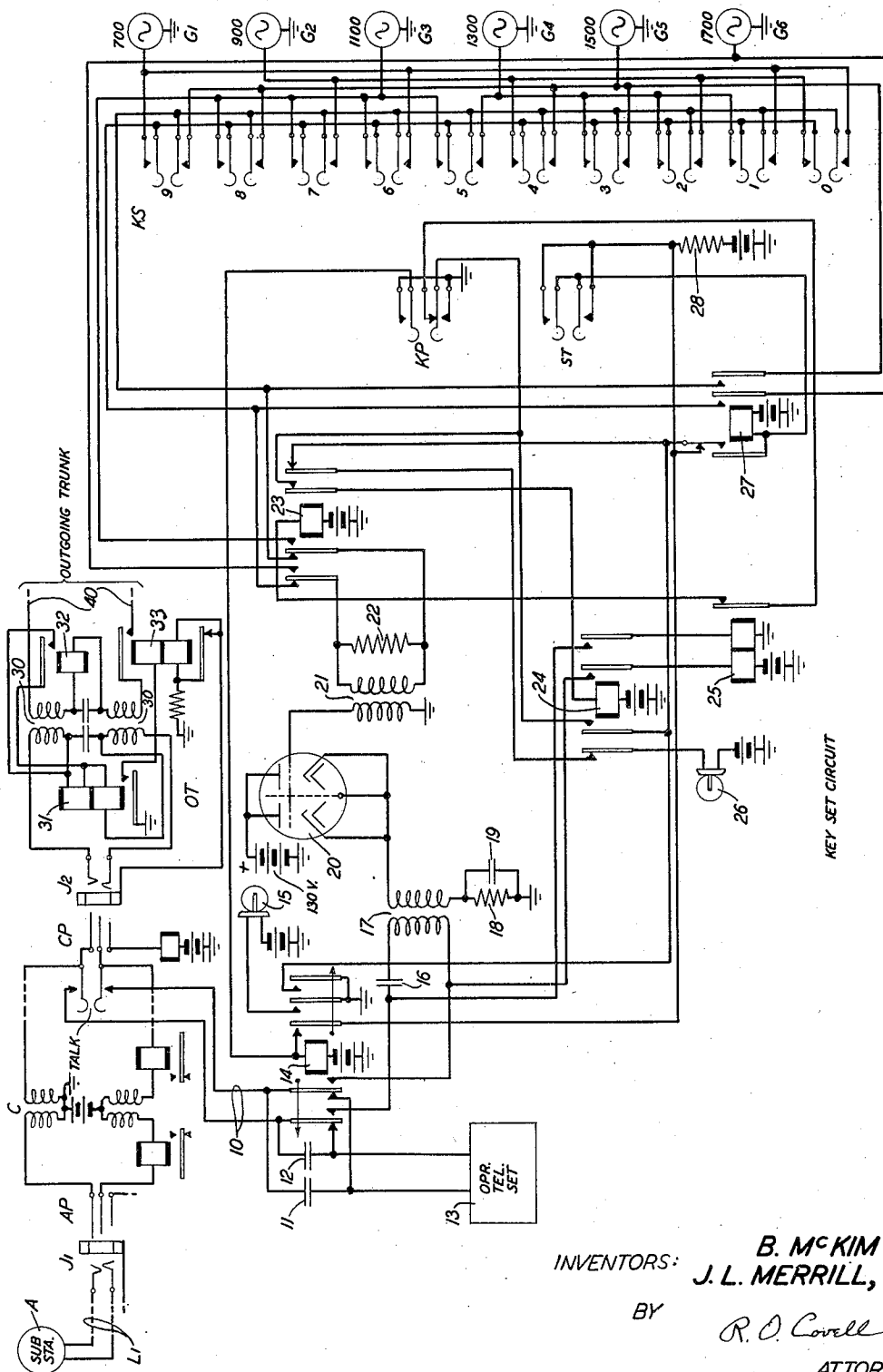


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TELEPHONE SYSTEM ARRANGED FOR VOICE
FREQUENCY SIGNALING
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TELEPHONE SYSTEM ARRANGED FOR VOICE
FREQUENCY SIGNALING

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This invention relates to telephone systems and particularly to systems in which selective signals are transmitted over the talking conductors of the connection by impulses of alternating current within the voice frequency range.

Objects of the invention are, the provision of keyset means at operator positions in local manual offices for extending calls to other offices arranged for receiving multifrequency key pulsing signals without necessitating any change in the cord circuits at these positions, the use of alternating current impulses of different frequencies within the voice frequency range for the transmission of selective signals over an outgoing trunk while maintaining the connection between the calling subscriber station and the trunk, and the prevention of voice interference with the transmission of the selective signals.

