Feb. 24, 1931. E. E. KLEINSCHMIDT 1,793,700

SIGNALING SYSTEM AND APPARATUS THEREFOR

Original Filed Jan. 30, 1925 3 Sheets-Sheet 1

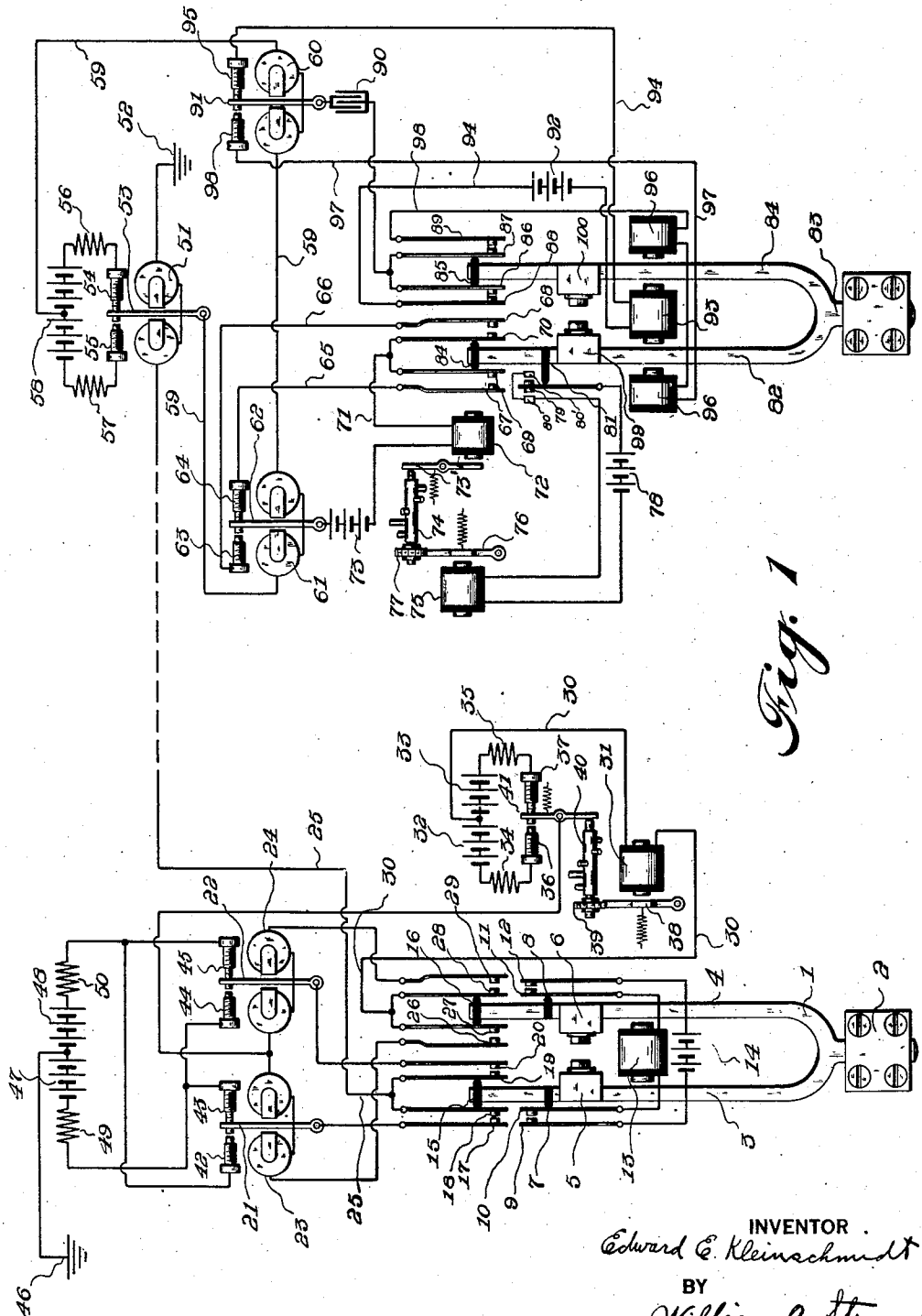


Fig. 1

INVENTOR
Edward E. Kleinschmidt
BY
William A. Strauch
ATTORNEY

Feb. 24, 1931. E. E. KLEINSCHMIDT 1,793,700

SIGNALING SYSTEM AND APPARATUS THEREFOR

Original Filed Jan. 30, 1925 3 Sheets-Sheet 2

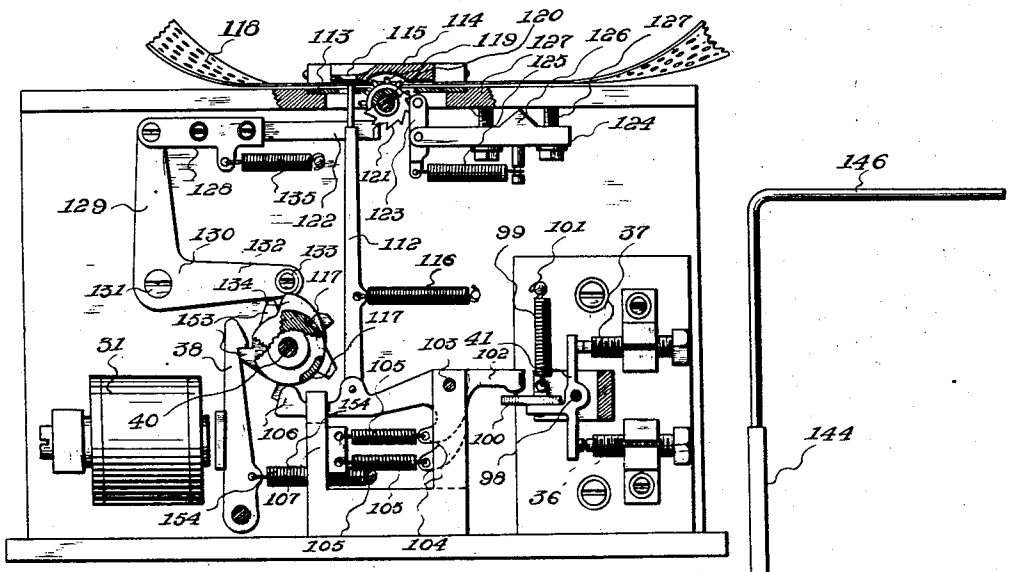


Fig. 2

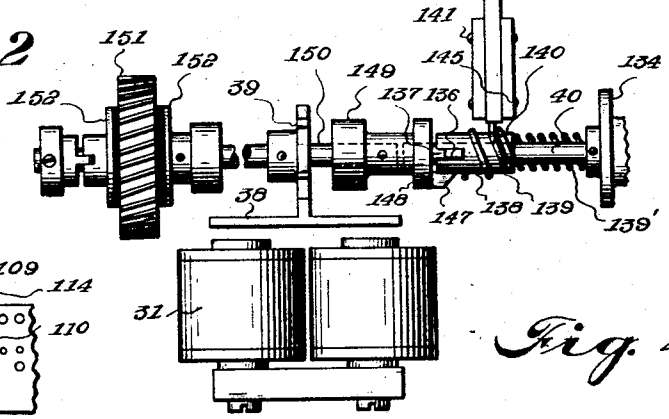


Fig. 4

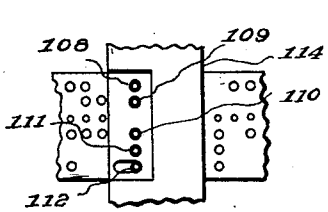


Fig. 3

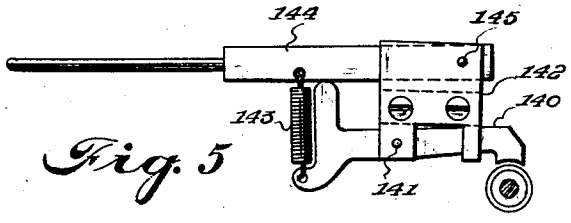


Fig. 5

Inventor
Edward E. Kleinschmidt

By William A. Strauch

Attorney

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SIGNALING SYSTEM AND APPARATUS THEREFOR

