March 16, 1948. W. Y. LANG 2,437,698

PRINTER AND CONTROL SYSTEM THEREFOR

Filed Dec. 12, 1942 4 Sheets-Sheet 1

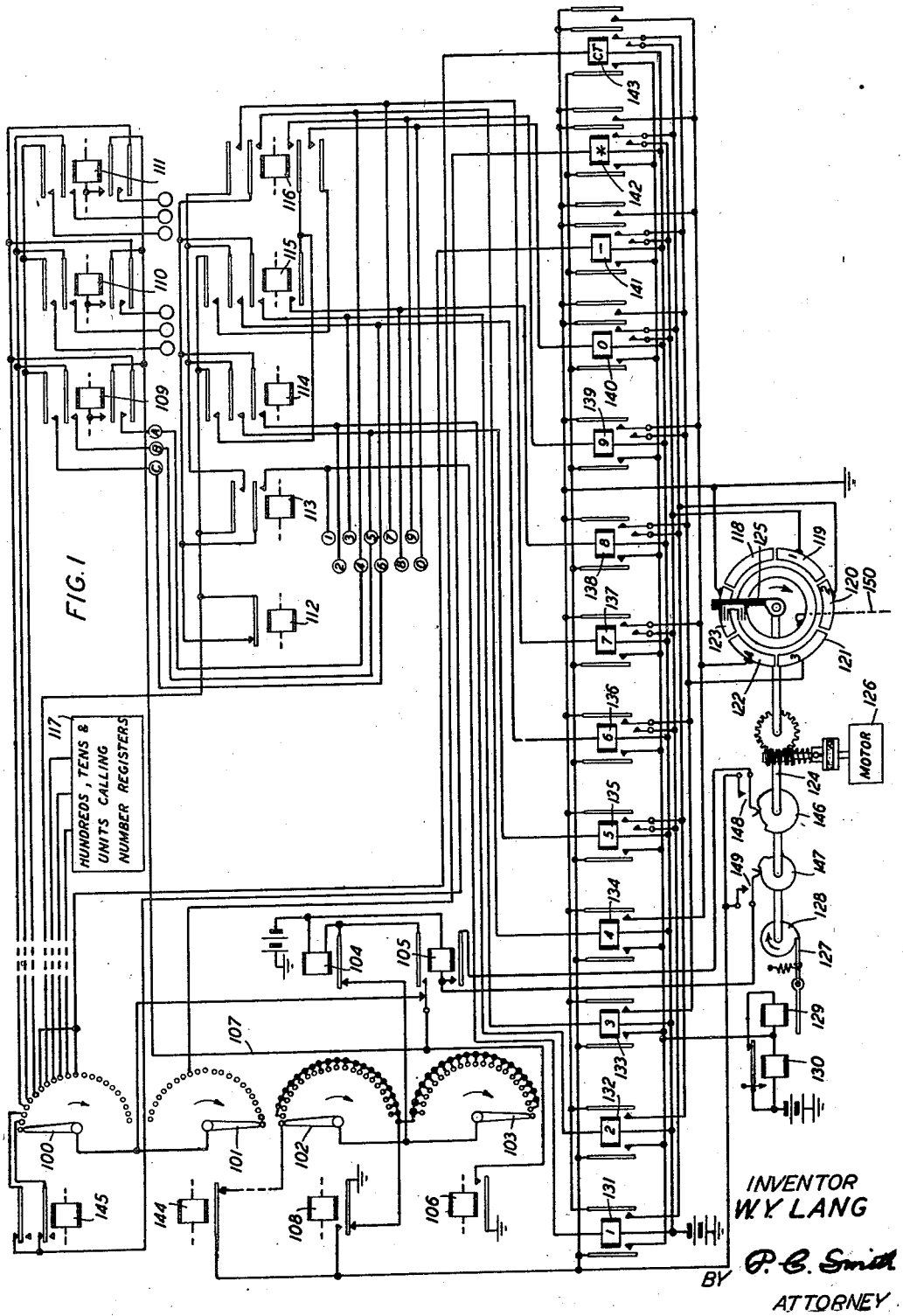

FIG. 1

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PRINTER AND CONTROL SYSTEM THEREFOR

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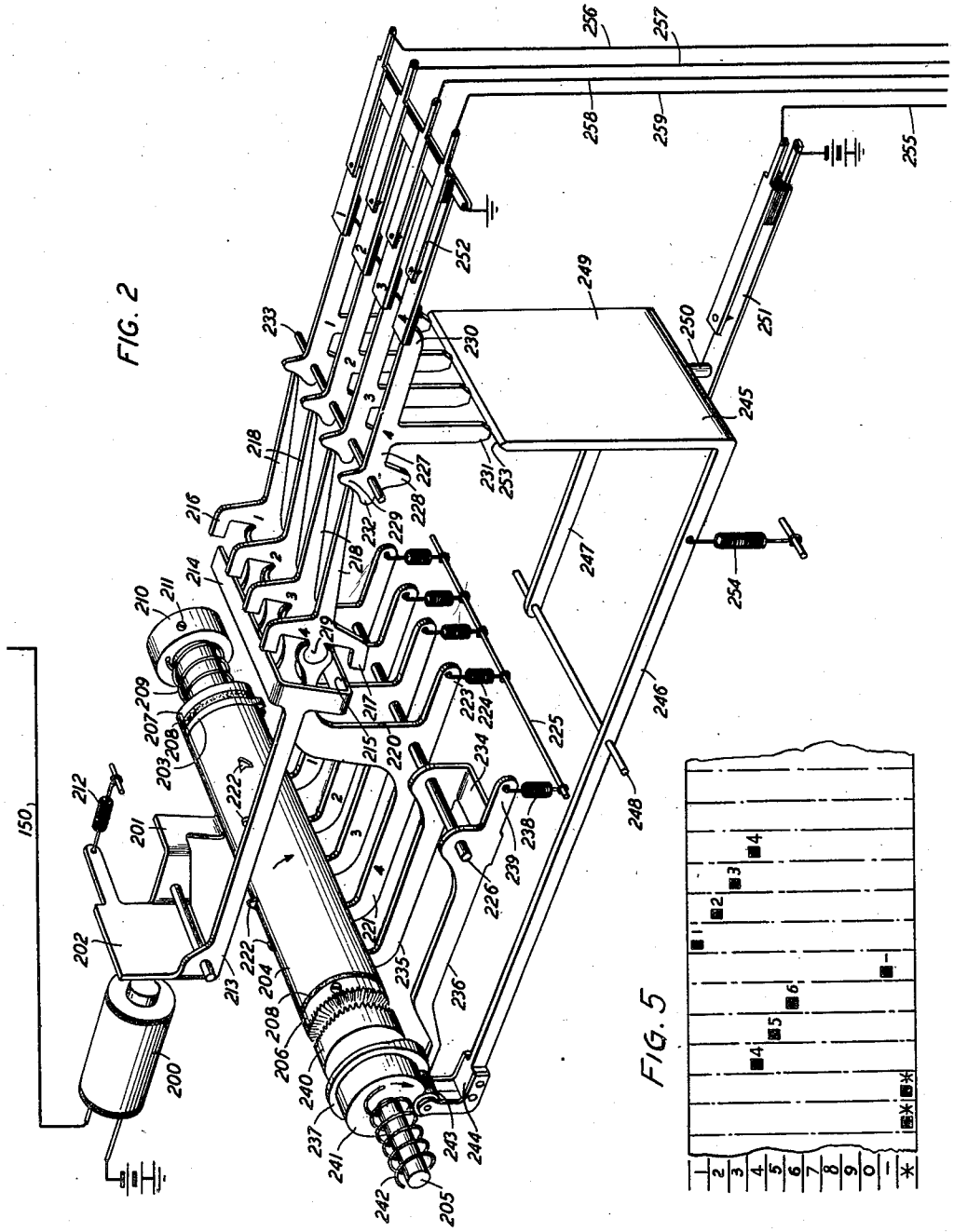

