

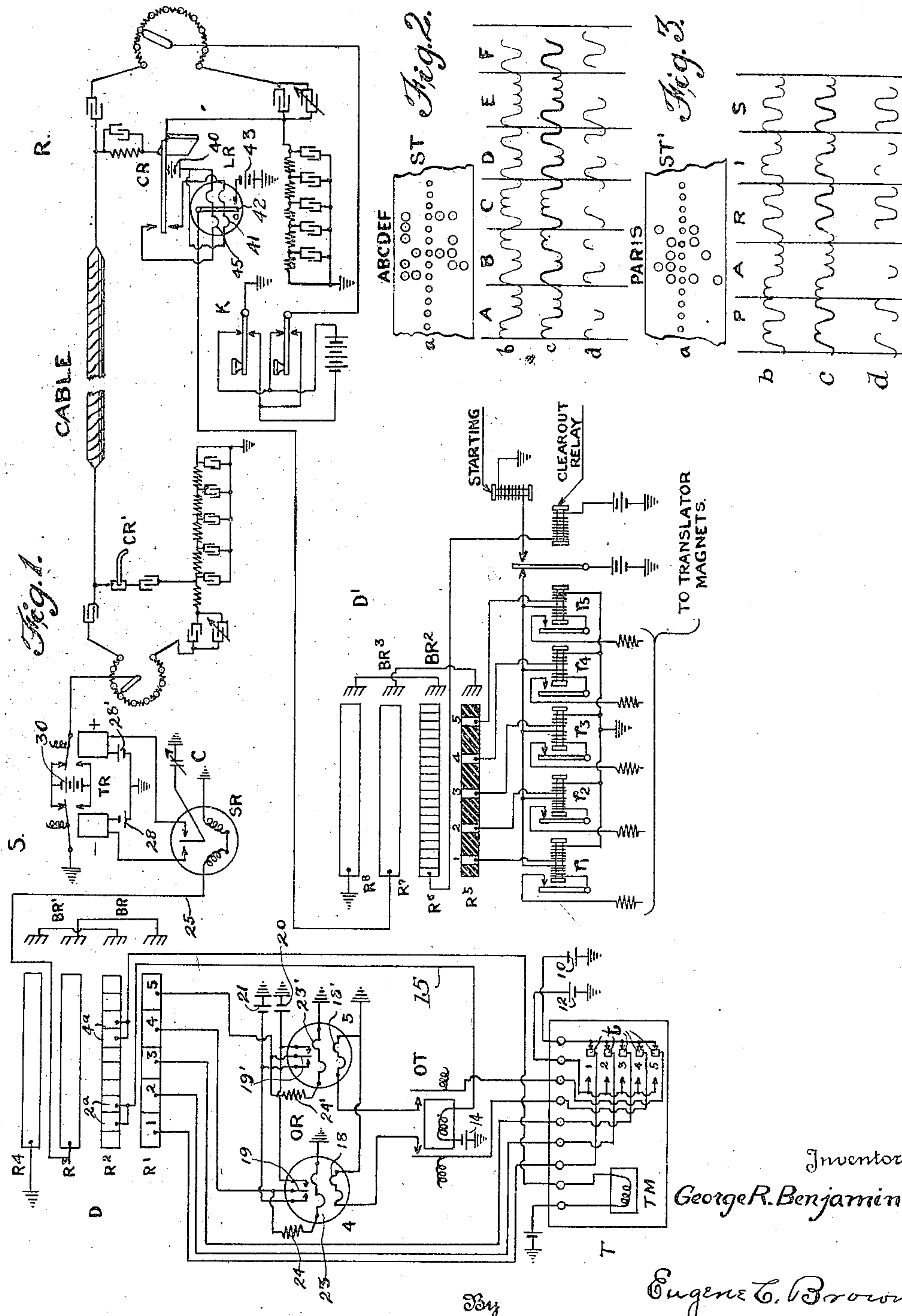
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METHOD OF AND APPARATUS FOR OPERATING SYNCHRONOUS TELEGRAPH SYSTEMS

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# UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR OPERATING SYNCHRONOUS TELEGRAPH SYSTEMS.

