

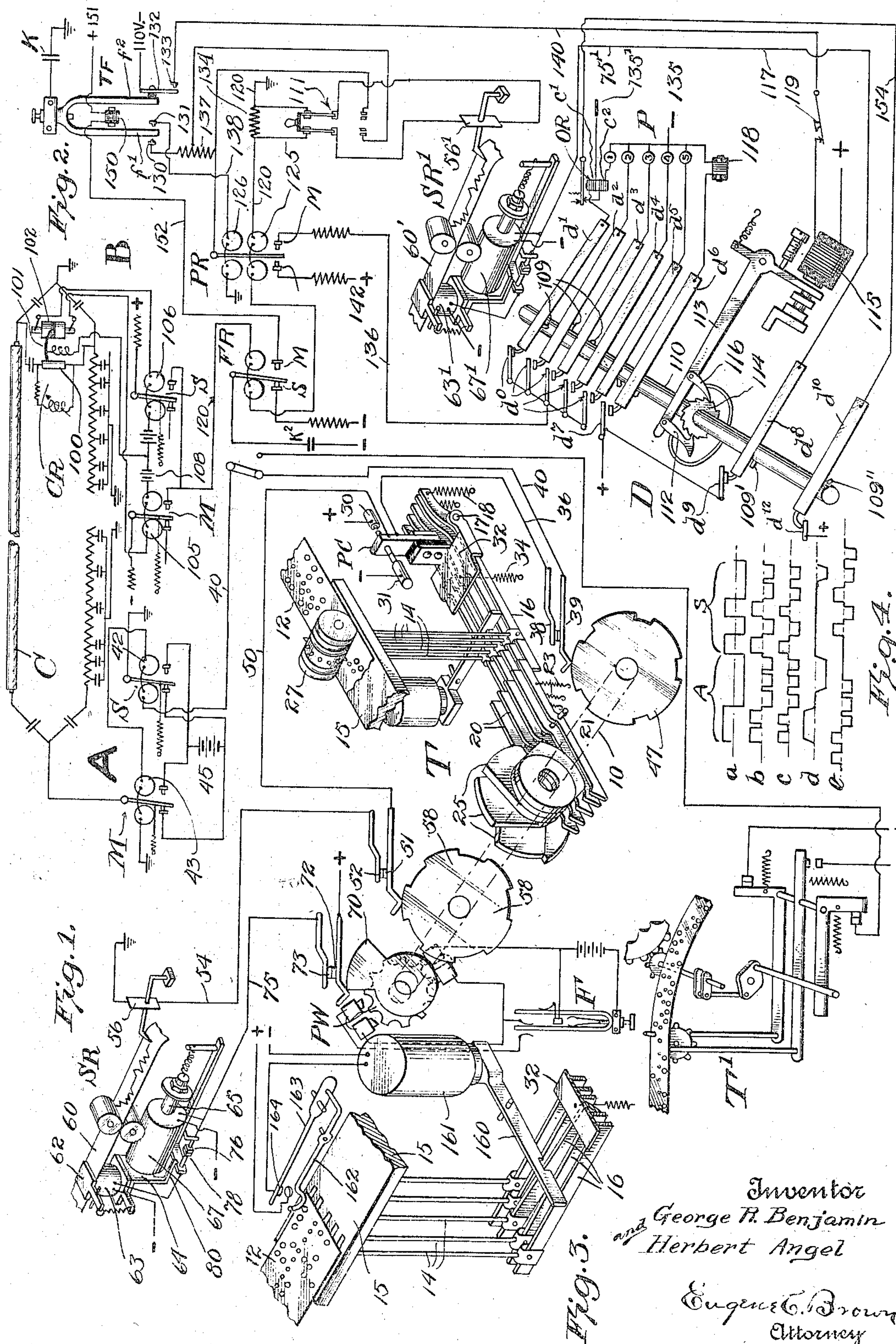
April 6, 1926.

1,579,999

G. R. BENJAMIN ET AL

CABLE TELEGRAPHY

Filed Oct. 23, 1922



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CABLE TELEGRAPHY.

Application filed October 23, 1922. Serial No. 596,467.

To all whom it may concern:

Be it known that we, GEORGE R. BENJAMIN, a citizen of the United States, residing at Jersey City, New Jersey, and HERBERT ANGEL, a subject of the King of Great Britain, residing at Brooklyn, New York, have invented certain new and useful Improvements in Cable Telegraphy, of which the following is a specification.

10 This invention relates to telegraph systems wherein the sending apparatus is automatically controlled by a code-perforated tape and the receiving apparatus controls a printer, the sending and receiving apparatus
15 being automatically maintained in synchronism. This system is especially intended for use over ocean cables but it may also be operated on land lines.

20 The main object of this invention is to provide an organization of apparatus and a method of operation which will facilitate the transmission of messages and increase the output or carrying capacity of cables over existing systems.

