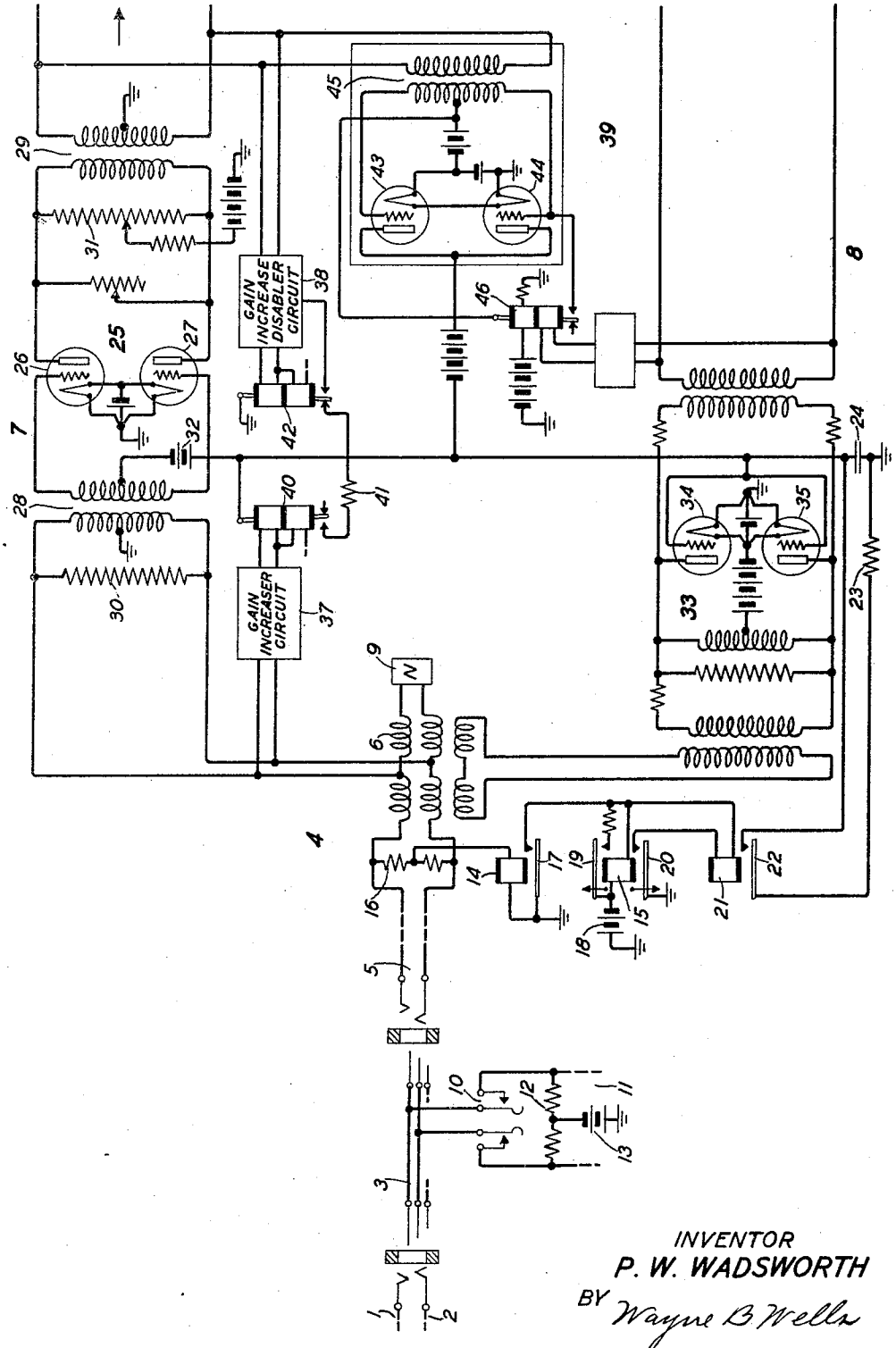
May 16, 1933. P. W. WADSWORTH 1,909,438

SIGNALING SYSTEM

Filed May 10, 1932



INVENTOR
P. W. WADSWORTH
BY Wayne B. Wells
ATTORNEY

Patented May 16, 1933 1,909,438

UNITED STATES PATENT OFFICE

PAUL W. WADSWORTH, OF NEW YORK, N. Y., ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

SIGNALING SYSTEM

Application filed May 10, 1932. Serial No. 610,384.

