

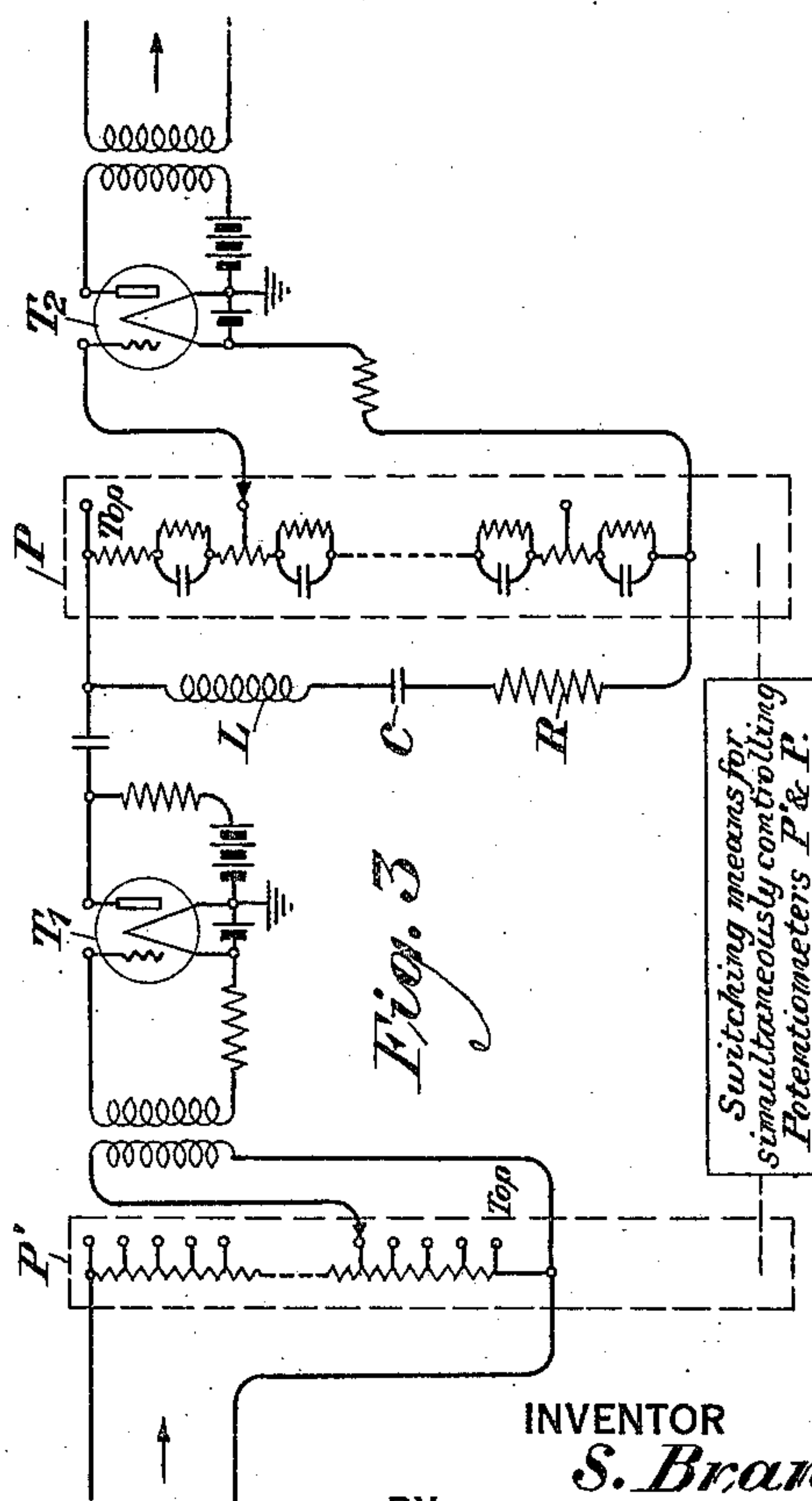
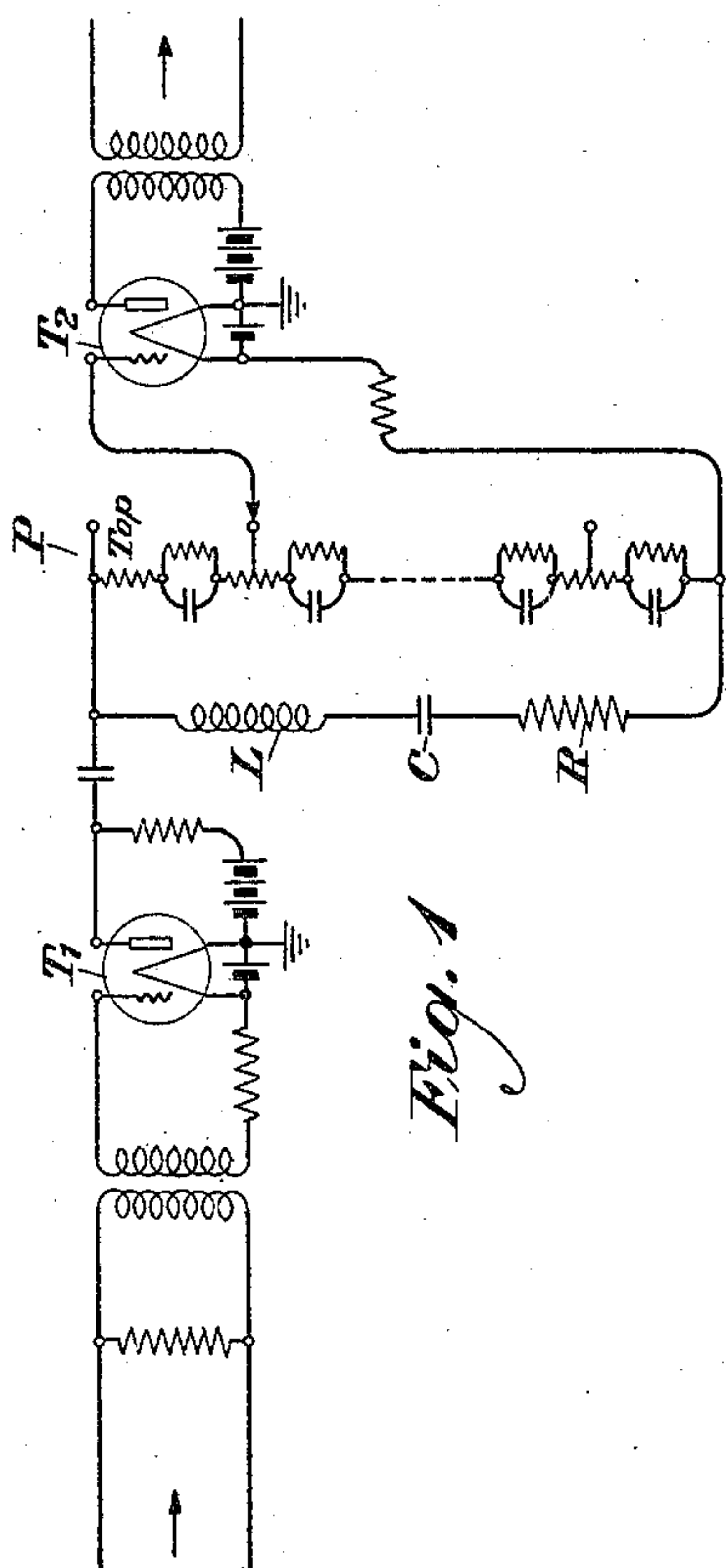