25 As is known, the signal impulses sent over an ocean cable are very much attenuated at the receiving end owing to its impedance and capacity and the cable must therefore be operated more slowly than land lines, the
30 signal impulses being proportionately longer. If the current impulses are too short or are sent into the cable too rapidly, they will be practically absorbed, or lost and will not reach the receiving end. We take advantage
35 of this condition by transmitting single code unit impulses at such a high rate of speed that they will not affect the relay at the receiving end and consequently single impulses will produce no effect at the distant end of
40 the cable, while impulses having a duration of two or more single impulses will actuate the cable relay. At the distant or receiving end we provide an organization
45 of apparatus which interpolates all of the missing impulses so that the printer magnets receive impulses corresponding to every impulse indicated in the code characters as they are perforated in the sending tape and pass through the transmitter.

50 In the following description we shall refer to the accompanying drawings, in which only so much of a telegraphic equipment has

been shown as will be necessary to a clear understanding of the invention.

Figure 1 illustrates an organization of ap- 55 paratus embodying our invention at the transmitting station; Fig. 2 shows apparatus for carrying out our invention at the receiving station; Fig. 3 is a fragmentary perspective view of a portion of the tape 60 transmitter; and Fig. 4 is a diagram illustrating the impulses corresponding to certain code characters as they would be sent out or received by different parts of the apparatus. 65

The signals are sent out at the transmitting station A by an automatic transmitter T, which is actuated by a La Cour motor or phonic wheel controlled by a vibrating reed or fork in the well known manner, such a 70 device being illustrated in U. S. patents to Murray No. 670,964 and Yorke & Benjamin No. 1,298,622. We have therefore merely indicated a phonic wheel PW connected to the driving shaft 10 of the transmitter. The 75 tape 12, which has been previously perforated with the code message is fed as usual across the table or plate 15 having a series of holes through which the pins 14 project as they are allowed to move upwardly in 80 succession against the tape. We have shown the transmitter provided with five pins and the tape perforated with five unit code characters but other codes may be employed. The pins are attached at their lower ends to 85 levers 16 pivotally mounted at 17 and urged upwardly by springs 18. These levers are normally held down by a corresponding set of control levers 20 mounted on the pivot rod 21 and yieldingly held downwardly by 90 springs 23. A series of equally spaced cams 25, mounted on the shaft 10, depress the outer ends of the control levers 20 in sequence, thereby permitting the levers 16 to rise successively and project the pins 14 up- 95 wardly against the tape 12. If at the instant any pin is permitted to rise, there is a corresponding perforation in the tape, the pin will pass therethrough into one of the channels in the presser guide roll 27, but if 100 there is no corresponding perforation, the lever and pin will be prevented from rising to any appreciable extent by the tape. A pole changer PC, which may oscillate be-

tween contacts 30 and 31, connected respectively to the plus and minus poles of a battery, is carried by an upwardly extending lug on the table 32, pivoted at 17 and yieldingly held by the spring 34, against the upper surface of the lever 16, so that the pole changer is normally against the contact 31. When any lever 16 is permitted to move upwardly by the passage of its pin 14 through a perforation in the tape, it will tilt the table 32 upwardly and cause the pole changer to move from contact 31 over against contact 30. We have shown a single pole changer actuated by each of the levers 16, but it is evident that a plurality of pole changers may be employed, actuated separately by the respective levers.

The perforations of each code character are in alinement across the tape, perpendicular to the longitudinal axis of the tape. Inasmuch as the tape moves continuously, while the five pins are moved in sequence, it is necessary that the pins should be arranged in staggered relation, each pin being advanced ahead of the preceding pin by an amount equal to the distance, which the tape travels during the time between the actuation of successive pins. Hence, if there were five perforations in any code character each pin would rise at just the proper instant to enter the corresponding perforation. It will be apparent that instead of arranging the pins in staggered relation, the perforations in the tape might be staggered and the pins could then be in alinement at right angles to the tape.

The operation of the apparatus at the transmitting station will now be apparent. The continuously rotating cams 25 actuate the control levers 20 in sequence and permit the corresponding levers 16 to lift the pins 14 whenever there are corresponding perforations in the moving tape 12. Each time a pin passes through a perforation the platform 32 is tilted upwardly and causes the pole changer PC to move from the minus contact 31 against the plus contact 30. A marking impulse is thereby transmitted from the positive pole through contact 30, pole changer PC, conductor 36, contacts 38, 39, conductor 40 and transmitting relays 42, 43 to return. The armature of marking relay 43 therefore swings over against its right hand contact, thereby transmitting a positive impulse from cable battery 45 into the cable C. The duration of this impulse is determined by the length of the cams or unbroken portions of the periphery of the curbing disk 47, carried by the transmitter shaft 10, the spaces or notches between the cams permitting the contacts 38, 39 to separate and break the circuit through conductor 40, thus allowing the armature of relay 43 to return to its back contact and thereby earth the cable for a part of the signal. The per-

centage of curbing may be changed by substituting cam disks having slots or notches of a different length.

