

Aug. 26, 1969

E. NORMAN

3,463,884

ELECTRONIC TYPING MACHINE AND TRANSFER TUBE THEREFOR

Filed Oct. 4, 1965

3 Sheets-Sheet 1

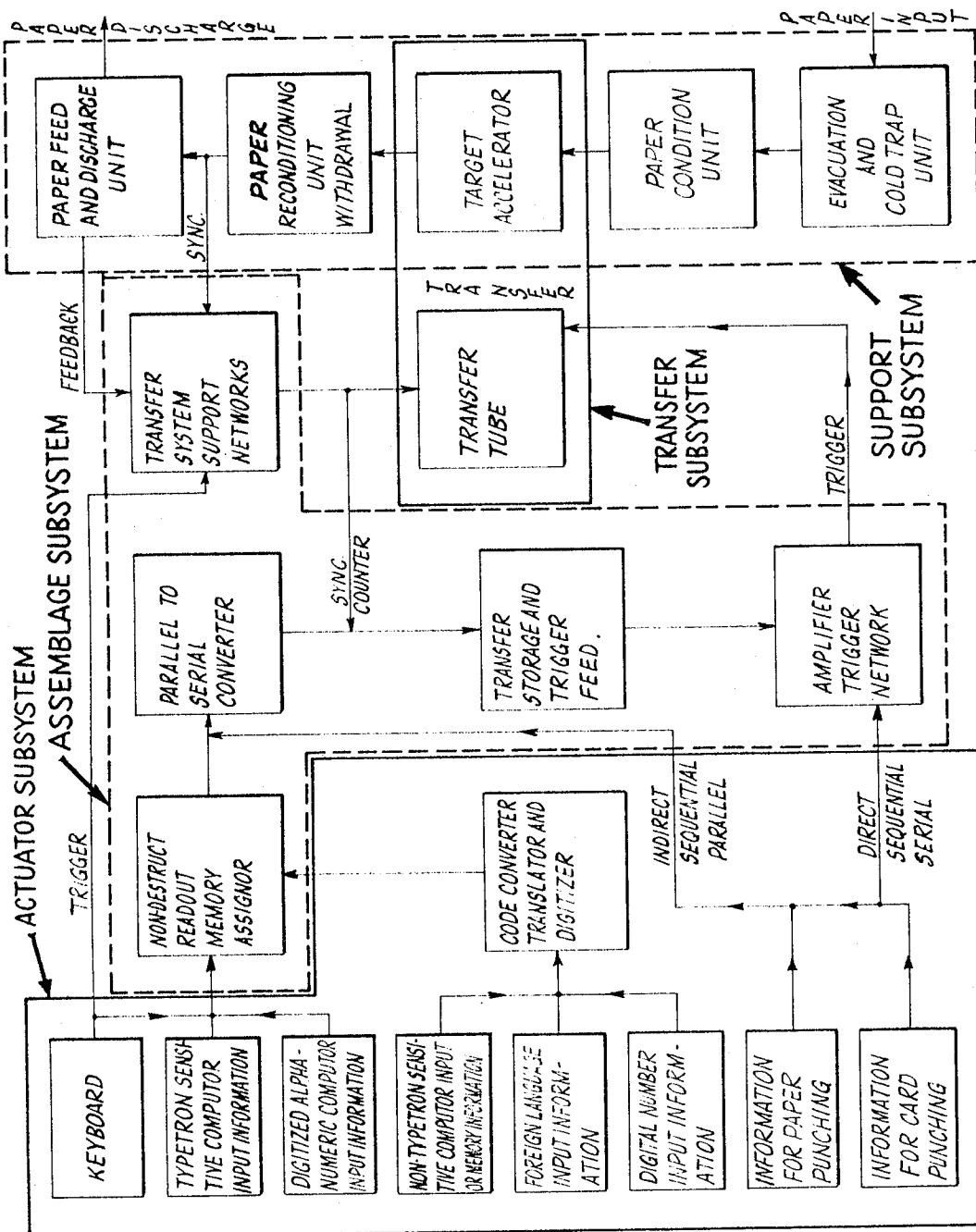


Fig. 1

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3 Sheets-Sheet 2

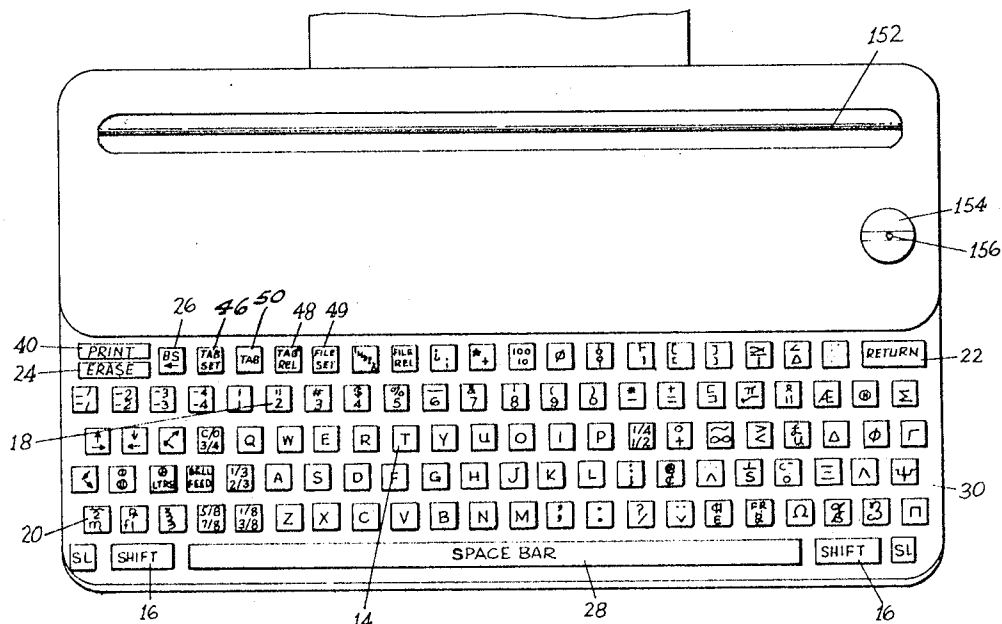


