April 13, 1948. H. L. THOLSTRUP 2,439,497

CARRIAGE SPACING MEANS FOR SIGNAL-CONTROLLED PRINTING APPARATUS

Filed May 12, 1945 7 Sheets-Sheet 1

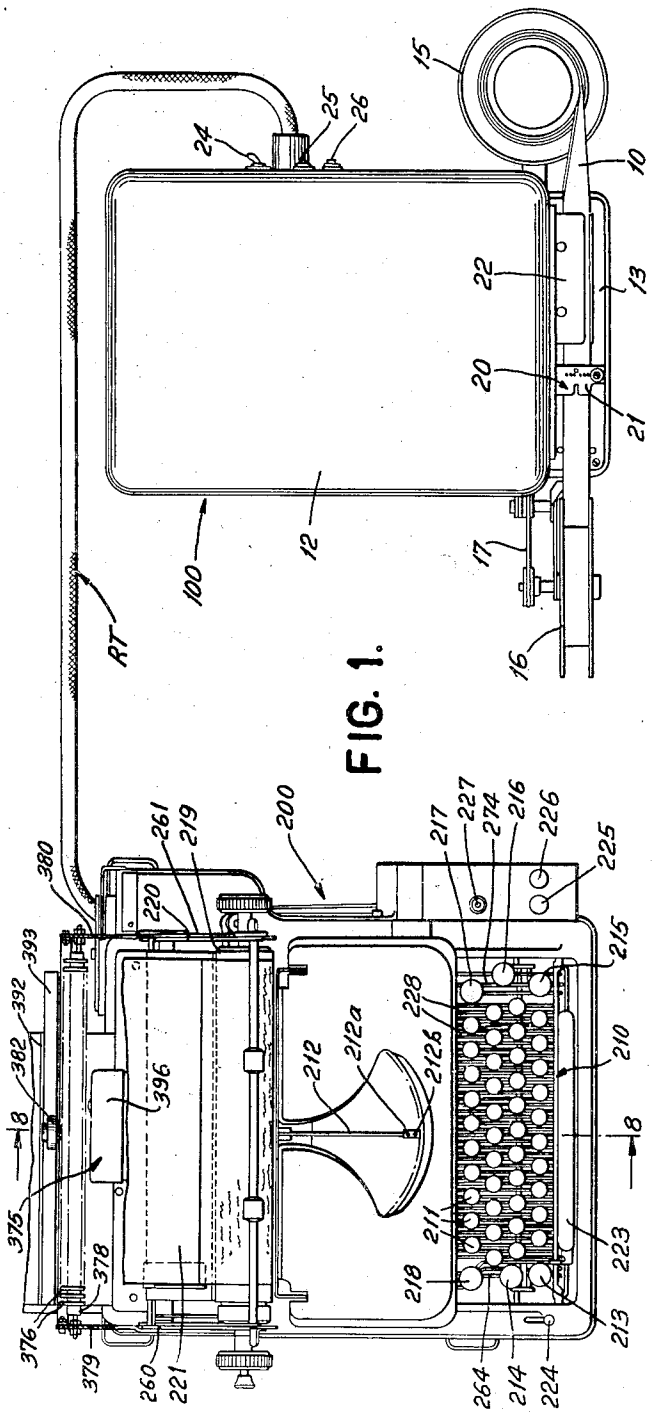


FIG. 1.

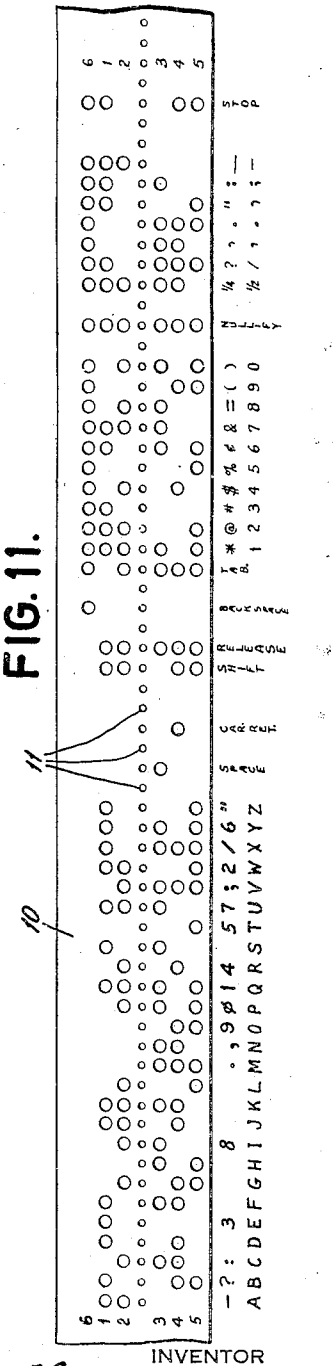


FIG. 11.

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FIG. 6.

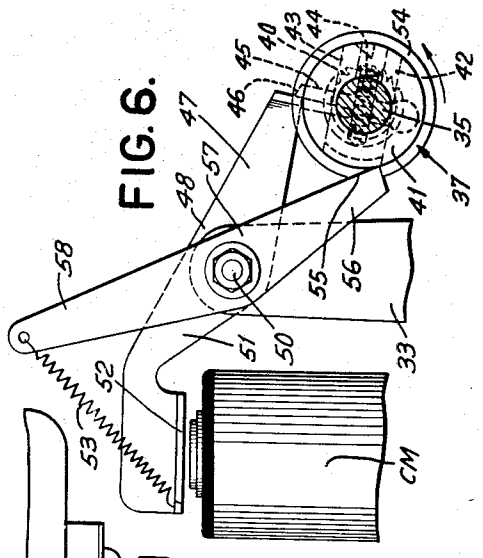


FIG. 2.

FIG. 4.

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CARRIAGE SPACING MEANS FOR SIGNAL-CONTROLLED PRINTING APPARATUS

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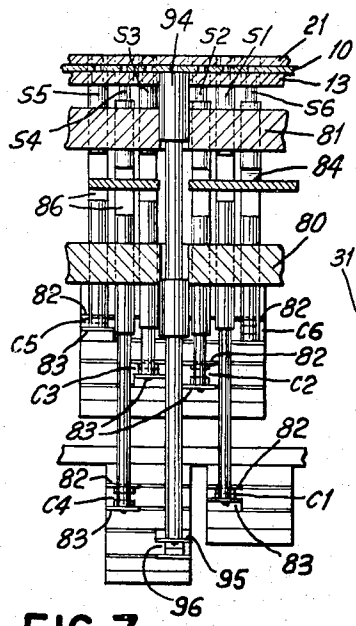


FIG. 7.

FIG. 5.

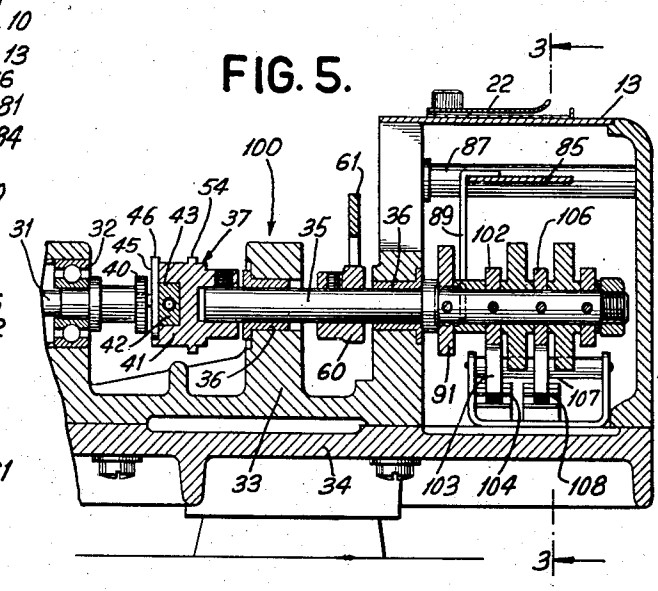
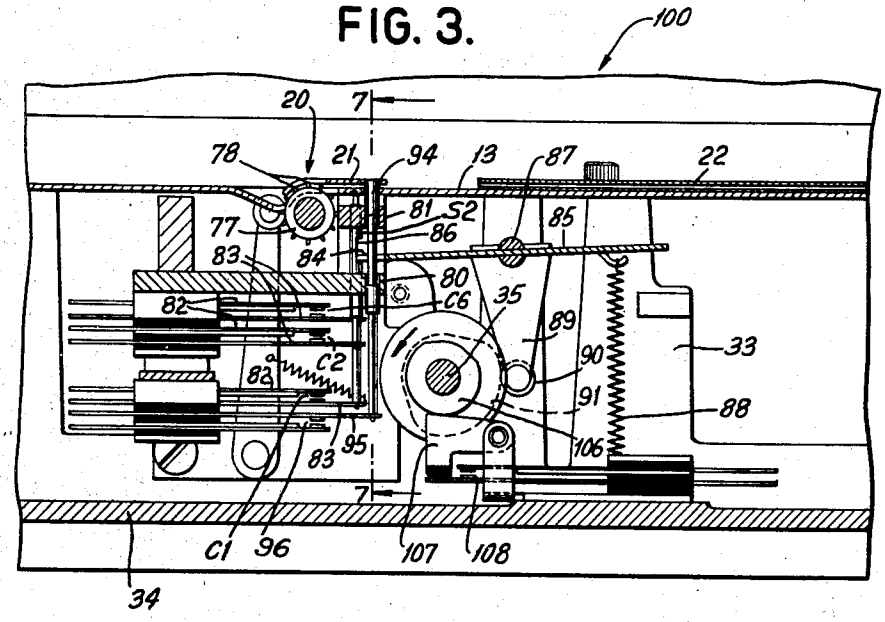


FIG. 3.



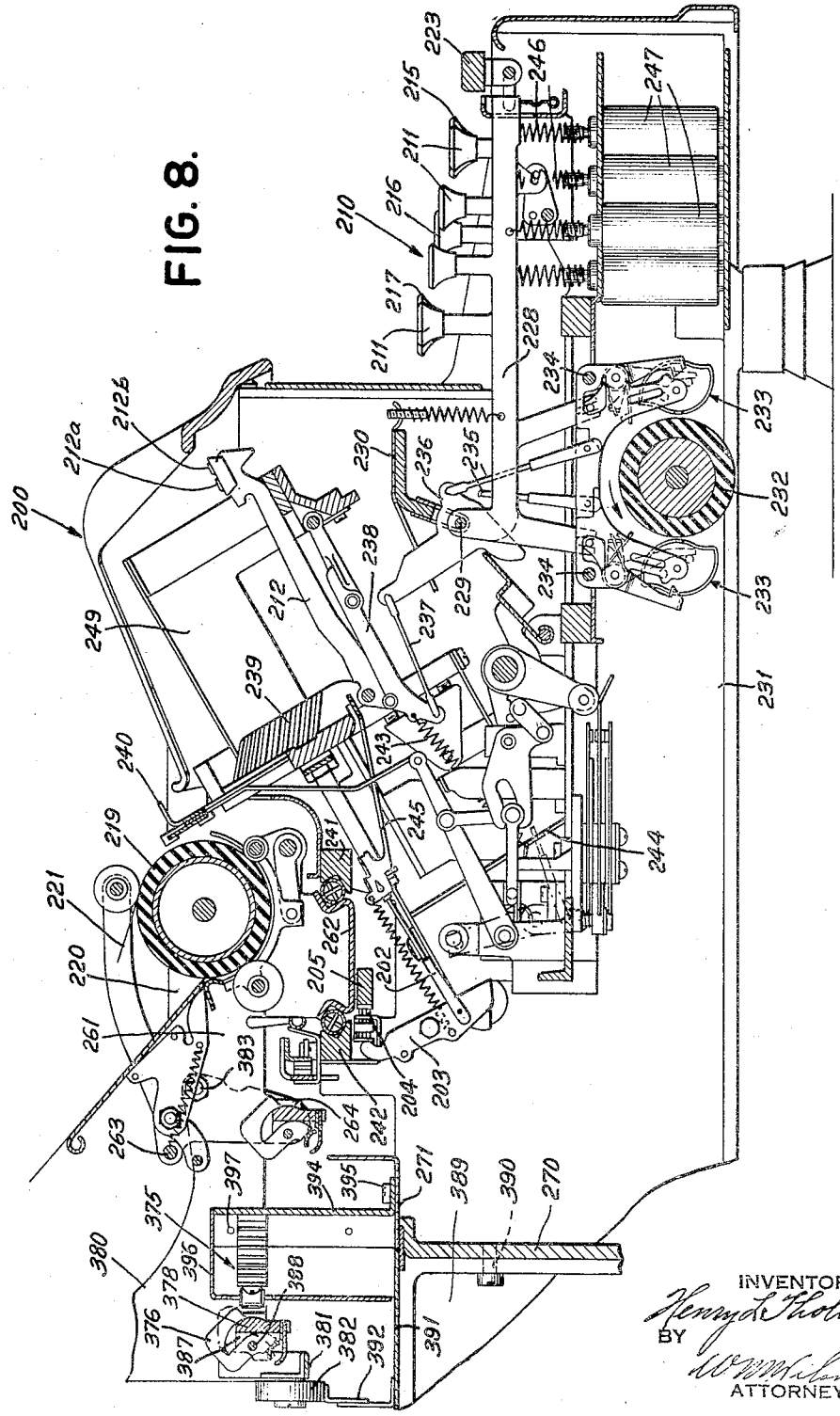
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CARRIAGE SPACING MEANS FOR SIGNAL-CONTROLLED PRINTING APPARATUS

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FIG. 8.



