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ELECTRICALLY CONTROLLED CHARACTER PRINTING APPARATUS

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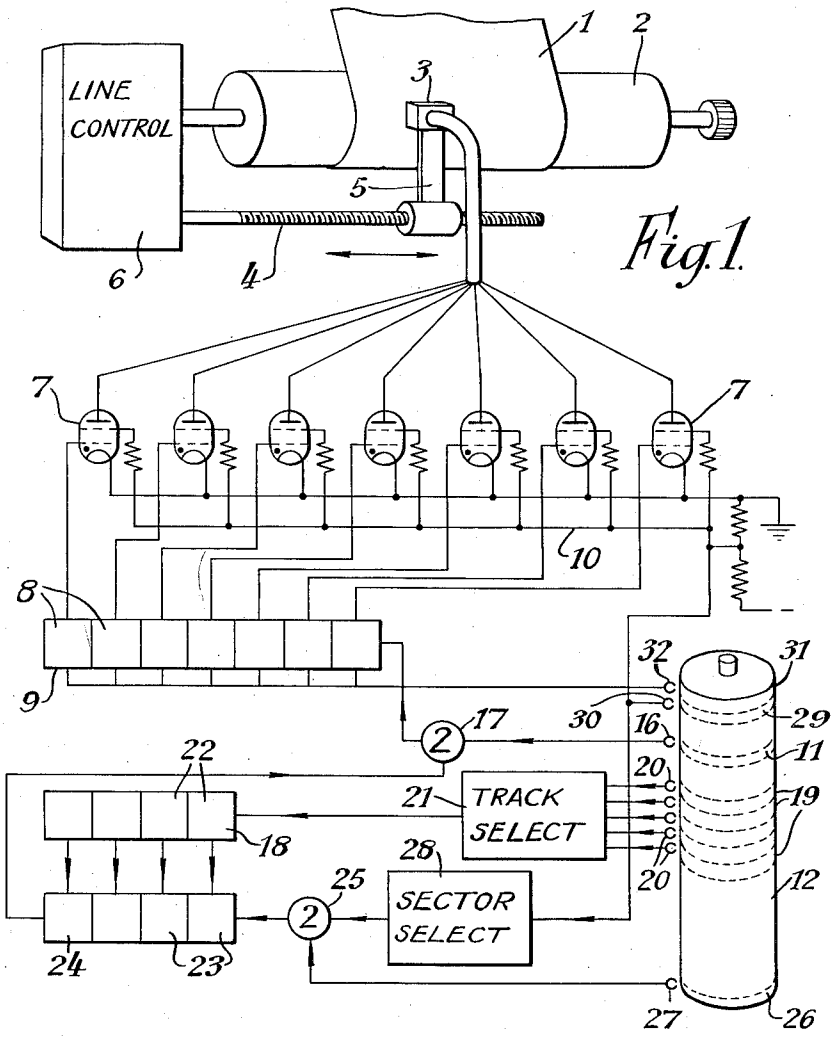

Fig. 1.

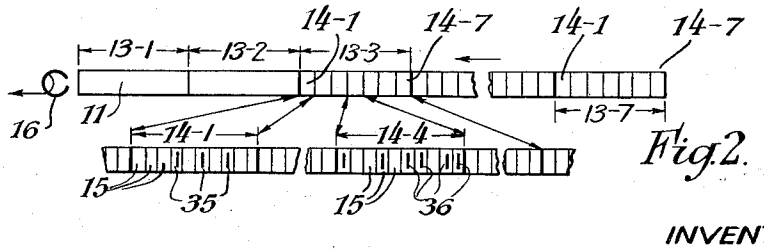

Fig. 2.

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ELECTRICALLY CONTROLLED CHARACTER PRINTING APPARATUS

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The present invention relates to electrically controlled character printing apparatus.

Conventional character printing devices, such as those operated under control of record cards, employ a print member such as typewheel or type bar which carries an individual type face for each different character to be printed. However, in another form of printing device, characters may be composite in form, each character being delineated by a number of dot-like elements. Thus the printing member consists of a group of impression members, each of which produces one of the dot-like elements, and any character may be printed by selective operation of the group of impression members.

