

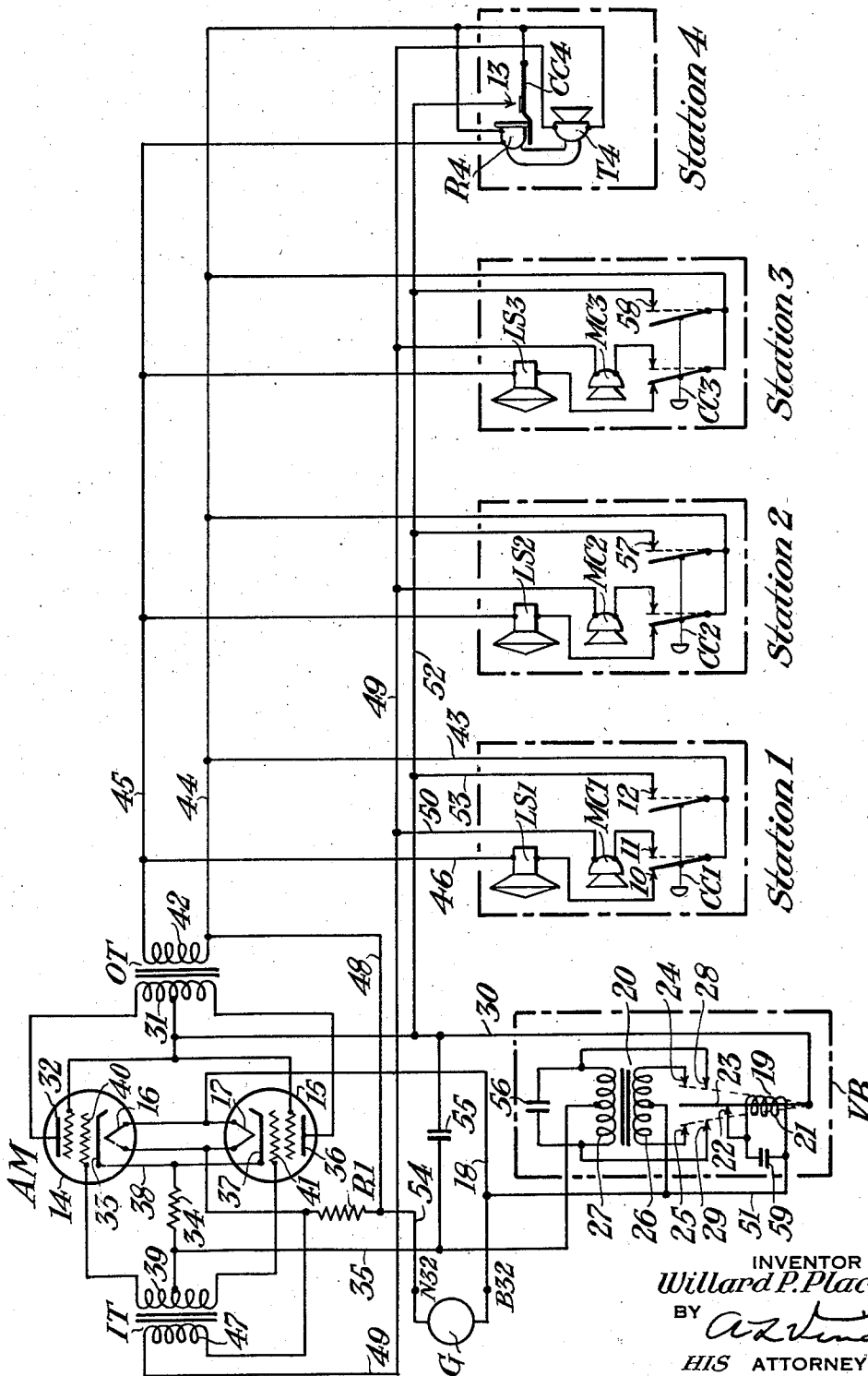
April 11, 1944.

W. P. PLACE

2,346,504

APPARATUS FOR COMMUNICATION SYSTEMS

Filed April 3, 1943



INVENTOR
Willard P. Place.
BY *A. J. Small*
HIS ATTORNEY

UNITED STATES PATENT OFFICE

2,346,504

APPARATUS FOR COMMUNICATION
SYSTEMS

Willard P. Place, Penn Township, Allegheny
County, Pa., assignor to The Union Switch &
Signal Company, Swissvale, Pa., a corpora-
tion of Pennsylvania

Application April 3, 1943, Serial No. 481,683

6 Claims. (Cl. 179—1)

My invention relates to apparatus for communication systems, and more particularly to apparatus for telephone inter-communication systems.

