Jan. 16, 1945. L. M. POTTS 2,367,427

TELEGRAPH TRANSMISSION SYSTEM

Original Filed Dec. 30, 1937 5 Sheets-Sheet 1

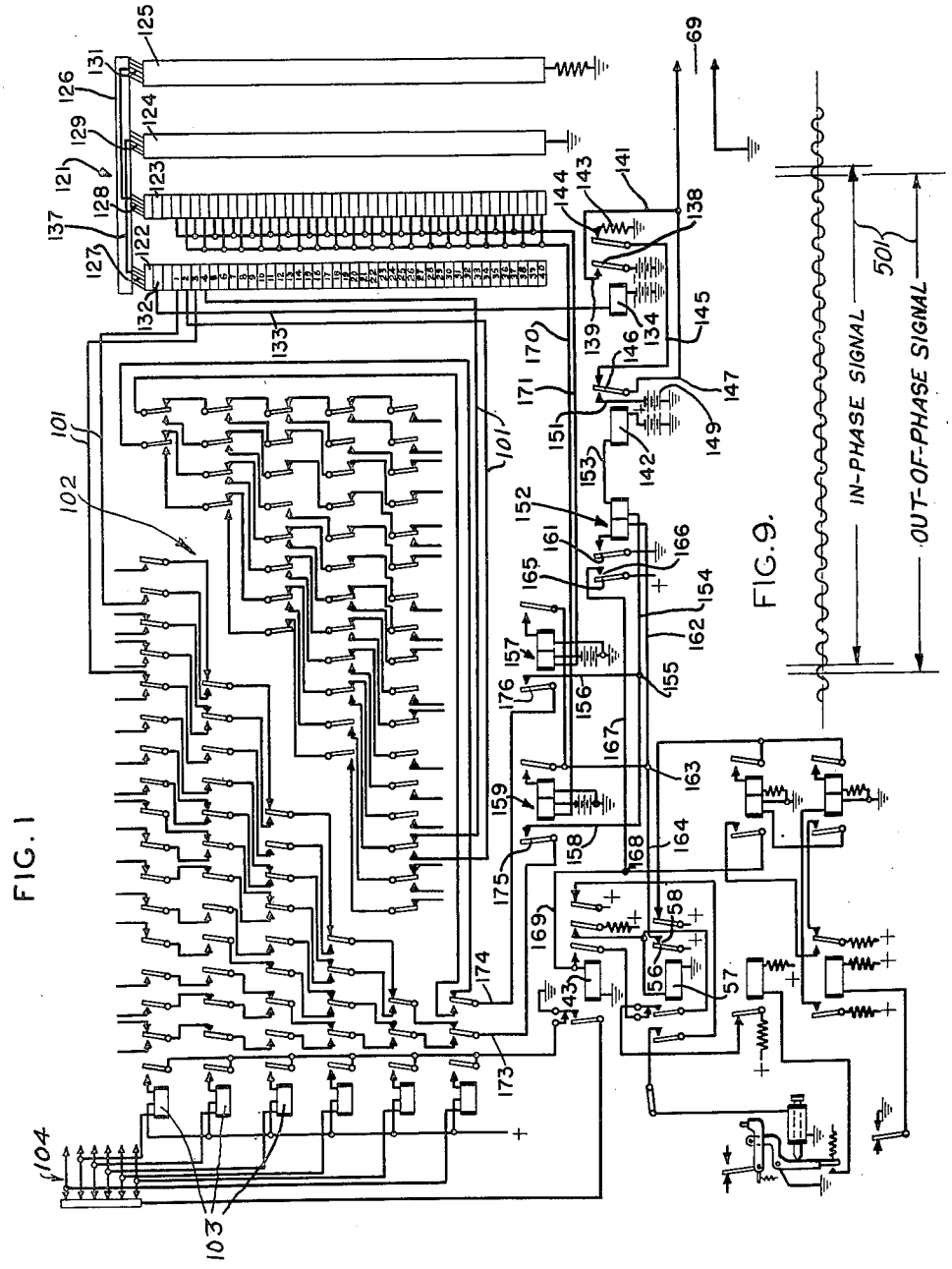


FIG. 1

FIG. 9.

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TELEGRAPH TRANSMISSION SYSTEM

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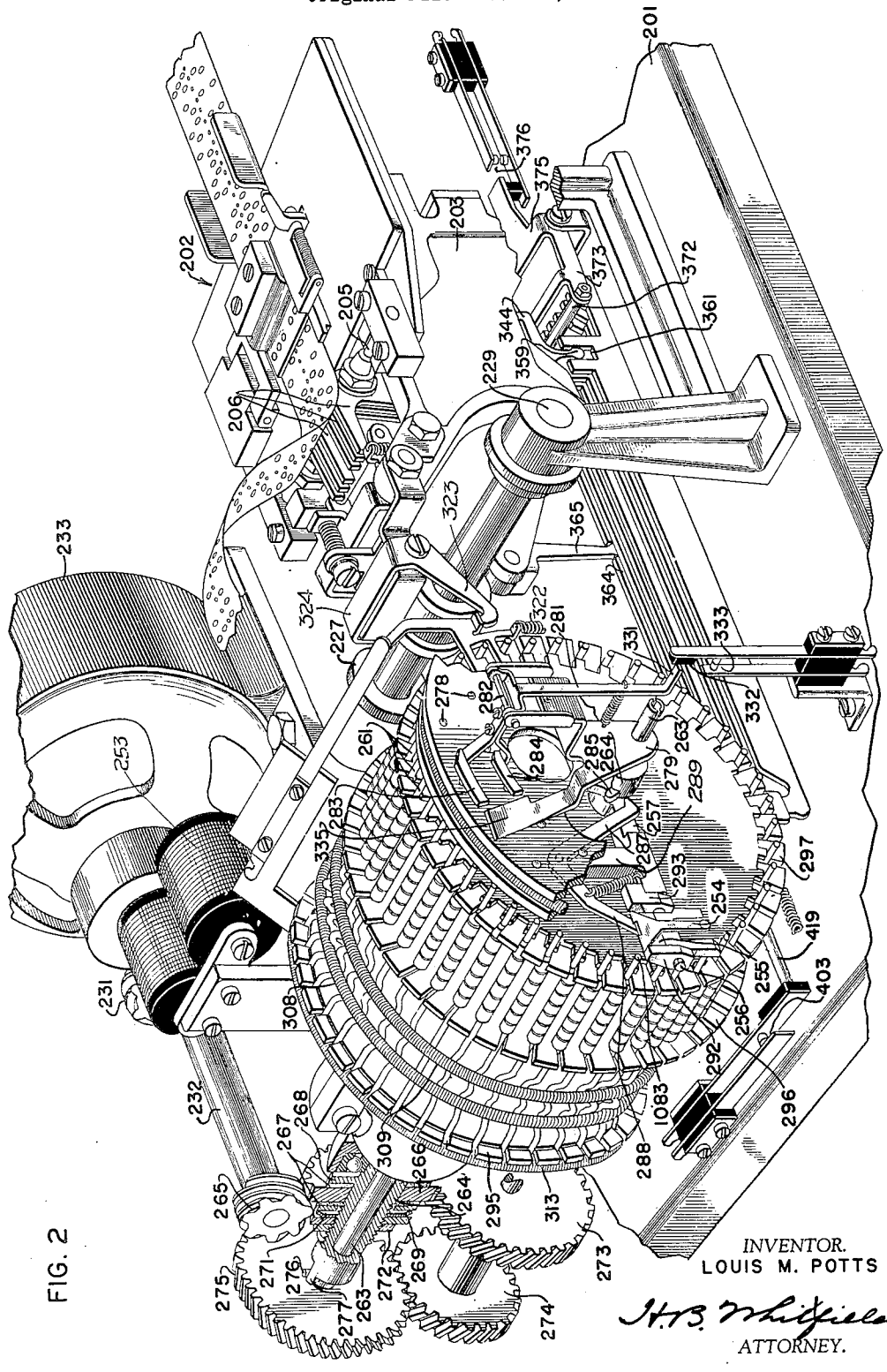