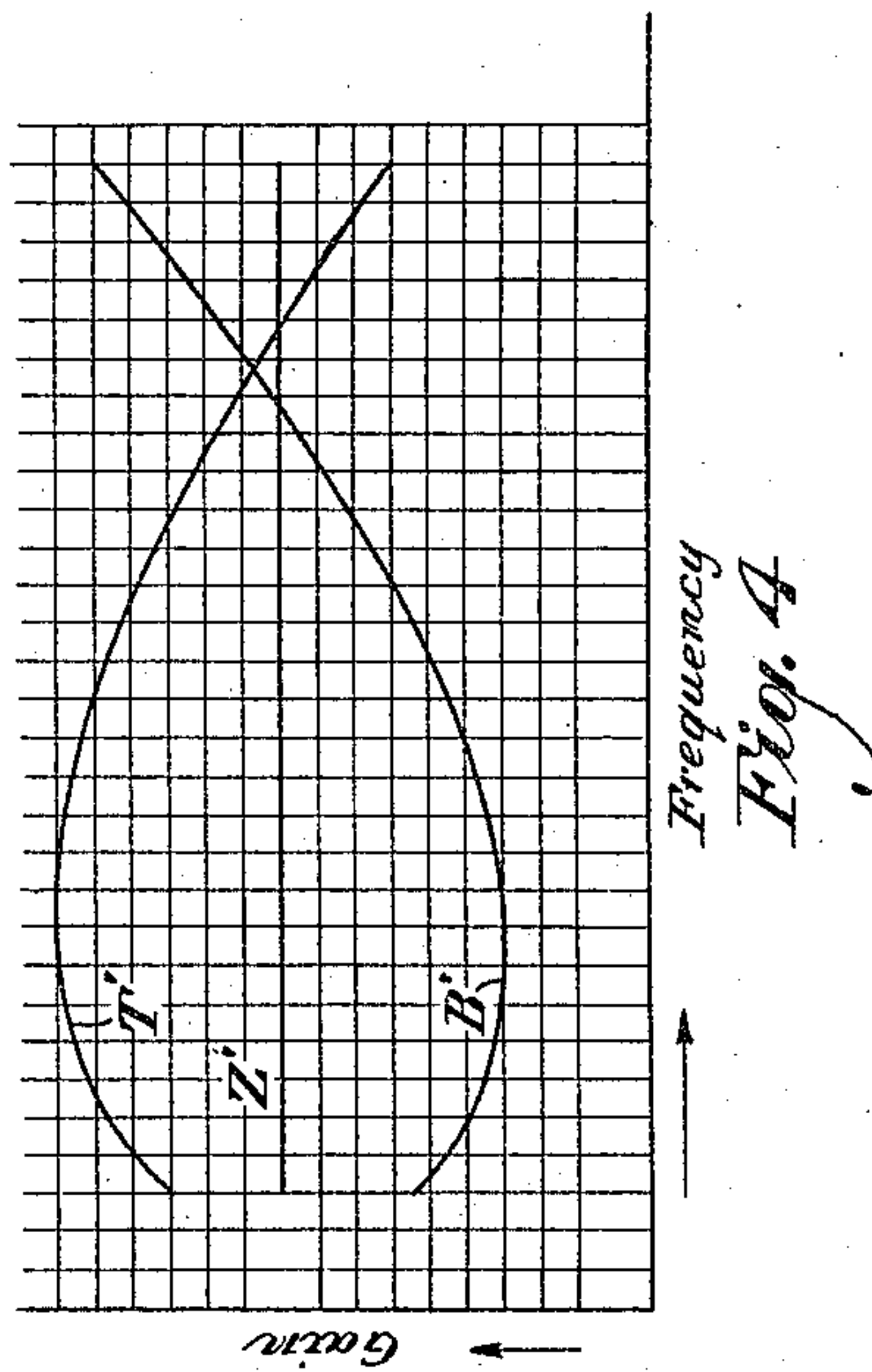
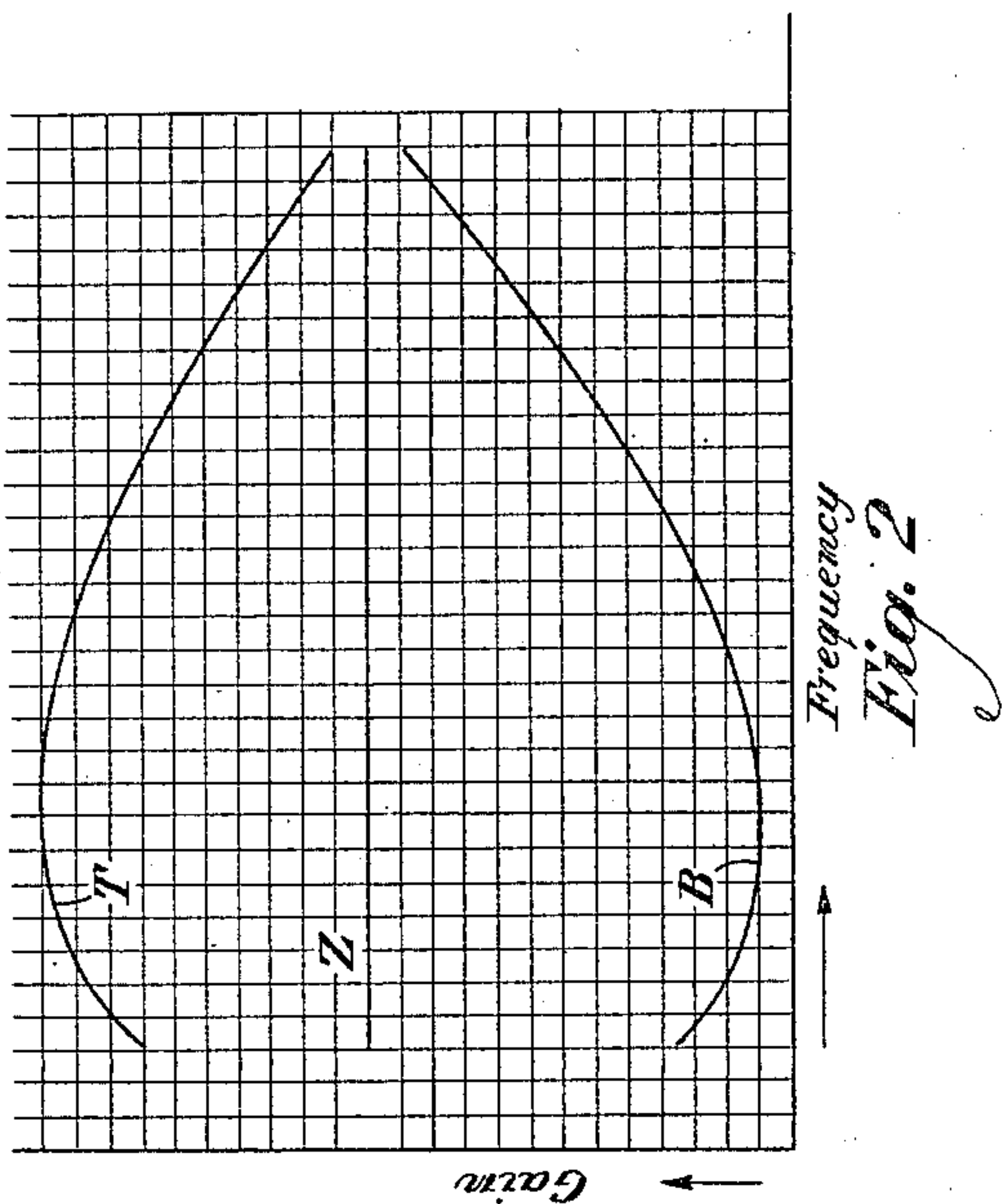
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TRANSMISSION REGULATION

