

United States Patent

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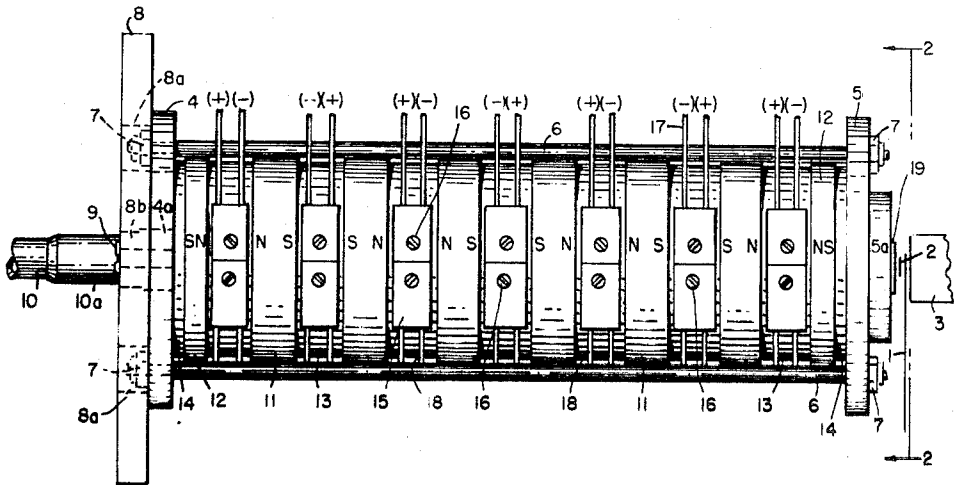
[54] MATRIX PRINTER PARALLEL WITH STYLI AND
PLURAL COAXIAL DRIVER COILS
22 Claims, 11 Drawing Figs.

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101/93
[51] Int. Cl. B41j9/00,
B41f19/00
[50] Field of Search 197/1,
101/93

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ABSTRACT: A matrix printer having electrically energizable circular coils spaced along and wound around a cylindrical center pole, styli wires of different lengths which are attached to the coils and extend substantially parallel to the center pole, permanent magnets, and pole members for providing paths for the magnetic lines of force from the magnets across the sides of the coils in directions substantially perpendicular to their axes. By selectively energizing the coils, selected coils are caused to move along the center pole and the styli wires attached to them are moved to print positions. The styli wires are thereafter withdrawn to nonprint positions by energizing the coils in the opposite directions.



