Aug. 13, 1963 N. B. WALES, JR 3,100,440

LINE PRINTER

Filed April 7, 1961 2 Sheets-Sheet 1

FIG. 1

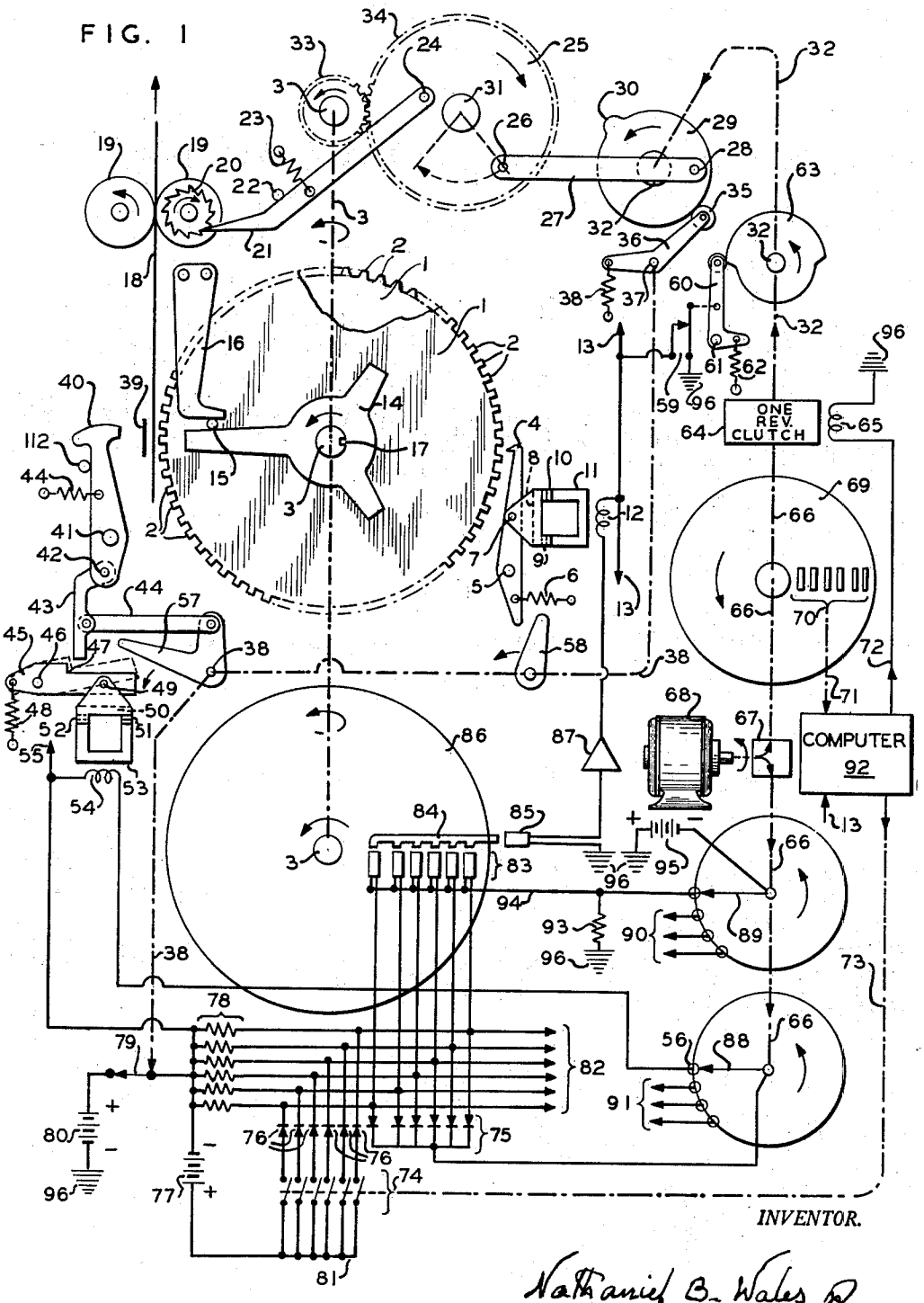

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FIG. 2

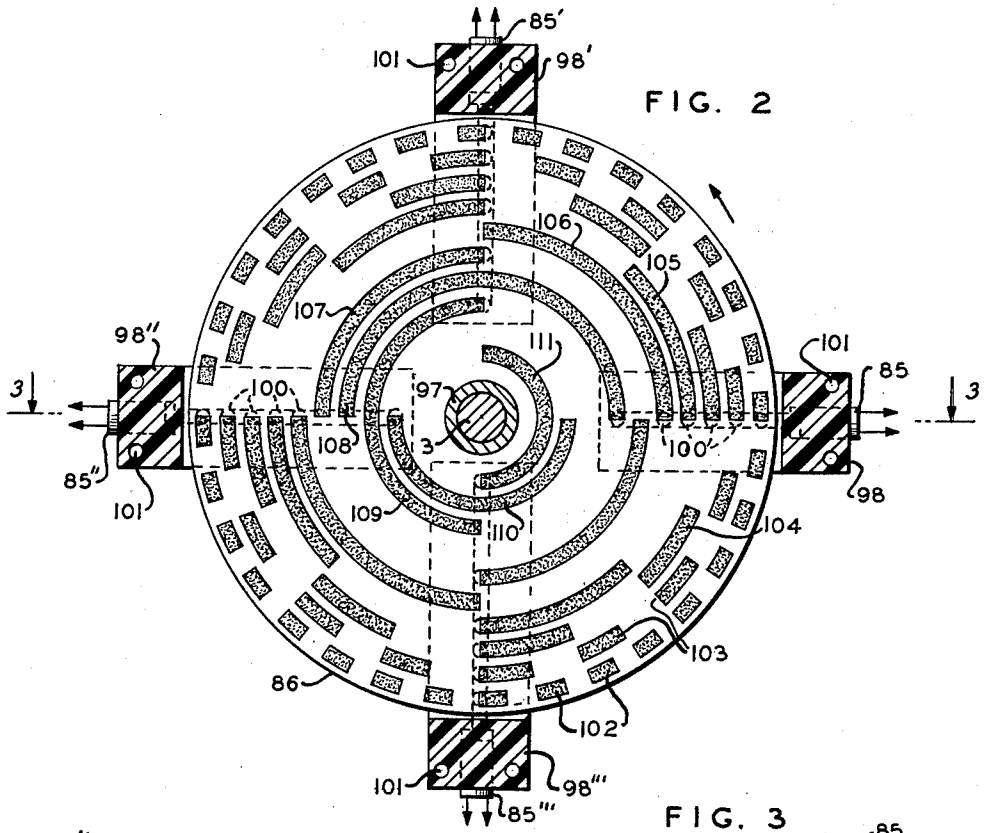


FIG. 3

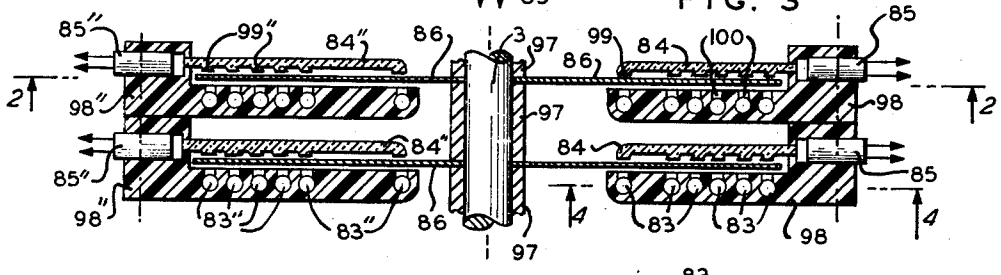


FIG. 4

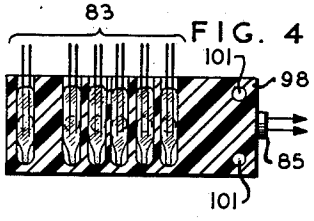


FIG. 5

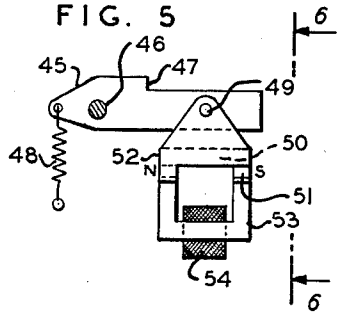
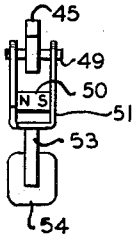


FIG. 6



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United States Patent Office 3,100,440 Patented Aug. 13, 1963

3,100,440

LINE PRINTER

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Filed Apr. 7, 1961, Ser. No. 126,358
10 Claims. (Cl. 101—93)

This invention relates to an improved control system for printing mechanisms having a buffer memory adapted to receive coded information in series or parallel form, and to print it on a page, one line at a time.

It is well known in the printer art to use a coaxial row of printing wheels which are positioned and then impacted simultaneously and selectively by a row of hammers through the copy paper to print a line of numeric or alphanumeric characters at a time.

However, the amount and cost of equipment heretofore required to store the coded information representing the line of print and then to decode and distribute it so as rapidly to position such multiple adjacent print wheels has been so great as to preclude the economic use of such a system in any medium size or medium speed computer or communication system.

The present invention makes possible an inexpensive and reliable computer output printer which will print on the order of 4 to 5 lines per second corresponding to 4 to 600 characters per second depending on the number of columns per line desired.

The means taught by my invention to accomplish this object includes the novel combination of a gaseous discharge tube memory used in conjunction with a plurality of photoelectric comparators and optical decoding disks.

The principle of my invention is to provide a separate code-memory, a comparator, and a stopping device for each print wheel, so that as all of the print wheels in unison are permissively allowed to scan through all of the available characters, each print wheel will be individually stopped when its comparator senses agreement between the stored character code and the code through which the permissive device is momentarily scanning. When the scanning operation is completed, the selected hammers simultaneously print the line composed by the stopped type wheels. Subsequently, the paper is advanced, and the print wheels, hammers, and memory are restored to begin a new cycle of line printing.

