NON-IMPACT PRINTING DEVICE FOR ELECTRONIC CALCULATORS

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A non-impact printing device for electronic calculators is designed to print characters on electrosensitive paper by means of electrodes mounted on a printing head which moves across the paper for printing each line of characters and then returns to the starting point. A toothed rack in the form of a loop cooperates with a gear associated with the printing head and a driving motor for effecting the translatory motion. A platen includes a portion for line spacing comprising inclined guide tracks which cooperate with guides for advancing the paper in conjunction with the movement of the head. A further portion of the platen includes a cleaning roller over which the electrodes are swept during each cycle of movement for automatic cleaning.

17 Claims, 11 Drawing Figures

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a non-impact printing device associated with an electronic calculator or the like for printing characters on electrosensitive paper by means of electrical impulses through a set of electrodes which are in contact with the sensitive surface of the paper. The electrodes are mounted on a printing head which moves transversely across the paper to print a line of characters and then returns to the starting point to repeat the printing cycle.

2. Description of the Prior Art

Prior art printing systems which have movable printing heads generally require complex and expensive mechanisms to achieve the required forward and reverse motion and line spacing. Such mechanisms require additional space and added weight making a compact, lightweight electronic calculator difficult to realize.

Furthermore, in printing devices of the non-impact type which employ electric discharges to burn an impression onto electrosensitive paper, there is generally created a powder residue which frequently becomes deposited on the electrodes forming a film which interferes with proper printing. In prior art devices the removal of this film was either accomplished by complex auxiliary devices or else, manually, thus requiring the machine to be taken out of service regularly for cleaning purposes.

OBJECTS AND SUMMARY OF THE INVENTION

The disadvantages of known devices are overcome in the inventive printing device for electronic calculators by providing means for printing characters by shifting the latter in one direction across the printing paper to print a line of characters and back to the rest position. The translating means includes a toothed rack in the form of a loop which is engaged by a gear associated with the printing head and a driving motor. A platen for supporting the printing paper has also associated with it a line spacing mechanism for advancing the paper in conjunction with the movement of the printing head.

Means for cleaning the electrodes automatically during each translatory cycle of movement of the printing head is also provided.

These and other features of the invention will become apparent from the following description of a preferred embodiment and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view in section of the printing device for electronic calculators according to the invention;

FIG. 2 is a plan view of the printing head;

FIG. 3 is a sectional view taken along line III—III of FIG. 2;

FIG. 4 is a partial sectional view taken along line IV—IV of FIG. 2;

FIG. 5 is a plan view, partially in section, of the printing device;

FIG. 6 is a rear view, partially in section, of the printing device;

FIG. 7 is a sectional view taken along line VII—VII of FIG. 5;

FIG. 8 is a front view of a detail of FIG. 5, partially in section;

FIG. 9 is a schematic of a portion of the electronic control system for the printing device;

FIG. 10 is a block diagram showing the electronic control system for the printing device;

FIG. 11 is a partial sectional view of an alternative method of coupling the printing head for movement.

DETAILED DESCRIPTION OF THE INVENTION

The printing apparatus according to the invention is intended for use in electronic business calculators which print characters on electrosensitive material, such as metallized paper.

Referring now to FIG. 1, the printing apparatus includes a printing head 10 mounted in proximity to a platen 11 along which the head is movably positioned for printing characters on an electrosensitive paper tape 12 which is threaded between the head 10 and the platen 11.

As shown in FIG. 2, the printing head 10 includes a body 13 preferably formed of plastic insulating material and having a portion 14 extending therefrom (FIG. 3) which is slightly curved on its underside for contacting the surface of the paper tape 12 which is to be printed. The curved underside portion of extension 14 is formed with a substantially "W"-shaped channel 18 (FIG. 4) in which a number of metallic electrodes 15 are aligned parallel to the longitudinal axis of the paper strip, each of the electrodes being of a length suitable for contacting the strip and platen. Each of the electrodes 15 is integral with a conductor 16, made of material such as tungsten wire, or the like, which is electrically connected to the control circuit by means of a corresponding conductive track 17 which forms part of a printed circuit control assembly to be hereinafter described.

Each of the conductors 16 is equally spaced from each other and is shaped in the form of a right angle 19 at the point of contact with the conductive track 17 and is supported at said point away from the body 13 of the printing head 10. In this manner, each conductor 16 makes resilient contact with its corresponding track 17 thus assuring good electrical contact between the elements as the printing head 10 moves for effecting printing.