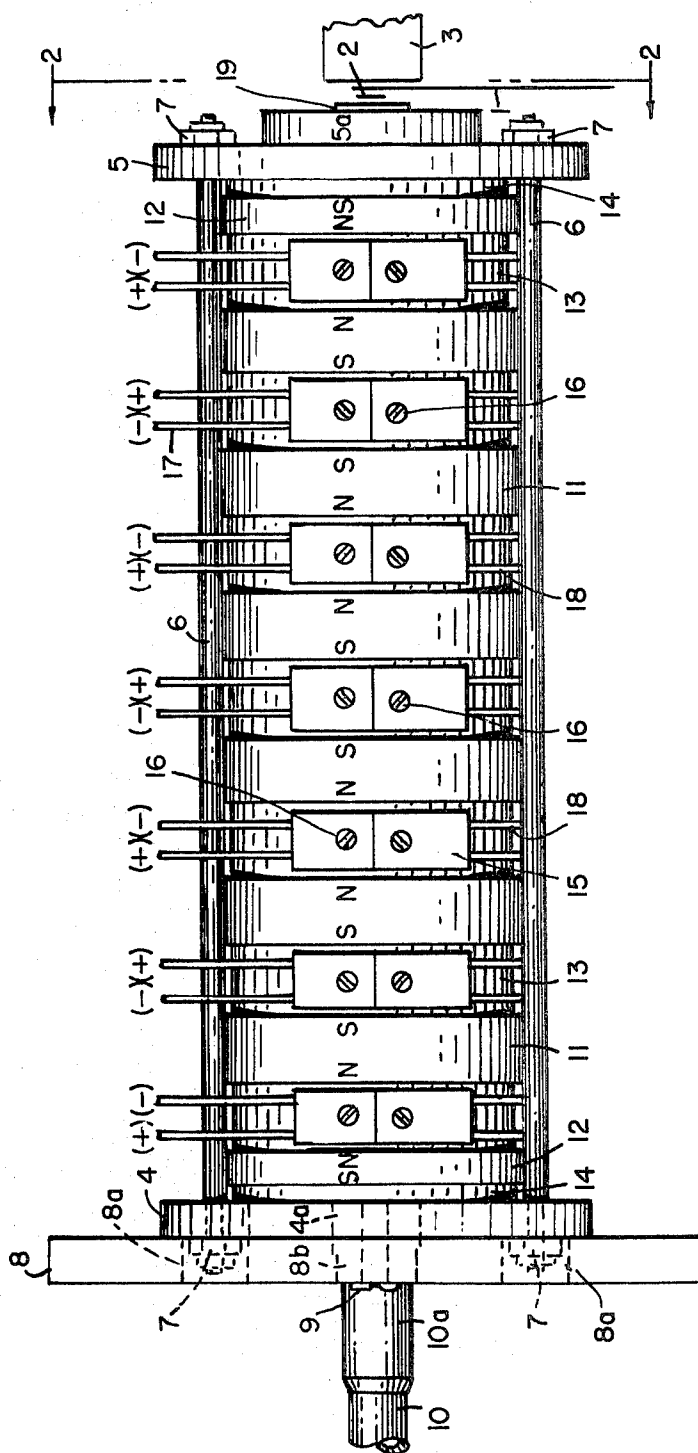


FIG. 2a

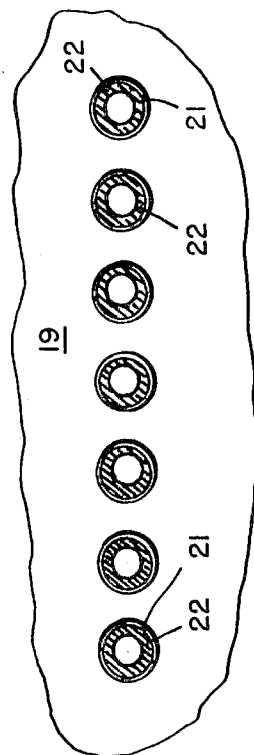


FIG. 1

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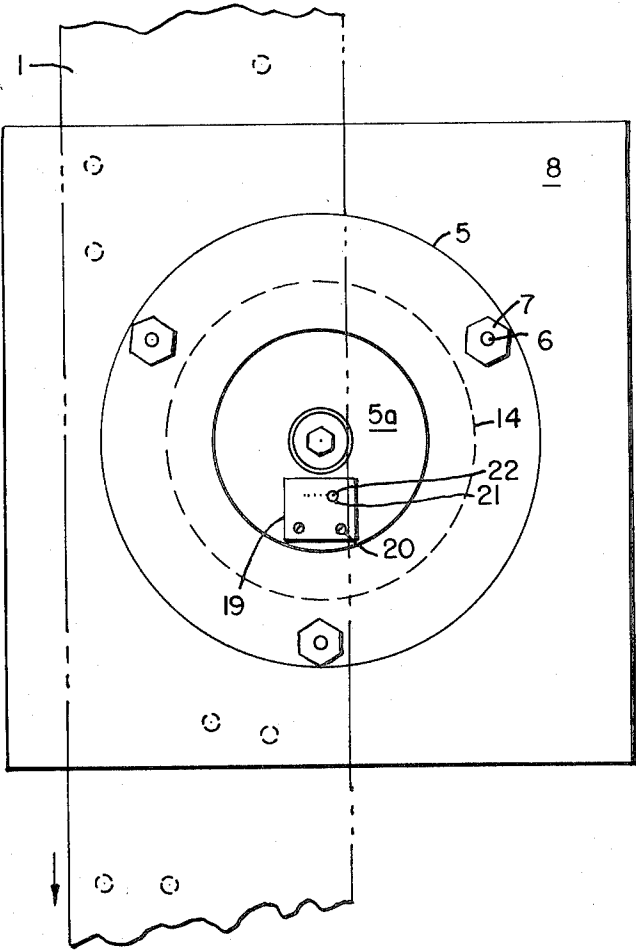


