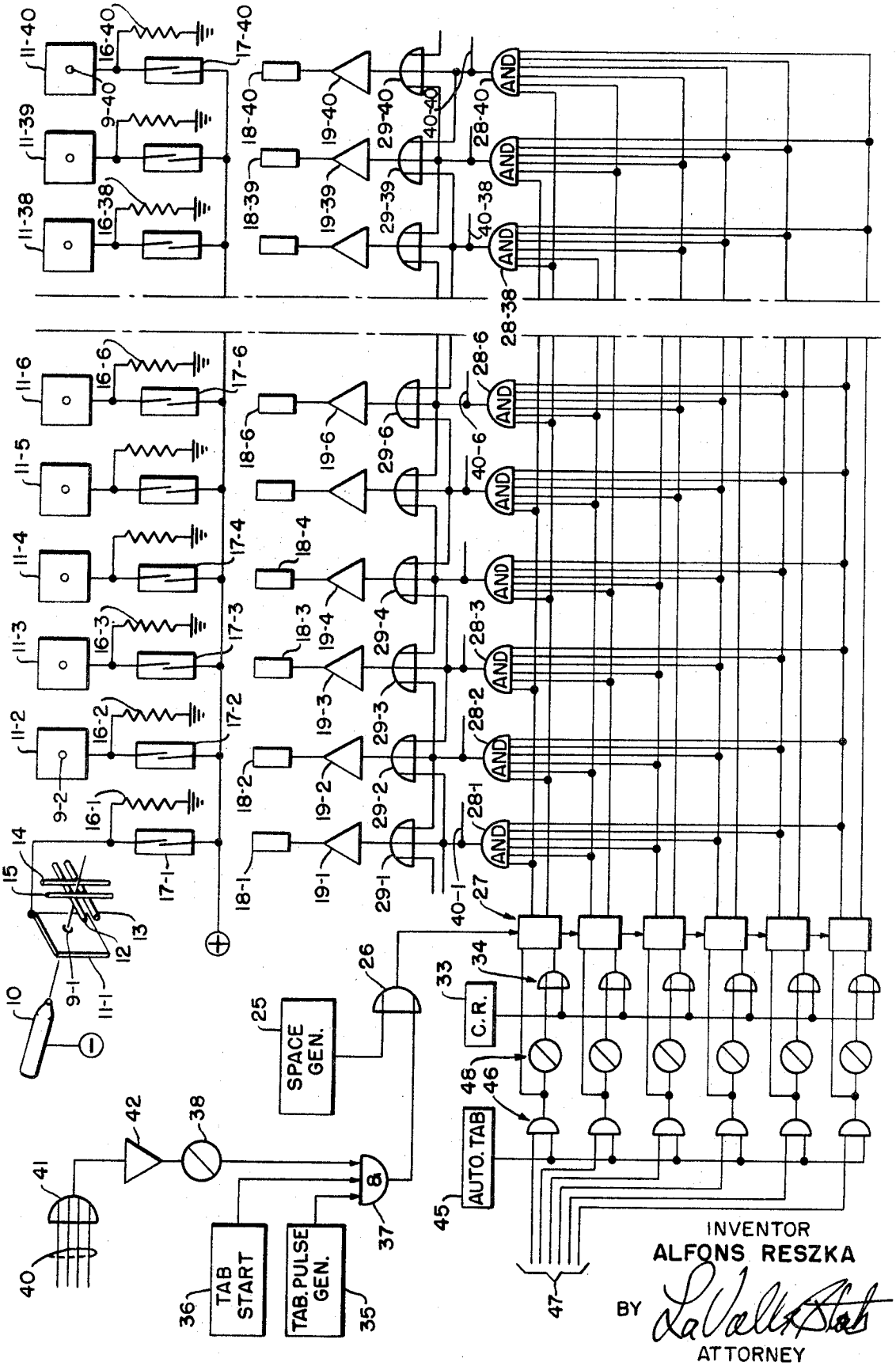
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COLUMN SELECTING AND TABULATING CIRCUIT FOR A PRINTING MACHINE

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COLUMN SELECTING AND TABULATING CIRCUIT FOR A PRINTING MACHINE

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ABSTRACT OF THE DISCLOSURE

The valving electrodes for controlling the ink flow in an electrostatic page printer having a plurality of ink-transfer nozzles mounted in side-by-side relationship are sequentially turned on and off by the output of a binary counter normally advanced one count for each character to be printed. To tabulate, advance pulses are applied to the counter at a rate which is considerably faster than the normal rate at which printing takes place, simulating rapid spacing of the printer, or the binary counter is set directly to a count corresponding to the desired column position on the page.