This invention relates to transmission lines having automatic gain control circuit connected thereto and particularly to means for adjusting the setting of the automatic gain control circuits connected to the transmission lines.

One object of the invention is to provide a central office for connecting a toll line to a transmission line having voice operated gain control circuits connected thereto with means under control of the operator at the central office to adjust the setting of the voice operated gain control circuits approximately to the setting for a talker on the toll line prior to the connection of the toll line to the transmission line.

Another object of the invention is to provide a central office for connecting a toll line to a transmission line that shall have means under control of the operator's talking key for adjusting automatic gain control circuits on the transmission line prior to the connecting of the toll line to the transmission line.

A further object of the invention is to provide a signal transmission system having a toll line adapted to be connected to a transmission line and voice operated gain control circuits connected to the transmission line that shall have means for adjusting the voice operated gain control circuits on the transmission line to approximately the adjustment required by the signals from the toll line prior to the connection of the toll line to the transmission line and the automatic control of the voice operated gain control circuits by the signals received from the toll line.

A transmission line having the volume of the signals thereon maintained substantially constant by voice operated gain control circuits will at the time of connecting a toll line to the transmission line have the voice operated gain control circuits first adjusted by the speech of the operator at the central office making the connection and then by the speech of the subscriber on the toll line. The speech currents of the operator will be relatively strong and operate the voice operated gain control circuits to lower the gain on the transmission line prior to the operation of the voice operated gain control circuits by the speech currents of the subscriber. The voice currents of the subscriber received on the transmission line from the toll line are generally much weaker than the voice currents received on the transmission line from the operator's talking circuit. Accordingly at the time of connection of the toll line to the transmission line, the voice operated gain control circuits are set for a much lower gain than is required by the speech currents from the toll line. This causes a short period of low volume signals on the transmission line.

According to the present invention the voice operated gain control circuits on the transmission line are adjusted under control of the operator at the central office just prior to connecting the toll line to the transmission line to approximately supply the gain on the transmission line required by the signals from the toll line. The present invention is disclosed in combination with gain control circuits of the type shown in the John L. Hogg and Stephen Doba, Jr., Patent No. 1,853,974, filed April 19, 1930, and the Stephen Doba, Jr., application Serial No. 608,362, filed April 30, 1932.

In the application of Stephen Doba, Jr., Serial No. 608,362, the gain control circuits are shown associated with a four-wire section of a transmission line. A gain control device comprising two space discharge tubes in push-pull relationship is connected effectively in series with the transmitting channel of the transmission line. A gain control device comprising two space discharge tubes is connected across the receiving channel of the space discharge device. The potential on the grid elements of the gain control devices in the transmitting and receiving channels of the transmission line is controlled according to the charge on a control condenser. The charge on the control condenser is so adjusted as to maintain constant energy volume on the transmitting channel beyond the gain control device therein.

The charge on the control condenser is governed by a gain increaser circuit, a gain increase disabler circuit and a gain decreaser circuit. The gain increaser circuit serves to

decrease the charge on the control condenser to increase the gain on the transmitting channel and decrease the gain on the receiving channel. The gain increase disabler circuit serves to prevent operation of the gain increaser circuit to increase the gain on the transmitting channel. The gain decreaser circuit serves to impress a charge on the control condenser for lowering the gain on the transmitting channel and for raising the gain on the receiving channel.

The gain increaser circuit is operated if the peaks of speech current before the gain control device in the transmitting channel are above the peaks for the weakest talker. The gain increase disabler circuit is operated if the peaks of speech beyond the gain control device in the transmitting channel are above a predetermined lower level. If the gain increaser circuit is operated and the gain increase disabler circuit is not operated, the charge on the control condenser will be reduced. However, if both of the above mentioned circuits are operated, no increase in the gain of the transmitting channel can take place. The gain decreaser circuit is operated by the peaks of speech beyond the gain control device in the transmitting channel to impress a charge on the control condenser if such peaks of speech beyond the gain control device in the transmitting channel are above an upper limiting value.

