March 21, 1944. K. W. PFLEGER 2,344,633

IMPULSE REPEATER

Filed Nov. 13, 1941

FIG. 1

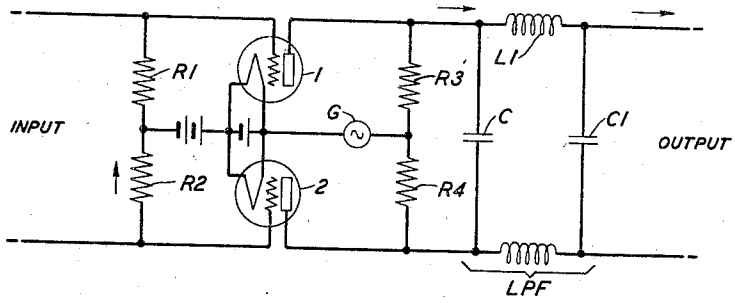


FIG. 2

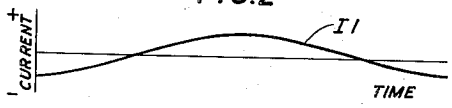


FIG. 3

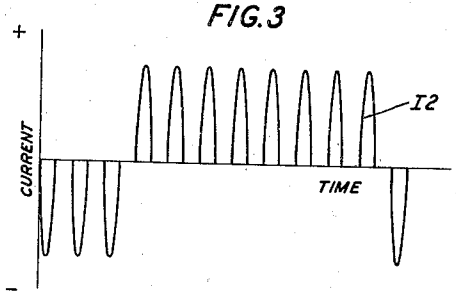


FIG. 4

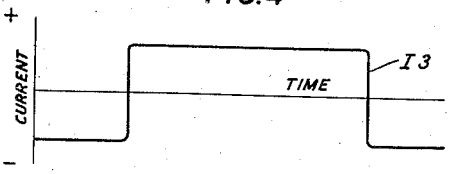
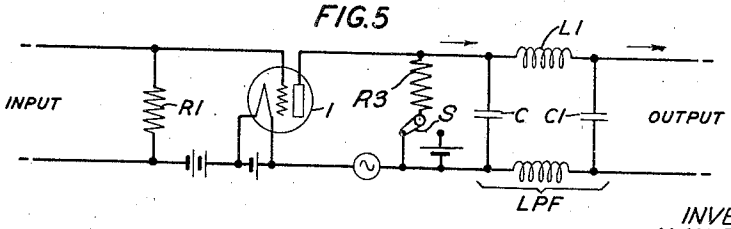


FIG. 5



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Patented Mar. 21, 1944

2,344,633

UNITED STATES PATENT OFFICE

2,344,633

IMPULSE REPEATER

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Application November 13, 1941, Serial No. 418,983

5 Claims. (Cl. 178—70)

This invention relates to amplifying, repeating and reshaping instrumentalities for low frequency impulses of the type used in direct current telegraphy.

There have previously been proposed various arrangements of gas discharge tubes for repeating or amplifying low frequency impulses.

One of the objects of the present invention is to improve the operation of such arrangements by providing modified and improved circuits therefor.

Another feature of improvement consists in organization of the parts which is less susceptible to interference than other similar arrangements heretofore known.

Other features and objects will appear from the following description taken in connection with accompanying drawing in which:

Fig. 1 comprises a generalized schematic arrangement in accordance with the invention;

Fig. 2 comprises a diagram of a wave form of a distorted input current which may be supplied to the input circuit of an arrangement according to Fig. 1;

Fig. 3 illustrates the form of impulses which may be applied to the input circuit of a filter between the repeater and the outgoing line;

Fig. 4 discloses an idealized form of current flowing from the output terminals of the filter into the outgoing line; and

Fig. 5 discloses a modified form of arrangement in which polar input impulses are repeated as current and no-current impulses.

In Fig. 1, the input circuit labeled "input" may comprise terminals of a telegraph line or other circuit which supplies polar impulses, that is, impulses a part of which are in one direction and a part of which are in another direction to be amplified. Currents incident to these impulses flow through resistances R1 and R2, thereby applying voltages to the input circuits of the tubes 1 and 2 which are of a well-known type so designed that a certain magnitude of positive potential applied to the grid thereof causes a discharge between the anode and cathode. By virtue of ionization which takes place in the tube, the grid very largely loses control over the tube in the discharging condition and the discharge continues to flow more or less independently of the potential of the grid so long as a suitable potential is applied between the anode and the cathode.