BACKGROUND OF THE INVENTION

Pat. No. 3,060,429, granted to C. R. Winston on Oct. 23, 1962, discloses a device for printing by transferring ink to paper in substantially the same way that a cathode-ray tube transfers electrons to a phosphorescent screen. As disclosed in the copending application to C. R. Winston, Ser. No. 449,732, filed on Apr. 21, 1965, now Pat. No. 3,432,844, it is possible to mount many of these ink-transfer devices side-by-side across the width of a page printer in order to print in lines across the width of a page. At any given time that one or more of the devices are used to print alphanumeric characters at predetermined locations (columns) on the page of paper, the rest of the ink-transfer devices are prevented from transferring ink to the paper. After a character is printed in one column on the paper, the next character is printed in the next column to the right of that one column until a complete line has been printed. When the end of a line is reached, the paper is advanced by a suitable line-feed mechanism; and printing of the next line is resumed at the left margin of the page. In such a printer, as in any printer, it is desirable to provide means for tabulating to predetermined columns quickly in response to a tabulation command.

SUMMARY OF THE INVENTION

According to the preferred embodiment of the present invention, as applied to an automatic-telegraph, character-by-character page printer using a plurality of ink-transfer devices, a binary counter normally receives from a pulse source one advance pulse each time that a character is printed in response to the completion of printing of that character. The output from the counter activates selected ones of the ink-transfer devices; and as the counter is advanced, ink-transfer devices that have printed a character are turned off and other ink-transfer devices located to their right are turned on, in order to print in successive columns from left to right on the page copy. To tabulate, advance pulses are applied to the counter at a rate which is faster than the normal rate at which characters are printed, simulating rapid spacing of the page printer. Alternatively, one or more telegraph character signals can be received to set the counter directly to a desired column position on the page—to the right or left of the character last printed.

BRIEF DESCRIPTION OF THE DRAWING

A more complete understanding of the invention may be obtained by those skilled in the art from the following detailed description considered in conjunction with the accompanying drawing, the single figure of which is a schematic diagram of a circuit for controlling spacing and tabulation across a page printer.

In the preferred embodiment of the present invention forty printing positions and printing devices are indicated. However, in the accompanying drawing only nine of these printing devices are actually shown. A dash-dot line is used to indicate that thirty-one printing devices have not been shown in the drawing, for clarity, since to show and describe them would simply be repetitious.

The several printing devices contain similar parts, and these similar parts are referred to with the same reference numbers. However, to designate the part of each individual printing device, a dash-number is used after the reference number. For example, the amplifier that is used in each device is referred to by the reference number "19." However, the amplifier that is used with the left-most or first printing device is referred to by the reference number "19–1" to indicate that it is an amplifier 19 but associated with the first printing device. Similarly the amplifier associated with the second printing device is also given the reference number "19" but is given a dash-number "2." Similarly, the amplifier associated with the sixth printing device is referred to by the reference number "19–6." A similar technique is used in referring to each of those parts in the drawing which are repeated for each printing device.

When referring generally to the construction of the circuit for any printing device, without specific reference to any particular one of the several devices, the reference number only is used without the dash number, thereby to indicate that part in any of the forty printing devices; and it is understood that similar parts are contained in each printing device.

In a like manner a nozzle 10 is shown in association with the valving electrode 11–1 of the first printing device; however, it is to be understood that there is a nozzle 10 associated with each valving electrode 11–1, 11–2, 11–3, etc. Each valving electrode 11 also has associated deflection electrodes 12-to-15, inclusive.

DETAILED DESCRIPTION

Referring now to the drawing, there is shown in a diagrammatic form an ink transfer device of the type shown in the above-mentioned patent to C. R. Winston. In that device ink is supplied at a negligible hydrostatic pressure to a nozzle 10. This nozzle 10 is constructed of a conductive material and is maintained at a negative electrostatic potential. A valving electrode 11, having a central hole 9, is positioned with this hole 9 directly in front of the nozzle 10. When the valving electrode 11 is maintained at a zero electrostatic potential, no ink flows from nozzle 10 and the ink transfer device is turned off. When the valving electrode 11 is maintained at a substantial positive electrostatic potential, ink which carries an electrostatic charge acquired from the metallic nozzle 10 is drawn from the nozzle 10 by electrostatic attraction and passes through the hole 9 in the valving electrode 11.