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CARRIAGE SPACING MEANS FOR SIGNAL-CONTROLLED PRINTING APPARATUS

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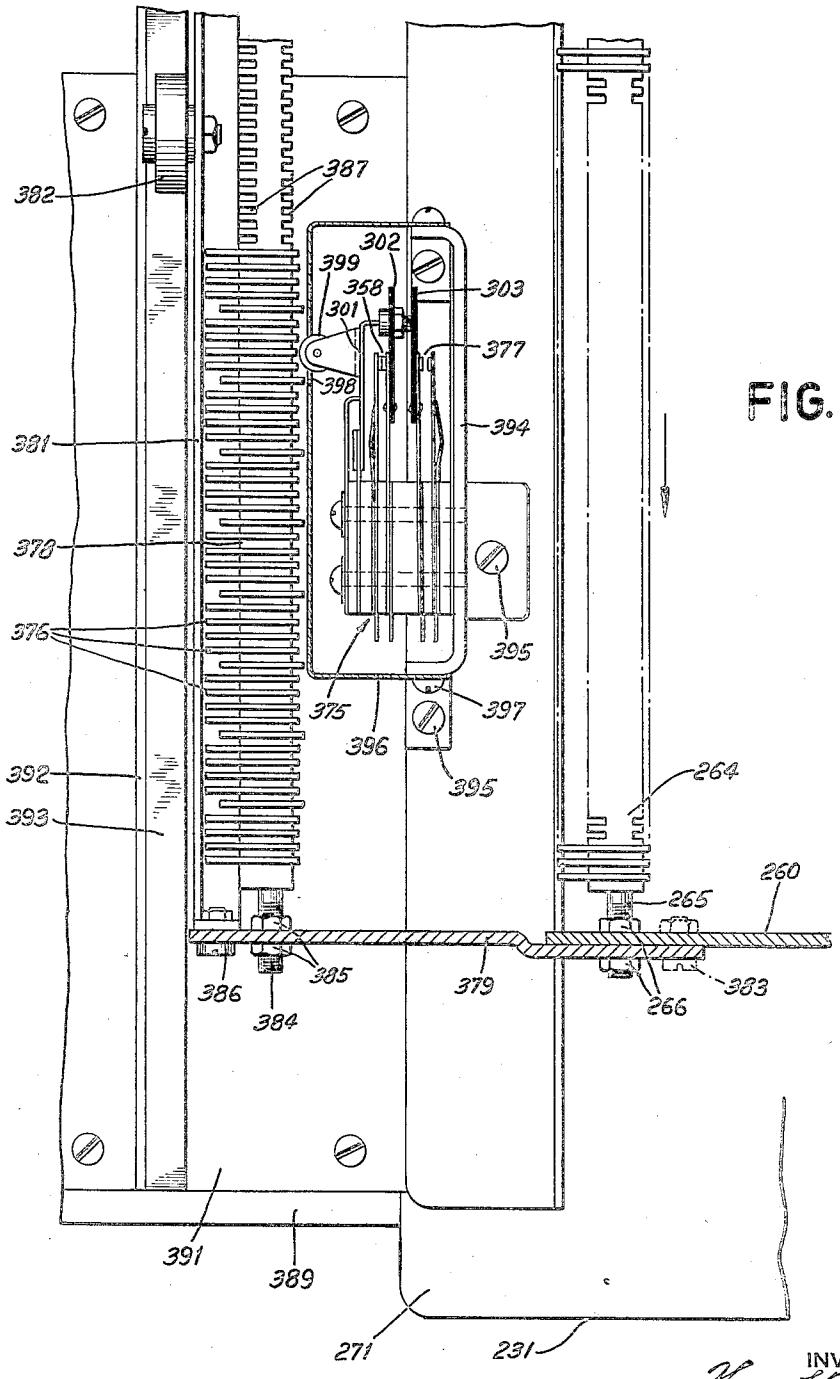


FIG. 9.

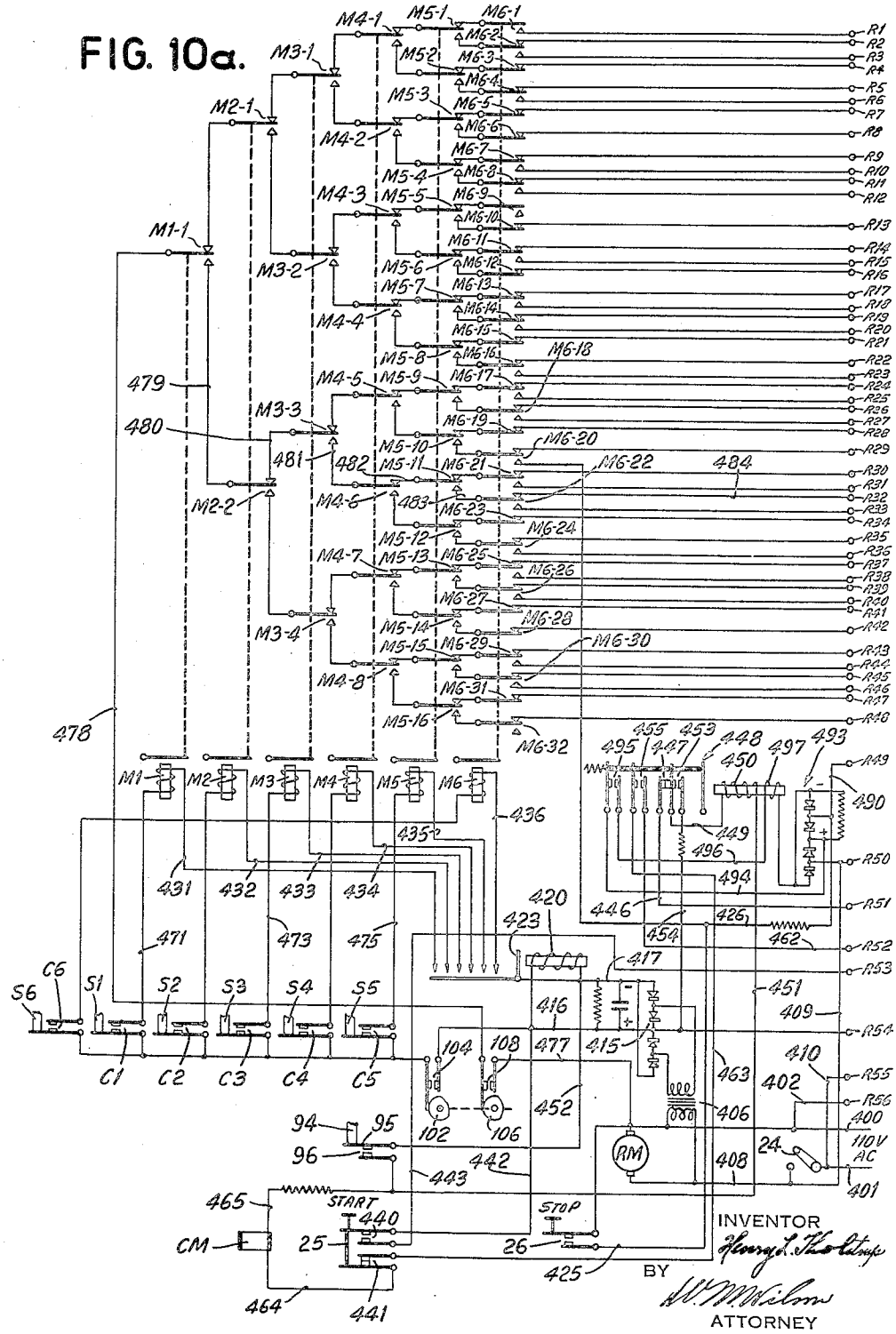
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CARRIAGE SPACING MEANS FOR SIGNAL-CONTROLLED PRINTING APPARATUS

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FIG. 10a.



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CARRIAGE SPACING MEANS FOR SIGNAL-CONTROLLED PRINTING APPARATUS

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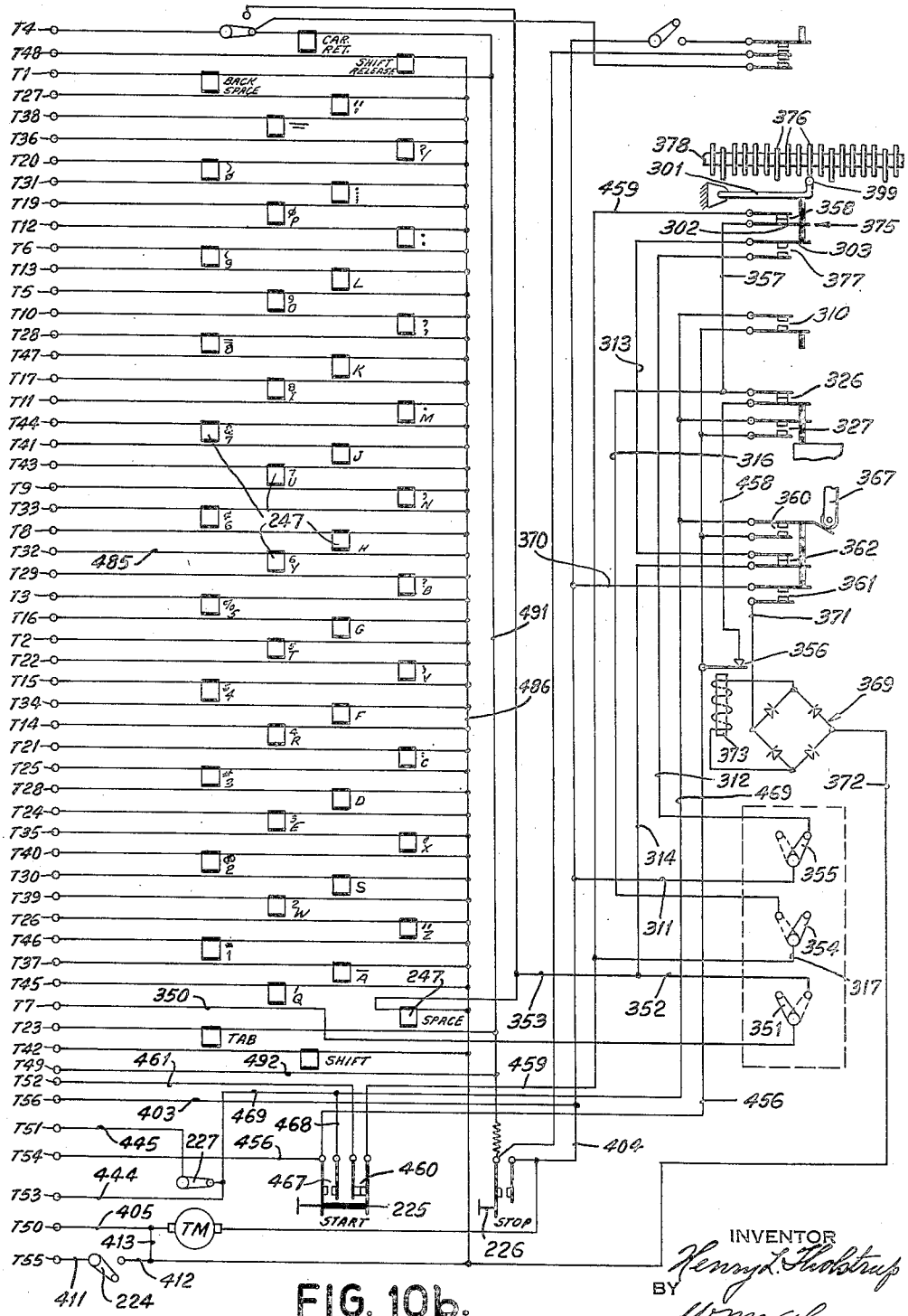


FIG. 10b.

