This invention relates to high-speed printers, and, more particularly, to improvements in apparatus for the utilization thereof.

There are presently commercially purchasable high-speed printers suitable for use as output printers for information-handling machines which require electronic apparatus for their operation. The letter and number type are secured to the drum periphery as axially extending columns. Each axial column contains the small type letter or number. Opposite each column at one end of the drum are markings, usually magnetic, which can be used to identify when a particular letter is opposite the printing position. Thus, if 26 letters and 10 numbers are all that is required, the drum will have 36 columns of type and appropriate marks at one edge to signify when a particular letter or number is opposite the printing position.

Paper which is to be printed upon, together with an inked ribbon, are passed through the printing position, which may be at the bottom of the drum. A column of individually movable hammers are employed which are selectively actuated to press the paper against the ribbon and type character at the printing position. These hammers usually extend in a column parallel to the columns of type on the drum. There are as many hammers in a column as there are type characters in a column. These hammers are usually individually actuated by solenoids which rapidly move them selectively as the drum rotates.

Electronic apparatus is employed to control the operation of the hammers.

In the operation of the high-speed printer, for every line of printing, the drum is required to make a complete revolution, since only in that manner can the alphabet and the letters from zero to nine be reviewed to determine which of them is required in the line of printing. Thus, the paper advances one line after every revolution of the drum. For each line to be printed, the present practice is to employ an electronic register into which there is entered in a suitable code the letters, numbers, and other symbols contained in a line of printing. Means are provided for scanning the register to determine whether or not the columns of letters presented to the paper at any given time contain any letter which should be printed in that line. In order to perform this operation, the presently favored practice is to compare the contents of the register at each position with the code identification of the letter present at the printing position. If this is a letter required in the line being printed for a particular position, then a solenoid which controls the hammer at that position is actuated, and the drum is printed. It will be appreciated that the time required to review and compare the contents of a register for a given line of printing with the code identifying the letter at the printing position is a factor which determines the speed of operation of the system. The more quickly this operation can be performed, the more advantageously the high-speed printer can be used.

An object of the present invention is to provide a novel arrangement for increasing the speed of operation of the high-speed printer.

Another object of the present invention is the provision of an arrangement for increasing the speed of operation of a high-speed printer without increasing the complexity of the apparatus required.

Another object of the present invention is to increase the reliability of a high-speed printer.

Another problem present in the utilization of a high-speed printer of the type described generally above is presented when it is desired to print numbers which, for example, represent dollars and cents. Usually, in the representation of numbers by information-handling machines, a number length is employed, and the absence of a number at any given position is filled by the representation of a zero. Thus, if it were desired to represent the number 382 in a system having, say, a six-digit number length, the code in the information-handling system would read 000382. In the use of the high-speed printer, the three zeros to the left of the numeral three will be printed out, unless a precaution is taken to prevent this from occurring. Yet, because of the fact that it is necessary to print zeros (for example, number 302, or 504.06), an arrangement must be found which only suppresses zeros in positions where they do not have significance.

Accordingly, a further object of the present invention is the provision of an improved circuit for utilization with a high-speed printer which prevents the printing of zeros which have a nonnumeric significance.

These and other objects of the invention are achieved in a system wherein data for a line of print is entered into a plurality of registers. The contents of each register is then circulated and compared with the letter present at the printing position, which is represented by a code identification. For the purpose of circulation, each register is divided into two parts. The circulation of the contents of the register is performed after the emptying of data into the register by circulating these two parts. Thus, when the register is divided in half, the circulation is from the center of the register to the front end and from the back end of the register to the center of the register. It will be appreciated that this permits access to the contents of the register for comparison purposes in much less time than would be normally required.

Zero suppression is achieved by first insuring that zero is the last number scanned. The printing of all zeros within a word is suppressed from left to right up to the first nonzero number, but no zero suppression is applied to the units position of a number. If it is desired to print numbers to the right of the decimal point, then no zero suppression is permitted in any of these number positions to the right of the decimal point.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

Figure 1 is a perspective view of the general type of output printer with which the embodiment of the invention may be employed;

Figure 2 is a block schematic diagram of an embodiment of the invention;

Figure 3 is a block schematic diagram of a comparator suitable for use with this invention; and

Figure 4 is a block schematic diagram of a circulating register suitable for use with this invention.