FIG. 2

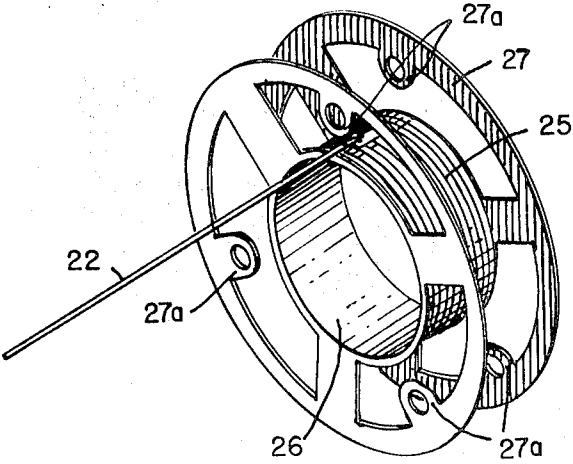


FIG. 5

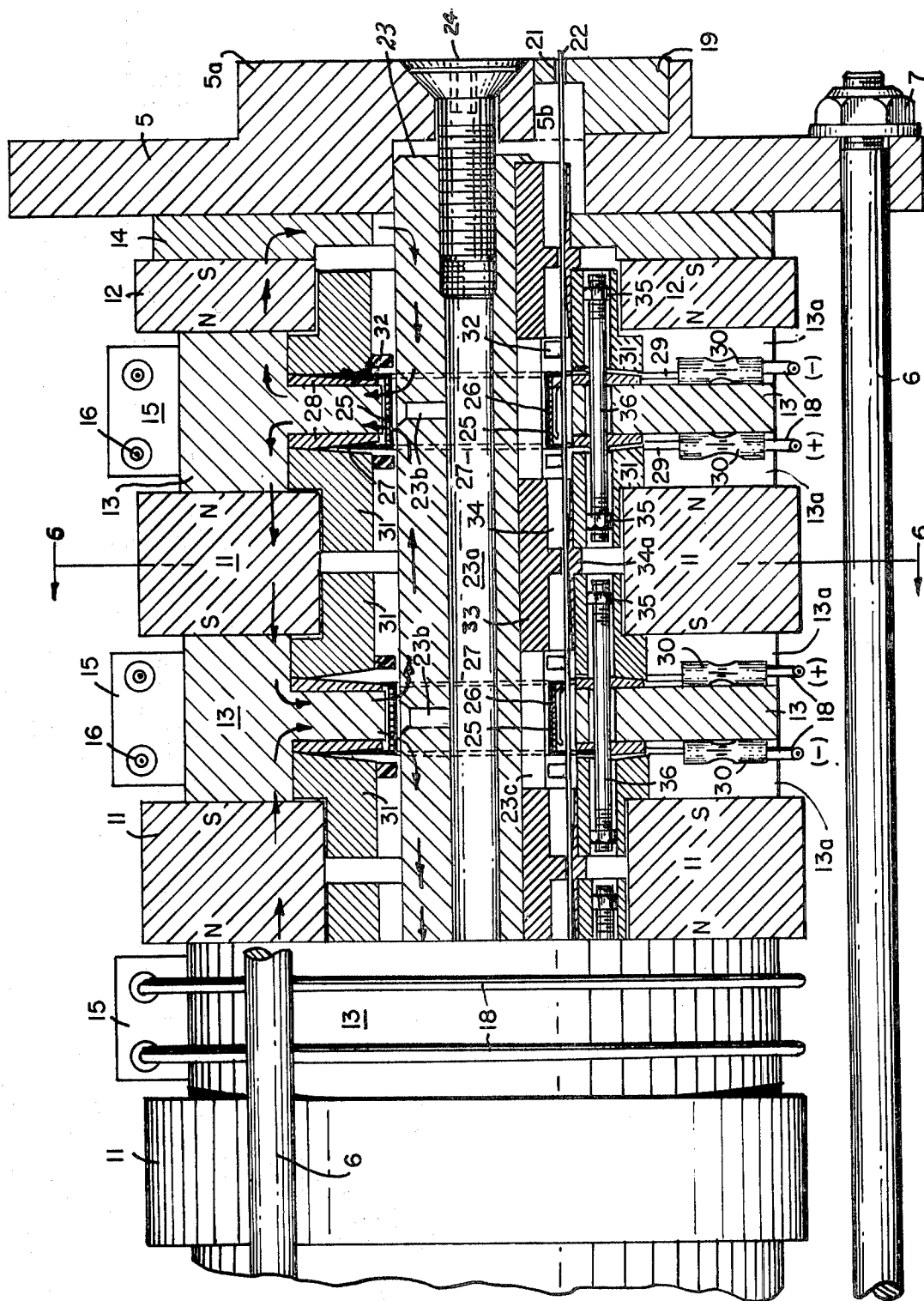


FIG. 3

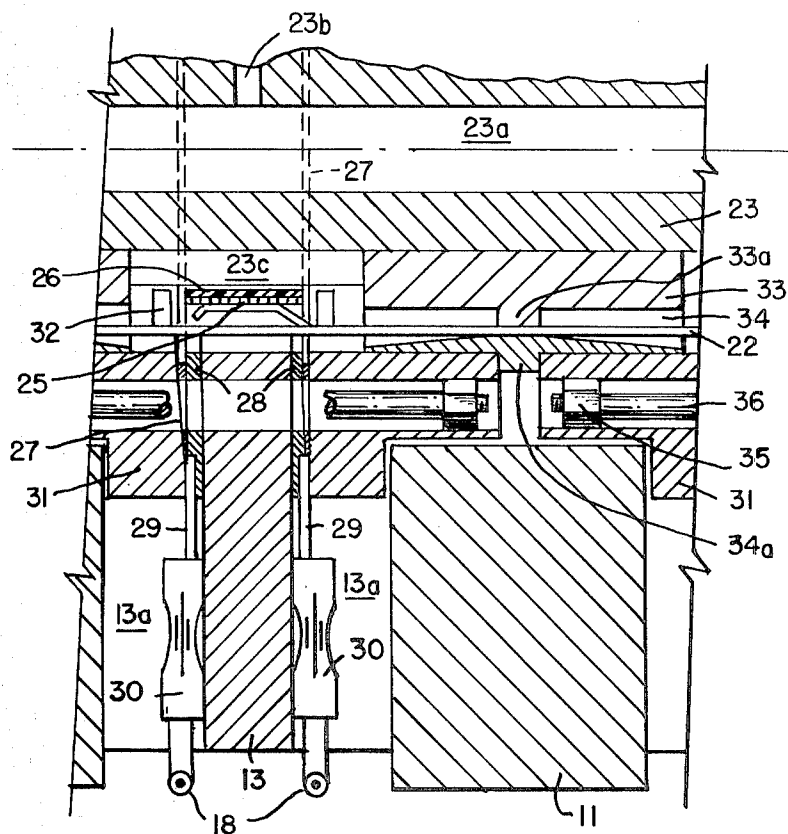


FIG. 4

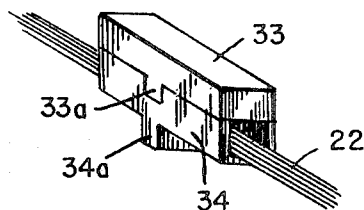


FIG. 7

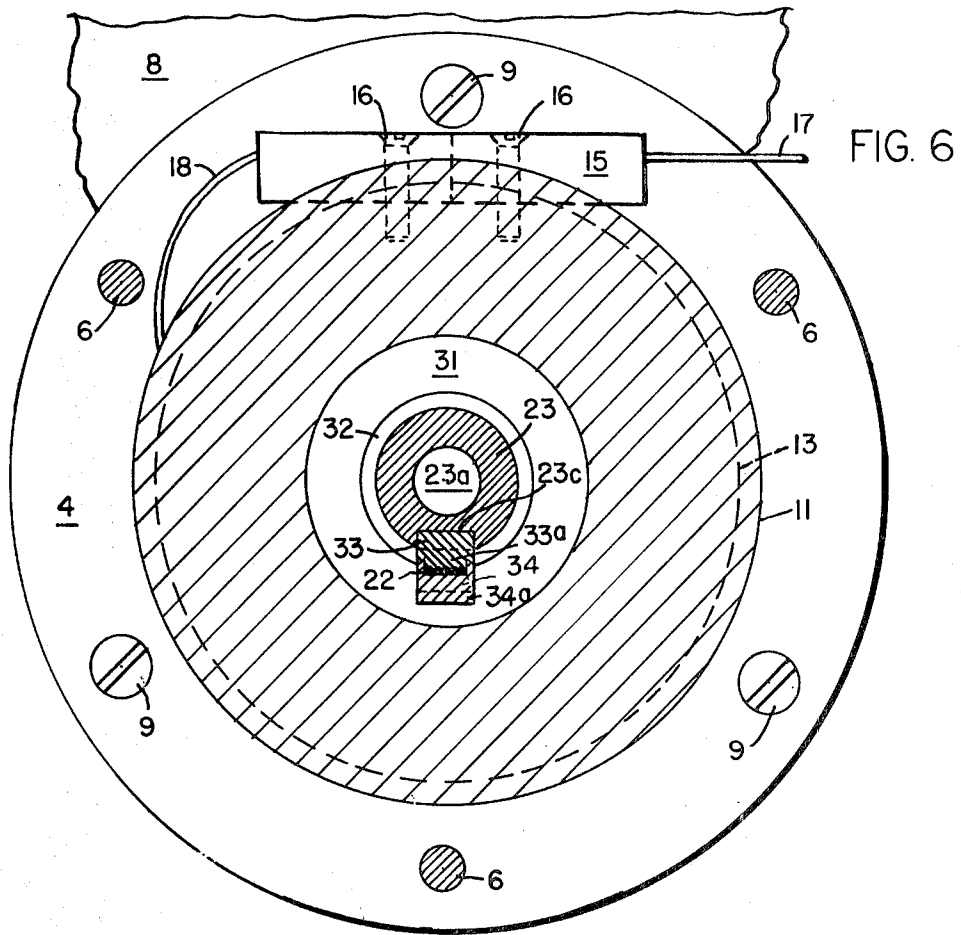


FIG. 6

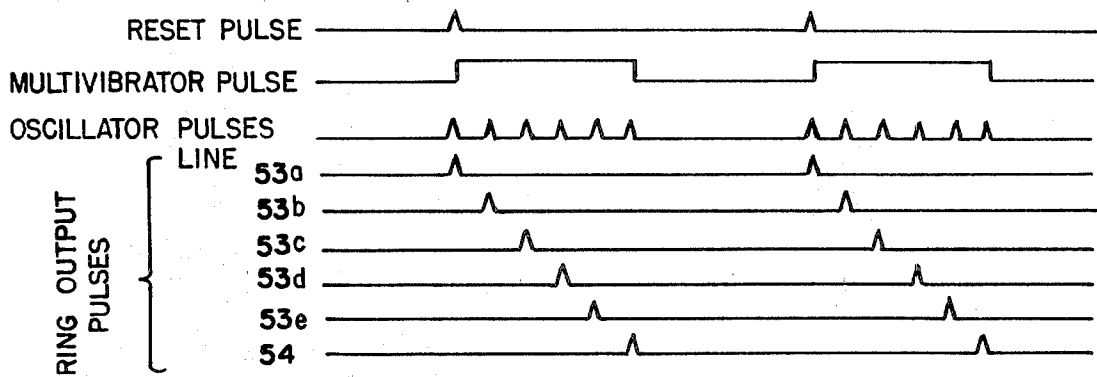


