April 26, 1949. N. A. NEWELL 2,468,305

SIGNALING SYSTEM

Filed Nov. 1, 1946 4 Sheets-Sheet 1

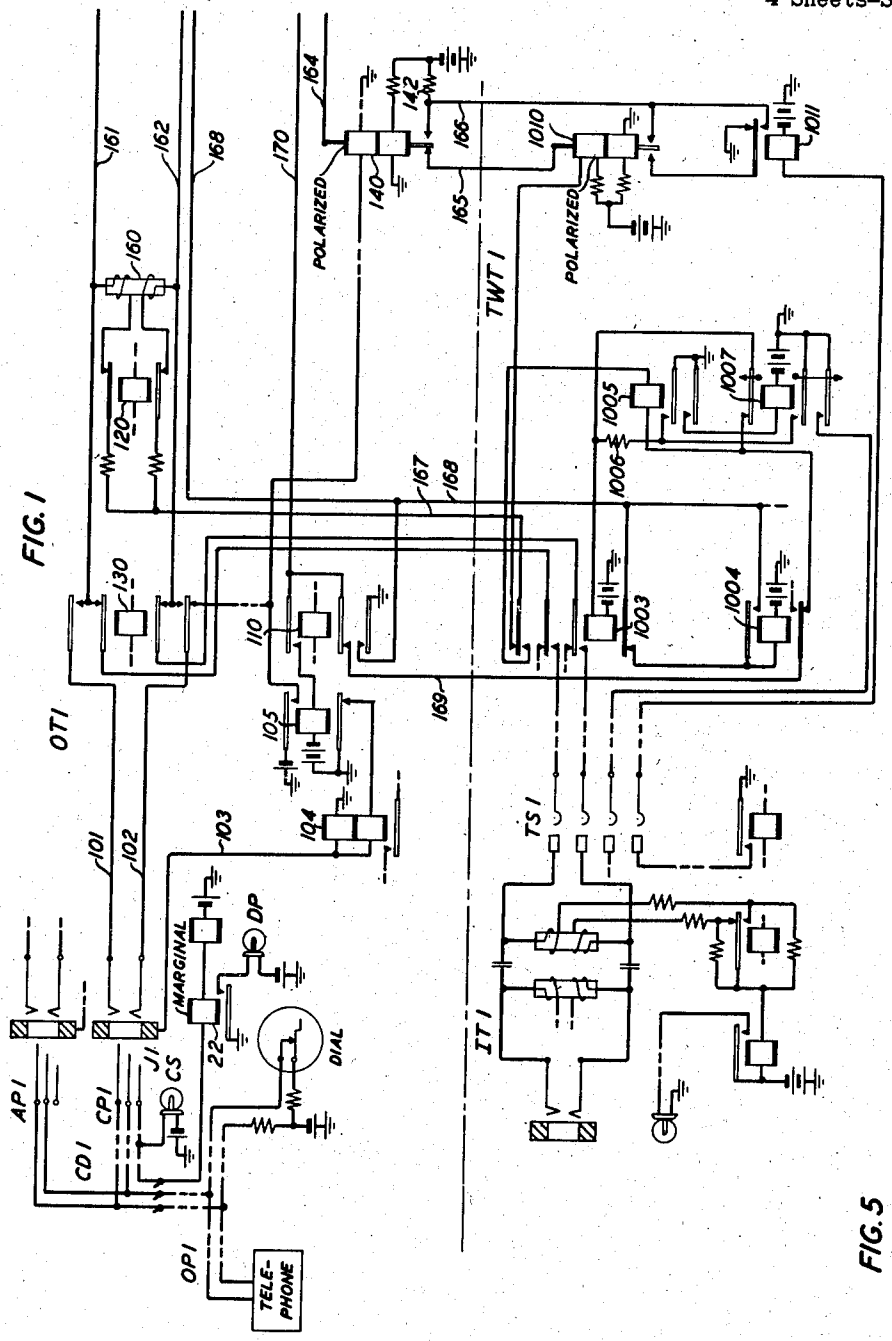


FIG. 1

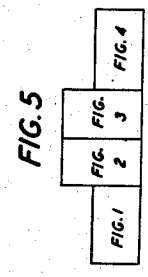


FIG. 5

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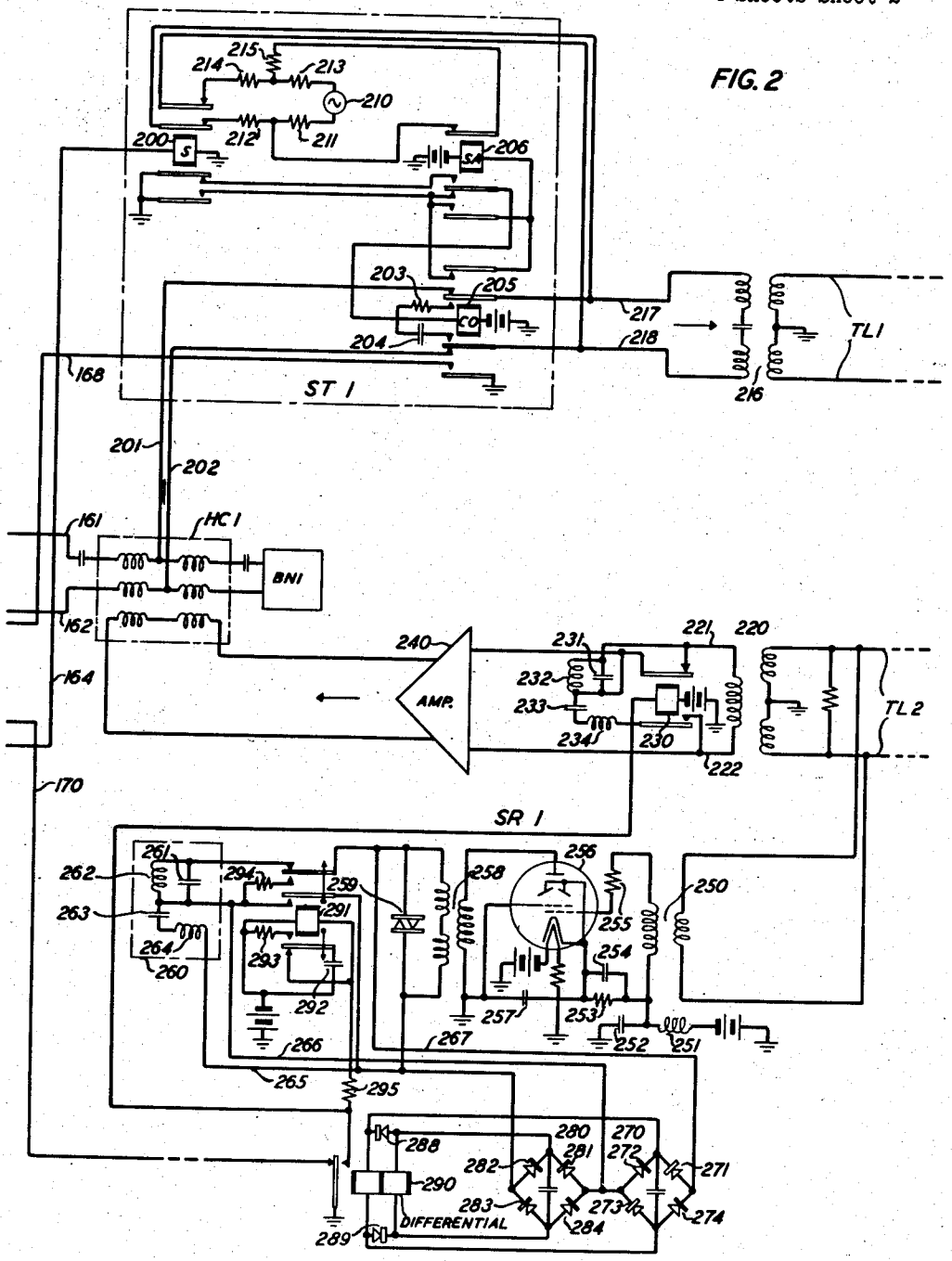
SIGNALING SYSTEM