FIG. 2

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FIG. 3

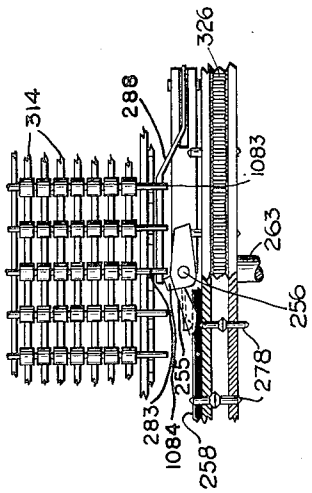
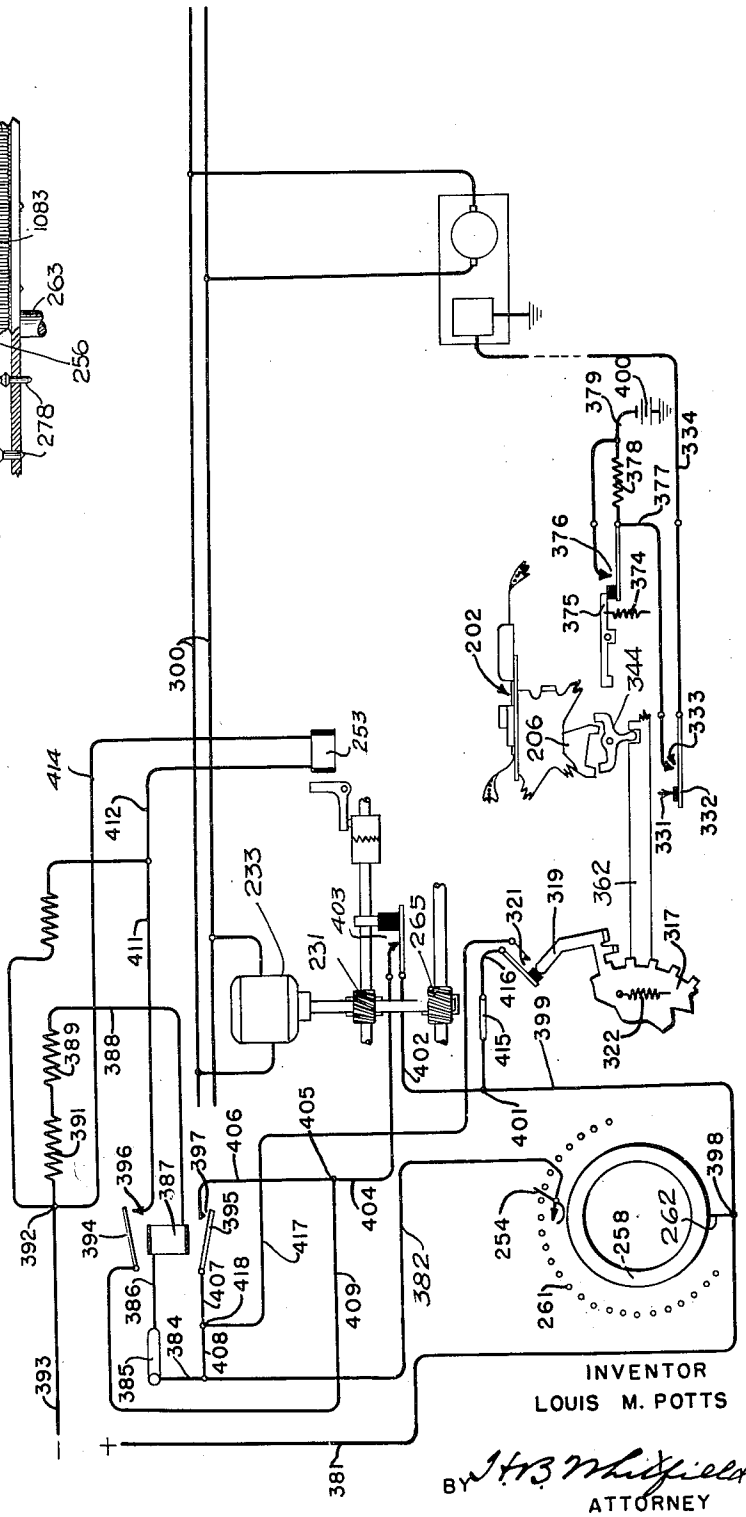


FIG. 4



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FIG. 5

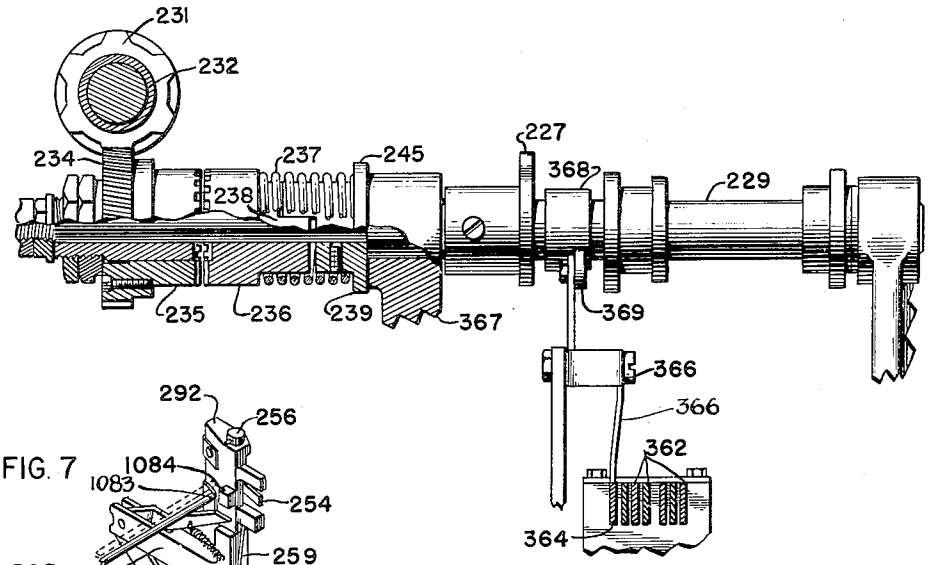


FIG. 7

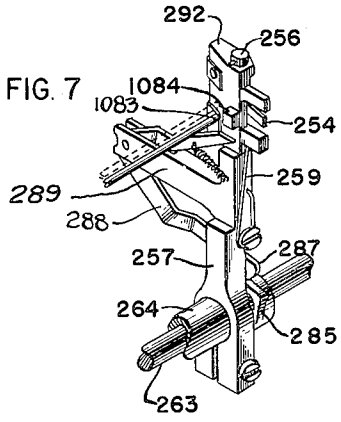
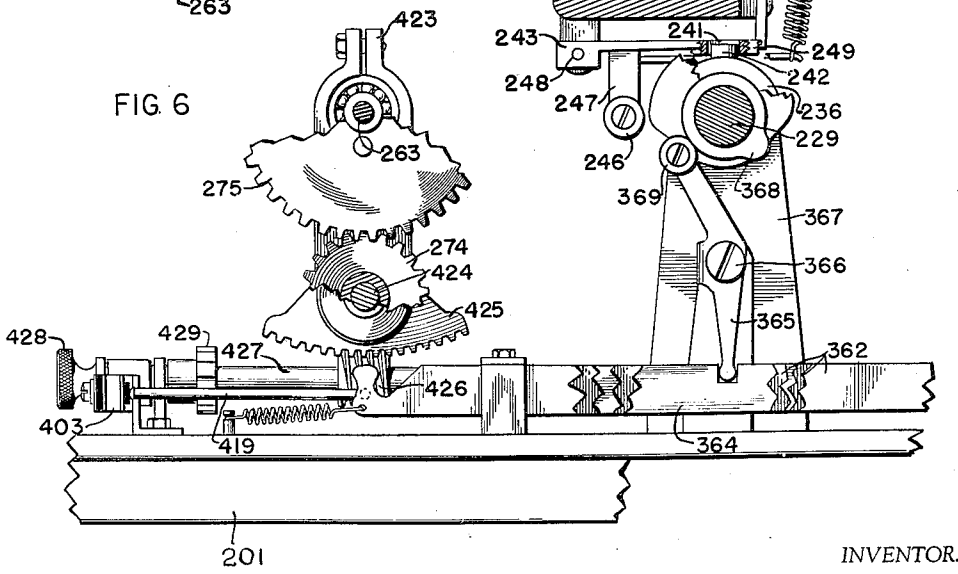


