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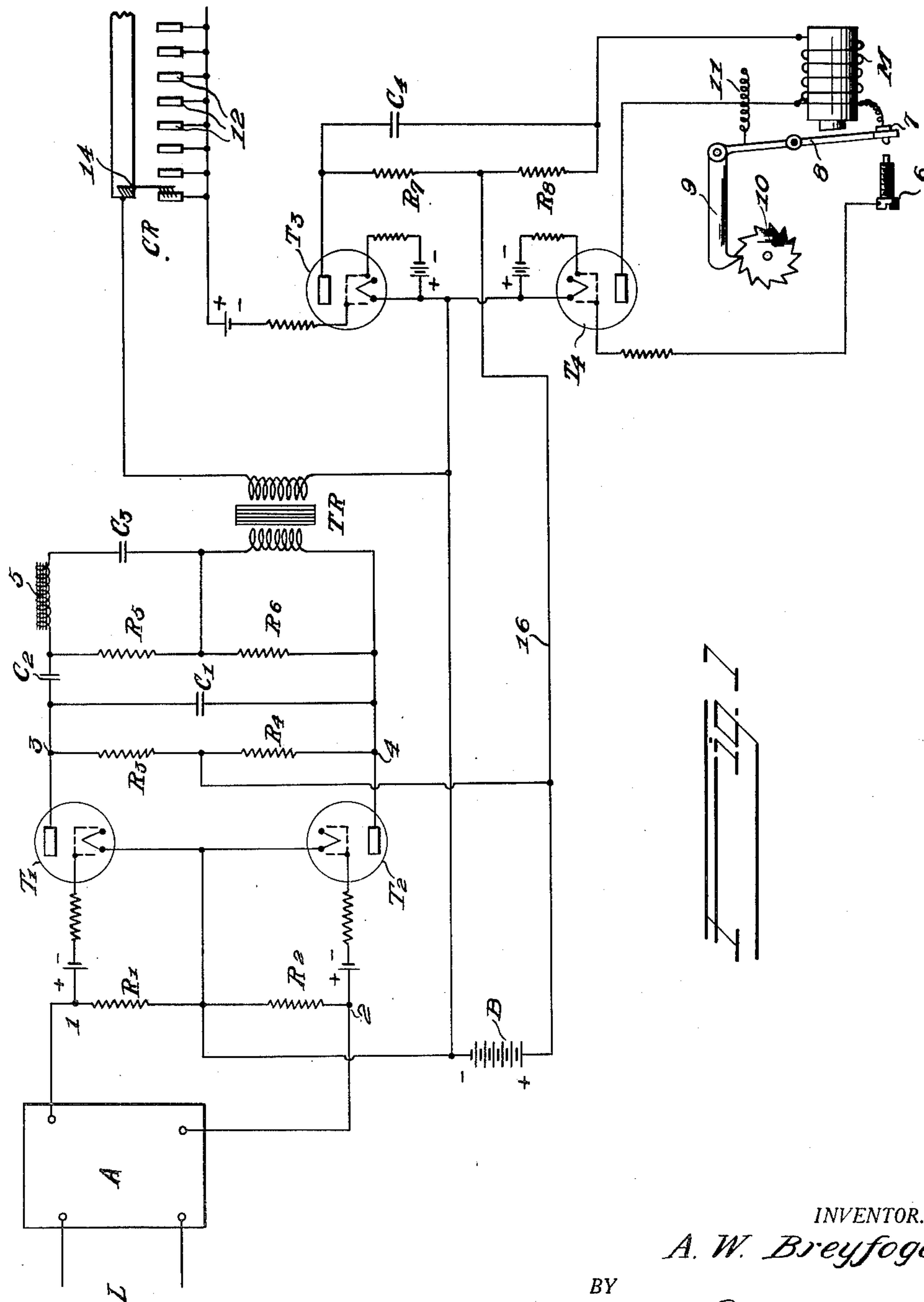
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CORRECTOR CIRCUIT FOR SYNCHRONOUS TELEGRAPH SYSTEMS