Filed Nov. 1, 1946

4 Sheets-Sheet 2

FIG. 2

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SIGNALING SYSTEM

Filed Nov. 1, 1946 4 Sheets-Sheet 3

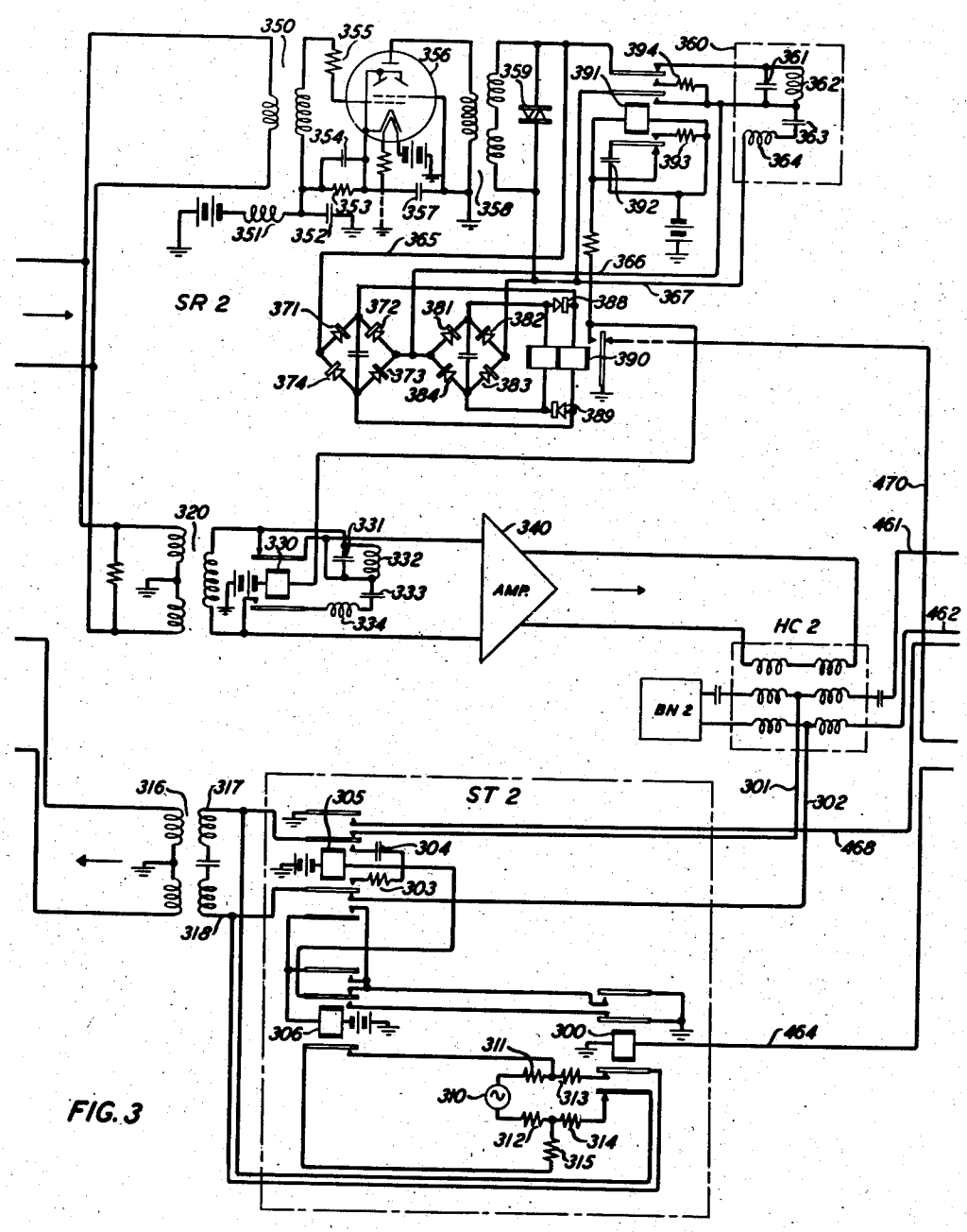


FIG. 3

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April 26, 1949. N. A. NEWELL 2,468,305

SIGNALING SYSTEM

Filed Nov. 1, 1946 4 Sheets-Sheet 4

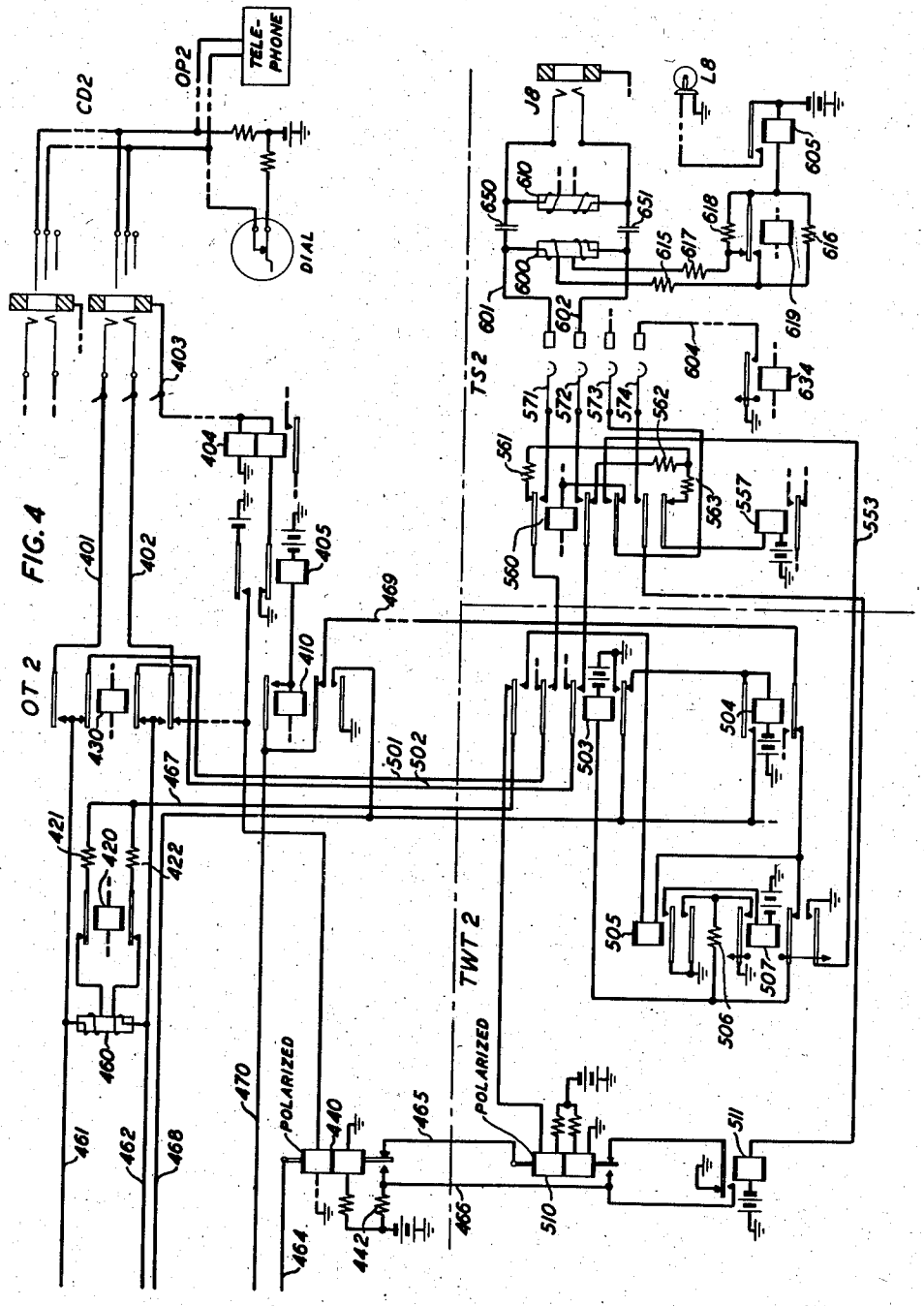


FIG. 4

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2,468,305

# UNITED STATES PATENT OFFICE

2,468,305

## SIGNALING SYSTEM

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Application November 1, 1946, Serial No. 707,255

5 Claims. (Cl. 179—1)

1

This invention relates to signaling systems and particularly to systems in which signaling is effected by the transmission of alternating currents.

Objects of the invention are the provision of more reliable signal receiving means for response to alternating current signals and the prevention of false operation of the signal receiving means responsive to interference currents having components of the particular frequency or frequencies used for the transmission of signals.

