Jan. 19, 1943. L. M. POTTS 2,308,539

TELEGRAPH TRANSMITTER

Filed Dec. 30, 1937 8 Sheets-Sheet 1

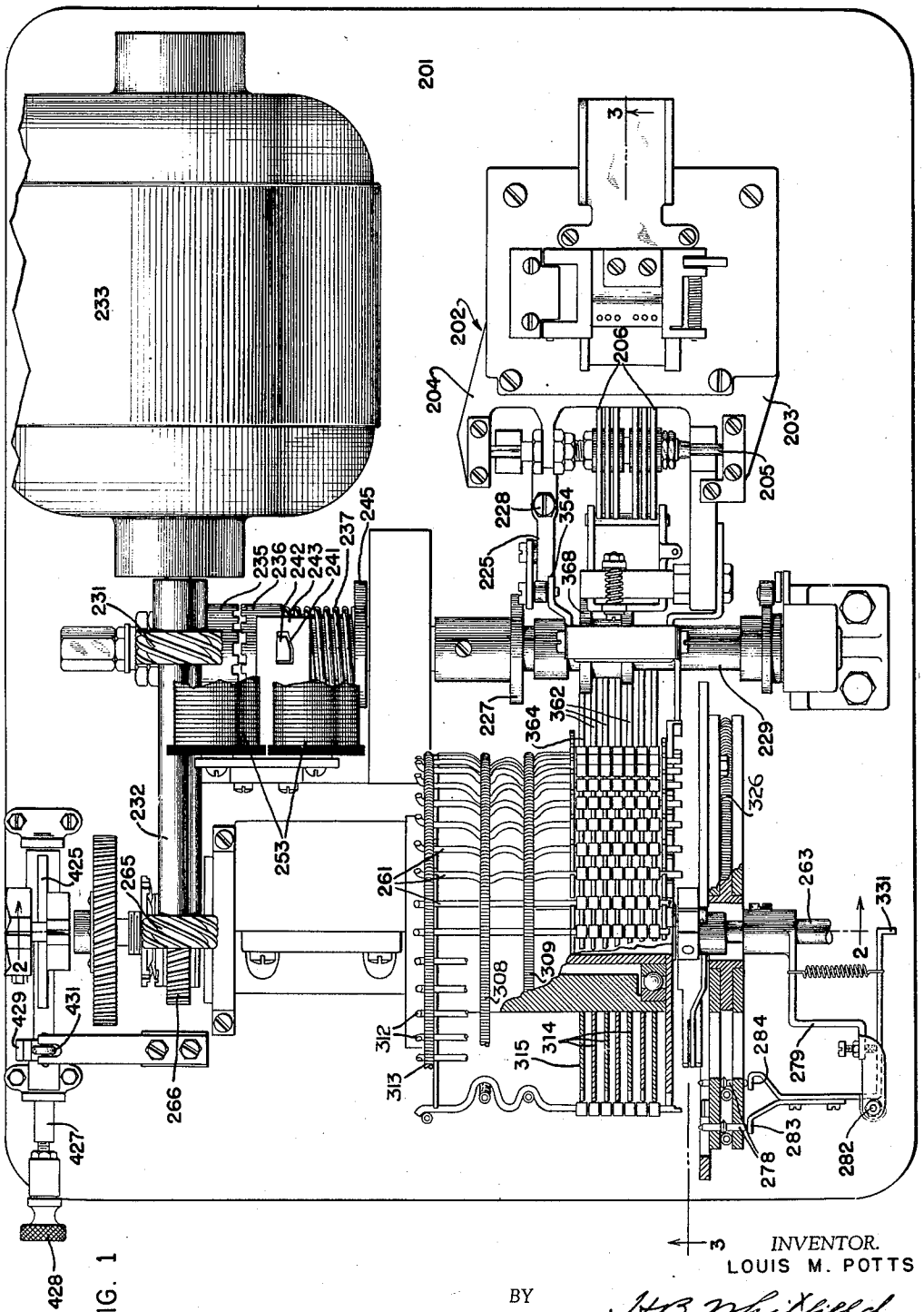


FIG. 1

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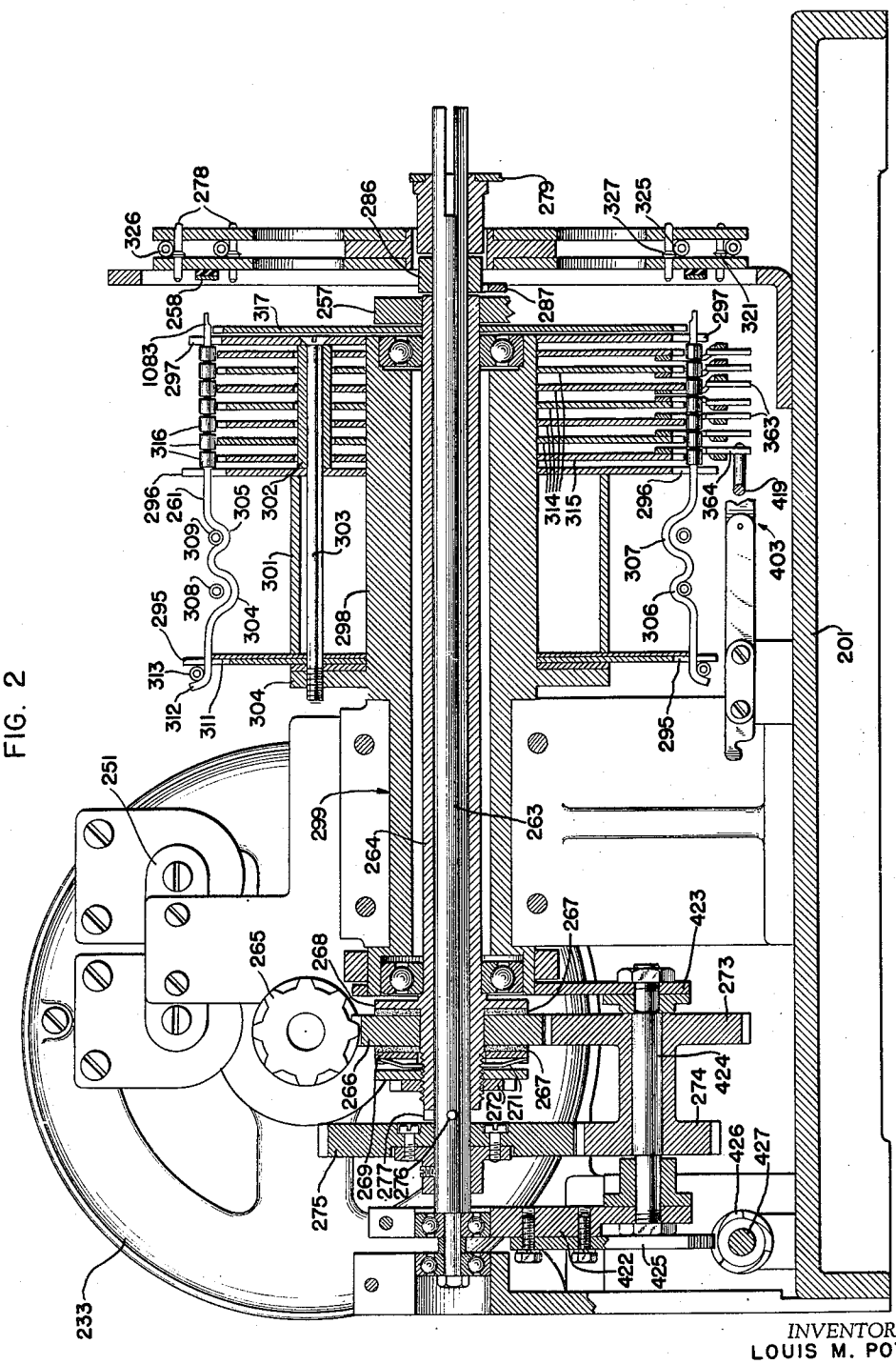
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Jan. 19, 1943. L. M. POTTS 2,308,539

TELEGRAPH TRANSMITTER

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FIG. 2



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TELEGRAPH TRANSMITTER

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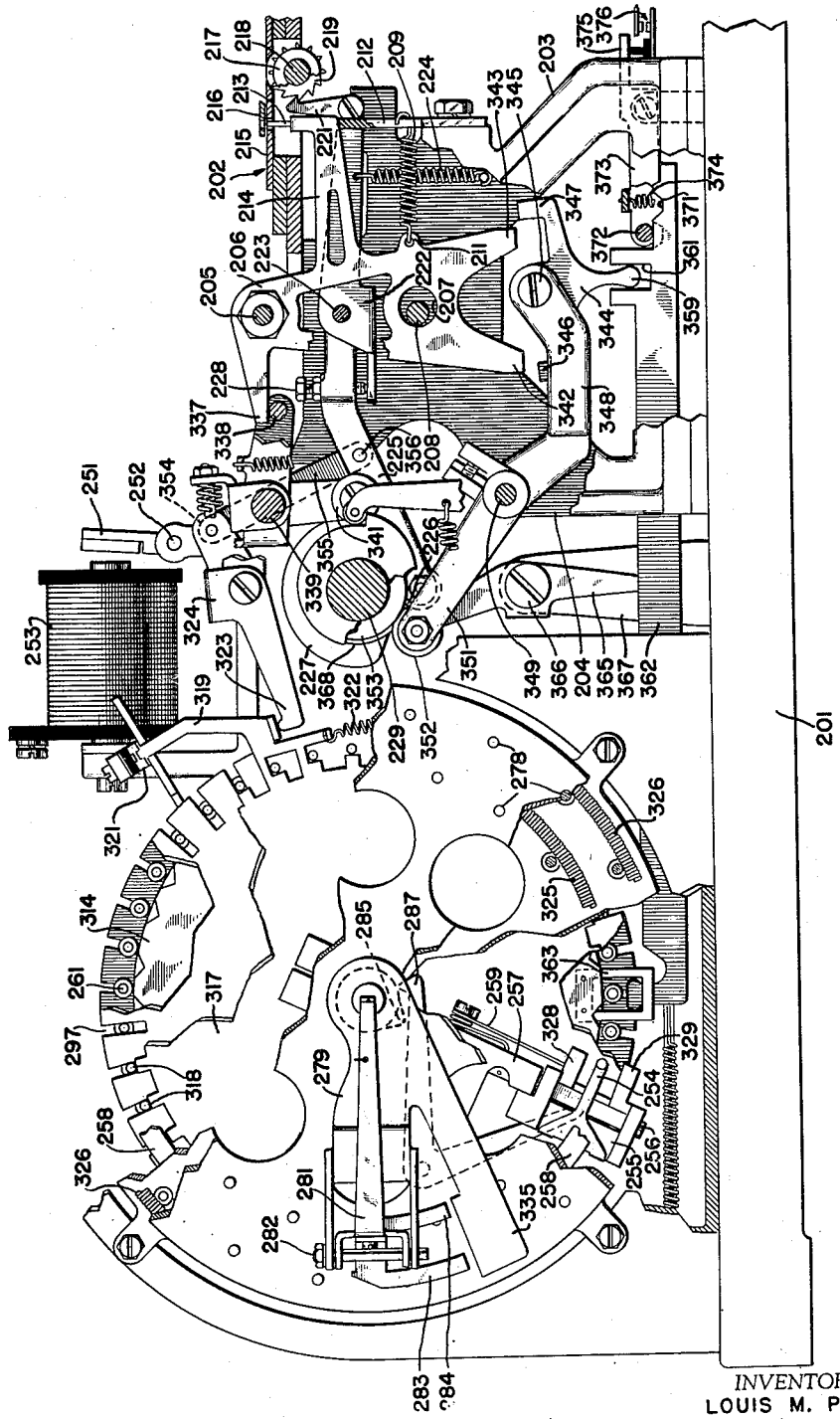


