May 3, 1932. H. H. HAGLUND 1,856,331

CORRECTOR SYSTEM FOR SYNCHRONOUS TELEGRAPH APPARATUS

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Fig. 1.

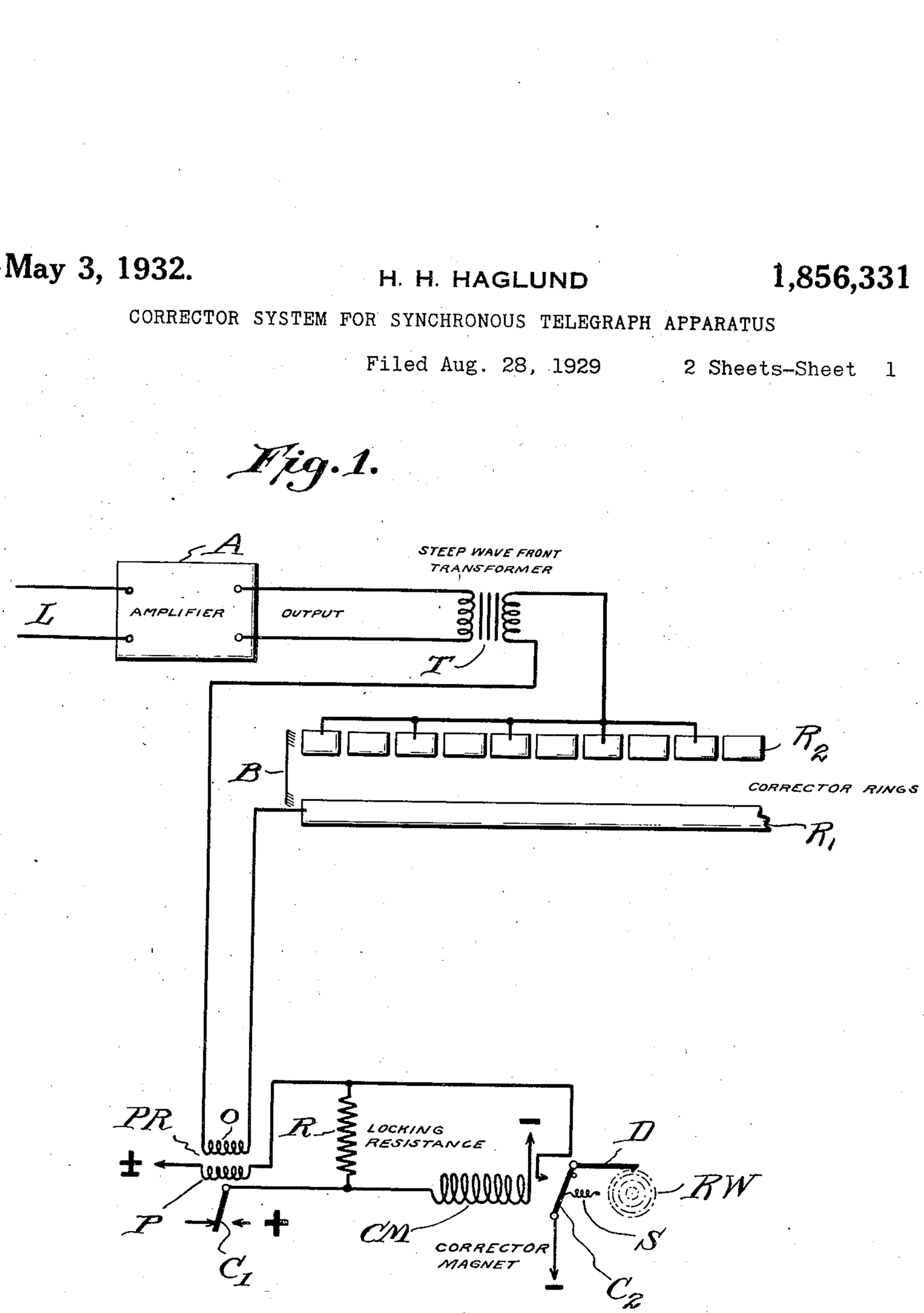