This invention is a signaling system in which the termination of currents of a particular frequency normally transmitted over a line constitute the first signal, in which an impulse of current of said particular frequency constitutes a second signal and in which the continued transmission of current of said particular frequency constitutes a third signal. A feature of the invention is a signal receiver comprising voltage dividing networks tuned to the signal frequency and connected through uni-directional devices to differentially energize the windings of a signal relay and effect operation of the relay only when current of the signaling frequency predominates.

Another feature of the invention is a signaling and switching system in which a signal receiver located at an intermediate switching point in the system is arranged to respond to signals transmitted over a line by current of a particular frequency and comprises means for connecting a band elimination filter unit in the line and bridging a band-pass filter unit across the line when the signal receiving relay is operated thereby to prevent interference from echoes and to substantially prevent the transmission of the signal current beyond the switching point.

A clear and complete understanding of the invention will be facilitated by considering a system embodying the invention and its features, one such system being represented schematically in the drawing of this specification. The invention is not limited in its application to the system and circuit arrangements shown in the drawings but is applicable generally to any system in which signals are transmitted by voice frequency alternating currents.

Referring to the drawings:

Figs. 1 and 2 represent a first toll office comprising an operator position OP1, an outgoing trunk OT1, a two-way trunk circuit TWT1, a selector TS1, an incoming trunk circuit IT1, a signal transmitting circuit ST1, and a signal receiving circuit SR1;

Figs. 3 and 4 represent a second toll office com-

2

prising an operator position OP2, an outgoing trunk OT2, a two-way trunk circuit TWT2, a selector TS2, an incoming trunk circuit IT2, a signal transmitting circuit ST2, and a signal receiving circuit SR2; and

Fig. 5 shows the relative positions of Figs. 1 to 4 to form an operative arrangement.

The system represented in the drawings includes a plurality of toll offices, each of which comprises a toll switch board with operators' positions and cords for answering calls incoming from manual or dial local offices, from toll subscribers' lines, from community dial offices, or from other toll offices; and for connecting calling intertoll trunks with switching trunks leading to called local manual or dial offices, to called toll subscribers' lines, to trunks to community dial offices, and to intertoll trunks to other toll offices. Outgoing jacks are connected to switching trunks, toll subscribers' lines, trunks to community dial offices and intertoll trunks. Answering jacks are connected to recording trunks, toll subscribers' lines, trunks from community dial offices and intertoll trunks. Intertoll first selectors, and intertoll second selectors, if required, are provided for use on calls incoming over intertoll trunks to establish connections with other toll, local or community dial offices. The operators' positions are provided with dials for use in controlling the operation of intertoll selectors in other toll offices and for controlling the operation of selector and connector switches in local or community dial offices.

Reference may be had to the patent to R. E. King and O. R. Miller No. 2,209,777 granted July 30, 1940 and to the patent to J. G. Walsh No. 2,306,236 granted December 22, 1942 for a complete disclosure of cord and operator position circuits provided in each of the two toll offices for interconnecting calling and called lines and trunks and controlling the completion of toll calls. The outgoing trunk circuits OT1 and OT2, incoming trunk circuits IT1 and IT2, two-way trunk circuits TWT1 and TWT2, and the toll route selector circuits TS1 and TS2 are all similar to corresponding circuits of the aforementioned King-Miller and Walsh patents.

The two toll offices shown in the drawings are interconnected by four-wire lines, one being shown in the drawings as consisting of two, two-wire lines TL1 and TL2 associated with trunk circuits OT1 and TWT1 in the first toll office and with trunk circuits OT2 and TWT2 in the second toll office. The line TL1 is used to transmit voice and voice frequency signaling currents from

the first toll office to the second and the line TL2 is used to transmit voice and voice frequency signaling currents from the second toll office to the first. A hybrid coil HC1 individual to the trunk circuits OT1 and TWT1 is arranged to transmit voice currents from these trunk circuits over toll line TL1 to the second toll office; and voice currents incoming over line TL2 are transmitted through repeating coil 220, a one-way amplifier 240 and hybrid coil HC1 to the trunk circuits. A like hybrid coil HC2 individual to the trunk circuits OT2 and TWT2 is arranged to transmit voice currents from the trunk circuits over toll line TL2 to the first toll office; and voice currents incoming over toll line TL1 are transmitted through repeating coil 320, one-way amplifier 340 and hybrid coil HC2 to these trunk circuits. Balancing networks BN1 and BN2 are connected to hybrid coils HC1 and HC2 in usual and well-known manner.

The signal transmitter ST1 comprises a generator 210 which generates alternating current of a particular voice frequency, for instance 3,200 cycles per second, a relay 200 responsive to seizure, selective, supervisory and disconnect signals which are to be transmitted over the toll line TL1, an auxiliary relay 206 and a cut-off relay 205 for disconnecting the toll line TL1 from the hybrid coil HC1 during the transmission of signals outgoing over toll line TL1. The generator 210 is normally connected through resistors 211 and 212, resistors 213 and 214, back contacts of relay 200, conductors 217 and 218, and windings of repeating coil 216 to the conductors of toll line TL1, the continued presence of a tone of 3,200 cycles on the toll line indicating that the line is idle. A one-way amplifier 240, connecting the toll line TL2 to the hybrid coil HC1, prevents the transmission of signaling current from signal transmitter ST1 over toll line TL2.

The signal transmitter ST2 associated with toll line TL2 in the second toll office is similar to the signal transmitter ST1, corresponding elements having reference characters with the same tens and units digits. The signaling current from generator 310 is normally transmitted over toll line TL2; and the one-way amplifier 340 is effective to prevent the transmission of signaling current from generator 310 over toll line TL1.