Referring now to Figure 1, there is shown a high-speed printer of the type previously generally described in which the present embodiment of the invention finds its greatest use. The high-speed printer comprises a drum 10, having
columns of printing type 12, extending axially across the periphery. Identifying marks for each column of printing type may be positioned at one end of the drum for indicating each of the type characters coming into the printing position. However, with the present embodiment of the invention, it is preferred to add a smaller drum, or disc, 14 on the shaft 16, upon which the drum rotates. This drum 14 is therefore rotated along with the drum 10 by the driving motor 18.

Identifying code marks for each column of type are magnetically or mechanically impressed upon this additional drum in the same code as is employed in the information-handling machine, with which the output printer may be associated. The reason for using this arrangement is that normally the drum may be manufactured with one set of indicia for the columns of printed characters and the information-handling machine with which the drum is to be associated may have another output code. It therefore becomes necessary to convert either the drum code to machine code, or vice versa, before a comparison for printing purposes can be performed. By the simple mechanical expedient described above, these complications are avoided.

A reading head 18 is employed to sense the identifying marks on the drum 14. This reading head may comprise several reading heads which are aligned so that the output from the reading head 18 can comprise a set of parallel existing signals. These are applied to a coincidence device 20, which comprises electronic circuitry for comparing the identification of the character read by the reading heads 18 with the identification of the character desired to be printed. A source of printer signals 22 provides the latter signals. The source of printer signals may be the information-handling machine, which furnishes these signals to some type of device which holds them in a line-by-line fashion, in order that the drum may complete one revolution for each line of print which is desired to be printed. Upon coincidence being found between the column of type at the printing position and the signal supplied from the source 22, a hammer-control apparatus 24 is actuated.

This hammer-control apparatus consists of circuitry for selectively energizing thyatrons which energize solenoids which drive hammers to strike paper 26, which is being slowly passed between the hammer 25 and the drum 10. A ribbon 26 supplies the ink for the necessary printing. The ribbon also travels slowly between the paper and the drum. The hammers 25 are usually in a column positioned underneath the lowermost part of the drum and are driven upwards to press the paper against the ribbon and type. Thus, a line of print can be completed before the paper can move to position a fresh area for the next line of print.

Reference is now made to Figure 2, which is a block diagram of an embodiment of the invention. Data from the source of printer signals is entered into a plurality of registers 30, 30', etc., successively, so that all the registers contain the code for one line of data to be printed. Each register, by way of example, holds 84 binary bits. The first 84 binary bits of code are entered into register 30. When this register fills, the next 84 binary bits are entered into register 30', etc. As many registers are employed as are required to hold the data desired to be printed in a line on the paper.

Methods for filling registers successively from a single source are well known in the art. One favored method is to have a gate positioned in front of each register. Information from the source of data is applied to each one of the gates in parallel. A counter is employed to provide successive enabling outputs to each one of these gates. When the counter counts off enough to fill the first register, the enabling input to the first gate is removed and is applied to the second gate. When the counter has counted off a sufficient amount so that the second register is filled, the enabling input to the second And gate is removed and applied to the third And gate, etc.

Of significance here is that a plurality of registers are used, each of which consists of two parts, respectively designated as 30a, 30b, 30a', 30b', etc. For the purposes of entry of data, each of these registers, which consists of two parts, may be considered as a single register. It is only when data is circulated that the data in the "a" portion of each one of the registers circulates, just as if it was an independent register, and the data in the "b" portion of the register circulates, just as if it was an independent register. In this manner, the contents of the registers for a line of type may be stored in much less time.

