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Aug. 12, 1924. 1,504,204

W. P. ANDRICK

SWITCHING CIRCUIT FOR RADIO AND SIMILAR SYSTEMS

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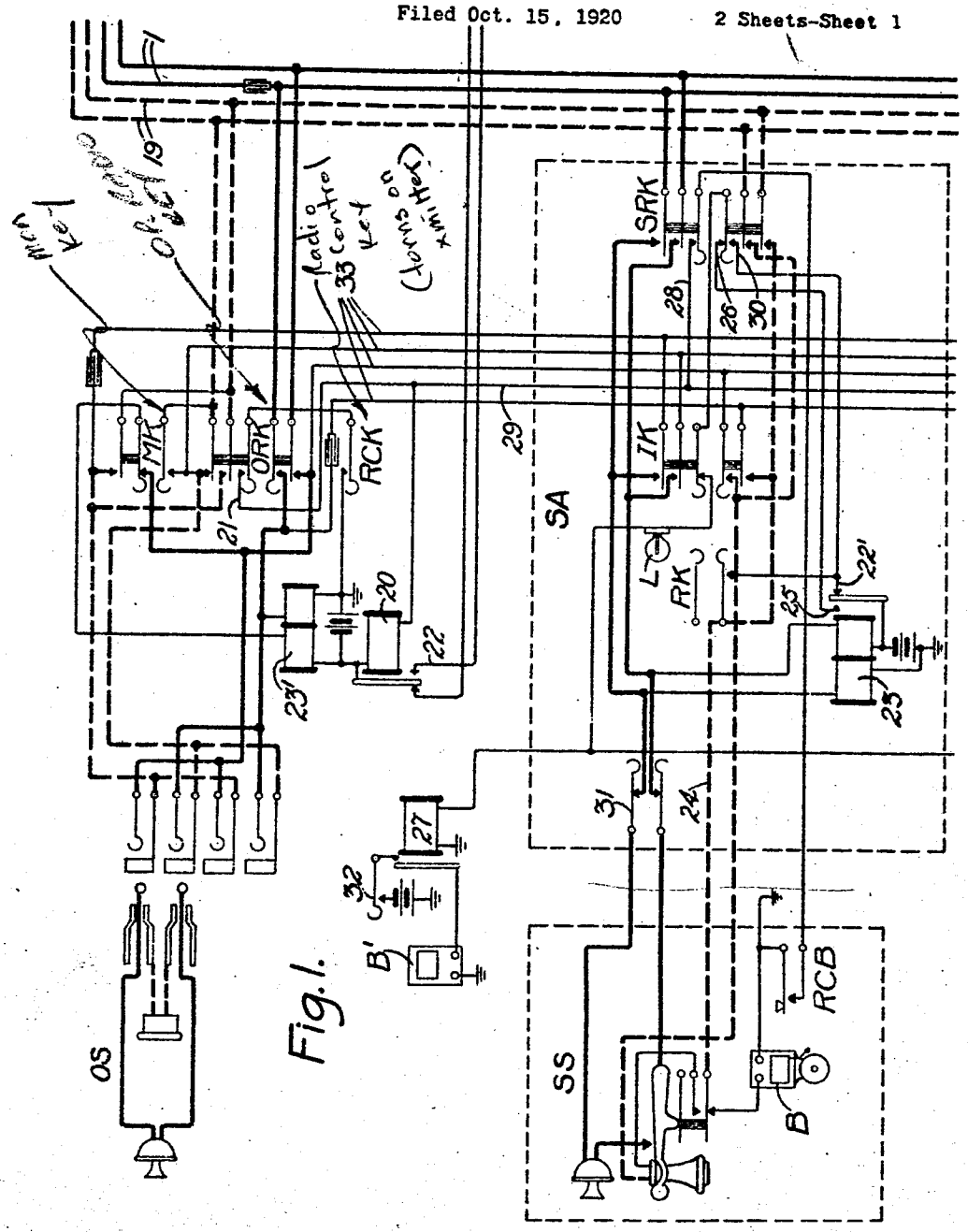

Fig. 1.

