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METHOD OF AND APPARATUS FOR OPERATING SYNCHRONOUS TELEGRAPH SYSTEMS

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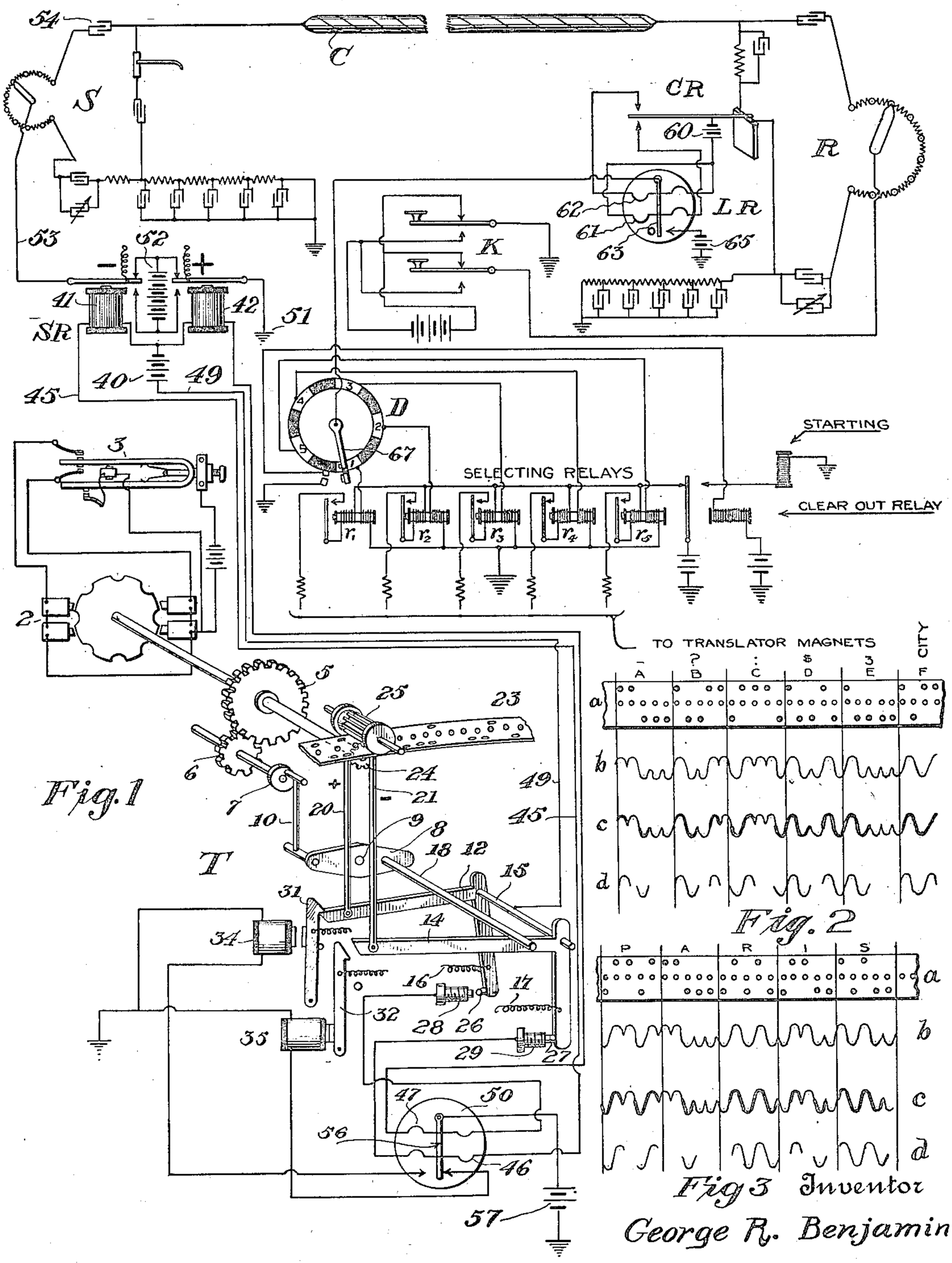

Fig. 1

Fig. 2

Fig 3

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Witnesses

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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 improvements in automatic cable transmitters particularly designed for use in synchronous printing telegraph systems.