The signal receiver SR1 comprises an input transformer 250 which is connected to the conductors of toll line TL2 in parallel with the primary winding of repeating coil 220 through which coil voice currents are transmitted to the input side of amplifier 240. The signal receiver SR1 further comprises a thermionic amplifier 256, an output transformer 258, a voltage dividing network 260, full wave rectifiers 270 and 280, a signal receiving relay 290 and an auxiliary relay 291. The resistor 255 in the grid circuit of tube 256 is a high resistance so that the signal receiver constitutes a high impedance shunt across the talking channel. Resistor 255 is also effective to limit the voltages applied to the grid of tube 256 due to the voltage drop in resistor 255 when there is current in the grid cathode circuit. A varistor 259 is bridged across the secondary winding of output transformer 248 to further limit the volume of the voltage applied across the tuned circuits of network 260 and rectifiers 270 and 280. The voltage dividing network 260, which is bridged across the output winding of the secondary winding of transformer 258, consists of two tuned circuit units connected in series, one unit being parallel resonant and the other series resonant at the signaling frequency. The parallel tuned circuit unit consists of condenser 261 and coil 262 connected in parallel, and the series tuned circuit unit consists of condenser 263 and coil 264 connected in series. A full wave rectifier 270 comprising copper-oxide type rectifiers 271, 272, 273 and 274 is connected across the parallel resonant circuit unit and a full wave rectifier 280 comprising rectifiers 281, 282, 283 and 284 is connected across the series resonant circuit unit of network 260. One winding of the signal receiving relay 290 is connected across the output terminals of rectifier 270 and the other winding of relay 290 is connected across the output terminals of rectifier 280 in such a manner that the windings are differentially energized. Two unidirectional conducting elements 288 and 289 are provided for shunting the winding which is connected to the series resonant circuit unit so as to prevent the operation of relay 290 when the current incoming over toll line TL2 is predominantly of frequencies other than the particular frequency used for signaling. When signaling current is being received over toll line TL2, the parallel resonant circuit unit 261, 262 constitutes a very high impedance and the series resonant circuit unit 263, 264 constitutes a low impedance; whereby the voltage applied across rectifier 270 is high and the voltage applied across rectifier 280 is low, so that the energization of the left winding of relay 290 exceeds the energization of the right winding of relay 290 sufficiently to effect the operation of this relay. When the current incoming over line TL2 consists of both signaling and non-signaling frequencies, which produce equal voltages across the parallel and series tuned circuits of network 260, the voltages applied through rectifiers 270 and 280 to the windings of relay 290 are equal and the relay 290 thus remains deenergized. When non-signalling frequencies predominate in the current incoming over line TL2, the impedance of the parallel resonant circuit unit is low and the impedance of the series resonant circuit unit is high; but due to the aforementioned shunting of the right winding of relay 290 by unidirectional elements 288 and 289, the energization of the right winding in one direction does not exceed the energization of the left winding in the opposite direction sufficiently to cause operation of the relay.

Since signaling current is normally transmitted over line TL2, relay 290 is normally operated; and so also are auxiliary relays 291 and 230. Relay 291, when operated, disconnects the parallel resonant circuit unit of network 260, short circuits the series resonant circuit unit of network 260, bridges resistor 294 across the secondary winding of transformer 258, and closes a circuit through resistor 293 for discharging condenser 292. Thus with relay 291 operated, the full voltage developed across the secondary winding of transformer 258 is applied across the resistor 294 and rectifier 270 energizing only the left winding of relay 290; so that the superimposing of voice currents or any interference currents of voice frequency on line TL2 is ineffective to cause the release of relay 290; and relay 290 remains operated until the transmission of signaling current over line TL2 is terminated. Relay 291 is rendered slow to operate by the connection of condenser 292 in parallel with the winding of relay 291 when relay 291 is not operated. Thus the protection against false operation of relay 290 provided by the tuned circuits of network 260 is not removed immediately when relay 290 operates. The time required for operating relay 291

due to the charging of condenser 292 is long enough so that relay 291 does not operate when relay 290 is being alternately operated and released responsive to dial impulses as hereinafter described. It is also the function of relay 291 to prevent release of relay 290 by voice currents transmitted over line TL2 from an answering operator in case the call is intercepted. To prevent interference from echoes and to prevent the transmission of signals incoming over to a line TL2 through amplifier 240, coil HC1, trunk circuits OT1 and TWT1 and out over another toll line on a built-up connection, the operation of relay 230 connects a parallel resonant circuit unit consisting of condenser 231 and coil 232 in series with the secondary winding of repeating coil 220 and bridges a series resonant circuit unit consisting of condenser 233 and coil 234 across the secondary winding of repeating coil 220. These circuit units are resonant at the signaling frequency, so little if any current of signaling frequency is transmitted through the voice channel while relay 230 is operated. Thus, signals incoming over toll line TL2 cannot be transmitted through the talking path to any other line with which trunk circuit OT2 may be connected. Furthermore, very little of the tone signal incoming over line TL2 is transmitted through amplifier 240 and hybrid coil HC1 back over toll line TL1 and the possibility of false operation of the signal receiver SR2 by echo effects is substantially prevented.

The signal receiver SR2 in the second toll office is similar to the signal receiver SR1, and the reference characters applied to corresponding elements have the same tens and units digits. Since signaling current is normally being transmitted from generator 210 of signal transmitter ST1 through repeating coil 216, over toll line TL1, relays 390, 391 and 330 are normally operated in similar manner to relays 290, 291 and 230 of signal receiver SR1 as above described and with like effect.

