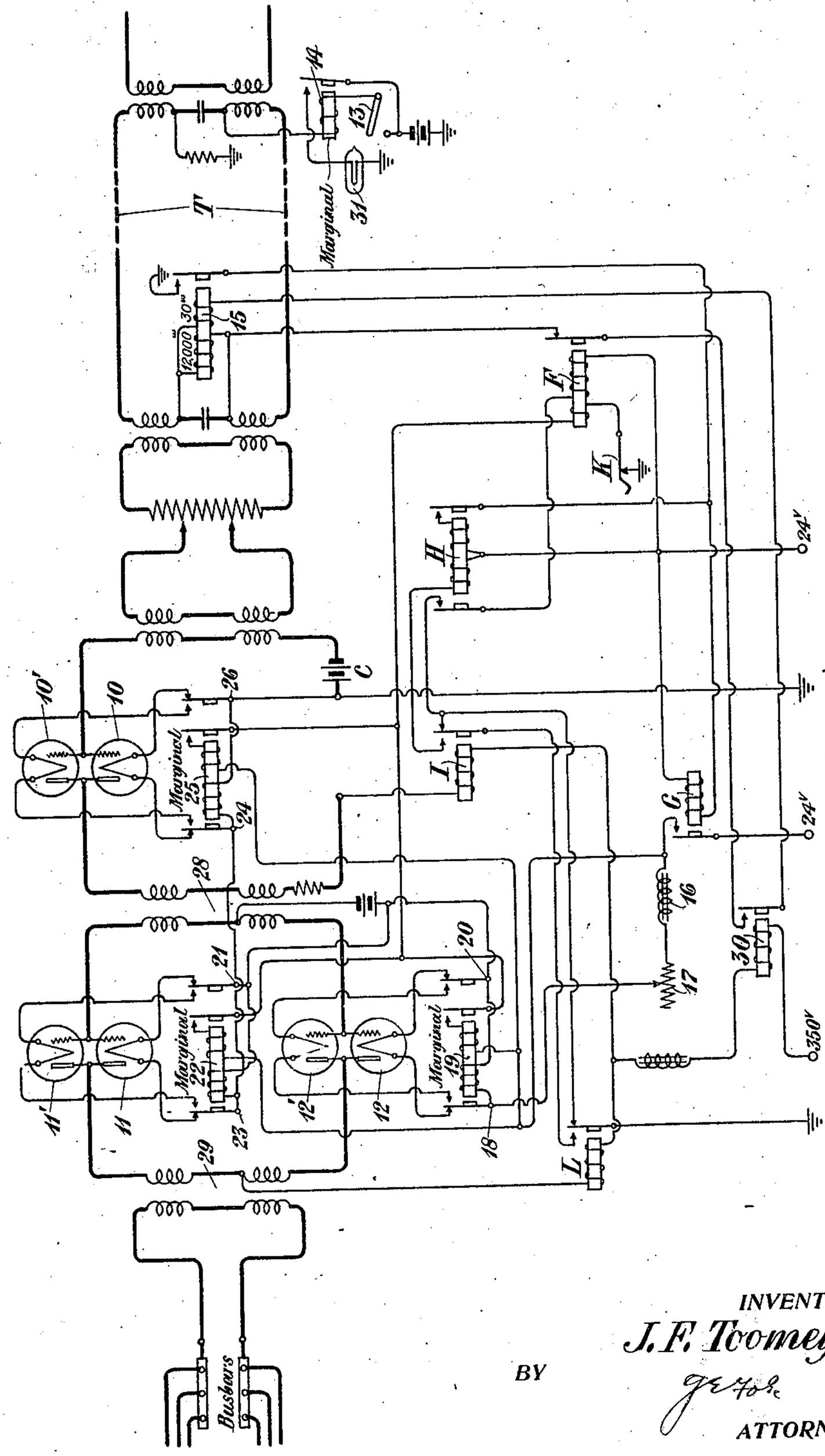
April 17, 1928. 1,666,154

J. F. TOOMEY

DISTRIBUTION OF PROGRAMS OVER WIRES

Filed July 12. 1924







INVENTOR
J. F. Toomey
BY
ATTORNEY

Patented Apr. 17, 1928. 1,666,154

# UNITED STATES PATENT OFFICE.

JOHN F. TOOMEY, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

## DISTRIBUTION OF PROGRAMS OVER WIRES.

Application filed July 12, 1924. Serial No. 725,643.

