

Sept. 3, 1940.

W. BENNETT

2,213,511

TELEPHONE SYSTEM

Filed Oct. 31, 1939

16 Sheets-Sheet 1

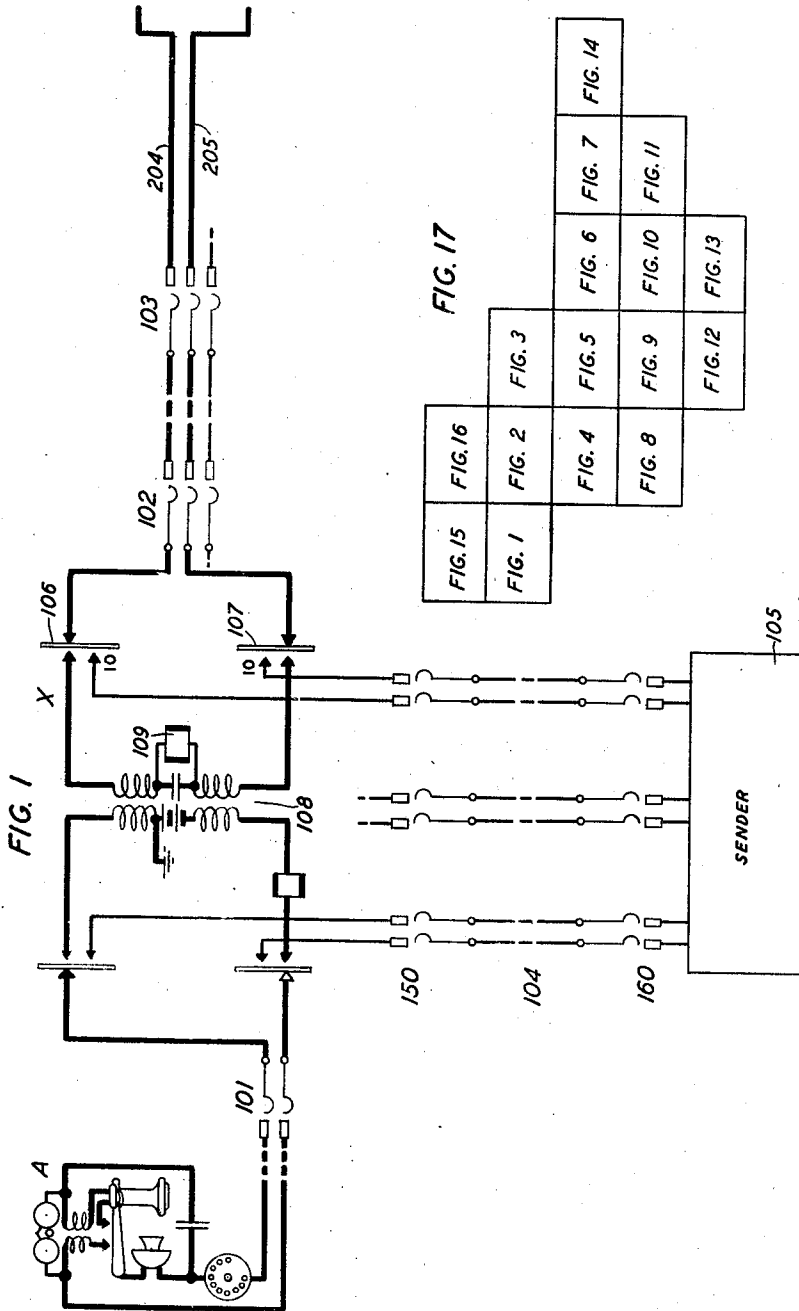
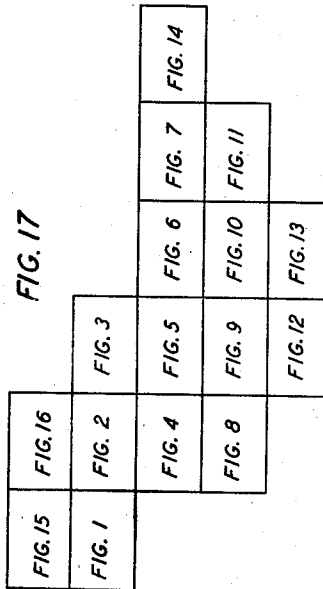


FIG. 17



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16 Sheets-Sheet 2

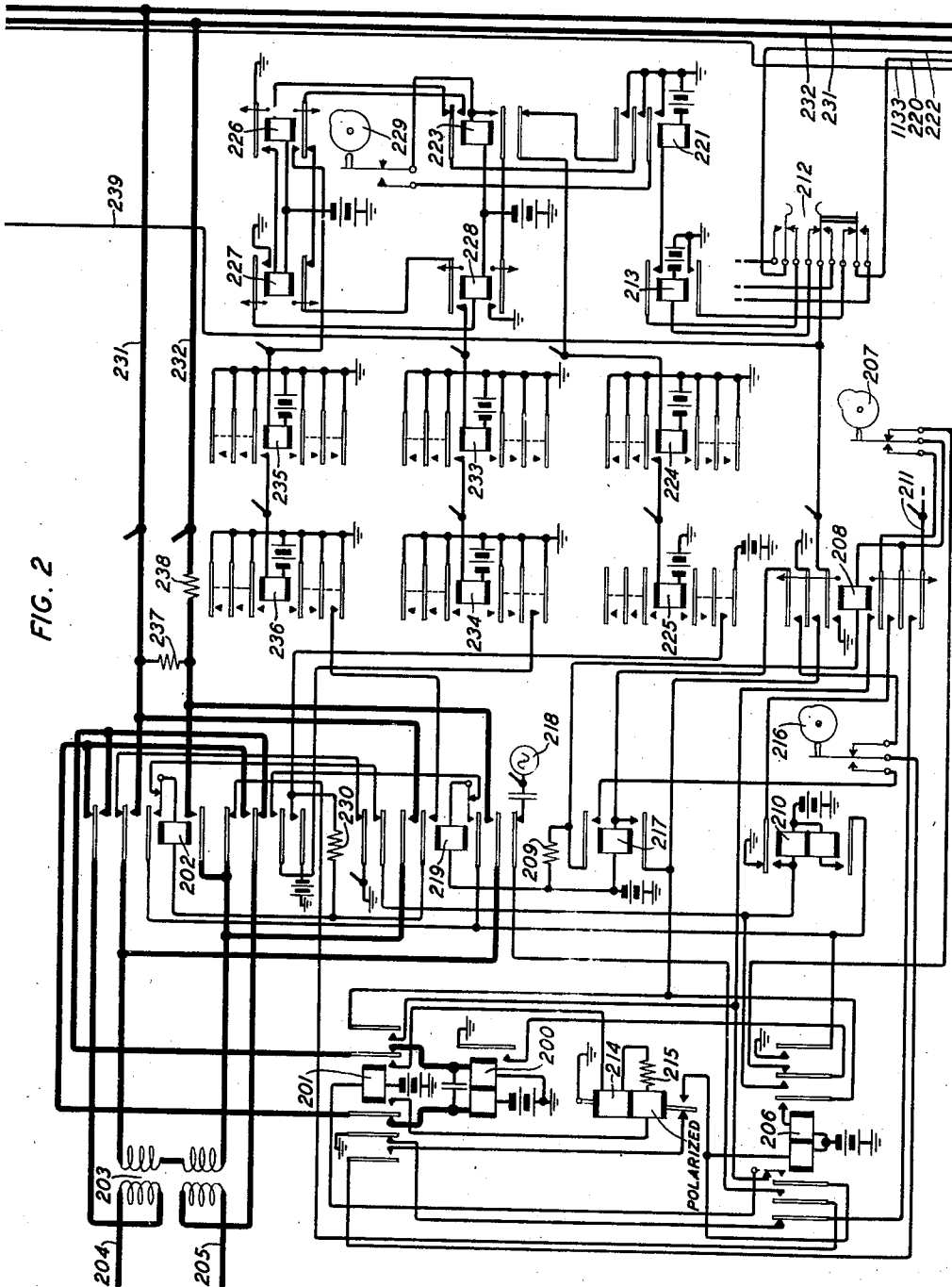


FIG. 2

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16 Sheets—Sheet 3

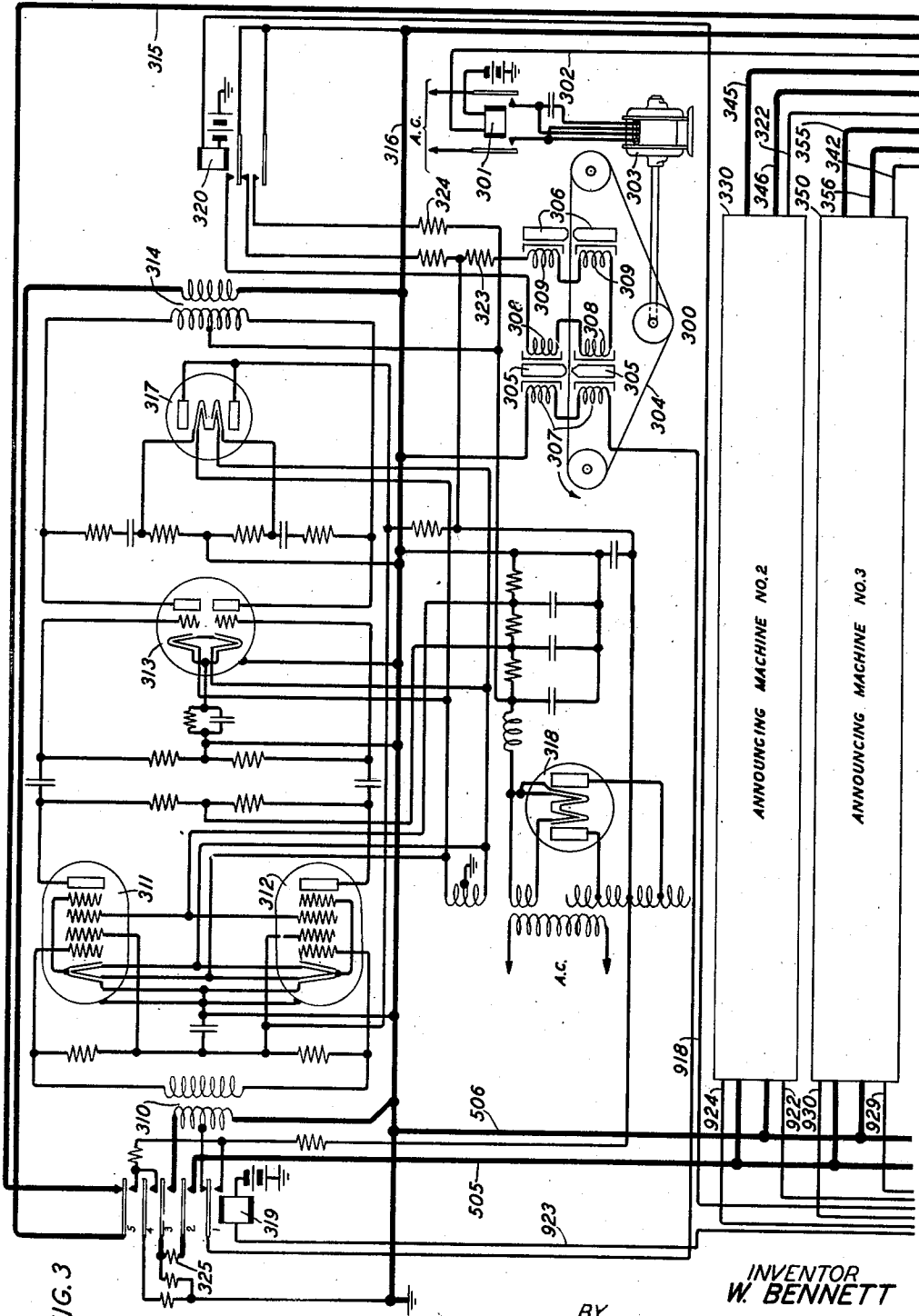


FIG. 3

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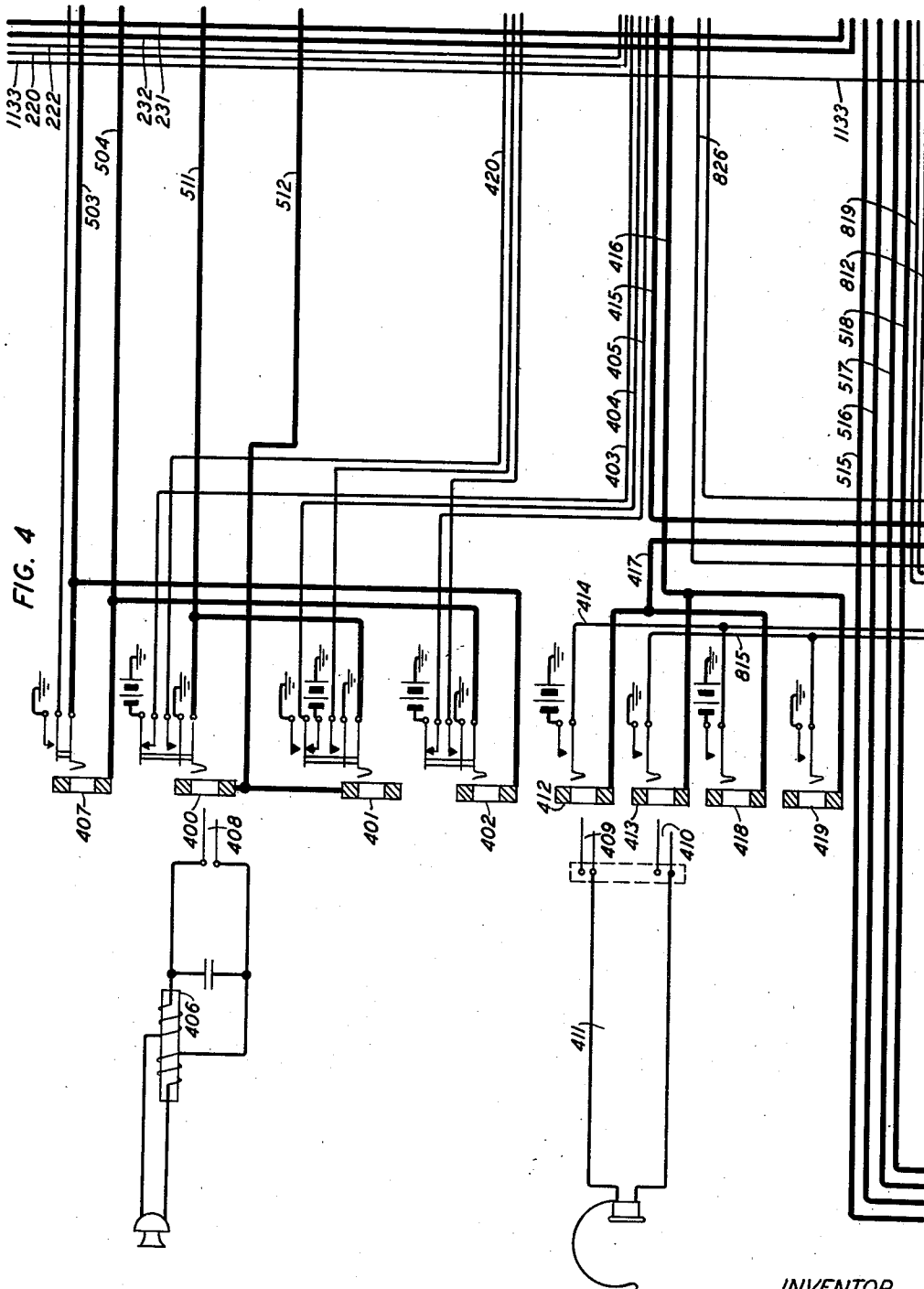
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16 Sheets-Sheet 4



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16 Sheets—Sheet 6

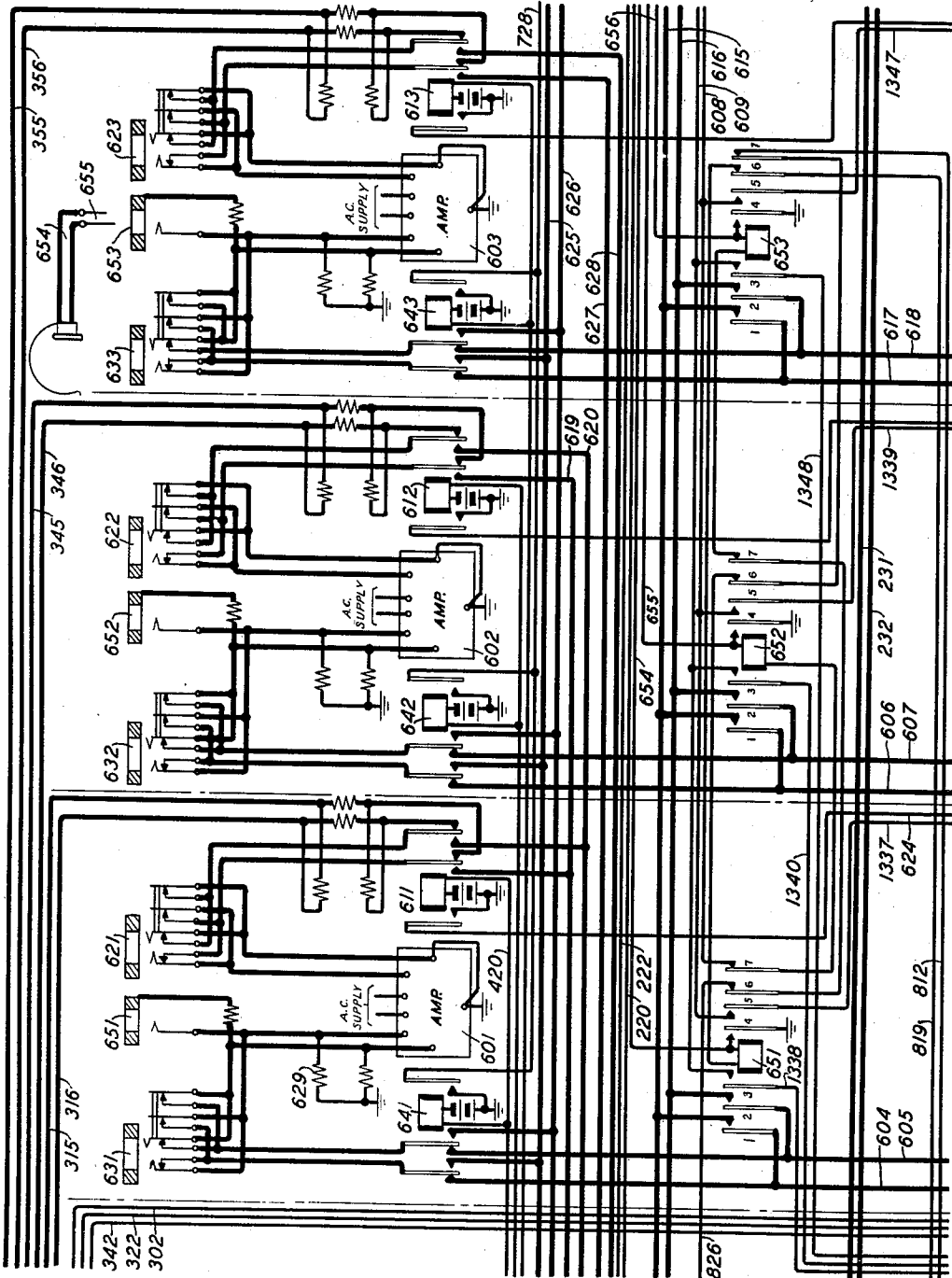


FIG. 6

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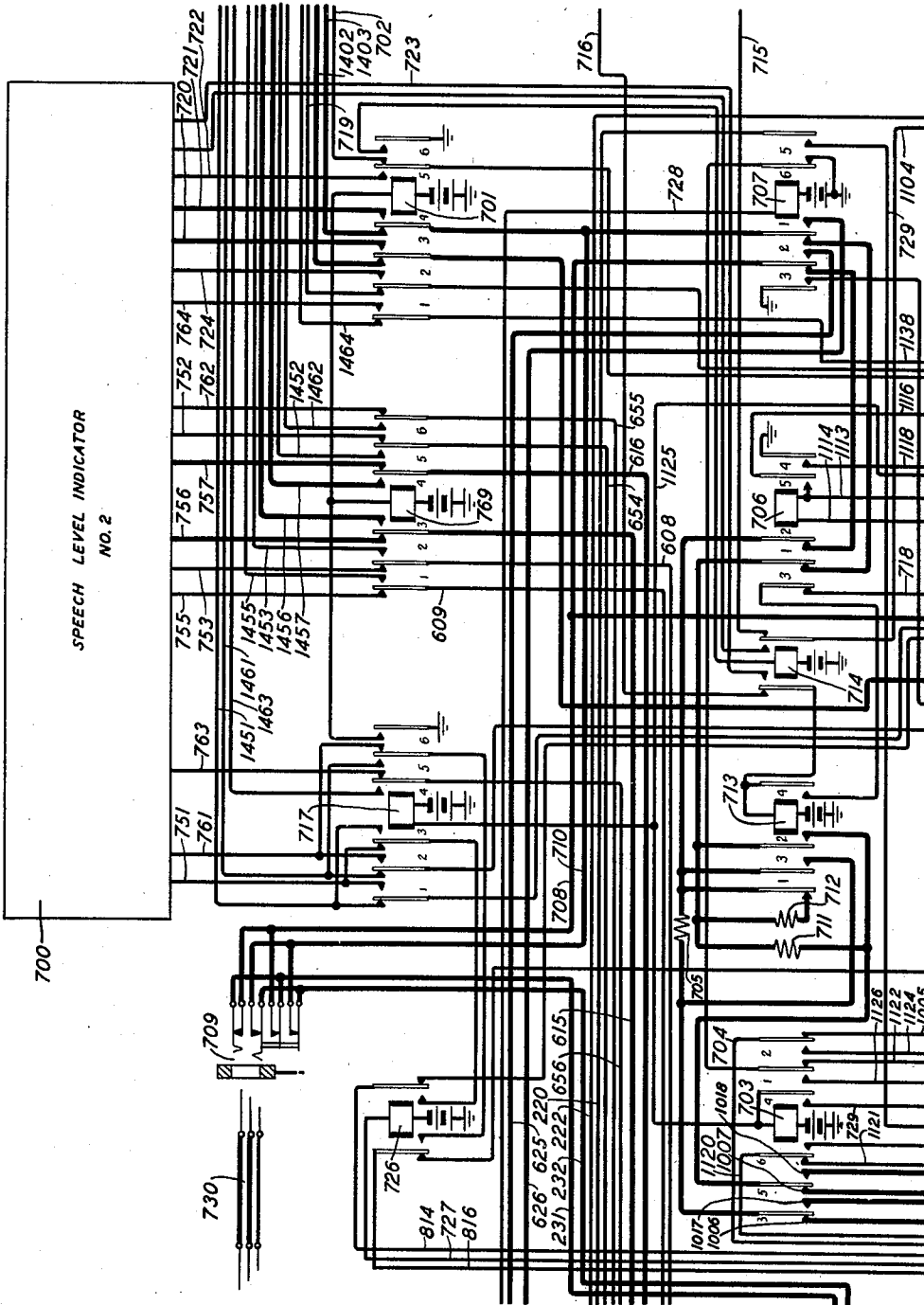
2,213,511