Original Filed Jan. 30, 1925 3 Sheets-Sheet 3

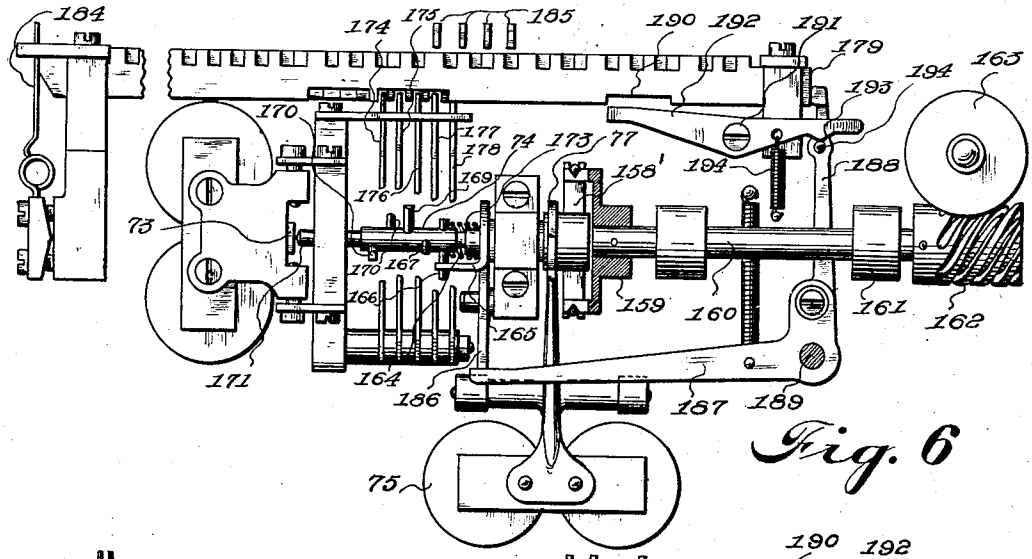


Fig. 6

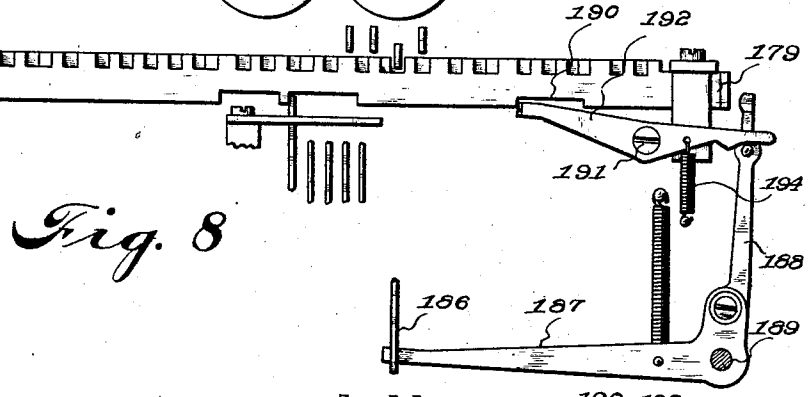


Fig. 8

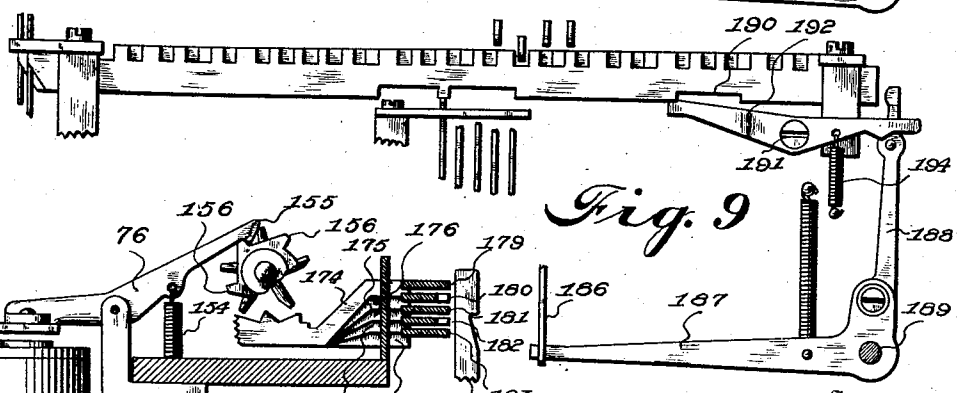


Fig. 9

Fig. 7

Inventor

Edward E. Kleinschmidt

By William A. Strauch

Attorney

Patented Feb. 24, 1931 1,793,700

UNITED STATES PATENT OFFICE

EDWARD E. KLEINSCHMIDT, OF EVANSTON, ILLINOIS, ASSIGNOR TO TELETYPE CORPORATION, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE

SIGNALING SYSTEM AND APPARATUS THEREFOR

Application filed January 30, 1925, Serial No. 5,740. Renewed September 17, 1929.

The present invention relates to improved systems of telegraphy and apparatus therefor.

More particularly, the invention relates to improved printing telegraph systems and improved transmitting, receiving and distributing apparatus therefor. The invention is especially adapted for use in a low frequency single channel system and has for one of its objects the elimination of troublesome rotary distributors, and the usual correcting apparatus necessary to establish and maintain concordance of action between rotary distributors.

Another object of the invention is the provision of novel correcting means in which the correcting impulses now commonly utilized are eliminated, and in which normal reversals of current on the line maintain proper concordance of action of the receiving and transmitting apparatus; to produce a simplified, reliable system that will function at minimum line frequencies, and to provide a novel system of signaling in which alternations are normally transmitted to the line and the selections are effected by reversing the alternations. In this manner a selecting or marking impulse may be of either polarity and the length of any impulse of either polarity is limited whereby charging of the line is reduced to a minimum, and for this reason the system is especially useful on high capacity lines.

Because of the fact that the special correcting impulses are eliminated, the usual interval utilized in single channel systems of the well known start-stop type for the transfer of selections in the receiver is substantially eliminated.

A further object of the invention is to provide an improved and simplified receiver which is especially adapted for use in the present system, in which an overlap may be attained without the usual interval between selecting combinations to allow for the transfer and storage of selections in the receiver.

Still other objects of the invention are the provision of a novel transmitter control in which each impulse is timed from the transmitting distributor; the provision of novel impulse storing means at the transmitter; and the provision of a novel stop arrangement in which the transmission is controlled either manually or by the tension of a transmitting tape in a manner to prevent mutilation of signals even though the signals are made up solely of selecting impulses and are not separated by correcting or stop intervals.

Further objects of the invention are such as may be attained by utilization of the various combinations, subcombinations and principles hereinafter set forth and defined by the terms of the appended claims, in the various other relations to which they are obviously adaptable.

Referring to the drawings—

Fig. 1 is a circuit diagram showing the invention as applied to a single channel system.

Fig. 2 is a side elevation of the improved tape transmitter.

