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MECHANICAL PHASE CORRECTOR FOR MULTIPLEX TELEGRAPH DISTRIBUTERS.

APPLICATION FILED DEC. 4, 1916.

1,253,889.

Patented Jan. 15, 1918.

2 SHEETS—SHEET 1.

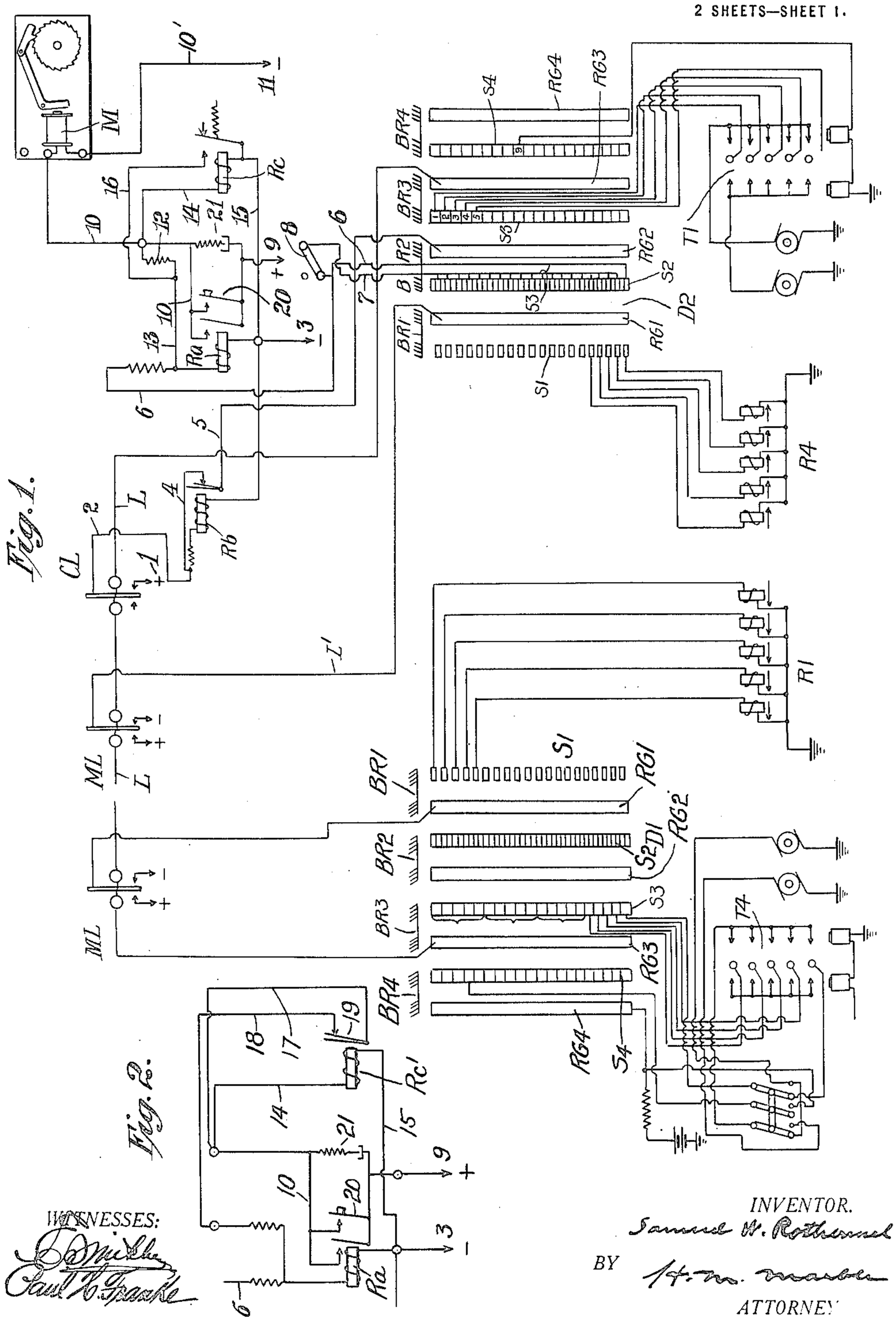

Fig. 1.

Fig. 2.

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2 SHEETS—SHEET 2.

Fig. 4.