Fig. 2

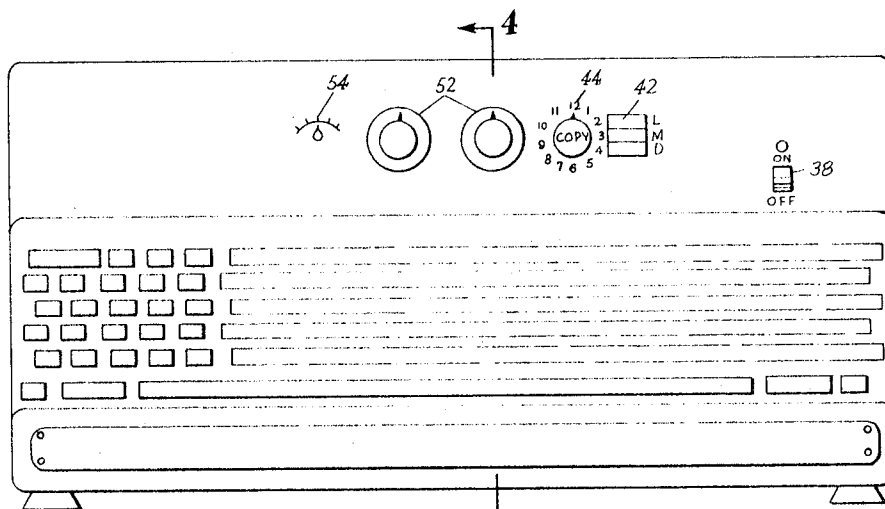


Fig. 3

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3 Sheets-Sheet 3

Fig. 4

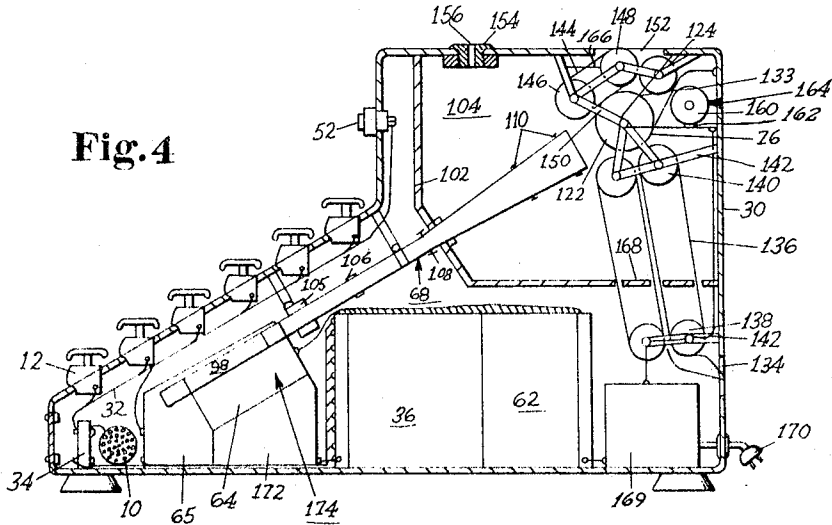


Fig. 5

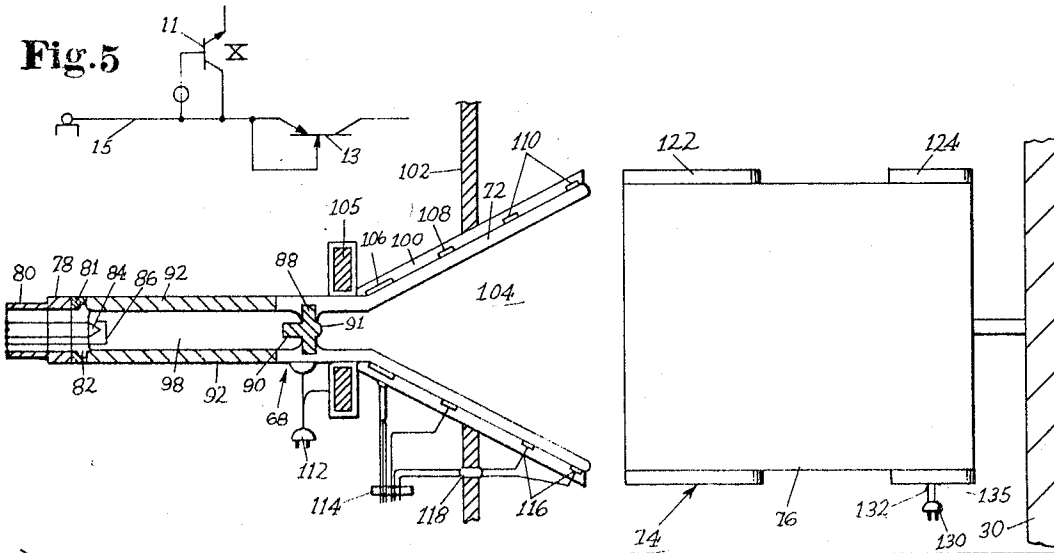
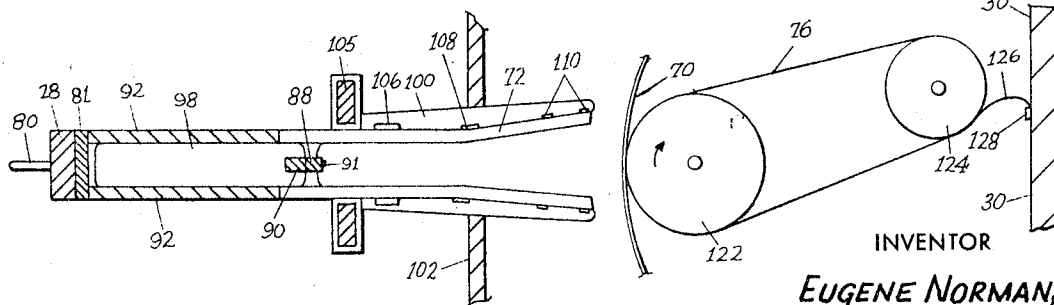