This invention relates to the distribution of programs over wire lines, and more particularly to an amplifying arrangement to be used in connection with such systems.

In a system for the distribution of music, news, entertainment, etc., over wire transmission lines, it is customary to establish a connection from the studio or other point at which the program originates over a trunk to a central office from which branch trunks extend to points in local areas, such as apartment houses. At each apartment house or other local area branches extend from each distributing trunk to the receiving equipment located at the subscriber's premises. At each distributing point, such, for example, as the central station, or the local distributing point, such as an apartment house, it is desirable to provide amplifying equipment to bring the transmission to a desired level in order that the necessary volume will be applied to each distributing trunk or subscriber's branch.

At such distributing points it is not always convenient to have an attendant on duty to maintain the amplifying equipment. It is the purpose of this invention, therefore, to provide means whereby, if any amplifier fails, spare amplifying equipment may be substituted for the regular equipment without interrupting the service thereby enabling a trouble man to rectify the difficulty at his convenience.

The invention will now be more fully understood from the following description when read in connection with the accompanying drawing, the figure of which illustrates an amplifying arrangement embodying the principles of the invention.

Referring to the drawing, T may be taken to represent a trunk extending from a studio to a distributing point or a trunk extending from a central distributing point to a local distributing point such as an apartment house. At the apartment house, amplifying equipment is provided comprising two amplifying stages, the first stage comprising preferably a single tube amplifier and the second stage comprising preferably a push-pull amplifier. A tube 10 is provided as the normal amplifier for the first stage, and an auxiliary tube 10′ is adapted to be switched in the circuit in the event that the tube 10 should fail. Similarly, tubes 11 and 12 normally function as the amplifiers of the second stage push-pull combination, auxiliary tubes 11′ and 12′ being provided to be substituted in the case of failure of the regular tubes. The circuits are so arranged that the switching of an auxiliary tube will be under the control of a marginal relay in circuit with the filament of the regular tube, the relay being so arranged that it will automatically disconnect the regular tube and substitute an auxiliary tube in case the filament of the regular tube should burn out.

Further details of the apparatus will now be clear from the description of the operation, which is as follows:

Whenever it is desired to place the circuit in condition for transmission, a switch 13 will be closed thereby completing a circuit from battery, over the switch 13, through marginal relay 14, over the ring side of the trunk T, through the high resistance winding of the relay 15, and back over the tip side of the trunk T to ground. The relay 15 is energized over the circuit above traced. The relay 14 being marginal does not pull up its armature in series with the high resistance winding of the relay 15. Relay 15 closes the circuit from ground, over its front contact, through the winding of relay G to the 24 volt battery, thereby energizing the relay G. Relay G in turn completes a circuit from the 24 volt battery over its front contact, through impedance coil 16 and resistance 17 to the point 18, thence in parallel over the left-hand back contact of marginal relay 19, through the filament of tube 12 and outer right-hand back contact of relay 19 to point 20, and from the point 18 through the energizing winding of marginal relay 19 to point 20. From point 20 the circuit extends to point 21 and thence in parallel over the outer right-hand back contact of marginal relay 22, through the filament of tube 11, and over the left-hand back contact of marginal relay 22 to the point 23, and from the point 21 through the energizing winding of marginal relay 22 to point 23. From point 23 the circuit extends to point 24 and thence in parallel over the left-hand back contact of marginal relay 25, through the filament of the tube 10, outer right-hand back contact of relay 25 to point 26, and from point 24 through the operating winding of relay 25 to the point 26. From point 26 the circuit extends to ground.

It will be seen from the circuit above

traced that the circuit extends through the filament of each normal tube in parallel with the operating winding of the marginal relay. Sufficient current flows through the filaments of each of the normal tubes 10, 11 and 12 so that the filaments glow and each filament shunts the energizing winding of the corresponding relay to such an extent that an insufficient amount of current flows through the marginal relay to cause its energization.

