

G. R. BENJAMIN.
AUTOMATIC TELEGRAPH SYSTEM.
APPLICATION FILED DEC. 11, 1916.

1,370,402.

Patented Mar. 1, 1921.

2 SHEETS—SHEET 1.

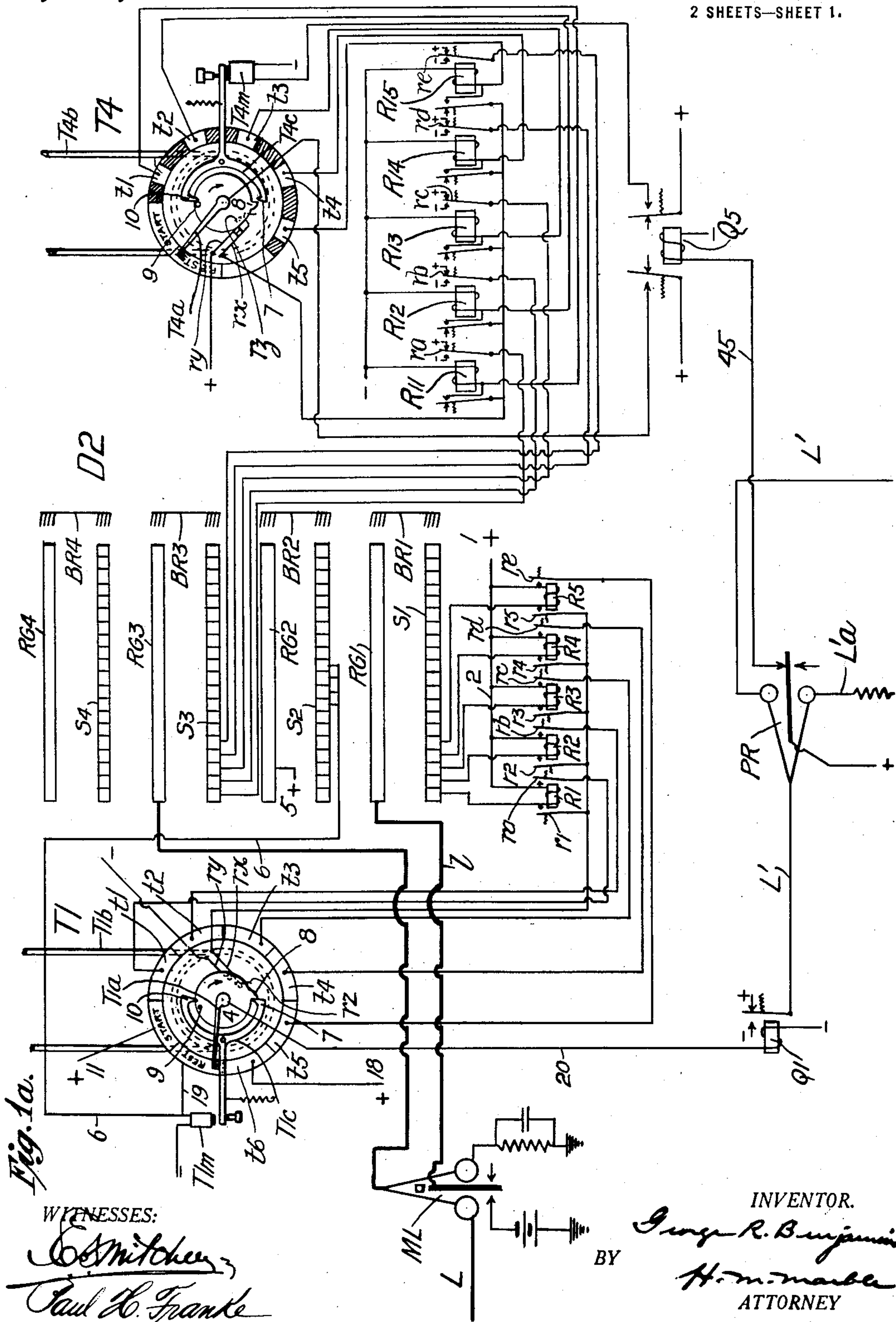


Fig. 1a.

WITNESSES:

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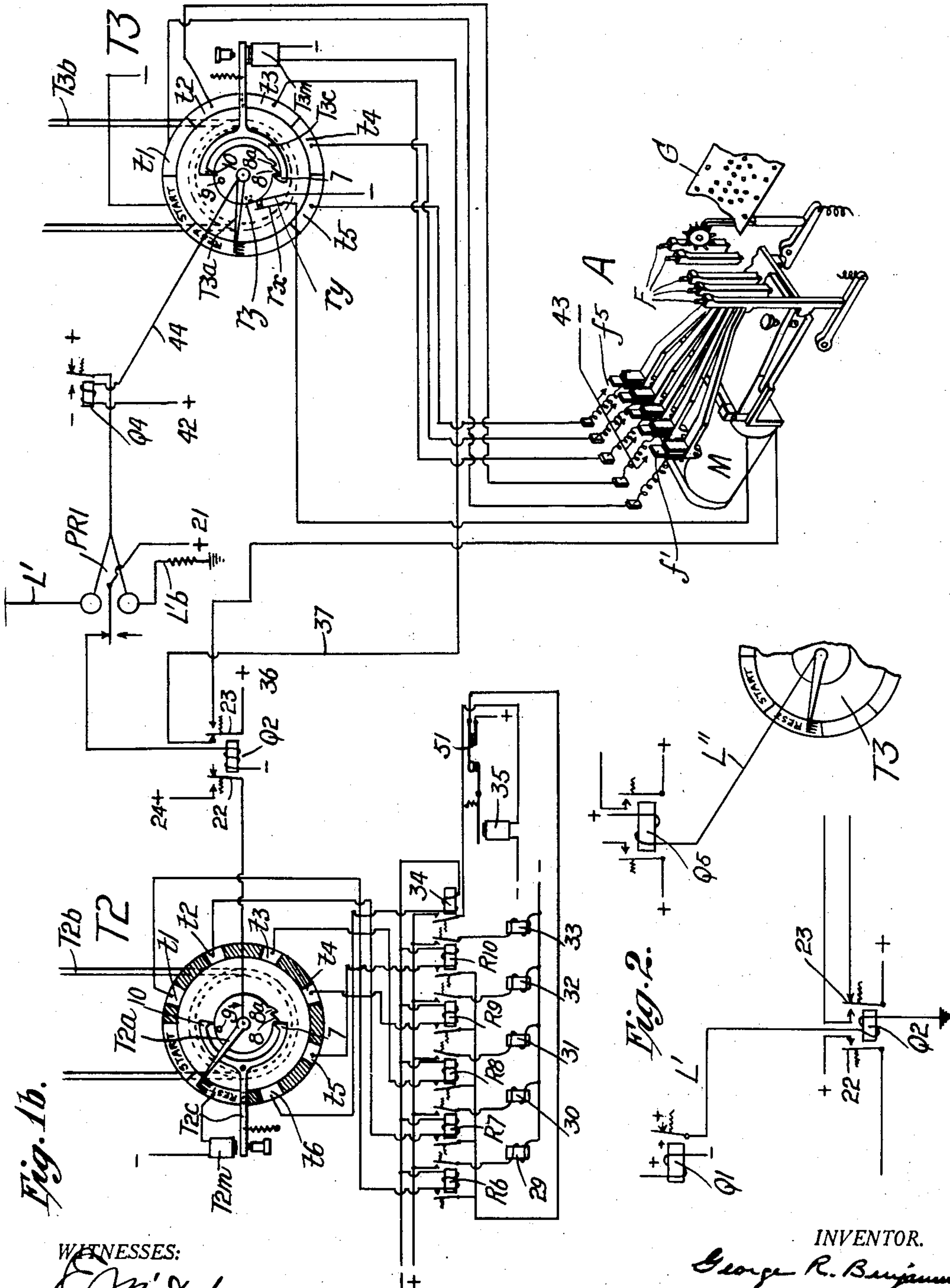
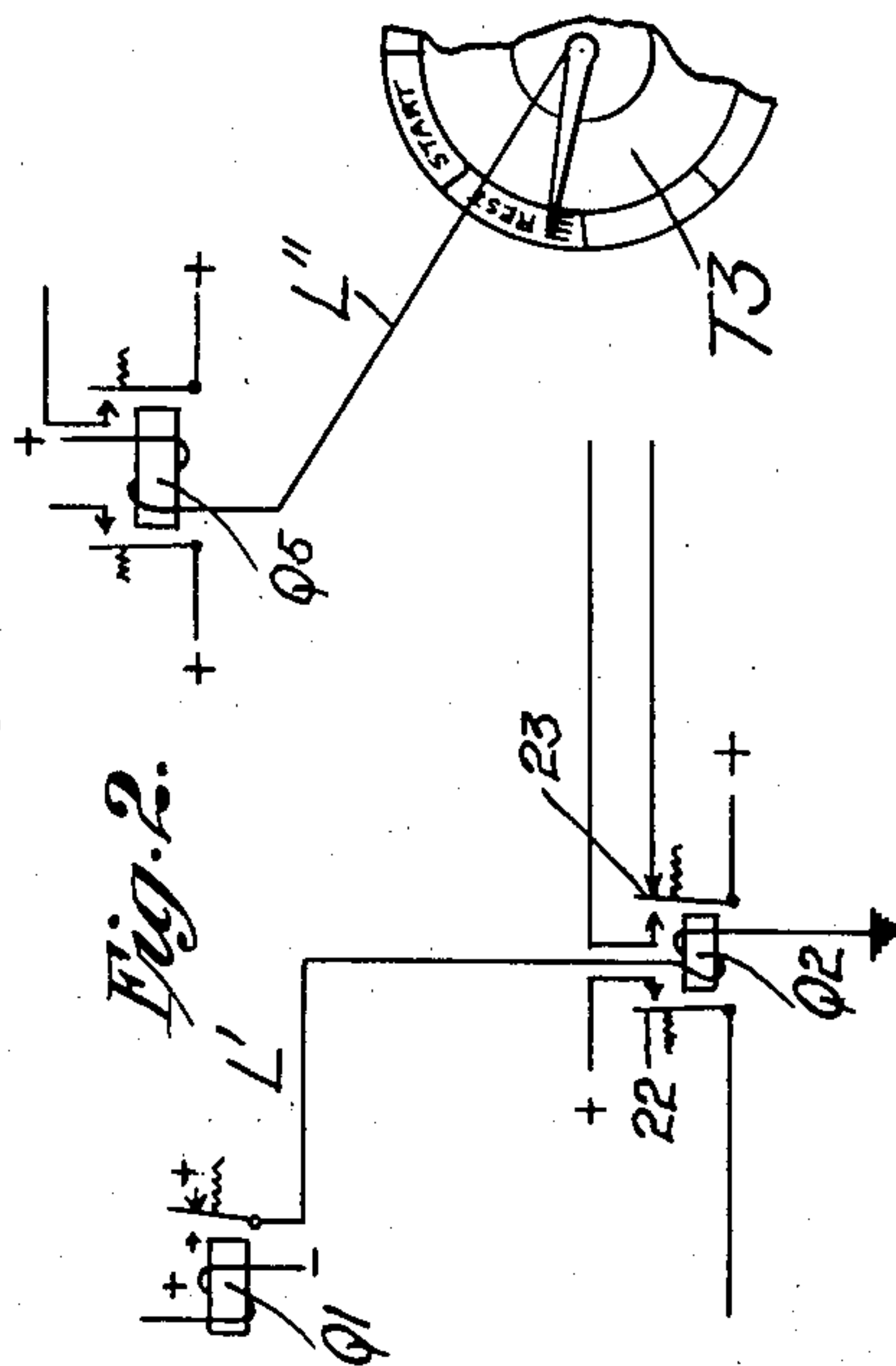


Fig. 1b.

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Fig. 2.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEGRAPH SYSTEM.

1,370,402.

Specification of Letters Patent.

Patented Mar. 1, 1921.

Application filed December 11, 1916. Serial No. 136,146.

To all whom it may concern:

Be it known that I, GEORGE R. BENJAMIN, a citizen of the United States of America, and a resident of Jersey City, county of Hudson, and State of New Jersey, have invented certain new and useful Improvements in Automatic Telegraph Systems, of which the following is a specification.

My invention relates to improvements in automatic telegraph systems, and comprises means whereby receiving apparatus may be operated in an extension loop from one terminal of an automatic telegraph system, and whereby transmitting apparatus may operate through an extension loop into one terminal of an automatic telegraph apparatus. My invention also comprises various other features as hereinafter pointed out.

Synchronous telegraph systems, wherein transmitting and receiving distributors or commutators at two ends of a line, operate in synchronism, are well known; certain of which systems, for example, the well known Baudot system, and its modifications and adaptations, provide a plurality of simultaneous channels of communication in each direction. It is sometimes desirable to operate one or more extensions from such synchronously operating apparatus. For example, supposing there be a line between New York and Chicago with synchronously operated telegraph transmitting and receiving apparatus in both such cities, it may be desirable to operate automatically one or more loops extending from the main office in one or both such cities, to a branch office or subscriber's station; and it is often desirable at such branch office or subscriber's station, both to receive messages transmitted through the synchronous apparatus at the main station, and to transmit from such branch station or subscriber's station into the synchronous apparatus at the main station. Oftentimes it is desirable to transmit and receive, directly and automatically, between a branch station in the one such city and a branch station in the other such city, through the synchronously operated transmitting and receiving apparatus at the two cities mentioned, and through the line wire connecting such cities. Such operation is termed "extended loop operation". For use at such branch or subscribers' stations of the extension loop, synchronous apparatus of

the type employed at the main stations is not convenient for various reasons, one of which is that the loop apparatus may be in operation intermittently only, and to put it into operation it must be brought into synchronism with the main office apparatus from which it is to receive, or into which it is to transmit; and this synchronizing takes some little time. Another reason is, that while little difficulty has been experienced in keeping two apparatus on the line in synchronism, much more difficulty would be experienced in keeping all of three or four apparatus in synchronism.