Fig. 7

Fig. 6



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ELECTRONIC TYPING MACHINE AND TRANSFER TUBE THEREFOR

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Filed Oct. 4, 1965, Ser. No. 492,598

Int. Cl. H04I 17/16

U.S. Cl. 178—30

16 Claims

ABSTRACT OF THE DISCLOSURE

Typing machine having plurality of key switches each of which actuates a non-destructive readout memory unit, and a parallel to serial converter for receiving digital information from said memory unit and feeding serial digital information to an open faced scanning tube which fires high energy particles toward an accelerator to produce an image on an image receiving surface disposed between the tube and the accelerator. The open faced scanning tube includes an evacuated chamber with a cathode at each end, means for causing one cathode to emit electrons, a magnetic field for confining these electrons centrally of the evacuated chamber, and means for supplying electrical impulses to the other cathode causing the first cathode to emit an energetic particle toward the open face of the tube.

This invention relates to an electronic typing machine, and more particularly to a machine which is capable of transforming human intelligent information (i.e., letters, symbols or other visually perceptible indicia) to computer intelligent information (i.e., characteristic electronic pulses), and of transforming computer intelligent information back to human intelligent information at an ultra-high rate of speed.

Since its original introduction, the basic mode of operation of the typewriter has remained unchanged; that is, a type bar is mechanically moved toward a sheet of paper, with an ink ribbon disposed in the path of movement of the type bar. A portion of the ink from the ribbon is then transferred to the paper, creating a letter or symbol. The type bar is moved into contact with the ribbon and paper by means of a complex mechanical linkage (in later developments, a power assisted mechanical linkage) which in turn is actuated by the operator manually depressing a desired key.

It is of course well known in the industry that the mechanical linkage involved is rather complex, and subject to numerous disadvantages including breakdowns, the need for maintenance and so forth. Furthermore, and more importantly today, the speed of operation of such a device is severely limited.

The typewriter industry has been successful in developing a linkage which can operate far faster than any human operator can manipulate the typewriter keys. However, with the rapid development of electronic computers, there has arisen a need for a machine which will print human intelligent characters at a much greater rate of speed.

It is of course possible to provide a great capacity of buffer storage in the computer to allow for the inability of present day printing devices to match the output speed of a normally operating computer. However, such buffer storage greatly increases the size, cost and complexity of the device.

Similarly, it has long been recognized as desirable to be able to transform a human intelligent input to computer intelligent information, to perform a multiplicity of pur-

poses, both computer oriented and non-computer oriented. (The computer oriented functions include programming, communication, and data processing, while the non-computer oriented functions include normal typing, copying repetitively, and slave typing.)

It is therefore a primary object of this invention to provide an electronic typing machine which can produce human intelligent information on an image receiving surface at an ultra-high rate of speed.

It is a further object of the invention to provide an electronic typing machine which will produce human intelligent information at such a rate of speed that it can match or exceed the output speed of present day computers, thereby eliminating the need for buffer storage in those computers.

A further object of the invention is the provision of an electronic typing machine which, by producing human intelligent information at an ultra-high rate of speed, will greatly increase the overall speed of a computer system.

It is another object of this invention to produce an electronic typing machine which will convert a human intelligent input to a computer intelligent form to be used in direct data processing.

It is another object of this invention to produce a typing machine which performs the data processing functions of information preparation, storage and retrieval.

It is a further object of this invention to provide a single device which will accomplish the computer oriented functions presently performed individually by separate machines of great complexity and cost.

In the non-computer oriented functions, and in addition to the problems inherent in mechanical linkages as described above, the operator must also contend with the necessity for changing ribbons, cleaning type, and in copying functions, the vastly increased problems of typing errors, and the generally poorer resolution found in each successive copy. In addition, the noise factor, particularly where a large number of machines are utilized in a small enclosure, is continuously at a very high level due to the hammer on platen action of existing machines.

It is therefore still another object of this invention to produce an electronic typing machine which will eliminate carbon ribbons, the complex mechanical linkages, and type bars.

Ancillary to the above object, the device of this invention will substantially eliminate the attendant noise of existing mechanical or electro-mechanical devices.

Still a further object of this invention is the provision of an electronic typing machine which is well suited to the preparation of scientific material, or of a multiplicity of foreign language material, wherein actuation of a single key will produce an entire formula, word, phrase, and so on.

Numerous other objects and advantages of this invention will become apparent to the skilled worker in the art upon reading this specification and examining the accompanying drawings in which:

FIGURE 1 is a block diagram of the electronic typing machine system showing the functional sequences.

FIGURE 2 is a plan view of the typing machine of this invention showing the key buttons with their designations where appropriate.

FIGURE 3 is a front elevational view of the electronic typing machine of this invention, showing the controls on the vertical face.

FIGURE 4 is a vertical cross sectional view showing the internal arrangement of components.