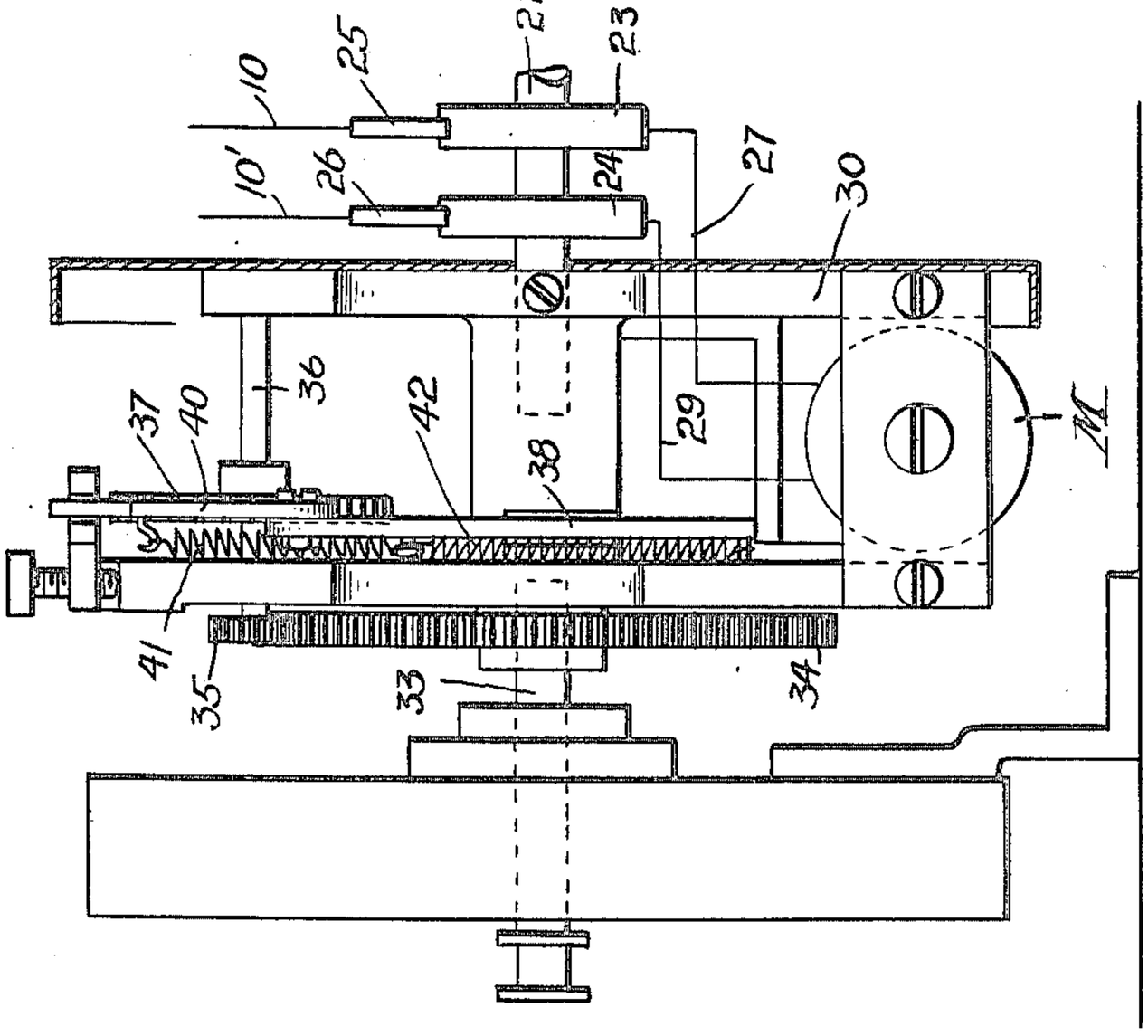