There is a type of automatic telegraph apparatus wherein both the transmitter and the receiver start operation at the beginning of transmission of a character, and come to rest at the end of the transmission of a character, restarting for the transmission of the next character; and so on; the interval of time required for the transmission of any one character being so short that, without the use of special synchronizing devices, the transmitting and receiving apparatus, if properly regulated, will not get "out of step" during the transmission of any one character; and since the transmitting and receiving apparatus start afresh for the transmission of each character, in practice they remain in step continuously.

I have found that automatic telegraph apparatus of the type which starts afresh for the transmission of each character, and stops at the end of transmission of each character, is particularly adaptable for extended loop operation of the type referred to above. For distinction I will term the main synchronously operating telegraph apparatus "continuously operating synchronous apparatus", and will term the extension loop apparatus, which starts afresh for the transmission of each character, and ceases operation at the end of transmission of each character, "restarting apparatus." In a companion application Sr. No. 129,421, filed November 4, 1916, I have illustrated and described the use of step-by-step translators, preferably of the Cardwell type, as the restarting apparatus operating in connection with the main line distributor, for transmission into and reception from, the extension loop. In the present specification and drawings I illus-

trate the use of "sunflower" or commutator devices as such "restarting" apparatus.

The object of my invention is to facilitate and make entirely automatic, the operation of transmitting and receiving apparatus operating through circuit means extending from or to "continuously operating synchronous" apparatus, particularly multi-channel apparatus of the general Baudot type; and to accomplish this object by relatively simple and reliable means.

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:

Figures 1^a and 1^b, together constituting one figure, show diagrammatically, a main receiving and transmitting distributor of the general Baudot type, located at one end of a line conductor, that is to say, located at a main station, together with an extension circuit conductor and transmitting and receiving apparatus adapted to receive automatically from and to transmit automatically into, the said main distributor, a single conductor only being employed for transmission from or into such main distributor. Fig. 1^a shows the apparatus at the main station, and Fig. 1^b the apparatus at the branch or subscriber's station.

Fig. 2 is a fragmentary diagram illustrating the use of two conductors for transmission from and into such main distributor, in lieu of the "duplex" arrangement, illustrated in Fig. 1 and requiring only one such conductor.

In the drawings D2 designates a combined transmitting and receiving distributor of the general Baudot type, and, particularly, of the type illustrated and described in the application of G. M. Yorke and myself filed January 5, 1915, Serial No. 654, and comprising alternate plain and segmented commutator rings arranged in pairs, each such pair being provided with connecting brushes, BR1, BR2, etc., which brushes, in the apparatus as actually constructed, rotate along the faces of said commutator rings. These rings are shown "developed" in the drawing. Certain of the rings have functions into which it is not necessary to go in the present description. For the present it suffices to say that rings RG1 and S1 are receiving rings; that a main receiving polar relay ML repeats, from a line L through a conductor 7 into ring RG1, signals received from main line L, and that such signals are transmitted, through brushes BR1, into the segments of ring S1. The segments of this ring S1 are divided into four groups of five segments each, and each segment of one such group is connected electrically to the magnet coil of a corresponding relay of a group of relays R1—R5 inclusive, and thence to return. (I have not illustrated

circuits for the other groups of segments of ring S1, as these other segments pertain to other "channels of communication".) These relays are "self-locking", that is to say, the magnet of each relay, when energized, attracts the two armatures with which it is provided, one of which armatures, designated by character *r1* or *r2*, etc., closes a local circuit from a source 1 through the sunflower T1 as hereinafter described. The magnets of relays R1—R2, etc., so energized from the source 1, remain energized until the energizing circuit is broken at the sunflower as hereinafter described.

T1 and T4 (Fig. 1^a) and T2 and T3 (Fig. 1^b) designate generally similar sunflowers or commutators, comprising a series of contact segments over which a brush T1_a, T2_a, etc., is adapted to sweep. It may be understood that such brush of each sunflower is driven by some driving device supplying approximately constant torque for driving such brush, but nevertheless permitting instantaneous arrest of the brush. As a diagrammatic illustration of such constant-torque driving-device, I have indicated a slip belt T1_b, T2_b, etc. In general one of the various well known spring drives will ordinarily be used in place of the slip belt; but the slip belt affords a more convenient diagrammatic representation of such constant-torque driving-devices.

Each sunflower further comprises a magnet T1_m or T2_m, etc., for operating an escapement device T1_c or T2_c, etc.

Each sunflower comprises a segment marked "rest", also a segment marked "start", (though the "start" segments of sunflowers T2 and T4 are without operative function, but are present merely to occupy space,) and other segments marked *t1*, *t2*—*t5* respectively, and which may be termed "signal-element segments". Sunflowers T1 and T2 also have further segments marked *t6*. Segments *t1*—*t5* inclusive of sunflower T1 are connected to the armatures *ra*, *rb*, etc., of relays R1, R2, etc., respectively. Sunflower T1 may be termed a home transmitting or controlling sunflower; sunflower T2 a distant receiving or controlled sunflower; and sunflowers T3 and T4 may be termed, respectively, a distant transmitting or controlling, and a home receiving or controlled, sunflower.

It will be understood by those skilled in the art, that the brushes of the distributor D2 rotate in synchronism with the brushes of a similar distributor (not shown) at the distant end of line L; and at the time when brushes BR1 are passing over the segments of ring S1 corresponding to relays R1—R5 inclusive, a corresponding series of segments of a transmitting ring of a distant distributor are being connected successively to the contacts of a transmitter. The signals of

the Baudot system consists each of five impulses, some of which impulses are positive and others negative, the various permutations required to make up the various signals of the alphabet being obtained by varying the polarity of the pulses. It may be understood that the relays R1—R5 inclusive are to respond to pulses of one polarity only (for example, positive pulses) transmitted through line L. That is to say, if the first, third and fifth impulses of a character so transmitted are positive, and the second and fourth negative, only relays R1, R3 and R5 will be operated, and therefore only contacts *ra*, *rc* and *re* will be closed; and by the closing of such contacts, circuit paths will have been completed, as hereinafter described, to contacts *t1*, *t3* and *t5* of sunflower T1.