For the purpose of keeping a check on the messages transmitted, a local record is produced simultaneously by a circuit from the pole changer PC through conductor 50, contacts 51, 52 and conductor 54 leading to a siphon recorder, indicated conventionally at 56. The block impulses sent from the transmitter T, may be broken up into their component unit code impulses and may be curved to any desired amount, by means of the curbing disk 58, the duration of the impulses transmitted to the recorder SR being determined by the length of the cams or unbroken peripheral portions of the disk while the notches determine the amount of curbing by permitting the contacts 51 and 52 to separate and break the circuit through conductor 50.

In order that the code messages recorded on the tape 60 of the local siphon recorder may be more easily read, we have devised a mechanism which causes each code character to be separated or spaced from the adjacent characters. The tape 60 passes between the armature 62 and the pole-piece of the magnet 63, the latter being carried by a bracket 64 secured to the end of the sliding plunger 65 of a solenoid 67. A cam 70 on the shaft 10 is so disposed that it closes the contacts 72 and 73 just after the fifth lever 16 has been actuated. At this instant a circuit is closed from the positive pole of battery through contacts 72, 73, conductor 75, solenoid 67 and magnet 63 in parallel to the minus pole of battery. The tape 60 is thus clamped between the armature and pole piece of magnet 63 and as the magnet is simultaneously moved forward on the bracket 64 carried by the core 65 of the solenoid, the tape will be momentarily pulled or dragged forward a short distance at the instant between the operation of the fifth pin and the first pin, that is, between successive code characters. In order that the tape may be released just prior to the end of the stroke of the core 65, we provide separable contacts 76, 78 in circuit with the conductor 75, the contact 78 being carried by a spring arm which is engaged by a hook or pawl 80 carried by the bracket 64, the parts being so disposed that the hook engages the spring arm and moves the contacts 78 away from the contacts 76 to thereby deenergize the magnet 63 and cause its armature to release the tape. It is obvious that this arrangement for introducing a space between adjacent code characters may be used with any so-called uniform length code in which an equal number of impulses are provided for each character.

The receiving end of the cable, station B, may be equipped with the usual drum relay

indicated conventionally by the suspended coil 100 carrying the contact arm 101 which swings to one side or the other of the revolving drum 102 to connect the relay 105 or 106 with the local battery 108.

The distributor D, which controls the current impulses sent into the selecting magnets 1, 2, 3, 4, 5 of the printer P, is actuated intermittently by a pawl and ratchet mechanism. The five contacts carried by the levers d^1, d^2, d^3, d^4, d^5 are moved in sequence into contact with the five corresponding contacts d^0 by a series of spirally arranged cam lugs 109 on the shaft 110, the shaft being moved intermittently as the pawl 112 is moved back and forth over the ratchet 114 by the magnet 115. When the magnet 115 is energized the pawl 112 slides over a tooth while pawl 116 steps the shaft 110 around a fraction of a tooth, thereby insuring a firmer pressure between the contacts then in engagement. When the magnet is deenergized pawl 112, which engages a tooth, steps the shaft 110 around the remainder of the tooth and at the same time shifts the position of the cam lugs 109 so that one pair of contacts is separated and the next succeeding pair is brought into contact. To permit this additional pressure between the contacts, we prefer to mount the stationary contacts d^0 upon spring arms. Immediately after the five impulses of a code character have been thus set up in the printer magnets, the lever d^6 is raised to bring its contact in engagement with the contact d^7 to operate the printing magnet 118, as usual. This is followed immediately by the closure of the contact lever d^8 with the contact d^9 to close a circuit through conductor 117 and actuate the clutch magnet 63' and solenoid 67' of the local siphon recorder 56' at the receiving station. This local recorder is a duplicate of the one at the transmitting station and consequently requires no further explanation.

It is sometimes desirable to be able to check the quality of the signals as they are received by the cable and also as they are regenerated by the operation of the relay PR and sent into the printer selecting magnets. For this purpose the siphon recorder 56' is connected to a double throw switch 111, so that it may be connected in shunt to the resistance 134 in the line 120 to receive the signals as they come in over the cable or may be shunted across the resistance 137 to receive the impulses regenerated by the operation of the relay PR and sent into the printer by the fork TF.

The printing operation requires a certain time period and in all prior systems employing a single channel circuit, a definite portion of the line time is assigned for this purpose, which is necessarily subtracted from the transmitting time and is therefore

a positive loss. In our present system, the line may be in use the full time, the impulses of succeeding code characters following each other without intermission. To provide for this, we lock up the impulse received by the first, and possibly the second, selecting magnet of the printer for a period sufficient to allow the printer to print the preceding character. We have illustrated one arrangement for accomplishing this purpose.