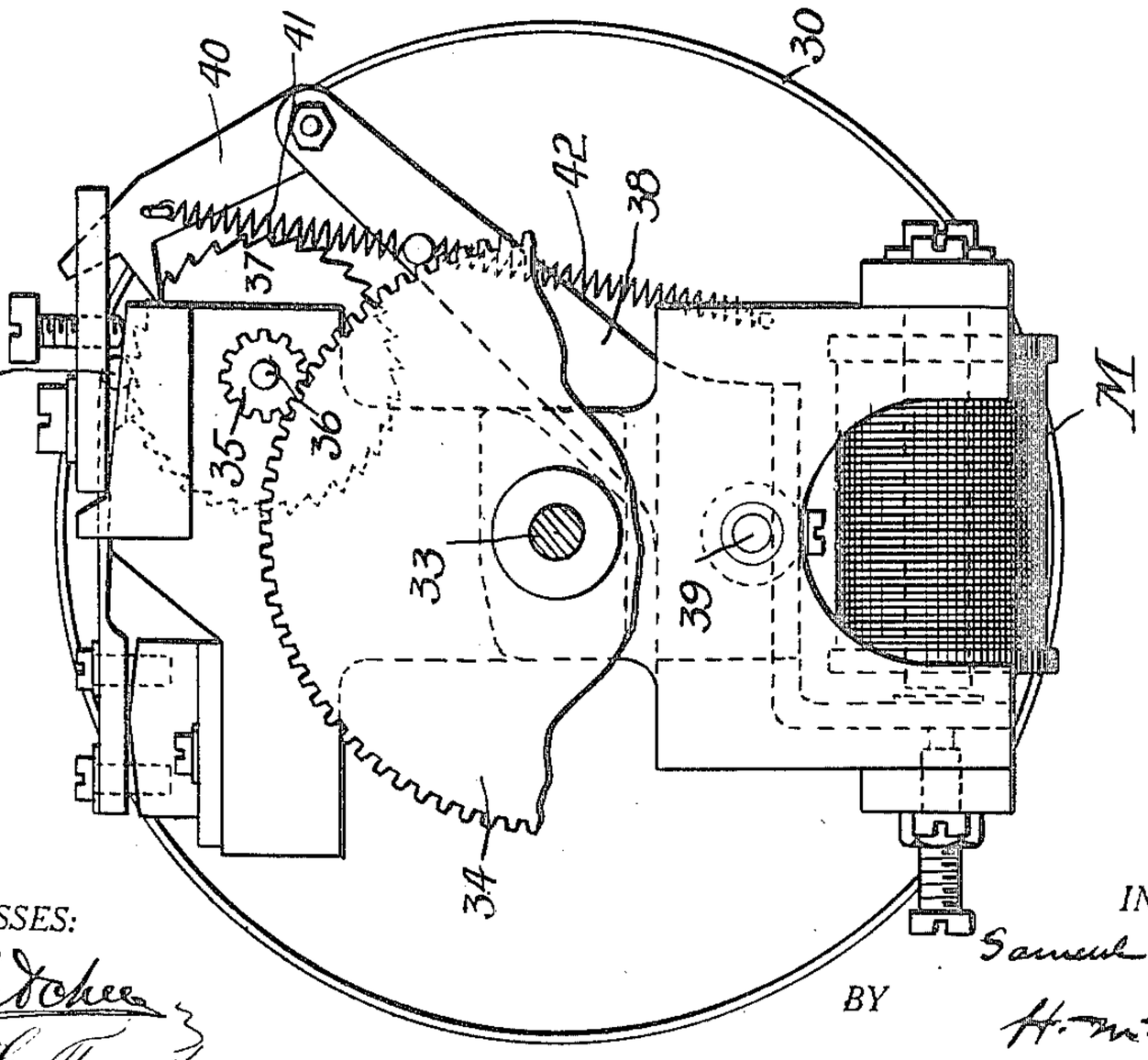


