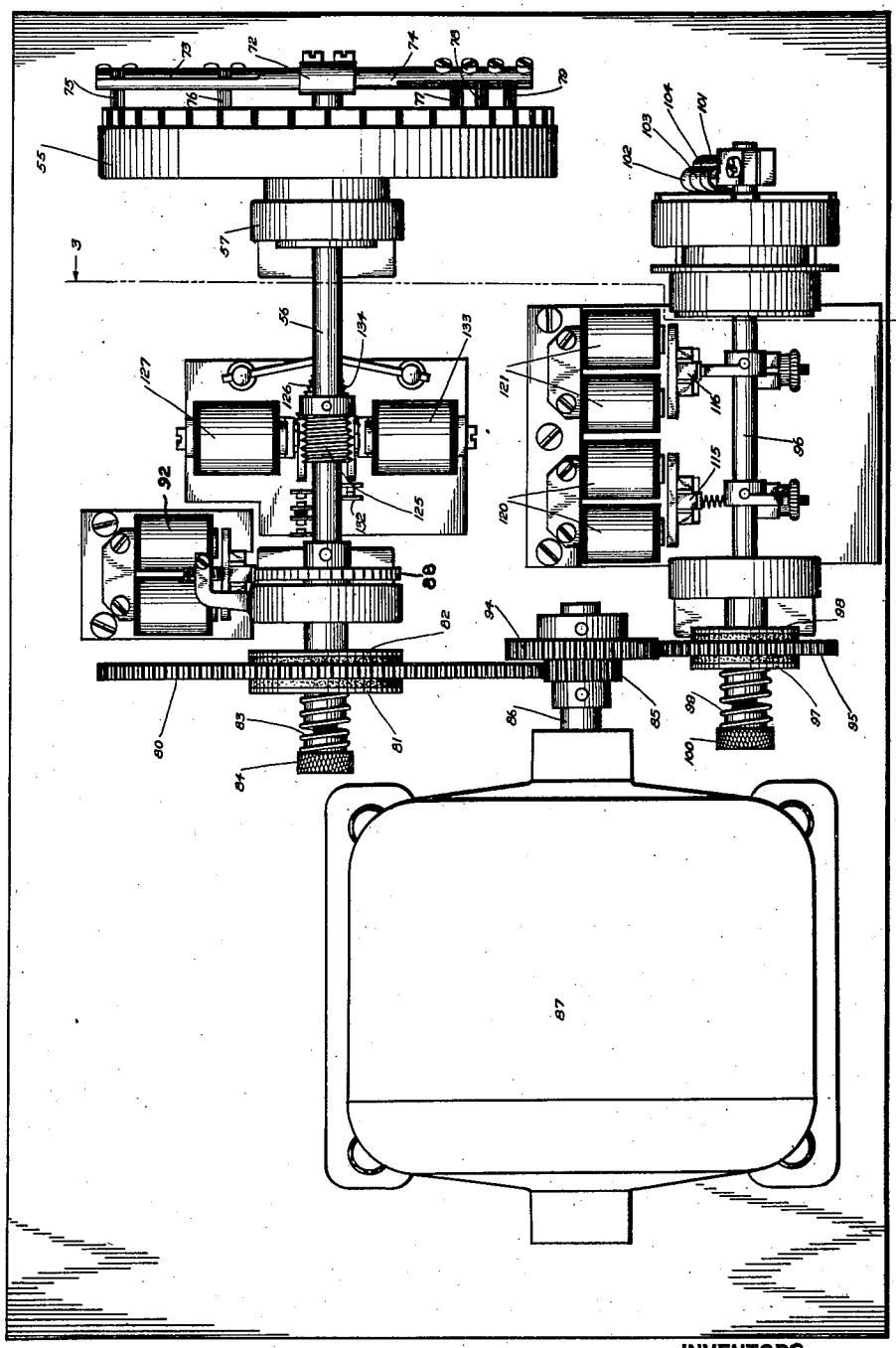
Oct. 15, 1935. J. J. ACKELL ET AL 2,017,087

TELEGRAPHIC PRINTING CONTROL METHOD AND APPARATUS

Filed Nov. 17, 1934 5 Sheets-Sheet 1

FIG.1.



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TELEGRAPHIC PRINTING CONTROL METHOD AND APPARATUS

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FIG. 2.

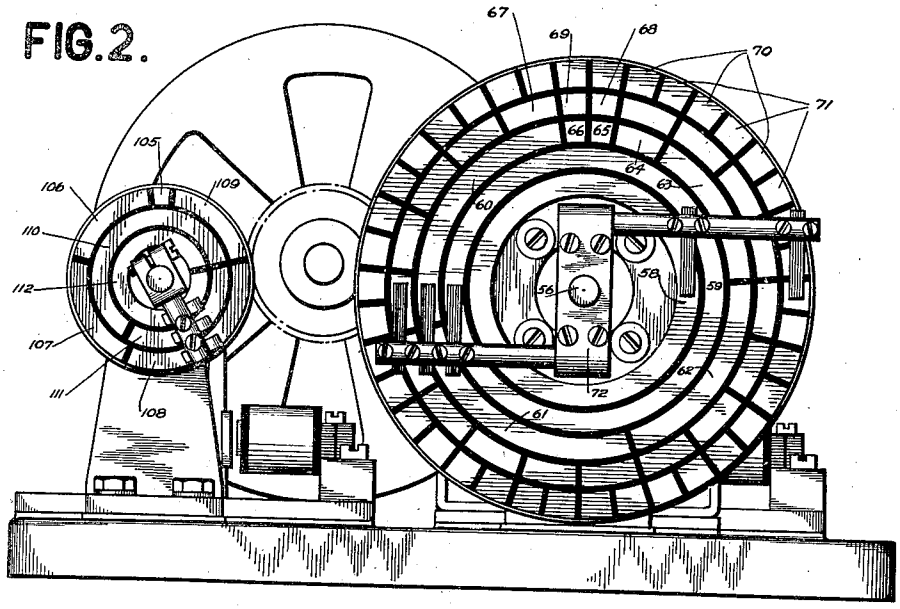


FIG. 3.

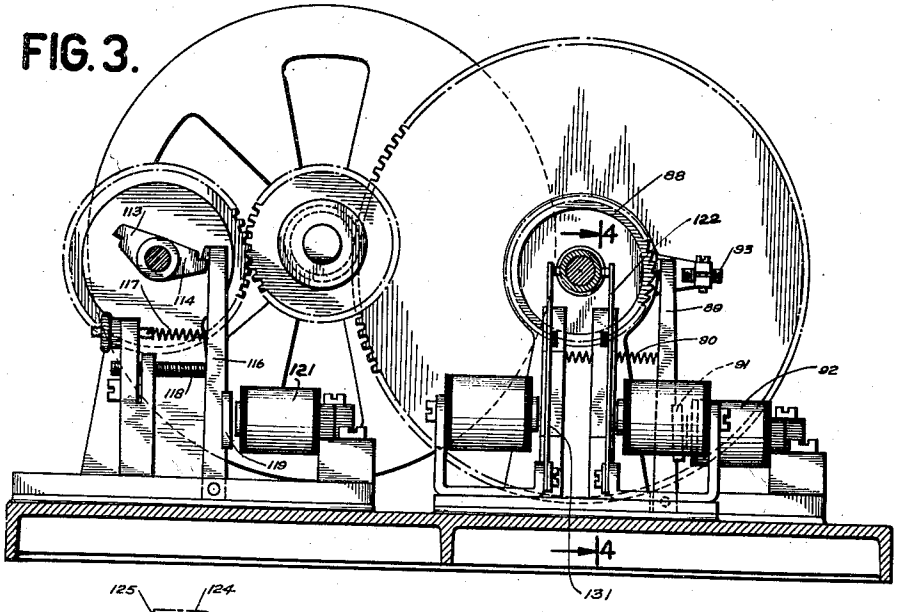


FIG. 4.

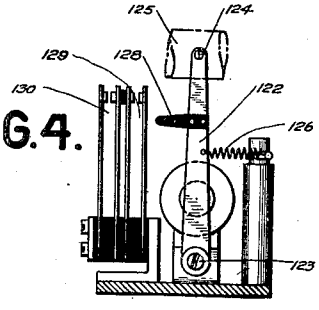
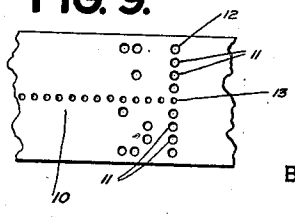


FIG. 9.



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TELEGRAPHIC PRINTING CONTROL METHOD AND APPARATUS

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FIG.5.

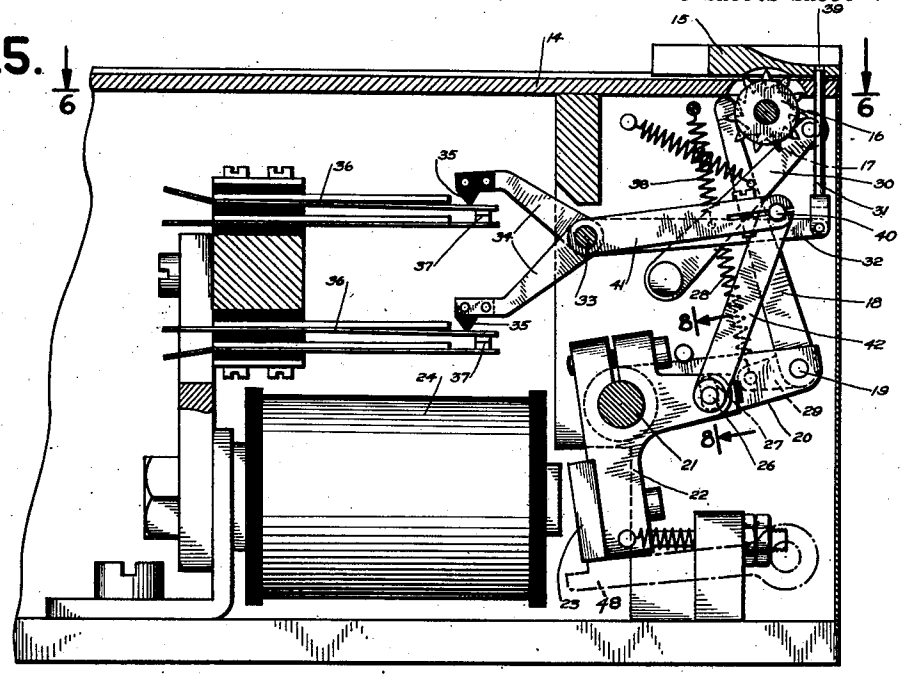


FIG.6.

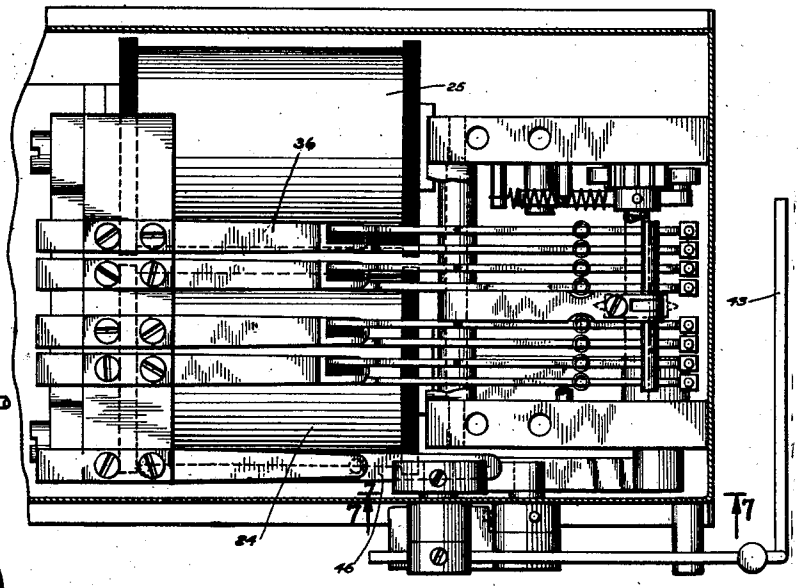


FIG.7.

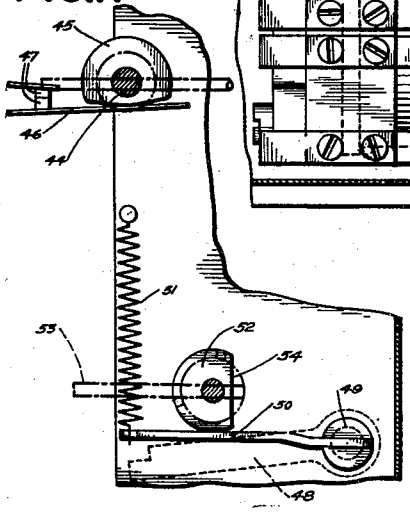
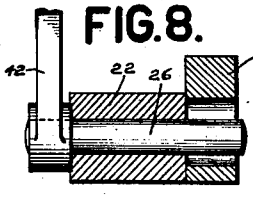


FIG.8.