Using conventional flip-flop or magnetic core memories, together with electronic comparators, such a system would be prohibitively expensive for a multiple column printer. My invention, however, is devised to allow low cost memory devices to be an integral part of the comparators. This is done by using for each memory device the well known memory properties of gaseous discharge diodes, and optically arranging the coded pattern of light generated by these gas diodes to fall on a single photoelectric cell through a coding disk shutter synchronized with the scanning mechanism of the print wheels. This combination of a coded group of electro-optic memory elements with a common photoelectric "observer" thus constitutes an "or" gate which signals a successful comparison between memory and print wheel code disk by the photoelectric condition corresponding to the absence of light. That is, the comparison is considered successful when every open window in the code disk has an unenergized gas memory tube behind it.

Mathematically, the foregoing comparison criterion is a necessary but not sufficient condition for guaranteeing identity of the two codes, since it does not say whether there may be energized tubes behind the closed windows, which should therefore signal disagreement. If it were necessary to meet this inverse or De Morgan condition,

the required equipment would be more than doubled so that, for instance, a six bit code would require twelve tubes behind twelve channels of coded windows with an arrangement for each code bit to light one tube for a "1" and another for a "0".

My invention, however, obviates this complication by selecting a code sequence on the print wheel decoding disks which in the normal direction of selective scanning presents no codes which are not initially correctly compared by the foregoing darkness criteria, thus permitting the use of the smaller number of channels (in the foregoing case, six).

In the preferred embodiment of my invention, the computer which is to control the subject line printer is provided with a six binary bit feed back signal on six wires which tells the computer continuously at which position a continuously running distributing commutator is currently located. This commutator sequentially enables groups of six neon memory tubes to receive ignition from a six wire printer input bus through which the computer can fill up the neon buffer memory with the information representing a line of characters.

A logical "or" gate is provided to monitor the six wire writing bus. Also, a second distributing commutator synchronized with the foregoing enabling commutator is arranged to distribute the signals from the foregoing "or" gate to a hammer-enabling memory device for each column of the printer. In this way, when the time comes to impact the hammers against the print wheels in the printing cycle, only those hammers under which a coded character was selected will fire, thereby preventing smudges at the columns requiring blank spaces.

Both the hammer enablying memory devices and the print wheel stopping devices may profitably employ the "Magnetic Release Structure" disclosed in my co-pending application No. 66,462, filed November 1, 1960, and for this reason the preferred embodiment here disclosed incorporates this high speed release system.

One object of my invention is to provide a low cost high reliability design for line printers suitable for communication channels and computer read-out.

A second object is to provide a combination buffer memory and comparator for the low cost distribution, storage, and read-out, of binary information.

A third object is to provide a combination memory-comparison system in which the logic of writing is accomplished by electrical means and in which the logic of reading and comparison is accomplished by photoelectric means.

A fourth object is to provide a method of construction for analog to digital coding masks which achieves compactness by permitting several reading stations to share their lower order coding tracks.

Other objects are implicit in the accompanying specifications and claims.

In the drawings:

FIG. 1 is the schematic diagram of the preferred embodiment of my invention;

FIG. 2 is a section through 2—2 of FIGURE 3 normal to the axis of an optical decoding-comparator disk of my invention showing the photoelectric comparison reading heads for four printing columns sharing the same decoding disk;

FIG. 3 is a section through 3—3 of FIG. 2;

FIG. 4 is a section through 4—4 of FIG. 3;

FIG. 5 is a view in elevation through 5—5 of FIGURE 6 showing the preferred magnetic release structure used for control and memory in my invention; and

FIG. 6 is an end view through 6—6 of FIG. 5.

The line printer depicted in FIG. 1 consists of a plurality of adjacent coaxial print wheels 1 each bearing a

font of character type faces 2 which protrude from the periphery of wheel 1 so as to form spaced teeth thereabout. Each type wheel 1 corresponds to a column within the line to be printed, and is journalled on and frictionally coupled to shaft 3. This frictional coupling is supplied for each column by a separate three fingered spring washer 14, which is keyed to shaft 3 by tongue 17 and whose fingers press axially on each type wheel 1.

The longer of the three fingers of washer 14 has a trajectory which embraces pin 15, secured to wheel 1, so that when shaft 3 is in the home position shown, pin 15 is entrapped between this finger and the fixed stop finger 16, thereby forcing print wheel 1 also to be in its home, or starting, position. When shaft 3 is rotated counterclockwise away from its home position, it frictionally, and without slippage carries with it all of the type wheels 1. Each type wheel 1 is provided with a stopping catch lever 4 which is urged by its spring 6 to rotate about pivot 5 so as to engage one of the teeth formed by type faces 2.

However, each lever 4 is normally restrained against the force of spring 6 to be out of engagement with the teeth of wheel 1 by the armature secured to it by pivot pin 7, and composed of pole piece 9 and pole piece 10, which embrace the permanent ceramic magnet bar 8. The poles 9 and 10 of this permanently magnetized armature normally are attracted to the stationary soft iron U-shaped magnetic core 11 by the magnetomotive force supplied by magnet 8.

On receipt of a suitable signal pulse by coil 12, which embraces fixed core 11, a flux is generated in core 11 which opposes the flux from the armature 8, 9, 10, thereby releasing lever 4 under the force of spring 6 to engage the tooth 2 which is momentarily under it, and to stop further advance of corresponding wheel 1 beyond the selected position. This stoppage then causes the friction fingers of corresponding washer 14 to slip relative to wheel 1 until shaft 3 comes to the end of its forward or setting rotation.