In order to maintain the conductors 16 in alignment with the corresponding track 17 while permitting resilient contact thereupon, each of the conductors 16 has a portion extending downward from the angled portion 19 (FIG. 4) which is guided by a cutaway 20 formed in the body 13 of head 10. In this manner transverse motion between conductor 16 and track 17 is prevented. The printing head body 13 had mounted thereon a bifurcated conductive strip 21 having its axis parallel to the electrodes 16. The two parallel fingers of strip 21 slope away from body 13 such that their extreme portions are aligned with the right angle portions 19 of conductors 16 in order to make electrical contact with corresponding conductors 23, 24 of the printed circuit whose function will be hereinafter described.

On the side opposite the extending portion 14, the body 13 is provided with a bore 25 (FIG. 3) for permitting the head 10 to pivot and slide along a shaft 26 (FIG. 5) supported between two frames 27, 28 of the machine chassis 29. The body 13, in addition, includes a second extension 30 (FIG. 3) in the form of an "L"
for engaging the mechanism for advancing the printing head 10 along the platen 11.

The advancing mechanism for the printing head 10 comprises a carriage 31 (FIG. 1), preferably of plastic material, having a rectangular prismatical shape, disposed parallel to and beneath shaft 26 in a corresponding passage 32 of the chassis 29. One external side 33 of carriage 31 (FIG. 6) includes a closed channel 34 comprised of two parallel sections 35, 36 joined by two semicircular sections 37, 38, the entire side edge of said channel being provided with a continuous row of teeth 39, thereby forming a loop. At the base of channel 34 (FIG. 7), parallel to and equidistant from row 39, there is provided a second channel 40 which serves as a guide track in which is inserted the extension of a pin 41. A toothed wheel or gear 42 is mounted on pin 41 for insertion into channel 34 and engagement with the row of teeth 39 thereby forming a rack and pinion arrangement. The extension of pin 41 keeps the gear 42 at the proper distance from the row 39 to maintain constant engagement between the teeth of said gear and row. The gear 42 is integrally formed with a second toothed wheel or gear 43 having a larger diameter. Gears 42, 43 and pin 41 are secured to the larger end of a plate 44 (FIGS. 5, 6) having a substantially oval shape the smaller end of which is pivotable about a drive shaft 45. The gear 43 meshes with driving gear 47 having a shaft 45 which is rotated by an electric motor 46. Upon excitation of the motor 46, shaft 45 and driving gear 47 cause the gears 42 and 43 to rotate. Gear 42, meshing with teeth 39 constrains the carriage 31 to move along the channel 34. During this movement, whenever the gear 42 reaches one of the curves 37, 38 of the toothed rack 39, the plate 44, being fixed to shaft 41 and pivotable about the motor shaft 45, function as a crank arm to constrain gear 42 to follow the channel 34 around its curved portion and then moving along the opposite straight track. Thus the carriage 31 is made to undergo a transfer in its direction of motion.

The edge of side 32 also includes a rectangular cutaway portion 49 (FIGS. 1, 6) in which a finger 30 of printing head 10 is inserted in order to couple the head 10 to the movement of carriage 31. The back-and-forth translatory motion of the carriage 31 governs the advancement of the printing head 10, along shaft 26 between the two fixed end points of travel.

The formation of cutaway portion 49 permits head 10 to move loosely in a vertical direction to a limited degree thus allowing resilient contact between the paper 12 and electrodes 16 sliding along the printed circuit 17, the electrodes being mounted with certain initial pressure with respect to the printed circuit board.

To prevent the carriage 31 from sliding out of channel 32 or being misaligned during its back-and-forth movement a cover panel 50 serves as a closure member. Panel 50 includes a rectangular slit 51 (FIG. 6) for allowing finger 30 of the head 10 to be inserted into cutaway 49 of carriage 31 and an additional cutout 52 for permitting the plate 44 and gear 42 to shift position whenever the curved portions of the rack 39 are reached.