The first impulse of each code character coming in over the lever d' , traverses the coil c' of the overlap locking relay OR, causing its armature to be attracted and closing a locking circuit from minus battery 135, through selecting magnet 1 of the printer, coil c^2 and armature of locking relay OR, conductor 154, lever d^{10} and contact d^{12} to plus battery. This circuit remains closed until cam lug 109'' on the shaft 110 lifts the lever d^{10} , thus breaking the circuit at the contact d^{12} . An overlap is thus provided to lock the impulse received by the first selecting magnet and hold it until after the printing magnet has registered the preceding character set up in the printer, thereby permitting the printing of one character to be effected simultaneously with the reception of the first impulse of the succeeding character.

As previously pointed out, we adjust the speed of the transmitter T so that the signal impulses are sent into the cable at a rate too rapid for single impulses to be received at the distant receiving end, or in other words impulses of unit length produce no effect upon the relay at the distant end. The speed of the transmitter is determined by the rate of vibration of the tuning fork which controls the phonic wheel PW operatively connected to the driving shaft 10 of the transmitter.

For the purpose of interpolating the single impulses of unit length and sending them into the printer, we have arranged an organization of apparatus controlled by a vibrating tuning fork operating synchronously with the fork at the transmitting end but adjusted to vibrate twice as fast.

This fork must perform two functions during the time of the reception of one impulse by the relay at the receiving end of the cable. It will be remembered that single impulses of unit length have no effect upon the receiving relay and that impulses of double length are received as single impulses of substantially unit length. During this unit period the fork must first prepare the circuit to a printer selecting magnet and then step the distributor to a new position in time to receive the next succeeding impulse.

In the method heretofore employed for maintaining the fork in vibration, the actuating magnet is controlled by a make and

break contact located directly on the fork, in the manner shown in the patents previously mentioned. In the present system, on the contrary, we maintain the vibrations by remote control, utilizing the received signals to vibrate the fork and also to maintain it in phase with the sending transmitter.

The cable relay CR at the receiving end is actuated by transmitted impulses having a duration of at least two unit code impulses. When a marking impulse is received, the contact pointer 101 swings over the lower part of the drum 102, causing the armature of the marking relay 105 to move to its right-hand contact and connect minus battery to conductor 120, thereby causing the armature of printer relay PR to move against its marking contact M, the armature of the fork controlling relay FR, remaining against its S contact. When a spacing impulse is received by the cable relay, its pointer 101 swings to the opposite side of the drum 102, thereby causing the armature of spacing relay 106 to swing against its right hand contact, thus connecting plus battery to conductor 120. This throws the armature of printer relay PR against its spacing contact S and the armature of fork relay FR against its marking contact M.

The operation of the system will be understood by following the sequence of actions which take place when code characters are transmitted, for instance, the letters AS. These letters are indicated in code characters in Fig. 4. Thus in Fig. 4^b it will be observed that the letter A consists of two plus or marking impulses above the zero line followed by three minus or spacing impulses below the zero line.

Assuming that the tape 12 has been perforated with code characters corresponding to the letters AS and is being fed through the transmitters T. The first two pins 14 will pass in sequence through the holes on the marking side of the tape corresponding to the first two impulses in letter A, and will cause the polechanger PC to swing over against contact 30 connected with plus battery. When two adjacent pins 14 of the transmitter follow in succession through adjacent perforations in the tape, the platform 32 does not drop between successive pins, the succeeding pin or pins maintaining it elevated. Accordingly, the pole-changer PC is held against contact 30 for a double unit period. A block impulse equal to two single unit impulses, as indicated at 4^a would therefore be transmitted over the conductor 36 to the relays 42 and 43, except for the action of the curbing disk 47 which permits the contacts 38, 39 to separate between successive block impulses. The duration of each impulse is determined by the length of the unbroken portions of the periphery of the disk 47, which maintain the contacts 38, 39

closed and likewise the amount or percentage of curbing is determined by the length of the notches between said peripheral portions. The effect of the curbing disk in separating the block impulses of the letters AS and curbing them to about 80% of unit length is illustrated at 4^a. While the resultant effect in the cable produced by the transmission of two or more single impulses of like sign is a continuous prolonged or block signal, nevertheless, the grounding of the cable at each curbing interval between blocks has the effect of preventing the so-called "wandering zero" and maintaining the axis of the current waves at zero or neutral potential.

