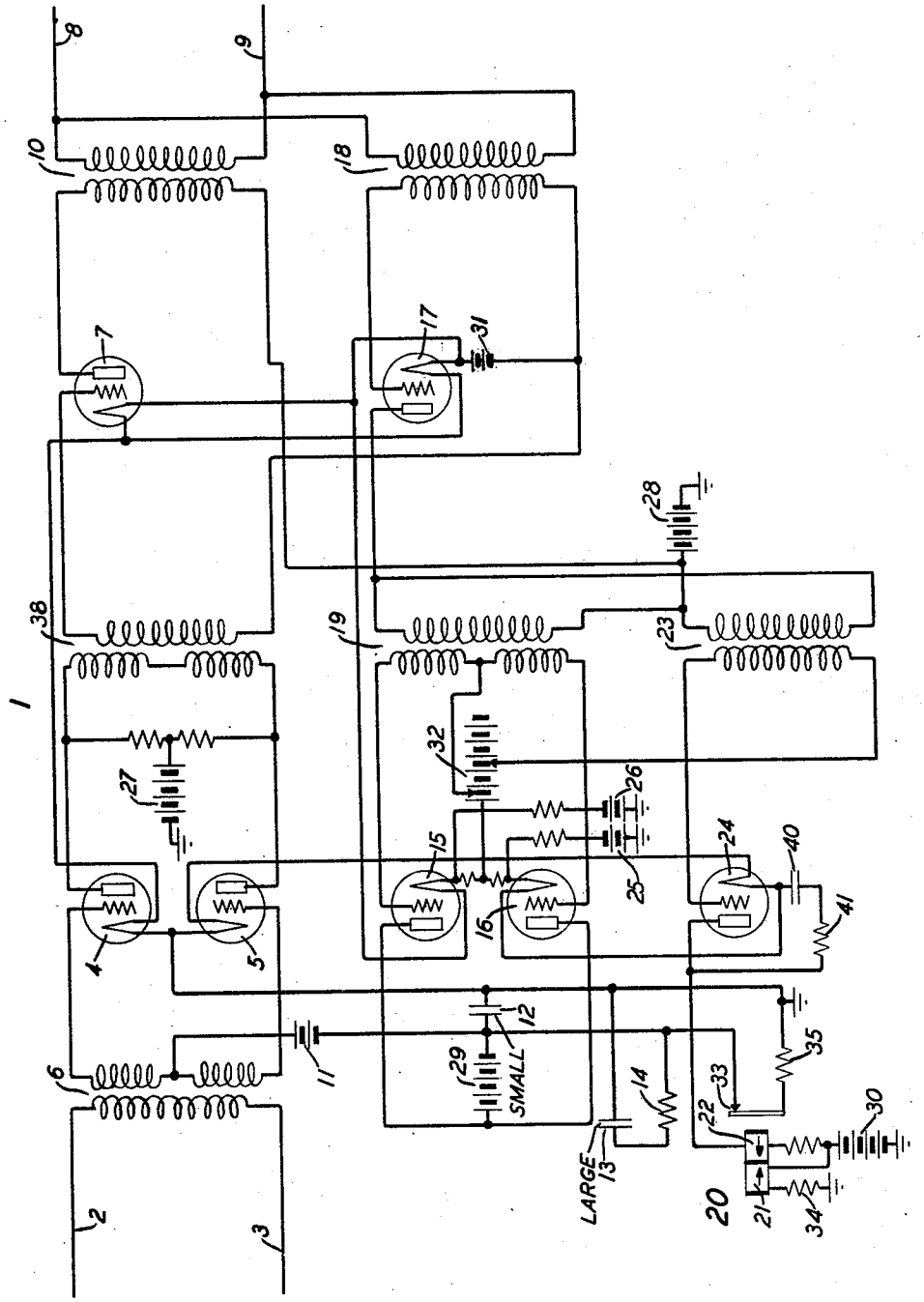
Oct. 4, 1932. S. DOBA, JR 1,880,889

SIGNAL TRANSMISSION SYSTEM

Filed May 25, 1931



INVENTOR
S. DOBA. Jr.