At this moment, the hammers 40 corresponding to each column to be printed are actuated to rotate about their common spindle shaft 41 so as to impact the printing ribbon 39 against the paper 18, and against the selected corresponding type faces 2, thereby printing the selected line of characters on the paper 18.

After the line is printed, the shaft 3 reverses and rotates clockwise to return all of the print wheels 1 to their original home positions shown.

The motive power for the foregoing rotary reciprocation of shaft 3 is supplied by the continuously running motor 68 which drives shaft 66 through reduction gear 67.

The continuous rotation of shaft 66 may be coupled by the one revolution clutch 64 to the drive shaft 32 on receipt of a command signal by electromagnetic release coil 65. Shaft 32, in turn, is suitably journalled, and has secured to it the cam-crank disk 29, which is coupled by link 27 and pivot pins 28 and 26 to the sector gear 25, which in turn is journalled on fixed pivot shaft 31.

Consequently, during the first half of the revolution of disk 29, link 27 drives segment gear 25 into approximately 90° of clockwise rotation; while during the second half of the revolution of disk 29, segment 25 executes counterclockwise rotation.

This sinusoidal angular displacement of gear sector 25 is multiplied by the ratio between pinion 33, secured to shaft 3, and the gear sector 25 to which it is meshed. This ratio is chosen to displace shaft 3 and its friction fingers 14 through the full arc occupied by the available type faces 2.

At the end of the clockwise reciprocation of shaft 3, cam surface 30 on disk 29 is designed to lift cam follower 35 on arm 36 so as to produce a clockwise displacement of shaft 37 against spring 38. The consequent momentary angular reciprocation of cam follower shaft 37 is communicated by the mechanical coupling

means 38 to levers 58 and 38, and also to normally closed switch 79 to open it momentarily.

The levers 58 use the foregoing reciprocation of shaft 37 to reset any of stop-levers 4 which may have been released into magnetic engagement between armatures 9—10 and the stationary magnetic circuits 11.

The levers 57, which are also actuated by the mechanical connection 38, utilize this cammed reciprocation to produce two sequential operations, namely: actuation of the selected hammers 40 (first), and reset of the selecting armatures 45 (second).

Mechanical connection 38 is arranged to cause the first half of the reciprocation of shaft 37 to produce a counterclockwise displacement of levers 57, and to cause the second half of reverse reciprocation to produce a clockwise return of levers 57.

During the first portion of the counterclockwise motion of levers 57, levers 43, which are pivotally secured to the hammer levers 40 by studs 42, are urged to the left by links 44 which interconnect levers 43 and 57.

If the bottom of a lever 43 is restrained from leftward motion (FIG. 1) by its engagement with the notch 47 of lever 45, then the foregoing leftward motion of link 44 will produce a clockwise moment on its hammer lever 40. This will overcome spring 44, which normally holds hammer 40 against stop bar 112, and impact the hammer face on the printing ribbon 39, paper 18, and character type face 2, to cause printing at the corresponding columnar position.

Conversely, if the bottom of lever 43 is unrestrained by virtue of the absence of a release signal to coil 54 for lever 45 so that notch 47 does not engage lever 43, then the leftward motion of link 44 will merely rotate lever 43 clockwise about its stud 42, leaving its hammer 40 undisturbed.

Near the end of the counterclockwise stroke of levers 57, they engage any of memory levers 45 which had been released, and carry them against the action of springs 42 into the reset position in which their armatures 50—51—52 are in magnetic engagement with their stationary magnetic circuits 53.

It is evident that the magnetic release structure for lever 45 is identical with that of lever 4, and so the detailed views of FIGS. 5 and 6 apply to both. As expounded in the copending application cited, this structure, in which a source of high-coercive, low-permeability magnetomotive force is located in the armature and supplied with a magnetic shunt by its distributed poles, provides a very high rate of change of flux with increasing gap separation. Consequently, a very short low energy pulse signal will effect release of such a device.

The paper 18 on which the line printing is effected (together with carbon copies if desired) is suitably guided, and is clamped for line advancement and format control between the resilient rollers 19. A ratchet 20 secured to one roller 19 is provided, so that at the end of the reciprocative rotation of sector 25, the pawl 21 which is pivotally secured to sector 25 by stud 24, as guided by pin 22 and biassed by spring 23, may advance ratchet 20 by one teeth, thus comprising an automatic line feed. Cam 63, secured to shaft 32, is followed by lever 60, pivoted at stud 61 and biassed by spring 62, so that switch 59, actuated by lever 60, is closed during the first half of the revolution of shaft 32, and open during the second half of its rotation.

Switch 59 is connected so as to enable coils 12 to release their stop levers during the forward, or selecting, phase of the print cycle, while disabling the energization of coils 12 after their levers 4 have been reset, and during the reverse restoration of the system to its starting position.

For the preferred design shown, a font of 63 characters (plus a home position) is provided, which thus requires a six bit binary code to specify uniquely a selected character.