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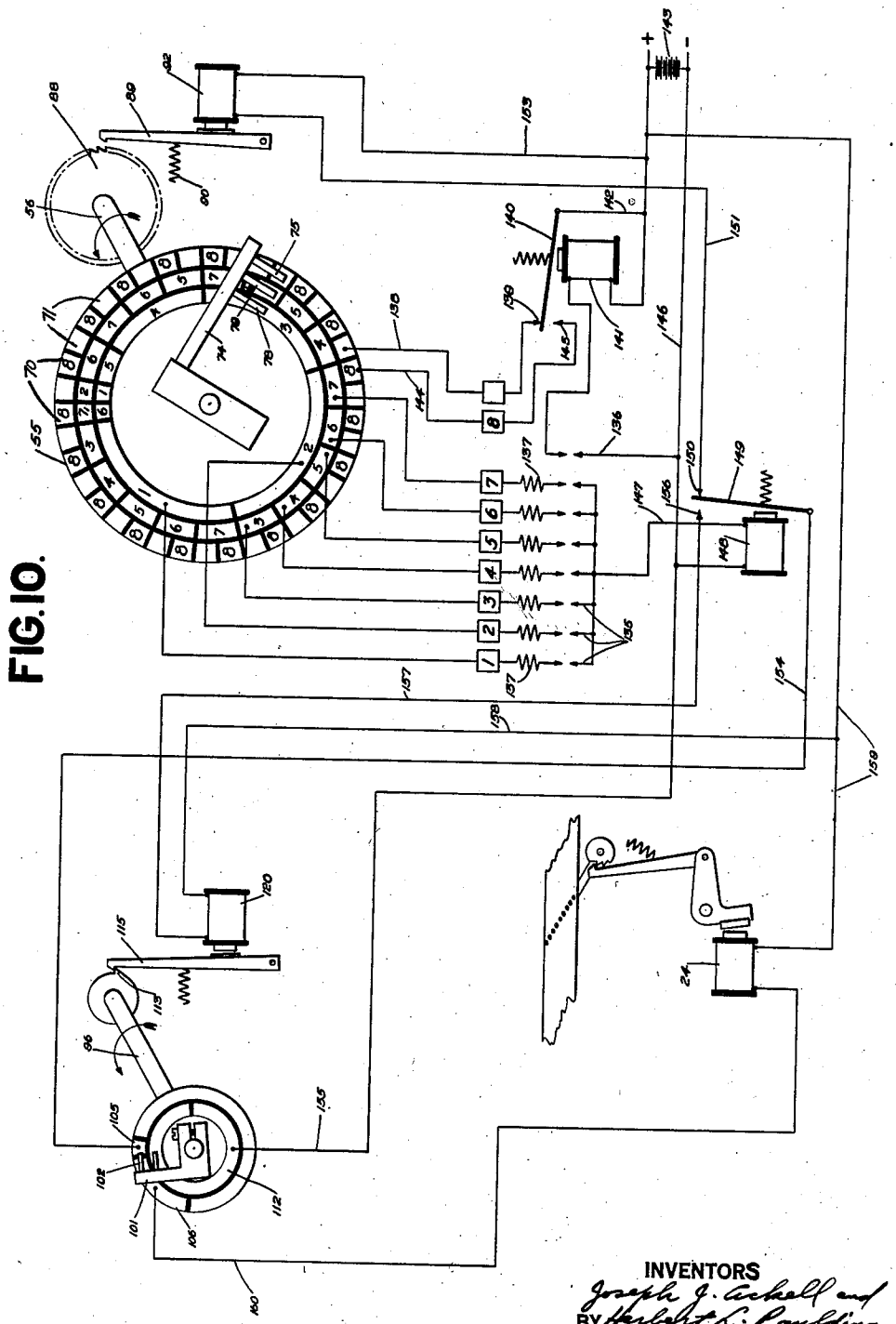


FIG. 10.

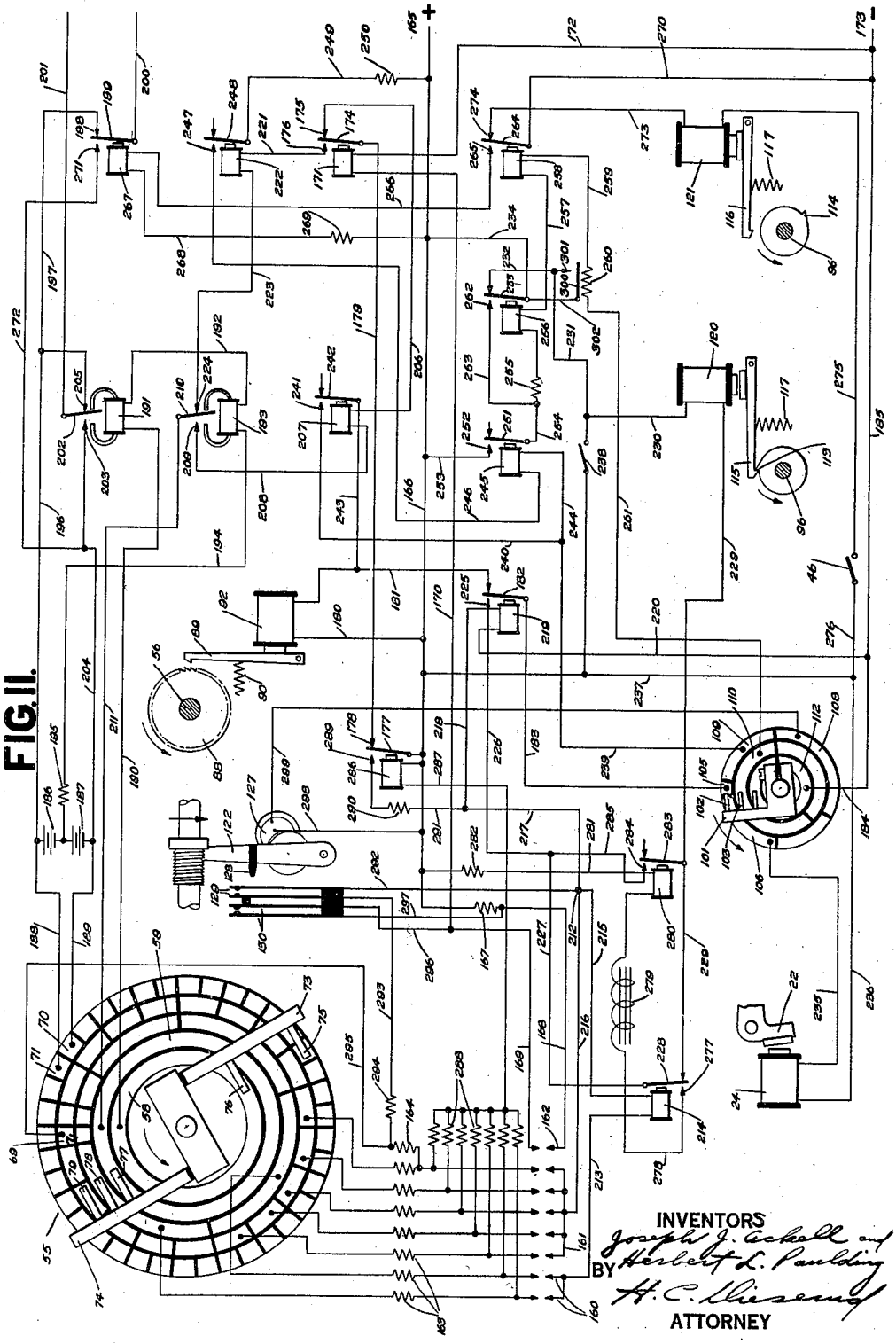
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TELEGRAPHIC PRINTING CONTROL METHOD AND APPARATUS

Filed Nov. 17, 1934 5 Sheets-Sheet 5

FIG. II.



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Patented Oct. 15, 1935

2,017,087

UNITED STATES PATENT OFFICE

2,017,087

TELEGRAPHIC PRINTING CONTROL METHOD AND APPARATUS

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Application November 17, 1934, Serial No. 753,454

71 Claims. (Cl. 178—4)

This invention relates to an improved method and apparatus by which telegraphic printing mechanisms may be simply and effectively controlled to provide for maximum efficiency in the operation of these devices. The improvement is of broader application to the control of other devices in which it is desired to set up or select any one of a variety of characters by electrical means. However, it is particularly applicable to the control of printing mechanisms of the step-by-step type in which a printing wheel or the like is adjusted to successive positions for the printing of selected characters on a tape or sheet.

More specifically, the invention contemplates the control of devices of the character mentioned by means of perforations in a punched tape or the like. Heretofore it has been the common practice to control the step-by-step type of printer directly from the keyboard of a central control machine. These machines have been provided with keyboards having a peculiar arrangement of keys due to the method of control involved. Considerable experience has been required to enable an operator to manipulate the keyboard of such a machine with any high degree of efficiency. This is due to the fact that the type wheel is always rotated in the same direction and must be rotated varying extents in setting up a character, depending upon the character previously set up. The keyboards have ordinarily been arranged in such a way as to indicate to the operator whether a relatively long or short time will be required to set up a new character, depending on the preceding character. Skilled operators can judge fairly accurately how much time must be allowed between the depression of different keys but in order to avoid the danger of depressing a new key before the previous key has completed its control, the tendency is to allow somewhat more time than is actually required. This necessarily slows down the operation of all of the printing machines controlled by the keyboard to a point considerably below their maximum capabilities.

By controlling the printers from a perforated tape in accordance with the present invention, they may be operated at maximum speed at all times. Thus, the sending or control mechanism may automatically take into account the actual time required to shift the wheel to a new setting and print therefrom so that the next character control can be initiated immediately upon the printing of the preceding character. In this way it is possible to operate the printers with a minimum loss of time between the printing of successive characters. While a single mechanism will ordinarily control the operation of a large number of printers, this mechanism may be supplied with tape from several sources. Several operators may be engaged in perforating the tape so that the matter which may be printed by a single machine is limited only by the speed with which the type wheel or the like may be shifted and the printing mechanism operated. Furthermore, since the manual operation of a keyboard is utilized only to perforate a tape and since each character requires precisely the same amount of time in punching the tape, regardless of the particular sequence, it is possible to use a keyboard with any desired arrangement of keys. Ordinarily, it will be found preferable to use the standard typewriter keyboard arrangement with minor changes so that skilled typists may readily operate the punching machines.

A feature of the invention is the provision of a control system of the character mentioned which enables the step-by-step setting of a printing element simultaneously with the operation of the selecting mechanism which determines and interprets the arrangement of perforations at a given point on the tape. The arrangement is such that pulses may be sent over the line to a series of step-by-step printers while the character determining devices are operating to interpret a particular group of perforations that has been shifted into controlling position. This avoids the delay incident to a system in which no signal can be sent to the printers until a group of perforations has been fully interpreted.

Numerous other features and advantages of the invention will appear from the detailed description of an illustrative embodiment of the same which will presently be given. It will be appreciated that while the invention is particularly disclosed in relation to the control of step-by-step printers, many features will be found of value in other relations. In the accompanying drawings, which form a part of this specification,

Figure 1 is a plan view of mechanism employed to interpret and transmit the signals designated by a control tape.

Figure 2 is an end view of the mechanism as seen from the right of Figure 1.

Figure 3 is a transverse section along the line 3—3 of Figure 1.

Figure 4 is a detail view of certain switches and operating mechanism therefor, taken along the line 4—4 of Figure 3.

Figure 5 is a vertical section through a por-

tion of a control box operating upon and controlled by the tape.

Figure 6 is a plan view of the mechanism of Figure 5, taken beneath the top of the box along the line 6—6 of Figure 5.

Figure 7 is a detail view taken along the line 7—7 of Figure 6.

Figure 8 is an enlarged, detail, sectional view along the line 8—8 of Figure 5.

Figure 9 is a detail view of a portion of the control tape.

Figure 10 is a diagrammatic view showing certain electrical circuits that may be employed in conjunction with the foregoing apparatus for the interpretation of a perforated tape, and

Figure 11 is a similar diagrammatic view of a more complicated system of circuits adapted to send out pulses to a printer or the like under the control of a tape and under a variety of different conditions.

General operation of system

Before entering into a detailed description of the particular illustrative mechanism and arrangement of circuits disclosed, a brief explanation will be given as to the general working of the system. The preferred arrangement is such that the control tape 10 (Fig. 9) is adapted to receive perforations in two or three of eight different columns or rows. Two of these perforations may be located in any two of seven positions, designated 11, across the tape while the third perforation, designated 12, whenever present, appears in the eighth column or row. This enables the selection of forty-two different characters or controls by the use of sometimes two and sometimes three perforations. The illustrated mechanism and circuits are particularly designed for use in conjunction with printer mechanisms of the type disclosed in the Conger Patent No. 1,178,215, granted April 4, 1916, and in the Vischer Patent No. 1,979,510 granted Nov. 6th, 1934, and in conjunction with a pulsing system of the type disclosed in the Paulding Patent No. 1,957,076 granted May 1, 1934.

Briefly, the printer comprises a rotatable type wheel having a series of thirty-six characters distributed around its periphery and two blank spaces, having no characters but being of equal width to the character spaces. One of these blank spaces is utilized in the spacing of the type carrier across the sheet upon which the characters are being printed. When a space signal is transmitted, no character is printed upon the sheet but at the same time the printing mechanism is operated in order to perform other necessary functions of the printer, such as operation of the escapement mechanism, causing the printing wheel carriage to shift one space toward the right. The second blank position on the type wheel corresponds with the carriage return signal. Whenever the type wheel is arrested with this space opposite the printing platen, no character will be printed upon operation of the platen but the escapement mechanism will be tripped so as to allow suitable devices to restore the printing wheel to its position at the left of the machine and to feed the paper one line space preparatory to the printing of a new line of characters. All of this is more fully explained in the above mentioned patents and further description is therefore believed to be unnecessary.

The characters on the printing wheel include all of the letters of the alphabet,—eight numbers, a dash and the mark "&". The number 1 is supplied by letter I while the cipher is supplied by the letter O. Obviously, the nature of the characters appearing on the wheel may be varied to suit the particular requirements of the machine. Inasmuch as the characters are set up by the successive, partial rotations of the wheel in one direction, the characters are ordinarily arranged in such a way as to bring those which are most frequently used in succession into position by a minimum portion of a revolution of the wheel. For this purpose the following arrangement of characters has been largely adopted: Q, J, B, T, W, P, C, H, L, M, E, A, U, I, O, N, G, R, F, D, Y, S, V, K, X, Z, 2, 3, 4, 5, 6, 7, —, 8, 9, &. Between the & and the Q the two blank spaces above mentioned corresponding to the carriage return and spacing functions, respectively, are provided. Obviously, this particular arrangement of characters and spaces may be varied, if desired, to suit particular circumstances.