One arrangement for printing composite characters is shown in French Patent No. 790,062. A key is provided for each character. When a particular character key is operated it renders effective a pulse generator which generates a carrier frequency modulated by a pulse pattern representing the corresponding character. The carrier may then be transmitted over a teleprinter line to a receiving station. The carrier is applied to a group of five filters at the receiving station and the output of each filter is used to control the operating electromagnet of an impression member. Each impression member consists of a pivoted lever with a small printing face. The printing faces of the five impression members are in a straight line and a strip of paper is fed past the impression members in a direction at right angles to such straight line of the printing faces. Simultaneous operation of the impression members produces a row of dots which merge to form a straight line across the strip. Repeated operation of one member produces a line along the strip. Selective operation of the members may produce a pattern of dots approximating to a circle, oval or diagonal line. The shape of any desired character may be produced by suitable modulation of the carrier wave produced by the pulse generators.

Each pulse generator utilized in the printer consists of an oscillator and a modulator. Various forms of modulator are described, including a commutator, a cam-operated switch and a toothed wheel of magnetic material which is rotated between the poles of a magnet to cause modulation of the reluctance of the magnetic circuit. A considerable number of such generators are needed for printing numeric and alphabetic characters and symbols. Furthermore, the arrangement described is suitable only for operation at normal keyboard operating speeds.

An object of the present invention is to provide an improved pulse generating arrangement for a composite character printing device.

Another object of the present invention is to provide a pulse generating arrangement suitable for the simultaneous control of a number of composite character printing devices.

Another object of the invention is to control a composite character printing device by signals derived from a cyclically operating magnetic storage device, such as a rotatable magnetic drum or disc.

In order that the present invention may be readily carried into effect, it will now be described with reference to the accompanying schematic drawing, in which:

FIG. 1 is an embodiment, partly in perspective, of a character printing apparatus operable under control of a magnetic drum storage device; and

FIG. 2 is an embodiment of part of a font track of the storage device of the embodiment of FIG. 1.

As shown in FIG. 1, a sheet 1 is fed by means of a conventional platen 2 past a character printing head 3. It is preferred to reciprocate the printing head 3 across the sheet 1 by means of a threaded rod 4 acting in conjunction with a printing head carrier 5. Since the printing head 3 and its associated carrier 5 are relatively light they may be reciprocated at higher speeds and with more precision than a heavier paper carriage. The threaded rod 4 and the platen 2 are driven by means of a line control mechanism 6 in a manner such that a line of characters may be printed each time the head 3 is moved across the sheet 1, and, at the conclusion of each line of printing the platen 2 may be line spaced or otherwise advanced in conventional manner.

The printing head 3 is a known arrangement for printing composite characters and includes a group of seven impression members. Each impression member consists of a pivoted lever having a small printing face. The printing faces of the seven impression members are arranged in a straight line at right angles to the direction of movement of the head across the sheet. Thus, simultaneous operation of all the impression members produces a row of dots which merge to form a vertical straight line on the sheet, whereas repeated operation of any one member produces a horizontal line on the sheet. It will be apparent therefore that a character may be printed by the selective operation of individual impression members, as the head moves across the sheet, in the manner well known in relation to so-called composite character printers.

In the present case five separate operating times or "strokes" for the impression members are provided for the printing of each character in a line. Thus each of the characters is formed within an area of a 7 x 5 matrix of dot positions. Two blank strokes are used to provide a space between adjacent characters so that the printing cycle for one character consists of seven strokes

Each of the impression members is operated to produce printing of a dot by energization of a control electromagnet (not shown) and, as indicated in FIGURE 1, a separate gas filled relay tube 7 is provided for the energization of each one of the impression member electromagnets. As will be seen, each of the gas filled relay tubes 7 is primed to fire under control of a respective stage 8 of a seven-stage shifting register 9 by means of a connection from that stage 8 to a first control electrode of the tube 7.