Filed July 29, 1930

3 Sheets-Sheet 1



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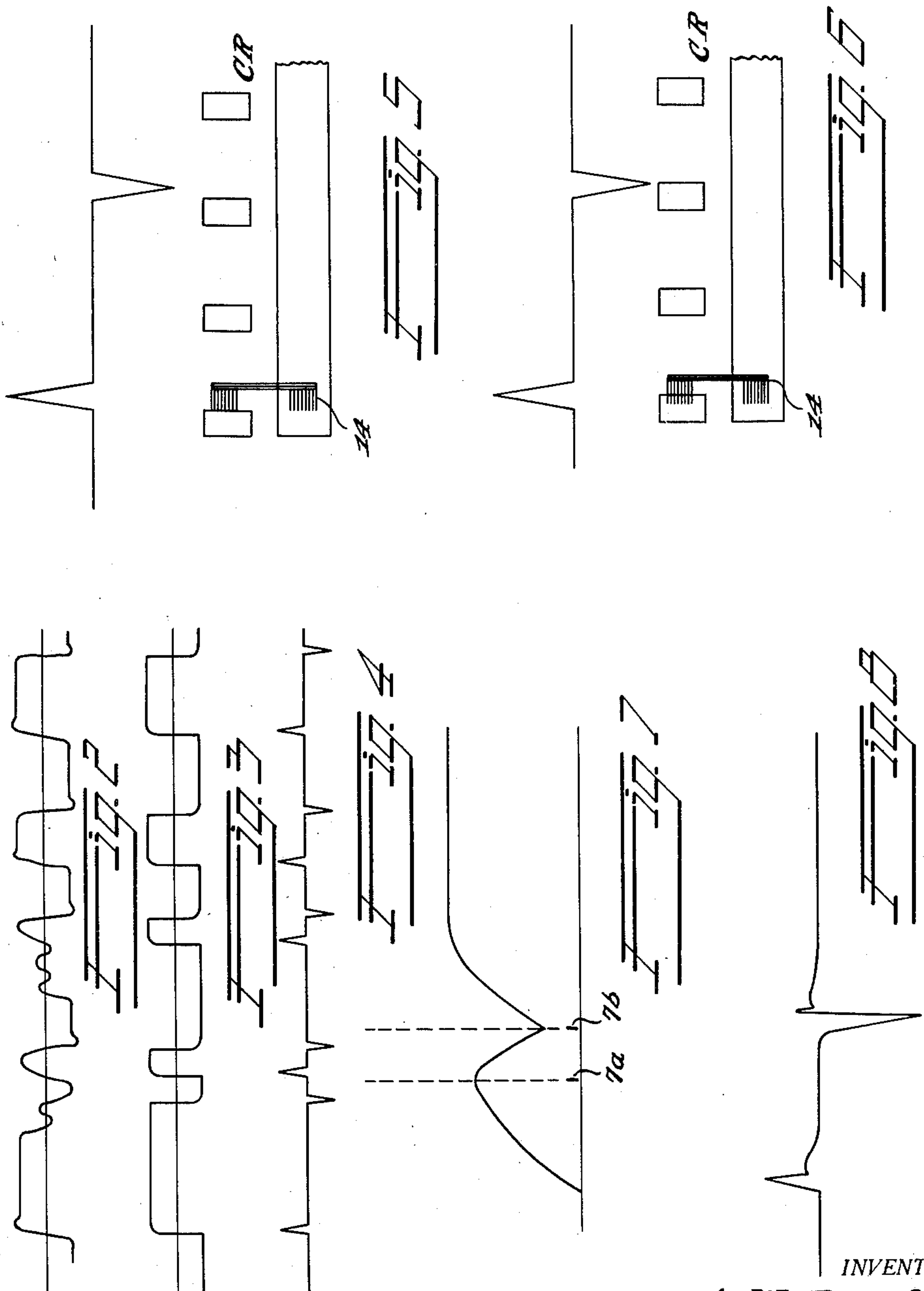
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