An inter-communication system usually provides that a message originating at any one of a plurality of different stations is simultaneously reproduced at each of the other stations. Thus the message of a person speaking into the microphone at one station of a telephone inter-communication system would be audibly reproduced at each of the other stations of the system. A telephone inter-communication system may have substations at noisy locations and other stations at quiet locations, and it is desirable that the transmitted message be loudly reproduced at the noisy stations, while at the more quiet stations an equal reproduction of the message would be annoying, and in fact at some stations the message may preferably be reproduced so as to be heard only when a person at that station is one party of a two-way conversation. An inter-communication system for a railway train, for example, may have stations located about the locomotive where it is extremely noisy and other stations located in passenger cars where it is comparatively quiet.

Accordingly, a feature of my invention is the provision of novel and improved apparatus for an inter-communication system.

Another feature of my invention is the provision of novel and improved apparatus for an inter-communication system and wherewith ample power is available for loudly reproducing a message at a noisy location or at a location where the attendant may be some distance away and occupied with other duties.

Still another feature of my invention is the provision of novel apparatus of the type here involved wherewith energy for heating the tube of an amplifier only is required during non communication periods, and a voltage converter is excited and operated to supply a relatively high voltage as required for the plate circuit of the amplifier tube when an attendant at a station makes preparation for initiating communication.

Other features, objects and advantages of my invention will appear as the specification progresses.

Apparatus embodying my invention consists essentially of a loud speaker or telephone receiver, a microphone or telephone transmitter and a circuit controller at each of a plurality of different stations, together with a source of

power, a voltage converter and an amplifier common to all the stations. Normally the filament of the amplifier tube is heated so that the amplifier can instantly be made active, this power for heating the tube being the only power required by the system during non communication periods. Circuits are provided so that when a person wishes to talk from a station, the circuit controller of such station is actuated and such operation of the controller causes the voltage converter to become excited and operated to supply the proper voltage to the plate circuit of the amplifier tube. Such operation of the circuit controller also energizes the microphone at that station and preferably disconnects the loud speaker. Voice frequency currents created by this person speaking into his microphone are amplified at the amplifier and are supplied to the loud speaker at each of the other stations causing the message to be reproduced at each of these other stations. At a station at a comparatively quiet location or at a preselected location, a hand set is preferably used in place of the loud speaker and microphone, so that the message is heard only in the case a person is listening.

I shall describe one form of apparatus embodying my invention, and shall then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view showing one form of apparatus embodying my invention when used for a railway train. It is to be understood that my invention is not limited to this one use and this form of the invention illustrates the many places where such apparatus is useful.

Referring to the drawing, four stations 1, 2, 3 and 4 are shown, although the number of stations may be more or less than four as required. For example, stations 1 and 2 might be locations in the engineman's and fireman's side, respectively, of the cab of a steam locomotive, or in the engineman's cab and in the engine room, respectively, of a Diesel type of locomotive; station 3 might be in a baggage or mail car, or in the kitchen of a diner, and station 4 might be in a passenger car at a place available to the train conductor or to a passenger. Each of the stations 1, 2 and 3 is provided with a loud speaker, a microphone and a circuit controller, these devices being designated by the reference characters LS, MC and CC, respectively, plus a numeral corresponding to that of the station. Station 4 is provided with a telephone hand set, together

with a circuit controller CC4, which is in the form of the usual hook switch.

Each of the circuit controllers is operable either to a first position or to a second position. For example, controller CC1 is operable to a first position, that is, to the position shown by solid lines in the drawing, and at which position contact 10 is closed, and to a second position, that is, to the position indicated by dotted lines in the drawing, and at which position contacts 11 and 12 are closed. Each of the controllers CC2 and CC3 are similar to controller CC1, but controller CC4 has but the one contact 13, which is closed when the hand set is removed from the hook switch.

The apparatus includes a source of supply designated by the reference character G, a voltage converter VB and an amplifier AM, and which devices are common to all the stations and may be located as desired. The current source G would be preferably the usual 32 volt train lighting generator when the system is for a railway train, the terminals of generator G being indicated at B32 and N32. It is to be understood, of course, that my invention is not limited to the usual train lighting generator as the source of supply, and a separate source can be used.