FIG. 10

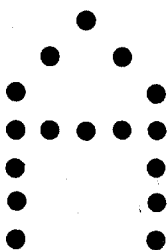


FIG. 9

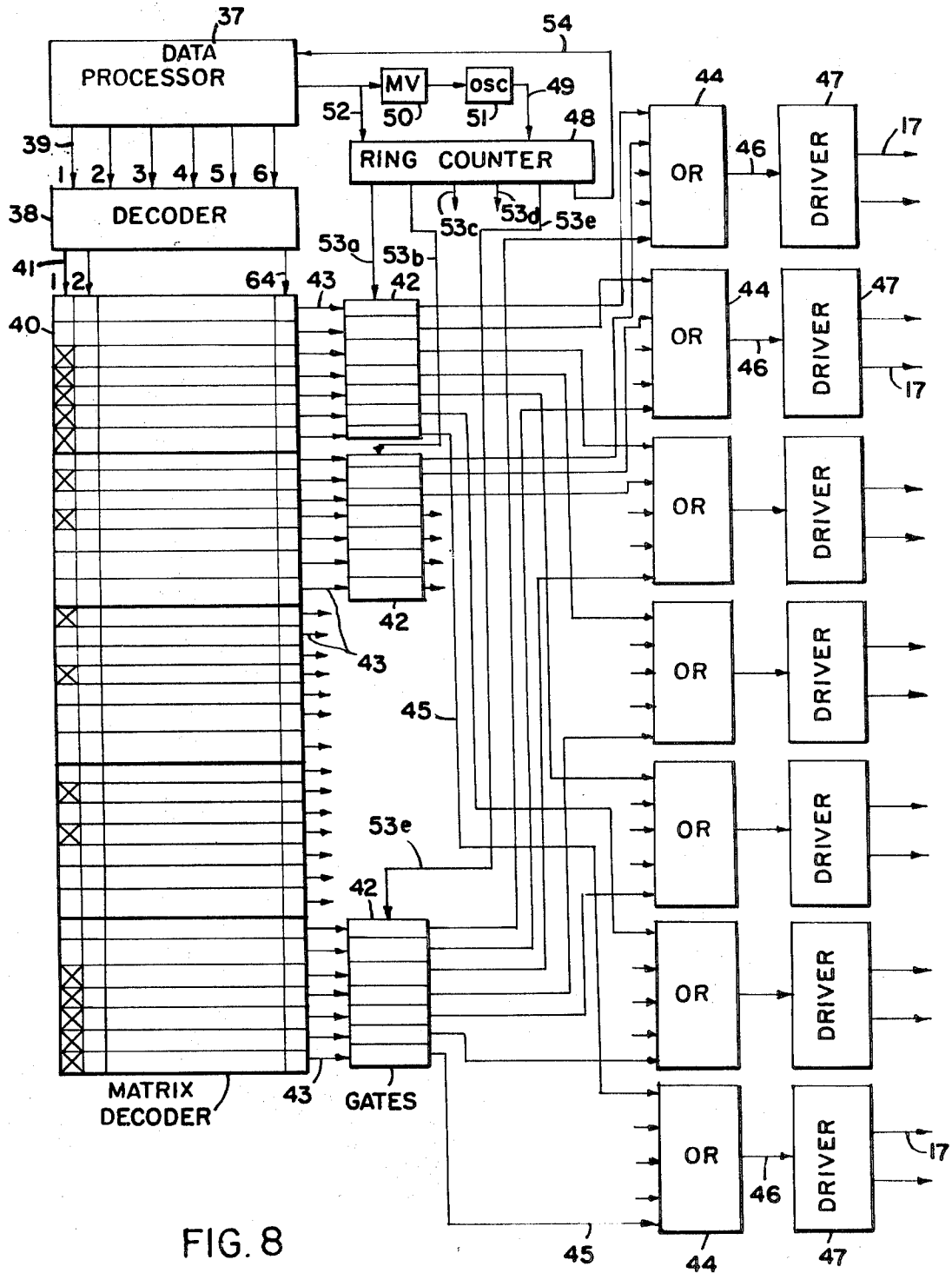


FIG. 8

MATRIX PRINTER PARALLEL WITH STYLI AND PLURAL COAXIAL DRIVER COILS

BACKGROUND OF THE INVENTION

This invention relates to a high speed printer of the matrix type.