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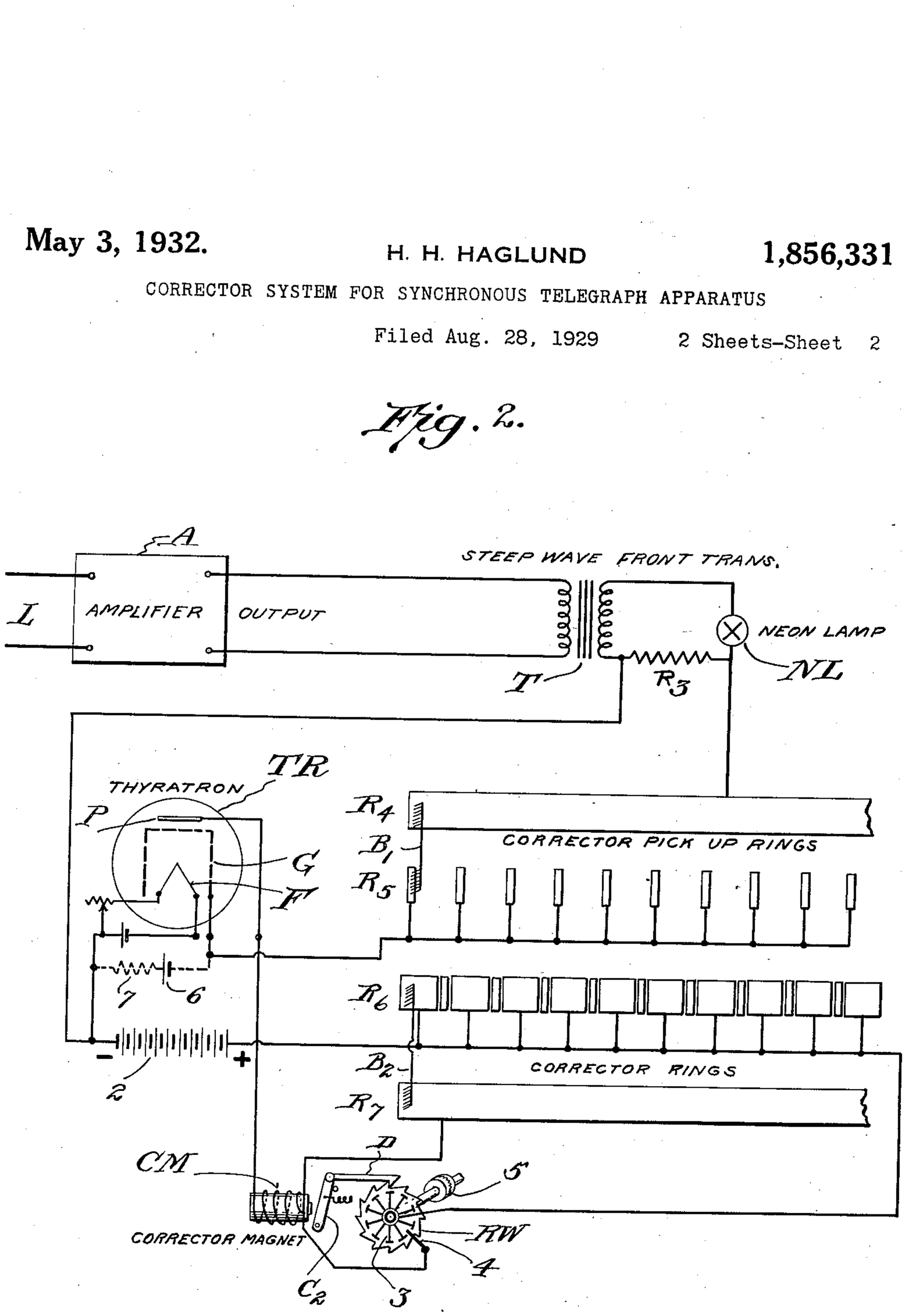
Fig. 2.



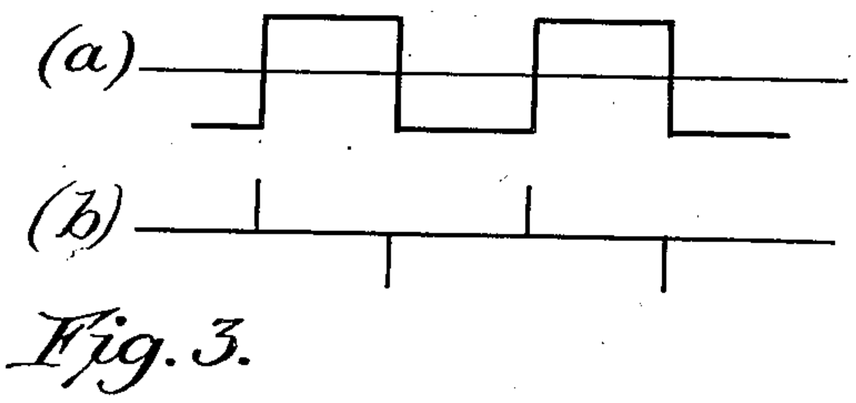


Fig. 3.

