

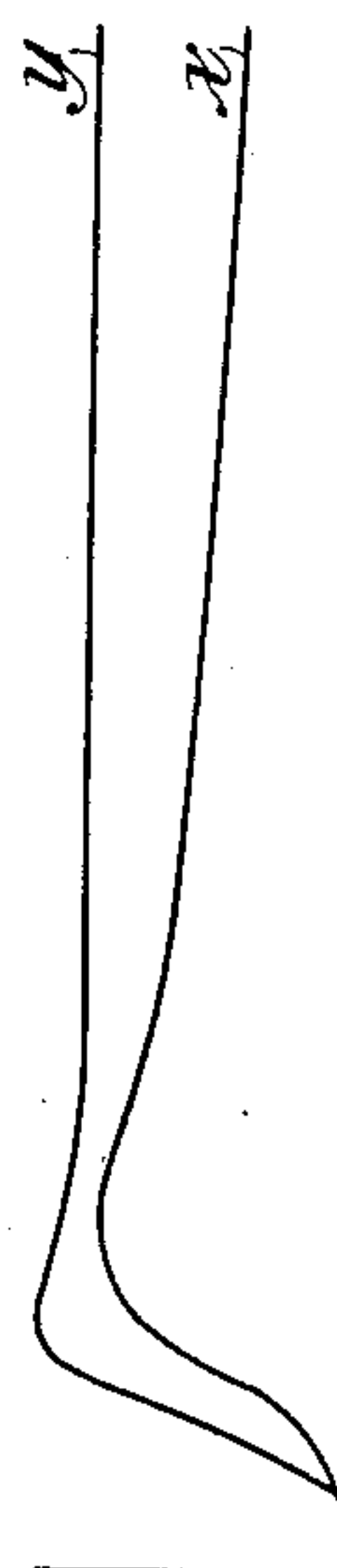
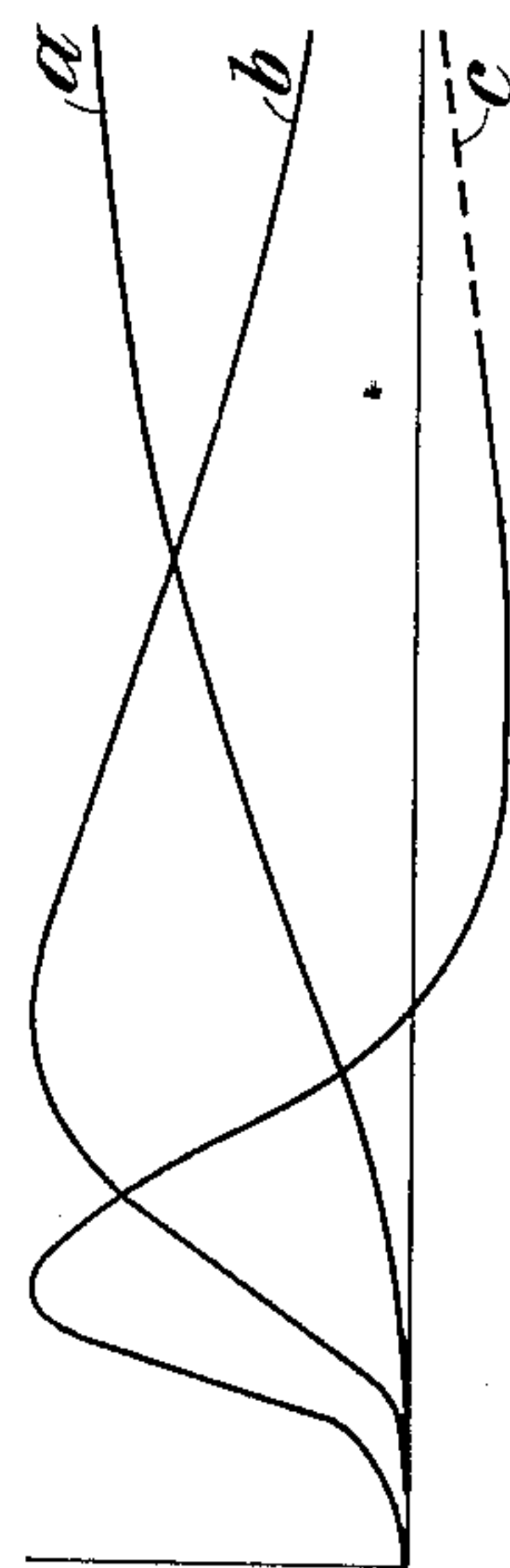
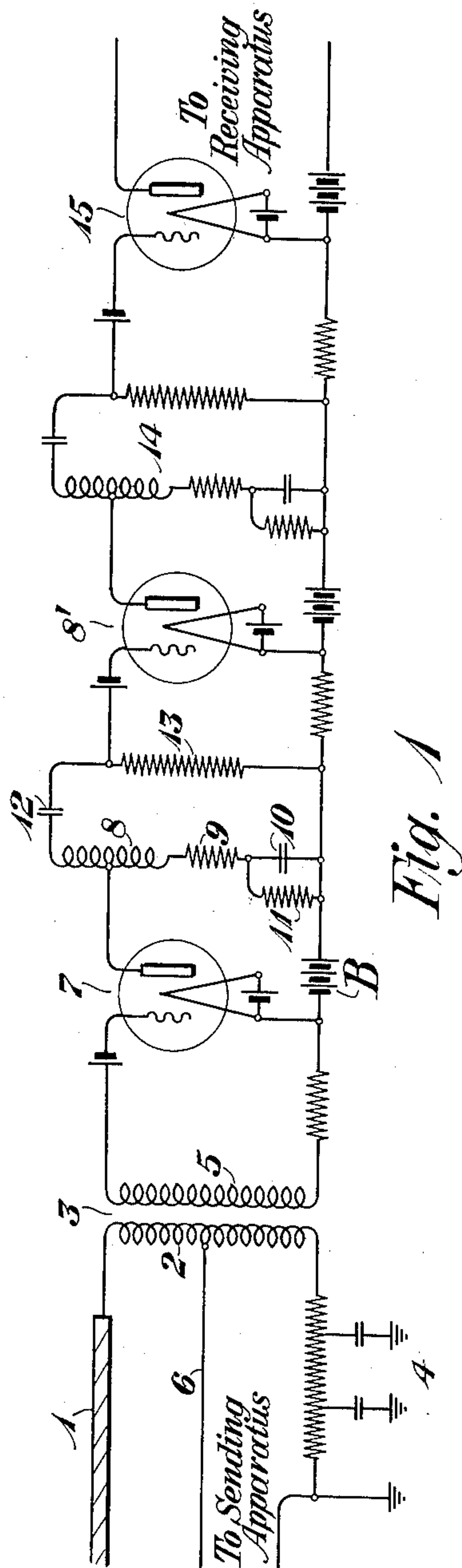
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J. R. CARSON