When transmitting signals over an ocean cable it is desirable to avoid a succession of impulses of like polarity owing to the large static capacity of the cable and for the same reason it is desirable to ground the cable as frequently as possible in order to remove its static charge. These advantages in cable operation may be attained when employing the five-unit code, in which each letter or character is made up of five impulses, by suppressing succeeding impulses of like polarity so that the transmitted impulses are always of reversed polarity.

One of the objects of this invention is to provide a cable transmitter which will automatically suppress an impulse or signal which succeeds one of like polarity but will transmit an impulse or signal of opposite or reversed polarity. A further object is to provide means for automatically supplying or introducing the suppressed impulses at the receiving station of the cable. It will be appreciated that this method of transmitting to the cable only succeeding current impulses of reversed polarity by suppressing the succeeding impulses of like sign and then injecting or supplying these suppressed impulses in the local relay circuit at the receiving end of the cable enables the messages to be sent at a greater speed.

In the accompanying drawings, Figure 1 is a diagrammatic illustration of the apparatus employed at the transmitting and receiving stations of a cable; and showing one form of an automatic cable transmitter embodying my invention; and Figs. 2 and 3 illustrate short pieces of perforated transmitting tape and the manner in which the succeeding signals of like polarity are suppressed.

The transmitter is preferably driven at a uniform speed by an electric motor 2 of the type known as the "La Cour phonic wheel," controlled by the vibrating reed 3. By suitable gearing 5, 6, the motor drives the eccentric 7, which actuates the rocking lever 8 pivoted at 9, through the pitman 10. The bell-crank levers 12 and 14 pivoted on the rod 15, are rocked against the restraint of the retractile springs 16, 17 by the oscillations of the rod 18, carried by the lever 8. The pins 20, and 21 which move in unison and are designed to enter the perforations in the code message tape 23, when they are permitted to move upwardly under the action of the springs 16, 17 upon the upward movement of the oscillating bar 18. It is understood, of course, that the pins enter the outer perforations, the central row of uniformly spaced perforations being engaged by the spur feed wheel 24.

When the pins pass through perforations in the tape, projecting into the spaces between the blades or ribs of the guide roller 25, the bell-crank levers 12, 14, rock on the pivot bar 15, sufficiently to close the contact points 26, 27 against the contact studs 28, 29. On the contrary, if one or both of the pins do not register with a perforation on the upward stroke, but are stopped by striking against the tape, the corresponding lever or levers will be arrested before the contacts on their lower ends engage the contact studs. It will be observed that either pin may pass through a perforation, while the other pin simultaneously engages an unperforated part of the tape so that one pair of contacts is closed while the other pair remains open.

A pair of latch dogs 31, 32, are pivotally mounted in the path of the outer ends of the levers 12, 14, and are normally spring pressed against stops so that they will yield when engaged by the levers on their downward stroke and will then restrain the levers against upward movement. The latch dogs carry armatures of electro-magnets 34, 35 which are adapted when energized to retract the dogs to thereby free the levers and permit them to move upwardly.

In some respects the mechanism above described resembles the Wheatstone type of transmitter, as illustrated in U. S. Patent No. 670,964 and generally known as the Western Union cable transmitter. I have

shown the transmitter in circuit with the local battery 40, and magnets 41, 42 of the main line sending relay S R at the sending station S for impressing permutations of positive and negative currents upon the cable C, the apparatus for balancing the constants of the cable being diagrammatically shown in the usual conventional manner, as are likewise the apparatus indicated at the receiving station R, which includes the cable receiving relay C R, the local receiving relay L R, the usual cable transmitting keys K, and the mechanism connected with the printing telegraph including the distributer D, and the associated selecting relays and magnets. It is to be understood that the distributer D is operated in synchronism and in proper phase relation with the transmitter, correction means controlled by the character impulses being employed to maintain such synchronous operation.

Cable transmitting and receiving apparatus of this type is well understood and therefore requires only a brief description here, except as the operation is modified by the present invention.

I have previously referred to the difficulties which occur in cable transmission due to the cumulative effect when the cable is charged or overcharged by successive current impulses or signals of the same polarity and which not only reduce the speed of transmission, but sometimes interfere with the accuracy of transmission. A method of transmitting code messages in which the successive signals or impulses sent into the cable are always of opposite or reversed polarity possesses many advantages. The present invention provides for the transmission of messages in the five-unit code with successive current impulses of opposite polarity by suppressing those impulses or signals which follow an impulse of the same polarity.