FIGURE 5 is a schematic diagram of the gating network.

FIGURE 6 is a vertical cross sectional view of the

transfer tube and target accelerator of this invention.

FIGURE 7 is a horizontal cross sectional view of the transfer tube and target accelerator of this invention.

Briefly considered, the instant invention contemplates the formation of human intelligent characters (viz letters of the alphabet or other visually perceptible indicia) on a sheet of paper or the like by changing the electrical charge of the carbon ions in the molecular hydrocarbon structure of papers. That is, in the manufacture of paper the elemental carbons of the basic constituents of paper are transformed into a stable state by the sharing of valence charges in the hydrocarbon radicals. The purpose, then, of the printing portion of the instant device is to return these shared valence charges, thereby returning the carbon to its elemental form, in which form it is black, and will show up on the paper as a dot.

According to this invention, the carbon shell is first broken by discharging high energy particles from a transfer tube to a target accelerator disposed behind a sheet of paper or other suitable image receiving surface.

Considering the machine as a whole, the human intelligent characters must first be transformed into computer intelligent information. In the preferred form of the invention, each character will be represented by sequential, parallel information bits from a memory unit having a seven by twelve matrix. That is, in the example given above, each character would be represented by eighty-four information bits arranged in twelve lines, each containing seven information bits.

The transfer tube of this invention scans the image receiving surface in a series of horizontally spaced parallel lines. In order to maintain the printing speed of the transfer tube, it is desirable that, for example, the top line of information bits of each character in a full line of typing be presented in a single scan of the tube. To this end, the so-called sequential, parallel information bits are converted to serial information in a parallel to serial converter memory unit.

After conversion to serial form, the information bits are amplified and fed to the transfer tube by means of a trigger which in response thereto emits the energetic particle forming the image as briefly described above.

As will be explained in more detail hereinafter, it is preferred that the transfer tube of this invention print a full line of information bits on each scan as indicated above, and, with alternate scans, print in opposite directions. This 180° out of phase read-out from the parallel to serial converter memory unit may be accomplished by prewiring of the read-out amplifiers of the conveyor memory unit.

GENERAL ARRANGEMENT

Referring to the schematic diagram of the electronic typing machine as shown in FIGURE 1, it may be seen that the machine is composed of several subsystems, including a transfer subsystem, an assemblage subsystem, an actuator subsystem, and accompanying support subsystems.

The transfer subsystem is composed of the transfer tube and the demounted target accelerator, with the image receiving surface being disposed between the transfer tube and the target accelerator. The transfer tube is an open-faced tube which is pulsed by digital information in serial form from the amplifier trigger network, causing the release of energized particles toward the target accelerator. The target accelerator assures that the energized particles will remain within their proper direction of travel and that their speed will be sufficient when they reach the image receiving surface to initially break the carbon shell and permit the release of an electron from the hydrocarbon radical of the image receiving surface.

As was stated previously, the open-faced transfer tube is pulsed by digital information in serial form which is amplified by the amplifier trigger network. The amplifier trigger network may be considered part of the assemblage

subsystem which also includes the transfer storage and trigger feed unit, the transfer system support networks, and the various memory units.

In operation, the assemblage subsystem accepts functional input information from the actuator subsystem, digitizes this information into sequential, parallel information bits in the non-destructive read-out memory units, converts the sequential, parallel information bits to sequential serial information bits in the parallel to serial converter memory units, and stores these information bits for synchronized feeding to the amplifier trigger network which in turn amplifies the bit impulses to energize the transfer tube.

The assemblage subsystem also contains transfer system support networks, including the synchronizer network, the feedback network, and the counter network. It is the purpose of these units to synchronize the operation of the transfer tube, the amplifier trigger, and the image receiving surface with respect to timing, position and initiation.

The actuator subsystem may consist of a wide variety of units for supplying functional input information. In the embodiment described hereinafter, the actuator subsystem comprises a more or less standard keyboard arranged to supply characteristic digital pulses to the non-destructive read-out memory of the assemblage subsystem.

Numerous other sources of input information can be coupled with the machine of this invention, as shown schematically in FIGURE 1. It will also be apparent that if the functional input supplied to the electronic typing machine is in the form of sequential, parallel information bits such as, for example, information for paper punching, or information for card punching, it is fed directly to the parallel to serial converter memory unit of the assemblage subsystem. Likewise, if the functional input supplied to the electronic typing machine is in the form of sequential serial information bits, it is fed directly to the amplifier trigger network. Also, if the functional input information supplied to the electronic typing machine is in the form of a foreign language, numerals or the like, an additional code converter, translator and digitizer unit must be provided in the actuator subsystem, or these units may be substituted in the assemblage subsystem for the existing non-destructive read-out memory units.

It will now be seen that the actuator subsystem and the assemblage subsystem together may be generally thought of as means for supplying sequential, serial information bit pulses to the transfer subsystem.

The accompanying support subsystems include the evacuation and cold trap unit, the paper conditioning unit, the paper reconditioning unit, and the paper feed and discharge unit. The evacuation and cold trap unit is simply a partially evacuated chamber maintained at a low temperature through which the image receiving surface is conveyed to reduce its temperature in order to limit the evaporation of internal moisture, and to also make the surface susceptible for the liberation of its carbon resulting from the energized particle bombardment. Both the paper conditioning system and the paper reconditioning system provide means for conveying the image receiving surface to and from its normally disposed position between the transfer tube and the target accelerator. The paper reconditioning system provides a moisturizer which returns moisture to the image receiving surface, compensating for the moisture which escaped from that surface in the vacuum chamber to prevent brittleness when the paper returns to atmosphere.