The tubes 7 each have two control electrodes and the second control electrodes of all the tubes are connected in common to a control line 10. Each printing stroke is accomplished (subject to control by the shifting register 9) by applying a signal to the line 10 and in consequence all those tubes 7 which have been primed are fired simultaneously. Thus the particular pattern of dots to be printed on each stroke is determined by signals applied to the shifting register 9. The signals applied to the shifting register 9 are in turn derived from signals recorded on a font track 11 of a magnetic storage drum 12 under control of a gate 17. The gate 17 is controlled by the particular character to be printed.

Before further considering the operation of the character selection apparatus it will be helpful at this point to consider the arrangement of signals recorded on the font track 11. FIGURE 2 shows schematically the arrangement of a part of a font track 11 for controlling the printing of the digits 0 to 9. The track 11 may be regarded as divided into seven equal stroke sectors 13–1 to 13–7, one stroke sector for each stroke of a printing

cycle. The first two stroke sectors 13–1 and 13–2 are blank, corresponding to the two blank strokes between adjacent printed characters.

Each of the remaining five sectors 13–3 to 13–7 is divided into seven sub-sectors 14–1 to 14–7, each sub-sector corresponding to one impression member of the print head 3. Each of the sub-sectors 14–1 to 14–7 is further divided into ten digit areas 15 corresponding to the digits 0 to 9.

The third sector will correspond to the first effective printing stroke since the first two strokes and sectors are blank. If the print head is moving from right to left the energization of all the control magnets on this stroke would produce a line of dots down the right hand side of the character printing area. The various combinations of impression members which need to be operated to print the various digits naturally depend upon the shapes chosen for each digit. It will be assumed that the impression member which prints the top part of the character is required to operate on the first stroke only when the digits 3, 5 and 7 are to be printed. To effect this operation signals are recorded in the 3, 5 and 7 digit areas 15 of the first sub-sector 14–1 of the third sector 13–3, as shown diagrammatically by marks 35. The fourth impression member from the top, on the other hand, might be required to be operated in printing the digits 0, 3, 5, 6, 8 and 9. Accordingly, the fourth sub-sector 14–4 of the third sector 13–3 would have signals recorded in the 0, 3, 5, 6, 8 and 9 digit positions 15, as represented by marks 36. Thus, it will be seen that a signal is recorded in a particular digit position 15 of a sub-sector 14 if the printing of the corresponding digit requires operation of the impression member associated with that sub-sector.

The signals recorded in the digit areas 15 are read out by a reading head 16 associated with the font track 11. The head 16 will therefore read out a serial train consisting of the signals required to control the first impression member to print or not print during the first stroke for recording the digits 0 to 9, followed by a similar group of signals to control the second impression member and so on. The seven groups of signals relating to the first stroke are followed by the seven groups of signals relating to the second stroke and so on. The signal train from the reading head 16 is fed to the gate 17 shown in FIGURE 1 which is arranged to pass only those signals which relate to the particular character to be printed. The control of the gate 17 will now be described.

The signals representing the character to be printed on a particular cycle are read from one of a group of data tracks 19 on the drum 12 by means of reading heads 20. The particular track 19 from which the signals representing a character are to be read out is determined by a track selecting arrangement 21 and the resultant signals are applied to a shifting register 18. In a preferred arrangement the character representing signals are recorded on the tracks 19 which are divided for this purpose into sectors and sub-sectors in the manner described in British patent application No. 34,981/57. In these circumstances the signals derived from the selected track 19 are in binary coded decimal form to represent the digits 0 to 9 and the transfer of these signals may take place when the first blank sector 13–1 of the font track 11 is passing the reading head 16. Upon completion of this transfer the shifting register 18 is set to a value which represents, in binary coded decimal form, the character to be printed. Each stage 22 of the shifting register 18 is connected to a stage 23 of a four-stage binary decimal counter 24 in such a manner that at the conclusion of the transfer of signals from a track 19 the counter 24 is set to the complement of the digit value which is to be printed. As the start of the third sector 13–3 (FIGURE 2) reaches the reading head 16 (FIGURES 1 and 2), a gate 25 is opened to allow a train of clock pulses to be fed to the input of the counter 24. Ten clock pulses are applied to the counter during the sensing of each sub-sector 14 by the head 16 and these pulses are derived from a clock track 26 on the drum 12 by means of a reading head 27. The gate 25 is controlled by a signal derived from a sector selecting arrangement 28 which receives impulses read from a timing track 29 by means of a reading head 30. The pulses from track 29 occur at the time when the beginning of each of the sectors 13 of the font track 11 is about to pass the head 16.

