

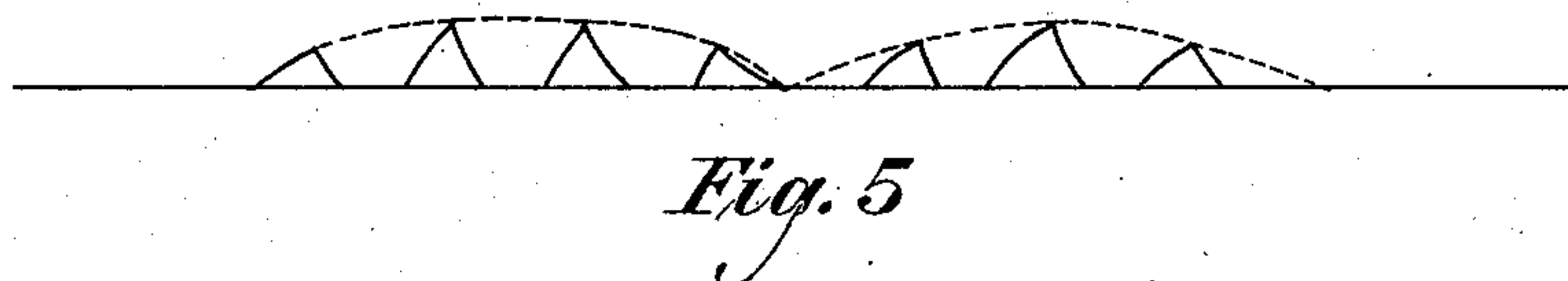
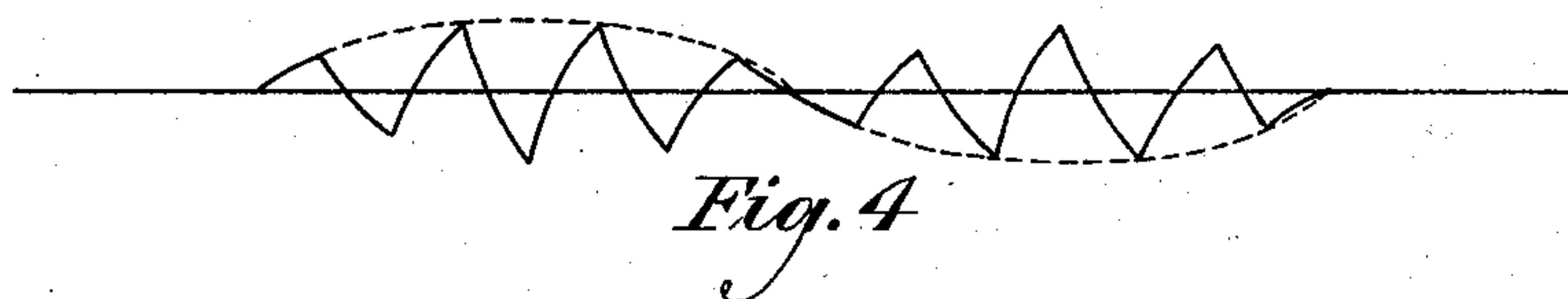
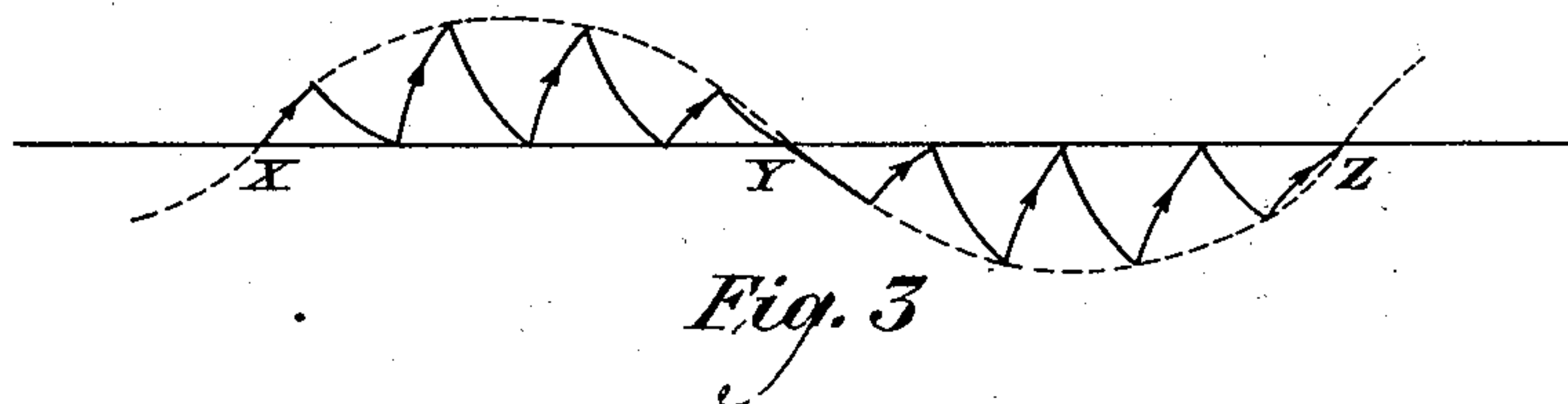