In other words, at each revolution of brushes BR1 a series of contacts is "set up" in relays R1—R5, which contacts are in series circuit with corresponding contacts of series *t1*—*t5* of the sunflower T1.

An instant after such contacts are so set up in the relays R1—R5, brush BR2 connects ring RG2 with a segment (or series of connected segments) of ring S2, thereby completing a circuit from a source 5, through rings RG2 and S2 and a conductor 6 to magnet T1*m*, and thence to return, thereby moving the lower escapement pallet 7 out of the path of the escapement tooth 8, so permitting a small movement of brush T1*a*, until escapement pin 9 is arrested by escapement pallet 10. Such movement of the brush T1*a* carries it over a portion only of the "rest" segment of sunflower T1, and does not carry it to the "start" segment. As soon as the distributor brush BR2 has passed beyond the segment or segments of ring S2 so connected to magnet T1*m*, that magnet is deenergized, disengaging escapement pallet 10 from escapement pin 9 and permitting the brush T1*a* to continue its sweep over the segments of the sunflower until arrested, at the conclusion of one rotation, by engagement of pallet 7 with tooth 8.

When, as previously explained, circuit is completed momentarily from source 5, through ring RG2, brush BR2 and a segment or segments of ring S2, and through conductor 6 and magnet T1*m* to return, current is also transmitted through branch circuit 19 to the "rest" segment of sunflower T1 and brush T1*a* and conductor 20 through the magnet of relay Q1 to return, the armature of the relay being thereby attracted; and thereby the current is reversed in the circuit, through the armature of relay Q1 and conductor L' and "artificial" line L'*b* (Fig. 1^b) to return, thereby operating relay PR1 at the "out" station, and in turn deenergizing the magnet of relay Q2 at the "out" station (said relay being energized normally by current from source 21 through the upper

contact of relay PR1). The armatures of relay Q2 then drop back; such movement of armature 22 resulting in energizing magnet T2*m* of sunflower T2 at the "out" office by current from source 24 through one back contact and armature 22 of relay Q2 and brush T2*a* of sunflower T2 rest segment of T2 and magnet T2*m* to return. Magnet T2*m* being so energized, escapement T2*c* is operated so as to cause pallet 7 to release tooth 8, and permit the sunflower arm T2*a* to move until arrested by engagement of pin 9 with pallet 10. This movement of arm T2*a* does not carry its brush to the "start" segment. When brush BR2 of distributor D2 has passed off from the segment or segments of ring S2 connected to conductors 6, the magnet of relay Q1 is again deenergized, relay PR1 at the "out" station is operated to again energize the magnet of relay Q2, and magnet T2*m* is again deenergized, the escapement then permitting brush arm T2*a* to move still farther, and close to, but not into, the "start" segment; and the brush is arrested by engagement of pallet 7 with tooth 8*a*. When magnet T1*m* of sunflower T1 is deenergized by the passage of distributor brush RB2 beyond the segment or segments of ring S2 connected to conductor 6, and brush T1*a* is released by pallet 7 and commences to move over the "start" segment of sunflower T1, the magnet of relay Q1 is energized, by current from source 11 through said "start" segment, brush T1*a* and conductor 20, and thereby relay PR1 at the "out" station is operated to again deenergize the magnet of relay Q2; whereby magnet T2*m* of sunflower T2 is again energized from source 24, and brush arm T2*a* is released by escapement pallet 7, and rotates around the sunflower disk, passing over the various segments of that sunflower in synchronism with the passage of brush arm T1*a* of sunflower T1 over the segments of sunflower T1; for it may be assumed that the constant torque driving devices of the brushes, of the sunflowers T1 and T2, move those brushes with substantially the same speed; and since these brushes start together, they will naturally travel in substantial synchronism, and will move over contact segments *t1*, *t2*, etc., of their respective sunflowers, at substantially the same moments. However, to afford ample working margin with respect to sunflower T2, I have shown the contact segments *t1*, *t2*, etc., of that sunflower, as separated by wider insulation-segments, than in the case in sunflower T1.

As explained previously, signals incoming through line L set up corresponding contact combinations in series *ra*—*re*; which combinations are retained, until the bank of relays R1—R5 is "cleared," because, the instant armature *r1*, *r2*, etc., of any of the re-

lays R1—R5 is attracted, a locking-circuit is completed from a source 1 through conductor 2, the magnet coil of such relay and the said armatures $r1$, $r2$, etc., to contact 5 springs rx and ry of the sunflower and thence to return; these contacts rx and ry being normally closed but being arranged to be separated, near the end of each cycle of the sunflower, by means of a projection rz 10 on the disk 4 which carries the escapement teeth 7 and 9 and rotates with the brush T1a. The closing of the selected contacts of series ra , rb , etc., closes circuit branches from source 1 to the corresponding sun- 15 flower segments $t1$, $t2$, etc., and as the brush T1a sweeps over such sunflower segments a circuit is completed therefrom through the brush and conductor 20 to the coil of relay Q1. The magnet of this relay being energized and deenergized, as brush T1a passes 20 over the segments connected with the selected relays R1, etc., pulses corresponding to the character to be transmitted are transmitted through line L' and through the 25 magnet of polar relays PR and PR1 in that line to relay Q2 (see Fig. 1^b) at the distant or subscriber's station; and said relay Q2 will repeat such impulses into brush T2a, and so into the particular segment of series 30 $t1$ — $t5$, over which that brush is passing at the instant of transmission of each such impulse. Relays PR and PR1 will be recognized as relays arranged for the "duplex" operation of line L'; artificial lines L'a and 35 L'b being provided. As will be understood by those skilled in the art, a signal transmitted by relay Q1 into the line L' does not operate relay PR but does operate relay PR1. Line L' extends to return through 40 the armature and back contact of a relay Q4 to be referred to hereinafter.

Sunflower T2 controls a telegraph printing device, represented in the drawings by magnets 29—33, respectively, and by a mag- 45 net 35 which may be understood to be the "printer magnet" of the printer. Telegraph printers arranged to have a character selected for printing by selective energization of a series of five magnets such as 29—33, 50 and by the subsequent energization of a magnet 35, are well known, and therefore it is not necessary for me to describe or illustrate such a printer herein.

The contacts $t1$ — $t5$ of sunflower T2 control printer-selecting-relays R6—R10 re- 55 spectively, which relays in turn control selecting magnets 29—33 respectively; while the sixth contact $t6$ of sunflower T2 controls a relay 34 controlling the printing magnet 60 35 of the automatic printer of which magnets 29—33 control selecting mechanism. It will be apparent that upon the transmission of each marking pulse transmitted through line L', the magnet of relay Q2 will

be deenergized and therefore a circuit will 65 be completed from source 24 through the brush T2a and the particular segment $t1$, $t2$, etc., of sunflower T2, with which that brush may be in contact at the moment, to the magnet of the corresponding relay of series 70 R6—R10 inclusive. These relays are self-locking relays in the same sense as are relays R1—R5, and therefore the effect is to set up a series of contacts, in relay series R6—R10, corresponding to the character to 75 be printed, with corresponding energization of the proper selecting magnets of series 29—33.

