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SIGNALING SYSTEM

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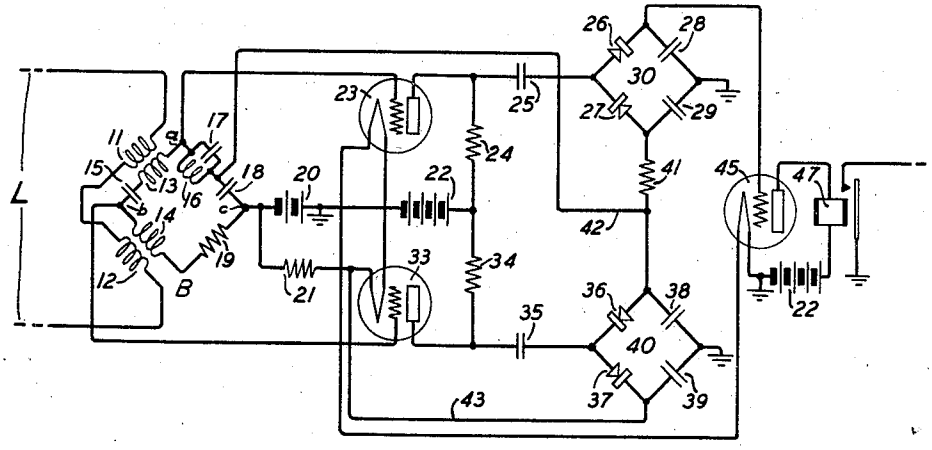

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SIGNALING SYSTEM

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This invention relates to signaling systems and particularly to signal receivers adapted to respond to signaling current of a particular frequency.

It is the object of the invention to provide a more reliable signal receiver adapted to respond to signaling current of a particular frequency without responding to non-signaling current of the same and other frequencies.

It is, of course, known to use alternating current for signaling over telephone lines and moreover to signal with current within the voice-frequency range. It is necessary in such signaling arrangements to provide means for preventing false operation of the signal device in response to voice currents which include the particular voice frequency which is used for signaling.

According to this invention a signal receiver comprises a signal device, a thermionic tube controlling the operation of the signal device, an impedance bridge connected to a signaling circuit, and two amplifiers through which the bridge is connected to the control tube. The bridge is balanced to current of a particular frequency and unbalanced to current of other frequencies and connected to the grid of the control tube by the two amplifiers in such a manner that current of the particular frequency is passed through the bridge and one of the amplifiers to raise the potential of the grid of the control tube to cause operation of the signal device and current of other frequencies is passed through the bridge and the other of the amplifiers to lower the potential of the grid of the control tube to prevent operation of the signal device.

A feature of the invention is a signal receiver as specified in the preceding paragraph in which the current in the output circuit of the amplifier, which receives current of frequencies other than the particular signaling frequency, is not only effective to lower the potential of the grid of the control tube but is also effective to lower the potential of the grid of the amplifier which receives current of the particular frequency and thereby further decreases the probability of false operation of the signal device.

Further explanation of the invention will be made by considering a circuit arrangement in which the invention is embodied, such an arrangement being shown schematically in the drawing which forms a part of this specification. The invention is, of course, not limited to the specific arrangement shown in the drawing and is in general applicable to all signal devices the operation of which is desired in response to signaling current of a particular frequency but only when there is substantially no current of other frequencies included with the signaling current of the particular frequency.

The drawing, which consists of a single figure, shows a signal receiver comprising an impedance bridge B, amplifiers **23** and **33**, and a signal relay **47** controlled by a thermionic tube **45**.