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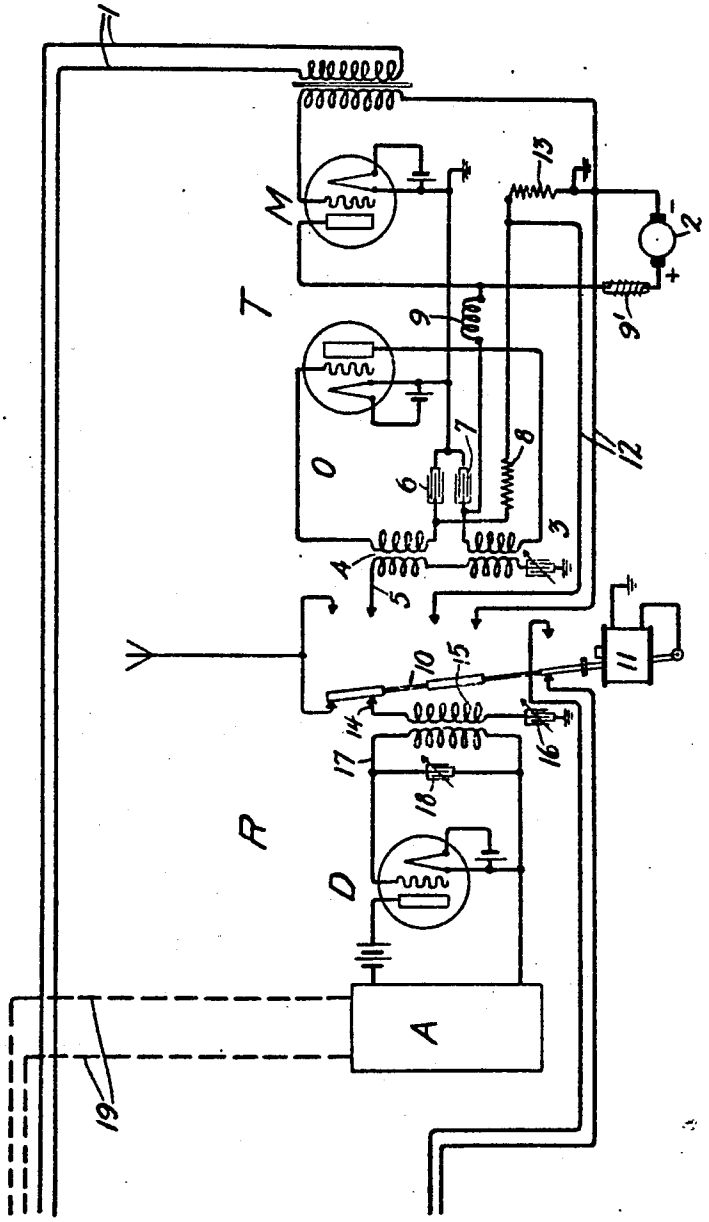

Fig. 2.

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Patented Aug. 12, 1924. 1,504,204

UNITED STATES PATENT OFFICE.

WALLACE P. ANDRICK, OF HOHOKUS, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SWITCHING CIRCUIT FOR RADIO AND SIMILAR SYSTEMS.

Application filed October 15, 1920. Serial No. 417,080.

To all whom it may concern:

Be it known that I, WALLACE P. ANDRICK, a citizen of the United States, residing at Hohokus, in the county of Bergen, State of New Jersey, have invented certain new and useful Improvements in Switching Circuits for Radio and Similar Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to improvements in switching circuits for use in connection with radio or equivalent systems whereby an operator is enabled to connect any one of several subscribers or substations with the radio or other system and supervise the connection so made. The practical embodiment of the invention described herein comprises a wireless transmitter and receiver, an operator's switching circuit having the controlling switches arranged at a switchboard, and any desired number of substations, any one or more of which can be connected to the radio system for communicating thereover with a distant station.