The code wheel 14 in Figure 1 besides providing as output code indications, has two additional tracks. One of these tracks provides a pulse output just before each column of type letters or numbers comes under the printing position. The remaining track provides an output pulse each time the drum has completed one revolution. Assume that the registers 30, 30', etc., have been filled. A pulse from the code wheel, indicative of the fact that a column of type is arriving at the printing position, applies a pulse to a flip-flop 32, driving it to its set condition, whereby its output is applied to two And gates 34, 36. A second required input to And gate 36, before it can provide an output, consists of pulses from a clock-pulse source. The clock-pulse source, as is well known in the information-handling field, provides the timing pulses whereby all operations of the information-handling machine are timed. These are regularly occurring pulses which may be derived in a number of ways. A preferred manner is to employ a magnetic drum having markings placed thereon which are read as the drum rotates to provide regularly occurring clock pulses.

The output of the And gate 36 is applied to a bit-phase counter 37. To illustrate the invention, but not to limit it, it will be assumed that each character desired to be printed is represented by seven binary bits. Each register holds 12 characters (84 binary bits); each register portion holds 6 characters (42 binary bits). The bit-phase counter is a ring counter which counts to seven and then starts counting over again. The seven outputs are applied to the shift-pulse generator 39 for the purpose of enabling the registers to cycle through their contents. The output of the bit-phase counter 37, when it is filled, is applied to the And gate 34, to provide the second required input whereby its output can occur. The output of And gate 34 is applied to a column-phase ring counter 41, which can count a total of six counts before it returns to its initial counting position. Each output of each stage of the column-phase ring counter is designated by the letters A through F. These outputs are applied to And gates elsewhere in the drawing. The use of the letters for the ends of the arrows from the column-phase ring counter 40 and for the beginnings of the arrows at various other portions of the drawing are employed in order to maintain clarity and to avoid confusion in the drawing, which would occur were these points connected.

The last output of the column-phase ring counter 40 is applied to reset the flip-flop 32. Thus, the bit-phase ring counter has a total of seven counts before it returns to its initial condition. When it attains its seventh count, it applies an output to the column-phase ring counter, which makes it count one. The column-phase ring counter counts a total of six counts before it can return to its initial counting condition. The bit-phase ring counter is therefore required to circulate six times to advance the column-phase ring counter six counts. As the shift-pulse generator applies shift pulses to the registers 30, 30', etc., the two halves of the registers circulate their contents. The circulating contents are applied to comparators 40a, 40b, 40a', 40b', etc., respectively associated with the registers 30a, 30b, 30a', 30b', etc. Another
input for comparison purposes is applied from the code wheel to all the comparators simultaneously. Thus, as the respective halves of the register circulate their contents, these are compared with the code representation of the column of type which is at the printing position.

The output of the comparator 40a is applied simultaneously to the comparators 50a through 50f. The output of the comparator 40b is applied to a succeeding six And gates (not shown). The output of the comparator 40c is applied to still another six And gates (not shown). The output of the comparator 40d is applied to yet another set of six And gates (not shown). Thus, it should be understood that the output of the comparators 40a through 40f, 40a through 40f, are described for the output of comparator 40a. Thus, for every complete register employed with the output printer, which register consists of two parts, there is required two sets of circuits of the type which will be described as being coupled to the output of comparator 40a.

Associated with each And gate 50a through 50f and driven thereby are flip-flops 52a through 52f. One of the other required inputs to And gate 50a is an output from the first stage of the column-phase ring counter 38, designated as A. Another required input to And gate 50a before it can drive the flip-flop 52a is an output from the rectangle representing the nonzero-on-code-wheel 60. This is merely well-known code-recognition circuitry which senses the outputs from the reader 18 on the code wheel 14, and so long as the printing drum 10 does not have a zero at the printing position, an enabling output is provided from the nonzero-on-code-wheel circuit 60. An illustration of a code-recognition circuit suitable for this purpose is by Ayres and Smith in their Patent No. 2,648,723.

