits, the sequence of completion of said control circuits being such as to provide a statement through said speakers of the identity of said one paging station and of the party selected to be paged.

15. The apparatus defined in claim 12, including means for de-energizing all components of said paging system subsequent to a paging operation, said sequential selector means being effective to operate said de-energizing means at the end of a paging operation.

16. The apparatus defined in claim 12 wherein said means for de-energizing said stepping relay and for starting said sequential selector means comprises a relay member and a contact controlled by said relay member, said controlled contact completing said stepping relay energizing circuit when said relay member is de-energized and completing a circuit for starting said sequential selector means when said relay member is energized, and a circuit for energizing said relay member completed through one of said stationary finder contacts and one of said stepping contacts.

17. A paging system comprising: a plurality of paging stations, each said station including a manually operable switch movable to a plurality of positions each corresponding to a party to be paged, a first plurality of relays and energizing circuits therefor, means for completing a different combination of said energizing circuits in each position of said manually operable switch; a plurality of electrically operated speakers distributed over an area; sound storage means comprising a tape having a plurality of parallel channels, each channel containing a sequence of sounds, the sounds of all said channels being combinable in sequence to correspond to the identities of all said paging stations, each channel further including the name of a different party to be paged; sound pickup means associated with each channel, a second plurality of relays associated with said pickup means respectively and arranged to connect said pickup means to said speakers thereby to transmit sound to said speakers for emission therefrom upon energization of any of said second plurality of relays; a finder switch including a plurality of rows of stationary contacts each associated with a different paging station, a plurality of stepping contacts respectively engageable simultaneously with the contacts of a single row of stationary contacts, and means operable in response to energization of any of said first plurality of relays to move said stepping contacts into engagement with the line of contacts connected to the paging station being used; a third plurality of relays respectively connected to some of said stepping contacts, engagement of said stepping contacts with said stationary contacts completing the same combination of energizing circuits for said third plurality of relays as was completed for said first plurality of relays, first and second groups of control circuits, each group con-

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trolling said second plurality of relays, one of said first group being partly completed in response to energization of a particular combination of said third plurality of relays, each of said second group being connected to one of the stationary contacts of said line of stationary contacts and being partly completed in response to engagement of said stationary contacts by said stepping contacts; and sequential selector means responsive to energization of any of said first plurality of relays to complete said partly completed circuit of said first group and said second group of partly completed control circuits in a predetermined sequence so as to provide a

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statement through said speakers of, respectively, the party selected to be paged and the identity of said one paging station.

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