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16 Sheets-Sheet 7

FIG. 7



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16 Sheets—Sheet 8

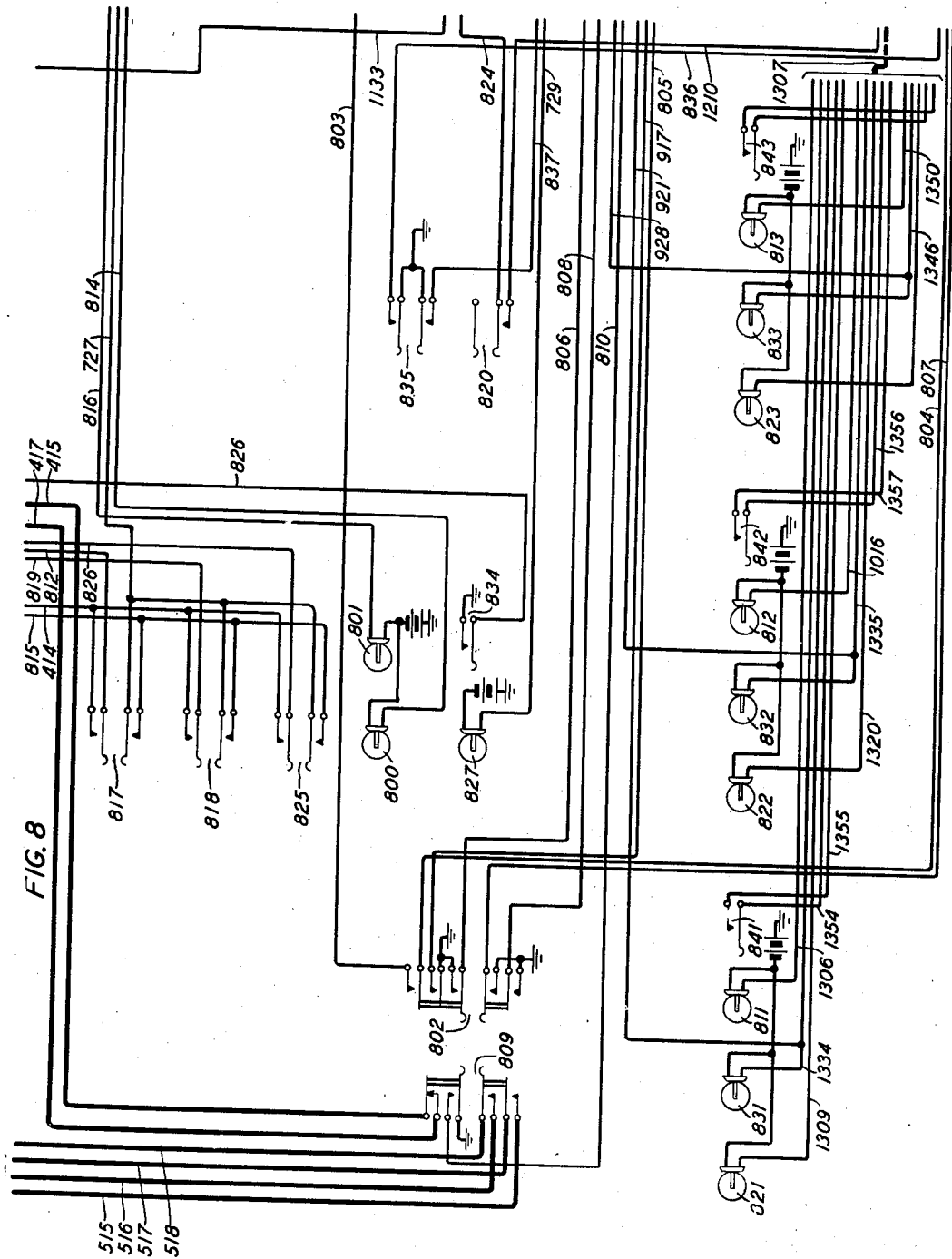


FIG. 8

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TELEPHONE SYSTEM

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16 Sheets-Sheet 9

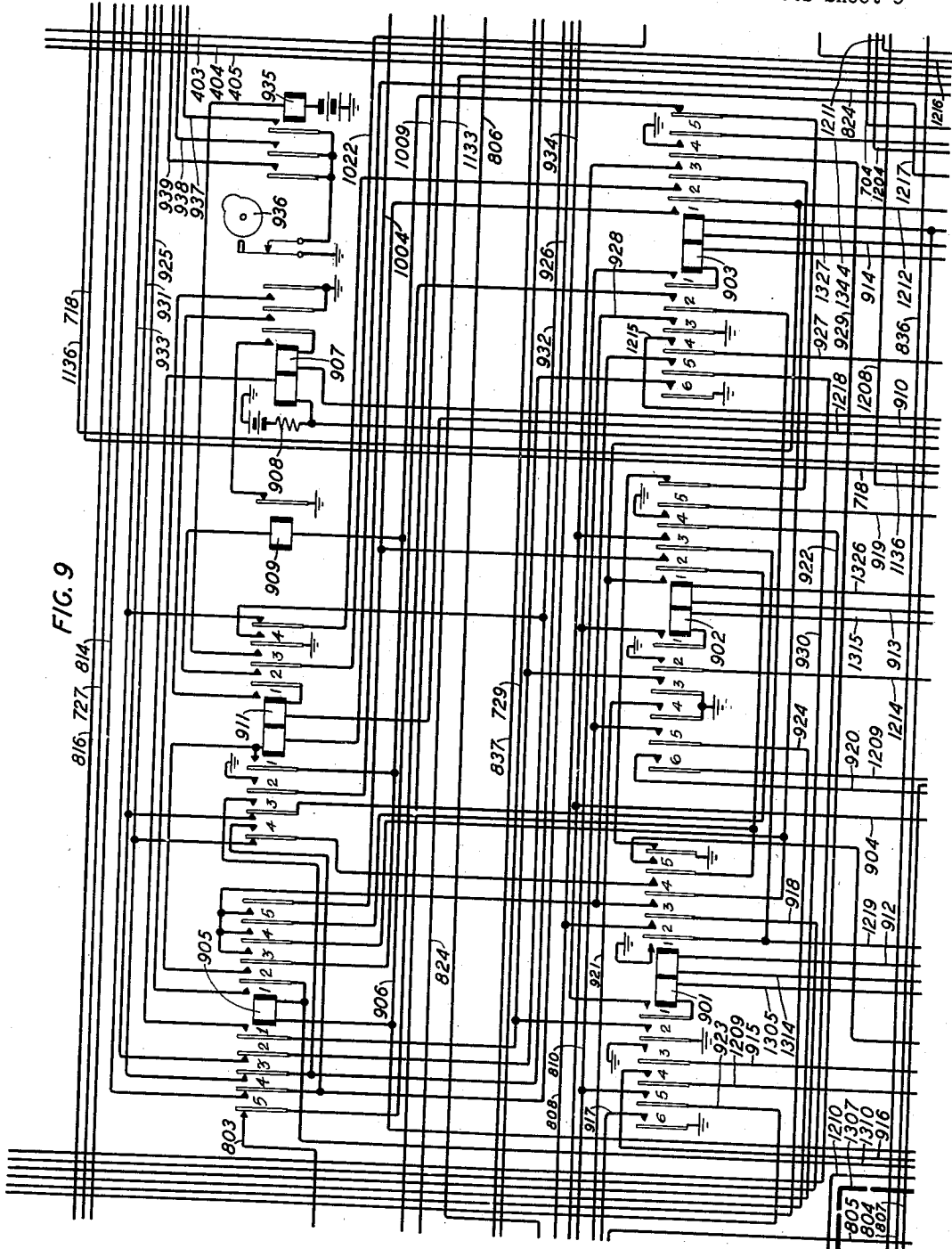


FIG. 9

1136, 718

816, 727, 814

837, 729

824

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16 Sheets-Sheet 10

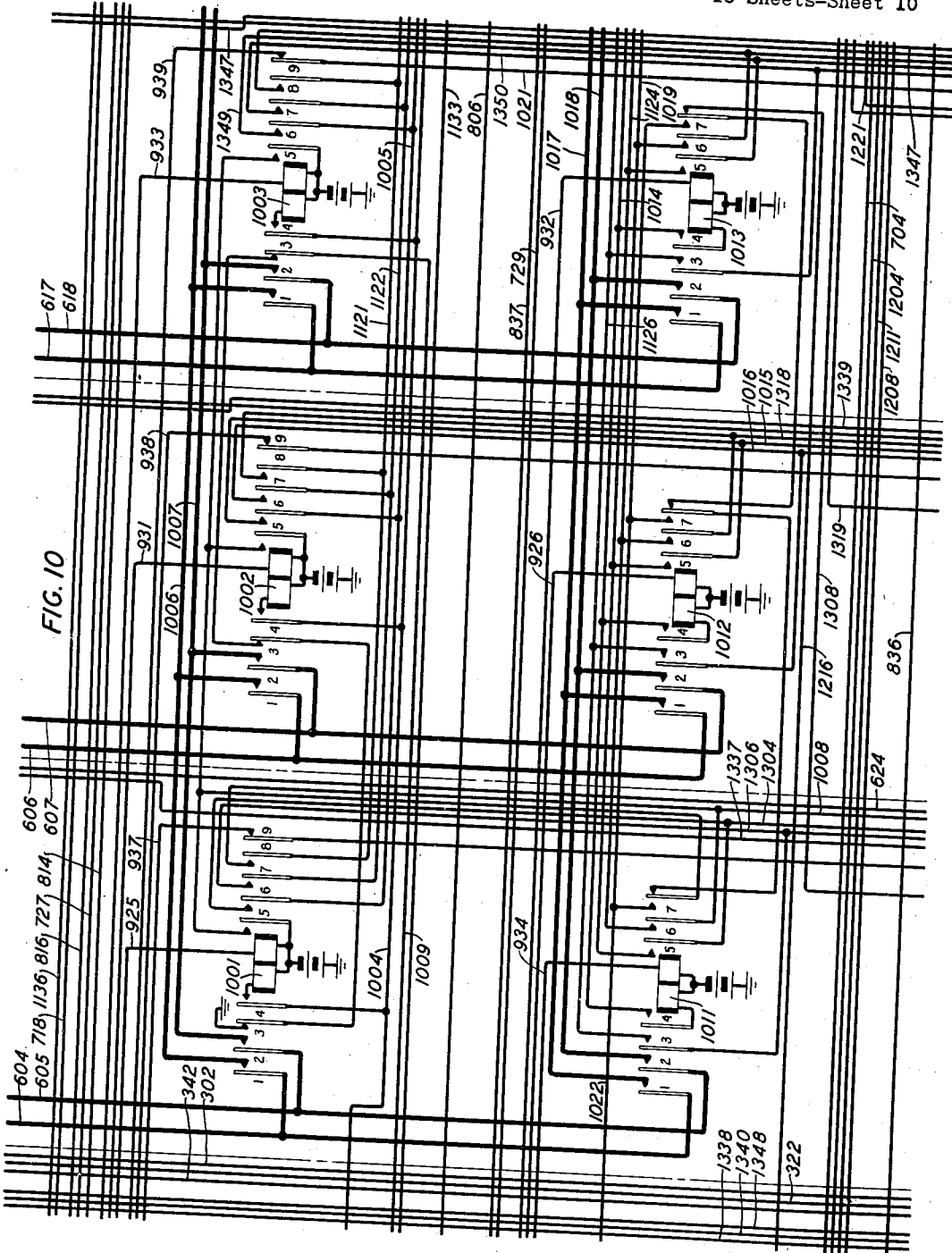


FIG. 10

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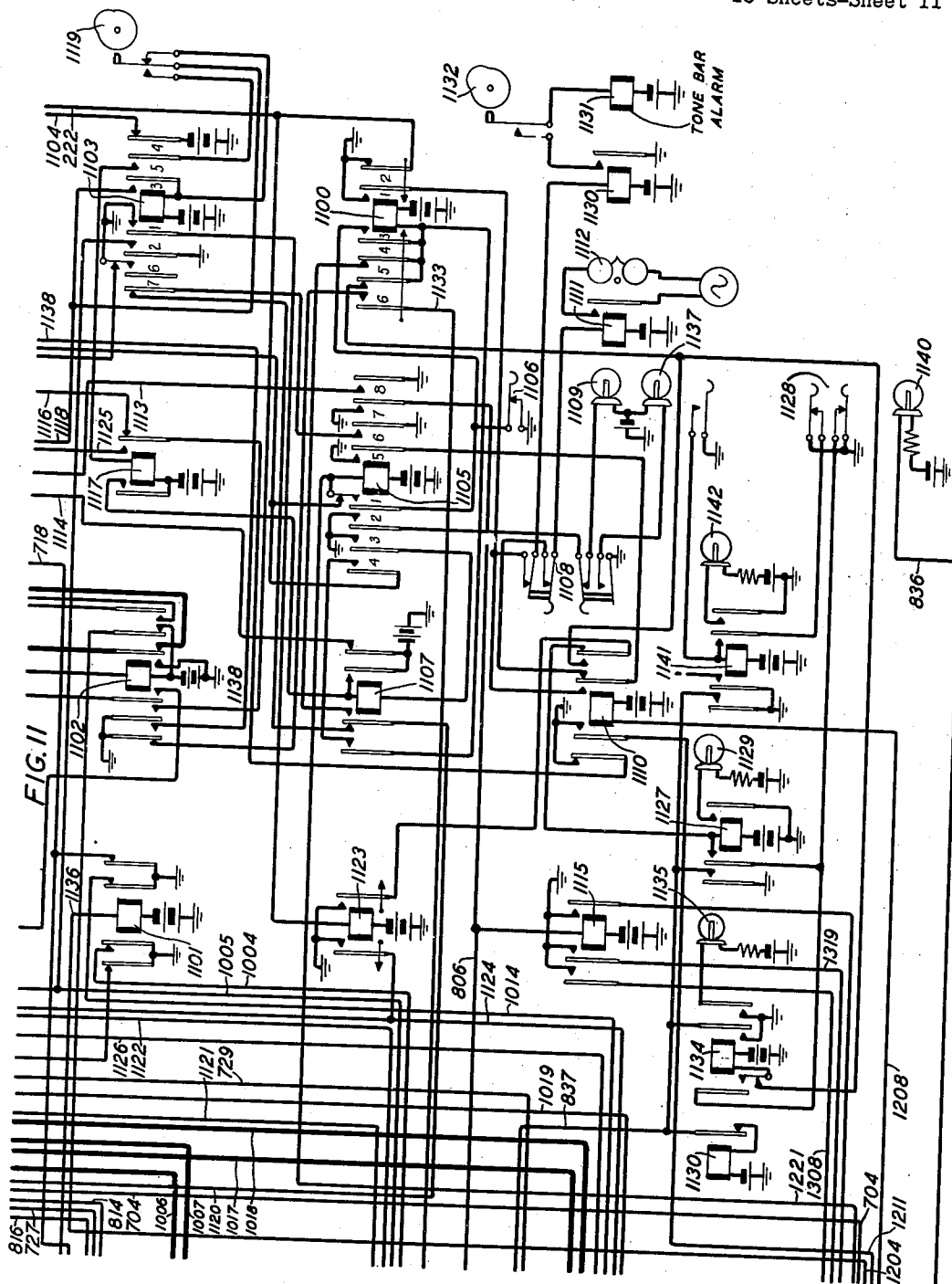
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16 Sheets-Sheet 11



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16 Sheets-Sheet 12

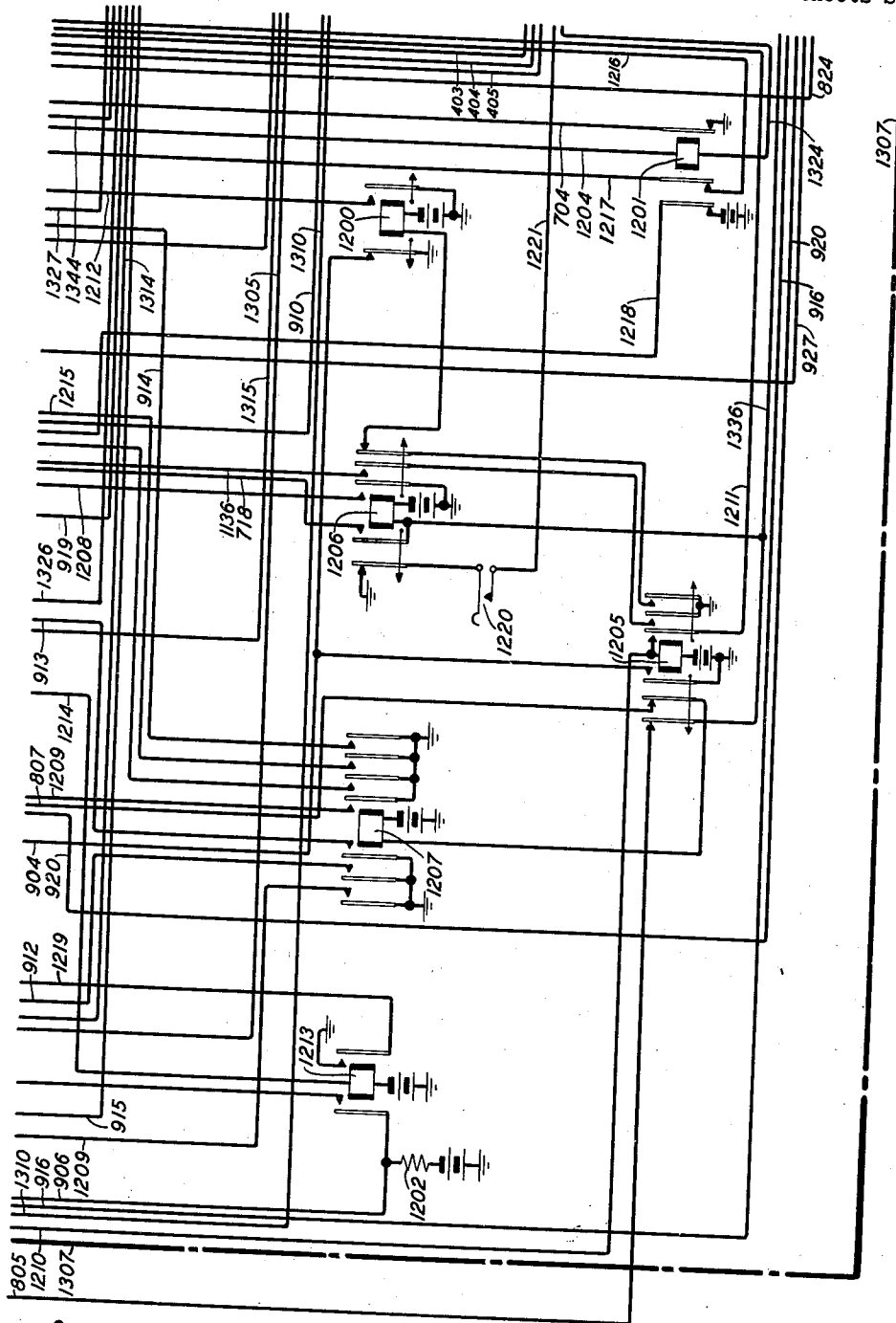


FIG. 12

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16 Sheets—Sheet 13

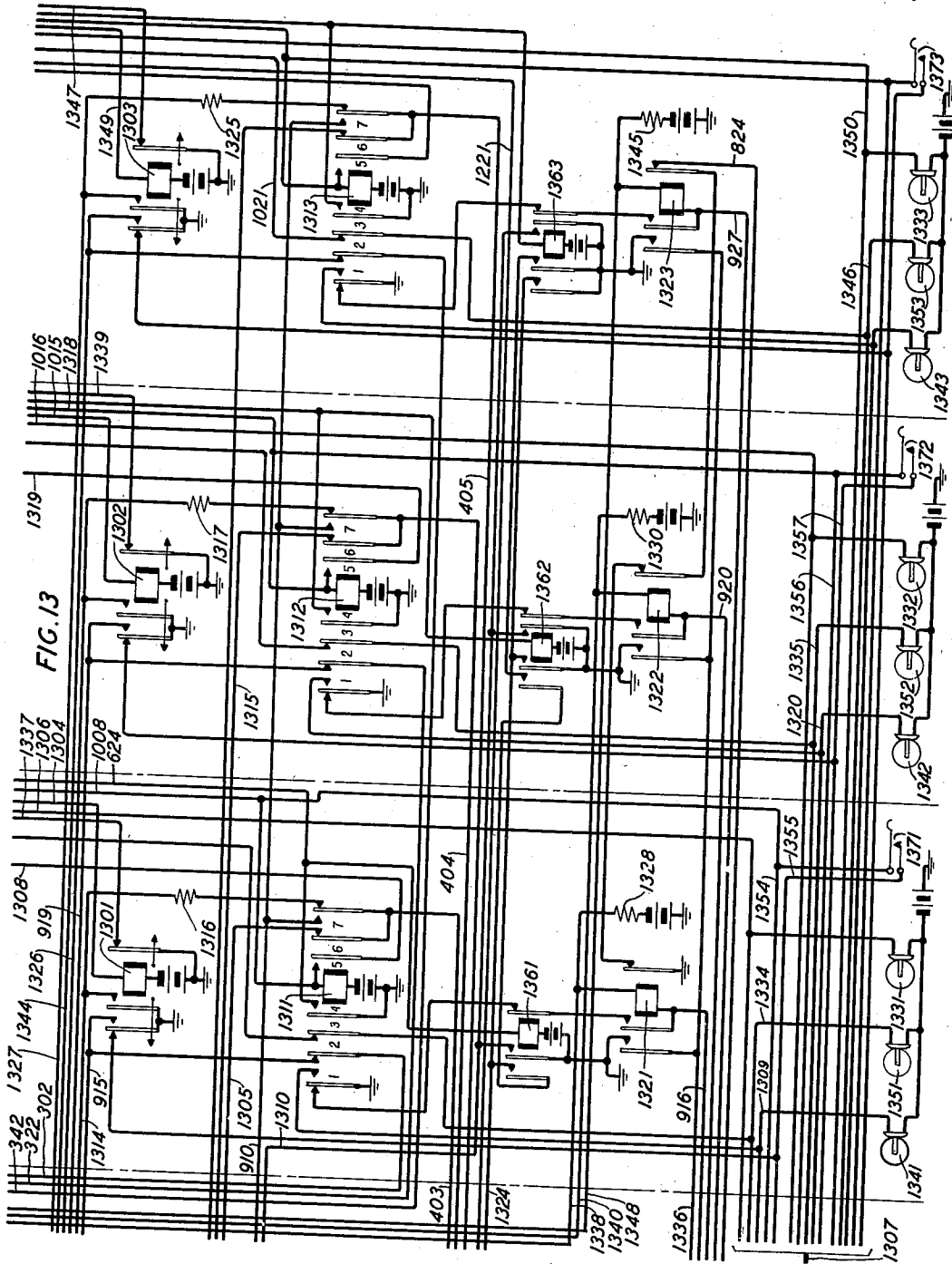


FIG. 13

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TELEPHONE SYSTEM

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16 Sheets-Sheet 14

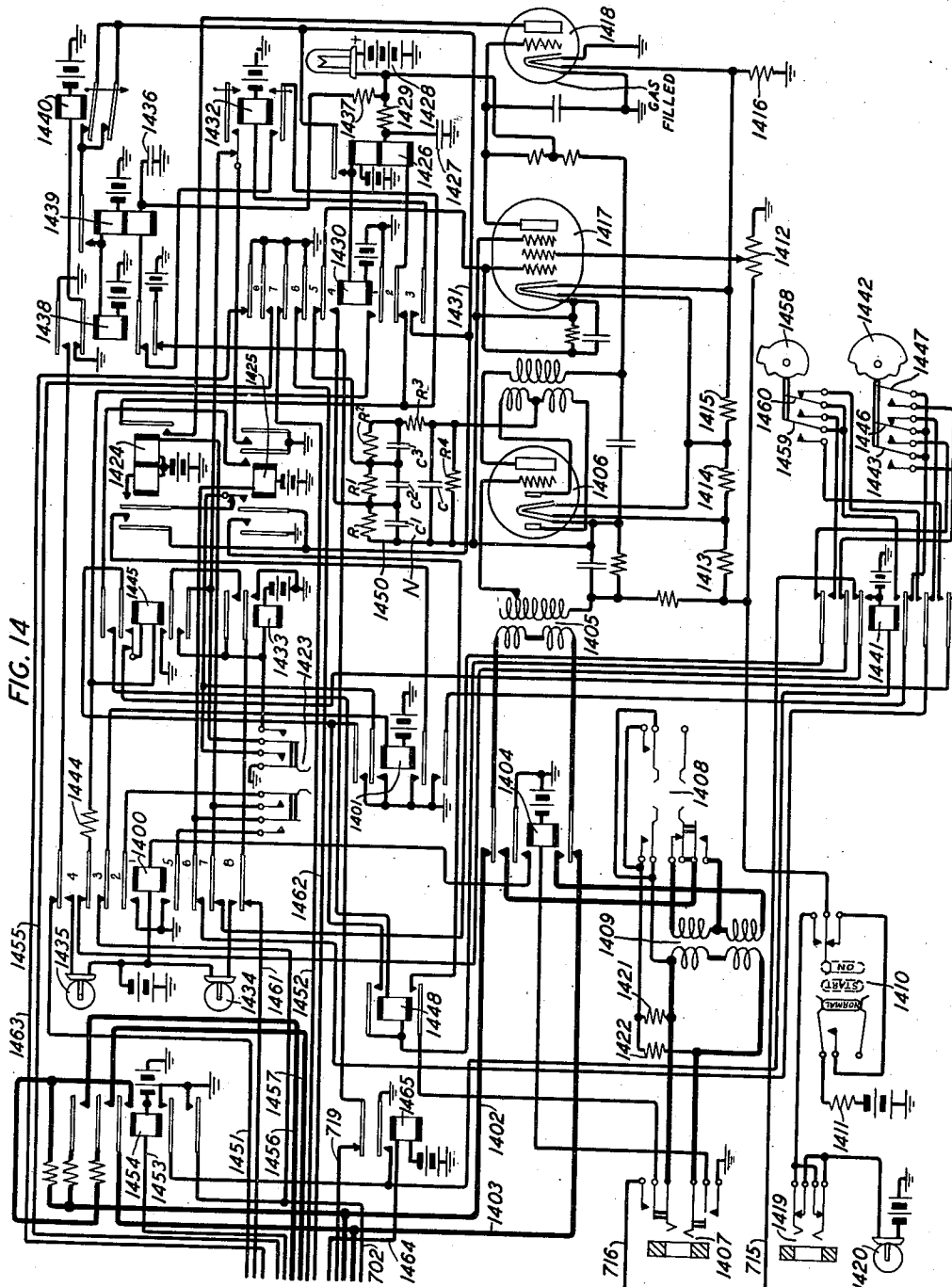


FIG. 14

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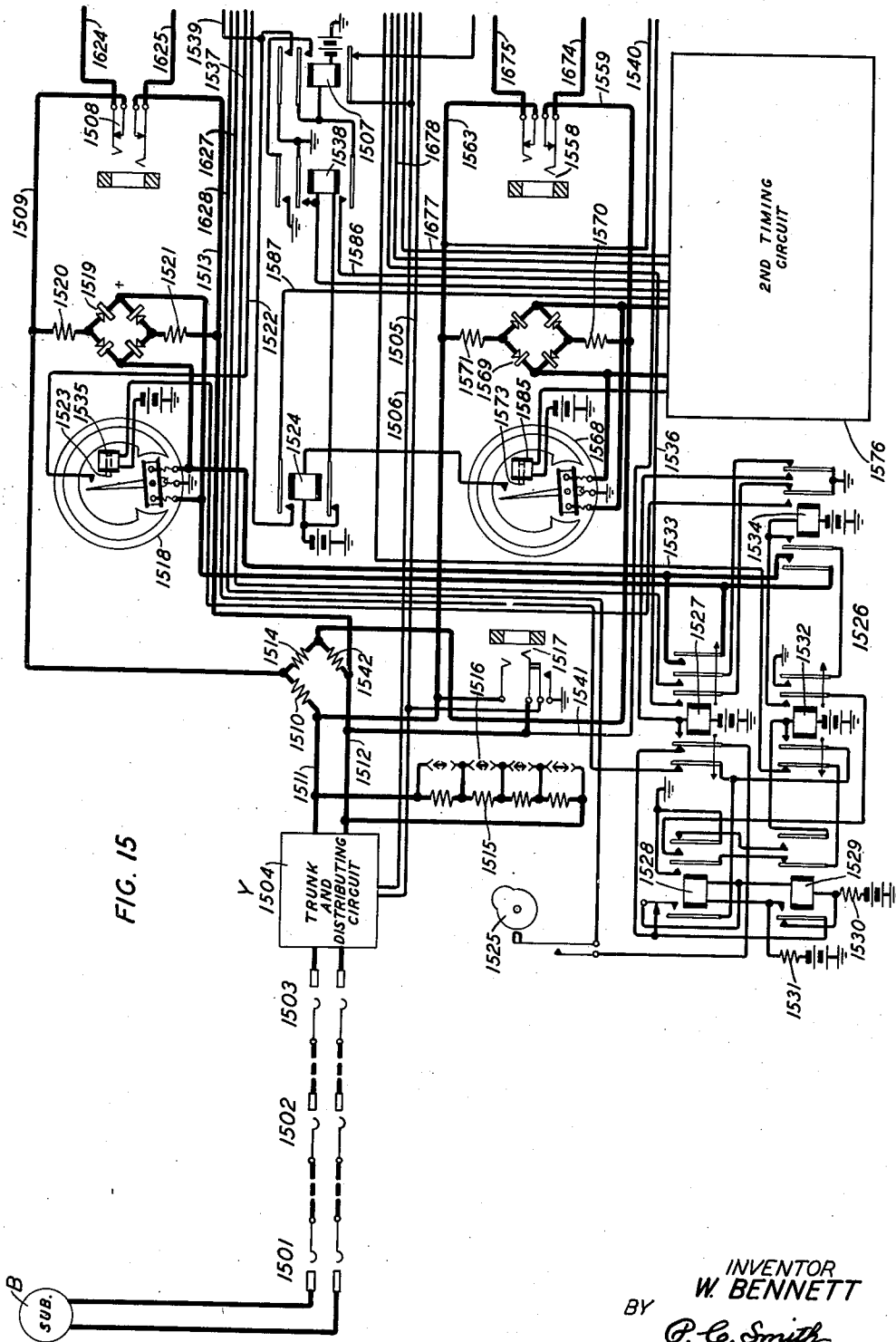


