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Giolitti et al.

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[45] **July 30, 1974**

[54] **NON-IMPACT PRINTING DEVICE FOR ELECTRONIC CALCULATORS**

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Sept. 6, 1971 Italy 69943/71

[52] **U.S. Cl.** ..... **346/74 E**, 346/74 S

[51] **Int. Cl.** **G01d 15/06**

[58] **Field of Search** ..... 346/74 E, 74 ES, 74 S, 346/74 SB, 139 R, 139 C; 179/100.2 D

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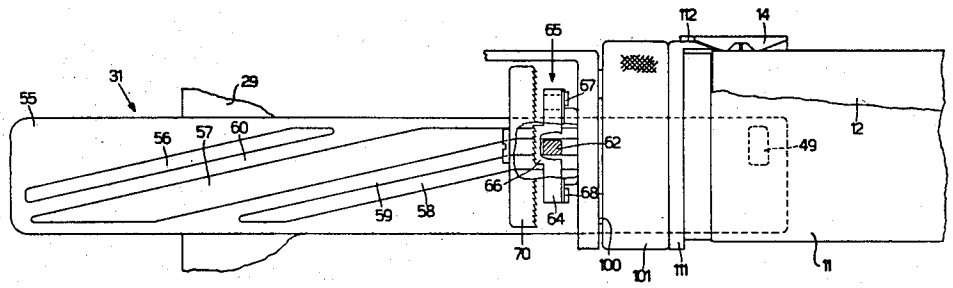
Primary Examiner—James W. Moffitt
Assistant Examiner—Jay P. Lucas
Attorney, Agent, or Firm—Ira J. Schaefer

