

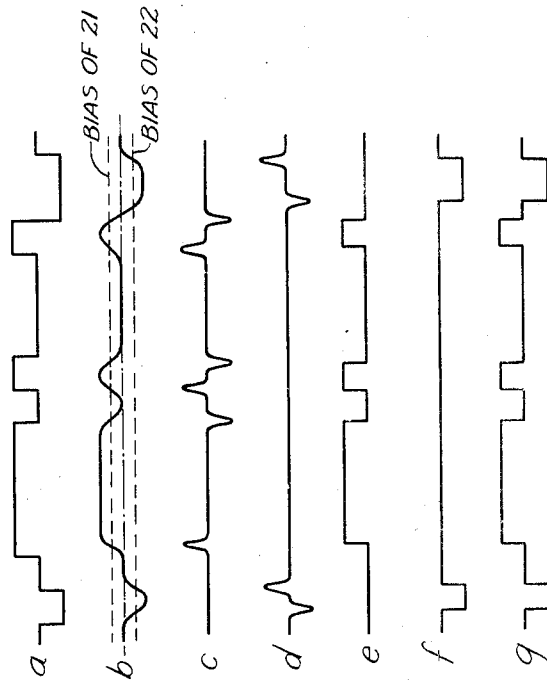
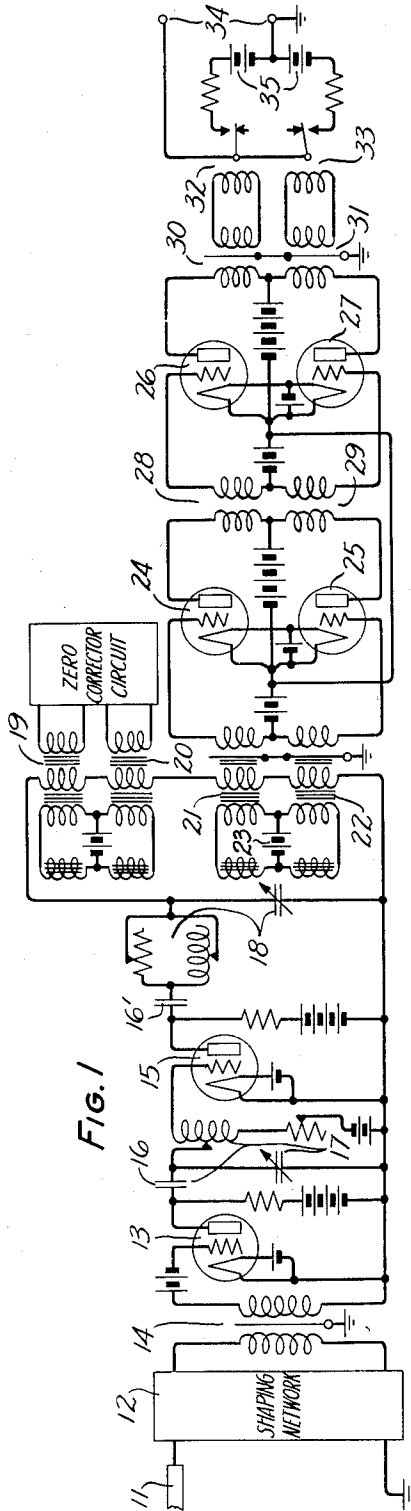
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SIGNAL SHAPING AMPLIFIER

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SIGNAL SHAPING AMPLIFIER

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This invention relates to signaling systems and more particularly to repeating equipment for such systems.

It has for its principal object the efficient operation of repeating devices in response to signal impulses or waves of low amplitudes and comparatively low frequencies.

Another object is to reduce the number of stages of vacuum tube amplifiers and/or the amplification per stage required to operate repeating relays of the electromagnetic type.

An object is to permit the use of high frequency (or impulse) amplifier stages for the latter part of the amplifier instead of using amplifiers to pass the low telegraph signal frequencies which amplifiers are more difficult to design and construct.

A feature of the invention is the adaptation of sensitive, low-current transformers, or impulse coils, to a signal shaping vacuum tube amplifier whereby the output of a low current vacuum tube when impressed on the primary windings of such transformers, produces short, sharp impulses of high voltage which when impressed on the grids of high current vacuum tubes, controls sufficient power to operate electromagnetic relays.