BY
Wayne B Wells

ATTORNEY

Patented Oct. 4, 1932

1,880,889

UNITED STATES PATENT OFFICE

STEPHEN DOBA, JR., OF NEW YORK, N. Y., ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

SIGNAL TRANSMISSION SYSTEM

Application filed May 25, 1931. Serial No. 539,830.

This invention relates to signal transmission systems and particularly to control circuits for limiting the energy volume of signals transmitted over transmission systems.

One object of the invention is to provide a signal transmission system that shall prevent the energy volume at any desired point in the system rising above a predetermined limit and that shall insure against any control of the energy volume below said predetermined limit.

Another object of the invention is to provide a signal transmission system with a loss device that at any desired point in the system shall not only prevent small peaks of energy volume rising above a predetermined limit but shall prevent the energy volume rising above said limit for extended periods while insuring against control of the energy volume when below said predetermined limit.

A further object of the invention is to provide a signal transmission system having a three-element vacuum tube loss device that shall vary the negative grid biasing potential on the device according to the charge on two condensers of different sizes and that shall so control the charge on said condensers as to prevent the energy volume in the system beyond the device rising above a predetermined limit.

In certain types of signal systems it is desirable to prevent the energy volume going above a predetermined limit without effecting any control to produce constant volume. An example of this type of system is a voice frequency carrier telegraph system. In order to protect transmission apparatus in such a system it is desirable to prevent isolated peaks of energy volume or extended periods of energy volume going above a predetermined limit.

In a signal system having volume control circuits constructed according to the present invention a transmitting channel is provided with two loss devices comprising two three-element vacuum tubes connected in push-pull relationship. The negative grid bias on the loss device is controlled in accordance with the charge on a condenser in the grid circuits and a second condenser of relatively large size connected in shunt to the first mentioned condenser and in series with a resistant element. The charge on the two condensers is so controlled as to prevent the energy volume on the transmitting channel beyond the loss devices going above a predetermined limit. The charge on the relatively small condenser serves to prevent small peaks of energy volume going above the predetermined limit and the charge on the relatively large condenser serves to prevent extended periods of energy volume going above the predetermined limit.

The two condensers which control the negative grid bias on the loss devices are charged in accordance with the energy volume above the predetermined limit by a circuit connected to the transmitting channel beyond the loss devices. A relay is provided for insuring the discharge of the two condensers whenever the energy volume on the transmitting channel beyond the loss devices is below said predetermined limit. The relay is controlled to effect discharge of the condensers at any desired rate when the energy volume in the transmitting channel beyond the loss devices is below said predetermined limit.

A volume control circuit having three-element vacuum tube loss devices connected in push-pull relationship in a transmitting channel is disclosed in the patent to S. Doba, No. 1,854,828 dated April 19, 1932. A volume control circuit having a vacuum tube loss device controlled in accordance with the charge on a condenser is disclosed in the patent to J. L. Hogg et al., No. 1,853,974 dated April 12, 1932.

The single figure in the accompanying drawing is a diagrammatic view of a volume limiting circuit constructed in accordance with the invention.

Referring to the drawing, a transmitting channel 1 is shown having input conductors 2 and 3 which are assumed to receive signals having a variable volume range. The input conductors 2 and 3 are connected to two three-element vacuum tube loss devices 4 and 5 by means of a transformer 6. The vacuum tube loss devices 4 and 5 are connected in the

transmitting channel in push-pull relationship and are connected to an amplifier tube 7 by means of a transformer 38. The amplifier tube 7 is connected to the outgoing conductors 8 and 9 by means of a transformer 10.

The negative grid bias on the loss devices 4 and 5 is not only controlled by battery 11 but also by the charge on a small condenser 12 and the charge on a relatively large condenser 13. The condenser 13 in series with a resistance element 14 is connected in shunt to the condenser 12. The charge on the condensers 12 and 13 is governed by a control circuit connected to the transmitting channel 1 at a point beyond the loss devices 4 and 5. The control circuit which governs the charge on the condensers 12 and 13 comprises two rectifier tubes 15 and 16 and an amplifier tube 17. The input circuit of the amplifier tube 17 is connected to the outgoing conductors 8 and 9 of the transmitting channel 1 by means of a transformer 18 and the output circuit of the amplifier tube 17 is connected to the input circuits of the rectifier tubes 15 and 16 by a transformer 19. The output circuits of the rectifier tubes 15 and 16 are connected to the condensers 12 and 13.