Fig. 3 is a fragmental plan view of the transmitter shown in Fig. 2.

Fig. 4 is a fragmental plan view showing the stop and clutch mechanism.

Fig. 5 is a sectional side view of the mechanism shown in Fig 4

Fig. 6 is a fragmental front elevation showing the essential parts and arrangement of the improved receiver.

Fig. 7 is a fragmental sectional side elevation with parts broken away to show the receiver selector and escapement parts.

Figs. 8 and 9 are fragmental views showing the details of the selector bar latch mechanism.

To effect the proper timing of the transmitters and receivers, and to distribute the impulses properly, tuning forks or vibrating reeds are relied upon and no other distributing means are utilized. The transmitting fork is relied upon as the master timing or pace setting fork, and the receiving fork is controlled by the reversals of line current to remain substantially in step with the transmitting fork. To insure a proper control, the receiving fork is preferably timed to vibrate naturally at substantially the same as the transmitting fork, and before the amount of phase difference becomes great

enough to affect the operation, the vibration of the receiving fork is corrected.

In Fig. 1, the transmitting fork 1 is secured to a fixed support 2 and is provided with tines 3 and 4 upon which are secured adjustable weights 5 and 6 for the purpose of regulating the vibration rate of the fork. Secured to tines 3 and 4 are insulating contact operating members 7 and 8 which as the tines 3 and 4 spread and come together, alternately and simultaneously close and permit fixed contacts 9, 10, 11 and 12 to open. Connected in series with these contacts is a magnetic drive magnet 13 and a battery 14. To start the fork into vibration, the tines are stressed by hand and released. The movement of the tines outward closes a circuit through magnet 13 which then attracts the tines and draws them inward. As the tines move inward, contacts 9, 10, 11 and 12 separate and de-energize the magnet 13. In this manner the fork is kept in powerful vibration at a uniform and predetermined rate.

Secured to the ends of tines 3 and 4 are insulating contact operating members 15 and 16. Member 15 alternately and successively opens and closes contacts 17, 18, 19 and 20. Contacts 17 and 20 are connected to transmitting tongues 21 and 22 of polarized transmitting relays 23 and 24, and contacts 18 and 19 are connected to line conductor 25. Member 16 alternately and successively opens and closes contacts 26, 27, 28 and 29. Contact 26 is connected to the winding of transmitting relay 23, contact 29 is connected to the winding transmitting relay 24, and contacts 27 and 28 are connected by conductor 30 through transmitter control magnet 31 to the midpoint between connected batteries 32 and 33. The outer terminals of batteries 32 and 33 are connected through resistances 34 and 35 to fixed contacts 36 and 37. In the form shown, magnet 31 actuates armature or escapement member 38 which controls escapement wheel 39. Escapement wheel 39 is mounted upon and controls the rotation of a pin barrel or cam shaft 40 which may be controlled as more fully set forth in co-pending application, Serial Number 741,578, filed October 4, 1924, or as hereinafter set forth in the description of Figures 2 to 5, to actuate a transmitting tongue 41 in accordance with code combinations to be transmitted. It will be understood, however, that the transmitter is not limited to my improved pin barrel type shown in the copending application, or as hereinafter set forth, but any of the single contact combination code transmitters may be adapted for use in the system by timing the impulses of the transmitted signals from the transmitting fork. Tongue 41 is actuated between contacts 36 and 37 and completes energizing circuits through relays 23 and 24, magnet 31 and batteries 32 and 33, causing tongues 21 and 22 to engage contacts 42, 43, 44 and 45 respectively applying code combinations of positive and negative impulses from ground 46, batteries 47 and 48, over resistances 49 and 50, contacts 17, 18, 19 and 20, to line 25, as will more fully hereinafter appear.

Impulses passing over line 25 actuate polarized line relay 51 in accordance with their polarity and pass to ground 52. Tongue 53 of relay 51 is actuated between contacts 54 and 55 in accordance with the received impulses. Contacts 54 and 55 are connected through resistances 56 and 57 to the end terminals of a split battery 58. The midpoint of battery 58 is connected to a local circuit comprising conductors 59, polarized relays 60 and 61 and tongue 53. Tongue 62 of relay 61 is adapted to engage fixed contacts 63 and 64. Contacts 63 and 64 are connected by conductors 65 and 66 to contacts 67 and 68 which in turn are adapted to engage fork actuated contacts 69 and 70. Contacts 69 and 70 are connected by conductors 71 through selector magnet 72 and battery 73 to tongue 62. Selector magnet 72 through armature 73′ controls cam shaft 74 of the receiver in accordance with the received code combinations to print the desired character, as will more fully hereinafter appear in the description of Figures 6 to 9. Magnet 75 actuates escapement or stepping armature 76 which controls the rotation of cam shaft 74 through escapement wheel 77 or through other suitable arrangements, as will more fully hereinafter appear. Magnet 75 is connected in series with battery 78 through contact 79 and fixed contacts 80 and 80′, contact 79 being actuated by an insulating member 81 carried on tine 82 of receiving fork 83. Contacts 67, 69, 68 and 70 are actuated by an actuating member 84 of insulation secured to tine 82. Tine 82 of fork 83 has secured thereto an actuating member 85 of insulation which actuates contacts 86 and 87 causing engagement thereof alternately and successively with fixed contacts 88 and 89. Contacts 86 and 87 are connected through condenser 90 to tongue 91 of relay 60. Contact 88 is connected through battery 92 to magnet 93 by conductor 94 to contact 95 of relay 60, and contact 89 is connected in series through drive magnet 96 by conductor 97 to contact 98 of relay 60. Weights 99 and 100 are provided on tines 82 and 84 to adjust the rate of vibration of the receiving fork.

Operation of system

In operation the transmitting fork is started by hand. As tines 3 and 4 spread apart, the drive circuit through magnet 13 is completed by closure of contacts 9, 10, 11 and 12, causing the tines to be attracted. As the tines move inward, the circuit through

magnet 13 will be interrupted and the tines will again move outward. In this manner the transmitting fork will be set into vibration at a uniform rate, and will connect tongues 21 and 22 to the line causing current reversals to be sent.

With tine 84 of the receiving fork at rest and contacts 86, 88, 87 and 89 adjusted to be in closed position, as shown in Fig. 1, impulses in unison with the line reversals will be sent alternately through magnets 93 and 96 causing the receiving fork to start into vibration in proper phase relation with the received impulses and to alternately open and close the fork controlled contacts. The receiving fork will also start into vibration in responses to the line reversals if only one pair of contacts 86 and 88 or 87 and 89 are normally closed when the receiving tine 84 is at rest. With contacts 86 to 89 normally open when tine 84 is at rest, the receiving fork must be started by hand. In this case operation of the line relay in response to reversals will attract attention of the receiving operator; or for this purpose an ordinary Morse key and sounder may be provided. The receiving operator then may start the receiving fork into vibration by hand.