The buffer memory component taught by my invention for registering the six bits representing the code for each columnar character is a gaseous diode glow tube **83** characterized by having a substantially higher ignition, or firing, potential than the glow, or running, potential appearing across it after firing and during conduction.

The foregoing electrical properties permit groups of six of such glow tubes **83** to be connected to a common signal bus **82** in such a way that parallel groups of six bit code signals emitted serially from a computer **92** (or similar signal source) can be distributed one column at a time to ignite only those glow tubes called for by the code groups, until a line full of binary character information has been accumulated in this buffer memory in the form of glow discharges.

As described in subsequent detail, the light from these groups of electrical glow discharges is then used optically to repeatedly interrogate a decoding mask **86**, which signals the code corresponding to the type face which is momentarily moving into registration with the hammer position during the scanning rotation of the type wheels **1** in the selection phase of the print cycle.

When the remembered buffer code, represented by the pattern of glow discharge for a given column, compares correctly with the pattern of the moving decoding mask, a signal is generated by the transition of a photoelectric cell **85** from illumination to darkness, since this cell has been arranged through the use of a light pipe **84** to operate as an "or" gate, by simultaneously looking through the mask at all the glow tubes in its group of six.

This signal is then amplified, inverted (in **87**), and used to release the corresponding stop lever **4**, thereby decoding the original buffered code and registering it as a type face alignment ready to print.

In FIG. 1 it may be seen that the main or sustaining potential source **80** is impressed between a common ground **96** and, through normally closed reset switch **79**, the common interconnection of the six load resistors **78** which serve the common six wire signal bus **82**.

One side of each glow tube **83** is connected to ground through lead **94** and common column load resistor **93**. The remaining side of each glow tube **83** is connected to one of the six bus leads **82** corresponding to its order of binary code representation.

All of the load resistors **93** and the bus load resistors **78** are made to be of sufficiently low value with respect to the total possible glow currents so that negligible voltage drops occur across them due to glow currents alone.

The potential of battery **80** is chosen to be less than the ignition potentials of tubes **83**, but greater than their extinction potentials. Under these circuit circumstances, once any glow tube **83** is ignited, it will remain so until switch **79** is opened at the end of the reset motion of mechanical connection **38**, and after the printing action of hammers **40** at which time all tubes **83** will be reset to extinction.

The distribution of the incoming signal information to the memory glow tubes **83**, and to the hammer enabling memory coils **54**, is accomplished by the electrical switch commutators **89** and **88** respectively, both being under direct drive from shaft **66**. Also mounted on the continuously rotating shaft **66** is the conventional analog to digital coding disk **69** which signals via brushes or photocells **70** and leads **71** to the computer **92** what the instantaneous position of the distributing switches **88—89** may be, and at what point the engagement of the one-revolution clutch **64** may take place.

Since the computer **92** also has access, via the common stop coil bus **13**, to phase switch **59**, it knows the instant at which printing and reset have occurred, and can proceed to actuate switches **74** via printer input bus **73** so as to emit the proper code signal group which it desires to distribute to the columnar position progressively signalled to it by coding disk **69**.

Switches **74** are shown in FIG. 1 as physical switches for simplicity. In practice, these switching means **74** would comprise computer-controlled current gates, preferably using solid state components. Diodes **76** are provided to prevent sneak circuits.

When any switch **74** is closed by the computer, it raises the potential of the corresponding bus wire **82** relative to ground by an amount determined by the current drop in the corresponding load resistor **78** due to current supplied by current source **77**. This signal bus potential rise is designed to be less than the difference between the potential of battery **80** and the firing potential of any glow tube **83**. Consequently, by itself, the closing of any switch **74** cannot fire a glow tube **83**.

Similarly, when the distributing switch arm **89** arrives at the lead **94** corresponding to a given column, current flows from current source **95** through load resistor **93** in such a direction as to raise the potential appearing across the glow tubes **83**. Again, this potential rise is designed to be less than the difference between the potential of battery **80** and the firing potential of any glow tube **83**, so that distribution-enabling switch **89** by itself cannot fire a glow tube **83**.

However, the actions of switches **89** and **74** are not only independent, but also additive, so that by choosing the correct design parameters it is possible by switch **89** to enable one column at a time, in sequence, to receive glow tube ignition signals over common bus **82**, since the coincidence of the additive signals at the currently addressed column will then exceed the ignition voltage of tubes **83**.

Once ignited, source **80** will sustain the discharge through the period of optical comparison, and until the opening of reset switch **79** extinguishes all tubes **83** for a new distribution cycle.

Switch **88** is synchronized with switch **89**, and serves to distribute the output of the diode "or" gate **75** to the hammer enabling coil **54** corresponding to a given column. In this way, current from source **77** will flow to a coil **54** during visitation by switch **88** only if a code signal over bus **73** was received, implying that a character was to be printed corresponding to the given code. The absence of such a signal is taken to mean the command for an unprinted space, and the corresponding hammer is prevented from impacting the paper by default of a release of its enabling lever **45**.

The return bus **13** from stop coils **12**, and the return bus **55** from the memory-enabling coils **54** are intended to extend to the corresponding coils belonging to all the remaining columns.

Similarly, the leads **90** and **91** extend to the corresponding tube group enabling circuits and hammer enabling circuits, respectively, of the remaining columns.