FIG. 15

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Filed Oct. 31, 1939

16 Sheets—Sheet 16

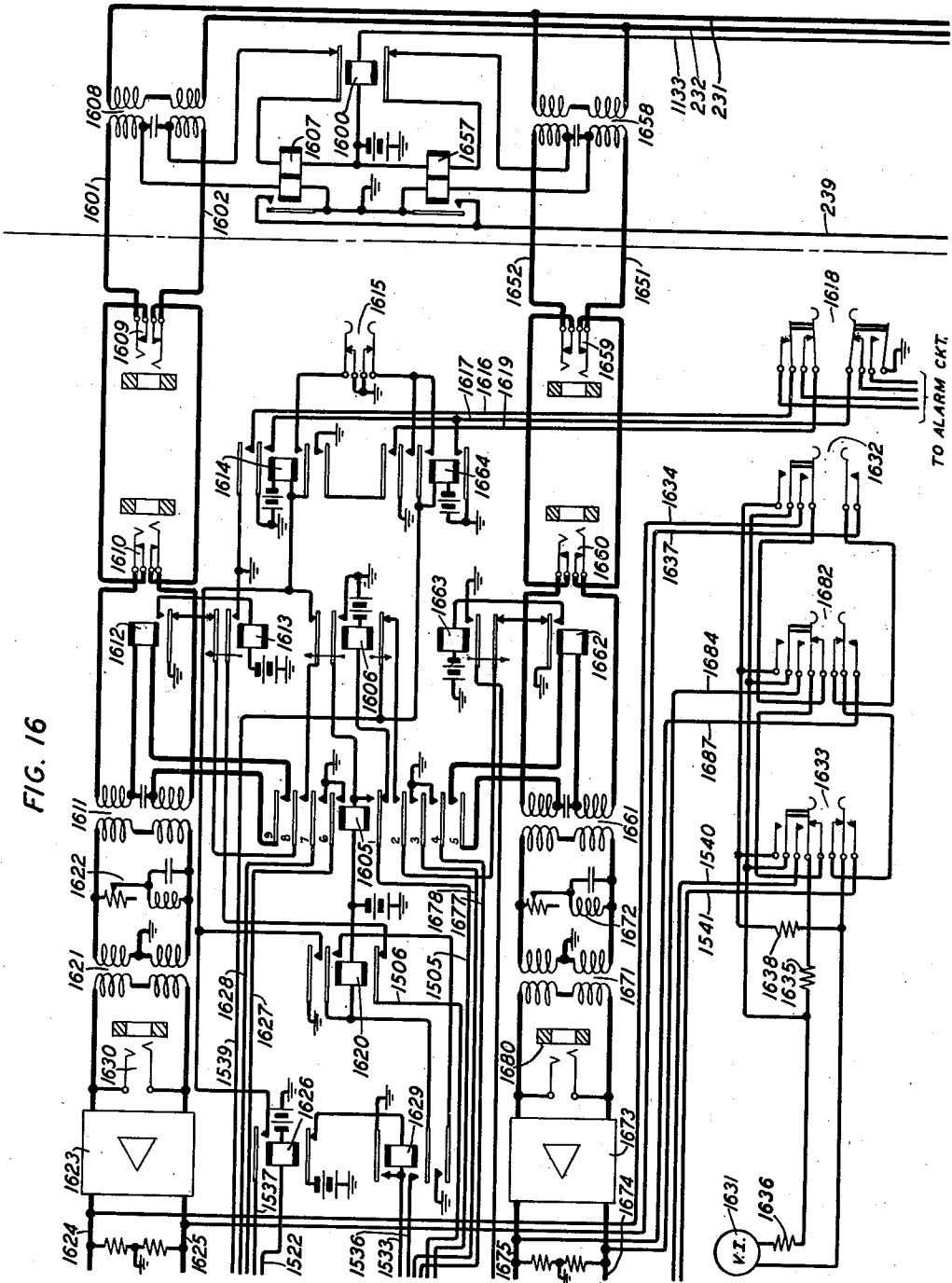


FIG. 16

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# UNITED STATES PATENT OFFICE

2,213,511

## TELEPHONE SYSTEM

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Application October 31, 1939, Serial No. 302,090

24 Claims. (Cl. 179—6)

This invention relates to telephone exchange systems and more particularly to systems in which any subscriber by calling a designated directory number may obtain a connection with a central information announcing bureau from which announcements, such as weather forecasts, crop reports, results of sporting events, etc., are automatically made.

The object of the invention is to enable the information announcements to be automatically and efficiently transmitted to as many subscribers in an exchange area or a plurality of such areas as concurrently initiate calls for such service.

This object is attained in accordance with the present invention by the provision of announcement trunks accessible from the terminal banks of selector switches of local offices or from the terminal banks of selector switches of tandem offices which are multiplied to a trunk outgoing to a central announcing bureau. Associated with the announcement trunks is a distributing circuit which is responsive to the seizure of any one of the announcement trunks to effect the cut-through of the speech transmission circuit over each calling trunk and to cause the opening of each transmission circuit after an interval sufficient to enable each calling subscriber to hear one or more complete announcements transmitted from the central bureau.

The trunk circuit incoming to the central bureau terminates at the bureau in a control circuit with which three announcing machines of the magnetizable tape type and two speech level indicators and alarm circuits are associable. Of the three announcing machines one is normally running and two have recorded on their tapes the latest information to be transmitted, such, for example, as the latest weather report received from the United States Weather Bureau. One of these two machines has its speech output circuit normally connected through suitable amplifiers to the incoming trunk circuit so that upon the cut-through of connections from one or more subscribers' lines such subscribers are enabled to hear the announcement transmitted from such machine. The second of the two machines is held as a spare in readiness for a service connection to the incoming trunk should the machine in service stop or fail to maintain a suitable speech level output. The third machine is held in reserve for the recording of a new message on its tape. During the time that a machine is in service its output circuit is connected to one of the speech level indicators which periodically makes a check to determine if there is a speech

output therefrom and if the output speech level is within desired lower and an upper volume limits. If the level is too low or there is no speech output the control circuit is operated to transfer the connection to the incoming trunk from the output circuit of the machine in service to the output circuit of the spare machine; to connect the output circuit of such spare machine to the other speech level indicator which similarly checks the volume of its output and to operate a minor alarm to indicate the failure of one of the machines and the fact that the spare machine is in service. If the speech level indicator finds that the speech level of the spare machine is not correct, it operates the control circuit to remove such machine from service and to operate a major alarm to indicate that there is no machine in service. The monitoring operator's turret is provided with in-service and out-of-order lamps individual to each machine which are lighted when the corresponding machine is in service or out of order.

The control circuit is arranged to connect the three machines in pairs for service and spare service in accordance with a definite pattern so that when the No. 1 machine is in service the No. 2 machine is on spare service, when the No. 2 is in service the No. 3 machine is on spare service and when the No. 3 machine is in service the No. 1 machine is on spare service. The operator's turret is provided with an erase key, which when operated removes the machine which is on spare service from such service and erases the record from the tape of such machine and from the tape of the reserve machine and is also provided with a recording key which connects the monitoring operator's recording transmitter with such machines for placing a new record on their tapes. The machines which have thus had new records placed on their tapes cannot again be placed in service until their output circuits have been connected to the speech level indicator which is not at the time being used for monitoring on the machine still in service. To monitor on newly recorded machines the monitoring turret is provided with a monitoring jack to which the operator's headset may be connected and with a monitoring key individual to each machine. During recording lamps individual to each machine are lighted on the turret to indicate which machines are being recorded. Provision is made to flash the recording lamp of any machine which has been removed from service and requires a new recording. If the speech level of either newly recorded machine is not correct

either a high or low level lamp on the turret will be lighted and the operator will thereupon erase the record on such machine and re-record. When both machines are correctly recorded the operator may place one of such machines in service and the other on spare service and transfer the machine in service to reserve by the operation of a cut-in service key on her turret.

The operator's turret is also provided with jacks individual to the machines into which she may plug her recording transmitter for giving manual announcements directly to calling subscribers in the event of machine failures, such announcements being monitored by one of the speech level indicators for correct volume and being at the same time recorded on machines which are at the time available for recording. A transfer key is also provided on a maintenance panel to enable the manual transfer of the load from the machine in service to the spare machine.

In some instances it is desirable to extend the information service to subscribers whose lines terminate in the offices of another exchange area. In this case it is not economical to extend direct trunks from such offices to the exchange area in which the information bureau is located. Therefore, for such extended service the local announcement trunks of the remote exchange area are terminated in an auxiliary control circuit located in such area and have associated with them a common distributing circuit. The auxiliary control circuit comprises two parallel trunk channels each provided with supervisory equipment, an amplifier, a speech detecting relay, a timing circuit and alarm equipment. The output ends of both channels are connected together through a Wheatstone bridge to the multiplied outgoing ends of the announcement trunks and the input ends of the channels extend as two cable pairs to a branched trunk circuit in the office in which the information announcing bureau is located. Each branch of this trunk circuit is provided with a repeating coil and with a supervisory relay, the input windings of the repeating coils being both connected to the trunk terminating in the control circuit of the central bureau. Both channels of the auxiliary control circuit normally function at the same time so that announcements from the central bureau are transmitted thereover to all calling subscribers' lines in the remote exchange area.

Whenever calls for information service are initiated in the remote exchange area announcement trunks in such area are seized and through their associated distributing circuit a start signal is transmitted to the auxiliary control circuit. This start signal causes the establishment of supervisory circuits over both cable pairs extending to the branched trunk circuit at the central bureau to signal the control circuit at the central bureau that a call is waiting. If the central bureau circuit is not functioning so that announcements may not be made, the branched trunk circuit receives a signal therefrom which operates a relay therein to open the supervisory circuits extending to the auxiliary control circuit in the remote area. If either supervisory circuit is not completed a minor alarm is given at the auxiliary control circuit and if neither circuit is completed, a major alarm is given. The closure of either supervisory circuit is also effective to transmit a signal to the distributing circuit of the remote area to cut through the calling announce-

ment trunks and to time the duration of the cut-through period.

As previously stated each channel of the auxiliary control circuit is provided with an amplifier and a speech detection relay. If speech reception is transmitted properly, through the amplifier of each channel, the speech detection relays will both operate. For determining if speech is being properly transmitted, each channel is provided with a timing circuit which during each cycle will first prepare the circuit of a test relay associated with the channel which will operate only if the speech detection relay is at the time unoperated, thereby indicating a failure of speech transmission over the channel. If the test relay operates, it is instrumental at a later period of the timing cycle to operate the alarm equipment associated with the channel which has failed. The timing circuit during each cycle is also arranged to restore the speech detection relay of its channel for reoperation. If both channels when tested are found to be transmitting no speech current, a major alarm is operated and the associated distributing circuit is signaled to prevent the further cut-through of calling announcement trunks.

A clearer conception of the scope and purpose of the invention will be obtained from a consideration of the following description taken in connection with the attached drawings in which:

Fig. 1 shows the line of a subscriber A terminating in an originating office X of a first exchange area, the schematic representation of a line-finder, a link circuit having a line-finder selector and a sender selector by means of which the line may become associated with a central office sender indicated by the box in the lower portion of the figure and the schematic representation of a district selector and office selector by means of which the calling line may be further extended;

Fig. 2 shows an outgoing announcement trunk accessible from the terminal banks of office selectors one of which is disclosed in Fig. 1 and a distributing circuit common to a plurality of announcement trunks;

Fig. 3 shows the three announcement machines associable with the central information announcing bureau, one machine and the associated power supply, control and amplifier circuits being shown in full and the similar circuits of the other two machines being represented by the boxes in the lower portion of the figure;

Figs. 4 to 13, inclusive, taken together show the circuits of the control circuit at the central information announcing bureau;

Fig. 14 shows one of the speech level indicators associable with the control circuit;

Fig. 15 shows the line of a subscriber B terminating in an originating office Y of a second exchange area, the schematic representation of a line-finder, district selector and office selector by means of which the calling line may be extended, a schematic representation of one of the announcement trunks accessible from the office selector and the associated distributing circuit and a portion of the auxiliary control circuit of the exchange area;

Fig. 16 shows at the left of the vertical dot-dash line the remaining portion of the auxiliary control circuit and at the right of the dot-dash line the branched trunk circuit at the first exchange area in which interexchange trunks extending between the exchange areas terminate

and which is connected to the control circuit of the first exchange area; and

Fig. 17 is a chart indicating the manner in which the several figures of the drawings should be assembled to disclose the detailed circuits of the invention.

#### General description

The apparatus of the originating offices shown in Figs. 1 and 15 is of the well-known panel type. The line finders 101 and 1501, selector switches 102, 103, 1502 and 1503, and the link circuit 104 of Fig. 1 may be of the same type and function in the same manner as the similar apparatus disclosed and described in Patent No. 1,690,206, granted to A. Raynsford on November 6, 1928. The sender 105 of Fig. 1 may be of the same type as disclosed in Patent No. 1,505,171, issued to F. A. Stearn on August 19, 1924. To simplify the drawings, these pieces of apparatus have been schematically represented and reference may be had to the above-identified patents for a full detailed disclosure thereof. To simplify the drawings, the link circuit and sender have been omitted from Fig. 15 but it is to be understood that a link circuit and sender similar to those represented in Fig. 1 would be employed.

While the invention has been illustrated in connection with switching apparatus of the panel type, it is to be understood that the announcement trunks of either or both exchange areas could terminate as well in office links and connector circuits of originating offices of the well-known cross-bar type or in the distant office selectors of tandem offices. The invention is equally applicable by slight modification of the announcement trunks to systems having originating offices of the manual or step-by-step type.

The speech level indicators one of which is disclosed in detail in Fig. 14 and the other of which is indicated by the box 700 of Fig. 7 are of the general type disclosed in Patent No. 2,119,212, granted May 31, 1938 to H. Kahl.

The magnetic tape announcing machines, one of which is schematically illustrated in Fig. 3 and designated by the numeral 300, are of the type disclosed in the application of C. C. Towne, Serial No. 284,155, filed July 13, 1939.

In Fig. 2, one of the announcement trunks outgoing from the bank terminals of selectors, such as 103, of the dial switching office X is shown in detail. Other similar trunks, sufficient in number to handle the peak demand for the information service, terminating in the same or other office selectors of office X and in office selectors of other similar originating offices or in the distant office selectors of tandem offices would be provided. These trunk circuits are all multiplied together at their distant ends and connected to a trunk 231, 232 extending into the control circuit of Figs. 4 to 13, inclusive. The distributing circuit shown in the right portion of Fig. 2 is common to all of these announcement trunks and to the trunks incoming from other exchange areas, such as the trunk shown in the right portion of Fig. 16.

The trunk and distributing circuit indicated by the box 1504 of Fig. 15 and located in another exchange area to which the information service is supplied are identical to the trunk and distributing circuit disclosed in Fig. 2.

#### Initiation of a call

It will be assumed that a subscriber A whose line terminates in office X of the exchange area

in which the information bureau is located initiates a call, for example, to obtain the latest weather report pertaining to the particular section in which the exchange area is located. The subscriber upon removing his receiver from the switchhook causes the setting of the brushes of the line finder 101 upon the terminals of the calling line and the extension of circuits from the wipers of the line-finder selector 150 and sender selector 160 of the link circuit 104 to an idle sender 105. Upon the seizure of the sender the sender transmits a dial tone to the calling subscriber's line in the usual manner to apprise the subscriber that he may commence dialing. The subscriber then proceeds to dial the digits of the directory number assigned to the central weather forecasting bureau which it will be assumed is WEather 6-1212 thereby setting the registers of the sender to record the office and numerical designations of the weather bureau number.

As soon as the sender has registered the wanted line designation it proceeds in the well-known manner in accordance with the office code registered therein to set the district selector 102 and the office selector 103 to select an idle announcement trunk extending toward the central bureau. It will be assumed that the trunk disclosed in Fig. 2 is idle and is seized for service by the office selector 103. During the setting of the office selector 103 the sequence switch of the district selector 102 is standing in position 10 and therefore upon the seizure of the idle trunk by the office selector 103 a fundamental circuit is established between the trunk of Fig. 2 and the sender 104 which may be traced in part from battery through the left winding of relay 200, inner left back contacts of relay 201, upper back contacts of cut-through relay 202, upper left winding of repeating coil 203, tip trunk conductor 204, tip brushes of selectors 103 and 102, right and lower left contacts of cam 106, thence through the link circuit 104, winding of the sender stepping relay (not shown), thence returning through the link circuit over the upper left and right contacts of cam 107, ring brushes of selectors 102 and 103, ring trunk conductor 205, lower left winding of repeating coil 203, outer lower back contacts of relay 202, right back contacts of relay 201, to ground through the right winding of relay 200.

The stepping relay of the sender and relay 200 now operate and since calls to the weather bureau are handled by the sender in the same manner as calls to a terminating office having a call indicator and the control sequence switch of the sender has therefore been set in response to the registration of the office code to control the sender to transmit call indicator code impulses in accordance with the numerical registration set up in the sender, the sender is now prepared to transmit such impulses. Relay 200 upon operating establishes a circuit from ground over its front contacts, the right back contacts of relay 206, the right contacts of interrupter 207, as soon as the cam of the interrupter closes such contacts, winding of relay 208, through resistance 209 to battery. Relay 208 thereupon operates, locks over its middle lower front contact and the upper back contacts of relay 210 to ground; over its lower front contacts connects conductor 211 extending to a peg count meter over the outer left back contacts of relay 206 and the outer left back contacts of relay 201 to ground to operate the peg count meter; at its inner upper front contacts, closes a start circuit over the inner upper normal

contacts of key 212, to battery through the winding of start relay 213 of the common distributing circuit and at its inner lower front contacts prepares a circuit for relay 201. After an interval sufficient to permit the sender to make the usual trunk guard test, interrupter 207 closes its left contacts, thereby completing the circuit of relay 201, which may be traced from ground over the back contacts of relay 210, middle lower front contacts of relay 208, left contacts of interrupter 207, inner lower front contacts of relay 208, inner left normal contacts of relay 206, through the winding of relay 201 to battery. Relay 201 now operates, locks in a circuit from battery through its winding, the inner left normal contacts of relay 206, the outer right contacts of relay 201, to ground over the middle upper front contacts of relay 208; at its outer left back contacts opens the circuit of the peg count meter; at its inner back contacts disconnects the windings of relay 200 from the tip and ring conductors 204 and 205 of the trunk and connects these conductors over its inner front contacts to a dry bridge including the windings of polarized relay 214 and resistance 215.

Relay 200 now releases without affecting the circuits previously established and the stepping relay of the sender also releases to start the impulsive of the sender to transmit relay call indicator impulses which are absorbed by the dry bridge including the windings of polarized relay 214. When the sender transmits the final heavy positive impulse relay 214 responds thereto closing a circuit from ground over its front contacts to battery through the left winding of relay 206 which thereupon operates, locks over its right winding and inner right front contacts to ground at the middle upper front contacts of relay 208, and at its inner left transfer contacts transfers the locking ground for relay 201 from the middle upper front contacts of relay 208 to the front contacts of relay 214. Upon the termination of the heavy positive impulse, relay 214 releases whereupon relay 201 releases to disconnect the winding of relay 214 from the trunk conductors and to reconnect the windings of relay 200 thereto. Following the sending of the relay call indicator impulses, the sender is advanced to the talking selection position in turn advancing the district selector sequence switch to the talking position and itself being disconnected from the established connection and restored to normal condition.

With the sequence switch of the district selector in the talking position and relay 201 released a circuit is established from battery through the left winding of relay 200, thence as traced over trunk conductor 204 and the tip brushes of selector switches 103 and 102, upper contacts of cam 105, upper right winding of repeating coil 108, winding of polarized supervisory relay 109, lower right winding of repeating coil 108, lower contacts of cam 107, thence as traced to ground through the right winding of relay 200. Relay 200 now reoperates but the current does not flow in the proper direction through the winding of polarized relay 109 to cause its operation at this time. Relay 200 upon operating establishes a circuit from ground over its contacts, the middle right front contacts of relay 206, to battery through the upper winding of relay 210, which in turn operates, locks over its lower winding and lower front contacts to ground at the outer right front contacts of relay 206; at its upper back contacts opens the holding circuit of relay 208,

and at its upper front contacts closes a new holding circuit for relay 208, whereby relay 208 is now held operated by the operating ground supplied for relay 210 over the contacts of relay 200. Relay 208, being slow to release, does not release during this transfer of its holding ground.

Relay 206, upon operating, also establishes a ringing tone circuit which may be traced from the source of ringing current 218, over the lower back contacts of relay 219, the outer left front contacts of relay 206, the inner lower back contacts of relay 202, thence through the right windings of repeating coil 203, over the next to outer upper back contacts of relay 202, to ground at the upper back contacts of relay 219, whereby ringing tone is transmitted inductively to the trunk circuit, through the right windings of repeating coil 108 at the district selector, and then inductively over the calling line loop as a signal that a connection has been completed from the calling line to an idle announcement trunk.

Since the trunk circuit is a two-wire circuit, it is necessary to lock up the circuit locally while the call indicator impulses are being received and absorbed. This is accomplished through the operation of relay 208 as previously described. In order that the trunk may be released if the call should not progress in a normal manner, with relay 208 operated a circuit is established upon the operation of relay 201 and prior to the operation of relay 214 as soon as the interrupter 216 makes its right contact, which may be traced from ground at the left contacts of relay 214, outer left contacts of relay 201, right contact of interrupter 216, upper contacts of relay 208 to battery through the winding of relay 217. Relay 217 thereupon operates, locks over its lower contacts to ground at the middle upper contacts of relay 208, and prepares at its upper contacts a short circuit for releasing relay 208. After approximately five seconds, during which interval all call indicator impulses should have been received and absorbed, if relay 201 has not released a circuit is established from ground at the left contacts of relay 214, over the outer left contacts of relay 201, left contact of interrupter 216, upper front contacts of relay 217 to a point between resistance 209 and the winding of relay 208, whereby the winding of relay 208 is shunted and relay 208 releases to wipe out the call.

When the start relay 213 of the distributing circuit operates upon the seizure of the trunk of Fig. 2 as previously described or upon the seizure of other similar trunks it prepares a circuit extending from ground over its lower contacts, the lower normal contacts of key 212, conductor 220 to the outer right front contacts of relay 707 for a purpose to be later described and over its upper front contacts establishes a circuit extending from battery through the winding of relay 221, upper contacts of relay 213, upper normal contacts of key 212, conductor 222, to ground at the right back contacts of alarm relay 1100, if there is an announcing machine in service at the central bureau ready to transmit announcements. Relay 221, upon operating, establishes over its upper front contacts and the lower back contacts of relay 223 circuits in parallel through a plurality of relays, such as 224, which in turn cause the operation of a plurality of relays such as 225, each serving ten trunks. As many relays, such as 225, are provided as are necessary to serve all of the announcement trunks. At its middle front contacts relay 221 also establishes a circuit extending over the upper back contacts of relay

223, through the winding of slow-to-release relay 226, which at its upper front contacts establishes the operating circuit for slow-to-release relay 227, which in turn at its upper front contacts establishes the operating circuit of slow-to-release relay 228. Relays 226, 227 and 228 thus operate in cascade upon the operation of relay 221.

Relay 225, upon operating, closes a circuit from battery over its lower contacts, through resistance 230, winding and inner upper normal contacts of cut-through relay 202, next to upper back contacts of relay 219, middle right front contacts of relay 206, to ground at the front contacts of relay 200 and relay 202 thereupon operates, locks over its inner upper alternate contacts to ground at the outer right front contacts of relay 206; connects a substitute operating battery to its operating circuit over its lower front contacts; disconnects the tone source 218 and ground from the trunk conductors at its inner lower and upper back contacts; at its upper and middle lower contacts reverses the connection of battery and ground through the windings of relay 200 to the trunk conductors 204 and 205 for operating the polarized relay 109 at the district selector for supervisory purposes and for controlling the charging for the call; at its inner upper and inner lower front contacts connects the right winding of repeating coil 203 to conductors 231 and 232 of the common trunk circuit extending into the central bureau control circuit, and at its next to lower front contacts prepares the circuit of relay 219. Relay 225 and similar relays also establish similar operating circuits for the cut-through relays of other trunks which are in a call awaiting condition.