The ink then passes between two vertical deflection electrodes 12 and 13, and differences in voltage between the two deflection electrodes 12 and 13 cause the electrostatically charged ink to be deflected in the vertical direction. Next, the ink passes between two horizontal deflection electrodes 14 and 15 placed at right angles to the vertical deflection electrodes 12 and 13; and the electrodes 14 and 15 are supplied with electrostatic potentials

of different magnitudes in order to deflect the ink droplets in the horizontal direction.

Analog signals are applied to the deflection electrodes **12, 13, 14** and **15** to cause the ink to trace an alphanumeric character on a piece of paper upon which it impinges. A circuit for supplying the analog deflection signals to the deflection electrodes **12, 13, 14** and **15**, in response to six-bit permutation-coded data signals received over a telegraph line, is disclosed in the above-mentioned copending Winston application.

A plurality of these ink transfer devices as shown in the above-mentioned Winston patent are arranged in a row transversely of the paper on which characters are to be printed in lines. Any one of these many devices may be turned on or off by controlling the voltage applied to its valving electrode **11**, and in the drawing, representative ones of the valving electrodes **11** are shown schematically. Each valving electrode **11** is connected to a zero-volt electrostatic potential or ground through a resistor **16** having a resistance of several megohms. The ground potential on the valving electrodes **11**, while it makes the potential of the electrodes **11** positive relative to the negative potential on the nozzles **10**, is well below the potential difference that must exist between the nozzles **10** and the electrodes **11** in order to draw ink at atmospheric pressure from the nozzles **10** associated with valving electrodes held at ground potential.

Each valving electrode **11** also is connected through a normally-open contact pair **17** to the positive side of a D.C. source. Whenever a contact pair **17** is closed, a relatively high positive potential is applied directly to the associated valving electrode **11**, providing sufficient electrostatic potential between the nozzle **10** and the associated valving electrode **11** to extract a stream of ink droplets from the nozzle **10**. Each normally-open contact pair **17** is closed when current flows through an associated relay coil **18**, operated by the output of an associated amplifier **19** whenever the corresponding printing position is to be activated.

A space generator **25** is shown in the drawing as a functional block and performs the same function as a comparable circuit disclosed in the above-mentioned copending application of C. R. Winston. The space generator **25** generates a spacing signal after each character has been printed in response to the completion of printing of the character. The presence of a spacing signal at the output of the space generator **25** indicates that a character symbol has been printed and that the next character symbol should be printed in the next printing position or column to the right. Each spacing pulse from the space generator **25** passes through an OR-gate **26** to advance a six-stage binary counter **27**, and each stage of the binary counter **27** provides two binary outputs that constitute a conjugate pair. The initial condition of the binary counter **27** selects the left-most nozzle **10** in the page printer for printing by providing all of the inputs necessary to select and AND-gate **28–1**. When the AND-gate **28–1** is selected, it delivers a signal through an OR-gate **29–1** to energize an amplifier **19-1** which causes current to flow in the relay coil **18–1**. When sufficient current flows in the relay coil **18–1**, contact pair **17–1** closes, applying a high positive potential directly to the valving electrode **11–1**, causing ink to flow from its associated nozzle **10**.

Due to transient conditions in the ink transfer device when the activating voltage is first applied to a valving electrode **11**, there is a slight lag in establishment of full emission from the nozzle **10**. To preclude this lag from restricting the printing speed, the output of the AND-gate **28** associated with any printing position also is used to turn on the ink transfer device located immediately to the right of the position. Thus, the output of the AND-gate **28–1** also passes through an OR-gate **29–2** and causes an amplifier **19–2** to pass current through a relay coil **18–2**. When current flows in the relay coil **18–2**, the contact pair **17–2** is closed, applying a high positive potential to the valving electrode **11–2**. At the time of such turning-on of an ink transfer device to the right of the printing position, the ink stream issuing from the nozzle **10** associated with that device is deflected vertically downwardly to impinge upon a baffle or mask (not shown), as is described more thoroughly in the above-mentioned application of C. R. Winston; so that at this time, ink is not deposited upon the paper by the preparatorily turned-on device. Therefore, while the left-most ink transfer device is printing the first character in a line of characters, the second ink transfer device is "warming up."

As soon as the left-most printing device has completed the printing of the first character of the line, the space generator **25** issues a spacing pulse which passes through the OR-gate **26** and advances the binary counter **27** by one increment. In this next condition of the binary counter **27**, five of the stages of the binary counter **27** remain unchanged but the first stage (connected to the OR-gate **26**) of the binary counter **27** changes state. The resulting second condition of the binary counter removes one input from the AND-gate **28–1** and applies it to the AND-gate **28–2**, producing an output from the AND-gate **28–2**.