It will be seen that the And gates 50a through 50f all have as one of their required inputs an output from the column-phase ring counter 38. Register 50a circulates its contents at the end of which time the column-phase ring counter counts one, whereby the output designated as A is applied to And gate 50a. The comparator 40a, if it finds that the contents of register A and the code-wheel indication are identical, applies its output to all the And gates 50a through 50f simultaneously. However, since only And gate 50a has the required enabling input from the column-phase ring counter 38, only it will be enabled to provide an output which drives the associated flip-flop 52a. If flip-flop 52a has been driven to its set condition, it is enabled to prime for fixing an associated thyatron tube 56a, which, when subsequently fired by a pulse from the fire-pulse source 62, can fire a hammer which prints a letter at the column position for that hammer. The fire-pulse source 62 is energized after the contents of the registers have been compared with the code-wheel indication, to determine whether or not printing should occur at the various positions along the column of type.

At this time it should be again emphasized that each one of the registers, before cycling, holds a total of 84 binary bits. Thus, when cycling occurs, each half of a register circulates 42 binary bits. In the present embodiment of the invention, seven binary bits represent a letter or a number. Therefore, at the end of the circulation of seven bits, And gate 50a will or will not have set the associated flip-flop 52a. The register continues to cycle and to present the next seven bits to the comparator. The code-wheel code is circulated again, to be compared by the comparator 40a. At the end of the interval for comparing the second set of seven binary bits, the comparator 40b provides an output or not, dependent upon whether or not there is an identity. At this time, And gate 50b is enabled and if an identity is established, will drive flip-flop 52b. Flip-flop 52b, if driven, can prime the associated thyatron tube 56b. Thus, as the register continues to cycle, there will be a comparison of each set of seven binary bits at the comparator and entry will successively be made, dependent upon whether or not an identity is established, into the successive flip-flops 52c through 52f. It should be noted that all the registers circulate their contents simultaneously, all the comparators perform the operation of comparison simultaneously, and all the sets of And gates and associated flip-flops associated with the respective comparators successively enter the information that a letter in the column presently at the printing position should or should not be printed.

As the printing drum continues to rotate, the indications from the code wheel initiate successive counting cycles of the counters 37, 38. The registers 50a, 50b, 50c, 50d, 50e, 50f, etc., circulate their contents together once each time signals are provided from the code drum that a letter or a number is approaching the printing position. At the end of the circulation of the contents of the registers, fire-pulse source 62 provides a pulse that fires the ones of the thyatrons which have been primed by their associated flip-flops. The flip-flops 52a through 52f are not reset until after a complete drum rotation occurs. Since the thyatrons are fired by discharging a condenser therethrough, which is only charged once prior to the beginning of the printing cycle of the drum, the thyatrons cannot be fired more than once for a printing-drum revolution.

For zero suppression, the Or gates 54b through 54f and the circuitry for recognition of a nonzero on the code wheel 60 are employed. When there is no zero present on the code wheel, representative of the fact that there is no zero present at the printing position, an enabling input is applied to all the And gates 50a through 50f, directly as in the case of And gate 50a, or through Or gates 54b through 54f. Before proceeding further with the explanation, it should be understood that one of the conditions necessary for the operation of the circuit described is that all the numbers from one through nine must pass under the printing position before the zero column reaches there. It is also necessary to reset all the flip-flops before the numeric-printing portion of the drum begins to pass under the printing position. This does not require any extra circuitry, since the zero suppression is required usually only when it is desired to print numbers only and not letters. When letters and numbers are desired to be printed together, then it is usually not desired that zero suppression occur.

With these conditions having been fulfilled, if a number is to be printed on a line, then one of the flip-flops 52a through 52f is left in its set condition. It should be noted at this time that the output from flip-flop 52a, when in its set condition, is applied to Or gates 54b through 54f. The output of flip-flop 52b, when in its set condition, is applied to Or gates 54c through 54f. And, similarly, the succeeding flip-flops (with the exception of flip-flop 52f) provide outputs to the succeeding Or gates. Accordingly, if flip-flop 52b were left in its set condition, indicative of the fact that one of the numbers from one to nine was printed, the succeeding And gates 50c through 50f will receive their third required enabling input and will be able to print a zero when a zero is called for in those positions. However, And gate 50a will not receive its enabling input and cannot print a zero at that position. Similarly, if flip-flop 52d were set and none of the preceding flip-flops, then a zero could only be printed in the positions serviced by flip-flops 42c and 52f. If dollars and cents values are to be printed, then no zero-suppression connections are applied to the positions which are to the right of the decimal point, and, if desired, the unit position is not connected into the zero-suppression circuit.