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*To all whom it may concern:*

Be it known that I, GEORGE R. BENJAMIN, a citizen of the United States, residing at Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Methods of and Apparatus for Operating Synchronous Telegraph Systems, of which the following is a specification.

This invention relates to automatic cable transmitters and is particularly intended for use in synchronous printing telegraph systems.

Owing to the large static capacity of an ocean cable it is desirable to ground it as frequently as possible to reduce the static charge and for the same reason it is desirable to avoid a succession of impulses of like sign or polarity. I attain these advantages by grounding the cable between successive impulses and by suppressing succeeding impulses of like polarity or sign, the transmitted impulses always being of reversed polarity.

The main purpose of my invention is to provide means at the cable transmitting end which will automatically suppress an impulse which succeeds one of like polarity and means at the cable receiving end which will automatically introduce or supply the suppressed impulses to the translator mechanism or recording apparatus. In the particular system herein described each telegraph character consists of five impulses, the necessary distinctions between the several characters being obtained by causing one or more of the current impulses to be of opposite "sign," direction or polarity from the other impulses of that character; the resulting reversals of current sign affording the number of permutations necessary for the distinction of the several letters of the alphabet, punctuation signs and special signals for the operation of the various parts of the transmitting and receiving apparatus.

Telegraph systems such as that in connection with which my invention is herein illustrated and described, comprise two or more distributors or commutators with means for maintaining synchronism. The type of automatic tape-controlled transmitter employed is shown in my prior U. S. Patent No. 1,298,440, dated March 25, 1919,

while the distributors, and method of correcting, locating and maintaining synchronous phase relations between two distributors at distant stations is disclosed in U. S. Patent No. 1,253,889, granted to Rothermel, January 15, 1918 and need not be further described herein.

For the purpose of clearly disclosing my invention I shall refer to the accompanying drawings in which—Figure 1 is a diagrammatic illustration of the apparatus employed at the transmitting and receiving stations of a cable and embodying one form of my invention; and Figs. 2 and 3 illustrate short pieces of transmitting tape perforated in accordance with certain signal characters and showing also the manner in which succeeding impulses of like sign or polarity are suppressed.

The apparatus at the transmitting or sending station S, comprises essentially the transmitter T, and distributor D with the interposed overlap transmitting relay O T and overlap relays O R, together with the sending relay S R and cable transmitting relays T R.

The apparatus at the receiving station R comprises essentially the cable relay C R, with its associated line relay L R, the distributor D' and the recording apparatus including the selecting relays, starting magnet and clear-out relay which are connected to the circuits and mechanism of the printing mechanism in the manner well understood.

For the sake of clearness I have illustrated only the transmitting apparatus at the station S at one end of the cable and only a receiving apparatus at the station R at the other end of the cable, but it is understood that it is common practice to duplex the cable operation so that each station may simultaneously send and receive messages. The requirements for this purpose would be to substitute the sending apparatus shown at station S for the cable key K at station R, and associate a receiving apparatus shown at station R with the cable relay C R' at station S.

The distributors or commutators D, D' comprise a series of concentric segmented and solid rings R', R<sup>2</sup>, R<sup>3</sup>, etc., rotarily mounted and having adjutably mounted stationary brushes B R, B R', etc., the disks or shafts carrying the rings being maintained



in synchronism and proper phase relation at the different stations in accordance with the Rothermel patent above mentioned. For the sake of clearness the distributor rings are developed as straight bands. These distributors have been described in various patents of The Western Union Telegraph Company, including Patent No. 1,253,889 above mentioned and need not be further described.

In illustrating the transmitter T, which is of the type shown in my prior patent mentioned, I have deemed it sufficient to indicate the circuit connections, omitting the perforated tape and tape feed mechanism. The movable tongues *t* normally rest against the back contacts which are connected to the negative pole of battery 10, the front contacts being connected to the plus or positive pole of battery 12. The tongues 1, 2 and 3 are directly connected to the corresponding segments of ring R' of distributor D, while tongues 4 and 5 are connected to the armatures of overlap transmitter relay O T. When the brushes B R' pass over the segments 2<sup>a</sup> of ring R<sup>2</sup> the relay O T is energized from battery 14, a circuit being completed through conductor 15, segments 2<sup>a</sup> of ring R<sup>2</sup>, brushes B R' and ring R<sup>4</sup> to ground. As the armatures of relay O T are drawn against their front contacts the tongues 4 and 5 will be connected to the energizing coils 18, 18' of overlap relays O R, causing the armatures 19, 19' to swing against the right or left hand contacts, depending upon whether the tongues 4, 5 are against the front or back contacts of the transmitter T. If the armatures swing to the right they will impress a positive charge on the segments 4, 5 of the ring R' from the battery 20, while they will impress negative charges thereon if they swing to the left from the battery 21. At the same time holding circuits are closed through the coils 23, 23', the holding currents being made very weak by including resistances 24, 24'.