When the AND-gate **28–2** is energized, it supplies a signal through the OR-gate **29–2** to the amplifier **19–2**. Since this amplifier **19–2** already was activated under the control of the AND-gate **28–1**, the AND-gate **28–2** merely takes over from the AND-gate **28–1** the control of the amplifier **19–2** and consequently the contacts **17–2** and valving electrode **11–2**. The contact pair **17–2** remains closed and activating potential continues to be applied to valving electrode **11–2**. It will be seen that when the AND-gate **28–2** is energized, it also supplies signals through the OR-gates **29–1** and **29–3**, taking over from the AND-gate **28–1** control of the contact pair **17–1** and causing the contact pair **17–3** to close, thereby maintaining the high positive potential on the valving electrode **11–1** and applying the same voltage to the valving electrode **11–3**, causing the device associated with the valving electrode **11–3** to "warm up." Therefore, ink is extracted simultaneously from the nozzles **10** associated with all three of these valving electrodes **11–1, 11–2**, and **11–3**.

At this time, the vertical deflection electrodes **12** and **13** associated with the devices represented by the valving electrodes **11–1** and **11–3** are maintained at suitable voltages to deflect their associated streams of ink droplets downwardly out of impinging relationship with the paper, while the stream of ink droplets issuing from the nozzle **10** associated with valving electrode **11–2** is controlled to impinge upon the paper. The extraction of ink from the nozzle **10** associated with the valving electrode **11–1** after a character has been recorded by ink issuing from that nozzle **10** (of the leftmost or No. 1 printing position) is not, in itself, beneficial. However, it is beneficial, as previously stated, to preparatorily extract ink from the next nozzle **10** (the No. 3 printing position, third from the left) to be used. There may be some possibility of interaction between the electrostatic fields of adjacent ink transferring devices, and compensation for such interaction is obtained by producing identical electrostatic fields in the devices on either side of the one that is recording a character. These fields then oppose and cancel one another in the region of the device which is recording the character.

Analog signals are applied to the vertical and horizontal deflection electrodes **12, 13, 14** and **15** associated with the valving electrode **11–2**, as disclosed in the above-mentioned Winston application, causing the stream of ink droplets passing through the hole **9–2** in the center of the electrode **11–2** to trace an alphanumeric character on the paper in front of the valving electrode **11–2**. After this character has been printed, another spacing pulse is generated by the spacing generator **25**. This next spacing pulses passes through the OR-gate **26** and causes the binary counter **27** to advance one more increment, causing the first stage (connected directly to the OR-gate **26**) of the binary counter **27** to revert to its initial con-

dition and causing the second stage (connected directly to the first stage and positioned immediately below it on the accompanying drawing) of the binary counter **27** to change state. In this condition of the binary counter **27**, only the AND-gate **28–3** is energized and supplies a signal through the OR-gates **29–2**, **29–3**, and **29–4** to the amplifiers **19–2**, **19–3**, **19–4**. These three amplifiers **19–2**, **19–3** and **19–4** cause contact pairs **17–2**, **17–3**, and **17–4** to apply high positive potential to the valving electrodes **11–2**, **11–3**, and **11–4**; thereby extracting ink from the nozzles **10** associated therewith.

In this way, three nozzles **10** normally issue ink simultaneously, and each spacing pulse from the space generator **25** causes the left-most nozzle **10** of any group of three nozzles to cease issuing ink and turns on the nozzle **10** to the right of the three nozzles **10** that previously issued ink. As successive characters are printed, printing advances from left to right across the page copy, until the binary counter **27** ultimately energizes the last AND-gate **28–40** in the circuit. When the AND-gate **28–40** is energized, it supplies a signal through the OR-gate **29–39** and **29–40** to amplifiers **19–39** and **19–40** in order to apply a high positive potential to the valving electrodes **11–39** and **11–40**.

It should be understood that the change of state of the several stages of binary counter **27** occurs within a matter of a few microseconds. When one AND-gate **28** is deenergized and the adjacent AND-gate **28** to the right is energized, only these few microseconds elapse. This short time is insufficient to allow any of the contact pairs **17** that are common to these two AND-gates **28** to open during the time that control of the contact operation is transferred from one amplifier **19** to another. The left-most contact pair **17** of the three contact pairs **17** previously closed, however, does open and remains open. Thus, in normal operation, once a given contact pair **17** closes, it remains closed for three character intervals, and the nozzle **10** associated with the contact pair **17** is recording a character during the second or middle of these three intervals. After a contact pair **17** is opened in normal operation, it remains open until the next line is printed.