The voltage converter VB may be any one of several different types. In the present application the voltage converter VB consists of a vibrator 19 and a transformer 20. An operating winding 21 of vibrator 19 is at times supplied with current from generator G by a circuit to appear shortly, and which circuit includes contact 22 and armature 23 of the vibrator. Hence when winding 21 is thus supplied with current, the armature 23 is caused to vibrate at a rate predetermined by the proportioning of the parts. Armature 23 when vibrated alternately engages contacts 24 and 25 to complete a circuit also to be later described, and by which circuit current from generator G is alternately supplied to the two portions of primary winding 26 of transformer 20, with the result an alternating electromotive force is induced in secondary winding 27 of transformer 20. Armature 23 also alternately engages contacts 28 and 29 to alternately connect the two portions of secondary winding 27 to the plate circuit of the tubes of amplifier AM, and the electromotive force induced in this secondary winding is rectified and applied to the plate circuit, the parts being so proportioned that the voltage of such rectified current is proper for operation of the tube of the amplifier. Hence, the power from the usual low voltage headlight generator is converted into a direct current voltage satisfactory for operation of the plate circuit of the amplifier tube.

Amplifier AM includes indirectly heated tubes 14 and 15 arranged in a push-pull arrangement. The filaments 16 and 17 of tubes 14 and 15, respectively, are heated by a circuit extending from terminal B32 through wire 18, filaments 16 and 17 in parallel and resistor R1 and wire 54 to terminal N32. Thus both tubes are constantly heated and the parts are so proportioned that a preselected voltage drop is created across resistor R1 due to the filament current. The plate circuits for the tubes can be traced from either the right-hand terminal of secondary winding 27 of transformer 20 of the voltage converter through contact 28 to armature 23, or from the left-hand terminal of winding 27 through contact 29 to armature 23, thence through wire 30 to a mid terminal of primary winding 31 of an output transformer OT,

either through the top portion of winding 31, plate 32 and intervening tube space to cathode 33 of tube 14 to wire 38, or through the lower portion of winding 31, plate 36 and intervening tube space to cathode 37 of tube 15 to wire 38, and thence through resistor 34 and wire 35 to mid terminal of secondary winding 27 of transformer 20. Consequently winding 27 of the voltage converter is the source of supply for the plate circuit of tubes of the amplifier, such plate current source being inactive except at such time as the operating winding 21 of the vibrator and winding 26 of transformer 20 are energized. Each tube 14 and 15 is provided with a control grid circuit that includes a portion of secondary winding 39 of an input transformer IT. The grid circuit for tube 14 includes control grid 40, top portion of secondary winding 39 of transformer IT, resistor 34, wire 38 and cathode 33; and the grid circuit for tube 15 includes control grid 41, lower portion of secondary winding 39, resistor 34, wire 38 and cathode 37.

Circuits are provided for connecting the amplifier AM and the power sources to the different stations for energization of the loud speakers and microphones. The loud speakers are connected in multiple to secondary winding 42 of output transformer OT. For example, the connection of loud speaker LS1 can be traced from the lower terminal of the operating winding of this loud speaker through contact 10 of controller CC1 and closed at the first position of this controller, wires 43 and 44, secondary winding 42 and wires 45 and 46 to the top terminal of the operating winding of this loud speaker. Loud speakers LS2 and LS3 have similar connections, while the receiver R4 of the hand set at station 4 is permanently connected to the secondary winding 42 by wires 44 and 45. It follows that energy transferred from the plate circuits of the amplifier tubes through output transformer OT is delivered to the loud speakers or telephone receivers of the stations at which the circuit controllers are in their first positions.

The microphones are connected in multiple across resistor R1 of the filament circuit through primary winding 47 of input transformer IT. Looking at microphone MC1, a connection extends from the lower terminal of this microphone through contact 11 of circuit controller CC1 and closed at the second position of the controller, wires 43, 44 and 48, resistor R1, primary winding 47 of input transformer IT and wires 49 and 50 to the top terminal of the microphone. Each of the other microphones is provided with a similar connection except the transmitter T4 of the hand set at station 4, the connection of transmitter T4 having no contacts of the circuit controller interposed therein. It is apparent, however, that the connection for the transmitter T4 can include a contact of controller CC4 to be closed when the hand set is removed from the hook. Consequently, operation of a circuit controller at a station in preparation to initiate communication energizes the associated microphone due to the voltage drop across resistor R1 of the filament circuit of the amplifier tubes, and voice frequencies created by speaking into the microphone of such a station are applied to the grid circuit of the amplifier tubes and reproduced in the plate circuits.