In the specific form of apparatus disclosed a four-wire circuit is used between the radio system and the operator's station or the substation, but the invention is not limited to four-wire systems since many of the features are capable of embodiment in other arrangements.

Means are provided whereby control of the radio system may be had by the subscriber at each local station when that local station is connected thereto.

The invention includes means whereby the operator can connect his telephone set or any of the substations to the radio circuit and can listen on the receiving circuit of any radio connection so made and can converse with any substation at any time whether a radio connection is made or not.

Among the objects of the invention are, furthermore, to provide means whereby the operator can monitor conversations taking place on the radio system and at the same time be enabled to hear call signals from other stations than the one with which a subscriber is communicating during such communication; whereby the user of the substation may request radio connection with a certain station and may then restore his receiver to await establishment of connection by the operator, and the operator may call the subscriber and connect him with the radio station after radio connection with a distant station has been established; whereby the operator can call or be called by other substations while a given substation is carrying on radio communication; and whereby a common source of current may be utilized for energizing the subscribers' substations, for operating the transmit-receiving switch, and the necessary relays, bells, and signaling lamps.

A noteworthy feature is that the system utilizes "positive supervision," i. e., the indication given by the lighting of a lamp or the production of an equivalent signal at the switchboard indicates that some action on the part of the operator is necessary.

The arrangement of the system is such that if any subscriber's line or substation is damaged it may be cut out of circuit without interfering with the normal functioning of the other apparatus of the system. On board vessels of war, for example, this would be highly desirable.

Preferably, but not necessarily, the switchboard operator is also the radio operator, i. e., the tuning and adjusting controls of the radio system are either directly before him or at his command through suitable distant control apparatus and can be adjusted while he is talking, listening or monitoring. Except for the transmit-receive switch, these controls are not illustrated since no specific forms of the various controlling or adjusting elements of the radio systems form a part of the invention, these varying in accordance with the particular system. A simplified circuit diagram of a convenient type of radio system is illustrated.

Other objects and advantages of the invention will be apparent to those skilled in the art after a perusal of the following detailed description and the appended claims. The system is illustrated in Figs. 1 and 2. In reading the drawing, the left end of Fig. 2 is to be placed adjacent the right end of Fig. 1 so that the corresponding conductors will connect.

The system comprises a radio transmitter T and receiver R which may be associated with the same or different antennae, an

operator's switchboard apparatus, operator's head set OS, any desired number of substation sets SS, each of which is connected to its appropriate switching circuit apparatus SA at the switchboard by appropriate lines. A single switching apparatus only is shown enclosed in dotted lines. Additional switching apparatuses will be provided in number equal to the subscribers' lines and each will be connected to the switchboard conductors 29 and 33 in the same manner as the one shown. For this reason the switchboard conductors are illustrated in Fig. 1 as extending indefinitely. The remaining switchboard apparatus (not included in dotted lines) serves for any desired number of substations.