As soon as the filaments of the tubes begin to glow, the space current flows in the output circuits of the amplifiers. Current therefore flows from the plate of the first stage tube 10, through the primary winding of transformer 28, through the winding of the relay I to the 350 volt source of space current, thereby energizing the relay I. Similarly, current flows in parallel from the plates of the tubes 11 and 12 of the second stage amplifier to the midpoint of the primary winding of the transformer 29 and thence through the winding of the relay L to the 350 volt plate source. Relays I and L, upon being energized, complete a circuit from ground over the front contact of relay L and over the front contact of relay I through the left-hand winding of relay H to the 24 volt battery thereby energizing relay H and locking it up through its right-hand winding and over its right-hand front contact to ground over the front contact of relay 15. A relay 30 is connected in the lead which extends to the 350 volt plate source so that as soon as current flows to the plate circuits of the amplifying equipment the relay 30 is energized and completes a shunt circuit through the low resistance winding of the relay 15, said shunt circuit extending over the back contact of the relay F. The closing of the low resistance shunt circuit increases the current flow over the trunk T thereby energizing the marginal relay 14 which completes a circuit for the lamp 31 to indicate that the circuit is in operative condition. Transmission may now take place in the regular manner.

In case the 350 volt power source should fail, the relay 30 will be deenergized and open the low resistance shunt winding of the relay 15, thereby causing the marginal relay 14 to be deenergized. When the armature of the relay 14 falls off, the lamp 31 will be extinguished, thereby indicating that there is trouble on the circuit. In the event the tube 10 should fail by reason of burning out its filament, the current through the left-hand winding of the marginal relay 25 will be increased owing to the opening of the shunt path about said winding. Marginal relay 24 will thereby be energized and will be locked up over a circuit from the 24 volt battery, over the front contact of relay G, through the right-hand locking winding of relay 25 and over its inner right-hand front contact and through the left-hand winding of relay F to ground over restoring key K. At its outer front contacts relay 25 substitutes the filament circuit of the auxiliary tube 10′ for the filament circuit of the tube 10 so that the tube 10′ at once functions, and transmission may proceed as before. The relay F, upon being energized, opens the low resistance shunt winding of the relay 15 to cause the signal lamp at 31 to be extinguished thereby indicating trouble upon the circuit, so that an attendant may substitute a new tube for the tube 10. Upon replacing the tube 10, the attendant opens the key K thereby releasing the relay F and unlocking the marginal relay 25 which is restored to normal and again connects the filament of the tube 10 in circuit, so that the tube 10 now functions as the amplifier. The releasing of the relay F again closes the circuit through the low resistance shunt winding of the relay 15 and causes the signal lamp 31 to again glow. A similar action takes place in case the filaments of either of the tubes 11 or 12 should burn out.

In the event that plate current should fail to flow through the relay I for any reason, its armature in falling off will complete a circuit from ground, over the front contact of relay L and back contact of relay I, front contact of lock up relay H and through the winding of the relay F to the 24 volt battery. Similarly, if the space currents should fail to flow through the winding of the relay L, a circuit will be completed from ground, over the back contact of relay L, front contact of relay H, and through the right-hand winding of relay F to battery. In every case the relay F will be energized thereby opening the low resistance shunt of the relay 15 and causing the lamp 31 to indicate trouble on the line.

When the circuit is no longer to be used for transmission, the switch 13 will be opened thereby deenergizing marginal relay 14 and relay 15. Relay 15 opens the locking circuit of relay H and also opens the circuit of relay G so that all of the apparatus is restored to normal.

It will be obvious that the general principles herein disclosed may be embodied in many 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 transmission circuit, an amplifier comprising a normal vacuum tube and circuits therefor, a spare vacuum tube, a marginal relay supplied with current from the filament current supply circuit of said normal vacuum tube, and means controlled by said relay whereby when said filament burns

out the spare vacuum tube will be switched into the amplifier circuit instead of said normal vacuum tube.

2. In a transmission circuit, an amplifier comprising a normal vacuum tube and circuits therefor, a spare vacuum tube, a current supply circuit for energizing the filament of said normal tube, a marginal relay connected in parallel with said filament, said marginal relay remaining deenergized while current flows through said filament and adapted to be energized when the filament burns out, and means controlled by said marginal relay for switching said spare tube into the amplifier circuit in place of the normal tube.

3. In a transmission circuit, a multi-stage amplifier comprising a normal tube and circuits therefor for each stage of amplification, a spare tube for each stage of amplification, a marginal relay connected in shunt with the filament of each normal tube, said marginal relay being deenergized as long as current flows through the filament but being energized when the filament burns out, and switching means controlled by each marginal relay for disconnecting the corresponding normal tube and substituting the spare tube therefor.

In testimony whereof, I have signed my name to this specification this 11th day of July, 1924.

JOHN F. TOOMEY.