[57] **ABSTRACT**

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



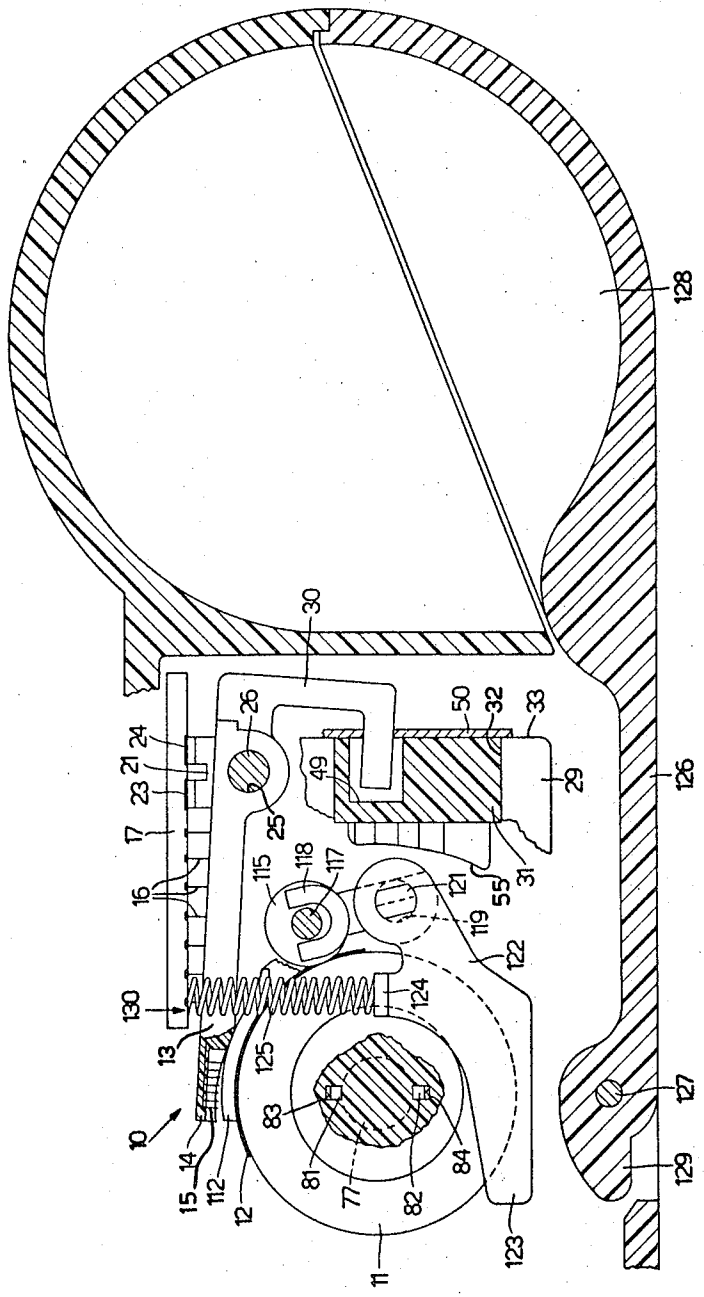

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Fig. 1

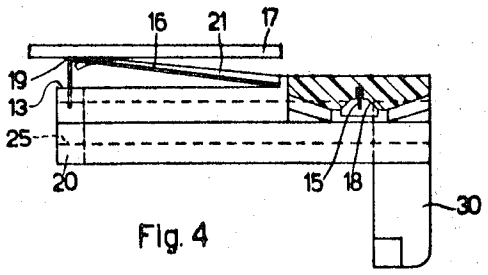

Fig. 4