At its inner front contacts relay 221 also prepares a circuit extending from ground thereover, through the contacts of interrupter 229, which close at approximately one minute intervals, to battery through the winding of relay 223, which with relay 220 operated, locks over its lower front contacts to ground at the lower front contacts of relay 228. At its lower back contacts relay 223 opens the operating circuits of all relays 224, which thereupon release, and in turn release all relays 225. Relays 225 upon releasing open the initial operating circuits of all trunk cut-through relays such as 202. At its upper back contacts, relay 223 opens the operating circuit of relay 226, which releases and opens the circuit of relay 227, which in turn opens the circuit of relay 228. Thus, after an interval following the operation of relay 223, as determined by their slow-to-release characteristics, relays 226, 227 and 228 become released. Relay 223 upon releasing opens the locking circuit of relay 223. With relay 223 still operated, over the contacts of interrupter 229, and relays 226 and 227 released, but before relay 223 releases, a circuit is closed from ground at the middle contacts of relay 221, upper front contacts of relay 223, back contacts of relays 226 and 227, upper front contacts of relay 228, through the winding of relay 233 and in parallel through the windings of other similar relays, which in turn close obvious circuits for a plurality of relays such as 234, each serving ten trunks. As many relays 234 are provided as are necessary to serve all of the announcement trunks. Relay 234 and similarly operated relays upon operating establish operating circuits for relays 219 of all trunks which at the time have their cut-through relays 202 operated for transmitting announcements. The circuit of relay 219 may be

traced from ground at the lower contacts of relay 234, next to lower front contacts of relay 202, inner lower normal contacts and winding of relay 219, to battery. Relay 219 now operates, locking over its inner lower transfer contacts to ground at the outer right contacts of relay 206; further opening the circuit over which the ringing tone current was applied at its upper and lower outermost contacts; opening at its next to upper back contacts a second point in the initial operating circuit of relay 202; preparing at its inner upper front contacts a circuit to be later described over which relay 202 is to be shunted down and at its next to inner upper and lower front contacts closing a by-pass around contacts of relay 202, whereby the right windings of repeating coil 203 are connected to the conductors 231 and 232 of the trunk extending to the control circuit of the central bureau.

As soon as the contacts of interrupter 229 open, relay 223 releases and recloses at its upper back contacts the operating circuit of relay 226 previously traced. After a short interval of approximately 1.6 seconds, interrupter 229 again closes its contacts, whereupon relay 223 reoperates. With relays 223 and 226 now both operated, a circuit is closed from ground over the middle contacts of relay 221, upper front contacts of relay 223, lower front contacts of relay 226 to battery through the winding of relay 235, and the windings of other parallelly connected relays, in turn operating relay 236 and similar relays. Each relay 236 serves ten announcement trunks and as many such relays are provided as are necessary to serve all of such trunks. Relay 236, upon operating, closes a circuit from ground over its lowermost contacts, the inner upper front contacts of relay 219, to a point between resistance 230 and the winding of cut-through relay 202, thereby shunting down relay 202, which thereupon releases and restores the normal battery and ground connections to the trunk conductors 204 and 205, thereby releasing the polarized relay 109 at the district selector 102 of the originating office. The announcement continues to be transmitted to the calling line over contacts of relay 219 until the calling subscriber hangs up or if he does not do so at once, until the district selector is automatically timed out and is released by the timing circuit associated therewith. When the calling subscriber hangs up or the district selector is timed out and the district selector 102 and office selector 103 are released, relay 200 releases, in turn releasing relay 206, whereby the locking circuits of relays 208, 210, 217 and 219 are opened and these relays release restoring the trunk circuit to normal. Relay 208 upon releasing opens the circuit of relay 213 which releases unless other announcement trunks are in a calling condition.

#### *Initial recording of machines*

Before proceeding with a discussion of the manner in which announcements are transmitted automatically to the lines of calling subscribers, it will be assumed that the announcement machines must be prepared for service. Each machine, such as 300 of Fig. 3, is provided with two pairs of pole-pieces 305 and 306 between which the steel tape 304 is traversed in the direction indicated by the arrow, the pole-pieces 305 being magnetizable by a pair of serially connected coils 307 which serve both as recording and reproducing coils and by a pair of serially connected biasing coils 308, and the pole-pieces 306 being mag-

netizable by a pair of serially connected erasing coils 309 which are also connected in series with the biasing coils 308. The speech input to the coils 307 during recording, when relay 319 is operated, and the speech output during reproduction, when relay 319 is unoperated, are impressed through transformer 310 upon the input coils of amplifying tubes 311 and 312 connected in push-pull relationship, the outputs of which are impressed upon the double electrode amplifying tube 313, the output circuit of which is connected through the output transformer 314 to the output conductors 315 and 316 and to the automatic volume control tube 317. Operating current for the tubes is supplied from a source of commercial alternating current and rectified by the rectifier tube 318. The circuit is also provided with a relay 319 which is operable when a new recording is required and with a relay 320 which is operable when it is necessary to erase a previous recording.

It will be assumed that it is necessary to initially prepare machines for service at which time there is no machine connected to the load. The monitoring operator will first depress erase key 802 located on her turret and, with no machine connected to the load and therefore with relays 1001, 1002, 1003 unoperated, a circuit will be closed from ground serially over the No. 3 back contacts of these relays, conductor 1009, No. 5 left back contacts of relay 905, conductor 803, upper contacts of erase key 802, conductor 804, to a point between the right winding of relay 903 and resistance 1325 to prevent the operation of relay 903 and thereby making the Nos. 1 and 2 machines 300 and 330 the choice for recording. Erase key 802 also establishes a circuit from ground over its upper middle contacts, conductor 805, outer left back contacts of relay 1205, through winding of relay 1206 to battery; establishes a circuit from ground over its inner upper contacts, conductor 806 through the winding of relay 1115; establishes a circuit over its inner lower contacts, conductor 807, inner left back contacts of relay 1205, through the winding of recording relay 1207 and at its lower contacts prepares erasing circuits for the erasing relay 320 of the No. 1 machine and the similar relay of the No. 2 machine 330.

Relay 1206 upon operating locks over its inner left front contacts and conductor 718 to ground at the outer right back contacts of release relay 1101 and closes a circuit extending from ground over its inner right front contacts and conductor 1208 through the winding of relay 1116 for a purpose to be later described. Relay 1207 upon operating establishes circuits for relays 901, 902 and 903, the circuit of relay 901 extending from battery, over the upper normal contacts of jack 400, conductor 403, No. 7 back contacts of relay 1311, resistance 1316, conductor 1314, right winding of relay 901, conductor 912 to ground at the middle left front contacts of relay 1207; the circuit of relay 902 extending from battery over the upper normal contacts of jack 401, conductor 404, No. 7 back contacts of relay 1312, resistance 1317, conductor 1326, right winding of relay 902, conductor 913 to ground at the inner left front contacts of relay 1207, and the circuit of relay 903 extending from battery over the upper normal contacts of jack 402, conductor 405, No. 7 back contacts of relay 1313 through resistance 1325, conductor 1327, right winding of relay 903, conductor 914 to ground at the outer right contacts of relay 1207. Relays 901 and 902 now operate but relay

903 does not since its winding is shunted by ground applied from key 802 over conductor 804.

Relay 901 upon operating locks over its No. 1 left contacts and conductor 904 to ground at the back contacts of relay 1200; establishes a circuit from ground over its No. 3 left contacts, conductor 915, the No. 2 back contacts of relay 1311, conductor 302 through the winding of start relay 301 of the No. 1 machine 300 for starting the motor 303 thereof; establishes a circuit from ground over the outer left contacts of relay 1207, conductor 1209, the No. 4 left contacts of relay 901, conductor 916 through the winding of relay 1321 and resistance 1328 to battery; closes a circuit from ground over its No. 6 left contacts, conductor 917 to battery through recording lamp 831 on the operator's turret and over conductor 1334 of cable 1307 to battery through recording lamp 1351 on the maintenance panel individual to the No. 1 machine to indicate that such machine is to be recorded and closes a circuit from ground over the lower contacts of erase key 802, conductor 308, over its No. 2 right contacts, conductor 918 to battery through the winding of erase magnet 320 of the No. 1 machine 300. With relay 320 operated a circuit is established from ground over the inner upper front contacts of relay 320, through biasing coils 308 and erasing coils 309, resistance 323, the direct current output circuit of rectifier tube 318, through resistance 324, lower front contacts of relay 320 to ground whereby the pole-pieces 306 are magnetized and since the machine is running the record on its tape 304 is erased.

Relay 902 upon operating locks over its No. 1 left contacts and conductor 904 to ground at the back contacts of relay 1200; establishes a circuit from ground over its No. 4 right contacts, conductor 919, No. 2 back contacts of relay 1312, conductor 322 and winding of the start relay of the No. 2 machine, corresponding to relay 301, for starting the motor thereof; establishes a circuit from ground over the inner right front contacts of relay 1207, conductor 1209, No. 6 left contacts of relay 902, conductor 920, winding of relay 1322 through resistance 1330 to battery; closes a circuit from ground over its No. 4 left contacts, conductor 921, to battery through recording lamp 832 on the turret and over conductor 1335 of cable 1307 to battery through recording lamp 1352 on the maintenance panel individual to the No. 2 machine to indicate that such machine is to be recorded; closes a circuit from ground over its No. 2 left contacts and conductor 1214 through the winding of relay 1213 to battery thereby operating relay 1213 but without effect at this time, and closes a circuit from ground over the lower contacts of erase key 802, conductor 808, No. 3 right contacts of relay 902, conductor 922 to battery through the erase relay of the No. 2 machine 330 corresponding to relay 320. In the same manner as previously described in connection with machine 300 the record on the tape of the No. 2 machine is erased.

It will be recalled that relays 1321 and 1322 were operated upon the operation of relays 901 and 902. These relays now lock in circuits, established over their inner left front contacts, the right back contacts of relays 1361 and 1362 to ground at the No. 1 back contacts of relays 1311 and 1312 and over their outer left contacts connect ground over conductor 1336 to hold relay 1206 operated until monitoring on machines 300 and 330 is completed.

The operator holds the erase key 802 operated for a long enough interval to insure the removal of the entire previous records from the tapes of the machines and then releases it thereby releasing relay 1207 and the erasing relays, such as 320, of the machines and then operates the recording key 809 and connects her recording transmitter circuit 406 with the recording jack 407 thereby operating relay 500 over a circuit extending to ground at the upper contacts of jack 407. With the key 809 operated a circuit is established from ground over its upper alternate contacts, conductor 810, No. 5 left contacts of relay 901, conductor 923 to battery through the winding of recording relay 319 of the No. 1 machine 300 and from conductor 810 over the No. 5 left contacts of relay 902, conductor 924 to battery through the winding of the recording relay of the No. 2 machine corresponding to relay 319. The operator now repeats into the recording transmitter the information which she desires to record which, it is assumed, is the latest weather report received from the United States Weather Bureau. Current for her recording transmitter is supplied from ground through the right winding of battery feed coil 501, in parallel through the left windings of repeating coil 502, over conductor 503, tips of jack 407 and plug 408 through transmitter circuit 406, rings of plug 408 and jack 407, conductor 504 to battery through the left winding of battery feed coil 501. The speech current generated in the left winding of coil 502 is impressed on the input circuits of the two announcing machines in a circuit extending from the upper terminal of the right winding of repeating coil 502, upper front contacts of relay 500, conductor 505, No. 2 contact of relay 319, through resistance 325, No. 3 contact of relay 319, through the primary windings of input transformer 310, returning over conductor 506, lower front contacts of relay 500, through the right winding of repeating coil 502. A similar input circuit is established to the No. 2 machine 330. The speech input is impressed on the input circuits of tubes 311 and 312 and is amplified thereby and by tube 313 and impressed upon the primary winding of output transformer 314, the secondary winding of which is at this time connected through the windings of recording coils 307, over the No. 1 and No. 5 front contacts of recording relay 319. The coils 307 being thus energized by the amplified speech current, the pole-pieces 305 magnetize the tape 304 in accordance therewith. The tape of the No. 2 machine 330 is similarly recorded. When the operator has made the complete announcement, recording key 809 is released thereby releasing recording relay 319 and the similar relay of the No. 2 machine 330.

#### 60 *Monitoring on newly recorded machines*

After a recording has been made the machines cannot be put into service until the operator has monitored on each one to check the text and the volume level. To monitor the operator inserts the plugs 409 and 410 of her headset receiver circuit 411 into the monitoring jacks 412 and 413 and first operates the monitoring key 817 individual to the No. 1 machine. With key 817 operated a circuit is now established from battery over the alternate contacts of jack 412, conductor 414, upper contacts of key 817, conductor 812, No. 7 back contacts of relay 653, No. 6 back contacts of relay 652, winding of relay 651, conductor 654, No. 5 back contacts of relay

769 over conductor 752 to ground in the No. 2 speech level indicator 700. Since this indicator is identical with the No. 1 speech level indicator shown in Fig. 14, the further discussion of the monitoring functions will be described in connection with the indicator of Fig. 14. Referring to Fig. 14 it will be noted that the ground supplied to conductor 1452, corresponding to conductor 752, is supplied over the No. 6 back contacts of relay 1430. Relay 651 upon operating establishes a circuit from ground at the right back contacts of start relay 1301, over conductor 1337, No. 5 contacts of relay 651, conductor 608, No. 2 back contacts of relay 769, conductor 753 to battery through a relay corresponding to relay 1454; opens at its No. 7 contacts the operating circuit for relay 652; opens at its No. 6 contacts the operating circuit for relay 653; connects the junction point between relay 1321 and resistance 1328 over conductor 1338 and its No. 3 contacts, conductor 609 and the No. 1 back contacts of relay 769 to conductor 755, corresponding to conductor 1455, and at its Nos. 1 and 2 contacts connects the output circuit of the No. 1 machine to conductors 615 and 616.

With the No. 1 machine 300 now running and relays 319 and 320 thereof both unoperated the coils 307 are now connected in a circuit extending through the lower left winding of input transformer 310 and the No. 1 back contacts of relay 319 and the circuit through coils 308 and 309 is open at the front contacts of relay 320. In the well-known manner the passage of the tape between the pole-pieces 305 causes the production of speech current through the coils 307 which through the right winding of transformer 310 is impressed upon the input circuits of amplifier tubes 311 and 312, is amplified thereby, and is impressed upon the input circuits of tube 313. Tube 313 further amplifies the current and impresses it upon the left winding of output transformer 314 which, in turn, impresses it upon the input circuit of amplifier tube 601 individual to the No. 1 machine and located in the control circuit, over a circuit which extends from the upper terminal of the right winding of transformer 314, over the outer back contacts of relay 319, conductor 315, inner right back contacts of relay 611, left normal contacts of input testing jack 621 through the input circuit of amplifier 601, outer right normal contacts of jack 621, outer right back contacts of relay 611, conductor 316 to the lower terminal of the right winding of transformer 314. The amplifier 601 further amplifies the speech current and impresses it upon the monitoring operator's headset circuit over a circuit extending over the left normal contacts of output testing jack 631, outer left back contacts of relay 641, conductor 604, No. 1 contacts of operated relay 651, conductor 615, right back contacts of relay 507, conductor 415, upper normal contacts of recording key 809, conductor 417, rings of jack 412 and plug 409 through the operator's headset circuit 411, rings of plug 410 and jack 413, conductor 416, padding resistance 508, left back contacts of relay 507, conductor 616, No. 2 contacts of relay 651, conductor 605, inner left back contacts of relay 641, right normal contacts of jack 631, back to the output circuit of amplifier 601. A padding resistance 509 is also bridged across conductors 415 and 416. The monitoring operator is thus enabled to check the accuracy of the record which she had previously recorded on the tape of the No. 1 machine. The speech current is further

impressed over conductors 615 and 616, the Nos. 3 and 4 back contacts of relay 769 upon conductors 756 and 757 extending to the No. 2 speech level indicator corresponding to conductors 1456 and 1457 of the No. 1 speech level indicator.

Prior to the use of the speech level indicators for service they must first be carefully calibrated. This, referring to Fig. 14, is accomplished by inserting a plug connected to a standard 1000-cycle 1-milliwatt source of power into the testing jack 1407 thereby operating relay 1404 to disconnect the input windings of transformer 1405 from conductors 1402 and 1403 extending to the associated control circuit and to connect these windings over its front contacts and the inner upper normal contacts of key 1408 through the right windings of repeating coil 1409. Relay 1404 at its inner upper front contacts also establishes an obvious circuit for test relay 1400 which also operates. The start key 1410 is also operated to its neutral or start position thereby closing a circuit from battery through resistance 1411, left alternate and right normal contacts of key 1410, potentiometer 1412 to ground and to ground through the resistance network comprising resistances 1413, 1414, 1415 and 1416 and the filaments of tubes 1406, 1417 and 1418. After about thirty seconds or a sufficient interval to permit the filaments to become heated the key 1410 is operated to the right thereby connecting the filament circuit over its right alternate contacts through the normal contacts of jack 1419 to battery through the ballast lamp 1420. A milliammeter plugged into jack 1419 should now indicate a filament current between .49 and .53 ampere.

With the tubes 1406, 1417 and 1418 energized the key 1408 is operated to the left thereby removing the upper right winding of repeating coil 1409 from the circuit previously traced through the left winding of transformer 1405; connecting the lower winding thereof into such circuit and shunting resistance 1421 from the bridge normally including resistances 1421 and 1422 around the left windings of repeating coil 1409. Test key 1423 is then operated and with relay 1400 operated the circuit of relay 1424 is established from battery through its right winding, inner left contacts of key 1423 to ground at the No. 1 contacts of relay 1400. The circuit of relay 1425 is established from battery through its winding, the outer left contacts of key 1423 to ground at the No. 5 contacts of relay 1400. Relay 1424 prepares at its right front contacts the operating circuit of relay 1426. Relay 1425 upon operating establishes the circuit of relay 1433 from battery through its winding, outer right contacts of key 1423, upper normal contacts of relay 1432 to ground at the outer right contacts of relay 1425. Relay 1433 upon operating establishes over its inner front contacts and the No. 3 front contacts of relay 1400 a circuit for lighting low volume test lamp 1434.

The current from the test source impressed by the transformer 1405 upon the input circuit of the full wave rectifier tube 1406 is applied to the control grid of the direct current amplifier pentode 1417, the output circuit of which is connected to the input circuit of the trigger tube 1418. Condenser 1427 is normally charged from battery 1428 through a ballast lamp resistance and resistance 1429. Potentiometer 1412 is then adjusted until tube 1418 just breaks down and completes a discharge circuit for condenser 1427 extending from ground over the cathode-anode cir-

cuit of tube 1418, right contacts of relay 1424, No. 2 back contacts of relay 1430, lower winding of relay 1426, through condenser 1427 to ground. Relay 1426 operates in this circuit and locks in a circuit from battery through its upper winding and front contacts to ground applied to conductor 1431 over the inner left alternate contacts of relay 1425 and the inner right contacts of key 1423 and extends its locking ground to the winding of relay 1430 which operates in turn establishing a circuit from battery through the winding of relay 1432 over the No. 3 contacts of relay 1430 to ground on conductor 1431. Relay 1430 also opens the discharge circuit of tube 1418 thereby extinguishing it. With relay 1432 operated, relay 1433 is released thereby extinguishing the test lamp 1434. If necessary, the tap on the right winding of transformer 1405 may be adjusted to bring about the desired operation. After the adjustments have been made they may be checked by releasing key 1423 to reset the circuit, operating key 1408 to the right and reoperating key 1423. Upon the reoperation of key 1423, relays 1424, 1425 and 1433 reoperate as previously described and lamp 1434 will be relighted. With key 1408 operated to the right, both right windings of repeating coil 1409 are included in the input circuit of transformer 1405 and resistance 1421 is again shunted. After the reoperation of key 1423 tube 1418 should again fire reoperating relays 1426, 1430 and 1432 and releasing relay 1433 to extinguish lamp 1434 as previously described. With keys 1408 and 1423 still operated, the potentiometer 1412 is now readjusted until the tube 1408 is intermittently fired as indicated by the flashing of high volume test lamp 1435, the circuit of which is controlled as follows: condenser 1436 which is normally charged from battery 1428 through the ballast lamp resistance and resistance 1437 discharges in a circuit from ground over the cathode-anode circuit of tube 1418 when the tube fires, right contacts of relay 1424, lower contacts of relay 1432, inner lower back contacts of relay 1438 through the lower winding of relay 1439 and condenser 1436 to ground. Relay 1439 operates in this circuit, locks from battery through its upper winding and front contacts over the normally closed contacts of relay 1440 to ground on conductor 1431 and extends its locking ground through the winding of relay 1438 to battery. Relay 1438 now operates opening at its inner lower back contacts the discharge circuit of tube 1418 which is thereby extinguished, closes at its upper front contacts a circuit extending from ground thereon and over the No. 4 front contacts of relay 1400 to battery through lamp 1435 to light the lamp and at its upper back contacts opens the normally established circuit of slow-to-release relay 1440. After an interval relay 1440 releases in turn releasing relays 1439 and 1438, relay 1438 opening the circuit of lamp 1435 to extinguish it and again closing the discharge circuit of tube 1418. When tube 1418 again fires the lamp 1435 is again lighted and then extinguished. Following the adjustment of potentiometer 1412 so that lamp 1435 flashes as just described, the test plug is removed from jack 1407, releasing relays 1404 and 1400, test key 1423 is released and key 1408 is restored to its neutral position. Relays 1424, 1425 and 1433 now release in turn releasing relays 1426, 1430, 1432, 1438 and 1439 if operated and reoperating relay 1440. The speech level indicator is now calibrated and reconnected by the release of relay 1404 to conductors 1402 and 1403 extending



to the control circuit. The No. 2 speech level indicator is similarly calibrated.

It has been assumed that the speech level indicator 700 has been seized for monitoring on the No. 1 machine by the operation of a relay corresponding to relay 1454. Considering the circuit of Fig. 14, when this relay operates the input speech conductors 1456 and 1457 are connected over its upper contacts through padding resistances to input conductors 1402 and 1403 whereby the output of the No. 1 machine being monitored is impressed over back contacts of relay 1404, through the input transformer 1405 upon the input circuit of tube 1406. Relay 1454 also at its inner lower front contacts establishes an obvious circuit for relay 1441 which operates and at its lower front contacts establishes a circuit extending over the No. 2 back contacts of relay 1400 to battery through the winding of relay 1401. Relay 1401 being operated connects ground over its lower front contacts and the inner lower front contact of relay 1441 to the armature springs of interrupter 1459. Approximately every ten seconds the armatures of this interrupter close their left contacts. On the first engagement of armature 1459 thereof with its left contact following the operation of relay 1401 a circuit is established from battery over the inner upper front contacts of relay 1441, No. 3 back contacts of relay 1400, resistance 1444, winding and inner upper normal contacts of relay 1445, lower front contacts of relay 1441, interrupter contacts 1459, thence to ground as traced over the lower front contacts of relay 1401. Relay 1445 upon operating locks over its inner upper alternate contacts to ground at the upper front contacts of relay 1401. Upon the closure of its left contact by interrupter armature 1460, a circuit is established from battery through the right winding of relay 1424, No. 7 back contacts of relay 1400, upper front contacts of relay 1441, left contact closed by interrupter armature 1460 to ground as traced at the lower front contacts of relay 1401 and relay 1424 operates and locks in a circuit from battery through its left winding and inner left front contacts over the inner left normal contacts of relay 1425 to ground over the inner upper front contacts of relay 1401.

When the announcement from the No. 1 machine which is being monitored is received over conductors 1402 and 1403 as previously described it is amplified by tube 1406 which also acts as a buffer so that any modulation products resulting from the amplification of the speech by the diodes of tube 1406 do not interfere with the announcement. The potential from the full wave rectifier tube 1406 is supplied to the network N comprising resistances R, R', R<sup>2</sup>, R<sup>3</sup>, and R<sup>4</sup> and condensers C, C', C<sup>2</sup> and C<sup>3</sup> which modifies the potential so that the potential fluctuates exactly as would the pointer of a dial type volume indicator. This fluctuation potential is applied to the control grid of the direct current amplifier pentode 1417 which acts as a voltage amplifier. The trigger tube 1418 indicates any volume in excess of the minimum load of the system by breaking down. Condenser 1427 was previously charged from battery 1428 through the ballast lamp and resistance 1429. When tube 1418 breaks down it completes the discharge circuit for condenser 1427 as previously traced through the lower winding of relay 1426 and relay 1426 operates, locks over its upper winding and contacts, conductor 1431, outer left front contacts of relay 1426 to ground at the inner lower front contacts of relay 1401; closes the

operating circuit of relay 1430 which in turn closes the circuit of relay 1432 from ground on conductor 1431 over its No. 3 front contacts to battery through the winding of relay 1432 and at its No. 2 back contacts opens the operating circuit of relay 1426 and the cathode-anode circuit through tube 1418 thereby extinguishing the tube. At its No. 7 contacts relay 1430 connects ground to conductor 1455 corresponding to conductor 755. It will be recalled that conductor 755 was connected by the operation of relay 651 over conductor 1338 to a point between the winding of relay 1321 and resistance 1328 and therefore the winding of relay 1321 is now shunted and relay 1321 releases.

It may be noted that the cathode of tube 1417 is connected to conductor 1450 while the control grid is normally connected over the No. 4 back contacts of relay 1430 to a point between resistances R1 and R2 so that the input circuit of the tube is connected across resistances R and R1. Following the operation of relay 1430 the connection of the grid is transferred to the point between resistances R and R1 so that the input circuit is then connected across resistance R. This change in the connection of the control grid reduces the fluctuating potential supplied thereto by approximately six decibels. The operation of relay 1432 opens the circuit of relay 1433 and connects the anode of tube 1418 over the right contacts of relay 1424, the lower front contacts of relay 1432, the inner lower back contacts of relay 1438 through the lower winding of relay 1439 to resistance 1437 and condenser 1436. Condenser 1436 is charged at this time by battery 1428 through resistance 1437. If now the volume of speech is such as to be in excess of six decibels higher than the low critical volume, trigger tube 1418 again breaks down thus causing the operation of relay 1439 by closing the previously discharge circuit for condenser 1436. Relay 1439 upon operating locks over the normally closed contacts of relay 1440 to ground on conductor 1431 and establishes the operating circuit of relay 1438. Relay 1438 upon operating opens the operating path of relay 1439 thereby extinguishing tube 1418, opens the operating circuit of slow-to-release relay 1440 and closes a circuit from ground over its upper contacts and the No. 4 back contacts of relay 1400, conductor 1451 corresponding to conductor 751, thence over the No. 3 back contacts of relay 717, right front contacts of relay 726 which operated in a circuit through its winding over conductor 727, the lower contacts of monitoring key 817 and conductor 815 to ground at the upper alternate contacts of jack 413, following the operation of monitoring key 817, thence over conductor 814 to battery through the high volume lamp 800 on the operator's turret as a signal that the speech level is too high. After an interval, relay 1440 releases in turn releasing relays 1439 and 1438 and upon the release of relay 1438 relay 1440 again operates. When interrupter armature 1460 now closes its right contact approximately ten seconds following the operation of relay 1424, the circuit of relay 1425 is established from battery through its winding, the No. 6 contacts of relay 1400, the middle lower front contacts of relay 1441, the left contact closed by armature 1460 of the interrupter thence as traced to ground at the lower contacts of relay 1401 and upon operating relay 1425 opens the locking circuit of relay 1424 which now releases. If the speech level was too low and tube 1418 did not

fire as previously described and therefore relays 1426, 1430 and 1332 did not operate prior to the operation of relay 1425 then relay 1425 upon operating establishes a circuit from ground over its outer right contacts, over the upper normal contacts of relay 1432, lower front contacts of relay 1445 to battery through the winding of relay 1433 which thereupon operates, locks over its upper front contacts to ground at the inner lower front contacts of relay 1445 and at its inner front contacts establishes a circuit over the No. 8 back contacts of relay 1400, conductor 1461, corresponding to conductor 761 of the speech level indicator 700, No. 5 back contacts of relay 717, left front contacts of relay 726, conductor 816 to battery through the low volume lamp 801 on the operator's turret to indicate that the speech level is too low or that there is no output from the No. 1 machine.