Any convenient allocation of the groups of perforations to correspond with given characters may be adopted. Preferably, however, the arrangement is such that for two adjacent characters on the type wheel, one will involve a certain pair of perforations in selected ones of the seven columns while the next will involve the same pair of perforations plus a third perforation in the eighth column. By designating the perforations by the numbers 1 to 8, according to their position across the tape it has been found advantageous to employ the following correlation between the perforations and the various characters or signals previously mentioned: for the carriage return signal, perforations 1 and 2; for the spacing signal, perforations 6, 7 and 8; and for the various characters the following:

Q—1—3;	J—1—3—8;	B—1—4;	T—1—4—8;	W—1—5;	P—1—5—8;
C—1—6;	H—1—6—8;	L—1—7;	M—1—7—8;	E—2—3;	A—2—3—8;
U—2—4;	I—2—4—8;	O—2—5;	N—2—5—8;	G—2—6;	R—2—6—8;
F—2—7;	D—2—7—8;	Y—3—4;	S—3—4—8;	V—3—5;	K—3—5—8;
X—3—6;	Z—3—6—8;	4—4—5;	5—4—5—8;	6—4—6;	7—4—6—8;
dash—4—7;	8—4—7—8;	9—5—6;	&—5—6—8.		

While the foregoing correlation between the perforations and the various characters and signals has been found quite convenient, in view of the existing characteristics of the printing mechanism intended to be controlled, it will be understood that other relationships may very readily be adopted. In addition to the perforations 11 and 12, the tape is also provided with a continuous series of small perforations 13, preferably between the fourth and fifth columns of control perforations, i. e., along the center of the tape. These small perforations, as will be explained more fully hereinafter, are for the purpose of enabling the step-by-step advance of the tape in analyzing the same. It is further contemplated that provision should be made in the perforating machine for punching a complete series of holes across the tape. As will be more fully explained hereinafter, the analyzing and interpreting devices are so constructed and arranged

that whenever a complete series of perforations is provided in this way, or, in fact, whenever four or more perforations appear in any position across the tape, no pulse or signal will be transmitted to the printers and the only function that will be performed is the advancement of the tape one step to the next position. This affords a convenient method of entering a correction upon the tape. For example, should a mistake be made in the depression of the keys of the punching machine and should this mistake be noted by the operator immediately, or after the depression of several additional keys, the tape may be spaced backwardly the desired number of steps and a correction key operated to produce one or more series of eight holes across the tape. This is a distinct advantage over the direct keyboard control of the printers since under that method a signal is sent out immediately upon the depression of a key. An error can then be corrected only by introducing an appropriate comment into the matter actually printed, thus consuming time and space.

Punching of tape

For the purpose of punching the tape in the manner explained, any suitable mechanism may be employed. A variety of machines are already known which may be very readily adapted for the punching of the perforations in the two or three columns, or in all eight columns, when a correction is desired, in the manner explained. It is not believed necessary to describe a suitable punching machine in detail since it forms no part of the invention intended to be covered in this case. Briefly, it may be stated that upon the depression of a key in the keyboard of the punching machine, two, three or eight slides may be shifted, depending upon the key depressed, and these slides may interpose a portion between an operating member and a series of punches. As a key is depressed further, it may close a circuit through an electro-magnet operating a suitable bar, which will then depress those punches corresponding with the slides that have been shifted. Thus, if a carriage return key is depressed, the one and two slides will be shifted so that upon operation of the bar over the punches, those in the 1 and 2 positions will be forced through the tape. Should the space key be depressed, the slides positioned over the punches in the 6, 7 and 8 positions will be shifted and thus cause these punches to be operated. A correction key may be made to shift all eight slides to produce operation of all eight punches. It will be understood that between the operation of successive keys, suitable mechanism will be operated to cause the tape to be fed a predetermined distance. While the spacing of the groups of perforations may be varied to suit particular circumstances, it has been found quite convenient to place them at about $\frac{1}{10}$ inch intervals. The tape feeding holes 13 may be punched either before the tape is placed in the punching machine to assist in feeding it through this machine or they may be formed in any suitable way by the machine. To enable the effective use of the correction key the punching machine should, of course, be provided with a back spacing key so that the tape may be quickly returned any desired number of spaces for the punching of the eight perforations in lieu of the lesser number incorrectly placed in the tape. A special key should also be provided to cause the tape to be advanced one step without punching it, thus leaving a blank space except for the control feed hole.

Tape analyzer

After the tape has been punched in the manner explained, it is fed to an analyzer adapted to feel the perforations and transmit the intended controls, corresponding with the perforations in a particular position on the tape, to an interpreting or translating mechanism. The analyzer may receive the tape directly from the punching machine, if desired, or, if several punching machines are employed to supply tape to a single transmitting unit, the tape may be fed from an independent source. The analyzer illustrated in Figs. 5 to 8 may comprise a relatively small box or casing having a flat top member 14. The tape may conveniently be fed across the top of this member and beneath a guide bar 15. The latter is preferably detachable or movably mounted on the box, as for example by pivoting one end at one edge of the box. At its opposite end the bar 15 is then preferably retained by a simple latch so that it may be conveniently raised whenever it is desired to introduce a new strip of tape.

The tape should be applied in such a way that one of the teeth on a toothed feed wheel 16 will extend through a perforation 13 in the tape. This will insure proper positioning of the perforations 11 and 12 with respect to the analyzing devices later to be explained. Secured to the same shaft as the feed wheel 16 is a ratchet wheel 17 adapted to be operated by a pawl 18 pivotally carried at 19 on an arm 20 loosely carried by a shaft 21. This shaft has secured, at a convenient point, a bell crank member 22 carrying an armature 23 adapted to cooperate with an electro-magnet having coils 24 and 25. A forwardly extending arm of the bell crank 22 carries a pin 26 cooperating with an elongated slot 27 formed in the arm 20. A spring 28 extending between a stud fixed on the frame and a rearwardly extending arm 29 of the pawl 18 serves to rock the latter to engage its tooth with the teeth of the ratchet 17 and, at the same time, serves to hold the arm 20 in elevated position. Any suitable means, such as the pin shown in Fig. 5, may be provided for limiting the upward movement of the arm 20 under the influence of the spring. It will be apparent from the foregoing that when the electro-magnet 24, 25 is energized, in the manner to be later explained, the bell crank 22 is rocked and after a brief free movement the pin 26 will engage the lower end of the slot 27 and will rock the arm 20 downwardly or in a clockwise direction, (Fig. 5). In so doing the pawl 18 will operate the ratchet 17 one step. Any suitable means may be provided for preventing overthrow of the ratchet. For this purpose a detent may be employed comprising a spring-urged arm 30 adapted to carry a roller yieldingly against the teeth of the ratchet.

For the purpose of analyzing the perforations in the tape, a series of eight feeler elements or pins 31 is provided. These are passed through suitable openings in the top member 14 of the analyzer and are spaced at the same distance as the perforations in the tape. They are also suitably located with respect to the teeth of the feed wheel 16 and ratchet 17 to insure the positioning of the perforations in the tape directly over the pins when the tape is at rest. The pins are pivotally attached to individual arms 32 loosely carried by a rod 33. Rearwardly of the rod 33 each of the arms 32 is provided with an

extension 34. Alternate ones of these extensions are bent upwardly and the remaining ones are bent downwardly, in the manner shown, so as to provide projections 35 at two different elevations. This is for the purpose of providing more room for a series of eight switches 36, one of which is related to each of the pins 31. The arrangement is such that when a pin 31 is permitted to rise through a perforation in the tape, the projection 35 on its associated arm 32 will force the contacts 37 of the related switch 36 into engagement. This, as will be later explained, serves to complete certain circuits by which the perforations may be properly interpreted. Each of the arms 32 is provided with a spring 38 tending to lift the arm and hence to force the pin 31 upwardly through a perforation when it is presented above the pin. At such time the upper end of the pin will preferably pass into a small opening 39 in the guide bar 15.

After a particular group of perforations has been analyzed and interpreted, it is necessary to withdraw the pins 31 to permit the tape to be advanced to the next position, in the manner previously explained. For this purpose a rod 40 is carried by an arm 41 loosely mounted on the rod 33. A link 42 extending downwardly from the rod 40 connects the latter with the pin 26. It will be seen, therefore, that when the electro-magnet 24, 25 is energized and the bell crank 22 is rocked, the rod 40 will be drawn downwardly and will pull all of the pins 31 to a point below the upper surface of the top member 14. Due to the pin and slot connection 26, 27 the feed pawl 18 will not be operated to rotate the ratchet 17 until after the pins 31 have been withdrawn from the tape.

Provision is made for arresting the operation of the analyzing and interpreting devices whenever the transmitter overtakes the operation of the punching machine. This is accomplished by passing the tape beneath a bar 43 before it is passed beneath the guide member 15. Bar 43 is carried by a stub shaft 44 that carries on its inner end a cam 45 formed of some insulating material. The latter is arranged to engage the arm 46 of a suitable master switch to break the circuit between contacts 47 whenever the cam is rotated a slight distance away from its position indicated in Fig. 7. Thus, whenever the tape becomes taut by virtue of the fact that the transmitting mechanism overtakes the operation of the punching machine, the bar 43 will be lifted and will rotate the cam 45 to open the master switch. This switch may also be opened manually at will by simply lifting the bar 43 or turning the shaft 44 in any other convenient way.

Means are provided for locking the bell crank 22 in the position in which it is rocked by the electro-magnet. In this position the pins 31 will be withdrawn from the tape and retained below the upper surface of the top member 14. For this purpose a latch 48 is pivotally carried by the side member of the casing by means of a stud 49. An arm 50 is also secured to this stud and is drawn upwardly by a spring 51. Upward movement of the arm may be prevented, however, by a cam 52 having an operating arm 53 arranged on the outside of the casing. When the cam is in the position shown in Fig. 7, it serves to retain the latch 48 out of operative engagement with the armature 23. However, if the arm 53 is turned through 90 degrees in a clockwise direction (Fig. 7), a flattened portion 54 of the cam will be over the arm 50 and hence when the armature 23 is attracted by the electro-magnets, the latch 48 will be permitted to rise and retain the bell crank 22 in shifted position. Whenever it is desired to release the armature, this may be done by returning the arm 53 to the position shown in Fig. 7. The purpose of this latch construction will be explained hereinafter.

Translating mechanism

Associated with the analyzer is another relatively simple device which may be designated an interpreter or translator. The function of this mechanism is to act upon the readings taken from the perforated tape by the analyzer and to send out appropriate signals to the various printers or other controlled mechanisms. This mechanism will now be described by reference to Figs. 1 to 4, inclusive. A commutator 55 is arranged around a shaft 56 adjacent to one end of the latter. This commutator, in the construction illustrated, is held fixed with relation to the supporting structure of the translating mechanism and for this purpose may conveniently be secured to a bearing member 57 which supports the shaft 56 near its outer end. The face of the commutator is divided into a series of separate conducting surfaces by insulating means provided between the conductors. Thus, adjacent the center of the commutator two continuous conductor rings 58 and 59 are provided. Surrounding the ring 59 there is provided a series of segments 60, 61, 62, 63, 64, 65 and 66, forming a complete ring but with insulation provided between the several sections. Similarly, surrounding the segmental ring just mentioned there is arranged another segmental ring composed of a series of sections 67 of equal dimension and two smaller sections 68 and 69, equal to substantially half of one of the sections 67. Again, surrounding this segmental ring is a further ring divided into a large number of segments 70 and 71, all of equal dimension. In the construction illustrated there are provided 19 of the segments 70 and 19 of the segments 71, these being alternately arranged around the face of the commutator. It will thus be seen that there is a segment 70 or 71 for each of the positions of the printing wheel. All of the segments 70 are connected together and arranged in certain circuits to be later explained. Suffice it to say here that these circuits are controlled by the switch 36 associated with the pin 31 in the eight position. The segments 71 are similarly connected together and arranged in suitable circuits. They are not, however, associated with any of the feeler pins and may, therefore, be considered as blank positions around the commutator. Each of the other switches 36 is connected with a number of the segments in the two other broken rings of the commutator. For example, the switch associated with the number 1 pin is connected with the segments 60 and 65 while the switch associated with the number 2 pin is connected with the segments 61 and 68. The switches of the other pins are connected to the segments bearing the corresponding numbers in the diagrammatic illustration of the portion of the commutator in Figure 10.

Secured to the shaft 56 is a member 72 adapted to support a pair of brush arms 73 and 74. These arms are so mounted on the member 72 as to be insulated from each other. The arm 73

carries a pair of brushes 75 and 76, the first of which is adapted to sweep over the segments 70 and 71 while the second is adapted to sweep over the face of the ring 58. Arm 74 carries a series of brushes 77, 78 and 79 adapted to sweep over the faces of the three intermediate rings of the commutator.

For the purpose of rotating the shaft 56 to cause the brushes to pass over the commutator segments mentioned, a gear 80 is loosely mounted upon the shaft between a pair of friction discs 81 and 82 lined with suitable friction material and keyed to the shaft. The disc 82 is held in fixed position while the disc 81 is yieldingly forced against the gear 80 and forces the latter against the disc 82 by means of a spring 83, which at its outer end abuts a collar 84 carried by the shaft 56. The collar 84 is preferably arranged to have a screw-threaded engagement with the shaft so that the tension in the spring 83 may be adjusted as desired. Meshing with the gear 80 is a pinion 85 secured to a shaft 86 of a motor 87. It will be understood that as the motor is driven, it will continuously drive the gear 80 and this in turn will rotate the shaft 56 through the friction discs 81 and 82 whenever the shaft is not held too firmly by other means.