KEYBOARD ACTUATOR SUBSYSTEM

Referring now to FIGURES 2, 3, and 4, the keyboard actuator subsystem unit will now be described in more detail. As was previously stated, functional information may be placed into the electronic typing machine by means of the various actuator subsystem units, shown in the left-

most column of the schematic system diagram of FIGURE 1. These units vary all the way from the keyboard actuator subsystem unit of the electronic typing machine itself, to the various individual input units, such as computers and the like, which must be connected to the electronic typing machine by means of the umbilical plug described hereinafter.

The keyboard actuator subsystem is substantially similar to a standard typewriter keyboard. As shown generally in FIGURE 2, this includes the key buttons and the operating controls such as the tab keys, etc. discussed later. The keyboard contains forty-four letter keys 14, two shift keys 16, ten number keys 18, ten symbol keys 20, a return key 22, an erase key 24, a backspacer 26, and a space bar 28, all mounted upon mounting plate 30. The functions performed by all keys are similar to those of normal typewriters with the exception of the erase key 24. Operating in conjunction with the backspacer 26, the erase key 24 may be used to erase the previous letter for retyping. Operated in conjunction with the return key 22, the erase key 24 may be used to erase the entire line being typed for retyping.

When the operator depresses a key button, the electronic typing machine cycle of operation begins. The key button on its depression energizes a key switch 12 (see FIGURE 4) which releases a characteristic pulse of given voltage potential to a memory unit in the assemblage subsystem. The key switches 12 are mounted directly beneath the key buttons and are of two types. Digital switches, such as "E.D. Switches," produced by Micro Switch, Inc., are used for the letter, numeral, and symbol keys. Each E.D. digital switch emits an individual characteristic wave, of plus or minus characteristic (one for an upper case character and one for a lower case character) depending on the reference voltage. The reference voltage is controlled by a shift key 16 which operates on the ground state of the addressing portion of the non-destructive read-out memory unit 36 of the assemblage subsystem, and allows a minus or plus potential to exist across the key switch to be used. If the shift key is not depressed, a plus voltage potential exists across the key switch to be used, and, upon depression of that key button, the E.D. digital switch for that key emits an individual characteristic wave of plus character. If the shift key 16 is depressed, and the key button is then subsequently depressed, the E.D. digital switch for that key will emit an individual characteristic wave of minus character.

Each E.D. digital switch is wired through the harness 32 to a gating circuit on terminal block 34 which, in conjunction with the reference voltage determined by the shift key, directs the pulse to the desired memory unit. The gating circuit may be described in terms of two loops (see FIGURE 5); each loop contains a junction transistor, the junction transistor 11 of one loop being of the N-P-N type, and the junction transistor 13 of the other loop being of the P-N-P type. An individual characteristic wave of minus voltage potential from an E.D. digital switch on line 15 will pass through the loop containing the N-P-N junction transistor 11, but not through the other loop containing the P-N-P junction transistor 13. Just the opposite result will occur if the individual characteristic wave from an E.D. digital switch is of a positive character. After leaving the gating circuit, the individual characteristic wave of plus or minus character from the E.D. digital switch proceeds from the terminal block 34 on to the non-destructive read-out memory units of the assemblage subsystem.

All control key buttons (those other than the letter, numeral, or symbol keys) have simple double pole double throw (D.P.D.T.) switches mounted beneath the key. These switches send out an ordinary pulse for their respective keys when those keys are depressed. No gating circuit is necessary with the D.P.D.T. switches. The pulses from the D.P.D.T. switches travel through the wiring harness 32 and the terminal block 34 to the appropriate control mem-

The actuator subsystem controls consist of the power switch 38, the print button 40, the print intensity selector switch 42, the copy selector 44, the tab set 46, the tab clear 48, the tab key 50, the file locator knobs 52, and the page width selector 54. When information is desired to be printed out of the electronic typing machine, the power switch 38 is turned to the "on" position and the print button 40 is depressed. Production of a required number of duplicate copies is controlled by the copy selector 44 which causes the machine to reprint a desired article a given number of times. The density of the characters produced on the image receiving surface is controlled by the print intensity selector switch 42. Functional input information is positioned in a given order on the image receiving surface by means of the tab set 46, the tab key 50, and the tab clear 48, the operation of which is within the purview of the worker in the art. For example, the proper paragraph indenting is set by means of the tab key 46. When it is desired that the characters be printed on the image receiving surface at this position, the tab key 50 is depressed to properly locate this position before the respective keys are depressed. The tab clear key 48 will subsequently allow changing of the tab positions as set by the tab set 46. The page width selector 54 functions as an automatic margin selector as described later. The file locator knobs 52 control a memory unit for relocating previously printed information for reprinting by the electronic typing machine.

External actuator subsystems may be connected to the machine via the umbilical plug 10, and computer information fed directly to the assemblage subsystem.

ASSEMBLAGE SUBSYSTEM

As was stated previously, each E.D. digital switch releases a characteristic pulse for its respective key button when that key button is depressed. Coupled with each E.D. digital switch is a gating circuit and at least two non-destructive read-out memory units. The individual characteristic waves emitted by each switch pass from the switch via the wiring harness 32, to the terminal blocks 34 and on to the non-destructive read-out memory units of the assemblage subsystem. The sequential individual characteristic waves of plus or minus voltage potential proceed through a gating network wired to each E.D. digital switch, as previously explained, before passing to the non-destructive read-out memory units of the assemblage subsystem. The gating network assures that the individual characteristic wave of plus or minus character reaches the proper non-destructive read-out unit for that particular key. For example, when biased with a positive character wave, the gating network allows the individual characteristic wave to pass to the lower case information memory unit 36 and, when biased with a negative character wave, allows the individual characteristic wave to pass to the upper case information memory unit 36.