When brush T1a of sunflower T1 reaches segment $t6$, a circuit is completed from a 80 source 18 through such segment $t6$ and the brush to relay Q1, whereby relay PR1 is caused to operate to cause relay Q2 to complete a circuit from source 24 through brush 85 T2a of sunflower T2 and segment $t6$ of that sunflower, to the magnet of relay 34; which magnet, being energized, closes a circuit through printer magnet 35, effecting the operation of the printer, and at the same time opening a contact 51 whereby the locking 90 circuit of relays R6—R10 is broken, said relays being thereby "cleared." At the conclusion of each rotation, the brushes T1a, T2a and T3a are arrested by engagement of their several pallets 7 with the several es- 95 capement teeth 8.

A designates a perforated-tape-controlled automatic transmitter located at the branch or subscriber's station. The illustration of 100 such transmitter contained in Fig. 1^b is intended to be diagrammatic only and not to illustrate actual details of construction. For fuller illustration and description of the particular transmitter diagrammatically 105 illustrated, see the said Yorke-Benjamin application Sr. No. 654, or my application Sr. No. 23,791, filed April 26, 1915. As many such perforated-tape-controlled trans- 110 mitters which are adaptable for use in the present system, are known, it suffices to say at present that this transmitter comprises an operating magnet M and a series of feelers F adapted to engage corresponding holes in the perforated-tape-strip G, together with 115 contacts $f1$ — $f5$, one or more of which will be closed, selectively, for the sending of each telegraph character, upon the deenergization of magnet M; the particular contact or con- 120 tacts $f1$ — $f5$ which are so closed being determined by the perforated tape. Contacts $f1$ — $f5$ so closed complete circuit paths from a source 43 to contacts $t1$ — $t5$ respectively, 125 of sunflower T3. At the time when relay Q1 was first operated, by closure of circuit from source 5 through rings RG2 and S2, conductors 6 and 19, "rest" segment of sun- flower T1, brush arm T1a, and conductor 20, with consequent operation of relays PR1

and Q2, a circuit was completed from source 36 through armature 23 of relay Q2 and the corresponding back contact to magnet M of transmitter A, and thence through contacts *rx* and *ry* of sunflower T3 to return; whereby the magnet M was energized and the perforated tape G was fed forward one space, the feelers F previously in engagement with that tape being withdrawn; and at the same time magnet T3m of sunflower T3 was de-energized, permitting brush T3a to move until arrested by engagement of escapement pallet 10 with pin 9. Upon the next operation of relays Q1, PR1 and Q2, consequent upon the passage of brush BR2 past the segment or segments of ring S2 connected to conductor 6, with consequent energization of the magnet of relay Q2, transmitter magnet M is deenergized, and such of the feelers F of that transmitter as are opposite perforations in the tape G, rise through those perforations, thereby setting up a new contact combination in the series of contacts *f1—f5* of the transmitter. At the same time magnet T3m of the sunflower is energized, the escapement being operated to permit brush T3a to move until arrested by engagement of escapement pallet 7 with tooth 8a. Upon the further operation of relays Q1, PR1 and Q2, due to the passage of brush T1a into the "start" segment of sunflower T1, and the consequent dropping back of the armatures 22 and 23 of relay Q2, magnet T3m of sunflower T3 is again deenergized, escapement pallet 7 being thereby disengaged from tooth 8a, so that brush T3a is permitted to pass over the "start" segment, of sunflower T3, and then over contact segments *t1—t5* in succession; but magnet M of transmitter A is not again energized, because by this time cam projection *rz* of sunflower T3 has passed beyond the coacting contact spring *ry*, and springs *rx* and *ry* are no longer in contact, the circuit through magnet M being thereby broken, and remaining broken until sunflower arm T3a has returned to its normal or rest position, shown in Fig. 1^b.

As the brush arm T3a passes over the several segments *t1—t5* of sunflower T3, it is apparent that relay Q4 will be operated through conductor 44 in accordance with the characters set up in the contacts *f1—f5* of transmitter A, and that this relay therefore will transmit the same character through line L' to relay PR at the main station, which relay will repeat such character, through conductor 45 and relay Q5, into sunflower T4, located at the main office.

The brush T4a of sunflower T4 is normally held arrested by engagement of pallet 10 of its escapement anchor with pin 9; the escapement anchor being in a position opposite that of the escapement anchors of sunflowers T1 and T2, and tooth 8 of sun-

flower T4 being so disposed that engagement of the pallet 7 with this tooth 8 does not arrest the rotation of the brush. Consequently, when brush T3a of sunflower T3 passes from its "rest" to its "start" segment, and a circuit is completed from source 42 through the coil of relay Q4, conductor 44, brush T3a and the said "start" segment, to return, a starting pulse is transmitted by said relay Q4 through relay PR1, to relay PR; which relay, being operated thereby, breaks the energizing circuit of the magnet of relay Q5, and the consequent retraction of the armatures of that relay, energizes magnet T4m of sunflower T4, starting the brush of that sunflower in rotation simultaneously with the starting of brush T3a of sunflower T3. As brush T3a of sunflower T3 passes over the several segments of that sunflower which are connected to corresponding contacts of the transmitter A, current pulses will be transmitted through relays Q4, PR and Q5, corresponding to the character "set up" in the contacts of the transmitter A, and thereby the brush T4a of sunflower T4 will complete, through the segments of that sunflower, circuits energizing the magnets of such relays of series R11—R15 as is required for the setting up, in armatures *ra—re*, of those relays, contact combinations corresponding to the character transmitted from transmitter A. These armatures *ra—re* of relay bank R11—R15, are connected to corresponding segments of transmitting ring S3 of distributor D2; and the two contact stops of each armature of series *ra—re*, are connected to opposite sources of current supply, as indicated; and it will be apparent that when, after such contact combination has been set up in relays R11—R15, the brush BR3 next passes over the segments of ring S3, so connected to relays R11—R15, the characters set up in such relays will be transmitted through line L.

Relays R11—R15 are self locking in the same sense as relays R1—R5, and when, near the conclusion of one cycle of operations of that sunflower its projection *rz* separates the contact springs *rx* and *ry* of the locking circuit of those relays, the relays are "cleared"; and the same is true with respect to sunflower T1 and relays R1—R5. Similarly, when sunflower T3 nears the end of its cycle of operations the projection *rz* of that sunflower brings together its contact springs *rx* and *ry*, so closing at that point the energizing circuit of the magnet M of transmitter A; though that circuit is not completed at relay Q2 until brush T1a begins another cycle of operations.