Because of the high speed at which data processing apparatus generate their output information, it is difficult to print this information efficiently. While chemical, magnetic and electrostatic printing are generally faster than mechanical methods, they are more complex. In addition, they are expensive, cannot produce multiple instantaneous copies, and are unable to provide the permanent and high-quality print available from mechanical printers.

The inertia of the mechanical elements involved is a factor which limits the speed of mechanical printers. This problem is partially overcome by matrix printers in which a plurality of styli wires form dots arranged in character configurations. With the relatively low mass of their wires, these printers are capable of very high speeds. Usually each wire need only travel a short stroke to make its impression on the medium to be printed upon and this feature also contributes to a high printing speed. Some matrix printers have their styli wires arranged along a line rather than completely forming a matrix and so require fewer wires. With this type, the medium to be printed upon is fed normal to the wires' line and each character is formed by a plurality of successive wire impacts on the moving medium.

SUMMARY OF THE INVENTION

According to the invention, a high-speed matrix printer is obtained by utilizing a plurality of coaxial electrically energizable circular coils spaced along their axis, and a plurality of styli wires of different lengths which are attached to the coils and extend substantially parallel to the coils' axes. Magnetic means provide magnetic lines of force across the sides of the coils in a direction substantially perpendicular to the coils' axes. Selectively operable circuit means energizes selected coils to thereby move each selected coil along its axis and the stylus wire attached to it to a print position. By energizing the selected coil in the opposite direction, the attached stylus wire is withdrawn to a nonprint position.

The printer of the invention is capable of 1,800 imprints per second per stylus. When the styli wires are arranged along a line and the medium on which characters are to be printed is continuously fed perpendicular to this line, the printer is capable of serially printing, character by character, 300 characters per second.

In addition the printer is uncomplex and thus is economical to manufacture and easily assembled and maintained.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an elevation view of a preferred embodiment of the printer.

FIG. 2 is a view along line 2—2 of FIG. 1.

FIG. 2a is an enlarged view of a portion of FIG. 2.

FIG. 3 is a view, partly in section, of the printing end of the printer shown in FIG. 1.

FIG. 4 is an enlarged view of a portion of FIG. 3.

FIG. 5 is a perspective view of one of the stylus wires, the coil to which it is attached, and the assembly for mounting the coil within the printer shown in FIG. 1.

FIG. 6 is a view taken along line 6—6 of FIG. 3.

FIG. 7 is a perspective view of a guide member for guiding the styli wires within the printer shown in FIG. 1.

FIG. 8 is a schematic block diagram of a control circuit for the printer.

FIG. 9 is a view illustrating the letter "A" as printed by the printer shown in FIG. 1.

FIG. 10 is a timing diagram showing pulses in the control circuit shown in FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows a printer printing upon an edge of a punched paper tape 1 continually moving past the printer in a direction perpendicular to the plane of the drawing. The paper tape travels between a ribbon 2, moving parallel to the tape 1, and a platen 3. The printer comprises a frame made up of a top cap 4 and a bottom cap 5 joined together by tie bars 6 which are connected to the caps with fasteners 7. A mounting plate 8 holds the printer in position by screws 9, and apertures 8a are provided in the mounting plate to accommodate the fasteners 7. The printer is air-cooled and a hose 10, connected to the mounting plate by a fitting 10a, conducts air to the printer. The air passes through an aperture 8b in the mounting plate, through an aperture 4a in the top cap, and into the printer's interior.

A plurality of permanent magnets are contained within the printer between the top and bottom caps. These include six inner magnets 11 and two end magnets 12 and are arranged such that the like poles of adjacent magnets face each other. Also included within the printer are a plurality of pole members consisting of seven inner pole members 13 and two end pole members 14. As shown in FIG. 1, the pole members and permanent magnets are placed in alternating locations. Seven electrical connector assemblies 15 are also included in the printer. Each of these is positioned at one of the inner pole members 13 and fastened thereon by screws 16. Each connector assembly is made up of two separable mating portions. A pair of wires 17 for transmitting coded input data in the form of electrical signals to the printer is connected to one portion of each assembly. The other portion is connected to a pair of wires 18 which transmit the input data to the interior of the printer. The latter portion is permanently mounted while the former is intended to be changed when input data from a different data processor is to be printed by the printer. In such a case, this portion and the wires 17 connected to it are removed and replaced with ones leading to the new data processor. For purposes explained hereinafter, the wires are of the polarities shown when energized, the polarity of each wire being the same as that nearest it in an adjoining pair.

The bottom cap 5 of the printer has a raised portion 5a in which a printhead 19 is mounted. As shown in FIGS. 2 and 2a, the printhead is connected to the bottom cap 5 by screws 20 and contains seven apertures 21 arranged along a line. Through these apertures the styli wires 22 of the printer are selectively moved. The tape 1 is shown in phantom in FIG. 2 and moves in the direction shown perpendicular to the line on which the apertures 21 and styli wires 22 are arranged. The tape already contains data in the form of punched holes and the printer only prints along one of the tape's edges. The printer forms characters by imprinting selected dots in a 7 × 5 matrix. Each character's height is formed with impacts by a selected number of the seven styli wires 22 aligned along the character's height. The character's width is generated by one to five impacts of the styli wires on the tape as it moves past the printing head 19. An "I" for example, is formed with a single impact of the styli wires, while a character such as an "A" or "H" is formed with five impacts.

Referring to FIGS. 3 and 4, a center pole 23 extends between the top and bottom caps of the printer. The center pole has a central bore 23a and is connected to the bottom cap 5 by a screw 24. Seven coaxial circular coils 25 are wound around the center pole at spaced locations. At the outside of each coil is attached one of the styli wires 22. Since the coils are placed along the center pole, the styli wires must be of different lengths to extend through the printhead 19. In FIG. 3, a styli wire (attached to a coil not shown) projects through the printhead 19 and is in a print position. Each of the styli wires extends substantially parallel to the center pole and is bent away from the pole near its attachment to a coil so that it does not contact any other coils. The styli wires are attached to the coils at closely spaced locations around the circumference of

the center pole, and thus are arranged along the arc of a circle having its center at the centerline of the center pole. However, because the wires are so closely spaced together, in effect they are placed along a line and, so arranged, extend into the apertures 21 in the printhead 19. A void 5b is provided in the bottom cap 5 to accommodate the wires.