At the transmitting station, as tines 3 and 4 move outward contacts 17 and 18 will be closed by tine 3 connecting tongue 21 of relay 23 to the line to transmit an impulse in accordance with the position of tongue 21. At the same time contacts 28 and 29 are closed by tine 4 and a circuit is completed from tongue 41 of the transmitter through battery 32 or 33, magnet 31 and relay 24. Energization of magnet 31 actuates escapement 38 and permits shaft 40 to rotate. As shaft 40 rotates it will position tongue 41 in accordance with the next impulse to be transmitted from tongue 22, and relay 24 will be energized to position tongue 22 for the next impulse. As the tines come together, contacts 17, 18, 28 and 29 are opened, and contacts 19, 20, 26 and 27 are closed. The interruption of contacts 28 and 29 interrupts the energizing circuit for magnets 24 and 31. Tongue 22 of magnet 24 will remain where set, and armature 38 of magnet 31 will be positioned in the path of the next tooth on escapement wheel 39 and will arrest shaft 40 after the impulse has been transmitted to position tongue 22, as will more fully hereinafter appear in the detailed description of the transmitter. The interruption of contacts 17 and 18 disconnects tongue 21 from the line and the closing of contacts 19 and 20 connects tongue 22 of relay 24 to the line to transmit the impulse stored therein. Closing of contacts 26 and 27 completes a circuit from transmitter tongue 41, through battery 32 or 33, magnet 31, and relay 23. Energization of magnet 31 as above set forth permits shaft 40 to rotate to position tongue 41 for the next impulse to be transmitted from 21, and as tines 3 and 4 separate, contacts 19, 20, 26 and 27 will be permitted to separate, and contacts 17, 18, 28 and 29 will be closed. Interruption of contacts 27 and 26 causes deenergization of magnet 31 and armature 38 thereof will arrest cam shaft 40 after the impulse has been sent to relay 23 and the cycle of operations as above set forth will be repeated. It will be apparent that while an impulse is being transmitted from one of the relays 23 or 24, the other of these relays is being conditioned for transmission of the next impulse so that the impulses from the tongues 21 and 22 are alternated in a definitely timed relation determined by the vibration of the fork. The length of each impulse is determined by the speed of vibration of the transmitting fork and tongue 41 of the transmitter need not send full length impulses to relays 23 and 24, and a storage or overlap of one impulse is provided. With the tongue 41 of the transmitter against the spacing contact, current reversals are sent to the line and for each marking impulse the polarity of an impulse is reversed.

At the receiving station movement of tine 82 outward closes contacts 67 and 69 connecting selecting magnet 72 in circuit with battery 73 and tongue 62 of relay 61, and at the same time closes contacts 79 and 80 causing magnet 75 to energize. Energization magnet 75 permits rotation of cam shaft 73. With the forks in synchronism and spacing conditions being received, tine 82 will move in unison with tongues 53 and 62. Tongue 62 will engage contact 63 as contacts 67 and 69 close, and the circuit through magnet 72 will be open at contact 64. If a marking condition is received as contacts 67 and 69 close, tongue 62 will be moved into engagement with contact 64 causing magnet 72 to energize. Energization of magnet 72 shifts rotating shaft 74 endwise and effects a selective setting of the receiver mechanism. As tine 82 moves inward, contacts 67, 69, 79 and 80 will be interrupted and magnets 72 and 75 will de-energize permitting shaft 74 to restore to unactuated position, and armature 76 to arrest the rotation of the shaft after it has moved through an angular distance allotted to one impulse. As the movement of tine 82 continues, inward contacts 68, 70, 79 and 80′ will be closed and magnet 75 will again energize, permitting shaft 74 to rotate for the reception of the next impulse and connecting magnet 72 again in circuit with battery 73 and tongue 62. If the incoming impulse is a spacing condition, tongue 62 will be against contact 64, and magnet 72 will remain de-energized. If the impulse is a marking condition, tongue 62 will engage contact 63 and magnet 72 will energize causing a selecting movement of shaft 74. On the outward movement of tine 82 contacts 68, 70, 79

and 80′ are opened permitting magnets 72 and 75 to de-energize. De-energization of magnet 75 arrests rotation of shaft 74 at the end of the selecting interval, and the movement of tine 82 continues outward closing contacts 67, 69, 79 and 80 for the reception of the next impulse.

In this manner it will be clear that so long as spacing impulses are received, tongues 53 and 62 will vibrate in unison and in phase with the tine 82, magnet 75 will energize with each impulse to permit rotation of shaft 74, but magnet 72 will not energize. Whenever a marking impulse is received, the movement of tongues 53 and 62 will be opposite in phase to the movement of tine 82, and magnet 72 will energize to produce a selective setting of the shaft 74.

Receiving fork drive and synchronization

In operation the transmitting fork is started vibrating manually, and the receiving fork either starts automatically or is manually started, as above set forth. Fork 1 is the pace setting fork for the system and is timed to vibrate so that the desired speed of transmission is attained, one impulse being transmitted for each inward movement, and one impulse being transmitted for each outward movement of the tines. The receiving and transmitting forks are timed to vibrate as nearly as possible at the same rate of speed. When the receiving fork is in synchronism or unison with the received impulses, and spacing impulses are received, tine 82 changes position simultaneously and in phase with the changes in position of tongues 53, 62 and 91. With the receiving fork in synchronism and tongue 91 of relay 60 against contact 95 in response to a received spacing impulse, tine 84 will be to the left in Fig. 1 with contacts 86 and 88 closed. A charging circuit will then be completed through condenser 90, tongue 91, contact 95, neutral drive magnet 93, and battery 92, causing a surge of current thru magnet 93 due to charging of condenser. The energization of magnet 93 caused by this current momentarily attracts tines 82 and 84 supplying energy to the fork and correcting any lack of synchronism. As the tine 84 returns to the right, contacts 86 and 88 will separate and contacts 87 and 89 will close. If the next impulse is a spacing impulse, tongue 91 will engage contact 98, and condenser 90 will discharge through drive magnets 96, and causing a drive and correcting pulse through these magnets which acts to spread the tines. With the receiving fork in synchronism with the incoming impulses, whenever a marking impulse is received, tongue 91 will engage contact 98 when contacts 86 and 88 are closed, and will engage contact 95 when contacts 87 and 89 are closed, so that when marking impulses are received no charge or discharge of the condenser 91 can occur and the mechanical vibration of the fork controls the contacts.

In starting the operation of the system, spacing conditions are transmitted. With the receiving fork 180 degrees out of phase, as may occur in manual starting of the receiving fork, no impulses can pass through magnets 93 and 96 so that the vibrations will gradually die away and the proper phase relation will be approached. As the receiving fork drops into phase, circuits will be completed through the magnets 93 and 96 as above set forth, and the receiving fork will then be pulled into and will be held in synchronism by the drive magnets. During the transmission of messages, on each spacing impulse a correcting and drive pulse will pass through magnets 93 and 96 and during marking impulses the receiving fork will vibrate mechanically and naturally in unison with the received impulses.

Orientation

Because the receivers have no normal or unison position from which they may be started at predetermined intervals, it is necessary that some means of orientation or letter finding be provided for use in starting proper reception. This is accomplished by having the transmitter or transmitters send test messages, and the receiving operator will then momentarily interrupt the operation of escapement magnet 75 by interrupting the energizing circuit therefor with a suitable key (not shown) or by holding armatures 76, so that the relation of cam shaft 74 with respect to the incoming impulses will be altered until the proper relation is reached, at which time the receiver will record intelligible messages. The orientation having been effected, regular transmission may proceed.