FIG. 2

FIG. 5

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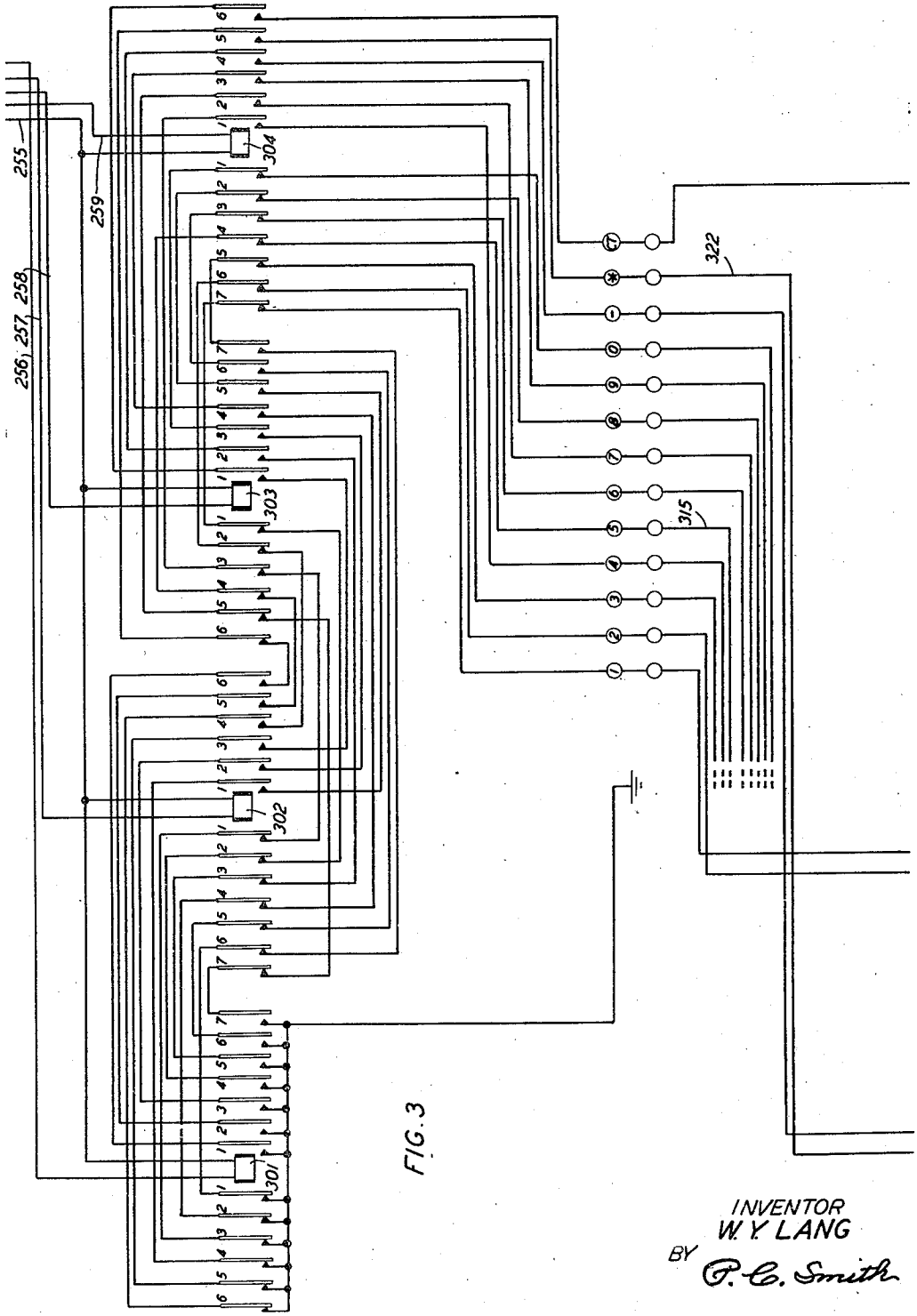

FIG. 3

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PRINTER AND CONTROL SYSTEM THEREFOR

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FIG. 4

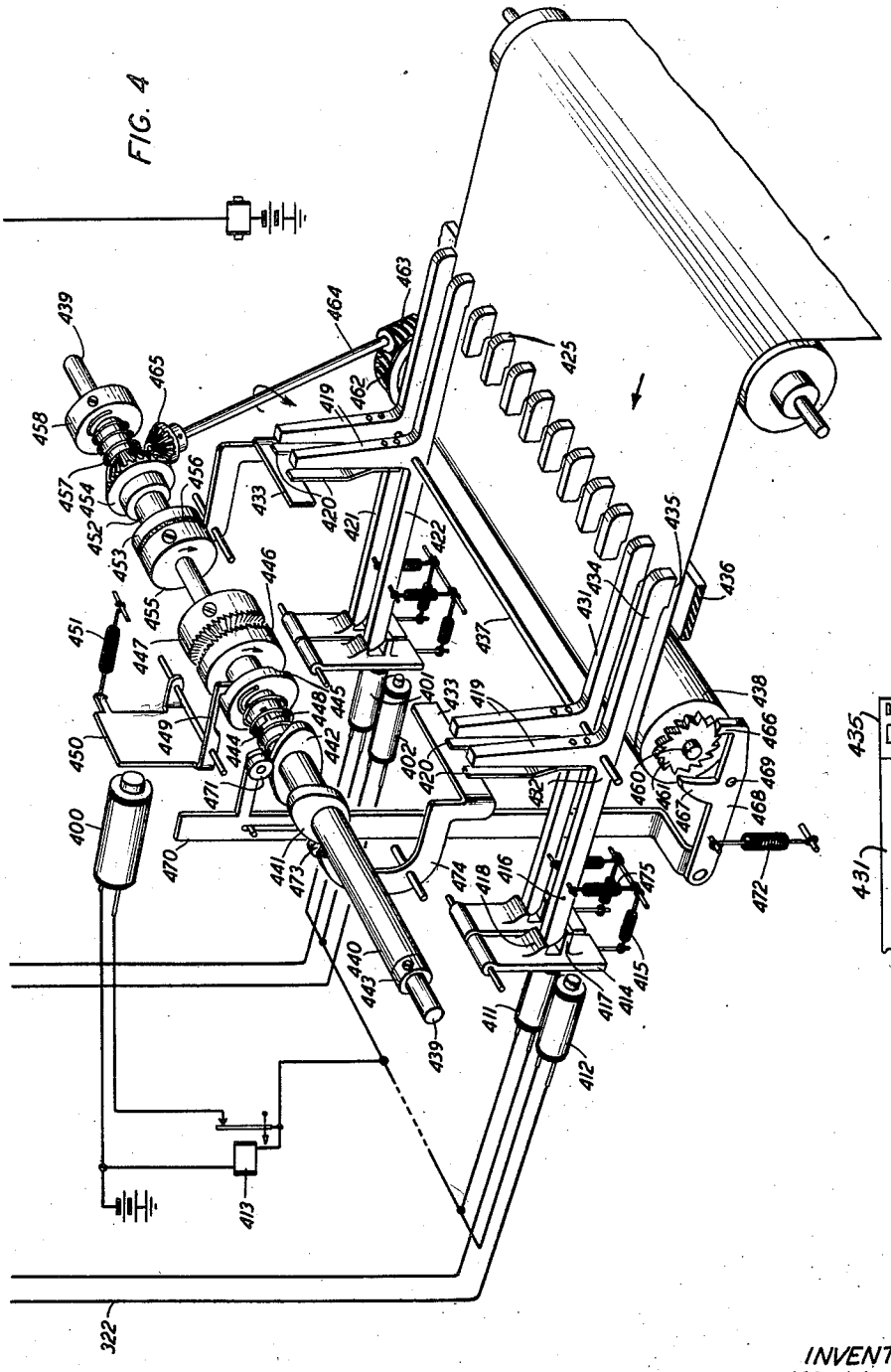
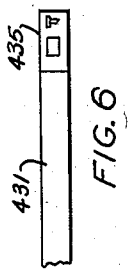


FIG. 6



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Patented Mar. 16, 1948 2,437,698

UNITED STATES PATENT OFFICE

2,437,698

PRINTER AND CONTROL SYSTEM THEREFOR

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Application December 12, 1942, Serial No. 468,789

9 Claims. (Cl. 179—7.1)

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This invention relates to printer control systems and more particularly to a system for controlling the ticket printer of an automatic toll ticketing system.