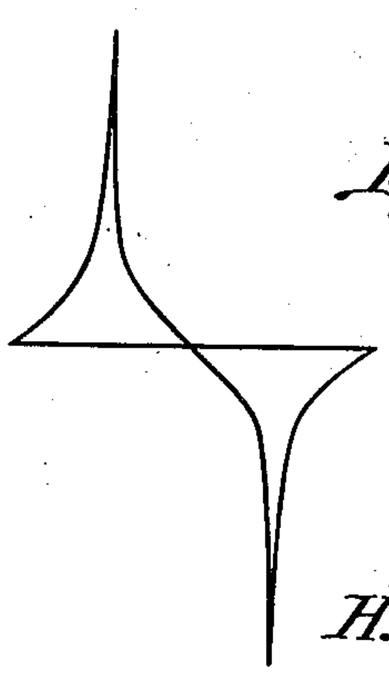


Fig. 4.

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Patented May 3, 1932 1,856,331

UNITED STATES PATENT OFFICE

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CORRECTOR SYSTEM FOR SYNCHRONOUS TELEGRAPH APPARATUS

Application filed August 28, 1929. Serial No. 389,032.

This invention relates to a system for maintaining synchronism between a rotary distributor at a receiving station and incoming signals on a telegraph line.

An object of the invention is to devise a corrector system employing a steep-wave front transformer or a transformer producing sharp voltage peaks in the secondary when telegraphic currents are supplied to the primary.

A further object of the invention is to devise a corrector system which will maintain synchronism with a high degree of accuracy.

A further object of the invention is to devise a corrector circuit in which the corrector relay operates at a speed lower than the line signals.

My invention is illustrated in the accompanying drawings in which:

Figure 1 shows one form of my invention employing an electromagnetic pick-up relay;

Figure 2 is another form of my invention employing a gaseous type of pick-up relay commonly known as a thyratron; and

Figures 3 and 4 are curves illustrating the operation of the transformer employed in my system.

Referring to Figure 1, L indicates a telegraph line supplying telegraphic signals to the input of amplifier A, the output circuit of which is connected to the primary of a special transformer T. One terminal of the secondary winding of transformer T is connected to the solid ring R_1 of the corrector rings through the operating winding (O) of pick-up relay PR. The other terminal of the secondary is connected to alternate segments of segmented ring R_2 of the corrector rings. B indicates the rotating brush associating the segmented and solid rings. The pick-up relay PR is provided with a locking winding P, one terminal of which is connected to neutral battery and the other terminal is connected to one terminal of the locking resistance R and to the contact on corrector magnet CM. The tongue C_1 of pick-up relay PR is connected to the remaining terminal of locking resistance R and to one terminal of the corrector magnet CM, the remaining terminal of the correcting magnet being connected to negative battery. The right-hand contact of pick-up relay PR is connected to positive battery. The tongue C_2 of corrector magnet CM is connected to negative battery, and also operates a pawl D which is associated with a ratchet wheel RW mounted upon the shaft of the rotary brush B. Armature C_2 of the corrector magnet is biased to the right hand position by a spring S.

The special transformer T is a steep-wave front transformer such as described in General Electric Review for March 28, 1928, pages 136 to 138. The special transformer has a magnetic circuit with a reduced cross section at one point to increase the rapidity with which the core becomes saturated. The saturation effect of the core produces voltage impulses like that shown in Fig. 4 for a positive and a negative signal impulse supplied to the primary. In Fig. 3 (*a*) is shown a rectangular flux wave of a series of positive and negative signal impulses, and Fig. 3 (*b*) shows the perpendicular voltage impulses produced by the flux waves shown in Fig. 3 (*a*). The curves shown in Fig. 3 are ideal and can only be approached in practice. The voltage impulses produced in the secondary circuit should have a well defined peak of short duration.