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Patented Apr. 13, 1948

2,439,497

UNITED STATES PATENT OFFICE

2,439,497

CARRIAGE SPACING MEANS FOR SIGNAL-CONTROLLED PRINTING APPARATUS

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Application May 12, 1945, Serial No. 593,367

13 Claims. (Cl. 197—20)

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This invention relates to printing apparatus and more particularly to apparatus of the same general type as is disclosed in my copending application Serial No. 492,896, filed June 30, 1943, which has matured into Patent No. 2,378,371, granted June 12, 1945. The present invention may be considered as being in the nature of an improvement of apparatus of the type disclosed in such application.

A broad or general object of this invention is to provide printing apparatus which is of improved construction and arrangement of parts.

In apparatus of the type referred to, it is customary to use code signals which may be produced under the control of data-representing designations recorded in a record sheet, or tape, or from any other suitable source of stored data designations, to effect automatic operation of a printer, for example, a typewriter, so as to reproduce on a copy sheet character-by-character the data represented by the stored designations. The stored data also usually includes designations representing the required functional operations of the printer such as character spaces between words, carriage-return, tabulating, etc. In certain uses of apparatus of this type, it is sometimes desirable to provide character spaces between characters at points other than provided for in the stored data. For example, it is sometimes desirable to group the printed characters on the copy sheet in blocks of a predetermined number of characters separated by character spaces.

It is, therefore, a more specific object of the present invention to provide printing apparatus embodying an improved means for inserting character spaces automatically at any desired point or points in the printed copy.

A further object is to provide an improved apparatus of the type referred to, wherein character spaces may be provided at any preselected character space positions and under the control of a carriage supporting the copy sheet and wherein the preselection of the character space position may be easily made in an improved and simple manner.

A still further object is to provide for selective group spacing of the printed characters and for selectively including or eliminating of those character spaces from the printed copy which are represented by designations in the source of data designations.

A further object is to provide for preventing operation under the control of the carriage while the latter is being returned to begin a new line of typing.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the

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invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a plan view showing generally the units composing one preferred embodiment of the present invention;

Fig. 2 is an enlarged fragmentary plan sectional view showing in detail the mechanical working parts of the reader, which form a component part of the preferred embodiment shown in Fig. 1; certain of the parts being broken away to illustrate the details of construction more completely;

Fig. 3 is a fragmentary vertical sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary vertical sectional view taken on the line 4—4 of Fig. 2, and illustrating the tape feeding mechanism;

Fig. 5 is a fragmentary vertical section through the reader, the section being taken at right angles to Figs. 3 and 4 and being indicated by the line 5—5 of Fig. 2;

Fig. 6 is a fragmentary vertical sectional view taken on the line 6—6 of Fig. 2, and illustrating the clutch mechanism and its controlling magnet which function to connect the reader operating shaft with a source of power;

Fig. 7 is a fragmentary vertical section taken on the line 7—7 of Fig. 3 and showing the code sensing pins of the reader and the manner in which each pin controls its related sensing contacts;

Fig. 8 is a transverse vertical sectional view through the center of the typewriter, the section being taken on the line 8—8 of Fig. 1;

Fig. 9 is an enlarged fragmentary plan view showing the back of the typewriter and the detailed construction of the control elements which contribute in providing for spacing the typewriter carriage at any preselected character space position;

Figs. 10*a* and 10*b* are two parts of an electrical wiring diagram illustrating diagrammatically the various control instrumentalities of the apparatus and the circuit wires connecting them; and

Fig. 11 is a view showing a portion of a record tape bearing all of the code hole designations of a preselected combinational hole code system.

Before considering in detail the construction and operation of the illustrated embodiment of the invention, it will be helpful to consider first one practical example of a preselected combinational code by means of which intelligence, such, for example, as a letter which it is desired to transcribe, can be recorded on a record strip or tape. In Fig. 11, a portion of a record tape 10 is shown, and punched in the tape are all of the code hole designations of a combinational six-hole code. The six code positions are indicated at both ends of the tape 10 by the refer-

ence numerals 1 to 6, inclusive. Each code designation is arranged in a vertical column or recording field, and opposite the several fields bearing the code designations and below the lower edge of the tape, are placed legends indicating, respectively, the characters or functional operations represented by the code designations in the fields. From a study of Fig. 11, it will be noted that most of the character code designations are indicated as representing two different characters, the character legends appearing therein in two transverse parallel rows extending lengthwise of the tape. The reason for the latter is that, in the code system illustrated, the "Shift" and "Release" code designations are used in conjunction with the character code designations to represent the different characters. The legends in the bottom transverse row may be properly referred to as "normal" or "letters" case characters and those in the upper row adjacent the lower edge of the tape as "shifted" or "figures" case characters. As will appear more fully hereinafter, the sensing of the "Shift" designation adjusts the typewriter to its shifted case position and the subsequent sensing of the character code designations in the tape will result in the printing of the corresponding "shifted" case characters. Also, the sensing of the "Release" designation adjusts the typewriter to its normal case position and the subsequent sensing of the character code designations will result in the printing of the corresponding "normal" case characters.

In Fig. 11, the smaller holes 11 at the center of the tape 10 and within each of the several recording fields are for the purpose of feeding the tape lengthwise during the reading or sensing operation. The code hole designations and the feed holes 11 may be punched in the tape by any suitable form of code perforator (not shown herein).

Referring now in detail to the construction of the preferred embodiment disclosed in the drawings, it will be noted that the signal-controlled printing apparatus is shown in Fig. 1 as comprising generally a tape reader 100 enclosed within a suitable housing 12, and a power operated typewriter 200. As will appear more fully hereinafter, the apparatus also includes an electrical relay translator of the pyramid type, and certain mechanisms, devices, circuits, and other control instrumentalities which provide for the automatic operation of the typewriter under control of the code designations in the record tape 10 sensed by the reader. The translator and these other control devices, instrumentalities, etc., and their connecting circuit wires are shown diagrammatically in Figs. 10*a* and 10*b*. As will appear more fully hereinafter, these control instrumentalities are suitably mounted within the reader housing 12 and on and under the typewriter 200. The circuit wires connecting the control instrumentalities mounted in the reader 100 with those mounted on the typewriter 200 are suitably enclosed within a cable RT shown in Fig. 1.

As viewed in Fig. 1 the reader is provided across its lower side with a platform or tape table 13 across which the record tape 10 bearing the recorded intelligence is fed step-by-step during the operation of the apparatus. A tape supply spool 15 is suitably mounted at the right-hand side of the table 13 and serves to support the record tape 10 to be read and transcribed. A second or tape storage spool 16 is provided at the left of the table 13; and, as will later appear, is rotated by

a flexible belt 17 during operation of the apparatus, for the purpose of winding the tape thereon after it leaves the sensing station of the reader. The sensing station is indicated at 20 and, as will appear more fully hereinafter, the recording fields of the tape are successively sensed during successive operating cycles, by sensing elements located at the station 20. A removable gate 21 is provided at the sensing station for properly positioning and holding the tape with respect to the sensing elements. The tape 10 is guided in its movement toward the sensing station by a suitable guide member 22 fixed to the top of the tape table 13.

At the right-hand side of the reader 100 as viewed in Fig. 1, are provided three electrical switches indicated, respectively, at 24, 25, and 26. As will appear more fully hereinafter, the switch 24 is the power switch and when closed, connects a convenient source of alternating current with a motor for driving the reader unit and with a motor for operating the typewriter. The reader motor is indicated by the character RM in Figs. 2 and 10*a*, and the typewriter motor by TM in Fig. 10*b*. The switch 25 is the start switch and when closed, starts the sensing and feeding of the tape and the automatically controlled operation of the typewriter key members. The switch 26 is the stop switch and when closed instantly stops the feeding and sensing of the tape and the controlled operation of the typewriter.

The typewriter 200 which is shown in plan in Fig. 1 and the detail construction thereof in Figs. 8 and 9, will be recognized as being a well known commercial form of power-driven typewriter and will be described more fully hereinafter. In Fig. 1, the typewriter 200 is shown as comprising a keyboard 210 including the required complement of character keys 211 which operate corresponding type bars 212, and the functional keys which include the shift key 213, shift lock key 214, shift release key 215, the carriage return key 216, the back space key 217, and the tabulating key 218. The space bar is indicated at 223. The typewriter 200 also comprises the conventional rotatable platen 219 mounted on the typewriter carriage 220 and which supports a copy sheet indicated at 221 and on which the data recorded in the tape 10 is automatically typed.

At the lower and left-hand side of the typewriter as viewed in Fig. 1, is provided a power switch 224 which, when closed, like the power switch 24, connects a source of alternating current with the typewriter and reader motors. At the lower and right-hand side of the typewriter is mounted a start switch 225 and a stop switch 226 which function, respectively, the same as the switches 25 and 26 on the reader 100. Thus, the operation of the apparatus may be controlled from either the typewriter or from the reader. An insert switch 227 is also provided on the typewriter which, when open, prevents starting of the tape feeding and sensing mechanisms in the reader 100 and thereby eliminates control by the latter of the typewriter, so that the keys of the typewriter key board 210 can be operated manually without interference from the reader. The insert switch 227 will normally be closed, and will be opened when it is desired to type manually an insert in the data being transcribed; for example, when it is desired to type manually the name and address of the person to whom the transcribed copy is to be sent or any other data which will be of interest only to the recipient of the copy.

The detail construction of the reader is shown in Figs. 2 to 7, inclusive. The reader comprises the reader motor RM which is suitably mounted within the housing 12 and which operates continuously as long as either the power switch 24 or power switch 224 is closed. The motor is at all times operatively connected by a suitable flexible drive belt 30 with a power shaft 31, the latter being mounted for rotation within suitable bearings 32 mounted within a frame 33 which is bolted to the base 34 of the reader.

The reader 100 also comprises an operating shaft 35 which is aligned with the power shaft 31 and is supported for rotation within suitable bearings 36 carried by the reader frame 33. The shafts 35 will be referred to hereinafter as the "reader" shaft. A clutch 37, under the control of a clutch magnet CM, is operable to connect and disconnect the reader shaft 35 and the power shaft 31. The reader shaft effects the operation of the tape feeding and sensing means.

A cycle of operation of the apparatus is effected during each revolution of the shaft 35; viz., the tape 10 is fed or spaced a distance sufficient to bring the next recording field of the tape into sensing position, such next field is sensed to determine the code designations therein, if any, and the typewriter is operated in response to the sensing of the code designation. As long as the shafts 31 and 35 are clutched together the cycles of operation are repeated and the typewriter continues to transcribe the data recorded in the tape being read.

In so far as the present invention is concerned, any suitable form of clutch may be used to connect the reader shaft 35 to the continuously operated power shaft. The clutch 37 which is shown, is well known to those skilled in this art, it being substantially the same as that disclosed in the U. S. Patent No. 2,206,646 granted July 2, 1940. If desired, reference may be had to said patent for a complete showing of the structural details thereof. For the purposes of the preesnt disclosure, it is believed sufficient to say that the clutch comprises a driving element in the form of a toothed wheel 40 fixed to the end of the power shaft 31, and a driven element in the form of a barrel 41 fixed to the reader shaft 35 and carrying a radially slidable clutch pawl 42. The barrel 41 is formed with a diametrically disposed slot 43 within which the pawl 42 is slidably mounted. To the outer end of the pawl 42 is fixed a tooth element 44 which, when the pawl 42 is moved radially inward, engages the toothed wheel 40 to provide the driving connection between the shafts 31 and 35. The pawl 42 is biased in a clutch engaging direction by a suitable spring mounted within the clutch barrel 41. A clutch releasing lever 45 also extends diametrically across the clutch barrel and at right angles to the slot 43 and is mounted for limited angular movement therein. The lever is provided with an outer extension 46 which, when intercepted and engaged by the outer end of one arm 47 of a rocking lever 48, is moved to move the clutch pawl 42 radially outward against the force of the aforementioned spring in the barrel 41 to disengage the clutch.