Transmitter

A simplified form of transmitter especially adapted for use in the present system is disclosed in Figures 2 to 5. Tongue 41 is pivotally mounted on a suitably supported fixed spindle 98 (Fig. 2) and is normally held out of engagement with adjustable contact 36 and in engagement with adjustable contact 37 by means of spring 99 secured to an operating bar 100 of tongue 41, and to a fixed pin 101. Bar 100 extends transversely across the transmitter and is adapted to be operated by five contact operating members 102 pivotally mounted on a fixed spindle 103. Members 102 are each provided with an extension 104 to which are secured springs 105 individual thereto and normally tending to cause movement of members 102 in a clockwise direction. Each member 102 is provided with an extension 106 guided in a comb 107, and pivotally mounted on extensions 106 are tape con-

trolled fingers 108 to 112. The upper ends of fingers 108 to 111 are guided in circular holes formed in guide plates 113 and 114, while the upper end of finger 112 is guided in an elongated slot 115 formed in guide plates 113 and 114. A spring 116 individual to finger 112 only, normally holds this finger to the right in Fig. 2. Secured to shaft 40 is a set of five cams, one individual to each member 106 and with depression 117 formed therein. The depressions 117 are so spaced with relation to each other that as shaft 40 rotates, members 106 are permitted to move upward successively into depressions 117. Upward movement of members 106 permits fingers 108 to 112 to move successively into engagement with perforated control tape 118 which is provided with transverse rows or groups of perforations in accordance with the code combinations to be transmitted.

Tape 118 is provided with a central row of feed perforations which co-act with the teeth of a tape feed wheel 119 in well known manner to effect the advance of the tape. Feed wheel 119 is mounted on a shaft 120 which has a toothed drive wheel 121 secured thereto. A drive member 122 mounted for reciprocation in suitable guides (not shown) is adapted to engage the teeth of wheel 121 and to advance shaft 120 and feed wheel 119 a distance equal to the spacing between successive groups of tape perforations for each reciprocation of member 122. A centering member 123, pivotally mounted on an adjustable member 124 is forced into engagement with the teeth of wheel 121 by a spring 125 and centers the tape feed wheel 119 to bring the tape perforations in proper alignment with the upper ends of the tape fingers. Member 124 is supported against the frame work on a projection 126 and may be adjusted by means of screws 127. Pivotally connected to the end of member 122 is a link 128, the other end of which is pivotally connected to arm 129 of a bell crank 130. Bell crank 130 is pivotally supported at 131 and supported on arm 132 thereof is a roller 133 which is held in engagement with cam 134 on shaft 40 by the action of spring 135 secured to and urging member 128 to the right in Fig. 2.

Cam shaft 40 extends beyond cam 134 (Fig. 4) and has secured thereto a drive key which fits slidably into a groove 137 formed in clutch member 138. Clutch member 138 is slidably mounted on shaft 40 and is pressed to the left by a helical spring 139′ interposed between cam 134 and the end of member 138. Formed on the outside of member 138 is a spiral groove 139 into which a member 140 is adapted to fit. Member 140 is pivoted at 141 (Fig. 5) in a supporting and guide member 142, and is connected at its opposite end by a spring 143 to a control arm 144 which in turn is pivoted at 145 to support 142. Arm 145 may be formed with an extension 146 under which tape 118 is adapted to pass.

Formed integrally with and projecting from member 138 is a drive finger 147 which is adapted to seat in a drive notch 148 formed in an end face of clutch drive member 149. The end of shaft 40 extends into and is journaled in member 149 which is rigidly secured to and rotatable with drive shaft 150. Shaft 150 is driven from a continuously rotating motor (not shown) through a continuously driven gear 151, rotatable shaft 150, and friction clutch members 152 secured to shaft 150 and driven by gear 151. Rigidly secured to shaft 150 is a ratchet or escapement wheel 39 provided with five teeth 153 each of which is adapted to engage a stop shoulder on armature 38 when the armature is shifted to the right in Fig. 2 under influence of spring 154. The position of teeth 153 with relation to cam depressions 117 is such that for each rotation of shaft 40 an angular distance of one tooth, one impulse will be transmitted by tongue 41, and the shaft will be arrested with the transmitting cams between impulse transmitting positions when any tooth 153 engages the shoulder on armature 38.

Transmitter operation

In operation, magnet 31 is energized and de-energized in response to closing of fork actuated contacts 26 to 29, and for each energization thereof shaft 40 is freed for a rotation of the distance between successive teeth 153. Fingers 108 to 112 are permitted to move upward successively as the respective cam depressions rotate past members 106. If a perforation exists in the tape above the respective fingers, the corresponding members 102 will move downward sufficiently under influence of springs 105 to shift tongue 41 from engagement with contact 37 to engagement with contact 36 and a marking impulse will be transmitted to relay 23 or 24. If no perforation exists in the tape, the respective finger will arrest the downward movement of the corresponding member 102 before tongue 41 can be shifted and a spacing condition will accordingly be transmitted. Immediately after tongue 112 has moved upward into engagement with the tape, and while tongue 41 is transmitting the fifth or last impulse of a code combination, roller 133 drops into the notch of cam 134 and shifts member 122 to the right in Fig. 2, causing rotation of toothed wheel 121 to bring the next group of perforations over the tape fingers. Finger 112 will be carried to the left in slots 115 against the tension of spring 116 in this movement. As finger 112 moves downward out of engagement with the tape, spring 116 restores it to the right. It will be noted that the transmission of successive code combinations proceeds continuously and the feed of the tape

occurs intermittently during the transmission of the last impulse of each code combination.

During transmission, finger 147 of clutch member 138 rests in notch 148 of member 149, and member 140 is held out of groove 139 by the weight of arm 144. To arrest transmission arm 144 is raised either manually or by increasing the tension of tape 118 pressing under extension 146 in well known manner by cessation of the perforating operation. As 144 is raised 140 will be thrown downward into groove 139 by the action of spring 143, and as member 138 rotates it will be shifted to the right in Fig. 4 until tooth 147 is disengaged from notch 148. The parts are so arranged that at this point roller 133 will drop into the notch on cam 134 and will hold shaft 40 from rotating after the fifth impulse of a code combination has been transmitted under control of finger 112, and just before the first impulse of the succeeding code combination is to be transmitted under control of finger 108. In this position of parts tongue 41 will be held against contact 37 and will transmit spacing conditions to relay 23 and 24. It will be noted that the depressions 117 are so shaped that between each impulse tongue 41 will be brought against contact 37.

After tongue 147 is disengaged from notch 148 magnet 31 will continue to be energized under the control of the transmitting fork and shaft 150 will continue to rotate. When transmission is to be started member 144 is lowered either manually or by slacking of the tape and member 140 is raised out of groove 139. Spring 139′ will then force member 138 to the left in Fig. 4, and when notch 148 registers with tongue 147, the tongue will enter into the notch and shaft 40 will again be driven with shaft 150. Transmission will then proceed as above set forth. It will be noted that transmitter operation is arrested only between completed code combinations and spacing conditions are transmitted during this interval. It will also be noted that once the transmitter operation is arrested, it can be resumed only after shaft 150 has made one or more complete revolutions during which the receiver cam shaft is stepped in unison with shaft 150. In this way proper orientation of the receiver is maintained.

Receiving apparatus

The mechanisms of the selector and printer are for the most part the same as disclosed in copending applications, Serial Number 649,562, filed July 5, 1923, and Serial Number 656,857, filed August 11, 1923. Accordingly, only so much of these mechanisms as will disclose their relation to novel parts herein disclosed will be shown and described.