To lessen their mechanical inertia, the styli wires 22 are preferably hollow as shown in FIG. 2a. Removable tips which may be replaced when worn may be put on the printing end of the wires. These tips may also be made adjustable so that they can consistently strike the ribbon and tape with equal force.

As shown in FIG. 3, the inner magnets 11 are annular and each surrounds the center pole 23 at a location between two adjacent coils 25. Each of the end magnets 12 is annular, surrounds the center pole 23, and is positioned between one of the caps, 4 or 5, and the coil adjacent that cap. Both the inner and end pole members are also annular and surround the center pole 23. Each inner pole member 13 is positioned between two adjacent permanent magnets, and the end pole members 14 are positioned between the end magnets 12 and the caps, 4 and 5. Each of the inner pole members is T-shaped in cross section with the sides of the horizontal portion of the T abutting the permanent magnets between which it is interposed. The end of the vertical portion of each T is located adjacent one of the coils 25.

The permanent magnets are arranged such that the like poles of adjacent magnets face each other. With this arrangement, a plurality of loops of magnetic lines of force are provided with adjacent loops traveling in opposite directions, and adjacent coils being crossed by magnetic lines of force moving in opposite directions. Two adjacent loops pass across each coil in the same direction and substantially perpendicular to the coil's axis.

As illustrated, the inner pole members 13 provide paths for the magnetic lines of force from two adjacent permanent magnets either from or to the coil located between them. Those magnetic lines of force passing across a coil from an inner pole member move in both directions along the center pole until they reach the next two inner pole members. They then pass across the coils adjacent these inner pole members and return to the magnets by passing through the pole members.

The end pole members 14 provide paths for the magnetic lines of force from the end magnets 12 to the center pole 23. These magnetic lines of force move along the center pole until they each reach an inner pole member 13. They then pass through the inner pole members and return to the end magnets 12.

Each inner magnet 11 is capable of providing twice the flux as each end magnet 12 is, so that all the coils have the same flux passing across their sides. The coils, by being so placed in magnetic fields, are each similar to the voice coil of an electrodynamic loudspeaker. When the coil is electrically energized, it moves parallel to its axis and along the center pole, the direction of movement depending on the direction of the current in the coil. By selectively energizing the coils in alternate directions, selected styli wires attached to the coils may be moved to print positions and thereafter withdrawn to nonprint positions.

As noted when referring to FIG. 1, the wires, 17 and 18, for transmitting input signals to the printer have definite polarities when energized. Since the magnetic lines of force crossing adjacent coils move in opposite directions, in order to move selected styli wires to print or nonprint positions, the current passing through adjacent coils must move in opposite directions. This is accomplished since the pairs of wires have the polarities shown in FIGS. 1 and 3 when energized. The polarity of each wire is the same as that nearest to it in an adjoining pair, so that current travels in opposite directions in adjoining pairs when all the wires are moved in the same direction.

Each coil is supported at its position in the printer by the assembly shown in FIG. 5. The coils 25 are wound around the inner portions 26 of spoollike members which are slideably

mounted on the center pole and whose rims 27 are placed adjacent the sides of the vertical portions of the T-shaped inner pole member 13. The rims 27 contain an electrically conductive material and the ends of each coil are connected to the rims of the spoollike member on which it is wound. Besides being electrically conductive, the rims are sufficiently flexible to allow the coils to move small distances in both directions along the center pole when energized. Rims made of beryllium copper of the proper thickness are preferable.

Preferably, each coil 25 is composed of a single layer of aluminum wire, anodized to provide electrical insulation between adjacent coil turns. The inner portions 26 of the spoollike members may have helical grooves around their circumferences within which the coils are placed. Such a feature facilitates winding the coils and increases the strength of the completed assembly.

In order to withstand the high temperatures caused by current passing through the coils, the inner portions of the spoollike members are made of heat-resistant material. The plastic Vespal by Du Pont has been found satisfactory. After being wound on the spoollike members, the coils are preferably covered with a coating of a heat-resistant epoxy resin to help it in withstanding high temperature. For this purpose, Epoxylite, No. 5403, marketed by the Epoxylite Corp., has been found satisfactory.

Gaps are provided between the inner portions 26 of the spoollike members and the center pole 23, and between the coils 25 and the ends of the vertical sections of the T-shaped inner pole members 13. The gaps eliminate friction between these elements when the coils and spoollike members move along the center pole.

Referring again to FIGS. 3 and 4, current is passed through each coil via the electrically conductive rims 27 of a spoollike member and a pair of annular conducting members 28 contacting the inside surfaces of the rims. The conducting members provide a uniform distribution of current in the rims 27 and thereby avoid hot spots. They are preferably aluminum and anodized, to provide electrical insulating properties, except where they contact the rims 27. Wires 29 are connected to the rims and provide the input and output leads for the coils and their spoollike members. These wires 29 and the wires 18 from the connector assemblies 15 are jointed at terminals 30. The wires and terminals are located in slots 13a in the inner pole members 13 which provide passageways from the interior to the exterior of the printer.

These slots 13a also provide the exhaust paths for the air cooling the printer. Air, conducted to the printer by the hose 10 (FIG. 1), passes through the central bore 23a of the center pole 23, and through seven branch passages 23b leading to the coils 25. The air flows around the coils, cools them, and exhausts out the slots 13a.

A pair of clamping rings 31 is located adjacent the sides of the rims 27 of each spoollike member and serves to clamp together the rims 27, a pair of conducting members 28, and the vertical portion of one of the T-shaped inner pole members 13. As shown in FIG. 3, the sides of the clamping rings which abut the rims 27 are slanted away from the rims to allow for movement of the coils 25 and bending of the rims 27 when the coils are energized. In order to keep the magnetic lines of force in their proper loops, the clamping rings are made of a material which does not conduct magnetic flux. On both sides of each coil 25 and secured to the clamping rings are pairs of annular resilient stops 32, preferably made of urethane. Each pair of stops 32 limits the movement in both directions along the center pole 23 of one of the coils 25 and its supporting spoollike member when the coil is energized.