The operator may then monitor the No. 2 machine by releasing key 817 thereby releasing relays 651 and 726 and then operating monitoring key 818. With key 818 operated and relay 651 released a circuit is established for relay 652 which may be traced from battery over the alternate contacts of jack 412, conductor 414, the upper contacts of key 818, conductor 319, No. 6 back contacts of relay 653, No. 7 back contacts of relay 651, winding of relay 652, conductor 655, No. 6 back contacts of relay 769, conductor 762, corresponding to conductor 1462 thence as traced to ground in the speech level indicator as soon as the relay thereof corresponding to relay 1430 is in an unoperated condition. Relay 652 upon operating locks to ground over its No. 4 contacts; opens at its Nos. 6 and 7 contacts the operating circuits of relays 651 and 653 to prevent their operation; connects ground from the right back contacts of relay 1302 over conductor 1339 and its No. 5 contacts to conductor 608 and thence as traced to battery through the winding of a relay of speech level indicator 700 corresponding to relay 1454; at its No. 3 contacts prepares a shunting circuit over conductor 1340 for relay 1322 and at its Nos. 1 and 2 contacts connects the output circuit of the No. 2 machine to the operator's head set circuit 411 and to the input circuit of the speech level indicator 700 over conductors 615 and 616. The circuit from the output transformer of the No. 2 machine 330, corresponding to transformer 314 is connected over conductor 345, inner right back contacts of relay 612, left normal contacts of input testing jack 622 through the input circuit of amplifier 602, outer right normal contacts of jack 622, outer right back contacts of relay 612 to conductor 346. The amplifier 602 further amplifies the speech current and impresses it upon conductors 615 and 616 over a circuit extending over the left normal contacts of output testing jack 632, the outer left back contacts of relay 642, conductor 606, No. 1 contacts of relay 652, to conductor 615 and returning over conductor 616 through the No. 2 contacts of relay 652, conductor 607, inner left back contacts of relay 642, right normal contacts of jack 632 back to the output circuit of amplifier 602. The operator may now check the text of the announcement and the speech level indicator 700 will check the announcement as previously described for its speech volume level. If the speech level is too high, lamp 800 will now operate and if the volume is too low or there is no output lamp 801 will light. If the volume is high enough ground received from the speech level indicator over con-

ductor 755, the No. 1 back contacts of relay 769 and conductor 609 will shunt down relay 1322. Upon the release of monitoring key 818, relays 652 and 726 release. If either of the machines fails to transmit speech or either transmit speech at too low a level, the monitoring operator will operate the erase key 802 to remove the records from the machine, will then operate recording key 809 to rerecord the machines and will then monitor on the machines as previously described.

When both machines have been properly recorded, the operator will remove plugs 408, 409 and 410 from the recording jack 407 and the monitoring jacks 412 and 413, thereby releasing operated relay 500. At this time both relays 1321 and 1322 will be shunted down and until this occurs the two machines cannot be cut into service. Assuming that both machines have been correctly recorded as indicated by the fact that the volume level indicating lamps 800 and 801 have not lighted, the operator then proceeds to cut them into service by the operation of the cut-in key 820 on her turret. Upon the operation of key 820 a circuit is established from battery through the winding of relay 1235, conductor 1210, contacts of key 820, conductor 824, right back contacts of relay 1323 and 1322 to ground at the right back contacts of relay 1321 and relay 1205 operates, locks over its inner right front contacts, conductor 1211 to ground at the left front contacts of relay 1110 which operated as previously described; opens at its inner left back contacts the operating circuit of recording relay 1207; opens at its outer left back contacts the operating circuit of relay 1206; closes at its left front contacts a holding ground for operated relays 901 and 902 to replace the holding ground supplied over the back contacts of relay 1200 following the subsequent operation of relay 1200 and at its middle right front contacts establishes a circuit from ground over the outer right front contacts of relay 1206, over conductor 1136 to battery through the winding of release relay 1101. Relay 1101 now operates opening one holding circuit for relay 1206 and, since the second holding circuit over conductor 1336 was opened by the release of relays 1321 and 1322, relay 1206 releases after an interval, opens the circuit of relay 1110 which releases in turn opening the locking circuit of relay 1205 which also releases if the non-locking cut-through key 820 has been released. After relay 1206 releases but before relay 1205 releases, a momentary circuit is established for slow-to-release relay 1200 from battery through its winding, the right back contacts of relay 1206 to ground at the outer right front contacts of relay 1205. Relay 1206 upon releasing also opens the circuit of release relay 1101 which releases.

During the time that relay 1200 is operated and while relay 1205 is still operated to hold relays 901 and 902 operated, a circuit is established from ground over its front contacts, conductor 1212, the No. 1 right front contacts of relay 902, the No. 4 right front contacts of relay 901, the No. 4 left back contacts of relay 911, conductor 925 to battery through the right winding of relay 1001 and in parallel therewith from conductor 925 over the No. 3 left back contacts of relay 905, conductor 926 to battery through the right winding of relay 1012. Relay 1001 is individual to the No. 1 machine 300 and upon operating is locked over its left winding and No. 4 contacts, conductor 1004 to ground at the inner left back contacts of relay 1101 and relay 1012

which is individual to the No. 2 machine 330 is locked over its left winding and No. 4 contacts, conductor 1014 to ground at the inner right back contacts of relay 1101. Relay 1205 has in the meantime released before relay 1200 has released and consequently the locking circuit of relays 901 and 902 have been opened and these relays release. With relay 1001 operated, the circuit of start relay 1301 individual to the No. 1 machine is operated over a circuit extending from battery through its winding, conductor 1304, No. 6 contacts of relay 1001, conductor 1005, the No. 2 back contacts of transfer relay 703, conductor 704 to ground at the right back contacts of relay 1201 and relay 301 of the No. 1 machine is operated over a circuit extending from battery through its winding, conductor 302, No. 2 back contacts of relay 1311 to ground at the outer left front contacts of relay 1301. With start relay 1301 operated a shunting ground is connected over its inner left front contacts to conductor 1314 between the right winding of relay 901 and resistance 1316 in the operating circuit of relay 901, previously traced to prevent a subsequent operation of relay 901. Relay 1001 also closes the circuit of in-service lamp 1331 on the maintenance panel and the in-service lamp 611 on the operator's turret over a circuit extending from ground at the right back contacts of relay 707, No. 1 back contacts of relay 703, conductor 1122, No. 7 front contacts of relay 1001, conductor 1306 to battery through lamp 1331 and in parallel over cable 1307 to battery through lamp 611 and these lamps light as an indication that the No. 1 announcing machine is in service.

*Transmission of announcements to subscriber's line*

With the No. 1 machine running and relays 319 and 320 of its circuit both unoperated, the speech output therefrom is impressed upon the input circuit of amplifier 601 in the manner previously described. The amplifier 601 further amplifies the speech current and impresses it upon the right windings of the repeating coil of the announcement trunk shown in Fig. 2 and the coils of other announcement trunks which have been cut through, over a circuit extending from the left normal contacts of output testing jack 631, the outer left back contacts of relay 641, conductor 604, No. 1 contacts of operated relay 1001, conductor 1006, No. 3 back contacts of transfer relay 703, through padding resistance 705, No. 2 back contacts of relay 706, No. 2 back contacts of relay 707, conductor 708, normal contacts of jack 709, conductor 231, middle upper front contacts of relay 202 through the right windings of repeating coil 203, inner lower front contacts of relay 202, padding resistance 238, conductor 232, normal contacts of jack 709, conductor 710, No. 1 back contacts of relay 707, No. 1 back contacts of relay 706, padding resistance 711, No. 5 back contacts of transfer relay 703, conductor 1007, No. 2 front contacts of relay 1001, conductor 605, inner left back contacts of relay 641, right normal contacts of jack 631, back to the output circuit of amplifier 601. The speech current is further impressed by the repeating coil 203 and the repeating coil 108 upon the calling line. The calling subscriber therefore hears the announcement. While the cut-through of his line may have occurred at such a time that he hears only a later portion of the announcement, his line will remain cut through as previously described for a sufficient period to enable

him to hear one or more complete announcements.

The padding resistances 237 and 238 are provided in each announcement trunk to prevent cross-talk between the several announcement trunks whose outgoing ends are multiplied to the common trunk conductors 231 and 232 to prevent a calling subscriber from interfering with the transmission of announcements should he attempt to talk. During the transmission over the circuit previously traced, the padding resistance 712 is bridged across the output speech channel over the No. 1 back contacts of relay 713.

During the transmission from the announcing machine 300, conductor 708 of the speech output channel is also connected over the inner right back contacts of relay 1102 and the No. 3 back contacts of relay 701, conductor 1402, upper back contacts of relay 1404 through the input transformer 1405 of the speech level indicator of Fig. 14, lower back contacts of relay 1404, conductor 1403, No. 4 back contacts of relay 701 to conductor 710 whereby the speech output is impressed through the right windings of transformer 1405 upon the input circuit of tube 1406.

Whenever the speech level indicator circuit is connected to the control circuit by reason of relay 701 being unoperated, the circuit of relay 1401 is established from ground over the No. 6 normal contacts of relay 1103, No. 5 back contacts of relay 1101, conductor 702, No. 2 back contacts of relay 1400 to battery through the winding of relay 1401. Relay 1401 being operated connects ground over its lower front contacts and the inner lower back contacts of relay 1441 to the armatures of interrupter 1442. Approximately every 30 seconds the armatures of the interrupter make their left contacts. On the first engagement of armature 1443 with its left contact following the operation of relay 1401, a circuit is established from battery at the No. 4 contacts of relay 1103 over conductor 1104, right back contacts of relay 714, conductor 715, inner upper back contacts of relay 1441, No. 3 back contacts of relay 1409, resistance 1444, winding and inner upper normal contacts of relay 1445, lower back contacts of relay 1441, left contact closed by interrupter armature 1443, thence to ground as traced over the lower front contacts of relay 1401. Relay 1445 upon operating locks over its inner upper alternate contacts to ground over the upper front contacts of relay 1401. Upon the closure of its left contact by interrupter armature 1446 a circuit is established from battery through the right winding of relay 1424, No. 7 back contacts of relay 1400, upper back contacts of relay 1441, left contact closed by interrupter armature 1446, to ground as traced at the lower front contacts of relay 1401 and relay 1424 operates and locks in a circuit from battery through its left winding and inner left front contacts, over the inner left normal contacts of relay 1425 to ground at the inner upper front contacts of relay 1401. Upon the closure of its left contact by interrupter armature 1447, a circuit is established from battery over the lower back contacts of relay 1438, winding of relay 1448, middle upper back contacts of relay 1441, contact closed by interrupter armature 1447, thence as traced to ground at the lower front contacts of relay 1401. Relay 1438 operates and locks over its upper front contacts to ground at the upper front contacts of relay 1401.

When the next announcement is received from

the control circuit over conductors 1402 and 1403 as previously described, it is amplified by tube 1406 and the fluctuating potential impressed upon the network N is impressed upon the input circuit of tube 1417 which acts as a potential amplifier and applies its output upon the trigger tube 1418. The trigger tube 1418 indicates any speech volume in excess of the minimum level of the system by breaking down. Condenser 1427 was previously charged from battery 1428 through the ballast lamp and resistance 1429. When tube 1418 breaks down it completes the discharge circuit for condenser 1437 as previously traced through the lower winding of relay 1426 and relay 1426 operates, locks over its upper winding and contacts, conductor 1431; outer left contacts of relay 1424 to ground at the inner lower front contacts of relay 1401; closes the operating circuit of relay 1430 which in turn closes the circuit of relay 1432 from ground on conductor 1431 over its No. 3 front contacts to battery through the winding of relay 1432 and at its No. 2 back contacts opens the operating circuit of relay 1426 and the cathode-anode circuit through tube 1418 thereby extinguishing the tube. As previously described relay 1430 upon operating also changes the connection of the control grid of tube 1417 to the network N thereby reducing the fluctuating potential supplied thereto by approximately six decibels.

The operation of relay 1432 opens the circuit of relay 1433 and connects the anode of tube 1418 over the right contacts of relay 1424, the lower front contacts of relay 1432, the inner lower back contacts of relay 1438 through the lower winding of relay 1439 to resistance 1437 and condenser 1436. Condenser 1436 is charged by battery 1428 through resistance 1437. If now the volume of speech is such as to be in excess of six decibels higher than the low critical volume, the trigger tube 1418 again breaks down thus causing the operation of relay 1439 by closing the previously traced discharge path for condenser 1436. Relay 1439 upon operating locks over the normally closed contacts of relay 1440 to ground on conductor 1431 and establishes the operating circuit of relay 1438. Relay 1438 upon operating opens the operating circuit of relay 1439 thereby extinguishing tube 1418, opens the operating circuit of slow-to-release relay 1440 and opens the initial operating circuit for relay 1448. At its upper front contacts relay 1438 prepares the circuit for the high volume lamp 800 on the operator's turret but this circuit is not effective during machine announcements. After an interval, relay 1440 releases in turn releasing relays 1439 and 1438 and upon the release of relay 1438, relay 1424 again operates. With the circuit reset, it will again test for a too high speech level until relay 1424 releases due to the opening of its locking circuit at the inner left normal contacts of relay 1425 when relay 1425 operates approximately 30 seconds following the operation of relay 1424 by the closure of the right contact of interrupter armature 1446. The circuit of relay 1425 may be traced from battery through its winding, the No. 6 back contacts of relay 1409, the middle lower back contacts of relay 1441, the right contact of armature 1446, the inner lower back contacts of relay 1441, to ground at the lower contacts of relay 1401. If during machine announcements relay 1438 does not operate indicating that the volume is not too high, relay 1448 will remain operated and relay 1425 upon operating will establish a circuit from ground at its outer left contacts, lower contacts of relay 1448, upper normal

contacts of test jack 1407, conductor 716, left back contacts of relay 714 to battery through the winding of relay 713 which will thereupon operate, lock over its right front contacts and the No. 3 back contacts of relay 706 and conductor 718 to ground at the outer right back contacts of relay 1101 and at its left contacts remove the padding resistances 705, 711 and 712 from the input circuit to the speech level indicator. This raises the speech level of the system by two decibels.

If the volume of the announcement is now sufficiently high and tube 1418 fires to operate relays 1426, 1430 and 1432, the operation of relay 1430 connects a shunting ground over its No. 1 contacts to a point between the winding of relay 1445 and resistance 1444 thereby shunting down relay 1445 which opens one point in the automatic transfer control lead 719 which otherwise would have been closed upon the operation of relay 1425. If, however, the volume of the announcement is not now sufficiently high to break down tube 1418, relays 1426, 1430 and 1432 will not operate and under this condition when relay 1425 operates with relay 1445 still operated ground is connected to lead 719 at the inner right front contacts of relay 1425 thereby completing a circuit from ground on lead 719 over the No. 2 back contacts of relay 701 and the No. 1 normal contacts and winding of relay 1105 to battery. Relay 1105 operates, locking over its No. 1 alternate contacts to ground over the normal contacts of trouble release key 1106; prepares at its No. 4 contacts the operating circuit for relay 1100; prepares at its No. 3 contacts the circuit of relay 1107; closes at its No. 2 contacts a circuit from ground over the inner lower alternate contacts of alarm release key 1108 on the maintenance panel to battery through minor alarm lamp 1109; closes at its No. 5 contacts a circuit from ground over the inner right back contacts of relay 1110 and the inner upper alternate contacts of key 1108 to battery through alarm relay 1111 which operates and closes an obvious circuit for alarm bell 1112; at its No. 7 contacts closes an obvious circuit for relay 1115; at its No. 6 contacts establishes a circuit extending from ground thereover, through the No. 7 back contacts of relay 1103, left back contacts of relay 1107, conductor 1120, No. 6 back contacts of relay 703, conductor 1121, No. 8 front contacts of relay 1001, assumed to be operated, conductor 1008, winding of relay 1311 to battery and at its No. 8 contacts establishes a circuit from ground over conductor 1113, winding of relay 706, conductor 1114 to battery at the right back contacts of relay 1107.

Relay 706 operates, locks over its No. 5 contacts, conductor 1116, back contacts of relay 1117 to ground at the left back contacts of relay 1110; at its outer right front contacts connects ground over conductor 1118 to the armature of interrupter 1119 and to the locking contact of relay 1103; at its outer left back contacts opens the locking circuit of relay 713, and at its Nos. 1 and 2 back contacts opens the input circuit to the speech level indicator. Relay 713 thereupon releases to restore the two decibel pad. As soon as interrupter 1119 closes its right contact, ground on conductor 1118 is supplied to the winding of relay 1103 which thereupon operates and locks to ground on conductor 1118; at its No. 6 contacts removes ground from lead 702 to prevent the speech level indicator from operating by releasing relay 1401 thereof; at its No. 7 contacts opens the previously traced operating circuit for relay

1311; at its No. 2 contacts connects ground to conductor 1005 for holding start relay 1301 operated following the subsequent operation of transfer relay 703; at its No. 5 contacts prepares the operating circuit of relay 1117 and at its No. 1 contacts closes an obvious circuit for slow-to-release relay 1123 which operates.

Relay 1123 upon operating, with relay 1012 operated as previously assumed, closes a circuit from ground at its left contacts over conductor 1124, No. 5 contacts of relay 1012, conductor 1015 through the winding of start relay 1302 individual to the No. 2 announcing machine. At its right contacts relay 1123 closes a circuit extending from ground over the outer right back contacts of relay 1119 to battery through the winding of relay 1127 which operates, locks over its inner left contacts to ground at the normal contacts of alarm release key 1128 on the chief operator's desk, at its right contacts closes the circuit of minor alarm lamp 1129 on the chief operator's desk and at its outer left contacts closes the circuit of buzzer 1130 to indicate to the chief operator that one of the machines has been removed from service. When relay 1311 operated as previously described following the operation of relay 1105, it locked over its No. 5 contacts and conductor 1300 to ground at the outer left front contacts of relay 1115; connected ground over its No. 1 front contacts to conductor 1309 which is connected through out-of-order lamp 1341 on the maintenance panel to battery and over the cable 1307 to battery through out-of-order lamp 821 on the operator's turret to indicate that the No. 1 machine is being removed from service; opens at its No. 2 contacts the circuit of start relay 301 of the No. 1 machine previously traced to stop that machine; opens at its No. 6 back contacts the locking circuit of relay 901; opens at its No. 7 back contacts the initial operating circuit of relay 901; closes at its No. 4 contacts an obvious operating circuit for relay 1361 and at its No. 7 front contacts prepares an operating circuit for relay 907. Relay 1361 upon operating establishes a circuit from ground over its inner left front contact, conductor 1310, winding of relay 905, conductor 906 through resistance 1202 to battery and relay 905 thereupon operates and establishes an operating circuit for relay 907 extending from ground over the No. 3 left contacts of relay 902, No. 1 left contacts of relay 905 through the left winding of relay 907 and resistance 908 to battery. Relay 907 locks in a circuit from ground over the back contacts of relay 909, inner right front contacts and right winding of relay 907, conductor 910, No. 7 front contacts of relay 1311 to battery on conductor 403; establishes a locking circuit for relay 905 from battery on conductor 906 through the winding and No. 1 right contacts of relay 905 to ground at the outer right front contacts of relay 907 and at its middle right front contacts prepares the locking circuit for relay 911.

Relay 1302 upon operating connects ground over its outer left front contacts and the No. 2 back contacts of relay 1312 to conductor 322 extending to the No. 2 machine 330 for operating its start relay, corresponding to relay 301, and at its inner left front contacts establishes a shunting ground between the operating winding of relay 502 and resistance 1317 in the operating circuit of relay 902 to prevent a subsequent operation of this relay.

After an interval of approximately five seconds or sufficient to permit the No. 2 machine to at-

tain its reproducing speed, interrupter 1119 closes its left contact thereby completing a circuit there-over from ground on conductor 1118, No. 5 contacts of relay 1103, winding of relay 1117 to battery. Relay 1117 now operates opening the locking circuit of relay 706; closing a circuit from ground at the left back contacts of relay 1110, over its right front contacts and conductor 1125 to battery through the windings of transfer relays 703 and 717 in parallel and completing the circuit of relay 1107 from battery over its left contacts, winding of relay 1107 to ground at the No. 3 contacts of relay 1105 whereupon relay 1107 operates, locks to battery over its inner right front contacts under the control of relay 1105; opens the operating circuit of relay 706 at its right back contacts whereupon relay 706 releases and at its outer left front contacts further prepares the circuit of relay 1100. When relay 706 releases it reestablishes the speech transmission circuit over its contacts and opens the locking circuit of relay 1103 which thereupon releases and in turn releases relays 1117 and 1123. Relay 1123 upon releasing opens the circuit of start relay 1302, but being slow to release, this circuit is not opened until after transfer relay 703 has operated and closed an alternative circuit over its No. 2 front contact to ground on conductor 704.

Transfer relay 703 upon operating locks itself and transfer relay 717 over its No. 4 contacts to ground at the outer left back contacts of relay 1101; disconnects at its No. 3 and No. 5 back contacts the previously traced output circuit extending from the No. 1 machine and at its No. 3 and No. 5 front contacts extends the output circuit from the No. 2 machine to the trunk conductors 231 and 232 to be presently traced; opens at its No. 2 back contacts the circuit of start relay 1301 which thereupon releases and at its outer left front contacts opens a second point in the circuit of start relay 301 of the No. 1 machine; at its No. 2 front contacts establishes the alternative operating circuit of start relay 1302 previously traced; at its No. 1 back contacts opens the previously traced circuit of in-service lamps 1331 and 811 which are thereupon extinguished and closes a circuit from ground at the No. 6 back contacts of relay 707, over the No. 1 front contacts of relay 703, conductor 1126, the No. 3 contacts of relay 1012, conductor 1016, through in-service lamp 1332 on the maintenance panel and over the cable 1307 through the in-service lamp 812 on the operator's turret individual to the No. 2 machine to indicate that the No. 2 machine has been placed in service. Transfer relay 717 upon operating closes an obvious circuit for transfer relays 769 and 701 whereby relays 717, 769 and 701 transfer control conductors of the control circuit from the No. 1 speech level indicator circuit of Fig. 14 to the No. 2 speech level indicator 700 indicated by the box in the upper part of Fig. 7 and transfer other control conductors of the control circuit from the No. 2 speech level indicator 700 to the No. 1 speech level indicator of Fig. 14.

With transfer relay 703 operated, the secondary winding of the output transformer of the No. 2 machine 330 corresponding to transformer 314 is connected over conductor 345, the inner right back contacts of relay 612, left normal contacts of input testing jack 622 through the input circuit of amplifier 602, outer right normal contacts of jack 622, outer right back contacts of relay 612 to conductor 346. The amplifier 602 further amplifies the speech current and impresses it up-

on the right winding of the repeating coil of the announcement trunk shown in Fig. 2 and the coils of other announcement trunks which have been cut through, over a circuit extending over the left normal contacts of output testing jack 632, the outer left back contacts of relay 642, conductor 606, No. 1 contacts of relay 1012, conductor 1017, No. 3 front contacts of relay 703, padding resistance 705, No. 2 back contacts of relay 706, No. 2 back contacts of relay 707, conductor 708, normal contacts of jack 709, conductor 231, middle upper front contacts of relay 202 through the right winding of repeating coil 203, inner lower front contacts of relay 202, padding resistance 238, conductor 232, normal contacts of jack 709, conductor 710, No. 1 back contacts of relay 707, No. 1 back contacts of relay 706, padding resistance 711, No. 5 front contacts of relay 703, conductor 1018, No. 2 contacts of relay 1012, conductor 607, inner left back contacts of relay 642, right normal contacts of jack 632, back to the output circuit of amplifier 602. As previously described, the speech output is further impressed by repeating coil 203 upon the calling line. During the transmission from the announcing machine 330, conductor 708 of the speech output channel is also connected over the inner right back contacts of relay 1102, and the No. 3 front contacts of relay 701, conductor 720, through the input transformer of the speech level indicator 709, corresponding to transformer 1405, conductor 721, No. 4 front contacts of relay 701 to conductor 710 whereby the speech level output is checked for the proper volume level in the manner previously described. The call waiting relay of the volume level indicator corresponding to relay 1401 being now operated in a circuit therefrom over conductor 722, the No. 5 front contacts of relay 701, thence as traced to ground at the No. 6 normal contacts of relay 1103.