Filed May 17, 1930



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TRANSMISSION REGULATION

Application filed May 17, 1930. Serial No. 453,284.

This invention relates to methods of and means for regulating the transmission over telephone or carrier telegraph circuits, and more particularly to regulation suitable to program transmission over telephone cable circuits.

Cable circuits are affected as to transmission characteristics by changes of temperature, the transmission characteristics being a function of the frequency of the transmitted current. In certain types of cables, at least, field measurements show that an increase of temperature, for instance, produces an increase of transmission loss at the low and intermediate frequencies and that this change of transmission varies with frequency change, passing through zero at a certain relatively high frequency and becoming a negative increment in loss at the higher frequencies.

The principal object of the invention is to provide for transmission regulation which will offset the variations mentioned above and produce a substantially flat transmission characteristic over the normal range of temperatures and a wide range of frequencies.

In general I accomplish the above-stated object by introducing a transmission-frequency distorting impedence to give a gain characteristic of suitable form and simultaneously introducing an adjusting impedance free from transmission-frequency distortion, as will be more fully disclosed hereinafter.

I do not claim as my invention the broader idea of introducing a combination of adjustable impedances and adjusting these impedances in accordance with the temperature and with the frequency characteristic of the transmission medium; this was proposed before the conception of the present invention. I have found, however, that the methods and arrangements described and claimed herein result—in certain cases, at least—in satisfactory transmission regulation with the maximum of simplicity and economy.

My invention will be understood by those skilled in the art when the following description is read with reference to the accompanying drawing, of which—

Figure 1 shows diagrammatically a circuit

arrangement for producing the transmission-frequency distorting adjustment between the stages of a vacuum tube repeater;

Fig. 2 shows curves illustrating the effect of the arrangement of Fig. 1;

Fig. 3 shows diagrammatically a desirable circuit arrangement for producing, in the case of a vacuum tube repeater, both the transmission-frequency distorting effect and the gain-adjusting non-distorting effect; and

Fig. 4 shows curves indicating the desired effect obtained by using the arrangement of Fig. 3.

It is to be understood that Figs. 1 and 2 serve the purpose of making clear the true nature of my improvement, but do not by themselves illustrate the invention in its complete aspect.