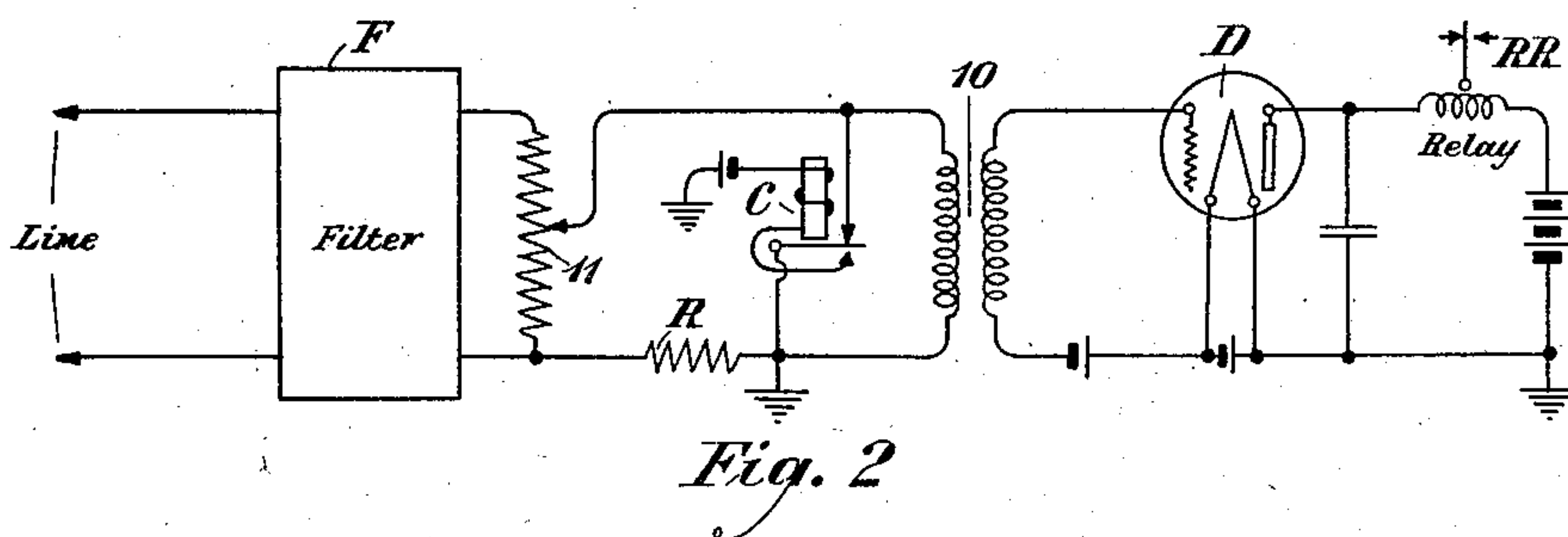
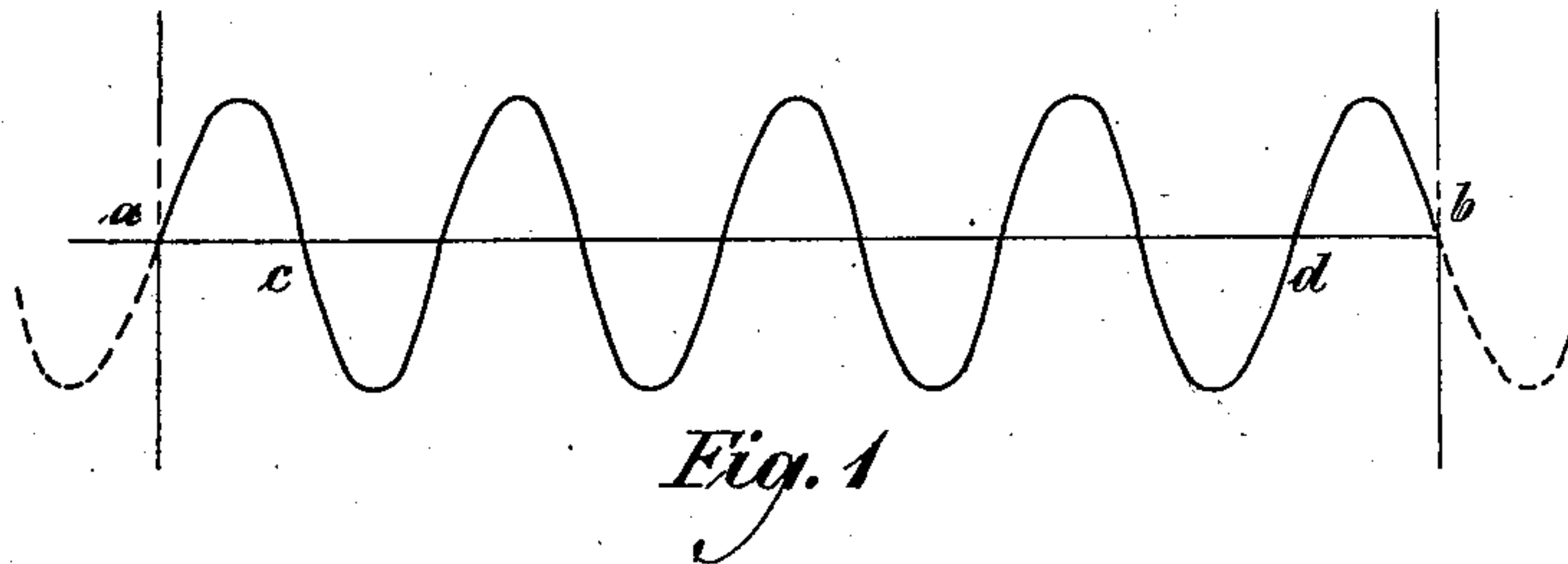
May 27, 1930.