Assume now that the plug AP1 of the cord CD1 at position OP1 in the first toll office is inserted in an answering jack to answer a call incoming over a recording trunk or an intertoll trunk or a trunk from a community dial office, that the operator has determined the destination of the call, that the plug CP1 of this cord is inserted in a jack associated with an outgoing trunk circuit over which the call may be extended, and that the trunk OT1 is associated with the jack J1 into which the plug CP1 is inserted. The insertion of plug CP1 in jack J1 closes a circuit for operating relay 104, thereby causing the operation of relay 110 as described in the aforementioned King et al. patent and closing a circuit including conductor 102 for operatively energizing the upper winding of signaling relay 140. The operation of relay 110 disconnects the signaling conductor 170 from conductor 169 thereby to prevent the operation of relay 1003 of two-way trunk circuit TWT1 when ground is connected to signaling conductor 170, connects answering supervisory relay 105 of the trunk circuit OT1 to conductor 170, and connects ground to conductor 168 to operate relay 1004 of two-way trunk circuit TWT1. Relay 1004 locks to conductor 168 independent of relay 1003 and further opens the connection between the winding of relay 1003 and the signaling conductor 170. The operation of relay 140 connects signaling battery through resistor 142, to conductor 164 to operate signal relay 200 of the signal transmitter ST1. The operation of relay 200 terminates the transmission of signaling current of 3200 cycles per second from the generator 210 over toll line TL1, thereby causing the release of the normally operated relay 390 of signal receiver SR2. Relay 200 also closes a circuit through its inner lower front contact for operating cut-off relay 205. Relay 205 disconnects the repeating coil 216 of toll line TL1 from conductors 201 and 202 leading to the hybrid coil HC1, connects the repeater termination comprising resistor 203 and condenser 204 across the repeating coil 216, connects ground to conductor 168 to hold relay 1004 operated independent of relay 110, and closes a circuit for operating relay 206. Relay 206 locks under the sole control of relay 200, opens the operating circuit of relay 205, and opens the shunt circuit through resistor 215 across the generator 210 thereby to increase the voltage applied to conductors 217 and 218 when relay 200 releases as hereinafter described. The release of relay 205 disconnects the repeater termination and closes the talking connection between repeating coil 216 and hybrid coil HC1.



The termination of the signaling current normally transmitted over toll line TL1 effects the release of relay 390 of signal receiver SR1. The release of relay 390 connects ground to signaling conductor 470 to cause the operation of relay 503 of trunk circuit TWT2. The circuit for operating relay 503 is traced from ground at the back contact of relay 390, through conductor 470, lower back contact of relay 410 of trunk circuit OT2, conductor 469, back contact of relay 504 of trunk circuit TWT2, back contact of relay 507 and the winding of relay 503. Relay 503 connects ground to conductor 468, to guard the outgoing trunk circuit OT2 from being seized on an outgoing call, and closes a circuit for operating relay 505. This circuit is traced from ground at the back contact of relay 390, through conductor 470, lower back contact of relay 410 of outgoing trunk circuit OT2, conductor 469, back contact of relay 504 of two-way trunk circuit TWT2, winding of relay 505, uppermost front contact of relay 503, conductor 467, thence in simplex through resistors 421 and 422, back contacts of relay 420 of outgoing trunk circuit OT2, windings of retard coil 460, conductors 461 and 462, inner back contacts of relay 430, conductors 501 and 502, front contacts of relay 503, back contacts of relay 560 of selector TS2, resistors 561, 562 and 563, and the winding of line relay 557. The line relay 557 of toll selector TS2 is thereby operated and so also is relay 505 of the two-way trunk circuit TWT2. Relay 505 closes a circuit through resistor 506 for holding relay 503 operated and closes a circuit for operating the slow-to-release relay 507. Relay 507 also closes a circuit through resistor 506 for holding relay 503 operated, opens the operating circuit of relay 503 and connects ground to conductor 553 of selector TS2 to hold selector TS2 (and any additional selector through which the connection is extended in the second office) until the connection is released at the first toll office.

When the calling operator in the first toll office operates the dialing key, (not shown) the upper winding of relay 140 is controlled by the impulse contacts of the dial at position OP1. Each release and reoperation of relay 140, in response to the dialing of the first digit of the called number, opens and closes the circuit through conductor 164 and the winding of relay 200, causing a corresponding release and re-

operation of relay 200. When relay 200 releases responsive to the first impulse of the digit, generator 210 is reconnected through resistors 211, 212, 213 and 214, back contacts of relay 200 and conductors 217 and 218 to the repeating coil 216; and 3200 cycle current is transmitted over toll line TL1 during the interval that relay 200 is released. This current is amplified by tube 356 of signal receiver SR2 and effects the operation of relay 390. When relay 200 reoperates at the end of the first dial impulse, generator 210 is disconnected from conductors 217 and 218 thereby terminating the current of the signaling frequency to effect the release of relay 390 of signal receiver SR2. Thus, each release and reoperation of relay 140 in response to the dialing of the first digit of the called number opens and closes the circuit through conductor 164 to cause a corresponding release and reoperation of relay 200 whereby a series of impulses of current of signaling frequency are transmitted over toll line TL1, each impulse causing the momentary operation of relay 390. Accordingly, relay 390 momentarily disconnects ground from conductor 470 as many times as there are impulses in the series received over toll line TL1; and relay 505 of trunk circuit TWT2 and line relay 557 of selector TS2 are alternately released and reoperated a like number of times. Since relay 507 is slow in releasing, the response of relay 505 to dial impulses is ineffective to cause the release of relay 507. Each release of relay 557 causes the operation of the vertical stepping magnet (not shown) of selector TS2 whereby the brushes 571, 572, 573 and 574 are stepped up to the level corresponding to the digit dialed. At the end of this train of impulses, the brushes are advanced step-by-step in the selected level until a set of terminals connected to an idle trunk or succeeding selector is encountered; whereupon relay 560 is operated to extend a connection to the selected switch or trunk all in usual and well-known manner.