To control the rotation of the shaft 56 in such a way as to permit it to partake of partial revolutions of as little as 1/38 of a revolution, or any multiple thereof, a ratchet 88, having 38 teeth, is secured to the shaft. This is arranged to be engaged by a pawl 89 pivoted at its lower end to the main support and drawn by a spring 90 into engagement with the ratchet. An armature 91 carried by the pawl is adapted to be attracted by an electro-magnet 92 for the purpose of withdrawing the pawl from the ratchet. It will be understood that whenever the pawl is withdrawn the shaft 56 will be rotated by the gear 80. Suitable means are provided for energizing the magnet 92 for predetermined intervals to allow such rotation of the shaft. As soon as the magnet is de-energized the spring 90 will, of course, draw the pawl into engagement with the ratchet to arrest the shaft. A set screw 93 may be arranged in rear of the pawl 89, if desired, to limit its outward movement under the control of the magnet. As will be later more fully explained, the operation of the magnet 92 is placed under the control of the punched tape in such a way that the brush arms 73 and 74 will be arrested when the brushes are on those segments of the commutator which correspond with the perforations in the tape.

Secured to the shaft 86 is a gear 94 cooperating with a gear 95 loosely mounted on a shaft 96. A pair of friction discs 97 and 98, each provided with a friction mat, is arranged one on either side of the gear 95. The disc 98 is fixed to the shaft 96 while the disc 97 is keyed to the shaft but is slidable axially. A spring 99 urges the disc 97 against the gear and the gear against the disc 98 to provide a friction drive. An adjustable collar 100 is provided to retain the outer end of the spring. At its opposite end the shaft 96 carries a brush arm 101 provided with a series of three brushes, 102, 103 and 104. These, upon rotation of the shaft 96, are arranged to sweep across the faces of segmental commutator rings, in general similar to the commutator 55. The outer ring of the commutator, cooperating with the brush 102, comprises a small segment 105 and a series of larger segments 106, 107, 108 and 109. The ring engaged by the brush 103 is composed of two sections, 110, 111. The inner ring 112, engaged by the brush 104, is continuous but split at a point in line with one of the divisions of the two other rings.

Means are provided for arresting the rotation of the shaft 96 and holding it stationary against the action of the frictional drive between the gear 95 and the discs 97 and 98. For this purpose a pair of arms 113 and 114 is provided on the shaft 96 at spaced points. The arm 113 is arranged to be engaged by a pawl 115 pivoted at its lower end to the base-plate of the device, while the arm 114 is similarly arranged to be engaged by a pawl 116, also pivoted at its lower end to the main support. A spring 117 attached to each of the pawls 115 and 116 serves to throw the latter into the paths of the arms 113 and 114. Set-screws 118 serve to limit this inward movement of the pawls. Armatures 119 carried by the pawls are in position to be attracted by suitable electro-magnets. The pawl 115 for this purpose has associated therewith an electro-magnet 120 while the pawl 116 is arranged to be retracted by an electro-magnet 121. The operation of these electro-magnets will be more fully explained hereinafter. Suffice it to say at this time that normally the machine is stopped by the engagement of the pawl 116 with the arm 114. However, in the operation of the machine the shaft 96 will be arrested by engagement of the pawl 115 with the arm 113 whenever the shaft 56 is being rotated, while when the latter is arrested in any position the shaft 96 will be rotated. The two shafts will not be operated simultaneously. When the shaft 96 is arrested by the engagement of arm 113 with pawl 115, the brush 102 will engage the segment 105. Arm 114 and pawl 116 arrest the shaft with the brushes in the position shown in Fig. 2.

As previously stated, the shaft 56 will normally be given only a partial revolution upon each operation. At times it may be given one complete revolution whenever certain characters are to be duplicated. At other times it may be given more than one revolution and means are then provided for automatically stopping the shaft after a predetermined number of revolutions. This is a safety arrangement and may also be used, in a manner to be later explained, for the purpose of bringing all of the printers controlled by the mechanism into unison. For so automatically stopping the shaft there is provided an arm 122 pivoted at 123 to the main frame. This arm carries at its upper end a pin 124 arranged to engage a spiral groove in a member 125 secured to the shaft 56. A spring 126 is so arranged as to draw the arm 122 to engage pin 124 with the spiral groove and at the same time to urge the arm 122 toward the right in Figures 1 and 4. Upon each rotation of the shaft 56 the pin 124 will tend to travel toward the left (Fig. 1) along the spiral groove. However, when the shaft 56 is arrested and the shaft 96 is released for rotation, certain circuits are closed and an electro-magnet 127 is energized to draw the arm in a direction to disengage the pin 124 from the spiral groove. When so disengaged the arm is drawn toward the right by the spring 126. Therefore, upon each partial revolution of the shaft 56, the pin 124 will travel along the spiral groove a short distance and will then be withdrawn and at once returned to its starting position.

When the shaft 56 is allowed to make more than a complete revolution, special means goes into

play to control the stopping of the shaft. This comprises a projection 128 carried by the arm 122 and arranged to engage a pair of switches 129 and 130. When the contacts of these switches are closed, certain circuits will be completed, as will be more fully explained hereinafter, to arrest the rotation of shaft 56, with the brush arms in a predetermined position. As a safety or precautionary measure, an arm 131, similar to the arm 122, arranged to engage a pin with the opposite side of the spiral groove in member 125, is adapted to cooperate with a switch 132. Ordinarily both of the arms 122 and 131 will travel outwardly and back at the same time, a magnet 133 being energized each time magnet 127 is energized, and a spring 134 functioning in the same manner as spring 126. However, if for any reason the arm 122 should become disabled and fail to travel along the spiral groove as it should, the arm 131 will open the switch 132 which may be arranged in the circuit through the motor 87 and therefore will result in stopping the machine. This at least reduces the liklihood of a mis-operation, since it is rather unlikely that both arms 122 and 131 will be disabled at the same time.

Character selecting circuits

Referring now to Fig. 10, a description will be given of certain circuits which may be employed in connection with a portion of the apparatus already explained, with slight modification, by which the punched tape is enabled to control the rotation and position of the shaft 56 and brush arm 74 at all times. The arrows 135 are intended to indicate diagrammatically one side of the switches 36 associated with seven of the feeler pins of the analyzer. Arrow 136 is similarly intended to represent one side of the switch associated with the eighth feeler pin. The opposite sides of the first seven switches are connected, through suitable resistances 137, with the various segments of the commutator 55, in the manner previously explained. Thus, the switch designated 1 should be considered to be connected with the two segments designated 1 in the diagram. Similarly, all of the other of the seven switches should be understood to be connected with the segments bearing corresponding numerals. In the simplified showing of the diagram the commutator is indicated as formed of only three segmental rings and only one of the brush arms is shown. This brush arm, furthermore, carries brushes equivalent to those designated 75, 78 and 79 in the mechanical drawings where they are shown as carried by two separate arms.

The outer ring of the commutator, as previously explained, is formed of alternate blank sections 71 and alternate sections 70 associated with the No. 8 pin. These, however, are not directly connected with the switch controlled by the No. 8 pin. A connection 138 is provided to place all of the blank segments 71 in communication with a contact 139 which in turn is engaged by an armature 140 of a relay 141. The opposite end of the armature is connected through a conductor 142 with a D. C. source of current 143. In a similar way all of the segments 70 are connected through a conductor 144 with a contact 145. The arrangement is such that when the relay 141 is operated, in a manner later to be explained, the armature 140 will be swung from contact 139 to 145, thus connecting the positive side of the current source with the No. 8 segments 70. Operation of the relay 141 is controlled by the No. 8 pin. Thus, when the switch indicated by arrow 136 is closed, the negative side of the source of current 143 will be connected with the relay through the conductor 146 while the positive side of the current source is always connected with the relay in the manner shown. Thus it will be seen that whenever a hole is presented in the tape above the No. 8 pin, the armature 140 will be operated to connect the segments 70 with the positive side of the current source, while when there is no such perforation the segments 71 will be connected with the positive side of the current source.

All of the seven switches indicated by the arrows 135 are connected by a conductor 147 with a relay 148. The opposite side of this relay is then connected with the negative side of the source of current 143 through the conductor 146. It will be seen from the foregoing that as the brush arm 74 sweeps over the commutator segments in a counter-clockwise direction, the outer brush 75 will alternately engage the segments 70 and 71 while the two inner brushes 78 and 79 will engage the segments connected with one or another of the resistances 137. When the brush arm is in the position shown in the diagram, it will be seen that current from the positive side of the battery 143 will be conveyed through the armature 140, contact 139, conductor 138 and the engaged blank segment 71 to the brush 75. The circuit will then be carried on through the segments 3 and 6, engaged by the brushes 78 and 79, and through the resistances identified with the 3 and 6 pins. Now, if these pins happen to be in line with perforations in the tape, the circuit will be completed through the conductor 147, relay 148 and conductor 146 with the negative side of the battery. If we assume, however, that the perforations in the tape are in the 3 and 7 positions, then the circuit is complete only through the No. 3 resistance. The circuit associated with the No. 6 pin will be broken at the pin switch while the circuit associated with the No. 7 pin will be broken between the brush 79 and the commutator. All of the other of the seven circuits will be broken both at the pin switches and at the commutator.

Now, the construction is such that when only one circuit is complete through the resistances 137, the resistance is so high that insufficient current is passed through the relay 148 to operate the armature 149. However, when the current is permitted to pass through two of the resistances in parallel, the amperage is sufficient to operate the relay. Thus, under the second condition assumed, when the brush arm 74 is shifted to carry the three brushes into engagement with the 3, 7 and blank segments of the three rings, the relay will be tripped and the armature 149 withdrawn from a contact 150. The latter is connected by a conductor 151 with one side of the magnet 92 that operates to hold the pawl 89 out of engagement with ratchet 88. The opposite side of this magnet is connected by conductor 153 to the positive side of the current source 143. The circuit through the magnet 92 is completed to the negative side of the line by a conductor 154 connecting the opposite end of the armature 149 with the segment 105 of the commutator surrounding the shaft 96. This segment is in turn connected, through the arm 101 and the brushes carried thereby, with the ring 112, which in turn is connected by conductor 155 and conductor 146 with the negative side of

the current source. Therefore, as long as the armature 149 is in the position shown, the pawl 89 will be retracted and the brush arm 74 will be rotated. However, when two circuits are completed through resistances 137, in the manner explained, the circuit through the magnet 92 will be broken at 150 and the spring 90 will draw the pawl 89 into the ratchet 88 to stop the rotation of shaft 56. If the perforations in the tape had been not only in the 3 and 7 positions but also in the 8 position, the armature 140 would have been drawn down into engagement with contact 145 so that the circuits would not be complete until the brush 79 is brought over the upper part of segment 7 and the brush 75 is brought into contact with the 8 segment. In this way the mechanism clearly distinguishes between a two-hole character and a three-hole character.

When the armature 149 is withdrawn from the contact 150, as explained, it is brought into engagement with a contact 156. The latter is connected by a conductor 157 with the magnet 120, the opposite side of which is connected by conductors 158 and 159 with the positive side of the battery 143. It will be understood that the circuit will be completed from the negative side of the battery, at this time, by the connections 146, 155, ring 112, brush arm 101, segment 105 and conductor 154 to the armature 149. Therefore, as the pawl 89 is released by its magnet, the pawl 115 will be withdrawn from the projection 113 by the energization of magnet 120. This frees the shaft 96 for operation. As soon as the brush arm 101 carries the brush 102 off of the segment 105, the circuit through the magnet 120 will be broken and the pawl 115 will be released to again engage the projection 113 upon the completion of one revolution of shaft 96. Furthermore, as soon as the brush 102 engages the segment 106, a circuit will be completed through the magnet 24 by conductors 160 and 159 to the positive side of the battery and conductors 146 and 155, ring 112 and brush arm 101 from the negative side of the battery. As previously explained, energization of the magnet 24 will cause retraction of the pins in the analyzer and the feeding of the tape one step to the next line of perforations.

As soon as the pins are retracted upon the operation of magnet 24, the circuit through the relay 148 will be broken and the armature 149 will return to the position shown. However, this will not restore the circuit through the magnet 92 since this circuit will now be broken between brush 102 and segment 105. This circuit will not again be completed until the brush arm returns to the position shown to engage brush 102 with segment 105. At this time the magnet 92 will be energized and the pawl 89 withdrawn from ratchet 88 to permit rotation of the brush arm 74 to the new position determined by the new set of perforations in the tape. As previously explained, the pawl 115 will already have come into position to stop the shaft 96. It will thus be seen that this much of the mechanism and of the circuits of the improved analyzer and translator will permit a brush arm 74 to rotate successively to positions determined by the perforations in a tape, or by any similar control, and to be temporarily arrested at that position. It may be mentioned that the ratio of the gearing for driving the shafts 56 and 96 is such that the shaft 96 will make a complete revolution in about one-fifth the time required for a complete revolution of shaft 56.

Complete circuits for printer control

Turning now to Fig. 11, there is here illustrated in a diagrammatic way the various connections between the analyzer and translator that may be employed for the control of a telegraphic printer of the type disclosed in detail in the previously mentioned patent and application. The devices and circuits illustrated in Fig. 11 not only provide for the transmission of positive and open circuit pulses to the printer, as required in its normal operation, but also provide for various special controls such as used, for example, in the repeating of certain characters. The nature of the particular printer which the illustrative system is designed to control is such that in the repetition of certain characters a negative pulse must be sent over the line. In the repetition of other characters, on the other hand, special circuits must come into play to insure the sending of sufficient positive and open circuit pulses to cause the printing wheel of the printer to rotate through one complete revolution. Various other special controls, which will be described in detail hereinafter, serve to further complicate the system to the end that a fully automatic arrangement for controlling printers of the type indicated is provided under all conditions met with in the operation of such printers.

Pin switch connections

The switches controlled by the pins of the analyzer are indicated by arrows 160, 161 and 162. For reasons to be explained hereinafter, two of these switches, designated 160, have one of their terminals connected together, and the next five, designated 161, similarly have one of their terminals connected together, while the last, designated 162, corresponding to the No. 8 pin of the analyzer, is independent of the rest. The branches or terminals of the switches 160 and 161 that are not connected, as above explained, are separately connected with various segments of the commutator 55. Thus, the No. 1 switch is connected with all of the segments designated 1 in the drawings, the No. 2 with all of the segments designated 2 in the drawings, and so on, just as in the Figure 10 arrangement. In each of the connections from the switches to the related segments there is provided a resistance 163 of any suitable value, say, for example, 6000 ohms. An additional resistance 164 of similar magnitude is provided between the No. 7 switch and a special segment, designated 7_1 in Fig. 11 or 69 in Fig. 2. This arrangement is such that when the switch associated with the 7 feeler pin is closed, the circuit may either be completed through the resistance 163 and one of the segments 7 of the commutator or through the resistance 164 and the special segment 7_1 of the commutator.