In Fig. 1, there is shown a repeater comprising the vacuum tubes T_1 and T_2 , inserted in a transmission line. Between the tubes T_1 and T_2 is a potentiometer P comprising a plurality of resistances and a plurality of condensers as shown. Associated with this combination of resistances and capacities is a shunt comprising the inductance L , the capacity C and the resistance R . It will be understood, of course, that the particular arrangement and the values of these impedance elements will vary with the particular circuits employed and the particular transmission problems presented. The effect of the introduction of such an impedance arrangement in the transmission circuit is, however, indicated in Fig. 2 of the drawing. The curves Z , T and B correspond to the zero, top and bottom steps, respectively, of the potentiometer setting according to temperature, the zero step representing, for instance, 55° Fahrenheit. At this temperature, let it be assumed, it is found that the transmission characteristic is substantially flat and that no correction with frequency change is required. When the temperature rises, however, it is found that the attenuation is increased at the lower frequencies and then decreases as the frequency increases, becoming a negative increment in loss at the higher frequencies. Accordingly, the potentiometer P at the top step set-

ting, for instance, must introduce some such characteristic as that represented by curve T. It will be noted that the effect is to introduce a gain which is relatively large at the lower frequencies and decreases as the frequency increases. Further, if the shape of curve T is such that the transmission characteristic of the system remains flat after these changes have been made there must be a net change of loss at all frequencies which is independent of frequency since the curve T does not cross zero. Likewise the curve B corresponding to the bottom step does not pass through zero within the range of frequencies to be regulated. In order to take care of this difficulty, I employ some such arrangement as that shown in Fig. 3.

In Fig. 3, as in Fig. 1, there is shown a two-stage repeater with tubes T_1 and T_2 and a potentiometer P between the tubes, this potentiometer having resistances, condensers and the shunt comprising the inductance L, the capacity C and the resistance R. A second impedance network takes the form of a potentiometer P' connected into the input circuit of the repeater. This potentiometer P' is specifically shown as a simple resistance potentiometer. It will be understood, of course, that it may, like the potentiometer P, take other forms in accordance with the particular requirements. The essential feature is that it introduces no transmission-frequency distortion. Accordingly, with both impedance networks in the circuit, the result will be the introduction of a transmission adjustment such as that indicated in Fig. 4 (with reference to Fig. 2). It will be noted that the curve Z', corresponding to the zero step, is flat, and that the curves T' and B', corresponding to the top and bottom steps, respectively, have the same curvatures as curves T and B, respectively, of Fig. 2; the characteristics have, however, been adjusted to pass through zero within the range of frequencies to be regulated, and thus they give the desired offset to the negative increment in loss at the higher frequencies, which has been discussed above.

It will be noted in Fig. 3 that the two potentiometers P and P' are arranged to step in opposite directions; when one increases the loss, the other should simultaneously step to decrease the loss. This arrangement will meet the usual requirements. Such simultaneous and opposite adjustments of impedance may, of course, be brought about by any suitable means—for instance, the "top" steps may be located as shown, and switching means such as master relays may give the simultaneous control of the potentiometers.

While the invention has been disclosed specifically for the purpose of illustration, it is to be understood that its true scope is determined by the appended claims.

What is claimed is:

1. In a transmission circuit in which the transmission varies with temperature and also with the frequency of the transmitted currents, a repeater, a potentiometer connected across said repeater and having a plurality of steps to correspond to temperature variation, a shunt impedance connected across said potentiometer, said potentiometer and said shunt impedance serving to produce a gain of said repeater which is variable with the frequency of the transmitted currents, a second potentiometer connected across said repeater, said second potentiometer having a plurality of steps to correspond to temperature variation and being so constructed that it introduces no transmission-frequency distortion, and means for simultaneously controlling the two potentiometers.
2. In a transmission circuit in which the transmission loss varies with temperature and also with the frequency of the transmitted currents, a repeater comprising a plurality of vacuum tubes, a potentiometer between two of said vacuum tubes having a plurality of steps to correspond to temperature variation, a shunt impedance connected across said potentiometer, said potentiometer and said shunt impedance serving to produce a gain variable with the frequency of the transmitted currents, a second potentiometer in the circuit ahead of the first of said two vacuum tubes, said second potentiometer having a plurality of steps to correspond to temperature variation and being so constructed that it introduces no transmission-frequency distortion, and means for simultaneously controlling the two potentiometers to introduce transmission effects in opposite directions.

In testimony whereof, I have signed my name to this specification this 15th day of May 1930.

SMART BRAND.

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