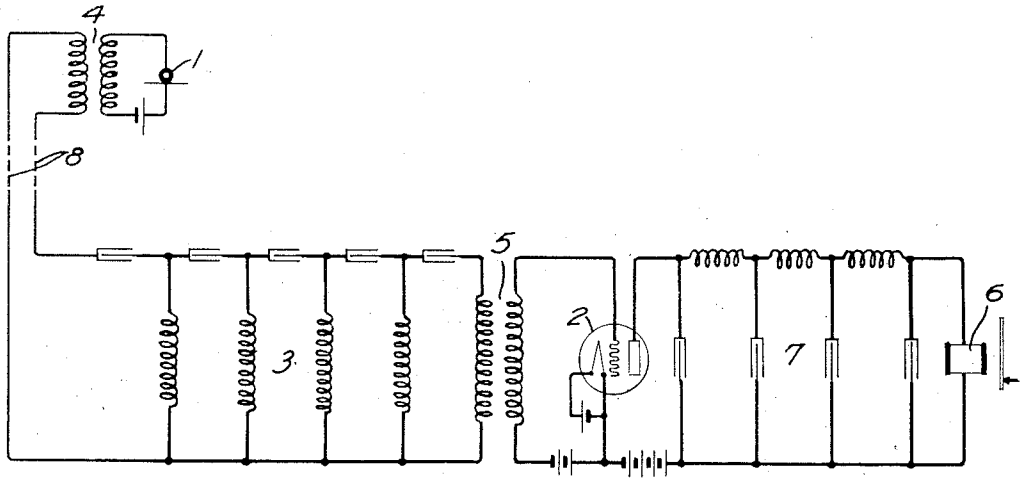
June 8, 1926. 1,588,186

R. V. L. HARTLEY

TRANSMITTING ELECTRICAL ENERGY

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TRANSMITTING ELECTRICAL ENERGY.

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This invention relates to transmitting electrical energy, and relates especially to operating a relay or the like by complex alternating currents, for instance voice currents, through the action of a space discharge tube or the like, operating to rectify the currents.

The purpose of the invention is to increase the speed and stability of operation of the system.

In the form of the invention chosen for illustration these objects are attained by inserting in the input circuit of the tube a high-pass filter having a cut-off frequently higher than the lowest frequency that is to be excluded from the relay, and inserting between the tube and the relay a low-pass filter having approximately the same cut-off frequency as the high-pass filter. The two filters insure that the only current fluctuations which will reach the relay are current variations corresponding to the amplitude variations of the waves of the voice currents or the like which control the relay. These filters, therefore, diminish relay chatter and prevent the relay from being affected by extraneous line currents, such as Morse thump and interference from power transmission lines. The low-pass filter permits the currents that are to operate the relay to be propagated through that filter in less time than would be required for such propagation were the cut-off frequency of the filter made lower, and consequently the relay operation will follow closely the starting and stopping of the voice currents.

The single figure of the drawing is a circuit diagram of one embodiment of the invention.

In the drawing, a telephone transmitter 1, or like source of varying currents feeds an amplifier rectifier 2 through a high-pass filter 3 having a cut-off frequency of say 500 cycles per second, the filter being connected to the transmitter by means of a transformer 4 and to the electron tube rectifier by means of a transformer 5. The tube 2 in turn feeds a relay 6 or the like through a low-pass filter 7 having approximately the same cut-off frequency as filter 3. A transmission line 8 is usually interposed between the filter 3 and the source of current 1 and may be subjected to disturbing currents due, for instance, to Morse thump or interference from power transmission lines, and lying either within or without the voice frequency range.

Were the relay connected directly in the out-put circuit of the tube without filters 3 or 7, difficulty would probably be encountered owing to the fact that the currents of voice frequency would be amplified by the tube and the low frequency components particularly, or the components having frequencies in the neighborhood of the mechanical resonance frequency of the relay tongue, would tend to cause chattering of the relay during the periods when it should be held in the operating position by the rectified voice currents. It would be possible to exclude these amplified voice currents from the relay by merely inserting a low-pass filter of the general type of filter 7, for instance, but with lower cut-off, between the output of the tube and the relay. However, unless the cut-off point of this filter were made fairly low, the voice currents whose frequencies were below the cut-off would cause chattering. If the cut-off frequency were made low the speed of operation of the relay would be reduced, since the time required for the propagation of the currents through a given number of filter sections varies inversely as the cut-off frequency. Increased speed of operation may be secured by using a low-pass filter with relatively high cut-off, say 400 or 500 cycles.