FIG. 6



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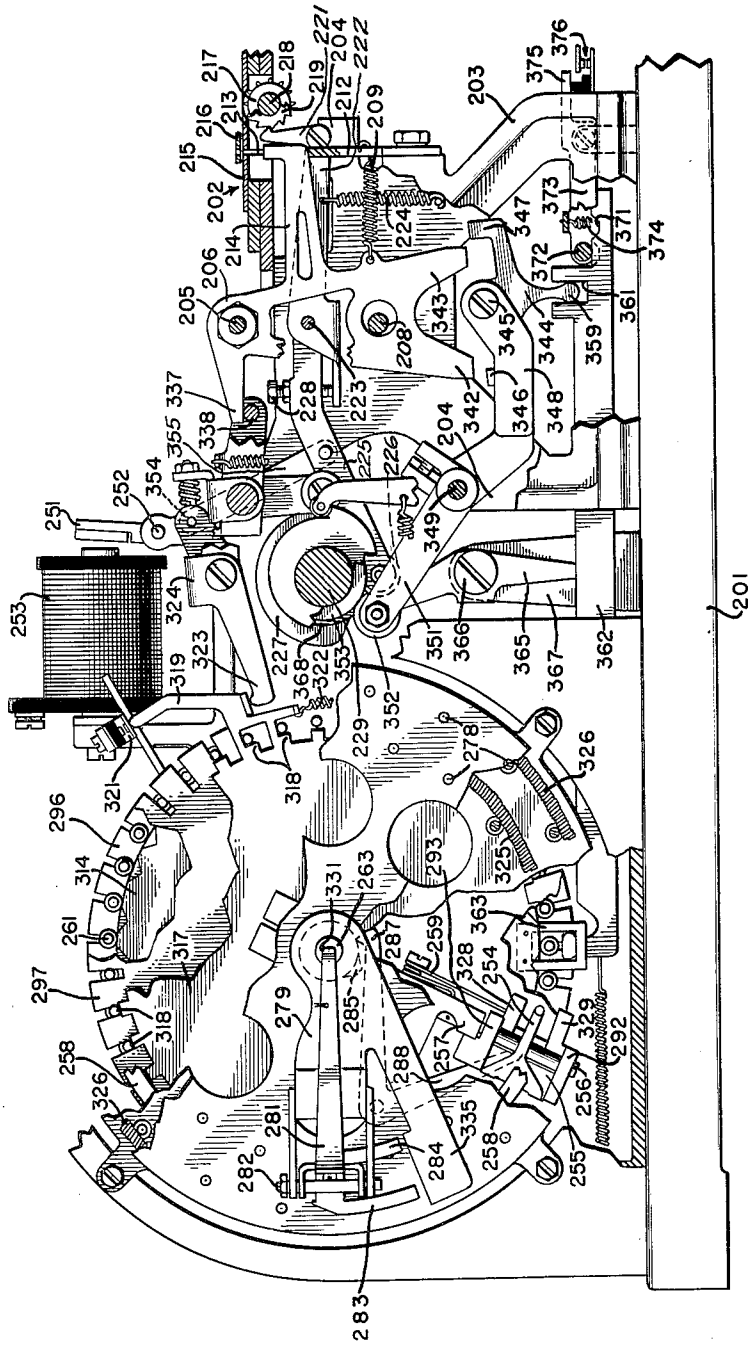


FIG. 8

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Patented Jan. 16, 1945 2,367,427

UNITED STATES PATENT OFFICE

2,367,427

TELEGRAPH TRANSMISSION SYSTEM

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

Original application December 30, 1937, Serial No. 182,422. Divided and this application October 17, 1942, Serial No. 462,360

14 Claims. (Cl. 178—17)

The present invention relates to telegraph transmitters and transmission systems and more particularly to telegraph apparatus and systems including arrangements for establishing and correcting the phase relationship between transmitting and receiving machines.

This application is a division of United States copending application Serial No. 182,422, which matured into Patent No. 2,308,539 on January 19, 1943.

The principal object of the present invention is to provide, in a telegraph signaling system in which a variable number of character signals may be transmitted within a single cycle, apparatus for periodically or predeterminedly transmitting to the receiving apparatus of the system an impulse which serves to phase said apparatus with the transmission of the signal impulses which represent the characters.

A further object of the invention is to provide apparatus for adjusting the phase relationship between the signal generating apparatus of a transmitter and its power operating mechanism where the latter is driven from a regulated alternating current.

In accordance with illustrated embodiments, there are featured several methods of generating periodic phasing impulses which are effective to produce phase correcting responses upon receiving apparatus such as printing telegraph of the type illustrated in U. S. Patent No. 2,249,040. The proposed improvement has particular application in signaling systems in which all of the signals have a constant period or cycle and in which the signal characteristic is produced by modifying the electrical characteristic, at an interval during the signal cycle. At the receiving station, apparatus is provided which is specially responsive to this modified condition in the signal cycle. Accordingly, it is to be understood that even slight discrepancies may affect the signal character and that therefore, it is vitally important to establish with a relatively high degree of accuracy the phase relationship between transmitting and receiving station apparatus; that is, the coincidence between signaling cycles of the transmitting apparatus and the receiving apparatus.

For a general understanding and illustration of typical transmitting apparatus designed to operate in accordance with systems herein under contemplation reference may be had to U. S. Patent No. 2,308,539, mentioned above, of which the instant application is a division. Moreover, in order to simplify the explanation of that portion of the system which relates to the particular subject under discussion, reference will be had to this copending application and to the aforenamed U. S. patent for specific knowledge concerning the apparatus.

Transmitting apparatuses are proposed, which, for the purposes of the present disclosure, have been especially designed in contemplation of a total of but forty selective possibilities or functional operations. This number happens not to exhaust the total number of selective possibilities afforded by a six unit permutation code of the Baudot class which affords sixty-four fundamental selective possibilities. Accordingly, a further objective of the disclosed system and one which is covered in the afore-mentioned copending application, is the provision of apparatus for translating from a six unit code to one of the type herein contemplated including means for assuring that signal transmission may continue by advancing the control form or tape even upon the occurrence in the tape of any of the code perforations which constitute the excess twenty-four signals of the total sixty-four that have no correspondence to the forty signals of the instant system of transmission.

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

Fig. 1 is a theoretical wiring diagram illustrating schematically an electrical adaptation of a permutation code transmitter adapated to generate signals and phasing impulses of the class contemplated;

Fig. 2 is a perspective view with parts broken away featuring a mechanical embodiment of transmitter and signal translating apparatus including a selector mechanism for reproducing signals and phasing impulses of the class contemplated.