The circuits for energizing winding 21 of vibrator 19 and winding 26 of transformer 20 are governed by the circuit controller of each station. For example, when controller CC1 of station 1 is operated to its second position closing contact 12, current flows from terminal B32 through wires 18

and 51, winding 21, contact 22, armature 23, wires 30, 52 and 53, contact 12, and wires 43, 44, 48 and 54 to terminal N32; and winding 21 is energized to vibrate armature 23. Current also flows from terminal B32 through wires 18 and 51 to mid terminal of winding 26 of transformer 20, either through the right-hand portion of winding 26 and contact 24, armature 23, or through the left-hand portion of winding 26 and contact 25 to armature 23, wires 30, 52 and 53, contact 12 and wires 43, 44, 48 and 54, to terminal N32; and the two portions of winding 26 are alternately energized to create an alternating electromotive force in secondary winding 27, which electromotive force is rectified and supplied to the plate circuits of the amplifier tubes, as explained hereinbefore. In a similar manner the circuits for windings 21 and 26 are controlled by contacts 57, 58 and 13 of the controllers CC2, CC3 and CC4, respectively.

A condenser 55 is preferably connected between the plate and grid circuits of the amplifier tubes to improve the operation of the amplifier, and condensers 56 and 59 are connected across windings 27 and 21, respectively, to suppress sparking.

In describing the operation of the apparatus I shall assume that a person at station 1 desires to converse with a person at station 2, both of these stations being places of considerable noise. Controller CC1 would be operated to its second position in preparing for such communication. The closing of contact 12 energizes the voltage converter and plate voltage is applied to the amplifier tubes. Closing of contact 11 energizes the microphone MC1, and the opening of contact 10 disconnects the loud speaker LS1. The person at station 1 speaks into the microphone MC1, the voice frequencies being applied to the grid of the amplifier tubes and applied through the output transformer OT to the loud speakers at the other stations. This initial message would be preferably of a nature that would inform the attendant at station 2 that communication is desired with that station. From this point on, proper operation of the circuit controllers CC1 and CC2 would permit the operators at these two stations to carry on communication, the voltage converter being active when either controller CC is operated to its second position, each microphone being connected and energized only when the person at that station is about to speak, and each loud speaker being disconnected to avoid acoustic feed back when the person at that station is speaking, and the conversation being reproduced at a relatively high energy level so as to be heard above the noise of the station. The hand set at station 4 is proportioned to avoid over-energization of the receiver by energy of such relatively high energy level and to avoid acoustic feed back to the transmitter T4. If desired, however, the transmitter T4 can be normally disconnected through a contact operated by the controller CT4 or a contact of a special push button. With station 4 provided with a hand set as here shown, a person at that station can initiate communication by lifting the hand set off the hook and then speaking into the transmitter.

The amplifier AM is preferably one with a push-pull circuit arrangement because such an amplifier is reasonably free from disturbances in the plate circuit supply and minimum filtering is required, condenser 55 being all that would ordinarily be necessary. Another reason is that more power is made available and less expensive loud speakers can be used. Also, if one tube fails, the system is not completely inoperative.

Apparatus for inter-communication such as here disclosed has the advantages that it is simple, of low cost, requires small amount of energy during non communication periods, is instantly active when communication is desired and power is available for reproducing the messages so as to be heard at noisy locations.

Although I have herein shown and described but one form of apparatus for communication systems embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination; a plurality of stations each including a loud speaker, a microphone and a circuit controller; each said controller operable to a first and a second position, an electron tube amplifier common to all of said stations, a filament circuit including a supply source of current and a resistor to heat said amplifier tube, a plate circuit including a winding of an output transformer and a plate current source for said tube, but which source is normally inactive, a grid circuit including a winding of an input transformer for said tube, a first circuit means for each of said stations and including a first position contact of the respective controller to connect the respective loud speaker to a winding of said output transformer, a second circuit means for each of said stations and including a second position contact of the respective controller to connect the respective microphone in series with a winding of said input transformer across said filament circuit resistor, and a third circuit means for each of said stations and including a second position contact of the respective controller to render said plate current source active.

2. In combination; a plurality of stations each having a loud speaker, a microphone and a circuit controller operable to a first and a second position; an electron tube amplifier common to all of said stations, a filament circuit including a supply source of current and a resistor to heat said tube, a plate circuit including a source of plate current and a winding of an output transformer for said tube but said plate current source normally inactive, a grid circuit including a winding of an input transformer for said tube, a first circuit means to connect said station microphones in multiple across said filament circuit resistor through a winding of said input transformer to apply to said tube the voice frequencies created by speaking into any one of said microphones, a second circuit means to connect said station loud speakers in multiple to a winding of said output transformer to reproduce at each station the voice frequencies applied to said grid circuit, and a third circuit means including a second position contact of each of said station controllers in multiple to render said plate current source active whereby operation of any station controller to its second position permits telephone communication to be effected from the respective station to each of the other stations.