A system is disclosed in the patent to P. B. Murphy No. 2,283,251, granted June 30, 1942, in which a keyset common to the cord circuits at a toll operator's position is used to transmit selective signals consisting of different combinations of two frequencies of a plurality of signaling frequencies within the voice frequency range on calls to other offices arranged to receive such signals and comprising register-senders for controlling the operation of switching means to extend connections to called subscribers' stations. The cord circuits provided in the system shown in the Murphy patent are arranged so that the calling end of the cord is disconnected from the called end of the cord when the keyset is being used to transmit impulses over an outgoing trunk to which the calling end of the cord is connected. Since the cord circuits provided in local manual offices are not arranged to split the connection between the answering and calling plugs, the keyset circuit shown in the Murphy patent cannot be used at local manual positions without modifying the cord circuit. This invention is a keyset circuit for use at operator positions in local manual telephone offices arranged to transmit selective signals consisting of impulses of alternating current of different frequencies within the voice frequency range over the voice transmission path of trunks outgoing to dial or tandem offices comprising register means arranged to receive such signals and to register the corresponding called office codes and called subscribers' numbers. A feature of the invention is a keyset circuit comprising an amplifier of the cathode follower type through which alternating current impulses of voice frequency representing different letters and digits of a called subscriber's number are

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transmitted to the talking conductors of an associated cord circuit and thence through a connected outgoing trunk without disconnecting the calling station from the trunk.

Another feature of the invention is a keyset circuit as above described which, when associated with a cord interconnecting a subscriber station and an outgoing trunk, offers a very low impedance to voice currents transmitted from the subscriber station, whereby the transmission of selective signals from the key circuit over the trunk is not subjected to interference from voice currents received from the calling station.

These and other features of the invention will be further explained by describing in detail a system in which the invention is embodied, such a system being represented in the drawing forming a part of this specification.

The drawing consists of a single figure and shows in schematic form a telephone system comprising a local manual office including subscriber's station A, cord circuit C, outgoing trunk circuit OT, operator's telephone set 13, and a keyset circuit including the keyset KS.

The subscriber's station is of the well-known common battery type, removal of the receiver thereat to initiate a call being effective to operate the line relay and light an answering lamp in usual manner. The line relay and lamp are not shown in the drawing and only so much of the cord circuit C is shown as is necessary for a complete explanation of applicants' invention. Reference may be had to the aforementioned Murphy patent for disclosure of incoming trunk, selector, link, sender and signal receiving circuits in a dial office to which the outgoing trunk extends. The key set circuit is similar to that shown in the Murphy patent and differs therefrom principally in the provision of an amplifier of the cathode follower type for transmitting voice frequency current impulses to the talking conductors of the associated cord. This amplifier functions primarily as an impedance changing device and the signal voltage applied to the trunk is of the same order as that applied in similar multifrequency signaling circuit arrangements. The keyset KS is a ten button keyset, and depression of each of the ten buttons connects a different combination of two of the six tone sources G1 to G6 through transformer 21 to the input circuit of amplifier 20. The frequencies of the current generated by these sources may be, for example, 700, 900, 1100, 1300, 1500 and 1700 cycles per second, respectively. A key KP is provided for effecting the transfer of the cord circuit from the

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operator's telephone to the keyset circuit and a start key ST is provided for transmitting a start signal when all of the selective signals have been transmitted. Each of the "KP" and "start" signals also consists of an impulse of current of a different combination of two of the six frequencies used for signaling.

Assume now that a call is initiated at station A, that the answering plug AP of cord C is inserted by an operator into jack J1 to connect with calling subscriber's line L1 and that the talking key of cord C is operated, thereby extending the connection through conductors 10 and back contacts of relay 14 to the operator's telephone set 13. Assume further that the call in question is a call to a subscriber station served by the dial office in which outgoing trunk 40 terminates. The answering operator then inserts the calling plug CP in jack J2 associated with outgoing trunk circuit OT, thereby closing a circuit from battery and ground, through the right windings of the repeating coil and the tip and ring conductors of plug CP and jack J2, left windings of repeating coil 30 of trunk circuit OT and through both windings of relay 31. Relay 31 is thereby operated, closing a circuit for operatively energizing the upper winding of relay 33. The operation of relay 33 connects the winding of relay 32 across the conductors of outgoing trunk 40. While incoming trunk and link circuits in the dial office are operating to effect the connection of the trunk to an idle signal receiving circuit and an idle sender circuit, relay 32 is operated, thereby short-circuiting the high resistance upper winding of relay 31 to give an "off hook" signal. After inserting plug CP in jack J2, the operator momentarily depresses the KP key of the keyset circuit. The operation of key KP closes circuits for operating relays 14 and 24. Relay 14 closes a locking circuit through its winding and right inner front contact, continuity back contact of relay 27, and the outer right front contact of relay 14. Relay 24 closes a locking circuit which includes the inner right back contact of relay 23, inner left front contact of relay 24 and the outer right front contact of relay 14. Thus, relays 14 and 24 remain operated after key KP is released. With relay 14 operated, the operator's telephone set is disconnected from the cord; and lamp 15 is lighted to indicate that the keyset circuit is attached to the cord. With relay 14 operated the secondary winding of the amplifier output transformer 17 is connected in series with condenser 16 across the tip and ring conductors of the cord. The condenser 16 is of large capacity and the secondary winding of transformer 17 is of low resistance and of low impedance at voice frequencies so as to prevent voice currents generated at the calling station from interfering with selective signal impulses transmitted over the outgoing trunk as hereinafter described. With both relays 14 and 24 operated, a circuit is closed for operating relay 25. This circuit is traced from battery through the left winding of relay 25, inner right front contact of relay 24, inner left front contact of relay 14, lower contact of the cord TALK key, ring conductors of plug CP and jack J2, lower left winding of repeating coil 30 of trunk circuit OT, lower (low resistance) winding of relay 31, front contact of relay 32, upper left winding of repeating coil 30, tip conductors of jack J2 and plug CP, upper contact of the TALK key, outer left front contact of relay 14, outer right front contact of relay 24, and right winding of relay 25 to ground.