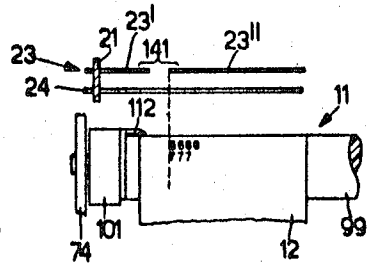

Fig. 9

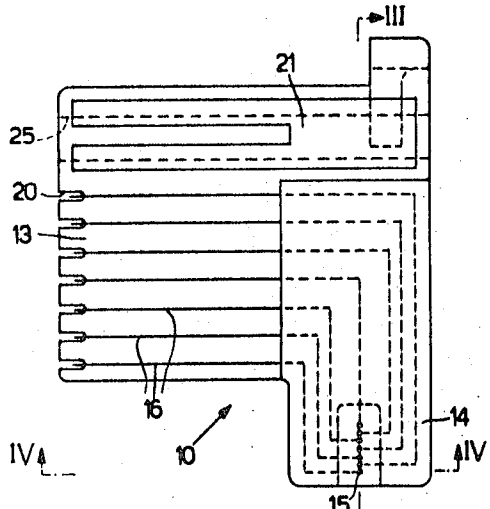

Fig. 2

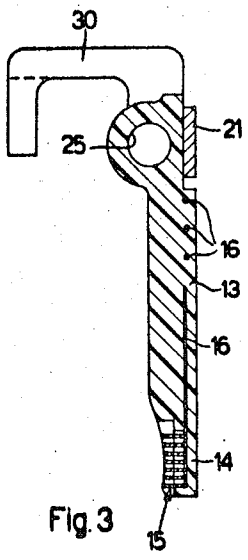

Fig. 3

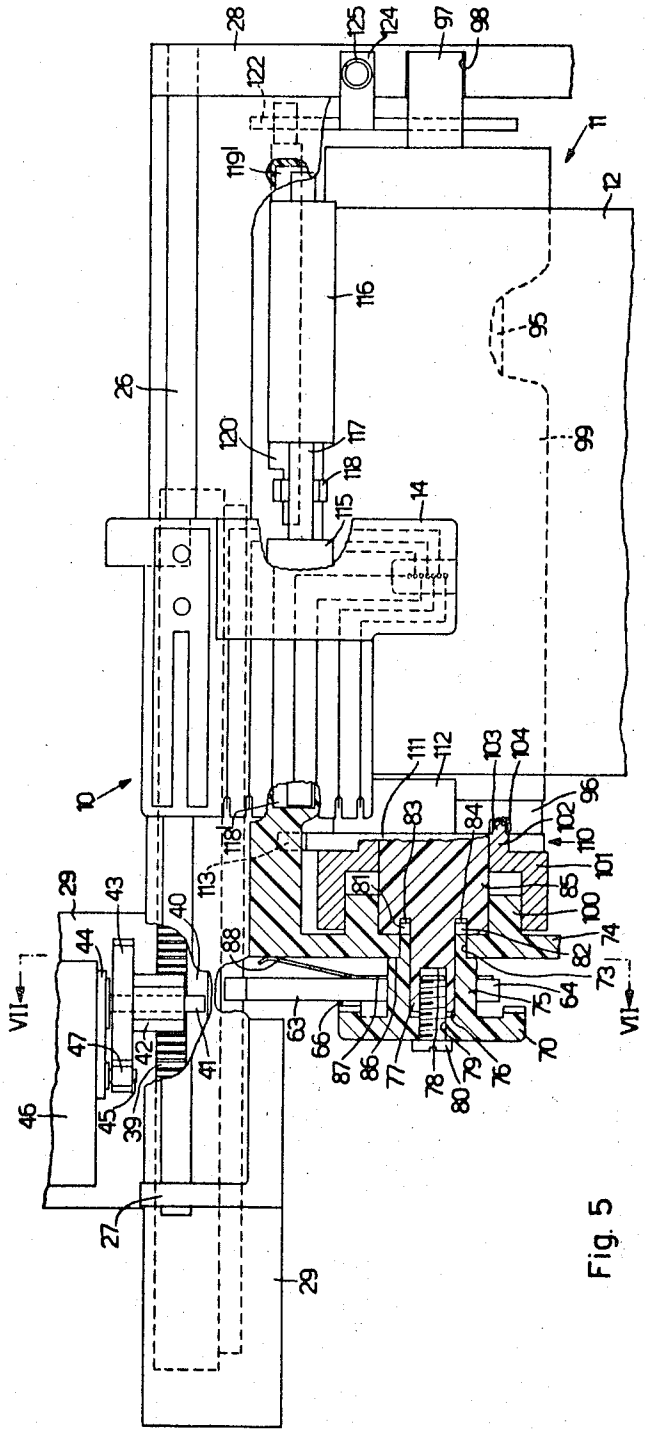
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Fig. 5

