A. B. CLARK.

TELEPHONE AND CALL SIGNAL SYSTEM.

APPLICATION FILED SEPT. 20, 1918.

1,371,298.

Patented Mar. 15, 1921.

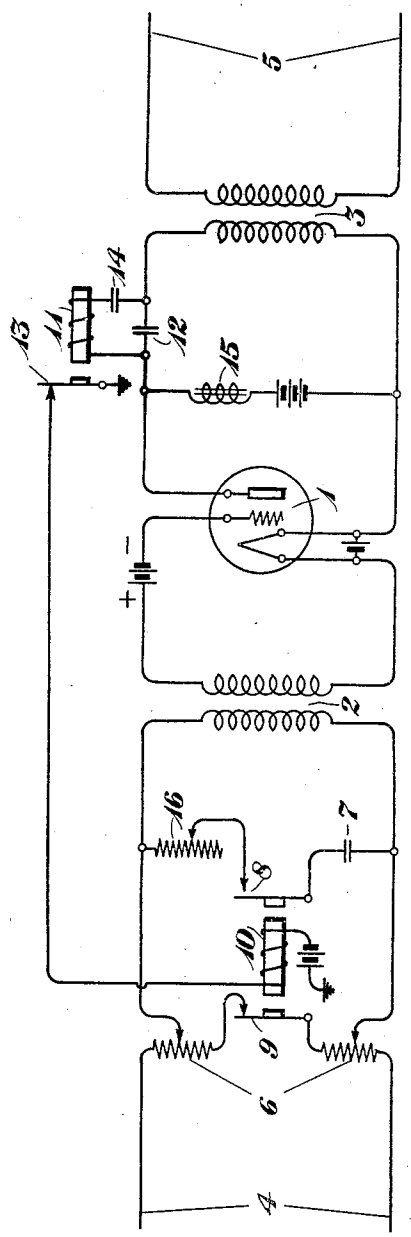

Fig. 1

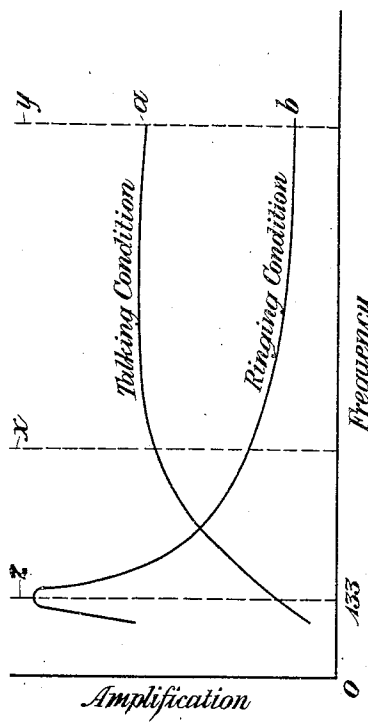

Fig. 2

INVENTOR.

BY A. B. Clark

G. E. Folc

ATTORNEY.

UNITED STATES PATENT OFFICE.

ALVA B. CLARK, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE AND CALL SIGNAL SYSTEM.

1,371,298. Specification of Letters Patent. Patented Mar. 15, 1921.

Application filed September 20, 1918. Serial No. 254,974.

To all whom it may concern:

Be it known that I, ALVA B. CLARK, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Telephone and Call Signal Systems, of which the following is a specification.

This invention relates to signaling systems in which it is desired to transmit currents of different frequencies at different times, as, for instance, the talking and ringing frequencies in a telephone circuit. The object of the invention is to make the circuit efficient for transmitting currents of either frequency.