Referring to Fig. 2, it will be observed from the impulse diagrams *b* that the letter "A" consists of two plus or positive impulses followed by three minus or negative impulses. The perforations for the letter "A" in the sending tape S T shown at *a* consists of only two perforations corresponding to the first two impulses. These permit the pins or feelers attached to the tongues 1, 2 of the transmitter T to pass through, thereby causing said tongues to swing over against the front contacts connected to the plus battery 12. As there are no perforations in the tape for the other three pins, the tongues 3, 4 and 5 remain against their back stops which are connected to negative battery 10. As a consequence when the tape S T is moved over the transmitter pins with the two perforations indi-

cated for the letter "A," tongues 1 and 2 will be charged positively from battery 12 and tongues 3, 4 and 5 will remain and be charged negatively from battery 10. The charges from tongues 1, 2 and 3 are directly impressed upon segments 1, 2 and 3 respectively of ring R' of the distributor, while the charges on tongues 4 and 5 are impressed on the two armatures of overlap transmitter relay O T.

As the brushes pass over the rings of the distributor the brushes B R first connect segment 1 of ring R' with ring R<sup>3</sup>, thereby transmitting the plus charge previously impressed on this segment through conductor 25 to the coils of sending relay S R. As this is a positive current the armature will swing over against the right hand contact, thereby sending a positive charge into condenser C from battery 28' and energizing the plus magnet of transmitting relay T R. The armature of the latter is drawn against its front contact, thereby sending a positive impulse from the main battery 30 into the cable. The capacity of the condenser C may be adjusted so that the charging current will continue for the full time the brush is passing across the segment 1. As soon as the condenser is fully charged, so that the charging current ceases to flow, the armature of the relay T R will be drawn against its back stop by its retractile spring, thereby grounding the cable through the armatures of the two magnets of the relay T R and the bridge wire connecting the back stops.

During the latter part of the movement of the brushes B R across segment 1 of ring R', the brushes B R' connect the segments 2<sup>a</sup> of ring R<sup>2</sup> to solid ring R<sup>4</sup>, thereby energizing the coil of relay O T from battery 14. The attraction of the armatures connects the tongues 4 and 5 of the transmitter T to the coils 18 and 18' of overlap relay O R and as the charging currents on both of these tongues is negative, the armatures 19 and 19' will swing against the left hand contacts thereby impressing negative charges upon the segments 4 and 5 of ring R' from battery 21. The armatures will be held in the left hand position by the small current flowing through the holding coils 23, 23', these coils being weaker than the actuating coils 18, 18'.

As the brush B R moves onto the segment 2 of ring R' a positive impulse will again flow through the sending relay S R, causing its armature to swing to the right and again connect the plus battery 28' to the condenser C. Inasmuch, however, as the condenser was fully charged with a positive current while the brush was passing over segment 1, no further charging current will flow and hence the plus magnet of transmitting relay T R will not be energized. Since no current impulse is transmitted to the



cable the effect of the second or succeeding positive impulse of the letter "A" is suppressed and the cable remains grounded. It will be evident that a succeeding impulse of like sign is suppressed in the same manner, even though it is the first impulse of a letter, if it follows an impulse of the same sign in the preceding letter or character.