Operation of the arrangement shown in Fig. 1 is as follows: Assume that the current in the output circuit of amplifier A is changing from "spacing" to "marking", a flux will be set up in transformer T which will produce a voltage impulse in the secondary. If the distributor brushes B are in phase with the incoming signal, they will at this moment be upon a dead correcting segment, but since the secondary of the transformer is open, no correction will take place. If, however, the brushes are out of phase with the incoming signal, the secondary circuit would be closed by the brush between the solid ring R_1 and a live corrector segment. The current flowing in the secondary will operate the pick-up relay PR to its "marking" position thereby establishing two circuits; one from positive battery on the marking contact of the pick-up relay through locking resistance R, through locking winding P to neutral battery. This

will lock the pick-up relay with its tongue on its marking contact. The second circuit may be traced from positive battery on the marking contact through the tongue of the pick-up relay, and through the corrector-magnet winding to negative battery. This circuit operates the corrector magnet to establish another circuit from neutral battery through biasing coil P of the pick-up relay, through the contact of the corrector magnet, and through the corrector magnet armature to negative battery. Since the current established by the circuit just traced flows in a direction opposite to that previously established in the locking coil P, this current will reverse the pick-up relay and restore the tongue to its spacing contact ready for operation again in response to the incoming signals. The closing of the corrector magnet contacts also permits a current to flow from positive battery through the tongue pick-up relay, through locking resistance R through the tongue on the corrector magnet to negative battery. This current is only incidental and has no harmful effect upon the operation of the circuit, provided the resistances of the various circuits are properly proportioned. When the correcting magnet operates, pawl D engages ratchet wheel RW and steps it back one tooth to place the brushes B in proper phase with the incoming signals, as is well understood.

When the signal current reverses from "marking" to "spacing", the voltage produced in the secondary of the transformer would tend to throw the pick-up relay to its spacing contact. The locking circuit, however, prevents this happening while a correction is taking place, and when the correction is completed, the pick-up relay is returned to its spacing contact automatically so that the tendency to throw the relay to its spacing contact has no effect. Accordingly, correction takes place only on changes from spacing to marking signals, but by reversing one of the transformer windings it can, of course, be made to correct on changes from marking to spacing.

In Figure 2 I have replaced the magnetic pick-up relay by a gaseous relay commonly known as a thyratron, which comprises a gas-filled thermionic tube of such construction that when the anode is connected to positive battery and a certain potential is applied to the grid, the tube will "start" and current will flow from the anode to the cathode. As soon as the plate current begins to flow the grid is instantly surrounded by a sheath of positive ions and has no further effect. This sheath, usually only a fraction of a millimeter thick, contains the whole voltage drop between the grid and the space surrounding it. Changing the grid voltage merely changes the thickness of the sheath and has no effect on the potential of the rest of the space. Hence the grid is powerless to stop the plate current, once it is started. It can only be stopped by removing the plate voltage.

The function of the grid may therefore be likened to a trigger. The amount of power required to start the tube is exceedingly small. A thermionic tube having the characteristics described is disclosed in patent to Irving Langmuir No. 1,289,823. The name Thyratron 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.

The secondary circuit of transformer T includes a resistance R_3 and a neon lamp NL connected in series. One terminal of resistance R_3 is connected to the cathode of the thyratron relay TR and the other terminal is connected to the solid ring R_4 of the corrector pick-up rings. The segmented ring R^5 of the corrector pick-up rings is connected to the grid element G of the thyratron tube. The rotating brush B_1 is associated with the solid and segmented rings of the corrector pick-up rings. The plate circuit of the thyratron tube includes a battery 2, segmented ring R_6, rotating brush B_2, solid ring R_7 and the correcting magnet CM. The plate circuit may also be completed through battery 2 and corrector magnet CM by way of a commutator 3 and brush 4 associated with ratchet wheel RW. Ratchet wheel RW has a clutch connection 5 with the shaft carrying rotating brushes B_1 and B_2, the same as in Fig. 1.

Operation of the arrangement shown in Figure 2 is as follows: If the rotary distributors at the transmitting and receiving stations are running in proper phase relation, the corrector brush B_1 will be out of contact with the segments on ring R_5 when a signal impulse is received over the line, and the thyratron relay TR will not be operated. If the distributors are not in proper phase relation when a signal impulse is received, contact will be established between a segment on ring R_4 and ring R_5 by brush B_1, thereby impressing upon th grid G the potential drop across resistance R_3, which will start plate current flowing in the plate circuit and energize the corrector magnet CM. Upon operation of the corrector magnet, pawl D engages the tooth on ratchet wheel RW, and as soon as the ratchet wheel begins to move, contact is established through commutator 3 and brush 4 so that current from battery 2 continues to flow through corrector magnet CM to thyratron TR regardless of the position of brush B_2, thereby insuring the completion of the stroke of the corrector. The current through corrector magnet MC is automatically out off at commutator 3 upon the completion of the stroke of armature C_2, and the armature,

with pawl D, is returned to its original position ready for operation again by incoming signals.