The signal receiver shown in the drawing is one in which the signal relay operates in response to current incoming over a telephone line if the current is of a particular signaling frequency within the voice frequency range and does not include other frequencies, voice currents being ineffective to cause operation of the signal relay. The incoming signaling circuit includes the line L and the primary windings **11** and **12** of a transformer, the secondary windings **13** and **14** of which constitute two like elements of the impedance bridge B. The coil **16** in parallel with capacitor **17** constitutes another element of the bridge; and the non-inductive resistor **19** is the fourth element of the bridge. The capacitors **15** and **18** are so large that their impedance to voice-frequency currents is negligible. The coil **16** and capacitor **17** constitute a tuned circuit having a very high impedance to current of the particular signaling frequency to which it is desired the signal relay **47** shall respond, and having a comparatively low impedance to current of all other frequencies. The particular frequency used for signaling, and to which it is desired that relay **47** respond, will hereinafter be referred to as the signaling frequency. The resistor **19** is of very high resistance so that its impedance, the same for all frequencies, is substantially equal to that of the tuned circuit **16—17** at the aforementioned signaling frequency.

The grid of amplifier tube **23** is connected to point *a* of the bridge B and through coil **16**, conductor **42**, rectifier elements **36** and **37**, conductor **43** and resistor **21** to the negative pole of battery **20**; the grid of amplifier tube **33** is connected to point *b* of the bridge B and thence through transformer winding **14** and resistor **19** to the negative pole of battery **20**; and the grid of control tube **45** is connected through rectifier elements **26** and **27**, resistor **41**, rectifier elements **36** and **37**, conductor **43** and resistor **21** to the negative pole of battery **20**. The filaments of tubes **23**, **33** and **45** are all energized in series by current from battery **20**, resistor **21** being included in this circuit to provide the desired

difference in potential between the filaments and grids of these tubes. The battery 22 supplies the desired difference in potential between the anodes and cathodes of the three tubes, resistor 24 being included in the anode circuit of tube 23, resistor 34 being included in the anode circuit of tube 33, and the winding of signal relay 47 being included in the anode circuit of tube 45.

If the current incoming over line L is of the signaling frequency and includes no other frequencies, there is no difference in potential across points *b* and *c* of the bridge B since at that frequency the very high impedance of the tuned circuit 16—17 is substantially equal to that of the resistor 19 and the bridge is said to be balanced; and the voltage induced in transformer windings 13 and 14 is, therefore, impressed on the grid of amplifier tube 23 without affecting the potential of the grid of amplifier tube 33. If the current incoming over line L is of a frequency or frequencies other than the signaling frequency, there is a difference of potential across points *b* and *c* of the bridge B since the impedance of resistor 19 is very high and the impedance of the tuned circuit 16—17 is comparatively low; and the voltage induced in transformer windings 13 and 14 is, in this case, impressed on the grid of amplifier tube 33 without substantially affecting the potential of the grid of tube 23. It is, therefore, evident that incoming current of the signaling frequency is amplified by tube 23 and incoming current of other frequencies is amplified by tube 33.

The rectifier elements 26 and 27 and capacitors 28 and 29 form a voltage-doubling unit 30 by which the grid of control tube 45 is connected to capacitor 25, and through this capacitor to the output circuit of amplifier 23; and the rectifier elements 36 and 37 and capacitors 38 and 39 form another voltage-doubling unit 40 by which the grid of control tube 45 is connected to capacitor 35, and through this capacitor to the output circuit of amplifier 33. The voltage-doubling units 30 and 40 are effective to make use of the energy of both halves of the cycle of the current in the output circuits of amplifiers 23 and 33. If, then, the current incoming over line L is of a frequency or frequencies other than the signaling frequency, the bridge B and amplifier 33 are effective to lower the potential of the grid of control tube 45, the amplifier 23 and relay 47 being unaffected; and, if the current incoming over line L is of the signaling frequency and no other, the bridge B and amplifier 23 are effective to raise the potential of the grid of control tube 45 and thereby increase the current in the anode circuit of tube 45 to operate signal relay 47, the amplifier 33 being unaffected; but, if the current incoming over line L includes other frequencies in addition to the signaling frequency, as is likely when voice currents are being transmitted over line L, the output of the amplifier tube 23 insofar as its effect on the grid of control tube 45 is concerned is opposed and neutralized by the output of the amplifier tube 33; and the operation of the signal relay 45, in response to that part of the incoming current which is of the signaling frequency, is prevented. Since the rectifier elements 36 and 37 of the voltage-doubling unit 40 are included in the above-described grid biasing connection between battery 20 and the grid of amplifier tube 23, the output of the amplifier tube 33 resulting from incoming current of non-signaling frequencies, is also effective to lower the potential of the grid of amplifier tube 23 and thereby decrease the amplification of the incoming current which is of the signaling frequency so as to further insure against the false operation of signal relay 47.