The double length marking impulses are received by the drum relay CR at the receiving end of the cable as single impulses of substantially unit length and cause the contact arm 101 to swing to the lower portion of the drum 102 thereby throwing the armature of marking relay 105 against its right hand contact, thus connecting conductor 120 to minus battery. This energizes winding 125 of printer relay PR in a manner to throw the armature against its marking stop M. Inasmuch as the tines or arms of the tuning fork TF vibrate at double the speed of the transmitter, the tine f' will engage the contacts 130 and 131 twice while the armature of the relay PR remains against its stop M and likewise the tine f'' will close the contacts 132, 133 twice during the same period. At the first swing of the tine f' against contact 130, magnet 1 of printer P is energized through a locking circuit from minus battery 135, coil c^2 and armature of overlap relay OR, conductor 154, lever d^{10} and contact d^{12} to plus battery. The overlap locking relay is itself energized through a circuit from minus battery 135', coil c' of the relay OR, contact lever d' , the first contact d^0 , conductor 136, armature of relay PR, resistance 137, contact 130, tine f' and the condenser K. On the return swing of the fork the minus charge on the condenser K is discharged through tine f' , contact 131, conductor 138 and coils 126 of printer relay PR. No effect is produced on the armature of relay PR since the magnetic effect of the coils 125 predominates over that of coils 126. Upon the next outward swing the tine f'' closes a circuit through conductor 140 which energizes magnet 115 and steps the distributor forward a half tooth insuring a firmer contact between d^2 and the corresponding contact d^0 which were made to engage when tine f'' left contact 133 at the completion of the first impulse of the letter A. Simultaneously magnet 2 of the printer is energized from minus battery 135 through contact lever d^2 as the tine f' engages the contact 130. The signal impulse through the coils 125 of relay PR terminates at the

same instant that the tine f' leaves the contact 130 for the second time, and as this tine then swings against contact 131, the discharge of the condenser K through the coils 126 is effective to cause the armature of relay PR to swing over against its S stop. In this manner, although but one impulse was received by the cable relay CR, two impulses have been sent into the printer in proper sequence to energize its magnets 1 and 2.

For the purpose of checking up the impulses regenerated by the relay PR, a record is made upon the tape 60' of the siphon recorder SR' by connecting its actuating coils, indicated conventionally at 56', across a portion of the resistance 137. A zero space between consecutive code characters is produced by means of a cam lug 109' which lifts the lever d^8 against the contact d^9 just after the fifth impulse of each character, closing a circuit through conductor 75' which energizes the magnet 63' and solenoid 67' momentarily, the action being identical with that previously described in regard to the siphon recorder SR located at the transmitting station.

The third, fourth and fifth impulses of the letter A are non-selecting or spacing impulses and consequently are not perforated in the tape. Accordingly the third, fourth and fifth pins of the transmitter T will not be permitted to rise and the pole changer PC will remain against contact 31, thereby causing spacing relay 42 to send three unit minus impulses into the cable C, which will be received at the cable relay CR as a block signal of three unit period. The receiving cable relay swings its contact arm 101 to the upper side of drum 102 too late for the third impulse but in time to receive the fourth and fifth impulses. The third impulse, however, is supplied by the operation of the fork, in the manner previously explained, and the fourth and fifth impulses are provided by the cable relay, thereby energizing spacing relay 106 and connecting conductor 120 to plus battery. During the interval that the tongue or armature of printing relay PR is thus held against its S contact, the tines of the tuning fork TF will engage contact 130 three times, but the printer selector magnets 3, 4 and 5 will not be energized because the circuit from minus battery 135 remains open at the contact M of the printer relay. At each vibration of the tine f^2 , the stepping magnet 115 is energized by the closing of the contacts 132, 133 so that the distributor shaft is stepped forward a tooth corresponding to each of the three spacing impulses after which the printing magnet 118 is energized as the contact lever d^6 is raised against its contact d^7 , thereby completing the cycle of operations for the letter A.

The letter S which has been assumed to follow the letter A, consists in the code character of three single impulses, positive, negative and positive, followed by two negative impulses. These are sent into the cable by the transmitter as indicated at 4^a, but inasmuch as the first, second and third impulses are single unit impulses of opposite sign, they produce no effect upon the receiving cable relay CR and its pointer 101 remains in zero position over the central insulating band of the drum 102. These missing impulses are, however, supplied or interpolated by the apparatus at the receiving station B in the following manner:—The armature or tongue of printer relay PR was swung against its S contact by the last signaling impulse of the letter A and the condenser K accordingly received a positive charge from plus battery 142 when the tine f' engaged contact 130. On its back stroke the tine f' engaged contact 131 and discharged a positive current through the windings 126 of relay PR, thereby shifting its armature tongue against its M contact. At this instant or rather just as tine f^2 left contact 133, the distributor raised the contact arm d^7 into engagement with the corresponding contact d^9 and consequently when tine f' makes contact at 130, the magnet 1 of the printer P is energized from minus battery 135 through the operation of the overlap relay OR which receives the impulse from minus battery 135' through lever d^7 and its cooperating contact d^9 , tongue of relay PR, contact 130, tine f' and condenser K. On the return stroke, as the tine f' engages the contact 131, the condenser discharges minus current through the windings 126 of relay PR which throws its armature against its S contact. At the same time the distributor has been advanced by the operation of the stepping magnet 115, in the manner previously described so that the contact arm d^2 engages its corresponding contact d^0 . Upon the next swing or vibration of the tine f' against the contact 130, no current can flow through selecting magnets 2 of the printer because the circuit is broken at the contact M of the relay PR. The condenser K, however, receives a positive charge from the plus battery 142 through the tongue of the relay PR. At the same instant the tine f^2 closes the contacts 132, 133 thereby energizing the magnet 115, and when tine f^2 leaves contact 133, thus deenergizing magnet 115, it steps the distributor around one notch to disconnect contact arm d^2 and simultaneously lift contact arm d^3 against its corresponding contact d^0 , thus preparing a circuit for selecting magnet 3 of the printer in advance of the next impulse. Upon the following return stroke of the tine f' the condenser K discharges a positive current through the windings 126 of relay PR, causing its tongue to swing over to its M contact, whereby when