Fig. 3.



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MECHANICAL PHASE-CORRECTOR FOR MULTIPLEX-TELEGRAPH DISTRIBUTERS.

1,253,889. Specification of Letters Patent. Patented Jan. 15, 1918.

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To all whom it may concern:

Be it known that I, SAMUEL W. ROTHERMEL, a citizen of the United States of America, and a resident of the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Mechanical Phase-Correctors for Multiplex-Telegraph Distributers, of which the following is a specification.

My invention relates to improvements in mechanical phase correctors for multiplex telegraph distributers and comprises means whereby the mechanism of such distributers is much simplified, whereby various contacts and other parts heretofore employed are eliminated, and whereby necessity for frequent readjustment is avoided; and the operation of the corrector is made more positive and reliable.

The corrector herein illustrated and described is particularly intended for use in connection with Baudot multiplex apparatus, and its modifications and adaptations; but the invention is by no means restricted to such systems, but is of general applicability where continuously operating synchronous commutators or distributers are employed in a line circuit. Since, however, it seems necessary to illustrate the invention in connection with one such synchronous system only, and since the Baudot system is a convenient system in connection with which to illustrate the invention, I have illustrated Baudot apparatus (or more properly a modification thereof) in the accompanying drawings. I have illustrated the system in connection with the method of and means for phase correction illustrated in the application of G. M. Yorke and G. R. Benjamin Serial No. 654, field January 5, 1915, and the application of Donald Murray, Serial No. 6,535 filed February 6, 1915.

The object of my invention is to reduce the complication of mechanical correctors heretofore employed in synchronous telegraph systems such as mentioned, to avoid the necessity for frequent adjustment of the different parts, to facilitate such adjustment as may be necessary, and to make such correcting devices more positive and reliable in their action.

I will now proceed to describe my invention with reference to the accompanying drawings, and will then point out the novel features in claims. In said drawings:

Figure 1 shows diagrammatically transmitting and receiving apparatus of the general Baudot type, but modified as described in the said Yorke-Benjamin application, with my improved correction arrangement illustrated as a part thereof.

Fig. 2 is a fragmentary diagram illustrating an arrangement of circuits and relays alternative to that shown in Fig. 1.

Fig. 3 shows a front elevation of a portion of the distributer and in particular shows in elevation the correction mechanism of the distributer as simplified in accordance with my invention.

Fig. 4 shows a side elevation and partial section of the distributer, the driving motor of that distributer and the brush arms and brushes being omitted.

Referring first to Fig. 1: D^1 and D^2 designate rotary distributers or commutators of the general Baudot type, located at opposite ends of a line wire L. Such distributers comprise a plurality of commutator rings (eight each, in the construction shown) alternate rings being plain, and alternate rings segmented, and suitable brushes being provided for connecting each plain ring electrically with its corresponding segmented ring. Corresponding rings of the two distributers shown are designated by the same reference characters, viz., S^1, RG^1, S^2, RG^2, S^3, RG^3, and S^4, RG^4; and the brushes are designated by characters BR^1, BR^2, BR^3 and BR^4. According to the Baudot system of transmission, each character consists of five current impulses, some or all of which may be positive, and some or all of which may be negative; the various impulse combinations required to differentiate each character from the others being obtained by permutations of the positive and negative impulses. The distributers shown in Fig. 1 are adapted each for four "channels of communication"; but for simplicity I have shown transmitting and receiving means for one "channel of communication" only in each direction. The distributer rings are shown "developed," and I have shown no means for driving the brushes, the mounting of the brushes with reference to the various distributer rings and the meth-

ods of rotating such brushes, being well known.

T^1 and T^4 designate automatic transmitters, one at each end of the line and each adapted to transmit, through its corresponding distributer, to receiving apparatus R^1 or R^4, at the opposite end of the line, and through the distributer at that end of the line. Since such transmitting and receiving apparatus are well known, detailed description thereof is not necessary here.

In practice, in these distributers, the brushes of each distributer are mounted upon a rotatable shaft, driven by a motor of very constant speed, the brush shaft of one distributer being usually driven at a normal speed very slightly greater or very slightly less, as preferred, than the brush shaft of the other distributer; and the function of the mechanical corrector is to step back or to step forward, as the case may be, the brushes of the one distributer with reference to the brush shaft of that distributer, in order to restore proper phase relation between the two distributers when such restoration is necessary. The distributer provided with such correction mechanism is termed the "corrected distributer," while the other distributer, which commonly has no correction mechanism, is termed the "correcting distributer." In Fig. 1, D^1 is the "correcting distributer" and D^2 is the "corrected distributer"; correcting mechanism being shown only in connection with distributer D^2.

Commonly, a line relay is interposed between each distributer and the line, and commonly the "corrected distributer" is provided with a "correcting relay" in the main line, by which correcting relay the correction mechanism of that distributer is directly controlled. In Fig. 1, ML designates the two main line relays, and CL the correcting relay employed in connection with distributer D^2.

According to the Yorke-Benjamin correction method, each current reversal affecting the correcting relay CL affords an opportunity for correction; but the correction mechanism operates only when, at the time of one or more of such reversals, one distributer is sufficiently out of phase with respect to the other distributer, to require correction.