The application of clock pulses in this way to the counter 24 causes the counter to generate a carry pulse at sometime during the sensing of each sub-sector 14, and the counter 24 will be cycled through ten counts during the sensing of each sub-sector, so that the registered value will be the same at the beginning and the end of each of the sub-sectors. The complemental value in the counter will cause the carry pulses to occur at the time of sensing of those digital positions 15 in each sub-sector 14 of the font track 11 which correspond to the digital value held in the register 18. For example, if the shifting register 18 is registering the value 3 the counter 24 will be set to register the complemental value 6. The carry will then occur on the fourth clock pulse, at which time the 3 digit position 15 of a sub-sector 14 of the font track 11 is being sensed. The carry pulse from the counter 24 is used to open the gate 17 which, it will be recalled, receives the signal train from the reading head 16 associated with the font track 11. Since the counter 24 is cycled by the clock pulses for each sub-sector 14 of the font track 11 the gate 17 therefore passes the signals from the selected digit positions 15 of each of the sub-sectors 14. The output signals from the gate 17 are fed to the input of the seven stage shifting register 9. Shifting pulses for this register 9 are derived from another timing track 31 of the drum 12 by means of a reading head 32. The track 31 provides one pulse at the end of each sub-sector 14 so that the pattern of output pulses relating to the selected character is entered and shifted along the register 9. It will be recalled that each stage 8 of the register 9 primes one of the gas filled relay tubes 7 controlling operation of an impression member in the printing head 3, so that at the end of each sector 13 the tubes 7 are primed to correspond to the printing pattern required for a printing stroke. An impulse from the track 29 is applied by means of the head 30 to the common line 10 which is in turn connected to the second control electrode of each of the gas filled relay tubes 7. Thus, at the end of the complete sensing of each sector those gas filled tubes 7 which have been primed by signals from the stages 8 of the register 9 are fired thereby energizing the appropriate electromagnets controlling the operation of the selected impression members of the printing head 3.

It will be appreciated that although three separate timing tracks 26, 29 and 31 have been shown, the various timing signals may all be derived from the clock pulse train generated by the clock track 26 by using suitable timing counters.

Further, although the apparatus has been described as operating to print the characters 0 to 9, it will be apparent that the number of characters which may be printed can be increased by providing a corresponding number of storage positions in each sub-sector. Each character may be represented by a five or six element binary code, the counter controlling the gate 17 being correspondingly enlarged. However, digital characters may be represented by a four element code as described and alphabetic characters may be represented by associating a zone coding with the digital coding in much the same manner as in punched card coding. Under these circumstances the gate 17 is replaced by a gating arrangement consisting of 5 gating elements, each generally similar to the gate 17 but having an additional control line. All the gating elements of the arrangement are primarily controlled by a counter similar in function to

the counter 24. Each gating element receives signals from a reading head associated with a separate one of five font tracks and the additional control lines of the gating elements are jointly controlled by three flip-flops. The outputs of the flip-flops are connected to the gating elements in such a manner that each element is rendered operative by a unique combination of settings of the flip-flops. The three flip-flops are set in accordance with the zone part of the character code at the same time that the counter is set in accordance with the digit part of the character code. In this way the zone part of the code controls selection of one of the five signal trains from the font tracks and the digit part of the code controls selection of the desired signals from the selected train.

Another group of font tracks may also be provided with the signal trains recorded in reversed sequence. This enables the drum to rotate in one direction only while controlling printing during both forward and return movement of the printing head across the sheet. The appropriate group of font tracks is selected by contacts which are set to a first or a second position in dependence upon the direction of movement of the printing head.