A. L. MATTE

1,759,950

ALTERNATING CURRENT TELEGRAPH SYSTEM

Filed Feb. 23, 1928



INVENTOR.

A. L. Matte

BY

J. H. R.
ATTORNEY

UNITED STATES PATENT OFFICE

ANDREW L. MATTE, OF SUMMIT, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

ALTERNATING-CURRENT TELEGRAPH SYSTEM

Application filed February 23, 1928. Serial No. 256,385.

This invention relates to an alternating current telegraph system adapted to utilize the frequency band below the telephone range and above the frequency band requisite for the satisfactory transmission of ordinary Morse signals.

Since the most essential lower frequencies necessary for good telephone transmission are somewhat above 200 cycles, and since a band from zero to in the neighborhood of 50 cycles suffices for the transmission of ordinary Morse signals, there is a range of frequencies in between these two limits which can be employed for the transmission of telegraph signals using a low frequency alternating current carrier. It has been found that a carrier channel employing a carrier frequency in the neighborhood of 200 cycles, and transmitting a telegraph band width extending from about 160 cycles to 240 cycles, can be operated in this range.

With such a low frequency carrier, however, the number of waves per signal is very small for high speed or short signals. For example, when using a 200-cycle carrier, a telegraph dot produced at a signaling rate of 20 dots per second represents only 10 cycles, and these 10 cycles will be reduced to the extent of the space signal intervening between successive dots. If rectifying detectors are used which suppress one-half of each cycle of the carrier wave (that is, which rectify only the positive or negative half), groups or trains of alternating impulses of equal length may give rise to direct current signals which will vary in length by as much as one complete cycle after rectification, depending on the phase incidence or presentation at the grid of the rectifying tube.

In order to overcome this condition, it is proposed, in accordance with the present invention, to break up, interrupt or modify the carrier wave at the receiving end of the circuit by means of a buzzer, chopper or other suitable device, thus increasing the effective frequency in so far as the detector is concerned. This permits the rectifying detector to rectify a number of higher frequency impulses for both the positive and negative halves of each cycle of the carrier wave.