As had been indicated, the leads of bus **82** also extend to all the memory-comparator tube groups of the remaining columns. Evidently, although there is a separate load resistor **93** for each tube group, there is only one common set of resistors **78**, diodes **76**, and gate diodes **75** for the whole system.

When the computer has completed its line signal distribution, as signalled to it by the positional code of disk **69**, it may energize the one-revolution clutch coil **65**, thereby initiating the mechanical selection and reset cycle.

This selection cycle comprises a comparison operation in which the electrically stored patterns of optical glow tube code information are repeatedly compared by photoelectric means to the patterns of a decoding disk **86** which moves synchronously with shaft **3** and its frictionally mounted type wheels **1**.

The optical de-coding disks **86** shown in FIGS. 1, 2, and 3 are mounted either integrally on shaft **3** by clamping spacers **97** as shown, or, if a more compact design is desired, on a separate countershaft which is mechanically coupled at unity ratio to shaft **3**.

Also for the sake of compactness, a means has been devised to permit one de-coding disk **86** to serve the comparators of four columns. Thus, in a typical 100 column

machine, there would be 25 such parallel disks. Each decoding disk is a photographically prepared transparent substrate 86 on which the ten concentric opaque coding track patterns 102 through 111 have been deposited.

The six glow tubes 83 associated with a one column buffer memory are mounted within an opaque plastic moulding 98, which also forms the housing for comparison photoelectric cell 85, and the support for the plastic moulded light pipe 84. The light guiding pipe 84 for each memory-comparison head 98 is made of a highly refractive plastic material such as "Lucite," and preferably is provided with an evaporated metal film coating except at the entrance and exit light ports, which are given a ground translucent finish. The six entrance ports 99 on each light pipe are located opposite six corresponding holes in moulding 98 leading to a glow tube housing chamber, so that each of the four comparison-memory heads, 98, 98' and 98'' and 98''' embrace a decoding disk 86 between their light pipes and glow tube chambers. These stacked sets of four heads are suitably supported by rods through mounting holes 101 at 90° intervals about the parallel decoding disks 86.

Since the disk 86 is divided into 64 coding positions to accommodate the 64 character (1 blank) type wheels, and since there are four equally spaced comparison reading stations, it follows that the four lowest orders of coding (102, 103, 104, 105) can be shared on the same physical coding tracks since the fourth binary order from the lowest corresponds to ⅛ of the circle, and to reading stations ¼ of a circle apart, the binary code patterns would look identically cyclic.

The fifth order tracks would look identical to heads 180° apart, and so only two varieties of the fifth order need be provided (106, 107) so as to be 90° out of phase with one another. Track 106 serves heads 98 and 98'', while track 107 serves heads 98' and 98'''.

Finally, the sixth binary order tracks, subtending 180° as they do, look differently in phase to each of the 4 heads, so that four phase-varieties of sixth order tracks 108, 109, 110, and 111 are provided to serve heads 98, 98', 98'', and 98''' respectively.

By thus sharing the four lowest orders of coding, and by partially sharing the fifth order, the comparator-memory assembly achieves a greatly improved compactness.

As shown in FIG. 2, the coding disk 86 is in the home position, and the light pipe entrance ports 99 are all partially uncovered by the opaque coding areas, so that the ignition of any one glow tube memory in any head is the only condition necessary to energize the corresponding photoelectric cell 85. The inverting amplifier 87, consisting of a single stage of transistor amplification, is arranged to cut off its output current to its stop coil 12 whenever its photocell 85 sees light, and to pass output current to coil 12 when it sees darkness.

Consequently, if the computer had distributed the code commanding the printing of the seventh character from home position into a memory-comparison head 98, it would have electrically ignited and optically lit, the three lowest order glow tubes lying on code tracks 102, 103 and 104, corresponding to the binary weights 1, 2, and 4 respectively.

For this reason, as the coding disk 86 starts to move counterclockwise in response to the tripping of clutch 46 away from the home position illustrated, the light from the glow tube illuminating track 102 will be cut off from access to photocell 85 after disk 86 has moved 1/64 of a revolution (or to the first character position).

However, the light from the glow tubes illuminating tracks 103 and 104 at this point are still unobscured, and since photocell 85 is still seeing light, coil 12 is unenergized, and lever 4 continues to be magnetically restrained. As disk 86 continues to the second character position, channel 103 will close, but channels 102 and 104 will still transmit light to photocell 85, so the corresponding type wheel 1 continues to follow shaft 3 and decoding disks 86. At the third character position, tracks 102 and 103 will be blocked, but track 104 will prevent release of the stop lever 4.

In like manner, this interrogation will continue to find at least one glow tube capable of blocking release of stop lever 4, until for the first time at the seventh character from the start, all three coding tracks 102, 103, and 104 will be obscured, and, since none of the remaining three higher order glow tubes are lit, the photocell 85 will suddenly be reduced to darkness, thereby causing inverting amplifier 87 to energize coil 12, and to release stop lever 4 so as to lock the print wheel 1 at the selected printing position.

Evidently, the engineering design of the system must take into account the speed of response of the photocell and stop lever system, as well as the physical dimensions and tangential velocity of the teeth of type wheels 1, so that safe margins for reliable operation will result.