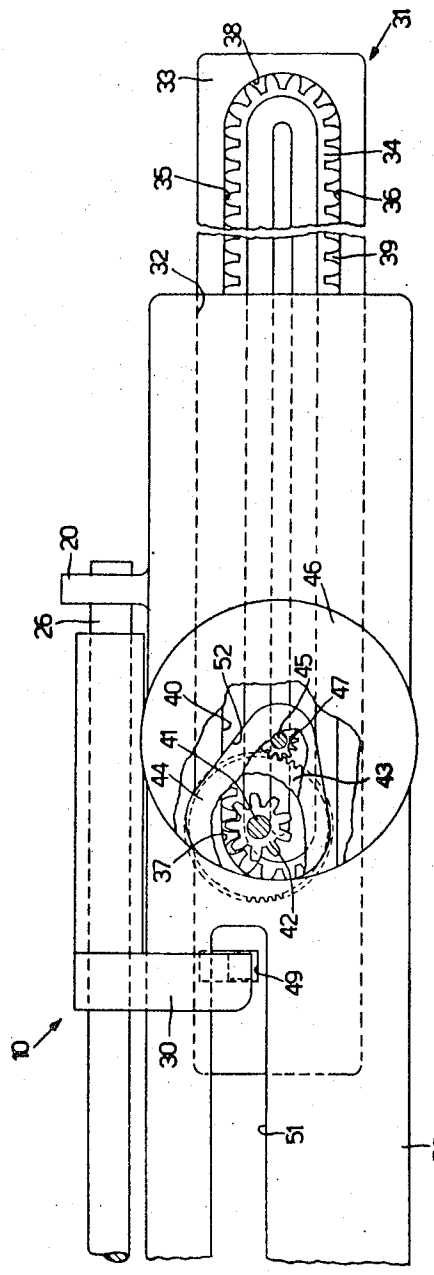
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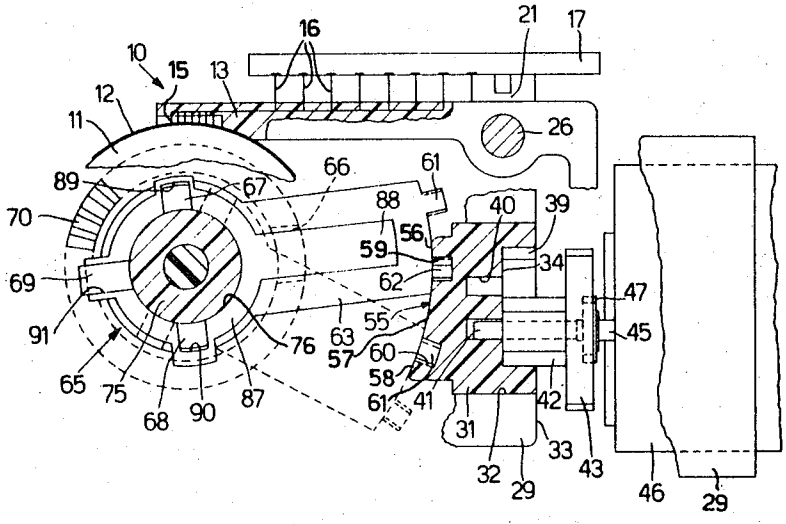
Fig. 6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21
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15
13
12
11
26
89
67
66
61
70
88
40
39
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69
62
47
91
55
45
76
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68
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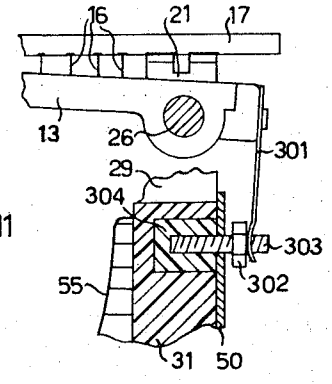
Fig. 7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26
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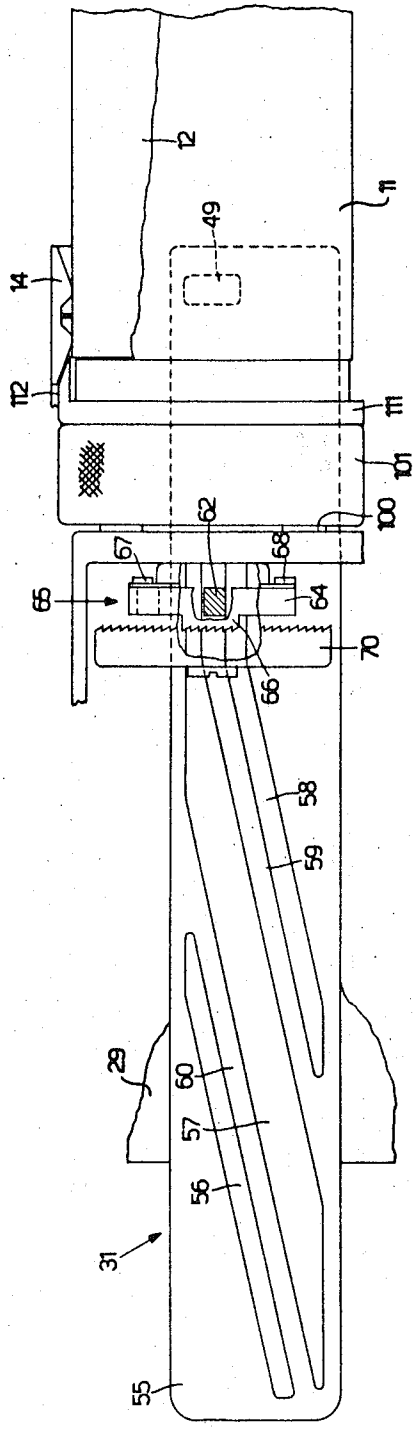
55
31
50

Fig.11


12
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112
111
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Fig. 8