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MEANS FOR RECEIVING WEAK SIGNAL CURRENTS

Filed June 18, 1918



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# UNITED STATES PATENT OFFICE.

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## MEANS FOR RECEIVING WEAK SIGNAL CURRENTS.

Application filed June 18, 1918. Serial No. 240,631.

*To all whom it may concern:*

Be it known that I, JOHN R. CARSON, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Means for Receiving Weak Signal Currents, of which the following is a specification.

This invention relates to signal transmitting systems and especially to telegraph systems involving transmission lines of large distortion and attenuation, such as are found in ocean cable work. The object of the invention is to improve the quality and speed of transmission over such lines.

In lines of the character mentioned, it is a matter of common knowledge that the speed of signaling is much limited by the losses in the line and the distortion of the current impulses and various schemes have been proposed for overcoming these difficulties. It has recently been proposed to combine a distortion network having a corrective effect upon the received impulses and a distortionless amplifier, such as the thermionic type, with transmission lines of this kind, and it has also been suggested that the correcting networks of the amplifiers may be used in stages alternately. These suggestions have originated with others and in themselves form no part of the present invention. It is the purpose of this invention to provide a correcting network of an especially efficient form for use in connection with the amplifying elements.

The invention will be described in connection with the accompanying drawing in which Figure 1 illustrates diagrammatically one end of a signaling system embodying the invention; Fig. 2 is a set of curves illustrating the operation of the invention, and Fig. 3 shows curves representing the results obtainable.

The terminal of the main line 1, here represented as a cable circuit, may be connected to one winding 2 of a transformer 3, the other side of this winding being connected to the artificial line 4, commonly used for duplex operation. The other winding 5 of the transformer will then be connected to the apparatus in the receiving branch of the circuit and the sending apparatus will be connected between a lead 6 tapped in at the center point of the winding 2 and ground. It will be understood, of course, that any other

common means for deriving the sending and receiving branches for duplex operation may be employed.

In the form of the invention here illustrated, I have shown an amplifier 7 connected immediately to the terminals of the transformer winding 5 with the input side next to the transformer and the output side connected to a correcting network arranged in accordance with this invention. It will be understood, however, that, if desired, the correcting network may be connected directly to the transformer winding and the amplification accomplished at subsequent stages. The correcting network comprises an inductance 8, resistance 9 and capacity 10, connected across the circuit, the capacity being shunted by a resistance 11 which co-operates with the capacity for the purpose hereinafter pointed out and at the same time provides the proper circuit for the B battery of the amplifier. The plate circuit of the amplifier is preferably connected somewhere between the ends of the inductance 8 to give an auto-transformer operation thereto which facilitates voltage adjustments in the successive stages of the apparatus. In general the voltage should be stepped up between stages. The total value of inductance 8 as well as the relative value of the parts on either side of the connection to amplifier 7 must be proportioned with a view to the desired correcting effect as well as the desired step up in voltage.