It is necessary to complete the cycle of the extended loop instruments before the cycle of the main line distributor D2 is completed.

In practice, the extended loop apparatus completes its cycle of operations in the time during which three fourths of the cycle of distributor D2 is completed.

5 By making the segments t_1 — t_2 , etc., of sunflowers T1 and T3 (these are the transmitting sunflowers) proportionately longer than are the corresponding segments t_1 , t_2 , etc., of the receiving sunflowers T2 and
10 T4, possibility of overlapping of a signal from one receiving sunflower segment to the next, through variable lag in the circuit, or other reason, is obviated, also there is current on the line well before the receiving
15 brushes T2a and T4a, contact with a segment through which a signal is to be sent, whereby disturbance from external sources is to a great degree obviated.

Obviously, instead of "duplexing" the extension conductor L', separate outgoing and return extension conductors may be employed. This is illustrated in Fig. 2, wherein, for simplicity, only the instruments directly connected with the incoming and out-
25 going extension lines L' and L'' are illustrated; similar reference characters to those employed in Figs. 1^a and 1^b being employed in Fig. 2, so that the connection between Fig. 2 and Figs. 1^a and 1^b is apparent. It
30 will be seen that in such double conductor arrangement the return extension line L'' passes directly from the brush of sunflower T3 to the magnet coil of relay Q5 at the home station.

35 Relays R1—R5 and R11—R15 are to be regarded, for the purpose of the claims, as parts of the distributors D2.

In referring hereinabove to the Baudot system, and to the Baudot five-unit code, I
40 do not intend to limit my invention to use with a Baudot system, or Baudot apparatus, or to use with a Baudot code. My invention is suitable for use in connection with any system or apparatus employ-
45 ing a code having the same number of current impulses for each character; for example, with systems the characters of which, or some of them, are made up of positive, negative and no-current units.

50 In my said companion application Serial No. 129,421 I have claimed broadly the invention common to the two applications, and therefore I claim herein only such features as are not disclosed in my said companion
55 application.

What I claim is:—

1. In an automatic telegraph system, the combination of a controlling and a controlled contact closing device comprising
60 corresponding main signal-transmitting contact members equal in number together with corresponding movable members adapted for synchronous coaction, respectively, with respect to their corresponding main

signal transmitting members, and magnet- 65 controlled escapement means controlling the start of the travel of such movable members, the escapement of the controlling contact device comprising means whereby two operations of that escapement release the 70 corresponding movable member for continued movement, the escapement of the controlled contact device comprising means whereby three operations of that escapement mechanism release the corresponding mov- 75 able member for continued movement, means for causing a simultaneous first operation of such escapements followed by a second operation of such escapements, and means for causing a third operation of the 80 escapement of the controlled contact device immediately following the start of the movable member of the controlling contact device on its continued movement.

2. In an automatic telegraph system, the 85 combination of a controlling and a controlled sunflower comprising corresponding main signal-transmitting segments, brushes adapted for synchronous travel over said segments, and magnet-controlled escape- 90 ment means controlling the start of the travel of such brushes, the escapement of the controlling sunflower comprising means whereby two operations of that escapement release the corresponding brush for con- 95 tinued movement, the escapement of the controlled sunflower comprising means whereby three operations of that escapement mechanism release the corresponding brush for continued movement, means for causing 100 a simultaneous first operation of such escapements followed by a second operation of such escapements, and means for causing a third operation of the escapement of the controlled sunflower immediately following 105 the start of the brush of the controlling sunflower on its continued movement.

3. In an automatic telegraph system, the combination of transmitting and receiving 110 sunflowers adapted for synchronous operation and comprising corresponding main signal-transmitting segments, brushes adapted for synchronous travel over said segments and magnet-controlled escapement means controlling the start of the travel of 115 such brushes, circuit means connecting the brush of the transmitting sunflower with the brush of the receiving sunflower, means for energizing initially and momentarily the escapement magnet of the transmitting 120 sunflower and then for deenergizing such magnet, the escapement of the transmitting sunflower comprising means whereby after deenergization of such magnet following energization, the brush of that sunflower 125 is released for continued operation through one cycle, means for transmitting a current pulse from the transmitting sunflower to

the brush of the receiving sunflower upon the first energization of the controlling magnet of such transmitting sunflower, and again after such brush has started upon its full rotation and before contact of such brush with any of the main signal transmitting segments, the escapement means of said receiving sunflower comprising means whereby a second energization of its controlling magnet, following first energization and subsequent deenergization of that magnet, is required to release the brush of such receiving sunflower, said receiving sunflower further comprising means for transmitting to its escapement magnet current pulses received from the transmitting sunflower prior to the starting of the brush of the receiving sunflower on its continued movement.

4. In an automatic telegraph system, the combination with a main line distributor, of a controlling and a controlled contact closing device comprising corresponding main signal-transmitting contact members equal in number together with corresponding movable members adapted for synchronous coaction, respectively, with respect to their corresponding main signal transmitting members, and magnet-controlled escapement means controlling the start of the travel of such movable members, the escapement of the controlling contact device comprising means whereby two operations of that escapement release the corresponding movable member for continued movement, the escapement of the controlled contact device comprising means whereby three operations of that escapement mechanism release the corresponding movable member for continued movement, said distributor comprising a series of contacts connected respectively to the main signal-transmitting contact members of the said controlling contact closing device and adapted to set up in such series of contacts various character contact-combinations, circuit connections between said distributor and escapement magnet of the controlling contact closing device, and between the controlling and controlled contact closing device, said distributor comprising means for causing, through such circuit connections, a simultaneous first operation of such escapements followed by a second operation of such escapements, and means for causing a third operation of the escapement of the controlled contact device immediately following the start of the movable member of the controlling contact device on its continued movement.

5. In an automatic telegraph system, the combination of a controlling and a controlled sunflower comprising corresponding main signal-transmitting segments, brushes adapted for synchronous travel over said segments, and magnet-controlled escapement

means controlling the start of the travel of such brushes, the escapement of the controlling sunflower being a two-toothed escapement, and that of the controlled sunflower being a three-toothed escapement, a distributor, circuit connections between said distributor and the controlling sunflower, and between the two sunflowers, whereby said distributor causes a simultaneous first operation of such escapements followed by a second operation of such escapements, said controlling sunflower comprising means for causing a third operation of the escapement of the controlled sunflower immediately following the start of the brush of the controlling sunflower on its continued movement.