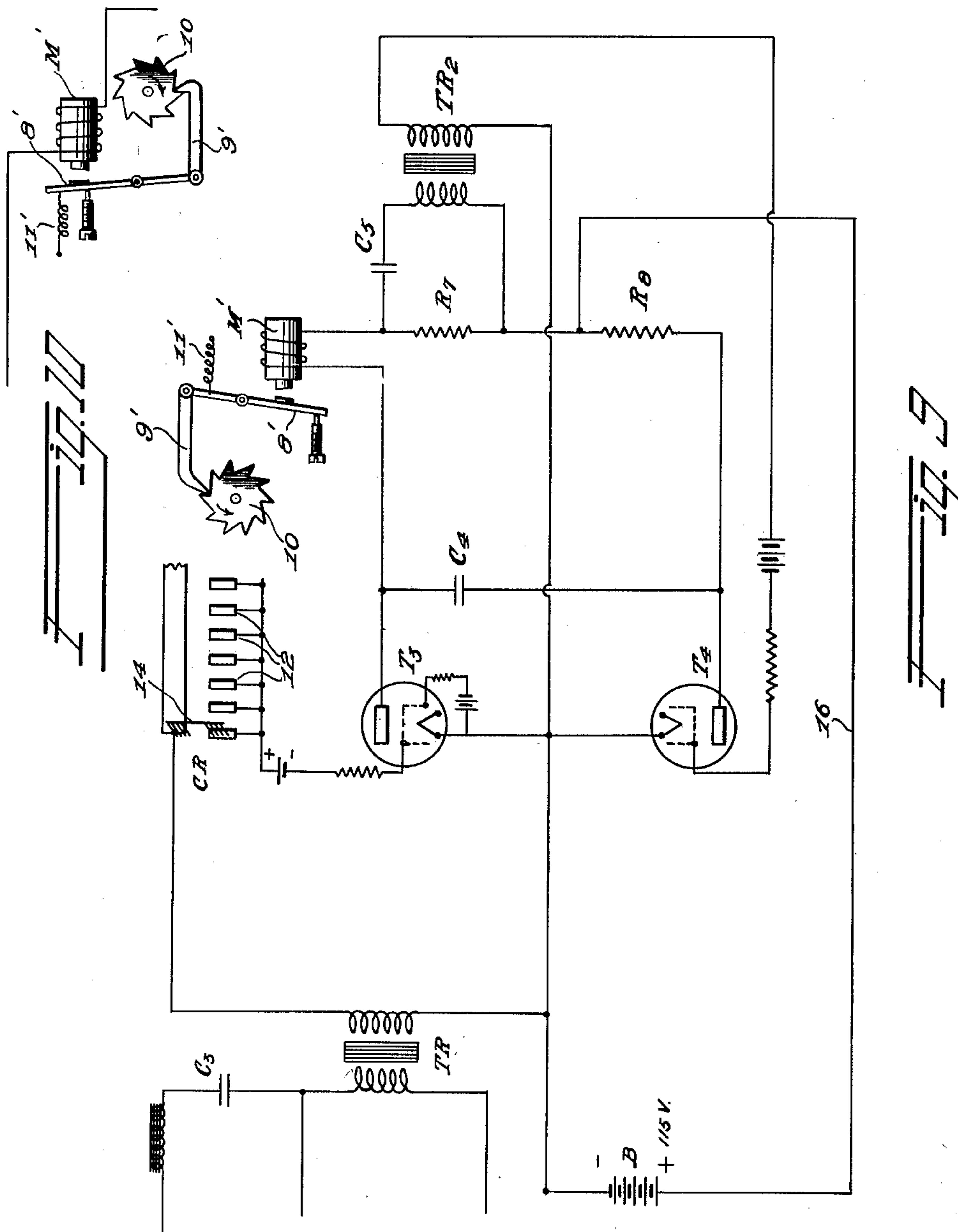
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CORRECTOR CIRCUIT FOR SYNCHRONOUS TELEGRAPH SYSTEMS