The current arriving over the line 1, when the distant end is closed through a source of currents and held closed, may be represented by the curve *a* in Fig. 2. The effect of the transformer 3 will be to give in the amplifier circuit only a current approximating the first derivative of this arrival current which may be represented by the curve *b* in Fig. 2. The effect of the inductance 8 in the correcting network is to give a second derivative represented by *c* in Fig. 2, while the resistance 9 maintains the first derivative or *b*. By inserting the capacity 10 in the manner here shown, the integral of the first derivative, which is the same as the arrival curve *a*, may be approximately obtained. It will be obvious from an inspection of Fig. 2 that if the curves *a*, *b* and *c* are given proper values that their combined effect will be a current curve having a fairly sharp rise



with a fairly well sustained value. In other words, it will approximate the form of current wave transmitted from the opposite end of the line and will be of the form desirable for use in recording apparatus. This combination of elements, therefore, constitutes a very efficient form of restoring network which, however, like all other similar networks, reforms the current wave at the expense of current strength and it for this reason necessary to use suitable amplifying apparatus if such networks are to be employed. The thermionic amplifier serves the purpose in hand because it can be made practically distortionless, thus avoiding the re-introduction of the defects which have been eliminated. The amplifier also serves an important function in preventing the networks from reacting upon one another so that each may be independently designed to have its desired effect. This results from the fact that the amplifier is a one-way device. The output side of the distortion network is, therefore, connected to the input side of an amplifier 8', as shown. To prevent the B battery of amplifier 7 from affecting the potential between grid and filament of amplifier 8', the condenser 12 is inserted, and a resistance 13 is bridged across the input circuit of the latter to permit of a proper control of potential difference between grid and filament in the latter amplifier. The condenser 12 and resistance 13 constitute no part of the corrective network and in order that they may not affect the action thereof the resistance 13 should be of very high value compared with the impedance of the network. The condenser 12 should also be of large capacity so as not to affect the signaling voltage in the input circuit of amplifier 8'.

Improved results are obtained by repeating the correction and amplification of the current through successive stages as indicated at 14 and 15. The number of stages and the values of the various elements of the distortion network will depend upon the character of the transmission line with which they operate. Curve "X" in Fig. 3 represents the current which may be obtained from an arrival current such as indicated at "a" in Fig. 2 by the use of two stages of the network with amplifiers intervening as shown in Fig. 1. Curve "Y" shows the results with three stages, which is a considerable improvement over "X" since it shows a sharper rise and a flatter top.

The invention is not to be regarded as limited to the details of the circuit arrangements herein shown as various modifications will suggest themselves to those skilled

in the art within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. The combination with a main line having distortion and attenuation, a correcting network comprising an inductance, a resistance and a capacity in series, and input and output circuits for said network arranged to give said inductance an auto-transformer operation for increasing the voltage in the output circuit.
2. The combination with a main line having distortion and attenuation, of a transformer connected to receive current impulses therefrom, a correcting network co-operating with said transformer to reform said signal impulses, said network comprising an inductance element receiving current through part of its coils and transmitting current through all of its coils whereby the voltage of the output circuit of said network may be increased.
3. The combination with a line of high distortion and attenuation, of a transformer receiving signal impulses therefrom, an amplifier having its input circuit connected across the secondary of said transformer, a distortion circuit connected across the output circuit of said amplifier and comprising inductance, resistance and capacity arranged in series, a second amplifier receiving impulses from said distortion circuit and means between the distortion circuit and said second amplifier for making the input circuit of the second amplifier of high impedance.
4. The combination with a signaling conductor having distortion and attenuation, of a wave shaping network, comprising a step-up auto-transformer, a resistance in series with the primary portion of said transformer in the primary circuit and also in series with the secondary portion in the secondary circuit, and means for impressing upon the primary circuit signal waves having components of very low frequencies.
5. The combination with a submarine telegraph cable having distortion and attenuation, of a wave shaping network comprising an auto-transformer, primary and secondary circuits therefor, a resistance common to said circuits, a space discharge amplifier of high impedance in said output circuit, and means for impressing upon said input circuit signal waves having very low frequency components.

In testimony whereof I have signed my name to this specification this 17th day of June, 1918.

JOHN R. CARSON.