Fig. 3 is a detailed fragmentary view of a portion of the selector mechanism featured in the mechanical embodiment of apparatus utilizing the present invention and illustrated in Fig. 2;

Fig. 4 is a schematic circuit diagram employing symbolic representations of the apparatus and featuring the method of circuit control which may be employed in connection with a transmitter of the type illustrated in Fig. 2;

Fig. 5 is a fragmentary detail elevation, partially in quarter-section, illustrating the distribution of cams for controlling the apparatus featured in Fig. 2;

Fig. 6 is a sectional detail view taken along a plane traversing the selecting mechanism of Fig. 2;

Fig. 7 is a detailed perspective view of the selector arm and its butterfly lever also visible upon the selector pin barrel shaft of Fig. 2;

Fig. 8 is an irregular transverse sectional view of the apparatus shown in Figs. 2 to 7 having various parts broken away to reveal the interior structure; and

Fig. 9 is a graphic representation of the type of character selecting signal employed in operating the structural embodiment of the present invention, and illustrates the coincidence of the wave cycles of the alternating current with the several character elements.

Referring now more particularly to the accompanying drawings, attention is first directed to the electrical embodiment featured in Fig. 1, which will for convenience be referred to as the preferred system. Reference character 121 designates a rotary transmitter having two segmented rings 122 and 123 together with related solid rings designated 124 and 125. Each of the rings 122 to 125 is served by an individual contact brush 127, 128, 129, or 131 of which brushes, those designated 127 and 129 are bridged by an electrical connector 137 and those designated 128 and 131 by another conductor 126. The segmented rings 122 and 123 are divided into forty-three mutually insulated segments, and each one of forty of the segments of ring 122 is electrically connected over an individual line to a contact point of a selective bank which will now be described in detail.

Each one of the general class of segments designated from one to forty in the segmented ring 122 is connected over an individual line 101 with an extreme contact point of a fan selector circuit, Fig. 1, generally designated 102, and subjected to the control of a set of selector magnets 103 which are energized in accordance with the operation of the record sensing apparatus 104 which effects the positioning of the several armatures of said magnets 103. As these armatures are placed rightwardly or leftwardly in accordance with the energization of their associated magnets 103 an individual selective path is established between a particular one of the forty distributor segments of ring 122 and one or the other of the two principal conditioning circuits 173 or 174.

The afore-mentioned principal circuits 173 and 174 are controlled by a pair of twin relays 159 and 157, respectively. Both of these relays are comprised of an energizing and a locking winding, each energizing winding being supervised over a control circuit 171 or 170. Circuit 170 is connected to alternate ones of the forty segments in ring 123 while relay 157 is controlled over a circuit 171 connected to the intermediate alternate segments of said ring 123.

As brush 128, which bridges ring 123 with ring 125, sweeps across the segments of its distributor ring, it encounters in alternate succession segments for establishing or preparing the control circuits 171 and 170 of the twin relays 159 and 157. The principal object of providing this arrangement in distributor 121 is to assure that the path over which the selecting impulse is subsequently transmitted through segmented ring 122 is fully established before such a time that the particular impulse is started through the selector 102. The segments of ring 122 align with the segmented ring 123 and are connected over lines 101 with different contacts of the fan circuit selector 102. Specifically, whereas segment No. 1 of ring 122 traverses through the selector fan 102 from the uppermost extremity of the circuit arrangement, Fig. 1, down through the circuit exiting over line 173, segment No. 2 continues over an oppositely extending path 101 upwards through the fan circuit 102 and out over line 174. Again segment 3 of ring 122 continues downwardly through the fan circuit 102 as did segment 1, etc., with alternate segments traversing the selector in corresponding manner.

The segment of ring 123 which aligns opposite segment No. 1 of ring 122 is connected over wire 171 conditioning that half of the selector circuit 102 which does not relate to the armatures affected by circuit 101 of segment No. 1. Hence the preparation by supervisory twin magnet 157 is conditioning for selective operation the even segments 2, 4, 6, 8, etc., of ring 123, and correspondingly while brush 128 is traversing the odd segments 1, 3, 5, and 7 of ring 123, brush 127, though it may be engaging the corresponding odd segments of ring 122, cannot at any particular instance complete a circuit until it encounters the even segments. In this way there is assured the complete and full length signal transmission of each impulse preventing thereby the inadvertent foreshortening or clipping of the signal impulses.

Once during each cycle of rotation, relay 134 is energized during a special impulse interval of the cycle when brush 127 engages said segment 132. As a result, an impulse is sent out over line 69 because the armature 138 of relay 134 is pulled up to engage its contact 139 extending negative battery to the main line over conductor 141. In accordance with one contemplation of the proposed system these negative impulses, differing as they do in electrical characteristic from the purely selecting impulses which are positive, serve to effect a periodic phase controlling function.

Normally, ground, through resistor 143 is connected through contact 144, line 145, armature 146, and its contact point, line 147 to the outgoing communication line 69, but upon the energization of phasing relay 134, the ground through contact 144 is removed simultaneously with the closure of armature 138 with its contact 139. Positive signaling impulses representing intelligence characters 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 front contact point 151, is at the same time withdrawn from its back contact, which is in communication 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 impulses for signaling or synchronizing purposes as the case may be.

Principal signaling relay 142 operates in series 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. The 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 are energized successively as the distributor brush 128 sweeps across the segments of ring 123.

Affecting the other winding of supervisory relay 152, a locking circuit is traceable from ground through armature 161 and its associated front contact, secondary winding of relay 152, line 162 to the junction 163 at which point branches of the locking circuit continue over line 164 to the

contact 58, armature 56, to current source which also supplies current to hold relays 159 and 157 energized all under the control of relay 57. Another armature 165 also under the control of supervisory relay 152 upon engagement with its contact point 166 completes a circuit for energizing the fan circuit relay transfer magnet 43 and this is traceable from current source through armature 165 and its contact 166, line 167 to the junction point 168, upwardly over line 169 through the winding of fan circuit relay transfer magnet 43 to ground. Twin relays 157 and 159 are energized over lines 171 and 170, as has been said, each of which lines is connected with a series of alternate 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 adaptation for permitting the practice of conditioning each segment of a distributor immediately before the arrival of its period of transmission. Then, following the energization of one or the other of the twin relays, ground is carried over the particular circuit established through the translator fan 102, 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 winding of relays 152 and 142, then to grounded battery, causing to be energized both the supervisory relay 152 as well as the principal signaling relay 142.

It will be noted from Fig. 1 that other features of the circuit are essentially the same as are those of the preferred embodiment shown in the copending application above mentioned, including the special function relay, which performs the tape step operation and those elements which exercise a supervision in the event that an unassigned signal finds its way into the translator apparatus. It will be understood that in a receiving printer appropriate accommodations will be provided to correspond with the number of segments employed in the segmented transmitting distributor ring 122.

Mechanical modification

In Figs. 2 to 8, there is illustrated an embodiment of the present invention in which mechanical agencies perform the functions, which in the above form employed solely electrical relays. The reference character 201 denotes a supporting base and reference character 202 a record reader. Several shafts are supported endwise by the side frames 203 and 204 of the record reader, among which is a principal supporting shaft 205 that carries pendulously a set of feeler levers 206. All of the feeler levers are identical in contour and through a circular opening 207 in the several outside levers there extends a rod 208 which serves to limit the degree of reciprocal movement permitted to each one of the levers 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 of the several levers 206 which are carried upon an uppermost extremity of their arms 214 seek to protrude through guide perforations of the bottom guide plate 215 and also through corresponding perforations in the top guide plate 216 which is spaced from the bottom guide plate 215 by an amount sufficient to permit the free passage of tape therebetween. As a strip of control form of tape having transverse perforations thereon is advanced between the aforedescribed top and bottom guide plate, the intermittent action of sprocket wheel 217 causes successive rows of the transverse perforation to be presented so that the sensing pins 213 of the several feeler levers 206 are aligned with said perforations or with the unperforated areas when no perforations occur in any particular instances.