Each of the non-destructive read-out memory units 36 is in the form of a 7 x 12 matrix and is pre-wired for the desired output as is well known in the art. That is, the 7 x 12 matrix consists of seven vertical wires and twelve horizontal wires, there being eighty-four bits or memory junctions between the wires. Each bit or memory junction may be pre-wired so as to accept an electric charge when the particular individual characteristic wave for that non-destructive read-out memory unit is received from the terminal block 34. Those bits or junctions not pre-wired to accept an electric charge remain electrically neutral. A letter, symbol, numeral, etc., is pre-wired on the 7 x 12 matrix by placing its pattern or shape upon the matrix and preparing those bits or junctions which intersect the pattern or shape desired to accept an electric charge. For example, an on-destructive read-out memory unit is pre-wired for the letter N by placing the pattern or shape of the letter N upon the 7 x 12 matrix of the memory unit. Each of the twelve horizontal lines of the matrix contains seven bits or junctions which may be pre-wired

to accept an electric charge. In the case of the letter N, the only bits or junctions which will be pre-wired to accept an electric charge in the first horizontal line of the matrix will be the first and last bit. That line would then be represented as 1000001. The remaining horizontal lines of the matrix would be wired in similar fashion. When the depressed key button is allowed to return to its normal non-depressed position, the non-destructive read-out memory unit related to that key button "reads out" its information as sequential, parallel information bits. That is to say, that the information bits of each line of the 7 x 12 matrix for each non-destructive read-out memory unit are released in parallel form.

As was previously stated, the transfer tube 68 of this invention scans the image receiving surface 70 in a series of horizontally spaced parallel lines. In operation, the top line of information bits of each character is presented in a single scan of the tube. This necessitates converting the sequential, parallel information bits from the non-destructive read-out memory units into sequential, serial information bits. This is accomplished by means of the parallel to serial converter memory unit 62. In operation, the parallel to serial information converter memory unit 62 stores the sequential, parallel information bits of the non-destructive read-out memory unit 36 until a complete line of characters has been entered. Whether or not a complete line of characters has been entered is determined by a bit counter within the parallel to serial converter memory unit which counts to the average number of information bits per line. For example, if the page width selector 54 is set for standard 8½ inch paper, the bit counter in the parallel to serial converter memory unit 62 is then biased to count the number of information bits which are contained on an average line of characters for that page width. In the case of 8½ inch wide paper, the average number of information bits per line is 501. This is based upon 60 characters per line, each character being composed of seven bits for a total of 420 bits. The remaining bits are accounted for because of the necessary spacing requirements.

When a complete line of characters has been entered in the parallel to serial converter memory unit 62, the shift register of that unit deposits such information in the destructive read-out memory of that unit, so that on read-out, the parallel information bits are read to the transfer storage and feed unit 64, and then to the amplifier trigger network 65 in serial form. The read-out amplifiers of the amplifier trigger network 65 are arranged such that six of the twelve matrix lines of information bits are read to the trigger portion of the amplifier trigger network 65, 180° out of phase to the other six lines, in an alternate arrangement. This allows the transfer tube 68 to scan the image receiving surface 70 in a series of horizontally spaced, oppositely directed parallel lines.

As was previously stated, the parallel to serial converter memory unit may accept input information from a number of actuator sources other than the keyboard actuator subsystem of the electronic typing machine. Computerized information may be fed directly to the parallel to serial converter memory unit if the information is in the form of sequential, parallel information bits. If the computerized information is not in the form of sequential, parallel information bits, it may be utilized only if a code converter, shown on the schematic diagram of FIGURE 1, is used ahead of the non-destructive read-out memory units. If it is desired to utilize a foreign language with this electronic typing machine, a translator unit may be used in place of the code converter ahead of the non-destructive read-out memory. The translator is really a modified form of code converter containing a pre-programmed memory of the format to be translated. Since translation is not the primary function of the electronic typing machine of this invention, the additional time burden placed upon the entire system by the translation unit is reflected in a slow-down of the system to the rate of the translation function. This slow-down, however, may

be virtually eliminated by the use of a special computer unit to provide for the proper input in the electronic typing machine.

The bit sequencer and slave sequencer are optional devices in the assemblage subsystem. The bit sequencer prints out sequential, serial information bits directly as they come from an external actuator unit, not an actual part of the electronic typing machine, by by-passing the memory units of the assemblage subsystem and presenting the sequential, serial information bits directly to the transfer storage and trigger feed units 64. The bit sequencer also provides for focusing signals and control signals to the transfer storage and trigger feed unit 64 to provide for a punch-through type of discharge to be utilized when the image receiving surface 70 is a paper-tape punching device. The slave sequencer performs a simple conversion of the bit sequencer so as to provide for printed outputs in a 7 x 7 matrix for data processing purposes.

After the sequential, parallel information bits have been converted to sequential, serial information bits, they are amplified and triggered within the amplifying trigger network 65 and fed to the transfer tube 68 which in response thereto emits the energetic particles which form an image on the image receiving surface 70.

TRANSFER SUBSYSTEM

The transfer tube shown generally at 68 in FIGURES 6 and 7, utilizes an open faced tube of glass insulation 72 with a demounted target accelerator indicated generally at 74. Disposed between the transfer tube 68 and the target accelerator 74 is the image receiving surface 70 which travels on target accelerator belt 76. The transfer tube 68 has a conventional socket 78 which houses the transfer tube contact plate 80. Adjacent the socket 78 is an evacuated chamber 98 having at one end an insulator 81, a dipole permanent magnet 82 and a primary "hairpin" cathode 86. A conventional heater 84 is provided for the cathode 86.