To accommodate the styli wires 22, keywaylike grooves are provided in the inner pole members 13, end pole members 14, and clamping rings 31 as shown in FIGS. 3, 4 and 6. Segments of the annular resilient stops 32 and conducting members 28 are also cut out to provide openings for this purpose.

Within the keywaylike grooves, the styli wires are surrounded by a plurality of spaced guide members (shown in

FIG. 7) made up of a key 33 and a trough-shaped cap 34. Each key 33 fits into a keyway 23c in the center pole 23 and has a lip 33a which projects into the trough of a cap 34 and slots in the cap's sides. The bottom edge of each lip 33a is saw-toothed with seven notches within which the styli wires 22 move. The bottom inside surface of each cap's trough slopes upwardly to where it adjoins the saw-toothed edge of the lip 33a.

The caps 34 have lips 34a which hold the guide members in place by projecting between two adjacent clamping members 31 or between a clamping member and an end pole member 14. Since portions of the guide members are located within the keywaylike grooves of the end pole members 14 and clamping rings 31, they interlock these parts with the center pole 23 and keep the interior parts of the printer properly oriented.

The spoollike members, conducting members 28, and inner pole members 13 are held in place within the printer by nuts 35 and screws 36 as shown in FIGS. 3 and 4. During assembly of the printer, the nuts 35 are tightly placed within holes in the clamping members 31 as illustrated. Each of the screws 36 joins two of the nuts 35 and passes through the holes in a pair of clamping members 31, ears 27a (FIG. 5) on the rims 27 of a spoollike member, holes in a pair of conducting members 28, and a hole in an inner pole member 13. While connected together, these elements are slid onto the center pole 23 and properly located.

One of a number of possible control circuits which may be used with the printer is illustrated in FIG. 8. The output of a data processor 37, such as a paper tape reader, is fed to a binary decoder 38 which accepts data in conventional binary coded form on leads 39 and produces a signal on the output leads 41 that corresponds to the data. The data processing machine is operated in synchronism with the operation of the printer so that the data representing a character to be printed is presented as the tape moves between character positions. In the preferred embodiment, the printer is capable of printing a font of 64 different characters. Thus, the binary-coded data processor output contains 6 bits. The output of the decoder 38 is connected to a matrix decoder 40 via 64 output lines 41, each of which corresponds to a different character in the printing font.

As previously noted, the printer forms characters by imprinting selected dots in a 7x5 matrix. The seven styli wires are aligned along the characters' height and the tape is moved perpendicular to the line formed by the styli wires. Each character is formed by one to five impacts of some or all of the styli wires as the tape moves past the printer.

The matrix decoder 40 is schematically illustrated as five vertically arranged main portions with 64 columns extending through them. Each of the five main portions are divided into seven minor portions, for a total of 35 portions, each corresponding to one of the 35 portions of a 7x5 character. Each column is connected to one of the lines 41 from the decoder 38 and represents that part of the matrix decoder which is energized for a particular character. The seven minor portions in each main portion correspond to the seven styli wires. The five main portions correspond to the five possible successive impacts made by the styli wires on the moving tape to form a character's width.

Those portions of the matrix decoder 40 which produce outputs when a character is to be printed are shown by X's in FIG. 8. For example, the character A as illustrated in FIG. 9 produces outputs as indicated by X's in the leftmost column of the matrix decoder. In forming the A, the lower five minor portions (indicated by X's) within the uppermost main portion initially impact the tape and form the left side of the A during a first printing subcycle. In a second printing subcycle, only two of the styli wires are moved and those portions of the matrix decoder which are energized are represented by the two X's in the main portion directly beneath the top one. Similarly, the X's in the middle, next-to-bottom and bottom main portions represent those portions of the decoder which are energized for a third, fourth and fifth printing subcycles when forming the A.

Five groups of seven gates 42 are provided and each of the five main portions of the matrix decoder 40 feeds its outputs over lines 43 to one of the five groups. Each gate in a group receives an input from one of the seven minor portions of the decoder. Thus, each group of gates 42 receives signals representing the styli wires to be moved during one printing subcycle, and the five groups together receive signals representing a complete character formed by up to five successive subcycles. For a character, such as an I, which is formed with less than five printing subcycles, the matrix decoder produces signals from less than all of the main portions, so the styli are activated in less than all five subcycles.

Seven OR gates 44, each having five input lines 45, are also provided. Those gates in each of the five groups of seven gates 42 which receive their inputs from the minor portions of the decoder 40 corresponding to the same stylus wire are connected to the same OR gate. Thus, the data fed to each of the OR gates concerns only one of the styli wires. The outputs of the OR gates are fed over lines 46 to seven drivers 47, each of which feeds its output over the wires 17 which transmit input data to the printer and are connected to one of the seven coils 25.

During each printing cycle, the five groups of seven gates 42 are sequentially opened by a ring counter 48. The ring counter is reset to its first position by a signal on a lead 52 from the data processor before each printing cycle begins. The same signal from the data processor activates a multivibrator 50 which develops a pulse which conditions an oscillator 51 for a period of time adequate to produce six oscillator output pulses on a lead 49. These pulses advance the ring counter through the five printing subcycles to produce signals on leads 53 a-e to the gates 42, and then to produce a sixth signal on a lead 54. The oscillator frequency is based upon the speed of movement of the tape so that a character of the desired width is printed during the time the oscillator produces five output pulses.

The output from the sixth position of the ring counter 48 on lead 54 is applied to the data processor to request new data. At this time, the styli wires are not moved although the tape continues to do so. This allows for a space between the characters being printed.

We claim:

1. A matrix printer comprising:

- a plurality of movable styli wires extending parallel to each other;
- a plurality of electrically energizable coils, each of which is attached to one of the styli wires, the coils being wound around a single axis extending parallel to the styli wires;
- magnetic means for providing magnetic lines of force across the sides of the coils such that the coils move in directions along the axis when energized; and
- selectively operable circuit means for energizing selected coils to thereby move each selected coil along the axis, whereby the styli wires are selectively moved.

