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D. SMITH

NETWORK CONTROLLING CIRCUITS

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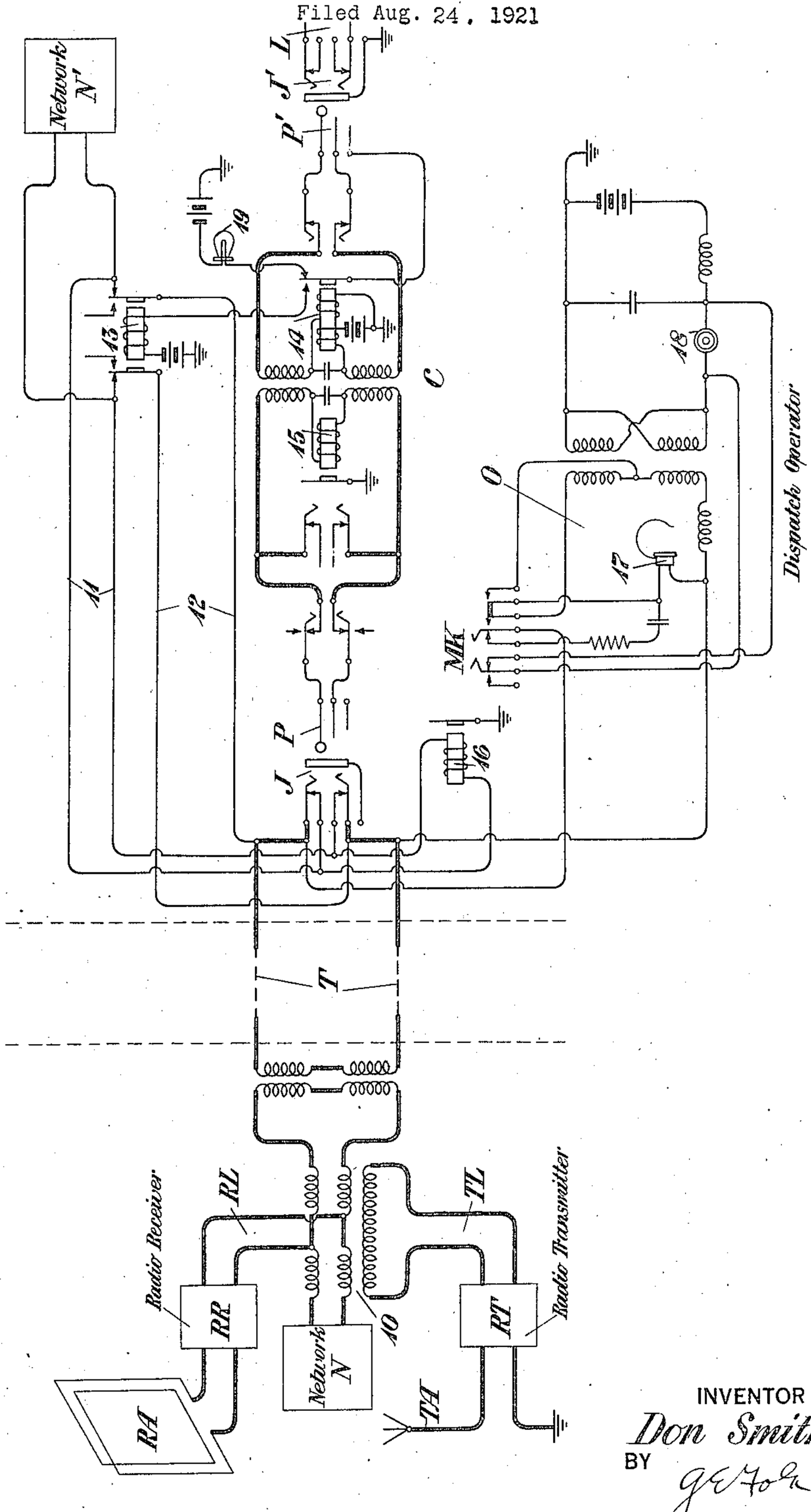

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NETWORK CONTROLLING CIRCUITS.

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To all whom it may concern:

Be it known that I, DON SMITH, residing at 1476 California St., San Francisco, in the county of San Francisco and State of California, have invented certain Improvements in Network Controlling Circuits, of which the following is a specification.

This invention relates to transmission circuits and more particularly to circuits adapted for the transmission of signaling currents, such as telephonic currents.