Incoming impulses are distributed in properly timed relation by receiving fork 83 to selector magnet 72 and escapement magnet 75. Magnet 75 actuates armature 76 against the tension of spring 154 and removes shoulder 155 thereof from engagement with teeth 156 of ratchet wheel 77, permitting shaft 157 upon which 77 is mounted to rotate an angular distance allotted to the reception of one impulse for each energization of magnet 75. Shaft 157 is suitably journaled in bearing 158 and is frictionally driven by means of springs 158′ secured in a friction drive member 159 mounted on a shaft 160 which is journaled in bearings 161 and is driven through gears 162 and 163 from a continuously rotating motor. Parts 159 to 163 correspond to parts 25 to 28 of copending application, Serial Number 649,562. Rotatably and slidably journaled in the end of shaft 157 is an extension 164 of cam shaft 74. Secured to shaft 157 is a slotted drive member 165, into the slot of which a cam and drive pin 166 secured to cam shaft 74 slidably fits. Secured to and spirally spaced around cam shaft 74 are selector actuating cam pins 166 and 170. Cams 166 to 170 correspond to the five cams 54 to 58 of copending application, Serial Number 649,562. Cam shaft 74 is provided with an extension 171 slidably journaled in a bearing 172, and forced into engagement with armature 73 of magnet 72 by a helical spring 173 interposed between member 165 and cam 166 which normally forces the cam shaft to the left in Fig. 6. It will be noted that the start-stop pin and mechanism of the copending application are eliminated. Otherwise the structure and operation of these cams is substantially the same as in application, Serial Number 649,562. The cams 166 to 170 selectively set selector bar control fingers 174 to 178 which correspond in structure and operation to selector fingers 37 to 41 of the copending case and are controlled by latches (not shown) of the same structure and in the same manner as the fingers 37 to 41 of the copending cases are controlled. Selector fingers 174 to 178 control the position of notched selector bars 179 to 183 (Fig. 7) corresponding to bars 59 to 63 of the copending case, bars 179 to 183 being normally urged to the right in Fig. 6 by springs 184 corresponding to springs 65 of the copending case. The position of bars 179 to 183 selectively controls actuating bars 185 corresponding to actuating bars 108 of the copending case, and bars 185 are actuated by a printing bail structure corresponding to the bail structure of the copending case.

Immediately after the fifth selecting impulse has been received and the finger 178 has been set, member 186 corresponding to member 73 of the copending case is tripped by a local control cam as disclosed in the copending case. This permits bell crank 187 and selector bar and control member 188, corresponding to members 76 and 77 of the copending case, to move spindle 189, corresponding to spindle 79 of the copending case

in a clockwise direction. As set forth in the copending case this permits the selected ones of the selector bars to move to actuated position and movement of spindle 189 trips the printer control clutch and starts the printer bail to complete the selected operation. As set forth in the copending case the printer bail permits the selected actuating bar to move into the aligned slots, moves it across the slots to effect a printing stroke and then removes it from the slots. After the actuating bar is moved from the slots, spindle 189 is actuated to restore the actuated ones of the selector bars to the left in Fig. 6, ready to move to the selected positions for the succeeding code combination. A full understanding of the mechanisms and operation controlled by the selector bars, and of the selector finger control operation and functions will be had by reference to the copending application, Serial Number 649,562, and further detail will not be given here for this reason.

Owing to the fact that the start and stop intervals of the signals of the copending application are eliminated in the present case, the first impulse of a succeeding code combination immediately follows the fifth impulse of the preceeding code combination. Therefore, to insure the proper functioning of the selecting mechanism it becomes necessary to store the setting of the first pulse selector bar 179 until the selected actuating bar has dropped into the aligned slots, otherwise setting of finger 174 for the succeeding code combination would interfere with the position of bar 179 in the preceding combination. A notch 190 is cut into the lower edge of bar 179. Pivoted to the frame work at 191 is a latch member 192 provided with a cam projection 193. A spring 194 holds cam projection 193 in engagement with pin 194 secured to member 188. The end of 192 is adapted to drop into notch 190 when bar 179 is in unactuated position and member 188 is tripped as shown in Fig. 8, and when bar 179 is in actuated position with 188 tripped, as shown in Fig. 9, latch 192 will engage the lower surface of the bar 179.

It will be noted that the only changes in the receiver of the copending application are the elimination of the start and stop mechanism, and the provision of the storage mechanism for the first selector bar to compensate for the time interval of the start and stop during which the selection is transferred from the selector fingers to the selector bars in the copending case.

Receiver operation

In operation, the impulses are received and shaft 74 is timed in rotation by the receiving fork to rotate in unison therewith, while magnet 72 shifts the shaft end-wise to effect the setting of the selector fingers in accordance with the received impulses. While finger 174 is being set, finger 176 is restored from the previous selection; while finger 175 is being set, 177 is restored; while 176 is being set, 178 is restored; and while fingers 177 and 178 are being set, the fingers 174 to 176 remain set. As soon as finger 178 is set, and towards the end of the fifth impulse, latch 186 is tripped by the local control cam permitting members 187 and 188 to move clockwise. As member 188 moves to the right, spring 194 will force the end of latch 192 upward. If finger 174 was not set so that bar 179 is to remain in unactuated position, the end of latch 192 will move into slot 190, as shown in Fig. 8. If on the other hand, latch 174 is set so that bar 179 is to move to actuated position, then as member 188 moves to the right, bar 179 will follow, and as the end of 192 moves upward it will engage the lower surface of 179 as shown in Figure 9. As soon as the point is reached where the end of 192 will enter slot 190 and hold bar 179, fingers 174 and 175 are restored. The parts are so timed that 192 enters slot 190 and fingers 174 and 175 are restored at the end of the fifth impulse. The fingers 174 to 178 may then be immediately set in accordance with the succeeding code combination. Latch 192 insures the holding of bar 179 in the position corresponding to the preceding code combination, and the printing of the selected character proceeds while the succeeding code combination is being set on the selector fingers. The printing is completed and member 188 restores bars 179 to 183 and removes latch 192 from engagement with bar 179, just in time to take up the positions in accordance with the succeeding selection. In this manner, it will be apparent that a complete overlap of selection and printing is attained without any interval between succeeding code combinations.

Because the transmitting and receiving forks are timed to vibrate as nearly as possible at the same speeds, the system may be operated with fork controlled repeaters. The method of synchronization and driving the receiving fork is also applicable to the multiple channel fork controlled system shown in my copending application, Serial Number 741,578, filed October 4, 1924, and the fork distribution synchronization drive and timing is applicable to picture transmission, multiplex telegraph and repeater systems, and other synchronous selective control systems. By adopting forks to vibrate at different frequencies and utilizing properly selective networks and transformer arrangements to transmit the various impulses to selectively receive them from the line, the present system may be multiplexed.

Having described preferred embodiments of the invention, what is desired to be secured by Letters Patent and claimed as new is:

1. A selecting system comprising means

for transmitting normal successive impulses of opposite polarities, means for reversing the polarity of predetermined ones of said impulses, and a selecting receiving mechanism connected for operation in response only to said impulses of reversed polarities.

2. A selective signaling system comprising vibrating means; means controlled by said vibrating means to transmit successive uniform length impulses alternating in polarity, and means for reversing the polarities of certain of said impulses.

3. The combination as set forth in claim 2 in which said last mentioned means are timed in operation by said vibrating means.

4. The combination as set forth in claim 2 in which said last mentioned means comprises an escapement, and a single tape controlled electrical contact controlled by said escapement.

5. A selective signaling system comprising vibrating means timed in operation by received impulses of normally alternating polarities; and a receiving selector timed in operation by said vibrating means; said selector being responsive only to said received impulses when said normal polarities are reversed in character.

6. A signaling system comprising normally vibrating means for transmitting selecting impulses at a predetermined rate, a receiving selector responsive to said selecting impulses; and vibrating means timed in operation by said selecting impulses controlling said receiving selector.