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3 Sheets-Sheet 3



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CORRECTOR CIRCUIT FOR SYNCHRONOUS TELEGRAPH SYSTEMS

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This invention relates to a corrector circuit for use in a multiplex telegraph system for correcting the position of rotating collector brushes to maintain synchronism between the brushes at the transmitting and receiving stations.

An object of my invention is to devise a corrector circuit utilizing a gaseous relay of the type commonly known as a thyatron tube, which has the characteristic of starting into operation when a certain positive potential is applied to the grid and continuing to operate thereafter unaffected by the grid potential. The name "thyatron" has been applied to tubes of this type in an article entitled "Gas-filled thermionic tubes," by A. W. Hull, published in the Journal of the American Institute of Electrical Engineers, November 1928, page 802, in which other forms are described.

A further object of this invention is to devise a corrector circuit in which the number of mechanically operated contacts are reduced to a minimum.

Still another object is to devise a corrector circuit capable of operation to effect either a forward or a backward correction of the brushes.

My invention is illustrated in the accompanying drawings in which:

Figure 1 is a circuit diagram of the corrector system;

Figure 2 is a graph of the incoming signal;

Figures 3 to 8 show graphs illustrating the operation of the corrector circuit;

Figure 9 is a circuit diagram of a modified arrangement of my corrector system; and

Figure 10 is a detail view of the brush shifting magnet arranged for forward correcting.

Referring to Figure 1: L is a telegraph line or cable circuit over which multiplex telegraph signals are received from a distant transmitting station, and A is an amplifier of usual construction for amplifying the received signals. The output circuit of the amplifier is completed through resistance elements R_1 and R_2 connected in series between terminals 1 and 2. The grid of a thyatron tube T_1 is connected to terminal 1 through

element, and the grid of a second thyatron tube T_2 is likewise connected to terminal 2 through a stabilizing battery and a high resistance element. The cathodes of the thyatron tubes are connected together and to the midpoint of resistances R_1 and R_2 and to the negative terminal of plate battery B. The plate elements of tubes T_1 and T_2 are connected together through resistance elements R_3 and R_4 connected in series between terminals 3 and 4. Space current is supplied to the plate elements of the tubes by a connection from the positive terminal of battery B to the midpoint connection between resistance elements R_3 and R_4 . A condenser C_1 is connected in shunt to the terminals 3 and 4. The output circuit of the thyatron tubes T_1 and T_2 includes a transformer TR connected across terminals 3 and 4 by means of a network including condensers C_2 and C_3 , resistances R_5 and R_6 , and an inductance 5. The secondary of transformer TR is connected at one terminal to the solid corrector ring and at the other terminal to the cathode of a corrector thyatron tube T_3 . The grid of tube T_3 is connected to the segments of the corrector ring CR through a suitable stabilizing battery and high resistance element. The grid is also connected to the cathode of the tube T_3 through a suitable stabilizing battery and a high resistance. The cathode of an auxiliary corrector thyatron tube T_4 is connected to the cathode of tube T_3 , and to the negative terminal of battery B. Space current for tubes T_3 and T_4 are supplied from battery B by a connection 16 through resistance elements R_7 and R_8 , respectively, which are shunted by a condenser C_4 , the plate circuit of tube T_4 including a corrector magnet M. The grid of tube T_4 is connected to its cathode element through a suitable stabilizing battery and a high resistance, and is also connected through a high resistance to a stationary contact 6, cooperating with an insulated contact 7, carried by the armature 8, of the corrector magnet M, contact 7 being connected to the conductor leading to the plate element of tube T_4 . The armature 8 carries a pawl 9 cooperating with a ratchet wheel 10 which has suitable well

a stabilizing battery and a high resistance known mechanical connection with the rotating brush structure of the rotary distributor for shifting the brushes while in operation. The arm 8 is normally biased by spring 11 against the operation of magnet M.

The operation is as follows: The incoming signal is represented by the graph in Figure 2. When the signal wave is such that terminal 1 becomes positive, and terminal 2 becomes negative operation of thyatron tube T_1 is initiated and current flows from battery B through resistance R_3 and the plate circuit of tube T_1 . Under this condition the voltage of terminal 3 connected to the plate of tube T_1 and to one terminal of condenser C_1 will be of the order of 15 volts, corresponding to the internal drop in tube T_1 . The other terminal of condenser C_1 , that is, terminal 4, will assume the full voltage of battery B (assume 115 volts) by reason of the connections through resistance R_4 .

Should the signal now reverse in polarity, making terminal 2 positive and terminal 1 negative, operation of tube T_2 will be initiated, and the voltage of terminal 4 will immediately drop from 115 volts to 15 volts. The voltage of terminal 3 must also instantaneously decrease by the same amount, which will bring it to minus 85 volts, from which it will rise gradually to plus 115 volts as the condenser C_1 is discharged and then again charged through resistance R_3 . This change of voltage at terminal 3, or at the plate of tube T_1 , is of such duration as to permit the ions to diffuse to the electrodes and stop the operation of tube T_2 . When the signal again causes terminal 1 to become positive and terminal 2 to become negative, the same operation described above with respect to the tube 2 takes place with respect to tube 1.