It has been proposed to enable calling subscribers to control the establishment of connections to lines terminating in nearby toll areas by dialing of the directory numbers of such lines. In such a system, in response to the initiation of a call, a connection is extended from the calling line to a trunk which trunk upon being seized becomes connected with an idle sender in which all of the office code digits and the numerical digits of the called line number dialed by the calling subscriber are registered. The sender then associates itself with an idle calling line identifier which proceeds to determine the identity of the calling line and to cause the registration in the sender of digits in accordance with such identification. The trunk is provided with a printer which is operable to print on a toll ticket such information as may be required to properly bill the call to the calling subscriber. The sender is arranged to control the setting of automatic switching mechanism in accordance with the digits of the called line number registered therein to complete the extension of the connection from the calling line over the trunk to the called line and to control the ticket printer of the trunk to print the data relating to the established connection which has been registered in the sender, such as the office code and numerical digits of both the calling and called line numbers.

To control the ticket printer fifteen control conductors extending from the sender to the trunk in which the toll ticket printer is located are required over any one of twelve of which a marking ground potential may be applied to any one of the twelve commutator segments of the printer, over one of which the ticket severing or cut magnet of the printer is controlled and over two of which either the cut magnet or the print magnet of the printer may signal the printer control progress switch of the associated sender that it has properly operated. The printer control circuits of this system are disclosed in the application of J. B. Retallack, Serial No. 448,783, filed June 27, 1942.

The ticket thus printed may be used by the commercial department of the operating telephone company to prepare a subscriber's monthly bill in the same manner as the ticket usually prepared by the toll operator is employed.

A further logical step in the development of an automatic ticketing system as just described, would be the utilization of the printed ticket to automatically prepare the subscriber's bill. To utilize such printed tickets it would be necessary to scan them by an electronic scanner and to make registrations of the scanned items of data for controlling computing and billing apparatus. Since the items printed on the ticket by the

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printer of the system just described are in numerical or character form, it would become desirable to print additional marks on the tickets corresponding to each numerical or character item to better enable the functioning of a scanner.

It is an object of the present invention to provide a ticket printer and control circuit therefore whereby the entire functioning of the printer may be controlled over a one-wire circuit with ground return or over a two-wire loop circuit extending from the printer control apparatus of the associated sender to the printer thus materially reducing the number of control conductors heretofore required.

A further object of the invention, and which object is allied to preceding object, is to enable the control of a printer which may be located at a considerable distance from the sender. For example, the ticket printer might be associated with a tandem trunk at a tandem office of the exchange area and the sender for controlling such printer might be located in the originating office in which the calling line terminates and the ticket printer would be controlled over the interoffice tandem trunk extending from the originating office to the terminating office. By thus concentrating the ticket printers in the tandem office, the number of printers required could be materially reduced.

A further object of the invention is to enable the printer to print additional marks on the ticket, corresponding to each numerical or character item printed, for enabling the functioning of a photoelectric scanner.

To attain these objects, it is proposed to provide a plurality of code translator relays in the sender including a relay for each of the ten numerical digits, a relay for the asterisk and a relay for the dash characters which the sender may require the printer to print and a relay for controlling the transmission of a cut signal to the printer. These translator relays are selectively operated in accordance with the settings of the various register relays of the sender and under the control of the sender progress switch and in turn cause the selective grounding of segments of a start-stop sending distributor of the type well-known in the telegraph art. Thus in each successive position of the progress switch one of the code translator relays corresponding to the particular digit or character to be transmitted to the printer is operated and the distributor brush arm is released to rotate through a single revolution to transmit a code of impulses over a single conductor with a ground return or over a two-wire loop to the receiving magnet of a single magnet receiver associated with the ticket printer. The codes of impulses may be in accordance with a four unit telegraph code as indicated in a table to be later referred to.

As just stated the receiver may be of the well-known single magnet type such, for example as is

disclosed in Patent 1,904,164, granted on April 18, 1933, to S. Morton et al. but modified to function on a four unit code and the selector fingers of which are arranged to cause the closure of circuits rather than to cause the operation of comb bars. The four contact pairs of this receiver which are selectively closed in code combinations in response to incoming code signals are connected to four translator relays which are thereby selectively operated to translate each incoming code signal and to cause the closure of a printer control conductor corresponding to that one of the thirteen digit or character signals transmitted from the sender in response to the operation of one of the thirteen translator relays of the sender.

Twelve of these control conductors are extended to the type bar release magnets of a twelve bar printer and the thirteenth control conductor is extended to the cut magnet of the printer. The twelve type bars of the printer are arranged in a single horizontal plane and any bar when released through the operation of its release magnet may be depressed into printing position by a printing bail operable by a cam on the printer control shaft. The paper feed of the printer is also controlled by a second cam on the control shaft. The type face of each type bar may, in addition to the numerical digit or asterisk or dash type carried thereby, be provided with a suitable marking type for printing a mark on the paper of suitable area for scanning. The linear position across the width of the paper or tape of the printed mark may be employed when scanned to determine the nature of the digit or character printed adjacent to it on the paper by the same type bar.

The features of the invention having now been described in a general manner, reference may now be had to the following detailed description taken in connection with the accompanying drawing in which:

Fig. 1 shows such portions of the sender of an automatic ticketing system as is necessary for an understanding of the invention and the code impulse sending apparatus in accordance with the present invention;

Fig. 2 shows in perspective portions of a single magnet receiving apparatus operative in response to the code impulses transmitted from the sending apparatus of Fig. 1;

Fig. 3 shows register relay circuits for cooperation with the receiving apparatus of Fig. 2 to translate the impulse codes received by the receiving apparatus and to control the operation of operating magnets of a printer in accordance therewith;

Fig. 4 shows in perspective portions of a printer operable from the register relay circuit of Fig. 3;

Fig. 5 is a section of a tape or ticket prepared by the printer; and

Fig. 6 shows the type face of one of the type bars.

In the consideration of the drawing, Fig. 2 should be placed beneath Fig. 1, Fig. 3 should be placed beneath Fig. 2 and Fig. 4 should be placed beneath Fig. 3.

As previously stated, the present invention is applicable to the automatic ticketing system disclosed in the application of J. B. Retallack, hereinbefore referred to and to the system more fully disclosed in the application of J. W. Gooderham, Serial No. 448,782, filed June 27, 1942. For the complete circuits of the sender, reference may be had to the Gooderham application. However, to simplify the present disclosure, only certain of the registers of the sender, the progress switch and a few of the control relays have been disclosed. The progress switch is of the step-by-step type, the brushes 100 to 103 of which are advanced step-by-step in response to the operation and release of the stepping magnet 104 in cooperation with the stepping relay 105. Relay 106 is an off-normal relay which is operated when the sender is first seized by a trunk to apply ground to the off-normal ground bus-bars of the sender such as bus-bar or conductor 107. Relay 108 is operated when an identifier is connected with the sender and such identifier has caused the digits of the identified calling line number to become registered in the sender. Relays 109, 110, and 111 are three of the ten calling office unit register relays one of which is operated from the identifier to determine the three office code digits of the identified calling line number. Relays 112 to 116, inclusive, are the relays of the thousands numerical digit register for registering the thousands digit of the identified calling line number, the corresponding relays of the hundreds, tens and unit digit registers for registering the other digits of the calling line number being indicated by the box 117. The other registers of the sender have been omitted to simplify the disclosure.