FIG. 3

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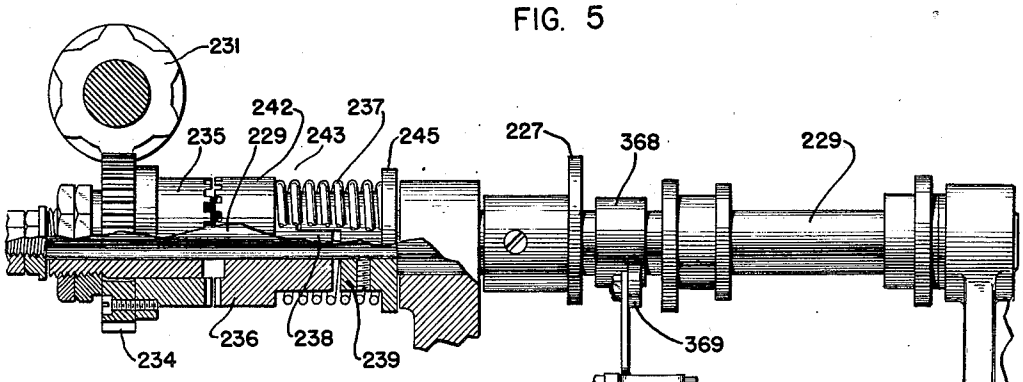
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Jan. 19, 1943. L. M. POTTS 2,308,539

TELEGRAPH TRANSMITTER

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FIG. 5



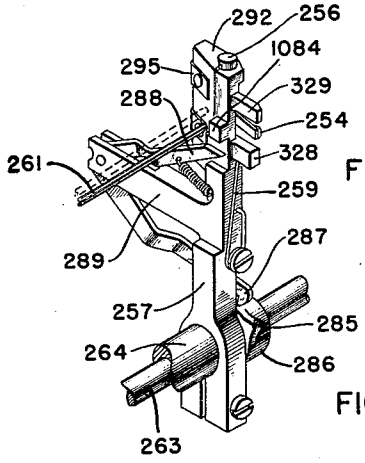


FIG. 12

FIG. 4

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TELEGRAPH TRANSMITTER

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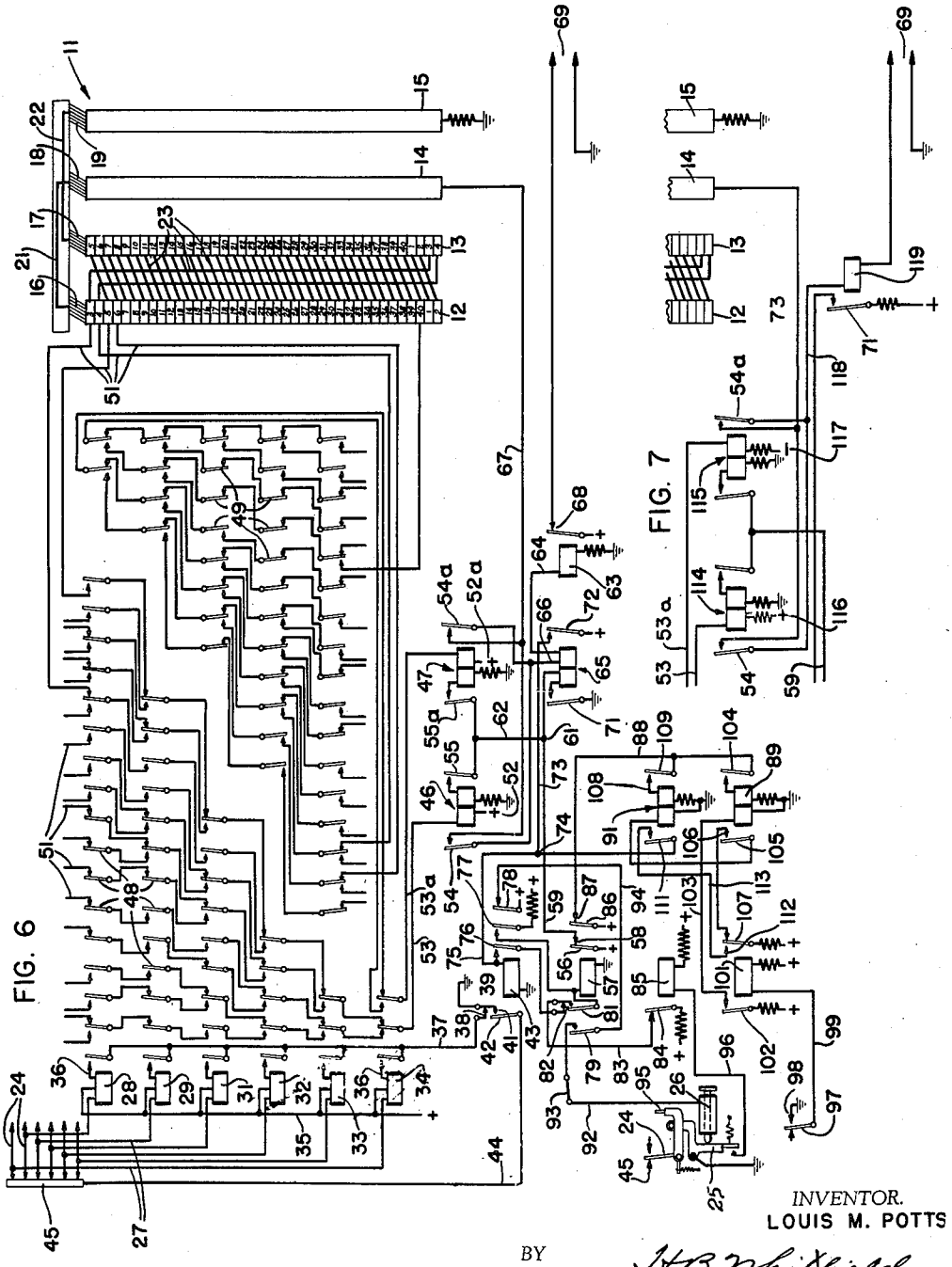


FIG. 6

FIG. 7

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TELEGRAPH TRANSMITTER

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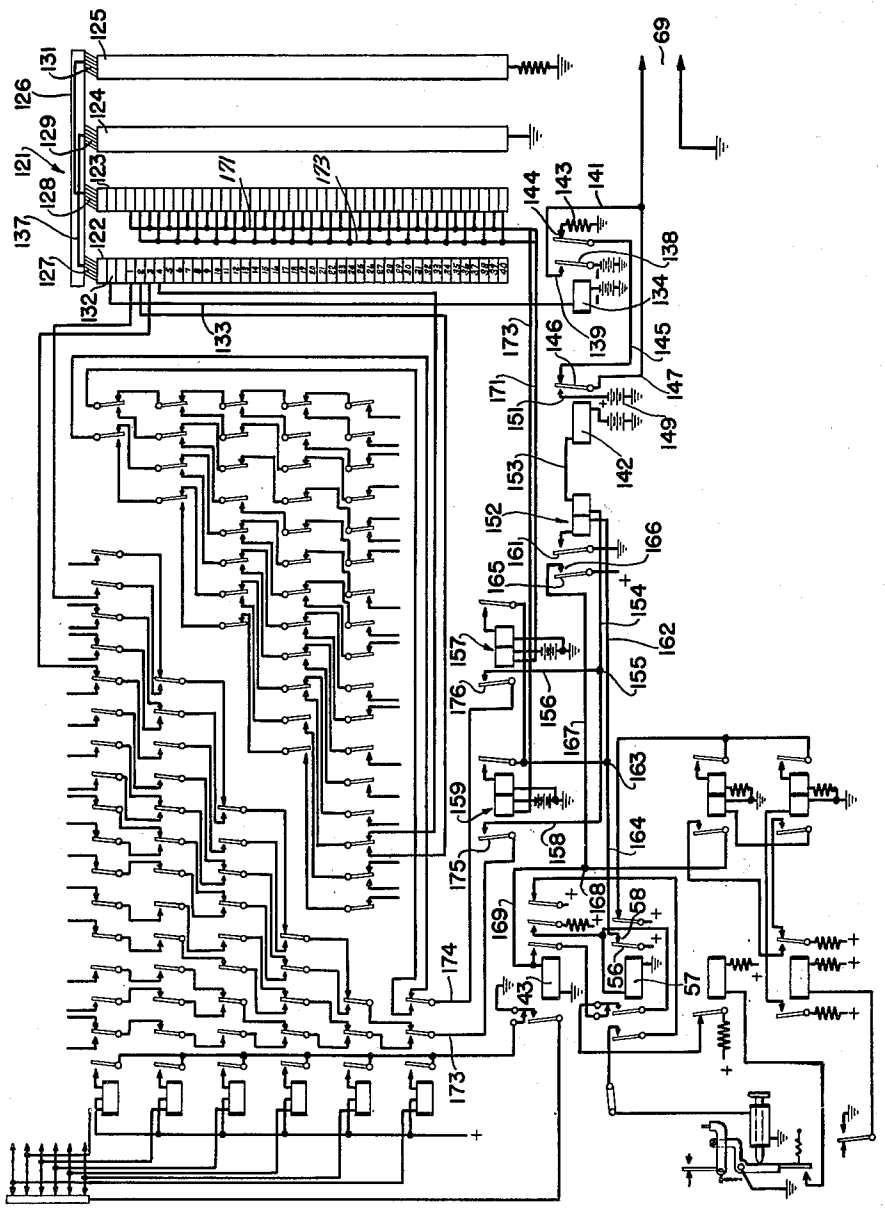


FIG. 8

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TELEGRAPH TRANSMITTER

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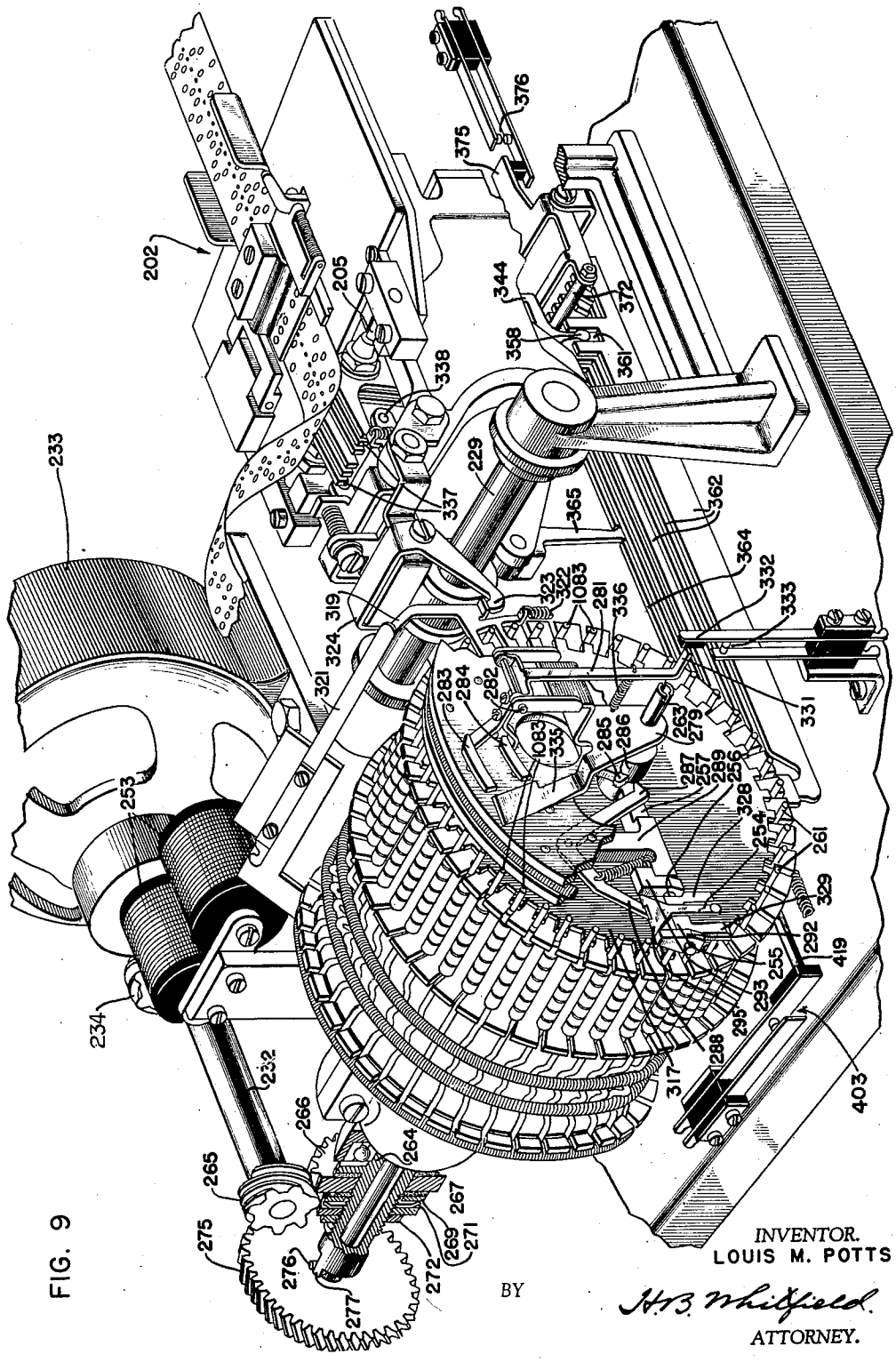