3. In combination; a plurality of stations each having a loud speaker, a microphone and a circuit controller; an electron tube amplifier common to all of said stations, a filament circuit including a supply source of current and a resistor to constantly heat said amplifier tube, a voltage converter having an operating winding

and a supply winding, a plate circuit for said tube including said supply winding and a winding of an output transformer, a grid circuit for said tube including a winding of an input transformer, a first circuit means to connect said station microphones in multiple across said filament circuit resistor through a winding of said input transformer to apply to said tube the voice frequencies created by speaking into any one of said microphones, a second circuit means to connect said station loud speakers in multiple to a winding of said output transformer to reproduce at each station the voice frequencies applied to said grid circuit, and a third circuit means including in multiple a second position contact of each of said circuit controllers to supply current from said supply source of current to said converter operating winding to create an electromotive force in said supply winding for effecting communication between any one station and all other of said stations.

4. In combination; a plurality of stations each having a loud speaker; a microphone and a circuit controller operable to a first and a second position; an electron tube amplifier common to all of said stations, a source of supply current, a filament circuit including said supply current source and a resistor to constantly heat said amplifier tube, a voltage converter having an operating winding and a supply winding, a plate circuit including said supply winding and a winding of an output transformer connected across the plate and cathode of said tube, a grid circuit for said tube and including a winding of an input transformer, a first circuit means including a first multiple path at each of said stations to connect said microphones in multiple across said filament circuit resistor through a winding of said input transformer, each of such first multiple paths including a second position contact of the controller at the same station, a second circuit means including a second multiple path at each of said stations to connect said converter operating winding to said supply current source and each of such second multiple paths including a second position contact of the controller of the same station, a third circuit means including a third multiple path of each of said stations to connect said loud speakers in multiple to a winding of said output transformer, and each such third multiple path including a first position contact of the controller of the same station.

5. In combination; a plurality of stations each having a loud speaker, a microphone and a circuit controller operable to a first and a second position; an electron tube amplifier common to all of said stations, a low voltage source of direct current, a filament circuit including said source of current and a resistor to constantly heat said tube, a voltage converter including a first transformer and a vibrator having an operating winding and an armature; a plate circuit for said tube and including a winding of said first transformer, contacts of said vibrator armature and a winding of a second transformer to apply a plate voltage to said tube in response to an electromotive force induced in said first transformer winding; a grid circuit for said tube

and including a winding of a third transformer, a first circuit means including a first multiple path at each of said stations to connect said microphone in multiple across said filament circuit resistor through a winding of said third transformer, each of such first multiple paths including a second position contact of the controller at the same station, a second circuit means including a second multiple path at each of said stations to connect said vibrator operating winding and a winding of said first transformer in series with contacts of the vibrator armature to said low voltage current source to induce an electromotive force in the first transformer winding included in said plate circuit, each of said second multiple paths including a second position contact of the controller at the same station, a third circuit means including a third multiple path of each of said stations to connect said loud speakers in multiple to a winding of said second transformer, and each of such third multiple paths including a first position contact of the controller of the same station.

6. In combination, a series of stations a first and a second one of which are at noisy locations and a third one of which is at a quiet location, said first and second stations each having a loud speaker and a microphone, said third station having a hand set comprising a receiver and a transmitter, each of said stations having a circuit controller operable to a first and a second position, a source of low voltage direct current, an electron tube amplifier, a filament circuit including said current source and a resistor to heat said tube, a voltage converter including an operating winding and a supply winding and operable to create a high voltage current in said supply winding when said operating winding is energized, a plate circuit for said tube and including said supply winding and a winding of an output transformer, a grid circuit for said tube and including a winding of an input transformer, a first circuit means connected to a winding of said output transformer and including a first multiple path at each of said stations, said first multiple path at said first and second stations each including the respective loud speaker and a first position contact of the respective controller and at said third station including said receiver; a second circuit means connected across said filament circuit resistor through a winding of said input transformer and including a second multiple path at each of said stations, said second multiple path at said first and second stations each having interposed therein the respective microphone and a second position contact of the respective controller and at said third station having interposed therein said transmitter, and a third circuit means to connect said low voltage current source to said converter operating winding to energize that winding and including a third multiple path at each of said stations and each of which third multiple paths has a second position contact of the respective controller interposed therein.

WILLARD P. PLACE.