The stop-start distributor is of the well-known telegraph type and comprises six commutator segments including a start segment 118, four sending segments 119 to 122, inclusive and a stop segment 123. The shaft 124 of the distributor carries a brush arm 125 and is driven through gearing and a friction clutch by a motor 126. Normally the shaft is restrained from rotation by the stop arm 127 which engages with the tooth of stop cam 128 carried by the shaft. The stop arm may be moved to disengage the tooth of the stop cam by the energization of the start magnet winding 129 under the control of relay 130.

The sending segments of the distributor are connected in various code combinations in accordance with a four unit telegraph code to the contacts of thirteen translator relays 131 to 143, inclusive, which relays are selectively operated in each terminal position of the progress switch in accordance with the setting of one of the registers of the sender.

It will be assumed that relays 106 and 108 have been operated following the seizure of the sender and the transfer of information determined by the identifier to registers of the sender and that office unit register relay 109 has been operated, relay 113 of the thousands digit register has been operated to register the thousands digit 1 and that relays of the hundreds, tens and units digit registers, indicated by the box 117, have been selectively operated to register the digits 2, 3 and 4. With relay 108 operated, a circuit is established from ground over the front contact of relay 108, the back contact of relay 144, the normal terminal of the arc engaged by brush 102 of the progress switch over the interrupter contacts and through the winding of stepping magnet 104 to battery and ground. Magnet 104 thereupon operates and releases to advance the brushes 100 and 102 to the second terminals of their respective arcs, brush 102 upon leaving the normal terminal of its arc, opening the circuit of magnet 104.

With brush 100 now engaged with the No. 2 terminal of its arc and off-normal relay 106 operated, a circuit is established from ground over contacts of relay 106, over the upper normal contacts of stepping relay 105, brush 100 and the No. 2 terminal of its arc, the inner upper back contact of relay 145 through the winding of

translator relay 142 to battery. Relay 142 thereupon operates, over its right front contacts connects ground to the Nos. 1, 2, and 4 sending segments 118, 120 and 122 of the distributor and at its left contacts establishes the circuits for relay 130 and start magnet 129. The circuit of magnet 129 extends over a back contact of relay 130 which is slow to operate so that magnet 129 first operates followed by the operation of relay 130 which when operated, releases magnet 129. Magnet 129 upon operating removes stop arm 127 from the tooth of stop cam 128 thereby permitting the motor 126 to drive the shaft 124. Since magnet 129 releases as soon as relay 130 operates, the stop arm 127 is again released into engagement with the stop cam 128 to arrest the rotation of the shaft 124 after it has made one complete revolution. Thus upon the energization of any one of the translator relays 131 to 143, inclusive, the distributor shaft 124 is released to make a single revolution and thereby sweeps the brush carried by the distributor arm 125 from its normal engagement with the stop segment 123 over the start segment 118 and the sending segments 119 to 122, inclusive, into engagement again with the stop segment 123.

With the brush of distributor arm 125 normally in engagement with the stop segment 123 and the sender connected with the printer of a trunk, as for example over a sender trunk connector as disclosed in the application of J. B. Retallack, hereinbefore referred to, a circuit is established from ground over segment 123, the distributor arm brush, conductor 150, through the winding of the receiver magnet 200 to battery whereupon the magnet 200 is energized to move the clutch release arm 201 secured to its armature 202 into a position with respect to the notch on stop disc 203 secured to the cam barrel 204 to arrest the rotation of the cam barrel in its normal position. When the brush of the distributor arm 125 disengages stop segment 123, and engages start segment 118, the circuit of magnet 200 is opened to release the cam disc 203 of the receiver for rotation and as the brush of arm 125 engages the Nos. 1, 2 and 4 segments to which ground has been connected by the operated translator relay 142, the magnet 200 is reenergized in the sending positions 1, 2 and 4 of the sending distributor for a purpose to be later described.

As the shaft 124 starts its rotation, cam 146 carried thereby closes the associated contacts 148 as soon as the brush of distributor arm 125 engages the start segment 118 and such contacts are held closed by the cam 146 until the brush reaches its stop position thereby preparing a holding circuit for stepping relay 105. When the distributor arm 125 has rotated until its brush is in engagement with the No. 4 sending segment 122, cam 147 carried by shaft 124 closes the contacts 149 associated therewith whereby the circuit of stepping relay 105 is established from battery through its winding over the contacts 149, the front contact of start relay 108 to ground and upon operating locks over its lower contacts and the closed contacts 148 to ground at the front contacts of relay 108. At its upper alternate contacts, relay 105 establishes a circuit from ground on off-normal ground conductor 107 through such contacts and the winding of stepping magnet 104 to battery, whereupon magnet 104 energizes preparatory to advancing the brushes of the progress switch one step upon its subsequent deenergization. At its upper normal contacts, relay 105 opens the previously traced

circuit for the operated translator relay 142 which releases to remove marking ground from the segments of the sending distributor and to release relay 130. As soon as the shaft 124 has rotated until cams 146 and 147 have caused both the contacts 148 and 149 to open, relay 105 releases in turn releasing stepping magnet 104 which then advances brushes 100 and 102 of the progress switch into engagement with the No. 3 terminals of their associated arcs.

With brush 100 in engagement with the No. 3 terminal of its arc, the asterisk translator relay 142 is again operated in a circuit extending over the upper back contact of relay 145 and the distributor arm 125 is released to rotate through one revolution as previously described, again sending code impulses in sending positions 1, 2 and 4 to the magnet 200 of the receiver, indicative of the asterisk symbol. Again through the operation of the cam operated contacts 148 and 149, the stepping relay 105 and the stepping magnet 104 are operated and released to release the operated translator relay 142 and to advance brushes 100 and 102 of the progress switch into engagement with the No. 4 terminals of their associated arcs.

With the calling office unit register relay 109 operated, and it being assumed that the terminals A, B and C connected with its contacts are cross-connected to the Nos. 4, 5 and 6 terminals, respectively, to indicate that the office code digits of the calling line number or 4, 5 and 6, a circuit is established from ground on off-normal ground conductor 107 over the upper normal contacts of relay 105, brush 100 and the No. 4 terminal of its arc, the lower front contact of register relay 109, terminal A strapped to terminal No. 4, thence to battery through the winding of the No. 4 translator relay 134. Relay 134 thereupon operates to cause the connection of ground over its right contacts to the No. 4 sending segment 132 of the sending distributor and to cause the operation of start magnet 129. During the rotation of the distributor arm through one revolution, a single code impulse is transmitted through the winding of receiving magnet 200 in sending position 4 of the distributor. In the manner previously described, stepping relay 105 and stepping magnet 104 are controlled by the cam operated contacts 148 and 149 to release the translator relay 134 and to advance brushes 100 and 102 of the progress switch into engagement with the No. 5 terminals of their respective arcs.

With brush 100 in engagement with the No. 5 terminal of its arc, a circuit is established from ground on off-normal ground conductor 107, over the upper normal contacts of relay 105, brush 100 and the No. 5 terminal of its arc, over the inner upper front contact of register relay 109, terminal B, strapped to terminal No. 5, thence to battery through the winding of the No. 5 translator relay 135. Relay 135 thereupon operates to cause the connection of ground over its right contacts to the Nos. 1 and 2 sending segments 119 and 120 of the sending distributor and to cause the operation of start magnet 129. During the rotation of the distributor arm through one revolution, two code impulses are transmitted through the winding of receiving magnet 200 in sending positions 1 and 2 of the distributor. In the manner previously described, stepping relay 105 and stepping magnet 104 are controlled by the cam operated contacts 148 and 149 to release the translator relay 135 and to advance brushes 100 and 102 of the progress switch into engage-

ment with the No. 6 terminals of their respective arcs.