The invention will now be more fully understood from the following description when read in connection with the accompanying drawing in which Figure 1 is a curve illustrating how a group or train of alternating cycles corresponding to a dot will give a direct current impulse varying in length depending upon the point in an individual cycle at which the wave train begins and ends; Fig. 2 is a diagram of a circuit arrangement embodying the present invention; Fig. 3 shows curves illustrating the operation of the chopper or interrupter used in accordance with the invention; Fig. 4 illustrates the form of wave appearing in the grid circuit of the rectifying detector; and Fig. 5 is a curve illustrating the rectified wave appearing in the output circuit of the detector.

As already stated, when a low frequency carrier is employed only a few cycles will be transmitted for a dot signal. Assume that the transmitter sends out a group or train consisting of $4\frac{1}{2}$ cycles of the low frequency carrier for a dot signal, the group beginning with a positive cycle and ending with a positive cycle, as shown by the curve of Fig. 1. If a rectifying detector is so poled that it rectifies the upper part of the wave, the direct current signal will have a length corresponding to ab , or a length corresponding to $4\frac{1}{2}$ cycles, but if it rectifies the lower part of the wave, the length of the direct current signal will be reduced to cd , and will correspond to only $3\frac{1}{2}$ cycles. Looking at it another way, if the detector is so poled as to rectify only positive impulses, and the group or train begins and ends with a positive impulse, the direct current signal will have a length corresponding to ab , but, on the other hand, if the train or group of waves begins and ends with a negative impulse, the rectified direct current signal will only have a length cd .

While such a condition might be remedied by using push-pull detectors which rectify both halves of the wave, such an arrangement would be expensive. In accordance with the present invention, therefore, it is proposed to break up the carrier wave at the receiving

end of the circuit by means of a buzzer or chopper or other suitable device.

An arrangement for accomplishing this result is illustrated in Fig. 2, where F represents the receiving filter for selecting the carrier frequency; D is the rectifying detector; and RR is the receiving relay to rectify the Morse telegraph signals. By means of a biasing source in the grid circuit of the detector D, the grid is made so negative with respect to the filament that normally no current will flow in the plate circuit. If an alternating current is superposed on the normal grid potential, the negative half of each cycle will merely render the grid more negative, and therefore will cause no change in the current flow in the plate circuit. The positive halves of each cycle, however, cause the grid to become less negative with respect to the filament and an impulse of current will therefore appear in the plate circuit flowing through the relay RR for the positive half of each cycle.

In order to break up the carrier wave at a relatively high frequency rate, a chopper is provided which consists of a buzzer C. When the armature of the buzzer C is on its back contact, current will flow through the winding of the buzzer and cause it to pull up its armature. This causes a short circuit to be established across the primary of the transformer 10. The circuit of the buzzer being interrupted at the same time, the armature immediately falls off and again opens the short circuit. Thus, the chopper functions to open and close a short-circuit path across the primary of the transformer 10. As long as no electromotive force is impressed upon the potentiometer 11, this make and break has no effect on the detector output. If, however, the half wave of an incoming carrier cycle is of such phase as to impress a positive potential upon the grid of the detector D, the short-circuiting of the primary of the transformer 10 causes said primary to discharge its magnetic field and produce a negative electromotive force upon the grid of the detector. Conversely, if the phase of the incoming half cycle is such as to make the grid of the detector negative, and hence in the absence of the interrupter to produce no output current in the detector, the discharge of the field of the primary winding will impress a positive electromotive force upon the grid of the detector D.

In Fig. 3, the dotted curve represents a complete cycle of the carrier, while the full line curve shows successive impulses passing through the primary winding of the transformer 10. The arrows may be taken as indicating the current impulses which produce a positive potential on the grid. Between the points X and Y these correspond to the opening of the short circuit, and between the points Y and Z they correspond to the closing of the short circuit.

Fig. 4 shows in the full lines the form of the current which is induced in the secondary of the transformer in response to the interrupting action of the chopper. It will be seen that this wave is roughly a higher frequency alternating current wave modulated in accordance with a wave of the normal carrier frequency. In response to the superposition of a potential wave corresponding to Fig. 4 upon the grid of the detector, relatively high frequency positive impulses will appear in the output circuit of the detector, both during the positive and negative halves of a cycle of the carrier frequency, as is shown by the curve of Fig. 5. The arrangement, therefore, provides a means for obtaining rectification of both halves of a low frequency alternating current cycle by means of a single tube detector.