In accordance with the present invention, the charge on the control condenser in the gain control circuits is adjusted by the operator at the central office prior to the connection of a toll line to the transmission line. The charge on the control condenser is adjusted by the operator to approximately the charge required to produce a correct gain on the transmitting channel of the transmission line for the speech currents received from the toll line. When the operator at a central office connects her talking circuit to the transmission line by means of the talking key, a simplex relay and a slow release relay are operated. When the operator is prepared to connect the toll line through to the transmission line, the talking key is operated to disconnect the operator's talking circuit from the transmission line. Such operation of the talking key releases the simplex relay which in the released position permits an energizing circuit to be completed through again control relay under control of the slow release relay. The gain control relay when operated completes a shunt circuit around the control condenser of the gain control circuits. The shunt circuit completed by the gain control relay includes adjustable resistance elements which insure a reduction in the charge on the control condenser. The shunt circuit is opened upon release of the slow-release relay which opens the energizing circuit for the gain control relay. The slow release relay and the resistance elements in the shunt circuits are adjusted so that the charge retained on the control condenser will give the correct gain on the transmitting channel of the transmission line.

The single figure on the accompanying drawing is a diagrammatic view of a signaling system constructed in accordance with the invention.

Referring to the accompanying drawing a toll line comprising conductors 1 and 2 is connected at a central station by a toll cord 3 to a transmission line 4. Transmission line 4 comprises a two-wire section 5 which is connected by a hybrid coil 6 to a four-wire section comprising a transmitting channel 7 and a receiving channel 8. The hybrid coil 6 is provided with a suitable balancing network 9.

At the central station the usual operator's key 10 is provided for connecting an operator's talking circuit 11 to the toll cord 3. A simplex bridge 12 having a grounded battery 13 connected thereto is connected across the operator's talking circuit 11 for supplying current to operate a simplex relay 14 and a slow-release relay 15 when the operator's talking circuit is connected by the key 10 to the toll cord 3 and the toll cord is connected to the transmission line 4. One terminal of the coil of the simplex relay 14 is connected to a simplex bridge 16 across the two-wire section 5 of the transmission line. The other terminal of the coil of the simplex relay 14 is grounded. Thus, the simplex relay 14 is operated from the battery 13 whenever the operator's talking circuit is joined to the toll cord 3 and the toll cord is connected to the transmission line 4. The armature 17 of the relay 14 completes a circuit from a grounded battery 18 for operating the slow-release relay 15. The slow-release relay 15 is provided with two armatures 19 and 20 for governing the operation of a control relay 21. When the slow-release relay 15 is operated and the simplex relay 14 is released a circuit is provided for effecting operation of the control relay 21. The circuit for operating the control relay 21 extends from one terminal of the battery 18 through the armature 19, coil of the relay 21, armature 20 of slow-release relay and ground return to the other terminal of the battery 18. The control relay 21 is held operated for a time dependent upon the time taken for the relay 15 to release. The armature 22 of the control relay 21 completes a circuit through a resistance element 23 across a control condenser 24 in the gain control circuits for the four-wire section of the transmission line 4. The function of the shunt circuit across the condenser 24 completed by the armature of the control relay 21 will be described hereinafter.

Gain control circuits of the type disclosed in the above mentioned application of S. Doba, Jr., Serial No. 608,362, are provided

for the transmitting channel 7 and the receiving channel 8 of the transmission line 4. Inasmuch as these gain control circuits are completely described in the above mentioned application of Stephen Doba, Jr. a detailed description of such circuits in this application is deemed unnecessary. The gain control circuits will only be described sufficiently to illustrate the present invention.

A gain control device 25 comprising two three-element space discharge devices 26 and 27 is connected effectively in series with the transmitting channel 7. A transformer 28 is connected in the transmitting channel before the gain control device 25 and a transformer 29 is connected in the transmitting channel after the gain control device. Impedance means 30 is connected across the primary winding of the transformer 28 and impedance means 31 is connected across the primary winding of the transformer 29. A battery 32 is provided for impressing a normal negative bias on the grids of two space discharge devices 26 and 27. The control condenser 24 impresses a potential on the grids of the space discharge devices 26 and 27 for controlling the gain effected by such devices in the transmitting channel 27.