The radio transmitter T comprises an oscillator O of any suitable type, combined with means for modulating the oscillations in accordance with voice currents. The modulating means illustrated is in the form of a variable impedance tube M to whose input circuits is connected the transmission circuit 1 of the four-wire circuit which extends to the switchboard. The output circuit of the tube M is connected in parallel to the oscillating tube O with respect to the source 2 of space current. Plate and grid circuit transformers 3 and 4 connect the tube O to the antenna circuit 5. The grid condenser 6, plate condenser 7, grid leak resistance 8, high frequency choke coil 9, and low frequency choke coil 9′ function in a known manner in transmitting systems of the present type, which are usually styled "constant current modulation systems." A transmit-receive switch or circuit closer 10 is controlled by a transmit-receive relay 11. Switch 10 constitutes a rigid extension of the armature of relay 11, but may be controlled thereby in any other suitable manner. When the armature of relay 11 moves to the right, switch 10 is moved to the right. When relay 11 moves to the left, switch 10 moves to the left. Relay 11 is a well-known type of snap relay which, when it is energized to move its armature in either direction, opens its energizing circuit and prepares another energizing circuit for its return operation. When the switch 10 closes the circuit 5, it also closes a circuit 12 which forms a shunt around high resistance 13. When the transmit-receive switch is in the receiving position, circuit 12 is opened and the resistance 13 is included in series with the resistance 8 in the leak path from the grid to the filament of tube O. The inclusion of resistance 13 increases the resistance of the leak path to such an extent that the generating action of tube O ceases. When the switch 10 is again thrown to the transmitting position, the generating tube O automatically starts up. When the switch 10 is thrown to the receiving position, it closes the receiving antenna circuit 14, containing coil 15 and the variable capacity 16. Coupled to the coil 15 is circuit 17 containing the variable capacity 18 across which is connected the input circuit of any suitable thermionic detector D or equivalent detecting device to the output circuit of which is connected an amplifier A, to which in turn is connected the receiving conductors 19 of the four-wire circuit.

When the system is otherwise idle the operator may listen for calls from distant radio stations, either by closing his monitoring key MK or the operator's radio key ORK. In the former case the operator can only listen while in the latter case, he will be able to reply to any received signal. It is supposed, of course, that the operator's set OS is plugged into the jacks adapted for its connection whenever the operator desires to converse. Whenever the set is thus plugged in, the operator's microphone is energized through a circuit extending from the negative side of the battery through one side of the speech retard coil 23′ and returning to ground through the other side thereof. Suppose that the key ORK is closed, and the operator receives from a distant radio station a request for connection to a definite substation. To reply, he closes the radio control key RCK which closes a circuit through the control relay 20 and the contact 21 of key ORK. When relay 20 is energized, it closes its front contact 22, thereby energizing the transmit-receive relay 11 and moving the switch 10 to the transmitting position. The operator then advises the communicating station that the call has been received and will be given attention. The keys ORK and RCK are now restored and the ringing key RK of the desired substation is operated. This closes a circuit from ground through the battery, the rear contact 22′ of relay 23, key RK, conductor 24 through the bell B to ground. When the subscriber removes his receiver from the switch-hook, the microphone of his set is energized through a circuit leading from and returning to the battery through the two windings of relay 13 which will act as a speech retardation relay when conversation begins. The energization of relay 23 closes its front contact 25 thereby lighting the lamp L through a circuit passing from the battery through contact 25, contact 26, the lamp, and to ground through the night alarm relay 27. When the lamp has indicated to the operator that the subscriber has answered he restores the ringing key and operates the intercommunication key IK which connects him to the subscriber by the conductors 33. He advises the subscriber at SS that there is a call on the radio system and then restores the key IK and closes or operates the subscriber's radio

key SRK which connects the subscriber's microphone to the radio transmission circuit and his receiver to the radio reception circuit. When the key SRK is closed or operated, a circuit is prepared through the subscriber's radio control button RCV, contact 28, control conductor 29, and relay 20. By closing and releasing the key RCB, the subscriber may operate the transmit-receive switch 11 to the transmitting or receiving position in accordance with whether he desires to talk or listen. In order to monitor the conversation and keep the radio apparatus tuned and adjusted, the operator may operate his monitoring key MK, which connects him to the radio receiving circuit.

If a second substation calls the operator while he is listening or monitoring, the corresponding lamp is lighted, observing which, the operator restores the monitoring key and operates the proper intercommunication key IK, whereupon he can converse with the calling subscriber and inform him whether the radio system is in use, or give other desired information. When this conversation is concluded, the intercommunication key IK is restored and the operator is able to resume monitoring by again closing the monitoring key.