Each succeeding train of dial impulses created by the operation of the calling operator's dial is repeated by relay 140 to relay 200; and a corresponding train of impulses of voice frequency signaling current is transmitted over toll line TL1 to operate relay 390. The operation of relay 390, responsive to these trains of impulses, effects the transmission of corresponding trains of impulses through brushes 571 and 572 and the selected terminals of selector TS2 to operate succeeding switches through which the connection is extended or to operate digit registers. When dialing is completed, the dial key at position OP1 is restored to normal and relay 130 is operated in the manner described in the aforementioned King-Miller and Walsh patents to complete the talking connection between cord CD1 and hybrid coil HC1.

Assume that the call in question is one which is routed through selector TS2 and a selected idle incoming trunk circuit to a toll operator's position in the second toll office and that the selected trunk circuit IT2 terminates at jack J8. In this case, the operation of relay 560 of selector TS2 closes a circuit for operating line relay 605 of trunk circuit IT2. This circuit is traced from ground at the back contact of relay 390, through conductor 470, lower back contact of relay 410 of outgoing trunk circuit OT2, conductor 469, back contact of relay 504, winding of relay 505, outer upper front contact of relay 503, conductor 467, thence in simplex through resistors 421 and 422,



back contacts of relay 420, windings of retard coil 460, conductors 461 and 462, back contacts of relay 430, conductors 501 and 502, front contacts of relays 503 and 560, brushes 571 and 572 of selector TS2, conductors 601 and 602 of trunk circuit IT2, windings of retard coil 600, resistors 615, 616 and 617 and the winding of line relay 605. Relay 605 is operated by the current in this circuit thereby to hold relay 507 and thus maintain the connection of ground through conductor 553. Relay 605 closes a circuit for lighting lamp L8. When a plug of the cord CD2 at position OP2 is inserted in jack J8 to answer the call, the lamp L8 is extinguished and the talking connection is completed through condensers 650 and 651. Relay 634 is operated in the manner described in the aforementioned patent to J. G. Walsh and closes a circuit from ground through conductor 604, brush 574 of selector TS2, a front contact of relay 560, and the winding of relay 511 of two-way trunk circuit TWT2. The operation of relay 511 closes a circuit for operating relay 300 of signal transmitter ST2. This circuit is traced from battery through resistor 442, conductor 466, front contact of relay 511, back contact of relay 510, conductor 465, back contact of relay 440, conductor 464 and the winding of relay 300. The operation of relay 300 disconnects generator 310 from conductors 317 and 318 to terminate the transmission of signaling current over toll line TL2 and thereby cause the release of relay 290 of signal receiver SR1. The operation of relay 300 also closes a circuit for operating cut-off relay 305. Relay 305 opens the talking connection between the repeating coil 316 and hybrid coil HC2, connects the repeater termination comprising resistor 303 and condenser 304 across coil 316, connects ground to conductor 468 to maintain a busy indication for trunk circuits OT2 and TWT2 while a signal is being transmitted over line TL2, and closes a circuit for operating relay 306. The operation of relay 306 opens the operating circuit of relay 305 and opens the normally closed shunt circuit through resistor 315 across generator 310 thereby to increase the voltage applied across conductors 317 and 318 when relay 300 releases to transmit a signal, for instance an on hook or busy signal. The release of relay 305 disconnects the repeater termination from coil 316, reconnects repeating coil 316 to coil HC2, and opens the operating circuit of relay 306. Relay 306 is then operated under the sole control of relay 300.

The release of relay 290 responsive to the termination of signaling current over toll line TL2, when the call is answered by an operator at position OP2, causes the release of relays 291 and 230; and connects ground to conductor 170, thereby operating supervisory relay 105 of trunk circuit OT2. Relay 105 disconnects ground from the low resistance winding of sleeve relay 104 thereby causing the calling supervisory lamp CS to be extinguished to indicate that the call has been answered at the called toll office. When the answering operator disconnects cord CD2 from jack J8, relay 634 releases. The release of relay 634 disconnects ground from conductor 604 causing the successive release of relays 511 of trunk circuit TWT2 and relay 300 of signal transmitter ST2. The release of relay 300 reconnects generator 310 to coil 316 thereby transmitting signaling current over line TL2 to cause the reoperation of relay 290 of signal receiver SR1. The operation of relay 290 disconnects ground from conductor 170 releasing relay 105 and thereby causing the lighting of lamp CS to give the calling operator an on-

hook signal. The aforementioned release of relay 300 also causes the operation of relay 305 and the release of relay 306. The release of relay 306 causes the release of relay 305 and again closes the shunt circuit through resistor 315 across generator 310, whereby the voltage applied across conductors 317 and 318 is reduced and the signaling current transmitted over line TL2 is reduced to the normal, idle condition.

If a busy condition is encountered in extending the connection, for instance, if selector TS2 finds all trunks busy in the selected level, relay 511 of two-way trunk circuit TWT2 is alternately operated and released under the control of an interrupter (not shown), thereby causing the alternate operation and release of relay 300 of signal transmitter ST2. Relay 300 alternately disconnects and reconnects generator 310 to coil 316 so that signaling current is intermittently transmitted over line TL2 to cause the alternate release and reoperation of relay 290 of signal receiver SR1. The alternate release and reoperation of relay 290 cause the alternate operation and release of supervisory relay 105 of trunk circuit OT1, whereby the supervisory lamp CS of cord CD1 is intermittently extinguished and lighted thus giving the calling operator a busy signal.