Sprocket wheel 217 is carried upon a rotary shaft 218 journaled in the side frame 203 and 204. A ratchet wheel 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 its 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-armed assembly including a power actuated 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 restoration spring 224. Cam 227 is one of several cams carried upon a principal cam shaft 229 which is driven in a clockwise direction, as viewed in Fig. 2, by a driving worm 231 integrally formed with bushing 232 which is secured to the rotor shaft of a speed-governed electric motor 233.

The driving worm 231 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 to be moved upon shaft 229 in a longitudinal direction but is restrained against rotation independently therefrom because of its tongue 238, Fig. 5, which fits into a corresponding groove of the bushing 239 held 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 clutch members are in mesh, but this engagement is cyclically withheld by reason of the retention, against a cam surface 241, of a lug 242 integrally formed with the driven section 236, Fig. 6.

The rotation of shaft 229, tends, through the engagement of lug 242 with the cam surface 241, to withdraw continuously driven clutch member 236 against the influence of spring 237 which holds shaft 229 at rest, but permitting the driving member 235 of the clutch to rotate continuously. When the arm 243, within which the cam surface is formed, is withdrawn from the path of lug 242 as it is compelled to do by a spring 244, driven sleeve 236 is immediately thrust 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, however, a cam 245, Fig. 5, carried thereby engages with its apex the follower roller 246, Fig. 6, carried upon a depending portion 247 of arm 243. This urges the latter member clockwise about pivot 248 returning it to its original position, as illustrated in Fig. 6, whereat the lug 242 again encounters the side cam projection 241 which withdraws the driven portion 236 of the clutch arresting the shaft 229 upon the completion of its cycle.

The effective or clutch separating position of

arm 243 is maintained against the influence of spring 244 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 Fig. 4. Through the above-described cyclic interruption of shaft 229, the progress of the record reader is accordingly controlled so that the stepping of the tape may be made to correspond with the advancement of the transmitting mechanism. The periodic impulses for energizing control magnet 253 are generated by a revolving contact lever 254, Fig. 7, integrally associated with a butterfly 255 pivoted upon the rock shaft 256. Revolving contactor 254 is preferably electrically connected to the revolving arm 257 but if preferred it may be insulated from its supporting members. The extremity of contactor 254 is urged into engagement with a continuous contact ring 258, Fig. 8, when the butterfly 255 which is normally biased by a torsion spring 259, encounters one of the selectable rods 261, which has been moved into selective position. Ring 258, is electrically insulated from its supporting structure, as indicated in Fig. 8, but is connected over by-wire 262 (Fig. 4) with a circuit for energizing the afore-described record reader shaft release magnet 253.

In Fig. 2 there may be noted several elements which are carried upon selector shaft 263 as well as some carried upon its sleeve 264. Another driving worm 265 integrally associated with the afore-described bushings 232, meshes with the worm wheel 266, which is floated between the friction discs 267 of a friction clutch assembly formed between a metallic disc 268 integral with the sleeve 264 and a tension disc 269 longitudinally movable upon sleeve 264 and adapted to be urged by a tension or compression disc 271 in the direction of the stationary disc 268. The tension of spring 271 which may be adjusted and then checked by tightening of the adjustment nuts 272, determines the degree of frictional embrace of driven wheel 266 by the friction discs 267 and any resistance to movement greater than this adjustment will permit, may cause 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 afore-described performance of driving sleeve 264, worm wheel 266 also serves to drive a reduction coupler comprised of a driven wheel of major diameter designated 273 and driving wheel of minor diameter designated 274, Fig. 2, 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 slower speed while sleeve 264 is frictionally driven in the same direction but at a somewhat higher rate of speed, being directly associated with the driven wheel 266.

A stud 276 extends from shaft 263 in the path of a horizontally projecting lug 277 integral with the sleeve 264. Sleeve 264 may be moved at a speed greater than that at which shaft 263 is moved, but only until projecting lug 277 encounters stud 276. Thereafter, the two members, namely, shaft 263 and sleeve 264, may travel in unison, the frictionally driven and faster sleeve 264 being held back to the rate of speed established by the positively driven and slower shaft 263.

The principal purpose of sleeve 264 is to drive the revolving selector arm 257 which seeks out the selected one of the several 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 movable about its pivot 282 when either of its tracker arms 283 or 284 encounters a conditioned pin 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 intermittently in accordance with each election when one of the extremities 1083 of a selectable element 261 is presented into the path of the projection 1084, Fig. 3, of the butterfly 255. The stopping of arm 257 is accordingly momentary, as will be explained later, and because of its greater speed, as aforeexplained, arm 257 is capable of overtaking transmitter arm 279 until the projecting lug 277 encounters the stud 276.

When the number or frequency of interruptions of seeker arm 257 as above described is sufficient to so delay its progress as to cause arm 279, which is positively driven by shaft 263 to overtake arm 257 which is frictionally driven together with sleeve 264, Fig. 2, and if thereafter arm 257 is positively blocked by one of the extremities 1083, a condition might obtain whereat pin 276 which travels as an integral part of arm 279, overtakes the projection 277 which is an integral part of arm 257 and attempts to continue thereafter and is forced and possibly shorn off. To prevent this condition from occurring, a cam 285, Figs. 2 and 7, has been provided which is so arranged that the cam apex will encounter one arm 287, Fig. 8, of a bell crank whose other arm 288 is disposed in front of seeker projection 1084, Fig. 7, and beneath the rod extremities 1083. In this way, when shaft 263 assumes the position whereat slow moving but positively driven transmitter arm 279 is about to overtake the rapidly driven but momentarily blocked selector arm 257, bell crank 287—288 will first encounter the cam apex 285 which will then cause said bell crank to cam out the selected pin 261 an instant before the time at which pin 276 would collide with projection 277. As a result, the selector arm 257 is not then arrested by the particular pin 276 but instead is permitted 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 happens so close together in terms of the arrangement of selectable pins 261 that arm 257 is repeatedly arrested after but short intervening movements between selections.

Camming out of the pins 261 from out of the path of arm 257 permits the latter to resume its rotation and to be far enough in advance of the oncoming transmitter arm 279 to prevent collision. It is to be noted that under such a circumstance, any pin 261 may already have performed its selective function, and that accordingly, the signal impulse which corresponds to such a pin 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 se-

lector arm 257, as is best illustrated in Fig. 7. In this illustration, also, there may be noted the longitudinal pivot shaft 256 upon which is carried the butterfly 255 and which is journaled at 292 and 293 in rigid portions of the arm 257. The afore-described revolving contactor 254 is preferably secured as at 295, Fig. 7, to the arm 257, and at its mid-portion, rests against the flattened clearance surface of longitudinal pivot 256. Thus, it will be noted that contactor 254 being constructed of resilient spring metal, serves as an electrically conductive contacting element for engaging the surface of continuous ring 258.

As may be viewed in Fig. 2, 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 during the time that they are out of selector position. The several rods are preferably supported in a floating condition within individual alignment of slots in disc 295, 296, and 297, which slots are parallelly arranged along the several discs and spaced radially from each other.

The selectable elements 261 are similarly bent as may be seen in Fig. 2 to collectively provide retention to a pair of garter springs 308 and 309 which repose within the peripheral clearance afforded by said alignments while the garter springs in turn, serve to maintain the several selectable elements 261 under centripetal tension. Each of the elements 261 terminates with a slightly upturned rearmost section disposed with sufficient clearance behind the rearmost plates 295 so as to afford a space therebetween to receive a garter spring 313 similar to the tensioning garter springs 308 and 309 afore-mentioned but serving in this instance to prevent accidental longitudinal displacement of any one of the selectable rods 261.