When the brush B R passes onto segment 3 of ring R' the negative current impulse from battery 10 through tongue 3 of transmitter T is sent through relay S R, causing its armature to swing to the left and connect condenser C to the negative pole of battery 28, a charging current flowing because it is in the same direction as the discharge from the previous charge. The minus magnet of relay T R being thus energized, draws its armature against its front contact and thereby causes a negative current impulse to flow into the cable from the battery 30. As the condenser C is fully charged negatively, the negative charges on the following segments 4 and 5 which energize the relay S R as the brushes B R pass over these segments, will not cause any further charging current to flow into the condenser and consequently these two negative impulses succeeding the negative impulse on segment 3, will be suppressed. It will be observed, therefore, that only the first positive charge on segment 1 and the first negative charge on segment 3 caused corresponding current impulses to be transmitted into the cable, the positive charge on segment 2 and the negative charges on segments 4 and 5 causing no currents to flow into the condenser and the corresponding impulses being therefore suppressed. This is shown graphically at *d* in Figs. 2 and 3.

Inasmuch as an interval of time must be provided for the operation of the tape feeding mechanism and in order that the current charges shall be set up on the first segment of the ring R' before the brushes leave the segment 5 and pass again upon the segment 1, provision is made for moving the tape forward to the next character and thereby setting up the combination of positive and negative charges of the succeeding letter on the tongues of the transmitter and likewise on the first three segments of ring R' while the brushes are still passing over segments 4 and 5; in other words, the current charges of the preceding letter on segments 4 and 5 are allowed to remain and overlap the setting up of the charges of the succeeding letter on the segments 1, 2 and 3.

To accomplish this purpose, as the brush B R moves onto segment 4 of ring R' brushes B R' connect segments 4<sup>a</sup> of ring R<sup>2</sup> with grounded ring R<sup>4</sup> thereby energizing the magnet T M of the transmitter which actuates the feeding device, withdrawing the pins from the tape and moving it forward, the

next character being thereby set up on the tongues of the transmitter.

While succeeding impulses of like sign are suppressed by the transmitter in the manner above described so that the cable remains grounded during the periods of such suppressed impulses or signals, the successive marking impulses of like sign are nevertheless set up by the distributor upon the relays of the receiving apparatus at the cable receiving station.

Referring now to the apparatus at the receiving station R, it will be seen that the impulses transmitted to the distributor D' and set up on the selecting relays  $r_1$ — $r_5$  are exactly the same as though each of the positive or marking impulses and each of the negative or spacing impulses of the five-unit characters set up on the five tongues *t* of the transmitter T had been transmitted over the cable and hence the suppression of the successive current impulses of like sign at the transmitting end has made no change in the resulting signals at the receiving end.

Thus when a positive impulse is transmitted over the cable, the coil of cable relay C R swings its arm in a direction to close a local circuit from battery 40 through the coils 41 of polarized relay L R, causing the armature 42 to swing to the right and connect the battery 43 with the ring R' of distributor D'. If at this instant the brush B R<sup>2</sup> is passing over segment 1 of ring R<sup>5</sup>, a current will flow through the energizing coil of selecting relay  $r_1$  which attracts its armature, the latter closing a circuit through a holding coil on the relay and through a magnet on the translator mechanism which actuates one of the selector disks of the tape printer in the manner well understood. Assuming that the letter "A" is being transmitted from the sending station S, the next succeeding impulse is also positive and consequently of the same sign and will therefore be suppressed, no signal being sent into the cable. However, as the tongue 42 of the polarized relay L R at the receiving station remains against the right hand contact, an impulse from the battery 43 will be transmitted through the ring R' and segment 2 of ring R<sup>5</sup> to energize selecting relay  $r_2$ . Its armature likewise closes a circuit through its holding coil and a magnet of the translator mechanism.

The next or third impulse of the letter "A" being negative and of opposite sign, is transmitted over the cable, causing the arm of cable relay C R to swing over to the other contact, closing a circuit from battery 40 through the coils 45 and causing the armature 42 to swing to the left against the stop. At this instant the distributor brush B R<sup>2</sup> is on segment 3 and consequently no current will be transmitted to relay  $r_3$ . The next two impulses of the letter "A" being also negative



and of the same sign as the preceding transmitted impulse, will be suppressed at the sending end and no signal will be transmitted to the cable. Accordingly the armature 42 of polarized relay L R remains  
 5 against the stop while the brush B R<sup>2</sup> passes over segments 4 and 5 of ring R<sup>5</sup> so that the corresponding selector relays are not energized. The result is exactly the same as  
 10 if a second and a third negative or spacing impulse had been transmitted over the cable.