Transmitting circuits containing transformers, or other localized inductance, are usually designed to transmit most efficiently the particular range of frequencies which it is expected to employ, and a circuit so designed is relatively inefficient for transmitting other frequencies. The efficiency of the circuit for transmiting those other frequencies can, however, be changed by connecting into it, in suitable relation, other elements of inductance or capacity, or by changing the value or relation of existing elements. In general, my invention consists in providing means responsive to the change in the frequency transmitted over the circuit for varying the character of the circuit to make it efficient with respect to the frequency being transmitted. It is here illustrated as applied to a telephone amplifier circuit for altering its condition when the ringing current is transmitted, and has been found especially useful in this relation but it will be understood that the invention is not limited to use in circuits of this particular character, or even to telephone circuits in general.

For a fuller understanding of the invention reference will be made to the accompanying sheet of drawings in which Figure 1 represents diagrammatically a telephone repeater circuit embodying the invention, and Fig. 2 shows curves illustrating the operation.

The amplifier 1 is here illustrated in its typical form, having transformers 2 and 3 in the input and output circuits respectively, the transformer 2 connecting with the incoming line 4, and transformer 3 with the outgoing line 5. An adjustable resistance 6, sometimes known as a potentiometer is connected into the incoming line 4, and serves to adjust the amount of amplification. It consists of a resistance connected across the circuit with provision for connecting the continuing line conductor to any desired point thereof whereby part of the resistance will, in general, be in series with the line and part in shunt. It is here shown as comprising two sections, one on either side of the line, this being merely for the purpose of preserving the balance.

The operation of the circuit as thus far described is indicated by curve *a* in Fig. 2, where amplification is plotted against frequency. The frequencies comprised within the talking range will be those lying between the dotted lines *x* and *y*. It will be observed that the amplification for the talking currents is very considerably above those within the ringing range as, for example, 133 cycles, indicated by the line *z*. This higher efficiency for the higher frequencies is due largely to the design of the retardation coil 15 and the transformers 2 and 3 particularly the input transformer 2. It is necessary to add materially to the cost of these input transformers to make them as efficient for the low frequencies as for the high frequencies. Furthermore, it is at times desirable that these transformers be inefficient at low frequencies in order to avoid interference from extraneous currents of low frequency, as for example, interference from Morse currents when the transmission circuit is used simultaneously for the transmission of Morse messages and telephone conversation.

To overcome this difficulty, I provide a condenser 7 to be connected across the circuit at the terminals of the transformer 2 when ringing current is transmitted. Its value is such that, with the winding of transformer 2 across which it is bridged, it constitutes a tuned circuit at the ringing frequency. The shunt containing the condenser is provided with a normally open switch 8. A switch 9 is provided for opening the potentiometer circuit when the condenser circuit is closed, and both of these switches are operated by a magnet 10 whose circuit is controlled by the relay 11, connected, preferably into the output circuit of the amplifier 1 and across the terminals of a condenser 12. A condenser 14 is also connected in series with the relay 11 to prevent the flow of direct current through it.

When talking current is being transmitted, the frequencies will be such as to readily pass through the condenser 12, and will not affect the relay 11, due to the relatively high impedance of its winding for these frequencies. When, however, ringing current, as for example 133 cycles, is transmitted, it will, because of its lower frequency, find a ready path through the relay winding 11 and condenser 14 whose capacity is such as to make it resonant, with the relay winding, for the ringing frequency; while the condenser 12, will present a higher impedance than at talking frequencies. The ringing current will, therefore, cause the contact 13 of the relay 11 to chatter, which will so reduce the current traversing the winding of relay 10 that it will release both of the switches 8 and 9, thus opening the circuit of the potentiometer 6 and connecting the condenser 7 across the line. The opening of the shunt, which the potentiometer circuit normally forms causes an increase in the voltage across the terminals of the transformer 2 for reasons which will be obvious, and the closing of the condenser shunt, which completes the local circuit tuned to the ringing frequency, greatly augments this increase by reason of the high impedance which the local circuit then presents in comparison with the rest of the circuit extending to the current source. The efficiency of the transmission lines at the ringing frequency, and particularly of the amplifier circuit, is thus greatly increased. The effect of the alteration of the circuit, as above described, is indicated by the curve *b* in Fig. 2. The resulting amplification of the ringing current can be made not only equal to, but even greater than, the amplification of the talking currents during normal line conditions, as indicated by the sharp rise of the curve *b* at the line *z*. On the other hand, the amplification for the frequencies within the talking range are considerably reduced, as indicated by the drop at the tail of the curve *b*.