The And gates and Or gates which have been recited as being employed in the embodiment of the invention shown in Figure 2 are well-known circuits in this art. Suitable ones are described and shown, for example, in an article by Chen T. C., in the Institute of Radio Engineers Proceedings, vol. 38, pp. 511-514, May 1950, entitled Diode...
coincidence and mixing circuits in digital computers. Flip-flop circuits are also well-known circuits, suitable ones being shown, for example, in the text Electronics, published by the McGraw-Hill Book Company, Inc., by Elmore and Sands, pp. 96-99. This book also shows suit-able gate and counter circuits.

Reference is made to Figure 3, which shows a suitable type of comparator which may be employed with the embodiment of the invention. Data from the reading apparatus 18 is employed to set or not the flip-flops 70A through 70G in accordance with the seven binary digit code representation of the column of type approaching the printing position. This, in turn, serves to prime or not And gates 72A through 72F, which are connected to receive output from the flip-flops when they are in their set condition. The bit-phase ring counter 37 provides successive outputs to the And gate 72A through 72F, all of which are coupled through output cathode followers 74A through 74F to the input to the comparator. Thus, as the bit-phase counter cycles six times, it will serialize and cycle six times the code identification of the column of type appearing at the typing position.

The flip-flops 78A through 70G are reset after the column of type is printed. The comparator has two inputs, one from the cathode followers 74A through 74F and the second from the circulating register with which the comparator is associated. For example, the input from the cathode followers is applied to an And gate 76 and an inverter 78. The input from the circulating register is applied to another And gate 80 and an inverter 82. The outputs of And gates 76 and 30 are applied to an Or gate 83. The output of the Or gate 83 is applied to an And gate 84. The output of the And gate 84 is applied to drive a reset condition a flip-flop 86. At the commencement of each cycle of operation of the comparator, a clock pulse and a start pulse are applied to an And gate 88 to set the comparator flip-flop 86 with its one output high. This is applied to an And gate 90, the output of which in response to a quiz pulse, whose timing will be subsequently described, is applied to all the And gates 50A through 59F.

In the comparator, at the start of a comparing cycle the flip-flop 86 is set with the one output high. At the end of the comparing cycle, if an identity was present during the entire comparison of the output from the circulating register and the output from the code-wheel serializer, the And gate 90 will provide an output when the comparator is applied thereafter since the flip-flop 86 remains in its set condition. Should an identity not occur, the flip-flop 86 is driven to its reset condition and no output will be provided from the And gate 90 at the time the quiz pulse is applied therein. In the presence of an input, the inverters 78 and 82 do not provide any output. In the absence of an input, the inverters 78 and 82 do provide an output. Therefore, if two identical inputs occur on the two input lines to the comparator, the And gates 76 and 80 are not opened, since only one of their two required inputs is provided.

When the inputs to the comparator are dissimilar, then either And gate 76 or And gate 80 will be opened to provide an output pulse to reset the flip-flop 86. The quiz pulse may be derived from a separately timed quiz-pulse source, which occurs between the seventh count of the bit-phase counter and the initial count thereof, or a quiz pulse may be derived from the successive outputs of the column-phase ring counter through a display line. The delay must not be such as to run into the next comparing cycle. The start pulse may be derived from a separate source, or may be obtained from the pulse which advances the bit-phase ring counter to its first count condition.

Figure 4 is a more detailed block diagram of the circulating registers which are preferred. Each circulating register consists of two parts, register A and register B. Register A and register B are connected together to load just as if they were a single register, and data is fed serially to the inputs. After the register is loaded, a circulate command is given and the register commences to circulate from the center toward the front end and from the back end to the center. The pulse from register A and register B, are each of the type shown and described in an article by Stevens and Knapp in Electronics Magazine for November 1949, pp. 181-184, entitled Gate type shifting register.