It is to be noted especially that the unambiguous operation of this system requires the choice of code sequence taught by my invention. This sequence is one in which the order of initial binary coding channel obscuration progresses from the lowest order toward the higher orders.

This may be understood from the foregoing example in which the electro-optical code for "seven" was set up by lighting the three lowest orders of glow tubes 83. If, in this example, the decoding disk 86 had been moved in a clockwise instead of counterclockwise direction, a signal of total darkness causing release of lever 4 would have been received immediately after 1/64 of a clockwise revolution even though this displacement led to the wrong character "64." This false signal is obviously due to the fact that no means has been provided to distinguish between darkness due to an unlit tube behind an open code window and darkness due to a lit tube behind a closed code window.

In order to provide such distinction optically, using the same photocell, a system of 12 code channels would have to be provided, together with the equivalent of six double throw switches (six flip flops), in place of the six single pole devices (74) shown. These six inverting switches would then be arranged mutually exclusively to light one of two glow tubes, corresponding to a binary 1 or 0 thus accounting for the twelve required channels.

The present invention avoids this complexity, and still avoids ambiguty, by chooseing the foregoing specification for the progression of initial obscuration in the several binary orders of coding.

The operation of my invention is as follows: When the signals 71 and 13 inform the computer 92 that the printer is free to receive a new line of printing, the computer may distribute parallel (or fast serial) groups of six binary code signals over bus 73 to switch-means 74 at the moments signalled to it by disk 69 (through bus 71) at which switches 87 and 89 are enabling the printing column in which the coded character is to be printed.

The switching means 74 in response to these signals produces pulses on the common bus 82, which in turn ignite the code pattern of glow tubes 85 in the memory head 98 corresponding to the column which distributing switch 89 is momentarily enabling.

Coincidentally with the distribution of any character code to a memory head 98, gate 75 release the corresponding hammer enabler 45 via switch 88, bus 55, and coil 54.

This distribution process continues until the memory heads 98 are filled with luminous discharge patterns representing a stored line of characters.

At this point, coded disk 69 signals to computer 92, via reading means 70, that the clutch 64 has a phase proper for engagement. If the computer responds to this signal by energizing clutch trip coil 65 over connection 72, then a printing cycle will have been initiated.

Engagement of clutch 64 will start a one-revolution

rotation of shaft 32 and crank pin 28. This causes shaft 3 together with decoding disks 86 and friction fingers 14 to move first counterclockwise, carrying with them the type wheels 1.

As decoding disks 86 interrogate the luminous memory code patterns for each column, character by character, there will come an instant for each column in which agreement will be signalled in the corresponding comparator photocell 85 by the occurrence of darkness. This successful comparison signal for each column, in turn, will release the corresponding stop lever 4, and so align the commanded line of type wheels 1.

At the end of the counterclockwise selection phase of the reciprocation of shaft 3, cam lobe 30 effects the impacting on paper 18 of those hammers 40 which have been selected, thereby printing the selected line.

The continuing action of lobe 30 then resets the hammer-enabling levers 45 and the stopping levers 4, and extinguishes the entire bank of memory glow tubes 83 by the momentary opening of switch 72.

Continued rotation of crank pin 28 then returns type wheels 1 to their home position, while disabling the stop coils 12 by means of cam operated switch 59.

At the end of the revolution of shaft 32, the ratchet mechanism 20 advances the paper 18 by one line, in preparation for the next printing cycle.

During the return reciprocation of shaft 3, the computer 92 is free to refill the buffer memory heads 98 with the coded signal information representing a new printing line.

To those skilled in the art, many modifications and substitutions will be obvious within the broad scope of my invention, and it is not intended that the specific disclosure here detailed shall limit the scope of the claims.

What I claim is:

1. In a line printer, the combination comprising: a plurality of parallel coaxial rotors bearing type faces on their peripheries; torque means to urge said rotors onto angular rotation about said axis in a character selective direction; a character scanning rotor; means to return said rotors to a home position; at least one decoding disk; means to rotate each said decoding disk in synchronization with said character scanning rotor during its selective direction of rotation; at least one arcuate binary decoding channel on each said decoding disk, each said channel having alternate window sectors and opaque sectors; a group of gas discharge tubes corresponding to each of said type face rotors, each tube being located adjacent to a code channel in said decoding disk; means to electrically ignite selected ones of said gas discharge tube groups in accordance with a coded line of character information to be printed; means to sustain the discharge of said tubes after said coded ignition whereby to maintain a corresponding pattern of light signals from each of said groups of tubes during selective rotation of said character scanning rotor; a photoelectric cell corresponding to each said group of gas discharge tubes; optical means to convey the light passing from any discharge tube within a group through a window in said decoding disk channel to the photocell corresponding to the said group; a separate electromechanical means to stop the selective rotational advance of each rotor in response to an electric stop signal; and means corresponding to each said photocell responsive to the intervention of an opaque sector of said decoding channel between each energized tube within the corresponding group and said corresponding photocell for generating an electric stop signal whereby to actuate said electromechanical stop means.