Should there be a failure of the output or the output from the No. 2 machine be too low, the speech level indicator will detect it in the manner previously described and will first connect ground to conductor 723 thereby completing a circuit over the left front contacts of relay 714, which operated in an obvious circuit over the No. 6 contacts of relay 701 upon the operation of relay 701, thence to battery through the winding of relay 713 thereby operating relay 713 to remove the padding resistances 705, 711 and 712. Relay 713 locks as before described under the control of relay 706. If the volume is still low the speech level indicator will thereafter connect ground to conductor 724 completing a circuit over the No. 2 front contacts of relay 701, the No. 4 contacts of relay 1105, the outer left front contacts of relay 1107 to battery through the winding of slow-to-operate relay 1100 whereupon relay 1100 will operate and lock over its No. 3 contacts to ground at the contacts of trouble release key 1106. Relay 1100 at its No. 2 contacts removes ground from conductor 222 extending to the distributor circuit of Fig. 2 to release relay 221 for preventing the cut-through of further announcement trunks until a new machine is conditioned for service; at its No. 1 contacts establishes a circuit extending from ground over the upper alternate contacts of alarm release key 1108 to battery through the winding of major alarm relay 1130 which operates to intermittently close the circuit of tone-bar alarm 1131 through the contacts of interrupter 1132 as an indication that the spare machine has failed and closes a circuit from ground at the outer left back

contacts of relay 1102 over its No. 6 contacts, conductor 1133 to battery through the winding of relay 1600 to signal the auxiliary control circuit of a distant area that no announcement trunks therein should be cut through. Since relay 1100 is slow to operate, before it has time to operate, its operating ground is connected over its No. 5 back contacts through the left normal contacts and winding of relay 1134 to battery causing relay 1134 to operate and lock over its left alternate contacts to ground at the contacts of alarm release key 1128 at the supervisor's desk; to close at its right inner contacts another circuit for the buzzer alarm 1130 and to close over its outer right contacts the circuit of major alarm lamp 1135 on the supervisor's desk as a signal that the spare machine has failed. The operating ground for relay 1100 is also connected over its No. 4 back contacts, the inner left front contacts of relay 1107, conductor 1120, the No. 6 front contacts of transfer relay 703, conductor 1019, the No. 6 contacts of relay 1012, conductor 1318 to battery through the winding of relay 1312.

Relay 1312 operates, locks over its No. 5 contacts and conductor 1319 to ground at the inner left front contacts of relay 1115; connects ground at its No. 1 front contacts to conductor 1320 which is connected through the out-of-order lamp 1342 on the maintenance panel to battery and over the cable 1307 to battery through the out-of-order lamp 822 on the operator's turret to indicate that the No. 2 machine is being removed from service; opens at its No. 2 contacts the circuit of start relay of the No. 2 machine to stop that machine; opens at its No. 6 back contacts the locking circuit of relay 902; opens at its No. 7 back contacts the initial operating circuit for relay 902; closes at its No. 4 contacts an obvious operating circuit for relay 1362 and at its No. 7 front contacts connects battery from the upper normal contacts of jack 403 over conductor 404 and conductor 910 into the locking circuit of relay 907. Relay 1362 upon operating connects ground over its inner right front contacts to conductor 1310 in parallel with the similar circuit previously established by the operation of relay 1361 and establishes a circuit from ground over its inner left front contacts, the outer left front contacts of relay 1361 which was operated when the No. 1 machine was removed from service, conductor 1324, winding of relay 1201, conductor 1204 to battery at the outer right back contact of relay 1102. Relay 1201 thereupon operates, removing ground at its right back contacts from conductor 704 to release start relay 1302 which permits the selection of the No. 2 machine for a new recording and opens the circuit of relay 911 to insure the cut-in of the machine as the load machine, as hereinafter described.

Upon hearing the buzzer 1130 and noting the lighted minor alarm lamp 1129 the chief operator may silence the buzzer and extinguish the lamp by momentarily operating release key 1128 which releases relay 1127. Upon hearing buzzer 1130 and noting the lighted major alarm lamp 1135, indicating that the spare machine has failed, the chief operator may release relay 1134 to silence the buzzer and extinguish lamp 1135 by momentarily operating key 1128.

The maintenance man may silence the alarms 1112 and 1131 and extinguish the alarm lamp 1109 by opening key 1108 whereupon lamp 1137 is lighted until the trouble has been rectified and the key 1108 has been restored. If one of the machines is found to be defective and has been

removed from service as indicated by the out-of-order lamp of that machine, such as lamp 1341 or 1342 located on the maintenance panel, being lighted, the maintenance man will operate the corresponding make-busy key 1351 or 1352 thereby establishing a holding circuit for operated relay 1311 or 1312. The holding circuit for relay 1311 extends, for example, from ground at the outer left back contacts of relay 1301 through the contacts of key 1371 to battery through the winding of relay 1311. After having made the defective machine busy the trouble release key 1106 is then operated, thereby releasing the alarm control relays 1100, 1105, 1107 and 1115. When relay 1115 releases, the locking circuit of the operated relay 1311 or 1312 is opened but this relay is maintained operated if the corresponding make-busy key 1371 or 1372 has been previously operated.

#### *Recording a new announcement*

It was previously assumed that the No. 1 machine was placed in service and that the No. 2 machine was placed on spare service by the operation of relays 901, 902, 1001 and 1012. It will now be assumed that while the No. 1 machine was in service a new weather bulletin is received from the Weather Bureau. A signal that a new bulletin is to be transmitted by teletype from the Weather Bureau operates relay 1141 on the chief operator's desk, which relay locks under the control of release key 1128, closes the circuit of buzzer 1130 and closes the circuit of teletype signal lamp 1142. The monitoring operator who is not ordinarily at the monitoring turret upon receiving this bulletin, for example, by teletype connection with the Weather Bureau, proceeds to the turret and first operates the erase key 802. With this key operated, relays 1206, 1115 and 1207 are operated as previously described. Relay 1207 upon operating now establishes the previously traced operating circuits for relays 901, 902 and 903 and relays 902 and 903 operate and lock but since start relay 1301 is at this time operated, the right winding of relay 901 is shunted in a circuit extending from ground over the inner left front contacts of relay 1301, conductor 1314, right winding of relay 901, conductor 912 to ground at the middle left front contacts of relay 1207. Relay 901 does not, therefore, operate. Relay 1206 upon operating establishes a previously traced circuit for relay 1110 which at this time removes ground at its left back contacts from the operating circuit of transfer relays 703 and 717 to prevent their operation to remove the No. 1 machine from the load at this time; at its inner right contacts transfers the alarm control circuit controlled by the No. 5 contacts of relay 1105 from the minor alarm relay 1111 to the major alarm relay 1130 so that should the control circuit be signaled by the No. 1 speech level indicator of Fig. 14 that the output of the No. 1 machine is too low or has failed, a major alarm will be indicated at the maintenance panel, and at its outer right contacts transfers the alarm control circuit controlled by relay 1123 from the minor alarm relay 1127 to the major alarm relay 1134 to indicate a major alarm at the supervisor's position should there be a machine failure.

Relay 902 upon operating establishes a previously traced circuit over conductor 322 for starting the No. 2 machine, establishes the previously traced circuits for relay 1322, for recording lamps 832 and 1352 which light to indicate

that the No. 2 machine is being recorded, for relay 1213 and for the erasing relay of the No. 2 machine, corresponding to relay 320. Relay 903 upon operating establishes a circuit from ground over its No. 4 right contacts, conductor 1344, No. 2 back contacts of relay 1313, conductor 342, to the start relay of the No. 3 machine corresponding to relay 301 for starting the motor thereof; establishes a circuit from ground over the next-to-outer right front contacts of relay 1207, conductor 1215, No. 4 left contacts of relay 903, conductor 927 through the winding of relay 1323 and resistance 1345 to battery thereby operating relay 1323; closes a circuit from ground over its No. 3 left contacts and conductor 928 to battery through recording lamp 833 on the turret and over conductor 1346 of cable 1307 through recording lamp 1353 on the maintenance panel individual to the No. 3 machine to indicate that that machine is being recorded and closes a circuit from ground over the lower contacts of erase key 802, conductor 808, No. 3 right contacts of relay 903, conductor 929 to battery through the erase relay of the No. 3 machine 350 corresponding to relay 320. In the manner previously described the records on the Nos. 2 and 3 machines are now erased.

Relays 1322 and 1323 are now both operated, relay 1322 locking as previously described to ground at the No. 1 back contacts of relay 1312 and relay 1323 locking over its inner left front contacts and the right back contacts of relay 1303 to ground at the No. 1 back contacts of relay 1313 and both connect ground over their outer left front contacts to conductor 1336 to provide an additional holding circuit for relay 1206 until monitoring on the machines has been completed. After the erase key has been operated for a sufficient interval to insure that the complete records on the tapes of the machines have been erased it is released thereby releasing relay 1207 which releases the erasing relays of the machines. The operator now operates the recording key 809 and plugs her recording transmitter into recording jack 407. With key 809 operated the previously traced circuit for the recording relay of the No. 2 machine is established over the No. 5 left contacts of relay 902 and a similar circuit for the recording relay of the No. 3 machine is established from ground over conductor 310, over the No. 5 left contacts of relay 903 and conductor 930. The operator now repeats the newly received bulletin into her recording transmitter circuit 406 whereby in the manner previously described new records are placed on the tapes of the Nos. 2 and 3 machines. After the recording is finished she then restores key 809 thereby releasing the recording relays of the machines. The operator, noting that the recording lamp 832 of the No. 2 machine is lighted, then proceeds to monitor on this machine by first plugging her headset circuit 411 into the monitoring jacks 412 and 413 and then operating the monitoring key 818 individual to the No. 2 machine. As previously described, relay 652 is now operated to connect the output circuit of the No. 2 machine to her headset circuit and, since at this time the transfer relays 717 and 769 are not operated, to connect the output circuit of the No. 2 machine to the No. 2 speech level indicator. The operation of key 818 also operates relay 726 as previously described. If the speech level is found to be too high the high level lamp 800 on the turret will be lighted or if the level is found to be too low or there is no output, 75

the low level lamp 801 will be lighted as previously described. If the output is present and not too low, relay 1322 will be shunted down as previously described. The operator will then release key 818 thereby releasing relays 652 and 726.

After having monitored on the No. 2 machine and noting that the No. 3 machine has been re-recorded, as indicated by the lighted recording lamp 833 individual to the No. 3 machine, the operator will depress the monitoring key 825 on her turret individual to the No. 3 machine. The operation of key 825 reoperates relay 726 and establishes an operating circuit for relay 653 which may be traced from battery over the alternate contacts of jack 412, conductor 414, upper contacts of key 825, conductor 826, No. 6 back contacts of relay 651, No. 7 back contacts of relay 652 through the winding of relay 653, conductor 656, No. 4 back contacts of relay 769, conductor 763 corresponding to conductor 1463 to ground in the speech level indicator 700 as soon as the relay thereof corresponding to relay 1430 becomes released. Relay 653 upon operating locks to ground over its No. 4 contacts; opens at its Nos. 6 and 7 contacts the operating circuits of relays 651 and 652 to prevent them from operating; connects ground from the right back contacts of relay 1303 over conductor 1347 and its No. 5 contacts to conductor 608 and thence as traced through the winding of the relay of speech level indicator 700 corresponding to relay 1454; at its No. 3 contacts prepares a shunting circuit over conductor 1348 for relay 1323 and at its Nos. 1 and 2 contacts connects the output circuit of the No. 3 machine to the operator's headset circuit 411 and to the input circuit of the speech level indicator 700 over conductors 615 and 616. The circuit from the output transformer of the No. 3 machine 350 corresponding to transformer 314 may be traced from conductor 355, inner right back contacts of relay 613, left normal contacts of input testing jack 623 through the input circuit of amplifier 603, outer right normal contacts of jack 623, outer right back contacts of relay 612 to conductor 355. The amplifier 603 further amplifies the speech current and impresses it upon conductors 615 and 616 over the left normal contacts of output testing jack 633, the outer left back contacts of relay 643, conductor 617, No. 1 contacts of relay 653 to conductor 615 and returning over conductor 616, the No. 2 contacts of relay 653, conductor 618, inner left back contacts of relay 643, right normal contacts of jack 633, back to the output circuit of amplifier 603.

The speech level indicator now functions in the manner previously described to test the speech level of the No. 3 machine. If the level is too high, high level lamp 800 on the turret will light or if there is no speech output or the output level is too low, lamp 801 will light as previously described. If there is an output which is not too low the previously traced circuit for shunting down relay 1323 will be established and relay 1323 will thereupon release.

It will be assumed that the machines are found to have been properly recorded as indicated by the fact that neither lamp 800 nor 801 lights. The operator will thereupon release the monitoring key 825 thereby releasing relays 653 and 726 and will disconnect her headset circuit 411 from the monitoring jacks 412 and 413 and will then disconnect her recording transmitter 406 from the recording jack 407 thereby releasing relay 500. The operator now operates the cut-in key 820 to cut the No. 2 machine into service and

to place the No. 3 machine on spare service and to remove the No. 1 machine from service and place it in reserve. As previously described, upon the operation of key 820, relay 1205 is operated thereby releasing relay 1207, closing an alternative locking circuit for relays 902 and 903 and establishing the circuit of relay 1101. Relay 1101 now operates, releasing relays 1001 and 1012 and opening one holding circuit for relay 1206 and, since the second holding circuit of relay 1206 over conductor 1336 was opened by the release of relays 1322 and 1323, relay 1206 releases after an interval, opens the circuit of relay 1110 which releases in turn opening the locking circuit of relay 1205 which also releases if the cut-in key 820 has been released. After relay 1206 releases but before relay 1205 releases, a momentary circuit is established for relay 1200 which operates. Relay 1200 upon releasing opens the circuit of in-service lamps 811 and 1331 and releases relay 1301 which in turn releases the start relay 301 of the No. 1 machine to stop it. Relay 1206 also opens the circuit of relay 1101 which releases. During the time that relay 1200 is operated and while relay 1205 is holding relays 902 and 903 operated, a circuit is closed from ground over its front contacts, conductor 1212, the No. 1 right contacts of relay 903, the No. 2 right contacts of relay 902, the No. 3 back contacts of relay 911 over conductor 931 to battery through the right winding of relay 1013. Relay 1002 individual to the No. 2 machine 330 and relay 1013 upon operating lock over their left windings and No. 4 contacts and conductors 1004 and 1014 respectively to back contacts of relay 1101. Relay 1205 has in the meantime released before relay 1200 releases and consequently the locking circuits of relays 902 and 903 are opened and these relays release to open the previously traced start circuits for the Nos. 2 and 3 machines.

With relay 1002 operated the previously traced circuit of start relay 1302 is closed which in turn closes the circuit for restarting the No. 2 machine and closes the previously traced circuit over conductor 1326 for shunting the winding of relay 902 to prevent a subsequent operation thereof. Relay 1002 also closes the circuit of in-service lamp 1332 on the maintenance panel and the circuit of in-service lamp 812 on the operator's turret which light to indicate that the No. 2 machine is in service. With relay 1002 operated the speech output circuit from the No. 2 machine previously traced is extended from conductors 606 and 607 over its Nos. 1 and 2 contacts to conductors 1006 and 1007 whereby the output of the machine is applied as previously described to calling subscribers' lines and to the No. 1 speech level indicator of Fig. 14. Relay 1013 upon operating connects the speech output circuit from the No. 3 machine previously traced to conductors 617 and 618, over its Nos. 1 and 2 contacts to conductors 1017 and 1018 whereby the No. 3 machine is held in readiness as a spare for giving service should the No. 2 machine fail.

If while the No. 2 machine is in service and the No. 3 machine is on spare service a further new bulletin is received the operator may proceed to rerecord the tapes of the Nos. 1 and 3 machines in the manner previously described by plugging her recording transmitter 406 into recording jack 407, operating erase key 802 for



an interval sufficient to insure the removal of the previous record on the tapes of such machines and then by operating the recording key 809. When key 802 is operated relays 1206, 1115 and 1207 operate as previously described and relay 1207 upon operating now establishes the previously traced operating circuits for relays 901, 902 and 903. Relays 901 and 903 operate but since the No. 2 machine is now in service and start relay 1302 thereof is operated the operating winding of relay 902 is shunted and relay 902 cannot operate. Relay 1206 upon operating causes the operation of relay 1110 for the purpose previously described.

With relays 901 and 903 operated, the previously traced circuits for starting the Nos. 1 and 3 machines are closed, the circuits for the erase relays of these machines are closed whereby the previous records on the tapes thereof are erased and the circuits for recording lamps 831 and 833 on the turret and for lamps 1351 and 1353 on the maintenance panel are lighted to indicate that these machines are being recorded. When the erase key 802 is released, relay 1207 releases thereby opening the circuits for the erase relays of the machines. When recording key 809 is operated, the previously traced circuits for the recording relays of the Nos. 1 and 3 machines are closed and the new information is recorded on their tapes when the operator repeats the information into her recording transmitter. After the recording has been completed, the operator monitors on the Nos. 1 and 3 machines as previously described by connecting her headset circuit 411 to the monitoring jacks 412 and 413 and by first operating monitoring key 817 to monitor on the No. 1 machine and then by operating monitoring key 825 to monitor on the No. 3 machine. When the monitoring has been completed and the new records have been found to be satisfactory as indicated by the failure of either lamp 800 or 801 to light, the cut-in of the newly recorded machines may be accomplished by the operation of cut-in key 820, since at this time relays 1321 and 1323 will have been released by the No. 2 speech level indicator 700 as previously described. When key 820 is operated, relays 1205, 1206, 1200 and 1101 function as previously described to release relays 1110, 1002 and 1013, to stop the No. 2 machine, to extinguish the in-service lamps 812 and 1332, to establish operating circuits for relays 1003 and 1011 and to thereafter release relays 901 and 903. While relay 1200 is still operated and before relay 1205 releases to release relays 901 and 903, the circuit for operating relays 1003 and 1011 may be traced from ground at the front contacts of relay 1200, over conductor 1212, the No. 3 right contacts of relay 901, the No. 2 right contacts of relay 903, the No. 4 back contacts of relay 911, conductor 933, to battery through the right winding of relay 1003 and in parallel from conductor 933 over the No. 5 back contacts of relay 905 and conductor 934 to battery through the right winding of relay 1011. Relays 1003 and 1011 thereupon operate and lock over their left windings and No. 4 contacts to ground on conductors 1004 and 1014, respectively, following the release of relay 1101. Relay 1003 upon operating closes the circuit of start relay 1303, extending from ground on conductor 1005 over the No. 6 contacts of relay 1003 and conductor 1349 to battery through the winding of relay 1303 which in turn closes the previously traced start circuit of the No. 3 machine and closes a

shunt over conductor 1327 for the operating winding of relay 903 to prevent its subsequent operation. Relay 1003 also closes the circuit of in-service lamps 813 and 1333 which may be traced from ground on conductor 1122 over the No. 7 contacts of relay 1003, conductor 1350, through in-service lamp 1333 to battery and over cable 1307 to battery through in-service lamp 813, these lamps being lighted indicating that the No. 3 machine is now in service. At its Nos. 1 and 2 contacts, relay 1003 extends the speech output circuit from the No. 3 machine previously traced, from conductors 617 and 618 to conductors 1006 and 1007 whereby the output of the machine is applied to the calling subscribers' lines and to the No. 1 speech level indicator of Fig. 14. Relay 1011 upon operating connects the speech output circuit from the No. 1 machine, previously traced to conductors 604 and 605 over its Nos. 1 and 2 contacts to conductors 1017 and 1018 whereby the No. 1 machine is held in readiness as a spare for giving service should the No. 3 machine fail.

From the foregoing description it will be apparent that the three machines are placed in service or on spare service in accordance with a definite pattern, that is, that when the No. 1 machine is in service, the No. 2 machine is on spare service and the No. 3 machine is held in reserve, that when the No. 2 machine is in service, the No. 3 machine is on spare service and the No. 1 machine is held in reserve; that when the No. 3 machine is in service, the No. 1 machine is on spare service and the No. 2 machine is held in reserve and that thereafter the allocation of the machines is repeated in accordance with the same pattern.

#### *One machine found to be defective*

If after recording two machines and monitoring such machines one of them is found to be defective, it may be removed from service by operating its individual make-busy key on the turret. Such keys individual to the Nos. 1, 2 and 3 machines are shown at 841, 842 and 843. It will now be assumed, for example, that when the Nos. 1 and 2 machines were initially recorded and monitored, as previously described, that the low level lamp 800 on the turret lighted indicating that the speech level from the No. 1 machine was too low or failed entirely but that the No. 2 machine was found to be properly recorded. The monitoring operator finding that it would not be possible to properly record the No. 1 machine therefore operates make-busy key 841 of such machine, thereby establishing a circuit from battery through the winding of relay 1311, over conductor 1354 of cable 1307, through the contacts of key 841, conductor 1355 of cable 1307 to ground at the outer left back contacts of relay 1301. Relay 1311 thereupon operates; at its No. 1 back contacts opens the locking circuit of relay 1321 which now releases since its operating circuit was opened by the release of relay 1207 following the release of erase key 802; at its No. 1 front contacts establishes the previously traced circuit for out-of-order lamps 821 and 1341 to light such lamps as an indication that the No. 1 machine is out of order; at its No. 4 contacts closes the circuit of relay 1361; opens at its No. 7 back contacts the previously traced operating circuit of relay 901; opens at its No. 5 back contacts the previously traced locking circuit of relay 901, whereby relay 901 now releases and at its No. 7 back contacts prepares

the previously traced locking circuit for relay 907. Relay 1361 upon operating opens a second point in the locking circuit of relay 1321 and over its inner left front contacts establishes the previously traced operating circuit for relay 905. Relay 905 thereupon operates and establishes the previously traced operating circuit for relay 907 which in turn operates, locks under the control of relay 1311, establishes the locking circuit of relay 905 and prepares the locking circuit of relay 911.

It has been assumed that the No. 2 machine has been correctly recorded and that therefore relay 1322 has been shunted down by the speech level indicator 700. When now the operator depresses cut-in key 820, relays 1205, 1206, 1200 and 1101 function as described to release relay 1110, to prepare operating circuits for relays 1001 and 1012 and to thereafter open the locking circuits of relays 901 and 902. While relay 1200 is still operated but before relay 1205 releases to release relay 902, relay 901 having been previously released by the operation of relay 1311, a circuit is established from ground over the front contacts of relay 1200, conductor 1212, No. 5 right contacts of relay 905, No. 2 right contacts of relay 902, No. 3 left back contacts of relay 911, conductor 931 to battery through the winding of relay 1002. No circuit is available at this time for operating any one of the relays 1011, 1012 and 1013 since relay 905 is operated. Relay 1002 will therefore function to cut the No. 2 machine into service as previously described by connecting the output circuit conductors 606 and 607 to conductors 1006 and 1007 and by operating start relay 1302 which functions as previously described to start the No. 2 machine and to prepare the shunt circuit for preventing the subsequent operation of relay 902. Relay 1002 also closes the previously traced circuit for lighting the in-service lamps 812 and 1332 for indicating that the No. 2 machine has been placed in service. After the cut-in has been completed and relays 901, 902 and 903 are all released, a circuit is established from battery over the No. 5 contacts of operated relay 1002, No. 7 back contacts of relays 1011, 1012 and 1013, conductor 1216, inner left back contacts of relay 1201, conductor 1217, left winding of relay 911, No. 2 right contacts of relay 905, No. 5 right back contacts of relays 903, 902 and 901 to ground. Relay 911 upon operating locks in a circuit from battery at the outer left back contact of relay 1201, over conductor 1218, its right winding and No. 1 right front contacts to ground at the middle right contacts of relay 907 and at its No. 3 right contacts closes an obvious circuit for relay 935. Relay 935 upon operating prepares circuits for flashing the recording lamps of the machines extending from ground over the contacts of interrupter 936, contacts of relay 935 to conductors 937, 938, 939, but since relays 1311 and 1002 are operated at this time, only the flashing circuit for the lamps of the No. 3 machine, which is the reserve machine, is effective. This circuit may be traced from ground on conductor 939 over the No. 9 back contacts of relay 1003, conductor 1021, No. 3 back contacts of relay 1313, conductor 1346 to battery through recording lamp 1353 on the maintenance panel and over cable 1307 to battery through lamp 833 on the operator's turret. The operator noting the flashing of lamp 833 is apprised of the fact that the No. 3 machine should be recorded at once.

Had the No. 1 machine been found to have

been properly recorded but the No. 2 machine found to have a too low speech level or no speech output, then the operator would have operated the make-busy key 842 of the defective machine thereby causing the operation of relay 1312 over a circuit from battery through the winding of relay 1312, conductor 1356 of cable 1307, contacts of key 842, conductor 1357 of cable 1307 to ground at the outer left back contacts of relay 1302. Relay 1312 thereupon operates closing an obvious circuit for relay 1362 which operates, opens at its No. 1 back contacts the circuit of relay 1322 which releases; at its No. 1 front contacts closes the previously traced circuit for out-of-order lamps 822 and 1342 to light such lamps as an indication that the No. 2 machine is out of order; opens at its No. 7 back contacts the previously traced operating circuit for relay 902; opens at its No. 6 back contacts the previously traced locking circuit of relay 902, whereupon relay 902 now releases; and at its No. 7 front contacts prepares the previously traced locking circuit for relay 907. Relay 1362 upon operating establishes the previously traced circuit over conductor 1310 for relay 905 which thereupon operates and establishes the previously traced operating circuit for relay 907 which in turn operates, locks under the control of relay 1312, establishes the locking circuit of relay 905 and prepares the locking circuit of relay 911.

It has been assumed that the No. 1 machine has been correctly recorded and that therefore relay 1321 has been shunted down by the speech level indicator 700. When now the operator operates cut-in key 820, relays 1205, 1206, 1200 and 1101 function as described to release relay 1110, to prepare operating circuits for relays 1001 and 1012 and to thereafter open the locking circuits for relays 901 and 902. While relay 1200 is still operated, but before relay 1205 releases to release relay 901, relay 902 having been previously released by the operation of relay 1312, a circuit is established from ground over the front contacts of relay 1200, conductor 1212, No. 4 right contacts of relay 905, No. 4 right contacts of relay 901, No. 4 left back contacts of relay 911, conductor 925 to battery through the right winding of relay 1001. No circuit is available at this time for operating any one of the relays 1011, 1012 and 1013 since relay 905 is operated. Relay 1001 will therefore function to cut the No. 1 machine into service as previously described by connecting the output conductors 604 and 605 to conductors 1006 and 1007 and by operating start relay 1301 which functions as previously described to start the No. 1 machine and to prepare the shunt circuit for preventing the subsequent operation of relay 901. Relay 1001 also closes the previously traced circuit for lighting in-service lamps 811 and 1331 for indicating that the No. 1 machine has been placed in service. After the cut-in has been completed and relays 901, 902 and 903 are all released, the previously traced circuit for relay 911 is completed and relay 911 operates, locks and establishes the circuit for relay 935. Relay 935 upon operating now functions to flash the recording lamps 833 and 1353 of the No. 3 machine over the previously traced circuit as a signal that the No. 3 machine should be recorded at once. After the defective machine, that is either No. 1 or No. 2 machine, has been serviced, the make-busy key thereof is released thereby releasing operated relays 1311 and 1361 or 1312 and 1362.