Where it is desired to establish connections between lines terminating at a central switching office and a station involving a four-wire transmission element such as a repeater station, or a radio station, it sometimes occurs that the trunk extending from the switching office to the repeater or radio station will be so short that difficulty will be encountered in balancing the transmitting and receiving channels of the repeater or radio station. Where a trunk is electrically long the impedance of the terminal apparatus connected to the trunk at the switching station does not materially affect the balance at the repeater or radio station, but where the trunk is short, the impedance of the trunk circuit as seen from the radio or repeater station will vary considerably with the character of the terminal apparatus. It is one of the principal objects of this invention to produce a circuit arrangement whereby the difficulties due to balance in circuits of this character may be eliminated.

This object, as well as other objects of the invention, may be attained by means of the arrangements set forth in the following description and illustrated in the accompanying drawing, the figure of which shows one form of circuit arrangement embodying the invention.

Referring to the figure, a radio station is illustrated in which a transmitting antenna TA and a receiving antenna RA are associated with the trunk T leading to a central switching office. The antenna RA is associated with the trunk T through a receiving channel RL, including radio receiving apparatus conventionally indicated at RR. Similarly, the transmitting antenna TA is associated with the trunk T through a transmitting channel TL including radio transmitting apparatus conventionally indicated at RT.

In order that the transmitting channel TL and the receiving channel RL may be substantially conjugate, these channels are connected to the trunk T through the usual type of hybrid coil 10, and a network N is associated with the terminals of the hybrid coil opposite to the terminals connected to the trunk. The network N is designed so as to present an impedance equal to that of the trunk T plus a cord circuit and a subscriber's line of average length, and arrangements are provided at the opposite terminal of the trunk to maintain the impedance of the trunk, as viewed from the hybrid coil, substantially equal to that of the network N under all service conditions.

For this purpose an auxiliary network N′ is associated with the end of the trunk T terminating in the central switching office, the impedance of this network being equal to that of a cord circuit plus a subscriber's line of average length. The network N′ is arranged so that it will be associated with the trunk T at all times except when a connection is established through the cord circuit over a subscriber's line, and the subscriber has answered by taking his receiver off the switchhook. This result is accomplished by bridging the network across the end of the trunk over two independent pairs of conductors, one pair 11 leading to the trunk over contacts of the terminal jack J of the trunk, and the other pair 12 leading to the trunk over contacts controlled by a relay 13, which responds when the subscriber has his receiver removed from the switchhook.

C indicates the usual type of operator's cord circuit for establishing connections at a central office, this cord circuit terminating in a plug P adapted to cooperate with the jack J of the trunk at one end, and terminating at the other end in a plug P′ adapted to cooperate with the jack J′ connected with a subscriber's line L. The cord circuit is provided with a relay 14 through which battery current is supplied to the subscriber's line, said relay controlling the usual super-

visory lamp 19, and also controlling the relay 13. A drop 15 is connected with the trunk side of the cord circuit and a similar drop 16 is connected to contacts of the jack J so that the drop 16 will be disconnected when the plug P is inserted in the jack. A despatch operator's set O is permanently bridged across the trunk for monitoring purposes. This set is provided with a monitoring key MK, which when in normal position, bridges the operator's receiver 17 across the trunk independently of the remainder of the set and maintains a short circuit closed about the terminals of the transmitter 18. When the key MK is actuated the receiver 17 is connected across one winding of the transformer and the transmitter 18 is rendered operative by opening the short circuit about its terminals. With the key MK actuated the despatch operator is enabled to both talk and listen over the trunk.

Further details of the apparatus will be clear from a description of the operation. Under normal conditions the balance is maintained between the network N and the trunk T by reason of the fact the network N′ is connected to the end of the trunk. Should a call come in from the radio station to the central office the drop 16 would be actuated in a well known manner and the operator would insert the plug P of the cord C into the jack J, thereby disconnecting the drop 16 and substituting the supervisory drop 15 of the cord circuit. The insertion of the plug P in the jack J also disconnects the connections 11 of the network N′ from the trunk, but an independent connection over conductors 12 still remains between the network N′ and the trunk T.