The clutch parts are shown in Figs. 2, 5, and 6 in their declutched position which is the home or starting position of the reader. The rocking lever 48 is mounted on a stud 50 carried by a part of the frame 33 and includes a second arm 51 which carries at its outer end the armature 52 of the clutch magnet CM. When the clutch magnet

CM is energized, the lever 48 is rocked counterclockwise, as viewed in Fig. 6, which moves the outer end of the arm 47 upward and thereby releases the outer extension 46 of the releasing lever 45, and the clutch spring within the clutch barrel 41 then moves the pawl 42 radially inward to engage the toothed wheel 40 in the manner explained above. When the clutch magnet CM is deenergized, a tension spring 53 rocks the lever 48 clockwise and moves the outer end of the arm 47 into the path of the outer extension 46 of the lever so that the latter is engaged and moved to move the pawl outward to disengage the clutch.

In order to prevent rebound of the parts when the clutch is disengaged and in order to hold the reader shaft 35 in the home position, the clutch barrel 41 is also provided with an annular extension or collar 54 having a notch 55 formed therein which, when the clutch is disengaged, receives the outer end of an arm 56 of a detent lever 57. The detent lever 57 is also pivoted on the stud 50 and includes another arm 58 which is connected to the armature 52 by means of the tension spring 53 previously mentioned. Thus, the spring 53 serves the dual purpose of urging the arm 56 into engagement with the periphery of the collar 54 so that it will fit within the notch 55 in home position, and of urging the arm 47 into position to intercept the extension 46 of the pawl releasing lever 45 and thereby declutch the parts.

As stated above, during the first part of each revolution of the reader shaft 35, the tape is fed or spaced lengthwise to bring a new recording field into sensing position. The tape feeding mechanism is shown more clearly in Figs. 2 and 4, and comprises a cam 60 mounted on the reader shaft 35 and cooperating with a rocking lever 61 pivoted on a fixed stud 62 carried by the frame 33 and comprising a pair of arms 63 and 64. The cam 60 and lever 61 are shown in Fig. 4 in the starting or home position and are so constructed that when the cam 60 begins to rotate in a counterclockwise direction, it first engages the arm 63 to rock the lever 61 counterclockwise and then engages the other arm 64 to rock the lever 61 clockwise and return the same to the position shown. A link 66 is pivoted at its lower end to the outer end of arm 64 and extends upwardly therefrom and is pivoted at its upper end by a stud 67 with a second link 68. The link 68 is also pivoted to a shaft 70 and serves to hold the link 66 in its upright position shown.

Also pivotally connected on the stud 67 is a feed pawl 71 which is held in operative engagement with a ratchet wheel 72 fixed to the shaft 70, by means of a tension spring 73 connecting outer extending arms of the pawl 71 and the link 68. A detent 74 is pivotally supported by a fixed stud 75 and is held in engagement with the teeth of the ratchet wheel 72 by means of a tension spring 76 and thereby serves to prevent reverse movement of the ratchet wheel 72 and shaft 70. From the above, it is apparent that when the clutch 37 is engaged to rotate the reader shaft 35 and when the lever 61 is first rocked counterclockwise by the cam 60, the pawl 71 will be moved downwardly thereby and will rotate the ratchet 72 and shaft 70 counterclockwise; and, when the cam 60 rocks the lever 61 clockwise, the pawl 71 will be moved upward to engage the next tooth of the ratchet 72.

The shaft 70 is the tape feed shaft and is provided with a feed wheel 77 having radially ex-

tending pins 78 which are adapted to engage the feed holes 11 in the tape 10. Thus, when the feed shaft is partially rotated in the manner just described, the tape is fed to the left as viewed in Figs. 1 and 2, a distance equal to the width of a recording field. The belt 17 which rotates the spool 16 shown in Fig. 1, is driven from a pulley 19 fixed to the tape feed shaft 70.

The mechanism for successively sensing the recording fields of the tape comprises six sensing pins indicated, respectively, by the characters S1 to S6, inclusive. There is one pin for each of the code hole positions and the pins are arranged in a single vertical plane extending at right angles to the direction of movement of the tape, and are arranged so that when the tape comes to rest at the end of a feeding operation, the upper end of each pin will be directly beneath its corresponding code hole position in the field of the tape then in position to be sensed. The pins are guided for vertical movement within aligned openings in spaced guide blocks 80 and 81, respectively, which are suitably fixed to the frame 33. Aligned pairs of guide openings are also provided in the table 13 and in the gate 21 and they are aligned with corresponding openings in the guide blocks so that during a sensing operation each pin can be moved upward and through the tape when there is a hole in the code position in the tape corresponding to such pin.

The six sensing pins are supported and operatively connected, respectively, at their lower ends to six pairs of spring blade contacts indicated, respectively, by the characters C1 to C6 inclusive. Each pair of contacts comprises an upper fixed blade 82 and a lower movable spring blade 83 which extends outwardly beyond the end of its related fixed blade and is connected at its outer end to the lower end of its related sensing pin. The construction is such that the spring blades 83 constantly urge their respective contacts upward into closed position and their related sensing pins upward as viewed in Figs. 3 and 7. Between sensing operations, the six sensing pins are held in home position, the position shown in Fig. 3, by the outer lateral edge 84 of a vane 85, which edge extends across all of the pins and within transversely aligned notches 86 provided, respectively, in the sides of the pins. The vane 85 is, in effect, a rocker arm pivotally supported on a rod 87 carried by the frame 33 and constantly urged to move in a clockwise direction, as viewed in Fig. 3, by a tension spring 88. The vane 85 is provided at its center with a depending arm 89 which carries at its lower end a roller 90 held by the spring 88 in contact with the face of a cam 91 mounted on the reader shaft 35. When the roller 90 is in engagement with the high point of the cam 91, the vane 85 is held in the position shown in Fig. 3 where the several sensing pins are held in their respective lower positions and the pairs of contacts controlled thereby are held open.

After the tape has been spaced by the feeding mechanism in the manner previously described and has come to rest with the new recording field above the sensing pins, the shaft 35 and cam 91 will have rotated counterclockwise from the position shown in Fig. 3, 94° of a revolution. When the shaft 35 has rotated 114°, the roller 90 will begin to move inwardly from the high point of the cam 91, and the vane 85 will move in a clockwise direction due to the force of the spring 88. The sensing pins S1 to S6, inclusive, will also follow the end 84 of the vane 85 upward due to the spring force in their respective movable blades 83. If there be a hole in the code position of the tape immediately above a sensing pin, its movable spring blade 83 will continue to move the pin upward and through such code hole and to a point where the pair of contacts controlled thereby will close. If there be no code hole in the position above a sensing pin, the upper end of such pin will strike the tape 10 and will be held thereby against further upward movement, and in the latter position its related pair of contacts are held open.

By way of example, Fig. 7 shows the relative position of the parts during the sensing of a record field bearing the 1—3—5 code designation, which as shown in Fig. 11 represents the normal case letter character "Y" and the shifted case figure character "6." Sensing pins S1, S3, and S5 are shown as having passed through code holes in the corresponding code positions 1, 3, and 5 in the tape 10 and their related contacts C1, C3 and C5 are shown closed. The sensing pins S2, S4, and S6 have been stopped in their upward movement by the tape and their related contacts C2, C4, and C6 are thereby held open.

From the foregoing, it is apparent that during a sensing or reading operation the contacts C1 to C6, inclusive, are closed by their related sensing pins singly or in combination, depending upon the code hole designation in the record field of the tape being sensed. The sensing operation is terminated by the high point of the cam 91 engaging the roller 90 on the arm 89 and moving the vane 85 counterclockwise, as viewed in Fig. 3, so that the end 84 thereof engages again the lower ends of the notches 86 in the several sensing pins S1 to S6 inclusive, and thereby moves the latter downward to the position shown in Fig. 3, where the related contacts are held in open position. The sensing operation is completed and the vane 85 is restored to home position at approximately 346° of each revolution.

In order to provide for automatically stopping the reading or sensing operation when there is no tape at the sensing station, a seventh pin 94 is mounted for vertical sliding movement within aligned openings in the spaced guide blocks 80 and 81 and in the table 13 and the gate 21 and is positioned so that it will engage the central portions of the tape. The lower end of the pin 94 is supported and operatively connected to the movable spring blade 95 carrying one of a pair of contacts 96. The blade 95 is normally urged upward by the spring force inherent therein, to open the contacts 96 and move the pin 94 upward. If there is a tape at the sensing station 20, the upper end of the pin 94 engages the underside of the tape and the contacts 96 are held closed. This is the position of the parts shown in Fig. 7. When the tape runs out, the pin 94 moves upward and opens the contacts 96 which, as will later appear, opens the energizing circuit for the clutch magnet CM and thereby stops the feeding and sensing operation of the reader. In Fig. 3, no tape is shown at the sensing position 20 and the pin 94 is shown in the upper position where the contacts 96 are open. The pin 94 is made sufficiently large in diameter so that the feed holes 11 in the tape 10 will not affect its operation.

Each sensing or reading operation produces a significant signal corresponding to the designation sensed. As will be explained more fully hereinafter in connection with the description of the wiring diagram shown in Figs. 10*a* and 10*b*, the

sensing contacts C1 to C6, inclusive, control respectively, the flow of direct current within six signal circuits, the latter including, respectively, six translator relays M1 to M6, inclusive, of a relay type of translator mechanism which, as stated, is diagrammatically shown in Fig. 10*a*. At this point it is sufficient to say that by energizing translator relays M1 to M6, inclusive, singly and in combination, due to the selective closing of their related contacts C1 to C6, inclusive, during the reading operation described above, a number of controlling circuit paths through the translator are selectively established, which circuit paths correspond, respectively, to the code designation sensed. With certain exceptions hereinafter explained, each of these circuit paths, when closed, actuates a related key member of the typewriter 200.

A cam 102 is also fixed to the reader shaft 35 and controls through a pivoted follower 103 the operation of a pair of spring blade contacts 104. As will appear more fully hereinafter the contacts 104 control the flow of signal current from a suitable D. C. source and through the contacts C1 to C6 inclusive, in parallel, to their related translator magnets M1 to M6, inclusive. The contacts 104 may be termed the D. C. common contacts and are normally held open by their movable spring blade. The cam 102 is so shaped and positioned on the operating shaft 35 that the contacts 104 are closed at 142° of a revolution which is after the time for closing the sensing contacts C1 to C6, inclusive, and are opened at 311° which is before the sensing contacts are opened by the vane 85. The purpose of the D. C. common contacts is to provide for simultaneously energizing and deenergizing the translator relays M1 to M6, inclusive.

A cam 106 is also fixed to the reader shaft 35 and controls through a pivoted follower 107 the operation of a pair of normally open spring blade contacts 108 which are herein termed the A. C. common contacts. As will appear more fully hereinafter, the current which flows through the controlling circuit paths of the translator previously mentioned as being conditioned by the selective energization of the translator relays M1 to M6, inclusive, is A. C. current, and the cam 106 is so shaped that it connects the source of A. C. current with these circuit paths at a predetermined point in each cycle of operation. In the structure shown, the cam effects the closing of the A. C. common contacts 108 at approximately 170° of each revolution and opens the contacts at 294°.

The detail construction of the typewriter is shown in Figs. 8 and 9, and as stated previously, is a well known commercial form of power driven typewriter. The structural features and principles of operation of this typewriter are fully disclosed in a number of U. S. patents, among which are Patent No. 1,777,055, granted September 30, 1930, and Patent No. 1,873,512, granted August 23, 1932. These patents disclose the general principles of operation of the key levers and how they control through related cam units, the operation of the type bars, and the manner of spacing the typewriter carriage. In view of the detailed description of the construction and operation of the parts given in the patents just mentioned, only a brief description will be given herein which will be sufficient to enable the present invention to be understood. Reference may be had to the aforementioned patents for further details.