What is claimed is:

1. In combination, a signaling circuit, a signal relay, a thermionic tube controlling the operation of said relay, two thermionic amplifiers, the output circuits of both amplifiers being connected to the grid of said control tube, and an impedance bridge connected to said signaling circuit, said bridge being balanced to current of a particular frequency and unbalanced to current of other frequencies, the grid of a first one of said amplifiers being connected to the bridge so as to be operatively affected only by current of said particular frequency and the grid of the second one of said amplifiers being connected to the bridge so as to be operatively affected only by currents of frequencies other than said particular frequency.

2. In a combination according to claim 1, a connection between the output of said second amplifier and the grid of said first amplifier for decreasing the output from said first amplifier when the current in said signaling circuit includes frequencies other than said particular frequency.

3. In combination, a signal relay, a thermionic tube controlling the operation of said relay, two thermionic amplifiers, the output circuits of both of said amplifiers being connected to the grid of said control tube, a signaling circuit, a transformer having a primary winding connected in said signaling circuit and two like secondary windings, a non-inductive resistor having a very high impedance, an inductor, and a capacitor, said inductor and capacitor connected to form a parallel resonant circuit tuned to a particular frequency, said secondary windings, resistor and tuned circuit connected to form an impedance bridge balanced at said particular frequency and unbalanced at other frequencies, the grid of one of said amplifiers being connected to the bridge at a point, the potential of which is substantially affected only by current of said particular frequency, the grid of the other of said amplifiers being connected to the bridge at a point, the potential of which is substantially affected only by current of frequencies other than said particular frequency.

4. In combination, a signal relay, a thermionic tube controlling the operation of said relay, two thermionic amplifiers, a capacitor and a voltage-doubling unit connecting the anode of one of said amplifiers to the grid of said control tube, another capacitor and another voltage-doubling unit and a resistor and the first-mentioned voltage-doubling unit connecting the anode of the other of said amplifiers with the grid of said control tube, each of said voltage doubling units comprising two rectifier elements and two capacitors, a signaling circuit, and an impedance bridge connecting said signaling circuit to the grids of said amplifiers, said bridge being balanced to current of a particular frequency and unbalanced to current of other frequencies so that the grid of one of said amplifiers is operatively affected by current of said particular frequency incoming over said signaling circuit and the grid of the other of the amplifiers is operatively affected by current of other frequencies.

5. In a combination according to claim 4, a connection from the grid of said one of the amplifiers through one of the arms of said bridge

and said other voltage-doubling unit and other capacitor to the anode of said other of the amplifiers.

6. In combination in a signaling system, a signaling circuit, a signal relay, and means for connecting said circuit to said relay to operate said relay in response only to signaling current of a particular frequency in said circuit and only when there is substantially no current of other frequencies in said circuit, said means comprising a thermionic tube for controlling the operation of the relay, two thermionic amplifiers, an impedance bridge balanced at said particular frequency to transmit only currents of said particular frequency to one of said amplifiers and unbalanced at other frequencies to transmit only currents of other frequencies to the other of said amplifiers, means connecting the output of said one of the amplifiers to the input of said tube to effect operation of said relay in response to signaling current of said particular frequency, and means connecting the output of said other of the amplifiers to the input of said tube to prevent the operation of said relay.

7. In a combination according to claim 6, means connecting the output of said other amplifier to the input of said one amplifier to decrease the amplification of signaling current of said particular frequency.

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