When printing is to begin again at the lefthand margin of the paper, the binary counter **27** is reset to its initial condition by a reset pulse from a carriage-return pulse generator **33**. The generator **33** is shown in the drawing as a functional block but is similar to the carriage-return function circuit that is disclosed in the above-mentioned copending application of C. R. Winston. A reset pulse from carriage-return pulse generator **33** passes through OR-gates **34** to reset the several stages of the binary counter **27** to the initial condition.

If a feature known in the telegraph art as automatic carriage-return is desired, the binary counter **27** can be arranged, according to known prior art techniques, to assume its initial condition after printing an alphanumeric character with the stream of ink droplets that passes through the hole **9–40** in valving electrode **11–40**. This can be accomplished, for example, by gating the output of the space generator **25** with the output of the AND-gate **28–40** to generate a reset pulse for the binary counter **27**. To facilitate immediate printing from the left-most nozzle **10** in the event of an automatic carriage return, the output of the AND-gate **28–40** can be connected to one of the inputs of the OR-gate **29–1** in order to "warm up" the ink stream associated with the electrode **11–1**.

In telegraph page printers and in typewriters, it is often desirable to space rapidly from a first printing position on the page to anohter printing position on the same line which is more than one space to the right of the first printing position. This is accomplished by a machine function called tabulation. In the circuit shown in the accompanying drawing, a tabulation pulse generator **35** constantly emits pulses at a rate significantly faster than the one-pulse-per-character rate of the spacing generator **25**. A tabulator start circuit **36**, shown as a functional block in the drawing, is similar to either the line feed or bell-ringing function decoding circuits **55** or **58** disclosed in the above-mentioned application of C. R. Winston. This tabular start circuit **36** issues a signal output to an AND-gate **37** when ever a code combination representative of a tabulate command signal is received by the telegraph receiver of which this invention forms a part. An inverter **38** normally delivers an enabling input signal to the AND-gate **37**. Therefore, rapid pulses from the tabulator pulse generator **35** pass through the AND-gate **37** whenever the tabulator start circuit **36** issues a signal. The signal issued by the tabulator start circuit **36** persists for an entire character duration until the next code combination is received over the telegraph line. When a tabulation command is received, tabulator pulses are sent from the generator **35** through the AND-gate **37** and the OR-gate **26** rapidly to advance the binary counter **27**. Tabulation pulses issue from the generator **35** at a rate high enough to advance the binary counter **27** from its initial condition, wherein the AND-gate **28–1** is selected to a condition wherein the AND-gate **28–40** is selected in the time normally required to print one character.

Each AND-gate **28** has a tabulator stop output **40** which can be manually connected (programmed) to one of the inputs of a tabulator stop OR-gate **41** in order to select any one of the AND-gates **28** to represent a possible tabulator stop position. Any electrical connection between the tabulator stop lead **40** of an AND-gate **28** and the tabulator stop OR-gate **41** is purely arbitrary (as on a typewriter). No such connections have been shown herein, but it is understood that any desired tabulator stop connection can be made by an operator by simply connecting a wire between the desired AND-gate **28** and the OR-gate **41**. When a signal is received by the tabulator stop OR-gate **41** over the lead **40** that is connected to the output of a selected AND-gate **28**, this signal is amplified by an amplifier **42** and is delivered to the inverter **38**. When the inverter **38** receives a signal from the amplifier **42**, the inverter **38** removes the enabling signal input to the AND-gate **37** and blocks the passage of further tabulator pulses to the OR-gate **26**. For example, assume the binary counter **27** is in a condition to select the AND-gate **28–2** and a tabulation command signal is received by the printer, the tabulator start circuit **36** issues a signal to the AND-gate **37** which permits tabulator pulse signals to pass from the tabulator pulse generator **35** through the OR-gate **26** to the binary counter **27**. Assuming that the printing machine has been programmed in such a way that the output from the AND-gate **28–6** has been connected by means of tabulator stop output **40–6** to the tabulator stop OR-gate **41**, the binary counter **27** rapidly advances until the AND-gate **28–6** is selected. When the AND-gate **28–6** is selected, a signal is issued from the tabulator stop output **40–6** to the tabulator stop OR-gate **41**. This signal passes through the OR-gate **41** and causes the inverter **38** to remove the enabling input signal from the AND-gate **37**, preventing further tabulator pulses from reaching the binary counter **27**. The binary counter **27** remains at a count which selects the AND-gate **28–6**, and tabulation has been accomplished. The next code combination received over the telegraph line is not normally another tabulator command signal; consequently, this next code combination causes the tabulator start circuit **36** to remove another one of the inputs to AND-gate **37**. At the same time, the character represented by this next code combination is printed by the nozzle **10** associated with the valving electrode **11–6** under control of the output of the AND-gate **28–6**.