6. In an automatic telegraph system, the combination with a distributor having signal-receiving and signal-transmitting means, each comprising a series of contacts in which contact combinations may be set up corresponding to telegraphic characters, of extended-loop transmitting and receiving apparatus comprising a controlling sunflower having segments each connected to a corresponding contact of the receiving series of the distributor and a controlled sunflower at a distant point having corresponding contact segments, said extended loop apparatus further comprising a controlling sunflower at a distant point and a transmitter therefor adapted to set up character combinations, said transmitter and said distant controlling sunflower having each a series of corresponding character element contacts, each such contact of the transmitter connected to a contact of the corresponding sunflower, said extension loop apparatus further comprising a controlled sunflower corresponding to the distant controlling sunflower and having character element contact segments connected respectively to corresponding contacts of the signal transmitting contact series of the distributor, circuit means connecting each controlling sunflower with the corresponding controlled sunflower, each sunflower comprising a brush adapted for travel over the segments of that sunflower synchronously with the travel of the brush of the corresponding controlling or controlled sunflower, each sunflower further comprising magnet-controlled escapement means controlling the start of the travel of the corresponding brush, said distributor comprising means, operating through the circuit connections from the distributor to one controlling sunflower and thence to the circuit connections between the several sunflowers, for starting each controlling sunflower and its corresponding controlled sunflower in synchronism, and for operating the transmitter associated with the distant controlling sunflower.

7. In an automatic telegraph system, the combination with a distributor having sig-

nal-receiving and signal-transmitting means, each comprising a series of contacts in which contact combinations may be set up corresponding to telegraph characters, of extended-loop transmitting and receiving apparatus comprising a controlling sunflower having character element segments each connected to a corresponding contact of the receiving series of the distributor and having also "rest" and "start" segments, and a controlled sunflower at a distant point having segments corresponding to the character element segments of said controlling sunflower, and having also a rest segment, said extended-loop apparatus further comprising a controlling sunflower at a distant point, and a transmitter therefor adapted to set up character combinations, said transmitter and said distant controlling sunflower having each a series of corresponding character element contacts, each such contact of the transmitter connected to a contact of the corresponding sunflower, said distant controlling sunflower having also a rest segment, said extended-loop apparatus further comprising a controlled sunflower corresponding to the distant controlling sunflower, and having character element contact segments connected respectively to corresponding contacts of the signal transmitting contact series of the distributor, circuit means connecting each controlling sunflower with the corresponding controlled sunflower, each sunflower comprising a brush adapted for travel over the segments of that sunflower synchronously with the travel of the brush of the corresponding controlling or controlled sunflower, each sunflower further comprising magnet-controlled escapement means controlling the start of the travel of the corresponding brush, the escapement of the first mentioned controlling sunflower being a two-toothed escapement, the escapements of the distant sunflowers being three-toothed escapements, said distributor comprising means for closing a circuit through the escapement magnet of the first mentioned controlling sunflower, and also for simultaneously closing circuit through such first mentioned controlling sunflower to the escapement magnets of the corresponding controlled sunflower and the distant controlling sunflower, the "start" segment of the first mentioned controlling sunflower having a source or current supply whereby when the brush of that sunflower reaches such start segment the magnets of the corresponding controlled sunflower, and the distant controlling sunflower, are operated; such distant controlled sunflower comprising means whereby when its brush is started for continued operation the brush of the corresponding controlled sunflower is also started.

8. In an automatic telegraph system, the combination with a continuously operating synchronous apparatus comprising a series of contacts and means for setting up contact combinations therein conforming to the make up of telegraph characters, of an extension circuit and transmitting means therefor comprising a sunflower having segments corresponding each to one of said series of contacts and connected thereto, and having also a brush adapted to travel over said segments, driving means for said brush, escapement means normally holding said brush stationary, said sunflower having also a "rest" segment upon which such brush normally rests, said escapement means comprising an operating magnet and said continuously-operating synchronous apparatus comprising means for operating such magnet, after the setting up of a character contact-combination, to cause said brush to move along the "rest" segment, to stop thereon, and finally to start for continued travel over the remaining segments.

9. In an automatic telegraph system, the combination with a continuously operating synchronous apparatus comprising a series of contacts and means for setting up contact combinations therein conforming to the make up of telegraph characters, of an extension circuit, and transmitting and receiving means therefor each comprising a sunflower, the transmitting sunflower having signal element segments corresponding each to one of said series of contacts and connected thereto, and having also a "start" segment, the receiving sunflower having corresponding signal-element segments, and a "rest" segment, each sunflower having a brush adapted to travel over said segments, driving means for said brush, escapement means normally holding said brush stationary, and an operating magnet for such escapement means, the escapement means of each sunflower normally holding the corresponding brush upon the "rest" segment, said continuously-operating synchronous apparatus comprising means for operating the magnet of the transmitting sunflower, after the setting up of a character contact-combination, to cause the corresponding brush to move over the "rest" segment, to stop thereon, and finally to start for continued travel over the remaining segments, and means for transmitting through said extension circuit to the magnet of the receiving sunflower signals to cause corresponding and simultaneous movements of the brush of the receiving sunflower.

10. In an automatic telegraph system, the combination with a continuously operating synchronous apparatus comprising a series of contacts and means for setting up contact combinations therein conforming to the

make up of telegraph characters, of extension circuit means, and means for transmitting from said continuously operating synchronous apparatus to a distant station in such extension circuit means, and for transmitting from such distant station through such extension circuit means into said continuously operating synchronous apparatus, comprising home transmitting and receiving sunflowers and distant transmitting and receiving sunflowers, the home transmitting sunflower having signal element segments corresponding each to one of said series of contacts and connected thereto, the other sunflowers having corresponding segments, each sunflower having also a "rest" segment, each sunflower having a brush adapted to travel over said segments, driving means for said brush, escapement means normally holding such brush stationary, and an operating magnet for such escapement means, the escapement means of each sunflower normally holding the corresponding brush upon the "rest" segment, said continuously-operating synchronous apparatus comprising means for operating the magnet of the home transmitting sunflower, after the setting up of a character contact combination, to cause the brush of such sunflower to move over the "rest" segment, to stop thereon, and finally to start for continued travel over the remaining segments, means for transmitting through such extension circuit means to the magnet of the distant receiving and transmitting sunflowers, a signal to cause corresponding and simultaneous movements of the brushes of such sunflowers, a distant transmitter comprising a series of contacts and means for setting up character combinations therein, such transmitter contacts connected to corresponding signal element segments of the distant transmitting sunflower, the distant transmitting sunflower comprising means for sending a current pulse through such extension circuit means to the magnet of the home receiving sunflower to start the brush of that sunflower in operation substantially simultaneously with the starting for continued operation of the brush of said distant transmitting sunflower; said continuously operated synchronous apparatus comprising means, controlled by the home receiving sunflower, for setting up contact combinations corresponding to characters set up in the distant transmitter and for transmitting from such contact combinations into such continuously operating synchronous apparatus.