Let us now trace the connections from the switch 162. Assuming that this switch is closed by the presence of an 8 hole in the position of the tape over the feeler pins, current will flow from the positive side 165 of a source of current through a line 166, a resistance 167, and a line 168 to one side of the switch 162. The opposite side of this switch is connected by lines 169 and 170, a relay 171 and a line 172 with the negative side 173 of the source of power. The relay 171 serves to draw an armature 174

to disengage it from a contact 175 and engage it with a contact 176. Thus, in any position of the tape, if there is no perforation in the 8 position, the armature 174 will engage contact 175 while, if a perforation is presented, the armature will engage contact 176. It is in this way that a perforation in the 8 position exerts its control over the system.

Character selecting and pulsing

As explained in connection with Figure 10, the selection of a character to be printed is effected through the rotation of the shaft 56 with its connected brush arms 73 and 74. These parts are rotated so long as a pawl 89 is held out of engagement with the ratchet 88 by means of the electro-magnet 92. This is effected by current flowing from the source 165 through line 166, branch 180, magnet 92, branch 181, arm 182, line 183, segment 105 of the small commutator, brush arm 101, ring 112 and lines 184 and 185 to the negative side 173 of the source of power.

In the course of rotation of the brush arm 73, brush 75 is carried successively over segments 70 and 71. As the brush 75 passes from one segment to another, a pulse must be transmitted to the printer for the purpose of operating the escapement to shift the printing wheel one step. These pulses are alternately positive and open circuit. The arrangement is such that as the brush sweeps over the segments 70 and 71 a periodic series of positive and open circuit pulses will be produced and each of the changes from positive to open circuit and from open circuit to positive will operate the escapement of the printer. The current for producing the signal may, for example, include a pair of batteries 186 and 187, or other equivalent sources of current. The positive side of the battery 186 is connected by a line 188 with each of the blank segments 71 of the commutator, while the negative side of the battery 187 is connected by a line 189 with each of the No. 8 segments 70 of the commutator. Furthermore, the negative side of battery 186 is connected with the positive side of battery 187.

Assuming now that the brush 75 at a given instant is on one of the blank segments 71, current will flow from the positive side of battery 186 through line 188, brush arm 73, ring 58, a line 190, a reversible relay 191, a line 192, a second reversible relay 193, a line 194, and a resistance 195, back to the negative side of battery 186. When the brush 75 shifts to one of the No. 8 segments 70, the circuit just mentioned will be broken but a new circuit will be completed from the positive side of battery 187 through the resistance 195, line 194, relays 193 and 191, line 190 to the ring 58, and through the arm 73 and the line 189 back to the negative side of battery 187. It will thus be seen that the direction of flow of current through the reversible relays 191 and 193 will be reversed upon each shifting of the brush 75 from a blank segment to a No. 8 segment and vice versa.

The positive side of battery 186 is also connected through a line 196 and a line 197 with a contact 198. The latter is normally engaged by an arm 199 connected with one side 200 of the transmission line which controls the various outlying printers. The opposite side 201 of this transmission line is connected with an arm 202 that is operated by the relay 191. Assuming that the arm 202 has been swung to the left to engage a contact 203, by virtue of the engagement of brush 75 with a blank segment 71, the circuit will be completed through a line 204 to the negative side of battery 187. Thus the combined power of the two batteries 186 and 187 will be effective in transmitting a signal over the transmission lines 200 and 201. This is the positive signal before mentioned and is created each time one of the blank segments 71 is engaged by the brush 75. However, when one of the No. 8 segments is engaged by the brush and the arm 202 is swung to the contact 205, the circuit previously mentioned will be incomplete and, in fact, there will be no complete circuit from the batteries to and through the transmission lines 200, 201. Tracing through the circuits at this time it will be found that both of the lines 200 and 201 are connected with the positive side of battery 186.

We now trace the circuits which bring about the de-energization of the magnet 92 and the operation of the pawl 89 to arrest the rotation of the shaft 56 with its brush arms. As explained in connection with Fig. 10, this system is so devised that if a circuit is completed through only one of the resistances 163, insufficient current will be passed to cause the magnet 92 to be de-energized. However, if two such circuits are completed in parallel, the current flow will be sufficient to operate a relay for this purpose. Current from the positive side 165 of the power source will flow through the line 166, armature 177, contact 178, line 179, armature 174, contact 175, a line 206, a relay 207, a line 208, a contact 209, to an armature 210 of the reversible relay 193, it being assumed that at this time this armature has been swung into engagement with contact 209 by virtue of the fact that a blank segment 71 is engaged by the brush 75. From this point the current flows through a line 211 to the ring 59 of the commutator, thence through brush 77, arm 74 and brushes 78 and 79 through appropriate segments of the commutator connected with those switches 160 and 161 which have been operated by the passage of the corresponding feeler pins through the tape. It will be understood that this occurs only when the brushes are rotated into the proper position to engage the selected segments. All of the switches 160 and 161 are connected with a common point or terminal 212. The connection from the switches 160 is through a line 213, a relay 214 and a line 215, while the connection from the switches 161 is directly through a line 216. From the common point 212 the circuit continues through a line 217, a branch line 218, a relay 219 associated with the arm 182, and finally through a line 220 to the return line 185 connected with the negative side of the current source. It will be seen, therefore, that when the brushes 78 and 79 find simultaneously the segments connected with those pin switches 160 and 161 which have been operated, sufficient current will flow through the relay 219 to attract the armature 182 and thus break the circuit previously mentioned through the armature 92 so that spring 90 may draw the pawl 89 into engagement with ratchet 88.

In tracing the foregoing circuit the absence of a perforation in the 8 position was assumed. If such a perforation were present in the tape the switch 162 would be closed and, as previously explained, the armature 174 would be attracted to engage the contact 176. The circuit through the commutator and pin switches would then be modified in that the current arriving at the arm 174 would now flow through contact 176, a line 221, a relay 222, a line 223, and a contact 224 to the arm 210 of the relay

193. The circuit at this point would not be completed until an 8 segment of the commutator is engaged by brush 75 causing the arm 210 to swing into engagement with contact 224. The remainder of the circuit will be the same as before, i. e., through line 211, ring 59, etc. It should be noted in this connection that when an 8 pin is permitted to rise along with, say, the 3 and 7 pins, the circuit through two of the resistances 163 and the relay 219 will not be complete when the brushes 78 and 79 engage the 3 and 7 segments, respectively, so long as the brush 75 is on a blank segment 71. This is due to the fact that the circuit is at this time broken between arm 210 and contact 224. Furthermore, the first described circuit through the contact 209 and arm 210 which would normally be completed if no 8 hole were present, would at this time be broken between the contact 175 and arm 174. Accordingly, under the conditions mentioned, the only way to complete the circuit through the relay 219 and through two of the resistances 163 is to have the brush 78 engage a 3 segment, the brush 79 simultaneously engage a 7 segment, and the brush 75 engage an 8 segment. When this condition arises and the relay 219 is operated, the circuit through the magnet 92 will be broken and the shaft 56 arrested.

At the same time that magnet 92 is de-energized, or immediately thereafter, the magnet 120 will be energized. To accomplish this the armature 182, in breaking the circuit through the magnet 92, will engage an inner contact 225 which is connected through a line 226 and a line 227 with an armature 228 associated with the relay 214. This armature in turn is connected by a line 229 with one side of the magnet 120. The opposite side of this magnet is connected by lines 230, 231 and 232 and by an armature 233 and a further line 234 with the line 166 extending from the positive side of the power source. The circuit is normally also completed from magnet 120 to the positive side of the line through a switch 238 and the lines shown, although, as will be explained later, the switch 238 may be opened when it is desired to operate a bell in the various printers. The circuit is completed from the armature 182 to the negative side of the power source by the line 183, segment 105, brush arm 101, ring 112 and lines 184 and 185. When the magnet 120 is energized in this way, and the pawl 115 is retracted from the projection 113, the shaft 96 will begin to rotate. At the commencement of this rotation the brush 102 will be carried away from the segment 105 so that the circuit through the magnet 120 will be broken and the pawl 115 will be released to stop the shaft 96 after one complete revolution. At the same time the circuit through the magnet 92 will be broken at the segment 105 so that even though the armature 182 may be released, the magnet 92 will normally remain de-energized until the completion of one rotation of shaft 96.

In passing from the segment 105 the brush 102 engages the segment 106, which is connected by means of a line 235 with the magnet 24. The opposite side of this magnet is connected by lines 236 and 237 with the line 166 extending from the positive side of the power source. To complete the circuit the negative side of the line is, of course, connected with the brush 102 through the lines 185 and 184, ring 112 and arm 101. Accordingly, the magnet 24 will operate the bell crank member 22 of the analyzer to retract the feeler pins and feed the tape one space. This will prepare the mechanism for the sending of the next character-determining impulses.

When the shaft 56 is arrested and the shaft 96 is released for rotation, in the manner explained, a long, drawn-out signal or pulse, either positive or open circuit and equal in length to about 7 or 8 of the periodic selecting pulses, is produced, and this, as explained in Patent No. 1,957,076, causes the printing magnet of the distant printer to be operated and the wheel carriage of this printer to be shifted one step to the next printing position; that is to say, whenever the final pulse of a series of periodic pulses is drawn out, in the manner explained, the printing and carriage shifting mechanism will automatically be operated. The speed of rotation of the shaft 96 and brush arm 101 should be so adjusted as to allow the necessary time for the operation of the printing magnet and the shifting of the carriage to the next position.

Repetition of characters

Ordinarily there will be simply a succession of operations of the same type explained above i. e., the shafts 56 and 96 will be alternately rotated, shaft 56 being turned only a fraction of a revolution, sufficient to carry the brushes 75, 78 and 79 to a new setting wherein the proper segments are engaged to complete a circuit through two of the resistances 163 and the relay 219. Certain special conditions arise, however, as when a given series of perforations in the tape is repeated. Furthermore, this condition gives rise to two possibilities. As has already been suggested, the construction of the printer is such that when certain characters are duplicated it is necessary to rotate the type wheel a complete revolution before effecting a printing operation while other characters may be duplicated by a simple repeated operation of the printing platen after the type wheel carriage has been stepped to the next position. The reason for this will be apparent when it is considered that in the special repeat operation, which will be later explained, a negative signal is employed, and from the further fact that when a particular character is selected by a final positive pulse, it is impossible to produce a negative pulse for repeat purposes without first passing through neutral or open circuit condition. Accordingly, for those 19 characters or signals which terminate with a positive pulse, it is necessary to produce a complete revolution of the type wheel to repeat the signal. Those 19 signals terminating with an open circuit pulse can be repeated, however, by a negative signal without rotation of the wheel.

Let us now consider the repetition of a character or signal requiring a full revolution of the type wheel. The selection of such a character or signal, as stated, terminated on a positive pulse and, therefore, in the construction disclosed it must terminate with the brush 75 on one of the blank segments 71. Assuming that the brush arms 73—74 have been stopped, with the brush 75 on a blank segment and with the brushes 78 and 79 on the 1 and 4 segments, the armature 210 of the reversible relay 193 will be attracted toward the contact 209 and a circuit will be completed through two of the resistances 163 associated with the 1 and 4 pins and through the relay 219 so that the circuit through magnet 92 will be broken in the manner previously explained. Now, as the brush arm 101 leaves the segment 105 and passes on to the segment 106, the pins will be retracted and the tape shifted to the next position. As

the brush 102 leaves segment 106, the pins will be again released and since the same pins, i. e., the 1 and 4 pins, again pass through openings in the tape, due to a repetition of the same signal, the circuits through the engaged segments of the commutator and through the two resistances 163 will again be completed so that the magnet 219 will be energized and the armature 182 attracted to the contact 225. This means that the circuit through the magnet 92 will remain open and the shaft 56 will be held against rotation even upon the completion of the rotation of the shaft 96. Furthermore, the magnet 120 would, under these conditions, be energized upon the return of brush 102 to segment 105 so that the shaft 96 would be free to rotate again. This, however, would not produce the desired effect, since it would simply prolong the printing signal to twice its normal length. It would not produce two printing signals and hence would not produce two printing impressions on the sheet of the printer.

In order to insure the proper repetition of the character or signal, means must be provided to complete the circuit through the magnet 92 before the shaft 96 completes its rotation. For this purpose the special segment 109 is provided on the outer ring of the small commutator, this being in the path of brush 102 during the last quarter of its revolution. When the brush reaches this segment the latter will be placed in circuit with the negative side of the source of current through brush arm 101, ring 112 and lines 184 and 185. The completion of the circuit to the positive side of the line will be through a line 239, a line 240, a contact 241, an armature 242 of the relay 207 (which will at this time be energized), a line 243 and then through the line 181, magnet 92 and line 180 to the line 166 connected with the positive side of the power source. It will be recalled from the previous explanation of circuits in the ordinary selection of one character that the relay 207 will be energized whenever a blank segment is engaged by the brush 75 at the time of completing other portions of the circuit through two of the resistances 163; on the other hand, the circuit will be completed through relay 222 instead of relay 207 whenever an 8 segment is engaged by the brush 75 under these conditions. Accordingly, it will be seen that under the circumstances mentioned the magnet 92 will be energized when the brush 102 reaches segment 109. This will cause the shaft 56 to commence rotation and will carry the brushes 75, 78 and 79 away from the particular segments which previously caused the completion of circuits to arrest the shaft 56. At the same time the release of armature 182 will cause the circuit through the magnet 120 to be broken even when segment 105 is reached, so that the shaft 96 will stop upon the completion of its revolution. Obviously, the result will then be a complete revolution of the shaft 56 until the same segments are again engaged by the brushes 75, 78 and 79 to complete the necessary circuits through the relay 219, causing the attraction of the armature 182 with its breaking of the circuit through the magnet 92 and making of the circuit through magnet 120. If the same setting is again repeated, the same cycle of operations will result.