Between the two foremost partitioning elements 296 and 297, there are supported for limited reciprocal movement a set of circular selecting discs, in the instant case six in number, indicated 314, Fig. 8, as well as a stripper disc. The peripheries of the several discs 314 are provided with a systematic distribution of obtuse angular notches. Each disc 314 is capable of limited reciprocal movement throughout an angular distance which corresponds to the spacing between adjacent selectable rods 261. The arrangement of said notches in the several discs 314 is in accordance with the 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 a transverse alignment of said peripheral obtuse notches.

As is well known to those acquainted with permutation selecting systems, the total mathematical selective possibilities afforded by a six unit permutation code selector is sixty-four. To accommodate all of the selective functions requisite to the operation of a printer such as that illustrated in U. S. Patent No. 2,249,040, all of the sixty-four possibilities are not required to be used, but instead only forty, leaving unused a total of twenty-four selective possibilities. Accordingly, though the six discs, 314, are mathematically capable of affording sixty-four different selections, there are provided only forty selectable rods 261. It will be understood, therefore, that in response to twenty-four of the total variations of sixty-four selective possibilities, 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, 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 may be reciprocated with less effort. The extremities 1083 of the several selectable rods 261 are slightly undercut so as to provide a shoulder. This practice permits of the maintenance of closer tolerances between the several extremities 1083 and the rotatable elements carried by the arm 257 which traverses the proximity just beneath or inside of the circular arrangement of said extremities 1083.

A plate 317 is supported for limited rotation beneath the extremities 1083 and its periphery is studded with a plurality of square shouldered projections 318 angularly spaced to register each 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 318, is disposed so that its foremost portion rests against one element of a contact pair 321 normally tensioned to remain open, but held in contactual engagement by said arm 319 during certain conditions of operation which will now be described.

A return spring 322, Fig. 8, one end rigidly anchored to a stationary portion of the unit, imparts a clockwise torque to plate 317 maintaining the latter member in the condition illustrated in Fig. 8, or in what may be termed its normal position. 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 of an element 261 accordingly is not instantly permitted, due to the blocking thereof by its engagement with one of the lugs 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 afore-described arms 319. The extremity 1083 of the particular selected rod 261 is then permitted to continue farther and as it does so it becomes a barrier to the return (clockwise) of disc 317 until such a time that it is restored by the stripper disc.

Bail 324 is operated as one of the incidents of the record reader unit and its operation may occur at a time in the cycle sufficiently in advance of the signal transfer and restoring operations 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 counterclockwise extreme position and maintaining the contact 321 closed throughout the ensuing cycle of operation. It is to be noted that the retention of disc 317 in its counterclockwise position is a condition responsive to those operations only which result in the selection of one of the rods 261, and that at other times when no rod 261 is selected as is the case if one of the afore-mentioned twenty-four unused permutation codes occur, then plate 317 will be permitted to return together with its actuating bail 324 allowing the contact pair 321 to close.

The storage pins 278 correspond in number and position to the selectable element 261. The pins 278 are distributed in two circular rows and also in staggered succession. A garter spring

325 is tensioned around the inner circle of pins 278 and a similar spring 326 encircles the outer row of pins. Each signal storage pin has at about its center an angular ridge 327. The tension of the springs 325 and 326 serves to detent its associated circular row of storage pins in one or the other of two possible longitudinal positions. The normal position of said pins 278 is the one as illustrated in Fig. 2, but when the butterfly 255 is deflected as portrayed in Fig. 3, as a result of having encountered a selected extremity 1083 of one of the pins 261, then one or the other of the vanes 328 or 329 is brought against the inner extremity of a storage pin 278 displacing the latter member longitudinally whereat it is retained by its associated afore-described garter spring 325 or 326.

As a consequence of an encounter with a protruding storage pin 278, the instant when transmitter arm 279 traverses the proximity of said selected storage pin, one or the other of its tracker arms 283 or 284, traveling clockwise with the transmitter arm 279 is caused to be cammed toward 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. 2 which then causes an open line signal condition of measured length to be established momentarily.

There is thus produced a signal condition sent out over the line 334, following which a restoring vane 335 integrally associated with the arm 279 and presented at an angle as best indicated in Fig. 2, thereupon encounters the condition pin 278 endwise, forcing it back against the holding tendency of its associated garter spring 325 or 326 and returning it to its normal position. It is to be noted that the sideward encounter of one of said storage pins 278 by the tracker arm 283 or 284 will not displace said pin because the force applied to the pin is transversely of its direction of movement. Thereafter a gentle camming action on the part of vane 335 applied endwise instantly depresses the condition pins 278 without so much as retarding the regular cyclic movement of the transmitter arm 279.

Attention is now again directed to the record reader mechanism 202, Figs. 2 and 8, where there was described that the feeler levers 206 present their feeler pins 213 to successive transverse areas of a control form cyclically. The sidewardly extended projections 337 are formed integrally with each one of the levers 206. The bail rod 338 traversing the proximity beneath said projections 337 forms part of a yieldable bell crank assembly pivoted on shaft 339 and actuated by the afore-described feeler lever operating cam 227 upon whose periphery there rides a follower roller 341 which is associated with another arm of said internally yieldable bell crank assembly.

The lowermost portions of feeler levers 206 are formed with a pair of opposite shoulders 342 and 343, Fig. 8, which, as each feeler lever 206 is presented for tape sensing operation, may assume a so-called marking (counter-clockwise) as viewed in Fig. 8, or spacing (clockwise) position. Beneath the projecting shoulders 342 and 343 are a set of transfer levers 344 of generally T-shaped conformation carried on a common pivot rod 345 with each lever associated with and moving in the same plane as one of said feeler levers 206. A pair of upwardly extending projections 346 and 347 is integrally formed with each transfer T-lever 344 and these projections 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 one of the upstanding projections 346 or 347 may collide with its projection 342 or 343 to the exclusion of the other one.

The other one of the two projections avoids direct engagement with its cooperating projection and instead swings around it causing the transfer lever 344 to be correspondingly rocked either clockwise or counterclockwise about its pivot 345. Thus, transfer of signals occurs during the time that the pivot rod 345 is being thrust upwardly by a bell crank carrier including one arm 348 pivoted on the rock shaft 349 from which there extends another arm 351 that terminates with a follower roller 352. The bell crank assembly 348—351 is actuated by a cam 353 which is also supported upon and rotated with the record reader operating cam shaft 229.

The bail 324 mentioned above is also actuated by shaft 229 through the instrumentality of an ear 354 formed at its remote end as viewed in Fig. 5, to which is connected one end of a link 355 whose other end is pivoted at 356 at an intermediate point upon the tape feed actuator arm 225. A follower roller of said follower arm 225 is actuated by a cam on shaft 229 and is pivoted at 223, upon which pivot is also carried a supporting lever 222 whose extremity carries the tape feed pawl 221.

Upon the counterclockwise movement of the tape feed stroke of lever 222, link 355 is pulled downwardly causing bail 324 to be rotated clockwise and causing its extremity 323 to rock disc 317 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 at the time selected, return movment of the disc 317 is for a moment prevented because of the blocking of one of its probing teeth or projections 318 and contact pair 321 is then held open.

Referring again to the transfer lever 344, it will be noted that the lowermost extremities thereof are provided with circular discs 359, each one of which is received within a parallelly sided slot 361 of a corresponding connecting rod 362. Each rod 362 is articulated at its left end by means of a retaining clip 363 and a suitable slot to one 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 disc 314.