Having ascertained the line to which connection is desired the operator inserts the plug P′ in the jack J′ of the line L, leading to the desired subscriber, and rings over the line by means of the ringing key. A circuit for the supervisory lamp 19 is completed as soon as the plug P′ is inserted in the jack J′, this circuit extending over the sleeve contacts of the plug and jack and over the back contact of the supervisory relay 14. When the called subscriber answers by removing the receiver from the switchhook the relay 14 is energized, thereby opening the circuit of the supervisory lamp 15 and completing a circuit for the relay 13 which opens the conductors 12 from the network N′ to the trunk T. This operation amounts to substituting the subscriber's line and cord circuit for the network N′ and consequently the balance is still maintained at the radio station. The despatch operator, by means of the set O, may monitor the connection thus established without talking or by throwing the monitoring key MK may both talk and listen on the connection thus established. Should the operator at any time withdraw either the plug P or the plug P′ from the corresponding jack the network N′ will at once be connected to the trunk T to maintain the balance. At the termination of the conversation, the connection is taken down in the usual manner in response to the supervisory signal and the network N′ is at once switched into circuit.

Should the connection be established in the opposite direction, that is, from the subscriber's line L to the radio station, the operator will, in response to a call from the line L, insert the plug P′ in the jack J′, thereby establishing a circuit for the relay 13 and opening the connection 12 from the network N′ to the trunk T. The network still remains connected with the trunk, however, over the conductors 11. When the operator completes the call to the radio station by inserting the plug P in the jack J the conductors 11 are opened and the network is disconnected, the impedance of the cord circuit C and of the line 11 being substituted for the impedance of the network N′ so that a balance is still maintained.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a signaling system, a trunk circuit of such length that its impedance is not independent of terminal apparatus connected to one end of said trunk circuit, transmitting and receiving channels connected to the other end of the trunk circuit, a network for balancing said trunk circuit, said network having an impedance equal to the impedance of the trunk circuit as modified by the average impedance of various types of terminal apparatus which may be connected to the trunk circuit, and a network connected to the other end of the trunk circuit, said network having an impedance simulating that of the average terminal apparatus connected to the trunk.

2. In a signaling system, a trunk circuit of such length that its impedance is not independent of terminal apparatus connected to one end of said trunk circuit, transmitting and receiving channels connected to the other end of the trunk circuit, a network for balancing said trunk circuit, said network having an impedance equal to the impedance of the trunk circuit as modified by the average impedance of various types of terminal apparatus which may be connected to the trunk circuit, a network connected to the other end of the trunk circuit, said network having an impedance simulating that of the average terminal apparatus connected to the trunk, and

means for disconnecting said last mentioned network when terminal apparatus is associated with the trunk.

3. In a signaling system, a trunk circuit of such length that its impedance is not independent of terminal apparatus connected thereto, means to associate any one of a plurality of transmission lines with one end of said trunk, a transmitting and receiving channel associated with the opposite end of said trunk, a network for balancing said trunk at said opposite end, said network having impedance equal to that of the trunk as modified by the impedance of the average transmission line connected to the trunk, and a network normally associated with the end of the trunk with which the transmission lines are connected, said network simulating the impedance of the average transmission line.

4. In a signaling system, a trunk circuit of such length that its impedance is not independent of terminal apparatus connected thereto, means to associate any one of a plurality of transmission lines with one end of said trunk, a transmitting and receiving channel associated with the opposite end of said trunk, a network for balancing said trunk at said opposite end, said network having impedance equal to that of the trunk as modified by the impedance of the average transmission line connected to the trunk, a network normally associated with the end of the trunk with which transmission lines are connected, said network simulating the impedance of the average transmission line, and means to disconnect said last mentioned network when a transmission line is associated with the trunk.

5. In a signaling system, a switching station at which transmission lines terminate, a translating station at which four-wire transmission apparatus is provided, a trunk extending from said switching station to said translating station having a length such that the impedance of the trunk is not independent of the terminal apparatus associated therewith, transmitting and receiving channels associated with said trunk at said translating station, and a network for balancing said trunk at said translating station, said network having an impedance equal to that of the trunk as modified by the impedance of the average transmission line terminating at said switching station, and a network associated with the end of the trunk at said switching station, said network having an impedance equal to that of the average transmission line terminating at said switching station.