Special repeat signal

Now, if the shaft 56 is arrested with the brush 75 on an 8 segment, and the same character is to be repeated, a different condition arises. As previously stated, the relay 222 is energized at this time instead of relay 207. Therefore, when the brush 102 reaches the segment 109, the circuit will now be completed to the positive side of the power source through line 239, a branch 244, a relay 245, a line 246, a contact 247, an armature 248 attracted by the relay 222, and a line 249 having a resistance 250 connecting into the line 166. Since the relay 245 is now energized, its armature will be attracted to engage a contact 252 connected with the line 166 through a line 253. The opposite side of armature 251 is connected through line 254, a resistance 255, a relay 256, a line 257, another relay 258, a line 259, a heating coil 260, a line 261, segment 110 of the commutator, brush arm 101, and lines 184 and 185 to the negative side of the line. Completion of this circuit will, in turn, complete another circuit through the relay 256 so as to hold this relay energized even after relay 245 is de-energized. This is accomplished by the attraction of the armature 233 of relay 256 into engagement with a contact 262 which, through a line 263, is connected with the resistance 255 and thence through the relay 256, line 257, etc. is connected with the segment 110 and the negative side of the line. The opposite end of armature 233 is directly connected with the positive side of the power source through the line 234. It will be seen, therefore, that while the circuit through relay 245 will be broken as the brush 102 leaves the segment 109, the circuit through relays 256 and 258 will be maintained so long as the brush 103 engages the segment 110. This circuit, therefore, is maintained through about 135° of rotation of the shaft 96 on the second or repeat operation.

Incidentally it should be noted at this point that as the brush 102 reaches segment 105 a circuit will be completed through magnet 120 to permit the shaft 96 to rotate again. This circuit will be formed from the negative side of the line in the same manner as previously explained i. e., through lines 185, 184, arm 101, line 183, armature 182, lines 226, 227, armature 228 and line 229. It is completed to the positive side through line 230, switch 238, which is normally closed, and the connections shown to line 166. The parallel circuit through line 231 etc. will be broken at this time by the attraction of armature 233.

When the relay 258 is energized, in the manner explained, an armature 264 is thrown to engage a contact 265 connected through a line 266 with a relay 267, the latter being connected through a line 268 and a resistance 269 with the positive side of the line. Armature 264 is directly connected with the negative side of the line through a connection 270. It is the energization of the relay 267 in this way that causes a negative signal to be transmitted over the lines 200 and 201 to the printer. As previously explained, when this relay is not energized the armature 199 thereof engages a contact 198 which is in circuit with the pulsing devices to produce positive and open circuit pulses. However, when relay 267 is energized, the armature is brought against a contact 271. At this time the armatures 202 and 210 of the reversible relays 191 and 193 will engage the contacts 205 and 224, as shown in the drawings, since an 8 segment 70 will be engaged by the brush 75. Therefore, the pulsing circuit is completed in the following way: The negative side of battery 187 is connected through the line 204, a line 272, the contact 271, and the armature 199, with the line 200; the return line 201 from the printers is connected through armature 202, con-

tact 205 and line 196 with the positive side of battery 186. It will thus be seen that the current pulse through the printers will be in the opposite direction from that of the normal, positive pulse.

The negative pulse produced in this way will be transmitted until the brush 103 leaves the end of segment 110. It will be seen, therefore, that about half of the time normally allowed for the transmission of a printing signal and the carrying out of the printing operation at the distant printers is consumed in the transmission of the negative repeat signal. For this reason it is necessary to provide special means to prolong or delay the completion of the rotation of the brush arm 101. This is accomplished by interposing the pawl 116 in the path of projection 114 carried by the shaft 96. Projection 114 is so arranged that it will engage the pawl 116 just after the brush 103 leaves the segment 110. Ordinarily the pawl 116 is held inactive by magnet 121 which is energized by a connection 273, contact 274, armature 264, and connection 270 with the negative side of the power source and a connection 275, switch 46 (which is normally closed), line 276, line 237, and line 166 extending from the positive side of the power source. This circuit, it will be seen, is broken when the armature 264 is attracted upon the energization of relay 258. Therefore, at this time the pawl 116 will be attracted by spring 117 into the path of projection 114 and will arrest the shaft 96 momentarily. As stated before, however, the brush 103 will at this time have left the segment 110 so that relay 258 will have become de-energized and armature 264 will have been released to engage contact 274. The inductance of magnet 121 is such that a brief interval is required to energize it sufficiently, upon the return of the armature 264, to cause the magnet to attract the pawl 116 against the action of spring 117. This time interval is preferably so adjusted as to equal the time normally required for the arm 101 to travel, from its normal position shown, down to the position in which it is arrested by the pawl 116. Therefore, the usual printing time is allowed for the operation of the printing platen and the stepping over of the printing wheel carriages of the various printers.

Manual control of transmitter

As pointed out above, the switch 46, which may be either manually operated or operated by the action of the tape on the rod 43, acting through the cam 45, is in the circuit through the magnet 121. Therefore, this magnet may be de-energized by the manual opening of the switch 46, or the automatic opening of this switch when the slack is removed from the tape as it is fed to the analyzer. Accordingly, the operation of the transmitter will be discontinued until the switch 46 is again closed.

Carriage return

After a complete line, or any desired portion of a line, has been printed across the papers of the various printers controlled by the transmitter of the present invention, it is necessary to return the printing wheel carriage toward the left for the commencement of a new line of printing. At the same time it is necessary to advance the sheet of paper in the usual way. These operations require somewhat more time than an ordinary printing operation. Therefore, means must be provided for retarding the operation of the transmitter for a sufficient interval to allow for the completion of the carriage return and paper feed operations. It will be understood that the actual control of these operations at the printers is effected by bringing the printing wheels to a special carriage return position followed by the operation of the printing magnet of the printers. According to the particular arrangement disclosed, the printing wheels will be brought to the carriage return position when the brushes 78 and 79 of the translator engage the 1 and 2 segments 65 and 68 of the commutator. When these segments are engaged by the brushes at a time when the No. 1 and No. 2 pin switches 160 are operated, due to the presence of holes in the tape at these positions, the circuit will be completed from the positive side of the power source, in the manner previously explained, up to and through the brushes 78 and 79, through the 1 and 2 segments, through the connected resistances 163, through the switches 160, thence through the line 213 and relay 214, line 215, line 217, line 218, relay 219, and line 220 to the negative side of the line. Energization of relay 219 breaks the circuit through the magnet 92 and thus stops the shaft 56.

A special circuit, however, goes into play at this time to control the magnet 120 which releases the shaft 96 for operation. This circuit is such that ample time is provided before the release of this shaft and during its one revolution to allow for the return of the carriages and the advance of the printed sheets at the various printers. The special circuit for this purpose involves a contact 277 against which the armature 228 of the relay 214 is thrown. Incidentally the attraction of armature 228 breaks the normal circuit through the magnet 120 which is effective on other character-selecting operations. Furthermore, it should be observed that while a circuit may be completed through the relay 214 when only one of the switches 160 is closed, there will not be sufficient current flowing through the relay to operate the armature 228. It is necessary to have the combined current flowing through two switches 160 to operate this armature. Now, armature 228 is connected with the negative side of the line at this time through the line 227, line 226, contact 225, armature 182, line 183, segment 105, brush arm 101, ring 112, and lines 184 and 185. The connection with the positive side of the line is through contact 277, a line 278, a choke coil 279, a relay 280, a line 281, and a resistance 282 to the line 166. The action of the choke coil 279 is such that it retards the building up of a sufficient current in the relay 280 to operate the armature 283. However, after a desired lapse of time the armature 283 will be thrown against a contact 284 which is connected through a line 285, the line 226, contact 225, armature 182, and remaining connections with the negative side of the line. The opposite end of armature 283 is connected with the positive side of the power source through the connection 229, magnet 120, connections 230, 231 and 232, armature 233, connection 234, and line 166. In this way it will be seen that the shaft 96 is finally released after a predetermined interval and the balance of the operation is then similar to an operation involving any other signal.

Eradicating signal

As previously explained, provision is made for the eradication of characters or signals punched in the tape by back spacing the tape in the punch-

ing machine and pressing a special eradicating key. This will cause the operation of all of the punches across the tape so that in lieu of the two or three holes previously present there will then be eight holes. When these eradicating holes reach the feeler fingers of the analyzer, special circuits are energized to cause the printing control shaft 96 and arm 101 to rotate through one revolution while the shaft 56 and its connected brush arms are held stationary. When the seven pins associated with the switches 160 and 161 are all permitted to rise, due to the eradicating perforations, a circuit will be closed from the positive side of the line through the connection 166, thence through a short branch to and through a relay 286, then through a line 287, to and through a group of resistances 288, arranged in parallel. One of these resistances is connected with each of the switches. The value of each of these resistances is considerably greater than that of the resistances 163. For example, in a typical set-up the resistances 288 may each be 50,000 ohms while the resistances 163 may be 6,000 ohms. Therefore, while two of these resistances 288, corresponding with the pin switches operated, will be connected in parallel with the circuit through the commutator segments, previously explained, upon a normal selecting operation, the resistance will be so great that the current flowing through this part of the circuit will not interfere with the intended operation of the various devices. However, when the seven resistances 288 are in parallel, the combined resistance will be only 7,000 ohms and this is sufficiently low to have the effect to be presently explained. Current flowing through resistances 288 and switches 160 and 161 will combine at the point 212 and pass through the line 217, 218, relay 219 and line 220 to the negative side of the line. This in itself will not be sufficient to energize the relay 219 since, as previously explained, this requires as much current as will flow through two of the resistances 163 in parallel. However, relay 286 is more sensitive and will be energized by the flow of current through the seven resistances 288. Therefore, armature 177 will be attracted against contact 289 so that a circuit is completed from the positive side through armature 177, contact 289, a resistance 290, line 291, and thence through line 218, relay 219, etc. to the negative side. Resistance 290 in the illustrative set-up may be around 5,000 ohms so that the combined current flowing through this resistance and the seven resistances 288 will be sufficient to operate the relay 219. Accordingly, the circuit through the magnet 92 will remain broken upon the completion of the rotation of the brush arm 101 during which the eradicating holes were brought into position. Therefore the selecting brushes will remain in their same positions while at the same time the magnet 120 will be energized upon engagement of the brush 102 with segment 105, in the manner previously explained, so as to cause the shaft 96 to partake of another revolution.

In order to prevent the operation of the circuits which come into play when a previous set-up is repeated, provision is made for disabling the circuits through the relays 207 and 222. It will be apparent that when all eight holes are punched the two or three that were previously punched will necessarily be repeated and the repeating circuits would otherwise be closed and set into operation. Breaking of the circuits through the relays 207 and 222 is brought about by the attraction of the armature 177 away from contact 178. The breaking of these circuits, furthermore, avoids overloading of the relay 219, which might otherwise occur due to current flowing not only through the resistances 288 and 290 but also through the resistances 163 connected with the segments of the commutator that happened to be engaged.

Unison signal

Provision is made for bringing all of the printers connected with a given transmitter into unison. Occasionally a printer may be thrown out of unison and, obviously, then the characters printed will be meaningless. In order to prevent any prolonged lack of unison between the transmitter and any of the printers, a special unison signal is sent over the line at rather frequent intervals. This is accomplished in the present construction by omitting all holes in the tape, with the exception of the feed holes, at a given position. Thus a special unison key may be provided in the punching machine to cause the tape to be advanced one step without punching any control holes. A unison signal will also be sent out if a single hole appears in the tape at any position. The effect of having no holes, or but a single hole, is to prevent completion of circuits through two of the resistances 163 so that insufficient current will flow to operate the relay 219. Therefore, the magnet 92 will remain energized and the shaft 56 will continue to rotate through a number of revolutions. A unison signal will also be sent out if the finger-piece 53 of the analyzer is operated. This is due to the fact that upon energizing the magnet 24 to retract the pins 31, the armature 23 will then become locked to hold the pins retracted. Therefore, when the shaft 96 reaches the position indicated in Fig. 11, the pawl 89 will be retracted to release shaft 56 and will permit it to continue to rotate until stopped by the special unison mechanism, now to be explained.

When the shaft 56 is permitted to rotate more than one revolution under any of the conditions mentioned above, the pin 124 will travel along the spiral groove 125 until the projection 128 engages the switches 129 and 130 and closes the contacts thereof. The arrangement is preferably such that shaft 56 is required to make five or six revolutions in order to close the two switches. In the meantime pulses are being sent continuously to the various printers and the printing wheels will be given three or so revolutions. At the end of these three revolutions all of the wheels will be brought to a stop in a definite position, i. e., in the space position. While the pulses will continue for some time, the wheels being positively arrested, will not turn further and there will simply be slippage between the driving mechanism and the printing wheel. This is all fully explained in the prior patents and application previously mentioned and will result in bringing all of the printers to the same space or position, regardless of what position they may have been in prior to the commencement of the unison signal.