Alongside the connecting rods 362, Figs. 3 and 6, is a parallelly shiftable bar 364 resembling generally the class of connecting rods 362 at its end whereat it is articulated to the stripper disc (not shown), but terminating at a point short of the rightward extremity of said general class of rods with a disc and socket connection associated with one of the levers 365 pivoted at 366 to a stationary part 367 of the tape sensing unit. The upper end of lever 365 terminates with a follower roller 369, Fig. 6, which rides the periphery of a cam 368, also carried on shaft 229. The purpose of cam 368 is, through lever 365, to rock the stripper disc of the code disc assembly following each selection in order to restore any one of the selected elements 261, which had been selected during the preceding cycle, to its normal position preparatory to a subsequent selection.

At their right-hand extremity, the several connecting rods **362** are notched as at **371**, Fig. 8, and the several notches **371** are arranged in a transverse alignment when said rods **362** are positioned in accordance with a certain code combination only which in the instant contemplation is the so-called all-marking signal condition. Upon the occurrence of this special code combination signal beneath a notch probing rod **372**, the supporting lever **373** which carries rod **372** is permitted to respond to the urge of its spring **374** and be rotated by it through a slight angle in a counterclockwise direction. As a result, there is withdrawn the opposite end **375** of lever **373** permitting the contactor **376** to be closed for achieving a purpose which will be described later.

General operation

In order to illustrate the relationship of the various components which comprises the mechanical embodiment of the invention just described, a concise description of a typical operating cycle will now be reviewed in conjunction with the exemplary circuit illustrated in the accompanying Fig. 4. Symbolic representations of certain mechanical details have been employed in order to suggest the particular structural embodiments which were shown in the mechanical adaptation. The reference character **334**, indicates an outgoing line, which it is presumed, is connected to a receiving printer of the type illustrated in U. S. Patent No. 2,249,040. This line at the transmitting station is traceable through the contact pair **333**, which effects signaling by producing regulated and periodic interruptions, thereafter continues over a conductor **377**, measured resistance **378**, to the battery lead **379**.

Resistance **378** is provided for the purpose of dividing the signaling current until it is sufficiently below that supplied by grounded line battery **400** in order that, when this resistance **378** is shunted out by the operation of switch **376** afore-described, the higher voltage may be applied to the line for the purpose of thereby effecting periodically a phase regulating strong impulse, which when received by the printer mechanism as disclosed in U. S. Patent No. 2,249,040 will be characteristically effective upon the phase regulating magnet discolsed in said patent under the reference character **43**. Upon the receipt of this regulating impulse, the magnet **43** which is always connected to line but is only marginally responsive to current stronger than ordinary signal strength effects an operation causing its armature to be disposed in the path of a cyclically rotatable wheel. Thereafter at the termination of this impulse, the wheel is permitted to resume rotation and thus phase adjustment is obtained at a critical instant in the printer cycle which is in precise phase relationship with a corresponding instant at the transmitting station apparatus.

Upon the occurrence of the particular code combination in the control form which effects the alignment of the notches **371**, Fig. 8, which code combination preferably is supplied at regular intervals, a synchronizing impulse is thereby obtained by shunting out the resistance **378**. The code 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 printer patent referred to above, the phasing interval should be of sufficient duration 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 delay, the control tape, during its preparation, is perforated with a succession of blank signals, that is, code combination signals having perforations in all positions, sufficient in number to equal the maximum phasing interval. This succession of blank signals is followed by an allotted code signal which effects the alignment of notches **371** on the connecting rods **362** and thereby operates the phasing supervision.

Perforated tape, which is prepared in contemplation of the particular system, is threaded into a record reader mechanism **202** and thereafter it proceeds in a step-by-step manner presenting its transverse code perforations successively to the proximity of the sensing pins. As the set of feeler levers **206** which carry the sensing pins is positioned cyclically, the transfer levers **334** transmit corresponding settings to the code discs **314**. Upon the completion of an operating or signal cycle, shaft **229** is brought to rest by means of the restoration cam and follower roller **246** which thereupon returns arm **243** to clutch disengagement condition.

Assuming that the particular code relates to a selection for which a rod **261** has been provided rather than to one concerning which no rod is provided as discussed above, there will result a selective displacement of said rod **261** under the influence of the garter spring **308** or **309** which will displace the rod at its extremity **1083** presenting the extremity thereof into the path of the revolving seeker projection **1084**, Figs. 2 and 3. Upon the succeeding operation of selector arm **257** when said arm traverses the proximity of the selector pin **261** thus conditioned, the butterfly **255** will be rocked thereby about its pivot rod **256** causing one or the other of its two vanes **328** or **329** to dislodge the associated storage pin **278** with which one or the other of said vanes happens to collide at the instance of effectiveness of such selector rod **261**. At the same time revolving contactor **254** is brought into engagement with the continuous ring **258** completing a circuit which may be traced in Fig. 4 from positive current over line **381**, continuous ring **258**, by wire **262**, revolving contactor **254**, line **382**, thence over line **384**, manually controllable switch **385**, line **386**, winding of relay **387**, line **388**, resistances **389** and **391** to the junction point **392**, line **393**, thence to negative source.

Upon the completion of this circuit, relay **387** is energized pulling up its armatures **394** and **395**. Armature **394** then closes with its contact point **396** while armature **395** does so with its contact point **397**. Contact pair **395—397** thereupon completes a locking circuit for holding relay **387** closed which is traceable from plus current over line **381** to junction point **398**, thence over line **399** to the junction point **401**, thence over line **402** through the (closed) contact pair **403**, line **404**, to the junction point **405**, thence the locking circuit continues over path **406**, the contact pair **397—395**, lines **407** and **408**, lines **384**, through the manual control switch **395**, line **386**, winding of relay **387**, line **388**, resistances **389** and **391**, line **393** to negative current.

As a result of the closure of contact pair **394—396** a circuit is prepared for energizing the start magnet **253** which is traceable as follows:

From positive current supply of line 381, junction 398, line 399, junction 401, line 402 through contact pair 403, line 404 to junction 405, line 409 to contact pair 394—396, lines 411 and 412, through the winding of magnet 253, line 414 to the junction 392, and thence over line 393 to negative current.

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 therefore be understood to depend for its start impulse of each cycle upon the selection of an element 261. Means are also provided for initiating the record reader mechanism in the event of a non-selecting signal in order that the tape may be advanced nevertheless and this is accomplished through the supervision of the disc 317 and its contact controlling arm 319.

Referring for the moment again to Fig. 8, it will be recalled that upon the occurrence of a non-selecting signal, disc 317 is permitted to be rotated clockwise by a spring 322 until it attains a position whereat the contact pair 321 is permitted to close, completing a circuit for energizing a storage relay 387, traceable in Fig. 4, as follows: From positive current supply, over line 381 to the junction point 398, line 399 to the junction 401, switch 415 to line 416, contact pair 321 (now closed), line 417 to junction 418, lines 408 and 384 to the manual switch 385, line 386, winding of relay 387, line 388, resistances 389 and 391 to junction 392, and thence over line 393 to negative current supply. As a result of the energization of relay 387 its armatures 394 and 395 are pulled up causing to be effected the record reader initiation by the resulting energization of start magnet 253 after the manner described above.

In each case, whether in response to a selecting (one of the forty) signal or to a non-selecting (one of the twenty-four) signal, the record reader cycle continues until the locking circuit of relay 387 is opened and this is done by a cam 368 on the record reader shaft, acting through lever 365 and through the parallelly shiftable bar 364, causing to be shifted the control rod 419, Fig. 6, until the contact pair 403 is opened. This not only breaks the locking circuit for relay 387 but also it restores the subordinated circuits to their normal condition preparatory to and in contemplation of a new cycle of operation.