With brush 100 in engagement with the No. 6 terminal of its arc, a circuit is established from ground on off-normal ground conductor 107 over the upper normal contacts of relay 105, brush 100 and the No. 6 terminal of its arc over the upper front contact of relay 109, terminal C strapped to terminal No. 6 and thence to battery through the winding of the No. 6 translator relay 136. Relay 136 thereupon operates to cause the connection of ground over its right contacts to the Nos. 1 and 3 sending segments 119 and 121 of the sending distributor and to cause the operation of start magnet 129. During the rotation of the distributor arm through one revolution, two code impulses are transmitted through the winding of receiving magnet 200 in the sending positions 1 and 3 of the distributor. In the manner previously described, stepping relay 105 and stepping magnet 104 are controlled by the cam operated contacts 148 and 149 to release the translator relay 136 and to advance brushes 100 and 102 of the progress switch into engagement with the No. 7 terminals of their respective arcs.

With the brush 100 in engagement with the No. 7 terminal of its arc, a circuit is established from ground on off-normal ground conductor 107 over the upper normal contacts of relay 105, brush 100 and the No. 7 terminal of its arc to battery through the winding of the dash translator relay 141. Relay 141 thereupon operates to cause the connection of ground over its right contacts to the Nos. 1, 3 and 4 sending segments 119, 121 and 122 of the sending distributor and to cause the operation of start magnet 129. During the rotation of the distributor arm through one revolution, three code impulses are transmitted to the winding of receiving magnet 200 in sending positions 1, 3 and 4 of the distributor. In the manner previously described, stepping relay 105 and stepping magnet 104 are controlled by the cam-operated contacts 148 and 149 to release the translator relay 141 and to advance brushes 100 and 102 of the progress switch into engagement with the No. 8 terminals of their respective arcs.

With the brush 100 in engagement with the No. 8 terminal of its arc and with register relay 113 of the thousands register assumed to be operated, a circuit is established from ground on off-normal ground conductor 107 over the upper normal contacts of relay 105, brush 100 and the No. 8 terminal of its arc, over the normal contacts of register relay 112, the inner front contacts of register relay 113 to battery through the winding of the No. 1 translator relay 131. Relay 131 upon operating causes the connection of ground over its right contacts to the No. 1 sending segment of the sending distributor and causes the operation of start magnet 129. During the rotation of the distributor arm through one revolution, one code impulse is transmitted through the winding of receiving magnet 200 in sending position 1 of the distributor. In the manner previously described, stepping relay 105 and stepping magnet 104 are controlled by the cam operated contacts 148 and 149 to release the translator relay 131 and to advance brushes 100 and 102 of the progress switch into engagement with the No. 9 terminals of their respective arcs.

In a similar manner as the progress switch advances through terminal positions 9, 10 and 11, code impulses are transmitted to the receiving magnet 200 under the control of the translator relays 132, 133 and 134 and the relays of the hundreds, tens and unit registers indicated by the box 117 and assumed to be operated to register the hundreds, tens and units digits 2, 3 and 4 of the calling line number. As the progress switch is advanced step-by-step, other items of information registered in the sender and in the associated month, day and hour circuit (not shown) are transmitted to the receiving circuit until brush 101 has been advanced into engagement with the No. 9 terminal of its arc, at which time a circuit is established from ground on off-normal ground conductor 107 over the upper normal contacts of relay 105, brush 101 and the No. 9 terminal of its arc to battery through the winding of the ticket cutting translator relay 143. Relay 143 thereupon operates to cause the connection of ground over its right contacts to the Nos. 1, 2 and 4 sending segments of the sending distributor and to cause the operation of start magnet 129. During the rotation of the distributor arm through one revolution, three code impulses are transmitted through the winding of receiving magnet 200 in sending positions 1, 2 and 4 of the distributor. In the manner previously described, stepping relay 105 and stepping magnet 104 are controlled by the cam operated contacts 148 and 149 to release the translator relay 143 and to advance the brushes 101 and 103 of the progress switch into engagement with the No. 10 terminals of their respective arcs, thereafter in the following successive terminal positions of brush 101 translator relays are operated in accordance with the settings of other sender registers to transmit codes of impulses to the receiving magnet 200 in the manner previously described.

When the sender has completed the transmission of all registered information to the receiving apparatus, relay 108 becomes released to close a self-interrupting circuit for stepping magnet 104 which may be traced from ground over the back contact of relay 108, strapped terminals of the arcs of the progress switch with which brushes 102 and 103 cooperate, the interrupter contacts and winding of magnet 104 to battery, whereupon the progress switch is advanced until it reaches its normal position in which position the circuit of magnet 104 is opened at brush 103. To complete the release of the sender, off-normal relay 106 is released to remove ground from the off-normal ground bus-bars such as 107 thereby releasing all operated relays of the sender.

The code series transmissible to the receiving apparatus by the sending distributor under the control of the translator relays of the sender for the various digits and characters, some of which code series have been previously referred to are in accordance with the following table:

Digit or Character	Translator Relay Operated	Sending Segment Positions of Sending Distributor Effective			
1	131	1			
2	132		2		
3	133			3	
4	134				4
5	135	1	2		
6	136	1		3	
7	137	1			4
8	138		2	3	
9	139			3	4
0	140	1	2	3	
—	141	1		3	4
*	142	1	2		4
Cut	143		2	3	4

It will be recalled that when the circuit over conductor 150 was initially established just prior to the transmission of the series of code impulses under the control of the sending distributor at which time the distributor arm brush was engaged with the stop segment 123, receiver magnet 200 operated to interpose the stop arm 201 in the path of the tooth on the stop disc 203 thereby arresting the rotation of the cam barrel 204. The barrel 204 is rotatably mounted on the motor driven shaft 205 between the toothed clutch collar 206 secured to and rotatable with the shaft 205 and the collar 207 which is slidable on the shaft 205 but keyed thereto. Interposed between one end of the cam barrel 204 and the clutch collar 206 and between the stop disc 203 secured to the other end of the cam barrel and the slidable collar 207 are friction washers 208. The frictional engagement between the cam barrel 204 and collar 206 and between the stop disc 203 and collar 207 is adjusted by means of helical spring 209 and the adjustable collar 210 secured to the shaft 205 by a screw 211. With the magnet 200 energized and the stop arm 201 engaged against the tooth of stop disc 203 the cam barrel which is driven from the shaft 205 through the friction clutches as just described is arrested but the driving motor continues to rotate the driving shaft 205.

During the first line pulse or start interval, that is, while the brush of the sending distributor is traversing the start segment 118, the circuit of magnet 200 is opened and the armature of such magnet is therefore retracted by the spring 212 to remove stop arm 201 from the tooth of stop disc 203 thereby permitting the cycle of operation of the cam barrel 204 to be initiated. During the signal code the stop arm 201 will be vibrated but without effect until the magnet 200 becomes energized at the end of the sending cycle when the brush of the arm 125 of the sending distributor again engages the stop segment 123 at which time the cam barrel will have completed a single complete revolution and the stop arm 201 of the energized magnet 200 will again engage the tooth of the stop disc 203.

Before proceeding with a discussion of the operation of the receiver in response to the receipt of an impulse series, the remaining members of the receiver will be briefly described. The armature of magnet 200 is in addition to the stop arm 201 provided with an arm 213 having two parallel and angularly disposed extensions 214 and 215 which may be moved opposite either the upper arms 216 or the lower arms 217 of the T-shaped selector fingers 218 through the energization of the magnet 200 or the deenergization thereof. The selector fingers of which there are four are thin flat members adapted to have two different movements, first a reciprocating movement and then a rocking movement. Each selector finger is provided with a circularly shaped portion 219 which is pivotally retained in a circularly shaped notch in the vertical arm of a T-shaped operating lever 220. Each operating lever has one of its horizontal arms 221 positioned with its end beneath the cam barrel 204 and in alignment with a cam projection, such as 222, of the barrel and has its other horizontal arm 223 connected to a spiral spring 224, the other end of which spring is anchored to a bar 225 supported in any suitable manner in the frame of the receiver. The four operating levers are pivoted on the rod 226 also suitably supported in the receiver frame and are

so normally positioned by their associated springs 224 that the ends of their arms 221 are in engagement with the under surface of the cam barrel 204 as disclosed.