A gain control device 33 comprising two three-element space discharge devices 34 and 35 is connected across the receiving channel 8 of the transmission line. The control condenser 24 impresses a potential on the grids of the devices 34 and 35 for governing the gain of such devices in the receiving channel 8 of the transmission line. A variation in gain on the transmitting channel by the variation in charge on control condenser 24 acting on the grids of the space discharge devices 26 and 27 will be accompanied by an opposite variation in gain on the receiving channel caused by the charge from the condenser 24 acting on the grids of the space discharge devices 34 and 35.

The charge on the control condenser 24 is governed by a gain increaser circuit indicated on the drawing by rectangle 37, a gain increase disabler circuit indicated on the drawing by a rectangle 38 and a gain decreaser circuit 39. The gain increaser circuit 37 is operated from the transmitting channel 7 for the gain control device 25 for operating a relay 40 when the peaks of speech before the gain control device 25 are above that of the weakest talker. The relay 40 when operated completes a discharge device for the control condenser 24 through a resistance element 41 if a relay 42 controlled by the gain increase disabler circuit is in released position as shown on the drawing. The circuit completed by the armature of the relay 40 may be traced from one terminal of the control condenser 24 through the armature of relay 40, resistance element 41, armature of the relay 42 and ground return to the other terminal of the control condenser 24. The control condenser is discharged at a rate determined according to the resistance value of the element 41.

The gain increase disabler circuit is operated from the receiving channel at a point beyond the gain control device 25. The gain increase disabler circuit operates the relay 42 whenever the peaks of speech on the transmitting channel beyond the gain control device therein are above a lower limiting value. The operation of the relay 42 by the gain increase disabler circuit prevents any discharge of the control condenser 24 by the gain increaser circuit.

The gain decreaser circuit 39 comprises two three-element space discharge devices 43 and 44 which have their input circuits connected by a transformer 45 across the transmission channel 7 beyond the gain control device 25. The output circuits of the space discharge devices 43 and 44 in the gain decreaser circuit 39 are connected across the control condenser 24. The grids of the space discharge devices 43 and 44 are biased so that no charge can be impressed on the control condenser 24 until the peaks of speech waves on the transmitting channel beyond the gain control device 25 are above an upper limiting value. A relay 46 is operated from the receiving channel for effecting operation of the gain increase disabler circuit and preventing operation of the gain decreaser circuit whenever the receiving channel is in use. A detailed description of this operation is deemed unnecessary.

In the above described gain control circuits the charge on the condenser 24 is controlled to govern the gain control devices in the receiving and transmitting channel. The gain control device in the transmitting channel is so controlled as to maintain substantially constant volume on the transmitting channel beyond the gain control device. The charge on the control condenser is automatically controlled by the signals being transmitted. When the operator at the central station is talking just prior to the connection of a toll line to the transmission line, the gain on the transmitting channel will be relatively low inasmuch as the speech of the operator at the central station will be relatively loud. The signal currents received from a subscriber over a toll line will have relatively low amplitudes as compared to the amplitudes of the signal currents received from the operator at the central station; thus when a subscriber begins to talk over the transmission line, the volume will be below normal for a short period of time.

In order to prevent the short period of low volume when the subscriber commences to talk over the transmission line, the control condenser 24 is discharged through the resistance element 23 under the control of the relay 21 to adjust the gain control circuits approximately to the setting required by a

talker on the toll line. When the operator's talking circuit 11 is connected to the toll cord by the key 10 the simplex relay 14 and the slow-release relay 15 are operated. When the operator's talking circuit is disconnected from the toll cord at the time of connecting the toll cord to the toll line the simplex relay 14 is released and the control relay 21 is operated by means of the slow-release relay 15. The control relay 21 as before set forth completes a discharge circuit for the control condenser 24 which is maintained as long as the slow-release relay is held operated.

Modifications in the system and in the arrangement and location of parts may be made within the spirit and scope of the invention and such modifications are intended to be covered by the appended claims.

What is claimed is:

1. In a signal system, a transmission line, control means for automatically maintaining the signals on said line at substantially constant volume, a toll line, a central office having means for connecting said toll line to the transmission line, and means operated from the central office at the time of connecting the toll line to the transmission line and prior to the operation of the control means by the signals from the toll line for approximately setting the control means to govern the volume of the signals from the toll line.