At the other end of the chamber 98 is a secondary or "slug" cathode 88. The secondary cathode 88 has a lobe 90 projecting into the chamber 98 and a projection 91 of substantially smaller size extending toward the open face.

Located within the hard vacuum chamber 98 and disposed between the primary cathode 86 and the secondary cathode 88, and extending substantially the length of the vacuum chamber 98, are four electro-magnets 92, spaced equally around the inside surface of the vacuum chamber 98.

Following the secondary cathode 88, the transfer tube 68 becomes an open-face tube formed of glass with a covering of Mu metal shielding 100. The open faced portion of the transfer tube 68 extends through vacuum cold-trap plate 102 into the cold-trap chamber 104 which is maintained at a partial vacuum (anything less than atmosphere). A circular focus coil 105 of conventional design surrounds the transfer tube 68 at a location just past the secondary cathode 88. The focus coil 105 and the secondary cathode 88 are connected to a power supply by means of the plug 112.

In the space between the Mu metal shielding 100 and the glass tube are a group of four traveling wave deflectors 106, a ring accelerator 108, and two ring exit accelerators 110. The four traveling wave deflectors 106 are arranged equidistant apart in a circular path about the transfer tube 68. The traveling wave deflector, ring accelerator, and two groups of exit accelerators are all wired through the Mu metal shielding 100 and the vacuum cold-trap plate 102 to the plug 114. To prevent influx of air into the cold-trap chamber 104, penetration insulators 116 and penetration seals 118 are provided.

In operation of the transfer tube 68, the heater 84 heats the primary cathode 86. Sufficient power is supplied via plug 112 to carry the secondary cathode 88 at its threshold current, so that it emits electrons into the vacuum

chamber 98. The dipole permanent magnet 82 creates eddy currents and the force patterns enable the energized particles (electrons) emitted by the secondary cathode 88 to completely fill the vacuum chamber 98 with a semi-stationary mass of energetic particles. When the amplified, sequential, serial pulse information is fed to the transfer tube 68 by the amplifier trigger network 65, the primary cathode 86 is pulsed, and it emits an energized particle (electron). The emitted energized particle immediately comes into contact with the semi-stationary mass of energized particles in the vacuum chamber 98, and its progress is impeded. However, the forward force of the emitted energized particle is transmitted through the semi-stationary mass of energized particles in the vacuum chamber 98 to the lobe 90 of the secondary cathode 88. The secondary cathode 88, presently at its threshold current, is easily stimulated and emits a stream of electrons from the projection 91 out of the open-faced transfer tube toward the image receiving surface 70 disposed between the transfer tube 68 and the target accelerator 74. The release of the electrons by the secondary cathode 88 creates an opposite force which is transmitted through the lobe 90 of the secondary cathode 88 to the semi-stationary mass of energized particles in the vacuum chamber 98. This force is transmitted through the semi-stationary mass of energized particles and an energized particle at the end of such mass is caused to return to the primary cathode 86, regenerating it. The focus coil 105 focuses the beam of electrons emitted from the secondary cathode 88 into a fine beam. The four traveling wave deflectors 106 direct the emitted electron stream to enable the transfer tube 68 to scan the image receiving surface 70 in a series of horizontally spaced, parallel lines and to assure that the beam of electrons is striking the image receiving surface 70 at the proper location, the deflectors 106 are synchronized with feedback information in the transfer subsystem support system. The ring accelerator 108 and the exit accelerators 110 accelerate the electron beam toward the image receiving surface 70.

The target accelerator 74 accelerates the beam of electrons toward the image receiving surface 70, and includes a forward belt drive 122 and a rear belt idler 124 around which is placed a woven metal target accelerator belt 76, which travels in a clockwise direction as shown in FIGURE 6. The collector strap 126, affixed to the electronic typing machine mounting plate 30 at terminal 128, collects charged particles from the target accelerator belt 76. The target accelerator belt 76 receives its power supply from input plug 130, and the slip ring and wiper assembly 132. Also in the assembly is a commutator 135 which provides positional feedback information to the transfer system support network. The target accelerator 74 generally is maintained in its position within the electronic typing machine by means of the support arrangement 133.

ACCOMPANYING SUPPORT SUBSYSTEMS

The image receiving surface feed system, the image receiving surface discharge system, the vacuum system, the cold-trap system, and the moisturizer are all part of the support subsystem for the transfer tube 68.

The image receiving surface 70 is supplied to the electronic typing machine through feed opening 134, and is conveyed into the cold-trap chamber 104 and between the transfer tube 68 and the target accelerator 74 by means of synchronized parallel input drive belts 136. The parallel input drive belts 136 are provided with forward belt drive 138 and rear idlers 140, and are supported by means of input drive belt supports 142. The image receiving surface 70 leaves the parallel input drive belts 136 and is continued through the electronic typing machine by means of the target accelerator belt 76. After the image has been formed on the receiving surface 70, discharge is provided by means of the discharge belt 144 which is synchronized to operate with the target accelerator belt 76. The dis-

charge belt 144 is provided with the drive 146 and rear discharge idler 148, and is supported by means of supports 150. The image receiving surface 70 is discharged through discharge opening 152.

The vacuum system includes a vacuum pump 160 which obtains pump suction through aperture 162 and pump exhaust through aperture 164. The vacuum pump 160 evacuates the printing chamber which is formed by the cold-trap plate 102 and the housing 30 of the device.

Evaporation of internal moisture from the image receiving surface 70 in the evacuated printing chamber, and preparation of the image receiving surface for liberation of carbon ions which will result from the energized particle bombardment, is accomplished within the cold-trap chamber 104 by the low temperature partial vacuum therein. The cold-trap chamber 104 is supplied with liquid nitrogen through charge valve 156. This chamber also has a nitrogen purge plug 154 to allow nitrogen gas to escape and a cold-trap baffle 168 to prevent the escape of liquid nitrogen.