When the calling operator disconnects plug CP1 from jack J1, relay 104 releases; but, if relay 105 is operated at this time, relays 110 and 140 are held operated. With relay 105 released, or as soon after the release of relay 104 as relay 105 releases, relays 110 and 140 were also released. The release of relay 140 causes the release of relay 200 whereby generator 210 is reconnected across conductors 217 and 218 thereby to effect the transmission of signaling current over line TL1 to effect the reoperation of relay 390 of signal receiver SR2. The release of relay 200 also causes the operation of relay 205 and the release of relay 206. The operation of relay 205 causes the release of relay 206 and closes the shunt circuit through resistor 215 across generator 210 whereby the voltage applied to conductors 217 and 218 is reduced to the normal level. The operation of relay 390 disconnects ground from conductor 470 causing the release of relay 505 of the trunk circuit TWT2 and line relay 605 of trunk circuit IT2. The continued release of relay 505 causes the release of relays 507 and 503 of trunk circuit TWT2 and the release of relay 560 of selector TS2 whereby selector TS2 is restored to normal in usual and well-known manner. The release of relay 503 also disconnects ground from conductor 468 thereby terminating the busy marking of trunk circuits OT2 and TWT2.

What is claimed is:

1. In a signaling system in which current of a particular frequency within the voice frequency range is used to effect the transmission of signals, a signal receiver, means for at times transmitting voice currents and/or signaling current to said receiver, a voltage dividing network in said receiver comprising a parallel resonant circuit and a series resonant circuit connected in series, both of said resonant circuits tuned to said particular frequency, means including volume limiting means in said receiver for applying across said resonant circuits in series voltages derived from the voice and signaling currents incoming to said receiver, a signal relay having two windings, rectifying means for applying the voltage across the parallel resonant circuit to energize one winding of said relay and the voltage across the series resonant circuit to energize the other winding of said relay, said windings being differentially energized, and uni-directional means shunting said other winding to permit operation of said relay only when the current incoming to said signal receiver is predominantly of said particular frequency.



2. In a signal receiver, an input circuit for receiving at times voice currents and/or signaling current of a particular frequency within the voice frequency range, an inductor and capacitor connected in parallel forming a parallel resonant circuit, an inductor and capacitor connected in series forming a series resonant circuit, said resonant circuits tuned to resonance at said particular frequency, means including volume limiting means for applying across said resonant circuits in series voltages derived from said input circuit, a signal relay, rectifier means for applying the voltages developed across said parallel resonant circuit to one winding of said relay, rectifier means for applying the voltages developed across said series resonant circuit to another winding of said relay, the energization of said other winding opposing the energization of said one winding, and uni-directional means shunting said other winding, whereby said relay is operatively energized when signaling current of said particular frequency is being received in said input circuit and is not energized when current of frequencies other than said signaling frequency predominates in said input circuit.

3. In a signal receiver, an input circuit for receiving at times voice currents and/or signaling current of a particular frequency within the voice frequency range, an inductor and capacitor connected in parallel forming a parallel resonant circuit, an inductor and capacitor connected in series forming a series resonant circuit, said resonant circuits tuned to resonance at said particular frequency, means including volume limiting means for applying across said resonant circuits in series voltages derived from said input circuit, a signal relay, rectifier means for applying the voltages developed across said parallel resonant circuit to one winding of said relay, rectifier means for applying the voltages developed across said series resonant circuit to another winding of said relay, the energization of said other winding opposing the energization of said one winding, uni-directional means shunting said other winding, whereby said relay is operatively energized only when signaling current of said particular frequency is being received in said input circuit, and means rendered effective by the operation of said relay to apply the voltages derived from said input circuit through the first mentioned rectifier means to energize only said one winding of said relay.

4. In a signal receiver, an input circuit for receiving at times voice currents and/or signaling current of a particular frequency within the voice frequency range, an inductor and capacitor connected in parallel forming a parallel resonant circuit, an inductor and capacitor connected in series forming a series resonant circuit, said resonant circuits tuned to resonance at said particular frequency, means including volume limiting means for applying across said resonant circuits in series voltages derived from said input circuit, a signal relay, rectifier means for applying the voltages developed across said parallel resonant circuit to one winding of said relay, rectifier means for applying the voltages developed across said series resonant circuit to another winding of said

relay, the energization of said other winding opposing the energization of said one winding, uni-directional means shunting said other winding, whereby said relay is operatively energized only when signaling current of said particular frequency is being received in said input circuit, and means including a relay operated responsive to the operation of said signal relay for disconnecting said parallel tuned circuit, for short circuiting said series tuned circuit, and for applying the entire voltage derived from said input circuit through the first mentioned rectifier means to energize only said one winding of said signal relay.

5. In a multioffice telephone system, a trunk line interconnecting a first and a second office, means in said first office for at times transmitting over said line voice currents and/or signaling current of a particular frequency within the voice frequency range, a talking channel in said second office for transmitting voice currents incoming over said line, a signal receiver in said second office connected to said line, said signal receiver comprising a signal relay and means for operating



said relay responsive to signaling current incoming over said line and for preventing the operation of said relay responsive to voice currents incoming over said line, an inductor and capacitor connected in parallel forming a parallel resonant circuit, an inductor and capacitor connected in series forming a series resonant circuit, said resonant circuits tuned to said particular frequency, and means for connecting said parallel resonant circuit in series in said talking channel and for bridging said series resonant circuit across said talking channel while said signal relay is operated.

NORMAN A. NEWELL.


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