time f' swings to contact 130, an energizing current flows through printer selecting magnet 3 from minus battery 135 to condenser K. From this explanation it is seen that the first, second and third impulses of the letter S have been interpolated in the local circuits and supplied in proper sequence and sign to the printer by means of the local impulse producer, although during this entire period, the cable receiving relay CR remained in zero position.

The fourth and fifth impulses of the letter S are minus or non-selecting impulses and are sent out from the transmitter T as a single impulse of double length, as indicated in the diagram 4^a, and are transmitted to the cable in the same manner by the spacing relay 42. Since the receiving cable relay CR is affected by impulses of double length, its pointer 101 will swing to the spacing side of the drum 102, arriving there too late for the fourth impulse but in time to receive the fifth impulse. In this case the fourth impulse is furnished by the fork just as in the case of the second impulse, while the fifth impulse is provided by the cable relay, thereby causing relay 106 to connect conductor 120 with plus battery, thereby causing relay PR to be held over to its spacing contact for the fourth and fifth impulses. From the previous description of the manner in which the non-selecting or spacing impulses of the letter A operated the apparatus at the receiving station B, it will be evident that the fork tines will engage the contacts twice during the time this double impulse energizes the cable relay CR, but that selecting magnet 4 and 5 of the printer P will not be energized because a circuit through conductor 136 is open at contact M of relay PR. The distributor D, however, will be stepped around by the stepping magnet 115 in synchronism with the vibrations of the fork TF, thereby completing the cycle of operations for the letter S. It will be observed that the impulse producer circuit from minus battery 135, through conductor 136 to condenser K, is continuously sending impulses of current of opposite sign to the preceding line currents, through the windings 126 of the printer relay PR but that these impulses only function to control the operation of the relay when the cable relay pointer is at zero position i. e. during periods when single impulses are sent out by the transmitter T because the windings of said relay are so designed that current in the winding 125 overpowers current in the winding 126.

It should be also noted that the fork relay FR has its tongue swung to its M contact whenever the conductor 120 is connected to plus battery by the reception of a non-selecting or spacing impulse. When this occurs the fork magnet 150 receives an energizing impulse from plus battery 151 through con-

ductor 152, contact M and tongue of relay FR to condenser K². This impulse is in phase with an impulse sent out by the transmitter T and consequently causes the magnet 150 to produce a pull upon the fork tines at just the proper instant to maintain the vibrations in synchronism and in phase with the transmitter. An energizing impulse is sent through the fork magnet 150 each time a spacing impulse is received by the cable relay CR. We have found that this is sufficient to maintain the fork vibrations in synchronism and proper phase relation with the transmitter, when its natural period of vibration has been properly adjusted to the same rate. We have further found that the fork will continue to vibrate during the intervals between successive impulses produced by the actuating magnet 150. This method of the remote control of the vibrations of the tuning fork has proven successful in actual practice.

In a printing telegraph system it is essential that the sending and receiving apparatus should be maintained in synchronism. As above pointed out, this condition exists as long as signals are being transmitted or in other words while the code-perforated tape is being fed through the transmitter. In this system of remote control, it is necessary that means should be provided for automatically continuing to send signals or impulses to keep the receiving apparatus in step with the transmitter when no tape is passing therethrough. To accomplish this purpose we provide means which operate automatically to lock certain levers and pins of the transmitter the instant the tape moves off of the transmitter, to thereby set up a combination of signals which will be continuously transmitted to the line during the absence of tape in the transmitter. We have shown a pivoted lever 160 which is normally positioned above the transmitter levers 16 and which may be brought into engagement therewith to prevent any upward movement by means of the magnet 161. The central lever is permitted to move upwardly into a notch provided for that purpose. When the end of the tape moves off of the transmitter, a lever 162 is thereby permitted to drop into a slot in the table 15 and thereby cause the lever 163 to close the contacts 164, thereby energizing magnet 161 and throwing the lever 160 down upon the transmitter levers 16. Accordingly, as the cams 25 of the transmitter continue to rotate, the third lever and pin rise during each period corresponding to a code character while the other four pins remain depressed. A signal will, therefore, be repeated continuously into the cable corresponding to the spacing combination in the printer code, namely, No. 3 marking and Nos. 1, 2, 4 and 5 spacing. This combination maintains the sending and re-

ceiving apparatus in synchronism and in addition serves to space the tape in the printer at the receiving end.