The motor 233 is preferably of the synchronous type as is also the printer motor at the remote stations with which the present apparatus is designed to have communication. Where a common alternating current supply is not available for the use of both stations, a special power line may be provided or another suitable method that may be adapted to this system is one such as is described in U. S. Patent No. 2,237,951.

Fig. 6 shows an apparatus for adjusting the phase of the signals sent out over a line to that of the alternating current supply source. Reference to Fig. 9 will now be had in order to illustrate what is meant by wave-signal orientation. The general reference character 501 designates a dimensional representation of a cyclic signal interval which may be considered as composed of a number (forty in the instant example) of component signal subintervals. During the transmission of the full signal interval, it is contemplated to occupy forty consecutive alternating current half waves or twenty full waves. The apparatus now to be described concerns means for accurately placing the cyclic signal so that each one of its component subintervals will coincide with an alternating current half wave.

Reference character 423 denotes one of two side frames pivotally supported on journals, carried concentrically with selector shaft 263 and sleeve 264. These side frames are provided with underhanging portions for supporting the pivot shaft 424 upon which driving coupling 273—274 is idly mounted. An auxiliary segment 425, secured to the 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 adjustment knob 428. Also secured to shaft 427 is a star wheel 429 against whose periphery there is tensioned a jockey roller or detent (not shown). By rotating shaft 427 one way or the other, segment 425 may be rocked clockwise or counterclockwise carrying with it the underhanging frame including the side members described above, and accordingly changing the angular position at which shaft 263 and sleeve 264 are relatively maintained. This rotation will shift the phase relationship of each signal to be generated to align with the alternating current supply so that a standard relative phase of transmission may be established and maintained and any setting thus obtained may be continued against a possibility of inadvertent changing through the operation of the holding jockey in cooperation with the start wheel 429.

While the present invention has been explained with reference to a particular set of embodiments, it is to be understood, nevertheless, that numerous modifications and variations may be introduced within the contemplation and spirit of the present disclosures. It is accordingly intended that the scope of the present invention be not confined to the details in the accompanying illustrations nor to the specific language contained in the foregoing specification except as designated in the hereunto appended claims.

What is claimed is:

1. In a telegraph transmitting device, a transmitting apparatus operated in regular consecutive cycles of identical time duration, apparatus responsive to a perforated control form, means controlled by said apparatus to transmit a variable number of character impulses during any one of said cycles, and means under the control of special perforations in said form to transmit a signal for phasing a signal responsive receiving device to the cycles of operation of said transmitting apparatus.

2. In a code perforated tape controlled transmitter, means to transmit character signal impulses having a given electrical characteristic at certain instants in a cycle in response to a general class of permutation code perforations in a tape, and means to transmit a phasing signal having a different electrical characteristic under control of a predetermined special code perforation in a tape.

3. In a code translating transmitter, means to transmit a signal impulse of one electrical characteristic in response to a general class of permutation code control perforations in a tape, and means to transmit a phasing signal of a dif-

ferent electrical characteristic under control of a particular code perforation in a tape.

4. In a signal transmission system, a record reader mechanism responsive to perforations in a control form, a rotary signal generator including a plurality of impulse elements, means under the control of said record reader for conditioning said impulse elements, means to generate cyclically signal intervals having a number of characteristic impulses in each cycle in accordance with the conditioned ones of said impulse elements, and means responsive to a special perforation in said control form for generating a signal impulse differing in electrical potential from said characteristic impulses.

5. In a signaling system, a signal transmitter including a plurality of conditionable impulse elements, a mechanism responsive to perforations in a control form for conditioning said elements, cyclic means to generate signals in each cycle having a number of impulses and each having a periodicity in accordance with the conditioned ones of said elements, and a means responsive to a special perforation in said control form for effecting a signal impulse differing electrically from said characteristic impulses.

6. In a signal transmission system, a transmitting distributor having a plurality of components each allocated to a signal characteristic of a code, means for operating said transmitter cyclically, means responsive to a perforated control form for conditioning each component to generate a signal characteristic impulse indicative, by its location in a cycle, of an intelligence character, and means under the control of special perforations in said form for transmitting a single impulse during each cycle differing electrically from said character impulses for establishing the phase relationship of a cyclically responsive receiving apparatus to the cycles of said transmission system.

7. In a signal transmission system, a rotary distributor having a plurality of components each relating to a character, means for operating said transmitter in cycles, means responsive to a perforated control form for conditioning each component to generate an electrical impulse indicative by its location in a cycle of a character, and means under control of special perforations in said form to transmit an impulse during each cycle differing in electrical characteristic from that of said character impulses for establishing the phase relationship of a receiving apparatus.

8. In a signal transmission system, a rotary distributor having a plurality of component signal elements each representing a code character, an apparatus responsive to general signals in a perforated control form for conditioning said elements for operation, means for transmitting one signal impulse in accordance with each conditioned one of said elements, and means under the control of a special perforation in said form for transmitting periodically a phase regulating impulse differing in electrical characteristic from that of said conditioned element signal impulses.

9. In a code translating and signal transmission system, a rotary distributor having a plurality of elements each representative of a code character, an apparatus responsive to a perforated control form for conditioning the elements of said distributor, means effective during each rotation of said distributor for transmitting one or more signal impulses in accordance with conditioned ones of said elements, and means under the control of special perforations in said form and independent of control by said elements for transmitting periodically a phase regulating impulse to regulate the rotation of receiving apparatus.

10. In a telegraph apparatus, a synchronous motor, a shaft driven by said motor, a signal impulsing device mounted on said shaft and driven by said motor including means for producing electrical current modifications coincident with the undulations of an alternating current supply source for driving said synchronous motor, a gear train between said motor and said impulsing device comprising a pair of integrally associated gears, and means to adjust for phase relationship between said motor and said device comprising an eccentrically supported jack shaft for said integrally associated gears, and apparatus for adjusting said jack shaft radially about said motor driven shaft and securing said jack shaft in variable angular adjustments.

11. In a telegraph apparatus, a synchronous motor driven shaft, a transmitting sleeve carried upon said shaft, a pair of integrally associated gears pivoted on a journal eccentric of said shaft and sleeve for imparting motion from said shaft to said sleeve, and a displaceable hanger for said journal including detentable adjustment means for shifting and thereat securing phase coincidence between said sleeve and said motor driven shaft.

12. In a mechanical phase adjusting apparatus, a shaft rotated in synchronism with a source of alternating current, a signal impulse generator for producing line current changes coinciding in periodicity with the current alterations of said source, and a driving train between said shaft and said generator including an eccentrically supported jack shaft, and means for displacing said jack shaft radially about said rotated shaft to thereby effect phase coincidence between said rotated shaft and said generator.

13. In a signal transmission system, a rotary distributor having a plurality of component elements, each relating to a character, means responsive to a perforated control form for conditioning said elements to effect correspondingly timed impulses indicative of characters by their periodicity in a cycle, and means under control of special perforations in said form to transmit a further impulse during each cycle differing in electrical characteristic from that of said character indicative impulses for effecting phase coincidence at a receiving apparatus.

14. In a telegraph apparatus, a synchronous motor, a shaft driven by said motor, a signal impulsing device mounted on said shaft and driven by said motor including means for producing electrical current modifications coincident with the undulations of an alternating current supply source for driving said synchronous motor, a gear train between said motor and said impulsing device comprising a pair of epicyclically arranged gears, and means to adjust for phase relationship between said motor and said device comprising an eccentrically supported jack shaft for said epicyclically arranged gears, and apparatus for adjusting said jack shaft radially about said motor driven shaft and securing said jack shaft in variable angular adjustments.

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