As shown in Fig. 8, the character keys 211 are mounted, respectively, on key levers 228, the latter being pivoted on a rod 229 which is supported by a cross frame 230 rigidly mounted in the typewriter frame. Rotatably mounted in the base 231 is the power roller 232 which is rotated in the direction of the arrow by means of an A. C. motor, not shown in Fig. 8, but indicated diagrammatically at TM in Fig. 10*b*. When the machine is in use, the power roller rotates continually.

Cooperating with the power roller 232 are the cam units 233 which are pivotally mounted on rods 234 extending parallel with the power roller 232. There is a cam unit 233 associated with each of the key levers 228, and each of the cam units which is operated by a character key 211, is connected by a link 235 with a sub-lever 236 pivoted on rod 229. The sub-levers 236 are connected by links 237 to type bars 212 through the medium of toggles 238. The type bars 212 are pivoted in the usual type bar segment 239 and the latter is provided with a type guide 240 located in front of the platen 219. As stated previously, the platen is adapted to support the work sheet 221 and is rotatably mounted in the carriage 220, and the latter is supported for lengthwise movement on front and rear rails 241 and 242, respectively, by means of suitable antifriction roller trucks. Springs 243 connected to a curved spring anchoring member 244 and to toggles 238, provide means for locking the toggles in their normal or inactive position shown in Fig. 8.

When any character key 211 is manually depressed, its related cam unit 233 is caused to operatively engage the power roller 232 in a well known way, thereby rocking the cam unit 233 clockwise or counterclockwise, according to whether the operative cam unit is pivoted on the left hand or right hand rod 234, respectively, as viewed in Fig. 8. The rocking of the cam unit 233 causes its link 235 to be drawn downward, thereby rocking the corresponding sub-lever 236 in a clockwise direction. This movement of the sub-lever 236, through the corresponding link 237 and toggle 238, causes the type bar 212 associated with the selected key to rock in a counterclockwise direction to effect the impression of the type upon the work sheet 221 wrapped around the platen 219. The type bar, near the end of its operating stroke, engages the usual universal bar 245 and causes the universal bar to move rearwardly and downwardly as viewed in Fig. 8 to space the carriage forward. As will be apparent from an examination of the above mentioned Patent No. 1,873,512, the bar 245 is connected through a link 202 with a rock lever 203; and, when the universal bar 245 is moved by the type bar in the manner just explained, the lever 203 is rocked clockwise to operatively engage the escapement pawls 204 and move the latter out of engagement with an escapement rack 205 carried by the carriage 220, and thereby space the carriage one character space position.

To each of the character key levers 228 is connected by a spring 246, an electrically responsive actuator in the form of a solenoid 247 which, when energized, pulls its related key lever 228 downward to operate the related cam unit 233 and type bar 212 in the same manner as described above when the related key 211 is manually depressed. As will appear more fully hereinafter, the solenoids 247 are selectively energized by the A. C. controlling circuit flow paths previously mentioned as being selectively established by the

energizing of the translator relays M1 to M6, inclusive.

As will be readily understood by those skilled in the typewriter art, one of the cam units 233 is operated by manually depressing the space bar 223 and its related key lever, and such cam unit when operated effects, through a connecting link and lever arrangement, the clockwise movement of lever 203 to space the carriage in the same manner as is fully disclosed in the above mentioned Patent No. 1,873,512. The detail linkage and mechanism for effecting this operation has not been shown herein as it would be a needless duplication of drawings and description. An actuator in the form of a solenoid 247 is also provided for operating the key lever on which the space bar 223 is mounted. The latter solenoid is shown diagrammatically in Fig. 10b.

The type bar segment 239 is mounted in a frame 249 and both the segment and the frame form parts of the type basket. The type basket is movably mounted in the framework of the machine for case shifting movement in a well known way and normally occupies an elevated position shown in Fig. 8 for the typing of the normal case characters referred to hereinabove. In Figs. 1 and 8, only one of the type bars 212 has been shown. The normal case type element on the bar 212 is indicated at 212a and the shifted case type element at 212b. The case shifting mechanism for drawing the type basket downward to permit the printing of shifted case characters is fully disclosed in U. S. Patent No. 1,945,097 granted January 30, 1934, and consequently need not be shown in detail herein, it being sufficient for the purposes of the present disclosure to note that each time the shift key lever 264 is moved downward by a solenoid 247 or by manually depressing key 213 or key 214, a cam unit engages the power roller 232 and the type basket is moved downward to its shifted case position, and each time a shift-release key lever 274 is moved downward by a solenoid 247, or by depressing key 215, the type basket is moved upward and returned to its normal case position. A full disclosure of the case-shifting mechanism is also included in my copending application referred to herein at the outset.

The other functional operations of the typewriter disclosed, such as back space, tabulating, and carriage return, are effected in a manner which is also well known to those skilled in this art. Consequently, a detail disclosure herein of the mechanisms for effecting these operating functions is considered unnecessary. They are disclosed fully in my said copending application and in prior U. S. patents identified therein. For the purposes of disclosing the present invention, it is considered sufficient to state that each of the keys 217, 218, and 216 is mounted on a corresponding key lever similar to the levers 226 and 264, and when each key is depressed, it actuates a corresponding cam unit which in turn operates the mechanism for effecting the functional operation corresponding to the depressed key. Also, a solenoid actuator 247 is connected to each of the key levers supporting the keys 217, 218, and 216 and when energized effects the operation of the corresponding cam unit in the same manner as when the keys are manually depressed.

The operation of the apparatus thus far described will now be described in connection with the wiring diagram shown in Figs. 10a and 10b. From an examination of these views, it will be noted that all of the control instrumentalities and circuit wires located within the reader 100 are shown diagrammatically in Fig. 10a, and this includes the relay translator mechanism previously referred to herein, and that all of the control instrumentalities and circuit wires mounted on the typewriter are shown in Fig. 10b. For the purposes of simplicity, the circuit wires of the reader which are connected, respectively, by the individual wires within the cable RT (Fig. 1) with corresponding circuit wires in the typewriter are shown as terminating at the right-hand margin of Fig. 10a in plug socket connections, designated, respectively as R1 to R56, inclusive. The corresponding circuit wires in the typewriter terminate at the left-hand margin of Fig. 10b in plug socket connections T1 to T56, inclusive. It is to be assumed that the plug sockets R1 to R56 are connected, respectively, to the plug sockets T1 to T56, inclusive by the individual cable wires.

As stated above, the relay translator mechanism comprises the series of relays M1 to M6, inclusive, which, during each cycle of operation of the reader, are energized singly or in combination, as a result of the producing of significant signals by the sensing of code hold designations in the record tape. The relay translator shown is a well known mechanism which, in response to the selective energization of its relay magnets in the manner just stated, sets up a number of controlling circuit paths corresponding, respectively, to the code designations sensed. The relays M1 to M6, inclusive, control, respectively, the operation of one or more related transfer contacts which during each sensing cycle will be transferred, or left at normal position, so that the contacts may be connected in combinational series to condition the just mentioned controlling circuit paths. As shown, the armature of relay M1 operates a pair of contacts M1—1; the armature of relay M2 operates two pairs of contacts M2—1 and M2—2; the armature of relay M3 operates four pair of contacts M3—1 to M3—4, inclusive; the armature of relay M4 operates eight contacts M4—1 to M4—8, inclusive; the armature of relay M5 operates sixteen contacts M5—1 to M5—16, inclusive; and the armature of relay M6 operates thirty-two contacts M6—1 to M6—32, inclusive. In Fig. 10a, these various relay-controlled transfer contacts are shown in their upper or normal position, which is the position they occupy when their related operating relays are deenergized. When any translator relay is energized, all of its related contacts transfer to the lower position.

With the exception of plug socket connection T7, the plug socket connections T1 to T48, inclusive, are shown in Fig. 10b as connected, respectively, by individual circuit wires with the solenoids 247 which actuate the character and functional key levers of the typewriter previously described. Plug socket T7 is shown as connected by a wire 350 with one terminal of a single pole single throw knife switch 351. The other terminal of switch 351 is connected by wires 352 and 353 with the solenoid 247 which when energized pulls down the key lever on which is mounted the space bar 223 of the typewriter. The solenoids 247 are shown in Fig. 10b in the same relative positions as are occupied by their related keys on the typewriter. Legends appear opposite the solenoids and indicate, respectively, the characters printed and the functional operations effected by the energizing of the solenoids. Where two character legends appear opposite a solenoid, the upper character is printed with the

type basket in shifted case position and the lower character is printed with the type basket in normal case position. Where only one character legend is opposite a solenoid, such character is printed only when the type basket occupies its normal case position because the corresponding type bar carries only a normal case type element.

In Figs. 10*a* and 10*b*, all switches, solenoids, relays, contacts, and associated parts are shown in the positions they normally occupy with no tape under the sensing gate 21 (Fig. 1) and with both power switches 24 and 224 in open position and with the type basket in its normal case position shown in Fig. 8. Manually controlled knife switch 351 (Fig. 10*b*) is shown open. A manually controlled knife switch 354 is also shown open and knife switch 355 is shown closed. The purpose of switches 351, 354, and 355 will be fully explained hereinafter in connection with the novel control of spacing operations of the typewriter. A source of alternating current is indicated in Fig. 10*a* by the lead wires 400 and 401.

As stated previously, both the reader motor RM and the tyewriter motor TM are operated when either the power switch 24 or the power switch 224 is in closed position. One side of the motor RM is permanently connected to the lead 400, and also one side of the motor TM is permanently connected to the lead 402 by a wire 402, plug socket connections R56 and T56, wire 403, and wire 404. Upon closing of switch 24, the other side of the motor RM is connected thereby to the other supply lead 401 by a wire 406, and the other side of the motor TM is connected to the supply lead 401 by a wire 405, plug socket connections T50 and R50 and wire 409. The closure of the switch 24 also energizes a rectifier transformer 406, one side of the primary being permanently connected to the supply lead 400, and the other side being connected to the wire 408, and through the latter and switch 24 with the other supply wire 401.

With one side of the motors RM and TM and transformer 406 being permanently connected to the lead 400 in the manner just explained, the closing of switch 224 also energizes the motors RM and TM and the transformer 406 as follows: from wire 401, wire 410, plug socket connections R55 and T55, wire 411, the switch 224, a wire 412, wire 413, and wire 405, to the other side of the motor TM; and through wire 405, plug socket connections T50 and R50, the wires 409 and 408, to the other side of the motor RM and the other side of the primary of transformer 406.

With the transformer 406 energized in the manner just explained, alternating current is supplied to the input terminals of a rectifier 415. The positive and negative D. C. output terminals of rectifier 415 are connected, respectively, to a plus bus 416 and to a minus bus 417. The opposite sides of the coil of a reader relay 420 are permanently connected with the plus bus 416 and the minus bus 417, so that as long as the rectifier is supplied with alternating current, the relay 420 remains energized. When the relay 420 is thus energized, the armature 423 thereof connects the minus bus 417 to each of wires 431, 432, 433, 434, 435, and 436, which are respectively connected to the return sides of the six translator relays M1 to M6, inclusive.

With a record tape 19 properly positioned under the gate 21 in the reader 100, the contacts 96 are closed by the pin 94 and the apparatus is ready for successively reading and transcribing the coded designations in the tape onto the record

sheet 221 in the typewriter 200. The tape sensing and feeding operation is started by depressing either the reader start switch 25 or the typewriter start switch 225. The reader start switch 25 is provided with two pairs of spring blade contacts 440 and 441, respectively, the contacts 440 being normally open and being closed upon depressing the start switch 25, and the contacts 441 being normally closed, and being opened when the start switch 25 is depressed. The movable one of the normally open contacts 440 is connected by a wire 442, with the plus bus 416. Thus, when contacts 440 are closed by depressing switch 25, direct current will flow from the plus bus 416 through the wire 442, contacts 440, a wire 443, plug socket connections R53 and T53, a wire 444, the normally closed insert switch 227, a wire 445, plug socket connections T51 and R51, a wire 446, normally closed pick-up contacts 447 of a master control relay 448, a wire 449 to one side of a main coil 450 of such relay 448; and, from the coil 450, through wire 451, the now closed contacts 96, and a wire 452 to the minus bus 417. When the master control relay 448 is thus energized, the armature thereof moves to the right and thereby opens the pick-up contacts 447 and closes a pair of holding contacts 453, the latter being connected directly to the plus bus 416 by a wire 454. The contacts 447 and 453 are of the overlapping type, that is, the holding contacts 453 make before the pick-up contacts 447 break. With the holding contacts 453 closed, direct current will flow through the holding circuit for the main coil 450 which is traced as follows: from the plus bus 416, through the wire 454, contacts 453, wire 449, to the coil 450; and, from the latter, through wire 451, contacts 96, and wire 452, to the minus bus 417.