The back-and-forth movement of carriage 31 is utilized to implement the line spacing function of the apparatus. Carriage 31 includes a curved surface 55 (FIGS. 7, 8), located opposite its surface 33, on which are formed three substantially rectangular and parallel ribs 56, 57, 58. The three ribs, accordingly, define two guide tracks 59, 60. Track 59 includes a first portion which is inclined with respect to the longitudinal axis of surface 55 and continues with a portion which parallels said axis while track 60 is parallel to the first portion of track 59. The two tracks 59, 60 engage two protrusions 61, 62 (FIG. 7) of an arm 63 secured to a disk 64 forming part of the line-spacing assembly 65 pivotal about the axis of rotation of the platen 31. Arm 63 includes a toothed crown section 66 (FIG. 8) extending parallel to the axis of assembly 65.

One side of disk 64 is provided with three lugs 67, 68, 69 (FIG. 7), the lug 69 being centered and spaced 90 degrees with respect to lugs 67 and 68. The crown section 66 (FIG. 7) includes a predetermined number of Z-shaped teeth adapted for engaging corresponding teeth on one edge of a circular crown 70 having a diameter greater than its supporting disk. Crown 70 is rotatable about a hole 73 (FIG. 5) provided on one side of chassis 29 by means of hub 75 secured to said crown.

The internal bore 76 of hub 75 engages a shaft 77 which is the cylindrical extension of the plate 11. Shaft 77 is provided with a threaded bore 78 at its end into which a screw 80, passing through hole 79 in crown 70, joins the latter to the plate 11. The crown 70 is further joined to the plate 11 by two diametrically opposite studs 81, 82, located at the end of hub 75, which are inserted in two corresponding apertures 83, 84 of the cylindrical extremity of plate 11. The crown 70 is kept separated from the chassis 29 by means of circumferential step 86 around hub 75.

The previously-mentioned line spacing assembly includes a cross-shaped member 87 having an elongated arm 88 (FIG. 7). The center portion of member 87 is bored to permit insertion of shaft 75. Furthermore, member 87 includes grooves 89, 90, 91 which mate, respectively, with lugs 67, 68, 69 of the line-spacing assembly for securing the member to the assembly.

Member 87 is maintained in position by means of the arm 88 which resiliently contacts the side 74 of chassis 29 (FIG. 5), thus constantly urging crown section 66 of line spacing assembly 65 against the toothed crown 70.

Accordingly, whenever the carriage 31 is moved in response to actuation of electric motor 46, the tracks 59, 60 cause the line spacing assembly to shift about the collinear axes of platen 11 and crown 70. During the first phase of the shifting motion, the teeth of crown section 66 (FIG. 8) act against those of crown 70 turning the latter through a certain angle together with the platen 11 to which crown 70 is joined. During the next phase the teeth of crown section 66 slip across the teeth of crown 70 and mesh with the next adjacent tooth, thus undergoing a ratchet type of movement as a result of the spring action of arm 88 urging the toothed members together. In this phase of the line shifting movement, the platen 11 remains motionless while the line spacing assembly 65 is readied for a successive shifting movement of crown 70.

The platen 11 (FIG. 5) includes a shaft, preferably of plastic, having a central portion 95 on which a layer of soft rubber 99 is deposited for supporting the paper tape 12 to be printed. The extreme ends of platen 11 comprise two equal cylinders 77, 97 which are journaled, respectively, in seat 73 of side 74 and seat 98 of side 28 of the chassis 29.
In addition, platen 11 incorporates a cylindrical portion 85 located between platen sections 77 and 96 which is seated in a cylindrical journal 100 joined to side 79 of chassis 29. The axis of journal 100 is slightly raised relative to the axis of platen 11, having, however, the same distance from the axis of shaft 26 as the latter bears of the platen axis.

Journal 100, accordingly, is off center with respect to the axis of platen 11 while remaining coaxial relative to the curved underside portion of extension 14 of the printing head 10. A cylindrical cleaning roller 101 mounted around journal 100 is adapted to clean the ends 15 of electrodes 16. The roller 101 has a portion which fits around cylindrical platen portion 85, extending into an annular rim 102 and is further provided with a knurled external surface. Rim 102 includes a projection 103 which wedges with a corresponding opening 104 in section 96 of platen 11 for rotation therewith.

The internal bore of cleaning roller 101 which turns around journal 100 is eccentric with respect to its external knurled surface. Thus, whenever platen 11 rotates by the line spacing apparatus the external surface of cleaning roller 101 varies in height relative to the axis of the platen.

