

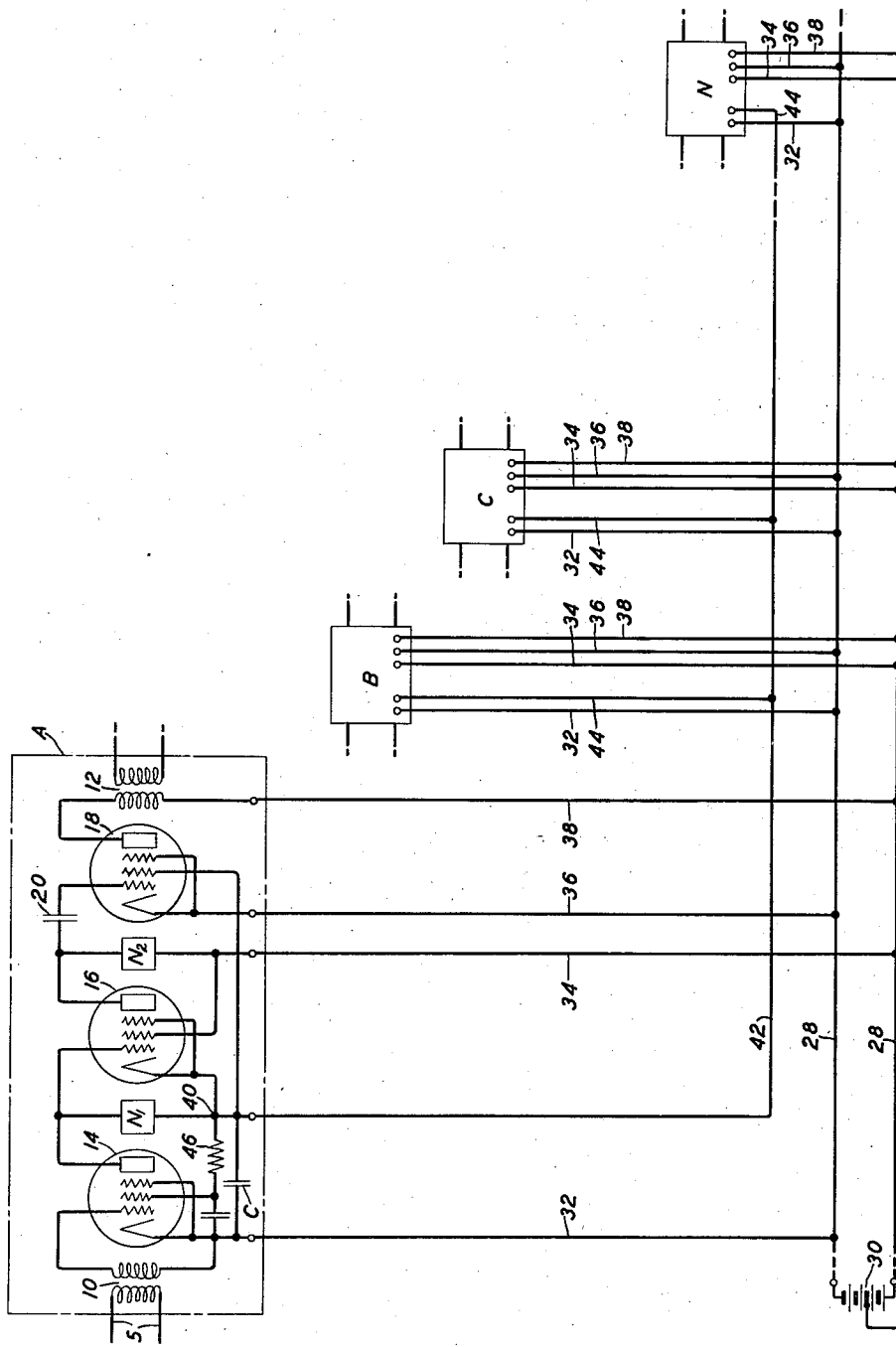
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REPEATER STATION

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REPEATER STATION

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This invention relates to a repeater station or installation for a telephone system, and, more particularly, to a power supply arrangement for a multiplicity of amplifiers at such a station.

An object of this invention is to simplify and reduce the expense of amplifier circuits for telephone systems.

A feature of the invention comprises operating a plurality of stages of an amplifier with their plate circuits in series, and utilizing the series-connected stages as a potentiometer or voltage divider to provide a desired potential for a specific electrode of one stage of the amplifier.

Another feature comprises providing a multiplicity of such amplifiers at a repeater station and connecting them in multiple at the point in each potentiometer from which is obtained the potential for the specific electrode of one stage of each amplifier.

Other and further features will be apparent from the general and detailed description which follows.