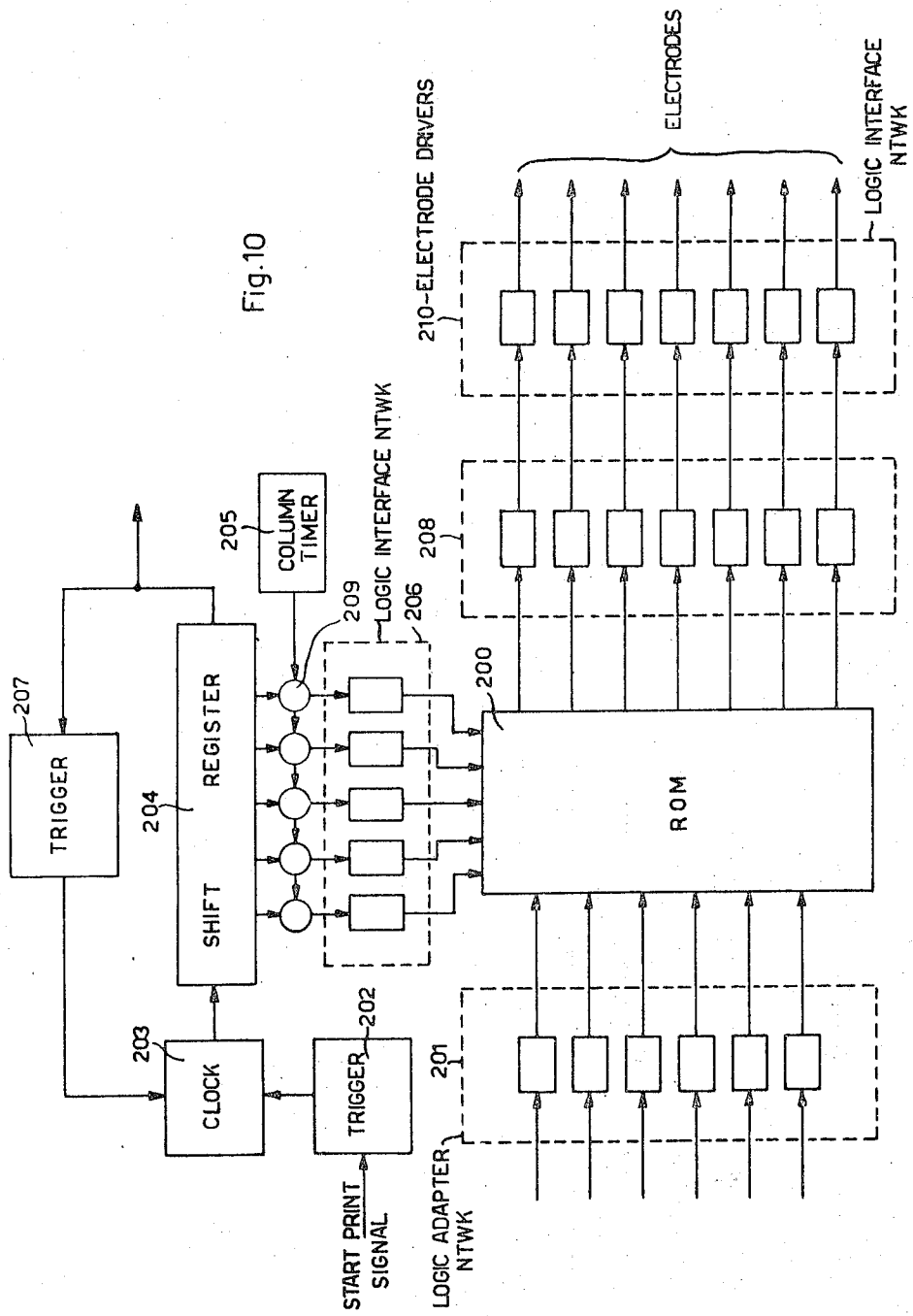
ELECTRODES
LOGIC INTERFACE NTWK
210-ELECTRODE DRIVERS
208
LOGIC INTERFACE NTWK
205
COLUMN TIMER
209
206
200
ROM
207
TRIGGER
204
REGISTER
SHIFT
203
CLOCK
202
TRIGGER
201
LOGIC ADAPTER NTWK
START PRINT SIGNAL

Fig.10

NON-IMPACT PRINTING DEVICE FOR ELECTRONIC CALCULATORS

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 translating means for the printing head for 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 conductive track 17 and is supported at said point away from the body 13 of 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 its 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 prismoidal 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** pivotable 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 platen **11.** The crown **70** is further joined to the platen **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 platen **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 nate, 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 a 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 slighly 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 lead 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 electrosensitive 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 metallized layer of the electrosensitive 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 self 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** accomodates 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 lead **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 biasel 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-inpact 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 engagememt 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 positioning 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 translatory 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 compising motor means for generating motion, converting means coupled for movement with said printing head means for converting the motion of said motor means to translator 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 translator 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 platen is provided with protecting means for protecting an edge of said recording medium adjacent to said cleaning roller during said stroke of said printing head means external to said recording medium.

10. Non-impact printing apparatus as set forth in claim **9,** wherein said protecting 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 ajacent 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 adjacently mounted 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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