2. In a signal system, a transmission line, gain control means connected to said transmission line, means automatically governed by the signals on said line for operating said gain control means to maintain the signals on said line at constant energy volume beyond said gain control means, a toll line, a central office for connecting the toll line to the transmission line, and means governed from the central office for approximately setting the control means to govern the volume of the signals from the toll line prior to the operation of the control means by the signals from the toll line.

3. In a signal system, a transmission line, gain control means automatically governed by the transmitted signals for maintaining the signals on said line at substantially constant volume, a toll line, a central office having means for connecting the toll line to the transmission line, and means operated from the central station for approximately setting said control means to maintain the signals from the toll line on the transmission line at constant volume prior to the automatic control of the control means by the signals received on the transmission line from the toll line.

4. In a signal system, a transmission line, control means for automatically maintaining the signals on said line at substantially constant volume, a toll line, a central office having an operator's telephone circuit under control of a talking key and means for connecting the toll line to the transmission line, and means governed according to the operation of the operator's talking key for governing said control means.

5. In a signal system, a transmission line, gain control means connected to said transmission line, control means automatically governed by the signals on the transmission line for operating said gain control means to maintain the signals on said line at constant energy volume beyond the gain control means, a toll line, a central office for connecting said toll line to the transmission line and having an operator's circuit under control of a talking key, and means governed according to the operation of the operator's talking key for approximately setting said control means to govern the volume of the signals from the toll line prior to the operation of the control means by the signals from the toll line.

6. In a signal system, a transmission line, control means for automatically maintaining the signals on said line at substantially constant volume, a toll line, an operator's telephone circuit, and means for preparing an auxiliary circuit to govern said control means upon connection of the operator's circuit to the transmission line and for completing said auxiliary circuit to govern said control means for a limited period when the operator's circuit is disconnected from the transmission line and the toll line is connected thereto.

7. In combination, a transmission line, gain control means connected to the transmission line, an operator's talking circuit under control of a talking key, a control relay, means under control of the talking key upon connection of the operator's talking circuit to the transmission line for preparing a circuit to operate said control relay and upon disconnection of the operator's talking circuit from the transmission line for operating the control relay for a predetermined period of time, and means governed by said control relay for adjusting said gain control means.

8. In a signal system, a transmission line, gain control means connected to said transmission line, a toll line, a central office for connecting said toll line to the transmission line, an operator's talking circuit and a talking key at the central office, means under control of said talking key upon connection of the operator's circuit to the transmission line for operating a simplex relay and a slow-release relay and upon disconnection of the operator's circuit from the transmission line for releasing the simplex relay to operate a control relay under control of the slow-release relay, and means operated by the control relay for adjusting said gain control means.

9. In a signal system, a transmission line, a gain control device connected to said line for controlling the volume of the transmitted signals, a control condenser for governing the

gain by said device according to the charge thereon, a toll line and an operator's telephone circut adapted to be connected to said transmission line, means for controlling the charge on said condenser according to the energy peaks of signals on said transmission line to maintain constant volume on the line beyond the gain control device, a relay and a circuit controlled thereby for controlling the charge on said control condenser, and means for operating said relay for a limited period of time upon connection and disconnection of the operator's telephone circuit from the transmission line and prior to control of the charge on said condenser by speech currents from the toll circuit to adjust the charge on said condenser so that the gain control device is approximately adjusted to the speech current received from the toll line.

10. In a transmission system, transmitting and receiving channels, a gain control device connected in series with the transmitting channel, a gain control device connected across the receiving channel, means comprising a control condenser for governing the gain of said gain devices according to the charge on said condenser, means for varying the charge on said condenser according to the energy peaks of the signals on the transmitting channel to maintain a constant volume on the transmitting channel beyond the gain control device therein, a toll line adapted to be connected to said channels, an operator's telephone circuit adapted to be connected to said channels, and means comprising a relay having an operating circuit therefor prepared upon connection of the operator's telephone circuit to said channels and completed upon disconnection of the operator's telephone circuit to effect operation of said relay for a limited time, and means controlled by the operation of said relay for controlling the charge on said control condenser prior to control of the charge on said condenser by voice currents from the toll line.

In witness whereof, I hereunto subscribe my name this 4th day of May, 1932.

PAUL W. WADSWORTH.