Each register consists of as many flip-flop stages as is desired to store binary digits of information. Thus, since the complete register stores 84 binary digits of information, there will be 84 flip-flop stages. Each half of the register, accordingly, has 42 flip-flop stages. A portion of these flip-flops is shown in register A. These are flip-flops 109, 102 at the input to the register. The reset output side of the flip-flop is coupled via a diode 104 to the reset side of the second flip-flop 102. The set side of the flip-flop 100 is coupled via a diode 106 to the set side of the flip-flop 102. Thus, when a shift pulse is applied from the shift-pulse generator, the diodes will conduct or not conduct in accordance with the output condition of flip-flop 100. This conduction and non-conduction is transferred to the gates of flip-flop 102, which then assumes the same condition as the one which flip-flop 100 had. Meanwhile, flip-flop 100 is made to assume the condition of the binary-digit signal which is applied to its input grids. These signals applied to flip-flop 100 may result either from new data coming in through an And gate 108 or old data being circulated through And gate 110. A feed command is also necessary to open And gate 108, whose output is applied to the Or gate 112. The output of the Or gate is amplified and applied to either set the first flip-flop stage in the register, or, if no output is received from And gate 108, then inverter 116 resets the input flip-flop stage so that it is representative of a zero.

And gate 118 is enabled to transfer the binary digital information it is receiving from the last flip-flop stage of register A only if the other required input, namely, the feed command, is present. In this event, it applies its output to an Or gate 120, the output of which is amplified by an amplifier 122 and applied to register B, either to set its input stage to a one condition or, in the absence of an input from And gate 118, to set its input stage to the zero condition by operation of the inverter 124. If it is desired to circulate the contents of register A and register B, And gate 118 does not receive the feedcommand enabling input, and And gate 110 receives a circulate command as also does And gate 126. These two And gates then are able to apply the data received from the ends of the half of the register to the respective Or gates 112 and 120, from whence it is re-entered into the respective halves of the registers. When new data is entered into the register, it replaces that already in the register, since the old data cannot circulate, and, therefore, is dissipated.

The shift-pulse generator 39 supplies pulses for either entering new data into the register or for circulating the data already there. For entering new data into the register, an And gate 130 receives an input from the feedcommand source and a second input consisting of the pulses which clock the derivation of data from the source from which it is received. These data-source pulses are applied from the And gate 130 to an Or gate 132, then amplified by an amplifier 134 and applied to the shift-pulse generator, which, in response thereto, generates the pulses applied for shifting the data into the register. When the register is filled, a circulate command which is identical with the one previously being applied to And gates 110 and 126, enables And gate 136 to apply the pulses received from the bit counters 37 to the Or gate 132 and thence to the shift-pulse generator 39 for circulating the data in the two halves of the register.
The circulate-command and feed-command inputs may be derived from the program circuitry of the information-handling machine with which this apparatus is employed. In the operation of this embodiment of the invention, the printing operation occurs during one complete revolution of the drum and the register-loading operation occurs during the next revolution of the drum. Where it is desired to print numbers and letters together, it may not be desirable to employ zero suppression. However, where it is desired to print only numbers, then the zero-suppression circuitry is employed. Since one cycle of a drum is employed for loading the registers and the other cycle of the drum is employed for circulating the registers, the circulate command and the feed command can be derived from the single-pulse track on the code drum, which applies the single pulse per revolution to a two-step counter, the output from which can be alternately used to signal feed information and then circulate information.

There has accordingly been shown and described above novel, useful circuitry for utilization with an output printer of the class described which enables much more rapid rotation of the output-register drum in view of the fact that the contents of the register are scanned in half the time previously required. Further, a novel arrangement is shown for the purpose of suppressing unwanted zeros in the print-out of numbers.