In accordance with the invention, an amplifier may comprise a plurality of amplifying stages utilizing electron discharge devices, at least two stages having their plate circuits connected in series, and including a power stage having an electron discharge device with a grid auxiliary to its input control grid. A connection is made from a point intermediate the series-connected stages to the auxiliary grid to maintain the latter at a preassigned potential. A multiplicity of such amplifiers at a repeater station have a common source of space current, and are connected in multiple at the point from which the auxiliary grid potential is derived.

The single figure of the drawing shows a multiplicity of amplifiers or repeaters A, B, C . . . N located at a repeater station, for example, of a carrier telephone system, each amplifier being associated with a separate communication circuit. These circuits may be telephone pairs in a lead-covered cable, or radio circuits, or open-wire telephone pairs. Each amplifier is similar in detail to amplifier A.

The amplifier A is connected in the communication circuit 5 through input and output transformers 10, 12, and comprises three stages of amplification provided by amplifying electron discharge devices 14, 16, 18. These devices are shown as pentodes, but the initial two stages could be triodes, screen grid tubes, or other multigrid devices. The final stage is a power stage, and, preferably comprises a screen grid or other multigrid tube. In either event, the

cathodes may be of the directly or indirectly heated type. The screen voltage of the power tube is lower than that of the plate; for comparatively high power outputs with low plate currents this is, in general, necessary.

The initial stages of the amplifier A have their space current circuits connected in series, the anode of device 14 being directly connected to the input control grid of device 16, the interstage network N₁ being proportioned so that its resistance component is sufficient to provide the desired biasing potential for the control grid of device 16. Although the conventional blocking condenser between the devices 14, 16 has been eliminated, the circuit does not constitute a direct-current amplifier, since the infinite impedance at zero frequency of by-pass condenser C reduces the gain to zero. The gain is not reduced, however, until the reactance of the condenser is comparable to the internal resistance of device 14. Biasing potential for the control grids of devices 14 and 18 may be provided in conventional manner, i. e., either by cathode resistors, or by biasing batteries. A suitable interstage network N₂ and blocking condenser 20 couple the output circuit of device 16 and the input circuit of the power stage. Space current for the amplifiers A, B, C . . . N is provided from a common source 30, which, as shown, may be a storage battery, or the filtered output of a rectifier, or a motor generator set. This source 30 may be at the repeater station, or it may be at a remote point, e. g., another repeater station, or at a terminal of the system. Space current for the first two stages of amplifier A is supplied from the supply conductors 28 through conductors 32, 34, and that for the power stage through conductors 36, 38. The first two stages constitute a potentiometer or voltage divider to provide potential for the screen grid of the power stage, the screen grid of device 18 being connected to the point 40 intermediate the devices 14, 16. This point 40 in each of the amplifiers A, B, C . . . N is connected in multiple through conductors 42, 44. If the battery 30 has its midpoint grounded, the point 40 in each amplifier may be connected to a common ground. The screen grid of tube 14 is connected to the point 40 through filtering resistance 46, and that of tube 16 to the high potential end of the network N₂.

The arrangement described is particularly advantageous in a carrier telephone system in which one or more auxiliary and unattended repeater stations are provided between main or

terminal and attended stations and the plate power supply balanced to ground at the auxiliary station is furnished from a main station, the power supply ground, however, not being carried over the cable connecting the stations. The output or power stage of the repeater station amplifiers may be operated at the full supply voltage, that is, for example, the plate or anode would be 125 volts above ground and the cathode 125 volts below ground with a plate supply of 250 volts at the repeater station. The conventional procedure with reference to the voltage amplification stages would then be to reduce the plate supply to a value suitable to the voltage amplifier tubes by means of a series resistance common to the station, thus introducing a power loss.

With the arrangement of this invention, however, the space current circuits of the first and second stages of the amplifier are connected in series so that approximately one-half of the plate supply voltage is applied to each tube. Since the tubes are in series, their space currents must be the same. The value of the space current will be determined by the resistance of the interstage network N_1 , and the amount of bias on the input control grid of the first tube.

Although the voltage distribution and space current will vary from tube to tube used in the voltage amplification stages, this effect is substantially eliminated by the multiplying of point 40 throughout the repeater station. With screen current of the output tube not too great, this point is a convenient source of screen supply for the output tube.

Although this invention has been disclosed with reference to a specific embodiment, it is to be understood that its scope is limited by the appended claims only.

What is claimed is:

1. An electric wave amplifier comprising a plurality of amplifying electron discharge devices with their space current circuits connected in series and so that the space current in each is the same, and an additional amplifying electron discharge device having a screen grid and whose space current circuit is independent of that of said plurality of devices, said plurality of devices constituting a potentiometer providing potential for said screen grid.

2. An electric wave amplifier comprising a plurality of electron discharge devices with their space current circuits connected in series and so that the space current in each is the same, another electron discharge device having its space current circuit independent of that of said plurality of devices and having an input control grid and an auxiliary grid, and a connection from a point in said series connected devices to said auxiliary grid to provide operating potential for said auxiliary grid.