The same functioning of the circuit for cutting in a single machine would take place in the event one of the machines had been found defective while in service and the make-busy key 1351, 1352 or 1353 of such machine been operated by the maintenance man to operate one of the relays 1311, 1312 or 1313, to operate one of the relays 1361, 1362 or 1363 and to operate relays 905 and 907 as previously described. If any operated relay 1311, 1312 or 1313 releases, by the restoration of the make-busy key of the defective machine before the next recording, that is, before the erase key 802 is operated, relay 905 will release.

Upon the next recording and cut-in with relays 905 and 911 operated, the proper one of relays 1011, 1012 and 1013 will be operated. It will first be assumed that on the previous cut-in, relay 1001 was operated to cut in the No. 1 machine and that the newly recorded machines Nos. 2 and 3 were found to be correctly recorded and their respective relays 1322 and 1323 have been released. When relays 902 and 903 are thereafter operated by the operation of the erase key 802, relay 1213 will operate upon the operation of relay 902, over conductor 1214 and the No. 2 left contacts of relay 902 and will establish a shunt around the winding of relay 905, extending from ground over its right contacts, conductor 1219, No. 2 left contacts of relay 903 to a point between the winding of relay 905 and resistance 1202, whereupon relay 905 releases. On the operation of the cut-in key 820, the operated relay 1001 will be released to remove the No. 1 machine from service. Thereafter when relay 1200 operates but before relays 902 and 903 release as previously described, a circuit is established from ground over the right contacts of relay 1200, conductor 1212, No. 1 right front contacts of relay 903, No. 2 right front contacts of relay 902, No. 3 left front contacts of relay 911, No. 3 back contacts of relay 905, conductor 925 to battery through the right winding of relay 1001 and in parallel over conductor 926 to battery through the right winding of relay 1012. Relay 1001 upon operating will reconnect the No. 1 machine to the load and relay 1012 upon operating will place the No. 2 machine on spare service and will establish a circuit for relay 909 extending from battery over the No. 5 contacts of relay 1001, No. 7 back contacts of relay 1011, No. 7 front contacts of relay 1012, conductor 1022, No. 2 right contacts of relay 911, winding of relay 909, No. 5 right back contacts of relays 903, 902 and 901 to ground upon their release. Relay 909 upon operating releases relay 907 which in turn releases relay 911. Relay 911 upon releasing releases relays 909 and 935 and the circuit is then prepared for regular recordings and cut-ins in accordance with the pattern.

Had the No. 2 machine been in service and relay 1002 been operated as previously described, then upon the correction of the trouble on the No. 1 machine, the operator would have released the make-busy key 841 thereof thereby releasing relays 1311 and 1361. Upon the next recording the Nos. 3 and 1 machines will be recorded and if recorded correctly relays 1321 and 1323 will be operated and relays 901 and 903 will be operated. With relays 901 and 903 operated, a shunt is established from ground over the No. 1 right front contacts of relay 901 and No. 2 left front contacts of relay 903 over conductor 906 to a point between the winding of relay 905 and resistance 1202 thereby shunting down relay 905. On the

next operation of the cut-in key 820, the operated relay 1002 will be released to remove the No. 2 machine from service. With relays 901 and 903 operated and during the operation of relay 1200, the previously traced circuit is established from ground over the right contacts of relay 1200, conductor 1212, No. 3 right contacts of relay 901, No. 2 right contacts of relay 903, No. 4 right contacts of relay 911, conductor 932 to battery through the right winding of relay 1013 and from conductor 932 over the No. 2 left back contacts of relay 905 and conductor 931 to battery through the right winding of relay 1002 whereby the No. 2 machine is reconnected to the load and the No. 3 machine is placed on spare service. Following the operation of relays 1002 and 1013 and the release of relays 901 and 903, relay 909 operates to release relays 907, 911 and 935 as previously described.

If one of the relays 1311, 1312 or 1313 individual to the machine that was out of order releases after one newly recorded machine has been put into service, but before the start of the recording of a reserve machine, the locking circuit of relay 907 will be opened and relay 907 will release in turn releasing relay 905, but relay 911 will remain operated over a holding circuit extending from battery over the No. 5 contacts of the operated one of relays 1001, 1002 and 1003, the No. 7 back contacts of relays 1011, 1012 and 1013, conductor 1216, inner left back contacts of relay 1201, conductor 1217, left winding and No. 1 left contact of relay 911, thence to ground over the No. 5 right back contacts of relays 903, 902 and 901, and will hold relay 935 operated. At this time there will be two machines available for recording and one newly recorded machine will be connected to the load. The recording lamps of both unrecorded machines will now flash. When the operator operates the erase key, relays 901, 902 and 903 corresponding to the idle machines will operate and relay 911 will release in turn releasing relay 935. When monitoring has been completed and the cut-in occurs, the two newly recorded machines will act as the load and spare machines and the machine that had been carrying the load will be removed from the load even though it has an up-to-date record.

While the cutting in of a single one of the Nos. 1 and 2 machines has been described in detail, it will be apparent that either the No. 2 or No. 3 machine may be cut in singly when the No. 2 machine is in service and the No. 3 is on spare service and that either the No. 3 or No. 1 machine may be cut in singly when the No. 3 machine is in service and the No. 1 machine is on spare service, in the same general manner in accordance with the established pattern.

If it is desired to monitor on the machine that is in service, the monitoring operator will plug her headset circuit into the monitoring jacks 412 and 413 and will operate the monitoring key of that machine, that is, key 817, 818 or 825, but since the start relay of that machine, that is, relay 1301, 1302 or 1303, is operated, no circuit is effective over conductor 608 and the No. 2 contacts of transfer relay 769 for operating the start relay 1454 of the No. 1 speech level indicator or the corresponding relay of the No. 2 speech level indicator 700 and therefore the speech level indicator is ineffective. The operator can, however, listen to the announcement from the machine. To enable a supervisory operator to monitor at the same time as the monitoring operator, a du-

uplicate set of monitoring jacks 418 and 419 is provided on the turret.

*Manual announcement by the monitoring operator*

5 In the remote possibility that all three machines should be out of service at the same time, the monitoring operator may make manual announcements directly to calling subscribers' lines  
10 by plugging her recording transmitter circuit 406 into one of the jacks 400, 401 or 402 individual respectively to the three machines thereby causing the operation of one of the pairs of relays 611 and 641, 612 and 642 or 613 and 643. It will be  
15 assumed that the Nos. 1 and 2 machines have become defective and that the No. 3 machine has been rendered capable of being recorded and that the operator plugs into jack 400 individual to the No. 1 machine. Upon the insertion of the plug  
20 408 into jack 400, battery is disconnected at its normally closed contacts from the circuit previously traced for operating relay 901 and a circuit is established from ground over the alternate contacts of the jack, conductor 420 to battery  
25 through the windings of relays 611 and 641.

Relay 611 upon operating connects ground over its left contacts and conductor 624 for holding relay 1361 operated, which relay will be operated  
30 at this time if the No. 1 machine has been found defective; disconnects the input circuit of amplifier 601 from the No. 1 announcing machine and connects it over conductors 619 and 620 through the right windings of repeating coil 510,  
35 the left windings of which are connected over conductors 511 and 512 over the tip and ring springs of jack 400 and plug 408 to the recording transmitter circuit 406. Relay 641 upon operating establishes a circuit from ground over its right contacts and conductor 728 to battery  
40 through the winding of relay 707 which thereupon operates; closes an obvious circuit for relay 1102 over its No. 3 contacts; opens at its No. 6 back contacts the previously traced circuit over which the in-service lamps of the machines are  
45 lighted and at its No. 5 contacts connects conductor 220 extending from the distributing circuit of Fig. 2 over conductor 729 to battery through the call waiting lamp 827 on the turret whereby this lamp will light to indicate whenever  
50 any calling subscriber has called for weather information service. Relay 641 also disconnects the output circuit of amplifier 601 from conductors 604 and 605 and connects it over conductors 625 and 626 and the Nos. 1 and 2 front  
55 contacts of relay 707 to the previously traced circuit extending to trunk conductors 231 and 232.

When thereafter the call waiting lamp 827 lights, the operator will announce the latest weather bulletin into her transmitter, the speech  
60 current from which will be amplified by the amplifier 601 and transmitted to the lines of all calling subscribers over trunk conductors 231 and 232. It is to be noted that when the transmitter circuit is plugged into either jack 400 or 401, the transmitter battery supply is applied through  
65 battery feed coil 513 and the speech current is transmitted through the windings of repeating coil 510 and over conductors 625 and 626 but that when the transmitter circuit is plugged into jack  
70 402, the transmitter battery supply is applied through battery feed coil 501 and the speech current is transmitted through the windings of repeating coil 502 and over conductors 627 and 628. This is to avoid tying up the service should a part  
75 of the apparatus become defective.

Relay 1102 upon operating removes ground at its outer left back contact from the previously traced circuit over conductor 1133 extending to the winding of relay 1600 in Fig. 16 to release relay 1600 should the relay 1100 be operated at this  
5 time; connects ground over its outer left front contacts, conductor 1138, No. 1 front or back contacts of relay 701 to either conductor 764 or 1464 depending upon whether relay 701 is energized or  
10 deenergized for operating relay 1465 of the No. 1 speech level indicator of Fig. 14 or the corresponding relay of the No. 2 speech level indicator 700; connects ground over its middle left contacts to conductor 222 for supplying an operating  
15 ground for relay 221 of the distributing circuit of Fig. 2 should relay 1100 be operated at this time; opens at its middle right back contacts the previously traced circuit of relay 1201 and prepares circuits extending to the speech level indicator  
20 whereby the speech level of the announcement may be checked and the monitoring operator apprised of its volume level by the high and low level lamps 800 and 801 on the turret.

It will be assumed that relay 701 is at the time deenergized and that upon the connection of  
25 ground to conductor 1464 by the operation of relay 1102, relay 1465 of the No. 1 speech level indicator of Fig. 14 has operated, closed the circuit of relay 1441 and opened the circuit over conductor 719 by which the alarm control relays 1105 and  
30 1100 of the control circuit are normally controlled from the speech level indicator. Manual announcement speech is now applied to the speech level indicator over a circuit from ground at the inner right front contacts of relay 1102, No. 3  
35 back contacts of relay 701, conductor 1402, upper back contacts of relay 1404, input winding of transformer 1405, lower back contacts of relay 1404, conductor 1403, No. 4 back contacts of relay 701, No. 1 front contacts of relay 707, conductor  
40 626, thence through the output of amplifier 601 to ground through resistance 629. The speech level indicator now functions in the manner previously described in connection with monitoring and if the speech level is too high, connects  
45 ground over conductor 1451, the No. 1 back contacts of relay 717, outer right front contacts of relay 1102, right back contacts of relay 726 and conductor 814 to battery through the high level lamp 800 on the turret for lighting such lamp,  
50 or if the level is too low, connects ground over conductor 1461, the No. 2 back contacts of relay 717, the inner left front contacts of relay 1102, left back contacts of relay 726, over conductor 816 to battery through the low level lamp 801 on  
55 the turret for lighting such lamp.

During the manual announcements a recording may be made on the Nos. 2 and 3 machines, if  
60 available, by first operating erasing key 802 to erase the tapes of such machines and then by operating recording key 809. Under these circumstances the speech output from the amplifier 601 is impressed over conductors 625 and 626 through repeating coil 514 and thence over  
65 conductors 515 and 516, the lower contacts of recording key 809, conductors 517 and 518, back contacts of relay 500 and conductors 505 and 506 upon the windings of the input transformers, such as 310, of the machines. The repeating coil 514 is provided with padding resistances 519 to 524.  
70 inclusive, to prevent interference should another recording transmitter be connected to recording jack 407 for recording and for use simultaneously with the manual announcement transmitter. The circuits will function in the same general man-  
75

ner if the recording transmitter should be plugged into jack 401 or jack 402 except that amplifier 602 or 603 would be employed.

#### *Manual transfer of machines*

A manual key 1220 is provided on the maintenance panel which may be operated to cause the load to be shifted from the machine in service to the spare machine. When this key is operated if recording is not in progress and relay 1206 is not therefore operated, a circuit is established from ground at the left back contacts of relay 1206 through the contacts of key 1220, conductor 1221 to battery through the winding of relay 1105. Relay 1105 thereupon operates and closes the circuit of relay 706 which operates, locks under the control of relay 1117, opens the speech transmission path to the trunk conductors 231 and 232, releases relay 713, if operated, and prepares the circuit of relay 1103 which operates as soon as interrupter 1119 closes its right contact. Relay 1103 performs the functions previously described for the automatic transfer of the machines, including the starting of the spare machine to permit it to gain its normal operating speed. As before described, the closure of the left contact of interrupter 1119 causes relay 1117 to operate and to release relay 706 which releases relay 1103 and brings about the operation of the transfer relays 701, 703, 717 and 769 as described for the automatic transfer.

#### *Jacks at the equipment*

An in-test jack, an out-test jack and a monitoring jack for each machine are provided on the maintenance panel for the convenience of the maintenance man. If one of the in-test jacks 621, 622 or 623 is plugged into, the testing equipment will become connected to the input circuit of the associated amplifier and the input circuit of the amplifier will be disconnected at the jack contacts from the output circuit of the associated machine. Similarly if one of the out-test jacks 631, 632 or 633 is plugged into, the testing equipment will become connected to the output circuit of the associated amplifier and the output circuit of the amplifier will be disconnected at the jack contacts from the usual transmission circuit. If necessary, the out-testing jack of any amplifier, such as jack 633 of the amplifier 603, may be connected with jack 709 by a patching cord 730 whereby the output of such amplifier is connected directly to the conductors 231 and 232 of the incoming trunk. By means of the monitoring receiver 654 and one of the monitoring jacks 651, 652 and 653, any machine may be monitored at the maintenance panel.

If a failure of some nature has made it necessary to provide manual announcements and after rectifying the trouble the maintenance man wishes to check the operation from the turret, all operated make-busy keys such as 841, 842 and 843 on the turret and corresponding keys 1351, 1352 and 1353 on the maintenance panel are restored and the test key 834 on the turret is operated, thereby operating test relay 507. Trouble release key 1106 should also be normal. The maintenance man may then plug the monitoring receiver 654 into monitoring jack 525. The two machines whose amplifiers 601, 602 or 603 are not in use for manual service are then erased, recorded, monitored and cut into service in the usual manner, the operations being repeated twice to see that both can be placed in service or on spare service. The operation of test relay 507 discon-

nects the speech channel conductors 615 and 616 from the usual monitoring jacks on the turret and bridges the padding resistance 509 across the outgoing trunk conductors 231 and 232. With the monitoring headset 654 plugged into jack 525, the maintenance man may listen to the announcements going out over the trunk conductors 231 and 232.

The monitoring operator may at any time call the supervisory operator at the chief operator's desk by operating key 835 on the turret thereby closing a circuit from ground over the upper contacts of key 835 and conductor 836 through the "weather" lamp 1140 at the chief operator's desk and closing a circuit from ground over the lower contacts of key 835 and conductor 837 through the buzzer 1130 at the chief operator's desk. The monitoring operator may converse with the supervisory operator over a tie line not disclosed.

#### *Calls originating in an adjacent exchange area*

As previously stated, provision is made for giving the information service to subscribers whose lines terminate in offices of other exchange areas which are not too remotely removed from the exchange area in which the information bureau is located. Such an exchange area is illustrated in Figs. 15 and 16 and is provided with a plurality of announcement trunks and a distributing circuit illustrated by the box 1504 which are identical with similar apparatus disclosed in Fig. 2, such trunks being accessible to all offices of the area, and with an auxiliary control circuit disclosed in the right portion of Fig. 15 and that portion of Fig. 16 to the left of the dot-dash line. This control circuit is connected to the exchange area in which the information bureau is located by two cable pairs 1601, 1602 and 1651, 1652, which terminate at the latter exchange area in supervisory equipment and which are connected to the trunk conductors 231 and 232 extending to the control circuit of the information bureau.

It will be assumed that the subscriber whose line is schematically illustrated at B, desiring information concerning the latest weather forecast, initiates a call and dials the directory number assigned to the weather forecast announcing bureau. In response thereto a connection is extended from such calling line by the operation of the line finder 1501, district selector 1502 and office selector 1503 to an idle announcement trunk similar to that disclosed in Fig. 2 and indicated by the box 1504. Upon the seizure of the trunk the relay of the trunk, corresponding to relay 208, establishes a circuit from ground over start conductor 1505, the No. 1 back contacts of relay 1605 to battery through the winding of slow-to-release relay 1606 which operates and closes an obvious operating circuit for relay 1605.

Relay 1605 upon operating locks over its No. 1 front contacts to ground on start conductor 1505; opens the operating circuit of relay 1606 at its No. 1 back contacts and at its Nos. 5 and 9 front contacts establishes supervisory circuits over the two previously mentioned cable pairs. The circuit over cable pair 1601, 1602 may be traced from ground through the left winding of start relay 1607 in the exchange area in which the information bureau is located through the upper left winding of repeating coil 1608, trunk conductor 1601, upper normal contacts of test jacks 1609 and 1610, upper right winding of repeating coil 1611, winding of supervisory relay 1612 in the auxiliary control circuit, No. 9 con-

tacts of relay 1605, lower right winding of coil 1611, lower normal contacts of jacks 1610 and 1609, trunk conductor 1602, lower left winding of repeating coil 1608, upper back contacts of relay 1600, if relay 1600 has not been operated because of the unavailability of an announcing machine to serve the call as previously described, thence to battery through the right winding of start relay 1607. If the channel over trunk conductors 1601 and 1602 is in working condition, relays 1607 and 1612 will thereupon operate. Similarly a circuit is established from ground through the left winding of start relay 1657, lower left winding of repeating coil 1658, trunk conductor 1651, lower normal contacts of test jacks 1659 and 1660, lower right winding of repeating coil 1661, winding of supervisory relay 1662, No. 5 contacts of relay 1605, upper right winding of repeating coil 1661, upper normal contacts of jacks 1660 and 1659, trunk conductor 1652, upper left winding of repeating coil 1653, lower back contacts of relay 1600 to battery through the right winding of start relay 1657. If the channel over trunk conductors 1651 and 1652 is in working condition, relays 1657 and 1662 will thereupon operate. With either start relay 1607 or 1657 operated, a circuit will be established over the front contacts thereof and conductor 239 over the inner lower normal contacts of key 212 to battery through the winding of start relay 213 of the distributing circuit of Fig. 2 which functions in the manner previously described to indicate to the control circuit of the announcing bureau that there is a call waiting for announcement service.

Should there be a fault in the cable pairs 1601, 1602, relays 1607 and 1612 will not operate and consequently upon the release of slow-to-release relay 1606, a circuit will be established from ground at the back contacts of relay 1612, back contacts of slow-to-release relay 1613, No. 8 contacts of relay 1605, upper back contacts of relay 1606 to battery through the winding of alarm relay 1614 which will thereupon operate, lock over its inner lower front contacts to ground at the normally closed contacts of trouble release key 1615 and establish alarm circuits from ground over its upper front contacts, conductors 1616 and 1617 and normal contacts of alarm release key 1618 to suitable minor alarms (not shown). Should there be a fault on the cable pair 1651, 1652, relays 1657 and 1662 will not operate and consequently upon the release of slow-to-release relay 1606, a circuit will be established from ground at the back contacts of relay 1662, back contacts of slow-to-release relay 1663, No. 2 contacts of relay 1605, lower back contacts of relay 1606 to battery through the winding of alarm relay 1664 which will thereupon operate, lock over its inner upper front contacts to ground at the normally closed contacts of trouble release key 1615 and establish alarm circuits from ground over its upper and lower front contacts, conductors 1616 and 1617 and normal contacts of key 1618 to the minor alarms. Should there be a fault in both cable pairs or relay 1600 be operated, indicating that no machine is available for announcing, then both alarm relays 1614 and 1664 would operate, thereby establishing a circuit from ground over the lower front contacts of relay 1614, the upper front contacts of relay 1664, conductor 1619, and normal contacts of key 1618 to a suitable major alarm.

It will be assumed, however, that both trunk channels are available and that consequently

upon the operation of relays 1612 and 1662 slow-to-release relays 1613 and 1663 both operate over obvious circuits closed at the front contacts of relays 1612 and 1662. Relay 1613 upon operating opens at its back contacts the previously traced circuit for relay 1614 and at its front contacts connects ground to a circuit extending over the back contacts of relay 1620 and conductor 1506 to the distributing circuit 1504. This conductor corresponds to conductor 222 of Fig. 2 and the connection of ground thereto operates a relay corresponding to relay 221 for initiating the cut-through of all announcement trunks which have been seized by calling subscribers' lines, such as the line of substation B. Relay 1663 upon operating opens at its back contacts the previously traced circuit of relay 1664 and at its front contacts also connects ground over the back contacts of relay 1507 to conductor 1506. It will be noted that if neither trunk channel is closed, for example because relay 1600 was operated, neither relay 1613 nor 1663 will operate and consequently no announcement trunk can be cut through.

With an announcing machine in service, the speech output therefrom is impressed over conductors 231 and 232 upon the right windings of repeating coils 1608 and 1658 and is further impressed by the left windings of such repeating coils upon the two trunk channels extending to the auxiliary control circuit. The speech current passing through the right windings of repeating coil 1608 is impressed thereby upon the cable loop including the left windings of repeating coil 1608, trunk conductors 1601 and 1602 and the right windings of repeating coil 1611 and is further impressed by the left windings of repeating coil 1611 upon the loop including the left windings of repeating coil 1621, across which loop an equalizing circuit 1622 is bridged and is further impressed by the left windings of repeating coil 1621 upon the input circuit of amplifier 1623. The speech current is now amplified by amplifier 1623 and if the calling announcement trunks have been cut through is impressed upon a circuit extending from the output circuit of amplifier 1623 over conductor 1624, upper normal contacts of test jack 1508, conductor 1509 through resistance 1510 of the Wheatstone bridge, conductor 1511, the upper inner contacts of a relay of distributing circuit 1504 corresponding to relay 202, through the repeating coil thereof corresponding to repeating coil 203 and returning over the inner lower front contact of such relay, conductors 1512 and 1513, lower normal contacts of jack 1508 and conductor 1625 to the output circuit of amplifier 1623. Similarly the speech current passing through the right windings of repeating coil 1658 is impressed thereby upon the cable loop including the left windings of repeating coil 1658, trunk conductors 1651 and 1652 and the right windings of repeating coil 1661, is further impressed by the left windings of repeating coil 1661 upon the loop including the left windings of repeating coil 1671 across which loop an equalizer circuit 1672 is bridged, and is further impressed by the left windings of repeating coil 1671 upon the input circuit of amplifier 1673. The speech current is now amplified by amplifier 1673 and is impressed upon a circuit extending from the output circuit of amplifier 1673 over conductor 1674, lower normal contacts of test jack 1558, conductor 1559 through resistance 1542, conductor 1512, thence as traced through the repeating coils of the announcement trunks, re-

turning over conductors 1511 and 1563, upper normal contacts of jack 1558, and conductor 1675 to the output circuit of amplifier 1673. The speech current is thus transmitted over both channels, the windings 1510, 1514 and 1542 of the Wheatstone bridge preventing a back-up of the speech current from the output circuit of one amplifier to the output circuit of the other amplifier should one of the channels fail to transmit speech current through its amplifier. For adjusting the padding across conductors 1511 and 1512, a bridged series of resistances 1515 is provided, the total resistance of which may be adjusted by the associated straps 1516. Monitoring on the input to the announcement trunks may be accomplished by plugging a monitoring headset into monitoring jack 1517, the tip and ring springs of which are connected to conductors 1511 and 1512. When the plug of the monitoring headset is inserted into jack 1517, ground is applied over the alternate contacts of the jack to conductor 1505 to hold the start circuit closed until monitoring is completed.

For detecting if there is speech current in each of the channels, each channel is provided with a speech detecting relay of the well-known Weston Sensitrol type. One of these relays 1518 has its moving coil connected to opposite junction points of a rectox bridge 1519, the other junction points of which are connected by resistances 1520 and 1521 to conductors 1509 and 1513 whereby if speech current is present, the pointer of such relay will be swung to complete a circuit from ground through the pointer thereof and the contact engaged thereby over conductor 1522 through the winding of relay 1626 to battery, thereby operating relay 1626. The pointer after engaging its contact is held to maintain the circuit of relay 1626 closed by engagement with the end of a permanent magnet 1523. The other of these relays 1568 has its moving coil connected to opposite junction points of a rectox bridge 1569, the other junction points of which are connected by resistances 1570 and 1571 to conductors 1559 and 1563, whereby if speech current is present the pointer of such relay will be swung to complete a circuit from ground through the pointer thereof, the contact engaged thereby, through the winding of relay 1524 to battery thereby operating relay 1524. The pointer after engaging its contact is held to maintain the circuit of relay 1524 closed by engaging with the end of a permanent magnet 1573.

When the start relay 1605 operated to perform the functions previously described, it also established a circuit from ground over its No. 6 contacts and conductor 1627 to the armature spring of interrupter 1525 of the timing circuit 1526 allocated to the upper channel and disclosed in the lower portion of Fig. 15, and connected to ground over its No. 7 contacts to conductor 1628 also extending to the timing circuit. Similarly relay 1605 connected ground over its No. 4 contacts and conductor 1677 to the armature spring of an interrupter, corresponding to interrupter 1525, of the timing circuit allocated to the lower channel and indicated by the box designated 1576 and connected ground over its No. 3 contacts and conductor 1678 to timing circuit 1576. The timing interrupters of both timing circuits are driven synchronously by a common driving motor (not shown).