When the subscriber using the radio system is ready to disconnect, and restores his receiver to the switchhook, the line relay 23 is deenergized and the lamp L is lighted through a circuit prepared by the key SRK and extended from the battery through contact 22′, contact 30, and the lamp to ground. The operator restores the subscriber's radio key SRK, whereupon the subscriber is cut off from the radio system and the whole apparatus resumes its normal condition.

The operator can, of course, call any subscriber when that subscriber's line is idle, by operating the ringing key RK and operating the corresponding key IK after the subscriber answers. Furthermore, the operator may close the key ORK and the subscriber's intercommunication key IK when the same subscriber's key SRK is closed and the subscriber is connected to and using the radio system. When this is done, both the subscriber and the operator may talk and listen on the radio system and at the the same time each may hear what the other is saying. Furthermore, any number of subscribers, as well as the operator, may be simultaneously connected to the radio system. In this case, they must, of course, arrange between themselves which one is to control the radio transmit-receive switch in order to avoid confusion. There is thus provided an arrangement in which any desired number of a series of substations may be connected to a radio system by a central operator. Each subscriber is enabled to independently call the operator and indicate that he desires his substation connected to the radio system. Where subscribers desire only to listen and not to transmit over the radio system the controlling means at their stations for the transmit-receive switch may be omitted, thus leaving the system wholly under the control of the operator.

The night alarm relay 27 is connected in series with the line lamps so that if the operator is absent from his position or inattentive, the buzzer B′ will call his attention provided the buzzer circuit key 32 is closed. It is understood that although for convenience, the switching circuit is shown as being provided with several independent batteries, in reality these are one and the same battery. They are shown separately in the manner usual in telephone circuit diagrams in order to simplify the drawing. A cut-off key 31 enables the subscriber's line to be effectively removed from circuit in case the line is injured or if its use becomes undesirable for any other reason.

When the operator or any subscriber is exclusively connected to the radio system, he is able to maintain exclusive control over the transmit-receive switch. This principle may be extended and applied in other relations whereby the connected subscriber is enabled to maintain control over any other element of a radio or other system which it is desirable to place under his control. In general, however, it is satisfactory to allow the operator to vary the tuning condensers 16 and 18, and otherwise control and adjust the radio apparatus as may be necessary.

One form of apparatus embodying the invention having been described in detail, the various novel features believed to be inherent therein are pointed out in the appended claims.

What is claimed is:

1. A signaling system, having a transmit-receive switch which in one position renders said system effective for transmission and in another position renders said system effective for reception, a plurality of substations adapted for connection to said system, a switching circuit for connecting a selected substation to said system, and means controlled by the connection of a selected substation to said system whereby said transmit-receive switch is placed under the control of means at the selected substation.

2. A signaling system having a transmit-receive switch which in one position renders said system effective for transmission and in another position renders said system effective for reception, a plurality of substations adapted for connection to said system, a switching circuit for connecting a selected substation to said system, and means controlled by the connection of a

particular substation to said system whereby said transmit-receive switch is placed under the exclusive control of means at the selected substation.

3. A radio system, a plurality of substations, a switching circuit for connecting any substation with said radio system, a radio control, and means associated with each substation whereby a subscriber thereat acquires operative control of said radio control for varying the operative condition of the radio system.

4. A radio system, a central station connected thereto, a plurality of substations having lines terminating at said central station, means at the central station for connecting any substation to said radio system, a radio transmit-receive switch, and a circuit controller at each substation for operating said transmit-receive switch.

5. A radio system, a plurality of local circuits, means at an operator's position for connecting any of said circuits to said system, means controlled by establishing such connection to give a subscriber on the connected one of said circuits control of said radio system to the exclusion of subscribers on circuits not so connected, and means operable by the connected subscriber for exercising said control.

6. A radio circuit, a plurality of subscribers' circuits and an operator's switching circuit, said switching circuit including means whereby any selected one or more of the subscribers' circuits may be connected to said radio circuit, singly or in groups.