The transformers employed in circuits involving this invention are provided with cores which are of a magnetic material having high permeability at low magnetizing forces and have magnetic circuits which become saturated at low intensities of the signal current. Therefore a signal wave of slowly varying intensity when received in the transformers, produces in the secondary windings thereof, a wave of short, discrete impulses, which occur while the magnetizing force is passing through values slightly above and slightly below zero. By biasing the transformers magnetically in opposite directions the intervals in which the sharp impulses occur are shifted to higher values of signal current so that one impulse is produced during the rise and another during the fall of a signal wave on

either the positive or negative side of the zero value. The impulses so produced by each signal wave are of opposite polarity and are produced in one or the other of the secondary windings depending on the polarity or direction of the signal wave, that is, those caused by a positive wave are produced in one winding and those caused by a negative wave are produced in the other winding. Transformers of the type just described may be designed to operate on less than one milliampere of primary current and therefore transformers of this type may be connected to the output circuit of a vacuum tube amplifier employing tubes of the low current type. The impulses produced by the transformers will be of such amplitude as to be conveniently amplified by vacuum tubes of the high current type. In this manner signal waves of low amplitudes produce impulses which may be amplified to operate relatively insensitive electromagnetic relays.

Fig. 1 of the drawings shows a schematic circuit of a preferred arrangement of applicant's circuit.

Fig. 2 shows a series of curves depicting the operation of the system.

Detailed description

Referring to Fig. 1, incoming signal impulses are received over loaded cable 11 by shaping network 12 wherein they are reshaped to conform somewhat to the shape that they had at the transmitting station. The details of the shaping network depend on the particular cable with which it is used, for example, with a continuously loaded submarine cable, such as is used between New York and the Azores, the network disclosed in U. S. Patent 1,586,972, granted to A. M. Curtis on June 1, 1926, is satisfactory. Reference is made to that patent for a detailed description of the function of this network.

The signal waves are then impressed on an amplifier wherein they are not carried be-

yond two, or at the most three, stages of vacuum tubes which have a low current output. The first stage comprising vacuum tube 13 is connected to the shaping network through transformer 14 and the second stage comprising tube 15 is connected to the first stage through coupling condenser 16 and shaping network 17. The low current output of tube 15 is impressed through coupling condenser 16' and shaping network 18 onto the primary windings, in series, of two pairs of low current transformers, or impulse coils provided with cores of magnetic material of high permeability at low magnetizing forces, as were hereinbefore described. The transformers 19 and 20 of the first or upper pair are included in a zero wander correction circuit, such as disclosed in a copending application of E. T. Burton Serial No. 293,816, filed July 19, 1928, and transformers 21 and 22 of the second or lower pair form part of the present invention wherein the low current output of the two stages of amplification in passing through the primary windings of the transformers produces in the secondary windings of the transformers 21 and 22 short, sharp voltage impulses of opposite polarities every time the signal wave in the primary windings rises and falls through a predetermined intensity. The predetermined intensity is determined by a source 23 of direct current which establishes a normal magnetic field of a definite value in each of the transformers 21 and 22, such magnetic fields being the same in value but opposite in polarities.

The short, sharp voltage impulses of opposite polarities produced in the secondary windings of transformers 21 and 22 are passed through one or more stages of high current amplification wherein the current resulting from the high voltage impulses is increased sufficiently to operate relays or repeating devices requiring a relatively high operating current. Two stages of impulse amplification are shown, the first comprising vacuum tubes 24 and 25 and the second comprising vacuum tubes 26 and 27. The tubes of the latter stage have a high current output. The tubes of each stage are arranged in push-pull relation and those of one stage are respectively connected through transformers 28 and 29 to those of the other stage. The output circuits of tubes 26 and 27 are respectively connected through transformers 30 and 31 to separate operating circuits for electromagnetic relays 32 and 33. Each of relays 32 and 33 are of the unbiased polarized type designed to transmit two-element signals but so arranged with respect to each other that their combined action is effective to transmit three-element signals over the output circuit 34 to a receiving terminal not shown. The relays are arranged to reproduce the signals substantially as originally

transmitted, in the output circuit 34, which includes an armature and contact of either relay, and battery 35, which has a mid-tap connected to ground. However, if the output circuit is completely metallic the mid-tap of battery 35 will be connected to a conductor extending to the distant terminal instead of being connected to the ground.