The anode circuit of tube 1 includes a resistance R3 and the anode circuit of tube 2 includes a resistance R4. From the common point of these resistances to the anode extends a path which includes a source of alternating current of the frequency considerably above the frequency of impulses to be repeated and higher than the highest essential harmonic thereof. Thus, if the fifth multiple frequency of the repeated waves is considered a sufficiently high frequency to produce an adequately square-top outgoing wave, the frequency of the generator should be considerably above five times the frequency of the shortest impulses to be repeated. Preferably, however, the frequency of the generator should be considerably higher than this. For example, in telegraphing with the impulses of such a nature that the shortest impulses correspond to a frequency of 23 cycles per second the frequency of the generator G might be of the order of 100,000 cycles per second. In such case, the low-pass filter LPF might have a cut-off at a frequency of 10,000 cycles per second and this combination would produce very little distortion connected to the output side of the filter of the terminals of an outgoing line or output path of any suitable type to which regenerated and amplified impulses are to be supplied. Although illustrated as a single section consisting of capacities C1 and inductances L1 arranged symmetrically with respect to the outgoing line, the filter might consist of any desired number of sections designed in accordance with well-known design principles for low-pass filters.

In the operation of the device the current wave I1 illustrated in Fig. 2 indicates the input wave. When this wave is appreciably below the zero axis of current the current is flowing into the resistance R2 in such a direction as to cause the grid of tube 2 to assume a positive value and discharge occurs through the tube upon every half cycle of the generator G which impresses a positive potential upon the anode of the tube. Similarly, in the case of tube 1, a series of discharges occurs whenever the grid of tube 1 is positive. This results in a series of impulses whose amplitudes are dependent essentially upon the nature of the tube and the constants of the output circuit and independent of the amplitude of the current at the particular instant flowing in the input circuit as illustrated in Fig. 3. Upon passing from a positive half wave to a negative half wave, one or a very small number of cycles in the generator G may not produce any impulse at all but with proper design the distortion resulting from this effect will be quite small or negligible and, moreover, will not result in any systematic production of bias into the trans-

mitted signals. The effect of the filter LPF is to smooth out each series of impulses shown in Fig. 3 into a square-top wave illustrated as I3, similar to the wave that was sent out on the line prior to undergoing line distortion. The wave form of Fig. 4 is idealized and may be approximated with any required degree of precision dependent upon the relative frequencies of generator G, the nature and constants of the filter LPF, and other constants of the circuit.

In accordance with Fig. 5, resistance R2, tube 2 and resistance 4 may be omitted and the circuit will then function so that the lower impulses of current I2 as illustrated in Fig. 3 will be absent and the part of the wave comprising the impulses below the axis as illustrated in Fig. 4 will be absent. This will result in the reception of polar impulses and transmission to the outgoing circuit of non-polar or open and closed pulses of the general type which would be transmitted by the armature of the relay moving between two contacts moving respectively between battery and ground. If a biasing battery of suitable voltage and polarity is added to the output circuit of Fig. 5 the open and closed pulses become polar like Fig. 4 so that the same result is attained as with Fig. 1 with the saving of one tube. The biasing battery may be added directly in series with one of the output leads, or in series with one of the inductances of the filter, or in series with the resistance which connects the alternating current generator to the plate of the tube. For example, the battery may be placed in series with the lead associated with the arrows in Fig. 5 and its electromotive force should act in the direction indicated by the arrows and be approximately equivalent to one-half the net effect of source G upon the outgoing line when tube 1 is conducting. Such a battery may be included by moving switch S from its left to its right-hand position.

In an arrangement such as described, if a sudden impulse is applied to the input circuit during a signaling pulse which causes the signaling pulse to be of reversed sign during a short portion of the signaling pulse, such interfering impulse will not cause the transmission of a complete or continuing impulse signal but may only cause the transmission of one or two false pulses of the type such as illustrated in Fig. 3. These may be completely ineffective, because of the action of the filter LPF, to cause any false impulse to be transmitted to the outgoing line.

What is claimed is:

1. A repeating system including a source of low frequency impulses and means for repeating the impulses in regenerated form comprising a pair of tubes of the gas ionization type arranged in push-pull relation having their inputs coupled to the source through a highly resistive means, their plate or anode circuits being coupled to an outgoing path through highly resistive means, a source of alternating current voltage in the said plate circuits of a frequency greatly in excess of essential frequencies inherent in the impulses, and a filter between the outgoing path and the second-named resistor means adapted to suppress waves of the frequencies of the source of alternating current voltage but not to suppress waves of essential frequencies inherent in the impulses.

2. A repeating system for low frequency impulses comprising a gaseous discharge tube having an input circuit extending between a cathode and a control element and an output circuit extending between a cathode circuit and an anode, an input coupling for supplying low frequency impulses to be repeated to the input circuit, an output coupling for supplying repeated waves to be transmitted to an output circuit, and a source of alternating current of frequency high as compared to the frequency of the shortest impulse to be repeated for supplying operating current to the anode-cathode circuit.

3. An arrangement in accordance with claim 2, in which a filter device between the anode-cathode circuit and the outgoing line is adapted to pass all frequencies up to several times the frequency of the impulses to be repeated and to impress higher frequencies including waves of the frequency of the alternating current source.

4. An arrangement in accordance with claim 2, which comprises two tubes as specified in claim 2 arranged in push-pull relation with each having its input circuit coupled to the incoming line and its output circuit coupled to the outgoing line.

5. An arrangement in accordance with claim 2, having a biasing battery suitably located in the output circuit whereby the output signals applied to the outgoing line are polar.

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