In order to make it possible to use a filter of this sort without chatter from the lower components of the voice currents, the high-pass filter 3 is used in the input circuit of the tube, the cut-off frequency of which is approximately the same as that of the low-pass filter. When such a filter is used the only currents reaching the relay are those resulting from the demodulation or detection of the higher voice frequencies, and hence the relay will respond more exactly to the starting and stopping of the voice currents.

A still further advantage of this arrangement is that it prevents the relay from being operated by extraneous line currents of low frequency such as cross-ringing, Morse thump and power interference, which are likely to be greater in actual magnitude than the voice currents themselves.

The invention is not limited to the de-

tails or illustrative frequency values set forth herein, but may have many and widely different embodiments within the spirit of the invention as defined in the appended claims. For example, the attenuated range of the low-pass filter may overlap the attenuated range of the high-pass filter, provided the rate of propagation through the former is rapid enough for the particular result desired.

E. D. Johnson Patent 1,526,550, February 17, 1925, may be mentioned as indicating an example of uses for relays actuated in response to voice currents through the action of a space discharge tube operating to rectify the currents.

The invention claimed is:

1. A system comprising a high-pass filter and a low-pass filter having approximately the same cut-off frequency, and a rectifier connecting said filters.

2. A system comprising a source of currents of various frequencies, a rectifier, a high pass filter connecting said rectifier to said source, a translating device, and a low-pass filter, having approximately the same cut-off frequency as said high-pass filter, connecting said translating device to receive current from said rectifier.

3. A system comprising a source of current having components of different frequencies, a direct current relay susceptible to having its operation deleteriously affected by said components, and means for operating said relay from said source and at the same time avoiding said deleterious effects, said means comprising a rectifier, a high-pass filter connecting said rectifier to said source, and a low-pass filter connecting said relay to said rectifier, said low-pass and said high-pass filters having cut-off frequencies approximately equal to the frequency of the lowest component which would have a material deleterious effect upon the operation of said relay.

4. A system comprising a source of current having a relatively low frequency component and a relatively high frequency component, means connected to said source for suppressing said low frequency component and rectifying said high frequency component, means fed through said first means for attenuating and substantially extinguishing current of said high frequency but capable of passing current of said low frequency, a switch contact, and means fed from said second means for controlling said contact.

5. A system comprising a source of voice current having a relatively low frequency component and a relatively high frequency component, a translating device, and means including filtering and rectifying devices having a propagation time less than that of a filter capable of suppressing said low frequency component, for transmitting energy of said first mentioned current to said translating device as direct current free from fluctuations of either of said two frequencies.

6. The method of producing direct current corresponding to the intensity of a complex voice current, which comprises separating relatively low frequency from relatively high frequency components of said voice current, rectifying said relatively high frequency components alone, and removing current fluctuations of said relatively high frequency components from the rectified current.

7. A system comprising a relay, a line carrying voice currents and subject to disturbing currents within the voice frequency range and means responsive to said voice currents for causing operation of said relay, said means comprising a high-pass filter connected to said source for suppressing currents of frequencies below and including the frequencies of said disturbing currents, a rectifier fed from said high-pass filter, and a low-pass filter connected between said rectifier and said relay.

8. A system comprising a high-pass filter and a low-pass filter each having a cut-off frequency of approximately 500 cycles per second, and a rectifier connecting said filters in tandem relation.

9. In combination, a source of voice current, and means for producing from said voice current a direct current corresponding to the intensity of said voice current, said means comprising means for suppressing relatively low frequency components of said voice current, means for rectifying a relatively higher frequency component of said voice current, and means for suppressing current fluctuations of said relatively higher frequency in the rectified current.

In witness whereof, I hereunto subscribe my name this 17th day of November, A. D. 1922.

RALPH V. L. HARTLEY.