Contacts 455 also close when master control relay 448 is energized and they thereby condition an energizing circuit for the clutch magnet CM. This conditioned clutch magnet control circuit is established when the start switch contacts 441 are again closed by the operator releasing the start switch 25. The clutch magnet circuit is traced as follows: from the positive bus 416 through the plug socket connections R54 and T54, a wire 456, normally closed relay contacts 356 which as will be explained hereinafter are under the control of elements for effecting carriage return of the typewriter, a wire 458, normally closed contacts 326 which are under the control of elements for effecting tabulating operations of the typewriter and will be explained hereinafter, a wire 357, normally closed contacts 358 of group spacing means to be described more fully hereinafter, a wire 459, normally closed contacts 460 of the typewriter start switch 225, wire 461, plug socket connections T52 and R52, wire 462, the now closed contacts 455 of the master control relay 448, a wire 463, the now closed contacts 441 of the start switch 25, wire 464, the clutch magnet CM, and from the latter through a wire 465, the now closed contacts 96, and wire 452 to the minus bus 417. The clutch magnet circuit just traced directly controls the operation of the reader in the manner previously explained; i. e. when the clutch magnet CM is energized by the closing of this circuit, the operating shaft 35 of the reader is connected by the clutch 37 to the power shaft 31 and the successive cyclic tape feeding and sensing operations will begin and will continue at a rate determined by the designed speed of the power shaft until the clutch magnet CM is de-energized by the opening of any of the now closed contacts in its control circuit.

The typewriter start switch 225 is connected in parallel with the reader start switch 25, so that the operation of the apparatus may be started by depressing and releasing the switch 225 in the same manner as just described in connection with the switch 25. As shown, the switch 225 is provided with two pairs of spring blade contacts which are the normally closed contacts 460 mentioned above, and a normally open pair of contacts 467. One contact of the pair of contacts 467 is permanently connected to the D. C. plus bus 416 through the wire 456 and plug socket connections T54 and R54. The other contact of the pair of contacts 467 is connected by a wire 468 and a wire 469 with the normally closed insert switch 227 which, as explained previously in connection with switch 25, is connected to the D. C. minus bus 417 through the wire 445, plug socket connections T51 and R51, wire 446, pick-up contacts 447 of the master control relay 448, wire 449, coil 450, wire 451, contacts 96, and wire 452. Thus, with the apparatus at rest, by depressing the switch 225 to close its contacts 467, and open the contacts 460, a flow path for direct current is established through the pick-up contacts 447 and coil 450 of the master control relay 448, and the latter, when energized, will close its holding contacts 453 and remain energized by the holding circuit established thereby which was previously traced. As explained above, the contacts 455 are closed by the energizing of relay 449 and the clutch magnet circuit is conditioned thereby. When the start switch 225 is released, its contacts 460 again close and the conditioned energizing circuit for the clutch magnet CM is thereby established.

As described previously, herein, when the reader shaft 35 commences to rotate, due to the energizing of the clutch magnet CM and the resulting engagement of clutch 37, the tape 10 is first spaced to move a record field into sensing position which is directly above the sensing pins S1 to S6, inclusive, and then the field is sensed by the pins to determine the code hole designation therein. As an example let it be assumed that the record field being sensed bears the code hole designation for the normal case letter character "Y" and the shifted case figure character "6." which, as shown in Fig. 11, comprises code holes in positions 1, 3, and 5. As shown in Fig. 7, and as previously explained, the sensing of the 1—3—5 code hole designation will result in the sensing pins S1, S3, and S5 moving upward through the code holes in the tape to close contacts C1, C3, and C5, respectively. The contacts C1, C3, and C5 will close at approximately 130° of the revolution of shaft 35 to condition signal circuits connected in parallel, and will remain closed until 325°, and the D. C. common contacts 104 are closed by the cam 102 at 142° to establish such signal circuits and are opened again at 311°. With the contacts C1, C3, and C5 closed, and with the D. C. common contacts 104 closed, the signal current will flow from the D. C. positive bus 416 through cam contacts 104, the contacts C1, C3, and C5 in parallel, and through signal wires 471, 473, and 475 to translator relay magnets M1, M3, and M5, respectively, and from the latter through wires 431, 433, and 435, respectively, the closed contacts of read relay 420, to the D. C. minus bus 417. With the translator relay magnets M1, M3, and M5 thus energized by the producing of a signal corresponding to the 1—3—5 code designation, their respective relay contacts are transferred to their lower positions. As the relays M2, M4, and M6 remain deenergized, their related transfer contacts will remain in their normal upper positions.

With the transfer contacts of the translator in the position just stated, and when the cam 103 on the reader shaft 35 closes the A. C. common contacts 103 at 170° of the revolution of shaft 35, alternating current will flow through the controlling circuit flow path established by the translator contacts, to the solenoid 247 controlling the key lever 226 for the normal case letter "Y" and shifted case numeral "6" on the typewriter, and, thereby, effect the operation of the related type bar 212 in the manner previously explained. Assuming the type basket to be in its normal case position, the energizing of the solenoid 247 as just explained will result in the normal case character "Y" being printed on the sheet 221. The closed A. C. circuit path for energizing the solenoid 247 is traceable as follows: from the A. C. supply lead 400, a wire 477, contacts 103 now closed, a wire 478, contacts M1—1 in the lower position, a wire 479, contacts M2—2 in the position shown, a wire 480, contacts M3—3 in the lower position, a wire 481, contacts M4—6 in the position shown, a wire 482, contacts M5—11 in the lower position, a wire 483, contacts M6—22 in the position shown, a wire 484, the plug socket connections R32 and T32, a wire 485, solenoid 247 for actuating the type bar carrying the normal case character "Y," a wire 486, and if the power switch 24 is closed, through the wires 413 and 405, plug socket connections T59 and R59, the wire 409, switch 24 to the A. C. supply wire 401. If instead, the switch 224 is closed, the circuit will include the wire 412, switch 224, wire 411, plug sockets T55 and R55, and wire 401.

From the foregoing it will be understood that if the clutch magnet CM remains energized, and the contacts 96 are closed by the tape 10 at the reading station 20, the cycles of operation of the apparatus will be repeated at the designed speed of the shaft 31. During each such cycle of operation, the tape will first be spaced to bring the new record field into sensing position, and such record field will then be sensed to determine the code designation therein in the manner previously described. When the field sensed bears a character code designation, a space code designation, the "Shift" code designation or the "Release" code designation, the translator relays will be operated to provide a controlling circuit path through the related solenoids to actuate the related key lever in the same manner as just explained in connection with the sensing of the 1—3—5 code designation.

As is disclosed fully in my said copending application when the code designation is sensed which represents a functional operation of the typewriter requiring a longer-than-normal time for its completion, provision is made for stopping the cyclic sensing operation of the reader when such functional operations are being effected by the typewriter and for resuming the sensing operations upon a completion of such functional operation. Examples of such functional operations requiring a longer-than-normal time for their completion are carriage-return, tabulating, and back-space. From an examination of Fig. 10*b*, it will be noted that each of the key lever actuating solenoids 247 for effecting these three last-mentioned functional operations is connected to a circuit wire 491, and that the latter is in turn connected through a wire 492, plug socket

connections T49 and R49 and the wire 490 with one input terminal of a rectifier 493. The other input terminal of the rectifier 493 is connected by the wire 489 and switch 24 with the A. C. supply wire 491. If the switch 224 is closed instead of switch 24 such other input terminal of rectifier 493 is connected to supply wire 491 through plug sockets R59 and T59, wire 495, wire 413, wire 412, switch 224, wire 411, plug sockets T55 and R55, and wire 410.

Thus, when the code designation corresponding to either the carriage return, tabulating or back space operation is sensed, and the translator is adjusted thereby to condition a controlling circuit through the solenoid 247 corresponding to the sensed code designation, the closing of the A. C. common contacts 100 will energize such corresponding solenoid 247 and will connect the input terminals of rectifier 493 across the A. C. supply line. One D. C. output terminal of the rectifier 493 is connected by a wire 494, relay contacts 495 and wire 496 with one side of a bucking coil 497 of relay 448, and the other side of the coil 497 is connected with the other D. C. output terminal of the rectifier. With the relay 448 energized, the contacts 495 are closed. Consequently, the just described closing of A. C. common contacts 100 will result in the energizing of bucking coil 497. The coils 497 and 450 are oppositely wound, and the coil 497 is of sufficient strength to overcome the coil 450 and cause relay 448 to drop out and thereby open its holding contacts 453. The contacts 495 also drop out and break the circuit through the bucking coil 497. The contacts 455 in the clutch magnet circuit, also open to deenergize the clutch magnet CM and thereby stop further sensing operations. The pick-up contacts 447 close, but the main coil 450 cannot be energized again until other normally open contacts in the pick-up circuit are closed.

As disclosed fully in my said copending application, the energizing of the solenoid 247 for effecting a carriage return operation effects actuation of a cam unit, not shown herein but which is somewhat like the unit 233, and such actuated cam unit is locked in its actuated position until the operation is completed, at which time it is released and returned to its normal position. In Fig. 10*b* the reference character 367 indicates a depending contact-actuating arm which forms a rigid part of this carriage return cam unit. The arm 367 is shown in its normal or inactive position. When the carriage-return cam unit to which the arm 367 is attached is actuated, the arm 367 moves to the left as viewed in Fig. 10*b* and thereby closes contacts 360 and 361 and opens contacts 362, and when the carriage return operation is completed and the arm 367 thereby returned to its inactive position shown, the contacts 360 and 361 move back to the open position shown and contacts 362 back to their closed position.

When the contacts 361 are closed by the arm 367, as just explained, a full wave dry plate rectifier 369 is thereby connected across the A. C. supply source by a circuit traced as follows: from the A. C. supply wire 490, wire 402, plug sockets R56 and T56, wire 403, wire 404, a wire 370, contacts 361, wire 371 to one input terminal of rectifier 369; and, from the other input terminal of rectifier 369, through a wire 372, wire 413, wire 405, plug sockets T59 and R59, wire 409, and switch 24 to the other A. C. wire 491. If switch 224 is closed, instead of 24, the circuit will include the wire 412, switch 224, wire 411, plug sockets T55 and R55, and wire 410. With the rectifier 369 thus connected across the A. C. source, a relay 373, which is connected across the output terminals of the rectifier, is energized. The energized relay 373 opens its relay contacts 356, previously described as being in the clutch magnet circuit.

Thus, when the carriage-return code designation is sensed, the master control relay 448 is dropped out with the energizing of the carriage return solenoid 247 and the energizing circuit for the clutch magnet is opened by the contacts 455 and also by the relay contacts 356. When the contacts 360 are closed by the arm 367, they establish a pick-up circuit for the main coil 450 of relay 448 through the now closed pick-up contacts 447. This pick-up circuit is as follows: from the D. C. plus bar 416, plug sockets R54 and T54, wire 456, contacts 360, wire 409, insert switch 227, wire 445, sockets T51 and R51, wire 446, pick-up contacts 447, wire 449, main coil 450, wire 451, contacts 96, and wire 452 to the minus bus 417. The relay 448 is thereby again picked up and is held by its hold contacts 453, as before, and its contacts 455 in the clutch magnet circuit close, but the latter circuit is not closed as typewriter contacts 351 are still closed, and relay contacts 356 are thereby held open. When the carriage-return operation is completed and the contacts 351 again open to deenergize relay 373 and thereby permit its contacts 356 to close, the clutch magnet CM is energized and the cyclic sensing operation of the reader continues as before.