Mounted about rim 102 of roller 101 is an elevating ring 110 having an edge 111. Ring 110 has a lug 113 suitably inserted into chassis 29 for preventing rotation of said ring as well as a tapered finger 112 extending parallel to platen 11. Finger 112 extends along and is slightly displaced from the surface of platen 11 and extends slightly beyond the edge of the paper tape 12 against the platen surface. A curved underside matches the curved surface of the platen 11 (FIG. 1).

The purpose of elevating ring 110 is to protect the edges of the paper tape 12 as the printing head 10 moves away from the cleaning roller 101. The ring 110 and in particular the finger 112 which is slightly tapered down towards the platen cause the head 10 to become lifted as to move towards cylinder 101 and as it returns the head 10 is guided beyond the edge of tape 12 and down towards the platen, thus avoiding tearing or misaligning the paper through contact with the edge. Sliding contact between the finger 112 and the extension 14 of head 10 is facilitated by the complimentary profile of the respective engaging surfaces. Finger 112 also serves as a paper tape 12 guide for keeping the tape against the platen 11 as well as maintaining the tape edge in proper registry.

The knurled external surface of cleaning roller 101 is level with the external end of finger 112 due to the eccentricity of journal 100 relative to platen 11. The printing head 10 has an extreme limit of travel of the leftmost point of cleaning roller 101 and thus as the head travels back and forth the ends 15 of electrodes 16 contact the knurled surface of said roller. This action serves to liberate the electrodes of powder (which would cause an insulating film) which accumulates as the head sweeps across the paper during printing. The shape of the notched channel 18 also aids in preventing the formation of an insulating film by forming a chamber for depositing the powder which would otherwise accumulate on the electrodes.

The eccentricity of cleaning roller 101 assures the cleaning of electrodes 15 regardless of any errors in mounting or manufacturing the parts; particularly between shaft 26 on which the printing head 10 pivots and the axis of the cleaning roller 101. Were it not for the eccentricity of roller 101, any misalignment of the mentioned parts would result in only a few of the electrodes being cleaned.

Accordingly, whenever the electrodes 15 approach roller 101 a different portion of the knurled eccentric surface contacts progressively each of the electrodes which are arranged in a row. Thus, as platen 11 makes a complete turn the row of electrodes 15 is swept across the surface of roller 101 and the electrode cleaning process is achieved and proper printing on the electro-sensitive paper is assured.

The paper tape 12 is fed by means of platen 11 on which it rests by means of two paper pressure rollers 115, 116 (FIG. 5) mounted on a shaft 117 which rotates between two cutouts 118, 119 of chassis 29. The rollers 115, 116 are separated in the center part of shaft 117 to allow the insertion of the forked end of an arm 118 (FIG. 1). The opposite end of arm 118 includes a semicircular notch 119 for engaging one end of a bar 120 (FIG. 5). The other end of bar 120 is engaged by the end of a lever 122 which includes a finger 123 and a tab 124. Tab 124 engages one end of a metal spring 125, the other end of which is in contact with a mechanically rigid point, the printed circuit board 17. Lever 122 is thus urged downward by spring 122 causing the pressure rollers 115, 116 to press against platen 11.

Rollers 115, 116 may be lifted away from the surface of platen 11, in case it should be necessary; for instance, in order to replace the roll of paper tape 12, by raising the cover plate 126 which pivots on shaft 127. The cover plate 126 includes a leg 129 which, when the cover is raised, cooperates with finger 123 of lever 122 causing the latter to rotate clockwise thus also shifting bar 120 and rollers 115, 116 away from the platen 11.

The rollers 115, 116, arm 118, bar 120, lever 122 and spring 125 comprise, in addition, the electrical return path for the printing circuit. The electrical signals which are fed through electrodes 16 and points 15 are conducted across the metallicized layer of the electro-sensitive paper 12 and thence to rollers 115, 116, eventually reaching spring 125 and the printed circuit at point 130. It can be seen, therefore, that spring 125 has both a mechanical and electrical function in the described embodiment.

The printing operation takes place when the appropriate keys on the keyboard (not shown) are depressed. This causes the electrical motor 46 (FIG. 7) to be actuated, which through gears 42, 43, 47 causes the carriage 31 and coupled printing head 10 to shift. The head 10 which is located at its rest position at the outer edge of the cleaning roller 101 shifts toward its other extreme position, located at the right edge of the paper tape 12 and back again.