2. In a line printer in accordance with claim 1: a hammer corresponding to each said rotor; a normally disabled means associated with each said hammer for impelling it towards the corresponding said type rotor; a binary memory device for each said hammer; means responsive to the obverse condition of said memory device to enable said impelling means; means to reset said memory devices in their reverse condition; means responsive to the ignition of any said discharge tube in a group for setting the corresponding memory device into its obverse condition; and means responsive to the completion of said selective rotation for energizing said impelling means.

3. In a line printer in accordance with claim 3: means responsive to the completion of the actuation of said impelling means for actuating said memory resetting means and for extinguishing said tubes.

4. In a line printer in accordance with claim 1: means to disable said electromechanical stop means during the action of said rotor return means.

5. In a line printer in accordance with claim 1: a common input signal bus having as many conductors as there are tube members in each said group; and means for distributing ignition signals from said bus to ignite the tubes in said groups serially in accordance with the signals appearing on said bus.

6. In a line printer in accordance with claim 1: a drive shaft; means continuously to rotate said drive shaft; a first driven shaft; incremental trip clutch means for coupling said driven shaft to said drive shaft for a fixed predetermined angular displacement; means for tripping said clutch; a second driven shaft; means to couple said scanning rotor to said second driven shaft during the said selective direction of said scanning rotor; means to couple said rotor return means to said second driven shaft during the return of said rotors to said home position; and means to reciprocate said second driven shaft through a fixed angular displacement in response to the said incremental advance of said first driven shaft.

7. In a line printer, the combination comprising: a plurality of parallel coaxial rotors; a plurality of character type faces located on the periphery of said rotors; means to urge said rotors into angular rotation about said axis in a character selection direction; a character scanning rotor; means to return said rotors to a home position; a plurality of decoding disks; means to rotate said decoding disks in synchronization with said scanning rotor during its selective direction of rotation; a plurality of concentric decoding channels on each of said decoding disks, each of said decoding channels representing a binary order of coding, and each channel having alternate window sectors and opaque sectors; a group of gaseous discharge tubes corresponding to each of said type rotors, each tube within a group being located adjacent to a different decoding channel in said decoding disk; means electrically to ignite selected ones of said gaseous discharge tube groups in accordance with a coded line of character information to be printed; means to maintain the discharge of said tubes after said coded ignition whereby to maintain a corresponding pattern of light signals from each of said groups of tubes during selective rotation of said scanning rotor; a photoelectric cell corresponding to each said group of discharge tubes; optical means to convey the light passing from any discharge tube within a group through a window in said decoding disk to the photocell corresponding to said group; a separate electromechanical means to stop the selective rotational advance of each said type rotor in response to an electric stop signal; and means corresponding to each said photoelectric cell, responsive to the intervention of an opaque sector of said decoding channels between each energized tube within the corresponding group and the said corresponding photoelectric cell, for generating an electric stop signal whereby to actuate said electromechanical stop means.

8. In a line printer in accordance with claim 7: said tube groups being arrayed substantially radially relative to said concentric channels; said window channel sectors subtending angles equal to the angles subtended by said opaque channel sectors; a plurality of said tube groups being associated with each decoding disk and equally spaced thereabout by an even number of the lowest order

sector widths; the codes of each of the said channels associated with a given group being a different binary order; and each of the said tube groups associated with a given disk sharing a number of channels equal to the number of such groups associated with each disk.

9. A printer comprising: a moveable type member bearing spaced type faces representing a plurality of characters and constrained to move in a path which causes said type faces to move serially into registration with a printing station; a hammer; a web; means to impress said web between said hammer and one of said type faces at said printing station; means to restore said type member to a home position; scanning means to urge said type member to move in a character selecting direction away from said home position; stop means to arrest the motion of said type member; a spaced array of gaseous discharge tubes; a moveable coding mask having a plurality of parallel coding channels corresponding to each said tube and each said channel comprising an alternating sequence of opaque areas and of window areas; said coding mask being constrained to move so that each channel uniquely masks and unmasks each said tube; means to move said mask in synchronism with said scanning rotor; electrical means to ignite a selected pattern of said discharge tubes; a photoelectric cell; optical means to convey the light from those ignited said tubes which are adjacent to a window area of said mask to said photoelectric cell; and means responsive to the occurrence of darkness at said photoelectric cell to actuate said stop means.

10. A printer comprising: a moveable type member bearing spaced type faces representing a plurality of characters and constrained to move in a path which causes said type faces to move serially into registration with a printing station; hammer means to effect the printing of the one of said type faces which is in registration with said printing station; means to restore said type member to a home position; scanning means to urge said type member to move in a character selecting direction away from said home position; stop means to arrest the motion of said type member; a spaced array of light sources; a moveable coding mask having a plurality of parallel coding channels corresponding to each said light source and each said channel comprising an alternating sequence of opaque areas and of window areas; said coding mask being constrained to move so that each said channel uniquely masks and unmasks each said source; means to move said mask in synchronism with said scanning rotor; electrical means to energize a selected pattern of said light sources; a photoelectric cell; optical means to convey the light from those energized sources which are adjacent to a window area of said mask to said photoelectric cell; and means responsive to the occurrence of relative darkness at said photoelectric cell to actuate said stop means.

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