Associated with each of the selector fingers 218 and operable thereby is a T-shaped contact operating lever 227 having three arms 228, 229 and 230 and a depending locking arm 231. The arms 228 and 229 are separated by a rounded protuberance 232 shaped to form with said arms two depressions in which the forwardly extending end of a selector finger 218 may rest depending upon whether the end of the finger is swung upwardly or downwardly as will be later described. The arm 230 of each of these levers engages beneath the insulated end of the movable spring of a pair of contact springs 252. The four contact operating levers 227 are pivotally mounted on a rod 233 which may be suitably mounted in the frame of the receiver. For maintaining each selector finger 218 in proper alignment with its associated operating lever 220 and with its associated contact operating lever 227, the assemblies of fingers and levers may be positioned between parallelly disposed guide plates which, to simplify the drawing, have been omitted therefrom.

Also pivotally mounted on the rod 226 is an additional clutch release lever 234 which is substantially U-shaped, one arm 235 of which has its end positioned beneath the cam barrel 204 in alignment with one of the cam projections 222 thereof and the other arm 236 of which is normally engaged against the cam face of the clutch throw-out disc 237. The arms are normally held in the positions disclosed with the end of arm 235 engaged against the lower surface of the cam barrel 204 by the spring 238 one end of which is connected to the arm 239 of the lever 234 and the other end of which is anchored to the rod 225.

The disc 237 is formed integrally with the toothed clutch disc 240 and with the cam disc 241 and is rotatably mounted on the shaft 205. The teeth of clutch disc 240 are arranged to mesh with the teeth in the outer face of the collar 206 when the disc 240 is permitted to slide on the shaft 205 toward the disc 206 under the influence of the spiral spring 242 upon the movement of the end of the clutch release lever arm 236 from engagement with the cam face of the clutch throw-out disc 237.

Cooperating with and normally engaged in the depression of cam disc 241 is a cam roller 243 rotatably mounted in the bifurcated end 244 of one arm of a locking member 245. The member 245 has two arms 246 and 247 by which it is pivotally supported on the rod 248 suitably supported in the receiver frame and has an upwardly extending lock plate 249 for cooperating with the depending locking arms 231 of the contact operating levers 227. A stud 250 of insulating material is secured in the lower edge of the plate 249 for engagement with the movable spring of a pair of springs 251. The locking member is normally held by the spiral spring 254 with its cam roller 243 engaged in the depression of cam 241, with the upper wedge-shaped edge 253 of its locking plate beneath the end of the depending arms 231 of the contact operating levers 227 and with its stud 250 normally holding the springs of the contact spring pair 251 disengaged.

The cam barrel 204 is provided with five cam projections 222 spaced 60 degrees apart around the circumferential surface of the barrel and arranged in a spiral on such surface, there being no cam projection on the barrel at the circumferen-

tial position opposite the stop position of the barrel. These cam projections engage with the ends of the arms 221 of the operating levers 220 and the end of arm 235 of the clutch release lever 234 whereby these arms are depressed in succession beginning with the No. 1 arm 221 in Fig. 2 and ending with the arm 235.

When the end of any lever 220 is engaged by a cam projection 222 and is depressed, the upper end of the vertical arm of such lever is moved towards the left as viewed in Fig. 2, thereby moving the associated selector finger 218 to the left. If magnet 200 is at that time unoperated, the lower extension 215 of the armature arm 213 will be positioned opposite the lower extension 217 of the finger 218 and when the finger is moved toward the left, the lower extension 217 thereof will engage the extension 215 thereby causing the finger 218 to rotate in the notch in the end of the vertical arm of the operating lever 220 to move the free end of the select finger to a position opposite the upper arm 229 of the associated contact operating lever 227. If, however, the magnet 200 is at that time operated, the upper extension 214 of the armature arm 213 will be positioned opposite the upper extension 216 of the finger 218 and when the finger is moved toward the left, the upper extension 216 thereof will engage the extension 214 thereby causing the finger 218 to rotate to move the end thereof to a position opposite the lower arm 228 of the associated contact operating lever 227. As soon as the cam projection 222 has passed by the end of the operating lever 220, the spring 224 restores the lever to its normal position thereby moving the vertical arm of the lever and the associated selector finger 218 to the right, whereupon its end presses either against the arm 228 or against the arm 229 of the lever 227 depending upon how the end of the finger has been previously positioned to cause the movement of the end of arm 230 of the lever 227 away from the movable spring of the associated contact pair 252 to maintain such springs disengaged or toward the movable spring to cause the springs to be engaged. It is to be noted that a contact pair 252 will become engaged only when the magnet 200 is energized at the time a cam projection 222 has caused the operation of the associated lever 220, selector finger 218 and lever 227.

Returning to a consideration of the functioning of the circuit, it will be recalled that upon the establishment of the operating circuit 150 between the sending distributor and the receiver, magnet 200 was energized to arrest the rotation of the cam barrel 204 in its stop position. It will also be recalled that for transmitting the first item of data, an asterisk, from the sender to the receiver, the translator relay 142 was operated to connect ground to the Nos. 1, 2, and 4 segments 119, 120 and 122 of the sending distributor and that the magnet 129 was energized to permit the distributor arm 125 to rotate through a single complete revolution. When in its rotation, the brush on arm 125 disengages the stop segment 123, and while it passes over the start segment 118, the circuit through the magnet 200 of the receiver is held open whereby the stop arm 201 is moved by the spring 212 out of engagement with the tooth of the stop disc 203 thereby permitting the cam barrel 204 to be frictionally driven from the shaft 205 through one complete revolution.

During this revolution, the operating levers 220 are successively depressed and released and since it has been assumed that ground has been connected to the sending segments 119, 120 and 122, magnet 200 will be held energized in these sending positions but will be released as the brush of distributor arm 125 passes over sending segment 121. Consequently the ends of the first, second and fourth selector fingers 218 will be depressed and the end of the third selector finger will be raised and will, upon the movement of such selector fingers toward the right, cause the operation of the first, second and fourth contact operating levers 227 into positions to close the associated Nos. 1, 2 and 4 contact pairs 252. When, thereafter the cam projection on the cam barrel 204 depresses and releases the arm 235 of the clutch release lever 234, the end of its arm 236 is moved from engagement with the cam face of disc 237 thereby permitting the engagement of the clutch disc 240 with the clutch collar 206 whereby the cam 241 is driven by the shaft 205 to depress the cam roller end of the arm 246 of the locking member 245. The locking plate 249 is thereupon moved upwardly past the left edges of the depending arms 231 of the contact operating levers 227 which have been positioned in their contact closing positions, in the case assumed the Nos. 1, 2 and 4 levers, and past the right edges of the depending arms 231 of the levers 227 which have been moved away from their contact closing positions, in the case assumed the No. 3 lever. At the same time the movement of the locking member 245 permits the closure of the pair of contact springs 251 for a purpose to be later described. The information which has been transmitted to the receiver in response to the transmission of the first series of code impulses has now been locked into the receiver and may be used as will be presently described to operate the associated printer. The selector fingers may now be reset in accordance with impulses of the next code series transmitted from the sending distributor.

When the receiver magnet 200 is deenergized during the interval that the brush on the distributor arm 125 is passing over the start segment 118, the cam barrel 204 is again released for rotation through a single complete revolution and the clutch throw-out disc 237 and associated cam disc 241 are rotated until the roller 243 again enters the depression in the cam disc 241 and the cam on the face of disc 237 engaging with the end of arm 236 of the clutch throw-out lever 234 has forced the clutch disc 240 against the tension of spring 242 out of engagement with the clutch collar 206 thereby arresting the rotation of cam disc 241. With the cam roller 243 seated in the depression in the cam disc 241, the stop plate is moved by the spring 254 to release the depending locking arms 231 of the contact operating levers so that they may be reset in accordance with the operation of the receiving magnet 200 in response to the impulse series then being received.