During this cylical shift, the two blades of an electrical contact wiper 21, joined to head 10, sweep along corresponding parallel conductive tracks 23, 24 of the printed circuit board 17.

Track 23 has a portion 141 (FIG. 9) which is interrupted and, therefore, nonconductive and serves to initiate an electrical impulse for use by the electronic control system as hereinafter described. The interrupted portion 141 is located just prior to the point on the paper tape 12 at which a line of printing is to commence. In the rest position of printing head 10 the
wiper 21 is bridged across the common conductive track 24 and the first portion 23' of the interrupted track 23.

As printing head 10 moves across the paper tape 12 the wiper 21 moves correspondingly, first contacting track section 23' then the interrupted portion 141 and finally track section 23''. When wiper 21 is at portion 141 electrical continuity between tracks 23 and 24 is interrupted. This electrical interruption may be utilized to signal the position of the printing head 10 as being at the precise beginning of a printing line to the trigger 202 (FIG. 10) of the electronic control system and thus causes the printing of the characters to commence.

After printing a line of characters, the head 10 returns to the starting position and wiper 21 sweeps from section 23'' to section 23'. The making of electrical contact with section 23', after the interruption 141, serves to signal to the electronic control system that the motor 46 should be turned off. Upon turning off motor 46 the printing head 10 returns to its rest position, the short distance being reached by the inertia of the head 10 as it moves back. Head 10 remains in the rest position until a new cycle of operation is initiated.

Although the electronic system for governing printing forms no part of this invention, a brief description thereof will be given. The system is particularly adapted for printing characters in the well-known format of a 5×7 matrix consisting of five columns each being printed sequentially, each column being comprised of seven row elements. The matrix is generated by means of an integrated circuit read only memory (ROM) 200 which is pre-programmed for generating alphanumerical characters when the ROM is fed with a suitable input code. Such memory units are presently available off the shelf and, consequently, their structure and operation, being well understood, need not be detailed herein.

Coded characters which represent the characters to be printed are fed by the output registers of the logic unit of the calculator (not shown) through an adapter network 201 (FIG. 10) for converting the logical output of the logic unit to logic compatible with MOS circuitry (e.g. DTL-TTL logic to MOS logic). The characters fed from the logic unit may consist of a six digit code, each digit being fed through a separate channel through individual logic adapter circuits included in network 201 and then into the ROM 200. The ROM 200 decodes and transforms the coded digits into matrix form representative of the row portions of the character to be printed having a 5×7 format.

The ROM 200 is fed with another set of channels which are intended to control the sequential printing of the columns of the 5×7 character. A signal is derived from the position of the carriage 31 during its back-and-forth movement to indicate that the carriage has reached the point where printing of the characters is to begin. This signal is fed into a trigger circuit 202 which initiates the running of an oscillator or clock 203. The output of clock 203 is fed to a seven bit shift register 204 in which a stored bit is shifted one stage at a time through each of its seven positions in a well-known manner. Output channels are connected to five adjacent positions of register 204 leaving two successive positions "floating," for a purpose to be described.

The five output channels are each connected to one input of an associated AND gate 209.

A column timing network 205 is provided for governing the sequential printing of each of the columns containing row elements of the character to be printed. The timing network 205 is connected to each of the AND gates 209 and causes each of the five AND gates to be turned on sequentially, that is with a predetermined time delay between the successive gates. In this manner, the movement of the printing head 10 may be synchronized with the printing of the successive columns of each character to be printed. Timing network 205 may be synchronized with clock 203 and serves to insure that each column is driven for an appropriate period of time in relation to the velocity of the printing head 10 for proper printing of the characters.

The two adjacent floating positions of the serial register 204 serve the purpose of providing two columns of spacing between successive characters for insuring legibility by not sending any columnar printing information to the ROM during the time that the printing head moves through a distance of two columnar spaces. The outputs of the AND gates 209 are fed through a logic interface 206 comprised of individual logical adaptors associated with each channel for compatibility with MOS-type logic.

Upon the arrival of the bit stored in serial register 204 at the final position it is then fed out after a cycle of seven positions to a trigger network 207 connected to clock 203 which is halted upon receiving the trigger pulse.

The output of the ROM 200 comprises seven output leads corresponding to the number of rows of the matrix character printed. Each lead will be electrically activated during the time interval when the corresponding row is to be printed as generated by the ROM 200 in accordance with the data input of character information from the logic unit and time control from the shift register 204. A seven channel logic interface 208 adapts the MOS-type logic of the ROM 200 to the logic required by the electrode driving network 210.