We claim:

1. In an output-printing apparatus wherein different columns of type are successively moved through a printing position, wherein first signals representative of the letters in a column of type at said printing position are compared with second signals representative of characters desired to be printed in a line at said printing position, and wherein there are means to print selected ones of the type in a column in response to identities of first and second signals being established, the improvement in said output-printing apparatus comprising a plurality of registers each having two parts, means to fill said registers with second signals, counting means, means to drive said counting means through successive count conditions, means to couple the output of each said register part with its own input for circulation of its contents, means to circulate the contents of all said register parts responsive to the successive count conditions of said counting means, a separate means for each register part for comparing first signals with the circulating contents of each register part to provide an output signal for each identity indicative of the presence in the column of type providing said first signals of characters for which printing is desired, a separate means coupled to each said means for comparing said first signals of characters for which printing is desired, a separate means coupled to each said means for comparing to hold output signals in a circuit sequence in accordance with the sequence of their occurrence during the circulation of the register parts, means to prevent from entering said means to hold output signals calling for the printing of unwanted zeros, and means responsive to said first signals being representative of a zero to prevent the entry of an output signal in each said means to hold unless an output signal was previously entered in said means to hold when said first signals were not representative of a zero.

2. In an output-printing apparatus wherein different columns of type are successively moved through a printing position, wherein first signals representative of the letters in a column of type at said printing position are compared with second signals representative of characters desired to be printed in a line at said printing position, and wherein there are means to print selected ones of the type in a column in response to identities of first and second signals being established, the improvement in said output-printing apparatus comprising a plurality of registers into which said second signals are entered, each said register having two parts, a separate group of flip-flop circuits associated with each register part, each said flip-flop circuit having a first and a second stable condition, a separate means associated with each register part to compare a first signal successively with the contents of said register part and to produce an output signal for each identity, means to couple the output from each said means to compare successively to the flip-flop circuits in the associated group to drive a flip-flop to its second stable condition in response to an output signal, and means to selectively energize said means to print responsive to the output from said flip-flops in second stable conditions.

3. In an output-printing apparatus as recited in claim 2 wherein each said register having two parts means to compare successively to the flip-flop circuits in the associated group includes a coincidence gate for each flip-flop circuit, in a group, a counting circuit, means to drive said counting circuit through successive count conditions responsive to the successive comparison by each said means to compare of a first signal with the contents of a register part and means to couple the output of said counting circuit to said coincidence gates to successively apply an enabling input to them responsive to the successive count conditions of said counter.

4. In an output-printing apparatus as recited in claim 3 wherein there is included a means to apply a second enabling input to the following coincidence gates in each flip-flop circuit group from a preceding flip-flop circuit which has been driven to its second stable state, and a means to apply a second enabling input to all said coincidence gates in response to said first signals representing a column of type other than zero.

5. In an output-printing apparatus as recited in claim 3 wherein there is included a means to apply a second enabling input to the following coincidence gates in each flip-flop circuit group from a preceding flip-flop circuit which has been driven to its second stable state, and a means to apply a second enabling input to all said coincidence gates in response to said first signals representing a column of type other than zero.

6. In an output-printing apparatus as recited in claim 3 wherein there is included a means to apply a second enabling input to the following coincidence gates in each flip-flop circuit group from a preceding flip-flop circuit which has been driven to its second stable state, and a means to apply a second enabling input to all said coincidence gates in response to said first signals representing a column of type other than zero.
isters with second signals, counting means, means to drive said counting means through successive count conditions, means to couple the output of each said register part with its own input for circulation of its contents, means to circulate the contents of all said register parts responsive to the successive count conditions of said counting means, a separate comparing circuit associated with each said register part, means for applying first signals to all said comparing circuits, means for applying the circulating contents of each register part to its associated comparing circuit for comparison with said first signals whereby for each successive identity said comparison circuit provides an output signal, a separate group of coincidence gates associated with each comparing circuit, means coupling the output of each comparing circuit with an input of the coincidence gates associated therewith, means for coupling said groups of coincidence gates to said counting means for simultaneously in all groups successively enabling a different gate in each group responsive to said successive count conditions, a different flip-flop circuit associated with each gate, each said flip-flop circuit having a first and a second stable condition, means coupling each said flip-flop circuit to its associated coincidence gate circuit to be driven to its second stable condition in response to output therefrom, and means to selectively energize said means to print responsive to a flip-flop circuit in its second condition.