Before the image receiving surface 70 is discharged to atmosphere through opening 152, a moisturizer 166 returns the moisture which escaped in the evacuated printing chamber. This is accomplished by means of a very fine spray directed at the printed side of the image receiving surface 70.

Should it be desired, an automatic self-filing and indexing system may also be provided.

The optional automatic self-filing and indexing system consists of a tape memory which stores the sequential, serial information bits from the parallel to serial converter memory unit. This information may then be indexed by frequency matching or by varying the resistance in an RLC network.

As is well known in the prior art, various power supply electronics systems may be utilized to support the various described subsystems. For example, a 220 volt three prong plug 170 and a power supply unit 169 are utilized to supply the electronic typing machine with its power input. Also, power pack 172 and tube electronics 174 support the transfer tube 68.

What is claimed is:

1. An electronic typing machine comprising:

- (a) means for supplying digital information in serial form;
- (b) open faced scanning tube means;
- (c) target accelerator means;
- (d) an image receiving surface disposed between said tube means and said target accelerator means;
- (e) trigger means connected between said supply of digital information and said tube means and adapted to energize said tube means, whereby high energy particles are fired from said tube means toward said accelerator means to produce an image on said surface;
- (f) means for conditioning said image receiving surface prior to its disposition between said tube means and said target accelerator means, said conditioning means including a vacuum chamber, means for maintaining sub-atmospheric pressure in said chamber, cold trap means associated with said vacuum chamber for maintaining a reduced temperature therein, and means for conveying said image receiving surface through said vacuum chamber and said cold trap means; and
- (g) means for reconditioning said image receiving surface after said image is formed thereon.

2. The typing machine claimed in claim 1 including synchronizing means associated with said trigger whereby energizing of said tube is synchronized with the scans of said tube.

3. The structure according to claim 1 wherein said means for supplying digital information in serial form comprises:

- (a) a plurality of key switches;

- (b) at least one non-destructive read-out memory unit for each key switch;
 - (c) means connecting said key switch and said non-destructive read-out memory unit;
 - (d) a parallel to serial convertor means; and
 - (e) means for supplying parallel digital information from a plurality of said non-destructive read-out memory units to said convertor means.
4. The structure according to claim 3 including two non-destructive read-out memory units for at least some of said key switches; gating circuit means between said key switches and said non-destructive read-out memory units; and means for selectively biasing the polarity of said gating circuit means whereby actuation of each of said key switches will energize one of its associated non-destructive read-out memory units.
5. The structure according to claim 1 including means for conveying said image receiving surface between said tube means and said target accelerator means.
6. The structure according to claim 5 including means for synchronizing said conveying means with the scans of said tube.
7. The structure according to claim 8 wherein said means for reconditioning said image receiving surface includes a moisturizer means; and means for conveying said image receiving surface through said moisturizer means.
8. The structure according to claim 5 wherein said means for conveying said image receiving surface between said tube means and said target accelerator means includes synchronized parallel belt means.
9. The structure according to claim 5 wherein said target accelerator comprises a woven metallic belt, drive means for said belt, and means for supplying an electrical charge to said belt.
10. The structure according to claim 9 including collector means for removing charged particles from said belt.
11. The structure according to claim 9 including means associated with said belt drive means for conveying positional information to said trigger.
12. An electronic typing machine which transfers information to a receiving surface comprising:
- (a) actuator subsystem means whereby functional input information impulses of given voltage potential are released;
 - (b) assemblage subsystem means including means for accepting said functional impulses of given voltage potential from said actuator subsystem means and converting said functional impulses to digital impulses in a parallel format, and means for converting said parallel format impulses into serial digital information impulses;
 - (c) transfer subsystem means wherein in response to said serial digital information impulses from said assemblage subsystem means, energy is released to said receiving surface, forming an image thereon; and

- (d) support subsystem means, including means for conditioning said receiving surface prior to the release of energy thereto, and means for reconditioning said receiving surface after energy is released thereto and an image is formed thereon, said conditioning means including a vacuum chamber, means for maintaining sub-atmospheric pressure in said chamber, cold trap means associated with said vacuum chamber for maintaining a reduced temperature therein, and means for conveying said image receiving surface through said vacuum chamber and said cold trap means.
13. The structure according to claim 12 wherein said transfer subsystem means includes an open faced scanning tube, a demounted target accelerator, and trigger means connected between said assemblage subsystem means and said open faced tube and adapted to energize said tube, whereby high energy particles are fired from said tube towards said target accelerator to produce an image on said receiving surface.
14. An electronic typing machine comprising:
- (a) means for supplying digital information in serial form;
 - (b) open faced scanning tube means;
 - (c) target accelerator means, including a woven metallic belt, drive means for said belt, and means for supplying an electrical charge to said belt;
 - (d) an image receiving surface disposed between said tube means and said target accelerator means;
 - (e) means for conveying said image receiving surface between said tube means and said target accelerator means; and
 - (f) trigger means connected between said supply of digital information and said tube means and adapted to energize said tube means, whereby high energy particles are fired from said tube means toward said accelerator means to produce an image on said surface.
15. The structure according to claim 14 including collector means for removing charged particles from said woven metallic belt.
16. The structure according to claim 14, including means associated with said drive means for said belt for conveying positional information to said trigger means.

References Cited

UNITED STATES PATENTS

2,771,336	11/1956	MacGriff.
3,195,113	7/1965	Giordano.
3,278,683	10/1966	Ashby et al.
3,305,872	2/1967	Fyler.

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U.S. Cl. X.R.

178—15; 197—1; 346—74