11. In an automatic telegraph system, the combination with a rotary distributor comprising a segmented commutator and a series of relays having magnet coils connected to segments of said commutator, and arranged

to be actuated by said commutator to set up contact combinations corresponding to characters received by said commutator, of an extension circuit, and transmitting and receiving means therefor comprising sunflowers having brushes and driving means therefor adapted to rotate such brushes in substantial unison, said sunflowers comprising escapement means normally holding the corresponding brushes stationary and further comprising magnets controlling such escapement means, said sunflowers each comprising a "rest" segment, the transmitting sunflower comprising further signal-element segments connected to corresponding contacts of said relays, the receiving sunflower having corresponding signal-element segments, a recorder, a series of selecting relays for said recorder connected to such last mentioned segments of the receiving sunflower, and means actuated by said distributor after the setting up of a character combination in the first mentioned series of relays, to cause the brushes of the sunflowers to move over their "rest" segments, to stop thereon, and finally to start for continued travel over the remaining segments.

12. In an automatic telegraph system, the combination with a rotary distributor comprising a segmented commutator, of an extension circuit and means for transmitting therethrough into said distributor comprising a transmitter having contacts adapted to be set up in combinations corresponding to characters to be transmitted, and transmitting and receiving sunflowers having brushes and driving means therefor adapted to rotate such brushes in substantial unison, said sunflowers comprising escapement means normally holding the corresponding brushes stationary, and further comprising magnets controlling such escapement means, the transmitting sunflower comprising signal-element segments connected to corresponding contacts of said transmitter, the receiving sunflower having corresponding signal-element segments, a bank of relays having magnet coils connected to such signal-element segments of the receiving sunflower, such relays having contacts, connected to segments of said distributor, in which contact combinations may be set up corresponding to the signals transmitted, and means for starting the brushes of said sunflowers in substantial unison.

13. In an automatic telegraph system, the combination with a rotary distributor comprising a segmented commutator and a series of relays having magnet coils connected to segments of said commutator, and arranged to be actuated by said commutator to set up contact combinations corresponding to characters received by said commutator, of an extension circuit, and transmitting and receiving

ing means therefor comprising sunflowers having brushes and driving means therefor adapted to rotate such brushes in substantial unison, said sunflowers comprising escape-
 5 ment means normally holding the corresponding brushes stationary and further comprising magnets controlling such escapement means, said sunflowers each comprising a "rest" segment, the transmitting sun-
 10 flower comprising signal-element segments connected to corresponding contacts of said relays, the receiving sunflower having corresponding signal-element segments, a recorder, a series of selecting relays for said
 15 recorder connected to such last mentioned segments of the receiving sunflower, and means actuated by said distributor after the setting up of a character combination in the first mentioned series of relays, to cause
 20 the brushes of the sunflowers to move over their "rest" segments, to stop thereon, and finally to start for continued travel over the remaining segments, the transmitting sunflower comprising means for clearing the
 25 relays of said distributor.

14. In an automatic telegraph system, the combination with a rotary distributor comprising a segmented commutator and a series of relays having magnet coils connected to
 30 segments of said commutator, and arranged to be actuated by said commutator to set up contact combinations corresponding to characters received by said commutator, of an extension circuit, and transmitting and re-
 35 ceiving means therefor comprising sunflowers having brushes and driving means therefor adapted to rotate such brushes in substantial unison, said sunflowers comprising escapement means normally
 40 holding the corresponding brushes stationary and further comprising magnets controlling such escapement means, said sunflowers each comprising a "rest" segment, the transmitting sunflower comprising sig-
 45 nal-element segments connected to corresponding contacts of said relays, the receiving sunflower having corresponding signal-element segments, a recorder, a series of selecting relays for said recorder connected to
 50 such last mentioned segments of the receiving sunflower, and means actuated by said distributor after the setting up of a character combination in the first mentioned series of relays, to cause the brushes of the sun-
 55 flower to move over their "rest" segments, to stop thereon, and finally to start for continued travel over the remaining segments, the transmitting sunflower comprising means for clearing the relays of said dis-
 60 tributer, and means for clearing the selecting relays for the recorder, said receiving sunflower having a further segment to which such clearing means is connected, and said transmitting sunflower having a further
 65 segment adapted to transmit an actuating

pulse through such extension circuit to such clearing segment of the receiving distributor.

15. In an automatic telegraph system, the combination with a rotary distributor comprising a segmented commutator, of an ex-
 70 tension circuit and means for transmitting therethrough into said distributor comprising a transmitter having contacts adapted to be set up in combinations corresponding
 75 to characters to be transmitted, and having transmitting and receiving sunflowers having brushes and driving means therefor adapted to rotate such brushes in substantial unison, said sunflowers comprising escape-
 80 ment means normally holding the corresponding brushes stationary, and further comprising magnets controlling such escapement means, the transmitting sunflower comprising segments connected to correspond-
 85 ing contacts of said transmitter, the receiving sunflower having corresponding segments, a bank of self-locking relays having magnet coils connected to such segments of the receiving sunflower, such re-
 90 lays having contacts, connected to segments of that distributor, in which contact combinations may be set up corresponding to the signals transmitted, said receiving sunflower having means for clearing such re-
 95 lays after transmission therefrom, and means for starting the brushes of such sunflowers in substantial unison.

16. In an automatic telegraph system, the combination with a rotary distributor comprising a segmented commutator, of an ex-
 100 tension circuit and means for transmitting therethrough into said distributor comprising a transmitter having contacts adapted to be set up in combinations corresponding to characters to be transmitted, and trans-
 105 mitting and receiving sunflowers having brushes and driving means therefor adapted to rotate such brushes in substantial unison, said sunflowers comprising escapement means normally holding the corre-
 110 sponding brushes stationary, and further comprising magnets controlling such escapement means, the transmitting sunflower comprising segments connected to corresponding contacts of said transmitter, the receiv-
 115 ing sunflower having corresponding segments, a bank of relays having magnet coils connected to such segments of the receiving sunflower, such relays having contacts, connected to segments of said distributor, in
 120 which contact combinations may be set up corresponding to the signals transmitted, and means for starting the brushes of said sunflowers in substantial unison, said transmitting sunflower having further a "rest"
 125 segment and a "start" segment, its brush being normally on the "rest" segment, said receiving sunflower having further a "rest" segment, upon which its brush normally rests, means for moving the brush of the
 130

transmitting sunflower from its "rest" segment to its "start" segment, and thence over its remaining segments, and means for transmitting a "start" signal to the magnet of
5 the receiving sunflower when the brush of the transmitting sunflower is on its "start" segment.

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

GEORGE R. BENJAMIN.

Witnesses:

H. M. MARBLE,

PAUL H. FRANKE.