8. In output-printing apparatus as recited in claim 7 wherein there are included means to apply another required input to all said coincidence gates responsive to said first signals representing a column of type other than zero, and means to apply other required input when said first signals represent zero to the succeeding coincidence gates in each group from a flip-flop circuit associated with a preceding coincidence circuit in the group which has been driven to its second stable condition.

9. In output-printing apparatus wherein different columns of type are successively moved through a printing position, wherein first signals representative of the letters in a column of type at said printing position are compared with second signals representative of characters desired to be printed in a line at said printing position, and wherein there are means to print selected ones of the type in a column in response to identities of first and second signals being established, the improvement in said output-printing apparatus comprising a plurality of registers into which said second signals are entered, each said register having two parts, a separate group of flip-flop circuits associated with each register part, each said flip-flop circuit having a first and a second stable condition, a separate means associated with each register part to compare a first signal successively with the contents of said register part and to produce an output signal for each identity, means to couple the output from each said means to compare successively to the flip-flop circuits in the associated group to drive a flip-flop to its second stable condition in response to an output signal, means responsive to said first signals being representative of a zero to prevent an output signal from a means to compare from driving a flip-flop circuit to its second stable condition unless said flip-flop circuit said group was driven to its second stable condition when said first signals were not representative of zero, and means to selectively energize said means to print responsive to the output from said flip-flop in second stable conditions.

10. In output-printing apparatus wherein different columns of type are successively moved through a printing position, wherein first signals representative of the letters in a column of type at said printing position are compared with second signals representative of characters desired to be printed in a line at said printing position, and wherein there are means to print selected ones of the type in a column in response to identities of first and second signals being established, the improvement in said output-printing apparatus comprising a plurality of registers each having two parts, means to fill said registers with second signals, counting means, means to drive said counting means through successive count conditions, means to couple the output of each said register part with its own input for circulation of its contents, means to circulate the contents of all said register parts responsive to the successive count conditions of said counting means, a separate comparing circuit associated with each said register part, means for applying first signals to all said comparing circuits, means for applying the circulating contents of each register part to its associated comparing circuit for comparison with said first signals whereby for each successive identity said comparison circuit provides an output signal, a separate group of coincidence gates associated with each comparing circuit, each coincidence gate having a first input derived from the output of the comparing circuit associated therewith, a second input derived from said counting means, a different one of the coincidence gates in each group being coupled to be responsive to a different count condition of said counting means, an unwanted zero-suppression circuit coupled to all said coincidence gates providing a third input to all said coincidence gates, a different flip-flop circuit associated with each gate, each said flip-flop having a first and a second stable condition, means coupling each said flip-flop circuit to its associated coincidence gate circuit to be driven to its second stable condition in response to output therefrom, and means to selectively energize said means to print responsive to a flip-flop circuit in its second condition.

11. In output-printing apparatus wherein different columns of type are successively moved through a printing position, wherein first signals representative of the letters in a column of type at said printing position are compared with second signals representative of characters desired to be printed in a line at said printing position and wherein there are means to print selected ones of the type in a column in response to identities of first and second signals being established, an unwanted zero-suppression circuit for said apparatus comprising a plurality of coincidence gates arranged in a sequence, means to successively apply identity signals successively to said gates, a plurality of flip-flop circuits each of which is associated with a different one of said coincidence gate circuits, each said flip-flop having a first and a second stable condition, means coupling each said flip-flop to its associated coincidence gate to be driven to its second stable condition in response to an output therefrom, means to apply an enabling input to all said coincidence gates when said first signals represent a column of type other than zero, means when said first signals represent a zero column of type to apply an enabling input to all succeeding coincidence gates from a flip-flop circuit associated with a preceding coincidence gate which has been driven to its second stable condition, and means to selectively energize said means to print responsive to a flip-flop circuit in its second stable condition.

No references cited.