When the typewriter begins a tabulating operation the contacts 326 in the clutch magnet circuit are opened by an element of the typewriter and contacts 327 are closed. Thus, when the code designation representing a tabulating operation is sensed, the typewriter carriage is tabulated and the master control relay 448 is dropped out by the energizing of the bucking coil 497, and the clutch magnet circuit is opened both by contacts 326 and 455. The closing of contacts 327 connects the wires 456 and 409, the same as contacts 360, and they thereby establish the pick-up circuit which was traced above for master control relay 449. The relay 448 is held energized by its contacts 453, and when the tabulating operation is completed and the contacts 326 again closed, the clutch magnet circuit is again established and cyclic reading operations are resumed.

When a back-space code designation is sensed, the typewriter is caused to back space and the master relay 448 is dropped out due to the energizing of the bucking coil 497, and the clutch magnet circuit is opened by relay contacts 455, as before. However, as a back space operation only requires a relatively short period of time to be completed, the relay 448 is immediately picked up again and held and the clutch magnet circuit restored to the contacts 455. The later is effected by contacts 310 connecting wires 456 and 409, such contacts 310 being closed by a typewriter element which moves as a result of a back-space operation as explained in said copending application.

The operation of the reader 100 may be manually stopped by depressing either stop switch 26 or 226. One side of switch 26 is connected directly to the A. C. supply wire 490 and the other side of switch 26 is connected to the other A. C. supply wire 491 through a wire 425, a wire 426, the rectifier 493 and wire 409 and switch 24.

One side of stop switch 226 is connected to the A. C. supply wire 400 through the wires 404, 403, plug sockets T56 and R56, and wire 402, and the other side of switch 226 is connected to the other A. C. supply wire 401 through the wires 491 and 492, plug sockets T49 and R49, the wires 490, the rectifier 493 and the wire 409 and switch 24. Thus, when either switch 26 or switch 226 is depressed, the rectifier 493 is connected across the A. C. supply line and the bucking coil 493 is thereby energized to drop out the master control relay 448 and there open the clutch magnet circuit and stop the reader. Reading operations can then be resumed only by depressing either of start switches 25 or 225 to pick up the master control relay, as previously described.

In accordance with the present invention, the illustrative embodiment includes a means for providing automatically during a tape-controlled typing operation, a blank space in the typewritten lines at any preselected character-space position or positions of the typewriter carriage 220. The blank spaces are provided under the control of spacing movements of the carriage. This means comprises generally a contact assembly 375 and a plurality of spaced settable contact-actuating elements 376 (see Figs. 8, 9, and 10*b*). As will presently appear, the contact assembly 375 is mounted on a fixed part of the typewriter frame 231 and includes the pair of break contacts 358 and a pair of make contacts 377. The spaced settable contact-actuating elements 376 correspond in number and spacing to the character-space positions of the carriage 220 and they are pivotally mounted in spaced parallel relation on a transverse horizontal bar 378 carried by the carriage 220.

The detailed structure of the above-mentioned carriage-controlled spacing means and its associated parts is shown in Figs. 1, 8, and 9. As shown, the carriage 220 comprises a pair of spaced vertical end plates 260 and 261, respectively, which are rigidly connected by a transverse horizontal plate 262, by a tie rod 263, and by the usual rack bar 264 for controlling tabulating operation of the typewriter. The ends 265 of the rack bar 264 are screw threaded and extend through openings in the end plates 260 and 261 and are secured thereto by suitable nuts 266 (Figs. 1 and 9). The two end plates 260 and 261 are provided, respectively with extension plates 379 and 380 and the latter extend rearwardly and are rigidly connected at their rear ends by the above mentioned horizontal transverse bar 378, which is substantially the same in construction as the rack bar 264, and by a horizontal angle bar 381 carrying a supporting roller 382. The extension plates 379 and 380 are in overlapping engagement with their respective end plates 260 and 261 and are secured thereto by the threaded ends 265 of the tabulating rack bar 264 and their coacting nuts 266 and by additional bolts 383 passing through aligned openings in the engaging plates. The transverse bar 378 is also provided with threaded end extensions 384 which pass through suitable openings in the extension plates 379 and 380 and are fixed to the latter by suitable screws 385. The two ends of the angle bar 381 are also fixed, respectively, to the extension plates 379 and 380 by suitable bolts 386.

As stated, the structure of the bar 378 is the same as the conventional tabulating rack bar 264, that is, the bar 378 is formed with a plurality of spaced pairs of vertical grooves 387. The grooves composing each pair are disposed, respectively, on opposite sides of the bar 378 and in a common vertical plane extending normal to the longitudinal axis of the bar 378. One of the settable contact actuating elements 376 is disposed within each pair of grooves 387. As shown in Fig. 8, the elements 376 are substantially U-shaped and are pivotally mounted on a rod 388 extending lengthwise of the bar 378 and across the rearmost groove of each pair of grooves 387.

The rear portion of the fixed frame structure 231 of the typewriter includes a transverse vertical wall 270 and a top wall 271. A rear extension housing 389 is suitably secured by screws 390 to the vertical rear wall 270 and includes a top wall extension 391 lying flush with the top wall 271. A transverse track member 392 is fixed to the top wall 391 and includes an upper horizontal flange 393 providing a bearing support engaged by the roller 382.

The contact assembly 375 is fixed to the rear side of an upstanding bracket 394 which is in turn fixed to the top wall 271 by suitable screws 395 and is inclosed by a removable housing 396. The housing 396 is secured by screws 397 to the bracket 394 and is provided with a slot-like opening 398 through which extends a roller 399. The roller 399 is carried by a movable arm 301 which forms a part of the contact assembly 375 and is attached at its outer end to the two movable spring blades 302 and 303 of the pairs of contacts 358 and 377, respectively.

As shown in Figs. 8 and 9, each settable contact actuating element 376 may be manually adjusted about its pivotal support to occupy either a non-operating position or a pre-set position. In its pre-set position, each element 376 will engage the roller 399 and actuate the contacts 358 and 377 when the carriage 220 is moved to the character-space position corresponding to such preset element 376. In Fig. 8 the non-operating position of element 376 is shown by full lines and its pre-set position by dotted lines. In Figs. 9 and 10*b*, the elements 376 in pre-set positions are shown as extending forwardly of the remaining elements which are shown in their non-operating positions. It is noted that adjacent elements 376 in pre-set positions are separated by four elements 376 in non-operating position.

From the foregoing, it will be apparent that with the typewriter 200 being operated under the control of code designations recorded in the record tape 10 as explained hereinabove, each time the carriage 220 is spaced to a character-space position corresponding to a pre-set element 376 such preset element will engage the roller 399 and move the arm 301 and spring blades 302 and 303 to open the break contracts 358 and close the make contacts 377. In the above description of the wiring diagram disclosed in Fig. 10*a* and 10*b*, it was explained that the break contacts 358 are in the energizing circuit for the clutch magnet CM. It will therefore be apparent that upon the carriage 220 moving to a position corresponding to a preset element 376 the clutch magnet CM will become deenergized by the opening of the contacts 358, which will result in stopping the reading and spacing operation of the tape reader 100. With the switch 355 in its full line closed position shown in Fig. 10*b*, the closing of the make contacts 377 by a preset element 376 in the manner just explained, will establish an energizing circuit for the solenoid 247 which actuates the space bar. This circuit is traced as follows: from A. C. supply wire 400 (Fig. 10*a*), wire 402, plug socket connections R56 and T56,

wires 403, and 404, a wire 311, the knife switch 355 in the full line closed position shown, a wire 312, the make contacts 377, now closed, a wire 313, contacts 362 of the group actuated by the carriage return cam unit, a wire 314, the wire 353, the solenoid 247 for the space bar, the wires 486, 413, and 405, plug socket connections T59 and R59, and wire 409 and switch 24 to the other A. C. supply wire 401. If switch 224 be closed instead of switch 24, the circuit will include instead the wire 412, switch 24, wire 411, and plug socket connections T55 and R55 and wire 410.

When the space bar solenoid 247 is energized by the closing of make contacts 377 by the circuit just traced, the escapement pawls 204 (Fig. 8) will be actuated to space the carriage one character-space position. It will be apparent that when the latter occurs, the pre-set element 376 will move out of engagament with the roller 399 and back to the position shown in Figs. 9 and 10*b* where the make contacts 377 in the energizing circuit for the space bar solenoid are open and the break contacts 358 in the clutch magnet circuit are closed. With the reclosing of the contacts 358, the clutch magnet CM is again energized and the operation of the typewriter 200 under the control of the code designations in the tape 10 will continue until the carriage is spaced to a character-space position corresponding to another pre-set contact-actuating element 376, at which time the above described spacing operation of the carriage will be repeated.

The manually operable knife switch 351 provides a means for selectively including or eliminating from the typed copy blank character spaces which are represented by space code designations in the record tape 10. With the knife switch 351 in its full-line open position shown in Fig. 10*b*, the controlling circuit path provided by the translator as a result of the sensing of the code designations representing a spacing operation, is open with the result that the sensing of such code designation will have no effect on the operation of the typewriter. Thus, with the contact actuating elements 376 pre-set as shown in Fig. 9, each line of typed matter will appear on the copy sheet as blocks of four characters separated by a blank character space. As is well known, such a result is desirable in certain types of work. If it is desired to also include in the typed lines, the spaces provided by space code designations in the record tape being sensed, the switch 351 is moved to the dotted line position shown so that the aforementioned controlling circuit path through the translator which is provided by the sensing of the space code designation, will be established to the solenoid 247 which actuates the space bar.

If it is desired to eliminate the control of the spacing operations of the typewriter by the carriage 220, the switches 354 and 355 are moved to their dotted line positions shown in Fig. 10*b*. With the switch 354 in its dotted line position, contacts 326 are thereby connected directly to the wire 459 by means of a wire 316 and a wire 317, thus shunting the contacts 358 out of the clutch magnet circuit and thereby eliminating control of the clutch magnet by the latter contacts. With the switch 355 in its dotted line position the circuit path from contacts 377 to the AC supply wire 400 which extends through the wire 312, 311, 404, and 403, the plug socket connections T58, R58 and the wire 402, is open at the switch 355, with the result that the closing of the contacts 377 can not establish an energizing circuit for the solenoid 247 which actuates the space bar of the typewriter.

In order to prevent the contacts 377 from energizing the space bar solenoid 247 while the carriage 220 is being returned to begin a new line of typing, the normally closed contacts 362 are provided. As explained above, when the cam unit for effecting operation of the carriage-return mechanism is actuated, the arm 367 is moved to the left as shown in Fig. 10*b* and thereby opens the contacts 362. The contacts 362 are in the energizing circuit for the space bar solenoid 247 which is controlled by the carriage actuated contacts 377. Thus, upon return movement of the carriage and the closing of the contacts 377 by the roller 399 engaging pre-set elements 376 the space bar solenoid 247 will not be energized. Also, because the clutch magnet circuit is opened at the beginning of a carriage-return operation, as explained previously, and remains open until such operation is completed, the opening of contacts 358 by pre-set elements 376 while the carriage is being returned will have no effect on the operation of the typewriter.

While there have been shown and described and pointed out the fundamental novel features of the invention, as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention therefore to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. Signal-controlled printing apparatus comprising means for successively producing character-representing signals and signals representing functional operations including a carriage-return signal; printing means including a carriage for holding a work copy in printing position, a plurality of character type elements, character actuating means responsive to the producing of each character-representing signal to effect printing from the character type element represented by such signal and to effect spacing of said carriage, carriage return means responsive to the producing of a carriage-return signal for returning said carriage to begin a new line of printing, and space actuating means operable when rendered effective to space said carriage the equivalent of one character space; control means operable when rendered effective to maintain continuing operations of said signal producing means and operable when rendered ineffective to stop operation of said signal-producing means; mechanism responsive to spacing movements of said carriage and operable upon said carriage occupying each of a plurality of predetermined character space positions to render said control means ineffective and said space actuating means effective and operable upon the spacing of said carriage from each of said predetermined space positions to render said control means again effective; and means responsive to the operation of said carriage return means for rendering said mechanism ineffective while said carriage is being returned to begin a new line of printing.