The operation of the system

The operation of the system may be understood by referring to Fig. 2 wherein curve *a* represents a signal wave transmitted from a distant station; curve *b* represents the amplified signal wave received in the primary windings of transformers 21 and 22, the received wave being shown with relation to the biasing currents from source 23 which produces a negative bias in transformer 21 and a positive bias in transformer 22; curve *c* shows the short, sharp voltage impulses produced in the secondary windings of transformer 21 every time the primary current rises and falls through the amplitude of the biasing current in transformer 21, the impulses so produced being in the same direction as the primary current at the instant that an impulse occurs; curve *d* shows the short, sharp voltage impulses produced in the secondary windings of transformer 22 every time the primary current rises and falls through the amplitude of the biasing current in transformer 22; curve *e* shows impulses produced by relay 32 in response to the amplified secondary impulses which originated in transformer 21; curve *f* shows the impulses produced by relay 33 in response to the amplified secondary impulses which originated in transformer 22; and curve *g* shows the combined effect of the impulses produced by relays 32 and 33 for transmission over the output circuit 34.

It is to be understood that the scope of the invention is not to be limited to the particular embodiment shown in Fig. 1 of the drawings, for example, the mechanical or electromagnetic relays may be replaced by other types of repeating devices such as, thermionic discharge devices, transformers, or the like, whereby the voltage impulses produced in the impulse coils may be converted into square topped signals for transmission over the output circuit 34.

What is claimed is:

1. A device for repeating electric impulses comprising an operating device of high inertia, an amplifier comprising low current and high current elements, a circuit connecting said high current elements with said operating device, and inductive elements, sensitive to very narrow ranges only of signal current intensities, connected between said low current and said high current elements and adapted to produce two short, sharp voltage impulses separated by a comparatively

long interval of zero voltage in response to each incoming signal impulse, said voltage impulses being of sufficient amplitude in said circuit to operate said operating device.

site polarities, output relays arranged to operate in response to the voltage impulses produced by the signal waves of positive and negative polarities respectively after said impulses are sufficiently amplified by said high current vacuum tubes.

In witness whereof, I hereunto subscribe my name this 29th day of April, 1930.

EVERETT T. BURTON.

2. In a device for repeating electric impulses of positive and negative polarity, an amplifier comprising low current and high current elements, an inductive element sensitive to waves of low amplitudes arranged intermediate said low current and high current elements and adapted to produce two voltage impulses of opposite polarity in response to each signal impulse, an electromagnetic device, said high current elements being arranged to amplify the voltage impulses sufficiently to operate said electromagnetic device.

3. A device for repeating polar signals as signals of increased number of elements comprising a source of impulses, a plurality of relaying devices, a plurality of plural winding electromagnetic devices each having core material of high permeability at low magnetizing forces, said electromagnetic devices being connected between said source and said plurality of relay devices, means for maintaining said electromagnetic devices polarized in opposite directions when no signals are being received from said source, said electromagnetic devices being effective to produce two short voltage impulses of opposite polarities every time the incoming signal wave rises and falls through a predetermined current value on either the positive or negative side of the zero value, and means for amplifying said voltage impulses sufficiently to operate one or the other of said relaying devices through a complete cycle, the selection of said relaying device depending on the polarity of the incoming signal impulse, and the operating sequence of said relaying device being so timed that each of the repeated impulses is followed by an interval of zero voltage.

4. A device for repeating polar signals as signals of an increased number of elements, according to claim 8, wherein the relaying devices are mechanically operated polar relays and the electromagnetic devices are transformers of the shell core type.

5. In a device for repeating electric current waves of negative and positive polarities, low current and high current vacuum tubes, a plurality of transformers comprising cores designed to become saturated at current amplitudes slightly above and slightly below zero values and connected intermediate said low current and high current vacuum tubes, a biasing circuit including windings on each of said transformers connected in opposite relation with respect to each other whereby each signal wave in the primary winding is effective to produce in one or the other of the secondary windings, two short, sharp voltage impulses of oppo-

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