The variation of potential across terminals 3 and 4 for signal currents represented in Figure 2 is shown in the graph in Figure 3.

The instantaneous voltage changes across condenser C_1 when impressed upon the input of transformer TR through its associated network, results in voltage kicks in the secondary of the transformer as shown in the graph in Figure 4. These kicks rise very rapidly to their maximum value and fall back to zero equally as rapidly. They are positive when the incoming signal changes from negative to positive, and negative when the signal changes from positive to negative. The voltage kicks or impulses are supplied from transformer TR to the grid circuit of corrector tube T_3 .

The brushes of the rotary distributor at the correcting station are set to run either slightly faster or slightly slower than the brushes of the distributor at the sending station, and the mechanical corrector is arranged to step the brushes either backward or forward in the well known manner. Sup-

pose the brushes at the correcting station are set to run slightly slower than those at the sending station, and the mechanical corrector is arranged to step the brushes forward. When the corrector brushes are in correct phase relation with the incoming signal, their position with respect to the segments 12 of the corrector, and with respect to the kicks from the secondary side of transformer T_1 , will be somewhat as shown in Fig. 5. As the brushes 14 are gradually brought back onto the corrector segment, a condition such as shown in Figure 6 will be reached, in which the grid circuit of the corrector tube T_3 is completed through the corrector brush on the corrector segment at the same instant that the pulse is produced in the secondary circuit.

The auxiliary corrector tube T_4 is normally energized, maintaining the corrector magnet M energized, thereby holding the armature 8 attracted and keeping contacts 6 and 7 open. Condenser C_4 is normally charged from battery B through resistance R_7 . When a signal impulse causes the grid of tube T_3 to become positive at the same time that the brush completes a circuit through a live segment on the corrector ring, the corrector tube begins to operate, causing its plate element to drop in potential from 115 volts to 15 volts, and through the action of condenser C_4 , stopping the operation of the tube T_4 . The armature 8 is moved away from the magnet core by the action of spring 11, thereby moving the ratchet wheel 10 one tooth and applying the correction to the rotating brushes. When the armature 8 completes its released stroke, contacts 6 and 7 complete the circuit from the plate element T_4 to its grid element, applying a positive potential to the grid of tube T_4 , thereby starting operation of this tube, and through the action of the condenser C_4 , stopping the operation of tube T_3 . The corrector magnet remains energized until the next correcting operation takes place. In adapting this system for backward correction of the distributor brushes, the correction is applied on the energizing stroke of the corrector magnet.

In Fig. 9 I have shown a slight modification of the corrector circuit in which the contacts 6 and 7 are eliminated. The receiving circuit is the same as in Fig. 1, the changes being confined to the circuit connected with the secondary of transformer TR.

The operation will be evident from the previous description of Fig. 1. The auxiliary corrector tube T_4 is normally operating, but the magnet M' connected with the brush shifting device, is in the output of tube T_3 and hence is normally deenergized so that its armature 8' is in retracted position. Condenser C_4 is normally charged from battery B, through resistance R_7 . When a positive signal impulse is received at the same in-

stant that the corrector brush 14 engages a segment 12 of the segmented ring of the corrector distributor, thereby causing the grid of thyatron tube T_3 to become positive, this tube begins to operate, thus causing its plate element to drop in potential from 115 volts to 15 volts and as previously explained, through the action of the condenser C_4 , stops the operation of tube T_4 .