FIG. 9

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TELEGRAPH TRANSMITTER

Filed Dec. 30, 1937 8 Sheets-Sheet 8

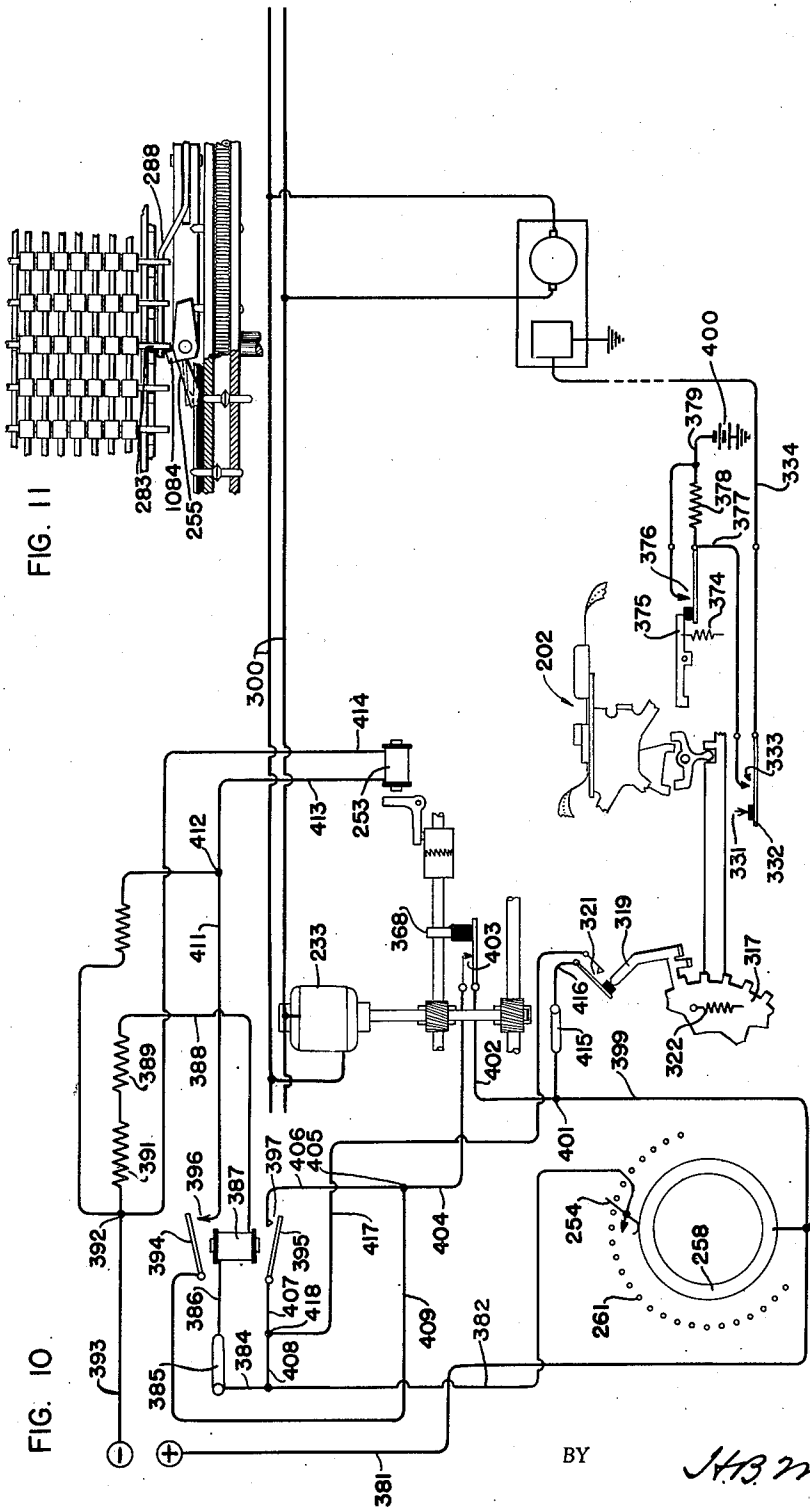


FIG. 11

FIG. 10

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Patented Jan. 19, 1943 2,308,539

UNITED STATES PATENT OFFICE

2,308,539

TELEGRAPH TRANSMITTER

Louis M. Potts, Evanston, Ill., assignor to Teletype Corporation, Chicago, Ill., a corporation of Delaware

Application December 30, 1937, Serial No. 182,422

61 Claims. (Cl. 178—17)

The present invention relates to telegraph transmitters and systems and more particularly to transmitting apparatus and systems for generating signals whose selective characteristic corresponds to their cyclic periodicity under the control of conventional permutation code signals.

A main object of the present invention is to provide monopulse or cyclic periodicity signal transmission under the supervision of conventional permutation code signals or conditions.

In the featured embodiments, there is contemplated the operation of printers, such as that illustrated in copending application Serial No. 215,343, filed June 23, 1938, whose total selective requirements exceed the fundamental selective possibilities which are available through the use of a conventional or standard five unit code, hence, the present invention is featured with a six unit supervisory code whose total selective possibilities are more than ample. Obviously, only such selective possibilities are employed as are necessary to the several functional operations of the printer, and those in excess of such necessary selective possibility may not be used. Printing apparatus for which the transmitters of the present invention have been especially designed contemplate a total of forty selective possibilities or different operations which does not exhaust the capacity of a six unit code which yields a total of sixty-four fundamental selective possibilities.

In each of the embodiments disclosed hereinafter, means are provided for supervising cyclically the operation of an intermittent feed record reader in which a set of tape sensing elements are alternately presented and withdrawn to successive transverse areas in a control form so that each tape feed operation is initiated cyclically as there is completed the transmission of a monopulse signal. Thus, while the incidents or variation of each signal characteristic is determined through the operation of the record reader mechanism and is thereby impressed upon the monopulse transmitter apparatus, yet reciprocally the progress of said record reader mechanism is supervised by the monopulse transmitter unit correlating the performance of each division of the unit and preventing, among other things, false signaling such as might be possible except for the provision of interrelating apparatus indicated hereinafter.

In the event that a perforated tape presents to the record reader mechanism one of the (twenty-four) unused signal combinations for which provision has not been made in the transmitting unit; that is to say, a signal which is impossible of conversion in accordance with an established translation apparatus, control means are provided to permit the record reader to advance an additional step or steps in accordance with the established rhythm until there is encountered a signal which is to be accommodated by the translating apparatus.

For a more comprehensive understanding of this and other features, reference will be had to the detailed specification following and to the accompanying drawings in which like reference characters designate corresponding parts throughout and in which,

Fig. 1 is a plan view of a signal converting transmitter designed in accordance with certain features of the present invention;

Fig. 2 is a transverse sectional view taken approximately on line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view taken approximately on line 3—3 of Fig. 1 and having certain portions of the foreground mechanism broken away;

Fig. 4 is a sectional detail view taken approximately on line 4—4 of Fig. 1;

Fig. 5 is a fragmentary detail elevation partially in quarter section illustrating the distribution of cams on the blank shaft;

Fig. 6 is a theoretical wiring diagram illustrating a schematic circuit arrangement of a modified adaptation of the main embodiment of the present invention;

Fig. 7 is a detailed modification in the circuit arrangement illustrated in Fig. 6;

Fig. 8 is a modified circuit arrangement contemplation of a somewhat different mode of operation and utilizing a variant form of the main embodiment of the present invention;

Fig. 9 is a fragmentary perspective view featuring the mechanical embodiment of transmitter and selector shown in Figs. 1 to 5;

Fig. 10 is a schematic circuit diagram of the apparatus and inter-control which may be employed in connection with a system such as that shown in Figs. 1 to 5;

Fig. 11 is a plan detail view of the selector arm and butterfly; and

Fig. 12 is a detail perspective view of the selector arm and butterfly featured in Fig. 11.

In the embodiment featured in Fig. 6, which will for convenience be referred to as the preferred electrical system, the reference character 11 indicates a rotary transmitter having two segmented rings 12 and 13 and their respectively related solid rings 14 and 15. Each of the rings 12 to 15 is served by an individual brush 16 to 19,

of which brushes 16 and 18 are bridged by an electrical connector 21 and brushes 17 and 19 by a connector 22. The segmented rings 12 and 13 are divided into forty mutually insulated segments, but each of the segments of ring 12 is electrically connected with a corresponding segment of ring 13; however, not in radial alignment. The segment connectors 23 are arranged so as to bridge corresponding segments but, in the direction of movement of the brush carrier, the segments of ring 12 are designed to be encountered by brush 16 two segment intervals in arrear of the time when their corresponding segments in ring 13 are encountered by brush 17.

The purpose of this staggered arrangement of the two classes of distributor segments is to enable the preparation of a signaling circuit sufficiently in advance of the time at which the signal impulse is generated and issued over a line, and to avoid thereby shortening or mutilation of character impulses. This purpose may also be expressed as one of testing aforehand the propriety of each translation. If the transfer of a signal from the transmitter contacts to the relays 28 to 34 is not fully established at the time when brush 17 engages the corresponding segment on ring 13, then neither relay 46 nor 47 can be energized, and hence the signal will not be transmitted at the time but will await the next revolution. If the transmitter starts after the brush touches the segment on ring 13, a short impulse may be sent to relay 46 or 47 causing it to be energized and locked, but the transmitted impulse in such cases will not be mutilated or foreshortened, but will instead partake of a full allotted impulse interval.

The record reader apparatus, which is adapted to be used with the system featured in Fig. 6, is preferably of a type in which a series of tape sensing elements have associated wtih them individual contactors 24 presentable during the appearance of a perforation in a tape into marking or contact closing condition, and during the occurrence of a non-perforated position, into spacing or open-contact condition. The several sensing elements are customarily spring urged into their marking condition but are collectively and simultaneously withdrawable under the supervision of a magnet armature 25 actuated by a tape step magnet 26.

Each contactor 24, over an individual conductor 27, is associated with an energizing winding of a fan circuit relay of which the instant embodiment comprises six indicated 28, 29, 31, 32, 33, and 34. A common current supply line 35 connects the terminal of each energizing winding of said relays with a source of electrical energy, while a locking winding of each relay, one of whose terminals may be identical with the midpoint associated with the common line 35, is provided with a locking contact 36 at its other terminal. The contact armatures of said several locking contacts 36 are connected together parallelly by a ground line 37, which leads to a normal closed contact point 38 of a make-before-break relay contact assembly whose common contacting element 39 is connected to ground. In its relaxed condition point 41 of contact blade 39 does not engage contact armature 42 of magnet 43 but instead engages the contact point 38, placing ground upon the common conductor 37. Upon energization of magnet 43, which event occurs cyclically as will appear, the same ground source is through armature 42 first placed upon the record reader wire 44 which connects with the terminal bar 45, then is removed from the common line 37. Accordingly, upon the energization of transfer magnet 43, there is effected this switching of ground momentarily from locking circuit 37 to line 44, so that a new code reading may be installed upon the several fan circuit relays 28 to 34.

Each relay of the fan circuit controls a plurality of armatures which form progressively and permutably a path from one of the distributor segments in ring 12 to one or the other of the twin signaling control relays 46 and 47. In this connection, a significant feature of the fan circuit, however, and one which differs from the conventional fan circuit arrangements heretofore employed is the inversion and reversal of one-half of the switching armatures indicated 48 and their displacement with respect to the other half 49, as a result of which there is obtained an equal or at least a more even distribution of contact armatures among the several fan circuit relays 28 to 34. Each of the lead wires 51 represents a circuit which is traceable through the fan circuit armatures, communicates with one of the segments in ring 12, and is individually labeled with an index number appearing on its segment. There being six relays 28 to 34, it will be understood that the total number of permutations possible, and, therefore, the total number of available paths 51 may be as many as sixty-four. However, for the purpose of operating monopulse printer apparatus of the type illustrated in the copending application referred to above, only forty permutative possibilities are required, hence, there remain twenty-four unused permutations.

Upon the conditioning of the fan circuit relays 28 to 34 in accordance with any one of said twenty-four unused permutations, no complete circuit path to one of the segments in ring 12 will be prepared. Since the tape stepping magnet is operated principally in response to a circuit path selection, special means have been provided, as will be described hereinafter, operative upon the presentation of a non-selecting permutation to exercise the tape step operation nevertheless so that the record reader may be advanced to a new tape sensing position.