6. In a signaling system, a switching station at which transmission lines terminate, a translating station at which four-wire transmission apparatus is provided, a trunk extending from said switching station to said translating station having a length such that the impedance of the trunk is not independent of the terminal apparatus associated therewith, transmitting and receiving channels associated with said trunk at said translating station, and a network for balancing said trunk at said translating station, said network having an impedance equal to that of the trunk as modified by the impedance of the average transmission line terminating at said switching station, and a network associated with the end of the trunk at said switching station, said network having an impedance equal to that of the average transmission line terminating at said switching station, and means for disconnecting said last mentioned network when a connection is established to said trunk over a transmission line.

7. In a signaling system, a switching station at which transmission lines terminate, a translating station at which four-wire apparatus is located, a trunk extending from said switching station to said translating station, the length of said trunk being such that its impedance is not independent of terminal apparatus associated therewith, link circuits at said switching station for interconnecting said trunk with any one of a plurality of transmission lines, transmitting and receiving channels at said translating station associated with said trunk, a network at said translating station for simulating the impedance of said trunk as modified by the impedance of a link circuit and the average impedance of a transmission circuit terminating at the said switching station, a network at said switching station normally associated with said trunk and having an impedance simulating that of a link circuit, as modified by the average impedance of a transmission line terminating at said station.

8. In a signaling system, a switching station at which transmission lines terminate, a translating station at which four-wire apparatus is located, a trunk extending from said switching station to said translating station, the length of said trunk being such that its impedance is not independent of terminal apparatus associated therewith, link circuits at said switching station for interconnecting said trunk with any one of a plurality of transmission lines, transmitting and receiving channels at said translating station associated with said trunk, a network at said translating station for simulating the impedance of said trunk as modified by the impedance of a link circuit and the average impedance of a transmission circuit terminating at the switching station, a network at said switching station normally associated with said trunk and having an impedance simulating that of a link circuit as modified by the impedance of

the average transmission line terminating at said station, and means for disconnecting said last mentioned network when a connection is completed over a transmission line to said trunk through said link circuit.

9. In a signaling system, a switching station at which transmission lines terminate, a translating station at which four-wire apparatus is located, a trunk extending from said switching station to said translating station, the length of said trunk being such that its impedance is not independent of terminal apparatus associated therewith, link circuits at said switching station for interconnecting said trunk with any one of a plurality of transmission lines, transmitting and receiving channels at said translating station associated with said trunk, a network at said translating station for simulating the impedance of said trunk as modified by the impedance of a link circuit and the average impedance of a transmission circuit terminating at the said switching station, a network at said switching station normally associated with said trunk and having an impedance simulating that of a link circuit as modified by the average transmission line terminating at said station, and means associated with said link circuit and responsive to the completion of a connection over a subscriber's line to said trunk through said link circuit for disconnecting said last mentioned network.

10. In a signaling system, a central switching station, transmission lines terminating thereat, a translating station at which four-wire transmission elements are located, a trunk extending from said switching station to said translating station having a length such that its impedance is not independent of the terminal apparatus connected thereto, a cord circuit for completing connections between said trunk and any of said transmission lines, a transmitting and receiving channel associated with said trunk at said translating station, a network at said translating station for balancing said trunk, said network having an impedance simulating the impedance of the trunk as modified by the impedance of said circuit and the impedance of the average transmission line terminating at said switching office, a network at said switching office for simulating the impedance of a cord circuit as modified by the average impedance of a transmission line terminating at said office, and connections between said network and said trunk jointly controlled by the connection of the cord circuit with the trunk, and by the establishment of a connection over a subscriber's line and a cord circuit.

11. In a signaling system, a central switching station, transmission lines terminating thereat, a translating station at which four-wire transmission elements are located, a trunk extending from said switching station to said translating station having a length such that its impedance is not independent of the terminal apparatus connected thereto, a cord circuit for completing connections between said trunk and any of said transmission lines, a transmitting and receiving channel associated with said trunk at said translating station, a network at said translating station for balancing said trunk, said network having an impedance simulating the impedance of the trunk as modified by the impedance of the cord circuit and the impedance of the average transmission line terminating at said switching office, a network at said switching office for simulating the impedance of a cord circuit as modified by the average impedance of a transmission line terminating at said office, connections from said network to the trunk, means to open said connections when the cord circuit is associated with the trunk, independent connections from said network to said trunk, and means associated with said cord circuit for opening said independent connections when a connection is established between the cord circuit and a transmission line and the circuit of the transmission line is completed.

In testimony whereof, I have signed my name to this specification this 14th day of August, 1921.

DON SMITH.