7. In a system comprising an operator's circuit, a plurality of substation circuits, and a radio circuit having a control means, a common battery for supplying the operator's circuit, the substation circuits, and the control means.

8. In a signaling system, a radio circuit, an operator's set, a plurality of substation sets, means at the operator's position whereby the operator's set or any substation set may be connected to the radio circuit, means whereby the operator's receiver may be connected to monitor any connection of a subscriber's set to the radio circuit, other means whereby the operator's set may be connected to any substation set for a two way connection therewith, and means whereby the operator may control the radio circuit.

9. A telephone system comprising a radio circuit, a plurality of substations, an operator's set, an operator's switching circuit, indicator means whereby a subscriber removing his receiver from the switchhook at a substation notifies the operator, means operated by the connection of the operator's set to the subscriber's set to restore the indicator, and means operated by connecting the subscriber's set to the radio circuit to prepare a circuit whereby when the substation receiver is restored to the switchhook the indicator means is again operated.

10. A signaling system comprising a radio circuit, an operator's set, a plurality of subscribers' sets, a four-wire circuit and switching means for connecting said radio circuit with said operator's set or with any selected one of said subscribers' sets, or for connecting any of said subscribers' sets with said operator's set.

11. A signaling system, comprising a circuit having a transmit-receive switch, a control relay therefor, a plurality of stations, means for connecting any selected one of said stations with said circuit, means at each of said stations effective upon the connection of a particular station for controlling said control relay when said station is connected to said circuit, and means for connecting a selected plurality of said stations to said circuit.

12. A signaling system comprising a high frequency circuit, a speech input circuit and a speech output circuit therefor, an operator's circuit, a plurality of substation circuits, a four-wire circuit connected to each of said operator's and said substation circuits, means for establishing a four-wire connection from any of said circuits to said input and said output circuits, and means for establishing a connection between said operator's circuit and any of said substation circuits.

13. A telephone system comprising a radio circuit, a subscriber's circuit, means for establishing a four-wire circuit connection between said radio circuit and said subscriber's circuit, an operator's circuit, and means for establishing a monitoring connection to the receiver of said operator's circuit exclusively or for establishing a parallel connection of said operators' and subscribers' circuits to said radio circuit.

14. A high frequency signaling circuit, channels for operatively connecting said circuit to an operator's position, a number of local circuits terminating at said operator's position, and means whereby an operator can select and connect to said high frequency circuit any desired number of said local circuits whereby signals incoming over said high frequency circuit are transferred to said local circuits, and means whereby a subscriber on any of said local circuits may signal to said operator the subscriber's desire to be connected to or disconnected from said high frequency circuit.

15. A high frequency terminal station; control means for said station; a low frequency system comprising apparatus at an operator's position and a plurality of line extensions; means under control of said operator for operating said control means; means whereby said operator can delegate

to a person remotely located on one of said line extensions control of said control means; and means whereby said operator can at any time resume exclusive control of said control means.

16. A radio telephone system comprising a group of subscribers' lines, generating and modulating apparatus for radiating waves modulated in accordance with speech coming in over a particular one of said lines to said modulating apparatus, means for connecting a selected subscriber's line to said apparatus, and means under the control of the subscriber so connected whereby he can render said apparatus operative during the time he desires to talk.

17. In a signaling system, two pairs of voice current conductors, two pairs of high frequency current conductors, means electrically connecting said voice current pairs with said high frequency current pairs, respectively, and monitoring means electrically adjacent to and in energy transfer relation with said connecting means.

18. In a signaling system, a terminal station, a second station, two pairs of voice frequency lines extending between said stations, a source of high frequency current and a detecting means connected to said pairs of lines, respectively, at said second station, and monitoring means at said second station common to said pairs of voice frequency lines.

In witness whereof, I hereunto subscribe my name this 11th day of October A. D., 1920.

WALLACE P. ANDRICK.