When a path has been prepared by the permutative placement of the fan circuit relays, one or the other of the twin signaling control relays 46 and 47 is energized, as already stated, over a course traceable from current supply 52 or 52a, through the primary winding of relay 46 or 47, line 53 or 53a, armatures of fan circuit relays 34, 33, 32, etc., terminal lead wires 51, to one of the segments 1 to 40 of segmented ring 12. When the brush carrier, which supports the brushes 16 to 19 and which is rotated synchronously with a corresponding distributor element in the printer apparatus wipes across the particular segment which terminates the prepared circuit, and when, for example, at the time brush 17 encounters segment No. 5 located in the secondary segmented ring 13, the circuit is continued over the bridging conduit 23, brush 17, electrical connector 22, solid ring 15, to ground. As a result, one or the other of the twin control relays 46—47 is energized causing to be pulled up its armatures 54 or 54a and 55 or 55a. The armatures 55 or 55a prepare locking circuits for maintaining energized said relays 46 or 47 over the path beginning with current supply and armature 56 of locking circuit release relay 57, its contact point 58, line 59, to the junction 61, thence over line

62, through the armature 55 or 55a and its contact point, secondary winding of relay 46 or 47, to ground.

As a result of the closure of one or the other of contact armatures 54 or 54a with its contact point, a circuit is prepared which may be traced from ground, through the winding of signaling relay 63, conductor 64, primary winding of transfer control relay 65, line 66, through one or the other of the armatures 54 or 54a, and its contact, line 67, solid distributor ring 14, its brush 18, bridging conductor 21, to the brush 16. Because of the displacement between segmented rings 12 and 13, by reason of which a particular segment in ring 13 is encountered by its brush 17 two segment intervals before the corresponding segment in ring 12 is encountered by its brush 16 the aforedescribed energization of one of the twin relays 46 or 47 is established during this brief interval in advance of the time that brush 16 encounters its corresponding segment (in the instant example 5) for completing the energizing circuit.

The description, supra, was carried up to the distributor brush 16 and with the establishment of one of the fan circuits, it may now be traced on through its corresponding lead wire 51, through the fan circuit, one or the other of the circuit paths 53 or 53a, the primary winding of the energized twin relay 46 or 47, to one of the sources of potential 52 or 52a.

As a result of the closure of this circuit, which prevails only through the brief interval of one segment length, two objects are attained. The signaling relay 63 is energized, causing to be opened contact pair 68 and introducing over the line 69, thereby, the time impulse which constitutes the characteristic signal in accordance with the monopulse system of transmission, while also the momentary energization of transfer control relay 65 pulls up its locking armature 71, which thereupon maintains the relay in its energized condition, while its armature 72 is brought into contactual engagement with its associated contact point, completing the circuit from current supply, through the contact pair 72, line 73 to the junction 74, line 75, winding of the fan release transfer magnet 43 to ground, causing to become energized the magnet 43.

As a result of the energization of magnet 43, a new source of current supplied through armature 76 is made available to the winding of said magnet 43 making said relay independent of the original current supply source under the supervision of transfer control relay 65. Also, its armatures 42, 77, and 78 are pulled up, the latter receding from its contact point but the others 42 and 77 engaging their respective contact points. In response to the opening of the contact pair including armature 78, no result is obtained at this time because the stepping magnet circuit in which it is located is also open elsewhere, viz., at the contact point including armature 79 to be discussed later. The pulling up of armature 42 removes ground from the fan relays locking circuit 37 and applies it momentarily to the transfer enabling circuit 44. A new record on the tape is thereby installed upon the relays 28 to 34 which is thereafter locked up upon the deenergization of magnet 43 when ground is applied through contact point 38 before it is removed from armature 42.

As a result of the closure of armature 77 with its contact point, relay 57 is energized over an obvious circuit and is locked when its armature 81 engages the make-before-break contact 82 introducing a locking current supply to itself over the line 83, contact point and armature 84 of the release relay magnet 85. This makes locking circuit release relay 57 independent of the energizing current supplied through armature 77. As a further result of the energization of locking circuit release relay 57, its armature 56 is withdrawn from engagement with the contact point 58. This withdraws current supplied over line 59 to the locking windings of relays 46, 47, and 65. As a further result of the operation of relay 57, another armature 86 thereof is withdrawn from engagement with its contact point 87 opening a locking circuit 88, which controls the special tape step supervisory relays 89 and 91 to be described later.

When release relay 57 is energized, the aforementioned armature 79 is compelled to close the principal tape step circuit so that when transfer magnet 43 is released permitting armature 78 to return to its back contact, the tape stepping circuit is completed from ground, through the winding of magnet 26, line 92, manual control switch 93, armature 79 and its contact, line 94, armature 78 and its contact to current supply source. As a result, magnet 26 is energized and its armature lever 25 is attracted placing ground on conductor 96 and completing a circuit for the energization of release relay restoring magnet 85 over an obvious circuit, which thereupon pulls up its armature 84 opening the locking circuit which had been holding energized the release relay 57. As a result of the deenergization of release relay 57, its armature 79 is permitted to fall back, opening the tape step circuit thereat and causing to become deenergized the tape step magnet 26. This permits the several spring urged feeler levers 95 to again engage the tape, those of them which encounter perforations moving farther than the others until with their contactors they engage the associated contact points or ground-circuit plate 45. In accordance with the code combination thus encountered by the feeler levers 95, the fan circuit relays 28 to 34 are permutably conditioned according to a succeeding combination.

Auxiliary control for the record reader

In the event that a code combination is encountered for which no special provision has been made in the translating mechanism, the aforedescribed principal energizing circuit of magnet 26 will fail to be completed because neither of the twin relays 46 nor 47 may become energized, and upon one of these is dependent the operation of the tape step magnet 26. Of course, it is not contemplated that in the control form intended for the operation of this type of translator mechanism the extraordinary code signals (one of the aforementioned twenty-four) should be used. However, the contingency should be provided for so that the transmission may be permitted to proceed continuously, if there is encountered one of the unprovided-for code combinations.

Upon the distributor shaft is situated a cam having an apex which cyclically effects the closure of a contact switch 97 with its grounded point 98 introducing ground into and thereby completing circuit 99 and energizing relay 101. This operation is but momentary, but as a result, the armature 102 of relay 101 is attracted closing an obvious circuit 103 which energizes the operating winding of special relay 89, the latter locking up, through its locking winding, armature 104 and the aforementioned locking circuit 88 which in-

cludes the release armature 86 of locking circuit release relay 57.

As a result of the energization of special tape step supervisory relay 89, its armature 105 is drawn up to its front contact 106 completing an energizing circuit which includes an armature 107 under the supervision of relay 101 which is, by this time, restored due to the progress of the distributor operating cam so that following the locking operation of special tape step supervisory relay 89, an energizing circuit is completed for the secondary supervisory relay 91 over an obvious circuit, the latter locking up, through its locking winding, contact 108 and locking armature 109 also situated in the aforedescribed locking circuit 88.

As a result of the operation of secondary supervistory relay 91, its armature 111 is pulley up but has no effect at the present instant because of the open condition between the contact point 112 and armature 107. It is not until the distributor shaft has completed a full revolution, therefore, and has entered upon a second cycle that the contact switch 97 is closed permitting relay 101 to be energized and pulling up armature 107 to engage the contact point 112 that current is provided over line 113, armature 111 and its contact point, junction 74, line 75, and winding of relay 43. In this way relay 43 is energized and permitted to start the afore-described cycle for stepping the tape. Relays 89 and 91 are subsequently released when their locking circuit 88 is opened, as a result of the energization of the locking circuit release magnet 57.

Though relay 101 is energized at every cycle, special supervisory relays 89 and 91 have no effect except upon the contingency that a complete cycle of the distributor shaft is consummated without encountering a through circuit for one of the twin relays 46 or 47, and then only is the special supervision permitted to become effective during the second cycle of operation of the distributor shaft. It will be understood. therefore, that during normal conditions of transmission, the signaling relay 63 will be energized during each cycle of rotation of the distributor 11, and that the period of energization with respect to each cycle constitutes the selective characteristic of the signal which is thereupon issued over line 69 to a receiving printer, the selective mechanism of which is enabled to respond to this characteristic signal because it too is provided with a distributor either rotary or otherwise which is operated in synchronism with distributor 11.

While in the foregoing embodiment line 69 is indicated as being normally closed with the characteristic signal constituted of an open line condition, it is deemed obvious that the system may be so modified as to embrace alternative principles of line signal operations.

Polar Signaling

In Fig. 7 is illustrated a manner of modifying the circuit of Fig. 6 so that instead of impulses of single polarity signals, there may be employed instead impulses of both polarities. The pair of twin relays 114 and 115 control the introduction of current from a positive source 116 and a negative source 117, respectively, over a signaling line in which is located a transmitter control relay 119 having supervisory functions generally akin to those of the aforedescribed relay 65. Lines 53 and 53*a* lead from the respective ones of the two translator relay banks, as in the case of Fig. 6, to the energizing windings of the twin relays 114 and 115 (corresponding to relays 46 and 47), while their locking windings are jointly controlled by the locking circuit 59. In this adaptation the line circuit 69 has in series the aforedescribed transmitter control relay 119 which therefore responds to each of the issued impulses (both plus and minus) and in so doing, pulls up its armature 72. As a result, positive current is placed upon line 73, causing to become energized the fan release transfer magnet 43 for a purpose similar to that already described above.

In this connection it may be observed that both in Fig. 6 as well as in Fig. 7 the consecutive segments of ring 12 are connected alternately to the outgoing translator circuits 51 of the two banks and that as a result, in the case of Fig. 7, there will be issued alternate plus and minus impulses over consecutive segments, because each bank is served by an associate one of the twin relays 114 and 115 whose related current is different from that of the other of said twin.

Synchronizing

In connection with synchronous systems of transmission, it is desirable to employ a synchronizing impulse in order to assure periodically that the proper phase relationship between transmitting and receiving distributors is being maintained. It will now be shown how the introduction of apparatus for attaining this type of synchronism may be incorporated harmoniously with the provisions of the present system. In Fig. 8 is featured a modified transmitting circuit having embodied therein special apparatus for generating an occasional phasing impulse for the aforedescribed purpose during signal transmission. The transmitting distributor 121 is provided with a segmented ring 122, another indicated 123, and a pair of associative solid rings 124 and 125. A brush carrier 126, which rotates in regular cycles, supports a set of brushes 127, 128, 129, and 131, which wipe across the rings 122 to 125 in a manner similar to that described in connection with the preferred embodiment. Segmented ring 122 is comprised of forty principal segments comparable to those of the preferred embodiment, and in addition, contains a special impulse segment 132 spaced from the selecting segments.

Conductor 133 connects segment 132 with the winding of a special signal control relay 134 whose other terminal is connected to negative battery. Brush 127, which traverses ring 122, is connected by a conductor 137 with distributor brush 129, and the latter wipes across solid ring 124 that is grounded. Once during each cycle of rotation, relay 134 is energized during the special interval of the cycle when brush 127 engages its segment 132. At that instant, an impulse is sent out over line 69 when the armature 138 of relay 134 is pulled up to engage its contact 139 introducing negative battery to the main line over its branch conductor 141.

Normally, ground, through resistor 143, communicates through contact pair 144, line 145, armature 146 and its contact point, line 147 to the outgoing communication line 69, but upon the energization of relay 134, the ground through contact pair 144 is removed simultaneously with the closure of armature 138 with its contact 139. Positive signaling impulses are introduced over line 69 under the control of the principal signaling relay 142 and they originate at the positive battery 149. Armature 146, upon being attracted to the contact point 151, is at the same time withdrawn from its back contact, which is in commu-

nication with the aforedescribed ground circuit, so that upon the operation of either synchronizing relay 134 or signaling relay 142, it will be seen that normal ground is removed from the line circuit to permit of the issuance of plus or minus signals for signaling or synchronizing purposes respectively.

Principal signaling relay 142 operates together with a supervisory relay 152 the latter having two windings. One of its windings is connected over line 153 with the winding of principal signaling relay 142 whose other terminal is connected to grounded battery. Said winding of relay 152 receives its energizing impulse over a line 154, which, at junction 155, connects with one terminal branch 156 under the supervision of the right-hand twin relay 157, and another terminal branch 158 which is under the supervision of a left-hand twin relay 159, the twin relays 157 and 159 having the same general ultility as that of the twin relays 46 and 47 of the principal adaptation discussed above.