7. A transmitter adapted to transmit code combinations of marking and spacing conditions in rapid succession without a substantial time interval between succeeding code combinations comprising a plurality of tape fingers, a control tape for said fingers; a cam shaft controlling the movement of said fingers a clutch driving said cam shaft, and means actuated by the tension of said tape for causing disengagement of said clutch to arrest rotation of said cam shaft only between completely transmitted signals.

8. The combination as set forth in claim 7 in which said clutch is driven by a frictionally driven escapement controlled shaft.

9. A printing telegraph selector comprising a plurality of notched selector bars; means responsive to received code combinations of impulses controlling said selector bars, and means for storing the setting of one of said bars to permit a complete overlap to be obtained in said selector without a transfer, and storage interval between selecting conditions of successive code combinations of said received impulses.

10. In a signaling system, a pair of transmitting relays, transmitting means selectively and alternately controlling the transmitting positions of said relays, and a common vibratory means timing the operation of said relays and said transmitting means, and the length of transmitted impulses.

11. The method of selective signaling which comprises transmitting normal successive spacing conditions made up of electrical impulses of alternate positive and negative polarity, maintaining a receiver unresponsive to these impulses, and reversing the normal polarity of one of these impulses for operating the receiver.

12. In a signaling system, means for transmitting impulses of alternate positive and negative polarity, a receiver unresponsive to said alternations of impulses, and means for reversing the polarity of one of said impulses, said receiver being responsive thereto.

13. In a signaling system, means for transmitting impulses of alternate positive and negative polarity, means for reversing the polarity of one of said impulses and a receiver unresponsive to said alternations of impulses and responsive to said reversed normal impulse.

14. In a signaling system, means for transmitting impulses of alternate positive and negative polarity, means for reversing the polarity of one of said impulses and a receiver maintained electrically disconnected for operation during said alternations and connected for operation during said reversal of the normal polarity.

15. In a printing telegraph system, a receiver, means for periodically connecting said receiver for response to impulses of one polarity, means for normally transmitting impulses of opposite polarity during these periodic intervals and means for reversing the normal polarity of an impulse to operate said receiver.

16. In a printing telegraph system, a receiver, means for rendering said receiver alternately responsive to impulses of opposite polarity, means for normally transmitting impulses of opposite polarity from that to which the receiver is responsive and means for reversing the normal polarity at any interval for operating said receiver.

17. In a printing telegraph receiver, a receiver comprising a neutral relay, means for transmitting impulses of opposite polarity, said relay being unresponsive to said impulses and means for reversing the normal polarity of one of said impulses for operating said relay.

18. In a printing telegraph receiver comprising a vibrating means, and a relay, means for transmitting successive impulses of opposite polarity to said receiver, circuits including said vibrating means for maintaining said relay open circuited during said alternations of polarity and means for reversing the normal polarity of one of said impulses to close said relay circuit.

19. In a printing telegraph system, a relay, a vibrator periodically preparing alternate

circuits for said relay and receiver, means responsive to impulses of successive reversals of polarity for further preparing said alternate circuits, said receiver normally operating out of phase with said vibrator.

20. In a printing telegraph system, a receiver relay, a plurality of circuits for said relay, means for successively preparing said circuits for completion, means responsive to received impulses for further preparing said circuits, said last mentioned means being normally out of phase with said first mentioned means.

21. In a printing telegraph system, a receiver relay, a plurality of circuits for said relay, means for successively preparing said circuits for completion, means responsive to received impulses for further preparing said circuits, said last mentioned means being normally out of phase with said first mentioned means, and means for changing said impulses whereby said last mentioned means is operated in phase with said received impulses.

22. In a printing telegraph system, a relay, a plurality of circuits for said relay, means responsive to received impulses for partially completing said circuits in succession, second means in synchronism but out of phase with said impulses, for successively partially completing said circuits and means for shifting the phase of said received impulses whereby one of said circuits is completed by said first and second means.

23. In a printing telegraph system, a transmitter and a receiver, a vibrator individual to said transmitter and said receiver, means for operating said vibrator in synchronism, means controlled by said transmitter for transmitting impulses of alternating positive and negative polarity to said receiver said impulses being transmitted in synchronism but out of phase with said receiver and means for transmitting a marking impulse in phase with said receiver.

24. In a printing telegraph system, a vibrator, a transmitter controlled by said vibrator for transmitting impulses and means including said vibrator for simultaneously storing one of said impulses to be transmitted and transmitting the previously stored impulse.

25. In a printing telegraph system, a vibrator, a single contact transmitter controlled for operation by said vibrator and means including said vibrator for transmitting impulses originated by said single contact transmitter.

26. In a printing telegraph system, a single contact transmitter, a vibrator controlling said transmitter, and means including said vibrator for storing impulses from said transmitter while transmitting a previously stored impulse.

27. In a printing telegraph system, a vibrator, a transmitter, controlled by said vibrator, a receiver, a second vibrator controlling said receiver, means for operating said vibrator in synchronism, means including said transmitter vibrator for transmitting code combinations of impulses from said transmitter, and means including said receiver vibrator for operating said receiver in accordance with said last code combination of impulses.

28. In a transmitter, a plurality of tape controlled fingers, a control tape for said fingers, a cam shaft for said fingers, a single contact transmitter controlled by said fingers, and a lever controlled by said tape, said lever being operative to stop the rotation of said shaft only at the end of a code combination of impulses.

29. A selective signaling system comprising an element capable of periodic motion, means including said element for generating signaling currents timed in accordance with the period of said periodic member, means whereby succeeding generated signaling currents are normally of alternate polarity and means for modifying the polarity of certain of said signaling currents for producing code combinations of signaling currents.

30. A selective signaling system comprising vibrating means, means controlled by said vibrating means to transmit successive uniform length impulses alternating in polarity, the length of the impulses being determined by the vibrating means and means for reversing the polarity of certain of said impulses.

31. A selective signaling system comprising vibrating means, means controlled by said vibrating means to transmit successive uniform length impulses alternating in condition, the length of the impulses being determined by the vibrating means and means for changing the condition of certain of said impulses.

32. A selective signaling system comprising vibrating means, means controlled by said vibrating means to transmit successive uniform length impulses alternating in condition, the length of the impulses being determined by the vibrating means, means for changing the condition of certain of said impulses and means for varying the period of said vibrating means for varying the length of the impulses.

33. A selective signaling system comprising vibrating means, means controlled by said vibrating means to transmit successive uniform length impulses alternating in condition, the length of the impulses being determined by the vibrating means and means for changing the condition of certain of said impulses.

34. A selective signaling system comprising vibrating means, means controlled by said vibrating means to transmit successive

uniform length impulses alternating in condition, the length of the impulses being determined by the vibrating means, means for changing the condition of certain of said impulses and means for varying the period of said vibrating means for varying the length of the impulses.

35. A selective signaling system comprising vibrating means, means controlled by said vibrating means to transmit successive uniform length impulses alternating in condition, the length of the impulses being determined by the vibrating means, a magnet periodically energized by said vibrating means, an escapement controlled by said magnet and a single tape controlled electrical contact controlled by said escapement for changing the condition of certain of said impulses.

36. A selective signaling system comprising vibrating means, means controlled by said vibrating means to transmit successive uniform length impulses alternating in condition, the length of the impulses being determined by the vibrating means and a single tape controlled electrical contact timed in operation by said vibrating means for changing the condition of certain of said impulses.

37. A selective signaling system comprising a vibrating means, means for timing the transmission of impulses normally reversing in condition, means for reversing the impulse condition from normal, a second vibrating means timed in operation by the received impulses and a receiving selector timed in operation by said vibrating means, said selector being responsive only to said received impulses when said conditions are reversed from normal conditions.