2. Signal-controlled printing apparatus comprising means for successively producing character-representing signals and signals representing functional operations including a carriage-return signal; printing means including a carriage for

holding a work copy in printing position, a plurality of character type elements, character actuating means responsive to the producing of each character-representing signal to effect printing from the character type element represented by such signal and to effect spacing of said carriage, carriage return means responsive to the producing of a carriage-return signal for returning said carriage to begin a new line of printing, and space actuating means operable when rendered effective to space said carriage the equivalent of one character space; control means operable when rendered effective to maintain continuing operations of said signal producing means and operable when rendered ineffective to stop operation of said signal-producing means; mechanism responsive to spacing movements of said carriage and operable upon said carriage occupying each of a plurality of predetermined character space positions to render said control means ineffective and said space actuating means effective and operable upon the spacing of said carriage from each of said predetermined space positions to render said control means again effective; and means responsive to the operation of said carriage return means for rendering both said mechanism and said control means ineffective while said carriage is being returned to begin a new line of printing.

3. In apparatus for printing character data on a copy sheet in accordance with the data-representing designations in a record sheet, the combination of means for sensing successively said data designations; printing means including a carriage for holding said copy sheet and movable successively to different character space positions, a plurality of selectively actuatable type elements operable when actuated to print corresponding characters on said copy sheet, spacing means operable when actuated to advance said carriage one character space position, character actuating means controlled by said sensing means and operable in response to the sensing of each character-representing designation to actuate the type element for printing the character represented by such designation and to actuate said spacing means; means for controlling the operation of said sensing means and including an electrically responsive device effective when energized to maintain continuing operation of said sensing means and effective when deenergized to stop operation of said sensing means; and mechanism responsive to spacing movements of said carriage and effective upon said carriage occupying each of a plurality of preselected character space positions to deenergize said device and actuate said spacing means and operable upon said carriage moving from each said preselected position to energize again said device.

4. In apparatus for printing character data on a copy sheet in accordance with data-representing designations recorded in a record sheet, the combination of means for sensing successively said data designations; translator means providing circuit flow paths corresponding, respectively, to the designations sensed; printing means including a carriage for holding said copy sheet and movable successively to different character space positions, a plurality of selectively actuatable type members for printing character data on said copy sheet, spacing means operable when actuated to advance said carriage one character space position, a plurality of character actuators operable when rendered effective to actuate, respectively, said type members and to actuate said spacing means and said actuators being rendered effective, respectively, by the establishing of corresponding circuit flow paths by said translator means, and an electrically responsive spacing actuator operable when energized to actuate said spacing means; means for controlling the operation of said sensing means and including an electrically responsive device effective when energized to maintain continuous operation of said sensing means and effective when deenergized to stop operation of said sensing means; and mechanism responsive to spacing movements of said carriage and effective upon said carriage occupying each of a plurality of preselected character space positions to deenergize said device and to energize said spacing actuator and operable upon said carriage moving from each said preselected position to energize again said device and deenergize said spacing actuator.

5. In apparatus for printing character data on a copy sheet under the control of data designations recorded in a record strip and representing, respectively, the character data to be printed and the functional operations of a printing means including a designation representing a spacing operation, the combination of means for successively sensing said data designations on the record strip; printing means including a carriage for holding said copy sheet in printing position and movable successively to different character space positions, a plurality of selectively actuatable type elements operable when actuated to print corresponding characters on said copy sheet, and spacing means operable when actuated to advance said carriage one character space position; character actuating means controlled by said sensing means and operable in response to the sensing of each character designation to actuate the type element for printing such character and to actuate said spacing means; space actuating means responsive to the sensing of the space representing designation for actuating said spacing means; means operable at the selection of the operator for rendering said space actuating means operative and inoperative; and means responsive to spacing movements of said carriage and operable upon said carriage occupying each of a plurality of predetermined character space positions to actuate said spacing means.

6. In apparatus for printing character data on a copy sheet under the control of data designations recorded in a record strip and representing, respectively, the character data to be printed and the functional operations of a printing means including a designation representing a spacing operation, the combination of means for successively sensing said data designations on the record strip; printing means including a carriage for holding said copy sheet in printing position and movable successively to different character space positions, a plurality of selectively actuatable type elements operable when actuated to print corresponding characters on said copy sheet, and spacing means operable when actuated to advance said carriage one character space position; character actuating means controlled by said sensing means and operable in response to the sensing of each character designation to actuate the type element for printing such character and to actuate said spacing means; space actuating means responsive to the sensing of the space representing designation for actuating said spacing means; means operable at the selection of the operator for render-

ing said space actuating means operative and inoperative; control means operable when rendered effective to maintain continuous operation of said sensing means and operable when rendered ineffective to stop operation of said sensing means; and means responsive to spacing movements of said carriage and operable upon said carriage occupying each of a plurality of predetermined character space positions to render said control means ineffective and to actuate said spacing means, and operable upon said carriage being spaced from each of said predetermined character space positions to render said control means again effective.

7. In apparatus for printing character data on a copy sheet under the control of data designations recorded in a record strip and representing, respectively, the character data to be printed and the functional operations of a printing means including a designation representing a spacing operation, the combination of means for successively sensing said data designations on the record strip; printing means including a carriage for holding said copy sheet in printing position and movable successively to different character space positions, a plurality of selectively actuatable type elements operable when actuated to print corresponding characters on said copy sheet, spacing means operable when actuated to advance said carriage one character space position, and carriage-return means operable when actuated to return said carriage to begin a new line of printing; character actuating means controlled by said sensing means and operable in response to the sensing of each character designation to actuate the type element for printing such character and to actuate said spacing means; space actuating means responsive to the sensing of the space representing designation for actuating said spacing means; means operable at the selection of the operator for rendering said space actuating means operative or inoperative; control means operable when rendered effective to maintain continuous operation of said sensing means and operable when rendered ineffective to stop operation of said sensing means; mechanism responsive to spacing movements of said carriage and operable upon said carriage occupying each of a plurality of predetermined character space positions to render said control means ineffective and to actuate said spacing means, and operable upon said carriage being spaced from each of said predetermined character space positions, to render said control means again effective; means responsive to the sensing of a significant designation for actuating said carriage-return means; and means effective during the carriage return operation for rendering said mechanism inoperative.

8. Signal-controlled printing apparatus comprising means for successively producing character-representing signals; a printer including a fixed frame element, and a carriage element for holding a work copy in printing position and movable to occupy successively different character space positions; a member mounted on one of said printer elements and extending in the general direction of movement of the carriage element; a plurality of spaced stop members mounted on said member and corresponding in number and spacing to the character space positions of the carriage; each said stop member being selectively movable transverse to the direction of carriage movement and from an inactive position to a pre-set or contact-actuating position; adjustable contact means mounted on the other of said printer elements and being so disposed that it is operatively engaged and adjusted to an actuated condition by each of the pre-set stop members when the carriage occupies the character space positions corresponding, respectively, to such pre-set stop members; said printer also including a plurality of character type elements and spacing means operable when actuated to space said carriage one character space position; character actuating means responsive to the producing of each character-representing signal to effect printing from the character type element represented by such signal and to effect actuation of said spacing means; an electrically responsive space actuator operable when rendered effective, to actuate said spacing means; electrically responsive control means operable when rendered effective to maintain continuous operation of said signal-producing means and operable when rendered ineffective to stop operation of said signal-producing means; and electrical circuit means including said contact means and operable upon said contact means being adjusted to its said actuated condition by operative engagement with any of said pre-set stop members to render said control means ineffective and said space actuator effective and operable upon said contact means being disengaged from said pre-set stop members, by spacing movement of said carriage element, to render said space actuator ineffective and said control means again effective.

9. Signal-controlled printing apparatus comprising signal-producing means operable to produce a continuous chain of successive signals representing, respectively, predetermined character and functional data; printing means including a carriage for holding a work copy in printing position, a plurality of character type elements, character actuating means responsive to the producing of each character-representing signal to effect printing from the character type element represented by such signal and to effect spacing of said carriage, and space actuating means operable, when actuated, to space said carriage the equivalent of one character space; a control device adjustable to either of two operating conditions and normally occupying one of said operating conditions, and said device being operable to maintain continuous operation of said signal-producing means when in its said normal operating condition, and being operable to stop operation of said signal-producing means when adjusted to the other of its said operating conditions; and means responsive to spacing movements of said carriage and operable upon said carriage occupying each of a plurality of predetermined character space positions to adjust said control device to its said other operating condition and to actuate said spacing means, and being operable upon the spacing of said carriage from each of said predetermined character space positions to adjust said control device back to its said normal operating condition.

10. Signal-controlled printing apparatus comprising a source of power; signal-producing means operable, when connected to said source of power, to produce a continuous chain of successive signals representing, respectively, predetermined character and functional data; printing means including a carriage for holding a work copy in printing position, a plurality of character type elements, character actuating means responsive to each character-representing signal to

effect printing from the character type element represented by such signal and to effect spacing of said carriage, and space actuating means operable, when actuated, to space said carriage the equivalent of one character space; a control device adjustable to either of two operating conditions and normally occupying one of said operating conditions, and said device being operable to provide a driving connection between said source of power and said signal-producing means when occupying its said normal one operating condition, and being operable to disconnect said source of power and said signal-producing means when adjusted to the other of its said operating conditions; and means responsive to spacing movements of said carriage and operable upon said carriage occupying each of a plurality of predetermined character space positions to adjust said control device to its said other operating condition and also to actuate said spacing means, and being operable upon the spacing of said carriage from each of said predetermined character space positions to adjust said control device back to its said normal operating condition.

11. Signal-controlled printing apparatus comprising a source of power including a continuously rotating power shaft; signal-producing means including an operating shaft adapted to be driven by said power shaft, and means driven by said operating shaft and operable when so driven to produce a continuous chain of successive signals representing, respectively, predetermined character and functional data; printing means including a carriage for holding a work copy in printing position, a plurality of character type elements, character actuating means responsive to each character-representing signal to effect printing from the character type element represented by such signal and to effect spacing of said carriage, and space actuating means operable, when actuated, to space said carriage the equivalent of one character space; a control device adjustable to either of two operating conditions and normally occupying one of said operating conditions, and said device being operable to provide a driving connection between said power and operating shafts when occupying its said normal one operating condition, and being operable to disconnect said power and operating shafts when adjusted to the other of its said operating conditions; and means responsive to spacing movements of said carriage and operable upon said carriage occupying each of a plurality of predetermined character space positions to adjust said control device to its said other operating condition and to actuate said spacing means, and being operable, upon spacing of said carriage from each of said predetermined character space positions, to adjust said control device back to its said normal operating condition.

12. In apparatus for printing character data on a copy sheet in accordance with data-representing designations, the combination of sensing means operable to sense successively said data designations; printing means including a carriage for holding said copy sheet and movable successively to different character space positions, a plurality of selectively actuatable type elements operable when actuated to print corresponding characters on said copy sheet, spacing means operable when actuated to advance said carriage one character space position, and character actuating means controlled by said sensing means and operable in response to the sensing of each character-representing designation to actuate the type element for printing the character represented by such designation and to actuate said spacing means; a control device adjustable to either of two operating conditions and normally occupying one of said operating conditions, and said device being operable to maintain continuous operation of said sensing means when in its said normal one operating condition, and being operable to stop operation of said sensing means when adjusted to the other of its said operating conditions; and mechanism responsive to spacing movements of said carriage and operable upon said carriage occupying each of a plurality of predetermined character space positions to adjust said control device to its said other operating condition and to actuate said spacing means, and being operable upon spacing of said carriage from each of said predetermined character space positions to adjust said control device back to its said normal operating condition.

13. Signal-controlled printing apparatus comprising signal-producing means operable to produce a continuous chain of successive signals representing, respectively, the character data to be printed and the functional operations of a printing means and including a signal representing a spacing operation; printing means including a carriage for holding a work copy in printing position, a plurality of character type elements, spacing means operable when actuated to advance said carriage one character space position, character actuating means responsive to the producing of each character-representing signal to effect printing from the character type element represented by such signal and to actuate said spacing means, and means responsive to the producing of a space-representing signal for actuating said spacing means; means operable at the selection of the operator for rendering said last-named signal responsive means operative and inoperative; and means responsive to spacing movements of said carriage and operable upon said carriage occupying each of a plurality of character space positions to stop operation of said signal-producing means and to actuate said spacing means.

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