In the foregoing description it has been assumed that the drum and the printing head are moving in synchronism. However, generally similar arrangements to those described may be employed under conditions where the drum is not rigidly synchronized with the movement of the printing head. The drum is operated at such a speed that it performs two revolutions for each character to be printed. An additional control circuit is provided to ensure that the selected font track is read out once only for each character to be printed. It will also be apparent that the same result may be alternatively achieved by arranging that the drum rotates at half this speed and providing two recordings of the complete font signal train in each font track.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What I claim is:

1. In a device for printing a composite character and including a printing head having a plurality of independently operable impression members in a line, with means for effecting relative movement in a direction at right angles to such line between the print head and the material to be printed whereby in each letter space on such material the printing head traverses a mosaic of "bit" areas in columns and rows, a first cyclically readable signal store having storage areas representative of the said bit areas taken in series column by column, permanent signals in all those storage areas representing a bit area which may contain a bit of any character to be printed; a first reading means for said first signal store; a second cyclically readable signal store receiving signals representative of particular characters to be printed; a second reading means for said second signal store; a plurality of electronic operating devices one for each of said impression members and each having two control elements; timing means making one of said control elements of all said electronic devices effective temporarily at each column position of the impression members in each said letter space; and gating means controlled by pulses from said second reading means to make effective the other of said control elements in each said column position

for each of the impression members selected by pulses from permanent signals read from the said first signal store.

2. In a device according to claim 1, a plurality of simultaneously readable signal tracks in said second signal store and a corresponding plurality of reading heads in said second reading means, selecting means for making any one of said reading heads effective in any cycle of reading, a shifting register receiving from such selected reading head a pulse train representing as a numerical value the character to be printed, an electronic counter connected to said shifting register so as to be set to a complement of such numerical value, and a clock pulse generator feeding pulses to said counter synchronously with the reading of said signal stores to determine when the counter operates said gating means.

3. In a device according to claim 2, a second timing means and a second gating means between said counter and said second timing means, and a second selecting means making said second gating means operative when said first control elements of all of the electronic operating devices are made effective.

4. Apparatus for printing a required composite character on a record member in a plurality of operating strokes comprising a number of individually operable printing elements arranged in a line, means for producing relative movement transversely between the line of elements and the record member and selecting means for operating individual ones of the elements in each of the operating strokes to cause the operated elements to print a part of the required character, the selecting means including a cyclically operable signal storage device having a font track divided into a number of sectors, each sector being associated with one operating stroke and containing a separate sub-sector corresponding to each of the printing elements and each sub-sector containing a storage area related to each character which may be printed, like areas in all sub-sectors being related to the same character, signals being stored only in those areas corresponding to the printing elements to be selected for each character during each operating stroke, means for reading out stored signals from the areas elated only to the required character as electrical signals and means for applying the electrical signals read out in each stroke to select corresponding printing elements for operation.

5. Apparatus according to claim 4, having a plurality of electronic operating devices one for each printing element and each having two control elements, a shifting register having its stages connected to one such control element in the operating devices, pulse timing means priming all said stages simultaneously, grating means between said shifting register and the said reading means for the font track, a second cyclically operable signal storage device receiving signals representative of the character to be printed and reading means therefor, and selecting means whereby pulses from such reading means make said gating means effective.

6. In a device according to claim 5, a plurality of simultaneously readable signal tracks in said second signal storage device and a corresponding plurality of reading heads in said second reading means, selecting means for making any of said reading heads effective in any cycle of reading, a shifting register receiving from such selected reading head a pulse train representing as a numerical value the character to be printed, an electronic counter connected to said shifting register so as to be set to a complement of such numerical value, and a clock pulse generator feeding pulses to said counter synchronously with the reading of said signal storage devices to determine when the counter operates said gating means.

7. In a device according to claim 6, a second timing means and a second gating means between said counter and said second timing means, and a second selecting means making said second gating means operative when said first control elements of all the electronic operating devices are made effective.

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