38. A selective signaling system comprising vibrating means, means controlled by said vibrating means to transmit successive uniform length impulses alternating in condition, the length of the impulses being determined by the vibrating means, means for changing the condition of certain of said impulses, a second vibrating means timed in operation by the received impulses and a receiving selector timed in operation by said vibrating means, said selector being responsive only to said received impulses when said conditions are reversed from normal conditions.

39. A selective signaling system comprising vibrating means, means controlled by said vibrating means to transmit successive uniform length impulses alternating in condition, the length of the impulses being determined by the vibrating means, means for changing the condition of certain of said impulses, a second vibrating means timed in operation by the received impulses and a receiving selector timed in operation by said vibrating means, said selector being responsive only to said received impulses when said conditions are reversed from normal conditions.

40. In a signaling system, a pair of transmitting relays, means controlling said relays for normally transmitting alternate impulse conditions, transmitting means for selectively modifying the transmitting conditions of said relays for varying the conditions of said impulses and a vibrating means for timing the operations of said relays and said transmitting means for controlling the length of the transmitted impulses.

41. In a signaling system, a pair of transmitting relays, means controlling said relays for normally transmitting alternate impulse conditions, transmitting means for selectively modifying the transmitting conditions of said relays for varying the conditions of said impulses, a vibrating means for timing the operations of said relays and said transmitting means for controlling the length of the transmitted impulses, and means for varying the period of said vibrating means.

42. In a single channel telegraph, means to transmit a series of permutation code signals so that the interval between the last impulse of one signal and the first impulse of the next signal is the same as the interval between succeeding impulses in the same signal and means to stop the transmission between succeeding signals.

43. In a single channel telegraph, means to transmit a series of permutation code signals so that the interval between the last impulse of one signal and the first impulse of the next signal is the same as the interval between succeeding impulses in the same signal and a single magnet repeater to directly record the characters corresponding to said signals in print.

44. In a single channel telegraph, means to transmit a series of permutation code signals so that the interval between the last impulse of one signal and the first impulse of the next signal is the same as the interval between succeeding impulses in the same signal, a single magnet receiver embodying a series of elements one corresponding to each permutation in the code, and means to selectively operate said elements according to the signal transmitted.

45. In a single channel telegraph, means to transmit a series of permutation code signals so that the interval between the last impulse of one signal and the first impulse of the next signal is the same as the interval between succeeding impulses in the same signal, a series of elements one corresponding to each permutation in the code, and means comprising a single magnet to control said elements according to the signal transmitted.

46. A selective signaling system comprising an element capable of periodic motion, means including said element for generating signaling impulses timed in accordance with

the period of said periodic member, means whereby the generated signaling impulses are composed of marking and spacing conditions, successive marking or spacing impulse conditions being of opposite polarity, and means for modifying the polarity condition of certain of said signaling impulses for producing code combinations of signaling conditions.

47. A selective signaling system comprising an element capable of periodic motion, means including said element for generating signaling impulses timed in accordance with the period of said periodic member, means whereby the generated signaling impulses are composed of marking and spacing conditions, successive marking or spacing conditions being of opposite polarity, and means timed in operation by said periodic member for modifying said signaling impulses.

48. A selective signaling system comprising an element capable of periodic motion, means including said element for generating signaling impulses timed in accordance with the period of said periodic member, means for varying the period of said periodic member, means whereby the generated signaling impulses are composed of marking and spacing conditions, successive marking and spacing conditions being of opposite polarity, and means for modifying the polarity condition of certain of said signaling impulses for producing code combinations of signaling conditions.

49. A selective signaling system comprising an element capable of periodic motion, means including said element for generating signaling impulses timed in accordance with the period of said periodic member, means for varying the period of said periodic member, means whereby the generated signaling impulses are composed of marking and spacing conditions, successive marking and spacing conditions being of opposite polarity, and means timed in operation by said periodic member for modifying said signaling impulses.

50. In a single channel telegraph, means to transmit a series of permutation code signals in which successive elements of the code signals have different conditions for spacing, a receiver comprising selector mechanism and means for periodically adjusting the receiver to operate in accordance with spacing conditions for successive spacing impulses of different conditions.

51. In a single channel telegraph, means for transmitting code combinations of marking and spacing impulse conditions in which any two succeeding spacing conditions are of different characteristics, a receiver comprising selector mechanism responsive to the received code combinations and means whereby the selector mechanism is conditioned to operate in accordance with spacing conditions in response to succeeding impulses of different characteristics.

52. In a single channel telegraph, means for transmitting code combinations of marking and spacing impulse conditions, in which any two succeeding spacing conditions are of different characteristics, a receiver comprising selector mechanism responsive to the received code combinations, means whereby the selector mechanism is conditioned to operate in accordance with spacing conditions in response to succeeding impulses of different characteristics, and means for modifying the characteristics of the pre-determined impulses for producing marking impulse conditions.

53. In a signaling system, a transmitter comprising an element capable of periodic motion, means including said element for generating signaling impulses timed in accordance with the period of said periodic member, means for varying the period of said periodic member, means whereby the generated signaling impulses are composed of marking and spacing conditions, successive marking and spacing conditions being of opposite polarity, means timed in operation by said periodic member for modifying said signaling impulses, a receiver comprising an element capable of periodic motion in synchronism with said transmitter periodic element and means for modifying said receiver whereby it operates in accordance with successive spacing impulse conditions in response to succeeding impulses of opposite polarity.

54. In a signaling system, means to transmit code combinations of impulse conditions in which successive elements of a code condition have different characteristics, a receiver capable of periodic motion and means for modifying the operation of said receiver whereby said receiver operates in accordance with spacing conditions for successive impulses of opposite polarity.

55. In a single channel telegraph, means to transmit a series of permutation code signals so that the interval between the last impulse of one signal and the first impulse of the next signal is the same as the interval between succeeding impulses in the same signal; a magnet responsive to said signals; and a receiving mechanism embodying permutation code elements controlled through solely mechanical connections by said magnet.

56. In a single channel printing telegraph, means to transmit a series of permutation code signals so that the interval between the last impulse of one signal and the first impulse of the next signal is the same as the interval between succeeding impulses in the same signal; a single magnet responsive to said signals; and receiving mechanism embodying permutation code elements and over-

lap mechanism controlled through solely mechanical connections by said magnet and operative to effect printing of a received character while the succeeding character is being received.

57. In a single channel telegraph, means to transmit a series of permutation code signals so that the interval between the last impulse of one signal and the first impulse of the next signal is the same as the interval between succeeding impulses in the same signal; a single magnet responsive to said signals; and a single magnet having mechanical printing means under the control of said magnet through solely mechanical connections.

58. In a single channel type printing telegraph, means to transmit a series of permutation code signals so that the interval between the last impulse of one signal and the first impulse of the next signal is the same as the interval between succeeding impulses in the same signal; a single magnet responsive to said signals; and a type printing receiver controlled through solely mechanical connections of said magnet to effect the printing of characters corresponding to the permutation code signals received by said magnet.

59. In a single channel telegraph, means to transmit a series of permutation code signals so that the interval between the last impulse of one signal and the first impulse of the next signal is the same as the interval between succeeding impulses in the same signal; a single magnet and a receiver embodying permutation code elements and overlap mechanism selectively controlled through solely mechanical means by said magnet to effect recording in accordance with one received permutation code signal, while a succeeding permutation code signal is being received.

In testimony whereof, I affix my signature.

EDWARD E. KLEINSCHMIDT.