The electrode driving network 210 includes an individual driver associated with each channel and thus with each electrode and serves to raise the power of the signals to an appropriate level as required by the paper characteristics for proper printing.

Referring now to FIG. 11, there is shown an alternative method for coupling the movement of carriage 31 to the body 13 of printing head 10 as well as to regulate the tension of the electrodes 16 as they slide along the conductive tracks of the printed circuit control assembly 17.

Carriage 31 is retained in channel 32 of chassis 29 by a panel 50 and is provided with an insert 304 on its external side which insert 304 accommodates a threaded bolt 303 extending through an opening in panel 50. One end of a resilient leaf 301 is positioned over the external end of bolt 303 on which is threaded a regulating nut 302. The other end of leaf 302 is fixedly attached to printing head body 13.

The free end of leaf 301 is normally biased in a clockwise direction, as viewed in FIG. 11, and thus when pressing against nut 302 causes the printing head body 13 to become biased in a counterclockwise direction about shaft 26. Since electrodes 16 are urged against tracks by their own resilient action, by adjustment of the nut 302 the tension load on electrodes 16 may be regulated.
It is to be understood that the inventive printing device for electronic calculators herein described may be changed or modified without departing from the scope of the invention which is to be measured solely from the appended claims.

What is claimed is:

1. Non-impact printing apparatus for printing lines of information on a record medium, including a platen for carrying said record medium, a carriage, motive means for moving said carriage with respect to said platen, and comprising:
   - a loop shaped rack recessed in one side of said carriage, said loop shaped rack including two rectilinear portions parallel to said platen and curved portions joining said rectilinear portions;
   - a pinion driven by said motive means;
   - and means for holding said pinion in continuous engagement with said loop shaped rack for producing reciprocal motion of said carriage across the platen, a printing head being carried by said carriage, in contact with the record medium carried by said platen.

2. Non-impact printing apparatus as set forth in claim 1, wherein said holding means comprise a guiding member carried by said pinion and guide elements integral with said carriage and substantially parallel to said curved portions to cooperate with said guiding member.

3. Non-impact printing apparatus as set forth in claim 2 wherein said guiding member includes a projection axially projecting from said pinion, and said guide elements include a groove further recessed in said carriage and having edges parallel to said loop shaped rack.

4. Non-impact printing apparatus as set forth in claim 1 wherein said motive means comprise a driving shaft, said shaft being axially fixed, transmission means for coupling the rotation of said shaft to said pinion, and means pivotal with respect to said driving shaft for position said pinion on a predetermined radial distance from said driving shaft allowing said pinion to follow said curved portions of said loop shaped rack.

5. Non-impact printing apparatus as set forth in claim 1, further comprising:
   - guide track means included in said movable carriage and inclined with respect to the path of transulatory motion of said carriage;
   - an arm member rotatable mounted coaxial with respect to said platen and adjacent thereto, said arm member having guide element means cooperating with said guide track means for rotating said arm member as a consequence of the movement of said guide track means as said carriage moves; and
   - unidirectional coupling means for transmitting the rotation of said arm member to a unidirectional rotation of said platen for line spacing of the record medium carried by said platen.

6. Printing apparatus for electronic calculators for printing characters on a recording medium of the electrosensitive type, comprising:
   - printing head means for supporting a plurality of electrodes for contacting the surface of said recording medium;
   - support means for supporting the recording medium;
   - a carriage carrying said printing head and movable transversely of said support means;
   - driving means for imparting relative motion between said printing head means and said support means to effect printing of characters;
   - said driving means comprising motor means for generating motion, converting means coupled for movement with said printing head means for converting the motion of said motor means to translatory motion of said carriage transversely of said support means, and guide means for cooperating with said support means for causing said support means to move said recording medium in response to said translatory motion;
   - said converting means comprising toothed members of said motor means including first and second toothed wheels secured to a shaft, said second wheel being rotatably driven by said motor means;
   - a first channel provided on one side of said carriage, said channel extending parallel to the direction of motion of said carriage and including parallel straight portions joined by curved portions at the end thereof, said straight and curved portions being provided with a continuous row of teeth for being engaged by said first toothed wheel, and
   - a second channel further provided on said carriage and extending parallel to said first channel;
   - said shaft extending into said second channel for guiding the translatory motion of said toothed members and said carriage during engagement of the straight portions of said row of teeth by said first wheel, and for reversing the direction of said translatory motion during engagement of the curved portions of said row of teeth by said first wheel; and
   - said shaft being held at a fixed distance from said toothed members of said motor means, whereby said first wheel is maintained in constant engagement with said row of teeth at each portion thereof.