A locking circuit for supervisory relay 152 affecting its other winding is traceable from ground, through armature 161 and its associated contact, secondary winding of relay 152, line 162, to the junction point 163 at which other branches of the locking circuit join, line 164 to the contact 58 and armature 56 of a locking circuit release relay 57, which may be the same as the one discussed above. Another armature 165, also under the control of supervisory relay 152, upon engagement with its contact point 166, closes a circuit for energizing a fan relay transfer magnet 43 and is traceable from current source through armature 165 and its contact point 166, line 167 to the junction 168, line 169 through the winding of fan relay transfer magnet 43 to ground. Twin relays 157 and 159 are energized over lines 171 and 173 each of which is connected with an alternate series of the segments in ring 123.

The arrangement illustrated whereby the segments of ring 123 are connected alternately to the twin relays 157 and 159 exemplifies an alternative adaptation for permitting the practice of conditioning each segment of a distributor before the arrival of its period of transmission. Following the energization of one or the other of the twin relays through ring 123, ground originating at ring 124 and one of the segments in ring 122 is carried over the particular circuit established through the translator fan, one of the lines 173 or 174 through the armature 175 of relay 159, or the armature 176 of relay 157, and its respective contact point branch line 158 or 156, junction 155, line 154 to the energizing windings of relays 152 and 152, thence to grounded battery, causing to be energized the supervisory relay 152 and the principal signaling relay 142.

It will be noted from Fig. 8 that other features of the circuit are essentially the same as are those of the aforedescribed embodiment in Fig. 6 including the special function relays, which perform the tape step operation, and those which exercise a supervision in the event that an unassigned signal finds its way into the receiving distributor of the translator apparatus. It will be understood that in a receiving printer appropriate accommodation will be provided to correspond with the number of segments employed in the segmented transmitting distributor ring 122.

Mechanical modification

In Figs. 1 to 5 there is illustrated an embodiment of the present invention in which mechanical agencies perform the functions which, in the form above, employed electrical relays. The reference character 201 denotes a suppporting base and the reference character 202 a record reader generally which is comprised of the side frames 203 and 204. A number of pivot shafts are supported endwise between the side frames 203 and 204. Notably among these is a shaft 205 upon which are pendulously supported a set of feeler levers 206. All of the feeler levers are identical in contour, and through a circular opening 207 in each there extends a rod 208 for limiting the movement of each lever 206. An individual spring 209 connecting an integral ear 211 of each lever with an anchor plate 212 imparts a counterclockwise influence so that the sensing pins 213, which are carried upon the extremity of the lever arms 214, seek to protrude through guide perforations not only in the bottom guide plate 215 but also partly through those in the top guide plate 216. As a strip of control form having transverse perforations is fed between the guide plates 215 and 216 through the intermittent action of sprocket wheel 217, successive rows of perforations are presented so that the sensing pins 213 of the several feeler levers 206 are in alignment with their corresponding perforations or with the unperforated areas when perforations do not occur.

Sprocket wheel 217 is carried upon a pivot shaft 218 journaled in the side frames 203 and 204. A feed ratchet 219 also secured to shaft 218 is engaged intermittently by the reciprocating tape feed pawl 221 whose supporting lever 222 is pivoted on a shaft 223 so that for each downward movement of pawl 221 under the influence of a lever return spring 224, ratchet wheel 219 as well as the other members of shaft 218 are rotated counterclockwise one tooth distance at a time, feeding the perforated tape intermittently at each operating cycle.

Lever 222 has been shown as part of a two arm assembly including a power arm 225 whose follower roller 226 engages the periphery of an actuator cam 227 and imparts through the adjustment screw 228 the aforedescribed reciprocal motion in opposition to return spring 224. Cam 227 is one of several carried upon a principal cam shaft 229 driven in a clockwise direction, as viewed in Figs. 3 and 4, by a driving worm 231, Fig. 1, integrally formed with bushing 232, which is secured to the rotor shaft of a speed governed electric motor 233.

The driving worm 231, best seen in Fig. 5, meshes with a driven wheel 234 having integrally associated with it the driving element 235 of a jaw clutch whose driven section 236 is urged by a spring 237 into driving engagement with the drive portion 235. Member 236 is free upon shaft 229 in a longitudinal direction but is restrained rotationally through its tongue 238, which fits into a corresponding groove formed in a bushing 239 rigid on shaft 229.

The motion, which is continuously imparted to drive member 235, is communicated to the shaft 229 through the driven clutch member 236 when the teeth of the members are in mesh, but this engagement is cyclically withheld by reason of the retention, by a cam surface 241, Fig. 1, of a lug 242 integrally formed with the driven section 236. The rotation of shaft 229 tends, through the engagement of lug 242, Fig. 4, with the cam surface 241, to continuously withdraw driven clutch member 236 against the influence of spring

237 holding shaft 229 at rest, but permitting the driving member or collar 235 to rotate continuously. When the arm 243, with which the cam surface 241 is formed, is withdrawn from the path of lug 242, as it is compelled by the spring 244, Fig. 4, driven sleeve 236 is immediately forced into engagement with the driving sleeve 235 whereupon shaft 229 is started into a cycle of rotation. Before one revolution has been completed by the shaft 229, a cam 245 carried thereby engages with its apex a follower roller 246 pivoted upon a depending portion 247 of arm 243 urging the latter clockwise, Fig. 4, about pivot 248 to its original position as illustrated in this figure, whereat the lug 242 again encounters the side cam projection 241 which withdraws the driven portion 236 of the clutch arresting the shaft 229 at the completion of its cycle. The effective position of arm 243 is maintained by the shouldered extremity 249 of an armature lever 251 pivoted at 252 and spring urged in a clockwise direction to be moved oppositely by its control magnet 253, the windings of which are also illustrated in Figs. 1 and 3. By means of the above described cyclic interruption of shaft 229, the progress of the record reader is controlled so that the stepping of the tape may be made to accord with the advance of the transmitting mechanism.

The impulse for energizing control magnet 253 is generated by a revolving contactor 254, Figs. 3 and 11, integrally associated with a butterfly 255 pivoted upon the rod 256. Revolving contactor 254 is preferably electrically connected to the revolving arm 257 but if desired, it may be insulated from its supporting member. The extremity of contactor 254 is forced into engagement with a continuous contact ring 258 when the butterfly 255, which is normally biased by torsion spring 259, encounters one of the selectable rods 261, which has been moved into selected position. Ring 258 is electrically insulated from its supporting structure, as indicated in Figs. 2, 3, and 11, but connected over by wire 262 (Fig. 10) with the circuit for energizing the aforedescribed record reader shaft release magnet 253.

In Fig. 2 there is revealed the several elements which are carried upon selector shaft 263 as well as those carried upon its sleeve 264. Another driving worm 265, integrally associated with the aforedescribed bushing 232, meshes with the worm wheel 266, which is floated between the friction discs 267 of a clutch assembly formed between a disc 268 integrally formed with the sleeve 264 and a tension disc 269 longitudinally movable upon sleeve 264 and adapted to be urged by the disc compression spring 271 in the direction of the stationary disc 268. The tension of spring 271, which may be adjusted and checked by the nuts 272, determines the embrace of driven wheel 266 by the friction discs 267 and any resistance to movement greater than this adjustment will permit said wheel 266 to slip between the friction washers in the manner of conventional friction clutches well-known in the art of printing telegraphy.

In addition to its aforedescribed purpose of driving sleeve 264, worm wheel 266 also serves to drive a reduction coupler comprised of a major radius driven wheel 273 and a minor radius driving wheel 274, the latter, in turn, meshing with a driven wheel 275 secured by a set screw to the shaft 263. The drive through coupler 273—274 is a positive one as distinguished from the frictional driving connection between worm wheel 266 and sleeve 264. Also, it is to be noted that by reason of the reduced gearing through coupler 273—274, shaft 263 is positively driven at a reduced speed while sleeve 264 is frictionally driven in the same direction at a somewhat higher rate of speed, being directly associated with the driven wheel 266. A stud 276 extends from shaft 263 in radial alignment with a projecting lug 277 integral with the sleeve 264. By reason of these elements, sleeve 264 may be moved at an accelerated speed beyond that of shaft 263, but only until projecting lug 277 encounters stud 276. Thereafter the two members, shaft 263 and sleeve 264, may travel in unison, the frictionally driven sleeve 264 being held back to the rate of speed established by the positively driven shaft 263.

The principal purpose of sleeve 264 is to drive the revolving selector arm 257 which seeks out the selected one of the selectable rods 261 and through its butterfly 255 effects a setting upon the storage pins 278. The principal purpose of shaft 263 is to drive the transmitter arm 279 whose rotating bell crank 281 is moved about its pivot 282 when either of its tracker arms 283 or 284 encounter the set or conditioned pins 278, which are displaced by the selector butterfly 255. In practice, selector shaft 263 and its arm 279 rotate continuously while sleeve 264 and revolving arm 257 rotate spasmodically in accordance with each selection when one of the extremities 1083 of a selectable element 261 is presented into the path of the seeker projection 1084, Figs. 9 and 11, of the butterfly 255. The stopping of arm 257 is but momentary, as will be explained later, and because of its greater speed, as afore-explained, arm 257 is capable of overtaking transmitter arm 279 until projecting lug 277 encounters stud 276.

When the number of interruptions of seeker arm 257 are sufficient to delay its progress to such an extent that arm 279, which is positively driven by shaft 263, is about to overtake said arm 257 which is frictionally driven together with sleeve 264, Fig. 12, and if thereafter arm 257 is positively blocked by one of the extremities 1083, a condition might obtain whereat pin 276 overtaking the projection 277 and attempting to continue thereafter will be forced and shorn off. To prevent this, a cam 285, Figs. 9 and 12, has been provided upon a collar 286 which will encounter one arm 287 of a bell crank, the other arm 288 of which is disposed in front of seeker projection 1084 and beneath the rod extremities 1083 so that as the shaft 263 assumes a position whereat transmitter arm 279 is about to overtake revolving selector arm 257, bell crank 287—288 is first to encounter the cam apex 285 which causes it to cam out the selected pin 261 an instant before the time at which pin 276 would collide with projection 277, freeing the selector arm 257 and permitting it to regain its lead in advance of the angular position of the transmitter arm 279. A circumstance such as that just described may result when the chance succession of characters happen so close together in terms of the arrangement of their selectable pins 261 that arm 257 is repeatedly arrested after but short intervening movements.

The camming out of one of the pins 261 permits arm 257 to resume its rotation and to be out of the way of the oncoming transmitter arm 279, since the latter rotation continues and moreover is positively driven. It is to be noted that under such a circumstance, a pin 261 has already performed its function, and that accordingly, the signal impulse corresponding thereto will have been transferred to one of the storage pins 278.

Bell crank 287—288 is pivoted upon a pin which passes through a slotted sidewardly extending arm 289 integrally formed with the selector arm 257, as best illustrated in Fig. 12. In this illustration also may be noted the longitudinal pivot 256 upon which is carried the butterfly 255, the pivot being journaled at 292 and 293 in rigid portions of the arm 257. The aforedescribed revolving contactor 254 is secured as at 295 to the arm 257, and at its mid portion rests against the flattened clearance surface, Fig. 9, of longitudinal pivot 256. Thus, it will be noted that contactor 254, being constructed of resilient spring metal, serves as a contacting element for engaging the surface of continuous ring 258.

As viewed in Fig. 9, shaft 263 and sleeve 264 together with their integrally associated members rotate in a clockwise direction. Just outside the radial path described by seeker projection 1084 as it is rotated together with its supporting arm 257 are the several extremities 1083 of the individually selectable rods 261 when they are out of selector position. The several rods are supported in a floating condition within individual alignments of slots in discs 295, 296, and 297 parallelly arranged and spaced, said supporting discs being fitted over the enlarged cylindrical section 298 of a tubular housing 299 and being spaced apart from each other by means of the spacing cylinder 301 and the plurality of spacer sleeves 302, Fig. 2. The entire assembly is held together by means of several circumferentially spaced and longitudinally extending binding screws 303 which clamp the several elements against the shoulder flange 304, itself an integral element of the tubular housing 299.