Referring to Fig. 2, *a* represents a short length of tape perforated for the first five letters of the alphabet in the five-unit code. *b* represents the plus and minus or positive and negative current impulses corresponding to these perforated letters or signals and which would be transmitted to the cable or main line by the usual automatic tape transmitter. *c* shows the same impulses with the first impulse of each group of positive and negative impulses in heavy lines and the succeeding impulses of like polarity in light lines. *d* shows only the first of each group of impulses of like polarity, the succeeding impulses of like polarity being suppressed and accordingly every succeeding impulse transmitted in this manner is of opposite or reversed polarity to the preceding and succeeding impulses.

In accordance with this method if a succeeding letter or character begins with one or more impulses of the same polarity as the last impulse of the preceding letter or impulse, said first impulse or group of impulses of the second letter will be suppressed. Thus as indicated in the diagrams of Fig. 3, showing the punched tape for the word "Paris" and the corresponding positive and negative impulses, the first two impulses of the letter A begins with two like impulses of the same polarity as the last impulse of the preceding letter P and consequently said first group of impulses must be suppressed. The first of the second group of three impulses of like sign in the letter A, which are of opposite sign from the first two and the last of the letter P, will be transmitted, but the other two impulses of this second group must be suppressed. It will be apparent, therefore, that the reversed impulses that are transmitted to the cable for the word "Paris" are as indicated at *d* in Fig. 3, the suppressed impulses being indicated by the intervening spaces.

The manner in which the above described method of suppressing successive impulses of like sign or polarity as carried out in accordance with my present invention will be understood by reference to Fig. 1. Assuming that the parts of the automatic cable transmitter T are in the position shown, the pin 21, having just completed its upward stroke and having passed through a perforation in the tape 23, so that the bell-crank lever 14 has been moved to the left by its spring 17 until the contact point 27 engages the contact stud 29. The circuit is thereby closed from the battery 40, through the magnet 41 of cable sending relay S R, conductor 45, coils 46 of relay 50, contacts 27, 29, lever 14, pivot bar 15 and return conductor 49 to battery 40. The magnet 41 attracts its armature and closes a circuit from ground 51, armature of magnet 42 and its back-stop, main line battery 52, front contact and through armature of magnet 41, and sending a minus impulse through conductor 53, charging the main line condenser 54 and sending a signal into the cable. Simultaneously the energization of coils 46 of polarized relay 50 causes its tongue 56 to swing to the left thereby breaking the circuit from battery 57 through magnet 35, and permitting the latch dog 32 to be drawn to the right by its spring against its front stop and into the path of the end of the lever 14, and at the same time the tongue of relay 50 closes a circuit through its left hand contact between battery 57 and magnet 34, the latter attracting its armature and withdrawing the latch 31 from lever 12. On the next upward stroke of the oscillating bar 18 the lever 12 and its pin 20 are free to be moved upwardly by the spring 16, but the lever 14 and its pin 21 are locked in lower position by the latch 32. Under these conditions if the

next perforation in the tape is the same sign as the preceding one and therefore in alignment with the depressed locked pin 21, no impulse will be transmitted to the cable, since both contacts 26 and 27 are held open, the latter by the action of the latch 32 and the former by the engagement of the pin 20 with an unperforated part of the tape. The same result follows if the two perforations of like signs are followed by a third perforation of the same sign. As soon as a perforation in the tape of the opposite sign is brought into alignment with the pin 20, which is free to move because the latch 31 is held in retracted position by the magnet 34, the passage of the pin through the perforation permits the contact 26 to engage the contact stud 28, thereby closing a circuit from battery 40 through magnet 42 of the main line relay and through coils 47 of relay 50. The attraction of the armature of magnet 42 sends a current impulse of positive sign to conductor 53, charging the condenser 54 in the opposite direction from the preceding charge and therefore reversing the current transmitted to the cable. Simultaneously the tongue of relay 50 is swung against the right hand contact by the coils 47, deenergizing the magnet 34 and energizing the magnet 35. The latch 31 is thus moved by its spring into the path of the lever 12, while the latch 32 is pulled back by the magnet 35 to release the lever 14. Accordingly if the next succeeding perforation is of the same sign no impulse will be transmitted because the lever 12 and pin 20 will be held down by the latch 31 and the circuit at the contacts 26, 28 will remain open.

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 distributer upon the relays of the receiving apparatus at the cable receiving station.

Referring now to the apparatus at the cable receiving station R, it will be seen that the impulses transmitted to the distributer D and set up on the selecting relays, 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 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.