7. Non-impact printing apparatus for electronic calculators for printing characters on a recording medium of the electrosensitive type, comprising:
   - printing head means for supporting a plurality of electrodes having ends contacting the surface of said recording medium;
   - a cylindrical platen for supporting the recording medium, said ends of said electrodes being disposed along a cylindrical surface corresponding to the cylindrical surface of said platen;
   - a cylindrical cleaning roller contiguous to said platen and having an axis parallel with said platen and a diameter substantially equal to that of said platen, said cleaning roller having a cleaning surface for cleaning said ends of said electrodes when in sliding contact therewith;
   - means for reciprocally transporting said printing head means across said platen and said cleaning roller for printing lines of characters on said recording medium and for cleaning said ends of said electrodes;
   - driving means for rotating said platen to space said recording medium; and
   - means for joining said cleaning roller to said platen for movement of said roller about said parallel axis.

8. Non-impact printing apparatus as set forth in claim 7 wherein said roller surface is eccentric with respect
to said parallel axis, so that the rotation of said roller, following said space rotation of said platen causes the distance of said cleaning surface to said parallel axis to vary, whereby contact between said cleaning surface and each of said electrodes is promoted.

9. Non-impact printing apparatus as set forth in claim 7 wherein said protective means comprises a fixed ring mounted about said platen, said ring having an extension for covering one edge of said recording medium, and said extension serving to lift said printing head means during movement thereof.

10. Non-impact printing apparatus as set forth in claim 9, wherein said protective means comprises a fixed ring mounted about said platen, said ring having an extension for covering one edge of said recording medium, and said extension serving to lift said printing head means during movement thereof.

11. Non-impact printing apparatus as set forth in claim 7, wherein said cleaning roller surface is knurled.

12. Non-impact printing apparatus for electronic calculators as set forth in claim 7, wherein said platen is rotatable about a fixed axis and said printing head is slidably pivoted about a pivoting axis parallel to said platen, said cleaning roller being supported offset with said fixed axis of said platen but coaxial with the cylindrical surface of said electrode ends.

13. Printing apparatus as set forth in claim 7, wherein a part of said writing electrodes contiguous to said writing ends is retained in a cavity of said printing head support adapted to collect particles formed as result of the action of said electrodes of said record medium.

14. Non-impact printing apparatus for electronic calculators for printing characters on an electrosensitive recording medium, comprising:
   a platen supporting said recording medium;
   a plurality of electrodes having writing ends contacting the surface of said medium for printing;
   a printing head support rigidly retaining portions of said electrodes adjacent to said writing ends, said writing electrodes including, opposite to said rigidly retained portions, resilient portions projecting from said printing head support;
   shifting means for shifting said printing head support transversely to said medium;
   an external control circuit for feeding said electrodes; and
   conductive tracks of a circuit support connected to said control circuit and adjacent to said printing head support, said tracks being parallel to each other and to said platen, for slidably and resiliently contacting said resilient portions of said electrodes during the shifting of said printing head.

15. Printing apparatus as set forth in claim 14, wherein said shifting means include a carriage, said printing head support being connected to said shifting means by means of a resilient member having one end integral with said printing head support and the other end engaging with a member adjustably fixed to said carriage.

16. Printing apparatus as set forth in claim 14, wherein said resilient portions of said writing electrodes are shaped in form of substantially right angles, the ends of said electrodes opposite to said writing ends being guided on corresponding holes of said printing head support.

17. Printing apparatus as set forth in claim 14, wherein said external control circuit further includes an actuating circuit for actuating said shifting means for the starting of printing of characters and said circuit support includes two further conductive tracks connected to said actuating circuit, said printing head support including two resilient contact shoes supported at one end by said printing head support and cooperating with the other end with said two further conductive tracks, one of said two further tracks having an interrupted portion substantially near the beginning of the shifting movement of said printing head support to constitute a switching point to stop the actuation of said shifting means.

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