If at any time the distributor at the receiving end is out of step with the transmitter, the operator may quickly step the distributor up until it is in phase by manipulating the key 119.

In the above description we have employed apparatus especially adapted for the so-called five unit code, but it is evident that my invention may be adapted to the use of different codes. Instead of arranging the code characters transversely across the tape, they may extend longitudinally thereof and be used in a transmitter of the Wheatstone type having two pins, as illustrated in the usual conventional manner at T'. This apparatus is familiar to telegraph engineers and therefore requires no further explanation. Other well known forms of distributors may be substituted for those illustrated.

We have described this system as applied to a single channel but it will be apparent to engineers that it may be used in a multiple channel system. A multiplex transmitter may be employed or the transmitter T may be provided with two or more groups of actuating cams 25. Likewise the receiving distributor D may be equipped with one or more additional sets of levers and cooperating contacts connected to different printers. The receiving equipment may be advantageously employed on land lines in which all of the transmitted impulses are received by the receiving relay. In some cases, in working on land lines, the curbing may be omitted, the block signals from the transmitter being sent directly to line.

Our system possesses many advantages over prior systems. A lower line frequency is used as compared with other systems for a given output. The circuit arrangements are more simple. No printing period is required and consequently the full line time is available for the transmission of code signals, resulting in the maximum output and giving the greatest possible operating margin. The degree of accuracy is thus increased. Moreover less attention is required for the maintenance of the relays and other operating parts of the equipment.

We claim:—

1. In a synchronous telegraph system, a tape-controlled transmitter, comprising a plurality of reciprocable pins adapted to pass in sequence through the tape perforations representing code characters, pole changing means connected to the transmitting circuit and arranged to effect a circuit change upon the reciprocation of any of said pins and means for actuating said pins in succession comprising a series of cams, a shaft carrying said cams and a uniform

speed motor operatively connected to said shaft.

2. In a synchronous telegraph system, a tape-controlled transmitter, comprising a plurality of reciprocable pins adapted to pass in sequence through the tape perforations representing code characters, the pins and perforations being staggered relatively to each other, single pole changing means actuated by the operation of any of said pins, and means operating continuously at a uniform speed to reciprocate said pins in unbroken succession.

3. In a synchronous telegraph system, a tape-controlled transmitter, comprising a plurality of reciprocable pins adapted to pass in sequence through the tape perforations representing code characters, pole changing means connected to the transmitting circuit and arranged to effect a circuit change upon the reciprocation of any of said pins, means for actuating said pins in succession comprising a series of cams, a shaft carrying said cams and a uniform speed motor operatively connected to said shaft, and a circuit breaker for said transmission circuit including a member operatively associated with said shaft for determining the duration of the impulses to be sent to line.

4. In a synchronous telegraph system as set forth in claim 3, said circuit breaker comprising a disk carried by said shaft and having a notched periphery, and a contact brush bearing upon said periphery, the position of the notches determining the points of curbing of the signal impulses and the intermediate unbroken peripheral portions determining the duration of the impulses to be sent to line.

5. In a synchronous telegraph system, a transmitting apparatus and a receiving equipment comprising a line relay, a printer including selecting magnets and a cooperating distributor, a vibrated fork provided with a synchronizing actuating magnet controlled by the impulses of the code characters, a fork relay controlling the impulses passing into said actuating magnet, and a printer relay controlling the impulses passing to the printer, said line relay controlling the operation of said fork relay and said printer relay.

6. In a synchronous telegraph system, a transmitting apparatus operated at a uniform rate of speed, and a receiving equipment comprising a printer mechanism, a distributor controlling the circuits of the selecting magnets of the printer, and a reed or fork vibrated synchronously with the transmitting apparatus at a multiple of the rate of speed thereof, said fork controlling the operating mechanism of the distributor and causing the marking impulses to be transmitted to the selecting magnets of the

printer corresponding to each unit current impulse of the transmitter.

7. In a synchronous telegraph system as set forth in claim 6, the receiving equipment having a receiving relay responding only to current impulses having a duration of two or more code unit impulses.

8. In a synchronous telegraph system, a tape-controlled transmitter, means for continuously driving said transmitter at a uniform speed, a relay at the receiving end of the line, a printer having selecting devices and an associated distributor, a printer relay responsive to current impulses received by said line relay, the armature of said printer relay controlling successively the circuits leading to the respective selecting magnets of the printer, a vibrating reed or fork actuated by current impulses corresponding to the impulses received by said line relay, said fork being adjusted to operate synchronously with the transmitter at a multiple of the rate of speed thereof, and contacts coacting with the fork to control circuits leading to said armature and to a magnet operating to advance said distributor step by step, said transmitter being operated at such a speed that the cable receiving relay will not respond to impulses having a duration equal to one unit code impulse but will respond to impulses equal to two or more unit code impulses.