In the event that it is necessary to tabulate the page printer without the use of a manually-programmed or pre-set tabulator stop, a one-or-two-character automatic tabulator signal may be sent to the printer over the telegraph line and is used directly to set the state of the

several stages of binary counter **27**. An automatic tabulator function command circuit **45** is shown in the drawing as a function block and is similar to the function decoding circuits **50**, **55**, and **58** that are disclosed in the above-mentioned, copending Winston application. The automatic tabulator command circuit **45** issues a command signal each time that a code combination representing an automatic tabulation function command is received over the telegraph line. This signal enables a set of automatic tabulator AND-gates **46** for a duration that is slightly longer than the period during which a single code combination is normally received. Each code combination that is received over the telegraph line is supplied to a set of automatic tabulator inputs **47**, but these code combinations normally are blocked by the disabled AND-gates **46**. When these AND-gates **46** are enabled by the circuit **45** in response to receipt of a coded automatic tabulator command signal, the code combination received next is passed through the AND-gates **46** directly to one set of inputs to the several stages of the binary counter **27**. A plurality of tabulator inverters **48** generate signals that are the binary inverse of the code combination that passes through the AND-gates **46** and deliver these inverted signals through OR-gates **34** to another set of inputs to the several stages of the counter **27**. The counter **27** then assumes a condition dictated by the code combination that followed the automatic tabulator command. Since any possible permutation code combination can be set into the counter **27** through the AND-gates **46**, the counter **27** can be set to energize any one of the AND-gates **28** to cause ink to be drawn from its associated nozzle **10**. Therefore, the page printer can be tabulated on command to a column position that is either to the left or to the right of the previous column position of the printer.

I claim:

1. A printer for selecting at least one of a plurality of column positions in which a symbol is to be printed including:

a plurality of printing means, each printing means individual to at least one of a plurality of column positions for causing the printing of any one of a plurality of symbols at its associated column positions;

a binary counter having a plurality of outputs;

means for normally advancing the counter a predetermined amount in response to the printing of a symbol by the printing means;

means responsive to the output of the counter for causing different printing means to be rendered operative for different counter outputs;

means for supplying a tabulation signal to the printer;

means responsive to the tabulation signal for advancing the counter at a rate which is substantially faster than the rate at which symbols are received;

a coincidence gate individual to a predetermined column position and having an output and a plurality of inputs, each of the inputs of the coincidence gate being connected to different ones of the outputs of the binary counter; and

means responsive to the output of the coincidence gate for disabling the fast counter advancing means.

2. A printer having a circuit for selecting at least one of a plurality of column positions in which a symbol is to be printed in response to a permutation-coded input signal, including:

a plurality of printing devices, each printing device corresponding to at least one of a plurality of column positions for printing symbols at its associated column positions;

means for controlling the operation of each printing device;

a counter;

means for normally advancing the counter a predetermined amount in response to printing of a symbol by the printing device;

means controlled by different output counts from the counter for selectively causing the controlling means to render the printing device for at least one column position operative;

means responsive to a first tabulation input signal for enabling the setting of the counter; and

means for setting the counter to a predetermined count in response to a second permutation-coded input signal corresponding to the predetermined count.

References Cited

UNITED STATES PATENTS

2,919,171	12/1959	Epstein et al.	346—74
2,930,847	3/1960	Metzger.	
2,988,275	6/1961	Thomason	235—132
2,997,234	8/1961	Hughes	235—160
3,060,429	10/1962	Winston	346—1
3,068,479	12/1962	Benn et al.	346—74
3,261,284	7/1966	Lynott et al.	197—1 X
2,830,865	4/1958	Meadows et al.	197—19 X
2,856,125	10/1958	Hildebrandt et al.	197—177 X
2,910,163	10/1959	Hanson et al.	197—19
2,954,860	10/1960	Woodhead	197—19
3,063,537	11/1962	Allen	197—176 X

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197—1, 19, 82; 346—1, 74; 340—324