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The operation of relay 25 opens the operating circuit of relay 23; and the operation of relay 24 prevents the lighting of lamp 26.

When a signal receiving circuit and an idle sender are attached through a link in the dial office to the incoming trunk circuit associated with trunk 40, the off-hook signal condition of the incoming trunk circuit is changed to the on-hook signal condition to cause the release of relay 32 in trunk circuit OT. The release of relay 32 opens the short-circuit across the high resistance upper winding of relay 31 to cause the release of relay 25 in the keyset circuit. The release of relay 25 closes a circuit, for operating relay 23, from battery through the winding of relay 23, back contact of relay 25, lower normally closed contact of the KP key, left front contact of relay 24, and outer right front contact of relay 14. The operation of relay 23 causes the release of relay 24 and connects tone sources G3 and G6 in series with the primary winding of input transformer 21; whereby an impulse of the two particular frequencies generated by these sources is transmitted through transformer 21, amplifier tube 20, output transformer 17, condenser 16, front contacts of relay 14, conductors 10, contacts of the talking key of the cord, tip and ring conductors of plug CP and jack J2 and through repeating coil 30 over the trunk 40 to the dial office. These tones are also transmitted through the repeating coil of cord C, plug AP, jack J1 and line L1 to the calling station A. When relay 24 releases, it causes the release of relay 23, thereby terminating the transmission of the KP signal by disconnecting generators G3 and G6 from the primary winding of transformer 21. Lamp 26 is lighted by the release of relays 23 and 24 as an indication to the operator that a sender is attached and digit keying may be started. The keys of the keyset KS are now depressed, one at a time in succession according to the called subscriber's directory number, thereby successively applying to the input circuit of the amplifier 20 the required two of the six tone sources to transmit a selective signal impulse identifying each digit of the directory number. When all of the digits have been transmitted, the start key ST is momentarily depressed to close a circuit for operating relay 27. Relay 27 locks under control of relay 14 and connects tone sources G5 and G6 to the input circuit of amplifier so as to transmit the start signal over trunk 40 to the dial office. The operation of relay 27 opens the locking circuit of relay 14; and the release of relay 14 causes the release of relay 27 to terminate the transmission of the start signal impulse. The release of relay 14 disconnects the secondary winding of transformer 17 from, and reconnects the operator's telephone set to, the cord C. Relay 14 is slow in releasing so that it will not release before relay 27 operates due to the shunt across its winding through resistor 28 while the ST key is operated. Completion of the desired connection is under control of the sender in the dial office. Answering supervision is repeated by relays 32 and 31 to the calling supervisory relay of cord C. When the calling subscriber replaces the receiver, the answering supervisory relay of cord C releases and the operator disconnects the cord from jacks J1 and J2. Relays 31 and 33 release when plug CP is removed from jack J2.

What is claimed is:

1. In a telephone system, a calling station, a trunk, a cord interconnecting said station and

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trunk, and a keyset circuit connected to said cord for transmitting selective tone signals over said trunk, each different signal consisting of a different combination of tones, said keyset circuit comprising a plurality of tone sources, means for selecting the sources of tone required for transmitting each different selective signal, and amplifier means for transmitting signaling current from the selected tone sources through said cord to said trunk, the output circuit of said amplifier being of low enough impedance with respect to speech currents from said calling station as to prevent signal interference due to speech current from said calling station while a signal is being transmitted.

2. In a telephone system, a calling station, a trunk, a cord interconnecting said station and trunk, and a keyset circuit connected to said cord for transmitting selective tone signals over said trunk, each of said signals consisting of alternating current of a particular combination of frequencies within the voice frequency range, said keyset circuit comprising a plurality of alternating current generators each of a different frequency, means comprising an amplifier of the cathode follower type for applying current from said sources through said cord to said trunk, and means for selectively connecting the required current generators to the input circuit of said amplifier to effect the transmission of any desired signal.

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3. In a telephone system, a telephone station, a trunk line, means closing a talking connection between said station and trunk line, signaling means comprising a source of signaling current of voice frequency, and means for connecting said signaling means across said talking connection to enable the transmission of a signal from said source over said trunk, said means comprising a transformer and a condenser, one winding of the transformer and said condenser being bridged across said talking connection, said one winding having a low resistance and said condenser having a large capacitance so as to constitute a low impedance to voice frequency currents and thereby prevent signal interference due to speech currents from said station.

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