The amplification of the ringing current can be adjusted to be equal to, or to have any ratio desired to the amplification of the talking currents during normal line conditions by connecting a resistance 16 of suitable value in series with condenser 7. As above indicated, it is preferable, though not essential to the invention, to connect the relay 11 in the output circuit of the amplifier, because even before the circuit conditions are changed, the ringing current is somewhat strengthened by the amplifier 1, and therefore, more readily affects the relay. This will be clear from the fact that the curve *a* crosses the line *z* somewhat above the zero line.

It will be obvious that the invention, when used in connection with an amplifier, may be applied to one-way repeaters, used in four-wire circuits and elsewhere, or with two-way repeaters, such as are in common use. The invention is obviously applicable to circuits other than amplifier or repeater circuits, and it will be manifest that the invention is not limited to the particular arrangement herein disclosed, as various modifications in details falling within the spirit and scope of the invention, will suggest themselves to those skilled in the art.

What is claimed is:

1. In a signaling system, a circuit designed to transmit currents of certain frequencies, a relay associated with said circuit which is unresponsive to currents of said frequencies, but responsive to currents of a different frequency, and means controlled by said relay for changing the characteristics of the circuit to make it more efficient for transmitting currents of said different frequency.

2. In a signaling system, a repeater circuit including input and output transformers, and designed for maximum amplification of certain frequencies, a relay associated with said circuit which is unresponsive to currents of said frequencies, but responsive to currents of a different frequency, and means controlled by said relay, for changing the characteristics of said repeater circuit to make it more efficient for transmitting currents of said different frequency.

3. In a signaling system, a circuit designed to transmit most efficiently currents of certain frequencies, a condenser connected in an open shunt across said circuit, and means responsive to current of frequency other than those for which the circuit is so designed, for closing said shunt to change the constants of said circuit whereby it is more efficient in transmission for such other frequency.

4. In a signaling system, a circuit designed to transmit most efficiently currents of certain frequencies including a resistance, part of which is arranged in a shunt across the circuit, and means for opening said shunt when current of a frequency other than those for which the circuit is so designed, is transmitted over the line to change the constants of said circuit whereby it is more efficient in transmission for such other frequency.

5. In a signaling system, a circuit designed to transmit most efficiently currents of certain frequencies including a resistance, part of which is arranged in a shunt across said circuit, a condenser connected in an open shunt across said circuit, and means for opening the shunt including the resistance, and for closing the shunt including the condenser, when the current of a frequency other than those for which the circuit is so designed, is transmitted over the line.

6. In a signaling system, a repeater circuit designed for most efficient transmission of currents of certain frequencies, comprising an amplifier, input and output circuits for said amplifier including transformers, means associated with the input transformer for rendering said repeater efficient for frequencies other than those for which the circuit is so designed, and mechanism responsive to current of said other frequencies for rendering said means effective.

7. In a signaling system, an amplifier, an input circuit for said amplifier, including a transformer and a resistance connected across said transformer, and designed to make said amplifier most efficient for certain frequencies, a condenser connected in an open circuit across said transformer, and having a value to make it resonant with the transformer winding at a frequency other than those for which the circuit is so designed, and means responsive to said other frequency to open the resistance circuit, and to close the circuit of the condenser.

8. In a signaling system, an amplifier having input and output circuits, and designed for a maximum amplification of currents of certain frequencies, a relay in the output circuit of said amplifier unresponsive to currents of said frequencies, but responsive to currents of a different frequency, and means controlled by said relay for giving said amplifier maximum efficiency for currents of said other frequency.

In testimony whereof I have signed my name to this specification this eighteenth day of September, 1918.

ALVA B. CLARK.