In considering the operation of my improved corrector, we will consider that telegraphic characters are being transmitted from distributer D^1 to distributer D^2. It will be noted that contacts of transmitter T^4 are connected by suitable conductors to five segments of ring S^3 of distributer D^1, and that, supposing various contact combinations to be set up in transmitter T^4, when brush BR^3 passes over the segments of ring S^3 to which said contacts of transmitter T^4 are connected, corresponding current impulses will pass through the left hand main line relay ML through line wire L and then through the right hand main line relay ML, and relay CL, to ground or other return. Signals from distributer D^1, repeated by the right hand relay ML, pass through local line wire L′ into ring RG^1 of distributer D^2 and thence, through brush BR^1 of that distributer, into ring S^1, and so into signal receiving device R^4. It is not thought necessary to describe in detail this signal receiving device; or the method of its operation.

Ring S^2 consists of alternate conductive and insulating segments, all but one of the conductive segments being connected together.

The armature of relay CL vibrates, as implied above, in unison with the vibration of the armature of the right hand relay ML. Supposing the armature of relay CL to move to the right, a circuit is completed from source of current supply 1 and the right stop of that relay, the armature of the relay, and conductor 2 and the coils of a relay R^b (commonly termed the "break relay") to return at 3. There is another circuit path from conductor 2 through conductor 4, the armature of relay R^b (when that armature is in retracted position) and conductor 5 to ring RG^2 of distributer D^2, and thence through brush BR^2 to ring S^2 of that distributer and thence through conductor 6 direct, or through conductor 7 (connecting all but one of the conductive segments of S^2) and switch 8 if closed (as it is normally) to conductor 6, and the coils of a relay R^a, to return. If distributers D^1 and D^2 are in proper phase relation, brush BR^2, will be over one of the insulated divisions between the conductive segments of ring S^2 at the instant of each completion of circuit through conductor 2 and through the coils of relay R^b; and before brush BR^2 can have passed on to one of the conductive segments of ring S^2 relay R^b will have attracted its armature, so breaking the circuit path to ring RG^2. But if, at the instant of completion of circuit by the relay CL through the coils of relay R^b, brush BR^2 is in contact with one of the conductive segments of ring S^2 of distributer D^2 (which may occur if the two distributers are not in exact proper phase relation) a circuit will be completed through conductor 4, the armature of relay R^b, conductor 5, ring RG^2, brush BR^2, ring S^2 and conductor 6, and the magnet coils of "make relay" R^a, to return at 3. The armature of relay R^a being thereby brought into contact with the front stop of that relay, circuit is completed from source of current supply 9, and the armature and front contact stop of relay R^a and conductor 10 to the magnet M of the corrector mecha-

nism and thence through conductor 10′ to return at 11. The closing of the said contacts of relay R^a locks the armature of that relay in attracted position by current flowing from 9 through conductor 10, resistance 12 and conductor 13 and the coils of relay R^a to return at 3; and thereby not only is the armature of relay R^a locked up, but also a steady flow of current through the magnet M is assured.

The closing of the contacts of relay R^a also closes circuit through the magnet coil of a further relay R^c as follows: From conductor 10 through conductor 14, the magnet coils of relay R^c and conductor 15 to return at 3. This relay R^c, thus energized, closes a shunt circuit from conductor 6 through conductors 13 and 16, the contacts of the relay, and conductor 15, to return at 3; that is to say, closes a shunt circuit around the magnet of relay R^a; and this shunt circuit, when closed, causes the armature of relay R^a to drop back, so deënergizing the corrector magnet M. But in the meantime magnet M has operated the ratchet mechanism of the corrector as hereinafter described.

Relay R^a is a very rapidly operating relay, and the magnet M is also a rapidly operating magnet. Relays R^b and R^c are more slow in operation. By properly timing the operation of relays R^b and R^c therefore, relay R^a may be energized, in case distributer D^2 is materially out of phase with respect to distributer D^1, for a time sufficient to cause the operation of the ratchet magnet M; and this relay R^a may be "locked up," with its contacts closed, for a time sufficient to insure a complete operation of such ratchet mechanism by magnet M, and then, by the operation of relay R^c, the magnet of relay R^a may be shunted and therefore deenergized. By that time the magnet of relay R^c will have been deënergized by the breaking of its energizing circuit by R^a. Also, by that time the armature of magnet M will have completed its operation. If further correction is required, upon the next reversal in the line L a similar series of operations will occur.