3. A transmission system comprising a multiplicity of electric wave amplifiers, each amplifier comprising a pair of electron discharge devices with their space current circuits connected in series such that the space currents in the devices are the same and such that approximately one-half of the anode supply voltage is applied to each device, a common power supply for said amplifiers such that substantially the same voltage is supplied across the series-connected pair of devices in each amplifier, the replacement of a device by another tending to alter the voltage distribution between the pair of devices and the space current in the series path of a pair of de-

vices, and means connecting said amplifiers in multiple at a point in the circuit of each intermediate its devices substantially to eliminate such tendency.

4. A transmission system comprising a multiplicity of electric wave amplifiers, each amplifier comprising a pair of electron discharge devices with their space current circuits connected in series such that the space current in each device is the same, each amplifier also comprising an output electron discharge device having a grid auxiliary to its input control grid, a common power supply for said amplifiers, connections for applying the full potential of said supply between the cathode of the first and the anode of the second of the series-connected devices of each amplifier, and between the cathode and the anode of said output device, said amplifiers being connected in multiple at a point in the circuit of each intermediate said series-connected devices, and a connection from said intermediate point in each amplifier to the auxiliary grid of its respective output device.

5. An electric wave amplifier comprising a pair of electron discharge devices each having a cathode, an anode and an input control grid, a source of space current connected between the cathode of one device and the anode of the second device, a direct connection between the anode of said one device and the grid of the second device, a connection through an interstage network from the anode of said one device to the cathode of said second device, the space current circuits of said devices being connected in series and said network having a resistive component the potential drop across which provides biasing potential for the grid of said second device, a third electron discharge device comprising a cathode, an anode, an input control grid, and an auxiliary grid, and a connection from the cathode end of said interstage network to said auxiliary grid.

6. An electric wave amplifier comprising a pair of electron discharge devices each having a cathode, an anode and an input control grid, a source of space current connected between the cathode of one device and the anode of the second device, a direct connection between the anode of said one device and the grid of the second device, a connection through an interstage network from the anode of said one device to the cathode of said second device, said network having a resistive component the potential drop across which provides biasing potential for the grid of said second device, a condenser connected between said cathodes, a third electron discharge device comprising a cathode, an anode, an input control grid, and a screen grid, and a connection from the cathode end of said interstage network to said screen grid.

7. An electric wave amplifier comprising a pair of electron discharge devices each having a cathode, an anode and an input control grid, a source of space current connected between the cathode of one device and the anode of the second device, a direct connection between the anode of said one device and the grid of the second device, a connection through an interstage network from the anode of said one device to the cathode of said second device, said network having a resistive component the potential drop across which provides biasing potential for the grid of said second device, a third electron discharge device comprising a cathode, an anode, an input control grid, a grid auxiliary to said con-

trol grid, and a connection from the cathode end of said interstage network to said auxiliary grid.

8. A transmission system comprising an unattended repeater station, a plurality of electric wave amplifiers at said station, each amplifier comprising a pair of electron discharge devices with their space current circuits connected in series such that the space current in each is the same, each amplifier also comprising an output multigrid electron discharge device, a pair of power supply conductors connecting the unattended station with another repeater station in said system whereby power supply for the amplifiers at the unattended station is provided over said conductors from said other station, a connection from one supply conductor to the cathode of the first of said series-connected devices and a connection from the other supply conductor to the anode of the second of said series-connected devices, the cathode and the anode of the output device being connected across the supply conductors, said amplifiers being connected in multiple at a point in the circuit of each intermediate said series-connected devices to equalize for differences in the characteristics of the devices successively employed in the series space current circuits portion of said amplifiers, and a connection from said intermediate point in each amplifier to a grid of its respective output device to provide operating potential for said grid.

9. A transmission system comprising a multiplicity of electric wave amplifiers, each amplifier comprising a pair of electron discharge devices having a cathode, anode and input grid and with

their space current circuits connected in series such that the space current in each is the same, each amplifier also comprising an output device, a common power supply for said amplifiers, connections for applying the full potential of said supply between the cathode of the first and the anode of the second of the series-connected devices of each amplifier, and between the cathode and the anode of said output device, said output device comprising also an input control grid and an auxiliary grid, said amplifiers being connected in multiple at a point in the circuit of each intermediate said series-connected devices to equalize for differences in characteristics of the devices successively employed in the series space current circuits portion of said amplifiers, and a connection from said intermediate point in each amplifier to the auxiliary grid of its respective output device to provide operating potential for said auxiliary grid.

10. An electric wave circuit comprising a plurality of electron discharge devices each comprising a cathode, an anode, and an input control grid, said devices having their space current circuits connected in series such that the space current in each device is the same, another discharge device whose space current circuit is independent of that of said plurality of devices and having a grid auxiliary to its input control grid, and a connection from a point in said series-connected devices to said auxiliary grid to provide operating potential for said auxiliary grid.

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