A polarized relay 20 having a holding coil 21 and an operating coil 22 is provided for discharging condensers 12 and 13 when the energy volume on the transmitting channel beyond the loss devices 4 and 5 is below the predetermined limit. The operating coil 22 for the relay 20 is controlled by a circuit connected to the output circuit of the amplifier 17 by means of a transformer 23. The transformer 23 is connected to the operating coil of the relay 22 by means of a three-element rectifier tube 24.

A battery 25 is provided for supplying filament heating current to the rectifier tubes 16 and 24 and the loss device 5. A battery 26 is provided for supplying filament heating current to the rectifier tube 15, amplifier tubes 7 and 17 and the loss device 4. A battery 27 is provided for supplying plate potential to the loss devices 4 and 5, a battery 28 is provided for supplying plate potential to the amplifier tubes 7 and 17, a battery 29 is provided for supplying plate potential for the rectifier tubes 15 and 16 and a battery 30 is provided for supplying plate potential to the rectifier tube 24. A negative grid biasing battery 31 is provided for the two amplifier tubes 7 and 17. A negative grid biasing battery 32 is provided for the three rectifier tubes 15, 16 and 24.

When the transmitting channel is idle or when the energy volume level beyond the loss devices is below the predetermined limit the armature of the relay 20 is held in engagement with the contact member 33 by the biasing coil 21. The biasing coil 21 is energized from the battery 30 in circuit with a resistance element 34. When the armature of the relay is in engagement with the contact member 33 condensers 12 and 13 will be discharged through a resistance element 35. The size of the resistance element 35 may be varied according to the rate at which it is desired to have the condensers 12 and 13 discharged. Under some conditions it is possible to dispense with the relay 20 and to permanently connect the resistance element 35 across the condensers 12 and 13 so as to discharge the condensers 12 and 13 at a fixed rate at all times.

The condenser 12 which is assumed to be of relatively small size is charged by small peaks of energy volume above the predetermined limit. The condenser 13 which is assumed to be relatively large in size is charged when the energy volume beyond the loss devices 4 and 5 tends to go above the predetermined limit for an extended period of time. Assuming signals on the transmitting channel having small peaks of energy volume beyond the loss devices which extend above the predetermined limit, the negative grid bias from the battery 31 on the amplifier tube 17 will be overcome to impress potential from the amplifier tube 17 on the input circuits of the rectifier tubes 15 and 16. The negative grid bias on the rectifier tubes will be overcome to lower the internal resistance of the rectifier tubes 15 and 16 and permit the battery 29 to apply a charge for short periods of time on the condensers 12 and 13. The condenser 12 which is relatively small will be charged very quickly to apply a negative potential to the grids of the loss devices 4 and 5 thus increasing the internal impedance of such loss devices to prevent the peaks of energy volume beyond the loss devices going above the predetermined limit. The condenser 13 which is relatively large in size and which is connected in series with the resistance element 14 will not be charged as the condenser 12 is charged when only small peaks of energy volume extend above the predetermined limit on the transmitting channel beyond the loss devices 4 and 5. When the energy volume beyond the loss devices is reduced the condenser 12 tends to discharge through the condenser 13 and to reduce the negative biasing potential on the grids of the loss devices 4 and 5. This action takes place rapidly and is independent of the discharge circuit controlled by the relay 20. At the same time the condenser 12 is charged the relay 20 is operated to break the shunt circuit around the condenser 12 which extends through the armature of the relay and the resistance element 35. The output circuit from the amplifier tube 17 is not only connected to the rectifier tubes 15 and 16 by the transformer 19 but is also connected by transformer 23 to a rectifier tube 24 which in turn controls the energization of the operating coil 22 of relay 20. A hold-over circuit com-

prising a condenser 40 and a resistance element 41 is connected across the output circuit of the rectifier tube 24 for governing the time of release of the relay 20. The size of the condenser 40 and the resistance element 41 may be varied to govern the time of release of the relay 20 and accordingly the discharge of the condenser 12 or condenser 13 as the case may be.