9. In a synchronous telegraph system, a transmitter, means for operating the same at such a rate of speed that impulses of unit code length have no effect at the distant end of the line, a receiving line relay responsive to impulses having a duration of two or more of said transmitted unit impulses, a translating mechanism provided with a series of selecting magnets corresponding to the unit impulses of the code characters, a controlling polarized relay for said translating mechanism having two sets of actuating coils, one set responding to the impulses received by the line relay, said polarized relay having an armature controlling an energizing circuit for said translating mechanism, a vibrating reed or fork operating synchronously with said transmitter at the same speed or at a multiple of the rate of speed thereof and operating to alternately close a circuit through said armature and through a condenser, and to discharge said condenser through said other set of coils of said polarized relay, the vibrating fork thereby functioning to supply the circuits of the translating mechanism with impulses corresponding to all of the unit marking impulses of the transmitted code characters.

10. A synchronous telegraph system, comprising a transmitter arranged to transmit successive impulses of like sign as single block impulses, translating mechanism embodying selecting magnets for respectively

receiving in sequence impulses corresponding to each unit impulse of the code characters, a vibrating reed or fork having an actuating magnet energized periodically by the code current impulses received by the line relay, said fork being adjusted to vibrate at twice the rate of the transmitter and operating to interpolate and to supply to said selecting magnets all of the marking impulses of the transmitted messages and to maintain the translating mechanism in synchronism with the transmitter.

11. In a synchronous telegraph system, transmitting and receiving apparatus, actuating devices therefor, and means for maintaining said devices in synchronism, comprising a reed or fork having an actuating magnet, said fork being vibrated by said magnet, the latter being operated by the impulses of the transmitted code characters.

12. In a telegraph system, a transmitter, means associated with the transmitter for setting up a combination corresponding to a special code character whenever the code message tape is withdrawn and causing said character to be transmitted repeatedly and until a tape is inserted in the transmitter.

13. In a telegraph system, a tape-controlled transmitter having a plurality of reciprocable pins adapted to pass in sequence through the tape perforations representing code characters, means for continuously operating the transmitter at a uniform rate of speed, and means actuated by the removal of the tape from the transmitter for locking certain of the pins against movement while permitting one or more pins to operate in the usual manner, whereby a definite signal is transmitted repeatedly when there is no tape in the transmitter.

14. In a telegraph system, a tape-controlled transmitter having a plurality of reciprocable pins adapted to pass in sequence through the tape perforations representing code characters, a polechanger which is actuated to send an impulse to line as each pin passes through a perforation, and an electro-magnetically controlled locking device which is actuated by the withdrawal of the tape to lock certain of the pins while permitting one or more pins to operate, whereby a definite signal is repeatedly transmitted when there is no tape in the transmitter.

15. In a telegraph system, a tape-controlled transmitter having a plurality of reciprocable pins adapted to pass in sequence through code perforations arranged transversely of the tape, said pins being positioned in staggered relation, each pin being in advance of its predecessor a distance equal to the travel of the continuously moving tape during the interval between the operation of successive pins, and a polechanger comprising a pivoted contact arm

connected to the transmitting conductor and adapted to contact with one or the other of two contacts connected to the respective poles of a current source, said arm normally engaging one of said contacts and being moved to engagement with the other contact upon the passing of any one of said pins through a perforation in the tape.

16. In a telegraph system, tape recording mechanism having auxiliary means operating to clamp the tape and quickly pull the tape after each character to thereby introduce an extended zero space or separation between adjacent characters on the tape.

17. In a telegraph system a tape-controlled transmitter, means for locally recording the signals sent out at the transmitting station, comprising tape recording mechanism operatively connected to receive impulses sent out by the transmitter and means operatively connected with the transmitter for curbing to any desired extent the impulses transmitted to said recording mechanism.

18. A system as set forth in claim 17, and auxiliary means coacting with the recording mechanism to quickly pull the tape of said recording mechanism after each

character to thereby introduce an extended zero space or separation between adjacent characters on the tape.

19. In a telegraph system, transmitting apparatus and a receiving equipment, the latter comprising a printer, a recording apparatus and switching means for connecting said recording apparatus at will to receive either the incoming impulses received by the line relay or the impulses transmitted to the printer by the printer relay.

20. In a telegraph system, a transmitting apparatus, a receiving apparatus including a printing apparatus operating in synchronism with the transmitter, a local recording mechanism operatively connected to receive the incoming signals, and auxiliary means associated with said recording mechanism and controlled by the printing apparatus to clamp the tape and quickly pull the tape of said recording mechanism after each character to thereby introduce an extended zero space between adjacent characters.

In testimony whereof we affix our signatures.

GEORGE R. BENJAMIN.
HERBERT ANGEL.