Now, when the switch 129 is closed, a circuit will be completed toward the negative side of the power line through a connection 292, line 217, line 218, relay 219, and lines 220 and 185. Connections to the positive side of the power line will be made through a line 293, a resistance 294 (which may in the illustrative machine be about 3,000 ohms), through a line 295 to the special segment

69 designated 7_1 in Fig. 11. When the brush 78 is brought to this segment, the circuit will continue through brush arm 74, line 211, armature 210, contact 224, line 223, relay 222, and line 221 to contact 176. At this point the circuit would appear to be broken, but the switch 130, having also been operated, will cause the relay 171 to be energized so that armature 174 is in contact with 176. Switch 130, therefore, functions in the same way as an 8 hole in the tape. The circuit is formed from one side of the switch 130 through line 296, line 176, relay 171 and line 172 to the negative side of the power source and is completed through line 297, resistance 167 and the line 166 to the positive side of the power source. Returning to the armature 174, the circuit which energizes relay 219 is completed from this armature through line 179, armature 177, and line 166 to the positive side of the power source. As a result of the completion of this circuit, through the switch 129 and special segment 7_1 of the commutator, the relay 219 will be energized in the same manner as if circuits had been completed through two of the resistances 163. In this connection it is to be noted that the resistance 294 should be of about the same value as two of the resistances 163 in parallel. Operation of relay 219 in this way breaks the circuit through magnet 92 and hence causes shaft 56 to be stopped. It also closes the circuit through the magnet 120 in the usual way to release the shaft 96 for one rotation. At the end of this operation the parts will be ready for another operation in the usual way, the brush arm 74 and the wheels of all of the printers being arrested in their space positions. It should be mentioned at this point that during each revolution of the shaft 96 a circuit is completed through the magnet 127 which attracts the arm 122 and withdraws the pin 124 from spiral groove 125. This permits spring 126 to return the arm to its initial position. Magnet 127 is energized by a connection 298 from the positive side of the line and a connection 299 extending to the segment 108 of the small commutator. When brush 102 reaches segment 108 the circuit is completed to the negative side of the line. This occurs upon each operation of the shaft 96 whether it is rotating at the end of a unison signal or at the end of any of the other signals.

Bell ringing signal

The present transmitting system is also adapted to send a bell-ringing signal to the various outlying printers. As explained in the previously mentioned Patent No. 1,957,076, the printers are preferably provided with special switches which, upon the receipt of a negative pulse of sufficient duration, will become heated to the point that a thermostatic element in the switch will cause a circuit through a bell or similar signal to be completed. In this way it is possible to attract attention to the printer whenever some item of particular importance is being printed. In accordance with the present system, it is possible to control the bell-ringing switches of the printers by opening, manually or otherwise, a bell-ringing switch in the transmitting system and then sending a repeat signal. The switch for this purpose is that designated 238, which may be operated in any convenient way. As has been previously explained, the switch 238 is in the circuit through the magnet 120, which is effective during repeat signal operations. Accordingly, when the switch 238 is open during a repeat signal operation, the circuit through the magnet 120 must follow a different course. It has already been explained that in the sending of a repeat signal current flowing through the relays 256 and 258 also passes through a heating coil 260. This supplies heat to a thermostatic element 300 with a contact 301. At this time the circuit through the electro-magnet 120 is completed to the positive side of the line through connections 230, 231, contact 301, armature 300, line 302 and line 234. The connections to the negative side of the line are the same as explained in the repeat signal operation. Therefore, when the thermostatic element 300 becomes sufficiently heated, the magnet 120 is energized to release the shaft 96 for rotation. The prolonged negative pulse which is sent out to the printers as a result of this delayed action is sufficient to operate the bell-ringing switches.

While certain illustrative devices and circuits have been disclosed in considerable detail it is to be understood that numerous changes and variations may be made without departing from the general principles and scope of the invention. Furthermore, various phases of the invention are of broad application and not limited to the particular use to which they have been put in the illustrative arrangement. The terms and expressions employed herein are to be regarded as terms of description rather than of limitation.

What we claim is:

1. In apparatus of the class described means for producing successive, periodic pulses of the same polarity in an electric circuit, feeler means arranged to cooperate with a punched tape, circuit closing means controlled by said feeler means, and means cooperating with said circuit closing means for controlling the number of pulses produced in accordance with the control of said feeler means.

2. In apparatus of the class described means for producing successive, periodic pulses of the same polarity in an electric circuit, feeler means arranged to cooperate with a punched tape, circuit closing means controlled by said feeler means, a commutator having a plurality of segments selectively connected with said circuit closing means, brush means, means for producing relative movement between said commutator and brush means, and means including circuits connected with said commutator and brush means for controlling said first mentioned means.

3. In apparatus of the class described means for producing successive electrical pulses of the same polarity, a rotatable member for determining the number of said pulses, and means controlled by a perforated tape for controlling said rotatable member.

4. In apparatus of the class described means for producing successive electrical pulses of the same polarity, a rotatable member for determining the number of said pulses, and means controlled by a perforated tape for arresting said member after a predetermined number of pulses have been produced.

5. In apparatus of the class described means for producing successive electrical pulses, a rotatable member for determining the number of said pulses, means controlled by a perforated tape for intermittently arresting said member after predetermined numbers of pulses have been produced, and rotatable means operated upon the stopping of said member for controlling the starting of the same after a predetermined interval.

6. In apparatus of the class described a plurality of switches, means for selectively operat-

ing said switches, a plurality of conducting segments arranged in rows, a plurality of brushes, means for moving said brushes over the faces of said segments, means for connecting each of said switches with at least one of said segments, a plurality of circuits any of which is arranged to be closed upon engagement of a brush with a segment connected with an operated switch, and means for arresting said brushes when they simultaneously engage segments connected with a plurality of switches that have been operated.

7. In apparatus of the class described a plurality of switches, means for selectively operating a predetermined number of said switches, a plurality of conducting segments, means for connecting each of said switches with at least one of said segments, brush means, means for operating said brush means to contact a number of said segments successively in a series of predetermined relations, and means including a plurality of circuits in parallel for stopping said operating means when segments connected with all of the selectively operated switches are simultaneously engaged by the brush means.

8. In apparatus of the class described a plurality of switches, means for selectively operating a predetermined number of said switches, a plurality of conducting segments, means for connecting each of said switches with at least one of said segments, brush means, means for operating said brush means to contact a number of said segments successively in a series of predetermined relations, said brush means engaging segments in the same relation in a plurality of positions, an extra switch, means for selectively controlling the operation of said extra switch, means for arresting the brush means when segments connected with all of the first mentioned selectively operated switches are simultaneously engaged, and means controlled by said extra switch for determining in which of the plurality of positions in which the segments are engaged in the same relation the brush means will be arrested.

9. In apparatus of the class described a plurality of switches, means arranged to be controlled by a perforated tape for selectively operating a predetermined number of said switches, a plurality of conducting segments, means for connecting each of said switches with at least one of said segments, brush means, means for operating said brush means to contact a number of said segments successively in a series of predetermined relations, and means including a plurality of circuits in parallel for stopping said operating means when segments connected with all of the selectively operated switches are simultaneously engaged by the brush means.

10. In apparatus of the class described a plurality of switches, means for selectively operating a predetermined number of said switches, a plurality of conducting segments, means for connecting each of said switches with at least one of said segments, brush means, means for operating said brush means to contact a number of said segments successively in a series of predetermined relations, said brush means engaging segments in the same relation in a plurality of positions, an extra switch, means for selectively controlling the operation of said extra switch, means for arresting the brush means when segments connected with all of the first mentioned selectively operated switches are simultaneously engaged, and means controlled by said extra switch for determining in which of the plurality of positions in which the segments are engaged in the same relation the brush means will be arrested, all of said switch operating means being arranged to be controlled by a perforated tape.

11. In apparatus of the class described a plurality of switches, means for selectively operating a predetermined number of said switches, a plurality of conducting segments, connections from each of said switches to at least one of a plurality of said conducting segments, brush means arranged to complete circuits in parallel simultaneously through a plurality of said segments and the connected switches, means for shifting said brush means to engage segments connected with different pluralities of said switches, and means for arresting said brush shifting means when a predetermined number of said circuits is completed.

12. In apparatus of the class described a plurality of switches, means for selectively operating a predetermined number of said switches, a plurality of conducting segments, connections from each of said switches to at least one of a plurality of said conducting segments, brush means arranged to complete circuits simultaneously through a plurality of said segments and the connected switches, means for shifting said brush means to engage segments connected with different pluralities of said switches, means for arresting said brush shifting means, and means operated upon the simultaneous completion of a predetermined number of said circuits in parallel for controlling the operation of said arresting means.

13. In apparatus of the class described a plurality of switches, means for selectively operating a predetermined number of said switches, a plurality of conducting segments, connections from each of said switches to at least one of a plurality of said conducting segments, brush means arranged to complete circuits simultaneously through a plurality of said segments and the connected switches, means for shifting said brush means to engage segments connected with different pluralities of said switches, means for arresting said brush shifting means, and means connected into all of said circuits and operated upon the simultaneous completion of a predetermined number of said circuits in parallel for controlling the operation of said arresting means.

14. In apparatus of the class described a signal transmission line, means arranged to be selectively operated under control of a perforated tape to designate any one of a number of items, means for sending periodic, positive current pulses over said transmission line in accordance with a sequence of items to be selectively designated under control of the tape, and means for sending a negative pulse over said line when certain items are repeated.

15. In apparatus of the class described a signal transmission line, means arranged to be selectively operated under control of a perforated tape to designate any one of a number of items, means for sending periodic, positive current pulses over said transmission line in accordance with a sequence of items to be selectively designated under control of the tape, and means for sending a negative pulse over said line when certain items are repeated, said last mentioned means being ineffective when other than said certain items are repeated.

16. In apparatus of the class described means for producing a series of periodic pulses, means arranged to be controlled by a punched tape for controlling said first mentioned means, and ro-

tatable means for prolonging the final pulse of a periodic series.

17. In apparatus of the class described means for producing a series of periodic pulses, means arranged to be controlled by a punched tape for controlling said first mentioned means, means for prolonging the final pulse of a periodic series to a predetermined extent and means for prolonging certain of said final pulses to an even greater predetermined extent.

18. In apparatus of the class described a commutator having a plurality of segments, a plurality of circuit closing means variously connected with said segments, means for selectively operating said means, brush means movable relative to said commutator to engage different segments, means for arresting said relative movement for a predetermined time interval when circuits are completed through the selected circuit closing means and connected segments, and means for prolonging said predetermined time interval for a definite additional period.

19. In apparatus of the class described a commutator having a plurality of segments, a plurality of circuit closing means variously connected with said segments, means for selectively operating said means, brush means movable relative to said commutator to engage different segments, means for arresting said relative movement for a predetermined time interval when circuits are completed through the selected circuit closing means and connected segments, and means effective when certain of said closing means are operated for prolonging said predetermined time interval.

20. In apparatus of the class described a commutator having a plurality of segments, a plurality of circuit closing means variously connected with said segments, means for selectively operating said means, brush means movable relative to said commutator to engage different segments, means for arresting said relative movement for a predetermined time interval when a plurality of circuits are completed in parallel through the selected circuit closing means and connected segments, and manually controlled means for prolonging said predetermined time interval.

21. In apparatus of the class described a commutator having a plurality of segments, a plurality of circuit closing means variously connected with said segments, tape controlled means for selectively operating said means, brush means movable relative to said commutator to engage different segments, means for arresting said relative movement for a predetermined time interval when circuits are completed through the selected circuit closing means and connected segments, and means controlled both manually and by said tape for prolonging said predetermined time interval.

22. In apparatus of the class described selectively adjustable means, means for shifting said first mentioned means to selected positions of adjustment, means for arresting said adjustable means in selected positions, timing means for controlling the operation of said arresting means, and means for varying the operation of said timing means.

23. In apparatus of the class described selectively adjustable means, means for shifting said first mentioned means to selected positions of adjustment, punched tape controlled means for determining the positions of adjustment of said first mentioned means, means for arresting said adjustable means in selected positions, timing means for controlling the operation of said arresting means, and means for varying the operation of said timing means.

24. In apparatus of the class described selectively adjustable means, means for shifting said first mentioned means to selected positions of adjustment, means for arresting said adjustable means in selected positions, means controlling said arresting means to hold said adjustable means for a predetermined interval after adjustment, and means for prolonging the interval determined by said controlling means.

25. In apparatus of the class described selectively adjustable means, means for shifting said first mentioned means to selected positions of adjustment, means for arresting said adjustable means in selected positions, means set into operation upon the stopping of said adjustable means for releasing said arresting means after a predetermined interval, and means for varying the duration of said interval.

26. In apparatus of the class described selectively adjustable means, means for shifting said first mentioned means to selected positions of adjustment, means for arresting said adjustable means in selected positions, means set into operation upon the stopping of said adjustable means for releasing said arresting means after a predetermined interval, and means for delaying the commencement of operation of said releasing means.

27. In apparatus of the class described selectively adjustable means, means for successively selecting positions of adjustment for said means, means for moving said adjustable means through a predetermined cycle until the selected position of adjustment is reached, and means for retaining said first mentioned means in adjusted position for a predetermined interval and then releasing the same for further adjustment, said retaining means being constructed and arranged to retain said adjustable means for a further predetermined interval when the selection of certain positions is repeated.

28. In apparatus of the class described selectively adjustable means, means for successively selecting positions of adjustment for said means, means for moving said adjustable means through a predetermined cycle until the selected position of adjustment is reached, and means for retaining said first mentioned means in adjusted position for a predetermined interval and then releasing the same for further adjustment, said retaining means being constructed and arranged to retain said adjustable means for a further predetermined interval when the selection of certain positions is repeated and to permit said adjustable means to move through a complete cycle when the selection of other positions is repeated.

29. In apparatus of the class described selectively adjustable means, means for successively selecting positions of adjustment for said means, means for moving said adjustable means until the selected position of adjustment is reached, means for retaining said first mentioned means in adjusted position, and rotatable means set into operation when a selected position is reached for controlling the release of said retaining means after a predetermined interval.

30. In apparatus of the class described selectively adjustable means, means for successively selecting positions of adjustment for said means, means for moving said adjustable means until the selected position of adjustment is reached,

means for retaining said first mentioned means in adjusted position, and means set into operation when a selected position is reached for controlling the release of said retaining means after a predetermined interval, said last recited means causing release of said retaining means in a shorter interval when the selection of certain positions is repeated.

31. In apparatus of the class described selectively adjustable means, means for successively selecting positions of adjustment for said means, means for moving said adjustable means until the selected position of adjustment is reached, means for retaining said first mentioned means in adjusted position, and means set into operation when a selected position is reached for controlling the release of said retaining means after a predetermined interval, said last recited means causing release of said retaining means in a shorter interval when the selection of certain positions is repeated and preventing release until after more than said predetermined interval when the selection of certain other positions is repeated.