If the energy volume on the transmitting channel beyond the loss devices 4 and 5 tends to go above the predetermined limit for an extended period of time the condenser 13 will be charged to approximately the same potential as the condenser 12. When the energy volume is reduced the potential on the condenser 12 will tend to be maintained for a longer period of time. The relay 20 is operated to break the discharge circuit across the condensers 12 and 13 in the same manner as was described when reference was made to the charging of condenser 12. When the energy volume on the output conductors 8 and 9 beyond the loss devices 4 and 5 falls below said predetermined limit the energy of the operating coil 22 of the relay 12 is reduced to such an extent that the biasing coil 21 of the relay forces the armature into engagement with the contact member 33 to insure the discharge of the condensers 12 and 13. By such means the energy volume on the conductors 8 and 9 beyond the loss devices 4 and 5 is prevented from extending above the predetermined limit while at the same time it is insured that no variation of the energy volume is effected by the loss devices when the energy volume on the conductors 8 and 9 is below said predetermined limit. It is apparent that a circuit might be constructed with condenser 12 only for controlling the negative grid bias of the loss devices 4 and 5 or with only the condenser 13 in series with the resistance element 14 for controlling the negative grid bias of the loss devices 4 and 5. However, in order to take care of all conditions of volume variations above the predetermined limit on the transmitting channel beyond the loss devices 4 and 5 it is preferred to employ a relatively small condenser 12 in combination with the relatively large condenser 13 in series with a resistance element.

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

What is claimed is:

1. In a signal transmission system, a transmission line, a three-element vacuum tube loss device connected in series with said line, means comprising a condenser connected in the grid circuit of said loss device for impressing a negative grid biasing potential thereon when charged, means for charging said condenser when the energy volume on the line beyond the loss device goes above a predetermined limit, and means for discharging said condenser when the energy volume on the line beyond the loss device falls below said predetermined limit.

2. In a signal transmission system, a transmission line, a three-element vacuum tube loss device connected to said line, means comprising a relatively small condenser connected in the grid circuit of said device for impressing a negative grid biasing potential thereon, means for controlling the charge on said condenser according to the energy volume on the line beyond the loss device to quickly charge the condenser and prevent short peaks of energy going above a predetermined limit, and means comprising a relay for discharging said condenser to prevent varying the energy volume beyond the loss device when below said predetermined limit.

3. In a signal transmission system, a transmission line, a three-element vacuum tube loss device connected to said line, means comprising a relatively large condenser connected in series with a resistance element in the grid circuit of said loss device for impressing a negative grid biasing potential thereon, means for controlling the charge on said condenser according to the energy volume on the line beyond the loss device to relatively slowly charge the condenser and prevent prolonged periods of energy volume beyond the loss device above a predetermined limit, and means for so discharging said condenser when the energy volume beyond the loss device falls below said predetermined limit.

4. In a signal transmission system, a transmission line, a three-element vacuum tube loss device connected in series with said line, means comprising a condenser shunted by a relatively large condenser and a resistance element for applying a negative biasing potential to the grid of said device according to the charge on the condensers to vary the loss caused by the device, and means for controlling the charge on said condensers according to the energy volume on the line beyond the loss device to prevent the energy volume beyond the device going above a predetermined limit while insuring against change in the energy volume when below the predetermined limit.

5. In a signal transmission system, a transmission line, a three-element vacuum tube loss device connected to said line, means comprising a relatively large condenser and a relatively small condenser for controlling the negative biasing potential on the grid of said device to govern the loss in said line, means governed by the energy volume on the line beyond said loss device for charging said small condenser quickly to prevent small peaks of energy volume on the line beyond the loss device above a predetermined limit

and for charging the large condenser at a slower rate by large volume changes to maintain the energy volume below said predetermined limit, and means for discharging said condensers when the energy volume beyond the loss device is below said predetermined limit.