The selectable elements 261 which, as has been said, reside in longitudinally aligned slots of discs 295 to 297 are generally similar to each other except that alternative ones, see Fig. 2, provide an enlarged rearward loop 304 and a small forward loop 305, while the intervening ones are provided with a small rearward loop 306 and an enlarged forward loop 307. The forward and rearward loops of the several elements 261 are in grouped peripheral alignments and a pair of garter springs 308 and 309 disposed within the clearance afforded by said alignments maintain the several selectable elements under centripetal tension. The purpose of providing alternative ones of the elements 261 with a corresponding difference of their loop formations is to afford a greater peripheral angle at each contactual engagement between the springs 308 and 309, and, therefore, a greater force component than would be otherwise possible were said springs or either of them to be engaged by consecutive ones of said elements 261 in their peripheral series. The fulcrum point for each element 261 is in the proximity of its rearward plate 295 adjacent to which there is disposed a fulcrum plate 311. Each of the elements 261 terminates with an upturned or hooked section 312 disposed with sufficient clearance behind the rearward plate so as to receive the intervening space of garter spring 313 for resisting the longitudinal displacement of any of the rods 261.

Between the two foremost partitioning elements there are supported for limited reciprocal movement a set of circular selecting discs, in the instant case six in number, indicated 314 as well as the stripper disc 315 to be described later. About the peripheries of the several discs 314 are provided a systematic distribution of obtuse angular notches, best seen in Fig. 3. Each disc 314 is capable of limited reciprocal rotation throughout an angular distance equivalent to the angular spacing between the selectable rods 261. The arrangement of said notches in the several discs 314 is in accordance with a permutation code so that for each possible disposition of the several of said discs 314, there is afforded to one of the selectable elements 261 a transverse clearance by reason of an alignment of said peripheral notches.

As is well known to those acquainted with permutative selecting systems, the total mathematical selective possibilities afforded by a six-unit selector is sixty-four. To accommodate all of the selective functions requisite to the operation of a printer, such as that illustrated in the copending application referred to above, all of said sixty-four possibilities are not required, but instead only forty, leaving twenty-four, unused because unnecessary, of said possibilities. Accordingly, though the six discs 314 are capable of affording mathematically sixty-four different selections, there are provided only forty of the selectable rods 261. It is to be understood, therefore, that in response to twenty-four of the total variations of disposition to which the code discs 314 may be placed, no selective response will be evident among the group of elements 261.

In peripheral registration with each of the code discs 314 as well as with the stripper disc 315 every selectable rod 261 is provided with an individual collar 316 for the purpose of minimizing the friction therebetween and so that the discs 314 and 315 may be reciprocated with less effort. The extremities 1083 of the several rods 261 are illustrated as being slightly undercut and shouldered. This practice permits of the maintenance of closer tolerances between the several extremities 283 and the rotatable element carried by the arm 257, which traverses the proximity just beneath or inside of the circular arrangement of said extremities 1083. A plate 317, Figs. 2 and 3, is supported for limited rotation beneath said extremities 1083, and its periphery is studded with a plurality of square shouldered projections 318 angularly spaced to register each one beneath one of the extremities 1083. An upwardly and leftwardly projecting arm 319, formed as a continuation of certain ones of the square shouldered projections 18, Figs. 3 and 9, is disposed so that its foremost portion rests against one element of a contact pair 321 normally tensioned to remain ajar but held in contactual engagement by said arm 319 during certain conditions of operation which will now be described.

A return spring 322 anchored in a stationary portion of the unit imparts a clockwise torque to plate 317 maintaining the latter in the condition illustrated in Fig. 3 or in what may be termed its normal condition. When, thereafter, in response to a certain disposition of the code discs 314 a selective clearance is afforded to one of the rods 261, the latter is forced centripetally under impetus of its garter spring 308 or 309. The full movement is not instantly permitted, however, due to the blocking thereof by its adjacent lug 318. Briefly, thereafter, plate 317 is rocked counterclockwise when the extremity 323 of an arm integrally formed with bail 324 engages a lug which extends sidewardly from the aforedescribed arm 319. The extremity 1083 of said selected rod 261 is then permitted to continue farther and as it does so, it becomes a bar

to the return (clockwise) of disc 317 until restored by the stripper 315.

Bail 324 is operated as one of the incidents of the record reader unit and may occur at a time in the cycle sufficiently in advance of the signal transfer and restoring thereafter so that if meanwhile one of the rods 261 is selected, its extremity 1083 will thereafter bar the return movement of disc 317, causing the latter to be retained in its counter-clockwise extreme position and maintaining the contact pair 321 closed throughout the ensuing cycle of operation. It is to be noted that the retention of disc 317 in its counter-clockwise position is peculiar to those operations only which result in the selection of one of the rods 261, while at other times when no rod 261 is selected, as is the case if one of the aforementioned twenty-four unused permutations occurs, then plate 317 will be permitted to return together with its actuating bail 324, allowing the contact pair 321 to close for a purpose which will be described in greater detail hereinafter upon the discussion of the record reader and circuit.

The storage pins 278 (Figs. 2 and 9) correspond in number and position to the selectable elements 261. The pins 261 are distributed in two circular paths and in a staggered succession. This design lends itself to a modified manner of operation in which two separate bell cranks are used in place of the one indicated 281, each having its own tracker 283 or 284. When an arrangement of this type is employed, plus and minus impulses may be generated by having two contact pairs with appropriate means under the control of each bell crank for controlling one of said pairs. A garter spring 325 is tensioned around the inner circle of pins 278, and a similar spring 326 encircles the outer circle of pins. From Fig. 2, it will be noted that each pin has at its center an annular ridge 327. Accordingly, the tension of each of the springs 325 and 326 serves to detent its associated storage pin 278 in either its right or left-hand position. The normal positions of said pins 278 are as illustrated in Fig. 2, but when the butterfly 255 is dislodged in the manner indicated in Fig. 11, as a result of encountering a selected one of the elements 261, one or the other of the vanes 328 or 329 is brought against the inner extremity of a particular storage pin 278 displacing the latter rightwardly, as viewed in Fig. 2, whereat it is retained by its associated garter spring 325 or 326.

As a consequence of the protrusion of a storage pin 278, the succeeding instant when transmitter arm 279 traverses the proximity of said pin, one or the other of its tracker arms 283 or 284 traveling clockwise with the transmitter arm 279, as viewed in Fig. 3, is caused to be cammed ...wards the axial center of rotation rocking the bell crank lever 281 about its pivot 282 so as to force the projection 331 thereof against the insulated block 332 and opening the contact pair 333, see also Fig. 10, which causes an open line signal condition of measured length to be established momentarily.

As soon as the transmitter arm 279, rotating continuously, has traversed the proximity of the conditioned storage pin 278 thus causing a signal condition to be sent out over the line 334, a restoring vane 335 integrally associated with the arm 279 and presented at an angle, as best indictated in Fig. 9, encounters the conditioned pin 278 endwise forcing it back against the holding tendency of its associated garter spring 325 or 326 and restoring it to its normal position, as illustrated in Fig. 2. It is to be noted that the encounter of one of said storage pins 278 by the tracker arms 283 or 284 is not sufficient to displace said pin because the force applied to the pin is transversely of its direction of movement, so that even the pressure communicated through the bell crank 281 by the return spring 336 is overcome but thereafter a gentle camming action on the part of vane 335 endwise instantly depresses the conditioned pin 278 without so much as retarding the regular cyclic movement of the transmitter arm 279.

Returning again to the record reader mechanism 202, Figs. 3 and 9, where it was described that the feeler levers 206 are cyclically permitted to present their feeler pins 213 to successive transverse areas in a control form, attention is directed to the sidewardly extending projections 337, one of which is formed integrally with each of said levers 206. A bail rod 338 traversing the proximity beneath said projections 337 forms part of a yieldable bell crank pivoted on shaft 339 and is actuated by the aforedescribed feeler lever operating cam 227 upon whose periphery there rides a follower roller 341 associated with another arm of said internally yieldable bell crank.

The lowermost extremities of the feeler levers 206 are formed with a pair of opposite shoulders 342 and 343 which, as each feeler lever 206 is presented for tape sensing performance, may assume a so-called marking (counterclockwise as viewed in Fig. 3) or spacing (clockwise as viewed in Fig. 3) position. Beneath said projecting shoulders 342 and 343 are a set of transfer levers 344 of T-shaped conformation carried on a common pivot rod 345 each lever being associated with one of said feeler levers 206. A pair of upwardly extending projections 346 and 347 are integrally formed with each transfer lever 344 and are spaced somewhat farther apart than are the projections 342 and 343 from each other, so that in accordance with each position of a lever 206, but one of the upstanding upwardly extending projections 346 or 347 may collide with its projection 342 or 343, while the other one thereof avoids direct engagement and swings around its associated shoulder, causing the transfer lever 344 to be accordingly rocked clockwise or counterclockwise about its pivot 345. The transfer happens when the pivot rod 345 is thrust upwardly by a bell crank carrier including one arm 348 pivoted on the rock shaft 349 from which extends also another arm 351 which terminates with a follower roller 352. The bell crank assembly 348—351 is actuated by another cam 353 also supported upon the record reader operating cam shaft 229.

The bail 324, mentioned above, is also actuated by shaft 229 by means of an ear 354 formed at its remote end, as viewed in Fig. 3, see also Fig. 1, to which is connected one end of a link 355 whose other end is pivoted at 356 at an intermediate point of the tape feed actuator or power arm 225. The latter is actuated by a follower roller and cam on shaft 229 and is pivoted at 223 upon which shaft is also pivoted a cooperating arm or supporting lever 222 whose extremity carries the tape feed pawl 221. Upon the counterclockwise or advance movement of the tape feed stroke, therefore, link 355 is pulled downward causing bail 324 to be rotated clockwise, as viewed in Fig. 3, and causing also its extremity 323 to rock disc

317 to be shifted counterclockwise. If none of the selectable elements 261 is conditioned, spring 322 may thereafter return disc 317 withdrawing the contact actuating arm 319 and permitting the contact pair 321 to close. However, in the event that one of the elements 261 is selected, return movement of disc 317 is prevented by the blocking of one of its probing teeth or projections 318 and contacts 321 are then held open.

Referring again for the moment to the transfer levers 344, it will be noted that the lowermost extremities thereof are provided with small discs 359 each of which is received within a parallel sided channel 361 of a set of connecting rods 362. Each rod 362, Fig. 3, is articulated at its left end by means of a retaining clip 363 and a suitable slot to ones of the code discs 314 so that the movement (rightwardly or leftwardly) communicated to the connecting rod by the transfer lever 344 results in a corresponding clockwise or counterclockwise shifting of its associated code discs 314.

Alongside the connecting rods 362, Figs. 1 and 2, is a parallelly shiftable bar 364 generally resembling the class of connecting rods 362 at its end whereat it is articulated to the stripper disc 315, but terminating at a point short of the rightward extremity of said general class or rods having a disc and socket associated with a lever 365 pivoted at 366 to a stationary arm 367 of the tape sensing unit. The upper end of lever 365 terminates with a follower roller 369, Fig. 4, which rides the periphery of a cam 368 also on shaft 229. The purpose of cam 368 is, through lever 365, to rock the stripper disc 315 following each selection in order to restore any one of the elements 261 which had been selected to its normal position preparatory to a subsequent selection.

At their right-hand extremity, the connecting rods 362 are specially notched, as at 371, the notches 371 on said several connecting rods being brought into a transverse alignment coincident with a certain code combination, in the instant embodiment an all-marking condition. Upon the occurrence of this special code condition beneath the sensing rod 372, the supporting lever 373, which carries said rod 372, is permitted to respond to the urge of its spring 374 and be rotated through a slight angle in a counterclockwise direction withdrawing its opposite end 375 and permitting the contact pair 376 to be closed for a purpose to be described later.

General operation

In order to illustrate the relationship of the various components, which comprise the embodiment just described, a concise description of a typical operating cycle will now be reviewed in conjunction with an exemplary circuit illustrated on the accompanying Fig. 10. Symbolic representations of certain mechanical details have been employed in order to suggest wherever it has been deemed advisable to do so, the particular embodiments employed in the mechanical illustrations. The reference character 334 indicates an outgoing line which, it is presumed, is connected to a receiving printer of the type illustrated in the copending application referred to above. This line at the transmitting station is traceable through the contact pair 333, which effects signaling by regulated interruptions, thereafter continues over a conductor 377, measured resistance 378, to the battery lead 379. Resistance 378 is provided to cut down the signaling current below that supplied by grounded line battery 400 in order that when this resistance 378 is shunted out by switch 376, a higher voltage may be applied for the purpose of obtaining periodical synchronism by means of a phase regulator at the receiver which is responsive solely to the higher voltage. Upon the occurrence of the particular code combination which effects the alignment of the notches 371, Fig. 3, which code combinations preferably are supplied at regular intervals, a synchronizing signal is effected by the shunting out of the resistance 378. The bars 362 retain their setting following each signal and are reset from a preceding signal to assume directly the condition of a succeeding signal. As described in the copending application referred to above, the phasing interval should be sufficient in length of time to afford ample opportunity for the type wheel to make at least one complete revolution, since the extreme out-of-phase relation between transmitter and receiver may be as much as, but never more than one character less than the total number of characters which comprise the periphery of the type wheel. To compensate for this time, the control tape is perforated with a plurality of blank signals sufficient in number to equal the maximum phasing interval. This plurality of blank signals is followed by an allotted code signal which effects the alignment of notches 371 and thereby operates the phasing supervision.