With the Nos. 1, 2 and 4 pairs of contacts 252 operated in accordance with the impulse series received to indicate that the printer should print an asterisk, then when the contact pair 251 is closed by the locking member 249, a first circuit is established from battery, over contacts 251, conductor 255, through the winding of register relay 301, conductor 256 and over the No. 1 contacts 252 to ground; a second circuit is established from battery over contacts 251, conductor 255, through the winding of register relay 302, conductor 257 and over the No. 2 contacts 252

to ground and a third circuit is established from battery over contacts 251, conductor 255, through the winding of register relay 304, conductor 259 and over the No. 4 contacts 252 to ground. With register relays 301, 302 and 304 energized and register relay 303 deenergized, a circuit is established from ground over the No. 1 right front contact of relay 301, the No. 6 right front contact of relay 302, the No. 6 left back contact of relay 303, the No. 5 right front contact of relay 304, conductor 322, through the winding of the asterisk type bar release magnet 412, through the winding of slow-to-operate relay 413 to battery and over the back contact of relay 413 through the winding of start magnet 400 to battery. Magnet 412 operates to attract its armature 414 against the tension of its restoring spring 415, whereupon the locking arm 416 of the T-shaped type bar 432 is released for operation.

The printer, as disclosed in Fig. 4, is provided with twelve T-shaped type bars 421 to 432, inclusive, each having a rearwardly extending locking arm 416 normally engaged between the detent projections 417 and 418 on the outer face of the associated release magnet armature 414, a vertically extending arm 419 having a leaf spring 420 riveted or otherwise secured thereto for engagement with the printing bail 433 and a forwardly extending arm 434 having a type face 435. The type faces of the twelve bars are in alignment and are disposed over a platen strip 436. The type faces of the type bars 421 to 430, inclusive, bear the digits 1 to 0, inclusive, the type face of the type bar 431 bears the character (-) and the type face of type bar 432 bears the character (*). In addition each type face bears a type area of suitable shape, such as a solid square, whereby when the type face of the type bar is depressed in a printing operation, such type area will be printed on the ticket or tape adjacent to the digit or character carried by the same type bar. The twelve type bars are pivotally mounted on a rod 437 which is suitably supported in the frame of the printer.

For operating the printing bail 433 and for advancing the paper feed roller 438, a motor driven shaft 439 is provided. Mounted on said shaft and normally uncoupled therefrom is a sleeve 440 having two cams 441 and 442 secured thereto. One end of said sleeve abuts the collar 443 secured to said shaft and the other end of said sleeve is keyed to the sleeve 444 which is slidable on the shaft 439. Sleeve 444 has formed integrally therewith a clutch throw-out cam disc 445 and a toothed clutch disc 446. The clutch disc is arranged to be engaged with the toothed clutch collar 447 secured to the shaft 439 under the influence of spiral spring 448 which surrounds the sleeve 444 between the cam 442 and the throw-out disc 445. The engagement of the clutch disc 446 with the clutch collar 447 is normally restrained by the clutch release arm 449 secured to the armature 450 of the magnet 400, the end of which arm engages the cam surface of the throw-out disc 445 under the influence of the armature restoring spring 451. When the magnet 400 is momentarily energized, the end of the clutch release arm 449 is removed from the cam face of the clutch throw-out disc thereby permitting the engagement of the clutch disc 445 with the clutch collar 447 whereupon the sleeve 440 together with the associated cams 441 and 442 are rotated with the shaft 439 through one complete revolution or until the cam face on the throw-out disc 445 again engages the end of the arm 449 which in the mean time has through the release of magnet 400 been positioned in its path. When the cam face reengages the end of the arm 449, the clutch disc 446 is forced out of engagement with the clutch collar 447 and the rotation of sleeve 440 and the cams 441 and 442 is arrested.

Also rotatably supported on the shaft 439 is a sleeve 452 having formed integrally therewith a friction clutch disc 453 and a bevel gear 454. Secured to the shaft 439 adjacent to the disc 453 is a collar 455 having a washer 456 of friction material secured to the face thereof and in engagement with the adjacent face of the disc 453. For holding the members 453, 455 and 456 in frictional engagement, a spiral spring 457 is provided which surrounds the sleeve 452 and is interposed between the gear 454 and the collar 458 secured to the shaft 439. The paper feed roller 438 has a shaft 460 which may be suitably supported in bearings secured to the printer frame and is provided at one end of the roller with an escapement ratched wheel 461 and at the other end of the roller with a driving gear 462 which is geared through the worm gear 463, the shaft 464 and the bevel gear 465 with the driving gear 454. The rotation of the feed roller 438 through the driving linkage just described is normally restrained by a pawl 466 of the escapement 468, the friction clutch comprising members 453, 455 and 456 slipping without stopping the rotation of the driving shaft 439. To hold the paper against the feed roller 438 to insure a positive feeding thereof, a pressure roller (not shown) would be employed. To simplify the disclosure, the usual inking apparatus has also been omitted from the drawing.

The escapement 468 has two pawls 466 and 467 which cooperate with the ratchet wheel 461 to permit the step-by-step rotation of the feed roller. The escapement is pivoted to the printer frame at 469 and one end thereof is pivotally connected to a slidably supported operating member 470, the upper end of which carries a roller 471 cooperating with the cam 442. Spring 472 connected at one of its ends to the escapement 468 and having its other end connected to the printer frame, serves to maintain the roller 471 in firm engagement with the surface of cam 442. When during the rotation of the cam 442, the operating member 470 is raised, escapement pawl 466 is disengaged from a tooth of the ratchet wheel 461 and the pawl 467 is moved to a position to be engaged by another tooth whereby the ratchet wheel is permitted to advance a half tooth step. When thereafter the cam 442 rotates a half revolution, the cam 442 permits the member 470 to be lowered by the spring 472 thereby disengaging the pawl 467 from a tooth of ratchet wheel 461 and moving the pawl 466 to a position to be engaged by another tooth, whereby the ratchet wheel is permitted to advance another half step. Two of the half step advances of the ratchet wheel are sufficient to advance the paper feed roller to feed the paper or ticket tape one half of a line space and since the cam 442 has two high points, the feed roller is operated through two half line space movements during each revolution of the cam 442.

The cam 441 cooperates with a roller 473 carried by the arm 474 of the printing bail 433 whereby the bail is pressed against the springs 420 carried by the arms 419 of all type bars and is effective thereby to press the type face of any released type bar against the paper. It is to be

noted that the high points on the printing bail operating cam 441 is in such a rotary position between the high points of the paper feed cam 442 that the paper is fed a half line space followed by the depression of a released type bar and then followed by a second advance of the paper another half line space.

Returning to the operation of the circuit, it will be recalled that in response to the transmission of the series of code impulses for the asterisk character, the type bar release magnet 412 and the start magnet 400 were both operated and that the relay 413 was also operated. Relay 413 is slow to operate and therefore does not operate until after both magnets 412 and 400 have operated but after being operated opens the circuit of magnet 400 which thereupon releases. Magnet 400 is therefore operated only momentarily or for a sufficient interval to permit the engagement of clutch disc 446 with the clutch collar 447 to start the rotation of the cams 441 and 442 which, since the magnet 400 is quickly deenergized, is terminated when the cams have made one revolution as previously described. The operated type bar release magnet 412 and relay 413 are held operated until the register relays 301, 302 and 304 are released through the operation of the receiver of Fig. 2.