6. In a signal transmission system, a transmission line, two three-element vacuum tube loss devices connected in push-pull relationship in said line, means comprising a condenser connected in the grid circuits of said loss devices for impressing a negative grid biasing potential on the tubes when a charge is impressed thereon, means for charging said condenser when the energy volume on the line beyond the loss devices goes above a predetermined limit, and means for insuring the discharge of said condenser when the energy volume on the line beyond the loss device falls below said predetermined limit.

7. In a signal transmission system, a transmission line, two three-element vacuum tube loss devices connected in push-pull relationship in said line, means comprising a condenser shunted by a relatively large condenser in series with a resistance element for applying a negative grid biasing potential to said devices according to the charge on the condensers to vary the loss caused by the devices, and means for controlling the charge on said condensers according to the energy volume on the line beyond the loss devices to prevent the energy volume beyond the device going above a predetermined limit while insuring the discharge of the condensers when the energy volume on the line beyond the loss devices falls below said predetermined limit.

8. In a signal transmission system, a transmission line, two three-element vacuum tube loss devices connected in push-pull relationship in said line, means comprising a relatively small condenser connected in the grid circuit of said devices for impressing a negative grid biasing potential thereon, means for controlling the charge on said condenser according to the energy volume on the line beyond the loss devices to quickly charge the condenser and prevent short peaks of energy going above a predetermined limit, and means comprising a relay for insuring the discharge of said condenser when the energy volume on the line beyond the loss devices falls below said predetermined limit.

9. In a signal transmission system, a transmission line, a loss device connected in series with said line, means comprising a condenser for controlling said device to vary the loss caused thereby in accordance with the charge on the condenser, means for charging said condenser when the energy volume on the line beyond the device goes above a predetermined limit, and means for insuring a quick discharge of said condenser when the energy volume beyond the loss device falls below said predetermined limit.

10. In a signal transmission system, a transmission line, a loss device connected in series with said line, means comprising a condenser shunted by a relatively large condenser in series with a resistance element for controlling said device to vary the loss caused thereby in accordance with the charge on the condensers, means for charging said condensers when the energy volume on the line beyond the device goes above a predetermined limit, and means for insuring a quick discharge of said condenser when the energy volume beyond the loss device falls below said predetermined limit.

11. In a signal transmission system, a transmission line, a three-element vacuum tube loss device connected to said line, means comprising a condenser for impressing a negative grid biasing potential on the loss device, means for controlling the charge on said condenser according to the energy volume on the line beyond the loss device, means comprising a relay for discharging said condenser when the energy volume on the line beyond the loss device falls below said predetermined limit, and means for controlling the time of operation of said relay upon lowering of the energy volume on the line below said predetermined limit.

12. In a signal system, a signal circuit, impedance means connected in said circuit for governing the energy volume in the circuit beyond the impedance means, quick-acting means for controlling said impedance means to prevent short peaks of energy in said circuit going above a predetermined limit and slower-acting means for controlling said impedance means to prevent prolonged periods of energy volume going above the predetermined energy limit.

13. In a signal system, a signal circuit, impedance means connected in said circuit for governing the energy volume in this circuit beyond the impedance means, quick-acting means automatically controlled according to the energy volume on said circuit beyond the impedance means for governing said impedance means to prevent peaks of energy in said circuit going above a predetermined limit and slower-acting means automatically controlled according to the energy volume on said circuit beyond the impedance means for governing said impedance means to prevent prolonged periods of energy volume on said circuit going above the predetermined energy limit.

14. In a signal system, a signal circuit, impedance means connected in said circuit for governing the energy volume in this circuit beyond the impedance means, quick-acting means automatically controlled according to the energy volume on said line for governing

said impedance means to prevent peaks of energy in said circuit going above a predetermined limit, and means for insuring against control of the impedance means by said quick-acting means when the peaks of energy volume fall below the predetermined limit.

15. In a signal transmission system, a transmission line, an impedance device connected in said line for limiting the amplitude of the signal waves, control means governed by the energy waves on the signal line beyond the impedance device for operating said device to prevent the signal waves going above a predetermined upper limit, and means for insuring against control of the amplitude of the signal waves by the device when the amplitude of the signal waves falls below the predetermined upper limit.

In witness whereof, I hereunto subscribe my name this 21st day of May, 1931.

STEPHEN DOBA, JR.