After the brushes of distributor D' have passed over all of the segments so that the combination of impulses representing a character are set up thereon, and as the brushes  
 15 start again over the rings, the brushes B R<sup>3</sup> connect the first segment of ring R<sup>6</sup> with the grounded ring R<sup>8</sup>, closing a circuit through the "clearout" relay and the latter  
 20 controls the circuits which deenergize the selector magnets and energize the starting magnet of the printing mechanism.

From the above description it is evident that my method of operating an automatic  
 25 cable transmission system provides for the suppression of succeeding current impulses of like sign after all of the five positive and negative charges corresponding with combination of any particular character have  
 30 been set up on the transmitter tongues and have been transmitted to the sending relay. The latter, therefore, responds to all of the positive and negative impulses of the different characters and may indicate locally  
 35 in any suitable manner the passage of these impulses or character combinations. In other words the suppression of impulses of like sign occurs in association with the cable transmitting relay. The condenser C which  
 40 constitutes the means for suppressing the desired impulses also furnishes a means of adjusting the length or duration of the impulses to correspond with the time required for a brush to pass over a segment of the  
 45 distributor.

Inasmuch as the resultant effect upon the translator mechanism at the receiving station is the same as it would be if all of the positive and negative impulses of the characters were transmitted over the cable the advantages which accrue from my method of suppressing all successive impulses of like sign and grounding the cable at all times when an impulse is not being transmitted,  
 50 will be appreciated by engineers.

I claim:—

1. In a synchronous telegraph system, the combination of a rotary distributor comprising a commutator divided into segments  
 60 and a brush rotatable thereover, means for transmitting to said segments positive and negative charges corresponding to the combinations of the telegraph characters, a relay connected to said brush and responsive  
 65 to said charges, and electro-magnetic trans-

mitting mechanism having actuating circuits controlled by said relay and including a condenser the capacity of which is adjustable to determine the duration of the flow of current in said actuating circuits to correspond with the passage of said brush over one of said commutator segments.

2. In a synchronous telegraph system, an automatic transmitter operating under the control of a code-perforated tape and having  
 75 operating members which receive positive and negative charges corresponding to the combinations of the telegraph characters, means for transmitting said charges in sequence, a relay responsive to said charges, and electro-magnetic transmitting mechanism having actuating circuits controlled by said relay and including a condenser the capacity of which is adjustable to determine the duration of the flow of current in  
 85 any direction.

3. In a telegraph system, a line circuit, sources of oppositely poled current, automatic circuit controlling means for transmitting a code consisting of positive and  
 90 negative current charges corresponding respectively to the combinations of said code characters, a single relay responsive to all of said charges, and electro-responsive means controlled by said relay operating to transmit to line successive impulses of opposite sign and to ground said line in substitution of successive repetitions of current impulses of like polarity.

4. In a synchronous telegraph system, an automatic transmitter having operating  
 100 members which receive positive and negative charges corresponding to the combinations of the telegraph characters, means for transmitting said charges in sequence, a single relay responsive to all of said charges, and impressing mechanism controlled by said relay and provided with means for suppressing successive impulses of like sign or polarity.  
 110

5. In a synchronous telegraph system, an automatic transmitter operating under the control of a code-perforated tape and having  
 115 operating members which receive positive and negative charges corresponding to the combinations of the telegraph characters, means for transmitting said charges in sequence, a single relay responsive to all of said charges, and electro-magnetic transmitting mechanism having actuating circuits controlled by said relay and including  
 120 a condenser the capacity of which determines the flow of current in any direction.

6. In a synchronous telegraph system, an automatic transmitting apparatus embodying  
 125 a condenser having a capacity which determines the flow of current in either direction to the period of one impulse and thereby suppresses successive impulses of the same sign or polarity.  
 130



7. In a synchronous telegraph system wherein the code signals comprise characters composed of different combinations of positive and negative current impulses, each  
5 code character having the same number of impulses, an automatic transmitting apparatus having a single electro-responsive device for receiving a charge corresponding with each of the positive and negative impulses of a code character, and means for 10 suppressing successive impulses of like sign or polarity.

In testimony whereof I affix my signature.

GEORGE R. BENJAMIN.