Perforated tape is threaded into a record reader mechanism 202 of the conventional type and proceeds in a step-by-step manner presenting its transverse code positions successively to the proximity of the sensing pins 213. As the set of feeler levers 206 are positioned cyclically, the transfer levers 344 transmit corresponding settings to the code discs 314. Upon the completion of a cycle, shaft 229 is brought to reset by means of the restoration cam and follower roller 246, which thereupon returns arm 243 to clutch disengagement condition. Assuming that the particular code related to a selection for which a rod 261 has been provided, there will result a displacement of one of said rods 261 under influence of its garter spring 308 or 309 presenting its associated extremity 1083 into the path of the seeker projection 1084, Fig. 11. Upon the succeeding operation of selector arm 257 when it traverses the proximity of the selector rod 261, the butterfly 255 will be rocked about its pivot rod 256 causing one of the vanes 328 or 329 to dislodge the associated storage pin 278, and at the same time revolving contactor 254 is brought into engagement with the continuous contact ring 258. This closes a circuit which may be traced in Fig. 10 from positive current source, over line 381, continuous contact ring 258, revolving contactor 254, line 382, thence over line 384, manual control switch 385, line 386, winding of relay 387, line 388, resistances 389 and 391 to the junction 392, line 393 to negative current source.

As a result of the completion of this circuit, relay 387 is energized pulling up its armatures 394 and 395. The former closes with its contact point 396, and the latter with its contact point 397. Contact pair 395—397 completes a locking circuit for holding relay 387 closed, which is traceable from plus over line 381 to the junction 398, line 399 to the junction 401, line 402 through the unlock contact pair 403, line 404 to the junction 405, whence the locking circuit continues over path 406, the contact pair 397—395, lines 407 and 408, line 384 to the manual control switch 385, line 386, winding of relay 387, line

388, resistances 389, 391, line 393 to negative supply.

As a result of the closure of contact pair 394—396, a circuit is prepared for energizing the start magnet 253 traceable as follows: from positive current supply of line 381, junction 398, line 399 to junction 401, line 402, through contact pair 403, line 404 to junction 405, line 409, through contact pair 394—396, line 411 to junction 412, line 413, through the winding of magnet 253, line 414 to the junction 392, and line 393 to negative current supply.

Thus, it is to be noted that relay 387 performs as a storage device, while at the same time its energization is contingent upon the closure of contactor 254 with ring 258 and that the latter operation may result only upon the selective conditioning of one of the elements 261. Since the record reader shaft is initiated by the magnet 253 while the latter is conditioned by the relay 387, the record reader mechanism 202 will be understood to depend for its start of each cycle upon the selection of an element 261.

As in the case of the preferred embodiment, however, means are provided for initiating the record reader mechanism in the event of a non-selecting signal in order that the tape may be advanced and thus accomplish through the intervention of the disc 317 and its contact controlling arm 319. Referring for the moment again to Fig. 3, it will be recalled that upon the occurrence of a non-selecting signal, disc 317 is permitted to be rotated clockwise by spring 322 until it attains the position whereat the contact pair 321 is permitted to close completing a circuit for energizing the storage relay 387 as follows: from positive current supply, over line 381 to junction 398, line 399 to junction 401, switch 415 to line 416, contact pair 321, line 417 to junction 418, lines 408 and 384 to manual switch 385, line 386, winding of relay 387, line 388, resistances 389 and 391 to junction 392, and line 393 to negative current supply. As a result of the energization of relay 387, its armatures are pulled up causing to be effected the record reader initiation by the resulting energization of start magnet 253 in the same manner as described above.

In each case whether in response to a selecting or non-selecting signal, the record reader cycle continues until the locking circuit is opened when a cam 368 on the record reader shaft, acting through lever 365 and parallelly shiftable bar 364, shifts the control rod 419, Figs. 2, 4, and 10, until the contact pair 403 is opened breaking the locking circuit for relay 387 and restoring the subordinated circuits to their normal condition preparatory to a new cycle of operation. The motor 233 is preferably of the synchronous type as is also the printer motor at a remote station with which the present apparatus is designed to communicate. Where an alternate current supply source is not available for the use of both stations, a special power line may be provided or another suitable method that may be adapted is one such as described in copending application Serial No. 151,827 filed July 3, 1937.

Figures 1, 2 and 4 show an apparatus for adjusting the phase of the signals to the phase of the alternating current supply source. Reference characters 422 and 423 denote side frames which are pivotally supported on journals carried concentrically with selector shaft 263 and sleeve 264 and which are provided with underhanging portions for, in turn, supporting the pivot shaft 424 upon which driving coupling 273—274 is idly mounted. An auxiliary segment 425, secured to side frame 422, is provided with teeth for meshing with a worm wheel 426. The latter member is secured to a horizontal shaft 427 one end of which carries the knurled setting knob 428. Also secured to shaft 427 is a star wheel 429 on whose periphery there is tensioned the jockey roller 431. By rotating shaft 427, segment 425 may be rocked clockwise or counterclockwise carrying with it the underhanging frame including the side members 422 and 423, accordingly changing the angular position at which shaft 263 and sleeve 264 are relatively maintained. Accordingly, the phase relationship of each signal may be oriented to the phase of the alternating current supply, so that a standard relative phase of transmission may be established and maintained, and any setting thus obtained may be retained against inadvertent changing by means of the holding jockey 431 and star wheel 429.

While the present invention has been explained with reference to a particular set of embodiments, it is to be understood that numerous modifications and variations may be introduced within the contemplation and spirit of the present disclosure. It is accordingly to be understood that the scope of the present invention is not to be inferred from the details of the accompanying illustrations nor from the terminology of the foregoing specification but only as defined by the hereinafter appended claims.

What is claimed is:

1. In a telegraph system, a transmitter for generating selection signals in which single impulses occurring at a variable period in terms of a cycle correspondingly represent different characters, a permutation code responsive apparatus, means controlled by said permutation apparatus for supervising the periodicity of said signal transmitter in accordance with a permutation code, and a record reader for communicating to said permutation code apparatus successive control conditions.

2. In a transmitting distributor, a first group of transmitting elements arranged in a circular path, a second group of transmitting elements arranged in a circular path concentric to that of said first group, a contact carrier rotatable concentrically of said paths, electrical conductor means for bridging the elements of said first group with those of said second group consecutively and in an out-of-phase relationship each to each, and contacting elements supported by said carrier for first engaging the elements of said second group to establish a transmitting path and for thereafter engaging the corresponding elements of said first group to transmit selecting impulses in accordance with said established transmitting path.

3. In a transmitter, a series of elements arranged in a circular path, a series of members arranged in a circular path concentric with the path of said series of elements, a device rotatable concentrically of said paths, means to displace one of the elements of said series into the path of movement of said device, a butterfly carried by said device for displacing one of the members of said series of members under the control of a displaced element of said series of elements, and rotating means responsive to a displaced member for transmitting telegraph signals individual to each one of said members of said series.

4. In a telegraph system, a record reader, a transmitting distributor, means to operate said

record reader at a substantially uniform rate, means to transmit telegraph signals under the control of said record reader over said transmitter at a non-uniform rate, and apparatus responsive to predetermined degrees of variation between said two rates for momentarily arresting the faster one of said record reader and transmitting means.

5. In a telegraph system, a record reader operable step by step to sense character perforations in a form, a transmitter, means to transmit a signal representing an intelligence character during each cycle of operation of said transmitter, and a storage mechanism intermediate said record reader and said transmitter including means for compensating between the rates of operation of said record reader and said transmitter.

6. In a telegraph transmitter, a series of permutation elements, means to condition said elements in accordance with varying permutative arrangements according to signals to be transmitted, a translating apparatus, and means to transmit a single impulse per character in accordance with each of said permutation codes under the supervision of said translating apparatus.

7. In a telegraph system, a tape sensing mechanism, a signal transmitting mechanism, means responsive to said tape sensing mechanism for conditioning said signal transmitting mechanism including a circular distribution of storage members, and a device for preventing the transmission of signals when consecutively set storage members occur at closer than predetermined minimum intervals.

8. In an automatic transmitter, a distributor having a plurality of conditionable elements arranged in a consecutive sequence, a permutation code controlled member for conditioning each of said elements in accordance with a permutative signal, and means to preclude the setting of two of said elementst in said sequence which in the direction of transmission are separated by less than a predetermined minimum distance.

9. In a system of signal transposition, a distributor having a sequence of elements each allocated to a signal characteristic, a permutation code controlled mechanism for preconditioning each of said elements in accordance with a corresponding permutative code characteristic, and means for generating a signal through said distributor the identity of which is characterized by its periodicity in a cycle, said means including a setting transfer medium effective to transmit its setting and to generate a signal during one of said cycles.

10. In a telegraph transmitter, a plurality of devices arranged in a circular path, means for conditioning each of said devices, and a unit for seeking out conditioned ones of said devices comprising one member for establishing a signal impulse preparation under the control of conditioned ones of said devices, and another member forerunning said one member for determining the propriety of each supervision by said conditioned devices.

11. In a telegraph system, a cyclically operating transmitter, a step-by-step record reader, means including said transmitter to transmit a series of single impulse signals the intervals between signals varying in accordance with their periodicity, and actuating means for said record reader operative under the control of each signal transmitted by said transmitter.

12. In a transmitter, means under the control of a storage medium for supervising the transmission of signals, a step-by-step operating medium to advance said supervising means from one storage signal to the next, and means to initiate said step-by-step means at irregular intervals in accordance with the transmission of signals.

13. In a telegraph transmission system, a record reader, means controlled by said record reader for generating characteristic telegraph signals, and means controlled by the periodicity of said signals for operating said record reader.

14. In a system of signal transposition, a distributor having synchronized cyclic operations, means to condition said distributor to issue telegraph signals whose characteristic is determined by their period of occurrence in a cycle, an automatic signal sensing apparatus, and means to actuate said apparatus under the control of each signal impulse and independently of said transmitting cycle.

15. In a system of signal transposition, a distributor having synchronized cyclic operation, means to condition said distributor to issue telegraph signals whose characteristic is determined by their period of occurrence in a cycle, an automatic signal sensing apparatus, and means to initiate said apparatus at a constant interval following each signal.

16. In a single impulse signal transmission system, a permutation code tape sensing apparatus, a selector for translating permutation codes set up on said apparatus into a single element signaling characteristic including a plurality of individually selectable elements fewer in number than the total mathematically selective possibilities afforded by a given code, a transmitting distributor under the supervision of said elements, and means responsive to a permutation code for which no selective element has been allocated for initiating said tape sensing apparatus.

17. In a system of signal transmission, a tape sensing apparatus responsive to standard unit permutation code signals, a plurality of individual character elements selectable in response to certain permutations of a code, a distributor under the control of said elements, means also under the control of said elements for initiating said tape sensing apparatus, and additional means for initiating said apparatus responsive to non-element selecting signals only.

18. In combination, a rotary transmitter mechanism comprising a plurality of peripherally arranged individually selectable elements, a rotary transmitting apparatus concentric with said selector mechanism, and a carrier including means for sensing conditioned ones of said individually selectable elements of said rotary mechanism and means for instantly conditioning said transmitting apparatus for signal transmission.

19. In a telegraph transmitter, a record reader, means to transmit signals sensed by said record reader, and means controlled by each of said signals to advance a tape in said record reader to a succeeding character position.

20. The combination set forth in claim 19 including means controlled by signals other than said transmitted signals for also advancing a tape through said record reader.

21. In a telegraph transmitter, a commutator ring divided into a plurality of segments each corresponding to an impulse to be transmitted, a second commutator ring having a correspond-

ing plurality of segments with consecutive alternate segments thereof connected electrically in a sequence, means to complete a circuit through alternative consecutive segments simultaneously, and means to prepare for effective closure the segments of one alternative sequence under the control of the segments of the other sequence.