It should be particularly noted that the operation of the buzzer C produces no effect upon the detector when no low frequency carrier wave is being received, and consequently no rectified current will flow through the relay RR during the spacing interval. It should also be noted that if the short-circuit connection controlled by the buzzer C be established directly across the output of the filter F, the output of the filter will be short-circuited each time the buzzer armature is pulled up. A resistance R is therefore included in the circuit between the filter and the point at which the short circuit is applied, to ensure that the output impedance of the filter will be unaffected by the operation of the chopper.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a low frequency alternating current carrier telegraph system in which each code element is transmitted as a limited number of alternating current waves of substantially uniform low frequency, a receiving arrangement comprising means to rectify half waves of only one polarity, and means to effectively break up both the positive and negative impulses of each carrier cycle of a train of carrier waves corresponding to a code element into a plurality of impulses of higher frequency to permit the rectifier to rectify elements of both half cycles.

2. In a low frequency alternating current carrier telegraph system in which each code element is transmitted as a limited number of alternating current waves of substantially uniform low frequency, a receiving arrangement comprising means to rectify half waves of only one polarity, means to effectively break up both the positive and negative impulses of each carrier cycle of a train of carrier waves corresponding to a code element into a plurality of impulses of higher fre-

quency to permit the rectifier to rectify elements of both half cycles, and means to prevent the transmission to the rectifier of high frequency waves corresponding to the breaking-up operation in the absence of the low frequency carrier wave.

3. In a low frequency alternating current carrier telegraph system in which each code element is transmitted as a limited number of alternating current waves of substantially uniform low frequency, a receiving arrangement comprising means to rectify half waves of only one polarity, and means to interrupt both positive and negative half cycles of each carrier wave of a train of carrier waves corresponding to a code element at a relatively high frequency rate to enable the rectifier to rectify elements corresponding to both positive and negative half cycles.

4. In a low frequency alternating current carrier telegraph system in which each code element is transmitted as a limited number of alternating current waves of substantially uniform low frequency, a receiving arrangement comprising means to rectify half waves of only one polarity, means to interrupt both positive and negative half cycles of each carrier wave of a train of carrier waves corresponding to a code element at a relatively high frequency rate to enable the rectifier to rectify elements corresponding to both positive and negative half cycles, and means to prevent the action of said interrupting means from affecting the rectifier in the absence of a low frequency carrier wave.

5. In a low frequency alternating current carrier telegraph system in which each code element is transmitted as a limited number of alternating current waves of substantially uniform low frequency, a receiving circuit comprising a rectifying detector, a transformer in the grid circuit of said detector, and a buzzer connected to short-circuit the primary of said transformer at a relatively high frequency rate, thereby effectively interrupting both positive and negative halves of each carrier cycle of a train of carrier waves corresponding to a code element to enable the detector to rectify components corresponding to both positive and negative half cycles.

6. In a low frequency alternating current carrier telegraph system in which each code element is transmitted as a limited number of alternating current waves of substantially uniform low frequency, a receiving circuit comprising a rectifying detector, a transformer in the grid circuit of said detector, a buzzer connected to short-circuit the primary of said transformer at a relatively high frequency rate, thereby effectively interrupting both positive and negative halves of each carrier cycle of a train of carrier waves corresponding to a code element to enable the detector to rectify components corresponding to both positive and negative half cycles, said

short-circuiting connection of the buzzer being established at such points in the circuit that no change in potential will appear upon the grid circuit of said detector in the absence of the low frequency alternating carrier current upon the circuit.

7. In a transmission system, a transformer means to apply a code element comprising a plurality of cycles of alternating current of substantially constant low frequency to the primary of said transformer, and means to periodically discharge the field of said transformer at a frequency rate which is high as compared with the frequency of said alternating current.

8. In a transmission system, a transformer means to apply a code element comprising a plurality of cycles of alternating current of substantially constant low frequency to the primary of said transformer, and means to periodically discharge the field of said transformer at a frequency rate which is high as compared with the frequency of said alternating current thereby producing a plurality of alternative wave forms for each half cycle of said alternating current, and a rectifier associated with said transformer to rectify said wave forms.

In testimony whereof, I have signed my name to this specification this 21st day of February, 1928.

ANDREW L. MATTE.

70

75

80

85

90

95

100

105

110

115

120

125

130