2. The matrix printer as recited in claim 1, wherein the styli wires are movable to print and nonprint positions, are of different lengths, and have ends arranged to lie in a straight line when in print positions.

3. The matrix printer as recited in claim 2, wherein the circuit means energizes selected coils in alternate directions, thereby causing each selected coil to move along the axis and return to its original location, whereby the styli wires are selectively moved to print and thereafter withdrawn to nonprint positions.

4. A matrix printer comprising:

- a plurality of electrically energizable coils;
- a center pole extending within the coils;
- a plurality of movable styli wires, each of which is attached to one of the coils and extends substantially parallel to the center pole;
- a plurality of permanent magnets surrounding and spaced along the center pole;
- A plurality of pole members spaced along and surrounding the center pole at locations which provide paths for a plurality of loops of magnetic lines of force from the per-

manent magnets, each loop passing through at least one of the pole members, across at least one of the coils and along the center pole; and

f. selectively operable circuit means for energizing selected coils to thereby move each selected coil along the center pole, whereby the styli wires are selectively moved.

5. The matrix printer as recited in claim 4 wherein: each coil is surrounded by one of the pole members; and the pole members and permanent magnets are alternately arranged along the center pole.

6. The matrix printer as recited in claim 5 wherein, the permanent magnets are arranged such that the like poles of adjacent magnets face each other, and the magnetic lines of force of adjacent loops move in opposite directions.

7. A matrix printer comprising:

a. a frame having two ends;

b. a printhead secured at one end of the frame and having a plurality of apertures;

c. a center pole located within the frame and extending between the frame's ends;

d. a plurality of spaced electrically energizable coils wound around the center pole;

e. flexible means for securing each of the coils at their spaced locations, such that they may slide along the center pole;

f. a plurality of styli wires of different lengths, each of which is attached to one of the coils and extends into one of the apertures in the printhead;

g. a plurality of permanent magnets;

h. a plurality of pole members for providing paths for magnetic lines of force from the magnets across the sides of the coils such that the coils move along the center pole when energized; and

i. selectively operable circuit means for energizing selected coils, thereby causing each selected coil to move along the center pole, whereby selected styli wires are selectively moved relative to the printhead.

8. The matrix printer as recited in claim 7 wherein: the apertures in the printhead are arranged along a line.

9. The matrix printer as recited in claim 7 wherein: the center pole has a bore and branch passages leading from the bore to each of the coils; and further comprising: means for introducing a gas into the center pole's bore and passages to cool the coils.

10. The matrix printer as recited in claim 7 wherein the styli wires are hollow.

11. The matrix printer as recited in claim 7 wherein: each of the styli wires extends substantially parallel to the center pole, and is bent near its attachment to one of the coils so that it may move without contacting other coils.

12. The matrix printer as recited in claim 7 and further including:

means for stopping the movement of each of the coils when the stylus wire attached to the coil moves to a print or a nonprint position.

13. The matrix printer as recited in claim 7 and further comprising:

means for guiding the styli wires during their movement to print and nonprint positions.

14. The matrix printer as recited in claim 7 wherein the styli wires are attached to the outsides of the coils.

15. The matrix printer as recited in claim 7 wherein the permanent magnets include:

a. a pair of end magnets, each of which provides one-half of the flux passing across one of the two coils which are adjacent the ends of the frame; and

b. a plurality of inner magnets, each of which provides twice the flux as one of the end permanent magnets, the flux

provided by each of the inner magnets being evenly distributed to two adjacent coils.

16. The matrix printer as recited in claim 15 wherein:

each of the end magnets surrounds the center pole at a location between one end of the frame and the coil adjacent that end; and

each of the inner magnets surrounds the center pole at a location between two adjacent coils: and the pole members include:

a. a pair of end pole members, each of which surrounds the center pole at a location between one of the end magnets and an end of the frame, each end pole member providing a path for the magnetic lines of force from one of the end magnets to the center pole; and

b. a plurality of inner pole members, each of which surrounds the center pole at a location between two of the permanent magnets, each inner pole providing a path for the magnetic lines of force from two permanent magnets to the coil located between them.

17. The matrix printer as recited in claim 16 wherein:

the like poles of adjacent magnets face each other, so that a plurality of loops of magnetic lines of force are provided, each of the loops passing across at least one of the coils, the magnetic lines of force of adjacent loops moving in opposite directions with each loop starting at one of the permanent magnets, passing through one of the pole members, passing along the center pole, passing through another pole member, and returning to the magnet.

18. The matrix printer as recited in claim 17 wherein:

the center pole is a cylinder;

each of the permanent magnets is an annulus;

each of the end pole members is an annulus; and each of the inner pole members is an annulus having a T-shaped cross section with each end of the T's horizontal portion abutting one of the permanent magnets, and the end of its vertical portion located adjacent one of the coils.

19. The matrix printer as recited in claim 18 wherein the flexible means for securing the coils comprises:

a. a plurality of spoollike members slidably mounted on the center pole, each of the spoollike members having one of the coils wound on its inner portion, the rims of each of the spoollike members being flexible and located adjacent the sides of the vertical portion of one of the T-shaped inner pole members; and

b. a plurality of pairs of clamping members, the clamping members of each pair being located adjacent the rims of one of the spoollike members.

20. The matrix printer as recited in claim 19, and having gaps between the center pole and each of the spoollike members mounted thereon, and between the coils and the portions of the inner pole members adjacent the coils.

21. The matrix printer as recited in claim 19 wherein:

the rims of each of the spoollike members contain an electrically conductive material;

each of the coils has its ends contacting the electrically conductive material contained in the rims of the spoollike member on which it is wound; and

the circuit means is connected to the rims of each of the spoollike members.

22. The matrix printer as recited in claim 21, wherein the circuit means includes:

a. a plurality of pairs of electrically conducting members, the members of each pair contacting the rims of one of the spoollike members; and

b. a plurality of pairs of lead wires, each pair being connected to a pair of conducting members.