As the cam 442 rotates through a first half revolution, escapement 468 is operated to advance the paper a half line space in the manner previously described. Thereafter the cam 441 becomes effective to operate the printing bail 433 to press the released type bar 432 to print an asterisk and a scanning mark on the paper. Although the bail also presses against springs 420 secured to the other type bars, since these type bars are locked against movement by the armatures 414 of their associated release magnets, the springs 420 yield without moving such type bars. As the cams 441 and 442 continue their rotation, the cam 441 releases the printing bail which is restored to its normal position by the tensioned springs 420 and the cam 442 again causes the escapement 468 to advance the paper another half line space. When the cams 441 and 442 complete a full revolution, the cam face of the cam throw-out disc 445 engaging the arm 449, disengages the clutch members 446 and 447 whereupon the rotation of the cams is arrested.

Upon the restoration of the printing bail 433, a spring 475 restores the operated type bar 432 to its normal position and with the release magnet 412 by this time deenergized, the end of the arm 416 of the type bar cams over the cam surface of the upper detent projection 418 carried by the magnet armature 414 and is locked between the two detent projections 417 and 418.

In a similar manner the printer is operated to print another asterisk on the paper in response to the next code signal series transmitted by the sending distributor. In response to the next signal series, assumed to be one impulse transmitted in sending position 4 of the sending distributor for the digit 4, the receiver responds to cause the operation of register relay 304 whereupon a circuit is established from ground over the No. 3 left back contact of relay 301, the No. 1 left back contact of relay 302, the No. 3 left back contact of relay 303, the No. 1 right front contact of relay 304, through the winding of type bar release magnet 405 (not shown) to battery through the winding of relay 413 and over the back contact of relay 413 to battery through the winding of magnet 400. Relay 413 and magnets 400 and 405 operate and the printer is thereby controlled in the manner previously described to cause the operation of the type bar 425 to print the digit 4 and a scanning mark on the paper. Other digits and the (-) character are printed in a similar manner.

It is to be noted that each of the twelve digit and character symbols, due to the transverse alignment of the type bar faces across the paper or tape, are printed together with their associated scanning marks in twelve different positions across the width of the tape and such scanning mark positions when scanned by an electronic scanner may be employed to determine the nature of the printed symbol. The faces of the type bars could equally well be arranged to operate a punch pin in the well-known manner to punch holes in the tape for sensing by an electric scanner or other suitable type of sensing apparatus.

What is claimed is:

1. In a printer control system, a line, a plurality of character conductors, a distributor, means controllable over said conductors for causing said distributor to selectively transmit codes of impulses over said line in accordance with the characters represented by said conductors, a printer having a type bar for each of said characters, a release magnet for each said type bars, a plurality of relays selectively operable to cause the selective operation of said type bar release magnets, and a receiver having a single magnet operable by code impulses transmitted over said line for selectively operating said relays.

2. In a printer control system, a line, a plurality of character conductors, a distributor, means controllable over said conductors for causing said distributor to selectively transmit codes of impulses over said line in accordance with the characters represented by said conductors, a printer having a type bar for each of said characters, a release magnet for each of said type bars, a printing bail common to said type bars, a rotatable cam for operating said bail, a start magnet for initiating the rotation of said cam, a plurality of relays selectively operable to cause the operation of said start magnet and the selective operation of said type bar release magnets, and a receiver having a single magnet operable by code impulses transmitted over said line for selectively operating said relays.

3. In a printer control system, a line, a plurality of character conductors, a distributor, means controllable over said conductors for causing said distributor to selectively transmit codes of impulses over said line in accordance with the characters represented by said conductors, a printer having a type bar for each of said characters, a release magnet for each of said type bars, a printer bail common to said type bars, a rotatable cam for operating said bail, a paper feeding mechanism, a rotatable cam for operating said feeding mechanism, a start magnet for initiating the rotation of said cams, a plurality of relays selectively operable to cause the operation of said start magnet and the selective operation of said type bar release magnets, and a receiver having a single magnet operable by code impulses transmitted over said line for selectively operating said relays.

4. In a printer control system, a line, a plurality of character conductors, a distributor, means controllable over said conductors for causing said distributor to selectively transmit codes of impulses over said line in accordance with the

characters represented by said conductors, a printer having a type bar for each of said characters, said type bars being positioned parallel to each other with their type faces aligned transversely with respect to the direction of movement of the paper through the printer, each of said type faces carrying a type symbol and a scanning mark, a release magnet for each of said type bars, a plurality of relays selectively operable to cause the selective operation of said type bar release magnets, and a receiver having a single magnet operable by code impulses transmitted over said line for selectively operating said relays.

5. In a printer control system, a line, a plurality of character conductors, a distributor, means controllable over said conductors for causing said distributor to selectively transmit codes of impulses over said line in accordance with the characters represented by said conductors, a printer having a type bar for each of said characters, a release magnet for each of said type bars, a printing bail common to said type bars, a constantly driven shaft, a rotatable cam for operating said bail, a normally disengaged clutch for coupling said cam to said shaft, means for normally holding said clutch disengaged, a start magnet for operating said latter means, a plurality of relays selectively operable to cause the operation of said start magnet and the selective operation of said type bar release magnets, and a receiver having a single magnet operable by code impulses transmitted over said line for selectively operating said relays.

6. In a printer control system, a line, a plurality of character conductors, a distributor, means controllable over said conductors for causing said distributor to selectively transmit codes of impulses over said line in accordance with the characters represented by said conductors, a printer having a type bar for each of said characters, a release magnet for each of said type bars, a leaf spring secured to each of said type bars, a printing bail common to said type bars and normally engaged with said springs, a rotatable cam for operating said bail, a start magnet for initiating the rotation of said cam whereby said bail operates a released type bar and flexes the leaf springs of unreleased type bars, a plurality of relays selectively operable to cause the operation of said start magnet and the selective operation of said type bar release magnets, and a receiver having a single magnet operable by code impulses transmitted over said line for selectively operating said relays.

7. In a printer control system, a line, a plurality of character conductors, a distributor, means controllable over said conductors for causing said distributor to selectively transmit codes of impulses over said line in accordance with the characters represented by said conductors, a printer having a type bar for each of said characters, a release magnet for each of said type bars, a plurality of relays selectively operable to cause the selective operation of said type bar release magnets, and a receiver operable by code impulses transmitted over said line for selectively operating said relays, said receiver having a set of contact pairs for establishing the circuits of said relays, a corresponding set of selectors for determining the open or closed condition of the contact pairs of said sets, an electromagnet responsive to code impulses transmitted over said line, a rotary member, and means controlled by said rotary member for operatively associating said selectors in order and each successively with the armature of said magnet and with the corresponding contact pair.

8. In a printer control system, a line, a plurality of registers, a plurality of character conductors, a plurality of translator relays individual respectively to said conductors and operable thereover, means for repeatedly and selectively operating said relays in accordance with the settings of said registers, a distributor, means controllable by said relays for causing said distributor to selectively transmit codes of impulses over said line in accordance with the characters represented by said conductors and associated relays, a printer having a type bar for each of said characters, a release magnet for each of said type bars, a plurality of register relays selectively operable to cause the selective operation of said type bar release magnets, and a receiver operable by code impulses transmitted over said line for selectively operating said register relays.

9. In a printer control system, a line, a plurality of registers, a plurality of character conductors, a plurality of translator relays individual respectively to said conductors and operable thereover, a progress switch operable in each successive position thereof to cause the selective operation of one of said relays in accordance with the setting of a different one of said registers, a start-stop distributor, means controlled by the operation of each one of said relays to cause the selective connection of ground to one or more of the segments of said distributor and to cause the operation of said distributor through a single operating cycle to transmit a code of impulses over said line in accordance with the character represented by the operated translator relay, a printer having a type bar for each of said characters, a release magnet for each of said type bars, a plurality of register relays selectively operable to cause the selective operation of said type bar release magnets, and a receiver operable by code impulses transmitted over said line for selectively operating said register relays.

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