The brush corrector magnet M' is in the plate circuit of the tube T_3 and is therefore energized, the current flowing from the plus pole of battery B through conductor 16, resistance R_7 , magnet M' , anode and cathode of tube T_3 , back to the negative pole of B battery. As its armature 8' moves toward the magnet core, the pawl 9' pushes the ratchet 10 forward one notch, thereby shifting the brushes backwardly a small amount and bringing them into exact phase relation with the incoming signal impulses. In this modification I have utilized the changing flux in the magnet to bring about the starting of the tube T_4 and the stopping of the tube T_3 , in the following manner:

The current in the coil of the magnet first rises, then falls and again rises in the manner indicated in the graph shown in Fig. 7. At the point 7a, the current has risen sufficiently to cause the armature 8' to move toward the magnet. As the armature approaches the core, the flux increases rapidly and produces a counter electromotive force which induces an E. M. F. opposing the battery, thus causing the current in the coil to decrease to a value indicated at 7b, when the armature strikes the core. The current then again increases and reaches a value dependent upon the constants of the circuit. This change in the current value produces a corresponding change in the voltage drop across the resistance R_7 which is impressed through the action of the condenser C_5 upon the primary of the transformer TR_2 and causes a sharp voltage kick in the transformer secondary, as indicated in the graph shown in Fig. 8. These kicks produced in the secondary circuit rise very rapidly to their maximum value and return to zero with equal rapidity. They are negative when the current starts to flow through the magnet coil and positive when the current decreases due to the influence of the moving armature.

These voltage kicks in the secondary of the transformer TR_2 are applied to the grid circuit of the thyatron tube T_4 . The kick of positive polarity causes the tube T_4 to start, resulting in a drop of potential at the plate or anode from 115 volts to 15 volts, and through the action of the condenser C_4 stops the operation of the tube T_3 . The magnet M' is thus deenergized and its armature is pulled to its back stop by the spring 11'.

When the distributor brushes at the correcting station are driven slightly slower

than those at the sending or transmitting station the corrector is arranged to step the brushes forward at each correction. In that case the armature of the corrector magnet may be connected to the pawl and ratchet in the brush shifting device in the manner indicated in Fig. 10.

From the foregoing it will be seen that I have devised a corrector system in which two relays of the thyatron tube type are arranged to repeat the positive and negative impulses into the corrector circuit, and means is provided for deenergizing one relay upon the energization of the other. It will also be seen that I employ thyatron relays in the corrector circuit proper for controlling the corrector magnet to apply the correction to rotating brushes, thereby reducing to a minimum the number of circuit contacts required in the system, as in Fig. 1, or eliminating contacts entirely as in the arrangements disclosed in Figs. 9 and 10.

I claim:

1. In a telegraph signaling system, the combination of a telegraph line, a pair of impedance elements connected in series across the terminals of said line, a pair of thyatron relays having their grid elements connected respectively to the terminals of said line, and their cathodes connected together and to the midpoint of said impedance elements, a circuit connection between the plate elements of said relays including two impedance elements in series, a source of space current connected between the cathodes of said relays and the midpoint of said last mentioned impedance elements, a condenser connected between the plates of said relays, and an output circuit including a condenser and a transformer connected in series across the terminals of said condenser.

2. In a telegraph corrector circuit the combination of a pair of corrector rings, a thyatron relay having a grid circuit completed through said corrector rings and including means for supplying correcting impulses from a telegraph line, means connected in the plate circuit of said relay for applying a correction to the rotating brush of said corrector rings, and means actuated by said correction applying means for deenergizing said thyatron relay.

3. In a telegraph corrector system, the combination of a pair of corrector rings including a rotating brush, means for applying a correction to said brush, means tending normally to apply a correction, means including a normally energized thyatron relay for opposing said second means, a second thyatron relay having a grid circuit completed through the corrector rings and including means for supplying correcting signal impulses, and means connected in the output circuit of said second relay responsive to the energization of the plate circuit thereof to de-

energize the first relay upon the closing of the grid circuit of the second relay through said corrector rings simultaneously with the occurrence of a correcting impulse.

5 4. In a telegraph corrector system, the combination of a pair of corrector rings including a rotating brush, means for applying a correction to said brush, means tending normally to apply a correction, means including
10 a normally energized thyatron relay for opposing said second means, a second thyatron relay having a grid circuit completed through the corrector rings and including means for supplying correcting signal im-
15 pulses, means connected in the output circuit of said second relay responsive to the energization of the plate circuit thereof to de-energize the first relay upon the closing of the grid circuit of the second relay through
20 said corrector rings simultaneously with the occurrence of a correcting impulse, and means actuated by operation of said correction applying means to deenergize said second relay.

25 In testimony whereof I affix my signature.
ALBERT W. BREYFOGEL.

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