When a positive or marking 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 60 through the coils 61 of polarized relay L R, causing the armature tongue 63 to swing to the right and connect the battery 65 with the rotating arm 67 of distributer D of the printer. If at this instant the arm 67 is on segment 1, a current will be sent through the energizing coil of selecting relay r_1, which attracts its armature which closes a circuit through a holding coil on the relay and through a magnet on the translating mechanism, which may actuate one of the selector disks of the tape printer. If the next succeeding perforation in the tape 23 at the transmitter T is of the same sign, the impulses will be suppressed and no signal will be transmitted over the cable, but as the tongue 63 of the polarized relay L R at the receiving station remains against the contact an impulse from the battery 65 will be transmitted through the arm 67 and segment 2 of the distributer, thereby energizing relay r_2. Its armature likewise closes a circuit through the contact and holding coil on the relay and a magnet on the translator device.

If the next perforation in the tape 23 is of reversed sign, a negative or spacing current impulse will be transmitted over the cable, causing the cable relay arm to swing against the other contact, which closes a circuit from battery 60 through coils 62 of the relay, causing the tongue 63 to swing to the left against the stop. At this instant the distributer arm 67 is on segment 3 and consequently no current will be transmitted to relay r_3. If the next succeeding perforation is of like sign the corresponding impulse will be suppressed by the transmitter T so that no signal will be transmitted over the cable, or, as it is sometimes expressed, zero signal is transmitted. Accordingly, the tongue 63 of the polarized relay L R remains against the stop so that no current is transmitted over the distributer arm 67 when it passes over segment 4 and the relay r_4 is not energized. The result is the same as it would have been if a second negative or spacing current impulse had followed the first one, since a second negative impulse through the cable relay C R, resulting in a current from battery 60 through relay coils 62, would tend to move the tongue 63 to the left in the same direction as before and consequently it would remain against the stop in the position resulting from the previous current impulse through the coils 62.

The detailed description above given makes it clear that my method of operating an automatic cable transmission system includes not only the suppression of succeeding current impulses of like sign at the transmitter so that each succeeding current impulse is of reversed sign, but the introduction of the corresponding suppressed impulses at the distributer D at the receiving station, so

that the signals set up on the selecting relays and corresponding translator magnets of the printer is exactly the same as they would be if all of the impulses of the code characters were sent over the cable.

I have described in sufficient detail the particular apparatus illustrated in the accompanying drawings for the purpose of explaining one manner of carrying out the invention, but it is to be understood that other forms of apparatus may be employed for this purpose and are covered by my claims.

I claim:—

1. In a synchronous telegraph system, an automatic transmitter adapted to transmit current impulses to the main line or the main line relay under the control of a tape perforated to indicate positive and negative impulses corresponding to the code signals, said transmitter having locking means to prevent the transmission of successive current impulses of like sign.

2. In a synchronous telegraph system, an automatic transmitter adapted to transmit current impulses to the main line or the main line relay under the control of a tape perforated to indicate positive and negative impulses corresponding to the code signals, comprising circuit closing devices having reciprocable members adapted to engage the tape and to pass through the perforations therein and locking means adapted to prevent the reciprocation of one of said members after engaging the first perforation of a plurality of successive perforations of like sign.

3. In a synchronous telegraph system, an automatic transmitter comprising circuit closing devices having means for engaging the code-perforated tape, and means for preventing said engaging means from entering a perforation of the tape which immediately follows a perforation indicating a current impulse of like sign.

4. The method of operating a synchronous telegraph system wherein the code signals comprise characters composed of different combinations of positive and negative current impulses, each code character having the same number of impulses, which comprises the preventing of the initiation of any current in the local transmission circuit in case of successive impulses of like sign to thereby transmit to the line or cable only successive impulses of opposite or reversed sign, and supplying to the local receiving apparatus impulses corresponding to all of the marking impulses of the code characters.

5. In a telegraph system, a line circuit, means for impressing permutations of positive and negative currents to said line, transmitting means for controlling said impressing means, means operatively connected to said transmitting means for causing said transmitting means to ground said line in substitution of successive repetitions of current of the same polarity.

6. In a telegraph system, a line circuit, sources of oppositely poled currents, electro-responsive means for including one or the other polarity to the line, an automatic transmitter controlling the operation of said electro-responsive means and means for operatively controlling said transmitter for causing the same to ground said line in substitution of successive repetitions of current of the same polarity.

In testimony whereof I affix my signature.

GEORGE R. BENJAMIN.