Considering the timing circuit 1526 allocated to the upper channel and disclosed in full, as soon as the interrupter 1525 closes its contacts,

a circuit is established from ground on conductor 1627 over such contacts, the inner left back contacts of slow-to-release relay 1527, through the left normal contacts of relay 1528, through the winding of relay 1529 and resistance 1530 to battery and through the winding of relay 1528 and resistance 1531 to battery. Relay 1528 thereupon operates and locks over its left alternate contacts, the outer left back contacts of relay 1527 and conductor 1628 to ground as traced, but relay 1529 does not operate since its winding is shunted at this time by ground applied over the contacts of interrupter 1525 and over the right back contacts of relay 1529 to a point between the winding of relay 1529 and resistance 1530. As soon thereafter as the interrupter contacts open, the initial operating circuit of relay 1528 is opened and with relay 1528 locked operated, a circuit is closed from ground on conductor 1628 over the outer left back contacts of relay 1527, the left alternate contacts of relay 1528 through the winding of relay 1529 and resistance 1530 to battery and relay 1529 operates. When relay 1528 operates but before relay 1529 operates, a circuit is closed from ground over the inner right front contacts of relay 1528, the right back contacts of relay 1527, the left back contacts of slow-to-release relay 1532, conductor 1533, winding of relay 1629 to battery at the back contact of relay 1626 if the speech detecting relay 1518 of the upper channel has not detected speech thereon and consequently relay 1626 is not operated. It will be assumed, however, that speech current is detected by relay 1518 and that relay 1626 is therefore operated and that consequently relay 1629 does not operate at this time.

Interrupter 1525 completes one cycle every two minutes and after approximately 116 seconds again closes its contacts thereby connecting ground from conductor 1627 over its contacts, the inner left back contacts of relay 1527, the left front contacts of relay 1529 to a point between resistance 1531 and the winding of relay 1528 thereby shunting down relay 1528 which now releases. With relay 1528 released, relay 1529 is held operated in a circuit from battery through resistance 1530 and its winding, the left normal contacts of relay 1528, the inner left back contacts of relay 1527, the closed contacts of interrupter 1525 to ground on conductor 1627. With relay 1528 released and relay 1529 operated, a circuit is now established from ground at the right back contacts of relay 1528 over the right front contacts of relay 1529 to battery through the winding of slow-to-release relay 1532 which thereupon operates and locks over its left front contacts and the outer left back contacts of relay 1527 to ground on conductor 1628. After another four seconds interrupter 1525 opens its contacts thereby releasing relay 1529. After another 116 seconds, the contacts of interrupter 1525 again close, reestablishing the previously traced operating circuits for relays 1528 and 1529. Relay 1528 thereupon operates and locks as previously described, but relay 1529 cannot operate during the closure of the interrupter contacts since its winding is hunted. With relay 1528 operated, a circuit is now established from ground over its outer right front contacts and the inner right front contacts of operated relay 1532 to battery through the winding of relay 1534 which now operates and locks to ground at the outer right front contacts of relay 1532; closes at its outer right front contacts an obvious operating circuit for relay 1527; closes at its inner

right front contacts an obvious energizing circuit for release winding 1535 of the Sensitrol relay 1518 for nullifying the magnetic attraction of the permanent magnet 1523 thereof and at its 5  
 5 outer left front contacts establishes a shunt around the moving coil of the Sensitrol relay. The pointer of the Sensitrol relay should now be restored to normal by the usual coiled spring thereby releasing relay 1626.

10 Relay 1527 upon operating locks over its left front contacts and the contacts of interrupter 1525 to ground on conductor 1627, opens at its left back contacts the locking circuits of relays 1528 and 1532 whereupon relay 1528 releases at 15  
 15 once and relay 1532 releases after an interval and at its outer right front contacts establishes an additional shunt around the coil of relay 1518. As soon as relay 1532 releases, it in turn releases relay 1534 which opens the circuit of the restoring 20  
 20 winding 1535 of relay 1518. With relay 1534 released and relay 1527 still operated, ground is applied over the inner right back contacts of relay 1534, inner right front contacts of relay 25  
 25 1527, to conductor 1536 but without effect at this time, since relay 1629 was assumed to have not operated, and ground is applied over the outer right back contacts of relay 1534 and the middle right front contacts of relay 1527 to conductor 30  
 30 1537 but without effect since relay 1626 has released. On the next opening of the contacts of interrupter 1525, the locking circuit of relay 1527 is opened and relay 1527 releases after an interval, removing the shunt from the coil of relay 35  
 35 1518 whereby relay 1518 again operates if speech current is detected and again operates relay 1626. With relay 1527 released, the timing circuit is prepared for recycling which is started when interrupter 1525 again closes its contacts after another 112 second interval. Thus at six minute 40  
 40 intervals the Sensitrol relay 1518 is conditioned to test the upper channel for speech transmission. In a similar manner the timing circuit 1576 functions in connection with the lower channel.

45 It will now be assumed that during the cycling of the timing circuit 1526, the Sensitrol relay 1518 has not responded thereby indicating that no speech is being transmitted over the upper channel and that therefore relay 1626 is not 50  
 50 operated. When, therefore, during the cycle the previously traced circuit of relay 1629 is established, relay 1629 will operate, lock to ground over its upper front contacts and prepare circuits over its lower front contacts. When later in the timing cycle relay 1527 operates and relay 55  
 55 1534 releases and ground is applied thereby to conductor 1536, a circuit is completed over the inner lower front contacts of relay 1629 through the winding of relay 1620 to battery. Relay 1620 will thereupon operate and lock over its inner 60  
 60 upper front contacts to ground at the lower front contacts of relay 1629. Relay 1620 also connects ground over its upper front contacts to the operating circuit of alarm relay 1614 which thereupon operates to close the minor alarm circuits 65  
 65 to indicate that one of the channels has become defective. At its lower back contacts relay 1620 removes one ground connection from conductor 1536 extending to the distributing circuit 1504.

70 In a similar manner, if during the cycling of the timing circuit 1576 the Sensitrol relay 1568 has not responded, thereby indicating that no speech reception is being transmitted over the lower channel and that therefore relay 1524 is not operated, when the circuit of test relay 1538 75  
 75 is established, relay 1538 will operate, lock itself

and prepare circuits over its upper and lower contacts. Thereafter when the timing circuit connects ground to conductor 1586 through the operation of the relay thereof corresponding to relay 1527 and the release of the relay thereof 5  
 5 corresponding to relay 1534, a circuit is established for relay 1507 which thereupon operates, locks under the control of relay 1538, opens at its back contacts one ground connection to conductor 1506 and at its upper front contacts connects 10  
 10 ground over conductor 1539 to the circuit of alarm relay 1664. Relay 1664 will thereupon operate to close the minor alarm circuits as previously described.

Should both channels indicate a failure at the same time and both relays 1620 and 1507 be 15  
 15 operated, all ground connections to conductor 1506 will be removed thereby signaling the distributing circuit 1504 to cut through no more announcement trunks. Alarm relays 1614 and 20  
 20 1664 will also be operated thereby closing the major alarm circuits.

If during a timing cycle of timing circuit 1526, the Sensitrol relay 1518 does not release, indicating a failure of such relay and relay 1626 25  
 25 therefore remains operated, the connection of ground to conductor 1537 upon the operation of relay 1527 and the release of relay 1534 will complete a circuit over the front contacts of relay 30  
 30 1626 through the winding of alarm relay 1614 to operate the minor alarms and similarly if during the timing cycle of timing circuit 1576 the Sensitrol relay 1568 does not release, indicating a failure of such relay and relay 1524 35  
 35 therefore remains operated, the connection of ground to conductor 1587 upon the operation of the relay corresponding to relay 1527 and the release of the relay corresponding to relay 1534 will complete a circuit over the front contacts 40  
 40 of relay 1524 and conductor 1539 through the winding of alarm relay 1664 to operate the minor alarms.

When the trouble on either channel has been rectified, relay 1626 or 1524 will be again operated thereby releasing operated relays 1629, 1620 45  
 45 and 1614 or operated relays 1538, 1507 and 1664. Should all waiting calls be served, the distributing circuit 1504 will remove ground from conductor 1505 thereby releasing relay 1605 which in turn releases the supervisory relays 1612, 1607, 50  
 50 1662 and 1657 of both channels and relays 1613 and 1663. With both relays 1607 and 1657 released, ground is removed from start conductor 239, indicating to the distributing circuit of Fig. 2 that there are no calls in the auxiliary exchange area waiting for information service. 55  
 55

The channels of the auxiliary control circuit are provided with test jacks 1609 and 1659 over which the speech transmission over the inter-exchange trunks 1601, 1602, 1651 and 1652 may 60  
 60 be tested; test jacks 1610 and 1660 giving access to the input windings of repeating coils 1611 and 1661 and test jacks 1630 and 1680 giving access to the input circuits of amplifiers 1623 and 1673. 65  
 65

The maintenance man may test the volume level output of amplifier 1623 by the dial type volume indicator 1631 by operating key 1632, may check the volume level output of amplifier 1673 by operating key 1682 and may check the 70  
 70 volume level on the trunk conductors 1511 and 1512 by operating key 1633. If key 1632 is operated, the volume indicator 1631 is bridged across the output circuit of amplifier 1623 from conductor 1624 over conductor 1634, inner upper 75  
 75



contacts of key 1632, inner upper normal contacts of key 1682, inner upper normal contacts of key 1633, through resistances 1635 and 1636, through the volume indicator 1631 over the lower normal contacts of key 1633, the lower normal contacts of key 1682, the lower contacts of key 1632 and conductor 1637 to conductor 1625. If key 1682 is operated, the volume indicator 1631 is bridged across the output circuit of amplifier 1673 from conductor 1674 over conductor 1684, the upper alternate contacts of key 1682, the upper normal contacts of key 1633 through resistances 1635 and 1636, through the volume indicator 1631, over the lower normal contacts of key 1633, the lower alternate contacts of key 1682 and conductor 1687 to conductor 1675. If key 1633 is operated, the volume indicator 1631 is bridged across the output trunk conductors from conductor 1511 over conductor 1549, inner upper alternate contacts of key 1633, through resistances 1635 and 1636 and volume indicator 1631, thence over the lower alternate contacts of key 1633 and conductor 1541 to conductor 1512. The operation of any one of the keys also bridges resistance 1638 across the volume indicator 1631. It is to be noted that through the arrangement of the contacts of the keys, the volume indicator 1631 can be connected at any time to only one test point.

Although only one auxiliary exchange area has been illustrated, it is to be understood that several such areas with equipment similar to that disclosed in Figs. 15 and 16 could be served from the main exchange area in which the announcement bureau is located.

What is claimed is:

1. In an announcing system, a central announcing bureau, an outgoing distributing point associated therewith, a plurality of offices, subscribers' lines terminating therein, a plurality of trunks extending from said offices and multiplied to said bureau, means in said offices for concurrently extending connections from calling lines over said trunks to said bureau, means at said distributing point operative whenever one or more of said trunks is in a calling condition for transmitting a cut-through signal to each of said trunks, means in each trunk responsive to said cut-through signal if said trunk is in a calling condition for cutting through a speech transmission path from the calling line connected therewith to said bureau, means at said distributing point operative after the elapse of a time interval for transmitting a cut-off signal for each of said trunks and means in each trunk responsive to said cut-off signal if said trunk has previously been cut through for opening the transmission path over said trunk.

2. In an announcing system, a central announcing bureau, an outgoing distributing point associated therewith, a plurality of offices, subscribers' lines terminating therein, a plurality of trunks extending from said offices and multiplied to said bureau, means in said offices for concurrently extending connections from calling lines over said trunks to said bureau, means at said distributing point operative whenever one or more of said trunks is in the calling condition and said bureau is conditioned for transmitting announcements for transmitting a cut-through signal to each of said trunks, means in each trunk responsive to said cut-through signal if said trunk is in a calling condition for cutting through a speech transmission path from the calling line connected therewith to said bureau,

means at said distributing point operative after the elapse of a time interval for transmitting a cut-off signal for each of said trunks, and means in each trunk responsive to said cut-off signal if said trunk has been previously cut through for opening the transmission path over said trunk.

3. In an announcing system, a central announcing bureau, an outgoing distributing point associated therewith, a plurality of offices, subscribers' lines terminating therein, a plurality of trunks extending from said offices and multiplied to said bureau, means in said offices for concurrently extending connections from calling lines over said trunks to said bureau, means at said distributing point operative whenever one or more of said trunks is in a calling condition for transmitting a cut-through signal to each of said trunks, means in each trunk responsive to said cut-through signal if said trunk is in a calling condition for cutting through a speech transmission path from the calling line connected therewith to said bureau, means at said distributing point for thereafter transmitting a reversing signal to each of said trunks, means in each of said trunks responsive to said reversing signal for preparing said trunks to disrupt said transmission path thereover, means at said distributing point for thereafter transmitting a cut-off signal after the elapse of a time interval sufficient for the transmission of a complete announcement from said bureau and means in each trunk which has responded to said reversing signal responsive to said cut-through signal for disrupting the transmission path thereover.

4. In an announcing system, a first exchange area having a central announcing bureau, a second exchange area having a plurality of offices and a distributing point associated therewith, subscribers' lines terminating in said offices, a pair of identical interexchange trunks extending between said exchanges and multiplied at said first exchange to said bureau, a plurality of announcement trunks extending from said offices and multiplied at their outgoing ends to said interexchange trunks, means in said offices for concurrently extending connections from calling lines over said trunks to said bureau, means at said distributing point operative whenever one or more of said announcement trunks is in a calling condition and said bureau is conditioned to transmit announcements for establishing a supervisory circuit over each of said interexchange trunks, means at said distributing point operative upon the establishment of said supervisory circuits for transmitting a cut-through signal to each of said announcement trunks, means in each announcement trunk responsive to said cut-through signal if said trunk is in a calling condition for cutting through a speech transmission path from the calling line connected therewith over said interexchange trunks to said bureau, means at said distributing point operative after the elapse of a time interval for transmitting a cut-off signal for each of said announcement trunks, and means in each announcement trunk responsive to said cut-off signal if said trunk has previously been cut through for opening the transmission path thereover.

5. In an announcing system, a first exchange area having a central announcing bureau, a second exchange area having a plurality of offices and a distributing point associated therewith, subscribers' lines terminating in said offices, a pair of identical interexchange trunks extending

between said exchanges and multiplied at said first exchange to said bureau, a plurality of announcement trunks extending from said offices and multiplied at their outgoing ends to said interexchange trunks, means in said offices for concurrently extending connections from calling lines over said trunks to said bureau, means at said distributing point operative whenever one or more of said announcement trunks is in a calling condition and said bureau is conditioned for transmitting announcements for establishing a supervisory circuit over each of said interexchange trunks, means at said distributing point operative upon the establishment of either of said supervisory circuits for controlling the cut-through and subsequent disruption of speech transmission paths from calling lines over said announcement trunks to said bureau, means for operating a minor alarm if either of said supervisory circuits is not established and means for operating a major alarm if neither of said supervisory circuits are established.

6. In an announcing system, a first exchange area having a central announcing bureau, a second exchange area having a plurality of offices and a distributing point associated therewith, subscribers' lines terminating in said offices, a pair of identical interexchange trunks extending between said exchanges and multiplied at said first exchange to said bureau, a plurality of announcement trunks extending from said offices and multiplied at their outgoing ends to said interexchange trunks, means in said offices for concurrently extending connections from calling lines over said trunks to said bureau, means at said distributing point operative whenever one or more of said announcement trunks is in a calling condition and said bureau is conditioned for transmitting announcements for establishing a supervisory circuit over each of said interexchange trunks, means at said distributing point operative upon the establishment of either of said supervisory circuits for controlling the cut-through and subsequent disruption of speech transmission paths from calling lines over said announcement trunks to said bureau, and means operative upon the failure of speech transmission over both of said interexchange trunks for preventing the cut-through of further speech transmission paths over said announcement trunks and for operating an alarm.

7. In an announcing system, a first exchange area having a central announcing bureau, a second exchange area having a plurality of offices, subscribers' lines terminating in said offices, a pair of identical interexchange trunks extending between said exchanges and multiplied at said first exchange to said bureau, each of said trunks having a repeater, a speech detection device and a timing means individual thereto, a plurality of announcement trunks extending from said offices and multiplied at their outgoing ends to said interexchange trunks, means in said offices for concurrently extending connections from calling subscribers' lines over said trunks to said bureau, means periodically controlled by each of said timing means for testing to ascertain if its associated speech detection device has detected the transmission of speech, and means controlled by said testing means for closing a minor alarm circuit if either of said speech detecting devices fails to detect speech transmission and operative to close a major alarm circuit if speech transmission is not detected over either interexchange trunk.

8. In an announcing system, a first exchange area having a central announcing bureau, a second exchange area having a plurality of offices and a distributing point associated therewith, subscribers' lines terminating in said offices, a pair of identical interexchange trunks extending between said exchanges and multiplied at said first exchange to said bureau, a plurality of announcement trunks extending from said offices and multiplied at their outgoing ends to said interexchange trunks, means in said offices for concurrently extending connections from calling lines over said trunks to said bureau, means at said distributing point operative whenever one or more of said announcement trunks is in a calling condition and said bureau is conditioned for transmitting announcements for establishing a supervisory circuit over each of said interexchange trunks, means at said distributing point operative upon the establishment of either of said supervisory circuits for controlling the cut-through and subsequent disruption of speech transmission paths from calling lines over said announcement trunks to said bureau, each of said interexchange trunks having a repeater, a speech detection device and a timing means individual thereto, means periodically controlled by each of said timing means for testing to ascertain if its associated speech detection device has detected the transmission of speech, and means controlled by said testing means for preventing the further cut-through of speech transmission paths if no speech transmission is detected on either of said interexchange trunks.

9. In an announcing system, a first exchange area having a central announcing bureau, a second exchange area having a plurality of offices, subscribers' lines terminating in said offices, a pair of identical interexchange trunks extending between said exchanges and multiplied at said first exchange to said bureau, each of said trunks having a repeater, a speech detection device and a timing means individual thereto, a plurality of announcement trunks extending from said offices and multiplied at their outgoing ends to said interexchange trunks, means in said offices for concurrently extending connections from calling lines over said trunks to said bureau, means periodically controlled by each of said timing means for testing to ascertain if its associated speech detection device has detected the transmission of speech, means periodically controlled by each of said timing means for restoring its associated speech detection device, and means controlled by said testing means if either of said speech detection devices fails to detect the transmission of speech or if said speech detection devices fail to restore for closing an alarm circuit.

10. In an announcing system, a first exchange area having a plurality of offices, a first distributing point common to said offices, subscribers' lines terminating in said offices, a plurality of trunks extending from said offices and multiplied at their outgoing ends to a pair of identical interexchange trunks, means in said offices for concurrently extending connections from calling lines over said first trunks to said interexchange trunks, a second exchange area having a plurality of offices and a central announcing bureau, a second distributing point associated with said bureau, subscribers' lines terminating in the offices of said second exchange area, a second plurality of trunks extending from said latter offices and multiplied together with

said interexchange trunks to said bureau, means in said latter offices for concurrently extending connections over said second trunks to said bureau, means at said first distributing point operative whenever one or more of said first plurality of trunks is in a calling condition and said bureau is conditioned for transmitting announcements for establishing a supervisory circuit over each of said interexchange trunks, means controlled over said supervisory circuits or from said second plurality of trunks for transmitting a start signal to said second distributing point to control the cut-through and disruption of transmission paths from calling lines in said second exchange over said second plurality of trunks to said bureau and means controlled by the establishment of said supervisory circuits for transmitting a start signal to said first distributing point to control the cut-through and disruption of transmission paths from calling lines in said first exchange over said first plurality of trunks and said interexchange trunks to said bureau.

11. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three announcing machines in said bureau any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being out of service in reserve, and switching means for successively placing different pairs of said machines in service whereby upon each switching operation, the machine which is at the time connected to said trunks is placed in reserve or out of service, the machine which is serving as a spare is connected to said trunks and the machine which is held in reserve is placed in service as a spare.

12. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three announcing machines at said bureau any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being held out of service in reserve, switching means for successively placing different pairs of said machines in service, a monitoring operator's turret, an in-service lamp on said turret for each machine, an out-of-order lamp on said turret for each machine, and means for lighting the corresponding lamp when any machine is in service or out of order.

13. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three announcing machines at said bureau any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being out of service in reserve, switching means for successively placing different pairs of said machines in service, a speech level indicator associable with an in-service machine while it is connected to said trunks and means controlled thereby if the speech level output of said machine is too low or no speech current is detected for transferring said trunks from connection with said machine into connection with the spare machine.

14. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three announcing machines at said bureau any two of which may normally be in service, one connected to said trunks and one maintained as a spare,

the remaining machine being held out of service in reserve, switching means for successively placing different pairs of said machines in service, a speech level indicator associable with an in-service machine while it is connected to said trunks, means controlled by said speech level indicator if the speech level output of said machine is too low or no speech current is detected for transferring said trunks from connection with said machine into connection with the spare machine, and means controlled by said indicator for operating a minor alarm to indicate that one of the machines has failed and has been removed from service.

15. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three announcing machines at said bureau any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being held out of service in reserve, switching means for successively placing different pairs of said machines in service, a first speech level indicator associable with an in-service machine while it is connected to said trunks, means controlled by said indicator if the speech level output of said machine is too low or no speech current is detected for transferring said trunks from connection with said machine into connection with the spare machine and for operating a minor alarm, a second speech level indicator associable with said spare machine while it is connected to said trunks, and means controlled by said second indicator if the speech level output of said spare machine is too low or no speech current is detected for operating a major alarm.

16. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three announcing machines at said bureau any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being held out of service in reserve, switching means for successively placing different pairs of said machines in service, a monitoring operator's turret, an in-service lamp and an out-of-order lamp on said turret for each machine, means for lighting the corresponding in-service lamp when any machine is in service, a speech level indicator associable with an in-service machine while it is connected to said trunks, means controlled by said indicator if the speech level output of said machine is too low or no speech current is detected for transferring said trunks from connection with said machine into connection with said spare machine, and means operable upon the removal of said defective machine from service for lighting the corresponding out-of-order lamp on said turret.

17. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three magnetic tape announcing machines at said bureau any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being held out of service in reserve, switching means for successively rendering different pairs of said machines available for service, a monitoring operator's turret having a record erasing key, a recording key and a recording transmitter thereon, means responsive to the operation of said erasing key for controlling the erasure of the records of the tapes of the spare and reserve

- machines, means responsive to the operation of said recording key for connecting said transmitter for recording new records on the tapes of said spare and reserve machines, a speech level indicator, means for associating each newly recorded machine with said speech level indicator for checking its speech level output, and a cut-in key on said turret for operating said switching means to transfer the machine then in service to reserve, to connect said newly recorded spare machine to said trunks for service and to prepare said newly recorded reserve machine for spare service only if the records when checked are found to have a proper speech level output.
18. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three magnetic tape announcing machines at said bureau any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being held out of service in reserve, switching means for successively rendering different pairs of said machines available for service, a monitoring operator's turret having a record erasing key, a recording key, a low speech level lamp, a high speech level lamp and a recording transmitter thereon, means responsive to the operation of said erasing key for controlling the erasure of the records on the tapes of the spare and reserve machines, means responsive to the operation of said recording key for connecting said transmitter for recording new records on the tapes of said spare and reserve machines, a speech level indicator, means for associating each newly recorded machine in turn with said indicator, means controlled by said indicator for selectively lighting said lamps when said indicator detects either a low or high level output of the machine connected thereto, and a cut-in key on said turret for operating said switching means to transfer the machine then in service to reserve, to connect said newly recorded spare machine to said trunks for service and to prepare said newly recorded reserve machine for spare service only if the records when checked by said indicator are found to have a proper speech level output.
19. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three magnetic tape announcing machines at said bureau any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being held out of service in reserve, switching means for successively rendering different pairs of said machines available for service, a monitoring operator's turret having a record erasing key, a recording key, recording lamps individual respectively to said machines and a recording transmitter thereon, means responsive to the operation of said erasing key for controlling the erasure of the records on the tapes of the spare and reserve machines and for lighting the corresponding recording lamps to indicate that such machines should be recorded, means responsive to the operation of said recording key for connecting said transmitter for recording new records on the tapes of said spare and reserve machines, a speech level indicator, means for associating each newly recorded machine in turn with said indicator for checking the speech level output thereof, and a cut-in key on said turret for operating said switching means to transfer the machine then in service to reserve, to connect said newly recorded spare machine to said trunks for service and to prepare said newly recorded reserve machine for spare service only if the records when checked are found to have a proper speech level output.
20. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three announcing machines any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being held out of service in reserve, switching means normally operative for successively rendering different pairs of said machines available for service, means for removing a defective machine from service, a monitoring operator's turret having a cut-in key thereon, and means responsive to the operation of said cut-in key and under the control of said latter means for transferring the machine in service to reserve and for connecting the single available machine to said trunks.
21. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three announcing machines any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being held out of service in reserve, switching means normally operative for successively rendering different pairs of said machines available for service, a make-busy key for each machine for removing it from service if it is found to be defective, a monitoring operator's turret having a cut-in key thereon and means responsive to the operation of said cut-in key if one of said make-busy keys has been operated for transferring the machine in service to reserve and for connecting the single available machine to said trunks.
22. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three announcing machines any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being held out of service in reserve, switching means normally operative for successively rendering different pairs of said machines available for service, means for removing defective machines from service, a monitoring operator's turret having recording lamps individual respectively to said machines and a cut-in key thereon, means responsive to the operation of said cut-in key if said latter means are operated for cutting into service an available one of said machines and means for flashing the lamp of any machine which has been removed from service as an indication that such machine should be rerecorded immediately.
23. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, three magnetic tape machines any two of which may normally be in service, one connected to said trunks and one maintained as a spare, the remaining machine being held out of service in reserve, switching means for successively rendering different pairs of said machines available for service, a monitoring operator's turret having a record erasing key, a recording key, a recording transmitter and manual announcement jacks thereon, said jacks being individual respectively to said machines, means responsive to the

connection of said transmitter with the jack allocated to the machine in service for disconnecting said machine from said trunks and for connecting said transmitter to said trunks, means responsive to the operation of said erasing key for erasing the records from the tapes of said other machines and means responsive to the operation of said recording key for connecting said transmitter to said other machines whereby a message is simultaneously manually transmitted to said trunks and is recorded on the tapes of the machines at the time associated with said transmitter.

24. In an announcing system, a central announcing bureau, a plurality of offices, trunks incoming to said bureau from said offices, announcing machines one of which is in service and connected to said trunks and another of which is maintained as a spare, a manual transfer key and means controlled thereby for transferring said trunks from connection with the machine in service into connection with the spare machine.

WILLIAM BENNETT.