Fig. 2 shows an alternative arrangement wherein the third relay, here designated by character $R^{c'}$, controls, through its armature and back contact stop, the locking circuit of relay R^a, relay $R^{c'}$ being, as is the case with respect to relay R^c of Fig. 1, a relatively slow acting relay. The circuits and apparatus whereby relay R^a is initially energized, in case correction is required, are the same as in Fig. 1, and hence require no further description. Upon the energization of the magnet of relay R^a, an energizing circuit for relay $R^{c'}$ is established from source 9 through the armature and front contact of relay R^a, and conductors 10 and 14, through the windings of relay $R^{c'}$, and conductor 15 to return at 3, as in Fig. 1; and at the same time a locking circuit for relay R^a is established from source 9 through the armature and front contact stop of relay R^a, conductor 10, a conductor 17 the armature and back contact stop of relay $R^{c'}$ and the conductor 18 to conductor 6, and thence through the magnet coils of relay R^a to ground at 3. It is convenient in this arrangement to provide the armature or relay $R^{c'}$ with a spring contact member 19, which will somewhat delay the breaking of contact upon the attraction of such armature; or other convenient well known means may be employed for delaying for a time the breaking of contact of such armature with its rear contact stop, during forward movement of the armature. By means of the spring 19 or whatever other breakage-delaying means may be employed, the breaking of the locking circuit of relay R^a is delayed for a time sufficient to insure the operation of the ratchet mechanism operated by magnet M; after which, the locking circuit of relay R^a being broken at the rear contact of relay $R^{c'}$, both relays R^a and $R^{c'}$ are deënergized.

In Figs. 1 and 2 I have shown various resistances, which are to be understood, in general, as being adjustable, and which are mere regulating resistances. The switch 8 previously mentioned is a switch which is opened when starting up the distributers, in order to bring them into synchronism; and as the general method of synchronizing pertains to the said Yorke-Benjamin application its not thought necessary to describe the use of said switch here. The switch 20 is provided for hand operation of the correction mechanism of the distributer in case for any reason that be necessary. The shunted condenser 21 is provided to prevent sparking to the contact points of relay R^a and switch 20.

Referring now to Figs. 3 and 4 showing the mechanical details of the ratchet correcting mechanism forming a part of the corrected distributer. 22 designates a shaft driven by the driving motor of the distributer (such motor not shown) and 23 and 24 designate collecting rings mounted on said shaft, and 25 and 26 corresponding brushes; conductor 10 (Fig. 1) being connected to one of these brushes and the conductor 10′ to the other of these brushes. Ring 23 is connected by a conductor 27 to one terminal of the coil of magnet M, and ring 24 is connected by a conductor 29 to the other terminal of the coil of magnet M. This magnet M is mounted on a suitable frame 30 carried by and rotating with shaft 22. The distributer brush shaft 33 is separate from shaft 22, and is provided with a gear 34 with which intermeshes a pinion 35 mounted

upon a shaft 36 having bearings in the frame 30. A ratchet wheel 37 is also mounted upon shaft 36. The armature lever 38 for magnet M is pivoted in the said frame 30 at 39, and carries a pawl 40 engaging ratchet wheel 37. Said pawl is provided with a spring 41; and armature lever 38 is provided with a retractile spring 42. A spring jockey 43 bears upon ratchet wheel 37 and serves to prevent reverse rotation of said ratchet wheel when pawl 40 is drawn back for engagement with another tooth of the ratchet wheel. It will be seen that, with ratchet wheel 37 held stationary shaft 33 is driven from shaft 22, through pinion 35 and gear 34; but that while shafts 22 and 33 are in rotation, if magnet M be energized, pawl 40 will force ratchet 37 forward through the space of one tooth, which in the particular arrangement shown, has the effect of stepping back shaft 33 (and therefore the brushes normally carried by that shaft) with respect to shaft 22. The adjustment of the shaft 33 and the brushes carried thereby is therefore similar to the adjustment of the hands of a clock, which may be effected by turning those hands while the clock mechanism is in operation, and for that reason, this method of regulating the position of the brushes of the distributer to bring the corrected distributer into proper phase relation with respect to the "correcting distributer" is commonly termed "clock hand regulation."