32. In apparatus of the class described selectively adjustable means, means for successively selecting positions of adjustment for said means, means for moving said adjustable means until the selected position of adjustment is reached, means for retaining said first mentioned means in adjusted position, and means set into operation when a selected position is reached for controlling the release of said retaining means after a predetermined interval, said last recited means being constructed and arranged to automatically vary the duration of said interval when the selection of a given position is repeated.

33. In apparatus of the class described constantly driven means, selectively adjustable means adapted to be driven thereby, punched tape controlled means for selecting successive positions of adjustment of said adjustable means, means adapted to be driven by said first mentioned means when said adjustable means reaches a selected position, and means controlled by said last recited means for advancing the tape to a new control position.

34. In apparatus of the class described constantly driven means, selectively adjustable means adapted to be driven thereby, punched tape controlled means for selecting successive positions of adjustment of said adjustable means, means adapted to be driven a predetermined extent by said first mentioned means when said adjustable means reaches a selected position; means controlled by said last recited means for advancing the tape to a new control position and means controlled by said tape controlled means for causing a second operation of said means that is driven a predetermined extent without intermediate operation of said adjustable means.

35. In apparatus of the class described constantly driven means, selectively adjustable means adapted to be driven thereby, punched tape controlled means including a plurality of independently operable devices for selecting successive positions of adjustment of said adjustable means, a member adapted to be driven by said first mentioned means when said adjustable means reaches a selected position, means controlled by said member for advancing the tape to a new control position, and means for causing a second operation of said member without intermediate operation of said adjustable means whenever the operation of a given number of said devices is predetermined by the tape.

36. In apparatus of the class described constantly driven means, selectively adjustable means adapted to be driven thereby, punched tape controlled means including a plurality of independently operable devices for selecting successive positions of adjustment of said adjustable means, a member adapted to be driven by said first mentioned means when said adjustable means reaches a selected position, means controlled by said member for advancing the tape to a new control position, and means for causing a second operation of said member without intermediate operation of said adjustable means whenever certain groups of perforations are repeated in the tape.

37. In apparatus of the class described a constantly driven member, devices arranged to be alternatively driven by said member, one of said devices being selectively adjustable and the other being driven a predetermined extent, and punched tape controlled means for controlling the driving of said devices, said means being constructed and arranged to provide for successive operations of one of said devices without intermediate operation of the other.

38. In apparatus of the class described a constantly driven member, a device arranged to be shifted to selected positions by said member, a plurality of selectively operable means for determining the successive positions of said device, a second device arranged to be driven a predetermined extent by said member between successive operation of said first mentioned device, and means for causing a second operation of said second device without intermediate operation of the first mentioned device under control of said selectively operable means.

39. In apparatus of the class described a constantly driven member, a device arranged to be shifted to selected positions by said member, a plurality of selectively operable means for determining the successive positions of said device, a second device arranged to be driven a predetermined extent by said member between successive operations of said first mentioned device and means controlled by said selectively operable means for causing said first mentioned device to remain stationary or move a portion of a revolution or more than one revolution depending upon the number of said means selectively operated.

40. In apparatus of the class described means for supporting and advancing a perforated tape, a plurality of means arranged to be separately controlled by said perforated tape, a device shiftable to selected positions within a definite cycle, means for shifting said device, means controlled by selected ones of said plurality of means for arresting said device in selected positions, said last mentioned means requiring the operation of at least a predetermined number of said plurality of means, and means for causing said device to be arrested in a definite position when less than said predetermined number of said plurality of means are operated.

41. In apparatus of the class described means for supporting and advancing a perforated tape, a plurality of means arranged to be separately controlled by said perforated tape, a device shiftable to selected positions within a definite cycle, means for shifting said device, means controlled by selected ones of said plurality of means for arresting said device in selected positions upon the operation of a predetermined number of said plurality of means, and means for causing said device to remain in its last set position when more than

said predetermined number of said plurality of means are operated.

42. In apparatus of the class described means for supporting and advancing a perforated tape, a plurality of means arranged to be separately controlled by said perforated tape, a device shiftable to selected positions within a definite cycle, means for shifting said device, means controlled by selected ones of said plurality of means for arresting said device in selected positions and means for causing said device to remain in its last set position upon a repeated operation of certain combinations of said plurality of means and for causing said device to shift through a complete cycle upon a repeated operation of other combinations of said plurality of means.

43. In apparatus of the class described means for supporting and advancing a perforated tape, a plurality of means arranged to be separately controlled by said perforated tape, a device shiftable to selected positions within a definite cycle, means for shifting said device, means controlled by selected ones of said plurality of means for arresting said device in selected positions and means for causing said device to remain in its last set position upon a repeated operation of certain combinations of said plurality of means including a given one of said means and for causing said device to shift through a complete cycle upon a repeated operation of other combinations of said plurality of means not including said given one of said means.

44. In apparatus of the class described means for supporting and advancing a perforated tape, means adjustable in accordance with the perforations in the tape, and means controlled by said adjustable means for producing positive, open circuit and negative pulses.

45. In apparatus of the class described means for supporting and advancing a perforated tape, means adjustable in accordance with the perforations in the tape, means controlled by said adjustable means for producing groups of periodic positive and open circuit pulses, and means for prolonging the final pulse of each group.

46. In apparatus of the class described means for supporting and advancing a perforated tape, means adjustable in accordance with the perforations in the tape, means controlled by said adjustable means for producing groups of periodic pulses, means for prolonging the final pulse of each group and means for further prolonging the final pulse upon a certain adjustment of said adjustable means.

47. In apparatus of the class described means for supporting and advancing a perforated tape, means adjustable in accordance with the perforations in the tape, means controlled by said adjustable means for producing periodic pulses of one character, and means controlled by said adjustable means upon the repetition of the same adjustment for producing a pulse of a different character.

48. In apparatus of the class described means for supporting and advancing a perforated tape, means adjustable in accordance with the perforations in the tape, means controlled by said adjustable means for producing periodic pulses of one character, means controlled by said adjustable means only upon certain adjustments thereof for producing a pulse of a different character, and means for prolonging said pulse of different character.

49. In apparatus of the class described means for supporting and advancing a perforated tape, means adjustable in accordance with the perforations in the tape, means controlled by said adjustable means for producing positive and open circuit pulses, and means controlled by said adjustable means for producing a negative pulse.

50. In apparatus of the class described means for supporting and advancing a perforated tape, means adjustable in accordance with the perforations in the tape, means controlled by said adjustable means for producing positive and open circuit pulses, means controlled by said adjustable means for producing a negative pulse, and means for prolonging said negative pulse.

51. In apparatus of the class described means for supporting and advancing a perforated tape, means adjustable in accordance with the perforations in the tape, means shiftable through a definite cycle to positions determined by said adjustable means, means for producing periodic pulses of one character upon the shifting of said shiftable means, and means for producing only a pulse of different character upon the repetition of certain adjustments of said adjustable means.

52. In apparatus of the class described means for supporting and advancing a perforated tape, means adjustable in accordance with the perforations in the tape, means shiftable through a definite cycle to positions determined by said adjustable means, means for producing periodic pulses of one character upon the shifting of said shiftable means, means for producing a pulse of different character upon the repetition of certain adjustments of said adjustable means and manually controlled means for prolonging said pulse of different character.

53. In apparatus of the class described means for supporting and advancing a perforated tape, means adjustable in accordance with the perforations in the tape, means shiftable through a definite cycle to positions determined by said adjustable means, means for producing periodic pulses of one character upon the shifting of said shiftable means, means for causing said shiftable means to shift through a complete cycle upon the repetition of certain adjustments of said adjustable means, and means for producing a pulse of different character upon the repetition of certain other adjustments of said adjustable means.

54. In apparatus of the class described means for supporting and advancing a perforated tape, means successively adjustable to a plurality of selected positions under control of said tape, a member shiftable through a predetermined cycle upon each adjustment of said adjustable means, and manually controlled means for arresting said member at an intermediate point in its cycle.

55. In apparatus of the class described means for supporting and advancing a perforated tape, means successively adjustable to a plurality of selected positions under control of said tape, a member shiftable through a predetermined cycle upon each adjustment of said adjustable means, and tape controlled means for arresting said member at an intermediate point in its cycle.

56. In apparatus of the class described means for supporting and advancing a perforated tape, means successively adjustable to a plurality of selected positions under control of said tape, a member shiftable through a predetermined cycle upon each adjustment of said adjustable means, means for causing said member to shift through a second cycle without intermediate adjustment of said adjustable means upon the repeated selection of certain positions of the latter, and means

for temporarily arresting said member during said second cycle.

57. In apparatus of the class described means for supporting a perforated tape, feeler means arranged to cooperate with the perforations in the tape, movable means controlled by said feeler means and adjustable through portions of a predetermined cycle to selected positions in accordance with the perforations in the tape, and manual means for controlling the continuous operation of said movable means through more than said predetermined cycle.

58. In apparatus of the class described means for supporting a perforated tape, feeler means arranged to cooperate with the perforations in the tape, movable means controlled by said feeler means and adjustable through portions of a predetermined cycle to selected positions in accordance with the perforations in the tape, means operable upon the adjustment of said movable means to a selected position for retracting said feeler means from the tape and advancing the latter, means for latching the feeler means in retracted position and means for causing said movable means to shift through more than a complete cycle when said latching means is effective.

59. In apparatus of the class described means for supporting a perforated tape, feeler means arranged to cooperate with the perforations in the tape, movable means controlled by said feeler means and adjustable through portions of a predetermined cycle to selected positions in accordance with the perforations in the tape, means operable upon the adjustment of said movable means to a selected position for retracting said feeler means from the tape and advancing the latter, means for latching the feeler means in retracted position, means for causing said movable means to shift through more than a complete cycle when said latching means is effective and means operable upon the movement of said movable means through more than a cycle for controlling the stopping of said movable means in a definite position.

60. In apparatus of the class described a selectively adjustable member, means for moving said member, means for arresting said member in a selected position, and means for controlling said arresting means including a relay operable only upon the completion of a plurality of circuits having a combined resistance below a predetermined minimum.

61. In apparatus of the class described a selectively adjustable member, means for moving said member, means for arresting said member in a selected position, a plurality of circuit closing means, means controlled by a perforated tape for operating said circuit closing means, and means for controlling said arresting means including a relay operable only upon the completion of a plurality of circuits through said circuit closing means having a combined resistance below a predetermined minimum.

62. In apparatus of the class described a selectively adjustable member, means for moving said member, means for arresting said member in a selected position, a plurality of circuit closing means, means controlled by a perforated tape for operating said circuit closing means, and means for controlling said arresting means including a relay operable only upon the completion of a plurality of circuits through said circuit closing means having a combined resistance below a predetermined minimum, said circuits being completed through one path when a given number of perforations is present in the tape and being completed along another path when a greater number of perforations is present in the tape.

63. A method of controlling telegraphic printers which comprises perforating a tape to designate matter to be printed, adjusting a member at the transmitting station in accordance with the perforations in the tape, and transmitting character selecting positive and open circuit pulses to the distant printers as the member at the transmitting station is being adjusted.

64. A method of controlling telegraphic printers which comprises perforating a tape to designate matter to be printed, adjusting a member at the transmitting station in accordance with the perforations in the tape, transmitting character selecting positive and open circuit pulses to the distant printers as the member at the transmitting station is being adjusted, retaining the member in adjusted position for a predetermined interval before readjusting it, and shifting the tape to a new control position as the member is being retained.

65. In apparatus of the class described a plurality of commutator segments, brushes arranged to engage said segments in predetermined order, means for producing relative movement between said segments and brushes, and means for automatically arresting said relative movement when a predetermined number of circuits are completed in parallel through said segments and brushes.

66. In apparatus of the class described a plurality of commutator segments, brushes arranged to engage said segments in predetermined order, means for producing relative movement between said segments and brushes, means for automatically arresting said relative movement when a predetermined number of circuits are completed in parallel through said segments and brushes, and punched tape controlled means for selecting the segments through which circuits are completed.

67. In apparatus of the class described a plurality of commutator segments, brushes arranged to engage said segments in predetermined order, means for producing relative movement between said segments and brushes, means for automatically arresting said relative movement when a predetermined number of circuits are completed in parallel through said segments and brushes, and means for producing successive electrical pulses upon relative movement between said segments and brushes.

68. In apparatus of the class described a plurality of commutator segments, brushes arranged to engage said segments in predetermined order, means for producing relative movement between said segments and brushes, means for automatically arresting said relative movement when a predetermined number of circuits are completed in parallel through said segments and brushes, punched tape controlled means for selecting the segments through which circuits are completed, and means for producing successive electrical pulses upon relative movement between said segments and brushes.

69. The method of transmitting telegraphic messages which comprises punching a tape to provide groups of two and three perforations to designate a series of characters, successively adjusting a member in the same direction to positions determined by the successive groups of perforations and transmitting to a distant point a

periodic series of pulses in accordance with the extent of each adjustment of the member.

70. The method of transmitting telegraphic messages which comprises punching a tape to provide groups of perforations to designate a series of characters, said perforations being arranged in a definite number of positions out of a predetermined greater number sometimes with and sometimes without a perforation in another position, successively adjusting a member in the same direction to positions determined by the successive groups of perforations and transmitting to a distant point a periodic series of pulses in accordance with the extent of each adjustment of the member.

71. The method of transmitting telegraphic messages which comprises punching a tape to provide groups of perforations to designate a series of characters, a predetermined number of perforations in selected ones of a given greater number of positions being provided to designate a portion of the characters and similar perforations in conjunction with a perforation in another position being provided to designate the remaining characters, successively adjusting a member in the same direction to positions determined by the successive groups of perforations, each group determining different positions, and transmitting to a distant point a periodic series of pulses in accordance with the extent of each adjustment of the member.

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