22. In a storage transfer mechanism, a first series of movable elements, means to set the elements in one or another of two positions according to a code signal, a second series of elements each corresponding to one element of the first set and also movable to one or the other of two positions, and a transfer device engageable perpendicular to the direction of the positioning motion with any one of the first set of elements when in a selected position to engage a corresponding element of said second series.

23. In a telegraph system, means to transmit a variable number of signals representing different characters according to their period of occurrence in a cycle, a tape sensing device, and means to operate the sensing device a number of times in each cycle corresponding to the number of characters transmitted.

24. In a rotary transmitter, a first rotatable member for effecting signal control having a constant speed of operation, another member rotatable concentrically with said first member having a greater speed of operation, frictional driving means for said other member, a plurality of stops for selectively arresting said other member for effecting signal translation, and a rejector for deflecting said arresting stops in the event that said first rotatable member overtakes said other member.

25. A communication system of the character described comprising a plurality of operable members, means for transmitting timed impulses of certain time duration upon the operation of each of said members, and means providing for the transmission of a complete impulse for every operation of said members, including means controlled by said members, irrespective of the time of operation of said members, to effect transmission of impulses of equal time duration.

26. A communication system of the character described comprising a plurality of individual circuits, periodic means sequentially cooperating with said circuits to condition each said circuit for transmitting conditions, means for energizing said circuits selectively to cause the transmission of a signal impulse upon cooperation of said periodic means with the particular circuit energized, and means controlled by the second mentioned means to delay the energization of certain of said circuits at certain times to prevent the transmission of a partial signal impulse.

27. A communication system of the character described comprising a plurality of different circuits, periodic means sequentially cooperating with said circuits, means for energizing said circuits to cause the transmission of a signal impulse upon cooperation of said periodic means with the particular circuit energized, and means controlled by the second mentioned means to delay the transmission of an impulse when any of said circuits is energized during the time that said periodic means is in cooperative relationship with that circuit.

28. A communication system of the character described comprising a plurality of different circuits, periodic means sequentially cooperating with said circuits, means for energizing said circuits to cause the transmission of a signal impulse upon cooperation of said periodic means with the particular circuit energized, and means controlled by the second mentioned means to suppress the transmission of an impulse in response to energization of one of said circuits unless energization of said circuit has been completed prior to the cooperation of said periodic means with that circuit.

29. In a communication system of the character described, a plurality of operable keys, means for transmitting a timed signal impulse of distinctive characteristics upon the operation of each of the several keys, and means controlled by the first mentioned means to suppress the transmission of a signal impulse upon operation of each of the said keys at certain times to prevent the transmission of a partial signal impulse.

30. A communication system of the character described comprising a plurality of operable keys, circuits associated respectively with said keys adapted to be conditioned upon operation of each of said keys, means cooperating with each of said circuits sequentially to transmit a timed signal upon cooperation thereof with a conditioned circuit, and means controlled by the said keys to delay the transmission of the signals in the event that the particular circuits are not conditioned prior to the cooperation of the said means therewith.

31. In a communication system of the character described, a plurality of operable members, circuits associated respectively with said members adapted to be conditioned upon operation of each of said members, a transmission circuit, periodic means cooperating with said first mentioned circuits sequentially to energize the transmission circuit upon cooperation with the conditioned circuits, means to delay the energization of said transmission circuit in the event that the circuits are not conditioned prior to cooperation of the said periodic means therewith, and means to maintain the circuits associated with said operated members conditioned until the energization of the transmission circuit is effected.

32. In a communication system of the character described, a plurality of operable members, circuits associated respectively with said members adapted to be conditioned upon operation of each of said members, a transmission circuit, periodic means cooperating with said plurality of circuits sequentially to energize the transmission circuit upon cooperation with the conditioned circuits, means to delay the energization of the transmission circuit in the event that the said circuits are not conditioned prior to cooperation of the said periodic means therewith, means to maintain the circuits associated with the said operated members conditioned until the energization of the transmission circuit is effected, and means operated upon the operation of said member to prevent operation of the others of said members until after the energization of the transmission circuit is effected.

33. A communication system of the character described which comprises a plurality of operable members, periodically moving means having a cooperative sequential relation with said members, means providing for the transmission of a signal of timed characteristics upon the cooperation of said moving means with an operated member, and means controlled by the operable members effecting a delay in the transmission of said signal until a succeeding cooperative relation when operation of said member occurs

during the existence of a cooperative relation between said means and said member.

34. In a signaling system, a signaling circuit, a rotary distributor having a plurality of segments, means for generating a character signal at each of several angular positions of said distributor over an associated one of its said segments, and means for preparing each of said segments for signal generation at times only when the angular position of said distributor is other than in correspondence with the segment associated with a particular signal to be generated.

35. In a signaling system, a signal transmission line, a distributor having cyclic rotation with a plurality of angular allotments each to one of a code of signals, relay means under the control of each said angular allotments to send a signal over said line, and relay conditioning means under the control of said distributor for preparing in advance said relay means for sending each signal.

36. A communication system of the character described comprising a plurality of operable members, a cyclic device, a transmission line, means responsive to operation of any one of said members to partially prepare a transmission controlling circuit identified with the operated member, means responsive to said cyclic device while said operated member is in operated condition to complete preparation of said transmission controlling circuit, and means controlled by said cyclic device through said completely prepared transmission circuit to transmit over said line a signal characteristic of said operated member.

37. A communication system of the character described, comprising signal selector members, a relay, and cyclic means for operating said relay through said signal selector members and for transmitting a signal through said signal selector members and through said operated relay.

38. A communication system of the character described, comprising signal selector members, a relay, cyclically operable means for energizing and operating said relay, and other cyclic means subsequently operable through said operated relay for transmitting a selective signal.

39. A communication system of the character described, comprising signal selector members operable to identify a specific selective signal, a relay, cyclically operable means operable after operation of said selector members for energizing and operating said relay, and other cyclic means subsequently operable through said operated relay for transmitting said specific selective signal.

40. In a signal transmission system, a rotary distributor comprising a plurality of segments, a record sensing device, a plurality of circuits each corresponding with one of said segments, means for preparing said circuits individually under the control of said sensing device, means responsive to each cycle of said distributor when a signal is transmitted for operating said circuit preparing means, and means responsive to a plurality of cycles when no signal is transmitted for operating said circuit preparing means.

41. In a signal transmission system, a rotary distributor, a record sensing device, a plurality of circuits, means for preparing said circuits individually under the control of said sensing device, means responsive to each cycle of said distributor when a signal is transmitted for operating said record sensing device, and means responsive to a plurality of cycles when no signal is transmitted for operating said record sensing device.

42. In a signal transmission system, a plurality of transmitting circuits, rotary means having communication with said circuits successively during cyclic operation, a record reader, means for transmitting signals over said circuits after their preparation, means under the control of said signal transmitting means for operating said record reader, and means under the control of said rotary means for operating said record reader.

43. In a signal transmission system, a tape controlled apparatus responsive to signals based upon a permutation code, a signal transmitting distributor based upon a periodic impulse code, and means for generating periodic impulse code signals through said distributor under the supervision of said tape controlled permutation code apparatus.

44. In a telegraph transmitting system, means to generate signal interruptions comprising a rotatable member, a plurality of elements each representative of a character and peripherally distributed about said rotatable member, means conditioned by character perforations in a control form to present selectively one of said plurality of elements into the path of said rotatable member, and means actuated by said rotatable member for initiating the performance of said conditioned means.

45. In a code translating apparatus, a power driven instrumentality, a record reader including an intermittent feeding device driven by said power driven instrumentality, a selective translator including a rotary switch controller driven by said instrumentality, and means under the supervision of said rotary switch controller for establishing engagement between said power driven instrumentality and said feeding device.

46. In combination, a selector mechanism including, a tape controlled apparatus and a set of code members having various distributions of notches and lugs for establishing any one of a plurality of individual selective clearances, a limited number of selectable elements, means for variously positioning said code members to selectively condition said elements in accordance with perforations in the tape as well as for non-selective positioning, and apparatus responsive to each selective positioning of said code members whether selective of one of said elements or not for advancing the tape.

47. In combination, a plurality of individually and selectively conditionable devices arranged in a circular path, a rotary seeker driven to traverse said path and responsive specially to any of said devices when the latter is in a selected condition, a record sensing mechanism responsive to perforations in a tape for selectively conditioning said devices in accordance with related signals, and means under the control of each special response of said rotary seeker for operating said record sensing mechanism.

48. In a signaling device, a set of code members, means for positioning said code members permutably, a set of members secondarily responsive to the setting of said code members, means to condition one of said secondary members in response to certain settings only of said set of code members, and an element operated only during an operative cycle when none of said sec-

ondary response members is altered in its setting.

49. In a signaling device, a set of principal notched code discs permutably conditionable, a series of spring pressed elements disposed to engage the periphery of said principal notched discs, means to position said discs so as to present an alignment of notches to each of said elements individually, a special disc associated with said set of principal discs, and means to position said special disc when said set of principal discs affords no alignment to any of said elements.

50. A signaling system comprising a plurality of movable permutation code elements, code members responsive individually to a limited number of possible permutative positionings of said elements, said code members being fewer in number than the total number of permutation possibilities of said elements, an additional member operated in response to all code element settings for which no individual selectable member is provided, a control form including apparatus for altering the position of said code elements, and means to control the spacing of said form by said additional member.

51. In a tape controlled transmitter, apparatus for sensing the perforations in a control form, apparatus for advancing a control form, a signaling device controlled by said tape sensing apparatus, a cam for operating said tape advancing apparatus, coupling means between a source of power for operating said signaling device and said cam, and means to disconnect said coupling means to permit said transmitting device to continue to rotate while holding in abeyance said tape advancing apparatus.

52. In a signal transmission system, apparatus for issuing conforming code signals, each comprised of two similar line characteristics separated by a variable-time condition of different electrical characteristic and indicative by its extent of an intelligence factor, and auxiliary apparatus for advancing a control form in response to code signals other than said conforming signals.

53. The method of transmitting telegraph signals which comprises the steps of assigning variable numbers of current alternations to predetermined intelligence characters, generating a starting impulse at a time interval, having a definite phase relation to the first alternating current cycle, and generating a code impulse in the same phase relation to a subsequent cycle with a variable number of intervening cycles according to the character to be transmitted.

54. In a telegraph system, means to transmit an initial impulse of a given line current condition, means to switch upon the line an alternative current condition of variable time interval corresponding predeterminedly to the characters of a code system, and means to transmit a concluding impulse corresponding in line condition to that of said initial impulse.

55. In a selector apparatus, a set of code elements, means for setting said elements into permutably variant positions, a series of selectable members fewer in number than the number of possible ones of said permutably variant positions, and a specially selectable member seeking at all times to move into selected position but barred from doing so upon the selection of any one of said series of selectable members.

56. In a selecting mechanism, a set of permutation code bars, a plurality of selectable bars fewer in number than the total possible number of coded permutations of which said set of bars is capable, a special selectable device, and means including said set of permutation code bars for selecting said special device in response to a permutation code other than one corresponding to one of said selectable bars.

57. In a code translating apparatus, a set of feelers for sensing the transverse permutations in a constant-unit permutation code form, a transmitting distributor having a plurality of successively arranged segments each segment related to a character corresponding to one of said permutation codes, and means under the control of said form sensing apparatus for issuing a characteristic code impulse for said transmitting distributor during the effective period of the transmitting distributor segment which correponds to a particular permutation code signal.

58. In a signal translation system, a transmitting distributor having a plurality of segments each conditionable to issue an impulse characterizing an intelligence item, a permutation code sensing mechanism having a plurality of perforation feelers permutably operative to establish an intelligence item selection, and means under the control of said sensing apparatus for conditioning a transmitting distributor segment which corresponds predeterminately to the same intelligence item sensed in said apparatus.

59. In a telegraph system, means for sensing permutation code signals, and means including a series of contacting devices for converting said permutation code signals into single impulse code signals with variable and characteristic spacing between successive characters.

60. A telegraph system, a transmitting circuit, means for sensing equal length permutation character code signals in a tape, means for storing said signals, and means including said storing means for translating said permutation code signals into periodic impulse code signals and for issuing periodic impulse code signals over said transmitting circuit.

61. A telegraph system comprising a code signal storage transmitter, a controlling apparatus adapted to form code signals of a different character from those of said storage transmitter, and means including said storage transmitter for supervising said controlling apparatus to transmit certain of its stored signals and to partially disable said device in response to certain other stored signals.

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