Heretofore the contacts controlling the locking circuit of relay R^a have commonly been mounted upon the rotating frame 30 of the distributer correction mechanism and have been operated by an arm mounted upon such frame 30 and by a linkage operated by the armature lever 38; which construction has, in practice, been found to possess numerous operative disadvantages; for example, when the locking contacts for relays R^a are on the rotating corrector mechanism, these contacts some times fail to close, or open the locking circuit too soon. Moreover, the mechanism operating these contacts could not be adjusted while the distributer was in operation; and in general, it is of course desirable to reduce to the lowest possible point parts which are on the rotating parts of the distributer. It will be apparent that by removing the locking circuit contacts from the distributer mechanism proper, together with the means for operating and adjusting those contacts, and substituting therefor a simple relay physically removed from the adjuster mechanism proper, a very great actual simplification is obtained; and furthermore, it now becomes possible to make all ordinary adjustments while the distributer is in operation.

What I claim is:—

1. The combination with a telegraph distributer having clock hand correction mechanism including an operating magnet, and armature therefor, of means for operating said armature through its magnet comprising a relay having a locking circuit which is closed when said relay operates to cause the operation of such armature, and a further slower acting relay likewise energized when said first mentioned relay is energized, such further relay arranged when so energized to cause deënergization of the first mentioned relay.

2. The combination with a telegraph distributer having clock hand correction mechanism including an operating magnet, and armature therefor, of means for operating said armature through its magnet comprising a relay having a locking circuit which is closed when said relay operates to cause the operation of such armature, and a further slower acting relay likewise energized when said first mentioned relay is energized, such further relay arranged when so energized to close a shunt circuit around the magnet of such first mentioned relay, thereby deënergizing such first mentioned relay.

3. The combination with a telegraph distributer having correction mechanism, including an operating magnet, and armature therefor, and having also a segmented correcting ring, of means for operating said armature through its magnet comprising a correcting relay, a make relay and a break relay, the latter relatively slow acting, a circuit through contacts of the correcting relay and through the magnet coils of the break relay, a branch from such circuit through contacts of the break relay, and the segmented correcting ring of the distributer and the magnet coils of the make relay, a locking circuit for the make relay passing through the contacts thereof, and through the magnet coils thereof, an operating circuit for the magnet of the correction mechanism likewise passing through the contacts of said make relay, a third relay and an energizing circuit therefor passing through the contacts of the make relay, said third relay being relatively slow acting and arranged when energized to cause deënergization of the make relay.

4. The combination with a telegraph distributer having correction mechanism, including an operating magnet, and armature therefor, and having also a segmented correcting ring, of means for operating said armature through its magnet comprising a correcting relay, a make relay and a break relay, the latter relatively slow acting, a circuit through contacts of the correcting relay and through the magnet coils of the break relay, a branch from such circuit through contacts of the break relay, and the segmented correcting ring of the distributer

and the magnet coils of the make relay, a locking circuit for the make relay passing through the contacts thereof, and through the magnet coils thereof, an operating circuit for the magnet of the correction mechanism likewise passing through the contacts of said make relay, a third relay and an energizing circuit therefor passing through the contacts of the make relay, said third relay being relatively slow acting, and arranged when energized to close a shunt circuit around the magnet of the make relay.

5. The combination with a telegraph distributer having correction mechanism including an operating magnet, and armature therefor, of means for operating said armature through its magnet comprising a relay having a locking circuit which is closed when said relay operates to cause the operation of such armature, and a further slower acting relay likewise energized when said first mentioned relay is energized, such further relay arranged when so energized to cause deënergization of the first mentioned relay.

6. The combination with a telegraph distributer having correction mechanism including an operating magnet, and armature therefor, of means for operating said armature through its magnet comprising a relay having a locking circuit which is closed when said relay operates to cause the operation of such armature, and a further slower acting relay likewise energized when said first mentioned relay is energized, such further relay arranged when so energized to close a shunt circuit around the magnet of such first mentioned relay, thereby deënergizing such first mentioned relay.

7. The combination with a telegraph distributer having rotatably mounted correction mechanism including an operating magnet, and armature therefor, of means for operating said armature through its magnet comprising a relay having a locking circuit which is closed when said relay operates to cause the operation of such armature, and means completely separated from the rotating portion of said distributer, and having a stationary mounting and arranged to break the said locking circuit at the end of a predetermined interval, following the closing of that locking circuit.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

SAMUEL W. ROTHERMEL.

Witnesses:

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