Due to the peculiar conduction characteristic of the neon lamp NL in the secondary circuit of transformer T, the action of the lamp may be likened unto that of a switch element for abruptly opening and closing the circuit, thereby accentuating the peak of the secondary current.

It may be found desirable to connect a battery 6 and a resistance 7 between the cathode and the grid of the tube to maintain the grid sufficiently negative to prevent its starting except when a pulse is received through the pick-up segments.

It will also be obvious that the conductor rings in the arrangement shown in Fig. 2 may be dispensed with in the same manner as disclosed in Fig. 6 of my co-pending application, Serial No. 343,109, filed February 27, 1929.

I claim:

1. A corrector system comprising the combination of a telegraph line, a rotary distributor, corrector means associated with said distributor, a pick up relay for controlling said corrector means, and a saturated transformer connecting said pick-up relay and said distributor to said line.

2. A corrector system comprising the combination of a telegraph line, a rotary distributor, a pick-up relay, and a saturated transformer, said transformer being connected to said line and having said rotary distributor and said pick-up relay connected in series in the secondary circuit thereof, and a corrector mechanism controlled by said pick-up relay.

3. In a corrector system, the combination of a pick-up relay having an operating winding and a biasing winding, a correcting device including a corrector magnet, a circuit controlled by said pick-up relay for energizing said corrector magnet, and a second circuit controlled by said pick-up relay including said biasing coil for biasing said relay to its operated position.

4. In a corrector system, the combination of a pick-up relay having an operating winding and a biasing winding, a correcting device including a corrector magnet, a circuit controlled by said pick-up relay for energizing said corrector magnet, a second circuit controlled by said pick-up relay including said biasing coil for biasing said relay to its operated position, and circuit connections controlled by operation of said corrector means for deenergizing said biasing coil upon completion of the corrector operation.

5. A corrector system comprising the combination of a telegraph line, a rotary distributor, corrector means associated with said distributor, a pick-up relay for controlling said corrector means, a saturated transformer for associating said pick-up relay and said distributor with said line for initiating operation of said corrector means when said distributor is out of synchronism with signals transmitted over said line, and means for maintaining said corrector means energized until the correcting operation is completed.

6. A corrector system comprising the combination of a telegraph line, a rotary distributor, a pick-up relay comprising a thyratron tube, corrector means operated by said pick-up relay, and a saturated transformer for connecting said rotary distributor to said line through the input circuit of said pick-up relay.

7. A corrector system comprising the combination of a telegraph line, a saturated transformer connected to said line, a pick-up relay comprising a thyratron tube, a rotary distributor including two sets of solid and segmented rings with cooperating brushes, the secondary of said transformer being connected to the input of said thyratron tube through one set of said rings, corrector means associated with said distributor including a corrector magnet, said magnet being included in the plate circuit of said thyratron tube in series with the other set of rings, and means embodied in said corrector means for maintaining said corrector magnet energized until the corrector operation is completed.

8. A corrector system comprising the combination of a telegraph line, a rotary distributor, corrector means associated with said distributor, a pick-up relay for controlling said corrector means, a saturated transformer connected to said line, a resistance and a neon lamp connected in series in the secondary circuit of said transformer, and circuit connections for controlling said pick-up relay by the drop in potential across said resistance.

In testimony whereof I affix my signature.

HAKON H. HAGLUND.

DISCLAIMER

1,856,331.—*Hakon H. Haglund*, Flushing, N. Y. CORRECTOR SYSTEM FOR SYNCHRONOUS TELEGRAPH APPARATUS. Patent dated May 3, 1932. Disclaimer filed November 2, 1933, by the patentee, assignee, *The Western Union Telegraph Company*, assenting.

Hereby enters a disclaimer to that part of the subject-matter of his said Patent No. 1,856,331, defined in claims 1, 2, and 5 thereof.

[*Official Gazette December 5, 1933.*]